

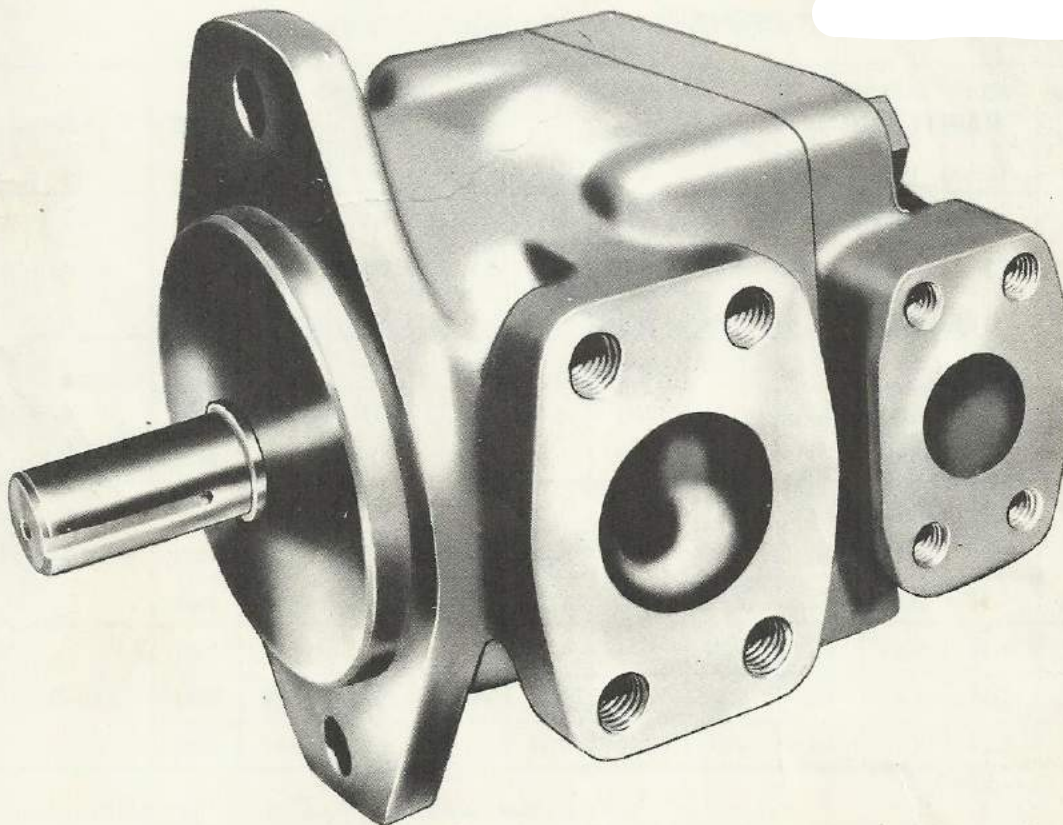
**Abex**

**DENISON**

**SERVICE LITERATURE**

**VANE TYPE PUMPS — SERIES T1C**

# **INSTALLATION, OPERATION AND OVERHAUL INSTRUCTIONS**



**Vane Type Pumps — Series T1C**

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# SECTION I

## INTRODUCTION AND DESCRIPTION

### A. GENERAL

This manual contains installation, operation, maintenance, and overhaul instructions for the Denison TIC vane type pump. These pumps are manufactured by the Denison Engineering Division of the American Brake Shoe Company, Columbus, Ohio.

### B. DESCRIPTION

The Denison TIC vane pump is an efficient, compact unit designed for continuous duty up to 2500 psi and 2500 rpm.

Four models are offered in this series supplying rated deliveries of 8, 11, 14, and 17 gpm at 1200 rpm and zero psi. (See Table I.)

The TIC pump consists of four basic components:

(A) a housing (refer to Fig. 2) with a plain ball bearing, lip seal, and an inlet connection, (B) a pumping cartridge consisting of rotor, vane springs, vanes, spring guides, cam ring, and a floating port plate, (C) shaft, and (D) an end cap with a needle bearing assembly and an outlet connection.

The shaft is supported by the bearing in the end cap and the ball bearing in the housing. This maximum support feature allows applications with high side loading on the shaft. The TIC pump will support a radial load of 479 lbs. at the center of the keyway.

The port plate is free to move axially within limits. Hydraulic pressure is used to counteract internal hydraulic pressure that tends to separate the elements of the pumping cartridge after the pump is primed and delivering oil under pressure. When the pump is idle and there is zero pressure in the circuit, a light spring provides the necessary clamping force to facilitate starting.

