



INSTRUCTIONS

BULLETIN 946000E

OILGEAR TYPE "C" & "CG" CONSTANT DELIVERY PUMPS

Sizes 4 thru 60

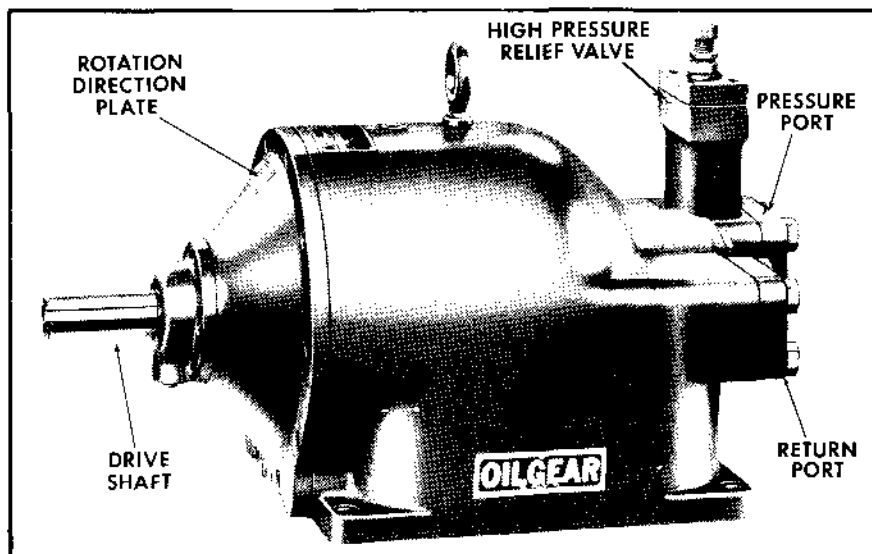


Figure 1. Type "C" Pump (50912).

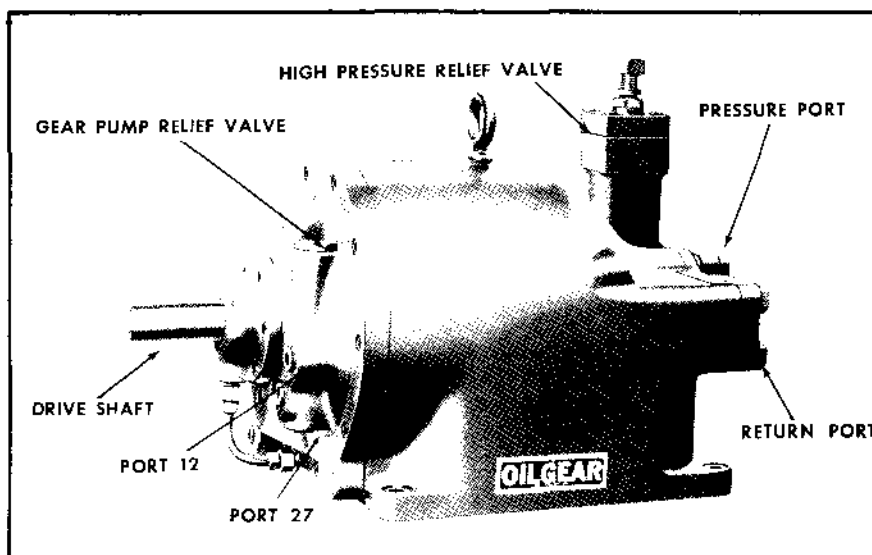


Figure 2. Type "CG" Pump. (53383)

REFERENCE INSTRUCTION BULLETINS

One-Way Pump Suction & Return Valves---- 947913
Some "CG" Pumps are fitted with "Two-Way" Pump
Plunger Type Suction and Return Valves with Plunger
blocked on the pressure side----- 947914
Duplex Pump Gear Pump w Unloading Valve 948912

Oil Recommendations----- 90000
Fire Resistant Fluids----- 90001
Piping Information----- 90011

TO THE USER AND OPERATOR OF OILGEAR UNITS

These instructions are written to simplify your work of installing, operating and maintaining Oilgear Type "C" and "CG" Pumps. Your acquaintance with the construction, principle of operation and characteristics of these units will help you attain satisfactory performance, reduce shut-downs and increase the pump's life. We feel confident the Oilgear pump will operate to your satisfaction, if these instructions are adhered to. Some Oilgear units have been modified from those described in this bulletin and other changes may be made without notice.

