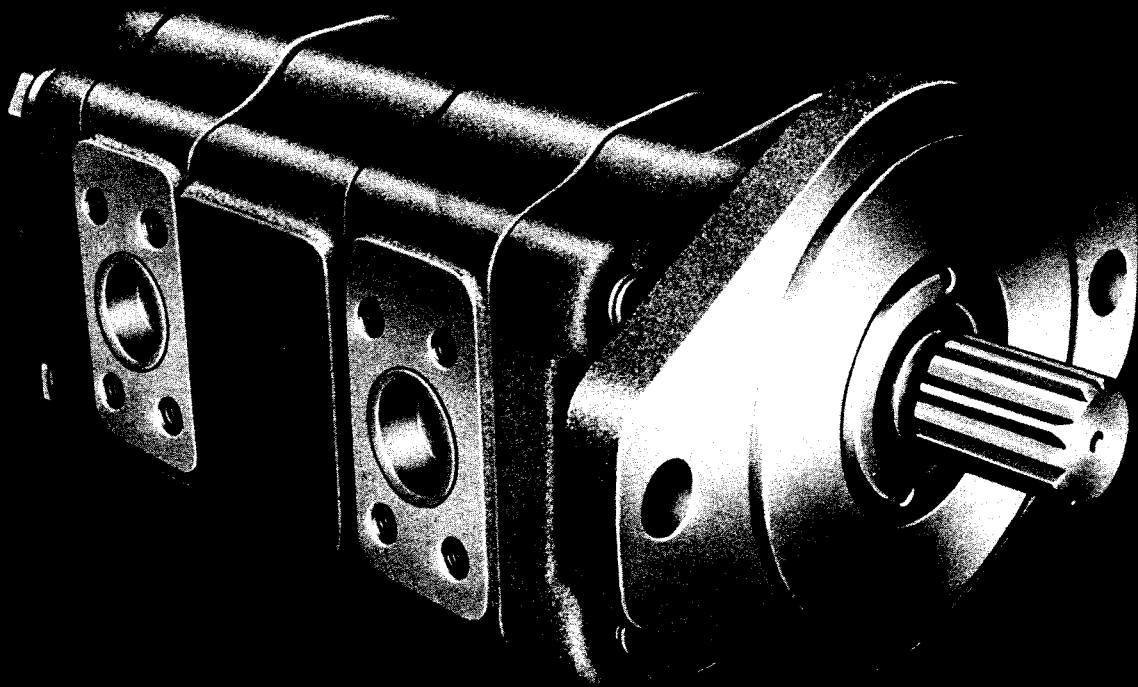


25X SERVICE MANUAL

single
and tandem
oil hydraulic
pumps—motors



**KEEP YOUR
PUMPS AND MOTORS AT
THEIR ORIGINAL EFFICIENCY . . .
USE ONLY GENUINE
COMMERCIAL REPLACEMENT PARTS
AVAILABLE THROUGH YOUR
ORIGINAL EQUIPMENT DEALER
OR YOUR AUTHORIZED
COMMERCIAL SHEARING DISTRIBUTOR**

foreword . . .

This descriptive guidebook will familiarize you with COMMERCIAL Model 25X single and tandem pumps and motors — their component parts — relative position of each part — proper methods for assembly or disassembly of units — care and use of these oil hydraulic units so that better performance and greater life expectancy will result for your benefit.

A photographic presentation with explanatory notes

covers the steps that should be closely followed when servicing the elements that comprise these units. Before any work is done in the repair of these units, it is suggested that all of the steps used in tearing down the assembled unit and all of the steps used in building up the unit be read. Such a digest will familiarize you with the general procedure of the work to be done and give you the feel of the specific operations involved.

general instructions . . .

Here you have a gear type fixed displacement oil hydraulic pump or motor which has been built to very high standards and a new design. The result is the Model 25X pump and motor having operating characteristics far superior to other pumps and motors of its type. Close fits and small running tolerances were originally built in to insure peak performance and highest operating efficiency.

Slippage is a factor which has considerable bearing on the performance. As the amount of slippage is reduced, the higher the operating efficiency. Best results develop when a close fit is made between the gears and all surfaces they come in contact with. Allowance of a minimum running clearance is, of course, necessary.

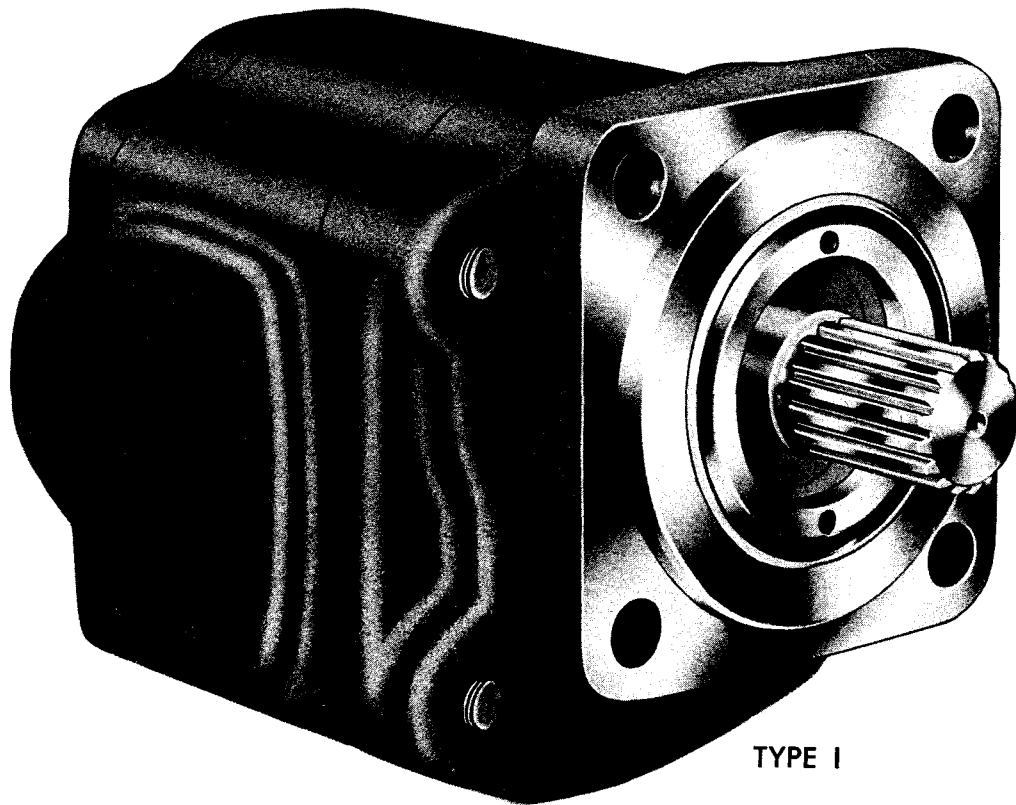
Inspection of all COMMERCIAL pumps and motors will disclose gears in matched pairs—all are original equipment, made by COMMERCIAL on specially built machines which produce surfaces within limits much closer than is standard practice.

Seldom should you find it necessary to service the

Model 25X oil hydraulic pump or motor during its life expectancy, but should a noticeable drop in performance occur it is advisable to make an inspection and replace such part or components which, due to some unusual condition, may have become worn. Should you find it advisable to replace the gears, insist they be in matched pairs and the product of the original manufacturer. Matched gears are the very vitals of the gear type pump or motor. Expendable parts such as "O" ring shaft seals, pocket seals, single and double-lip oil seals and back-up rings should never be re-used even though inspection may show these items as being serviceable for future use. Such parts for replacement are available at a cost which is insignificant in view of your investment and when you consider the vital function of these items is to prevent leakage. All replacement parts should be given your final inspection to insure that no damage has resulted after final factory inspection was made.



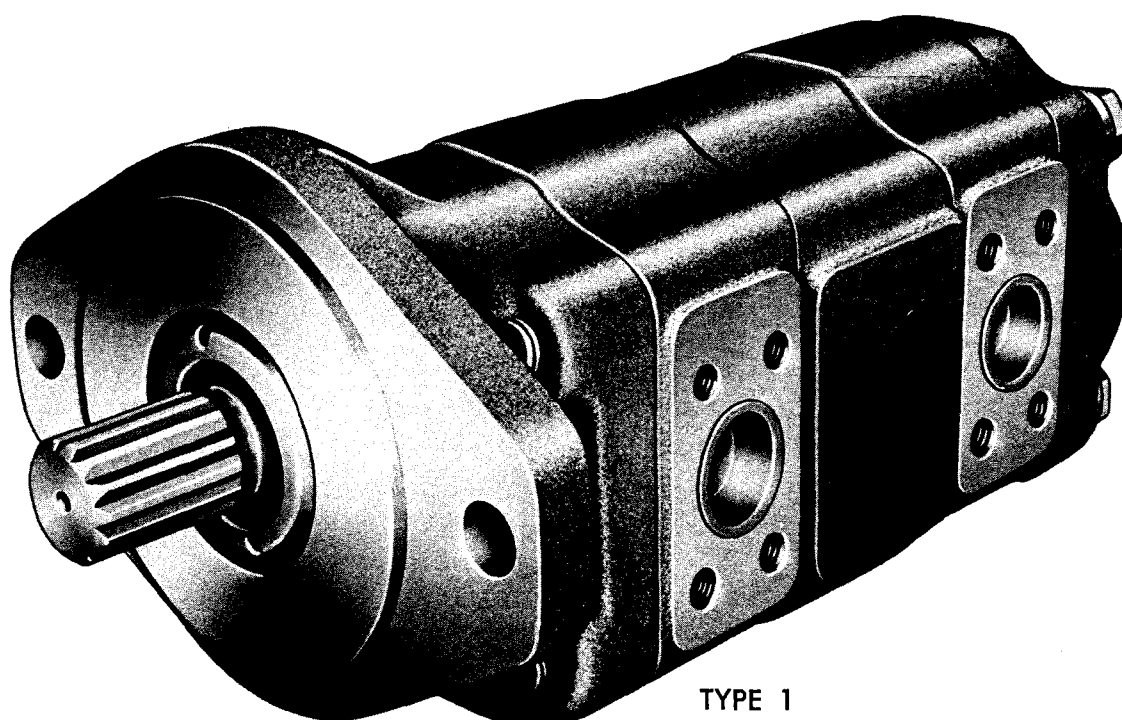
single COMMERCIAL Model 25X Oil Hydraulic Heavy Duty Pump-Motor



Exploded view, showing all parts and their nomenclature which are used in the Model 25X single pump or motor, is shown on page 6 and 7. Complete instructions are given on pages 8 and 9 covering the disassembly by subassembly of the single pump or motor.

Instructions to assemble all parts into subassemblies and to complete the assembly of the Model 25X single pump or motor, are outlined in detail on pages 10, 11, 12, and 13.

tandem COMMERCIAL Model 25X Oil Hydraulic Heavy Duty Pump-Motor



TYPE 1

Exploded view, showing all parts and their nomenclature which are used in the Model 25X tandem pump or motor, is shown on page 14 and 15. Complete instructions are given on pages 16 and 17 covering the disassembly by subassemblies of the tandem pump or motor.

Instructions to assemble all parts into subassemblies and to complete the assembly of the Model 25X tandem pump or motor are outlined in detail on pages 18, 19, 20, 21, 22, and 23.