**TABLE I**  
**TYPICAL PUMP OPERATING CHARACTERISTICS\*\***

MODEL	RPM	DELIVERY - GPM VS. PRESSURE						HORSEPOWER - INPUT VS. PSI					
		100 PSI	500 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	100 PSI	500 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI
TIC-008-21*	1200	8.0	7.7	7.4	7.1	6.8	6.5	.7	2.7	5.2	7.8	10.3	12.9
	1800	12.0	11.7	11.4	11.1	10.8	10.5	1.1	4.1	7.8	11.6	15.3	19.2
	2400	16.0	15.7	15.4	15.1	14.8	14.5	1.8	5.7	10.7	16.0	21.0	26.3
TIC-011-21*	1200	11.0	10.7	10.4	10.1	9.8	9.5	.9	3.7	7.0	10.5	14.0	17.5
	1800	16.5	16.2	15.9	15.6	15.3	15.0	1.5	5.6	10.7	15.9	21.0	26.2
	2400	22.0	21.7	21.4	21.1	20.8	20.5	1.8	7.4	14.5	21.5	28.5	36.5
TIC-014-21*	1200	14.0	13.8	13.4	13.1	12.8	12.5	1.2	4.6	9.1	13.5	17.9	22.1
	1800	21.0	20.8	20.4	20.0	19.8	19.5	1.8	7.0	13.6	20.1	26.6	33.2
	2400	28.0	27.8	27.4	27.0	26.8	26.5	2.7	9.9	18.7	27.4	36.3	45.0
TIC-017-21*	1200	17.0	16.7	16.4	16.0	15.7	15.4	1.2	5.7	10.8	16.0	21.3	26.8
	1800	25.5	25.2	24.9	24.6	24.3	24.0	2.1	8.5	16.2	24.3	32.2	40.1
	2400	34.0	33.7	33.4	33.1	32.8	32.5	3.1	11.7	22.2	33.0	43.9	54.8

\* Rotation (Rot.) "R" clockwise, "L" counterclockwise.

\*\* Based on the use of fluid with a viscosity of 200 SSU at 100°F. Tested at 130°F.

## SECTION II INSTALLATION

### A. MOUNTING

These pumps should be mounted on a base of sufficient strength and in such a manner as to maintain a positive alignment with the prime mover. Close shaft alignment with the prime mover is of utmost importance. A flexible-type coupling must be used between the prime mover and the pump to allow for misalignment.

The pump must be installed with the suction line attached to the body, the end cap is the pressure outlet. The TIC pumps are internally drained at all times and drain lines are not required.

The direction of oil flow through the pump cannot be changed.

#### ROTATION

These pumps can be assembled to operate as a right or left hand rotation pump. They are bi-directional pumps. The installation position of the cam ring assembly on the port plate determines the direction they should rotate. (See Fig. 3 & 4 for the alternate arrangements.)

The outlet port can be assembled in any of four positions in relation to the inlet (suction) port. (See Fig. 1 for porting arrangement.)

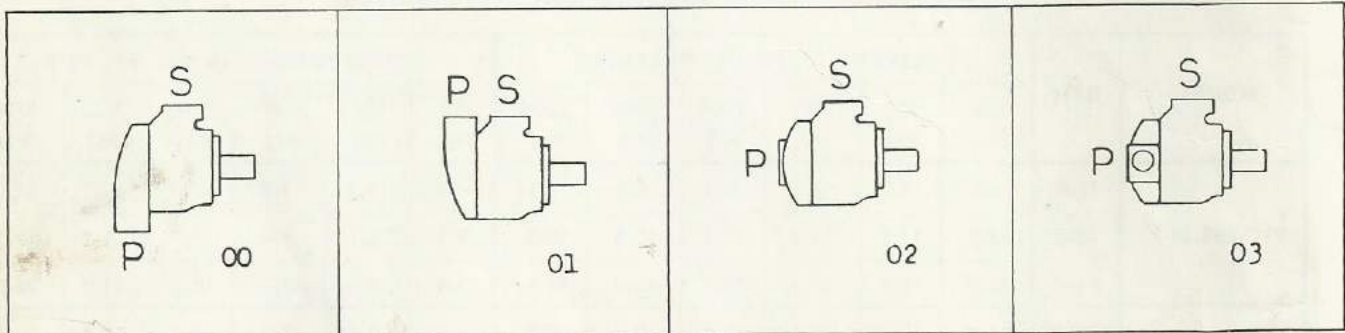
### B. PIPING

All piping should be of adequate size and strength to assure free flow at the pressure involved. All system piping must be cleaned with solvent or in accordance with specification MIL-C-17795 before the pump is connected. Piping workmanship must be accurate in order to eliminate any undue strain on the pump when tightening flange bolts.

Be sure that the entire hydraulic system is free from dirt, lint, scale, and other foreign material. Do not use galvanized pipe.

### C. FILL PUMP

Immediately before pump installation, fill the pump with clean hydraulic fluid. Use fluid in accordance with specifications given in Table II.



