Instructions

for Operation and Maintenance of OILGEAR TYPE "DH" PUMPS FOR STEERING GEARS

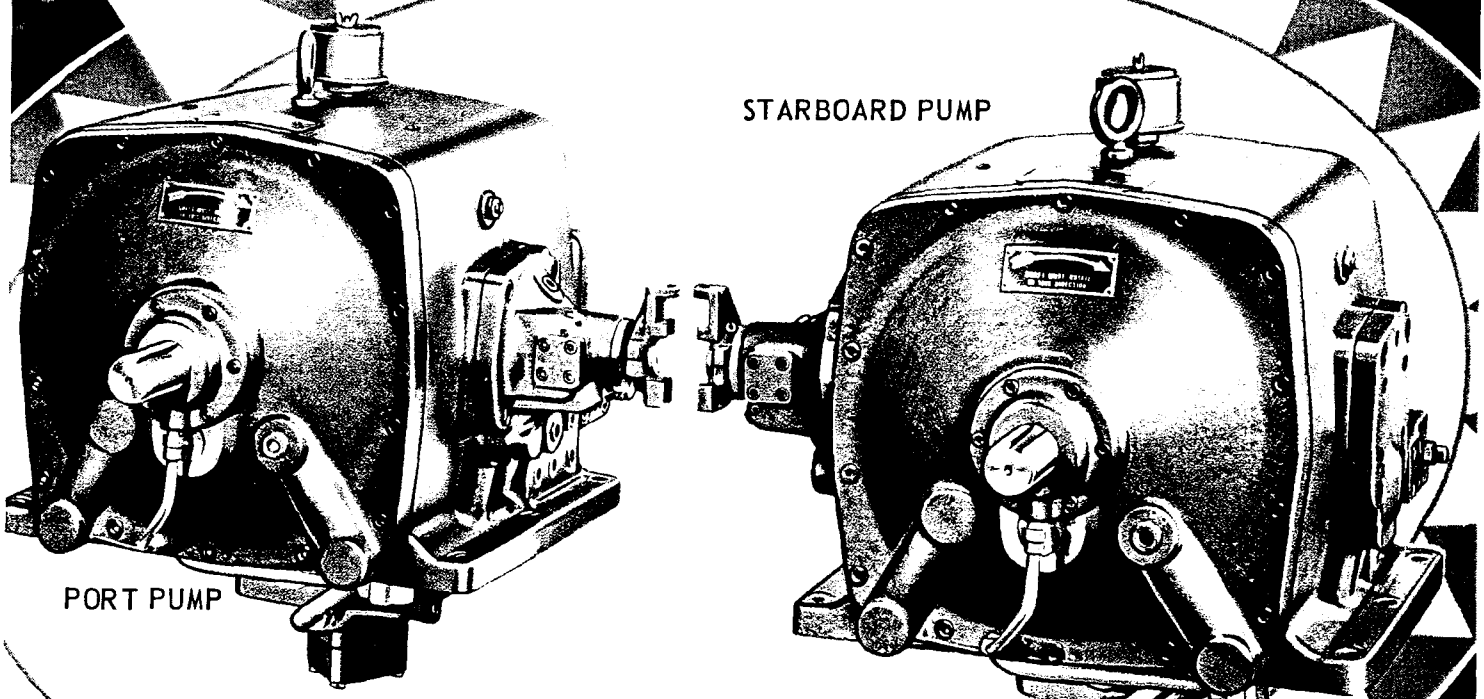


FIGURE 1. TYPE "DH" TWO-WAY VARIABLE DELIVERY PUMPS FOR STEERING GEARS

OILGEAR Fluid Power

THE OILGEAR COMPANY

LITHO IN U.S.A.

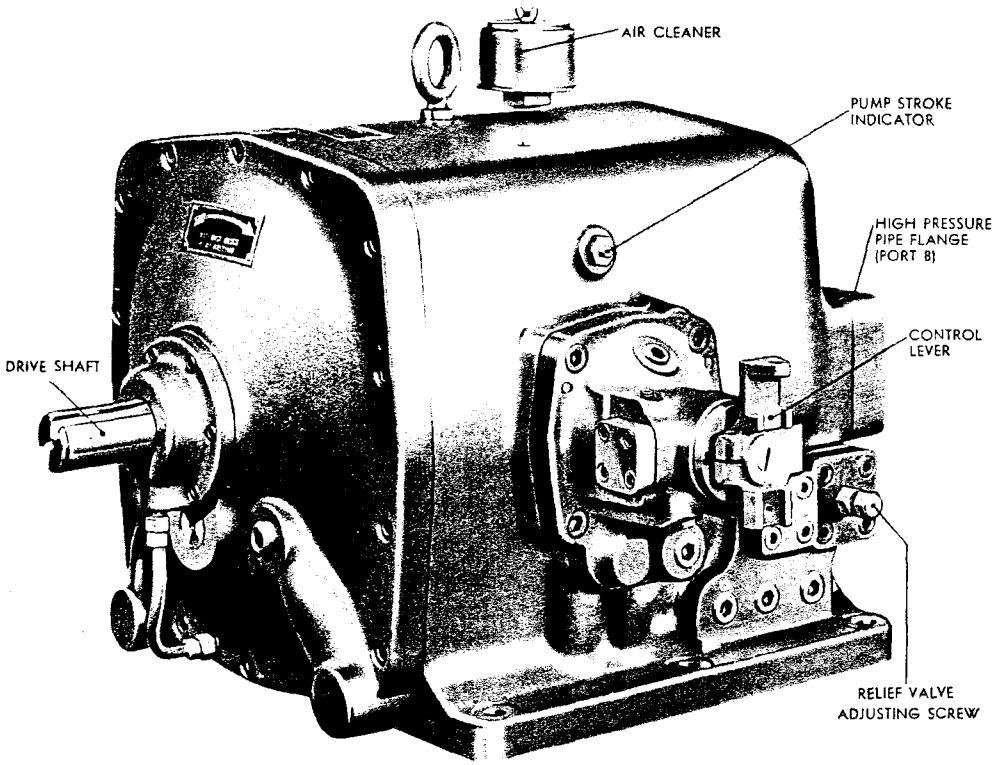


Figure 2. Type "DH" Port Pump, Three-Quarter View, Shaft End

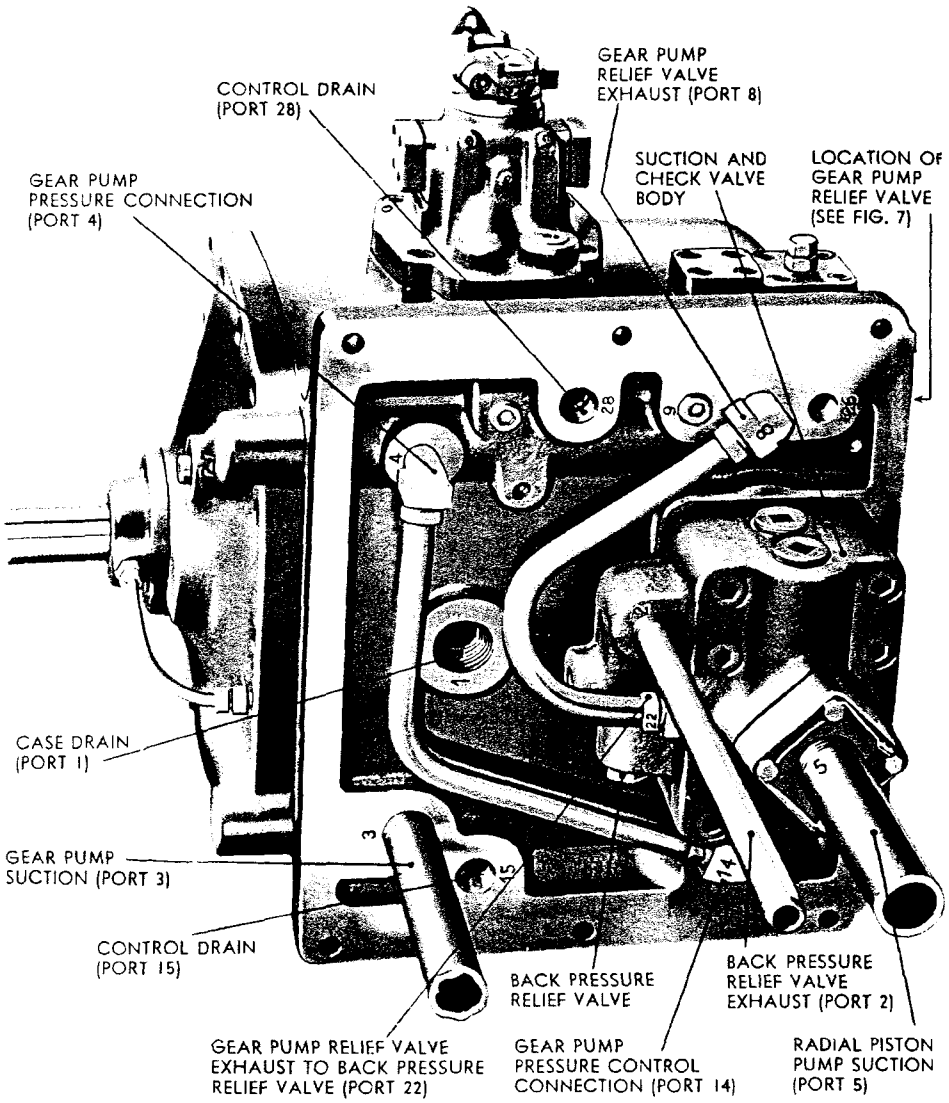


Figure 3. Type "DH" Port Pump, Bottom View

TO THE OPERATOR OF OILGEAR STEERING GEAR PUMPS

A careful study of this manual, its photographs, oil circuit diagrams and parts drawings, will both simplify and minimize your work. Oilgear fluid power pumps and controls have certain characteristics and functions which, when known, make proper and satisfactory operation easy, reduce malfunctioning, and increase their life expectancy.

For your convenience, this manual has been divided into the following sections:

INDEX TO ILLUSTRATIONS

I. INTRODUCTION

A. PURPOSE AND CHARACTERISTICS.

1. PURPOSE . . . Two Oilgear Type "DH" two-way variable delivery pumps, with hydraulic servo-motor lever controls (one port and one starboard), supply controlled fluid power for actuating the steering gear cylinders. Both the direction and volume of fluid flow from the active pump or pumps are selected through movement of the hydraulic servo-motor lever control on each pump by the steering gear control.

2. CHARACTERISTICS . . . Several characteristics inherent in these Oilgear Fluid Power Pumps are--steplessly variable and preselected delivery in either direction--hydraulic servo-motor lever control of pump functions--automatic protection against overload--pressure and flood lubrication of working parts by fluid in the system.

B. COMPONENTS.

1. TWO OILGEAR TYPE "DH" TWO-WAY VARIABLE DELIVERY PUMPS.

a. VARIABLE DELIVERY UNIT . . . Each pump contains a variable delivery, radial rolling piston unit, to supply fluid power in any volume up to maximum and at any pressure up to maximum.

b. SUPERCHARGING AND CONTROL GEAR PUMP . . . Built into the Type "DH" Pump is a gear pump that supercharges and lubricates the radial piston unit, and actuates the control pistons and slideblock.

c. CONTROL MECHANISM . . . Integral with each pump is a hydraulic servo-motor lever mechanism which is connected to the steering gear control. Any volume from zero to maximum can be selected with this control.

d. VALVES . . . Incorporated in each pump are two high pressure relief valves for protection of the pump and steering gear against overload. A built-in dashpot type relief valve limits the gear pump pressure. Built into the pump suction valve is a plunger type relief valve for maintaining back pressure to supercharge the pump. Two built-in disc type check valves prevent the high pressure fluid from flowing into the suction side of the pump. Another built-in disc type check valve directs the gear pump discharge to the suction side or back pressure relief valve and permits the variable delivery pump to draw fluid direct from the reservoir when necessary.

C. GENERAL DESCRIPTION OF OILGEAR PUMPS FOR STEERING GEAR SERVICE.

1. Two Oilgear type "DH" pumps, each mounted on separate fluid reservoirs and directly connected to separate electric motors, utilize a high grade hydraulic fluid as the power medium for actuating the steering gear rams. The active pump or pumps will deliver any desired volume of fluid from zero to maximum at any pressure up to the maximum working pressure. When rudder motion is not required, the steering gear control holds the pump control levers in neutral position and no fluid is delivered to the steering cylinders by the pump or pumps. When rudder is to be turned, the steering gear control moves the control levers on the pumps from neutral to maximum stroke or any portion thereof (the speed of rudder motion being approximately in direct proportion to the degree of control lever movement). When the control levers are moved to one side of neutral position, the rudder turns to port and when the control levers are moved to the other side of neutral position the rudder turns to starboard. The speed of acceleration and deceleration varies with the speed of control lever movement. When the selected rudder position is reached, the steering gear control returns the pump control levers to the neutral position, holding rudder in the selected position.

2. Both type "DH" pumps are alike except for the mounting of the hydraulic servo-motor lever controls. When facing the pipe flange end, the port pump has the control on the left hand side while the starboard pump has the control on the right hand side. The neutral position of the pump control lever is 50° or one-half the arc from maximum stroke positions I and III.

3. The pump has a built-in gear pump on the drive shaft for actuating the control pistons and for supercharging and lubricating the radial piston unit. When the electric motor rotates the pump shaft, the gear pump builds up to its rated pressure. A back pressure relief valve resists the fluid discharged past the gear pump relief valve to maintain the rated back pressure for supercharging and lubricating the radial piston pump.