1. PREPARATION & INSTALLATION.

A. MOUNTING.

1. PUMPS WITHOUT RESERVOIRS. These pumps are shipped with or without suction and discharge tubes in place. When shipped WITH tubes in place,

avoid undue jarring or abusive handling to protect tubes and pump mechanism. Remove all pipe tap protectors from case bottom. IMPORTANT: Drain port "1" must be open to discharge above the reservoir fluid level . . . no tube is required. When pump is shipped WITHOUT tubes in place, remove

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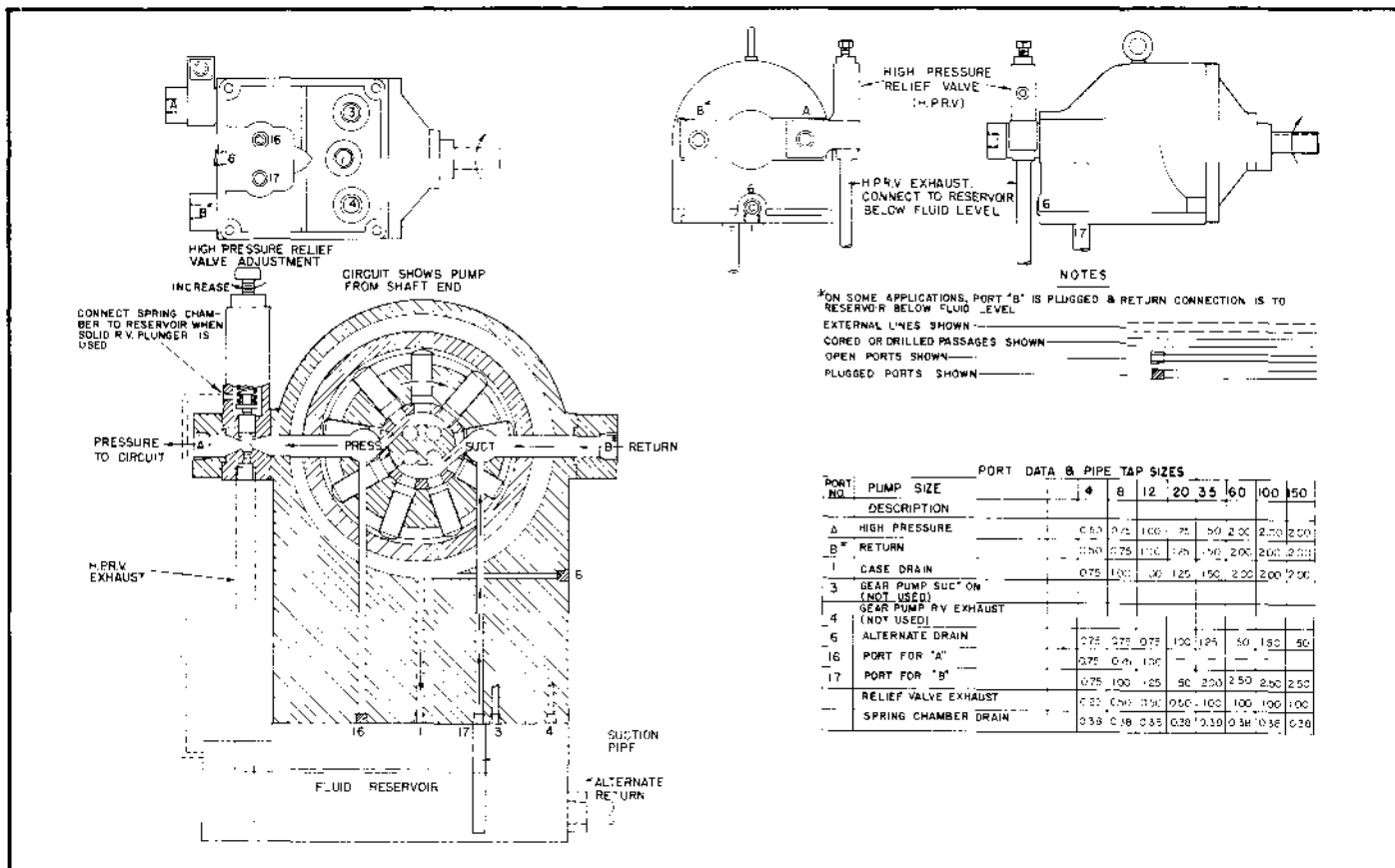


Figure 3. Fluid Circuit for Type "C" units. DS-946020-C (594880C).

all pipe tap protectors (not pipe plugs) from case bottom. Port numbers are stamped on pump case, suction valve and furnished tubes. Screw tubes securely in place to prevent air being drawn into the system (see "Piping Information" bulletin). For size 60 and other units equipped with solid relief valve plunger, be sure to connect spring chamber drain to reservoir above fluid level. Suction and discharge tubes should reach within one or two times the tube diameter from bottom of reservoir. Do not allow tubes to bottom on reservoir. Clean external surfaces of pump thoroughly and secure pump with gasket to mounting surface.

2. PUMPS WITH RESERVOIRS. These units are usually fully equipped. Mount reservoir on a level foundation at least six inches above floor level to facilitate draining of fluid.

B. PIPING AND FITTINGS.

See Oilgear bulletin on "Piping Information".

C. POWER & STARTING

Power is required in proportion to pressure used. Motor size recommendations for specific applications can be obtained from The Oilgear Company. Standard low starting torque motors are suitable for most applications. Never start or stop unit under load unless system is approved by Oilgear. Some circuits require a delivery bypass.

