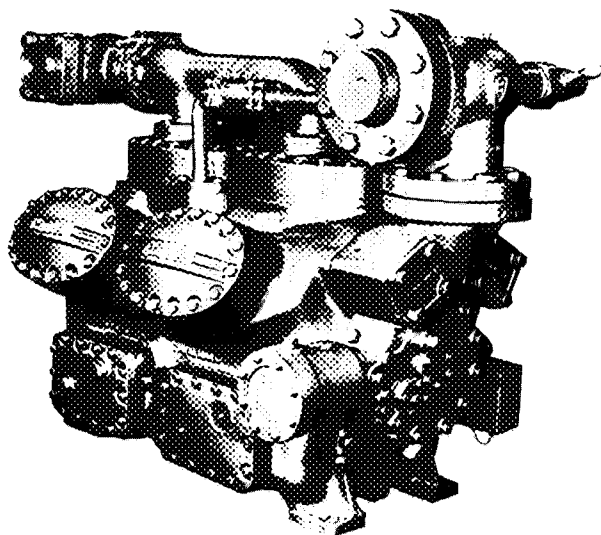


**Carrier**

## Service Instructions



*Reprinted 3/65*

# 5F,H FREON COMPRESSORS, CONDENSERS

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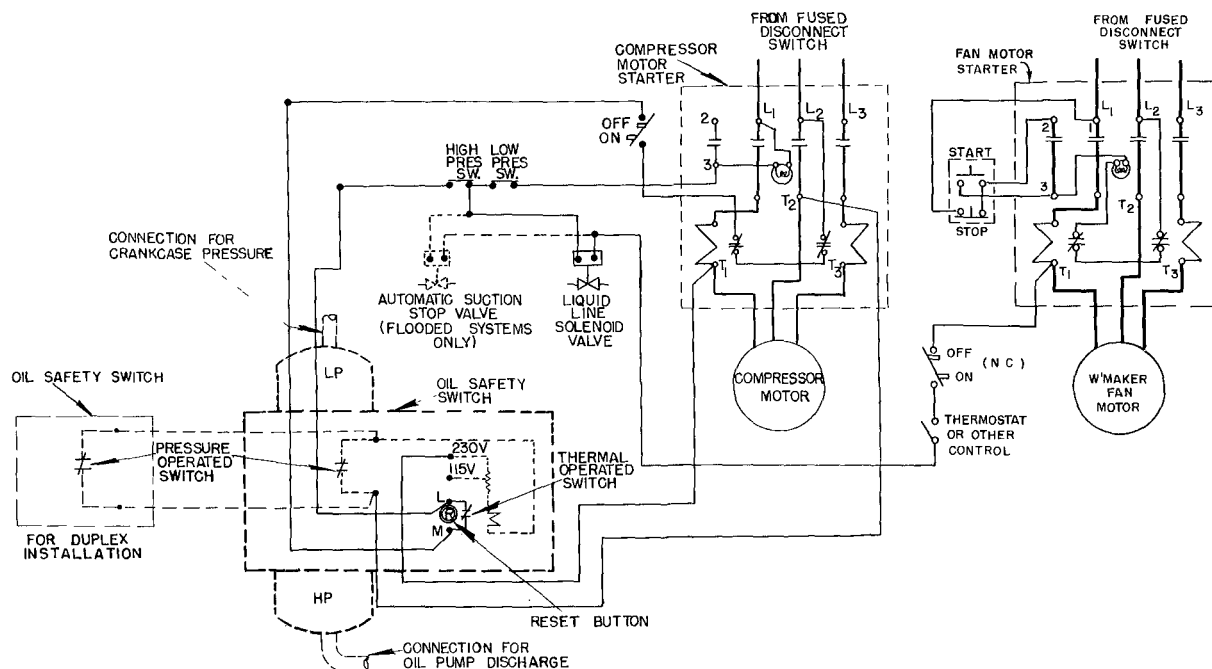


FIG. 1 - TYPICAL SYSTEM WIRING DIAGRAM - SHOWING OIL SAFETY SWITCH AND PUMP DOWN CONTROL

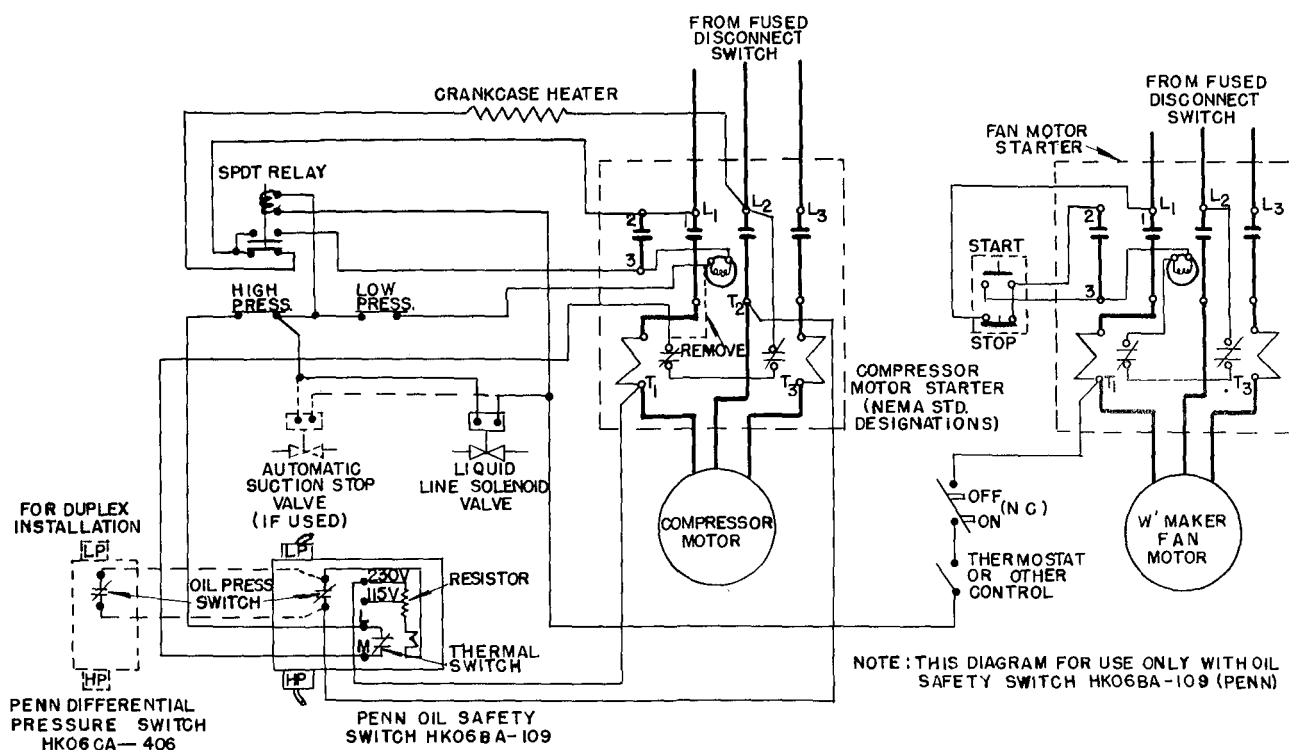


FIG. 2 - TYPICAL SYSTEM WIRING DIAGRAM - SHOWING  
CRANKCASE HEATER AND SINGLE PUMP-OUT CONTROL

## INTRODUCTION

## INTERCHANGEABILITY

These instructions cover the servicing of Carrier compressors, Model Nos. 5F20, 5F30, 5F40, 5F60, 5H40, 5H60, 5H80, and 5H120. These numbers following the model designation, 5F or 5H, indicate the numbers of cylinders. For example, the 5F40 has four cylinders and the 5H120 has twelve cylinders.