II. PREPARATION FOR SERVICE

A. MOUNTING EQUIPMENT.

1. Before mounting the type "DH" pumps on the fluid reservoirs, be sure the thread protectors in pipe taps stamped 1, 15, 26, 28 underneath pumps are removed and the ports left open. Also, be sure tubes of the proper length are screwed securely into the pipe taps stamped 3, 5 and 22 to prevent air being drawn into the system. IMPORTANT: Tubes in ports 3, 5 and 22 vary in length and shape to suit the depth and type of fluid reservoir used. All tubes should extend to within approximately 1-1/4" of inside bottom of fluid reservoir. On some pumps, an elbow is fitted to end of the tube screwed into port 2. The opening of this elbow should face toward port 4. On other pumps, the tube connected to port 3 is bent toward the drive shaft to fit into a deeper section of the fluid reservoir. Whenever a replacement pump is installed, be sure it has the same length and type of tubes as on the unit removed.

B. DRIVE.

1. An electric motor is direct-connected through a flexible coupling to each "DH" pump. If necessary, shim motor feet until both drive shafts are concentric. Fasten motor to reservoir. Connect flexible coupling.

2. The pump shaft must rotate as indicated by the rotation direction plate when facing end of shaft. See arrow on pump housing. For rated shaft speed, see Specification Bulletin and nameplate on top of pump.

3. Do not run pump until the proper quantity and quality of fluid is in reservoir.

C. FILLING SYSTEM WITH HYDRAULIC FLUID AND STARTING PUMPS.

1. See bulletin on "Oil Recommendations" for the type of fluid to use in system. Since many of the parts in the pump have highly finished surfaces working together, it is obvious that acid, water or grit in the fluid will inevitably cause trouble and repairs. Use CLEAN hydraulic fluid only, handle in CLEAN CONTAINERS and pour into the system through a STRAINER. See General Steering Gear Instructions for approximate capacity of entire system.

2. Fill both reservoirs to the required fluid level.

3. The system can be filled with fluid from the gear pump in the Oilgear pump. Before starting the pump, turn the drive shaft a few revolutions by hand to be sure all working parts are free. Move pump control lever to "NEUTRAL" position or be sure pump volume is bypassed when pump is started. DO NOT START EITHER PUMP UNDER LOAD. Start and stop motor several times before allowing pump to reach full speed. Shift change-over valve to connect active pump to cylinders. Open globe valves in low pressure system to permit fluid from the cylinders to return to the active pump reservoir. If each cylinder is drained, one at a time for about 30 seconds, the gear pump flow will be sufficient to remove air and foreign matter from piping effectively. Also, open air drain cocks on cylinders. Close air drain cocks when solid stream appears. Ordinarily, when this method of filling is used, it is not necessary to open the air drain cocks in piping.

4. Drain entire system (piping, valve, cylinders and bases) every SIX months. Wipe out bases thoroughly with lint-free cloths to be sure all acid, scale and other foreign matter is removed.

D. LUBRICATION.

1. Remove wing nut and cover from air breather (107) and lubricate screen or fill chamber with hydraulic fluid. Every Six months clean screen with solvent and then oil screen or fill chamber in breather.

2. No other external lubrication is necessary because all working parts of the pump are either flood or pressure lubricated by the fluid in the system.

E. VOLUME AND DIRECTIONAL CONTROL ON PUMPS. (See Fig. 11.)

1. Both the volume and direction of fluid flow to the steering cylinders is controlled by the steering gear control through the hydraulic servo-motor lever control on each pump. Any volume from zero to maximum can be selected in either direction by moving the pump control levers to either side of neutral (Position II). The volume of fluid delivered and the speed of rudder movement is approximately proportional to the movement of the control levers from Position II.

III. CONSTRUCTION AND PRINCIPLE OF OPERATION

A. TYPE "DH" VARIABLE DISPLACEMENT PUMP.

1. PUMP CONSTRUCTION. (See Figs. 9, 10, 12, 13 and 14.)

a. The radial piston pump consists essentially of a tapered pintle (5), a cylinder and bushing (6 and 7) with closely fitted pistons (8), thrust rings (18), rotor (16), rotor head (65), slideblock (82) and a hydraulic servo-motor lever control mechanism. As drive shaft (1) rotates on two ball bearings (12 and 11), drive coupling flange (19) rotates cylinder and bushing (6 and 7) on the pintle (5) pressed into case (56). Centrifugal force and supercharging pressure from the gear pump keeps the beveled surfaces of pistons (8) against the beveled surfaces of thrust rings (18). Rotor (16) and rotor head (65) rotate with cylinder (6) and drive shaft (1) on ball bearings (9 and 10) through contact of the radial pistons (8). The slideblock is mounted on liners (85 and 84) and is actuated in one direction by gear pump fluid on one control piston (62) and in the other direction by gear pump fluid on the other larger control piston (301). Plunger (309) actuated by control lever (315-R or L), controls the flow of fluid to and from control piston (301). The gear pump fluid is always connected to piston (62), but will not move it until the trapped fluid behind piston (301) is drained through plunger (309). High pressure relief valve plungers (34) and springs (42) limit the peak pressure of the radial piston pump. Gear pump gears (22 and 23) driven by shaft (1) supply fluid for operating slideblock control pistons (301 and 62) and for supercharging and lubricating the radial piston pump. Relief valves (50 and 51) limit this gear pump pressure. Check valve (209) directs the discharge fluid from the gear pump to supercharge and lubricate the radial piston pump. Excess gear pump fluid is discharged past the back pressure relief valve (214).

2. PUMP PRINCIPLE OF OPERATION.

a. RADIAL PISTON UNIT: Pump drive shaft (1) is driven as indicated on rotation direction plate (109) when facing drive shaft. This rotation is transmitted directly to cylinder, bushing and pistons (6, 7, and 8) mounted on the fixed pintle (5) through the splined floating coupling (19, 21, and 20). Centrifugal force, combined with pressure in the hydraulic system, keeps the beveled surfaces of the pistons (8) against the thrust rings (18) at all times. Through contact of the pistons (8), the thrust rings (18) and rotor (16) rotate on anti-friction bearings (9 and 10) with cylinder (6) and drive shaft (1). Slideblock (82), which carries the rotor unit, is guided between four liners (85). As the slideblock (82) and rotor unit are moved to the left (see port pump, Fig. 11), reciprocating motion is so imparted to radial rolling pistons (8) that those passing over the upper port in pintle (5) are drawing or filling up with fluid returning from the steering cylinders and fluid from the gear pump, while those passing under the lower port in pintle (5) are delivering fluid to the steering cylinders. Thus, when the centerline of rotor (16) and cylinder (6), do not coincide, the difference between the radii from the center of the cylinder to the points of contact of the pistons (8) with the thrust rings (18) causes the pistons (8) to move faster or slower than their points of contact with the thrust rings (18). This difference in speed is adjusted by slow partial rotation of each piston (8) in its cylinder bore, in one direction during one-half revolution and in the opposite direction during the other half revolution. The pistons thus rotate and reciprocate simultaneously. Fluid flows to and from the pistons (8) through passages in pump case (56), pintle (5), bushing (7), and cylinder (6). The volume of fluid delivered increases proportionately with the increase in eccentricity of slideblock (82).

b. PUMP CONTROL: The slideblock (82) of port pump moves from the neutral (Position II), concentric with pintle (5) and cylinder (6), (see starboard pump shown in Fig. 11) to the eccentric position (see port pump shown in Fig. 11) when control lever (315-L) is moved to maximum delivery (Position I). As control lever (315-L) is moved from neutral (Position II) to maximum delivery (Position I), or any portion of the 50° arc, fluid pressure in chamber behind piston (301) drops as the fluid flows out the drain spiral slot in control plunger (309). At the same time, gear pump pressure in the chamber behind piston (62) moves the slideblock (82) to maximum starboard delivery position or any portion thereof as selected by control lever (315-L). As control lever (315-L) is moved from neutral (Position II) to maximum delivery (Position III), or any portion of the 50° arc, gear pump fluid flows through the center of control plunger (309), one of the spiral slots on control plunger (309) and hole in control sleeve (307) to increase the pressure in chamber behind piston (301). The gear pump pressure on piston (301), which is larger than piston (62), moves slideblock (82) to port, to maximum port delivery position, or any portion thereof as selected by control lever (315-L). Control piston and sleeve (301 and 307) move parallel to axis of plunger (309) but do not rotate with plunger (309). The hole in hub of sleeve (307) closely follows the spiral "land" between the two spiral slots on plunger (309) to shut off the entrance of gear pump fluid into the chamber behind piston (301) or discharge the fluid from piston chamber to drain. The spiral slot on end of plunger (309) opens piston chamber to drain while the other parallel spiral slot

directs fluid from the gear pump to the piston chamber. As control lever (315-L) is moved from maximum delivery (Position III) toward maximum delivery (Position I), the spiral slot on end of plunger (309) connects with the hole in sleeve (307) to open the chamber behind piston (301) to drain. At the same time, gear pump pressure in the chamber behind piston (62) moves slideblock (82) and piston (301) so the hole in sleeve (307) closely follows the "land" on plunger (309) to cut off the drain of fluid through the spiral slot. When the "land" on plunger (309) and hole in sleeve (307) coincide, the fluid in chamber behind piston (301) is trapped and the slideblock can no longer move in that direction. Thus, slideblock (82) is held in the position selected by lever (315-L) As control lever (315-L) is moved from maximum delivery (Position I) toward maximum delivery (Position III), the other spiral slot in plunger (309) connects with the hole in sleeve (307) to increase the pressure in chamber behind piston (301). Increasing the pressure on piston (307) moves the slideblock to port until the hole in sleeve (307) coincides with the "land" on plunger (309) and the fluid behind the piston (301) is trapped. Movement of slideblock (82) can be seen and measured on pump stroke indicator stem (88). The functions of the starboard pump control are similar to those described for the port pump.

IV. FLOW OF FLUID IN PUMPS (See Fig. 11.)

A. NEUTRAL . . . PORT AND STARBOARD PUMPS AT POSITION II.

1. When either or both pumps are running and the control levers (315-L and R) are in neutral (Position II), the gear pump gears draws fluid from the reservoir and deliver it to plunger (309) and the chambers behind pistons (301 and 62) to hold slideblock (82) concentric with cylinder (6), no fluid is delivered by the radial piston unit. Excess gear pump fluid discharges past the gear pump relief valve plunger (50) and flows to the check valves (201 and 209) and back pressure relief valve (214) under pump. Check valve (209) and the back pressure relief valve direct the fluid through check valves (201) to supercharge and lubricate the radial piston unit and maintain back pressure on ports "A" and "B." Excess fluid discharges past the back pressure relief valve and into the reservoir.

B. FULL STROKE . . . PORT PUMP AT POSITION I.

1. When the port pump is running and control lever (315-L) is moved to Position I (see Fig. 11) fluid in the chamber behind piston (301) flows out the drain spiral slot in control plunger (309). At the same time, gear pump fluid in the chamber behind piston (62) moves slideblock (82), piston (301) and sleeve (307) to starboard, maximum delivery position. The hole in sleeve (307) closely follows the "land" on plunger (309) to cut off the drain of fluid through the spiral slot. When the "land" on plunger (309) and hole in sleeve (307) coincide as the slideblock (82) reaches full stroke, the fluid in the chamber behind piston (301) is trapped, and any further movement of the slideblock and sleeve will open piston (301) chamber to gear pump pressure and move slideblock until hole in plunger is again over the "land." As the slideblock (82) and rotor (16) move from neutral (Position II) to starboard, fluid from the radial piston unit flows out of pump port "B" to the steering cylinders. Fluid returning from the other steering cylinders flows into port "A" and supplies fluid to the radial piston unit. Excess gear pump fluid discharged past the gear pump relief valve plunger (50) flows through the suction valve body and check valve (201) at pump port 16 to supercharge the intake side of radial piston unit. The check valve (201) at port 17 prevents high pressure fluid from flowing out the back pressure valve. Excess supercharge fluid discharges past the back pressure relief valve into the reservoir. The pressure at port "B" varies in direct proportion to the force required to turn or hold the rudder. If the pressure exceeds the maximum working pressure, the fluid delivered by the radial piston unit discharges past the high pressure relief valve, out port 7 to the suction valve body, and past check valve (201) into port 16 to the radial piston unit.

C. FULL STROKE . . . PORT PUMP AT POSITION III.

1. When the port pump is running and control lever (315-L) is moved to Position III, gear pump fluid flows through the center of control plunger (309), one of the spiral slots in plunger (309) and hole in sleeve (307) to increase the pressure in chamber behind piston (301). The slideblock moves and forces the gear pump fluid in the chamber behind piston (62), out. Slideblock (82) moves to port, maximum delivery position. When the "land" on plunger (309) and the hole in sleeve (307) coincide, as the slideblock reaches full stroke, the gear pump fluid flowing to the chamber behind piston (301) is cut off and thus there is no further movement of the slideblock. As the slideblock (82) and rotor (16) move from neutral (Position II) to port, fluid from the radial piston unit flows out pump port "A" to the steering cylinders. Fluid returning from the other steering cylinders flows into port "B" and supplies fluid to the radial piston unit. The intake side of the radial piston unit is supercharged by excess gear pump fluid

flowing past check valve in port 17. Excess supercharge fluid discharges past the back pressure relief valve into the reservoir. The pressure at port "A" varies in direct proportion to the force required to turn or hold the rudder. If the pressure exceeds the maximum working pressure, the fluid delivered by the radial piston unit discharges past the high pressure relief valve, out of port 6 to the suction valve body, and past check valve (201) into port 17 to the radial piston unit.