D. DRIVE

Pump driveshaft must rotate clockwise when facing end of pump shaft. (Special pumps are available for counter-clockwise rotation). See Rotation Direction plate on front housing, or circuit. Use either direct, belt, silent chain or gear drive. Pro-

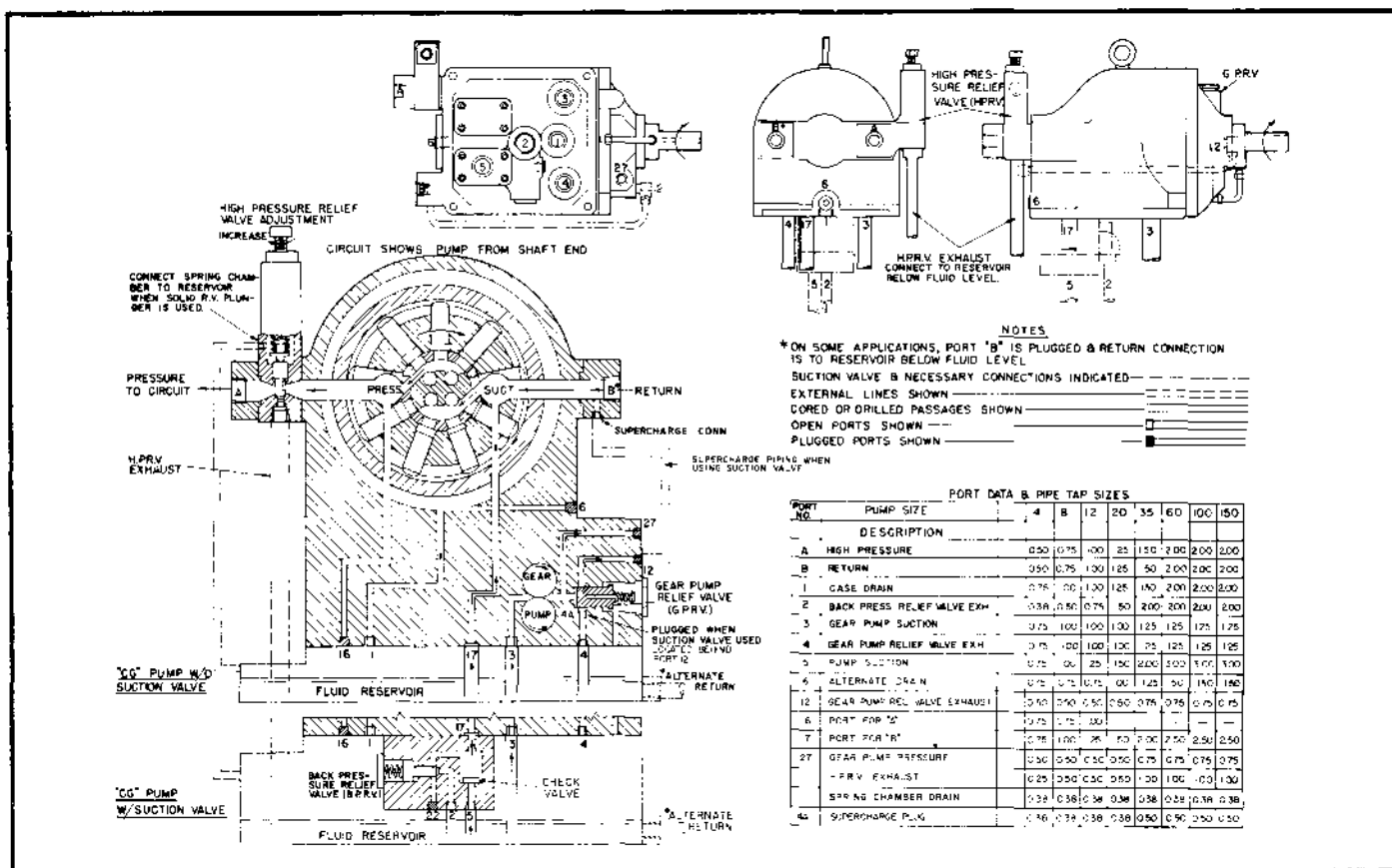
vide an easy slip fit for coupling, pulley, sheave, sprocket or gear and fasten with set screw. Do not use a drive fit.

E. FLUID & FILLING RECOMMENDATIONS

Refer to instruction plate on reservoir or machine, and/or Oilgear bulletins on "Oil Recommendations" or "Fire Resistant Fluids". Pour all fluid thru filler pipe and strainer. Fill reservoir to, but not above, high level on sight gage. Turn driveshaft a few times by hand to be sure parts are "free". Make certain systems control valve is in a position to bypass pump delivery. Turn drive unit on and off several times before allowing pump to attain full speed. The system is filled by running the pump and operating the control valves. Watch fluid level and stop pump if level becomes low. Add fluid and start again. On differential systems, be sure fluid level is not above "high level" when ram is retracted, or below "low level" when ram is extended. Air should be bled from system by loosening connections or opening petcocks at the highest points in the system. Tighten connections or close petcock when a solid stream of fluid appears. To assure long service life from an Oilgear unit, keep hydraulic fluid clean at all times.

F. AIR BREATHER.

On most installations, an air breather is mounted on top of fluid reservoir. Keep breather case filled to fluid level mark. About once every six months, remove wing nut and cover from breather and clean screen with solvent. Fill container to mark with clean fluid and install dry screen. It is important the air breather be of adequate size and kept clean to allow air flow in and out of reservoir as fluid level rises and falls.