Since the construction of 5F and 5H compressors is similar for all sizes, assembly and disassembly procedures are the same. In addition, interchangeability of parts within each line, 5F or 5H, simplifies the service and parts problems.

The use of cylinder sleeves makes it unnecessary to rebore a cylinder or replace the crankcase if a cylinder wall is scored or worn excessively. It is only necessary to replace the sleeve.

Capscrew and pipe plug sizes are standardized to reduce the number of tools required for service. Handhole covers or bottom plates of adequate size make it easy to reach the inside of the crankcase.

Table 1 shows the major parts that are interchangeable.

Table 2 gives the torque values for tightening bolts.

TABLE 1 - INTERCHANGEABILITY CHART

Part	5F20	5F30	5F40	5F60	5H40	5H60	5H80	5H120
Cylinder Heads								Note 1
Valve Plates								
Cylinder Sleeves								
Pistons								
Connecting Rods With Inserts								
Main Bearing, P.E.								
Main Bearing, Center		None			None		Note 2	Note 2
Main Bearing, S.E.								
Seal Assembly								
Pump End Brg. Head								Note 3
Hand Hole Cover Plate	None		Note 4					Note 5
Pump End Cover		None			Note 6			None
Unloader Power Elements								

## NOTES:

1. Cylinder heads on 5H120 are the same as other 5H compressors, except for the two center heads.
2. Center main bearings used on 5H80, 120 compressors only, but are not interchangeable.
3. Pump end bearing head and oil pump assembly includes capacity control valve assembly (on 5H120 only).
4. Hand hole cover plate includes capacity control valve assembly.
5. One hand hole cover plate on 5H120 has oil level sight glass 1-3/16" above center line of cover.
6. Pump end cover includes capacity control valve assembly.

TABLE 2 - TORQUE VALUES FOR 5 LINE COMPRESSOR BOLTS

Size Dia. In.	Wrench Size, In.		Threads Per Inch	Torque Range Pound - Feet		
	Hex	Allen				
1/4	7/16	3/16	20 (Coarse)	6	-	10
5/16	9/16		24 (Fine)	25	-	28
5/16	9/16	7/32	18 (Coarse)	18	-	22
3/8	5/8	5/16	16 (Coarse)	30	-	35
7/16	3/4		20 (Fine)	42	-	47
7/16	3/4	5/16	14 (Coarse)	45	-	50
1/2	13/16	3/8	13 (Coarse)	50	-	60
5/8	15/16		18 (Fine)	100	-	120

## WEAR LIMITS

Tables 3 and 4 give the permissible wear limits.

## SERVICE TOOLS

The following tools are needed in addition to the tools normally carried by the mechanic:

1. 5F20-2061 Suction Valve Clips. } Used when valve plates are assembled on compressors. See
2. 5H40-2061 Suction Valve Clips. } Page 22 for usage.
- \*3. 5F20-932 Bearing Puller Assembly. Used to remove the seal end main bearing. See Page 36  
for usage.
- \*4. 5F20-572 Cylinder Sleeve Puller. } Used to remove cylinder sleeves from compressors. See
- \*5. 5H40-572 Cylinder Sleeve Puller. } Page 24 for usage.
6. Elongated Socket. Used to remove the internal relief valve from early 5H60 compressors. See  
Page 21 for details.
- \*7. 5F20-A322 SPIG. Used to predict the remaining bearing life without disassembling the com-  
pressor. Instructions are included with the SPIG.

\*Obtain from Robinair Manufacturing Corp., Edgerton, Ohio.

TABLE 3 - WEAR LIMITS FOR 5F COMPRESSORS

Part Name	Factory Maximum		Factory Minimum		Maximum wear Before Repair	
	5F30-30	5F40-60	5F20-30	5F40-60	5F20-30	5F40-60
SEAL END						
Main Bearing Diam.	1.6266	2.0636			.002	.001
Main Bearing Journal Diam.			1.6233	2.060	.003	.002
PUMP END						
Main Bearing Diam.	1.6266	1.6266			.002	.001
Main Bearing Journal Diam.			1.6233	1.6233	.003	.002
CONNECTING ROD						
Bearing Diam. (After Assembly)	1.6255	1.6255			.002	.002
Bearing Thickness			.06225	.06225	.001	.001
Crankpin Diam.			1.6233	1.6233	.003	.003
CRANKSHAFT						
Throw	1.0005	1.0005	.9985	.9985		
THRUST WASHERS (Thickness)						
Seal End			.129	.129		
Seal End (Steel)			.155	.155		
Pump End			.129	.129		
Replace Thrust Washers When End Clearance Exceeds					.035	.035
CYLINDERS						
Bore	2.501	2.501			.003	.003
Piston (Diam.)			2.4980	2.4980	.003	.003
Wrist Pin (Diam.)			.7498	.7498	.001	.001
Wrist Pin Bushing	.7507	.7507			.001	.001
Piston Ring End Gap (Comp. and Oil)	.017	.017	.007	.007	.030	.030
Piston Ring Side Clearance (Comp. and Oil)	.0025	.0025	.001	.001	.003	.003
OIL PUMP						
*Axial Clearance	.0015	.0015	.0005	.0005	.0025	.0025
Drive Shaft Diam.			.4354	.4354	.000	.000
Drive Shaft Bushing Diam.	.4375	.4375			.000	.000
SUCTION VALVE						
Suction Valve Disc. (Depth of Wear Below Face)					.005	.005
Suction Valve Seat (See Fig. 1 for Dim. "A")			.012	.012		
Minimum Height of "A" before replacing cylinder sleeve (.010)						

TABLE 3 - WEAR LIMITS FOR 5F COMPRESSORS - CONT'D.

Part Name	Factory Maximum		Factory Minimum		Maximum Wear Before Repair	
	5F30-30	5F40-60	5F20-30	5F40-60	5F20-30	5F40-60
DISCHARGE VALVE						
Discharge Valve Disc (Depth of Wear Below Face)					.005	.005
Discharge Valve Seat (See Fig. 1 for Dim. "B")			.012	.012		
Minimum Height of "B" before replacing valve plate and discharge valve inner seat (.010)						

\* Return assemblies for factory exchange.

TABLE 4 - WEAR LIMITS FOR 5H COMPRESSORS

Part Name	Factory Maximum	Factory Minimum	Maximum Wear Before Repair
	5H40-60-80-120	5H40-60-80-120	5H40-60-80-120
SEAL END			
Main Bearing Diam.	2.6264		.001
Main Bearing Journal Diam.		2.6225	.002
PUMP END			
Main Bearing Diam.	2.2516		.001
Main Bearing Journal Diam.		2.248	.002
CENTER (5H80 and 120 only)			
Main Bearing Diam.	2.6264		.001
Main Bearing Thickness		.0942	.001
Main Bearing Journal Diam.		2.6225	.002
CONNECTING ROD			
Bearing Diam. (After Assembly)	2.2505		.002
Bearing Thickness		.06225	.001
Crankpin Diam.		2.248	.002
CRANKSHAFT			
Throw	1.376	1.372	
THRUST WASHERS (Thickness)			
Seal End		.186	
Seal End (Steel)		.186	
Pump End		.186	
Replace Thrust Washers when End Clearance Exceeds			.045

TABLE 4 - WEAR LIMITS FOR 5H COMPRESSORS - CONT'D.

