

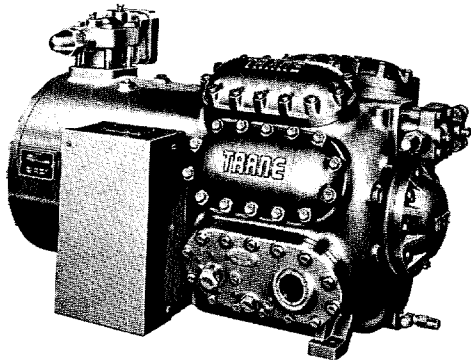
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AUGUST, 1969  
 SUPERSEDES 2D2E  
 MARCH, 1966

# HERMETIC RECIPROCATING COMPRESSORS

## COMPRESSOR SERVICE AND OVERHAUL

### MODEL F 4-5-6 AND 8 CYLINDERS DESIGN SEQUENCE A AND B



The Model F Hermetic Reciprocating Compressor may be serviced without being removed from its base or foundation. Handhole covers are provided for inspection, cleaning and repair without tearing down the entire compressor. However, it may be advantageous to set the compressor on a work bench or table when performing a complete overhaul.

Preselective fit is not required with Trane compressor parts. All parts may be replaced with standard stock items.

As parts are removed, do the following:

1. Clean each part with a refrigerant parts cleaner.
2. Inspect each part for evidence of wear, breakage or copperplating. As a guide for replacement, Table 1 lists tolerances and wear limits.
3. Coat each part with clean compressor oil.

1. Use new gaskets and "O" rings.
2. Use a torque wrench when tightening bolts or nut and bolt combinations. Improper tightening can cause premature wear, stripping of threads or even failure of a part. Table 2 lists the torques to be followed.
3. Lubricate all bearing surfaces before placing in the machine. This will enable the compressor to run without seizing when it is first started up and before oil pressure is built up.

Before repairing, pump down the compressor and close the suction and discharge service valves. If the compressor cannot be operated, close the service valves and relieve the pressure. Open the system disconnect switch and lock in that position or remove the fuses from the switch. If the compressor is being removed from its base or foundation, support the suction and hot gas lines

TABLE 1—Recommended Wear Limits and Tolerances

PART NAME	ORIGINAL SPEC.	RECOMMENDED LIMIT	MAXIMUM RECOMMENDED OIL CLEARANCE
MAIN BEARINGS	2.1265 - 2.1280	2.1305	.0055
CRANKSHAFT - MAINS	2.1245 - 2.1250	2.1230	
CONROD - CRANK PIN (VERT.)	2.0022 - 2.0030	2.006	.007
CRANKSHAFT - CRANK PIN	1.9995 - 2.0000	1.997	
PISTON PIN	.8748 - .8750	.8744	.0011
CONROD - PIN BORE (VERT.)	.87505 - .87530	.8755	
CYLINDER LINER	2.7500 - 2.7505	2.7520	.0035
PISTON (PERPENDICULAR TO CENTERLINE OF PIN BORE)	2.7480 - 2.7487	2.7470	
PISTON RINGS (GAP IN 2.7500 GA.)	.007 - .017	.040 COMPRESSION RINGS .060 OIL RINGS	
VALVES (ALL)	VALVES ARE .033" THICK - SHOULD BE REPLACED WHEN SEAT GROOVE WEAR DEPTH EXCEEDS .010" (.023" THINNEST SECTION).		
VALVE SPRINGS (ALL)	WHENEVER COMPRESSOR IS DISASSEMBLED FOR SERVICING, VALVE SPRINGS SHOULD BE REPLACED WHERE THEY HAVE OPERATED IN EXCESS OF 5000 HOURS ON R-12 OR 3000 HOURS ON R-22.		
BELLOWS SPRINGS	REFRIGERANT 12		REFRIGERANT 22
	BLACK		GREEN
ALLOWABLE AIR GAP, ROTOR AND STATOR - .008 - .010 SIDE TO SIDE.			
END PLAY (CRANKSHAFT) - .015"-.025"			

NOTE 1—The above recommended wear rates are for individual parts. For mating parts, the maximum recommended oil clearance should predominate. In most cases this means that both mating parts should not each be at the recommended limit dimension.  
 NOTE 2—These recommended limits are listed as good practice for normal service rebuilding of compressors which will be reliable when put back into service. It is not necessary to rebuild a compressor when these limits are anticipated.

**TABLE 2—Bolt Torques**

ITEM	TORQUE FOOT-POUNDS	ITEM	TORQUE FOOT-POUNDS
CYLINDER HEAD BOLTS	43	CONNECTING ROD BOLTS	14
DISCHARGE VALVE BOLTS	40	OIL PUMP MOUNTING BOLTS	14
HANDHOLE COVER BOLTS	43	OIL PUMP COVER BOLTS	43
SIGHT GLASS MOUNTING BOLTS (B DESIGN)	6	SUCTION COVER BOLTS	58
DISTRIBUTOR COVER BOLTS	23	MOTOR BEARING BOLTS	23
CAPACITY CONTROL BOLTS	23	MOTOR TERMINAL NUTS	2½
SUCTION SERVICE VALVE MOUNTING BOLTS	115	MOTOR TERMINAL LUGS	2½
SUCTION SERVICE VALVE FLANGE SCREWS	115	MOTOR TERMINAL LUG SET SCREWS	14
DISCHARGE SERVICE VALVE MOUNTING BOLTS	58	MOTOR TERMINAL BOARD RETAINING RING BOLTS	14
DISCHARGE SERVICE VALVE FLANGE SCREWS	12		
MOTOR ROTOR BOLTS	135		

**TABLE 3—Operating Data**

NO. CYLINDERS	BORE	STROKE	R.P.M.	NOM. TONNAGE		VALVE CONNECTIONS		WEIGHT		OIL PRES-SURE	OIL CA-PACITY	RECOMMENDED OILS
				R-12	R-22	SUCTION	DISCHARGE	R-12	R-22			
4	2-3/4"	2"	1750	13	20	2-1/8"	1-3/8"	770	810	50-60	18 PTS.	* (1) ANSUL 300
5	2-3/4"	2"	1750	15	25	2-1/8"	1-5/8"	800	850	50-60	19 PTS.	* (2) CITIES SERVICE—TRANE 1001
6	2-3/4"	2"	1750	20	30	2-5/8"	1-5/8"	830	880	50-60	19 PTS.	* (3) STANDARD OIL OF INDIANA—LM INDUSTRIAL # 32-P
8	2-3/4"	2"	1750	25	40	2-5/8"	1-5/8"	890	950	50-60	20½ PTS.	

\* THESE OILS ARE COMPATIBLE AND MAY BE MIXED

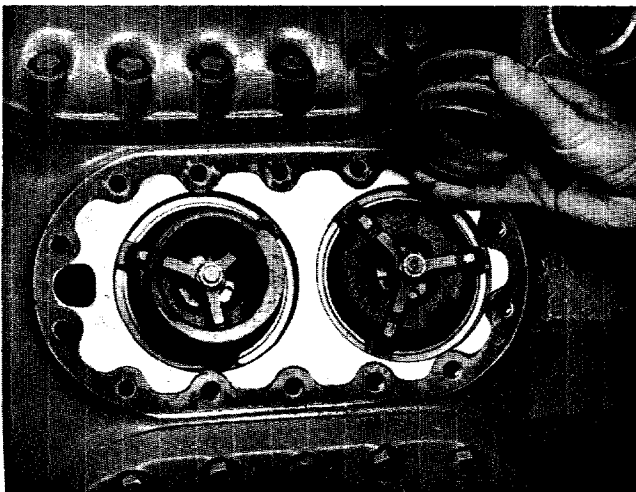
to prevent undue strain on the piping and joints. Plug the compressor control lines to prevent entry of foreign matter. Tag or mark the motor electrical leads as they are removed for ease of reassembly.

The following procedures detail methods of removing, inspecting and reinstalling each compressor part. The sequence is also correct for complete compressor tear-down.

**CYLINDER HEAD**

**TO REMOVE:**

Loosen and remove all but two cylinder head bolts at opposite ends of the cylinder head. Back off the remaining two bolts two or three turns. If the cylinder head is not following the bolts, jar the head with a rawhide hammer. Loosen the last two bolts alternately to relieve the tension of the safety head springs. When the bolts have been removed, lift off the cylinder head and safety head springs (Figure 1).



**FIGURE 1—Removing Safety Head Spring.**

**INSPECTION:**

The cylinder head and housing sealing surfaces should be smooth and level. Nicks or grooves will not provide the proper seal.

**TO INSTALL:**

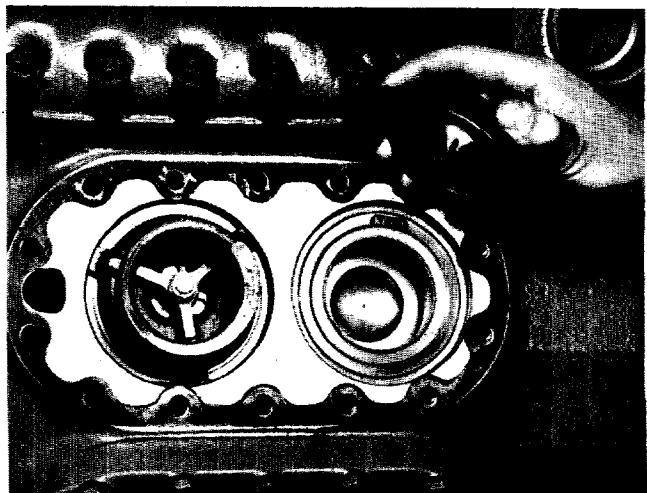
Center the safety head springs on the discharge valve cage assemblies (Figure 1). Insert two bolts (on opposite sides) through the cylinder head, oil the cylinder head gasket with clean compressor oil and place on the cylinder head using the two bolts as a guide. Turn the two bolts two or three full turns and check the safety head springs to be sure they are still in proper position. Draw the head down evenly by tightening the two bolts alternately. Insert the remaining bolts and tighten all bolts to final torque.