II. CONSTRUCTION.

"C" and "CG" constant delivery radial piston pumps consist basically of a case (56), a tapered pintle (5) a cylinder (6) and bushing (7) with closely fitted pistons (8), a rotor (16), rotor cover (65), a drive coupling (19), anti-friction bearings and a flanged high pressure relief valve assembly (33). In addition, the "CG" pump has a gear pump (22 & 23) and gear pump relief valve (GPRV) (51) built into the gear pump housing (72) and, in some cases, has a suction valve flanged to the bottom of the pump case. The pintle, pressed into the case, serves as a bearing for the cylinder assembly and as a valve to direct fluid to and from the radial pistons. The rotor (18) and rotor cover (65) assembly is free to rotate on anti-friction bearings (9 & 10). It encloses the thrust rings (18) which force the radial pistons inward during the pumping stroke. The floating drive coupling (19) absorbs any minute misalignment between the drive-shaft and cylinder.

The flanged high pressure relief valve (HPRV) limits the pressure of the pump to protect it, the work and machine against overloads.

III. PRINCIPLE OF OPERATION. (See figures 3 and 4).

Torque applied to the driveshaft is transmitted thru the splined floating drive coupling to the cylinder assembly, causing it to rotate about the pintle. As the assembly rotates, centrifugal force (plus return and gear pump pressure, when used) keeps the beveled pistonheads against the beveled surfaces of the thrust rings at all times. Thru contact of the pistons, the rotor, cover and thrust ring assembly rotates with

the cylinder and driveshaft on anti-friction bearings mounted in counterbores of the case and front housing. These counterbores are eccentric with respect to the centerline of the pintle. Consequently, with the cylinder rotating about the pintle and the pistons following the thrust rings in the rotor, reciprocating motion is imparted to the pistons. Those moving outward in their bores are filling with fluid from the lower pintle port, while those moving inward are delivering fluid to the upper pintle ports. The change in radii from the center of the cylinder to the point of contact of each piston with the thrust ring causes each piston to move faster or slower than its point of contact. This difference in speed causes a slow partial rotation of each piston in its bore, in one direction during one-half revolution of the cylinder and in the other direction during the other half revolution. The gear pump on "CG" pumps, fitted with suction valve, is used to supercharge and lubricate the radial piston pump and to supply fluid for auxiliary purposes. On "CG" pumps without suction valves, the gear pump is used for auxiliary purposes only. For instructions on type "C" Duplex pumps, see reference bulletin.

IV. MALFUNCTIONS & CAUSES.

- IRREGULAR OR UNSTEADY OPERATION.
 - Fluid level in reservoir is too low.
 - Air in the fluid power system.
 - Sticking pistons or worn radial piston unit.
 - Faulty hydraulic motor or cylinder.

B. LOSS OF PRESSURE OR VOLUME.

- Foreign material in high pressure relief valve, sticking high pressure relief valve plunger or defective high pressure relief valve spring.

2. Worn radial piston pump
3. Obstructed suction passages in case or pintle.
4. Bushing turned in cylinder.

C. OVERHEATING.

1. Worn radial piston unit.
2. Leakage past high pressure relief valve.
3. Insufficient cylinder running clearance.
4. Low fluid level in reservoir.
5. Excessive gear pump pressure or worn gear pump (Type "CG" pump only).
6. Continuous operation at excessive pressure.

D. EXCESSIVE NOISE.

1. Worn bearings or radial piston unit.
2. Air in fluid power system.
3. Incorrect clearance in radial piston unit.

V. SPECIFICATIONS

A. RADIAL PISTON UNIT

- a. Rotor eccentricity in inches.
- d. Rotor end play in inches + .010
- e. Cylinder should begin to get tight when pintle projects amount shown + .03.
- f. Approximate force in tons to press out pintle.
- g. Approximate force in tons to press in pintle.
- j. Cylinder off-of-tight position in inches.
- k. Maximum normal rated speeds in rpm.

Size	a	d	e	f	g	j	k
411	.198	.010	.14	12	8	.14	1200
425	.198	.010	.12	12	8	.13	1200
811	.187	.015	.16	15	10	.16	1200
817	.187	.015	.14	15	10	.14	1200
825	.187	.015	.14	15	10	.14	1200
1211	.250	.015	.25	30	20	.25	1200
1217	.250	.015	.22	30	20	.22	1200
1225	.250	.015	.22	30	20	.22	1200
2011	.250	.020	.44	40	35	.41	1200
2017	.250	.020	.31	40	35	.31	1200
2025	.250	.020	.31	40	35	.31	1200
3511	.375	.031	.59	50	30	.56	900
3517	.375	.031	.41	50	30	.41	900
3525	.375	.031	.38	50	30	.38	900
6011	.375	.031	.69	50	30	.75	900
6017	.375	.031	.44	50	30	.49	900
6025	.375	.031	.44	50	30	.49	900

B. GEAR PUMP & RELIEF VALVE, "CG" units only. (For duplex units, see reference bulletin).

1. Gear pump volume for new pumps in cubic inches per minute at 150 psi and rpm given in column k of above table (some size 8, 12 and 20 pumps have larger gear pumps delivering 2500 cimp).
2. Gear pump relief valve setting in psi.
3. Maximum gear pump pressure in psi when using standard spring. Consult The Oilgear Company for special settings.