Part Name	Factory Maximum	Factory Minimum	Maximum Wear Before Repair
	5H40-60-80-120	5H40-60-80-120	5H40-60-80-120
CYLINDER			
Bore	3.2515		.003
Piston (Diam.)		3.2480	.003
Wrist Pin (Diam.)		.9998	.001
Wrist Pin Bushing	1.0008		.001
Piston Ring End Gap (Comp. and Oil)	.017	.007	.030
Piston Ring Side Clearance (Comp. and Oil)	.0025	.001	.003
OIL PUMP (1)			
Axial Clearance	.0015	.0005	.0025
Drive Shaft Diam.	.4359	.4354	
Drive Shaft Bushing Diam.	.4375	.4370	
Drive Shaft Diam. (5H120 only)	.4984(2) .6865(3)	.4982(2) .6862(3)	
Drive Shaft Bushing Diam. (5H120 only)	.5000(2) .6880(3)	.6875(3)	
SUCTION VALVE			
Suction Valve Disc (Depth of Wear Below Face)			.005
Suction Valve Seat (See Fig. 3 for Dim. "A")		.012	
Minimum Height of "A" before replacing - cylinder sleeve (.010)			
DISCHARGE VALVE			
Discharge Valve Disc (Depth of Wear Below Face)			.005
Discharge Valve Seat (See Fig. 3 for Dim. "B")		.012	
Minimum Height of "B" before replacing valve plate and discharge valve inner seat (.010)			

(1) Return assemblies for factory exchange

(2) Prior to Serial No. 0447119

(3) Beginning Serial No. 0447119

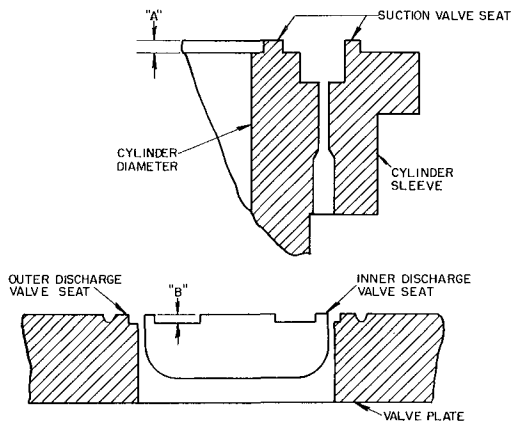


FIG. 3 - SUCTION AND DISCHARGE VALVE SEAT HEIGHT

## DESCRIPTION AND OPERATION OF MAJOR COMPONENTS

## ELECTRICAL CONTROLS

Since a knowledge of the electrical controls is necessary for the proper service of a compressor, descriptions and wiring diagrams are included in this Manual. See Wiring Diagrams (Fig. 1 and 2).

## VALVES

The suction and discharge valves are of special alloy steel. They are vapor cushioned, non-flexing ring type with large area and low lift for extremely quiet operation. The suction valve seats are on the cylinder sleeve; the discharge valve seats are on the valve plate.

Fig. 4 shows how the valves operate.

## CAPACITY CONTROL SYSTEM

## DESCRIPTION

Except for the 5F20 and 5F30 compressors, capacity control is standard on 5F and 5H compressors. Fig. 5 describes the operation of the control system except for the 5H120 which is described in Fig. 6 and 7.

The capacity control valve is located on the hand hole cover on 5F40 and 5F60 compressors and on the pump end of 5H compressors. Fig. 8 shows how the suction valve lifting arrangement differs for the 5F and 5H compressors.

For detailed instructions on setting the capacity control mechanism, see the 5F and H Installation Manual.

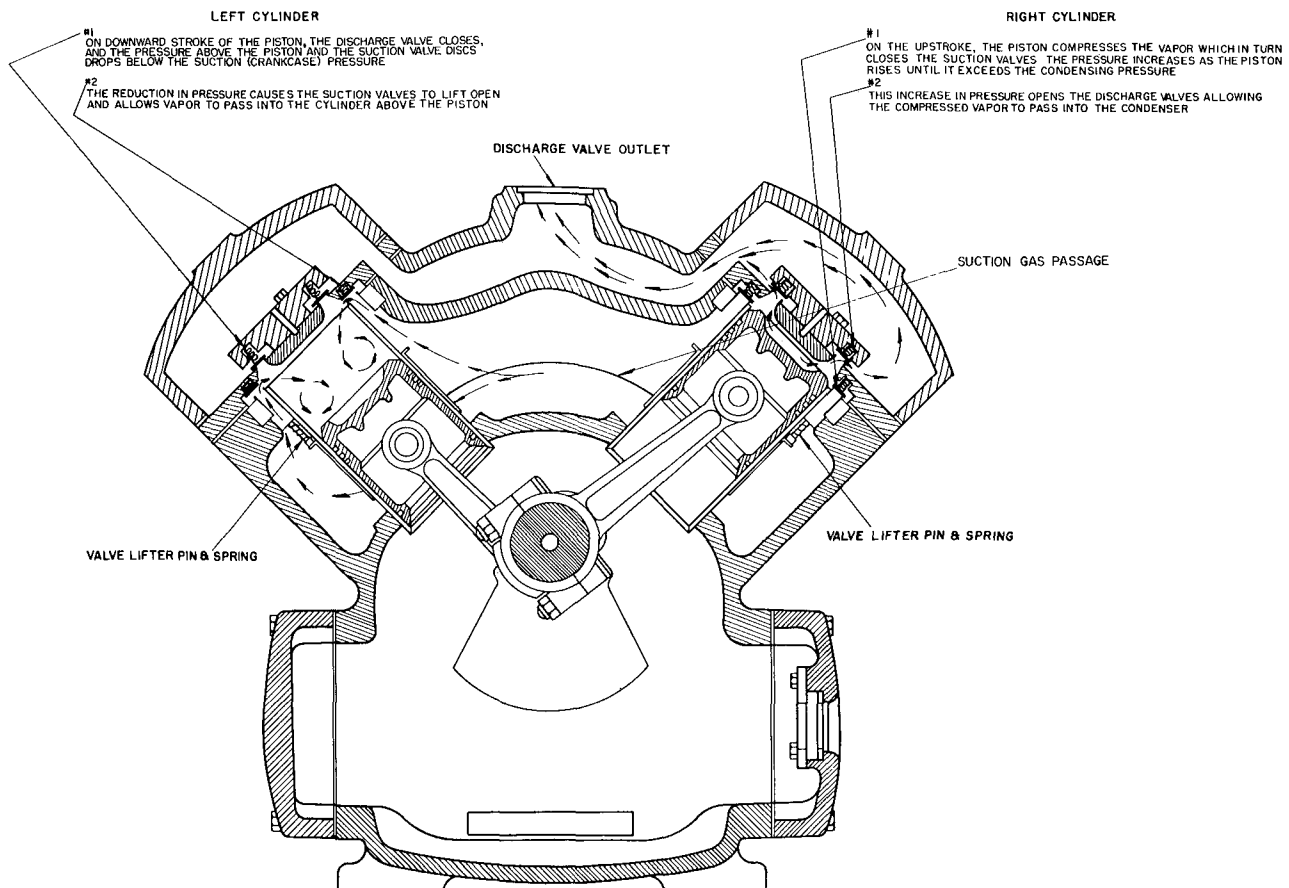
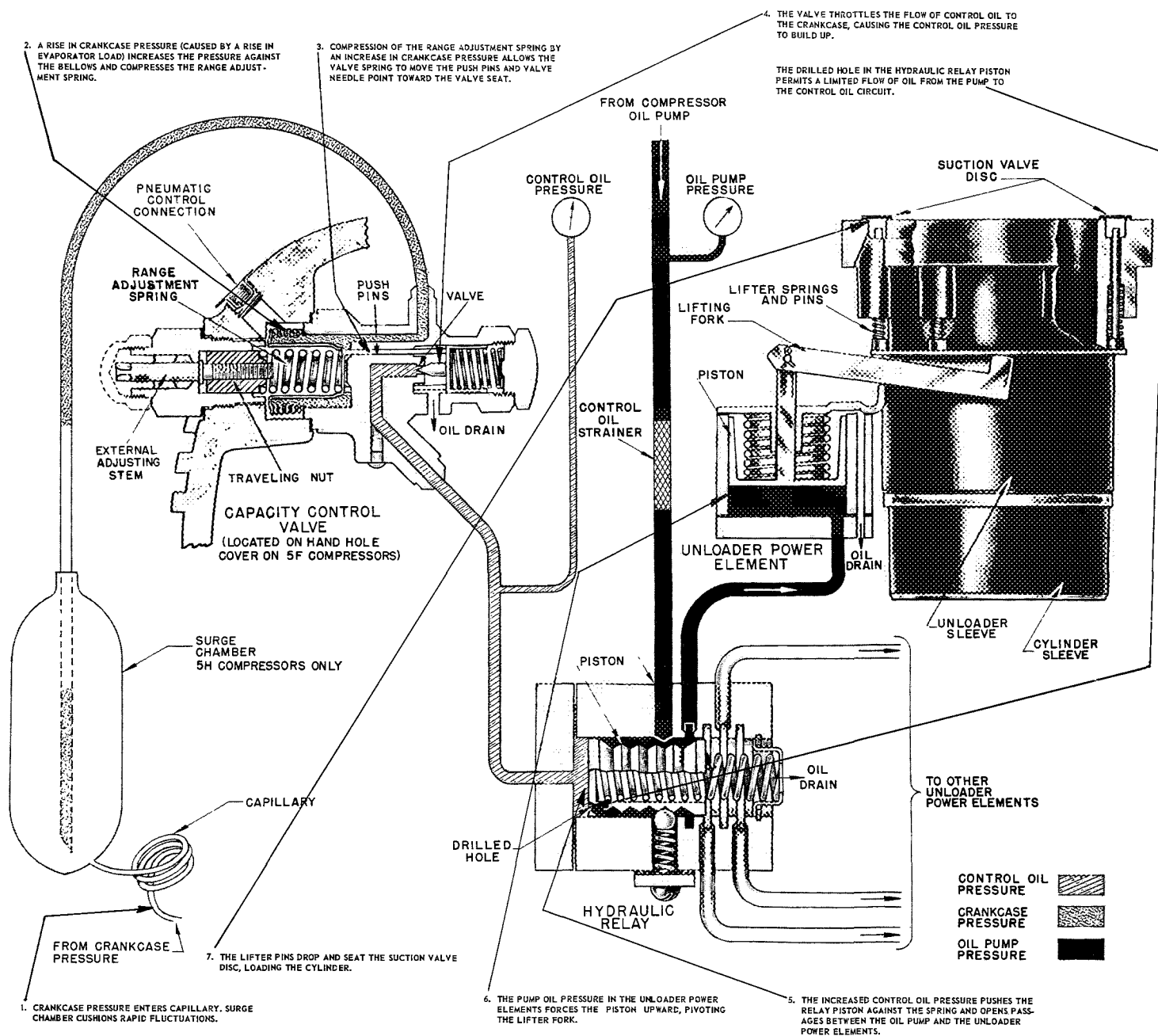


