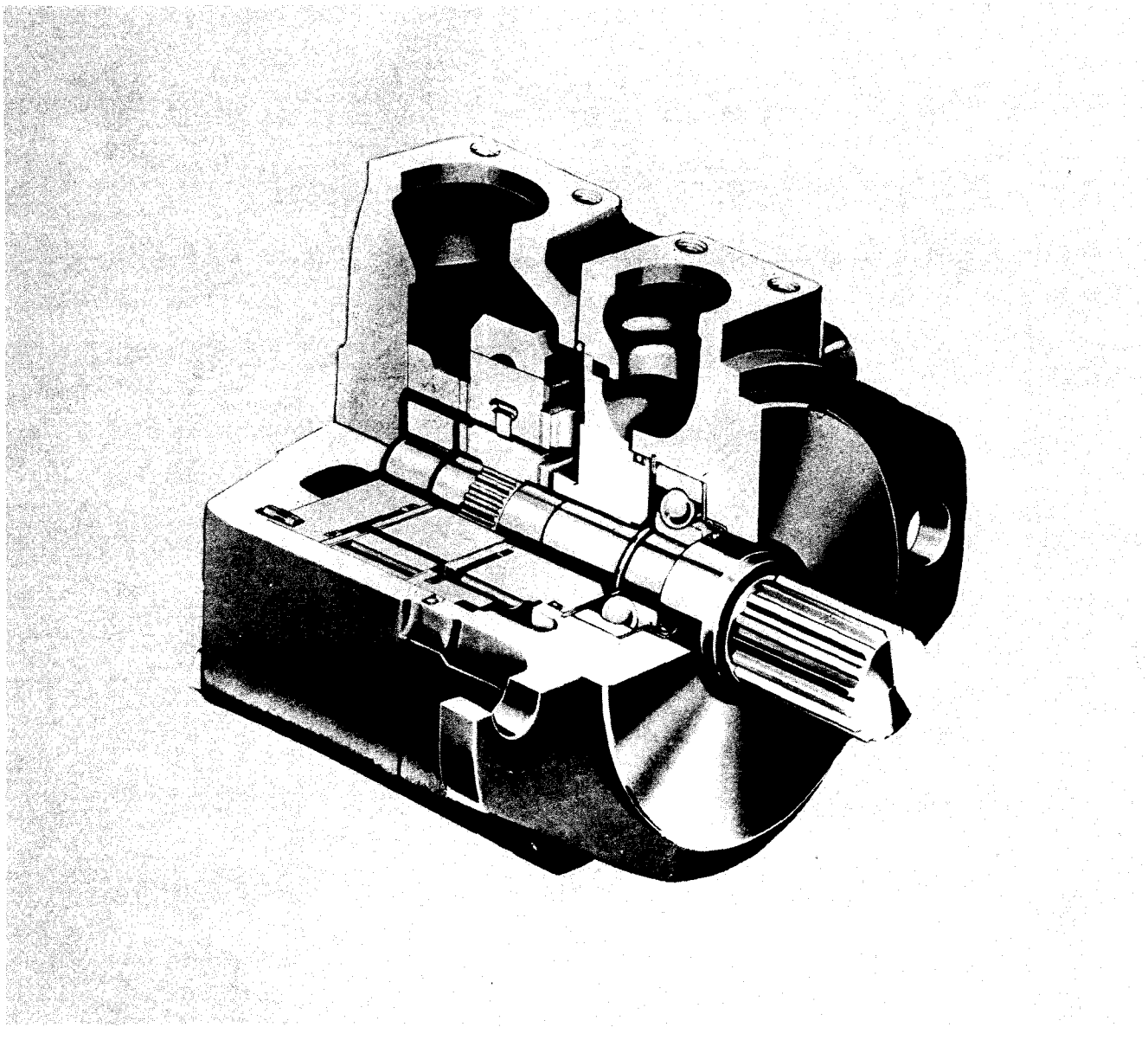
Overhaul Manual

VICKERS

Single Pumps

20VQ, 25VQ, 35VQ, &45VQ



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A. PURPOSE OF MANUAL

This manual is to assist users of high performance VQ single pumps in properly installing, maintaining and reparing their units. The single pumps are described in detail.

Their theory of operation is discussed and instructions for installation, maintenance and overhaul are presented.

The general series of models covered are 20VQ, 25VQ, 35VQ and 45VQ. The information given applies to the –20 and –30 design series listed in Table 1.

B. GENERAL INFORMATION

1. Related Publications – Service parts information and installation dimensions are not contained in this manual. The parts drawings listed in Table 1 are available from authorized distributors or sales engineers.

MODEL CODE BREAKDOWN

F3 ** VQ * ** A * – * * * ** * 20 (*)**

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13]

[1] Special seals

F3 = Viton® seal
Blank = Omit if not required

[2] Flex plate intra–vane series

20VQ = 18 to 36 cm^3/r (1.1 to 2.8 in^3/r)
25VQ = 40 to 67 cm^3/r (2.45 to 4.12 in^3/r)
35VQ = 81 to 121 cm^3/r (4.98 to 7.42 in^3/r)
45VQ = 138 to 193 cm^3/r (8.46 to 11.8 in^3/r)

[3] Integral valve option

F = Flow control cover (20VQ models only)
P = Priority control cover (20VQ models only)
Blank = Omit if not required

[4] Geometric displacement

Code = rated capacity (USgpm) @ 1200 rpm, 6.9 bar (110 psi)

Code	cm^3/r	in^3/r	frame size
5 =	18	1.10	20VQ
8 =	27	1.67	20VQ
11=	36	2.22	20VQ
12=	40	2.45	25VQ
14=	45	2.76	25VQ
17=	55	3.37	25VQ
21=	67	4.12	25VQ
25=	81	4.98	35VQ
30=	97	5.96	35VQ
35=	112	6.88	35VQ
38=	121	7.42	35VQ
42=	138	8.46	45VQ
50=	162	9.90	45VQ
60=	193	11.80	45VQ

[5] PORT CONNECTIONS

Code	Series	Inlet	Outlet
A	All*	SAE 4–bolt	SAE 4–bolt
B	20/25VQ	Str. thd.	Str. thd.
C	20/25VQ	SAE 4–bolt	Str. thd.
D	20/25VQ	Str. thd.	SAE 4–bolt

* Standard porting

[6] Port connection modifier

M = SAE connection with metric threads
Blank = Omit for inch threads

[7] Mounting and shaft seal assembly

S = Flange mount and double shaft seal
Blank = Omit for flange mount and single shaft seal

[8] Shaft options

Code	Description	Single pump
1	Straight, keyed, single shaft seal only	20VQ, 25VQ, 35VQ, 45VQ
11	Splined, single shaft seal only	25VQ, 35VQ, 45VQ
86	Straight, keyed, single shaft seal only	25VQ, 35VQ, 45VQ
123	Splined, single or double shaft seal	25VQ, 35VQ
130	Splined, single or double shaft seal	45VQ
151	Splined, single or double shaft seal	20VQ

[9] Port orientation

(Inlet position viewed from cover end)

A = Opposite inlet
B = 90° CW from outlet
C = Inline with outlet
D = 90° CCW from outlet

[10] Controlled flow rates

For pump with integral flow control –20VQF only

Code	nominal flow rate l/min (USgpm)	Code	nominal flow rate l/min (USgpm)
2	7.57 (2)	8	30.28 (8)
4	15.14 (4)	10	37.85 (10)
6	22.71 (6)	12	45.42 (12)

For pump with priority cover – 20VQP only

Code	nominal flow rate l/min (USgpm)	Code	nominal flow rate l/min (USgpm)
1	3.79 (1)	4	15.14 (4)
2	7.57 (2)	5	18.93 (5)
2.5	9.46 (2.5)	6	22.71 (6)
3	11.36 (3)	8	30.28 (8)

[11] Relief valve setting 20VQF & 20VQP

Code	nominal flow rate l/min (USgpm)	Code	nominal flow rate l/min (USgpm)
A	17 (250)	F	104 (1500)
B	35 (500)	G	121 (1750)
C	52 (750)	H	138 (2000)
D	69 (1000)	J	155 (2250)
E	86 (1250)	K	173 (2500)

[12] Design number

20 = For 25VQ, 35VQ, 45VQ
30 = For 20VQ models only

[13] Rotation

(Viewed from shaft end)
L = Left hand rotation
Blank = Right hand rotation

2. Model Codes - Variations within each basic model series are covered in the model code. Table 1 is a complete breakdown of the codes covering these units. Service inquiries should always include the complete unit model code number as stamped on the pump cover.

MODEL SERIES	PARTS DRAWING	Installation Information
20VQ	—	GB-MV-106
25VQ	I-3165-S	—
35VQ	I-3167-S	—
45VQ	I-3168-S	—