Size	1	2	3
4	1100	150	190
8	1670	150	190
12 & 20	1670	150	190
35	2050	150	160
60	2780	150	160

C. HIGH PRESSURE RELIEF VALVES (HPRV)

1. Pumps for general straight-line applications. Rating for continuous service is 1100, 1700 and 2500 psi as indicated by the figure 11, 17 or 25 in the body of the unit type designation. Relief valve setting is 1475, 2100 and 3000 psi respectively when blowing pump volume.
2. Pumps for rotary drive applications. Rating for continuous service of 1100 and 1700 series pumps is 1100 and 1700 psi. Relief valve setting of these pumps is 1700 and 2500 psi respectively when blowing pump volume.
3. Relief valves may be set for lower pressures to limit overload peaks, as determined by the application.

VI. TESTING & ADJUSTING.

A. HIGH PRESSURE RELIEF VALVE (HPRV).

Check pressure by installing a high pressure gage in the pressure port of the pump and operate machine. To check peak pressure, block pressure port momentarily by stalling cylinder ram or hydraulic motor. Keep periods of relief valve discharge short; avoid overloading of electric motor. To increase the pressure setting, turn the high pressure relief valve adjusting screw (40) clockwise; opposite to reduce setting.

B. GEAR PUMP RELIEF VALVE (GPRV).

To check gear pump pressure, ("CG" units only) connect a pressure gage (500 psi) to pump port 27 and run pump. Compare reading with V-B "Specifications." Note: The gear pump pressure may be higher than specified when the fluid is cold. Do not take reading or make adjustments until fluid is warm. Stop unit. Remove cap (55) and gasket (54). Insert additional shims (53) to increase pressure or remove shims to decrease pressure. Each 1/32 inch shim will change pressure about 12 psi for sizes 4 thru 20 and 5 psi for sizes 35 and 60. CAUTION: Do not shim for pressures higher than those in V-B "Specifications," or the spring will be compressed solid. Special springs are available for recommended maximum pressures up to 300 psi. If additional shims in GPRV fail to increase pressure, disassemble gear pump relief valve, inspect and clean. Reassemble and recheck pressure.

C. GEAR PUMP (For duplex units, see reference instruction bulletin).

If gear pump pressure is still insufficient, remove pipe plug from port 27 and install one leg of a tee fitting into port, needle valve in the other and a 500 psi gage in the remaining leg. Place a suitable container near the needle outlet to catch gear pump fluid. Start pump (with delivery bypassed). Open needle valve until gage reads 100 psi and then measure gear pump volume. See V-B. Limit discharge to prevent dropping reservoir fluid below low fluid level. Check all components in hydraulic circuit supplied by gear pump to insure gear pump fluid is not bypassed or leaking somewhere in the circuit.

D. RADIAL PISTON UNIT.

Remove the eyebolt (90) from top of pump case. Start the pump and run it at rated pressure for several minutes while looking in the tapped hole. If fluid begins to rise in the case or flow out of the hole, the radial piston unit is worn excessively.

E. SUCTION VALVE.

See reference bulletin for instructions on suction valve.

VII. DISASSEMBLY (Refer to figure 5)

Depending on what parts are to be inspected or replaced, complete disassembly may not be necessary. Refer to applicable sub-section. Disconnect unit from circuit and drive motor. Remove flange (79), relief valve assembly (33), pintle cover (80) and pump mounting bolts. Lift pump from reservoir with crane and set on flange end. Block pump to hold it securely in this position. Observe position of, and tag all gaskets, O'rings and shims during disassembly so they can be returned to their original position on assembly.

A. SUCTION VALVE --See reference instruction bulletin.

B. GEAR PUMP ASSEMBLY. ("CG" only) For duplex units, see reference instruction bulletins. Remove gear pump housing screws (72A), fasten a clamp to driveshaft (1A) or screw hook bolts into taps in outer rim of gear pump housing (72) and carefully lift entire gear pump assembly with a crane. Remove lock wire (69A), gear pump cover screws (69) and gaskets (70). Remove cover (73), gears (22 & 23) and key (26).

C. PISTON UNIT. Remove housing (57 or 72) and driveshaft (1 or 1A) assembly. Remove lock wire (106) and rotor cover screws (66). Screw three square head set screws into taps in rim of cover (65) and jack cover evenly from rotor (16). Lift cover (65) and bearing (10) out by hand or use hook bolts and crane. Lift out coupling flange (19), coupling rollers (20) and coupling ring (21). Due to the fixed eccentricity the entire rotor (16) cylinder (6) assembly will have to be removed as a unit. If cylinder is frozen to pintle, pintle will have to be pressed out of case before attempting to separate them. Screw hook bolts into end of rotor (16) and carefully lift assembly off the pintle. Do not cock unit and scratch inside of bushing when removing the assembly. If pintle (5) has to be removed, set pump case with open end down, in a press. Insert a piece of wood or other soft material under inside end of pintle so when it is pressed from case it will not be damaged. Apply pressure to case end of pintle (see V-A-f for approximate force). Pintle has 0.005 per inch taper, so after pintle is pressed down a short distance, it will drop the rest of the way. If it is necessary to remove thrust rings (18) from rotor, break the inner spacer ring (17A) with a drift punch inserted in one or more of the radial holes in rotor directly behind the spacer ring. Then drive out the thrust rings (18) and outer spacer (17) by striking a brass or soft steel rod inserted in the axial holes in bearing end of rotor.