FIG. 4 - REFRIGERANT GAS FLOW THROUGH 5 LINE COMPRESSORS

FIG. 5 - 5F,H CAPACITY CONTROL SYSTEM (EXCEPT 5H120)



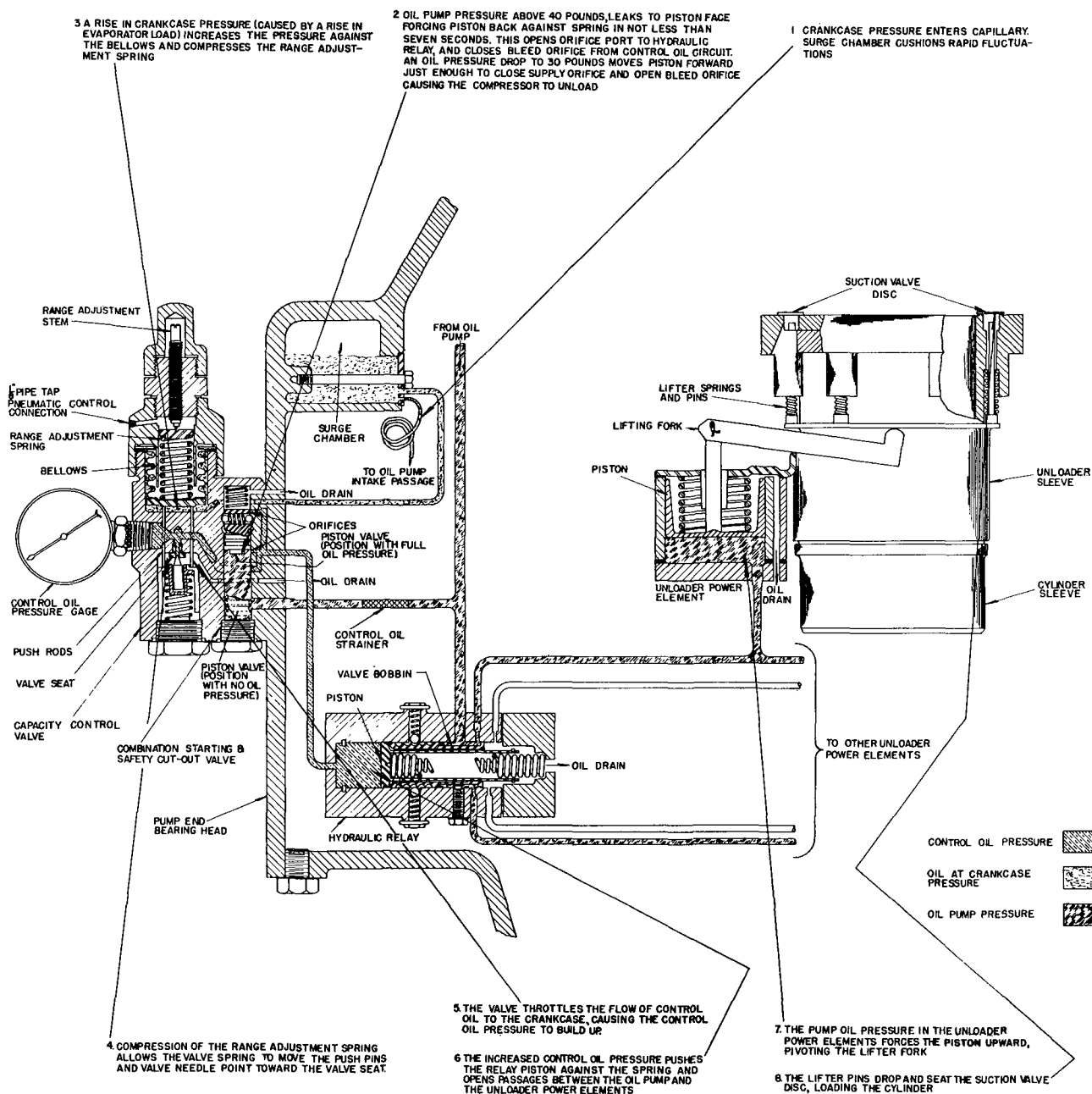


FIG. 6 - 5H120 CAPACITY CONTROL (PRIOR TO SERIAL NO. 0447119)