**FIGURE 1 - PORTING COMBINATIONS**

**TABLE II  
RECOMMENDED OIL SPECIFICATIONS**

Viscosity Range . . . . .	150 to 300 SSU at 100° F.
Viscosity Index . . . . .	90 or above
Maximum Viscosity at starting temperature . . . . .	7500 SSU
Neutralization number . . . . .	10 or below (when using new oil)
Additives - Recommend Rust and Oxidation Inhibitors	
Consult a Denison representative before using fluid which does not meet these specifications or higher temperature operation.	
<b>CAUTION: Temperature of the oil should never exceed 150° F. for most efficient operation.</b>	

## SECTION III

### OPERATION

#### A. INITIAL STARTING

- a. Be certain that pump is marked to operate in the same direction as the prime mover.
- b. Be certain that the oil used in the system conforms to specifications given in Table II.
- c. Adjust the system relief valves for minimum pressure.
- d. Start the unit and allow it to build up to operating speed.
- e. Increase the system pressure to approximately 500 psi.
- f. At the start there will probably be some air trapped in the system. Purge the air from the system by venting at one of the hydraulic system valves. Operate the pump at low pressures (up to 500 psi) until it has been purged.

#### B. STOPPING

Reduce the pressure setting for minimum pump delivery and cut the power.

#### C. LOW TEMPERATURE STARTING

When the temperature conditions are lower than the operating temperature ranges recommended in the oil specifications of Table II, use the following procedure:

- a. Set the system relief valves for minimum pressure setting.
- b. Start the prime mover and allow the pump to reach idle operating speed.
- c. Allow the pump to idle until the oil is warmed within operating specifications.

## SECTION IV

### MAINTENANCE

#### A. GENERAL

Maintenance is limited to operations which do not require complete system or pump teardown. For example, repair of system, pump leaks, or sticky valves. The first operation in the repair of any leak is to tighten the screws or fittings around the leakage area. If this does not remedy the leak, it may be necessary to open the pump and replace a gasket or "O" ring.

If the pump does not operate properly or there is evidence of damage, overhaul the equipment in accordance with Section V.

Before reassembling any parts, be certain each

part is absolutely clean and free from dirt, lint, or other foreign matter. All parts must be washed in a cleaning fluid such as Stoddard solvent or its equivalent. All "O" rings and gaskets must be clean and carefully examined for cuts or other damage. Replace any damaged parts.

#### B. TROUBLESHOOTING

Table III lists probable causes of trouble and possible remedies. Perform only those operations possible under maintenance. Refer to Section V for overhaul procedures.

TABLE III - TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
EXTERNAL LEAKAGE AROUND SHAFT	Shaft seal worn	Replace shaft seal per preceding instructions
PUMP NOT DELIVERING OIL	Foot valve in suction line. Pump did not prime.  Wrong direction on shaft rotation or incorrect pump model.  Tank oil level too low.  Oil intake pipe or suction filter clogged.	These should never be used. Bleed air from pump outlet (install needle valve for this purpose) or Denison air bleed off valve AB04-15. Must be reversed immediately to prevent seizure and breakage of parts due to lack of oil. Check rotation arrows on cam ring. Add recommended oil and check level on both sides of tank baffle to be certain pump suction line is submerged. Filters must be cleaned of lint soon after new oil is added, due to fact new oil contains considerable amount. Check for water pockets around filter. Filter should be at least twice the maximum pump volume in GPM.

TABLE III - TROUBLE SHOOTING CHART (cont'd)

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
PUMP NOT DELIVERING OIL (cont'd)	Air leak in suction line. Oil viscosity too heavy to pick up prime. Broken pump shaft or rotor. Pump not delivering oil for any of the above reasons.	Tighten and seal connections. Thinner oil should be used, per recommendation for given temperature and service. Refer to preceding service data for replacement instructions. Check oil circulation by watching oil in tank, or removing plug in pressure line near pump.
PUMP NOT DEVELOPING PRESSURE	Relief valve setting not high enough. Relief valve sticking open. Leak in hydraulic control system (cylinders or valves) Free recirculation of oil to tank being allowed through system. Pump shaft sheared due to rotor seizure. Relief valve venting.	Block machine travel, or oil circulation, and test with pressure gauge. Dirt under pressure adjustment ball or cone. (See relief valve instructions.) Must be tested independently by blocking off circuit progressively. Directional control valve may be in open center, neutral or other return line open unintentionally. Disassemble and repair pump. Test venting circuit (if one is used) by blocking vent line near relief valve.
PUMP MAKING NOISE.	Small air leak at pump intake piping joints. Air leak at pump shaft packing. Relief valve chattering. Housing breathing. Partially clogged intake line, intake filter, or restricted intake pipe. Restriction pulled into intake cores (rags or paper) Air bubbles in intake oil. Tank air vent plugged. Pump running too fast. (Cavitation) Too high an oil viscosity. Filter too small. Broken spring under vane. Cam ring not properly aligned.	Test by pouring oil on joints while listening for change in sound of operation. Tighten as required. Pour oil around shaft while listening for change in sound of operation. Air being drawn into system at pump intake or pump shaft packing. (Check as above.) Increase housing bolt torque. Pump must receive intake oil freely or cavitation will take place. Disassemble and clean pump. Remove head and clean carefully after valve plate bushings are removed. Check thoroughly to be certain return lines are below oil level and well separated from intake. Must be opened through breather opening or air filter. Check recommended maximum speed from descriptive literature. See oil specification sheet. (Use thinner oil) Capacity may be adequate only when just cleaned and should have added capacity. (Normal size should be at least twice the maximum pump volume in gpm. Shut down and replace immediately. Check cam to rotor concentricity with feeler gages. Both lips of vanes must seal on constant radius portion of cam.