Torque—43 Foot-Pounds

**DISCHARGE VALVE**

**TO REMOVE:**

Remove cylinder head (see "To Remove Cylinder Head"). Lift off safety head springs (Figure 1). Lift off discharge valve cage (Figure 2).



**FIGURE 2—Removing Discharge Valve Cage.**

## TO DISASSEMBLE DISCHARGE VALVE:

Loosen locknut on discharge valve bolt. Remove valve bolt and seat. Remove valve ring, springs, cushion retainer and cushion (Figure 3).

## INSPECTION:

Inspect all discharge valve parts for evidence of copper-plating, liquid slugging or wear. See Table 1 for valve and valve spring replacement data.

## TO ASSEMBLE DISCHARGE VALVE:

Place valve cushion into the discharge valve cage making sure that the outer edge of the cushion is tucked into the undercut slot in the valve cage. Press valve cushion retainer into place (Figure 3). Place valve springs into the spring pockets in valve cage. Lay the valve ring over the springs (Figure 4) and insert valve seat and cage bolt into the cage assembly. Before tightening locknut, make sure the valve ring registers in the valve guide (Figure 5). Attach locknut and tighten. Recheck valve ring movement to make sure that it is not restricted (Figure 5). Tighten to final torque.

Torque—40 Foot-Pounds

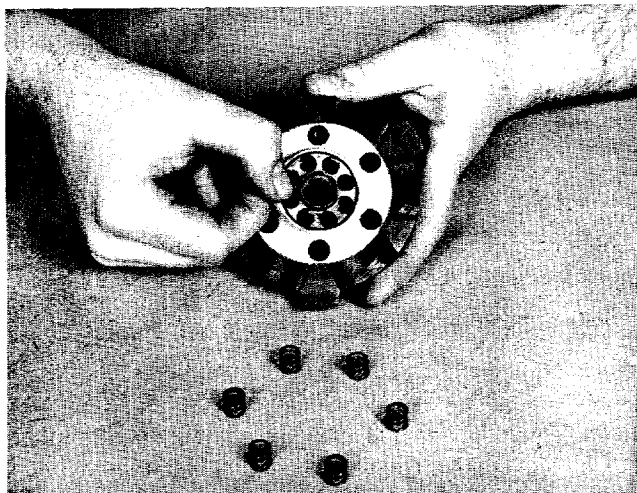


FIGURE 3—Inserting Discharge Valve Cushion Retainer.

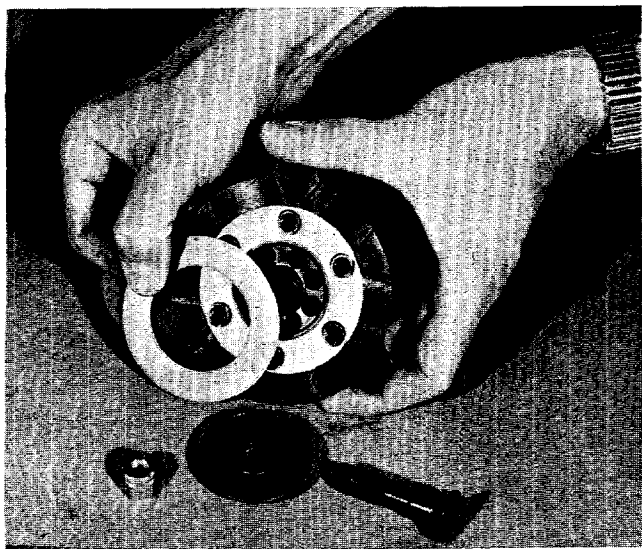


FIGURE 4—Inserting Discharge Valve.



FIGURE 5—Checking Valve Movement.

## TO INSTALL:

Set the valve assembly in place, making sure that it seats properly.

## SUCTION STRAINER ASSEMBLY

### TO REMOVE:

Remove all of the suction cover screws with the exception of the top screw. Back out the top screw 10 or 12 full turns. The cover plate is provided with jackscrew holes and two of the cap screws should be inserted into these jackscrew holes to assist in breaking the seal. Remove the top screw while supporting the weight of the cover. The strainer pan is attached to the cover and is removed with the cover (Figure 6).

### INSPECTION:

Inspect the suction strainers for dirt or damage to the wire mesh. If necessary, clean or replace.

The oil filter at the bottom of the strainer assembly cannot be cleaned. If it is dirty or the wire mesh is damaged replace the filter.

### TO INSTALL:

With the suction strainer assembly attached to the cover, place two screws in the cover (opposite sides).

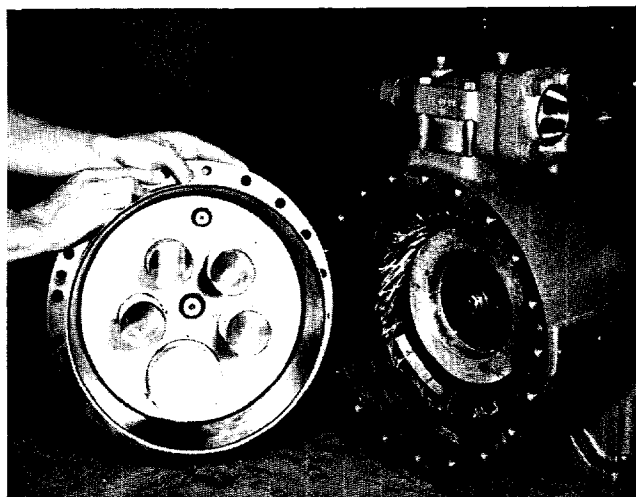


FIGURE 6—Removing Suction Strainer Assembly.

Lubricate the cover gasket and place on the cover using the screws as a guide. Set the assembly against the housing and draw the screws up hand tight. Insert and tighten the remaining screws and tighten all screws to final torque.

Torque—58 Foot-Pounds

## CYLINDER LINERS

Cylinder liners can be removed and replaced without removal of the piston and connecting rod assemblies.

### TO REMOVE:

Remove cylinder head, safety head spring and discharge valve cage assembly from above the cylinder liner to be removed (see "To Remove Discharge Valve"). The suction valve plate which is mounted on the top of the cylinder liner is tapered in toward the top. A metal liner puller block is available which fits this taper (Figure 7).

Rotate the crankshaft until piston head is down about two inches from the top surface of the valve plate. Place liner puller block in cylinder so that tapered ends fit inside of valve plate and hold in position. Rotate the crankshaft until piston head contacts puller block and continue to rotate shaft, forcing cylinder liner out of housing. After cylinder assembly is forced out beyond the "O" ring seal (Figure 8) it can be withdrawn by hand.

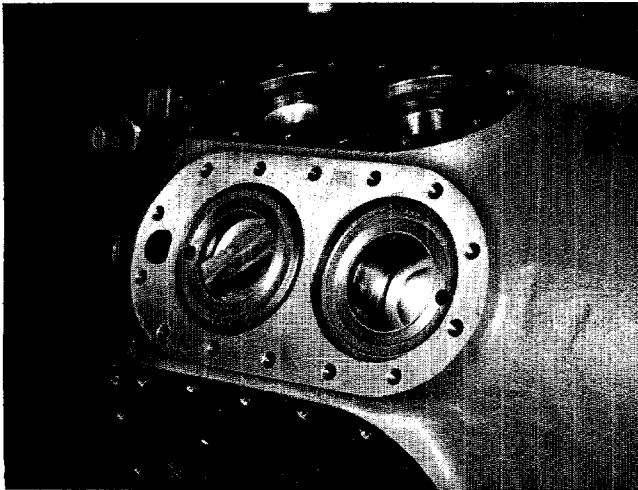


FIGURE 7—Liner Puller Block.



FIGURE 8—Pulling Cylinder Liner.

Support the piston to prevent it from falling against the housing as the liner is pulled out of the housing.

On cylinder liners equipped with unloaders, the unloader mechanism may come out with the cylinder liner.

In some cases it may be impossible to rotate the crankshaft. In such cases it will be necessary to remove the handhole covers and drive the cylinder liners out by hand. This is done by placing a small block of hard wood against the skirt of the cylinder liner and tapping against the block with a light hammer. In this fashion, drive the cylinder liner up until the "O" ring clears the top of the cylinder.

### INSPECTION:

Replace the liner if there is evidence of excessive wear or scoring on the inside wall. Wear limits are listed in Table 1.

### TO INSTALL:

#### (CYLINDER LINER ASSEMBLY WITHOUT UNLOADER)

The bottom of the cylinder liner assembly is tapered for entry of the piston and piston rings. Before placing the liner over the piston, rotate the piston rings on the piston to stagger the gap of the rings.

Rotate the crankshaft so that the piston is near the top of its stroke. While rotating the shaft, guide the piston so that it does not become wedged in the cylinder hole.

