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Rev. A

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# **D**SERIES

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## **INSTALLATION, OPERATION, PARTS LIST, AND MAINTENANCE MANUAL**



**THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO**

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

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# INTRODUCTION

This installation, operation, and maintenance manual is designed specifically to help you achieve the best performance and longest life from your Gorman-Rupp diaphragm pump.

This is a positive displacement type pump utilizing a single-action diaphragm to produce a straight-through flow of liquid. Since this pump handles liquids ranging from clear water to construction-site muck, it is ideally suited to industrial and contractors' applications.

This pump is provided with an engine drive.

If you have any questions regarding the pump which are not covered in this manual or in other literature furnished with the unit, please contact your Gorman-Rupp distributor, or write:

The Gorman-Rupp Company	or	Gorman-Rupp of Canada Limited
P.O. Box 1217		70 Burwell Road
Mansfield, Ohio 44901		St. Thomas, Ontario N5P 3R7

For information or technical assistance on the engine, contact the local dealer or representative of the engine manufacturer.

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel.

### NOTE

Instructions to aid in installation, operation, or maintenance, or which clarify a procedure.

### CAUTION

Instructions which must be followed to avoid causing damage to the product or other equipment incidental to the installation. These describe the procedures required and the damage which could result from failure to follow the procedure.

### WARNING

Instructions which must be followed to avoid causing injury or death to personnel. These describe the procedure required and the injury which could result from failure to follow the procedure.

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## WARNINGS

**THESE WARNINGS APPLY TO DIAPHRAGM PUMPS WITH ENGINE DRIVE.**

//  
//  
// Before attempting to open or service the pump: //  
// 1. Familiarize yourself with this manual. //  
// 2. Disconnect the engine ignition to ensure that the pump will remain //  
// inoperative. //  
// 3. Allow the pump to cool if overheated. //  
// 4. Close all close all valves in lines connected to the pump, and drain //  
// the pump. //  
//

//  
//  
// This pump has not been designed to pump volatile, corrosive or flammable //  
// liquids. Do not attempt to pump any liquids for which this pump has not //  
// been designed, or any liquids which may attack pump fittings or com- //  
// ponents. //  
//

//  
//  
// Overheated pumps can cause severe burns and injury. If overheating of the //  
// pump occurs: //  
// 1. Stop the pump immediately. //  
// 2. Allow the pump to cool. //  
// 3. Refer to instructions in the manual before restarting the pump. //  
//

//  
//  
// After the pump has been installed, make certain that the wheels have been //  
// blocked and secured, and that the pump and all piping connections are //  
// secure, before attempting to operate the pump. //  
//

//  
//  
// Never install a positive shut-off valve in the discharge line; discharge //  
// restrictions will cause excessive friction loss resulting in overloading and //  
// destruction of pump and drive components. It is strongly recommended //  
// that unless absolutely necessary, no positive shut-off valve be installed in //  
// the suction line; excessive restriction will cause incomplete filling of the //  
// diaphragm chamber and result in short diaphragm life. //  
//



///  
//  
// Do not operate this pump without the coupling guard in place over the drive //  
// shaft. Exposed rotating parts can catch clothing, fingers, or tools, causing //  
// severe injury to personnel. //  
// //  
///

///  
//  
// The gear box provided with this pump has been designed to be operated at //  
// 2385 RPM **maximum**. If the gear box is operated at a higher RPM, pump //  
// components may be destroyed. //  
// //  
///

///  
//  
// Never run this pump backwards. Be certain that rotation is correct before //  
// fully engaging the pump. //  
// //  
///

///  
//  
// Do not operate an internal combustion engine in an explosive atmosphere. //  
// When operating internal combustion engines in an enclosed area, make cer- //  
// tain that exhaust fumes are piped to the outside. These fumes contain car- //  
// bon monoxide, a deadly gas that is colorless, tasteless, and odorless. //  
// //  
///

///  
//  
// Fuel used by internal combustion engines presents an extreme explosion //  
// and fuel hazard. Make certain that all fuel lines are securely connected and //  
// free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel //  
// tank. Always use the correct type of fuel. //  
// //  
///

# INSTALLATION

Pump installations are seldom identical. This section summarizes recommended installation practices related to inspection, pump positioning, hardware, and suction and discharge piping.

Approximate physical dimensions of this pump are shown in figure 1.

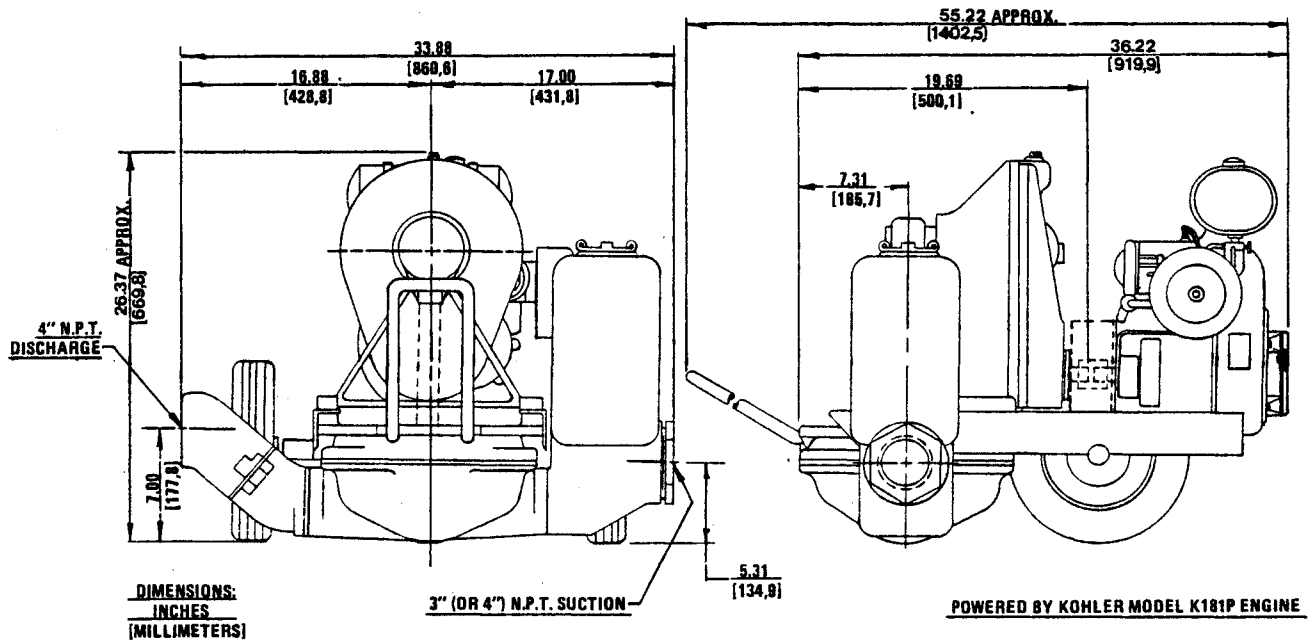


Figure 1. Pump Model 4D-K181P

## Preinstallation Inspection

The pump assembly was inspected and tested before it was shipped from the factory. Before installation, check the pump for damage which may have occurred during shipment. Check as follows:

- a. Inspect the pump end, gear box, and engine for cracks, dents, damaged threads, and other obvious damage.
- b. Check for and tighten loose bolts; nuts, capscrews, and other attaching hardware.
- c. Carefully read all tags, decals, and markings on the pump assembly, and follow the instructions indicated. Note the direction of rotation indicated on the pump; make certain that the engine will drive the pump in the proper direction.





## SUCTION AND DISCHARGE PIPING

### Materials

Piping materials must be compatible with the liquid being pumped.

Either pipe or hose may be used for suction or discharge lines, but hose used in suction lines must be the rigid-wall type to prevent collapse under suction.

Suction lines should be the same size as the pump inlet.

### CAUTION

The discharge line should be the same size as, or larger than, the suction line. Never install or operate this pump with a discharge line smaller than the suction line; a restricted discharge line will cause excessive friction loss resulting in overloading and destruction of pump and drive components.

### Configuration

When installing hose or piping, keep suction and discharge lines as straight as possible.

When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action could result and cause damage to the pump.

Never pull a line into place by tightening connections at the pump. Connections must be aligned exactly with the pump port. Lines near the pump must be independently supported to avoid strain on the pump which could cause serious vibration and increased diaphragm and gear train wear. Hose-type lines should have supports strong enough to secure the line when it is filled with liquid and under pressure.

### Fixed, Rigid Piping

If this pump is mounted in a system with fixed, rigid piping, it is recommended that a flexible connection be installed at or near the suction and discharge ports to absorb shock which would otherwise be transmitted through the drive train and greatly accelerate pump wear.

This pump is equipped with an integral suction accumulation chamber which promotes an efficient flow of liquid and acts as an air cushion against shock. Since the air in this chamber will leak away during pump operation, the air must be replenished periodically. To introduce air into the chamber, stop the pump and remove the suction accumulator plug and integral gasket; this will break prime and allow the liquid in the chamber to drain away through the suction line.



**ALIGNMENT****CAUTION**

It is imperative that alignment be checked and before the pump is operated.

**WARNING**

Before checking alignment, make certain that the engine ignition is disconnected.

This pump end, gear box, and engine were aligned and secured at the factory, but fastening hardware may have become loosened during shipment. Check and tighten this hardware before checking alignment.

To check coupling alignment, use a feeler gauge or taper gauge between the coupling halves every 90 degrees. The coupling is in alignment when the hubs are the same distance apart at all points.

To check parallel adjustment, lay a straightedge across both coupling halves at the top, bottom, and side. The coupling is in horizontal parallel adjustment when the straightedge rests evenly on both halves of the coupling. Use a feeler gauge between the coupling to measure the amount of misalignment.

Adjustments may be made by loosening the securing hardware and shifting components, or by shimming as required.

**WARNING**

Do not operate the pump without the coupling guard in place and secured. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.





## OPERATION

This pump has not been designed to pump volatile, corrosive, or flammable liquids. Do not attempt to pump any liquids for which this pump has not been designed, or any liquids which may attack pump fittings or components.

The particular service in which this pump is used will affect pump performance, especially discharge velocities. Consult the Gorman-Rupp factory for actual performance levels of this pump.

### STARTING

Refer to LUBRICATION in MAINTENANCE AND REPAIR, and check that the gear box is properly lubricated. Refer to the engine manufacturer's lubrication recommendations.

#### CAUTION

The pump end is designed to operate at 52 cycles per minute through a gear box with a 45.85:1 ratio and a 2385 RPM **maximum** input drive. Make certain that engine input does not exceed this RPM. Otherwise, pump components may be destroyed. Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, pump components could be seriously damaged.

Consult the manual(s) furnished with the engine before starting the pump.

Open any valves installed in the suction and/or discharge lines, and start the pump.

#### WARNING

Make certain that any positive shut-off valve installed in the suction line is open before operating the pump; excessive restriction will cause incomplete filling of the diaphragm chamber and result in short diaphragm life. No positive shut-off valve should be installed in the discharge line.





### **STRAINER**

Check the strainer regularly during operation or if the flow rate begins to drop, and clean it as necessary. Be especially alert for unusual noises when pumping liquids containing solids.

### **STOPPING**

After stopping the pump, disconnect the engine ignition to ensure that the pump will remain inoperative.

In below-freezing conditions, drain the pump to prevent damage from freezing, and clean out any solids by flushing with a hose.

If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, drain the pump and flush it thoroughly with clean water. To prevent solids from clogging the drain port, insert a rod or stiff wire in the drain port and agitate the liquid during the draining process. Clean out any remaining liquids by flushing with a hose.







## TROUBLESHOOTING

```

////////////////////////////////////
//
//   Before attempting to open or service the pump:
//   1. Familiarize yourself with this manual.
//   2. Disconnect the engine ignition to ensure that the pump will remain
//      inoperative.
//   3. Allow the pump to cool if overheated.
//   4. Close all valves in lines connected to the pump, and drain the
//      pump.
//
////////////////////////////////////

```

Trouble	Possible Cause	Probable Remedy
PUMP FAILS TO PRIME	Air leak in suction line. Lining of suction hose collapsed. Integral suction or discharge check valve clogged, binding, or not seating properly. Cracked or broken diaphragm. Diaphragm not securely in place. Strainer clogged.	Correct leak. Replace suction hose. Clean valves, check that flange nuts are tight. Replace diaphragm. Secure diaphragm. Clean strainer.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Air leak in suction line. Suction intake not properly submerged. Lining of suction hose collapsed. Cracked or broken diaphragm. Diaphragm not securely in place. Suction lift or discharge head too high. Integral suction or discharge check valve clogged, binding, or not seating properly.	Correct leak. Check installation. Replace suction hose. Replace diaphragm. Secure diaphragm. Check installation, and correct as required. Clean valves. Check that flange nuts are tight.