Table 2. Parts & installation literature

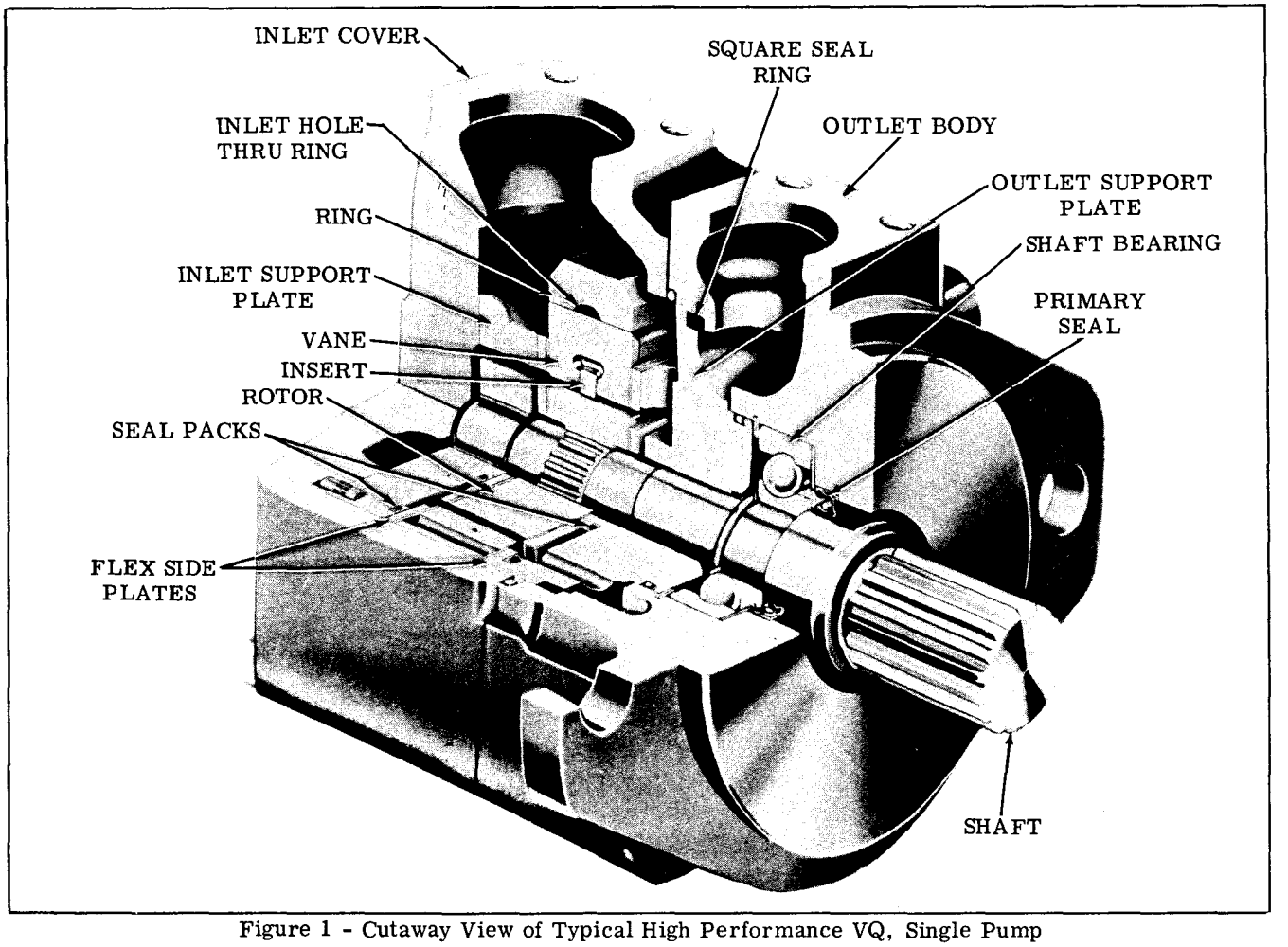


Figure 1 - Cutaway View of Typical High Performance VQ, Single Pump

Section II - DESCRIPTION

A. GENERAL

Pumps in this series are used to develop hydraulic fluid flow for the operation of Industrial and Mobile equipment. The positive displacement pumping cartridges are of the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

B. ASSEMBLY AND CONSTRUCTION

1. Basic Pumps - The pump illustrated in Figure 1 is representative of all single pumps in this series. The unit consist principally of an inlet cover, outlet body, driveshaft and pumping cartridge. The principle components of the cartridge are an elliptical cam ring, a slotted rotor splined to the driveshaft, an inlet and outlet support plate fitted with four special seal packs, two flex side plates, and ten vanes and inserts fitted to the rotor slots. Fluid enters the cartridge through the inlet port in the cover and is discharged through the outlet flex side plate and support plate to the outlet port in the body.

C. APPLICATION

Pump ratings in GPM, as shown in the model coding, are at 1200 RPM and 100 PSI. For ratings at other speeds and pressures, methods of installation or other application information, refer to the applicable sales installation drawing or consult an application engineer.

Section III - PRINCIPLES OF OPERATION

A. PUMPING CARTRIDGE

As mentioned in Section II, fluid flow is developed in the pumping cartridge. The action of the cartridge is illustrated in Figure 2. The rotor is driven within the ring by the driveshaft, which is coupled to a power source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes the vanes to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor causes the chamber volume between the vanes to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

An additional inlet fluid path exists through a drilled hole in the cam ring. This hole connects the inlet port directly to the inlet areas of the cam ring and provides an additional flow path for fluid to get into the cartridge. (See Figure 1.)

Fluid is trapped between the vanes and carried past a sealing land to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

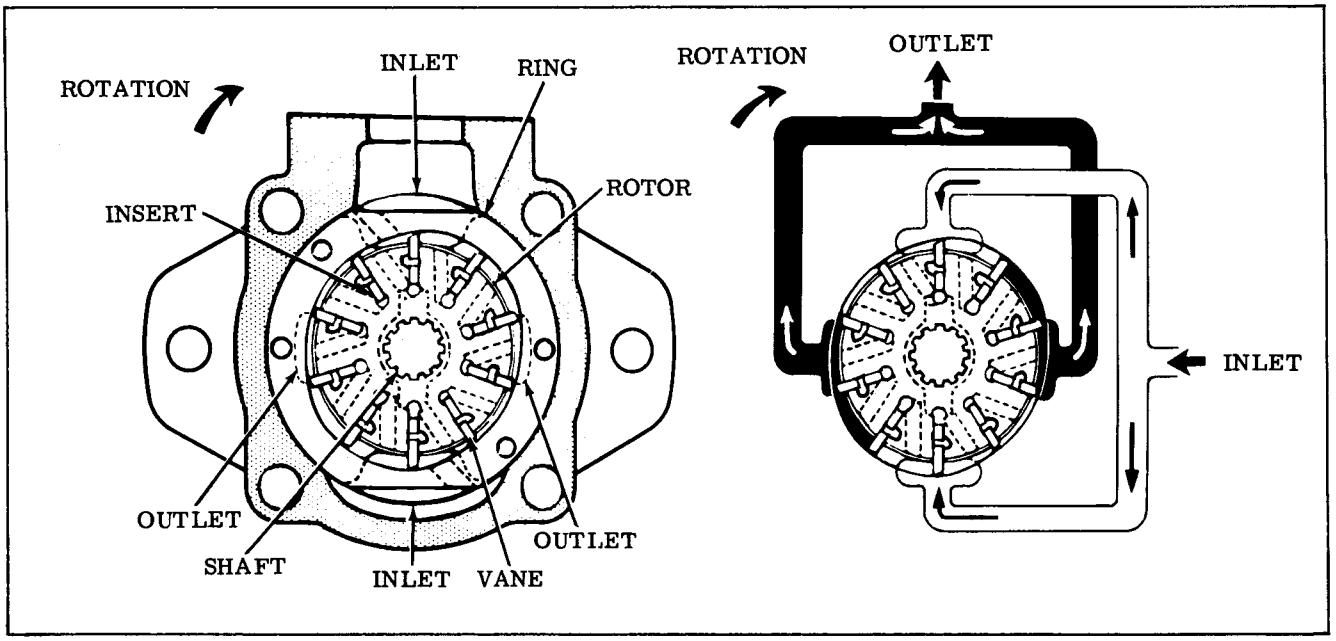


Figure 2 - Operation of Balanced, Vane-Type Cartridge.

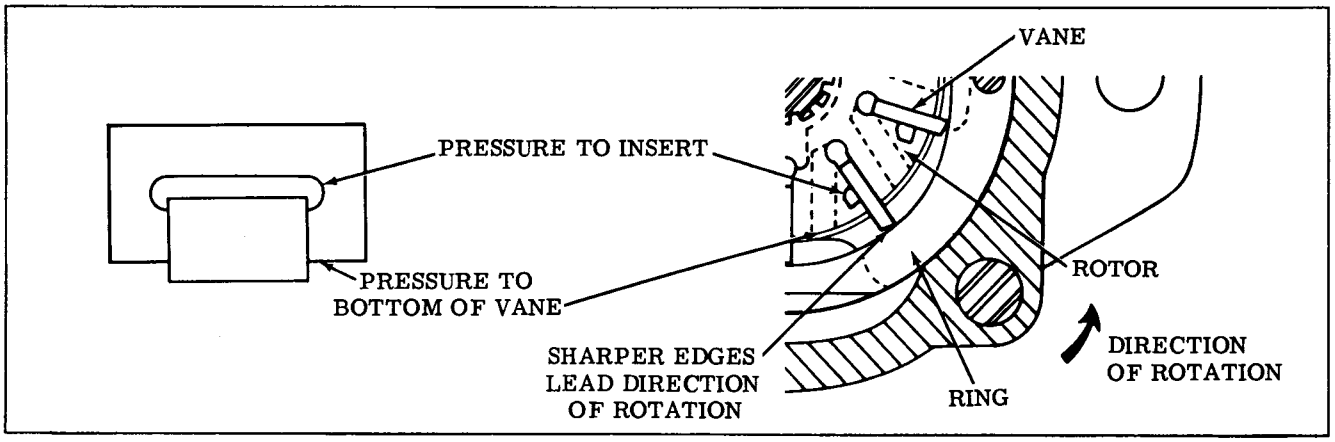


Figure 3 - Pressure Feed to Vanes in Intra-Vane Cartridge.

B. VANE PRESSURE FEED

The intra-vane design provides a means of controlling the outward thrust of the vane against the ring and maintains tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied only to the area between the vane and insert. This area is small and thrust is correspondingly light.

During vane travel through pressure areas, full system pressure is applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 3. This selective application of pressure maintains the vane in substantially constant radial hydraulic balance in all positions.