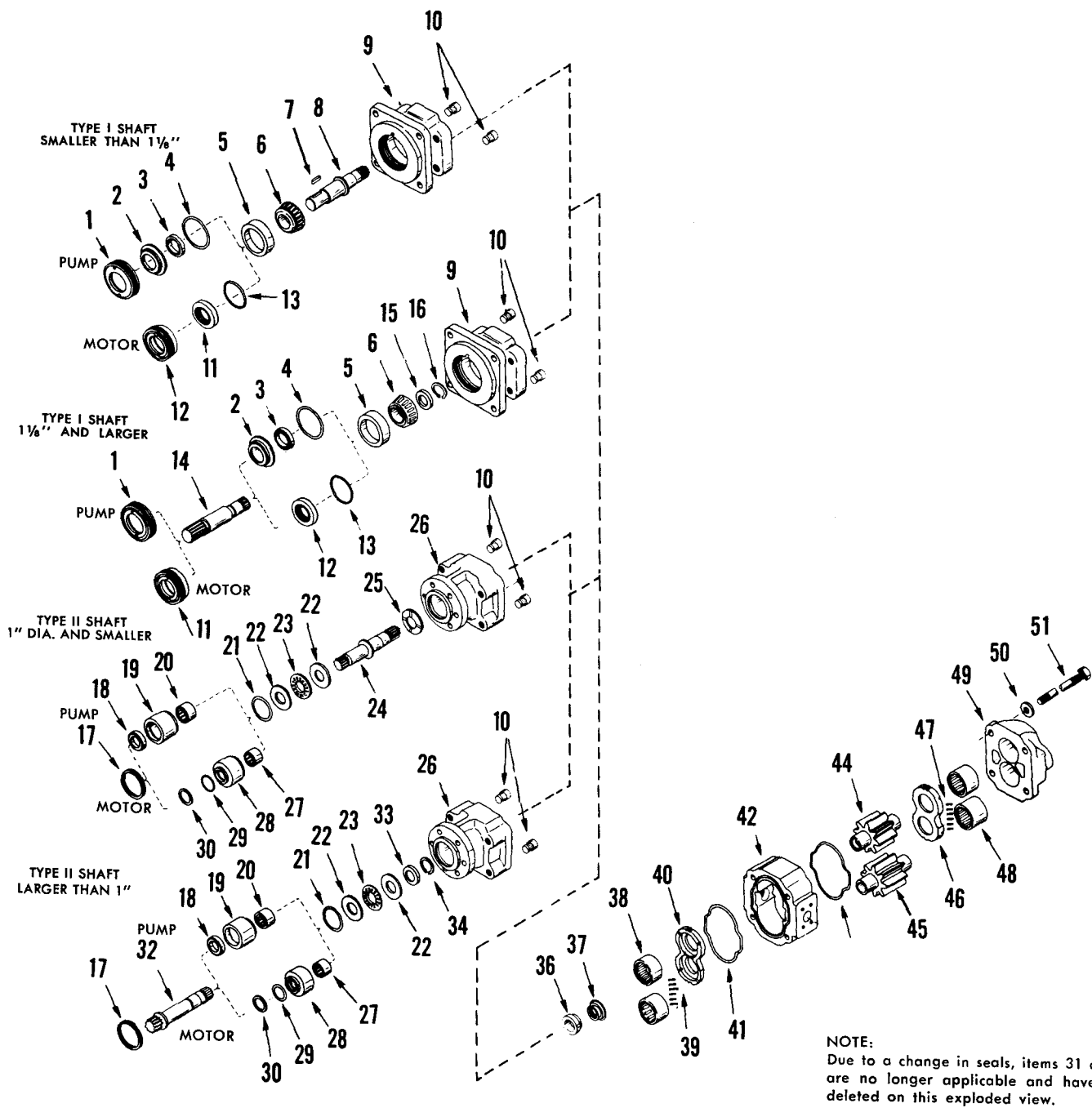


Fig. 1 Exploded View of Single Pump or Motor

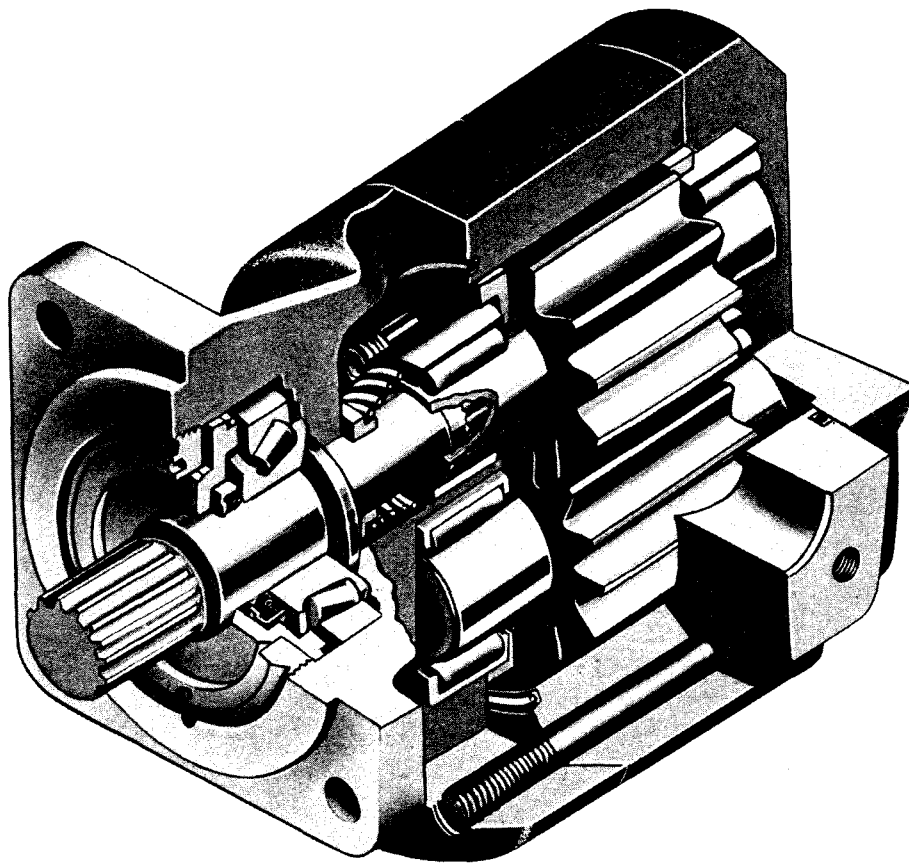


Fig. 2 Cutaway View of Single Pump, Type I

COMMERCIAL Model 25X single pumps and motors can be furnished with either the Type I or Type II shaft. The Type II shaft is used with a thrust bearing and a needle bearing in place of the tapered roller bearing used in the Type I

assembly, in order to provide for the 6 bolt— $2\frac{3}{8}$ " dia. pilot shaft end cover. Component parts for the Type I and Type II shaft end cover subassemblies are not interchangeable.

No.	Description
1	Retainer Ring
2	Seal Retainer
3	Double Lip Seal
4	"O" Ring
5	Bearing Cup
6	Tapered Bearing
7	Key
8	Drive Shaft
9	Shaft End Cover
10	Check Assembly
11	Motor Shaft Seal
12	Seal Retainer
13	"O" Ring
14	Drive Shaft
15	Spacer
16	Snap Ring
17	Spirolox Snap Ring

No.	Description
18	Double Lip Seal
19	Bearing and Seal Retainer
20	Needle Bearing
21	"O" Ring
22	Thrust Bearing Race
23	Thrust Bearing Rollers
24	Drive Shaft
25	Thrust Washer
26	Shaft End Cover
27	Needle Bearing
28	Bearing & Seal Retainer
29	"O" Ring
30	Back-Up Ring
32	Drive Shaft
33	Snap Ring Retainer
34	Snap Ring

No.	Description
36	Bronze Shaft Bushing
37	Conical Spring
38	Roller Bearings
39	Pocket Seal
40	Thrust Plate
41	"O" Ring Gasket
42	Gear Housing
43	"O" Ring Gasket
44	Drive Gear
45	Driven Gear
46	Thrust Plate
47	Pocket Seal
48	Roller Bearings
49	Port End Cover
50	Washer
51	Cap Screw

single pump disassembly

GENERAL NOTES

Remember, dirt is the enemy of any hydraulic system. The best way to fight this enemy is to prevent its entry into the system. Make sure you disassemble and reassemble this pump in spotlessly clean sur-

roundings. Apply a coating of grease (cup grease consistency) to surfaces of all "O" rings and oil seals to facilitate positive location as they are installed in a reassembly.

TYPE I

DISASSEMBLY BY SUBASSEMBLY

1. Back off the threaded retainer ring (1) at least three full turns to release the bearing preload. **WARNING:** this must be done before any servicing work is performed on the pump.
2. Index mark the port end cover (49), gear housing (42), and shaft end cover (9) to facilitate reassembly.
3. Remove the four cap screws (51) and washers (50) from the port end cover (49).
4. Lift off port end cover (49). The thrust plate (46) with pocket seals (47) and roller bearings (48) will also be removed in this operation.
5. Remove the driven gear (45), drive gear (44), and gear housing (42) from the shaft end cover (9). Be sure to keep gears together as they are a matched set.

SHAFT END COVER

1. Turn the shaft end cover (9) over so that the drive end of the shaft is facing up. Remove retainer ring (1).
2. Pull the assembled drive shaft out of the shaft end cover (9).

3. Turn the cover over so that the thrust plate is up. Pry off thrust plate (40) carefully with a knife blade or thin screwdriver. Remove and discard pocket seals (39).
4. Pull the bearings (38) with a bearing puller from the shaft end cover (9) — **ONLY** — if they are being replaced. To remove conical spring (37) and shaft bushing (36) — **ONLY THE SHAFT END DRIVE BEARING NEED BE PULLED.**
5. On shafts 1 $\frac{1}{8}$ " diameter or smaller, disregard this step and go on to step 6. On models with shafts larger than 1 $\frac{1}{8}$ " diameter, remove snap ring (16) and spacer (15) from gear end of shaft.
6. Press tapered bearing (6) with cup (5) and seal retainer (2) with the lip seal (3) off gear end of shafts larger than 1 $\frac{1}{8}$ " diameter and off drive end of shafts 1 $\frac{1}{8}$ " diameter or smaller.
7. Remove and discard "O" ring (4) from shaft bore.
8. Remove and discard lip seal (3) from seal retainer.

Continue with HOUSING, Type I and II

TYPE II

DISASSEMBLY BY SUBASSEMBLY

1. Index mark the port end cover (49), gear housing (42), and shaft end cover (26) to facilitate reassembly.
2. Remove the four cap screws (51) and washers (50) from the port end cover (49).
3. Lift off the port end cover (49). The thrust plate (46) with pocket seals (47) and roller bearings (48) will also be removed in this operation.
4. Remove the driven gear (45), drive gear (44), and gear housing from the shaft end cover (26). Be sure to keep gears together as they are a matched set.
3. Turn the cover over so that the thrust plate is up. Pry off the thrust plate (40) carefully with a knife blade or thin screwdriver. Remove and discard the pocket seals (39).
4. Pull the bearings (38) with a bearing puller from the shaft end cover (26)—ONLY—if they are being replaced. To remove conical spring (37) and shaft bushing (36),—ONLY the shaft end drive bearing need be removed.

SHAFT END COVER

1. Turn the shaft end cover (26) over so that the drive end of the shaft is facing up. Using a sharp pointed tool or screwdriver, remove the snap ring (34).
2. Pull the assembled drive shaft out of the shaft end cover. The needle bearing assembly, consisting of the "O" ring (21), needle bearing (20), seal retainer (19) and seal (18) along with the thrust bearing races (22), and thrust bearing rollers (23), will also be removed in this operation. On models with shafts larger than 1" in diameter, the snap ring (34) and snap ring retainer (33) will be removed in this operation. On models with shafts 1" diameter and smaller, remove the thrust washer (25) from bottom of bearing bore.