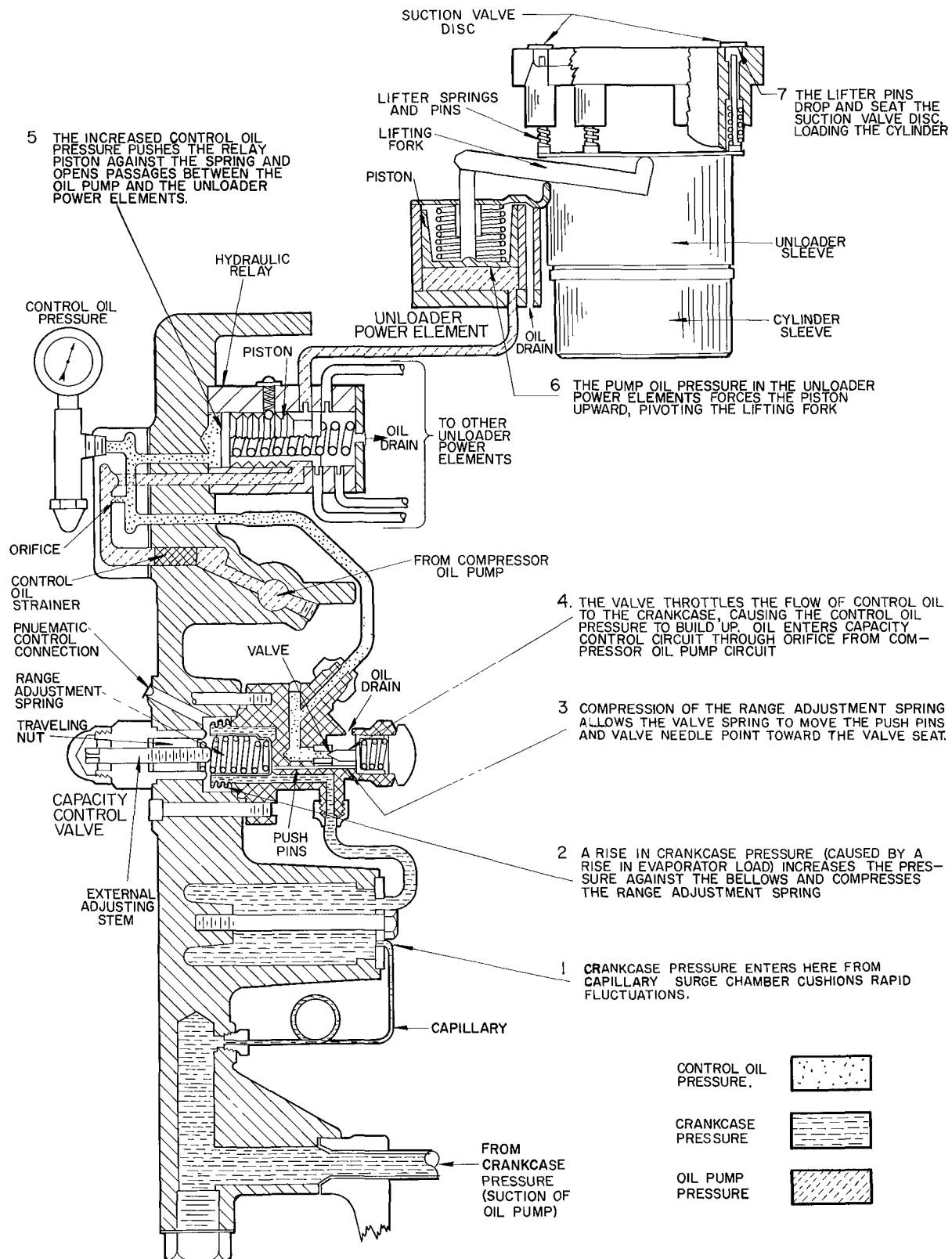


FIG. 7 - 5H120 CAPACITY CONTROL (BEGINNING SERIAL NO. 0447119)

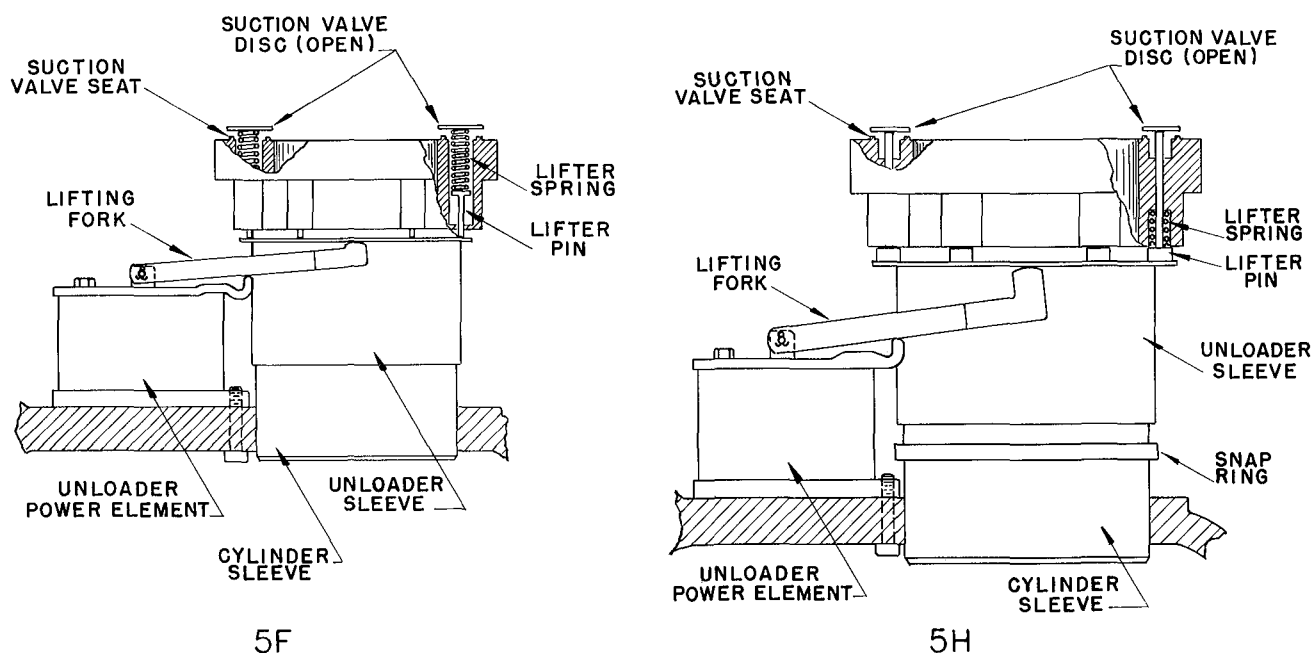


FIG. 8 - SUCTION VALVE LIFTING ARRANGEMENT

Fig. 9 shows the sequence and number of cylinders that unload with each step.

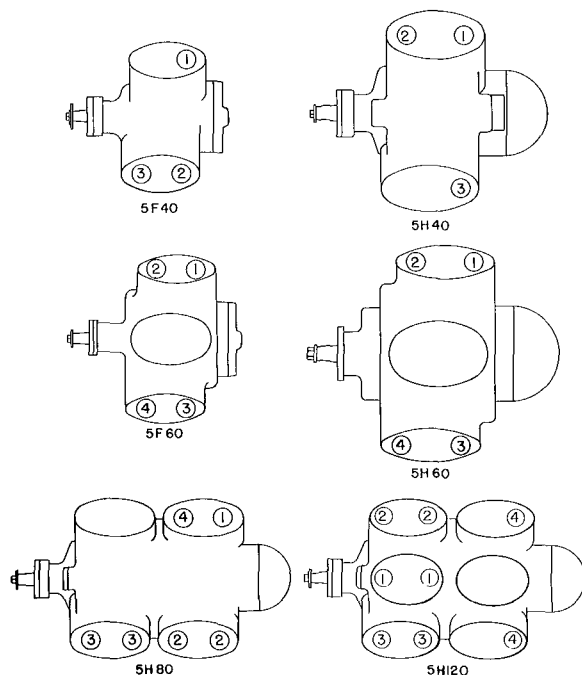


FIG. 9

APPROXIMATE CONTROL OIL PRESSURE FOR  
LOADING AND UNLOADING

ALL 5F, 5H40, 5H60 AND 5H80		
	Loading	Unloading
Step No. 1	30	19
Step No. 2	26	16
Step No. 3	23	12
Step No. 4	20	9

5H120 ONLY		
	Loading	Unloading
Step No. 1	30	17.5
Step No. 2	26	14
Step No. 3	23	10.5
Step No. 4	20	7

## LUBRICATION

## OIL PUMP

The oil pump on all 5 line compressors is located in the pump end bearing head and is a gear type positive displacement pump. (See Fig. 10.) Current production compressors use a manually reversible pump while earlier production compressors used automatic reversing pumps.