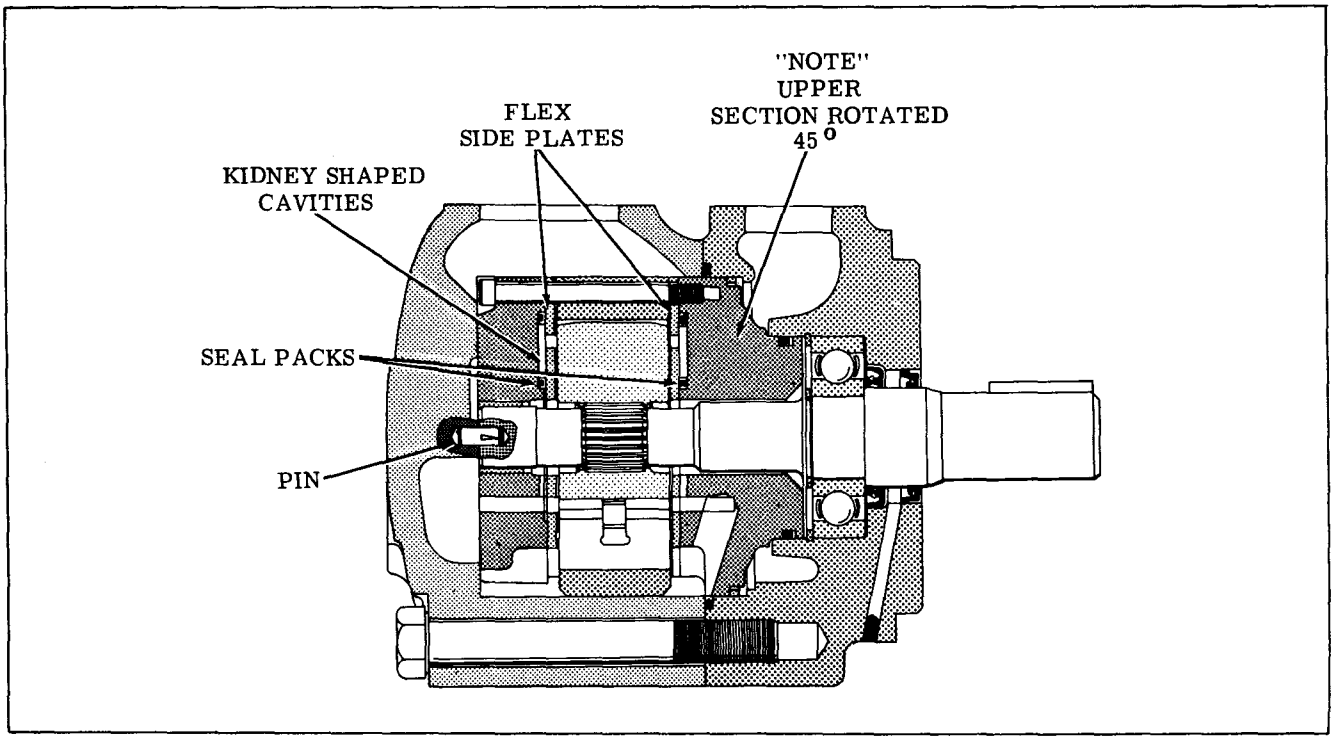


Figure 4 - Flex Side Plate Operation

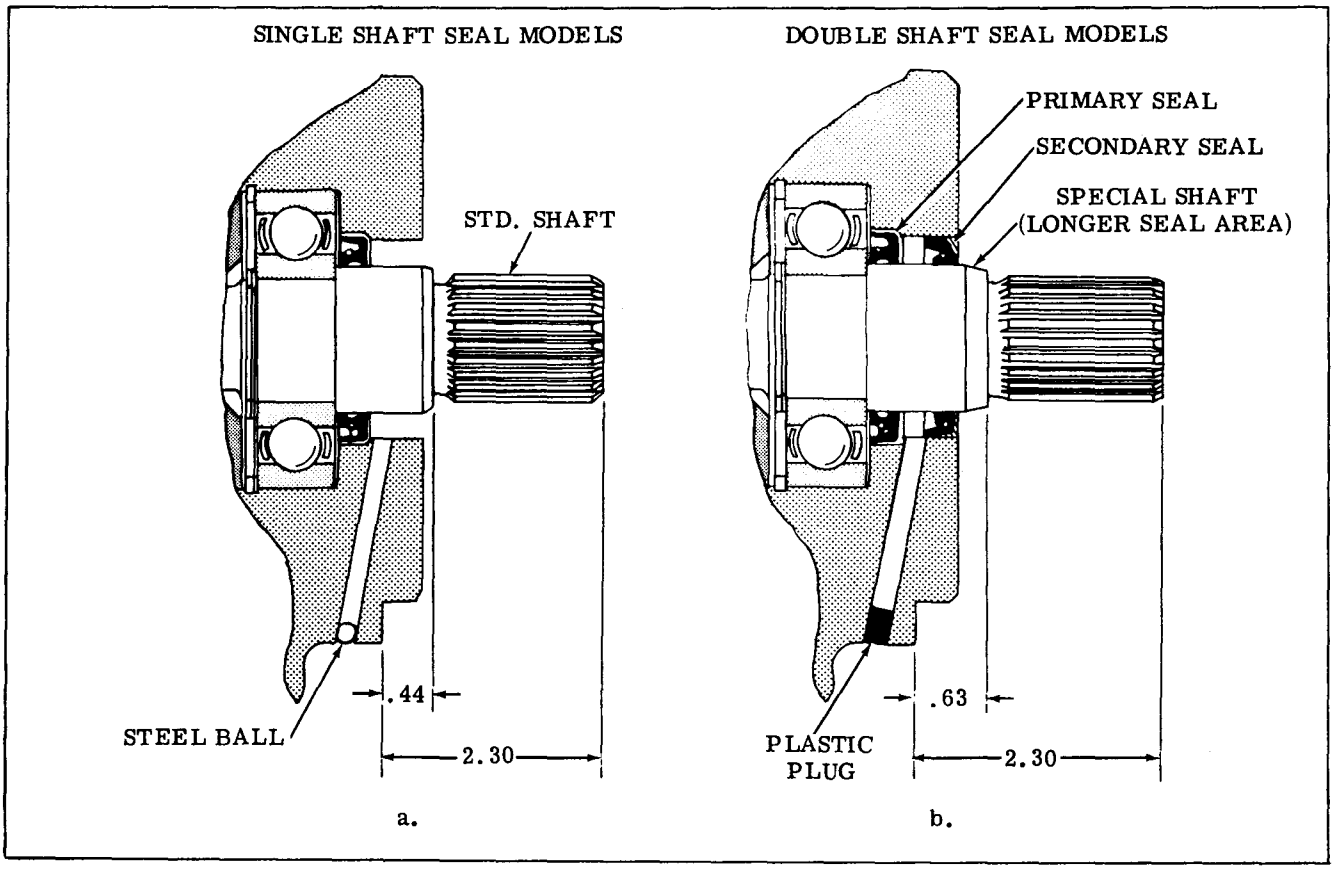


Figure 5 - Shaft Seal Arrangements

Vane tip wear is compensated for automatically. As the vane wears, pressure moves the vane farther out in the rotor slot holding the vane tip against the cam ring.

C. HYDRAULIC BALANCE

The pump ring is shaped so the two pumping chambers are formed 180 degrees apart (Figure 2). Thus, opposing hydraulic forces which develop side loads on the shaft cancel out.

D. FLEX SIDE PLATE OPERATION

The flex side plates for both inlet and outlet are symmetrical. Pressure is fed behind each side plate into two kidney shaped cavities which are sealed by special seal packs. The two flex side plates and their associated kidney shaped cavities function in the following manner. As pressure builds up in the outlet, pressure also builds up in the cavities. The pressure in the cavities hold the flex side plates in hydrostatic balance against the rotor and provide optimum running clearances for minimum internal leakage and minimum friction (see Figure 4).

The flex side plates also provide passages for feeding under vane pressure to the space between the vane and insert.

The bronze faces of the flex side plates ride next to the rotor and provide excellent wear and cold start characteristics.

The inlet and outlet support plates hold the flex side plates in position and contain passages which allow fluid to pass from the inlet to the pumping cartridge and from the carridge to the outlet port.

E. INLET BODIES

Two inlet body configurations and two shaft seal arrangements are available in this pump series. (See Figure 5.)

When a single shaft seal is used, a steel ball is pressed into the body. (See Figure 5a.)

Double shaft seal models use a plastic plug to seal the body drain opening. This prevents external contamination from entering the area between the seals. (Refer to Figure 5b.) The outer shaft seal is rated 7 PSI from an internal source and 2 PSI from an external source.

Double shaft seal models require a different shaft that may or may not be interchangeable with previous designs. This is due to an increase in shaft shoulder length to accommodate the second shaft seal. The overall shaft length of both models are the same as previous designs.

Section IV - INSTALLATION AND OPERATING INSTRUCTIONS

A. INSTALLATION DRAWINGS

The installation drawings listed in Table 2 show correct installation dimensions and optional port locations.

B. MOUNTING AND DRIVE CONNECTIONS

High performance vane pumps are designed for foot or flange mounting.

1. Direct Drive - A pilot on the pump mounting flange (Figure 6) assures correct mounting and shaft alignment, provided the pilot is firmly seated in the accessory pad of the power source. Care should be exercised in tightening all flange mounting screws to prevent misalignment.

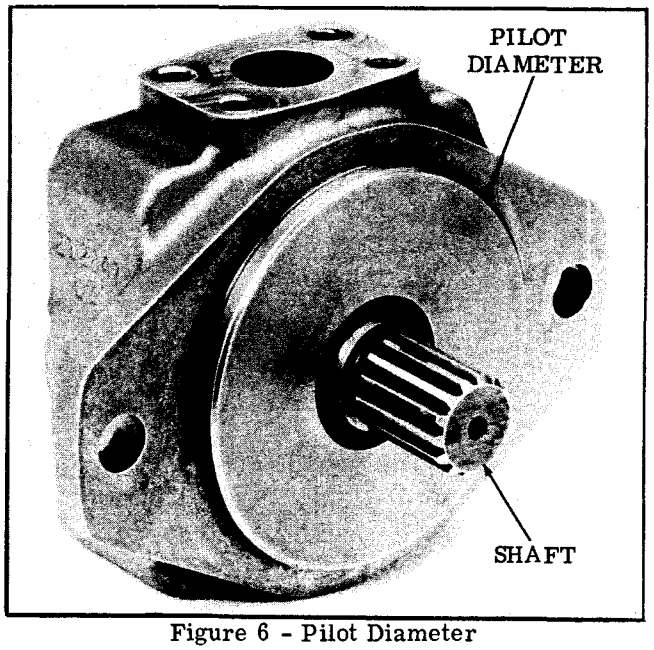


Figure 6 - Pilot Diameter

If gaskets are used between flanges, they should be installed carefully so as to lie flat and should not be the type that will take a set. Shaft keys and couplings must be properly seated to avoid slipping and possible shearing.