DRIVE SHAFT 1" DIAMETER AND SMALLER

5. Slide the needle bearing assembly off the drive end of the shaft (24). The thrust bearing rollers (23) and the two thrust bearing races (22), are now easily removed from the drive end of the shaft (24).

DRIVE SHAFT LARGER THAN 1" IN DIAMETER

5. Hold the needle bearing assembly forward toward the drive end of the shaft (32), and with a pair of Eaton pliers, remove snap ring (34). The snap ring retainer (33), thrust bearing races (22), and rollers (23) along with the "O" ring (21), seal and bearing retainer (19), seal (18), and needle bearing (20) are now easily removed from gear end of the shaft (32).
6. Remove and discard seal (18) and "O" ring (21) from seal and bearing retainer (19).
7. Press needle bearing (20) from seal and bearing retainer (19)—IF—replacing bearing.

Continue with HOUSING, Type I and II

TYPE I AND II

HOUSING

1. Remove and discard "O" rings (41), and (43) from grooves in housing (42) faces.

PORT END COVER

1. Pry off the thrust plate (46) with a knife blade

or thin screwdriver. Remove and discard the pocket seals (47).

2. Pull the bearings (48) with a bearing puller from the port end cover (49)—ONLY—if they are being replaced.



single pump assembly

TYPE I SHAFT END COVER

1. Place the shaft end cover (9), gear side up, in a vise with soft jaws. Install bronze shaft bushing (36) with flange side toward bottom of bore.
2. Next, install conical spring (37) with smaller end of spring over pilot shoulder of shaft bushing.
3. Install two roller bearings (38) in the bores of the cover—IF they were removed. Be sure top of spring (37) does not become wedged between bearing and bottom of bearing counterbore.
4. Turn shaft end cover (9) over in vise with flange side up.

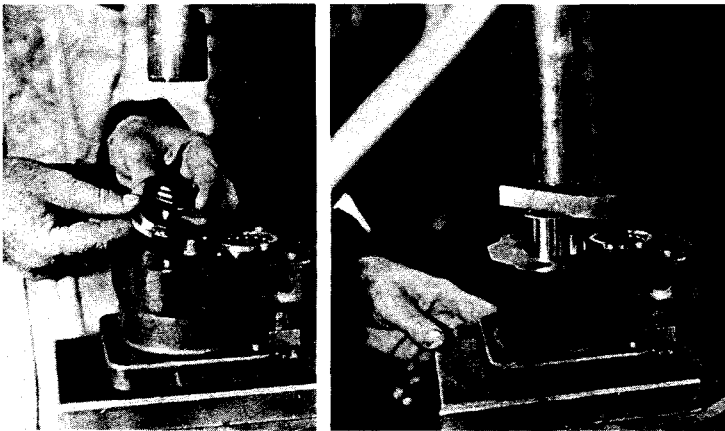
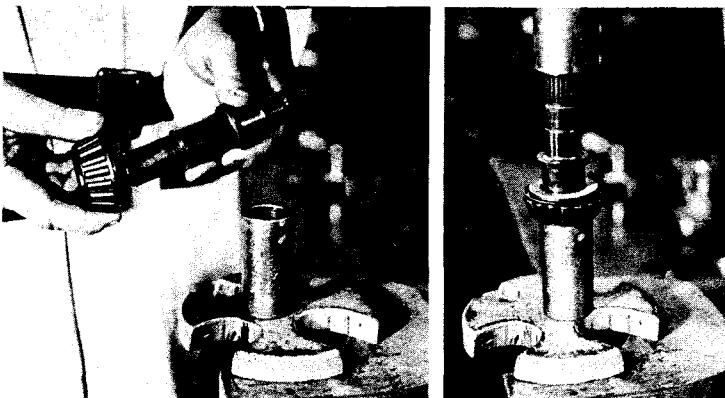


Fig. 3 Installing spring, bushing and bearings

DRIVE SHAFT SMALLER THAN 1 1/8" DIAMETER

5. Repack the tapered roller bearing (6) with a high quality cup grease. Press the bearing onto the drive shaft (8) being sure that larger diameter of bearing is seated against the shaft shoulder. Insert the assembled shaft in the shaft end cover (9), and be sure shaft bushing (36) is centered around shaft bore. Next, place the cup (5) over the bearing. Tap or press cup (5) to seat solidly against bottom of bearing bore.
6. Before installing a pump or motor seal (item 3 or 11), clean the bore of the seal retainer and the outside of the seal with naphtha. Dry and apply a thin coat of Permatex Aviation Type 3, Loctite 71-31 pipe sealant or comparable anaerobic setting compound. Press double lip seal or motor seal (3 or 11) into the pump or motor seal retainer (2 or 12). Make sure the main lip of the seal is facing outward. Install greased "O" ring in the groove on the seal retainer.

Fig. 4 Pressing bearing onto drive shaft



NOTE: In double outboard bearing assemblies there is a machined groove in the shaft end cover (9) in which the greased "O" ring should be placed.

PUMPS—Install the seal retainer sub-assembly onto the shaft (8) making sure it seats against the bearing cup (5).

MOTORS—A fiber sleeve should be used when installing 25X seal retainer assemblies over the drive shaft. Oil the seal and push sleeve carefully through it. Place the sleeve over the shaft. Hold it tightly against the shoulder and push the retainer from the sleeve onto the shaft with a turning motion. Hold the sleeve tightly against the shoulder until the retainer ring threads are started. If installing the seal retainer over a shaft without using a sleeve, be careful not to cut the seal during installation.



Fig. 5 Type I motor kit parts
DRIVE SHAFT 1 1/8" DIAMETER AND LARGER

5. Clean seal (3 or 11) and bore of retainer (2 or 12) with naphtha. Dry and lightly coat O.D. of seal with Permatex Aviation Type 3, Loctite 71-31 pipe sealant or comparable anaerobic setting compound. Press seal into bore recess of retainer. Install or press seal retainer sub-assembly over shaft from the small diameter end. Be sure main lip of seal faces small inside end of shaft. Place greased "O" ring (4 or 13) in groove on seal retainer.

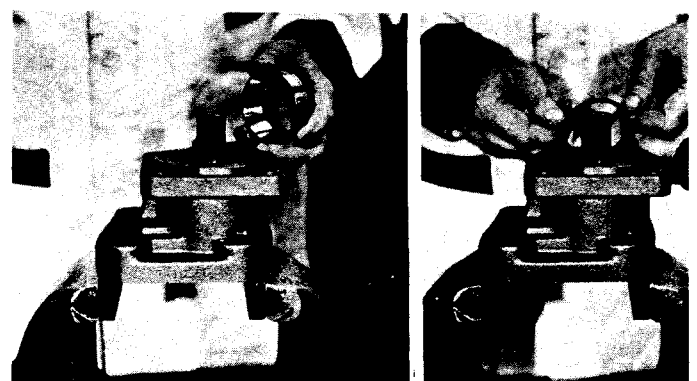
NOTE: In double outboard bearing assemblies there is a machined groove in the shaft end cover (9) in which the greased "O" ring should be placed.

Repack the tapered roller bearing (6) with a high quality cup grease.

Press the bearing onto the drive shaft (14) being sure that the small diameter of the bearing faces the seal retainer. Next, place outer cup (5) over the bearing. Install spacer (15) over gear end of shaft and then place snap ring (16) in its proper groove on shaft. Press seal retainer sub assembly, bearing, cup and spacer tight against the snap ring.

6. Insert the assembled shaft in shaft end cover (9).

Fig. 6 Installing bearing cup, and "O" ring



7. Thread retainer ring (1) loosely into the shaft end cover (9). DO NOT preload the bearing when installing the retainer ring.
8. Turn shaft end cover over in vise with gear side up. See that plug or check assemblies are in

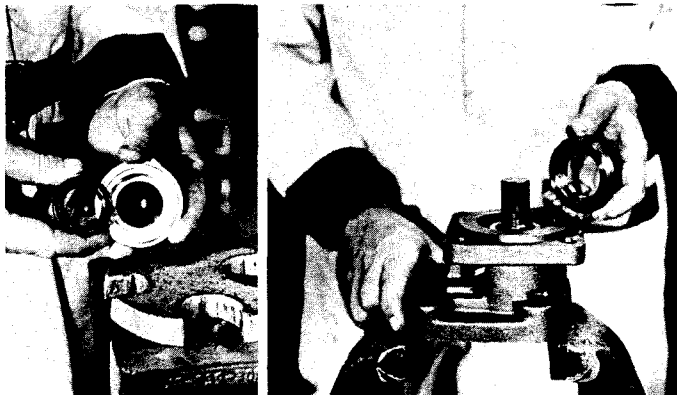


Fig. 7 Installing seal retainer and retainer ring

proper place—IF—they were removed. NOTE: Double rotation units require two check assemblies as shown by item (35). Single rotation units do not require check assemblies. Instead, a plug is installed on the high pressure side of pump with the low pressure side left open.

TYPE II SHAFT END COVER

1. Place the shaft end cover (26), gear side up, in a vise. Install bronze shaft bushing (36) with flange side toward bottom of bore.
2. Install spring (37) with small end of spring over pilot shoulder of shaft bushing.
3. Install two roller bearings (38) in the bores of the cover—IF—they were removed. Be sure top of spring (37) does not become wedged between bearing and bottom of bearing counter-bore.
4. Turn shaft end cover (26) over in vise with flange side up.
5. Press seal (18) into its recess in the seal retainer (19) with lip of seal facing outward. Press needle bearing (20) in seal retainer (19), if being replaced. Place "O" ring (21) over the small diameter of seal retainer (19).

NOTE: For motors using either size of shaft—use special seal retainer (28) which uses an "O" ring (29) and back-up ring (30) in groove in i.d. of seal retainer and a washer (31) which fits its offset in the retainer.

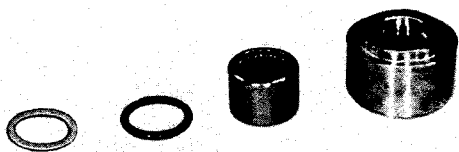


Fig. 8 Type II motor kit parts

25X pump and motor service manual

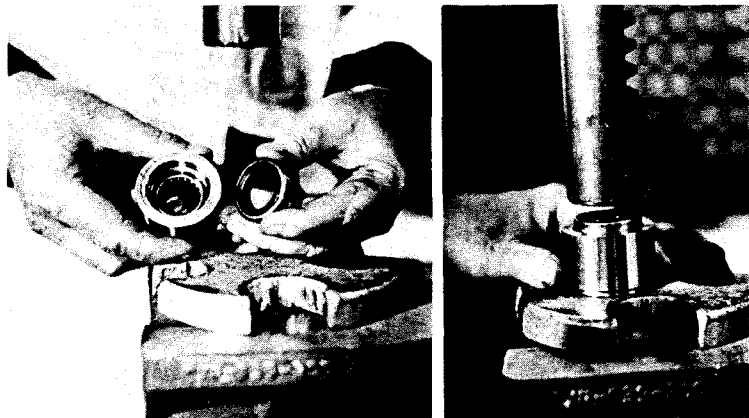


Fig. 9 Pressing double-lip seal into retainer

DRIVE SHAFT 1" DIAMETER AND SMALLER

6. Place thrust washer (25) in bottom of bearing bore with grooves facing up.
7. Place one thrust bearing race (22) over drive end of shaft (24) so as to rest against shaft shoulder. Follow with thrust bearing rollers (23) and other thrust bearing race (22). Next, install needle bearing assembly onto shaft (24) so that "O" ring (21) is against thrust bearing race. Continue with step 8.