All 5F and 5H compressors using the manually reversible pump have direction arrows cast on the top of the pump cover plate. The 5H40, 60 and 80 compressors have an additional direction arrow on a metal plate on the pump end bearing head adjacent to the oil fill connection.

When it is necessary to operate a 5 line compressor in the direction opposite to that shown

by the arrow on the oil pump cover plate, proceed as outlined in the 5F,H Installation Manual.

**CAUTION:** If the gasket between the oil pump cover and oil pump is damaged replace only with correct gasket and check oil pump end clearance before operating compressor. To check for proper clearance of the oil pump bushing, grasp the tang of the oil pump shaft with a pair of pliers and try to move it in or out. If any end play can be felt, the bushing is not properly positioned and there is too much clearance. If no axial movement is felt and if the oil pump shaft rotates freely without binding, the position of the oil pump bushing is correct. Always check oil pressure on any pressure lubricated compressor when putting equipment into operation. (See Fig. 10.)

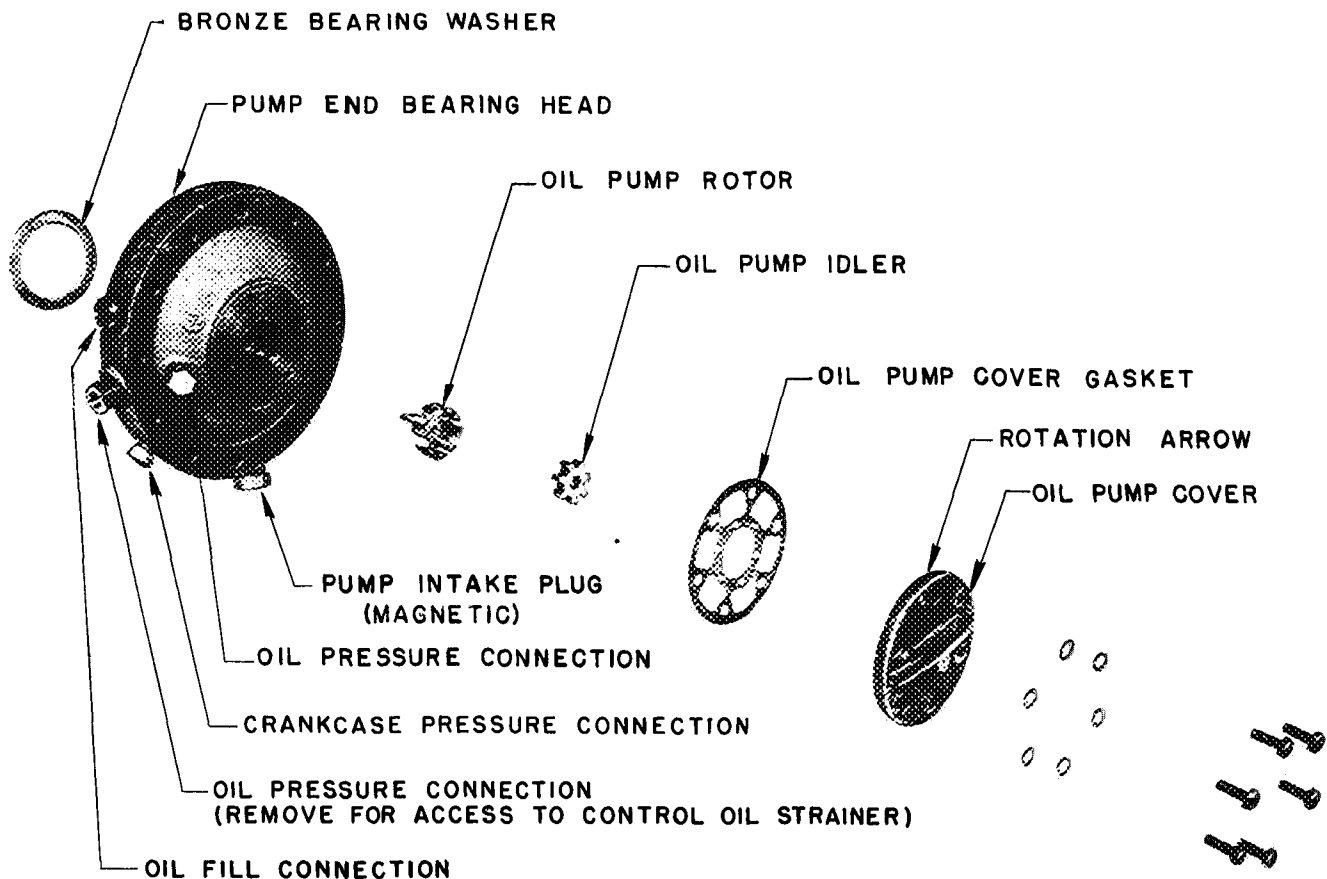


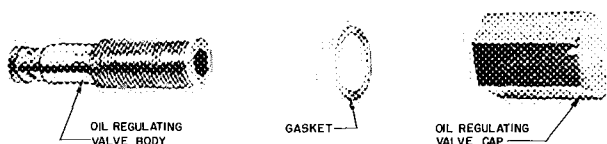
FIG. 10 - EXPLODED VIEW OF 5F OIL PUMP

## OIL PRESSURE REGULATOR

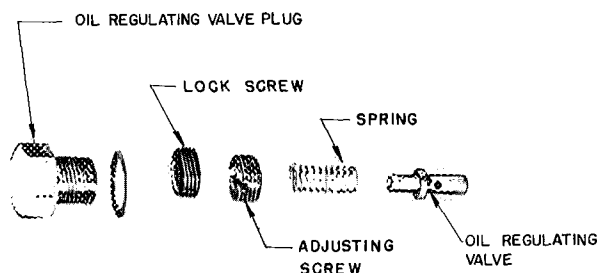
Correct oil pressure is important in maintaining adequate lubrication and satisfactory un-loader operation. All 5F and 5H compressors are designed to operate with the oil pressure 45 to 55 psi above suction pressure. For example, if the suction gage reading is 40 psi, the correct oil pressure gage reading should be from 85 to 95 psi.

An oil pressure regulating valve is located on the side of each 5F and 5H crankcase adjacent to the seal housing.

Current production compressors have a cartridge type pressure relief valve which requires no adjustment. Earlier production compressors are equipped with a pressure relief valve which may be adjusted in the field if necessary. Both type valves are shown in Fig. 11.



OIL REGULATING VALVE (NON-ADJUSTABLE)



OIL REGULATING VALVE (ADJUSTABLE)

FIG. 11 - OIL PRESSURE REGULATING VALVES

The cartridge (non-adjustable) type oil pressure regulator is interchangeable on all 5F and 5H compressors except for early production 5F20, 5F30 and all 5H120 compressors. Whenever it is necessary to replace an adjustable type regulating valve, it should be replaced with non-adjustable type if possible. The 5H120 regulating valve is larger and can be used on the 5H120 compressor only.

To make oil pressure adjustments where the adjustable valve is used, proceed as follows:

**CAUTION:** This valve should not be adjusted to within less than one full turn of completely closed. If this is necessary replace the valve or bearings.