Proper coupling alignment is essential to prolong pump life.

CAUTION

Pump shafts are designed to be installed in couplings with a slip fit or very light press. Pounding the coupling end on the shaft can ruin the bearings. Shaft tolerances are shown on the pump installation drawings. (See Table 2.)

2. Indirect Drive - Indirect drive is not recommended for these pumps.

C. SHAFT ROTATION

NOTE

Pumps are normally assembled for right-hand (clockwise) rotation as viewed from the shaft end. A pump made for left-hand rotation is identified by an "L" in the model code. (See Table 1.)

If it is desired to reverse the direction of drive rotation, it is necessary to disassemble the pump and reverse the location of the cartridge inlet and outlet support plates. (See Section VI.)

CAUTION

Never drive a pump in the wrong direction of rotation. Seizure may result, necessitating extensive repairs.

D. PIPING AND TUBING

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sandblasting, wirebrushing and pickling.

NOTE

For instructions on pickling refer to instruction sheet 1221-S.

2. To minimize flow resistance and the possibility of leakage, use only as many fittings and connections as are necessary for proper installation.

3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow. Tubing must not be bent too sharply. The recommended radius for bends is three times the inside diameter of the tube.

E. HYDRAULIC FLUID RECOMMENDATIONS

GENERAL DATA

Oil in a hydraulic system performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components with particular emphasis on hydraulic pumps. Any oil selected for use with pumps is acceptable for use with valves or motors.

Data sheets for Industrial Applications order I-286-S. For Mobile Applications order M-2950-S.

The oil recommendations noted in the data sheets are based on our experience in industry as a hydraulic component manufacturer.

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your sales or engineering representative.

CLEANLINESS

To insure the hydraulic system is clean:

1. Clean (flush) entire new system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminants into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

4. Provide continuous protection of system from entry of airborne contamination, by sealing the system and/or by proper filtration of the air.

5. Proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over emphasized.

6. Good system and reservoir design will insure that aeration of the oil is kept to a minimum.

SOUND LEVEL

Noise is indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining optimum reduction of system sound levels.

Some of the major factors affecting fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start-up temperatures can cause pump noises due to cavitation.

2. Running with a moderately high viscosity fluid will slow the release of entrained air. The fluid will not be completely purged of such air in the time it remains in the reservoir and air will be recycled through the system.

3. Aerated fluid can also be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings, or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

4. Contaminated fluids can cause excessive wear of internal pump parts which may result in increased sound levels.

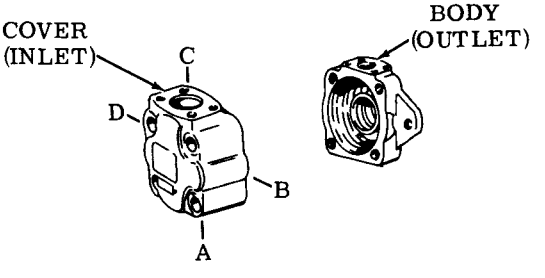
F. OVERLOAD PROTECTION

A relief valve must be installed in the system as close to the pump outlet as possible. The relief valve limits pressure in the system to a prescribed maximum and protects the components from excessive pressure. The setting of the relief valve depends on the work requirements of the system.

G. PORT POSITIONS

The pump cover can be assembled in four positions with respect to the body. A letter in the model code (Table 1) identifies the cover position as shown in Figure 7.

Disassembly and assembly procedures are in Section VI-B and D.



MODEL	INLET COVER POSITIONS (Viewed From Cover End)
VQA-***A-20(L)	Opposite Outlet Port
VQA-***B-20(L)	90° Clockwise From Outlet
VQA-***C-20(L)	Inline With Outlet
VQA-***D-20(L)	90° Counterclockwise From Outlet

Figure 7. Cover Positions

H. START-UP

Whenever it is possible to do so, fill the pump ports with system hydraulic fluid. This will make it easier for the pump to prime when it is first started.

Self-Priming – With a minimum drive speed of 600 RPM, a pump should prime almost immediately. Failure to prime within a reasonable length of time may result in damage due to lack of lubrication. Inlet lines must be tight and free from air leaks. However, it may be necessary to crack a fitting on the outlet side of the pump to purge entrapped air.

No-Load Starting – These pumps are designed to start up with no load on the pressure ports. They should never be started against a load or a closed center valve.

Section V – SERVICE, INSPECTION AND MAINTENANCE

A. SERVICE TOOLS

Two special tools are required to service these pumps. A driver should be used to assure installation of the primary shaft seal without damage, and a "bullet" should be placed over the end of the shaft, to avoid damaging the seal lip when the shaft is installed. Installation of the secondary seal does not require a driver. (See Figure 5.)

The driver can be made from tubular stock as shown in Figure 8. The tool applies a uniform pressure to the recessed area of the seal, rather than to the lip of the seal. The inside diameter of the tool will not interfere with the garter spring located around the lip of the seal.

Pump Series	Length "A" (Inches)	Undercut "B" (Inches)	O.D. "C" (Inches)	I.D. "D" (Inches)
20VQ 25VQ	3.500	.281	1.580	1.375
35VQ	3.500	.331	1.765	1.622
45VQ	3.750	.375	2.187	1.938

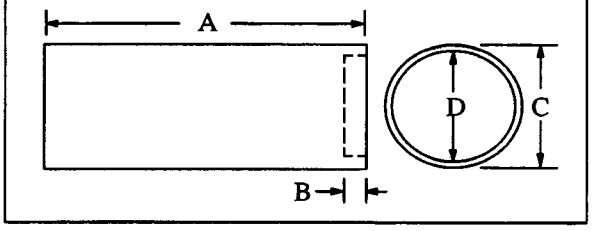


Figure 8. Primary shaft seal driver

B. INSPECTION

Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly.

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the system, resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants. If the fluid becomes contaminated the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. Air bubbles in the reservoir can ruin the pump and other components. If bubbles are seen, locate the source of the air and seal the leak. (See Table 3.)

5. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operations corrected.

C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to replenish the system, it should always be poured through a fine wire screen (200 mesh or finer) or preferably pumped through a 10 micron (absolute) filter.

It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

D. ADJUSTMENTS

No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

E. LUBRICATION

Internal lubrication is provided by the fluid in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

F. REPLACEMENT PARTS

Reliable operation throughout the specified operating range is assured only if genuine manufacturer's parts are used. Sophisticated design processes and material are used in the manufacture of these parts. Substitutions may result in early failure. Part numbers are shown in the parts drawing listed in Table 2.

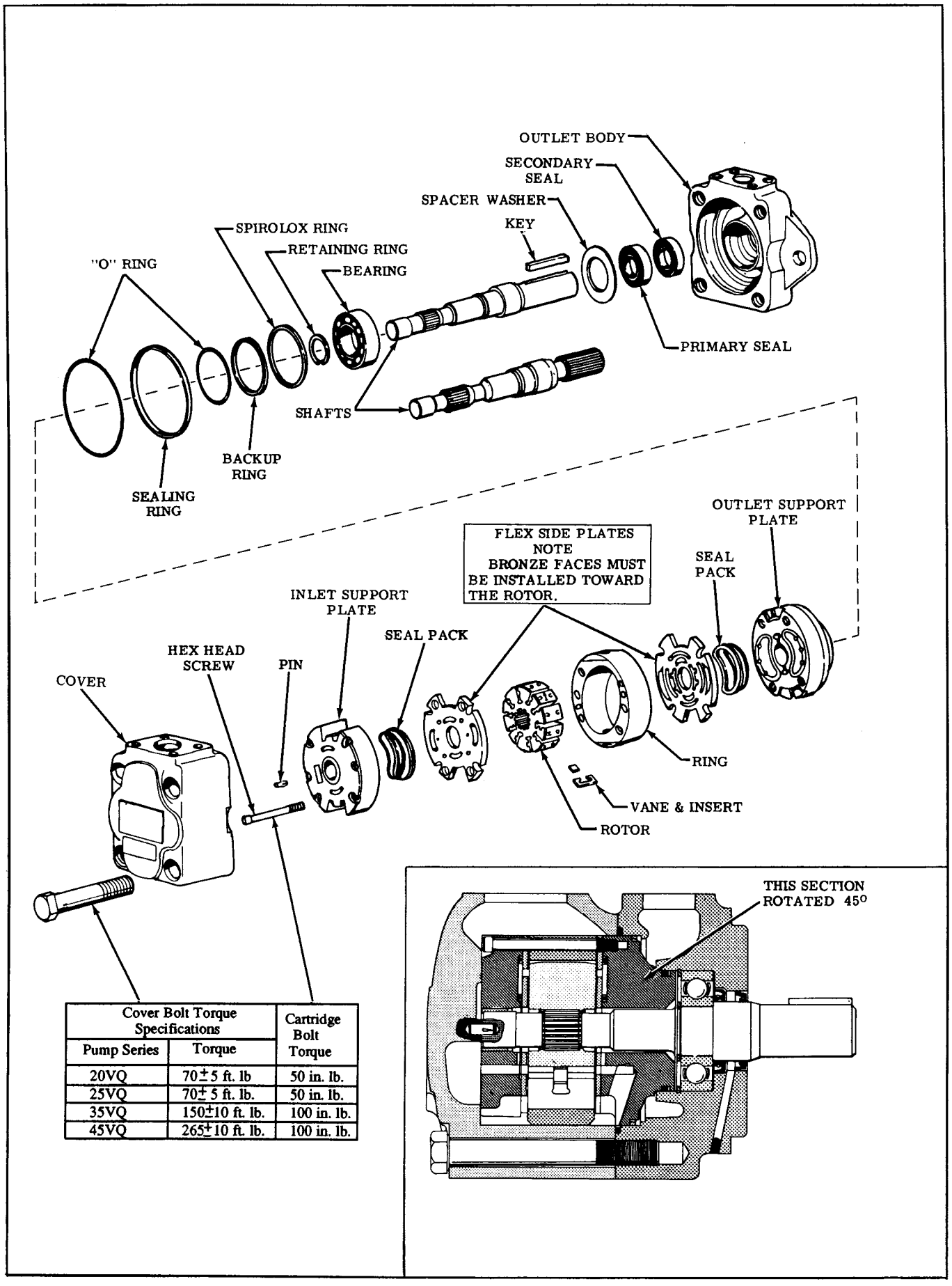
G. TROUBLESHOOTING

Table 3 lists the common difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