Trouble	Possible Cause	Probable Remedy
PUMP REQUIRES TOO MUCH POWER	Liquid solution too thick. Pump speed too high. Integral discharge check valve clogged or binding. Discharge head too high.  Bearings in engine or gear box worn or binding.	Dilute if possible. Reduce engine speed. Clean valve.  Shorten total discharge length or install larger diameter discharge line.  Check bearings.
PUMP CLOGS FREQUENTLY	Integral suction or discharge check valve clogged, binding, or not seating properly.	Clean valves. Check that flange nuts are tight.
EXCESSIVE NOISE	Pump, gear box, or engine not securely mounted.  Gear box or engine not properly lubricated.	Check and tighten mounting bolts.  See LUBRICATION in MAINTENANCE AND REPAIR.



## MAINTENANCE AND REPAIR

MAINTENANCE AND REPAIR OF THE WEARING PARTS OF THE PUMP WILL MAINTAIN PEAK OPERATING PERFORMANCE.

### PERFORMANCE TEST DATA FOR PUMP MODEL 4D-K181P

IN GALLONS PER MINUTE, 52 STROKES PER MINUTE

STATIC LIFT IN FEET	STATIC DISCHARGE HEAD IN FEET					
	0	5	10	15	20	25
5	150	125	119	113	112	104
10	126	118	108	105	105	100
15	98	97	75	74	73	70
20	94	82	74	73	66	63
25	74	82	70	66	60	52

IN LITERS PER MINUTE, 52 STROKES PER MINUTE

STATIC LIFT IN METERS	STATIC DISCHARGE HEAD IN METERS					
	0	1,5	3,0	4,6	6,1	7,6
1,5	567,8	473,1	450,4	427,7	423,9	393,6
3,0	476,9	446,6	408,8	397,4	397,4	378,5
4,6	370,9	367,1	283,8	280,1	276,3	264,9
6,1	355,8	310,3	280,1	276,3	249,8	238,4
7,6	280,1	310,3	264,9	249,8	227,1	196,8

### \* STANDARD PERFORMANCE FOR PUMP MODEL 4D-K181P

\*Based on 70°F clear water at sea level with minimum suction lift, using 3-inch (7,62 cm.) suction hose and 4-inch (10,16 cm.) non-collapsible discharge hose. Since pump installations are seldom identical, your performance may be different due to such factors as viscosity, specific gravity, elevation, and temperature.

If your pump serial number is followed by an "N", your pump is NOT a standard production model. Contact The Gorman-Rupp Company to verify performance or part number.

# SECTIONAL DRAWING

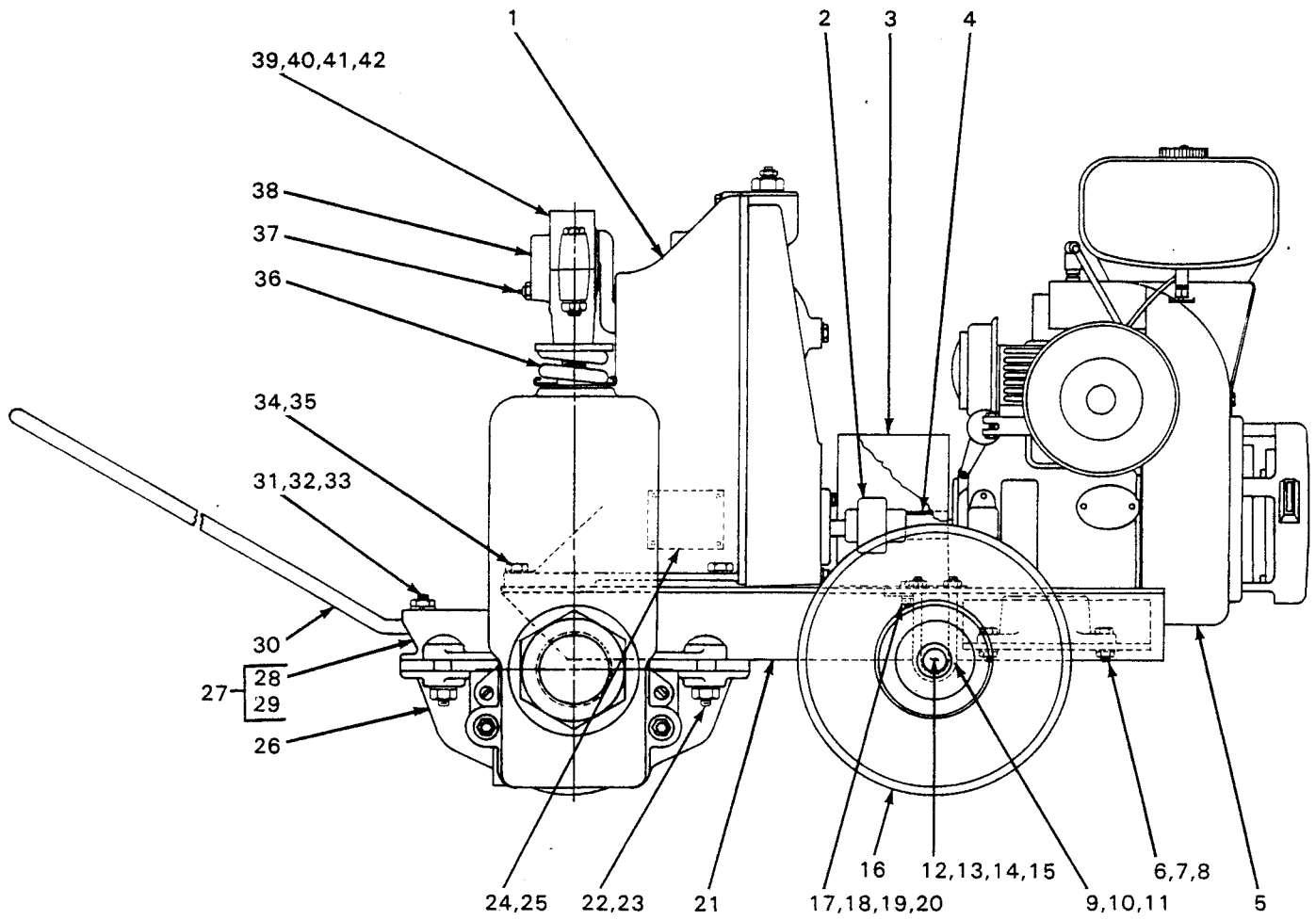


Figure 1. Pump Model Assembly Model 4D-K181P



## PARTS LIST

### PUMP MODEL ASSEMBLY 4D-K181P

(From S/N 714582 up)