Insert the liner in the housing until the liner is against the top of the piston. Center the head of the piston in the bottom of the liner. Rock and rotate the liner on the piston, and at the same time press down firmly against the rings. The rocking and rotating motion will guide the rings into the tapered cylinder liner.

**CAUTION:** Do not hammer or attempt to force the liner over the ring. Sudden shock can cause ring breakage.

When all rings are in the liner, push the liner all the way down into the cylinder housing. Be sure it is seated in the housing.

### TO INSTALL:

#### (CYLINDER LINER ASSEMBLY WITH UNLOADER)

The only difference between installation of the liner and the liner with unloader is in the proper positioning of the unloader in the housing.

The unloader cylinder housing is fitted with a register pin and an oil connector. The underside of the unloader assembly has two holes which correspond to the above. These holes are 180 degrees apart. The register pin protrudes further from the face of the housing than the oil connector and serves as a guide for the unloader assembly. It also permits proper registration of the oil connector.

Insert the unloader assembly into the housing, making sure the holes in the unloader are aligned properly with the register pin and oil connector.

**CAUTION:** Damage to the oil connector or register pin may result if the unloader is forced into position while placed improperly in the housing.

When the unloader is in position in the housing cylinder hole, push the liner down into the housing and over the piston as described previously.

## CYLINDER UNLOADER ASSEMBLY

If high heat or dirty crankcase oil is encountered, the unloader mechanism should be disassembled and the "O" rings replaced. Figure 9 illustrates the unloader "O" rings.

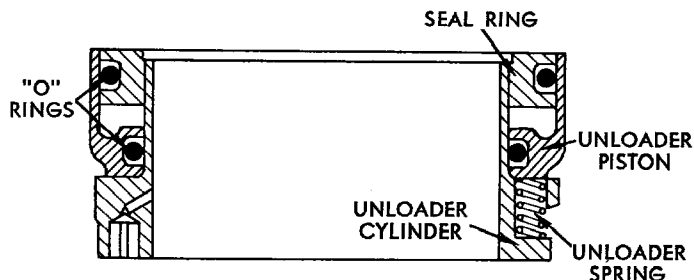


FIGURE 9—Cross Section View of Unloader.

### TO REMOVE:

In some cases it may be necessary to jar the unloader loose from the liner. This may be done by gripping the unloader assembly in the hands and striking the skirt or bottom of the cylinder liner against a soft wood surface (Figure 10).



FIGURE 10—Removing Unloader From Liner.

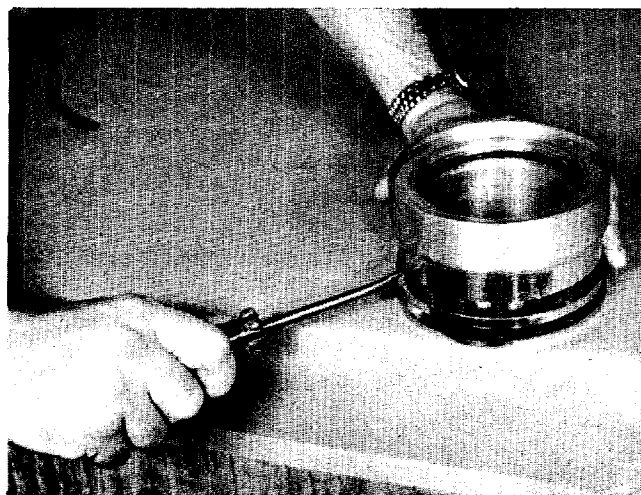


FIGURE 11—Disassembling Unloader.



FIGURE 12—Removing Seal Ring.

### TO DISASSEMBLE UNLOADER:

Work the unloader piston and seal ring off the unloader cylinder (Figure 11). A screwdriver may be used for this purpose. When the top section is free, remove the seal ring from the piston (Figure 12).

### INSPECTION:

Inspect the "O" rings for damage or deterioration and replace if necessary. The seal ring and unloader piston are not available as separate parts. If damage is noted on either part, replace the complete unloader assembly.

### TO ASSEMBLE UNLOADER:

Wet all surfaces, including "O" rings, with new, clean compressor oil. With "O" rings in place, push the unloader piston down over the unloader cylinder.

Place the seal ring on top of the unloader piston. Drive the seal ring into position as shown in Figure 13. The face of the seal ring should be approximately  $\frac{1}{4}$ " below the upper edge of the unloader piston. Be sure the "O" rings do not become damaged as this may cause excessive oil leakage into the refrigeration system.

### TO INSTALL:

The unloader mechanism should be installed in the housing followed by the cylinder liner as described in "To Install Cylinder Liner Assembly Without Unloader."

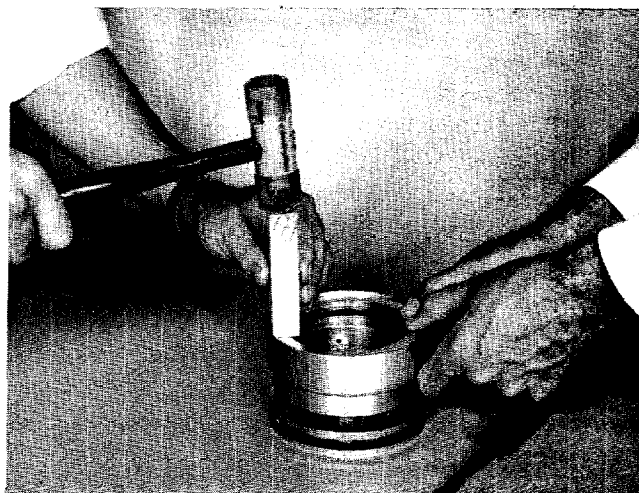


FIGURE 13—Positioning Seal Ring.

## SUCTION VALVE ASSEMBLY

### TO REMOVE:

Invert the cylinder liner and valve assembly. Remove the three retainers (Figure 14). Do not move the liner around on top of the valve assembly.

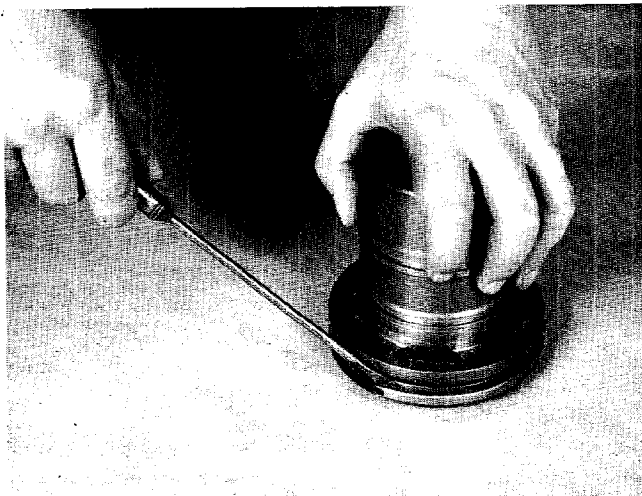


FIGURE 14—Removing Suction Valve Retaining Rings.



FIGURE 15—Lifting Off Liner.

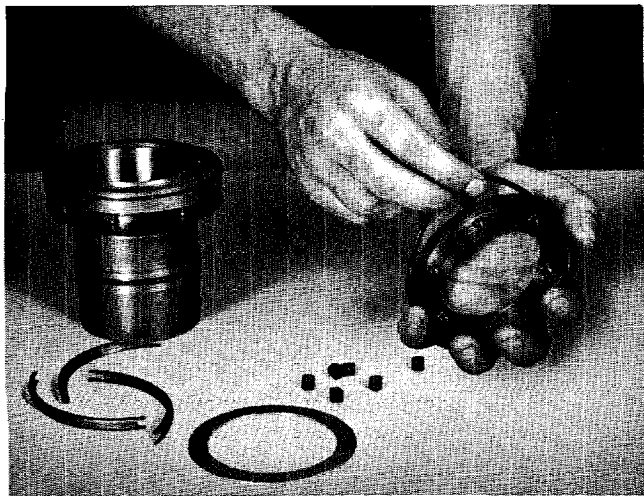


FIGURE 16—Removing "O" Ring.

Lift the liner assembly away from the valve assembly (Figure 15). With the cylinder liner separated from the valve assembly, the valve ring, springs and "O" ring can be removed (Figure 16).

### INSPECTION:

Inspect the valve ring for copperplating or wear. See Table 1 for tolerances and wear limits.

Replace the valve springs if the compressor has operated in excess of those hours listed in Table 1.

### TO ASSEMBLE:

Set the suction valve plate in an inverted position and place the "O" ring on the valve plate. Place the springs in their pockets and the valve ring in the valve plate (Figure 17). Set the valve plate assembly in an inverted position and place the cylinder liner on the valve plate (Figure 15). Fasten the suction valve assembly to the liner by installing the three retainers. One edge of these rings is wider than the other and fits into the cylinder liner (see Figure 18). Check the movement of the suction valve to see that it is not restricted within the assembly (Figure 19).



FIGURE 17—Removing Suction Valve Ring.