It should always be remembered that many apparent pump failures are actually the failures of other parts of the system. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid	Driven in the wrong direction of rotation	The drive direction must be changed immediately to prevent seizure. Refer to section VI.D. for the correct ring position for each direction of rotation.
	Coupling or shaft sheared or disengaged	Disassemble the pump and check the shaft and cartridge for damage. (See Section VI.) Replace the necessary parts.
	Fluid intake pipe in reservoir restricted	Check all strainers and filters for dirt and sludge. Clean if necessary.
	Fluid viscosity too heavy to pick up prime	Completely drain the system. Add new filtered fluid of the proper viscosity.
	Air leaks at the intake. Pump not priming	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump.
	Relief valve stuck open. (Models with integral relief valve only)	Disassemble the pump and wash the valve in clean solvent. Return the valve to its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the lands or attempt to polish the bore. Wash all parts and reassemble the pump.
	Vane(s) stuck in the rotor slot(s)	Disassemble the pump. Check for dirt or metal chips. Clean the parts thoroughly and replace any damaged pieces. If necessary, flush the system and refill it with clean fluid.
Insufficient pressure build-up	System relief valve set too low	Use a pressure gage to correctly adjust the valve.
Pump making noise	Pump intake partially blocked	Service the intake strainers. Check the fluid condition and, if necessary, drain and flush the system. Refill with clean fluid.
	Air leaks at the intake or shaft seal. (Oil in reservoir would probably be foamy)	Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening.
	Pump drive speed too slow or too fast	Operate the pump at the recommended speed.
	Coupling misalignment	Check if the shaft seal bearing or other parts have been damaged. Replace any damaged parts. Realign the coupled shafts.

Table 3. Troubleshooting Chart



Cover Bolt Torque Specifications		Cartridge Bolt Torque
Pump Series	Torque	
20VQ	70±5 ft. lb	50 in. lb.
25VQ	70±5 ft. lb.	50 in. lb.
35VQ	150±10 ft. lb.	100 in. lb.
45VQ	265±10 ft. lb.	100 in. lb.

Figure 9 - Exploded and cross-section views of typical pump

NOTE

Complete cartridges are available in service kits for rebuilding these pumps. Refer to the parts drawings listed in Table 2 for part numbers. If a replacement cartridge is being installed, proceed as in step B-1 for disassembly and step D-2 for assembly.

WARNING

Before breaking a circuit connection, be certain that power is off and the system pressure has been relieved. Lower all vertical cylinders, discharge all accumulators and block any load whose movement could generate pressure. Plug all units and cap all lines to prevent entry of dirt into the unit or system.

A. GENERAL

Plug all removed units and cap all lines to prevent the entry of dirt into the system. During disassembly, pay particular attention to identification of the parts, especially the cartridges, for correct assembly. Figure 9 is an exploded view which shows the proper relationship of parts for disassembly and assembly. Refer to Figure 1 and Figure 9 for the correct assembled relationship of the parts. Various steps in the overhaul process are shown in Figures 10 through 22.

B. DISASSEMBLY

1. Basic Pump - Remove the foot mounting and shaft key, if used. Support the pump on blocks or clamp the body in a vise as shown in Figure 10. If a vise is used, use protective jaws to avoid damage to the body and its machined surfaces. Mark the pump body and cover for correct reassembly. Remove four cover screws and lift the cover off the pump.

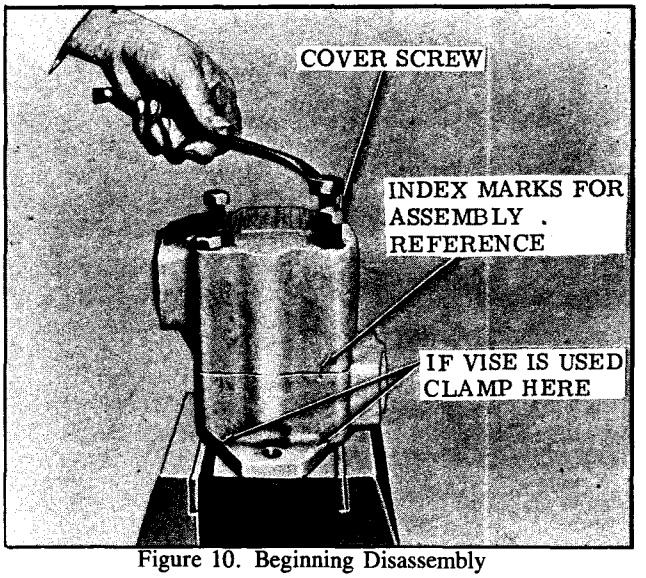


Figure 10. Beginning Disassembly

Remove the cover "O" ring. Pull and/or pry out the cartridge as shown in Figure 11.

Remove the large spirolox ring and pull the shaft and bearing from the body. Drive the shaft seals out of the body. If it is necessary to remove the shaft bearing, first remove the small snap ring and then press the shaft out of the bearing while supporting the bearing inner race.

2. Cartridge Disassembly

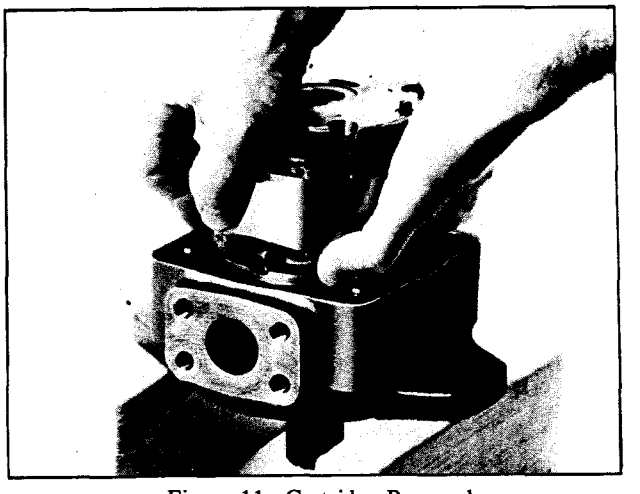


Figure 11. Cartridge Removal

a. Remove the "O" ring, back-up ring and square sealing ring from the outlet support plate.

b. Scribe a line across the outer surface of the cartridge kit. (See Figure 12.) The scribe marking will provide a reference for parts during assembly.

c. Place the cartridge on a flat surface (outlet support plate down) and remove the two socket head screws.

CAUTION

Do not slide flex side plates across the ring and rotor. Burrs on the ring or rotor can cause deep scratches in the soft brass surface.

d. Slide the inlet support plate and seal packs off the cartridge. DO NOT allow the flex side plate to slide with the support plate. (See Figure 13.)

Move the flex side plate off center just enough to grab the edge and lift up and away without sliding. (See Figure 14.)

If a small flat piece of wood is available, place it over the ring and rotor and reverse the cartridge to have the outlet support plate pointing up. (See Figure 15.) Slide the outlet support plate and seal packs off the cartridge, do not allow the flex side plate to slide with the support plate. Refer to Figure 16.

Move the flex side plate off center just enough to lift up and away without sliding. (See Figure 17.)

Remove the cam ring from the rotor and vanes. Locate the arrow stamped into the rotor periphery. Remove the vanes and inserts in order, starting at the arrow. Keep them in order for inspection. (See Figure 18.)

NOTE

Do not remove cartridge locating pins from the inlet support plate unless they are damaged. The pins are of a drive-loc type and can be difficult to remove.

C. INSPECTION AND REPAIR

CLEANING. All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water contamination.

1. Discard the shaft seal(s), "O" rings, back-up rings and seal packs. Use a new seal kit for reassembly. Refer to parts drawings noted in Table 2 for kit numbers. Wash the metal parts, blow them dry with air and place on a clean surface for inspection.

2. Check the cartridge wear surfaces for pickup, scoring and excessive wear. Slight heat discoloration of the flex side plate bronze surface is normal. Score marks deeper than .001 inch and scratches deeper than .002 inch indicate a new part is needed. Slight scoring and/or scratches can be removed with an oiled Arkansas stone.

CAUTION

DO NOT use a dry stone on the bronze surface or scratches will result.

3. Inspect both sides of each vane and insert in order. If pickup, heavy wear or scoring is found, inspect the appropriate rotor slot. Replace scored parts. Refer to the parts drawings noted in Table 2 for part numbers.

4. Inspect the cam ring for vane chatter marks, wear and/or scratches. Replace if scoring is evident.

CAUTION

Replacement ring width must be identical to the ring being replaced or reduced life and/or output flow will result. The minimum ring to rotor clearance limits are noted below.

MODEL	Min. Clearance limit in inches
**20VQ	0.0007
**25VQ	0.0012
**35VQ	0.0015
**45VQ	0.0016

Minimum Allowable Ring Rotor Clearance

NOTE

All cartridge kit parts must be free of burrs. Stone the mating surfaces of each part with an oiled Arkansas stone prior to assembly.

NOTE

Pre-assembled replacement cartridge kits are available. If the old cartridge is worn extensively, a new kit should be used. Refer to the parts drawings listed in Table 2.

5. Vane and rotor wear can be checked by inserting the vane in the rotor slot and checking for excessive play. Replace the rotor and vanes if wear is evident.

6. Rotate the bearing while applying pressure to check for wear, looseness and pitted or cracked races.

7. Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if marks cannot be removed by light polishing.

D. ASSEMBLY

NOTE

Coat all parts except seals and back-up rings with clean hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold the "O" rings in place during assembly.

IMPORTANT

During handling and shipping of the precision machined cartridge parts, it is possible to raise burrs on the sharp edges. All sharp edges on the parts of a new cartridge kit should be stoned prior to installation.

NOTE

To reverse direction of a new cartridge kit, simply reverse location of the inlet and outlet support plates, and realign the cartridge with the cover. See steps V.D.1. h through j.

1. Cartridge - The direction of rotation is as viewed from the shaft end; right-hand rotation is clockwise; left-hand, counterclockwise.