ITEM NO.	PART NAME	PART NUMBER	MATERIAL CODE	QTY
1	GEARBOX ASSEMBLY (See fig. 4)	44161-010		1
2	★ COUPLING	11730	00000	1
3	COUPLING GUARD	34613-005		1
4	SLEEVE	2-R	16000	1
5	KOHLER K181P ENGINE	29127-081		1
6	HEX HEAD CAPSCREW	B00605	15991	4
7	LOCK WASHER	J00006	15991	4
8	HEX NUT	D00006	15991	4
9	U-BOLT	6945	15000	2
10	LOCK WASHER	J00006	15991	4
11	HEX NUT	D00006	15991	4
12	AXLE	6619	15990	1
13	SPACER	6619-A	15070	2
14	FLAT WASHER	S01532		4
15	★ COTTER PIN	M00306	15990	2
16	PNEUMATIC WHEEL	S00263		2
17	HEX HEAD CAPSCREW	B00404	15991	2
18	FLAT WASHER	K00004	15991	2
19	LOCK WASHER	J00004	15991	2
20	HEX NUT	D00004	15991	2
21	BASE	11148	24000	1
22	LOCK WASHER	J00012	15991	4
23	HEX NUT	D00012	15991	4
24	NAME PLATE	2613-BP	13990	1
25	DRIVE SCREW	BM#04-03	15990	4
26	DIAPHRAGM POT ASSEMBLY (See fig. 2)	46475-702		1
27	DIAPHRAGM RING ASSEMBLY	41881-061		1
28	RING	6621	13010	1
29	RIB MACHINE BOLT	BJ01211	15990	4
30	DRAW BAR	5438	15990	1
31	U-BOLT	5495	15990	2
32	LOCK WASHER	J00006	15991	4
33	HEX NUT	D00006	15991	4
34	HEX HEAD CAPSCREW	B01010	15991	4
35	LOCK WASHER	J00010	15991	4
36	PLUNGER ROD ASSEMBLY (See fig. 3)	6959		1
37	LUBE FITTING	S00191		1
38	END CAP	6643	10010	1
39	BEARING CAP	6560	10010	REF
40	HEX HEAD CAPSCREW	B00813-S	15991	REF
41	HEX NUT	D00008-S	15991	REF
42	LOCK WASHER	J00008	15991	REF
NOT SHOWN:				
	ALLEN HEAD SETSCREW	GA00602	15990	4
	STRAINER	4917	24000	1
OPTIONAL:				
	STATIONARY BASE	8283		1