D. FULL STROKE . . . STARBOARD PUMP AT POSITION I.

1. When the starboard pump is running and control lever (315-R) is moved to Position I, the control functions are similar to those described for the port pump in paragraph IV-C-1 except the slideblock moves to starboard and fluid from the radial piston pump is delivered out port "A."

E. FULL STROKE . . . STARBOARD PUMP AT POSITION III.

1. When the starboard pump is running and control lever (315-R) is moved to Position III, the control functions are similar to those described for the port pump in paragraph IV-B-1 except the slideblock moves to starboard and fluid from the radial piston pump is delivered out of port "B."

V. TROUBLE SHOOTING

A. TROUBLE, PROBABLE CAUSE AND PROBABLE REMEDY.

1. UNRESPONSIVE OR SLUGGISH CONTROL.

a. Binding, loose or disconnected control linkage. Repair.
b. Low gear pump pressure. Strike cap (55) a sharp blow to dislodge foreign sediment on relief valve plunger or dashpot plunger. Shut off pump and insert a low pressure gage in pump port 27 or 13, check pressure while pump is running. Check for foreign matter on end of relief valve plunger. To disassemble and inspect gear pump relief valve, see paragraph VI-G. Clean valve seat and valve bore with lint free cloth . . . Worn gear pump gears. To test slip, see paragraph V-B-3. To disassemble and inspect gears, see paragraph VI-C . . . Tube (126) from port 4 to 14, is broken or loose. Remove reservoir cover to inspect tube and fittings.
c. Sticking slideblock (82). Watch movement of indicator stem (88) for action of slideblock . . . Inspect liners and check working clearance as per paragraphs VI-A-9 and VI-B-2.
d. Sticking control plunger (309), bent control sleeve pin (307A) or marred thrust cup (303) and plate (304).
e. Excessive clearance between lever (315L or R) and gland (312). See paragraph VI-D-5.
f. Seal (310) may be caught on shoulder of plunger (309). This will prevent slideblock from going to full stroke.
g. Air in the system. Open air drain cocks, if any.

2. INSUFFICIENT VOLUME.

a. Pump slideblock is not going to full stroke. Check movement of slideblock, indicator stem (88). Check gear pump pressure, control action and slideblock clearance as described in paragraphs V-A-1 and VI-A-9.
b. Leaking check valve discs (201) or high pressure relief valves. Inspect per paragraph V-B-1.
c. Worn pumping unit. Remove air filter on top of pump and see if fluid in case overflows when pump is operating under pressure. Inspect as per paragraph V-B-2.

3. EXCESSIVE HEATING.

a. Operating pump or pumps when change-over valve is in neutral position to bypass both pumps. Restricted valve passages increase fluid temperature rapidly. Stop pumps when fluid power is not needed.
b. Insufficient quantity of the proper fluid in system. Check and refill.
c. Leaking check valves or relief valves in pump. Inspect as per paragraph V-B-1.
d. Worn pumping unit. Refer to paragraph V-B-2.
e. Excessive gear pump pressure. Check as per paragraph V-A-1-b.
f. Excessive discharge past either high pressure relief valve.

4. NOISY PUMP.

a. Lack of back pressure. To check pressure, place a gage in port 12 and run pump. Remove and clean plunger (214), if necessary.
b. Air is entering system. Check fluid level in reservoir. If there is excessive foam on fluid in reservoir, check for loose connections at ports 3 and 5 or irregular tightening of suction valve body and gasket to pump case.
c. Worn thrust rings, pistons or pumping unit. Disassemble and inspect pump per paragraph VI-A.

5. SHAFT WILL NOT TURN.

a. Defective starter control. Frozen electric motor, gear pump gears or radial piston unit. Disconnect drive coupling, check pump and motor shafts independently. Disassemble and in-

spect gear pump and radial piston unit per paragraphs VI-A-3 and 6.

B. SLIP AND MALFUNCTIONING TESTS.

1. CHECK VALVE AND RELIEF VALVE LEAKAGE.

a. Shut down the Oilgear pumps. Open the globe valves connecting cylinders to low pressure system. Set change-over valve in position to connect the questionable pump to the cylinders. Adjust globe valves in low pressure system to operate rudder with hand pump. Do not close globe valves in high pressure system. Operate the hand pump to build up as much pressure as possible. Check stroke indicator (88) to make sure pump is in neutral position. Remove the hand hole cover on the fluid reservoir and unscrew the nipple from port 2 on the bottom of the pump. If fluid discharges out of port 2, it is escaping past the relief valve plunger (34) or one of the check valve discs (201). Reverse the flow of fluid from the hand pump to check the other relief and check valve. If the discharge is less than 15 cubic inches per minute, the check valve and relief valves are sealing correctly. If the discharge is more, remove questionable relief valve plunger (34) and clean according to paragraph II-F and replace carefully. Repeat hand pump test to check for fluid leakage. If discharge out of port 2 is still excessive, remove suction valve and inspect check valve discs (201). See paragraph VI-I. Repeat hand pump test to make sure relief and check valves are seating properly.

2. WORN CYLINDER AND PISTON UNITS.

a. Set change-over valve in position to connect questionable pump to cylinders. Start the Oilgear pump and close globe valves in high pressure system. Move control lever (315L or R) just sufficient to build up about 1,000 pounds per square inch pressure on one of the gages placed in flanges (79) (Fig. 13). Measure movement of slideblock on stroke indicator (88) with scale or depth gage. Reverse pump by moving lever (315L or R) to opposite side of neutral and repeat same test. The distance slideblock moves to each side of neutral should be equal. If not, one of the relief valves (34) or check valves (201) is leaking. If movement is the same while check valves and relief valves are seating properly, check the condition of the cylinder and piston unit. The slip stroke of a new pump is approximately 5% of the travel from neutral to full stroke on stroke indicator (88) at normal operating temperatures. If travel is 20% or more from neutral, the pumping unit is worn and leaks excessively. Disassemble and inspect unit. To repair, install a new cylinder and bushing unit.

3. GEAR PUMP.

a. To test for worn out gear pump, run pump at neutral and check pressure. Remove hand hole cover on fluid reservoir and measure case slip out of port 1. The normal case slip is usually less than 20% of the gear pump volume given in the Specification Bulletin.

VI. DISASSEMBLY, INSPECTION AND ASSEMBLY OF TYPE "DH" PUMPS

The construction and principle of operation of the Oilgear steering gear pumps is fully described in this bulletin. If either pump fails to function correctly, the trouble should be diagnosed. Replacing working parts and reassembling pump is not a difficult task. If parts other than those supplied as spares are required, reference to the parts drawings in this bulletin will greatly aid and speed up service from the factory. Care should be taken to specify the Symbol Number, Oilgear Part Number, Part Name and Bulletin Number from which this data has been taken. Also specify the Serial Number of the pump. See Specification Bulletin for Oilgear Part Numbers.

Time and effort will be saved and malfunctioning and annoying leaks eliminated if the recommendations given for disassembling and assembling the various units are followed. Observe positions of gaskets upon removal and anneal all copper gaskets to prevent annoying leaks when replacing parts . . . be sure all internal screws on rotor head, slideblock head, and gear pump cover are locked in place with wire . . . inspect all O'Ring packings for deterioration and replace if necessary . . . flush all parts with clean mineral spirits and be sure chips, grit, or other foreign matter is removed before assembling parts. Only a few conventional tools, plus those in the tool kit, will be required, to disassemble a pump.

A. DISASSEMBLY AND INSPECTION OF RADIAL PISTON PUMPING UNIT. (See Figs. 12, 13 & 14.)

1. PIPE FLANGES. Remove flanges (79) at ports "A" and "B" on inactive pump. Catch fluid from pump and piping in a convenient receptacle.

2. PUMP. Disconnect electric motor coupling and pump control lever (315L or R) linkage. Remove pump mounting bolts. Lift pump off reservoir and set pump on flange end. Handle pump carefully. Unnecessary shocks will cause serious injury to pump mechanism. Do not allow full weight of pump to rest on piping. Avoid bending, fracturing or loosening of tubing or fittings. Block pump securely so it will not slip. (Note: If pintle (5) is to be pressed out of pump case (56) remove cover (80) before lifting pump off reservoir so pump can be set on flange end without blocking).

3. GEAR PUMP ASSEMBLY. Remove gear pump housing screws (72A), fasten a clamp to drive shaft (1) or screw three hook bolts into taps in outer rim of housing (72) and lift entire gear pump housing assembly upward with a small crane. Raise assembly carefully to prevent damage to shaft (1), bearing (12) or coupling flange (19).

4. SLIDEBLOCK HEAD. Remove wire (105) and slideblock head screws (74). Screw three set screws into taps in rim of head (75) and jack head from slideblock (82). Turn each screw a little at a time to avoid cocking head. Lift head out by hand or use hook bolts and crane.

5. ROTOR HEAD. Remove wire (105) and rotor head screws (66). Jack head (65) from rotor (16) with set screws. Lift head and bearing (10) out by hand or use hook bolts and crane.

6. CYLINDER. Screw hook bolts into end of cylinder (6) and very carefully lift the cylinder, bushing, and piston assembly (6, 7 and 8) off pintle (5). Do not cock unit and scratch inside of bushing when removing assembly. Inspect working surfaces on pintle (5), bushing (7), piston holes in cylinder (6), pistons (8) and thrust rings (18).

7. ROTOR. Screw hook bolts into end of rotor (16) and lift rotor assembly (16, 17, 18 and 9) out of slideblock (82). Inspect rotor bearing (9).

8. SLIDEBLOCK. Should it be necessary to inspect and clean slideblock (82) and inside of case (56), remove screws (300A) and pull out the control housing assembly (300). Pull sleeve assembly (307) out far enough to be free from slideblock (82). Remove bushing (87) and pull out stroke indicator assembly (88). Remove screws (94A) and (61) and lift off control cylinder head (94). Remove gaskets (31 and 32). Remove locking wire (106) and control piston screws (64). Pull piston assembly (62) out far enough to be free from slideblock (82). Screw hook bolts into slideblock (82) and lift slideblock out of case (56). Liners (84) are doweled to the slideblock (82). Liners (85) are doweled to the case (56). If liners are removed for inspection, mark each liner to be sure each returns to its previous position. Some pumps have liner shims (84A). Make certain shims are returned to their original position.

9. PINTLE. Place pump case, with open end down, in a press. See Specification Bulletin for size of press. Insert a block of wood or other soft material inside of case to protect pintle (5) when it drops from hole. Apply pressure on "E" end of pintle (5). Pintle shank has .005" taper per inch of length. After pintle is pressed down a short distance, it will drop the rest of the way. If cylinder bushing (7) is tight on pintle (5), press out pintle to remove the cylinder, bushing, piston, and pintle unit.

10. THRUST RINGS. If it is necessary to remove thrust rings (18) from rotor (16), first break out the inner spacer ring (17) by striking a rod inserted in one or more of the radial holes in rotor (16) and directly behind the spacer ring (17). Then drive out the thrust rings (18) and outer spacer (17A or 17) by striking a brass bar inserted in the axial holes on bearing end of rotor (16).

B. ASSEMBLY OF RADIAL PISTON PUMPING UNIT. (See Figs. 12,13 & 14.)

1. PINTLE. Set case (56) in a press with drive shaft end facing upward. See Specification Bulletin for size of press. Apply a thin coat of white lead to large diameter surface of pintle (5). Insert small end "E" of tapered pintle into hole and locate pintle in case with key (77). Slip a sleeve over cylinder end of pintle to shoulder on large diameter or insert a bar in bearing (12) end of pintle and press pintle downward until shoulder on pintle is flush with finished boss in case. Pintle surface "E" should be flush with case. Do not press directly on small end of pintle.

2. SLIDEBLOCK. Insert the bronze liners (85) in case (56) in the same positions from which they were removed. Insert the steel liners (84) and (84A) on slideblock (82) in the same positions from which they were removed. Check for proper working clearance at "A." See Specification Bulletin.

3. STROKE INDICATOR. Slip spring (89) on stem (88), insert stem into bushing (87) and screw bushing (87) tight against case (56).

4. SMALL CONTROL PISTON AND HEAD. Fasten piston (62) to slideblock (82) with screws (64) and locking wire (106). Fasten control cylinder head (94) and gasket (31 and 32) to case (56) with screws (94A and 61).

5. HYDRAULIC SERVO-MOTOR LEVER CONTROL. Push sleeve assembly (307) against slideblock (82). Be sure hole in spiral slot in sleeve faces upward. Slip plunger (309) into sleeve (307) and fasten control housing (300) and gasket (31) to case (56) with screws (300A). See paragraph VI-D for assembly of hydraulic control parts.

6. CYLINDER. Test cylinder and bushing for proper running clearance. See Specification Bulletin. Insert hook bolts in cylinder and clean pintle and bushing working surfaces thoroughly. Lower cylinder (6) carefully and gradually until it is difficult to revolve cylinder on pintle. Measure distance from end of pintle to face of cylinder. See Specification Bulletin. When in normal running position, cylinder is flush with end of pintle (size 2, 60, 100 and 150 units are not flush). Lift cylinder off pintle (5). Avoid scratching working surface.

7. THRUST RINGS. Press a new spacer ring (17), thrust rings (18) and another spacer ring (17A or 17) into rotor (16). Avoid cocking rings in assembly.

8. ROTOR. Lift rotor (16) bearing (9) and cylinder, complete with pistons, over pintle and into slideblock (82). When cylinder (6) rests on inside of rotor, the pintle should project beyond face of cylinder. See Specification Bulletin for proper distance. Add or remove shims (14) beneath bearing (9) to obtain the proper dimension.