## SECTION V OVERHAUL

### A. GENERAL

The instructions contained in this section cover a complete teardown of the TIC pump.

### B. SPECIAL TOOLS

There are no special tools required for the overhaul of this equipment.

### C. DISASSEMBLY

#### 1. GENERAL

The steps listed under *DISASSEMBLY* are a suggested procedure.

#### 2. DISASSEMBLY

- a. Drain the pump.
- b. Secure the pump in a vise with the shaft (29) extended down.
- c. Remove the screws (12) and remove the end cap (15) from the housing (27).
- d. Remove the long dowel pin (9) from the cam ring (22).
- e. Remove the seal (10) from the end cap (15).

#### NOTE

Do not remove roller bearing (11) unless it is worn and must be replaced.

- f. Using two No. 10-24 screws in the two tapped holes provided as puller holes in the cam ring (22), remove the cam ring, rotor (19), vanes (21), vane springs (20) and spring guides (20A) as a unit to prevent the springs from throwing the vanes out of place.

#### WARNING

The vanes are held against the cam ring by tension from the springs in the rotor. If the rotor is pulled from the cam ring with no protection, tension from the springs will cause the vanes to be thrown forcibly out from the rotor in all directions. Serious damage may result to the operator or serviceman since the vanes have fine, sharp edges.

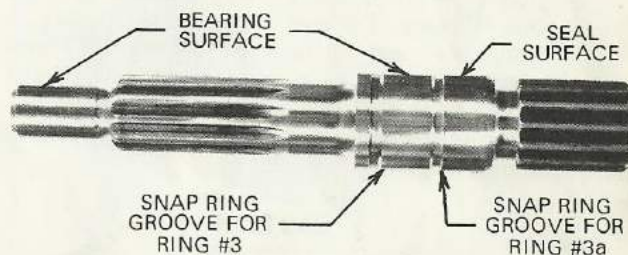
Place the pumping cartridge (cam ring, rotor, vane springs, vanes and spring guides) on a clean flat surface. Push the rotor and vanes *simultaneously* out of the cam ring far enough so that a ring compressor can be securely fastened around the vanes. Once

the ring compressor is in place, push the rotor and vanes the remainder of the way out of the cam ring. Ease the tension of the ring compressor slowly so that the vanes do not fly out of the rotor.

- g. Remove short dowel pin (8).
  - h. Using two No. 10-24 screws in the tapped holes provided, remove the port plate (23) by pulling it out over the splined end of the shaft (28).
  - i. Remove the wavy washer spring (6) from the hub of the port plate.
  - j. Remove the two seals (5 and 7) and the snap ring (4) from the housing (27).
  - k. Remove the key (29) from the shaft (28) and push the shaft assembly from the housing.
  - l. Examine the bearing for wear before removing it from the shaft. Apply a little pressure to the outer race and rotate the bearing to check the balls and race for wear or cracks. Check for looseness. Remove bearing from shaft if a replacement is needed. Inspect the outside diameter of the shaft at the point of contact with the bearing in the cartridge and also the sealing surface diameter for the shaft seal.
- If the bearing is defective remove snap ring (3) and press bearing (2) from the shaft (28). Remove snap ring (3a).

#### WARNING

Snap ring (3a) must be removed by passing over the bearing surface of the shaft and not the shaft seal surface. A damaged seal surface will cause the seal to leak.



### D. CLEANING, INSPECTION, AND REPAIR

#### 1. CLEANING

Wash all metal parts in cleaning solvent, (Stoddard Solvent or equal) and blow dry with clean compressed air.

**CAUTION**

Dirt is a major cause of wear and pump failure. Cover all parts after cleaning to prevent dust and dirt from settling on them. All surfaces should be coated with a film of hydraulic lubricating oil, after they have been cleaned.

**2. INSPECTION AND REPAIR**

- a. Inspect the seal for wear and breaks. Replace a defective seal.
- b. Inspect all springs for cracks or permanent set. Replace a defective spring.
- c. Inspect the cam ring for wear. Replace a defective cam ring.
- d. Inspect the rotor for scores or marring on the wear face. Replace a defective rotor.
- e. Inspect the housing for cracks or other possible casting damage. Replace a damaged housing.