NOTE

If locating pins were removed from the inlet support plate, install new pins with locking flutes located within the inlet support plate. Drive the new pins into the support plate, with a soft tip hammer.

a. Place the inlet and outlet support plates on a flat surface as shown in Figure 19. Install seal packs into cavities with seal retainer surface up. ("O" rings facing downward into the cavities.)

b. Place a flex side plate over each of the support plates with bronze wear surface facing up. Align scribe marks to make sure the correct flex side plate is used with the correct support plate.

NOTE

Flex side plates develop a wear pattern with the rotor and vanes and should not be interchanged.

c. For right-hand rotation units, set the rotor on the flat wooden board with the arrow pointing right. (For left-hand rotation the arrow should point left.) Assemble the vanes and inserts into the rotor in reverse order. (See Figure 18.) Make sure the sharp chamfer edge of each vane leads in the direction of rotation. All vanes must move freely in the rotor slots with no evidence of bind.

d. Assemble the cam ring over the rotor and vanes with the arrow pointing in the same direction as the rotor. Lubricate the top surface of the rotor and vanes liberally with system fluid.

e. Locate the scribe mark on the cam ring, the outlet support plate, and the flex side plate.

Hold the outlet support plate and flex side plate together and assemble over the cam ring and rotor with the scribe marks in-line.

f. Hold the cartridge together to prevent movement and turn the assembly over so the outlet support plate rests on a flat surface, and the flat wooden board is up. (See Figure 20.) Remove the flat wooden board.

g. Lubricate the exposed surface of the rotor and vanes with system fluid. Locate the scribe mark on the inlet support plate and flex side plate. Hold the inlet support plate and flex side plate together and assemble over the cam ring and rotor with scribe marks in-line. (See Figure 21.)

NOTE
The cast-in arrows located next to the socket head screws, indicate cartridge direction of rotation.

h. Thread the two socket head screws into the cartridge until snug (hand tight).

NOTE
The O.D. of all component parts of the cartridge kit must be in-line with each other or the cover cannot be installed. Align the cartridge as follows:

i. Install the cover over the cartridge. Tap lightly on the cover with your hand until each part centers. Remove the cover gently so as not to disturb alignment. Torque socket head screws to the torque noted on Figure 9, and recheck kit alignment with the cover. Repeat until cartridge kit is aligned. (See Figure 22.)

j. Check the rotor for bind by inserting the index finger through the shaft opening of the inlet support plate. Hold the cartridge kit in a horizontal shaft position and lift the rotor with the finger. The rotor should move freely back and forth within the cartridge. If the rotor binds, open the kit, clean and stone all possible areas of bind, then reassemble using the aforementioned procedure. The rotor MUST move freely within the cartridge when assembled.

2. Basic Pump - Clamp the body in a vise or place on 2×4 wooden blocks to facilitate assembly. (See Figures 10 and 11.)

a. Lubricate the primary shaft seal with petroleum jelly and place in position within the body, garter spring up. See Figure 5 for seal arrangements.

b. Use the seal installation tool shown in Figure 8 to prevent damage to the seal. Press the seal into the body until it bottoms out.

NOTE
Two shaft seal arrangements are available in the VQ pump series. See Figure 5 and Table 1. If the pump model code (Table 1) indicates that a secondary seal is required, perform the following step.

c. Lubricate the secondary seal with petroleum jelly and place the seal in position against the shaft end of the body. See Figure 5b. Use a small hardwood block to drive the seal evenly into the body. Installation is complete when the seal face is flush with the front of the body. DO NOT drive the seal past flush as it can block the body drain opening.

NOTE
If the shaft bearing was defective, install a new bearing as follows:

d. Press the shaft into the new bearing with an arbor press while supporting the bearing inner race. Refer to Figures 5 and 9 for correct location of bearing on the shaft. Install a small snap ring behind the bearing.

e. Place the bearing spacer washer over the shaft, against the front of the bearing. Use a "bullet" over the shaft end to prevent damage to the seal(s). Lubricate the "bullet" with petroleum jelly and carefully push the shaft through the sels until the bearing and spacer is in location within the body. Install the large spirolox ring into the body snap ring groove behind the bearing.

f. Install the square sealing ring into the body. See Figures 1 and 9 (sectional view) for location.

g. Install the "O" ring and back-up ring on the cartridge, outlet support plate hub. See Figure 9 for location.

h. Carefully install the cartridge into the body so one of the chamfers on the cam ring aligns with the cover inlet port.

i. Lubricate and install the large cover to body "O" ring in place.

j. Install the cover in position; move back and forth until the cartridge pins drop into the cover holes.

k. Oil and install the cover to body bolts (4 required). Torque to the value noted in Figure 9.

l. Turn the pump shaft by hand to verify freedom of the cartridge.

Section VII - TESTING

Industrial and Mobile application engineering personnel should be consulted for test stand circuit requirements and construction. If test equipment is available, the pump should be tested at the recommended speeds and pressures shown on the installation drawings (see Table 2).

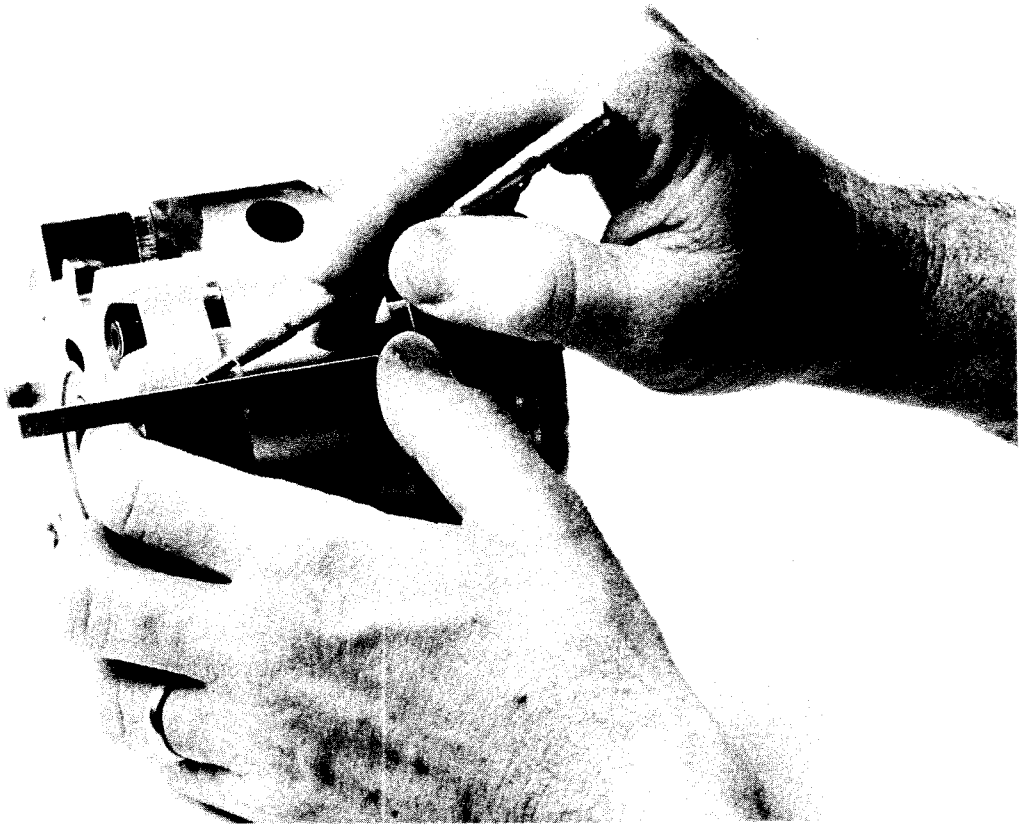


Figure 12 - Scribing the cartridge.

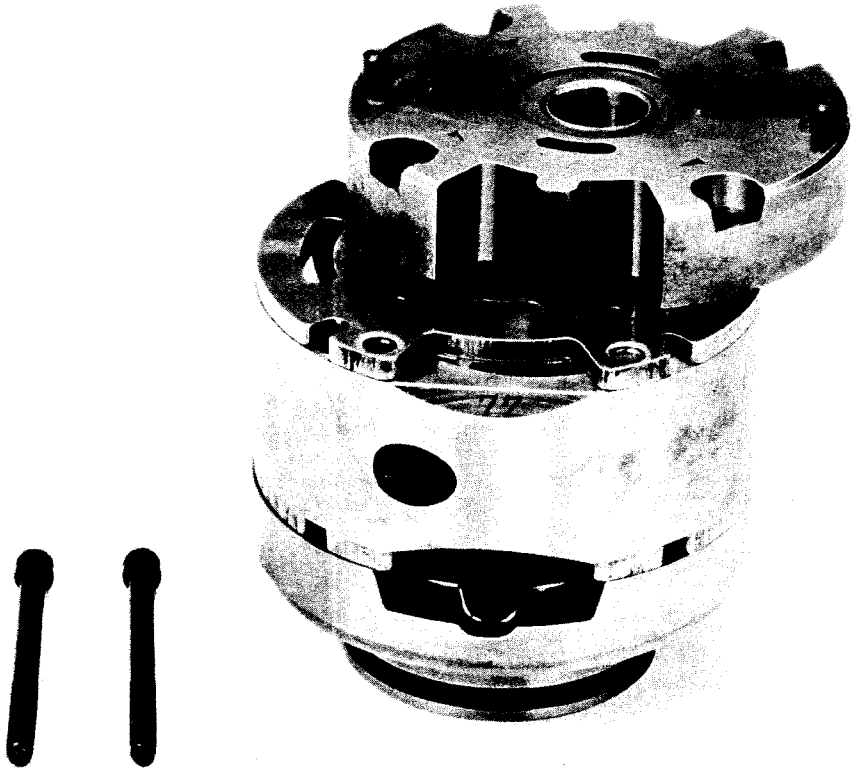


Figure 13 - Inlet support plate removal.