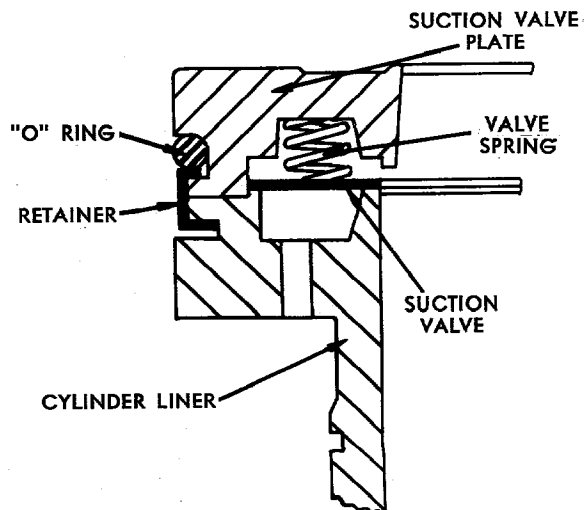


FIGURE 18—Illustration of Suction Valve Retainer.



FIGURE 19—Checking Suction Valve Movement.

## TAKE-UP RING AND LIFT PINS

### TO DISASSEMBLE:

Place cylinder liner in an inverted position. Release retaining ring (Figure 20) and slide off cylinder liner. Slide take-up ring off the cylinder liner. Remove lift pins and lift pin springs.

### INSPECTION:

Inspect the take-up ring, lift pins and springs for damage.

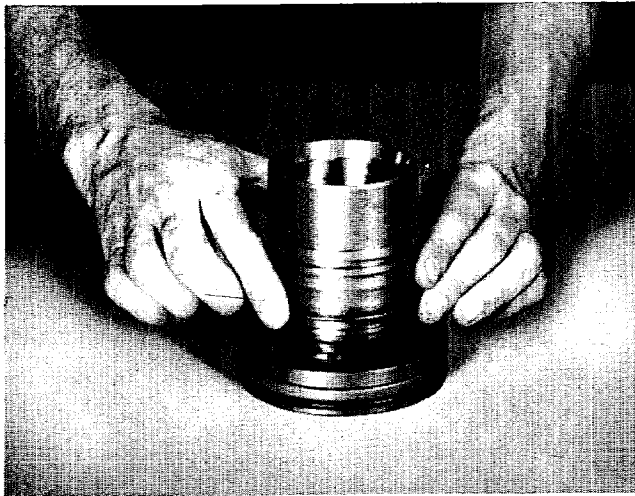


FIGURE 20—Removing Retaining Ring.

### TO ASSEMBLE:

Place cylinder liner in an inverted position. Place springs on lift pins and insert lift pins into holes on underside of cylinder liner (Figure 21). Push take-up ring down over the cylinder liner and slide retaining ring into the ring groove on the cylinder liner (Figure 20). With retaining ring in position, work the take-up ring up and down to make sure the lift pins move freely and can raise and lower the suction ring valve. Replace liner-to-unloader "O" ring.

## CRANKCASE HANDHOLE COVERS

The handhole cover at the front of the compressor contains the oil level sight glass, a cleanable oil strainer



FIGURE 21—Inserting Springs and Lift Pins.

and the compressor capacity control actuator when external electric capacity control is not used. A capacity control actuator adjustment screw is located on the front side of the cover. The handhole cover at the back of the compressor is fitted with a crankcase heater and a tapping for a crankcase oil equalizing line.

### TO REMOVE ACTUATOR BELLOWS SPRING:

Remove the adjusting screw plug and gasket on the face of the handhole cover. Using a screwdriver, remove the adjusting screw and slotted plug inside the cover. Pull the bellows spring and spring plug out of the cover. See Figure 22.

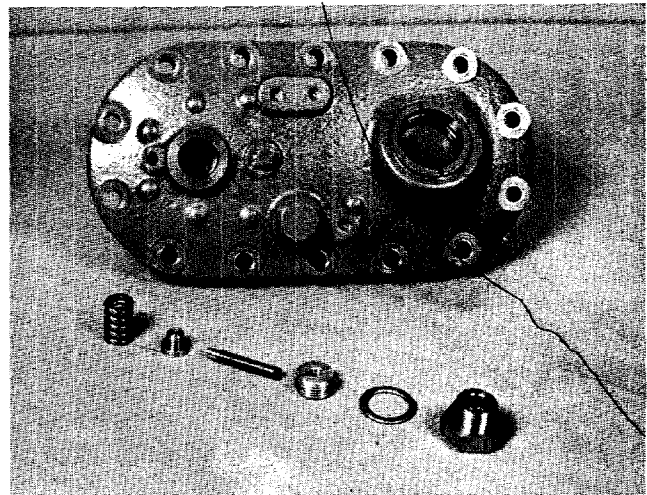


FIGURE 22—Bellows Spring and Adjusting Screw Assembly.

### INSPECTION:

Check the spring for damage and color coding. See Table 1.

### TO INSTALL BELLOWS SPRING:

Insert the bellows spring and spring plug into the handhole cover. Install the slotted plug, turning until it bottoms. Replace the adjusting screw in the slotted plug. Replace the gasket and adjusting screw plug turning hand tight.

When the system is again started, the compressor

loading and unloading sequence must be reset by the adjusting screw. See "Operation and Maintenance, Hermetic Reciprocating Compressors".

**TO REMOVE HANDHOLE COVERS:**

Remove all but the top center bolt on the handhole cover. The top screw should then be backed out approximately 8 to 10 turns. Tap lightly around the rim of the handhole cover to break it loose from the gasket. When the seal is broken, support the cover and remove the remaining screw.

**INSPECTION:**

Inspect the handhole cover and housing sealing surfaces for nicks or large grooves.

**TO INSTALL HANDHOLE COVER:**

Insert two bolts through the cover (opposite each other), oil the gasket with clean compressor oil and place the gasket down over the cover using the two bolts as a guide. Insert the bolts and pull them up hand tight. Insert the remaining bolts, pull them up hand tight and then tighten all bolts to final torque.

Torque—43 Foot-Pounds

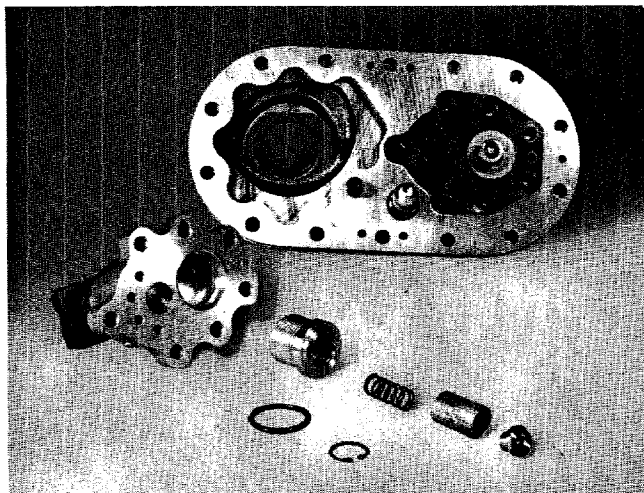


FIGURE 23—Bellows Assembly.

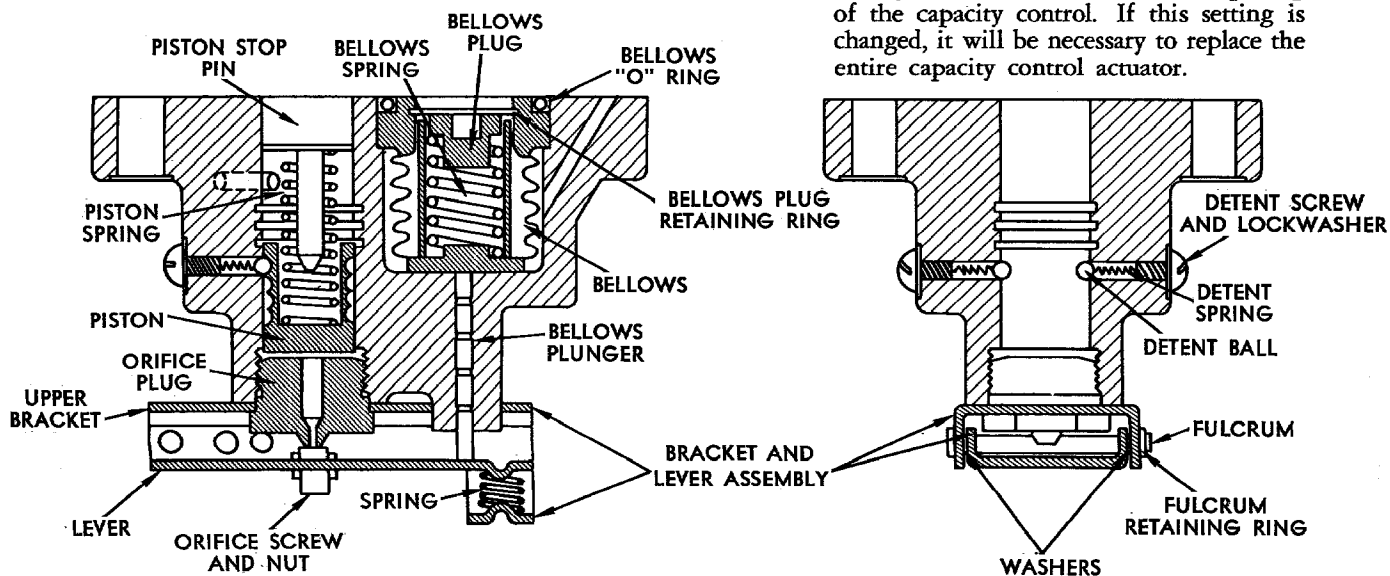


FIGURE 24—Cross Section Views of Capacity Control Actuator.

**TO REMOVE OIL STRAINER:**

Remove the plug on the face of the handhole cover. Withdraw the "O" ring, spring and oil strainer.

**INSPECTION:**

Clean or replace the oil strainer as necessary.