DRIVE SHAFT LARGER THAN 1" IN DIAMETER

6. Take this seal retainer subassembly and install on shaft (32) with seal (18) next to shoulder of drive end of shaft. Now place one thrust bearing race (22) on shaft next to the "O" ring (21). Follow with thrust bearing rollers (23), other thrust bearing race (22), and snap ring retainer (33).

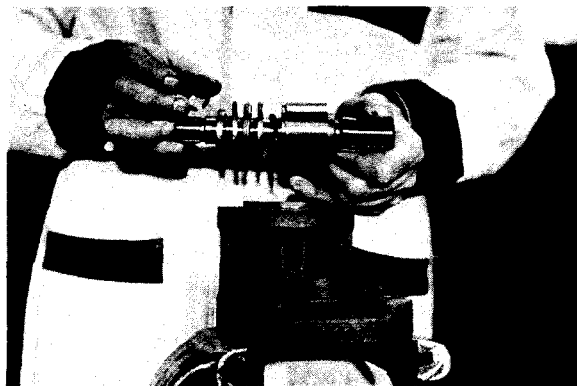


Fig. 10 Type II drive shaft assembly

7. Push this bearing assembly forward and hold next to shoulder near the drive end of shaft. Now install the snap ring (34) in place to hold this assembly. Continue with step 8.
8. Insert assembled shaft in shaft end cover (26).
9. With ends of spirolax snap ring (17) spread



single pump assembly (continued)

apart, insert one end of snap ring into groove, then wind balance of the snap ring into this groove.

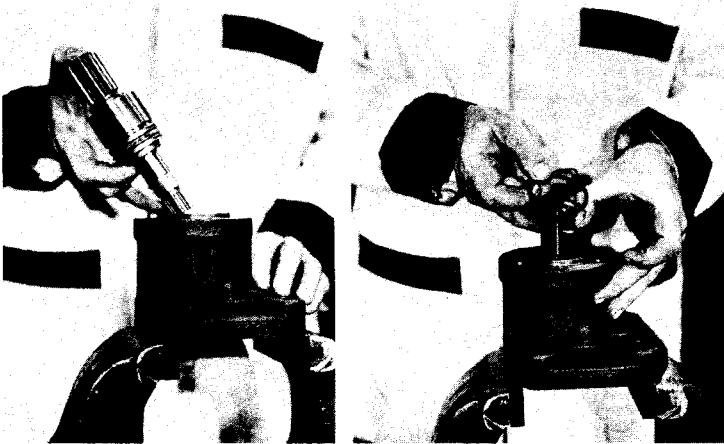


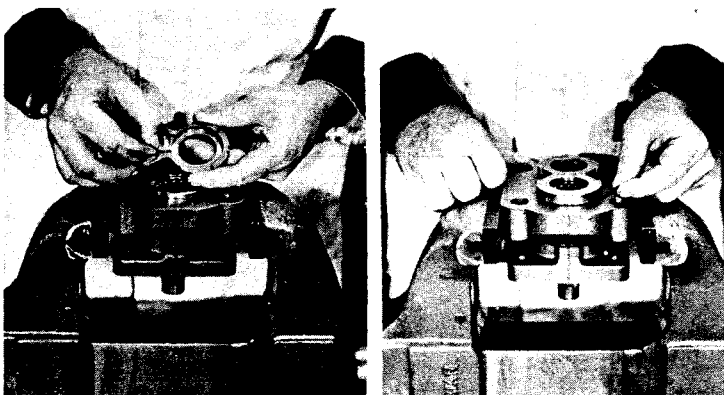
Fig. 11 Installing drive shaft and snap ring

10. Turn shaft end cover over in vise with gear side up. See that plug or check assemblies are in proper place. NOTE: Double rotation units require two check assemblies as shown by item (10). Single rotation units do not require check assemblies. Instead a plug is installed on the high pressure side of pump with the low pressure side left open.

TYPE I AND II

11. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (40) and insert pocket seals (39).
12. Place the thrust plate (40) with pocket seal slots toward the face of the shaft end cover over the bearings (38). Check to see that the pocket seals (39) in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately $\frac{1}{32}$ " between the thrust plate (40) and the shaft end cover (26).
13. Into each of the four open slots in the thrust plate (40) insert a pocket seal (39). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the shaft end cover.

Fig. 12 Inserting center and outer pocket seals



Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals (39) square and flush with side of the thrust plate.

PORT END COVER SUBASSEMBLY

1. Install the two roller bearings (48) into their respective bores in the port end cover (49)—IF—they were removed.
2. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (46) and insert pocket seals (47).
3. Place the thrust plate (46) with pocket seal slots toward the face of the port end cover (49) over the bearings (48). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately $\frac{1}{32}$ " between the thrust plate (46) and the port end cover (49).
4. Into each of the four open slots in the thrust plate (46) insert a pocket seal (47). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the port end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals square and flush with sides of the thrust plate.

FINAL ASSEMBLY

1. Place the assembled shaft end cover in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication of gears. Install the drive gear (44) on the shaft. Next, install the driven gear (45) in its respective bore. Stone the gear ends before installation to remove any minute burrs.
3. Stone the faces of the gear housing (42) to remove any burrs that might have occurred in handling. Blow or carefully wipe clean before installing pregreased "O" rings (41) and (43) in the grooves in the faces of the housing (42).
4. Place the gear housing (42) on the shaft end cover and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch the "O" ring (41) when positioning the housing. Pour a small amount of oil over the gears to provide initial lubrication when putting the pump back into service.
5. Install the port end cover subassembly on the gear housing (42). Hubs of gears fit into the I.D. of the roller bearings (48) and thrust plate (46) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing, making sure the "O" ring on the face of the housing is not pinched.

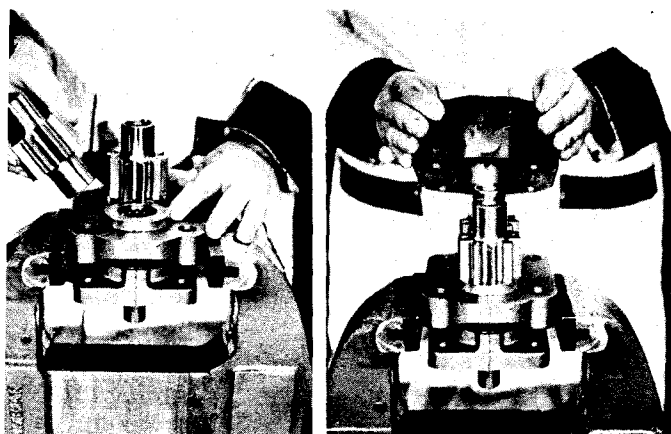
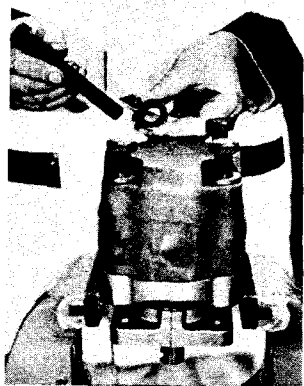


Fig. 13 Installing driven gear and gear housing

6. Thread the four cap screws (51) with washers (50) under the heads of the cap screws, into the shaft end cover. Tighten the four cap screws alternately to 200 ft. lbs. of torque. Rotate the shaft with a six inch wrench. Protect the shaft splines when using a wrench. The shaft should rotate easily.



Fig. 14 Installing port end cover assembly. Inserting and tightening cap screws with washer.



the retainer ring (1) with a pin type wrench until it is tight. Proper bearing preload and running clearance is obtained by backing off the threaded retainer ring.

8. Final adjustment of running clearance is obtained in the following manner:

With the threaded retainer ring tightened until it stops or is snug, scribe a line, so that it is visible across the face of the retainer ring and over onto the face of the flange or pilot of shaft end cover. Now back the retainer ring off $\frac{1}{2}$ ", measuring from the scribed line at the outside diameter or edge of the retainer ring.

This amount of movement or back off will provide approximately .005" clearance, which has been carefully calculated as the prescribed bearing adjustment.

With the retainer ring backed off to the proper setting, upset or stake the outer edge of the retainer ring into the groove or slot provided at the inside diameter of the pilot of the shaft end cover. Use a blunt tool to force the metal from the outer edge of the retainer ring into the groove or slot. Make sure the retainer ring is securely locked in this manner.

NOTE: THE RETAINER RING MUST NOT BE BACKED OFF IN DOUBLE OUTBOARD BEARING ASSEMBLIES. TIGHTEN UNTIL SNUG AND STAKE TO PREVENT LOOSENING.

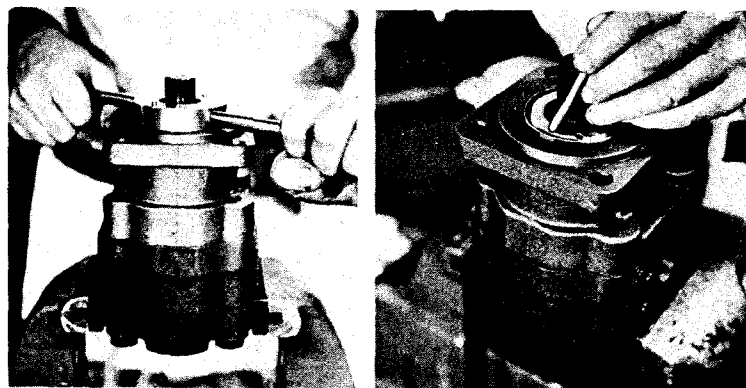


Fig. 15 Adjusting and staking retainer ring

IMPORTANT PRECAUTION TO OBSERVE BEFORE OPERATING NEW OR REBUILT HYDRAULIC PUMP:

To avoid possible pump damage to a new or rebuilt hydraulic pump, back off the main relief valve adjusting screw (or remove adjusting shims or spacers) before operating pump, then, **AFTER PUMP HAS RUN IN FOR ABOUT 5 MINUTES AT ZERO PRESSURE** (with all control levers in neutral position) adjust relief valve pressure to proper and prescribed setting. Failure to observe this precaution can result in almost immediate failure of the hydraulic pump—if the relief valve pressure setting should be excessive.