★ INDICATES PARTS RECOMMENDED FOR STOCK

CANADIAN SERIAL NO. . . . . AND UP

# SECTIONAL DRAWING

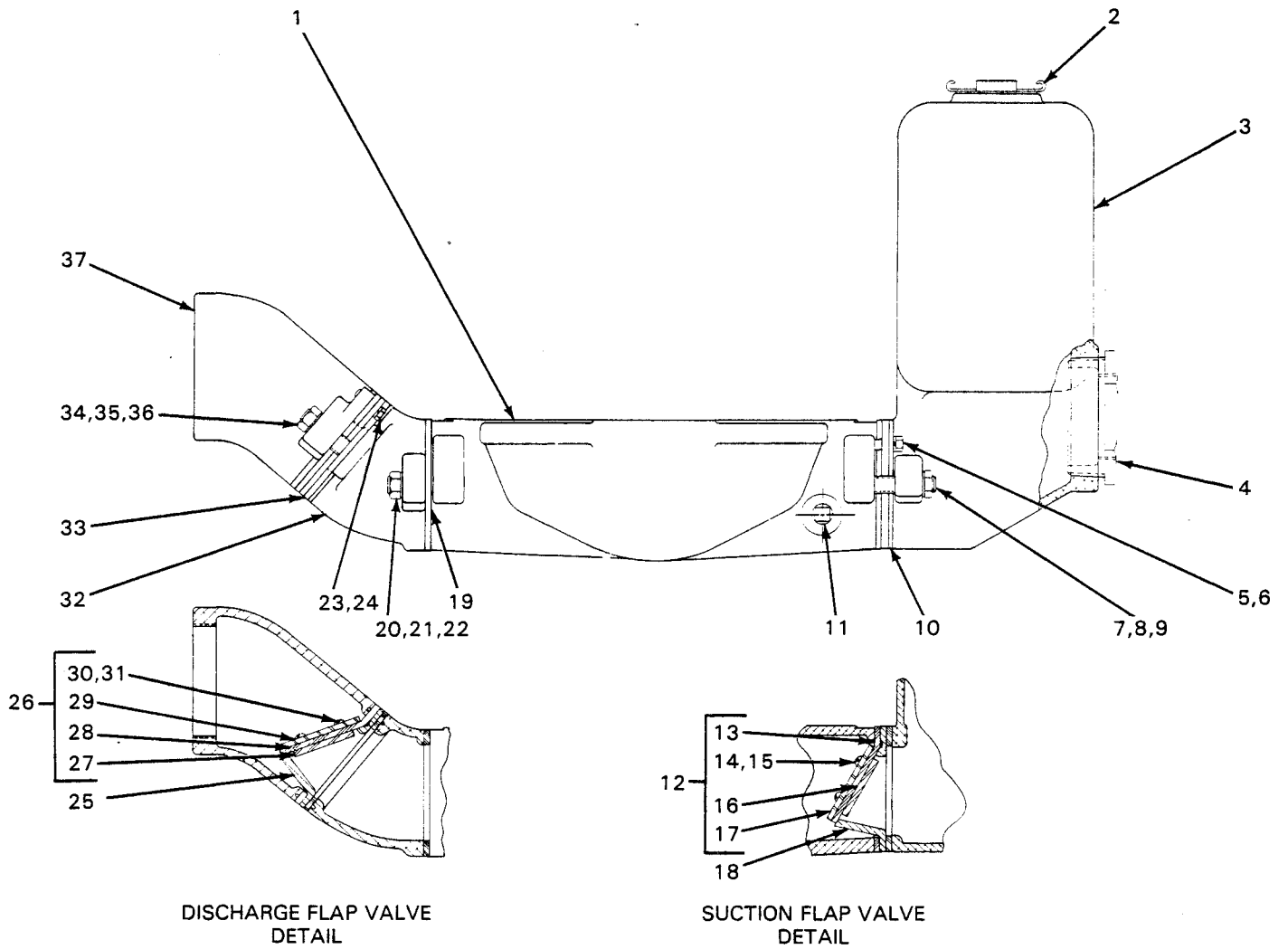


Figure 2. 46475-702 Diaphragm Pot Assembly



## PARTS LIST

### 46475-702 DIAPHRAGM POT ASSEMBLY

ITEM NO.	PART NAME	PART NUMBER	MATERIAL CODE	QTY
1	DIAPHRAGM POT	6622	13010	1
2	SUCTION ACCUMULATOR PLUG & GSKT	S00591		1
3	SUCTION ACCUMULATOR	6625	13010	1
4	REDUCING PIPE BUSHING	AP-6448	11990	1
5	HEX HEAD CAPSCREW	B00504	15991	2
6	LOCK WASHER	J005	15991	2
7	STUD	C01013	15991	2
8	FLAT WASHER	KE0010	15991	2
9	HEX NUT	D00010	15991	2
10	★ SUCTION ACCUMULATOR GASKET	6625-G	19100	1
11	DRAIN PLUG	P00006	11990	1
12	SUCTION FLAP VALVE ASSEMBLY	46413-007		1
13	★ FLAP VALVE	6925	19100	1
14	ROUND HEAD MACHINE SCREW	X00402½	17090	4
15	LOCK WASHER	J00004	17090	4
16	★ VALVE WEIGHT	6801	15990	1
17	★ VALVE WEIGHT	6642	15990	1
18	★ SUCTION FLAP VALVE SEAT	6635	10010	1
19	★ DISCHARGE FLANGE GASKET	6625-G	19100	1
20	STUD	C01010	15991	2
21	FLAT WASHER	KE0010	15991	2
22	HEX NUT	D00010	15991	2
23	HEX HEAD CAPSCREW	B00504	15991	2
24	LOCK WASHER	J00005	15991	2
25	★ DISCHARGE FLAP VALVE SEAT	6635	10010	1
26	DISCHARGE FLAP VALVE ASSEMBLY	46413-007		1
27	★ VALVE WEIGHT	6801	15990	1
28	★ FLAP VALVE	6925	19100	1
29	★ VALVE WEIGHT	6642	15990	1
30	ROUND HEAD MACHINE SCREW	X00402½	17090	4
31	LOCK WASHER	J00004	17090	4
32	DISCHARGE FLANGE	6627	13040	1
33	★ DISCHARGE ELBOW GASKET	6625-G	19100	1
34	STUD	C01013	15991	2
35	FLAT WASHER	KE0010	15991	2
36	HEX NUT	D00010	15991	2
37	DISCHARGE ELBOW	6626	13040	1