D. SHAFT REMOVAL Driveshaft (1 or 1A) need not be removed unless inspection of shaft seal (27) and front shaft bearing (11) is necessary. Unscrew shaft seal gland screws (71A). File burrs on keyway. Place shim stock or scotch tape over keyway to prevent cutting of shaft seal. Carefully slide seal gland (71) and seal off shaft. Lift shaft and bearing assembly out of front housing. Remove washer (4) and lock nut (3). Pull bearing (11) off shaft (1 or 1A). CAUTION: Keep shims (15) in front and rear of bearing separate to insure correct reassembly.

E. GEAR PUMP RELIEF VALVE, ("CG" only) Unscrew cap (55) and remove gasket (54), shim (53), spacer (49), dashpot plunger (50), spring (52) and valve plunger (51). Avoid marring highly finished surfaces on dashpot and valve plungers.

F. HIGH PRESSURE RELIEF VALVE Mark setting of screw so it can be returned to original setting. Turn out adjusting screw (40) until spring tension is relieved, remove cap (38) with adjusting screw. Withdraw spring guides and spring (42). If plunger (34) and bushing (35) is to be removed, remove flange (32) and push bushing out from top (spring side).

VIII. INSPECTION

A. GEAR PUMP ASSEMBLY. ("CG" only) For duplex units, see reference bulletin. Inspect gear (22 & 23) teeth for wear. Check stub shaft (25) and roller bearing (24). Inspect wear surfaces in gear housing (72) and cover (73). Check depth of driving and driven gear pockets with depth gage and add amount of wear in cover. Measure width of gears. Normal running clearance is 0.001 to 0.0035 inch for units thru size 20 and 0.003 to 0.005 inch for the larger units. Normal clearance over outside diameter of gear is 0.001 to 0.003 inch for units thru size 20 and 0.003 to 0.005 inch for the larger units.

B. SHAFT SEAL. Inspect shaft seal (27) for cracks, cuts, hardening or deterioration of seal material. If replacing, drive out old seal and press new seal in carefully to prevent distortion.

C. RADIAL PISTON PUMP. Clean all parts thoroughly and make certain that all chips, grit and foreign matter have been removed. Inspect all bearings for pitting, galling and binding. Inspect pistons and bores for cracks, scratches or other signs of wear. Inspect working surfaces on pintle, bushing, and thrust rings. Check scratch mark or number stamp on upper face of cylinder and bushing, across joint line, to make certain that bushing has not turned in cylinder. Replace any parts which appear worn or damaged.

D. GEAR PUMP RELIEF VALVE ("CG" only) Wash parts thoroughly. Clean dirt from grooves in dashpot plunger and small hole in end of valve plunger. Check valve plunger seat for scoring, wear, or foreign matter. Polish or lap sticking plungers.

E. HIGH PRESSURE RELIEF VALVE Wash parts thoroughly. Clean foreign matter from grooves in plunger. Check seat in bushing for scoring, wear, or foreign matter. Relap plunger on seat, if necessary.

Be sure reservoir, system components, and hydraulic fluid are clean.

IX. ASSEMBLY

Clean and lubricate all parts with a film of fluid just prior to assembly. If bearing races are heated in oil to ease assembly, exercise extreme care to prevent heating over 300°F.

Parts used in this assembly are per Oilgear specifications. Use Oilgear parts to insure compatibility with assembly requirements. When ordering replacement parts, include pump type and serial number, bulletin number and part number. Specify type of hydraulic fluid for packings and seals.

O-RING SIZES

Cross Section x O.D. Duro + 5

Size Unit	4	8	12 & 20	35	60
36	3/32x9/16 70	3/32x13/16 70	3/32x13/16 70	3/32x1-11/16 70	3/32x1-11/16 70
36A					3/16x2-5/8 70
37	3/32x13/16 70	1/8x1-1/4 90	1/8x1-1/4 90	1/8x1-7/8 90	1/8x1-7/8 90
41A					1/16x3/4 70
46A		3/32x1-1/2 70	1/8x1-9/16 70	1/8x1-1/8 70	1/8x1-5/8 70

A. HPRV

Reassemble in reverse order of disassembly. Be sure plunger is free in bushing and retaining ring is installed. Be sure orifice spacer (44) is installed. Turn screw in to previously marked position. Recheck pressure when pump is assembled and mounted.

B. GPRV ("CG" only)

Reassemble in reverse order of disassembly. Anneal gasket (54) if necessary and be sure it is on cap shoulder before tightening cap.