**TO INSTALL OIL STRAINER:**

Insert the oil strainer into the handhole cover and place the spring over the top of the oil strainer. Place the "O" ring and plug on the handhole cover and tighten the plug hand tight.

**CAPACITY CONTROL ACTUATOR**

**TO DISASSEMBLE CAPACITY**

**CONTROL ACTUATOR:**

Remove the bolts that hold the capacity control actuator to the handhole cover.

Remove the bellows assembly "O" ring and remove the bellows assembly from the actuator. To disassemble the bellows, remove the retaining ring and pull the spring, spring plug and sleeve out of the bellows (Figure 23).

Remove the retaining ring from the fulcrum pin that holds the lever of the bracket assembly. Remove the fulcrum pin, lever and two small washers. Loosen the orifice plug and remove it from the actuator housing (Figure 24).

To remove the internal piston and piston spring, remove the two detent screws, washers, springs and balls at the sides of the actuator housing. After they have been removed, the piston and piston spring will drop out of the actuator housing. All parts can now be cleaned. Parts of the bellows assembly may be replaced if necessary. However, parts are not available for the piston, spring, orifice plug and detent assembly. If they become worn or broken, a new capacity control actuator must be installed.

**CAUTION:** Do not attempt to adjust or otherwise turn or remove the orifice screw and nut that are attached to the lever of the bracket assembly. They have been factory set to control the orifice opening of the capacity control. If this setting is changed, it will be necessary to replace the entire capacity control actuator.



## TO ASSEMBLE CAPACITY CONTROL ACTUATOR:

Set the piston spring down over the piston stop pin inside the actuator housing. Slide the piston into position. Insert the detent balls, springs, washers and retaining screws. Install the orifice plug and upper bracket.

Replace the lever of the bracket assembly and fasten in place with the fulcrum pin and retaining ring. The two small washers should be placed between the upper channel and lever to act as bearing surfaces. Insert the spring.

Place the sleeve, spring and spring stop into the bellows assembly. Fasten in place with the retaining ring. Set the bellows assembly into the actuator and replace the bellows assembly "O" ring.

Set the complete control actuator assembly and gasket on the handhole cover and attach with the seven bolts. Tighten to final torque.

Torque—23 Foot-Pounds

## CONNECTING ROD AND PISTON ASSEMBLY

### TO REMOVE:

Remove cylinder head (see "To Remove Cylinder Head," Page 2). Remove discharge valve cage (see "To Remove Discharge Valve Cage," Page 2). Remove suction strainer assembly (see "To Remove Suction Strainer," Page 3). Remove cylinder liner (see "To Remove Cylinder Liner," Page 4). Remove handhole covers (see "To Remove Handhole Covers," Page 8). Rotate the crankshaft until the connecting rod nuts are accessible through the handhole cover. Remove the two nuts and two washers from the connecting rod bolts.

With a block of wood or lightweight mallet, slowly and alternately drive the connecting rod bolts up through connecting rod. When body-bound section of the bolt is free of the connecting rod cap, the cap may be removed. After the cap has been removed, the piston and connecting rod assembly may be drawn out through the top of the cylinder.

### INSPECTION:

Follow the wear limits listed in Table 1 for the connecting rods and crankpins. Check for evidence of copperplating and make sure the oil control holes are open in the piston head.

### TO INSTALL:

Lubricate the bearing surfaces on the rod and shaft with clean compressor oil. Because connecting rod bolts are body-bound, they must be driven into the connecting rod with a lightweight mallet or hammer (see Figure 25). Be sure that the beveled side of the head of the connecting rod bolt is turned toward the shank of the connecting rod.

All connecting rods have two marked marks which identify the rod and cap as a unit. **THESE TWO MATCH MARKS MUST BE ASSEMBLED SO THAT THEY ARE ON THE SAME SIDE OF THE ROD.** On the crankshaft, the **MATCH MARKS MUST FACE THE DISCHARGE END OF THE COMPRESSOR.**

Invert cylinder liner on clean work surface using care not to mar the valve seat on the top side of the liner assembly. Rotate the piston rings on the piston to stagger



FIGURE 25—Inserting Connecting Rod Bolts.

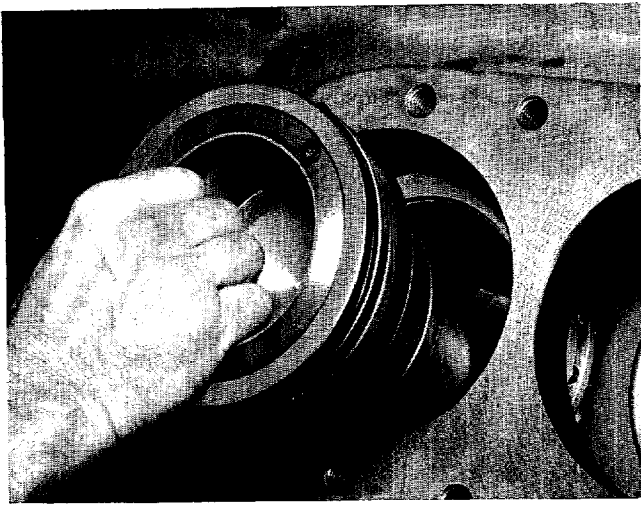
the gap in the piston rings. Start the head of the piston down into the cylinder liner. The cylinder liner skirt is tapered to assist the entry of the piston and ring into the liner. With the piston started into the liner, rotate and rock the piston and at the same time press down firmly on the skirt of the piston (see Figure 26). After all rings have passed the bottom of the liner skirt, push the piston down into the liner until the bottom of the piston is even with the bottom of the cylinder liner.



FIGURE 26—Inserting Piston and Connecting Rod Assembly Into Liner.

Rotate the crankshaft until the shaft journal is in position to accept the connecting rod. Lower the entire assembly down into the cylinder (Figure 27). Press the liner into final position (see "To Install Cylinder Liner with Unloader," Page 4). With the rod in position against the shaft, place the cap on the connecting rod bolts. Be sure that the match marks are correct.

Place the connecting washers and nuts in place and tighten the connecting rod nuts on the bolts. When drawing up the connecting rod nuts, do so alternately to



**FIGURE 27—Installing Liner and Piston Assembly In Crankcase.**

pull the cap up against the rod evenly. It is essential that all connecting rod nuts be drawn tight with a torque wrench. Improper tension will cause distortion of the rod and result in premature wear or failure of the connecting rod bearings.

Torque—14 Foot-Pounds

**CAUTION:** After connecting rod bolts and nuts have been tightened to proper torque, rotate the crankshaft to make sure that the rod turns freely. Repeat as each rod is installed.

## PISTON AND WRIST PIN ASSEMBLY

### TO REMOVE:

Remove the two snap rings that hold the wrist pin in the piston. Drive the pin out through the wrist pin hole, using a wood block or a brass driving rod. Use care not to nick the surface of the piston or distort the shape of the hole.

### INSPECTION:

Check the piston pin and pin bore tolerances as listed in Table 1. Replace the pin and/or piston if grooves are found on the bearing surfaces. Check the oil control holes in the piston to be sure they are open.

### TO INSTALL:

Place the connecting rod in the piston and drive the wrist pin through the connecting rod by tapping lightly with a rawhide mallet and brass driving rod. When the wrist pin is in position, insert the two wrist pin locking rings.

## PISTON RINGS

Always replace piston rings as a set. A set consists of two compression rings and one oil ring.

### TO REMOVE:

The piston rings can be removed from the piston by using shim stock between the rings and the piston. Carefully work the rings out of the groove and slide them over the shim stock and off the piston.

### INSPECTION:

The ring grooves must be clean and must not contain burrs. Roll the back edge of the rings in the grooves to make sure they fit freely. Table 1 contains wear limits and tolerances.

### TO INSTALL:

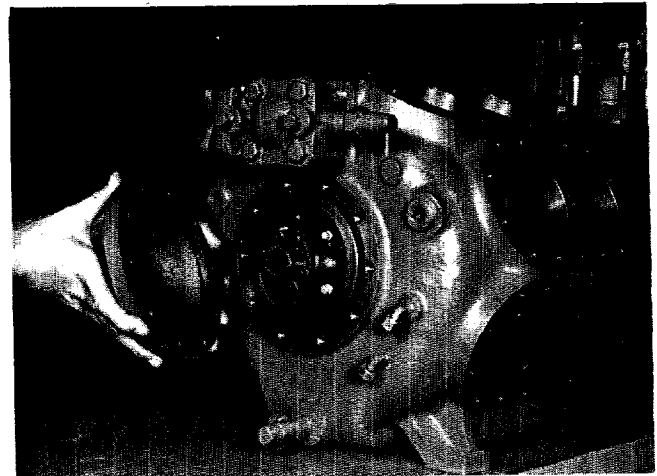
To install the rings, work them carefully down over the piston to their proper groove, using shim stock to slide the rings into position. The oil control ring goes in the bottom groove on the piston and the two compression rings go in the upper two grooves with the chamfer on the inside diameter of the ring facing the top of the piston. When the rings are in final position, be sure they move freely in their grooves.

## OIL PUMP ASSEMBLY

The oil pump is a complete assembly and cannot be repaired in the field. If it becomes inoperative, the complete pump must be replaced.

### TO REMOVE:

Loosen and remove the screws which hold the oil pump cover and "O" ring to the housing (Figure 28).