★ Indicates Items Recommended For Stock

# SECTIONAL DRAWING

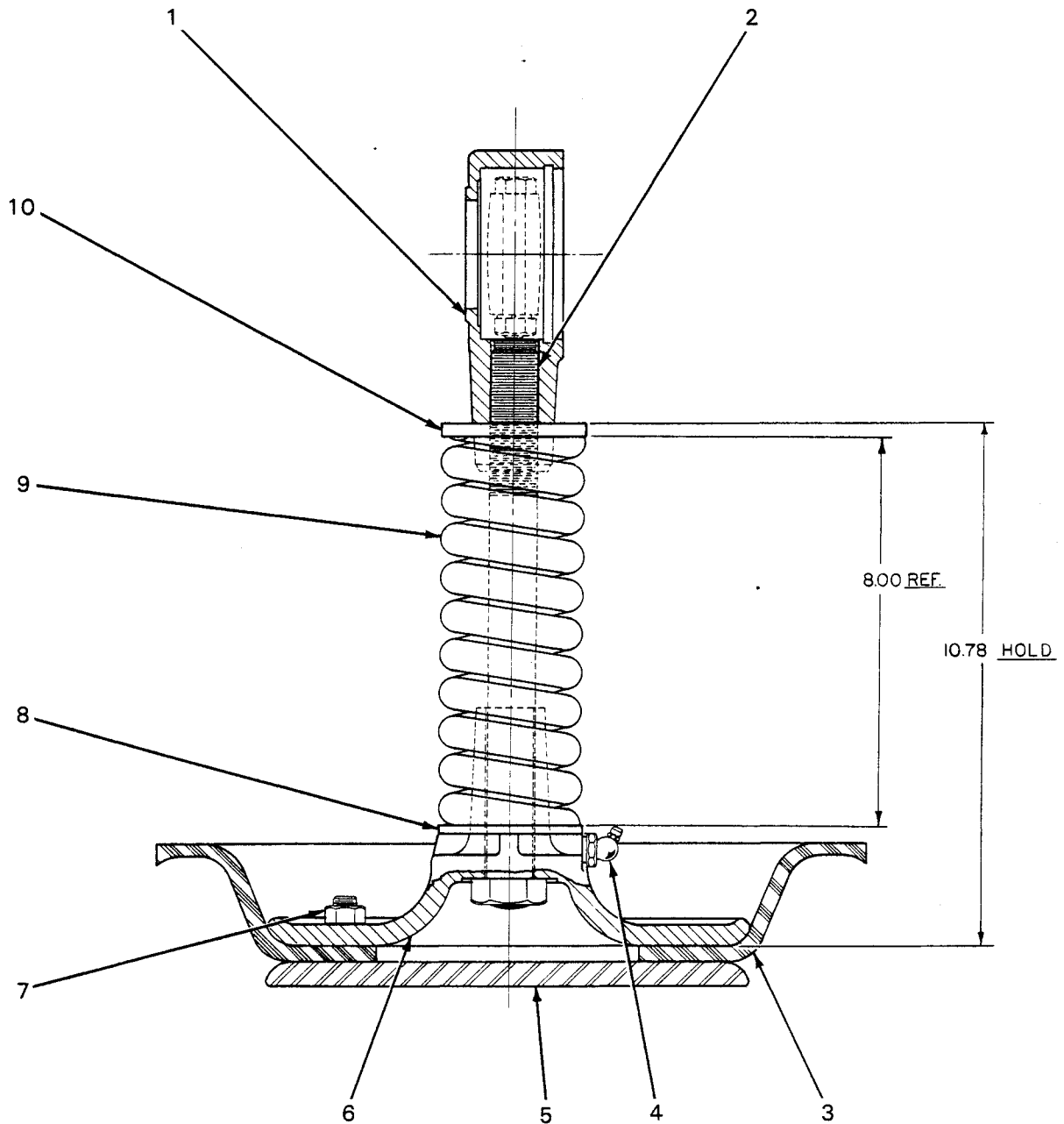


Figure 3. 6959 Plunger Rod Assembly





## PARTS LIST

### 6959 PLUNGER ROD ASSEMBLY

ITEM NO.	PART NAME	PART NUMBER	MATERIAL CODE	QTY
1	BEARING CAP	6560	10010	1
	HEX HEAD CAPSCREW	B00813-S	15991	2
	HEX NUT	D00008-S	15991	2
	LOCK WASHER	J00008	15991	2
2	★ PLUNGER ROD ASSEMBLY	6633	15990	1
3	★ DIAPHRAGM	S01017		1
4	LUBE FITTING	S00194		1
5	LOWER DIAPHRAGM PLATE	6629	15990	1
6	UPPER DIAPHRAGM PLATE	6628	10010	1
7	HEX NUT	D00008	15991	4
8	SPRING WASHER	6639	15000	1
9	★ PLUNGER SPRING	6547	16080	1
10	SPRING RETURN NUT	6638	11000	1