Figure 14. Inlet Flex Side Plate Removal

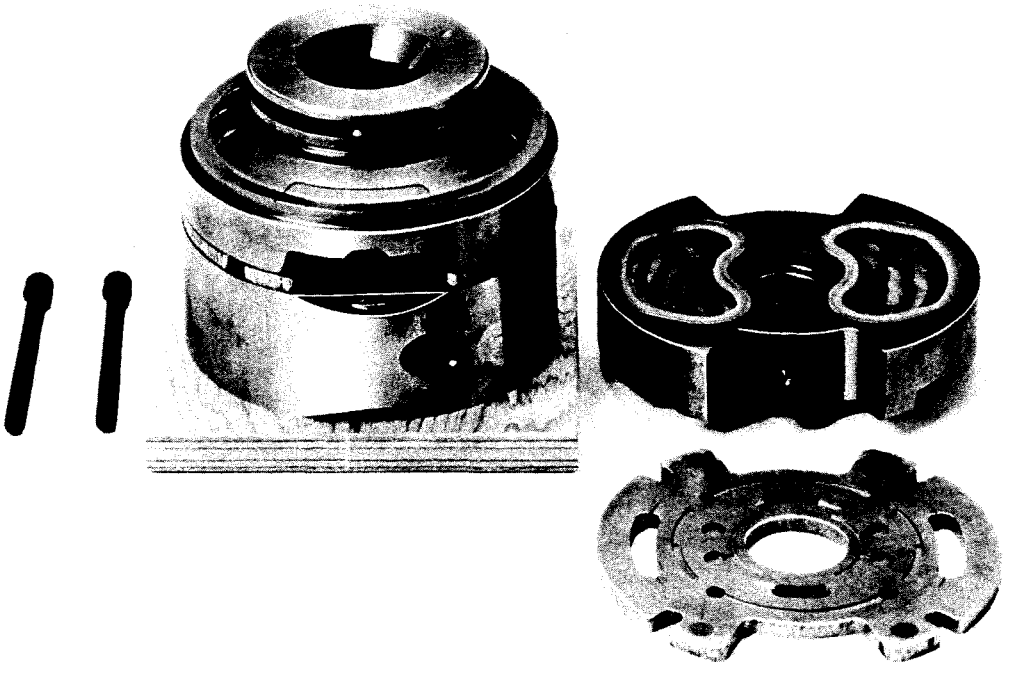


Figure 15. Reverse cartridge, use a piece of wood to hold ring, rotor and vanes

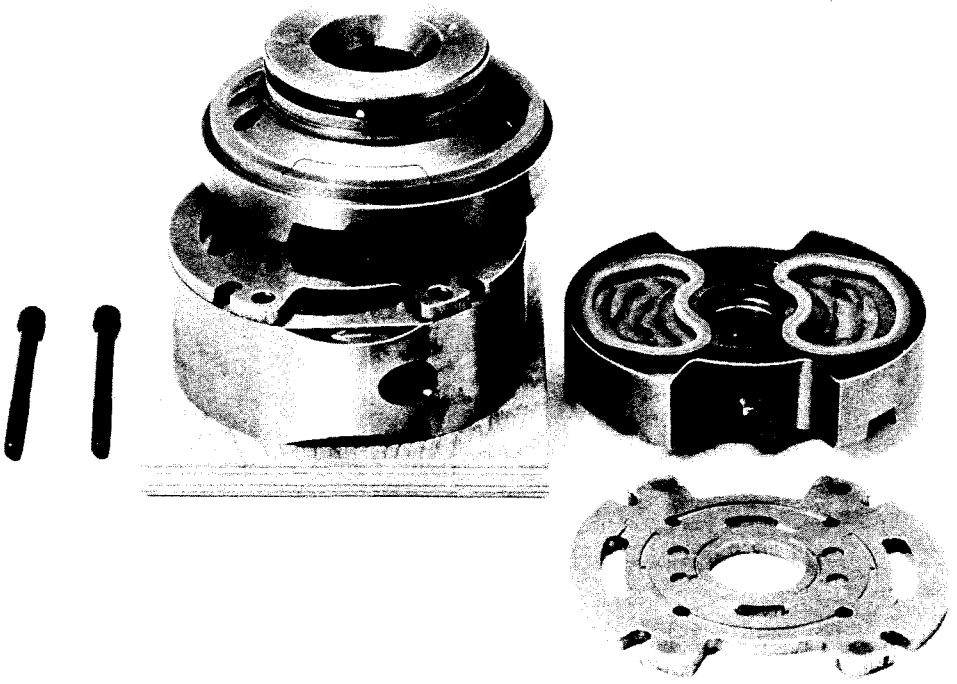


Figure 16. Outlet Support Plate Removal

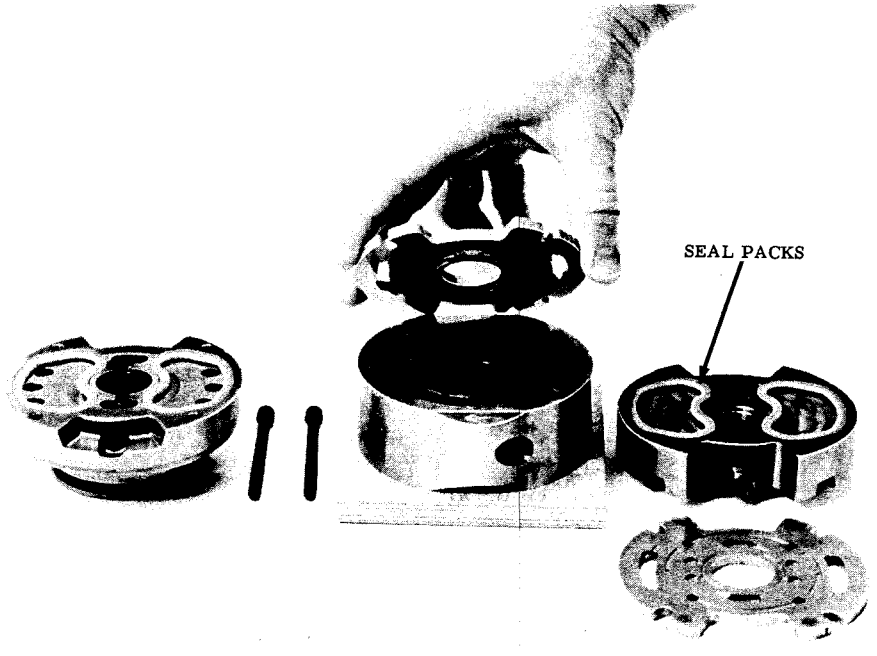


Figure 17. Outlet Flex Side Plate Removal

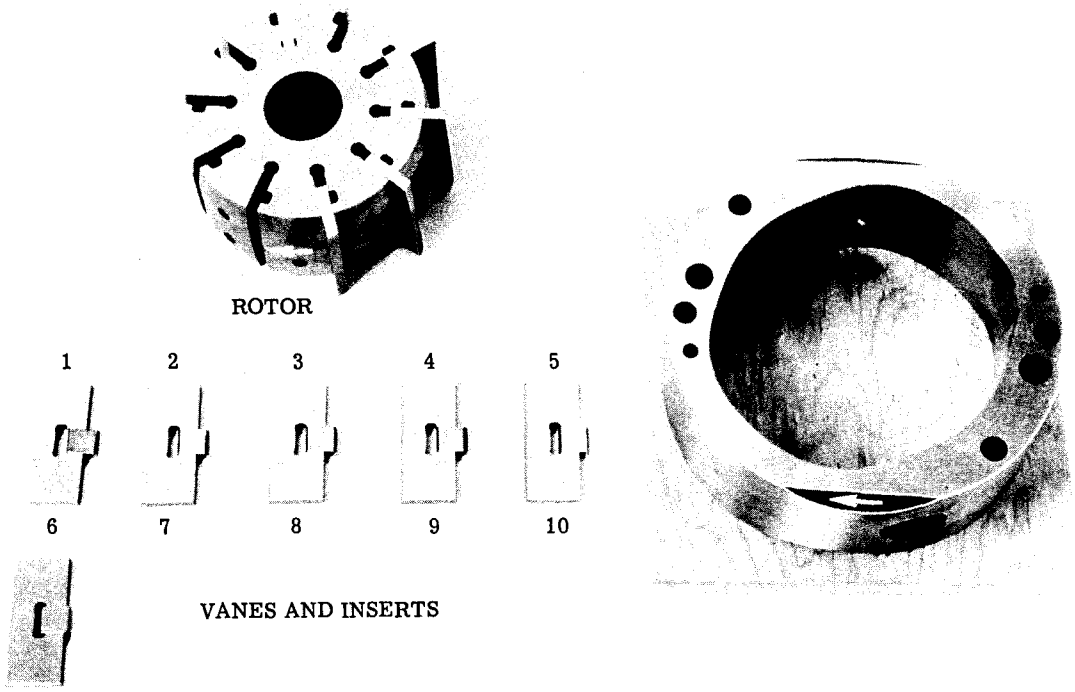


Figure 18. Sequential removal of vanes from rotor. Starting at arrow on rotor.