9. ROTOR HEAD. Press bearing (12) into end of pintle (5). Insert coupling ring (21), coupling rollers (20), flange coupling (19), and rotor head (65). Force rotor cover down uniformly with screws (66) to hold spacers (17) and thrust rings (18) firmly in place. Avoid cocking rotor head. There should be approximately 1/16" clearance between rotor and head face. Lock screws with wire (105).

10. SLIDEBLOCK HEAD. In assembling slideblock head (75), insert sufficient shims (13) to provide proper rotor end play. See Specification Bulletin. To determine the number of shims required, be sure inner race of bearing (10) is tight against shoulder on head (65). Place head (75) tight against slideblock (82). With feeler gage, measure distance between bearing (10) and counterbore in head (75). Shim for proper clearance. See Specification Bulletin. Fasten head (75) to slideblock (82) with screws (74). Lock screws with wire (105).

11. GEAR PUMP HOUSING. Adjust for proper slideblock end play with shims (67). See Specification Bulletin. To determine the number of shims required, place spacer ring (68) on head (75) and measure distance from face of case (56) to top of spacer ring (68). Also measure distance from face of gear pump cover (73) to face of gasket (29), when tight against housing (72). Gasket (29) is normally .016" thick when free and .008" thick when assembled in place, so deduct accordingly. Remove drive shaft (1) before fastening gear pump housing assembly to case. To remove shaft (1), file burrs off edges of keyway, remove screws (71A) and carefully slide housing (71) and shaft seal (27) off shaft. Insert a rounded half key or place shim stock over keyway to prevent cutting seal. Loosen lockwasher (4), unscrew nut (3) with spanner wrench and pull shaft (1), bearing (11), and spacer (2) out of housing. Fasten gear pump housing assembly and gasket (29) to case (56) with screws (72A).

12. DRIVE SHAFT. When installing shaft (1), retain proper end play for cylinder (6). See Specification Bulletin. Remove bearing (11) and slide shaft (1), with spacer (2) and key (26) in place, through gear pump housing assembly and coupling flange into bearing (12). While shaft (1), spacer (2), coupling (19), and cylinder (6) rest on inner face "G" of rotor (16), measure distance from upper face of housing (72) to shoulder on shaft (1), which contacts inner race of bearing (11). Then insert shims (15) into counterbore of housing (72) until they are higher than shoulder on shaft (1). See Specification Bulletin. Also measure distance from face of housing (72) to end of shaft (1), before and after bearing (11) is fitted in place to be sure shaft (1) rises to provide proper end play for cylinder (6) at "B." Thread bearing (11), lockwasher (4), and nut (3) on shaft (1). Tighten bearing against shoulder on shaft and bend one prong on washer (4) to lock nut (3) in place. Insert sufficient shims (15) between outer race of bearing (11) and housing (71), to eliminate shaft end play and leakage at gasket (28). Distance from tongue face of housing (71) to face of gasket (28) when tight against housing (71), plus about .008" for compression of gasket, should be the same as the distance from face of housing (72) to top of shims (15). Insert a rounded half key or place shim stock over keyway and slip housing and seal assembly (71 and 27) on shaft (1) with care to avoid cutting seal on keyway. Fasten housing (71) to housing (72) with screws (71A). Test shaft for end play.

13. PUMP MOUNTING. Bolt pump and gasket (56A) to reservoir. Assemble pipe flanges and control linkage to pump. Couple pump and motor drive shafts together.

C. GEAR PUMP UNIT. (See Figs. 4 and 12.)

1. HOUSING AND SHAFT ASSEMBLY REMOVAL. To remove gear pump housing and shaft assembly without removing pump from the oil reservoir, disconnect the drive coupling, remove electric motor mounting screws and slide motor back on base. Remove screws (72A), screw two hook bolts into taps on top of housing (72) and slide assembly out horizontally. Avoid supporting gear pump housing assembly on shaft alone while removing unit from pump case.

2. SHAFT REMOVAL. To remove shaft, see paragraph VI-B-11. Unless inspection is necessary, leave seal (27), housing (71) and bearing (11) on shaft to avoid damaging seal on keyway edges. Shaft does not have to be removed to inspect gears (22 and 23).

3. GEAR REMOVAL. Remove wire (106), screws (74) and gaskets (70). Lift off cover (73) and gear pump gears (22 and 23). All gears are fitted with .003" to .005" side clearance and outside diameter clearance.

4. ASSEMBLY. Reassemble parts in reverse order of that used for disassembly. See paragraphs VI-B-11 and 12.

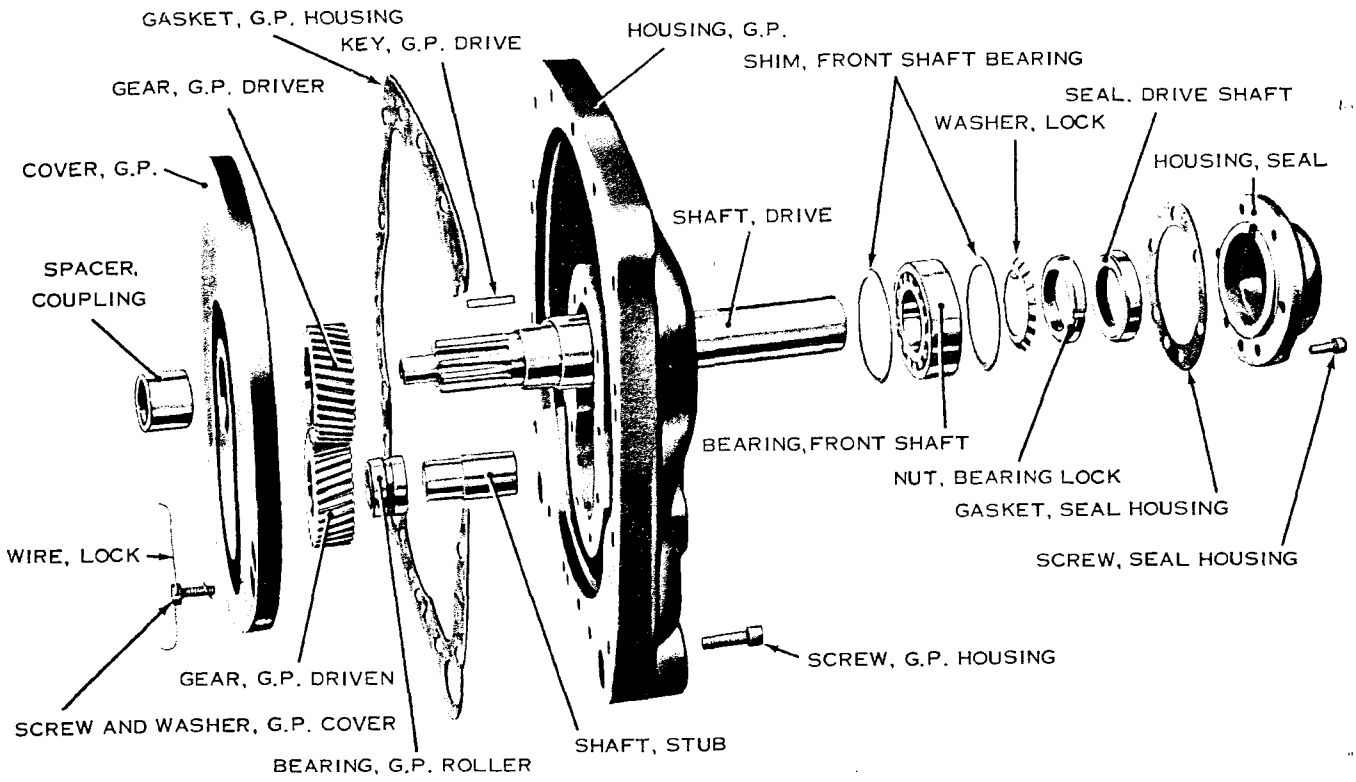


Figure 4. Gear Pump, Assembly, Exploded View

D. HYDRAULIC SERVO-MOTOR LEVER CONTROL UNIT. (See Figs. 5 and 12.)

1. HOUSING REMOVAL. Control housing (300) and associate parts can be removed for inspection without removing pump from reservoir. Remove screws (300A) and pull housing (300) and associate parts out carefully to avoid bending control sleeve pin (307A) in slideblock (82). Pull out sleeve (307), control piston (301) and associate parts.

2. BEARING INSPECTION. To inspect bearing (305), remove screws (308A), retainer plate (308), and thrust plate (304).

3. PLUNGER SEAL INSPECTION. If inspection of oil seal (310) is necessary, remove screw (317) and washer (316). Loosen lever clamping screw (324) enough to slip lever (315L or R) off plunger (309). Remove key (313), screws (312A) and gland (312). Slip plunger (309) out the short way.

4. ASSEMBLY. Reassemble parts in reverse order of that used for disassembly. When inserting plunger (309) in housing (300), be careful not to damage seal (310) and be sure it does not hook on plunger shoulders. Be sure to insert the same number and thickness of shims (311 and 311A) between gland (312) and housing (300). When tighten-

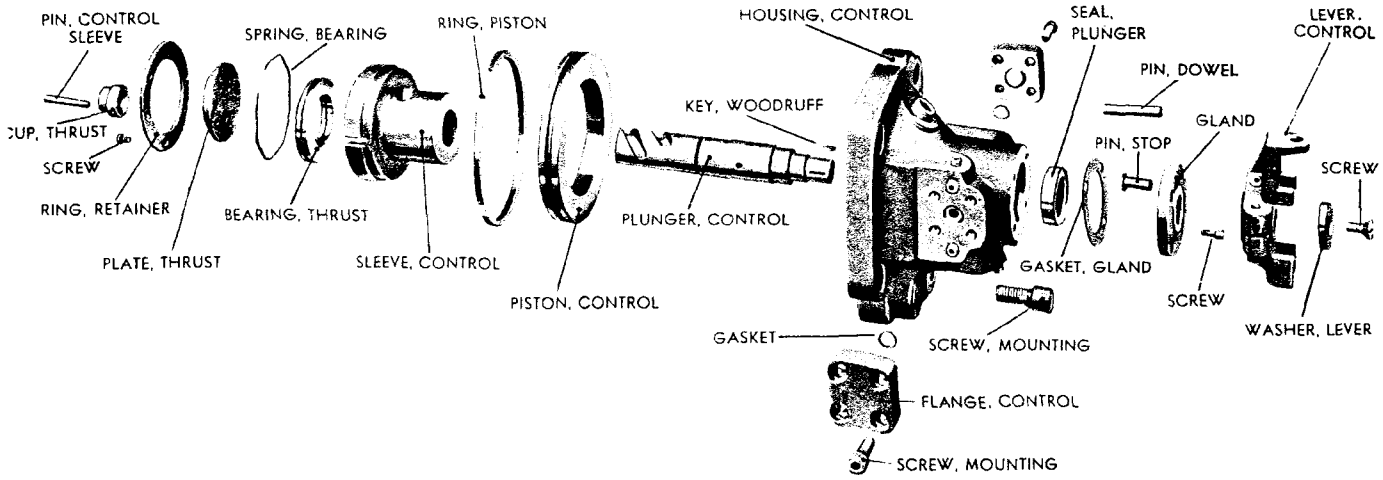


Figure 5. Pump Hydraulic Servo-Motor Lever Control, Assembly, Exploded View

ing screw (317), allow approximately .001" clearance between lever (315L or R) and gland (312). Tighten clamping screw (324) firmly. Be sure to install sleeve (307) with spiral slot on top and plunger (309) with hole in spiral slot facing upwards. Lever (315L or R) should be free to move through a 100° arc. Force to move lever varies with size of pump; however, this should never exceed 100 inch-pounds.

5. CHANGING CONTROLS. To change a port pump to a starboard pump or vice versa, it will be necessary to remove hydraulic servo-motor lever control unit (Fig. 5). See paragraph VI-D-1. Use a hardened steel screw to jack cup (303) out of slideblock (82). Remove head (94) and small piston assembly (62). See paragraph VI-E-1. Tap cup (303) into opposite side of slideblock (82). Mount both assemblies on opposite sides of pump. When properly assembled, operate pump and test to see if slideblock and stroke indicator stem (88) move to neutral position when lever (315L or R) is in Position II. If not, remove screw (317), lever (315L or R), key (313) and gland (312). Add or remove shims (311 and 311A) to suit, and continue adjusting until the proper control action is obtained.

E. CONTROL PISTON UNIT. (See Fig. 12.)

1. PISTON REMOVAL. Remove mounting screws (94A and 61) and lift off control cylinder head (94) and gaskets (31 and 32). To remove piston (62), cut lock wire (106) and remove screws (64). Pull out piston (62) and ring (63). Adapter (60) can be removed if necessary by lightly tapping on adapter (60).

2. ASSEMBLY. Reassemble parts in reverse order of that used in disassembly. Be certain that gaskets (31 and 32) fit correctly over all holes to case (56) and adapter (60).

F. HIGH PRESSURE RELIEF VALVE. (See Fig. 6 and Section "F-F" in Fig. 13.)

1. GENERAL. Relief valves can be removed without draining system or removing pump from reservoir. Before removing screws (38A) and flange (38), measure location of adjusting screw (40) so that the same setting will be obtained when valve is reassembled. All parts for one relief valve must be kept together and assembled in same pump on same side.

2. PLUNGER REMOVAL. Loosen nut (40A) about one turn (note amount loosened) and turn screw (40) counter-clockwise until spring tension is released. Remove screws (38A), flange (38), shims (45), gasket (39), seat (41), spring (42), seat (43), retainer (44), and plunger (34). Examine plunger seat and relap if necessary. When lapping seat, retain the close fit between the smaller plunger diameter and bushing (35).