★ Indicates Items Recommended For Stock

# SECTIONAL DRAWING

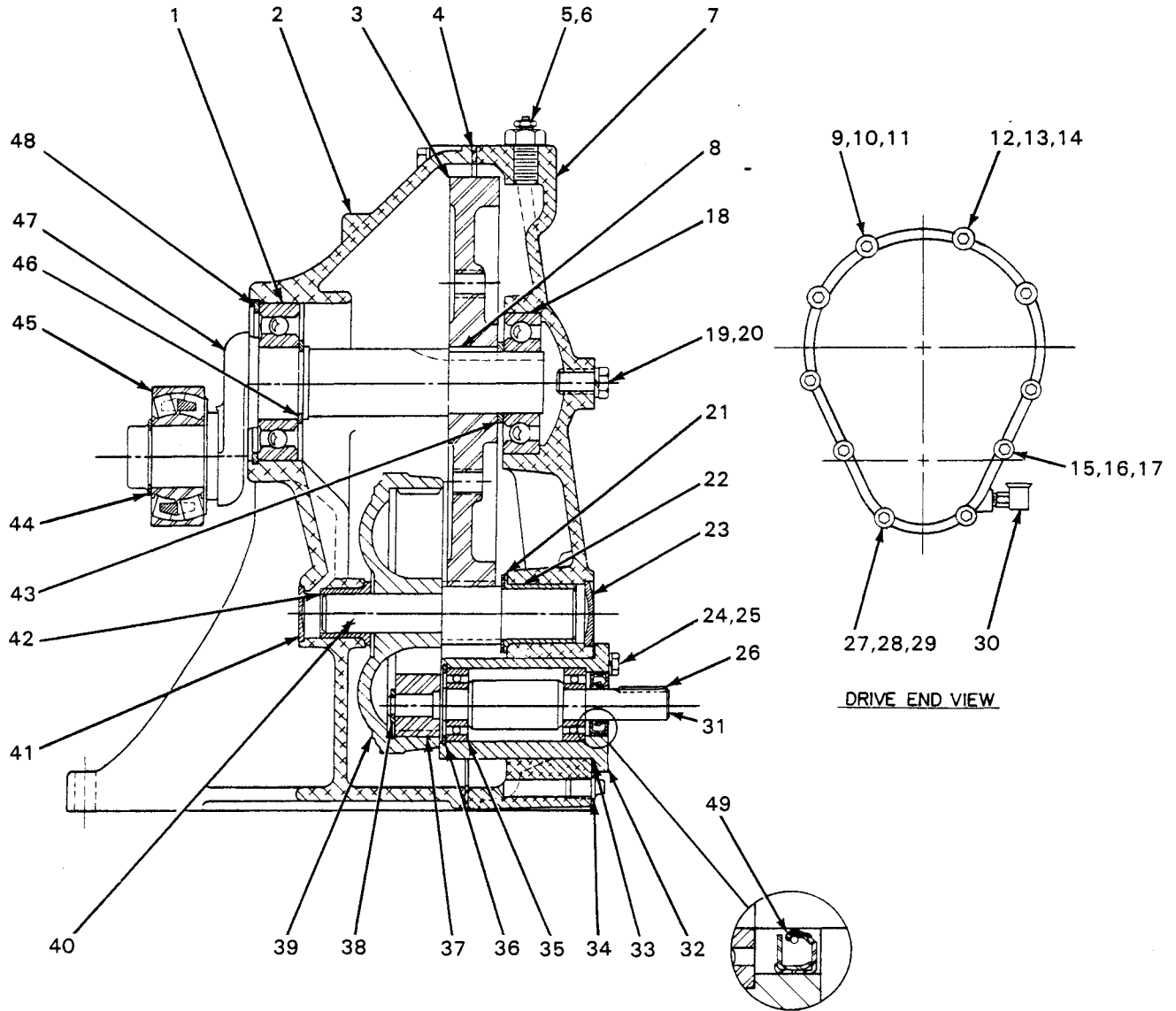


Figure 4. 44161-010 Gearbox Assembly



## PARTS LIST

### 44161-010 GEARBOX ASSEMBLY

ITEM NO.	PART NAME	PART NUMBER	MATERIAL CODE	QTY
1	★ CRANKSHAFT INBOARD BALL BEARING	S00374		1
2	GEAR HOUSING	6624	13040	1
3	★ CRANKSHAFT GEAR	6641	15060	1
4	★ GEAR HOUSING GASKET	6624-G	18000	1
5	VENT BOLT	31871-038		1
6	★ PRESSURE RELIEF FITTING	S01523		1
7	GEAR COVER	6623	13010	1
8	★ CRANKSHAFT GEAR KEY	N00605	15990	1
9	HEX HEAD CAPSCREW	B00511	15991	5
10	HEX NUT	D00005	15991	5
11	LOCK WASHER	J00005	15991	5
12	SHOULDER BOLT	S01018		1
13	HEX NUT	D00005	15991	1
14	LOCK WASHER	J00005	15991	1
15	HEX HEAD CAPSCREW	B00518	15991	3
16	HEX NUT	D00005	15991	3
17	LOCK WASHER	J00005	15991	3
18	★ CRANKSHAFT OUTBOARD BALL BEARING	S01080		1
19	HEX HEAD CAPSCREW	B01004	15991	1
20	FLAT WASHER	KE0010	15991	1
21	WASHER	6637	15000	1
22	★ PINION SHAFT OUTBOARD BUSHING	S01016		1
23	GEAR COVER PLUG	S01053		1
24	HEX HEAD CAPSCREW	B00504	15991	4
25	LOCK WASHER	J00005	15991	4
26	★ DRIVE SHAFT KEY	N00304	15990	1
27	SHOULDER BOLT	S01019		1
28	HEX NUT	D00005	15991	1
29	LOCK WASHER	J00005	15991	1
30	OIL CUP	S00617		1
31	★ DRIVE SHAFT	6631	15010	1
32	ECCENTRIC HOUSING	6632	10010	1
33	★ ECCENTRIC HOUSING GASKET	6632-G	18000	1
34	GEAR BOX DRAIN PLUG	P00004	11990	1
35	★ DRIVE SHAFT BALL BRG	S01044		2
36	★ RETAINING RING	S00204		1
37	★ HELICAL DRIVE GEAR	6488-A	16040	1
38	★ SNAP RING	S01004		1
39	★ PINION GEAR	S01014		1
40	★ PINION SHAFT	6634	16070	1
41	GEAR HOUSING PLUG	S01054		1
42	★ PINION SHAFT INBOARD BUSHING	S01015		1
43	WASHER	6636	15990	1
44	★ SNAP RING	S00244		1
45	★ CRANKSHAFT ROLLER BEARING	S01011		1
46	★ RETAINING RING	S00442		1
47	★ CRANKSHAFT	6550	11000	1
48	★ SNAP RING	S01010		1
49	★ OIL SEAL	S01012		1

★ Indicates Items Recommended For Stock



To remove the gear box assembly (1), remove the hardware (34 and 35) securing the gear box to the base, and slide the gear box drive shaft from the flexible coupling, retaining the drive shaft key. Remove the gear box assembly from the base.

#### **Flap Valve Disassembly (See figure 2)**

For access to the suction flap valve assembly (12), loosen the hardware (8 and 9) securing the suction accumulator (3)—which is slotted for quick removal—and gasket (10) to the diaphragm pot (1), and remove the suction accumulator by pulling straight up off the diaphragm pot studs (7).

Remove the hardware (5 and 6) securing the suction valve seat (18) and flap valve assembly in the suction port, and remove the valve seat and flap valve assembly.

For access to the discharge flap valve assembly (26), loosen the hardware (35 and 36) securing the discharge elbow (37)—which is slotted for quick removal—gasket (33), and assembled discharge flap valve components to the discharge flange (32), and remove the discharge elbow by lifting off the discharge flange studs (34).

Remove the hardware (23 and 24) securing the discharge flap valve seat (25) and flap valve assembly in the discharge elbow, and remove the valve seat and flap valve assembly.

#### **NOTE**

The suction and discharge flap valve assemblies consist of identical parts.

If desired to disassemble the flap valves, remove the round head machine screws (14 and 30) and lock washers (15 and 31) securing the valve weights (16 and 17, and 27 and 29) to the flap valves (13 and 28).

#### **Plunger Rod Disassembly (See figure 3)**

To remove the diaphragm (3), remove the hex nuts (7) securing the lower diaphragm plate assembly (5) to the upper diaphragm plate (6).

Unscrew the bearing cap (1) from the plunger rod assembly (2), unscrew the spring return nut (10), and remove the plunger spring (9) and spring washer (8).

#### **NOTE**

Tension on the the plunger spring will be released as the spring return nut is removed.



### **Gear Box Disassembly (See figure 4)**

Remove the drive shaft key (26), and tag it for reference during reassembly.

Drain the gear box lubricant by removing the drain plug (34). Clean and reinstall the drain plug.

Remove the hardware (24 and 25) securing the eccentric housing (32) and gasket (33) to the gear cover (7), and pull the complete drive shaft sub-assembly from the gear cover.

To disassemble the drive shaft sub-assembly, remove the snap ring (38) retaining the helical drive gear (37), and slide the drive gear off the drive shaft (31). Remove the inboard bearing retaining ring (36), and press the drive shaft and assembled bearings (35) out of the eccentric housing from the drive end. Press the oil seal (49) from the drive shaft housing bore. To remove the drive shaft bearings, use a bearing puller.

For access to the remaining gear box drive components, the gear cover and gasket (4) must be separated from the gear housing (2). The cover is secured to the housing by two close-tolerance shoulder bolts (12 and 27)—which act as pilots to ensure accurate concentric positioning of the cover—and hex nuts and lock washers (13, 14, 28, and 29), and by hex head capscrews (9 and 15) and hex nuts and lock washers (10, 11, 16, and 17).

#### **NOTE**

The shoulder bolts and capscrews securing the gear box cover to the gear box housing are of different lengths. Be certain to record the positions of the shoulder bolts and capscrews before, or at the time of, removing them.

Remove the hardware securing the gear cover to the housing, and remove the cover.

#### **NOTE**

If the gear cover does not readily separate from the housing, remove the capscrew and lock washer (19 and 20) in the cover, install a 5/8-11 UNC by 4-inch capscrew in the threaded hole, and jack the cover from the housing. Remove the jackscrew, and replace the capscrew and lock washer.

After the gear cover has been removed, press the cover plug (23) and outboard pinion shaft bushing (22) out of the cover bore.

Slide the pinion shaft washer (21) off the shaft, and tag it for reference during reassembly.

Install two 5/8-11 UNC capscrews in the tapped holes in the crankshaft gear (3), and use a gear puller to remove the gear, outboard bearing (18), and washer (43) from the crankshaft (47). Tag the washer and the crankshaft gear key (8) for reference during reassembly, and remove the capscrews from the gear.

Remove the bearing snap ring (48), and drive the crankshaft and assembled inboard bearing (1) out of the gear box housing. To remove the crankshaft inboard bearing, remove the bearing retaining ring (46). To remove the crankshaft roller bearing (45), remove the bearing snap ring (44).