**FIGURE 28—Removing Oil Pump Cover.**

The oil pump assembly is bolted to the pump end bearing. Remove the four screws and lockwashers and rock the pump up and down to break the gasket seal. Do not strike the pump with a hammer.

### INSPECTION:

The oil pump may be disassembled for inspection and cleaned if necessary. If wear or breakage is found, replace the entire pump.

### TO INSTALL:

Clean the face of the bearing head and oil pump. Place two screws through the flange of the oil pump, lubricate the oil pump gasket and place on the face of the oil pump using the screws as a guide. Be sure the holes in the gasket match the holes in the oil pump and bearing head. The drain slot in the oil pump must be at the bottom.

Turn the oil pump key to match the slot in the end of the crankshaft. Attach the pump and gasket to the bearing and draw the screws up hand tight. Tighten all screws to final torque.

Torque—14 Foot-Pounds

Lubricate the oil pump cover "O" ring and place in the slot between the bearing head and the housing. Set the cover over the oil pump, insert and tighten the mounting screws hand tight. Tighten all screws to final torque.

Torque—43 Foot-Pounds

## MOTOR ROTOR AND STATOR

In most cases, the stator may be eased out of the housing without using the motor puller after the rotor has been removed. If it becomes necessary to use the puller, it is available from The Trane Company.

The procedure for using the motor puller follows. However, part of this information applies also when the puller is not used.

### TO REMOVE ROTOR:

Remove the suction strainer pan assembly (see "To Remove Suction Strainer Assembly") and a handhole cover (see "To Remove Handhole Cover").

Place a soft block of wood against one of the crankshaft counterweights to prevent the crankshaft from turning. Remove the rotor retaining bolt and washers. Attach the puller bar to rotor and ease the rotor off the end of the crankshaft. A rotor-crankshaft key will slide with the rotor as it is removed.

### TO REMOVE STATOR:

Figure 29 illustrates the motor terminal board and terminals. Disassemble the terminal lugs, lock nut, buss bars and sealing spacers. Remove the terminal board mounting ring and pull the assembly out of the housing. Work the "O" rings off the terminals and push the terminals out of the terminal board and locating plate.

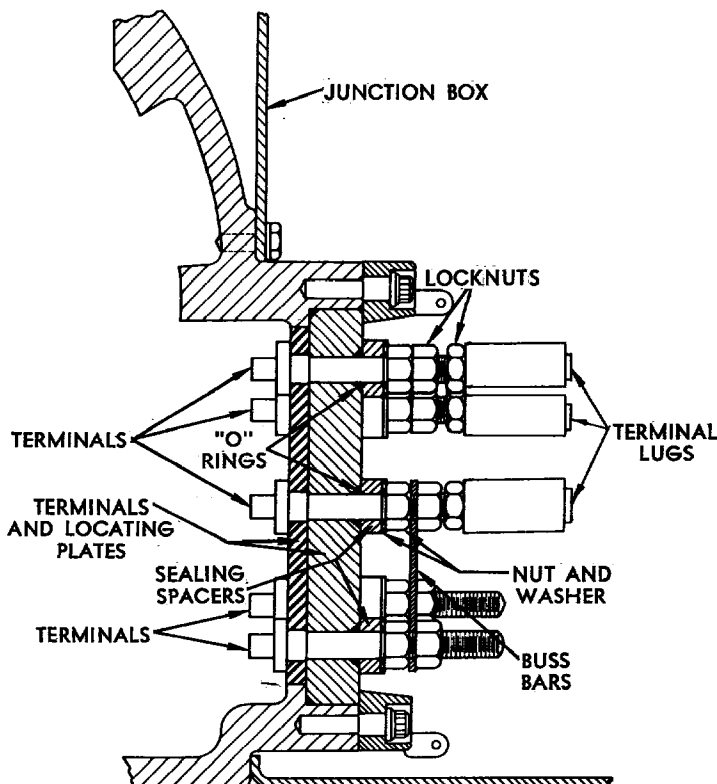


FIGURE 29—Motor Terminal Assembly.

Disconnect the motor thermostat leads.

Attach the stator cradle and bracket to the housing using the suction cover bolts (Figure 30). The front edge of the cradle must fit into the housing groove provided for the suction cover assembly.

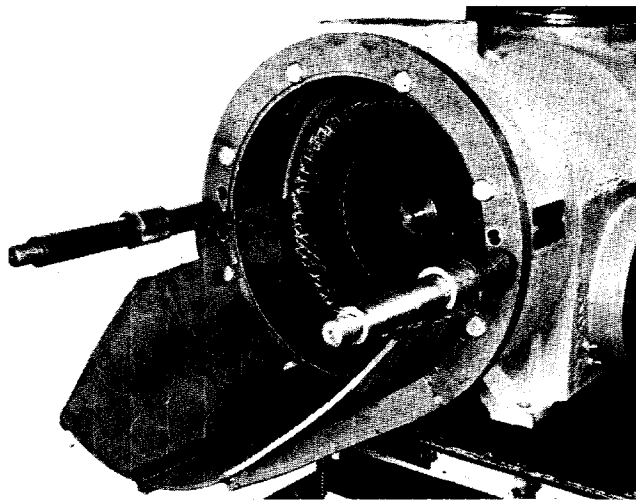


FIGURE 30—Attaching Stator Cradle.

Remove the stator mounting bolt on top of the housing.

NOTE: Early production Model F Compressors had two stator mounting bolts which were located top and bottom. During production, it has been found that the bottom mounting bolt is not required. If the compressor has two bolts, remove the threaded portion of the bottom bolt and re-install the plug and "O" ring.

Place the bottom puller bar inside the stator with the hook at the front of the bar engaging the back edge of the stator iron (Figure 31). Slide the ram on the cradle slide bars and place the top puller bar inside the stator. Engage the hook on the top bar to the stator iron.

With the hooks engaging the stator iron, pull the front end of the bars toward each other and fasten with the "T" handle bolt attached to the lower puller bar (Figure 32).

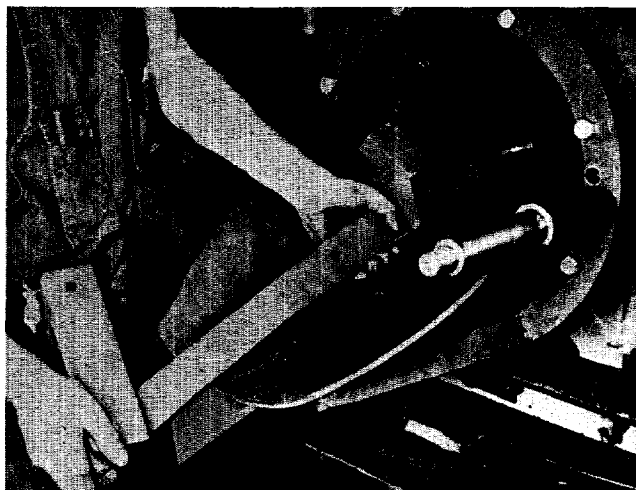


FIGURE 31—Inserting Puller Bar.

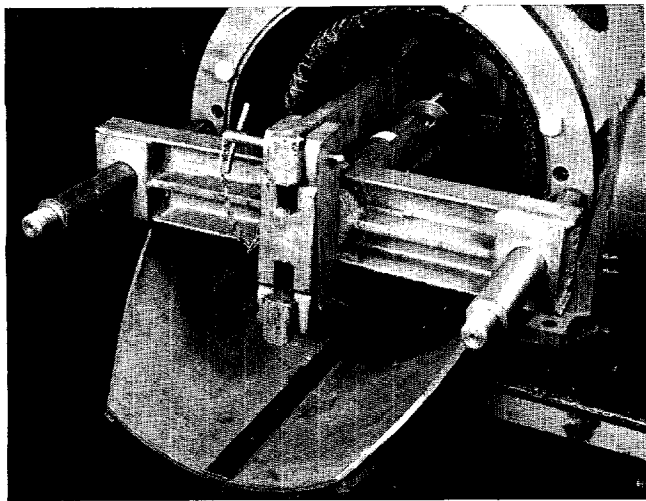


FIGURE 32—Ram and Puller Bars In Position.

Slide the ram back toward the puller bar fastening angle. Loosen the Allen head setscrews in both collars on the cradle slide bars. Position the collars against the ram, measuring the distance to be sure both collars are set the same, and tighten the collar setscrews.

Attach the hydraulic jack to the ram. Close the valve on jack by turning clockwise and work the jack to force the stator out of the housing. Make sure the stator leads do not become caught in the housing.

NOTE: Use standard hydraulic jack fluid if it becomes low in the jack.

When the ram reaches the end of its stroke, open the jack valve and slide the ram toward the puller bar fastening angle. Place the take-up sleeves on the cradle slide bars and fasten in place with the angle bolt keys attached to the sleeves (Figure 33). Work the jack until the stator is free of the housing.

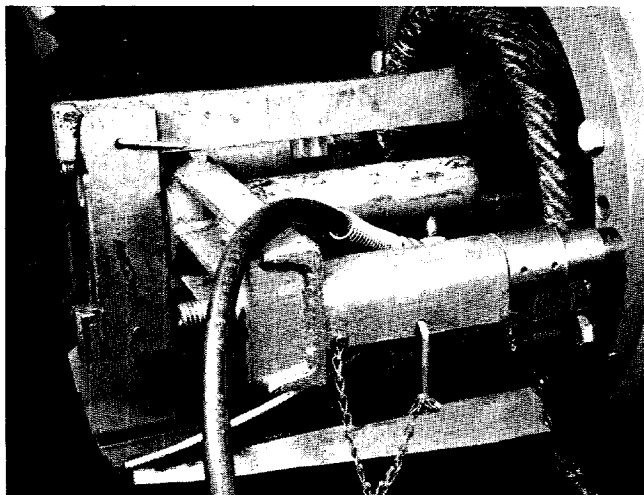


FIGURE 33—Attaching Take-up Sleeves.