3. BUSHING REMOVAL. Avoid removing bushing (35). If replacement is necessary, remove screws (38A), flange (47), and pipe plug (48). Insert a rod and drive bushing (35) out.

4. ASSEMBLY. Reassemble parts in reverse order of that given for disassembly. In reassembling bushing (35), tap it lightly in place. Be sure plunger (34) is free in bushing (35). Insert sufficient shims (45) to hold retainer (44) tight against bushing (35) and also prevent fluid leakage at gasket (39). Turn in screw (40) to previous position. Tighten nut (40A).

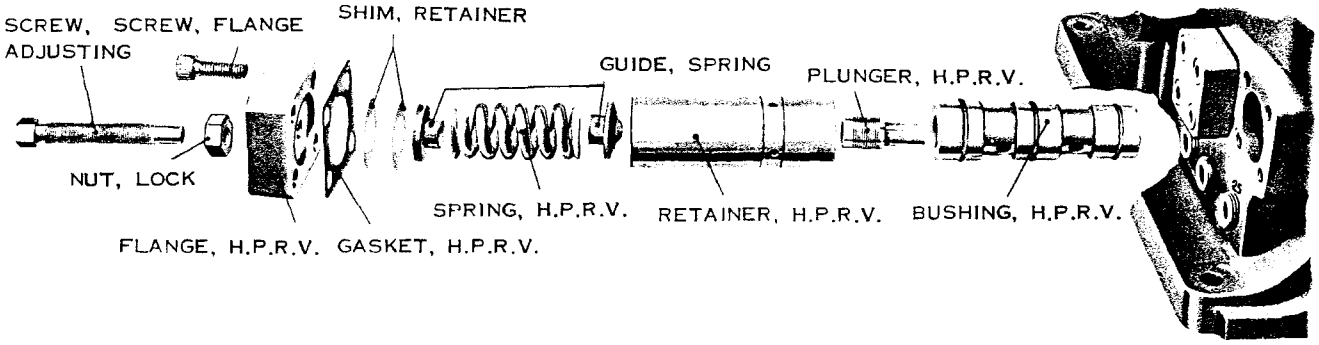


Figure 6. High Pressure Relief Valve, Assembly, Exploded View

G. GEAR PUMP RELIEF VALVE. (See Fig. 7 and Section "G-G" in Fig. 13.)

1. REMOVAL. Relief valve can be removed without draining system or removing pump from reservoir. Unscrew cap (55), gasket (54), and remove shims (53), spacers (49), dashpot plunger (51), spring (52), and valve plunger (50).

2. PRESSURE ADJUSTMENT. Insert additional shims (53) to increase pressure or remove to decrease pressure. Each 1/32" thick shim will change pressure about 12 pounds per square inch in units up to and including size 20 and 5 pounds per square inch in sizes 35 and larger. To check pressure, connect gage to pipe tap in pump port 13. Note, the gear pump pressure is higher when

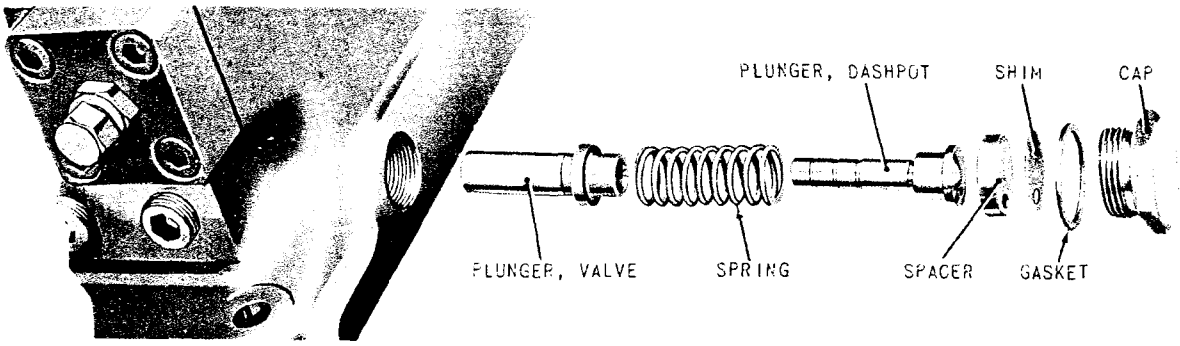


Figure 7. Gear Pump Relief Valve, Assembly, Exploded View

fluid is cold. Do not make adjustments until fluid is warm. See Specification Bulletin for pressure setting.

3. ASSEMBLY. Reassemble parts in reverse order of that used for disassembly. Be sure gasket (54) is in place on shoulder of cap (55) before tightening cap.

H. BACK PRESSURE RELIEF VALVE. (See Fig. 8 and Section "H-H" in Fig. 13.)

1. GENERAL. This valve can be removed without draining system or removing pump from reservoir. Remove hand hole inspection cover on fluid reservoir.

2. PRESSURE ADJUSTMENT. Insert additional shims (216) to increase pressure or remove to decrease pressure. Each 1/16" thick shim will change pressure about 9 pounds per square inch. See Specification Bulletin for pressure setting.

3. PLUNGER REMOVAL. Remove cap (218) and gasket (217) to remove spring (215), shims (216) and plunger (214) through hand hole in fluid reservoir.

4. ASSEMBLY. Reassemble parts in reverse order of that used for disassembly.

I. SUCTION AND CHECK VALVES. (See Figs. 8, 12, and 13.)

1. PUMP REMOVAL. Remove pump from reservoir. See paragraphs VI-A-1 and 2.

2. CHECK VALVE REMOVAL. To inspect suction check valve (209), remove lock wire (212A), screws (212) and flange (211). Seat (210), disc (209) and cage (207) are free to be removed.

3. CHECK VALVE ASSEMBLY. Reassemble parts in reverse order of that used for disassembly. Be sure mounting screws (212) are tightened uniformly to prevent air from entering the system.

4. BODY AND CHECK VALVE REMOVAL. To inspect check valve (201), remove tube (130). Remove the eight mounting screws (200A) (support suction valve body (200) while removing screws). Remove valve body (200) and gasket (202). The disc (201), cage (205), seat (204) and gaskets (203-A) are free to be removed.

5. ASSEMBLY. Reassemble parts in reverse order of that used for disassembly. Be sure mounting screws (200A) are tightened uniformly and tube (130) tightened securely to prevent air from entering the system.