STEPS 7 AND 8 APPLY TO TYPE I ONLY

7. Remove the assembled pump from the vise and turn it over so the end of the shaft is up. Tighten



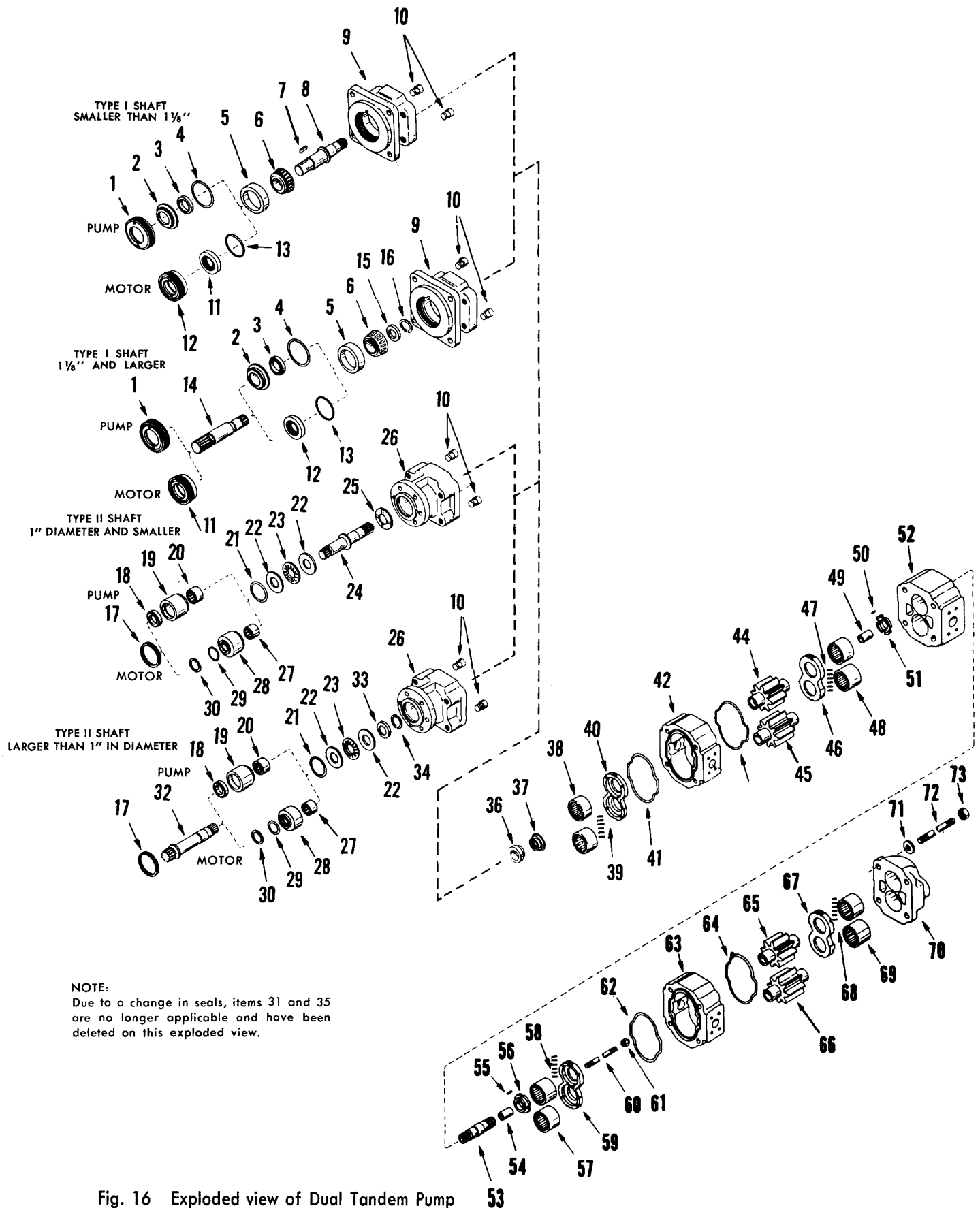


Fig. 16 Exploded view of Dual Tandem Pump
or Motor

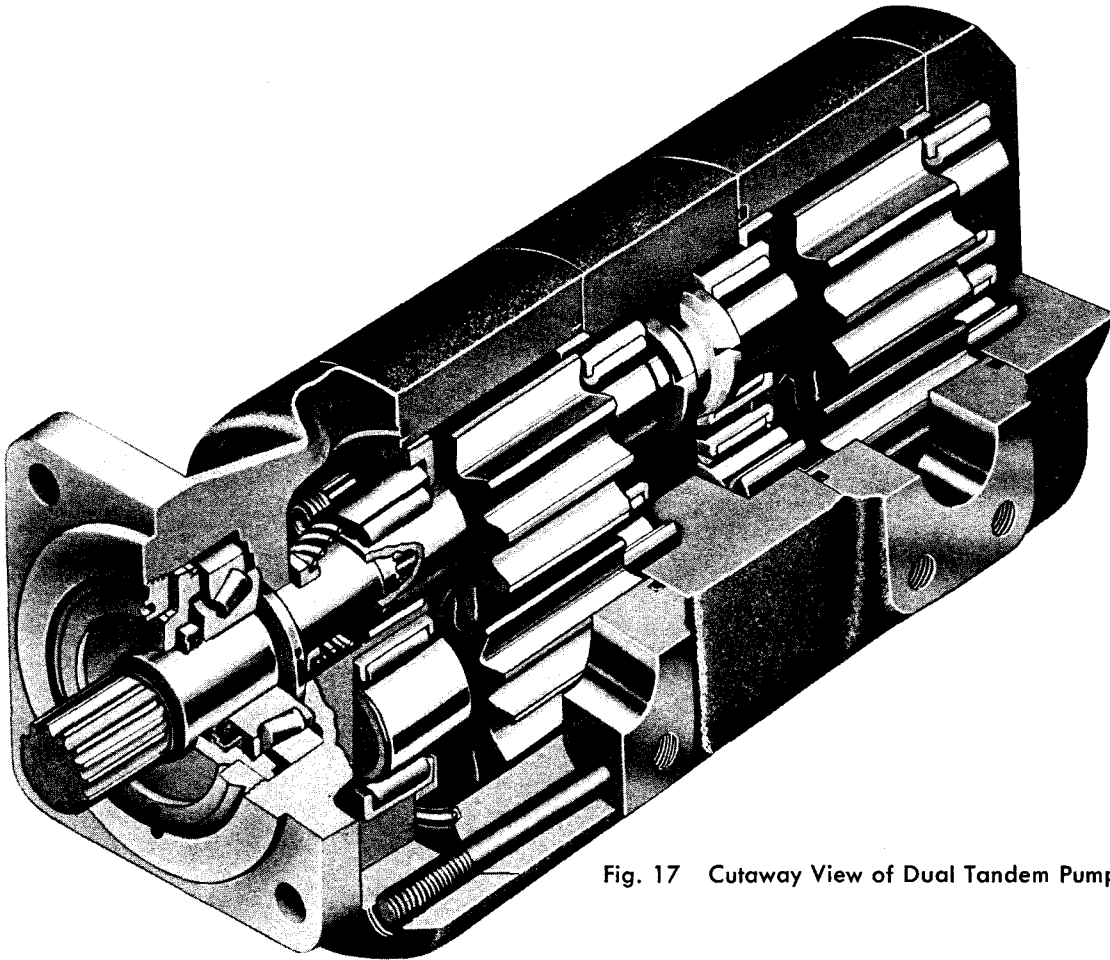


Fig. 17 Cutaway View of Dual Tandem Pump, Type I

COMMERCIAL Model 25X tandem pumps and motors can be furnished with either the Type I or Type II shaft. The Type II shaft is used with a thrust bearing and a needle bearing in place of the tapered roller bearing used in the

Type I assembly, in order to provide for the 6 bolt— $2\frac{5}{8}$ " dia. pilot shaft end cover. Component parts for the Type I and Type II shaft end cover subassemblies are not interchangeable.

No.	Description	No.	Description	No.	Description
1	Retainer Ring	25	Thrust Washer	50	Roll Pin
2	Seal Retainer	26	Shaft End Cover	51	Shaft Bushing
3	Double Lip Seal	27	Needle Bearing	52	Bearing Carrier
4	"O" Ring	28	Bearing & Seal Retainer	53	Connecting Shaft
5	Bearing Cup	29	"O" Ring	54	Spacer
6	Tapered Bearing	30	Back-Up Ring	55	Roll Pin
7	Key	32	Drive Shaft	56	Shaft Bushing
8	Drive Shaft	33	Snap Ring Retainer	57	Roller Bearings
9	Shaft End Cover	34	Snap Ring	58	Pocket Seal
10	Check Assembly	36	Bronze Shaft Bushing	59	Thrust Plate
11	Motor Shaft Seal	37	Conical Spring	60	Connecting Stud
12	Seal Retainer	38	Roller Bearings	61	Lock Nut
13	"O" Ring	39	Pocket Seal	62	"O" Ring Gasket
14	Drive Shaft	40	Thrust Plate	63	Gear Housing
15	Spacer	41	"O" Ring Gasket	64	"O" Ring Gasket
16	Snap Ring	42	Gear Housing	65	Drive Gear
17	Spirolox Snap Ring	43	"O" Ring Gasket	66	Driven Gear
18	Double Lip Seal	44	Drive Gear	67	Thrust Plate
19	Bearing and Seal Retainer	45	Driven Gear	68	Pocket Seal
20	Needle Bearing	46	Thrust Plate	69	Roller Bearings
21	"O" Ring	47	Pocket Seal	70	Port End Cover
22	Thrust Bearing Race	48	Roller Bearings	71	Washer
23	Thrust Bearing Rollers	49	Spacer	72	Stud
24	Drive Shaft			73	Hex Nut



tandem pump disassembly

GENERAL NOTES

Remember, dirt is the enemy of any hydraulic system. The best way to fight this enemy is to prevent its entry into the system. Make sure you disassemble and reassemble this pump in spotlessly clean sur-

roundings. Apply a coating of grease (cup grease consistency) to surfaces of all "O" rings and oil seals to facilitate positive location as they are installed in a reassembly.

TYPE I DISASSEMBLY BY SUBASSEMBLY

1. Back off the threaded retainer ring (1) at least three full turns to release the bearing preload. **WARNING:** This must be done before any servicing work is performed on the pump.
2. Index mark the port end cover (70), gear housings (42), (63), bearing carrier (52), and shaft end cover (9) to facilitate reassembly.
3. Remove the four hex nuts (73) and washers (71) from the studs.
4. Lift off port end cover (70). The thrust plate (67) with pocket seals (68) and roller bearings (69) will also be removed in this operation.
5. Remove the driven gear (66), drive gear (65), and gear housing (63) from the bearing carrier (52). Keep the gears together as they are a matched set.
6. Remove four studs (72).
7. Using a wrench to hold the drive end of shaft (8), remove lock nut from connecting stud (60). Protect end of shaft when using wrench.
8. Remove spacer (54) and connecting shaft (53) from connecting stud (60).
9. Remove the bearing carrier (52) from the gear housing (42). The thrust plates (59), and (46) with pocket seals (58) and (47), roller bearings (57) and (48), shaft bushings (51) and (56) will also be removed.
10. Remove driven gear (45), drive gear (44), and gear housing (42) from the shaft end cover (9). Keep the gears together as they are a matched set.
11. Remove connecting stud (60) from tapped hole in gear end of shaft (8).

12. Remove spacer (49) from connecting stud (60). The above information is to cover a two section tandem pump. The same routine is followed on the three or four section pump.

SHAFT END COVER

1. Turn the shaft end cover (9) over so that the drive end of the shaft is facing up. Remove retainer ring (1).
2. Pull the assembled drive shaft out of the shaft end cover (9).
3. Turn the cover over so that the thrust plate (40) is up. Pry off the thrust plate (40) carefully with a knife blade or thin screwdriver. Remove and discard the pocket seals.
4. Pull the bearings (38) with a bearing puller from the shaft end cover (9)—ONLY—if they are being replaced. To remove conical spring (37) and shaft bushing (36) only the shaft end drive bearing need be removed.
5. On shafts 1 $\frac{1}{8}$ " diameter or smaller, disregard this step and go on to step 6. On models with shafts larger than 1 $\frac{1}{8}$ " diameter, remove snap ring (16) and spacer (15) from gear end of drive shaft.
6. Press tapered bearing (6) with cup, and seal retainer (2) with lip seal (3) off gear end of shafts larger than 1 $\frac{1}{8}$ " diameter, and off drive end of shafts 1 $\frac{1}{8}$ " diameter or smaller.
7. Remove and discard "O" ring (4) from shaft bore.
8. Remove and discard lip seal (3) from seal retainer (2).