C. GEAR PUMP ("CG" only) see reference bulletins for duplex units.

Replace parts in reverse order of disassembly. Check driveshaft key (26) fit in driveshaft and driving gear (22). Gear must be sliding fit over shaft and key. Check clearances as described in VIII-A. Lock gear pump cover screws (69) with soft iron or brass wire (106). If only the gear pump assembly was dismantled, refer to following paragraphs on "Driveshaft" for insertion and shimming of front shaft bearing and correct shimming for cylinder end-play.

D. RADIAL PISTON UNIT

1. PINTLE If pintle (5) was removed, set case with open end facing up in a press (see V-A-g) for force needed). Apply a thin coat of anti seize lubricant on the large tapered surface of pintle and insert pintle into case locating it with key (77). Slip a sleeve over the small pintle end so it rests against shoulder, not pintle's small end*. Press on sleeve until pintle end is flush with back of case. Cylinder bushing (7) and pintle (5) have .005" taper on diameter per inch of length. Suspend cylinder — bushing assembly (6 & 7) in a crane with large end of bore downward. Clean pintle and bushing surfaces thoroughly. Slowly lower cylinder over pintle, do not scrape bushing against edges or pintle ports. Stop when cylinder begins to become tight on pintle. Do not let entire weight of cylinder rest on pintle or cylinder will become too tight and damage the bushing. At this point, pintle should project past the cylinder bushing face the amount shown in V-A-e (see figure 6). Record actual dimension and identify it as "c". Remove cylinder from pintle.

*Early model pumps have no shoulder. Press pintle in with a bar in bearing counter bore in small end of pintle.

2. ROTOR If removed, press spacers (17 & 17A) and thrust rings (18) in evenly. If new rotor bearing (9) is used, install bearing on rotor hub, thrust side of outer race faces away from hub shoulder (on size 60s — install original shims (14) in case and press outer race of roller bearing, with thrust flange down, into case; install inner race on rotor hub). Lubricate rotor bearing with hydraulic fluid. Replace original rotor bearing shims (14) and place rotor assembly in case. Make sure bearing turns freely.

3. CYLINDER Lubricate mating surfaces on pintle (5) and cylinder bushing (7). Lower cylinder without pistons (8) on pintle, do not scratch bushing on pintle edges. With cylinder resting on rotor (16), be sure cylinder turns freely. Use dimension given in V-A-j. See figure 7. If dimension "e" recorded in IX-D-1 is greater than "j", subtract "j" from "e" (e minus j). The difference should equal pintle projection beyond the cylinder bushing face. — If "e" is less than "j", subtract "e" from "j" (j minus e). The difference should equal the cylinder bushing projection beyond pintle. — Add, or remove rotor bearing shims (14) to obtain correct off tight position of cylinder on pintle. If new rear driveshaft bearing (12) is used, install in pintle with thrust side of outer race facing away from open end of case. Lubricate bearing. Remove cylinder and rotor from case. Place pistons (8) in cylinder, place cylinder in rotor. Center cylinder over pintle bore in rotor and lower assembly carefully into the case over the pintle.

4. ROTOR COVER If new rotor cover bearing (10) is used, install on rotor cover (65) so thrust side of outer race faces open case end. (Size 60 units, measure race protrusion, see figure 8 and record + "t" dimension.) Insert coupling ring (21), coupling rollers (20) and coupling flange (19). Force cover (65) down uniformly with screws to hold spacers (17) and thrust rings (18) firmly in place (on size 60s, match balance "o" marks on cover with rotor). Clearance between rotor and cover should be approximately .06". Secure screws with new soft iron locking wire (106). To check for correct rotor end play at "d", (see figure 9) lay a straight edge across the open end of case (56) and measure distance from

the bottom edge to top face of inner race of bearing (10). Write down this measurement (X). Measure distance from front housing (57 or 72) where it mates against gasket (29) to bottom surface of front housing (57) or assembled gear pump cover (73). Subtract 0.008 from this dimension (compressed gasket thickness) and label remainder (Y). Measure distance from bottom surface of front housing (57 or 72) to shims (13) be sure they are compressed in bearing counterbore. Write it down as (Z). Subtract the latter figure from previous dimensions (Y-Z). The remainder should equal dimension X minus "d", see V-A-d, (Y-Z=X-d). If not, add or remove shims until it is. For size 60 units this should be Y-Z=X-(d+t).

5. DRIVESHAFT Remove shaft (1) from front housing (57 or 72) assembly (see VII-D on "Shaft Removal") and fasten housing assembly with gasket (29) to case. To adjust for proper cylinder end play of .031", remove front bearing (11) and slide shaft with coupling spacer (2) and key (26) in place, thru housing assembly and coupling flange into rear driveshaft bearing (12) firmly. While shaft, spacer, coupling and cylinder rest on rotor, measure distance from upper face of housing to driveshaft shoulder which contacted the inner front driveshaft bearing race (11).

Insert shims in housing counterbore until they are .031" higher than shoulder. Measure distance from face of housing to driveshaft end before and after bearing is installed to be sure driveshaft rises .031". Install bearing (11), lockwasher (4) and tighten nut (3) to hold bearing against shoulder. Bend one prong of washer to lock nut. Insert sufficient shims (15) between outer race of front driveshaft bearing and gland (71) to eliminate driveshaft end play and leakage at gland gasket (28). Install seal (27) and gasket (28), with all holes aligned and secure gland to housing.