**E. LUBRICATION**

No lubrication is required for this unit. The normal operation of the pump keeps parts adequately lubricated.

**F. REASSEMBLY**

- a. Press the shaft seal (1) in the housing.

**NOTE**

The open face of the seal must be facing the end cap.

**CAUTION**

Special care must be taken to keep foreign matter from the sealing lips of the seal to prevent cuts or abrasion of the edges.

- b. Pass snap ring (3a) over the internal end of the shaft (28) and install it in the snap ring groove between the bearing surface and the seal surface. Do not allow the snap ring to touch the seal surface on the shaft. Press bearing (2) over the same end of the shaft and install snap ring (3). See shaft sketch in disassembly procedure. Be sure (3 & 3a) are fully seated in groove.

**CAUTION**

When installing bearing (2) use care to prevent damaging or distorting snap ring (3a).

- c. Install the shaft assembly in the housing (27) and insert the key (29).
- d. Install the snap ring (4), apply heavy grease to seals (5 and 7) and insert in the housing (27).

- e. Install the wavy washer spring (6) on the hub of the port plate (23). Use heavy grease to hold (6) in place.
- f. Place the cam ring, rotor, vane springs, spring guides, and vanes on a clean flat surface. Arrange the vanes side by side with the three spring holes up.

Insert the 30 vane springs in the vanes, insert the spring guides in the springs.

Install the 10 vanes with the guides and springs in the slots in the rotor.

**WARNING**

Be certain that the heads of the spring guides and springs are started in the holes in each rotor slot.

Place a ring compressor around the vanes and tighten the compressor gradually until the springs and vanes are in the position they will occupy while in the cam ring. Install the rotor in the cam ring using a backup plate to prevent the vanes from sliding endwise in the slots and damaging the springs. If the vanes slide endwise, inspect and replace any damaged springs.

**WARNING**

Be certain that the assembly is inserted far enough in the cam ring so that when the ring compressor is removed the vanes do not fly out of position.

- g. Press needle bearing (11) in the end cap. Apply heavy grease to seal (10) and place on outer edge of pilot on end cap.
- h. Assemble the front port plate (23), dowel pins (8 and 9), cam ring assembly and end cap with seal as shown in Fig. 3, for right hand operation (as viewed from shaft end).

Assemble as shown in Fig. 4, for left hand operation.

Start the port plate in the housing by tapping lightly with a hammer handle.

Make certain that the short dowel (8) is inserted in the correct hole in the port plate and the long dowel is in the dowel pin hole in the end cap. The correct hole is adjacent to the arrow that indicates the desired rotation of the pump.

If the pump is to be operated with the "00" porting as shown in Fig. 1, insert screws (12) through the cap and tighten to 70-ft.lbs. torque.

If a different porting is desired hold the end cap firmly against the cam ring assembly and rotate the cap and all internal parts to the required location and insert the screws and tighten.