Continue with HOUSING, Type I and II

TYPE II DISASSEMBLY BY SUBASSEMBLY

1. Index mark the port end cover (70), gear housing (63) and (42), bearing carrier (52), and shaft end cover to facilitate reassembly.
2. Remove the four hex nuts (73) and washers (71) from the studs (72).
3. Lift off port end cover (70). The thrust plate (67) with pocket seals (68) and roller bearings (69) will also be removed in this operation.
4. Remove the driven gear (66), drive gear (65), and gear housing (63) from the bearing carrier (52). Keep the gears together as they are a matched set.
5. Remove four studs (72).
6. Using a wrench to hold the drive end of shaft, remove lock nut from connecting stud (60). Protect end of shaft when using wrench.
7. Remove spacer (54) and connecting shaft (53) from connecting stud (60).
8. Remove the bearing carrier (52) from the gear housing (42). The thrust plate (59) with pocket seals (58), roller bearings (57), and shaft bushings (56) will also be removed.
9. Remove driven gear (45), drive gear (44), and gear housing (42) from the shaft end cover (26). Keep the gears together as they are a matched set.
10. Remove connecting stud (60) from tapped hole in gear end of shaft (24).
11. Remove spacer (49) from connecting stud (60). The above information is to cover a two section tandem pump. The same routine is followed on the three or four section pump.

SHAFT END COVER

1. Turn the shaft end cover (26) over so that the drive end of the shaft is facing up. Using a sharp pointed tool or screwdriver, remove the snap ring (17).
2. Pull the assembled drive shaft out of the shaft

end cover. The needle bearing assembly, consisting of the "O" ring (21), needle bearing (20), seal retainer (19), and seal (18) along with the thrust bearing races (22) and thrust bearing rollers (23) will also be removed in this operation. On models with shafts larger than 1" in diameter the snap ring (34) and snap ring retainer (33) will be removed in this operation. On models with shafts 1" diameter and smaller, remove the thrust washer (25) from bearing bore.

3. Turn the cover over so that the thrust plate is up. Pry off the thrust plate (40) carefully with a knife blade or thin screwdriver. Remove and discard the pocket seals (39).
4. Pull the bearings (38) with a bearing puller from the shaft end cover (26)—ONLY—if they are being replaced. To remove conical spring (37) and shaft bushing (36), only the shaft end drive bearing need be removed.

DRIVE SHAFT 1" DIAMETER AND SMALLER

5. Slide the needle bearing assembly off the drive end of the shaft (24). The thrust bearing rollers (23) and the two thrust bearing races (22) are now easily removed from the drive end of the shaft (24).

DRIVE SHAFT LARGER THAN 1" IN DIAMETER

5. Hold the needle bearing assembly forward toward the drive end of the shaft (32), and with a pair of Eaton pliers, remove snap ring (34). The snap ring retainer (33), thrust bearing races (22), and rollers (23), along with the "O" ring (21), seal retainer (19), seal (18), and needle bearing (20) are now easily removed from gear end of the shaft (32).
6. Remove and discard seal (18) and "O" ring (21) from seal retainer (19).
7. Press needle bearing (20) from seal retainer (19)—IF—replacing bearing.

Continue with HOUSING, Type I and II

TYPE I AND II

HOUSING

1. Remove and discard "O" rings (41), (43), (62) and (64) from grooves in housing (42), (63) faces.

PORT END COVER

1. Pry off the thrust plate (67) with a knife blade or thin screwdriver. Remove and discard the pocket seals (68).
2. Pull the bearings (69) with a bearing puller from the port end cover (70)—ONLY—if they are being replaced.

BEARING CARRIER

1. Pry off the thrust plates (46), (59) with a knife blade or thin screwdriver. Remove and discard all pocket seals (47), (58).
2. Pull the four bearings (48), and (57) with a bearing puller from the bearing carrier (52)—ONLY—if they are being replaced.
3. Remove the two shaft bushings (51) and (56).
4. Remove the two roll pins (50), (55) if desired.



tandem pump assembly

TYPE I SHAFT END COVER

1. Place the shaft end cover (9), gear side up, in a vise with soft jaws. Install bronze shaft bushing (36) with flange side toward bottom of bore.
2. Next, install conical spring (37) with smaller end of spring over pilot shoulder of shaft bushing.
3. Install two roller bearings (38) in the bores of the cover—IF—they were removed. Be sure top of spring (37) does not become wedged between bearing and bottom of bearing counter-bore.
4. Turn shaft end cover (9) over in vise with flange side up.

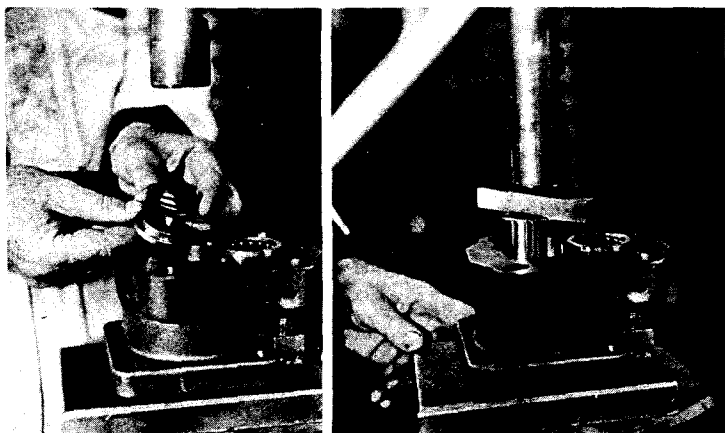
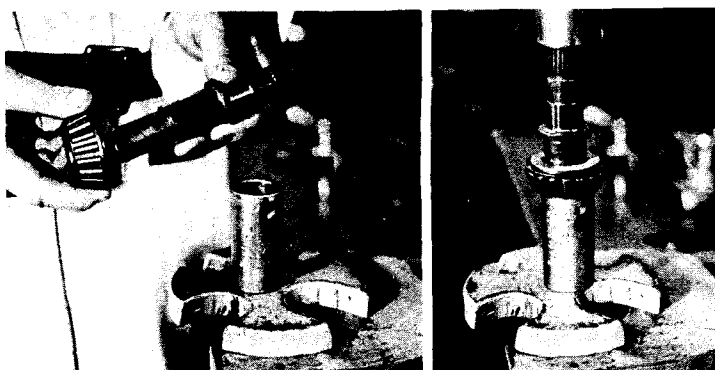


Fig. 18 Installing spring, bushing, and bearings

DRIVE SHAFT SMALLER THAN 1 1/8" DIAMETER

5. Repack the tapered roller bearing (6) with a high quality cup grease. Press the bearing onto the drive shaft (8) being sure that larger diameter of bearing is seated against the shaft shoulder. Insert the assembled shaft in the shaft end cover (9), and be sure shaft bushing (36) is centered around shaft bore. Next, place the cup (5) over the bearing. Tap or press cup (5) to seat solidly against bottom of bearing bore.
6. Before installing a pump or motor seal (item 3 or 11), clean the bore of the seal retainer and the outside of the seal with naphtha. Dry and apply a thin coat of Permatex Aviation Type 3, Loctite 71-31 pipe sealant or comparable anaerobic setting compound. Press double lip seal or motor seal (3 or 11) into the pump or motor seal retainer (2 or 12). Make sure the

Fig. 19 Pressing bearing onto drive shaft



main lip of the seal is facing outward. Install greased "O" ring in the groove on the seal retainer.

NOTE: In double outboard bearing assemblies there is a machined groove in the shaft end cover (9) in which the greased "O" ring should be placed.

PUMPS—Install the seal retainer sub-assembly onto the shaft (8) making sure it seats against the bearing cup (5).

MOTORS—A fiber sleeve should be used when installing 25X seal retainer assemblies over the drive shaft. Oil the seal and push sleeve carefully through it. Place the sleeve over the shaft. Hold it tightly against the shoulder and push the retainer from the sleeve onto the shaft with a turning motion. Hold the sleeve tightly against the shoulder until the retainer ring threads are started. If installing the seal retainer over a shaft without using a sleeve, be careful not to cut the seal during installation.

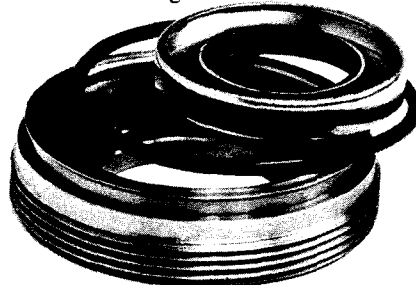


Fig. 20 Type I motor kit parts

DRIVE SHAFT 1 1/8" DIAMETER AND LARGER

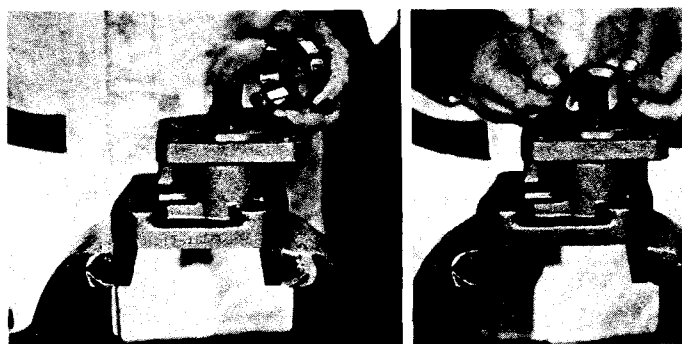
5. Clean seal (3 or 11) and bore of retainer (2 or 12) with naphtha. Dry and lightly coat O.D. of seal with Permatex Aviation Type 3, Loctite 71-31 pipe sealant or comparable anaerobic setting compound. Press seal into bore recess of retainer. Install or press seal retainer sub-assembly over shaft from the small diameter end. Be sure main lip of seal faces small inside end of shaft. Place greased "O" ring (4 or 13) in groove on seal retainer.

NOTE: In double outboard bearing assemblies there is a machined groove in the shaft end cover (9) in which the greased "O" ring should be placed.

Repack the tapered roller bearing (6) with a high quality cup grease.

Press the bearing onto the drive shaft (14) being sure that the small diameter of the bearing faces the seal retainer. Next, place outer cup (5) over the bearing. Install spacer (15) over gear end of shaft and then place snap ring (16) in its proper groove on shaft. Press seal retainer sub assembly, bearing, cup and spacer tight against the snap ring.

Fig. 21 Installing bearing cup, and "O" ring



6. Insert the assembled shaft in shaft end cover (9).
7. Thread retainer ring (1) loosely into the shaft end cover (9). DO NOT preload the bearing when installing the retainer ring.

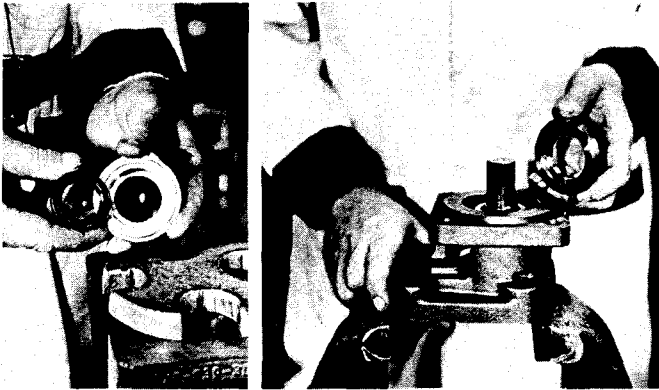


Fig. 22 Installing seal retainer and retainer ring

8. Turn shaft end cover over in vise with gear side up. See that plug or check assemblies are in proper place—IF—they were removed. NOTE: Double rotation units require two check assemblies as shown by items (35). Single rotation units do not require check assemblies. Instead a plus is installed in the high pressure side of pump with the low pressure side left open.