F. GEAR PUMP ("CG" only)

Place gasket (29) on case and secure complete gear pump and driveshaft assembly to case.

G. SUCTION VALVE See reference bulletins for suction valves.

H. MOUNTING

Bolt pump and pump case gasket (56A) to reservoir. Rotate driveshaft by hand several revolutions to make certain no parts are binding. Couple pump to drive motor; re-install piping and electrical connections; test pump and adjust relief valves if necessary.

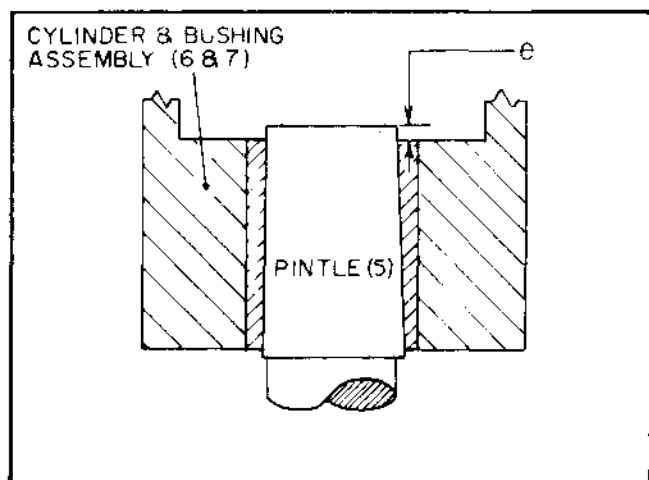


FIGURE 6 TIGHT POSITION

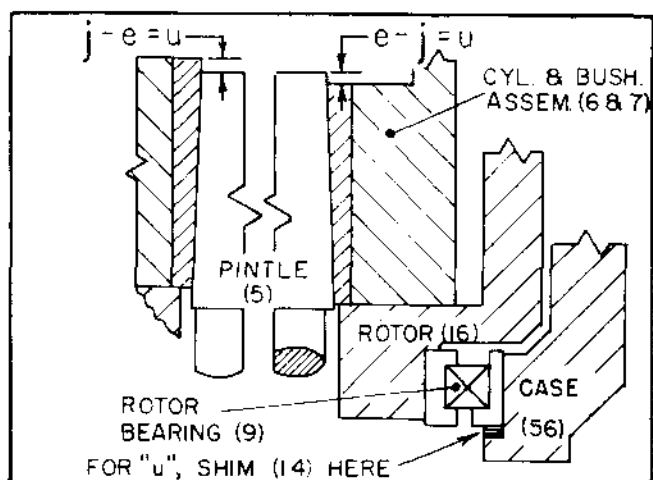


FIGURE 7 OFF-TIGHT POSITION

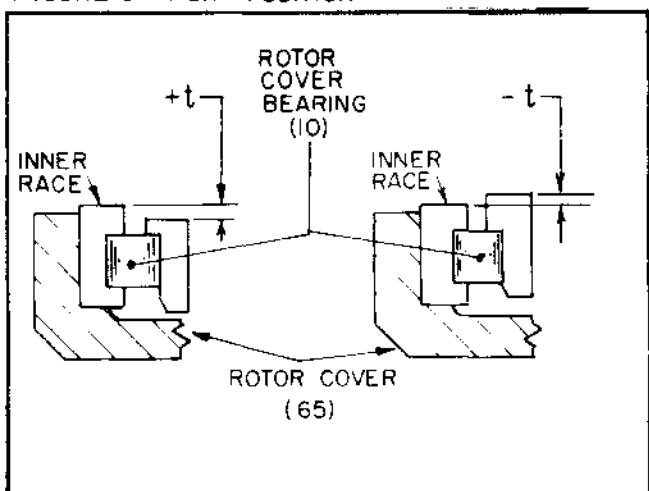


FIGURE 8 INITIAL ROLLER BRG. RACE PROJECTION

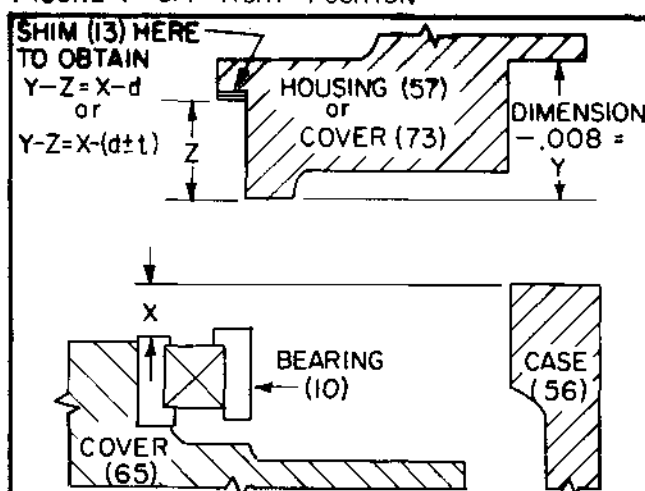


FIGURE 9 ROTOR END PLAY SHIMMING.