6. PUMP MOUNTING. Mount pump on reservoir. See paragraph VI-B-13.

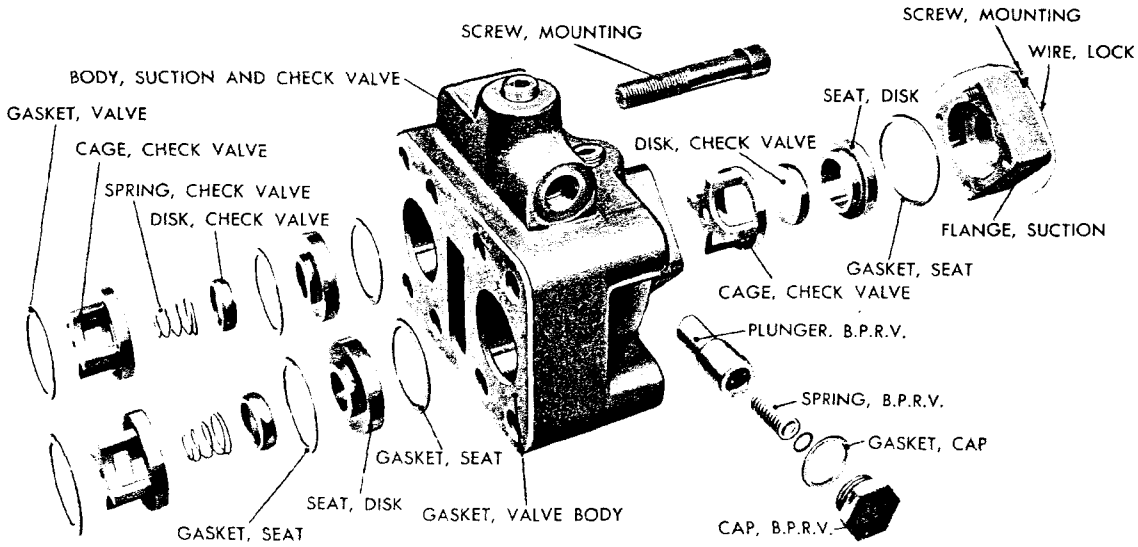


Figure 8. Pump Suction and Check Valve, Assembly, Exploded View

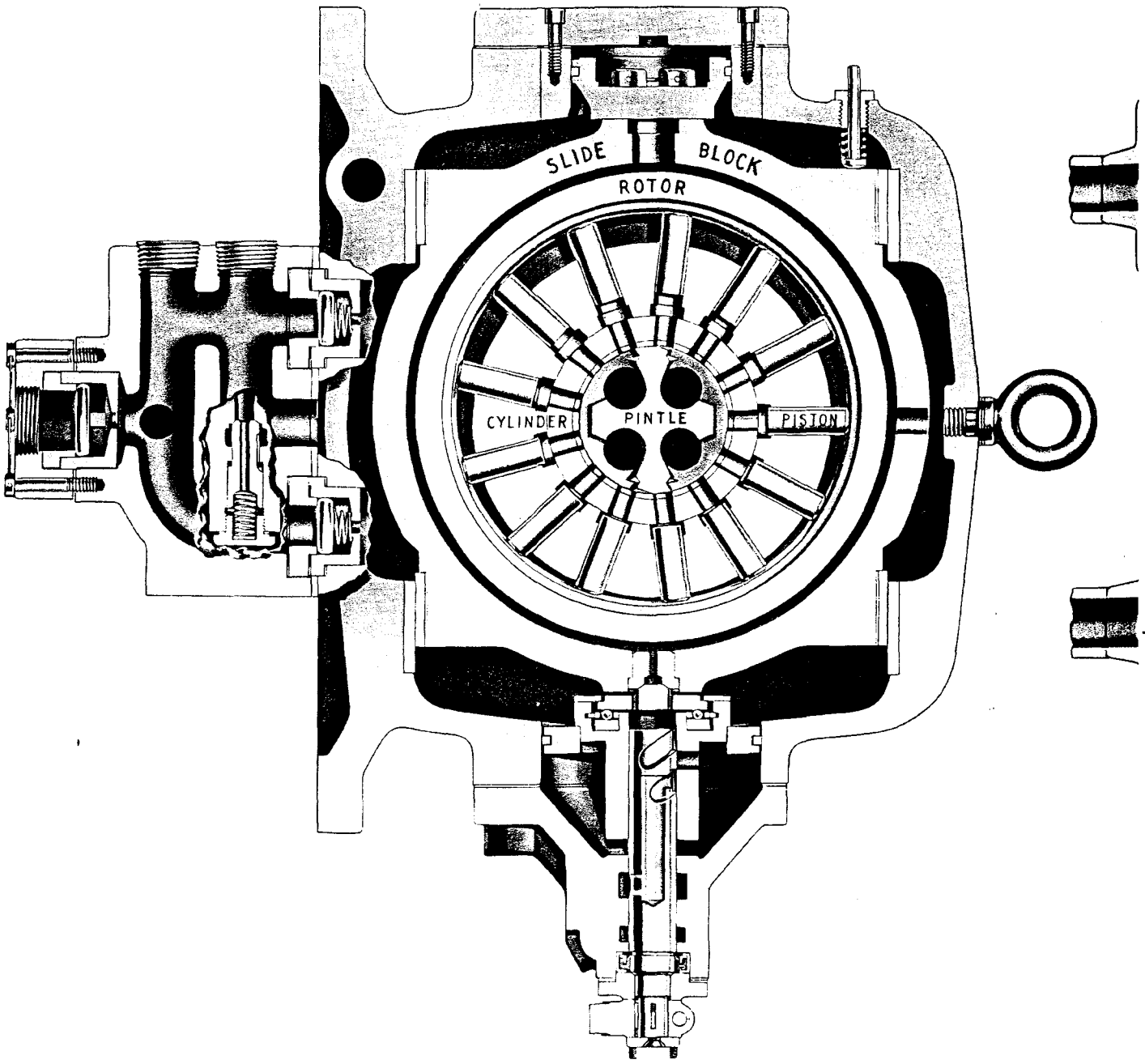


Figure 9. End View, Cross Section of Type "DH" Pump at Full Delivery Stroke

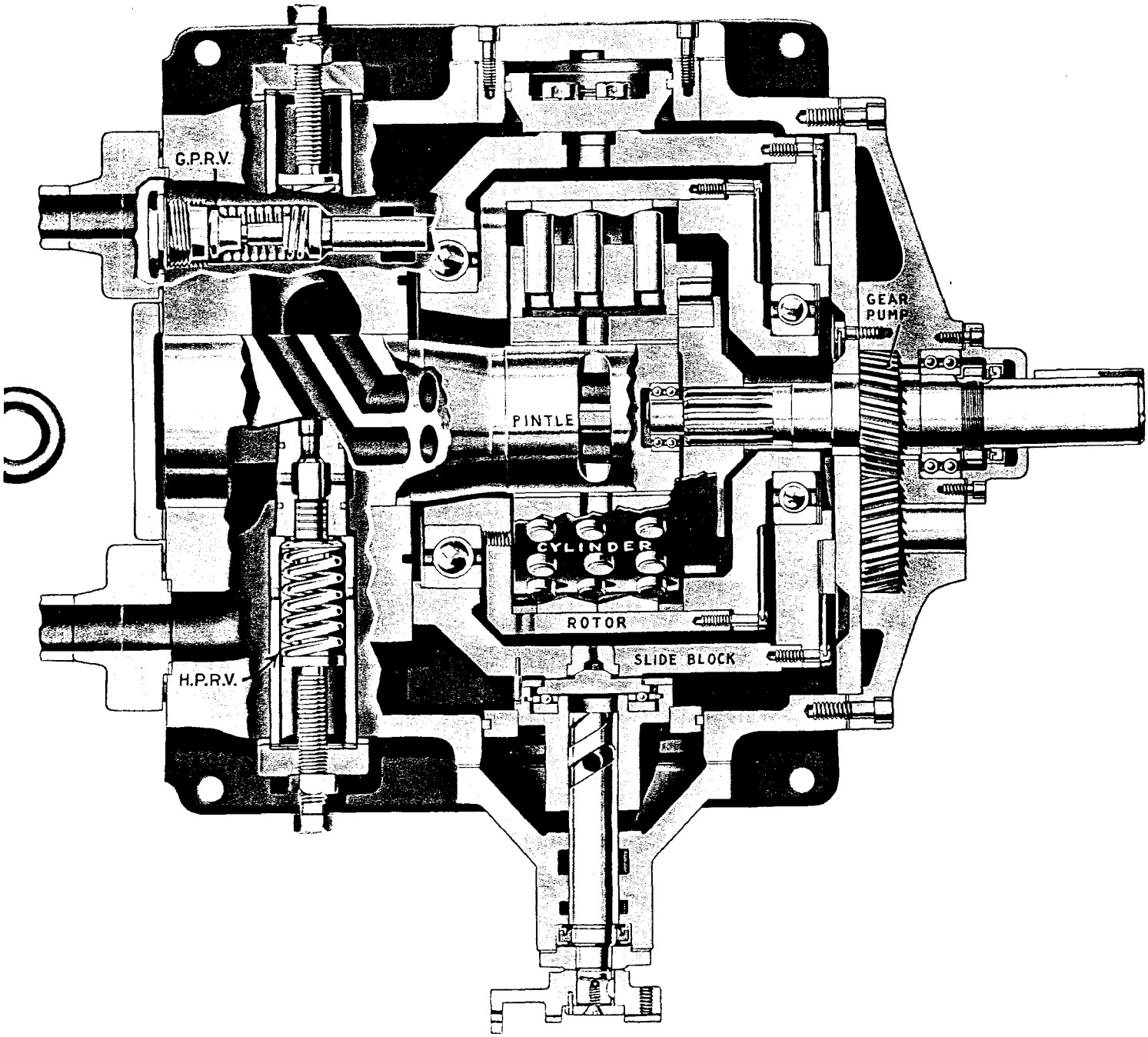


Figure 10. Plan View, Cross Section of Type "DH" Pump at Full Delivery Stroke

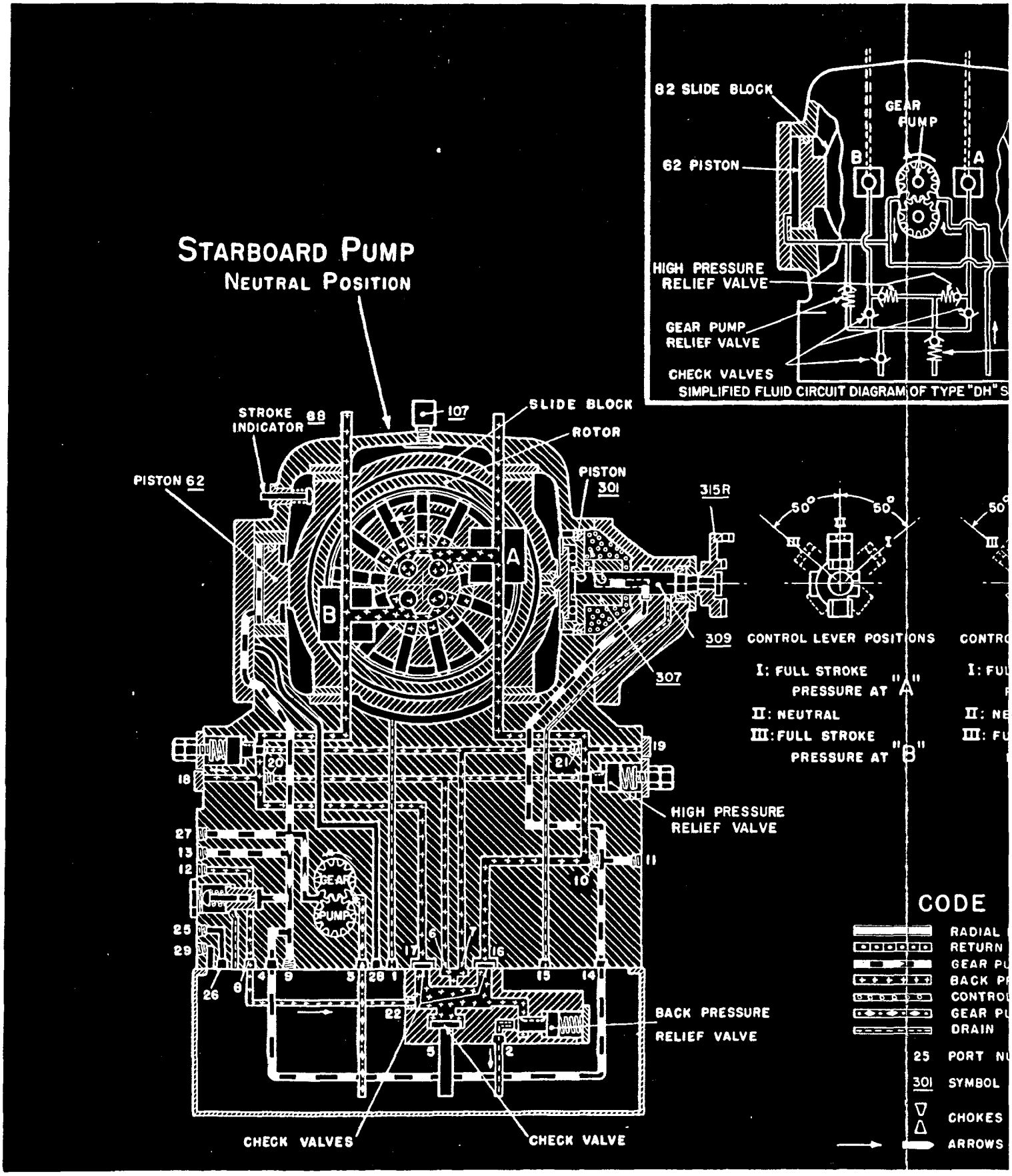
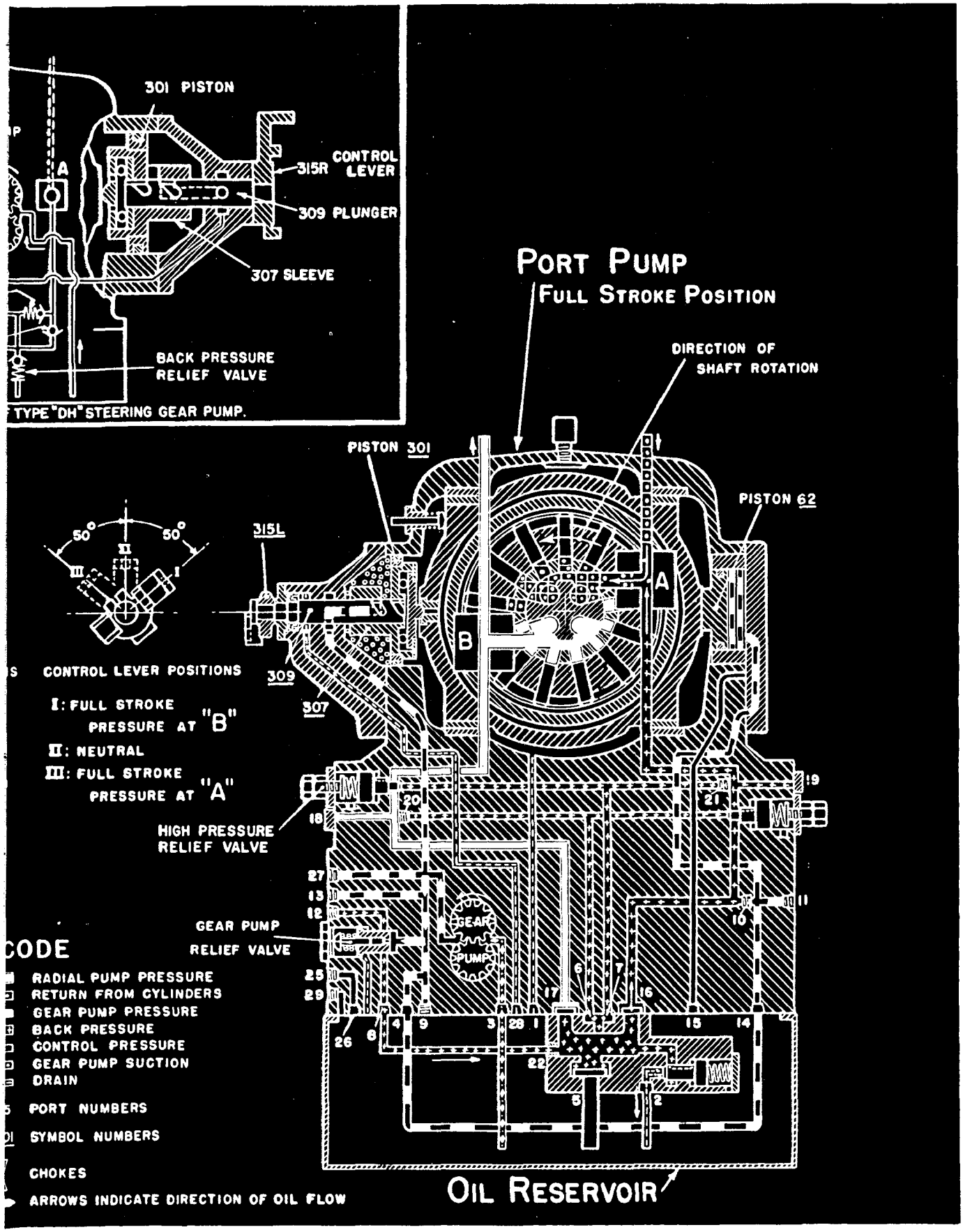