1. Pump the compressor down.
2. Remove the oil pressure adjustment plug and washer.
3. Remove the internal threaded lock screw with an Allen wrench.
4. Turn the adjusting screw (clockwise will increase the oil pressure). The pressure will be varied approximately 5 psi for one full turn.
5. Replace the lock screw, capscrew and washer. **CAUTION:** The beveled side of the lock screw should be turned in facing the adjusting screw.
6. Open the suction shut-off valve.
7. Check oil pressure.

OIL RETURN CHECK VALVE (SNIFFER VALVE)  
(SEE FIG. 48)

The oil return check valve allows oil to return from the suction manifold to the crankcase. It is a normally open valve and will close when crankcase pressure becomes higher than suction pressure.

On 5F20 and 5F30 compressors the oil return check valves are located on the underside of the partition between the suction manifold and the crankcase, one on each side of the compressor. They are the disc type and can be removed either through the bottom cover or through the pump end of the compressor when the pump end bearing head is removed.

On 5F40,60 and 5H40,60 and 80 compressors leaf type oil return check valves are located at the top center of the hand hole cover openings. They are easily removed when the hand hole cover is off.

**CENTRIFUGAL OIL SEPARATOR (5H120 ONLY)**

This centrifugal oil separator is mounted on the crankshaft. (See Fig. 38.) During flooded start up gas and oil foam can escape from the crankcase only by moving inward through the centrifugal oil separator. Rotating rapidly the oil is centrifuged out of the foam and thrown back to the crankcase. When foaming subsides and when the crankcase pressure and the suction manifold pressure equalize, oil from the system can return to the crankcase through the centrifugal fan (oil separator).

**OIL SEALS**

The seals in the 5F and 5H compressors are of the rotary type, continuously immersed in oil. They are precision built and are capable of adjusting automatically to wear and radial and axial movement of the shaft.

The rotating "seal head" is factory assembled as a single unit. (See Fig. 27,28 and 29.) It consists of a flexible neoprene bellows, lapped carbon seal washer, retainer shell, driving band and flange retainer. The rotating seal washer mates with a stationary seat on the cover plate. Both faces are precision lapped to prevent leakage.

Positive drive within the "seal head" is achieved by tightly compressing the neoprene bellows against the shaft with a metal driving band so that it will rotate with the shaft. Non-slipping is insured by projections on the metal driving

band which engages slots in the retainer shell. The retainer shell in turn drives the seal washer by means of interlocking notches.

Spring pressure is transmitted to the seal washer through the retainer shell, flange retainer and neoprene bellows flange. Special bellows construction allows the "seal head" and seal washer to move freely along the shaft so that constant contact with the seat face is maintained at all times.

The Carrier rotary seal is designed for quick and easy replacement. It is recommended that the seal assembly be replaced and that no attempt be made to make repairs or replace components of the seal.

**CRANKCASE HEATERS**

These heaters are available as an accessory. They maintain the crankcase oil at a temperature higher than other portions of the system during shut down to minimize the absorption of refrigerant by the oil and prevent damage to the compressor caused by flooded start-ups. They should be de-energized during the operating cycle to prevent excessive crankcase temperature. Systems with a crankcase heater installed can be operated on single pump out of the compressor before shut down if desired, instead of on automatic pumpdown control. Instructions for the installation of crankcase heaters are included in each package. (See Fig. 1 - 8 in Installation Manual for Crankcase Heater locations.)

## REMOVING, INSPECTING, AND REPLACING COMPONENTS

If a given part of a compressor is to be replaced, it may be necessary to remove other parts first. For this reason, the components are taken in the normal order of removal for

complete disassembly of the compressor. Fig. 12 is an exploded view of a 5H40 compressor, and Fig. 13 shows the internal parts.