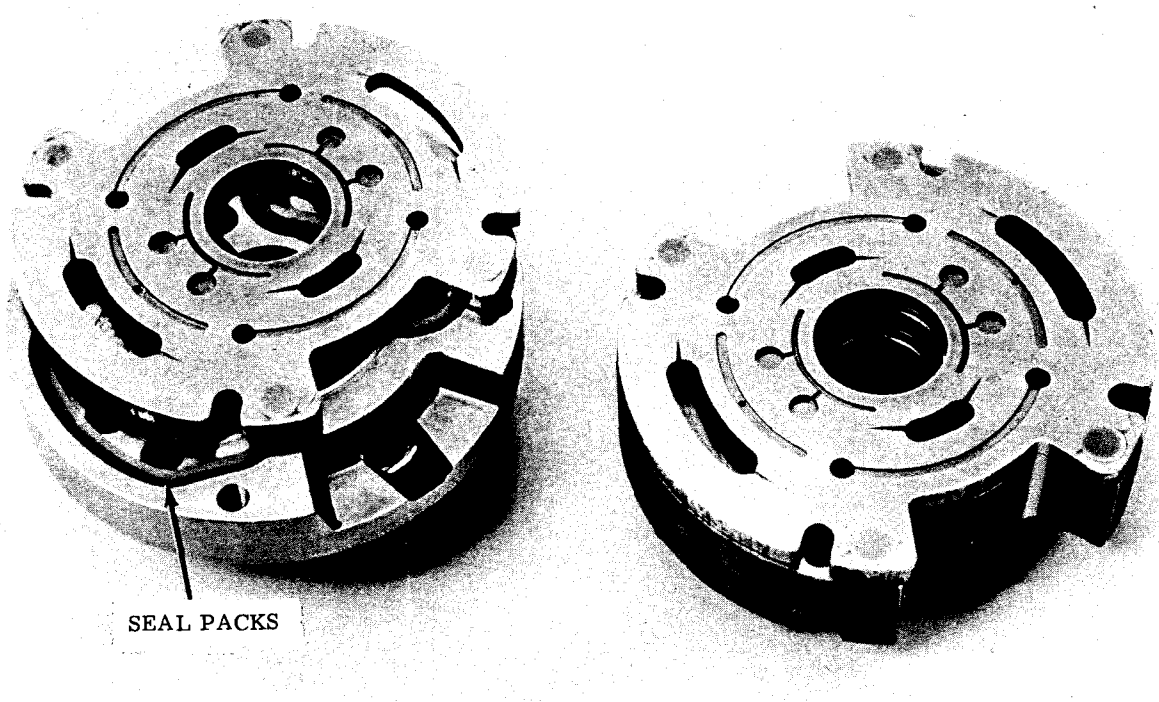


Figure 19. Assembly of flex side plates over seal packs onto the inlet and outlet support plates.

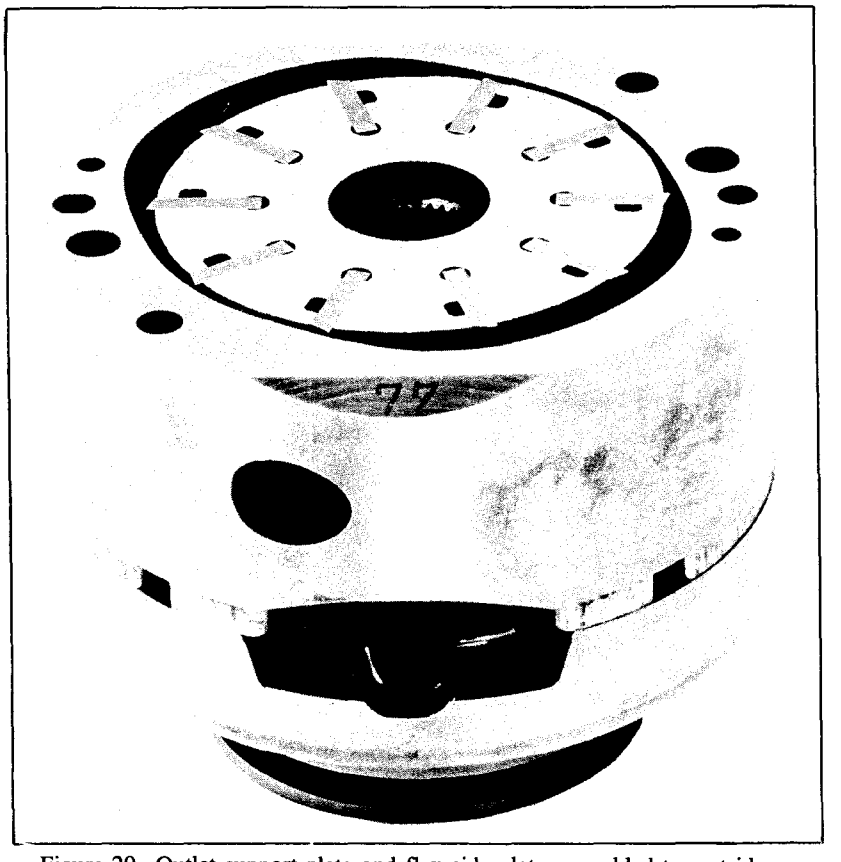


Figure 20. Outlet support plate and flex side plate assembled to cartridge. Ready for installation of inlet support plate and flex side plate.

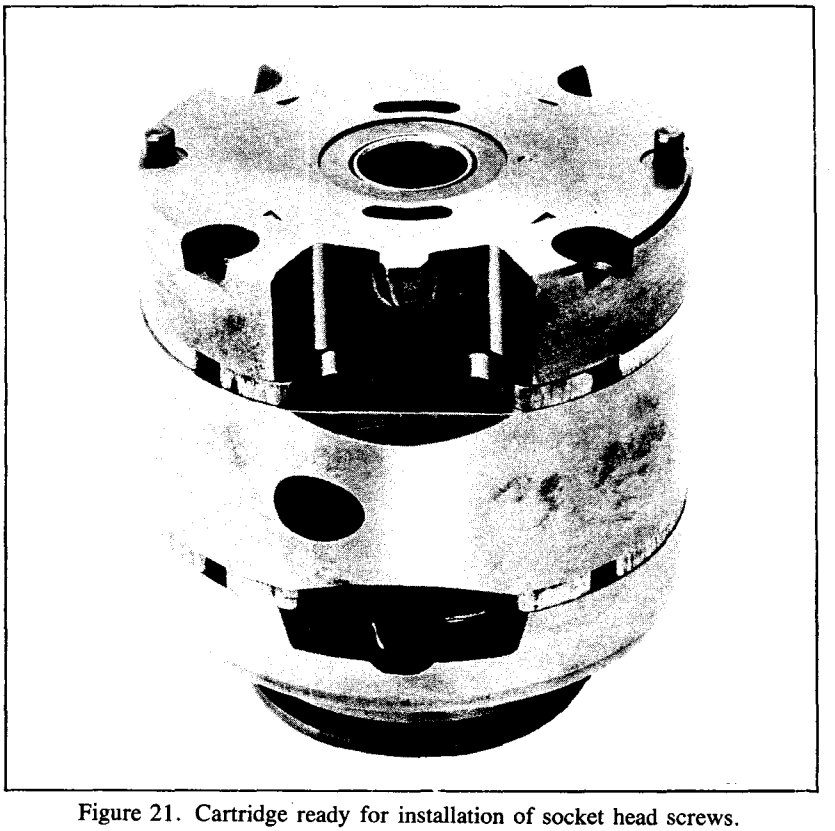


Figure 21. Cartridge ready for installation of socket head screws.

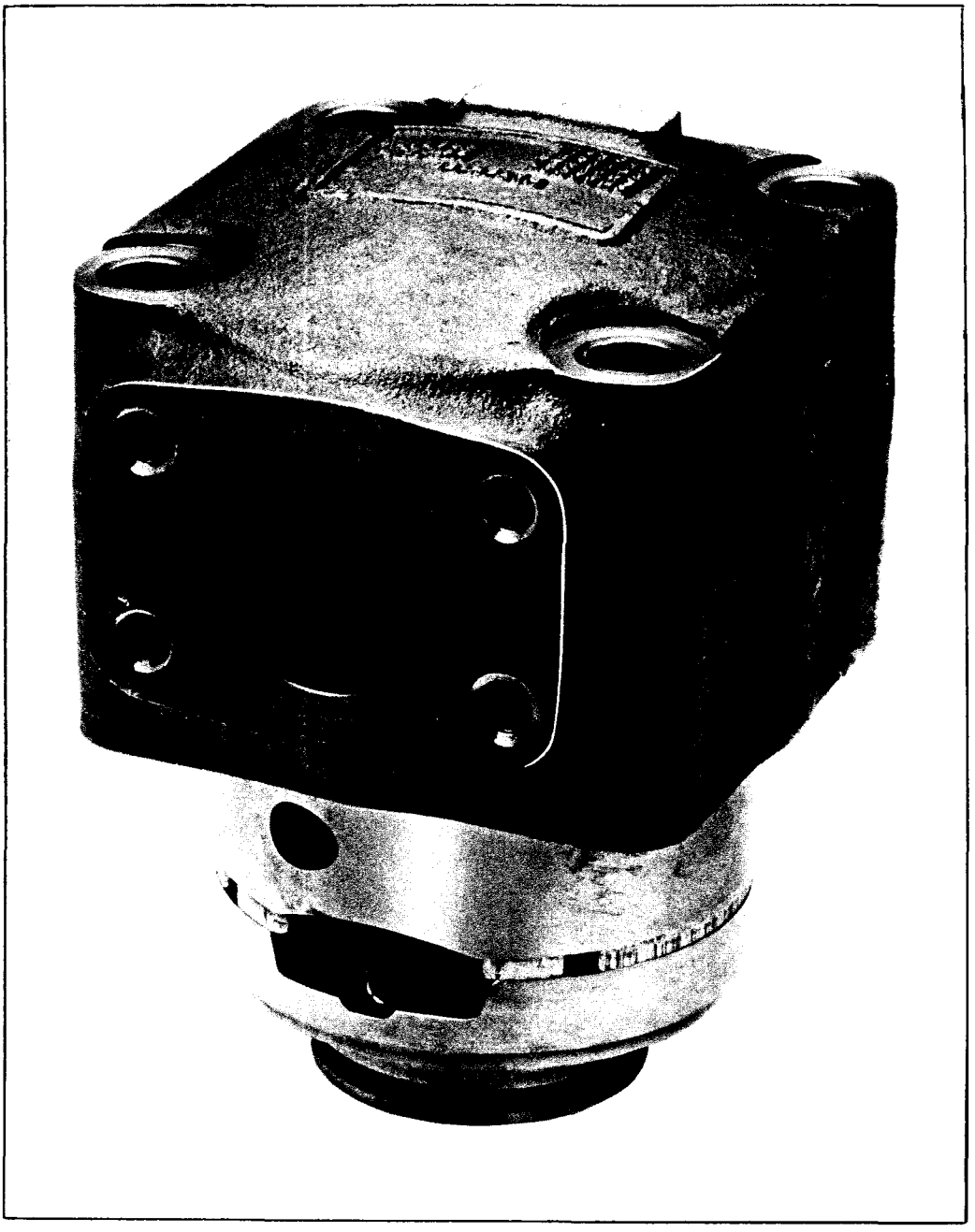


Figure 22. Aligning cartridge kit with cover.