### INSTALLING STATOR:

Scribe a guide line across the stator iron through the center of the bolt mounting hole. A similar line should be scribed on the housing from the center of the bolt hole to the suction end opening. With these guide marks aligned, the mounting bolt holes will match when the stator is in position.

Tie a string around the stator and thermostat leads and pull them back inside the stator. Remove the collars from the cradle slide bars. Set the stator on the cradle and start the stator into the housing (Figure 34). Align the guide marks.

CAUTION: Be extremely careful not to damage the stator windings.

Pull the stator and thermostat leads out through the junction box opening.

Place the pusher bar against the stator iron as shown in Figure 35. Attach the ram and collars, fastening in place with large nuts at the end of the slide bars. Attach the hydraulic jack to the ram and close the jack valve. Work the jack to force the stator into the housing.

CAUTION: Be sure the stator leads do not become pinched.

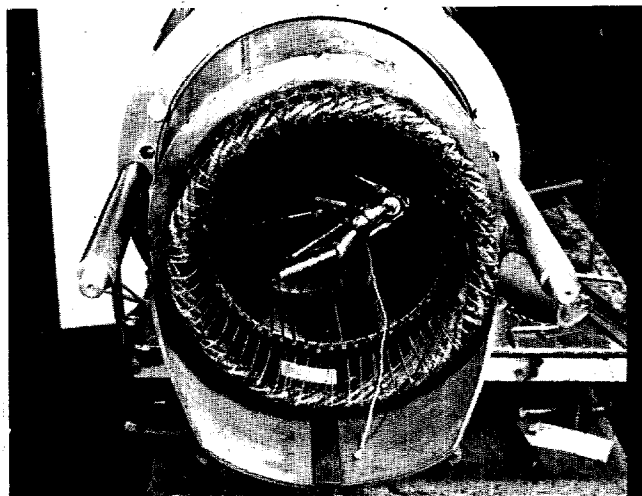


FIGURE 34—Installing Stator.

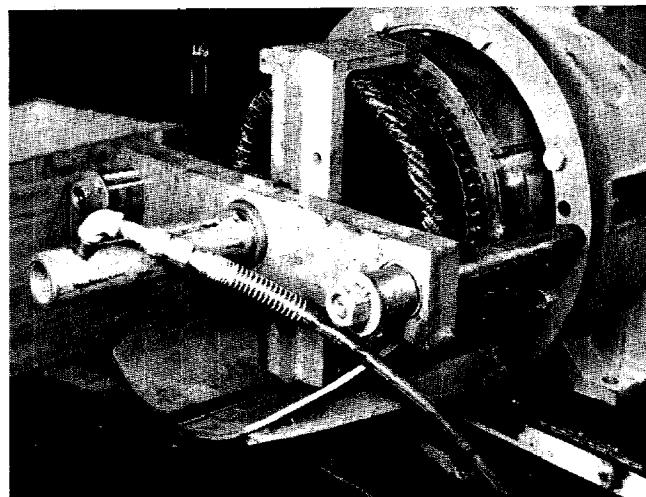


FIGURE 35—Pusher Bar and Ram In Position.

When the ram reaches the end of its stroke, open the jack valve and slide the ram and stator pusher bar toward the stator. Attach the take-up sleeves to the slide bars. Close the jack valve and work the jack. As the stator reaches the positioning lands at the back of the housing, raise the stator to help clear the lands. This may be done with a pinch bar through the junction box opening.

CAUTION: Do not touch stator windings with pry bar.

Continue to work the jack until the stator mounting holes line up. Install the stator mounting bolts and "O" ring. Tighten as required.

Attach the motor thermostat leads to the spade connections inside the housing.

Reassemble the terminal and locating boards, studs, "O" rings and nuts (Figure 29). Tighten to the required torque.

Torque—2½ Foot-Pounds

Place the assembled terminal board in the housing and install the retaining ring and mounting bolts. Tighten retaining ring mounting bolts to the required torque.

Torque—14 Foot-Pounds

### INSTALLING ROTOR:

Place the rotor on the crankshaft and push it into position, lining up the key way in the rotor and crankshaft. Insert the key and tap into final position.

Insert the rotor retaining bolt and washers and draw the bolt up hand tight. Block the crankshaft so that it will not turn by placing a block of wood against one of the crankshaft counterweights and land area of the housing. Tighten the rotor retaining bolts to the required torque.

Torque—135 Foot-Pounds

Check the rotor-stator air gap with a feeler gage. ALLOWABLE AIR GAP—.008"-.010" SIDE-TO-SIDE.

### MAIN BEARINGS AND CRANKSHAFT

The pump-end and motor-end main bearings contain sleeve type, steel-backed babbitt bearing inserts which are pressed into the bearing head. If either bearing insert becomes damaged or worn, it may be replaced. An arbor press is required to prevent damage to the bearing.

The pump-end bearing contains a spring loaded ball bearing type oil regulating valve and the motor-end bearing has a foam breaker. Both the oil regulating valve and foam breaker may be removed for inspection, cleaning or replacement.

Whenever the crankshaft or either main bearing is removed from the compressor, crankshaft end play must be adjusted. Adjustment is made by using .005, .010 or .020 metal shims between the pump-end bearing and the pump end bearing thrust collar.

### TO REMOVE MOTOR END BEARING:

Remove the motor rotor (see "To Remove Rotor") and handhole cover (see "To Remove Handhole Cover").

Loosen and remove all of the bearing head screws. Pull the bearing off the end of the crankshaft and, at the same time, hold the crankshaft to prevent it from following the bearing. Do not bump the bearing head on the motor stator.

The crankshaft will balance in the pump-end bearing and does not need to be blocked.

If the crankshaft is frozen in the bearing head, remove the connecting rod assemblies (see "To Remove Connecting Rods") and pull the bearing head-crankshaft assembly as a unit.

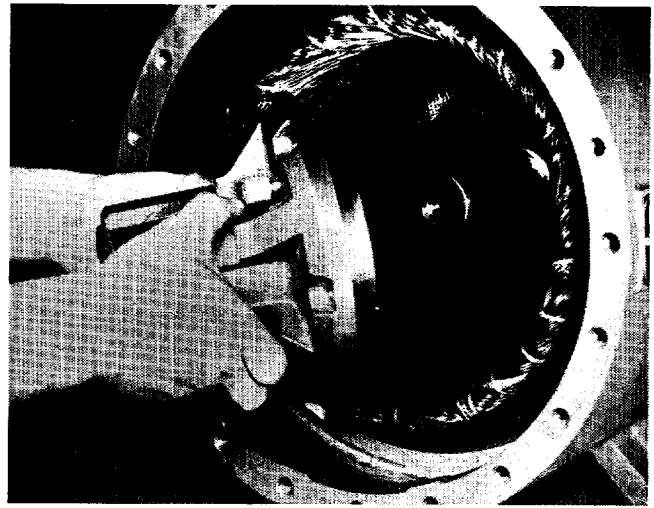


FIGURE 36—Removing Motor End Bearing.

### INSPECTION:

Examine the bearing surfaces for damage or copper-plating. Check the oil passages and clean them if necessary. Wear limits are given in Table 1.

### TO REMOVE CRANKSHAFT:

The crankshaft is removed from the compressor through the motor-end of the compressor. Remove the connecting rods and piston assemblies (see "Connecting Rod And Piston Assembly," "To Remove," Page 9). Remove the motor-end bearing (see "To Remove Motor End Bearing").

Grip the crankshaft at the center and at the motor-end of the shaft. Place one hand through the handhole opening and the other at the end of the shaft. Carefully draw shaft out of pump-end bearing. When shaft end is clear of bearing, shift hands so that shaft is gripped through suction end of compressor. Draw shaft out of compressor housing (Figure 37). Be careful not to drop the crankshaft on the stator.

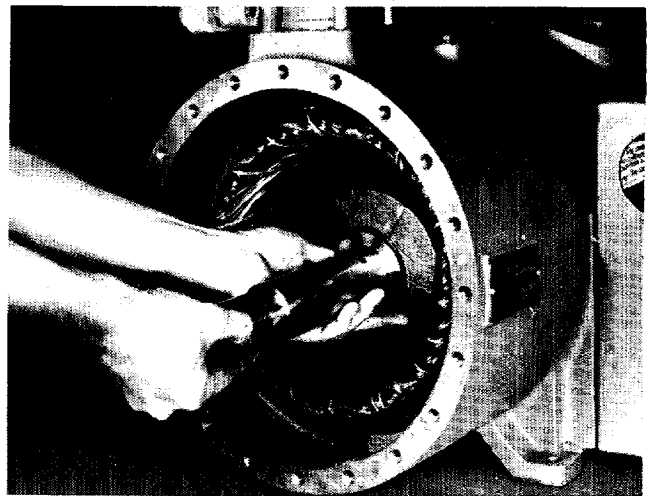


FIGURE 37—Removing Crankshaft.

## INSPECTION:

Examine the crankshaft journals and bearing surfaces for damage or copperplating. Check the oil passages and clean them if necessary. Wear limits are given in Table 1.