Figure 11. Fluid Flow Chart Showing Port Pump at Full Deliv



Full Delivery Stroke and Starboard Pump at Neutral

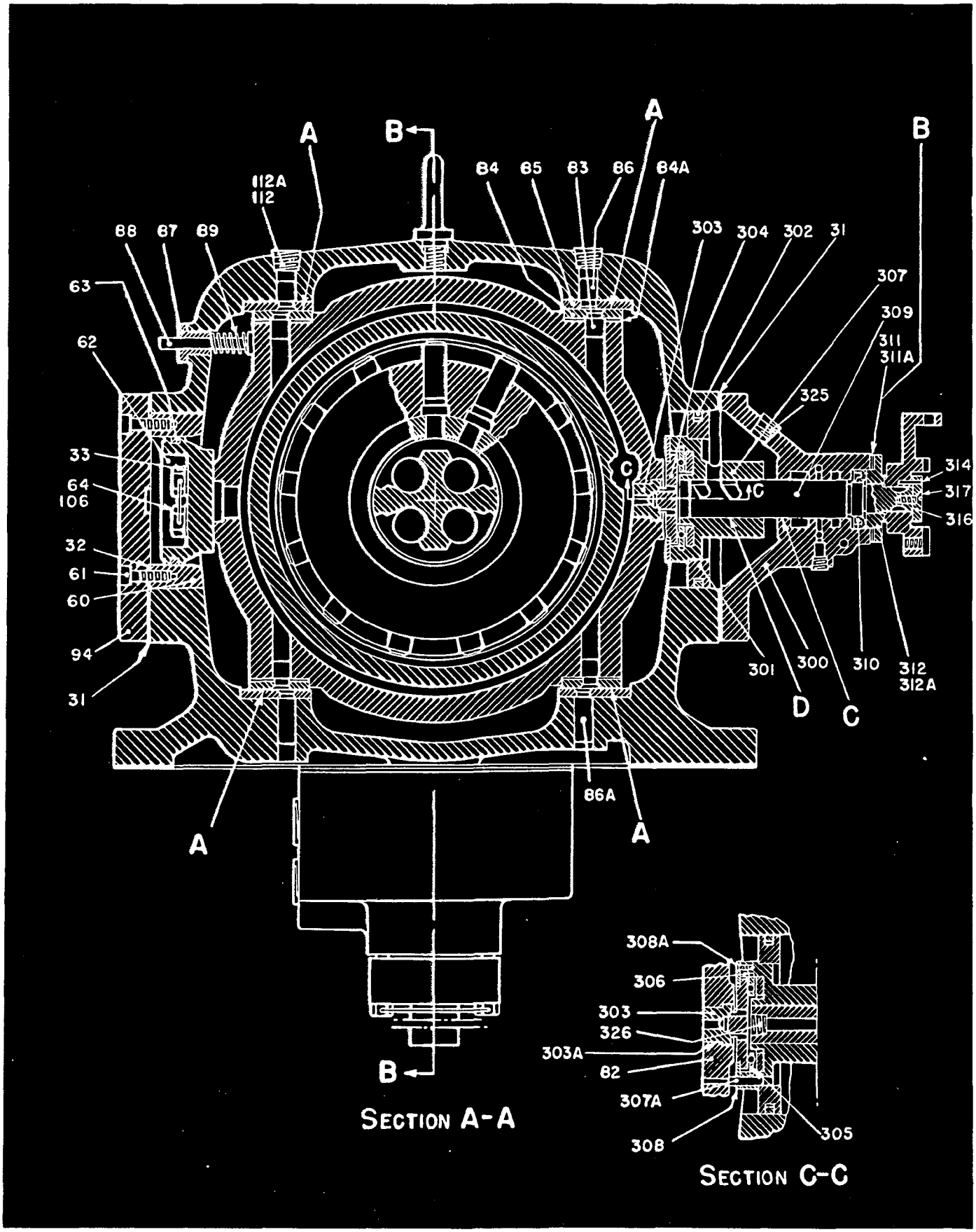
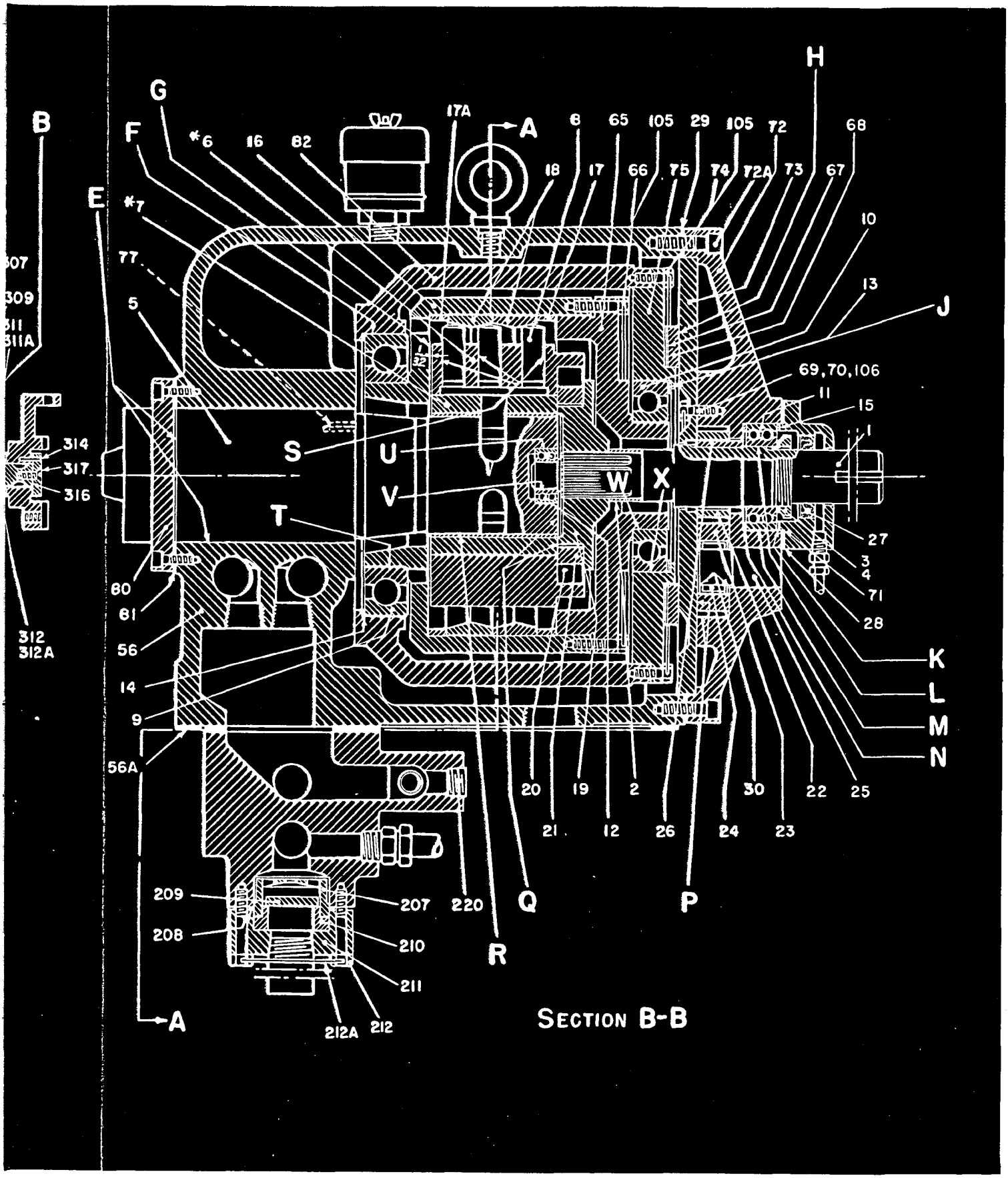


Figure 12. Parts Drawing of Type "DH" Pump (also see Figs. 13 and



;s. 13 and 14) (See Specification Bulletin for Parts List and Assembly Notes)

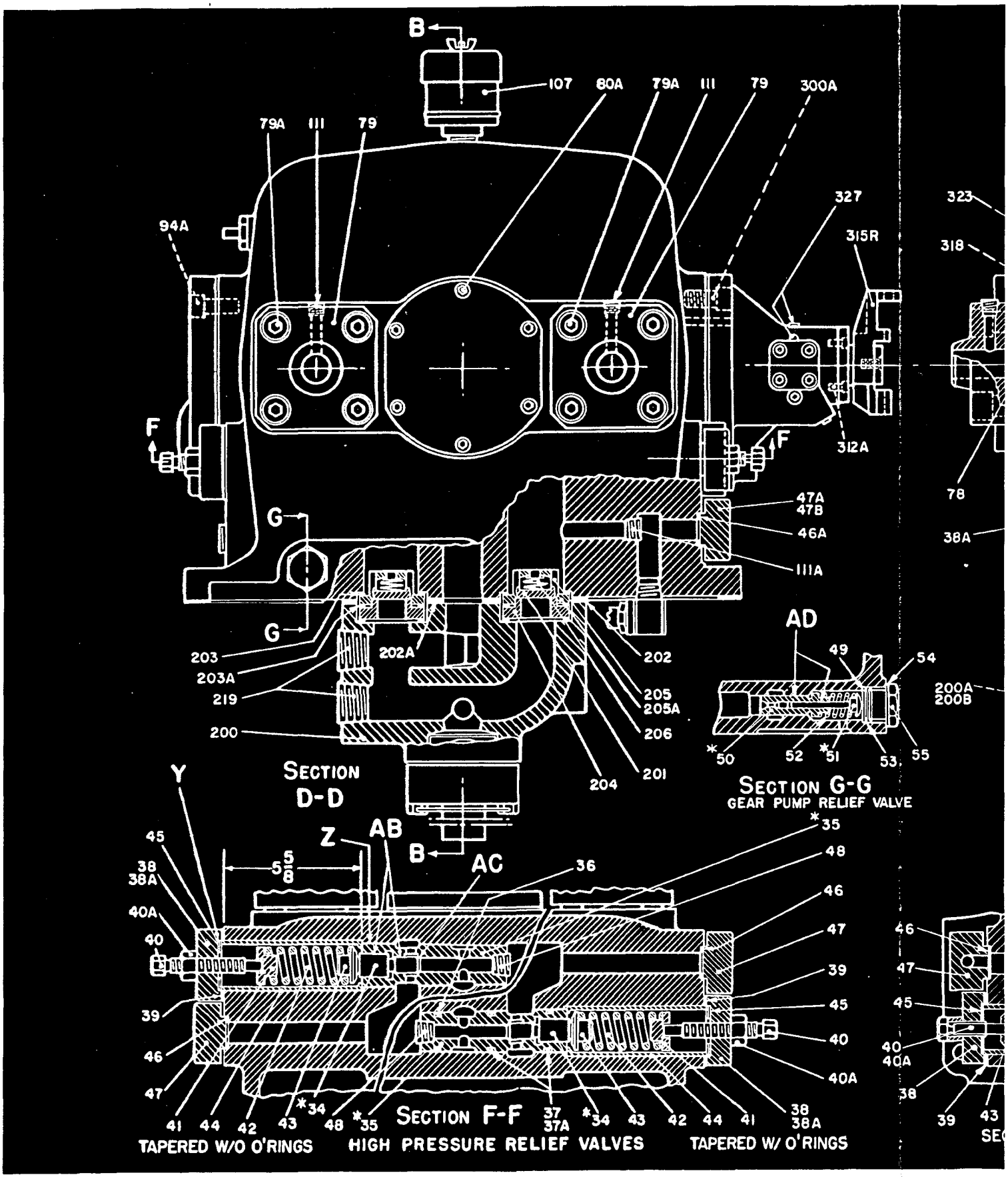
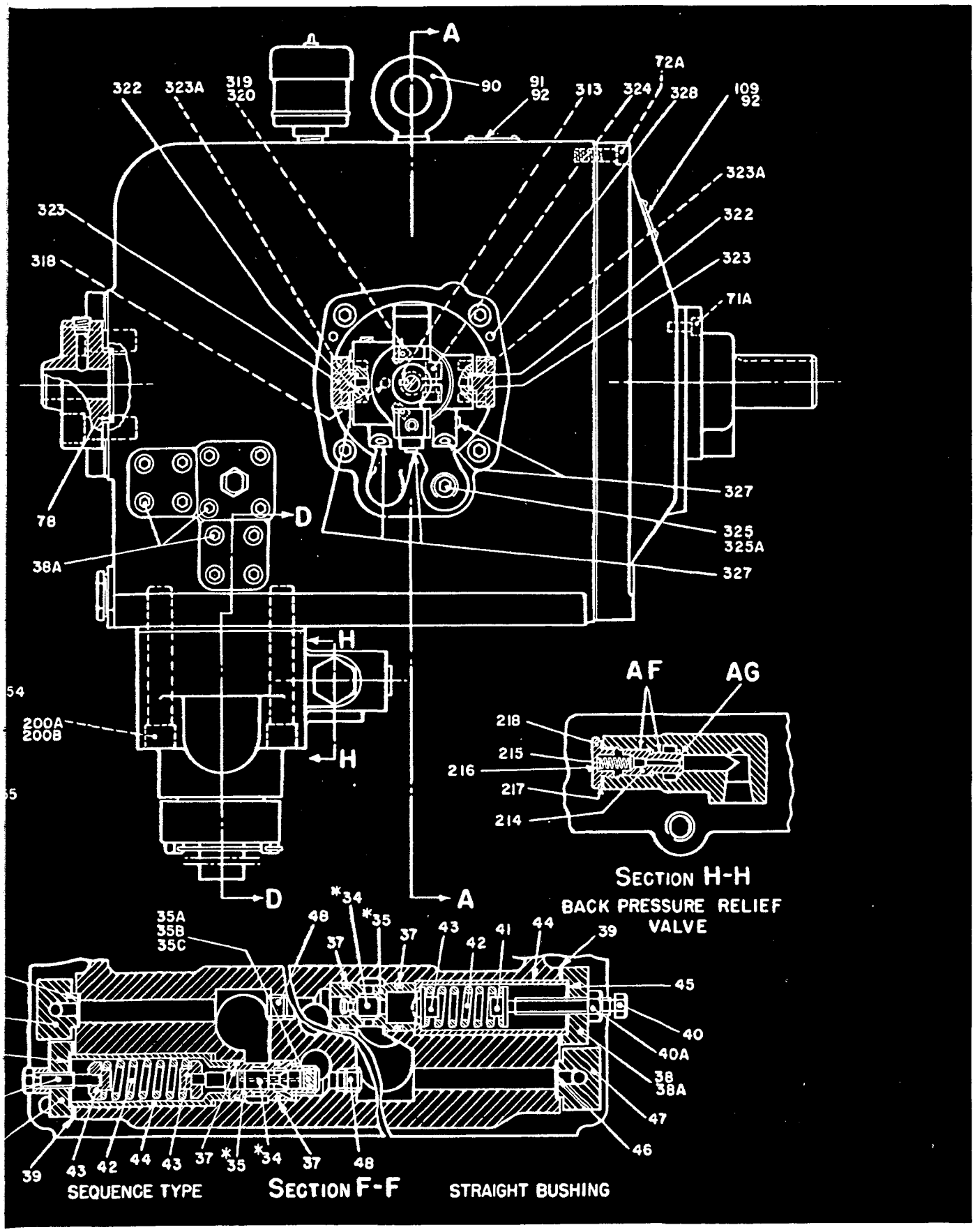


Figure 13. Parts Drawing of Type "DH" Pump (also see Figs. 12 and 14) (See



id 14) (See Specification Bulletin for Parts List and Assembly Notes)