TYPE II SHAFT END COVER

1. Place the shaft end cover (26) gear side up in a vise. Install bronze shaft bushing (36) with flange side toward bottom of bore.
2. Install spring (37) with small end of spring over pilot shoulder of shaft bushing.
3. Install two roller bearings (38) in the bores of the cover—IF—they were removed. Be sure top of spring (37) does not become wedged between bearing and bottom of bearing counterbore.
4. Turn shaft end cover (26) over in vise with flange side up.
5. Press seal (18) into its recess in the seal retainer (19) with lip of seal facing outward. Press needle bearing (20) in seal retainer (19)—IF—being replaced. Place "O" ring (21) over the small diameter of seal retainer (19).

NOTE: For motors using either size of shaft—use special seal retainer (28) which uses an "O" ring (29) and back-up ring (30) in groove in i.d. of seal retainer and a washer (31) which fits its offset in the retainer.

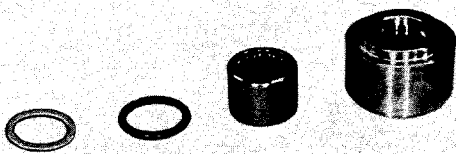


Fig. 23 Type II motor kit parts

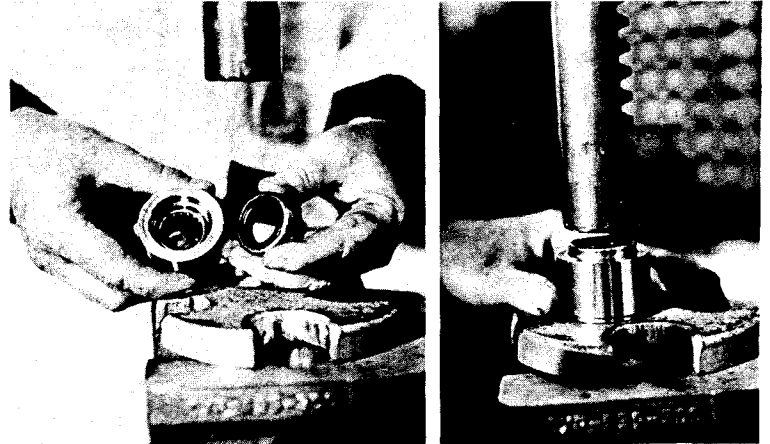


Fig. 24 Pressing double-lip seal into retainer

DRIVE SHAFT 1" DIAMETER AND SMALLER

6. Place thrust washer (25) in bottom of bearing bore with grooves facing up.
7. Place one thrust bearing race (22) over drive end of shaft (24) so as to rest against shaft shoulder. Follow with thrust bearing rollers (23) and other thrust bearing race (22). Next, install needle bearing assembly onto shaft (24) so that "O" ring (21) is against thrust bearing race. Continue with step 8.

DRIVE SHAFT LARGER THAN 1" IN DIAMETER

6. Take the seal retainer subassembly and install on shaft (32) with seal (18) next to shoulder of drive end of shaft. Now place one thrust bearing race (22) on shaft next to "O" ring (21). Follow with thrust bearing rollers (23), other thrust bearing race (22), and snap ring retainer (33).



Fig. 25 Type II drive shaft assembly

7. Push this bearing assembly forward and hold next to shoulder near the drive end of shaft. Now install the snap ring (34) in place to hold this assembly.
8. Insert assembled shaft in shaft end cover (26).
9. With ends of spirolox snap ring (1) spread apart,

tandem pump assembly (continued)

insert one end of snap ring into groove, then wind balance of the snap ring into this groove.

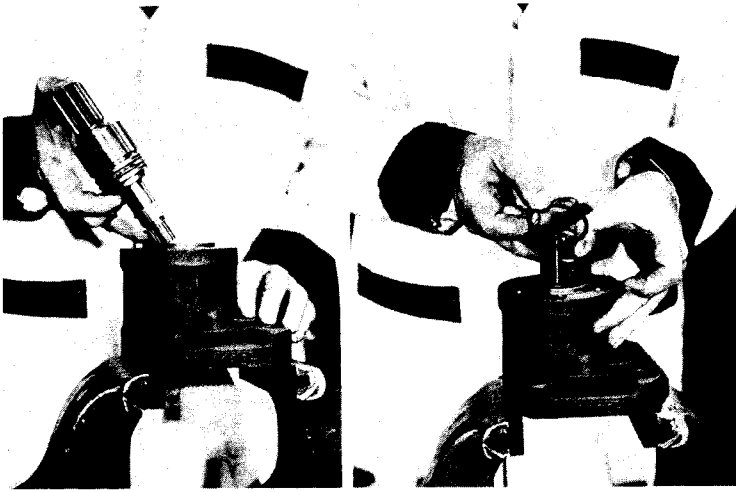


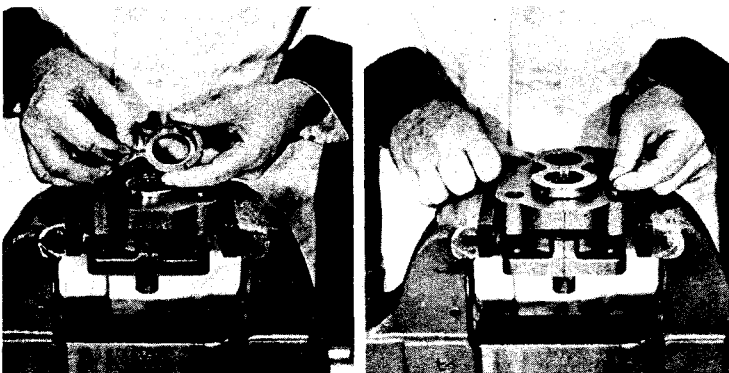
Fig. 26 Installing drive shaft and snap ring

10. Turn shaft end cover over in vise with gear side up. See that plug or check assemblies are in proper place. NOTE: Double rotation units require two check assemblies as shown by item (10). Single rotation units do not require check assemblies. Instead a plug is installed on the high pressure side of pump with the low pressure side left open.

TYPE I AND II

11. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (40) and insert pocket seals (39).
12. Place the thrust plate (40) with pocket seal slots toward the face of the shaft end cover over the bearings (38). Check to see that the pocket seals (39) in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately $\frac{1}{32}$ " between the thrust plate (40) and the shaft end cover.
13. Into each of the four open slots in the thrust plate (40) insert a pocket seal (39). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the shaft end cover. Using a razor blade or sharp knife, trim away

Fig. 27 Inserting center and outer pocket seals



the excess from the exposed ends of the pocket seals (39) square and flush with side of the thrust plate.

PORT END COVER SUBASSEMBLY

1. Install the two roller bearings (69) into their respective bores in the port end cover (70)—IF—they were removed.
2. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (67) and insert pocket seals (68).
3. Place the thrust plate (67) with pocket seal slots toward the face of the port end cover (70) over the bearings (69). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately $\frac{1}{32}$ " between the thrust plate (67) and the port end cover (70).
4. Into each of the four open slots in the thrust plate (67) insert a pocket seal (68). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the port end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals square and flush with sides of the thrust plate.

BEARING CARRIER SUBASSEMBLY

1. Install the two roll pins (50) and (55) in the holes provided for them in the drive shaft bores.
2. Install two shaft bushings (51), (56) in the shaft holes so that flange side of each bushing will be against bottom of bearing bore. Fit one slot of bushing over roll pin. This prevents bushing from turning on shaft. Do one side at a time.

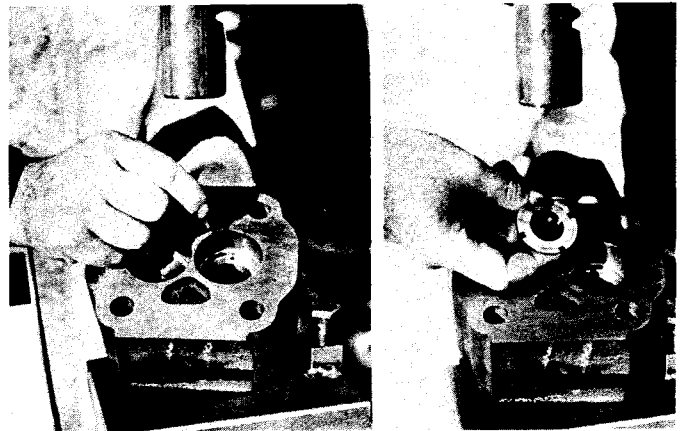


Fig. 28 Inserting roll pin and bushing

3. Install four roller bearings (48, 57)—IF—they were removed.
4. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (59) and insert pocket seals (58).
5. Place the thrust plate (59) with pocket seal slots

toward the face of the bearing carrier (52) over the bearings (57). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately $\frac{1}{32}$ " between the thrust plate (59) and the bearing carrier (52).

6. Into each of the four open slots in the thrust plate (59) insert a pocket seal (58). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the bearing carrier. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals square and flush with sides of the thrust plate.

FINAL ASSEMBLY

1. Place the assembled shaft end cover in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication in its respective bore. Stone the gear ends before installation to remove minute burrs.
3. Stone the faces of the gear housing (42) to remove any burrs that might have occurred in handling. Blow or carefully wipe clean. Install pregreased "O" rings (41) and (43) in the grooves in the face of the housing (42).
4. Place the gear housing over the gears (44) and (45) and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch the "O" ring (41) when positioning the housing. Pour a small amount of oil over the gears to provide initial lubrication when putting the pump back into service.
5. Install spacer (49) and then the connector shaft (53) into the bore of the drive gear (44).

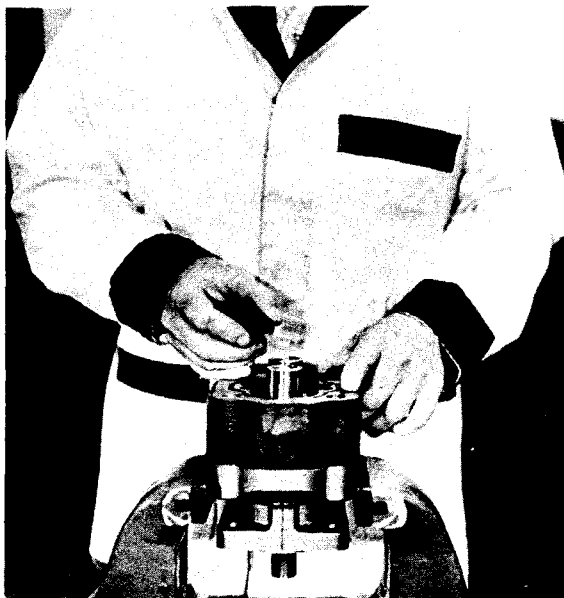


Fig. 29 Inserting spacer

6. Insert the shaft connecting bolt (60) through the bore of the connector shaft (53) and thread into tapped hole in the end of the drive shaft. Use Loctite Sealant on end of bolt before threading. Place other spacer (54) on bolt (60) and then install lock nut, but do not tighten nut. Be sure

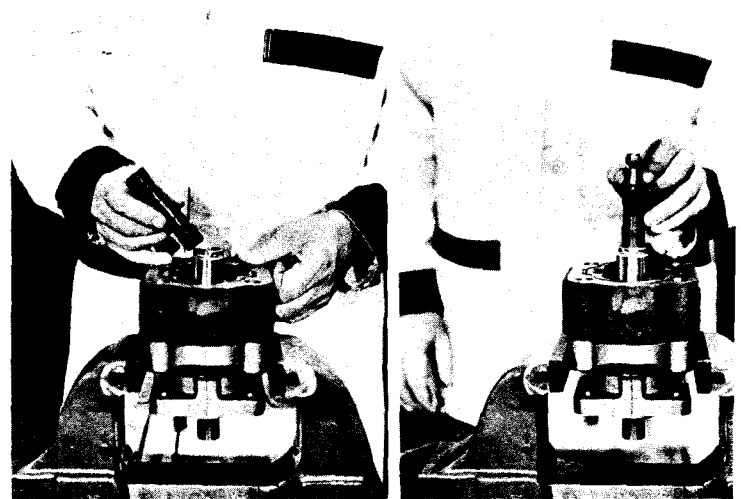


Fig. 30 Installing connector shaft, stud, spacer, and lock nut

correct length of spacer is used. Use spacer $\frac{3}{8}$ " shorter than gear length. Example: If tandem pump is made of 2" pump and $1\frac{1}{4}$ " pump, use $1\frac{1}{8}$ " spacer between drive shaft and connecting shaft, and $\frac{7}{8}$ " spacer under lock nut.