To disassemble the pinion shaft (40) and components, slide the shaft and assembled pinion gear (39) out of the inboard shaft bushing (42). The pinion gear is retained on the pinion shaft by a tight friction fit and does not normally require removal; if removal is required, press the pinion gear from the shaft. Press the gear housing plug (41) and the shaft bushing out of the gear housing bore.

**Gear Box Reassembly (See figure 4)**

Clean shafts, gears, and the bores of the gear cover and gear housing with a soft cloth soaked in cleaning solvent.

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**WARNING**

Most cleaning solvents are toxic and flammable. Use them only in a well-ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

Clean all bearings and bushings in cleaning solvent free of grit or metallic particles.

Inspect all shafts, gears, bearings, and bushings, and replace as necessary.

If removed, press the pinion gear on the pinion shaft until it seats squarely against the shaft shoulder. Install the pinion shaft inboard bushing in the gear housing bore, and install the pinion shaft and assembled gear in the bushing. Install the gear housing plug.

Install the crankshaft and the inboard bearing snap ring in the gear housing bore. Press the inboard bearing on the crankshaft until it seats squarely against the snap ring, and install the bearing retaining ring.

Install the crankshaft gear key in the shaft keyway. Press the gear on the crankshaft, making certain that it engages the pinion shaft and seats squarely against the crankshaft shoulder. Install the crankshaft washer, and press the outboard bearing on the shaft until it seats squarely against the washer. Tap the crankshaft with a soft-faced mallet to ensure that all components are seated squarely.

Install the crankshaft roller bearing and the bearing snap ring.

Install the pinion shaft washer, and press the pinion shaft outboard bushing on the shaft until it seats squarely against the washer.



Inspect the pressure relief fitting (6), and replace it if necessary.

Position the gear cover so that respective bores slip over the crankshaft outboard bearing and the pinion shaft outboard bushing, and tap the cover into place with a soft-faced mallet.

Install the shoulder bolts, capcrews, lock washers, and nuts securing the gear cover to the gear housing, and tighten them evenly.

**CAUTION**

Make certain to install the shoulder bolts and capscrews in the same holes from which they were removed. The shoulder bolts and capscrews are of different lengths, and if they are incorrectly installed they could crack or otherwise damage the gear cover and/or housing.

Install the gear cover plug.

Press the drive shaft bearings on the shaft until they seat against the shaft shoulders. Install the shaft and assembled bearings in the eccentric housing, and install the inboard bearing retaining ring. Install the helical drive gear on the shaft, and install the gear snap ring.

**NOTE**

The bore of the eccentric housing is not concentric to the eccentric housing flange. Install the eccentric housing with the bore in the lower position.

Replace the eccentric housing gasket, and install the housing and assembled drive shaft sub-assembly in the gear cover, making certain to engage the pinion gear. Secure the drive shaft housing to the gear cover.

Inspect the oil seal, and replace it if necessary. Install the oil seal with the lip positioned as shown in figure 4.



**Plunger Rod Reassembly (See figure 3)**

Clean the plunger rod, plunger spring, spring return nut, and the bores of the bearing cap and upper diaphragm plate with a soft cloth soaked in cleaning solvent.

Inspect the plunger rod, and replace it if bent or warped. Install the plunger rod in the upper diaphragm plate. Install the spring washer and spring on the upper diaphragm plate, and install the spring return nut.

Refer to figure 3, and adjust the spring return nut until the spring is compressed to 8 inches. With the spring compressed, there should be a distance of 10.78 inches between the top of the spring return nut and the bottom of the upper diaphragm plate. Screw the bearing cap on the plunger rod, making certain not to disturb the setting of the spring return nut.

**NOTE**

Because the bearing cap mating surfaces are machined, both halves of the bearing cap must be replaced if either half requires replacement.

Inspect the diaphragm, and replace it if damaged or worn. Install the diaphragm on the lower diaphragm plate, and secure the lower diaphragm plate to the upper diaphragm plate.

**Flap Valve Reassembly (See figure 2)**

Inspect all diaphragm pot components for wear or damage, and replace as necessary.

Install the discharge valve seat and flap valve assembly in the discharge elbow.

Replace the discharge elbow gasket, position the slotted discharge elbow and assembled flap valve components on the discharge flange studs, and tighten the hardware securing the elbow to the flange.

Install the suction valve seat and flap valve assembly in the suction port.

Replace the suction accumulator gasket, position the slotted suction accumulator on the diaphragm pot studs, and tighten the hardware securing the accumulator to the diaphragm pot.

**Pump Reassembly (See figure 1)**

If the engine has been removed, secure the engine to the base. Install the sleeve (4) on the engine drive shaft.

Install the engine drive shaft key, and install the flexible coupling (2) on the drive shaft.

Install the gear box drive shaft key in the shaft keyway, engage the drive shaft in the flexible coupling, and secure the gear box to the base.



Secure the coupling guard to the base.

Remove the upper half of the plunger rod bearing cap. Position the end cap on the gear box crankshaft, position the upper and lower halves of the plunger rod bearing cap so that they engage the end cap, and secure both halves of the bearing cap over the crankshaft roller bearing.

Secure the diaphragm pot assembly to the diaphragm ring, making certain that the lip of the diaphragm is seated evenly between the diaphragm pot and the diaphragm ring.

See LUBRICATION (following), make certain that all piping connections are secure, and open all valves in lines connected to the pump before starting the pump.

See Section C for operation.

## LUBRICATION

### Plunger Rod Assembly

#### CAUTION

The plunger rod assembly should be lubricated thoroughly after each 8 hours of operation. Failure to do so may cause the roller bearing and/or plunger rod to overheat.

Lubricate the plunger rod with Citgo #2 or equivalent automotive grease through the upper lubrication fitting (37, figure 1), and the lower lubrication fitting (4, figure 3).

Apply sufficient grease to the upper lubrication fitting so that grease escapes from the bearing cap (1, figure 3). Apply sufficient grease to the lower lubrication fitting so that grease escapes from the top of the upper diaphragm plate (6, figure 3).

### Gear Box

Refer to figure 4, remove the vent bolt (5) and pressure relief fitting (6) from the top of the gear box, and fill the oil cup (30) to its midpoint with a good grade of SAE 20-30 non-detergent motor oil. Reinstall the vent bolt and pressure relief fitting.

## ENGINE

Refer to the engine manufacturer's recommendations for engine lubrication.



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