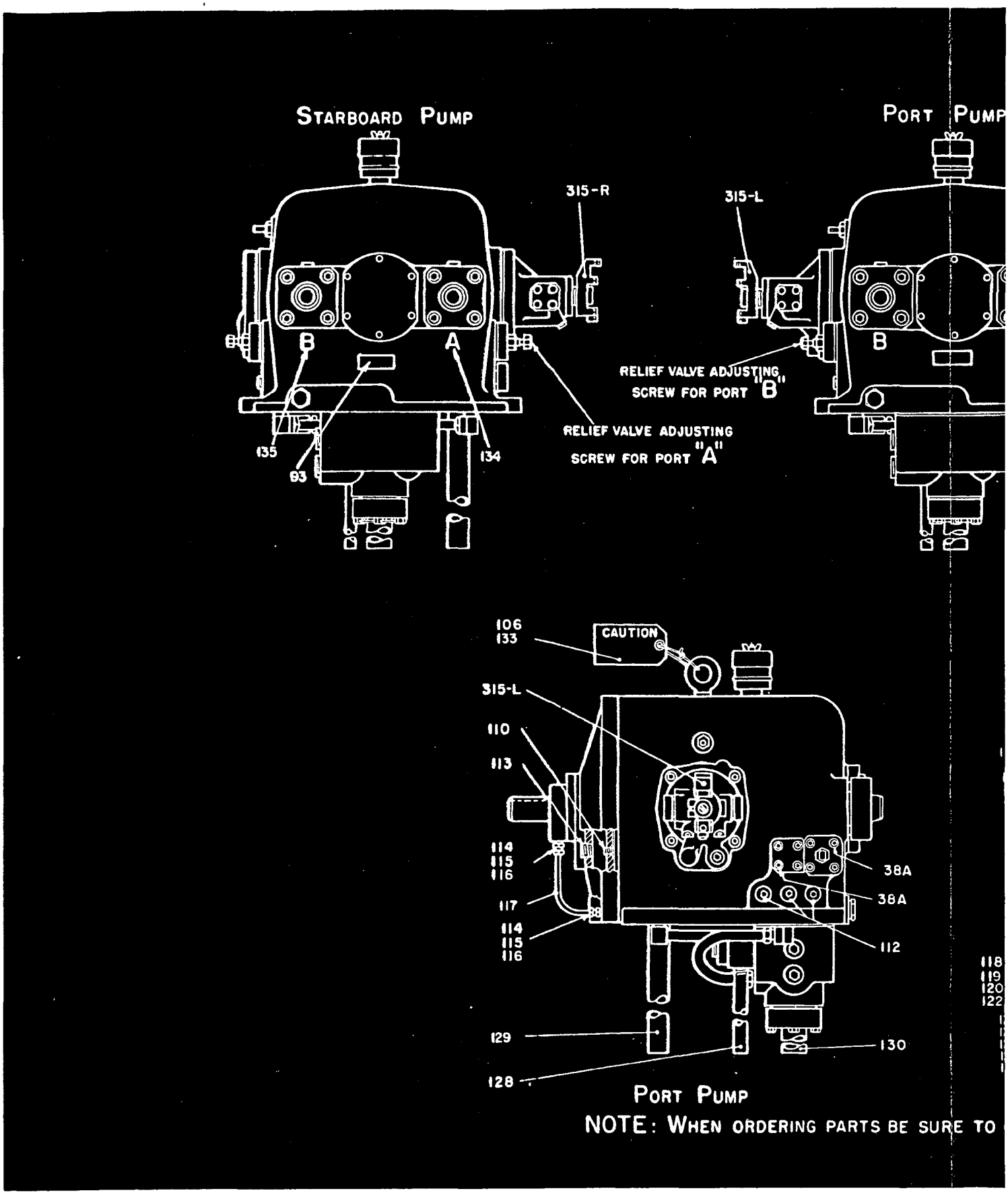
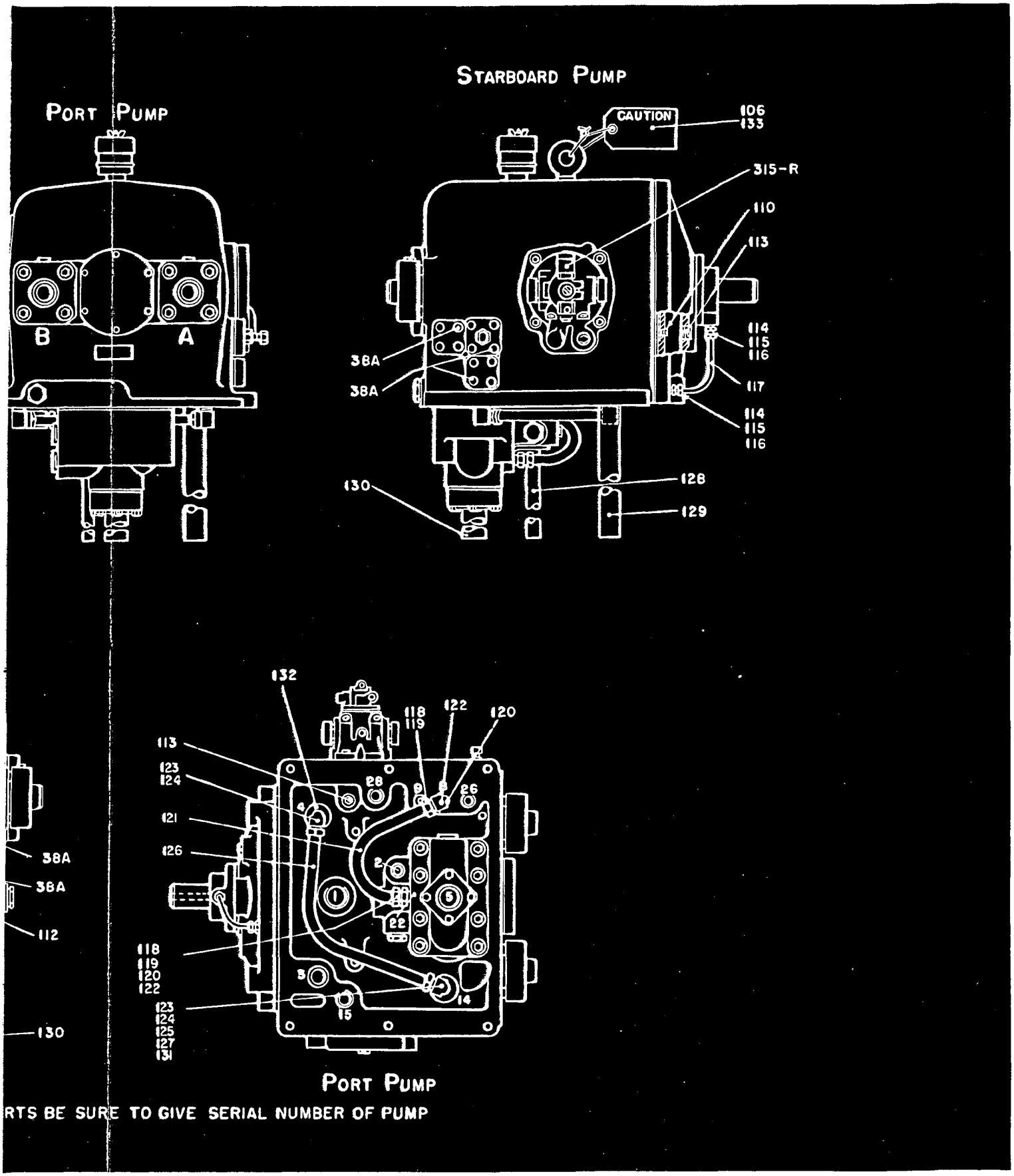


Figure 14. Parts Drawing of Type "DH" Pump (also see Figs. 12 and 13) (Se



Figs. 12 and 13) (See Specification Bulletin for Parts List and Assembly Notes)

VII. PARTS LIST

(See Figures 12, 13 and 14.)

A. TYPE "DH" PUMPS.

(See Specification Bulletin on size of pump used for Parts List, giving Oilgear part numbers and the number of parts required.)

Symbol No.	Description
1.	Shaft, Drive
2.	Spacer, Coupling
3.	Nut, Lock
4.	Washer, Lock
5.	Pintle
*6.	Cylinder
*7.	Bushing, Cylinder
8.	Piston
9.	Bearing, Rear Rotor
10.	Bearing, Front Rotor
11.	Bearing, Front Shaft
12.	Bearing, Rear Shaft
13.	Shim, Front Rotor Bearing
14.	Shim, Rear Rotor Bearing
15.	Shim, Front Shaft Bearing
16.	Rotor
17.	Ring, Spacer
17A.	Ring, Spacer
18.	Ring, Thrust
19.	Flange, Coupling
20.	Roller, Coupling
21.	Ring, Coupling
22.	Gear, Driver
23.	Gear, Driven
24.	Bearing, Gear Pump
25.	Shaft, Stub
26.	Key, Driver
27.	Seal, Drive Shaft
28.	Gasket, Seal Housing
29.	Gasket, Gear Pump Housing
30.	Spacer, Bearing
31.	Gasket, Control Cylinder
32.	Gasket, Control Cylinder Adpt.
33.	Gasket, Control Piston Screw
*34.	Plunger, H.P. Relief Valve
*35.	Bushing, H.P. Relief Valve
35A.	Plug, Bushing
35B.	Packing, O'Ring
35C.	Ring, Retaining
36.	Packing, O'Ring
37.	Packing, O'Ring
38.	Cap, H.P. Relief Valve
38A.	Screw, Sock. Hd. Cap
39.	Gasket, Relief Valve Cap
40.	Screw, Adjusting, Relief Valve
40A.	Nut, Hexagon
41.	Guide, Spring
42.	Spring, H.P. Relief Valve
43.	Guide, Spring
44.	Retainer, Bushing
45.	Shim, Retainer
46.	Gasket, Blind Flange
47.	Flange, Blind
48.	Plug, Pipe
49.	Spacer, G.P. Relief Valve
*50.	Plunger, G.P. Relief Valve
*51.	Plunger, Dashpot
52.	Spring, G.P. Relief Vlv.
53.	Shim, G.P. Relief Valve
54.	Gasket, G.P. Relief Valve
55.	Cap, G.P. Relief Valve
56.	Case, Pump
56A.	Gasket, Pump Mounting
60.	Adapter, Control Cylinder
61.	Screw, Cap, Sock. Hd.
62.	Piston, Control
63.	Ring, Piston
64.	Screw, Control Piston
65.	Head, Rotor
66.	Screw, Rotor Head
67.	Shim, Slideblock
68.	Ring, Slideblock Spacer
69.	Screw, G.P. Cover
70.	Gasket, Cover Screws
71.	Housing, Shaft Seal
71A.	Screw, Sock. Hd. Cap
72.	Housing, Gear Pump
72A.	Screw, Sock. Hd. Cap
73.	Cover, Gear Pump
74.	Screw, Slideblock Head
75.	Head, Slideblock
77.	Key, Pintle
78.	Gasket, Flange
79.	Flange, High Pressure
79A.	Screw, Sock. Hd. Cap
80.	Cover, Rear
80A.	Screw, Sock. Hd. Cap
81.	Gasket, Rear Cover
82.	Slideblock
83.	Dowel, Slideblock Liner
84.	Liner, Slideblock
84A.	Shims, Liner
85.	Liner, Case
86.	Dowel, Case Liner
87.	Bushing, Indicator Stem
88.	Stem, Stroke Indicator
89.	Spring, Indicator Stem
90.	Eyebolt
91.	Plate, Name
92.	Screw, Drive
93.	Plate, Instruction
94.	Head, Control Cylinder
94A.	Screw, Sock. Hd. Cap
105.	Wire, Lock
106.	Wire, Lock
107.	Breather, Air
109.	Plate, Rotation Direction
110.	Plug, Pipe
111.	Plug, Pipe
111A.	Plug, Pipe

A. TYPE "DH" PUMPS – PARTS LIST (Continued)

(See Figures 12, 13 and 14.)

Symbol No.	Description
112.	Plug, Pipe
113.	Plug, Pipe
114.	Fitting, Ermeto
115.	Nut, Ermeto
116.	Sleeve, Ermeto
117.	Tubing
118.	Fitting, Ermeto
119.	Nut, Ermeto
120.	Sleeve, Ermeto
121.	Tubing
122.	Fitting, Ermeto E11
123.	Fitting, Ermeto E11
124.	Nut, Ermeto
125.	Sleeve, Ermeto
126.	Tubing
127.	Fitting, Ermeto
128.	Tube, Port 2
129.	Tube, Port 3
130.	Tube, Port 5
131.	Bushing, Reducing
132.	Bushing, Reducing
133.	Tag, Caution
134.	Decal, Port A
135.	Decal, Port B
200.	Body, Suction Valve
200A.	Screw, Sock. Hd. Cap
201.	Disc, Check Valve
202.	Gasket, Suction Valve
203.	Gasket, Upper Cage
203A.	Gasket, Lower Cage
204.	Seat, Check Valve
205.	Cage, Check Valve
206.	Spring, Check Valve
207.	Cage, Check Valve
208.	Gasket, Suction Flange
209.	Disc, Suction Check Valve
210.	Seat, Check Valve
211.	Flange, Suction
212.	Screw, Sock. Hd. Cap
212A.	Wire, Lock
214.	Plunger, Back Press. Relief Vlv.
215.	Spring, Back Press. Relief Vlv.
216.	Shim, Back Press. Relief Vlv.
217.	Gasket, Back Press. Valve Cap
218.	Cap, Back Press. Relief Valve
219.	Plug, Pipe
220.	Plug, Pipe
300.	Housing, Control
300A.	Screw, Sock. Hd. Cap
301.	Piston, Control
302.	Ring, Piston
303.	Cup, Thrust
304.	Plate, Thrust
305.	Bearing, Thrust
306.	Spring, Thrust Bearing
307.	Sleeve, Control
307A.	Pin, Control Sleeve
308.	Plate, Retainer
308A.	Screw, Fl. Hd. Mach.
309.	Plunger, Control
310.	Seal, Control Plunger
311.	Shim, Gland
311A.	Shim, Gland
312.	Gland, Seal
312A.	Screw, Sock. Hd. Cap
313.	Key, Woodruff
314.	Pin, Control Lever
315L.	Lever, Control, Port Pump
315R.	Lever, Control, Starboard Pump
316.	Washer, Retainer
317.	Screw, Fl. Hd. Mach.
318.	Pin, Locating
319.	Pin, Stop
320.	Screw, Full dog pt. Set
322.	Gasket, Flange
323.	Flange, Blind
324.	Screw, Sock. Hd. Cap
325.	Plug, Pipe
326.	Plug, Pipe
327.	Plug, Pipe

IMPORTANT

WHEN WRITING THE OILGEAR COMPANY ABOUT A TYPE "DH" PUMP, BE SURE TO GIVE THE SERIAL NUMBER. THIS NUMBER IS STAMPED ON A PLATE MOUNTED ON TOP OF PUMP CASE.