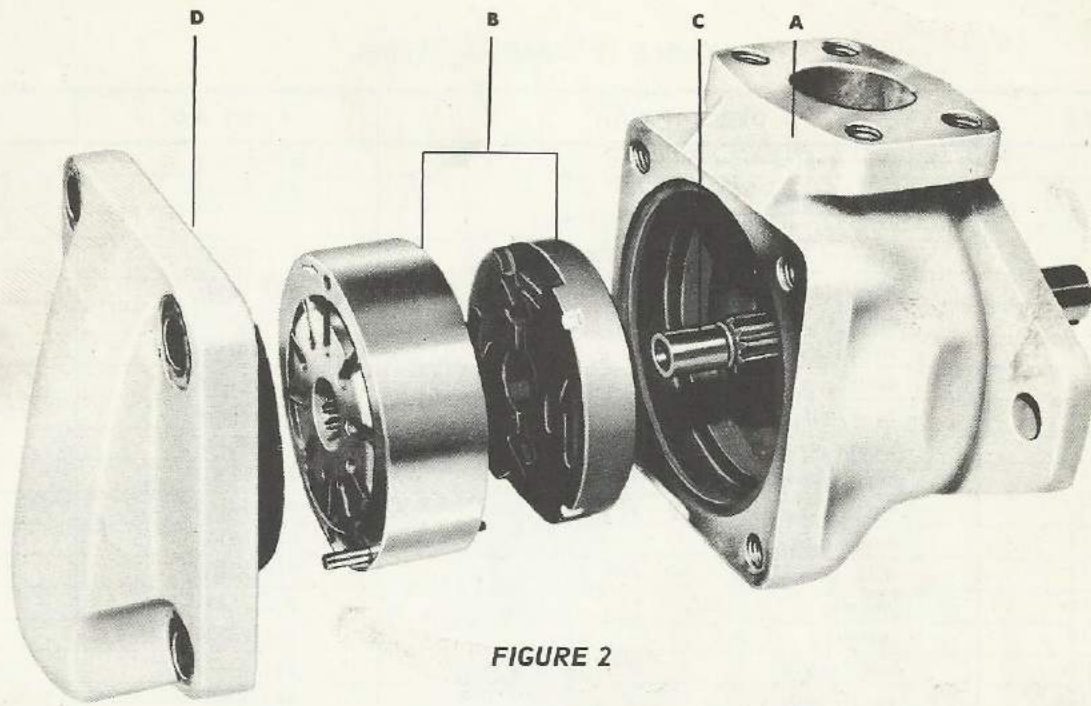
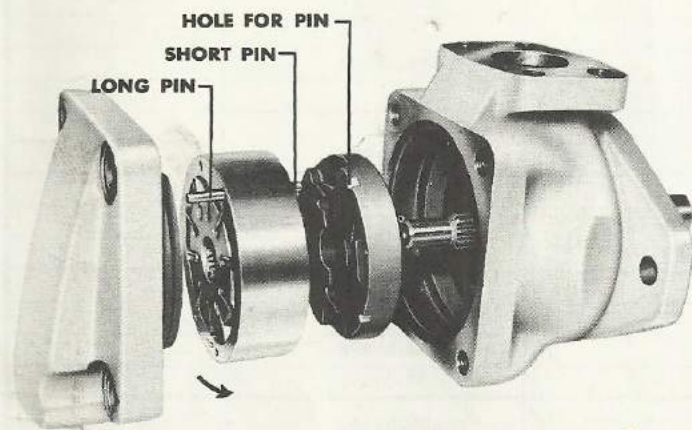
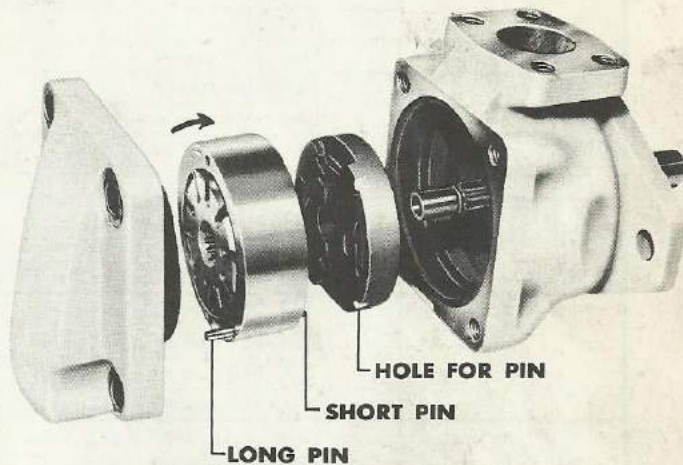


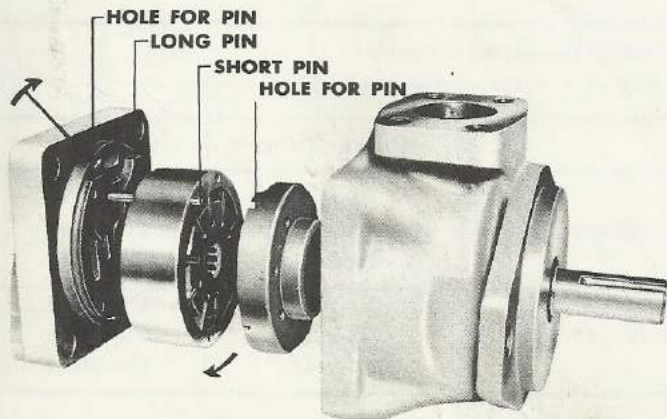
FIGURE 2



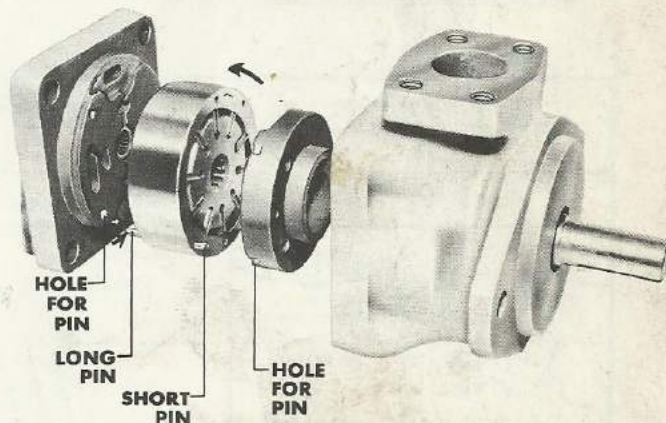
Assemble in this manner for right hand rotation