7. Install the bearing carrier (52) subassembly on the gear housing (42). Care must be taken so as not to score the shaft bushing in the shaft bore.

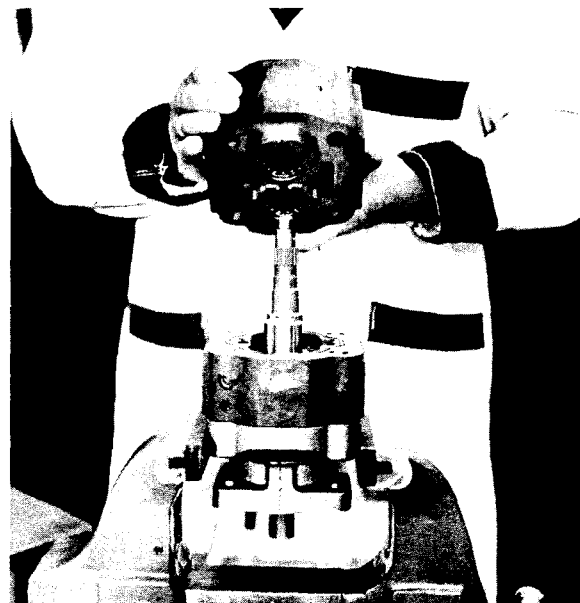


Fig. 31 Installing assembled bearing carrier

8. Tap bearing carrier (52) in place with a soft



tandem pump assembly (continued)

hammer, being careful not to pinch "O" ring (43), in the face of the housing (42).

9. Install drive gear (65) over the connector shaft (53), spacer (54), and lock nut.
10. Install the driven gear (66) into its respective bore. Next, hold drive end of shaft with wrench and tighten locknut to 19 footpounds with a torque wrench.

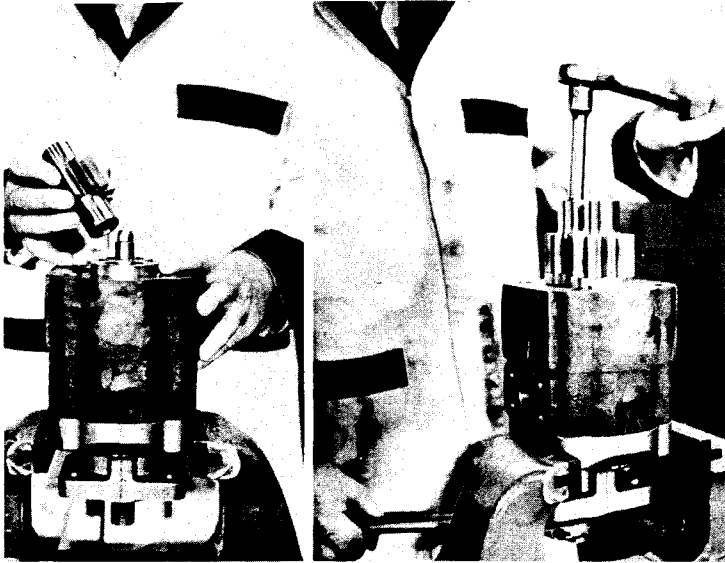


Fig. 32 Installing driven gear, tightening lock nut

11. Place gear housing (63) over gears (65), (66), and tap into place against bearing carrier. Pour a small amount of oil over the gears to provide lubrication when putting pump back into service.

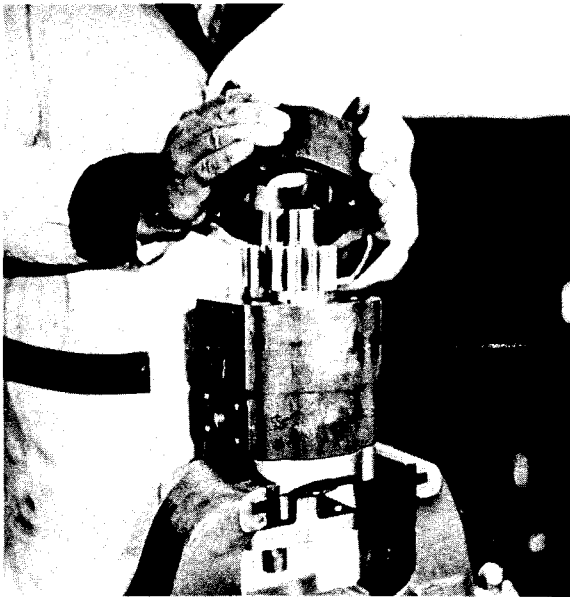


Fig. 33 Installing second gear housing

12. Install the port end cover subassembly on the gear housing (63). Hubs of gears fit into the I.D. of the roller bearings (69) and thrust plate (67) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing, making sure the "O" ring on the face of the housing is not pinched.

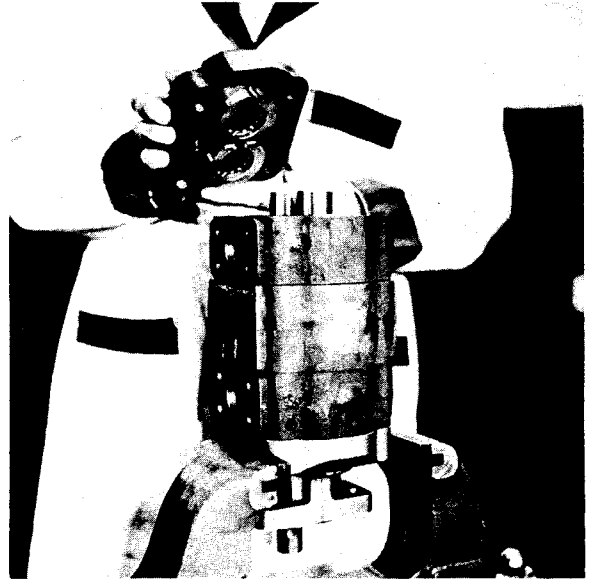


Fig. 34 Installing assembled port end cover

13. Thread the four studs (72) into the shaft end cover leaving enough thread protruding above the port end cover to accommodate the washers (71) and hex nuts (73). Rotate the shaft by hand or with a six inch wrench. Protect the shaft end when using a wrench. If the shaft is easily rotated, tighten the four nuts (73) to 200 ft. lbs. of torque.

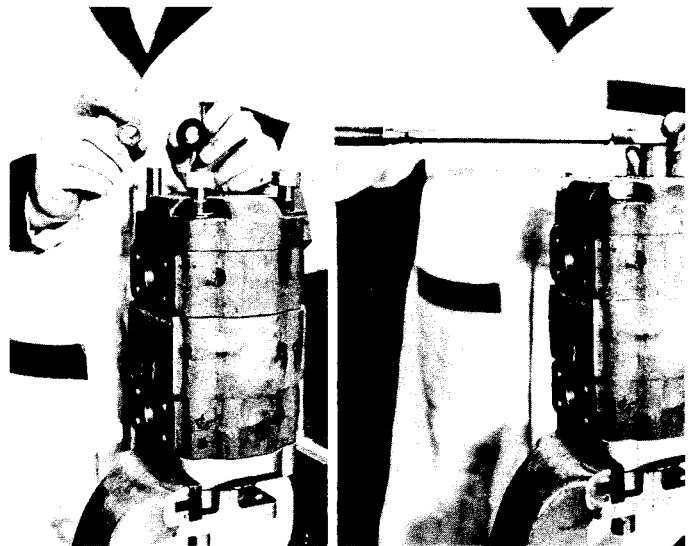


Fig. 35 Inserting and tightening studs, washers, and nuts

STEPS 14 AND 15 APPLY TO TYPE I ONLY

14. Remove the assembled pump from the vise and turn it over so that end of shaft is up. Tighten the retainer ring (1) with a pin type wrench until it is tight. Proper bearing preload and running clearance is obtained by backing off the threaded retainer ring.
15. Final adjustment of running clearance is obtained in the following manner:

With the threaded retainer ring tightened until it stops or is snug, scribe a line so that it is visible across the face of the retainer ring and over onto the face of the flange or pilot of shaft end cover. Now back the retainer ring off $\frac{1}{2}$ ", measuring from the scribed line at the outside diameter or edge of the retainer ring. This amount of movement or back off will provide approximately .005" clearance, which has been carefully calculated as the prescribed bearing adjustment. With the retainer ring backed off to the proper setting, upset or stake the outer edge of the retainer ring into the groove or slot provided at the inside diameter of the pilot of the shaft end cover. Use a blunt tool to force the metal from the outer edge of the retainer ring into the groove or slot. Make

sure the retainer ring is securely locked in this manner.

NOTE: THE RETAINER RING MUST NOT BE BACKED OFF IN DOUBLE OUTBOARD BEARING ASSEMBLIES. TIGHTEN UNTIL SNUG AND STAKE TO PREVENT LOOSENING.

The pump is now ready for installation and run-in.

IMPORTANT PRECAUTION TO OBSERVE BEFORE OPERATING NEW OR REBUILT HYDRAULIC PUMP:

To avoid possible pump damage to a new or rebuilt hydraulic pump, back off the main relief valve adjusting screw (or remove adjusting shims or spacers) before operating pump, then, **AFTER PUMP HAS RUN IN FOR ABOUT 5 MINUTES AT ZERO PRESSURE** (with all control levers in neutral position) adjust relief valve pressure to proper and prescribed setting. Failure to observe this precaution can result in almost immediate failure of the hydraulic pump if the relief valve pressure setting should be excessive.

lubrication . . .

All parts of the units are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the circuit system clean. Whenever there is a pump or motor failure and there is reason to feel that metal particles may be in the system, the oil must be drained, the entire system flushed clean, and any filter screens thoroughly cleaned. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Model 25X pumps and motors should meet the following specifications:

Hydraulic oils should have a viscosity index of 90 or higher and a viscosity SUS 150 to 200 at

100°F. Aniline point should be 165 or higher. Oil operating temperatures should not exceed 200°F.

Oil should have anti-foam and anti-oxidation additives.

Do not use low viscosity naphtha base oils, aircraft hydraulic fluid, or hydraulic brake fluid. Oil with a low pour point should be used when operation is to be in cold, low temperature climates.





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