## TO REMOVE PUMP-END BEARING:

Remove the oil pump (see "To Remove Oil Pump"). Pull the bearing head out of the housing (Figure 38). This bearing is not bolted in place but is held by the oil pump cover. An "O" ring seals the inner bearing surface to the housing and it may be necessary to force the bearing out of the housing.

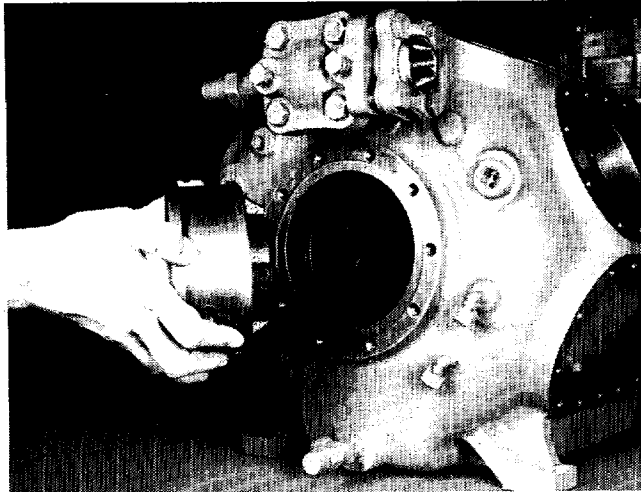


FIGURE 38—Removing Pump End Bearing.

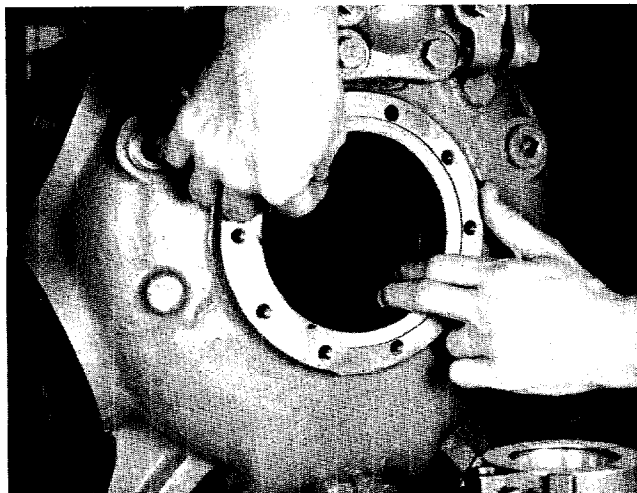


FIGURE 39—Installing Pump End Bearing "O" Ring.

## INSPECTION:

Examine the pump-end bearing for damage or copperplating and clean the oil passages if necessary. Wear limits are given in Table 1.

## TO INSTALL MAIN BEARINGS AND CRANKSHAFT:

Lubricate the pump-end bearing "O" ring and place in the groove in the housing (Figure 39).

Clean the pump-end bearing and lubricate all bearing surfaces. Guide the bearing into the housing with the roll pin in the housing fitting into the hole in the bearing flange. Attach the oil pump cover but do not install the oil pump. Tighten the bolts to the required torque.

Torque—43 Foot-Pounds

Lubricate the thrust washer and place on the pump-end of the crankshaft. Place a .010" shim on the same end of the crankshaft and lubricate all bearing surfaces of the crankshaft. Place the crankshaft in the housing and into the pump-end bearing. Be sure the thrust washer and shim are in position.

When the crankshaft is in position, it can be released and does need to be supported.

Lubricate the other thrust washer and place it on the motor-end bearing head.

The motor-end bearing has a small "O" ring near the bottom of the flange which rests against the housing. Lubricate the "O" ring and place it on the bearing. Push the bearing into position against the housing making sure the thrust washer is positioned correctly. Insert and tighten the bearing mounting screws to the required torque.

Torque—23 Foot-Pounds

Crankshaft end-play adjustment is determined by the number and thickness of the shims placed under the pump-end bearing thrust collar. These shims are .005", .010" and .020" thick.

Push the crankshaft against the pump-end bearing thrust collar. With a feeler gage, measure the distance between the crankshaft shoulder and the motor-end thrust collar. Push the crankshaft against the motor-end bearing thrust collar and measure the distance between the shaft shoulder and the pump-end thrust collar. This measurement should be the same on both ends of the shaft.

Crankshaft end play clearance should be .015" to .025". End play may be adjusted by the number and thickness of shims installed between the pump-end bearing and the pump end bearing thrust collars.

When final selection of shims has been made, remove the oil pump cover and install the oil pump (see "To Install Oil Pump"). Tighten oil pump screws to final torque.

Torque—14 Foot-Pounds

Install the oil pump cover and "O" ring and tighten all screws to final torque.

Torque—43 Foot-Pounds

Recheck crankshaft end play.

## FOAM-BREAKER

### TO REMOVE:

If it becomes necessary to clean the foam-breaker assembly within the motor end bearing head, remove the retaining ring and end ring. With the end ring removed the foam-breaker screen can be removed for cleaning (Figure 40).

It may be necessary to remove the Allen head plug and bearing head to clean the passages within the bearing head assembly. The entire assembly may be washed with a suitable refrigerant compressor parts cleaner.

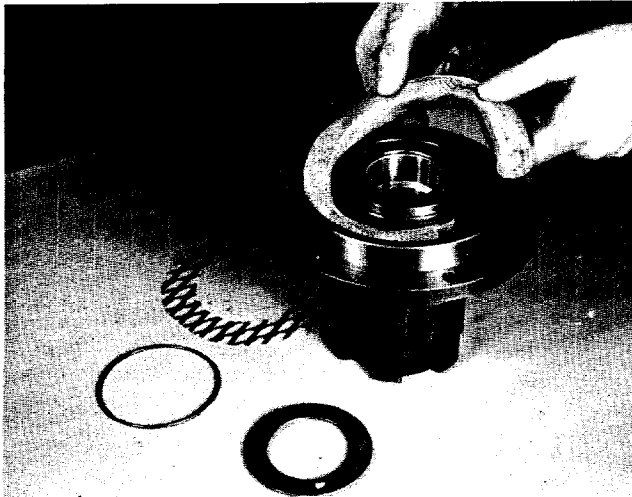


FIGURE 40—Removing Foam Breaker.

### TO INSTALL:

Roll the foam-breaker screen into approximate shape and insert into bearing head (Figure 40). Replace end ring and retaining ring. Replace plug.

## RELIEF VALVE

If compressor discharge pressure becomes excessive and other safety devices fail to function, a pressure relief valve within the compressor will open. When this happens, hot gas is directed back to the suction side of the compressor.

The compressor pressure relief valve is located inside the housing directly behind the discharge service valve. If the relief valve has opened, check the compressor for internal damage.

## CRANKCASE OIL STRAINER ASSEMBLY

Whenever a compressor is opened for repairs, the oil strainer assembly should be removed and the screen cleaned with a suitable refrigeration parts cleaner.

### TO REMOVE:

Remove handhole covers (see "To Remove Handhole Covers," Page 8). The strainer screen assembly is held in position by a steel spring hold-down strip. Grip the hold-down strip and pull out and up to release. Disconnect the flare nut and remove the oil strainer screen assembly.

### TO INSTALL:

Place strainer assembly in position and connect flare nut to crankcase. Do not tighten. Snap the hold-down strip into position (fits into channel on top of strainer assembly). With the strainer assembly in position, tighten flare nut connection to crankcase.

## OIL CHECK VALVES

Two oil check valves are located in the two lower banks of cylinders at each side of the compressor. Their function is to return oil to the compressor crankcase which has collected in the upper suction chamber. Oil which may collect in the suction strainer pan assembly is returned to the compressor crankcase through an oil check valve located in the suction chamber wall.

These valves are ball-seating type valves. If necessary, they may be removed and cleaned with a refrigerant parts cleaner.

## OIL REGULATING VALVE

### TO REMOVE:

Remove pump end bearing head assembly (see "To Remove Pump End Bearing"). Remove cotter pin holding oil regulating valve in bearing head (Figure 41). Holding

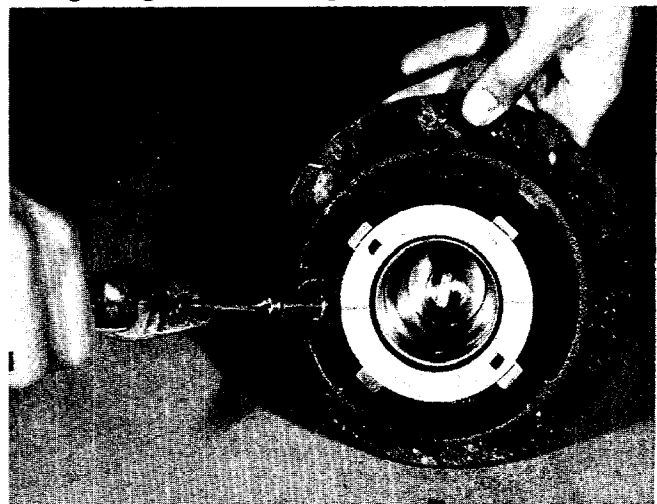


FIGURE 41—Removing Oil Regulator Valve from Pump End Bearing Head Assembly.

cotter pin in a pair of pliers, insert head of cotter pin into top of oil regulating valve and turn  $\frac{1}{4}$  turn. Pull regulating valve out of bearing head. Clean and inspect for foreign material between ball and seat.

Check condition of O-ring.