Assemble in this manner for left hand rotation



Assemble in this manner for right hand rotation



Assemble in this manner for left hand rotation

FIGURE 3

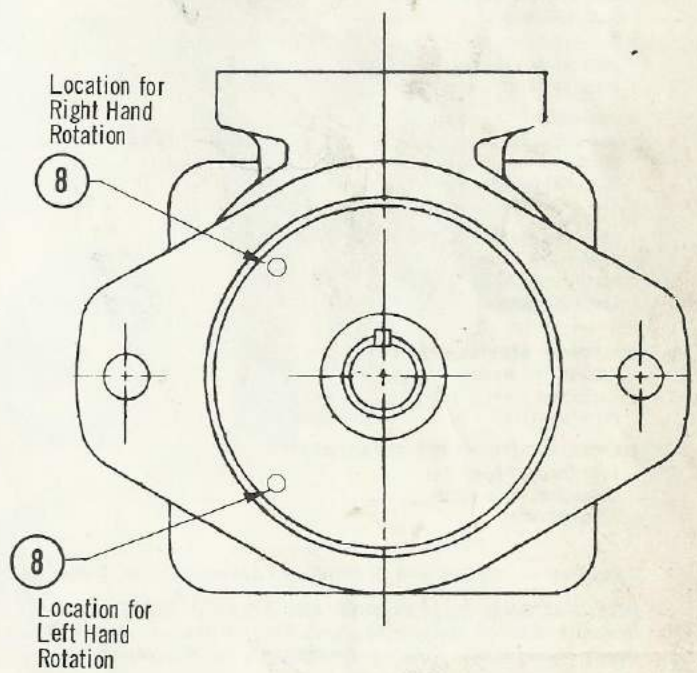
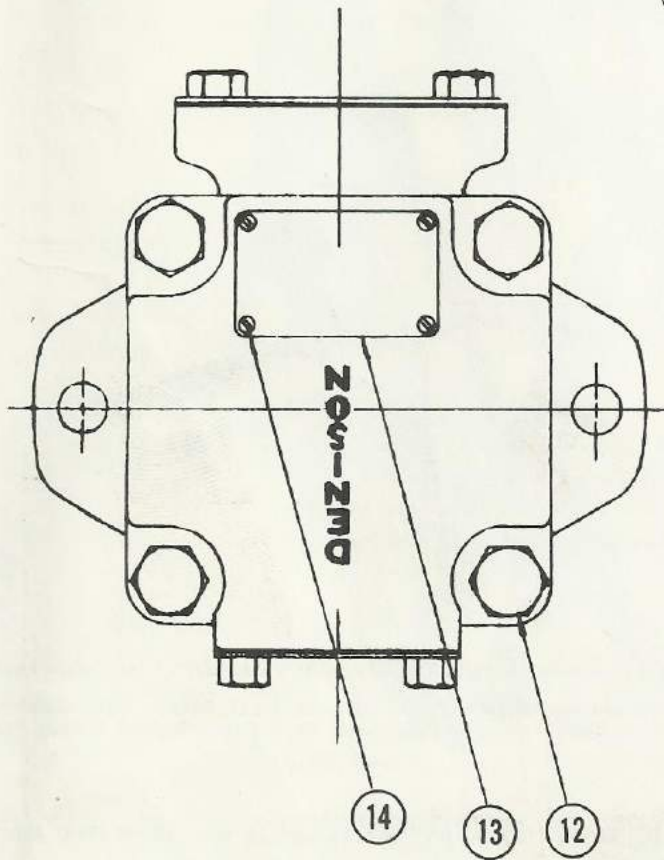
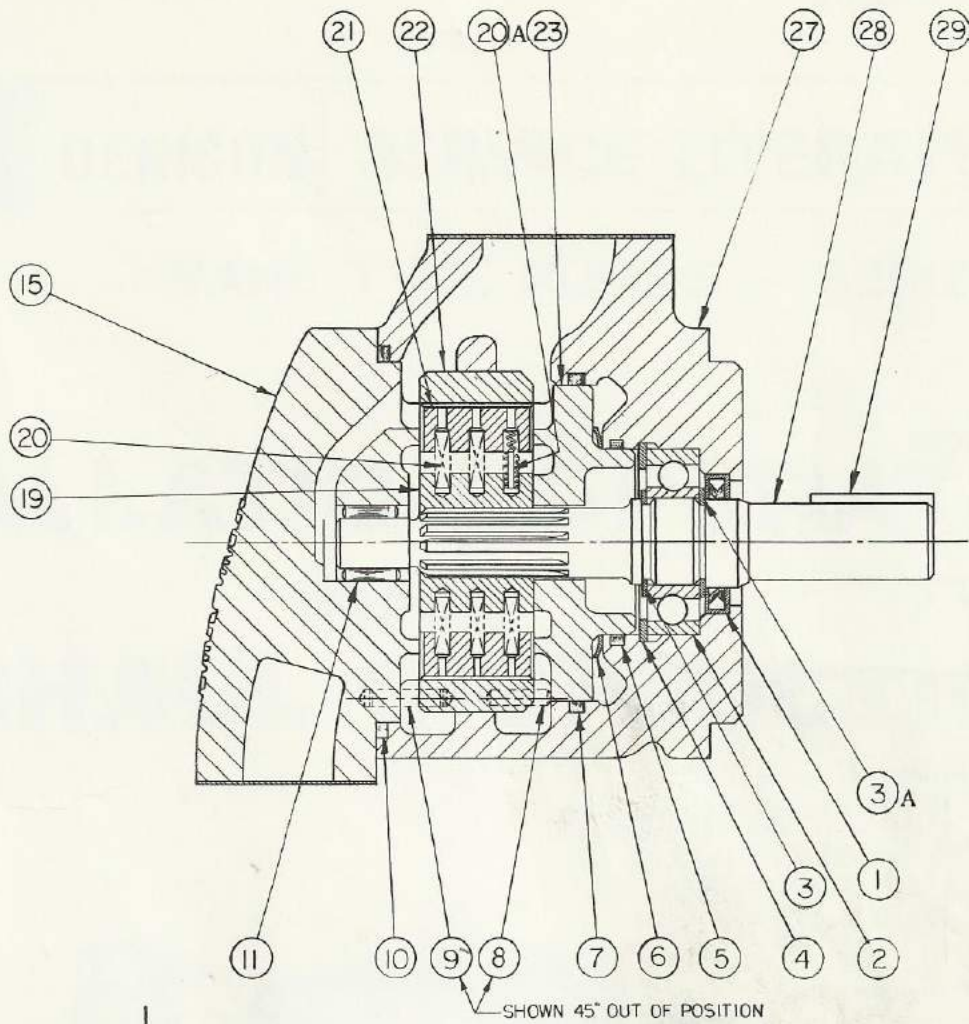
FIGURE 4

TABLE IV - PARTS LISTING

ITEM	DESCRIPTION	PART NO.	QTY
(s) 1	✕ shaft seal (1½" x 1 x ¼)	620-82012	1
2	*ball bearing	230-82128	1
3 & 3a	*external retaining ring No. 5100-98		2
4	internal retaining ring No. 5000-206	356-30206	1
(s) 5	square sect. seal No. 137	691-10137	1
6	wavy spring washer	350-10002	1
(s) 7	square sect. seal No. 238	691-10238	1
8	dowel pin, 3/16 x 1/2	324-21208	1
9	dowel pin, 3/16 x 7/8	324-21214	1
(s) 10	square sect. seal No. 242	691-10242	1
11	needle bearing No. BH-912	230-82008	1
12	hex hd cap screw, 1/2 - 13 x 1½ (spec.)	306-40148	4
13	data plate	034-18168	1
14	R.H. screw type F, No. 4-40 x 3/16	320-20403	4
15	end cap	034-27254	1
▲ 19	rotor	034-27256	1
▲ 20	vane spring	034-41676	30
▲ 20A	spring guide	034-40687	30
▲ 21	vane	034-27257	10
▲ 22	T1C-008 cam ring	034-27262	1
	T1C-011 cam ring	034-27277	1
	T1C-014 cam ring	034-27278	1
	T1C-017 cam ring	034-27261	1
23	front port plate	034-43276	1
27	body (housing)	034-41989	1
28	*shaft with keyway	034-	1
	*shaft with 13 tooth spline	034-	1
29	shaft key	034-19578	1
(s)	seal kit	S14-08893	1
	seal kit S4 (phosphate ester base fluids)	S14-08893-S4	1
	seal kit S5 (silicate ester base fluids)	S14-08893-S5	1
▲	T1C-008 cam ring assembly	S14-06691	1
	T1C-011 cam ring assembly	S14-06692	1
	T1C-014 cam ring assembly	S14-06693	1
	T1C-017 cam ring assembly	S14-06694	1
	✕ Shaft seal (1-9/16 O.D.) was used in pumps before Serial No. 5984.	620-05109	

These parts available only in the following sub assemblies:  
 S14-24489 Keyed shaft assembly  
 S14-24720 Splined shaft assembly

The parts included in connection assembly:				
Order by code number →				
DESCRIPTION	SCREWS (4 req.)	SEAL	CONNECTIONS	CODE NO.
1¼ NPT } Inlet	358-20220	(s) 691-10227	034-27264	S14-10786
1¼ Soc. Weld } or			034-24477	S14-08446
1½ SAE 24 } Suction			034-24479	S14-08453
1" NPT } Outlet	306-16220	(s) 691-10222	034-27265	S14-10787
1" Soc. Weld } or			034-24348	S14-08054
1" SAE 16 } Pressure			034-24476	S14-08445



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