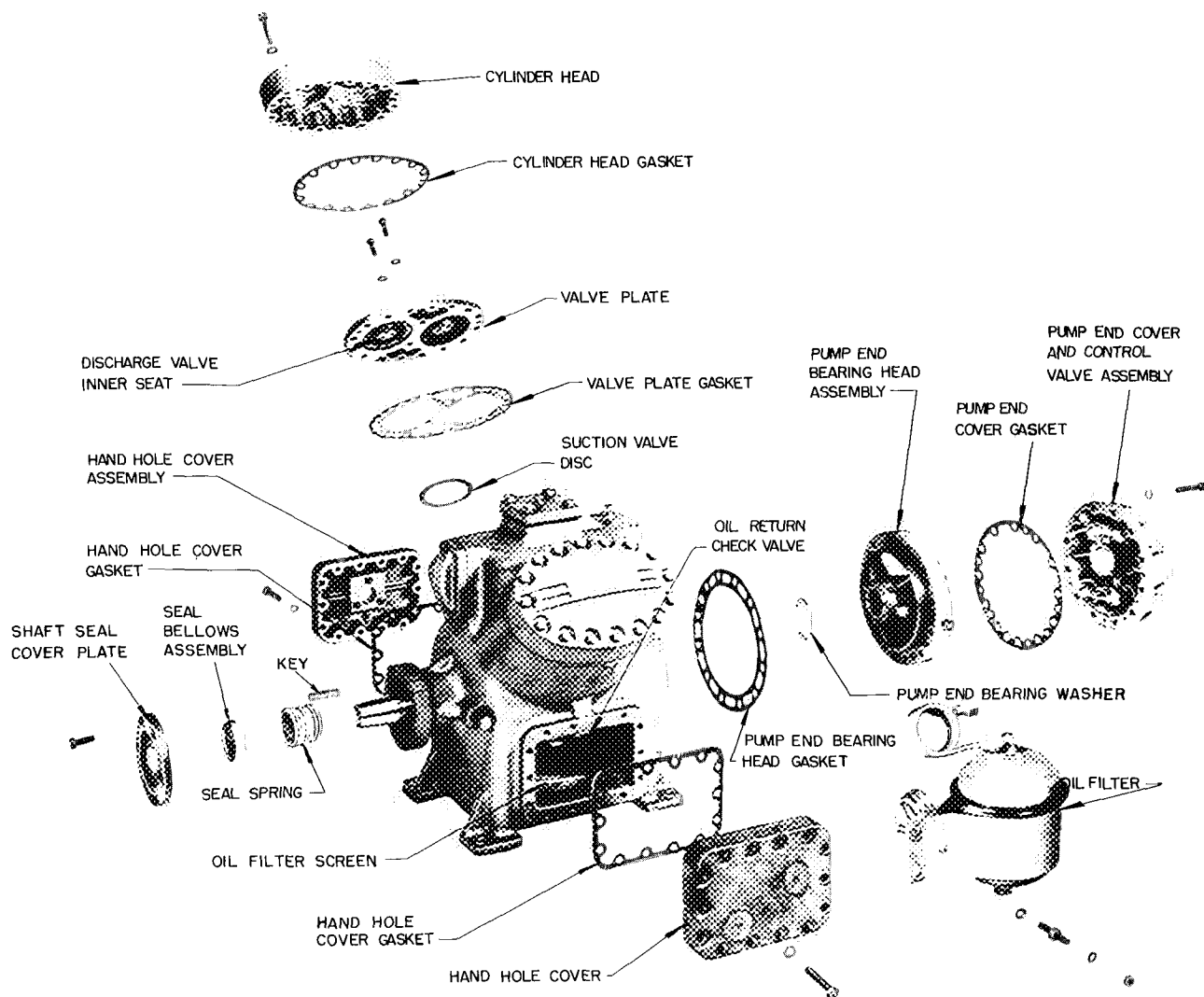


FIG. 12 - 5H COMPRESSOR ASSEMBLY

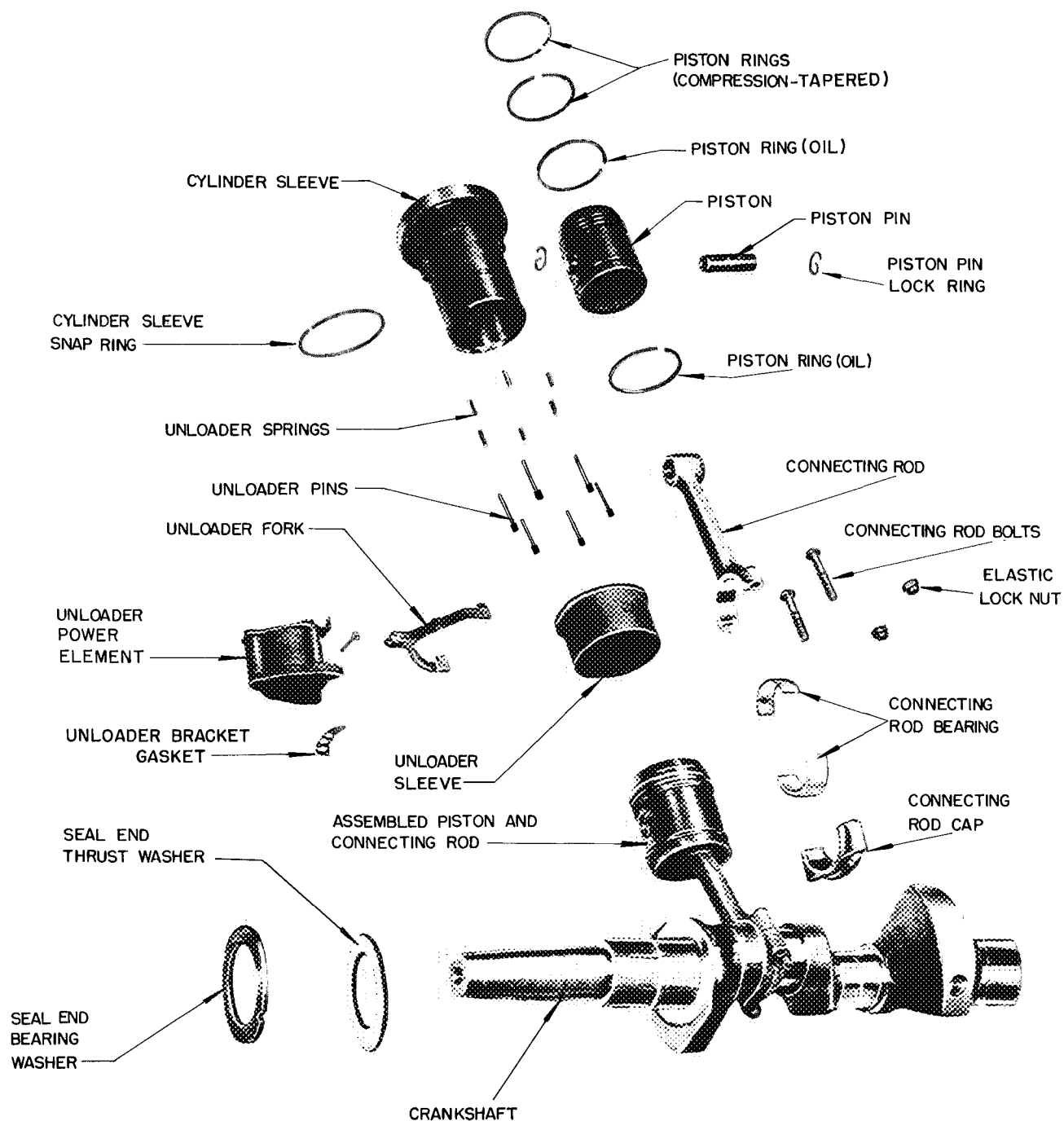


FIG. 13 - 5H INTERNAL PARTS

### OIL SAFETY SWITCH

The oil safety switch has a differential pressure switch that measures net oil pressure (the difference between the oil pump discharge pressure and crankcase pressure) and a thermal switch that cuts off the compressor. If the net oil pressure drops below the permissible limit, the differential pressure switch energizes a heater element that opens the thermal switch and cuts off the compressor in approximately one minute. Low oil pressure may result from loss of oil, oil pump failure, worn bearings or excessive refrigerant in the crankcase.

The differential pressure switch in the oil safety switch is factory adjusted to open when the pump oil pressure is 18 psi greater than the crankcase pressure and to close when the difference is 11 psi. This setting should not be adjusted in the field.

To check the oil safety switch:

1. Inspect the wiring and piping connections to make sure they are tight.
2. Stop the compressor and inspect the differential pressure switch to make sure it closes.
3. Start the compressor and move the lever arm on the left side of the switch forward. This closes the switch and the compressor should stop in about one minute.
4. Allow the heater to cool about three minutes, then press the reset button on the switch.

If the compressor continues to run after one minute, the time delay heater circuit is defective and the oil safety switch should be replaced, providing the wiring has been checked and found correct.

This test should be made once a month and also when the compressor is put back in service after it has cut out on the oil safety switch.

**WARNING:** Do not by-pass or manually control the oil safety switch to operate the compressor

if the switch has cut out. To protect the compressor from damage, find and correct the trouble before putting the compressor back into operation.

### PREPARATION

#### CLEANING PARTS

All parts should be cleaned with solvent after disassembly. Use a stiff brush to remove dirt from grooves and crevices. Do not use carbon tetrachloride for cleaning polished steel parts because it removes the oil film and the steel may rust. Coat all moving parts with compressor oil before assembly.

#### PUMPING DOWN THE COMPRESSOR

If the compressor is to be opened up, pump it down as follows:

1. Front seat (close) the suction shutoff valve.
2. Hold the pressurestat switch closed so it will not stop the compressor.
3. Run the compressor until the suction pressure is approximately 2 psig. It may be necessary to do this several times before the pressure remains at 2 psig.
4. When the pressure remains at 2 psig., close the discharge shutoff valve.

**WARNING:** Place a tag on the starting switch to warn against starting the compressor with the discharge shutoff valve closed. Pull the fuses so the compressor cannot be started. Serious damage will result if the discharge valve is not opened before the compressor is started.

#### DRAINING OIL

If the crankcase is to be opened during disassembly, the oil must be drained. Pump down the machine, vent the crankcase, loosen the drain plug, and allow the oil to drain slowly.

## OIL FILTER

5H40, 5H60, AND 5H80

The 5H40, 60 and 80 have bleed-type, high pressure throwaway filters (see Fig. 14). To replace the filter:

1. Close the shutoff valves in the oil lines on both sides of the filter.
2. Remove and replace the filter.

**WARNING:** Orifice elbow must be installed as shown in Fig. 14.

5H120

The 5H120 has a full flow filter with a renewable cartridge. (See Fig. 15.) The cartridge shipped with the compressor should be replaced after the first 200 operating hours or whenever the pressure drop across the filter approaches 5 psi. To do this, install a gage at the connection shown in Fig. 15. The difference between the pressure on this gage and the oil pressure gage is the pressure drop across the filter.

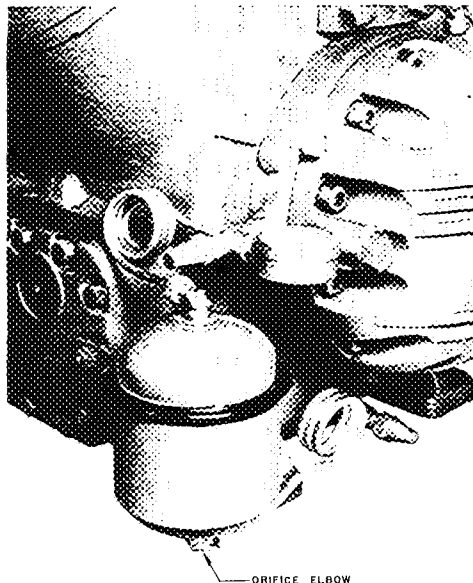


FIG. 14 - OIL FILTER INSTALLATION  
(5H40,60,80)

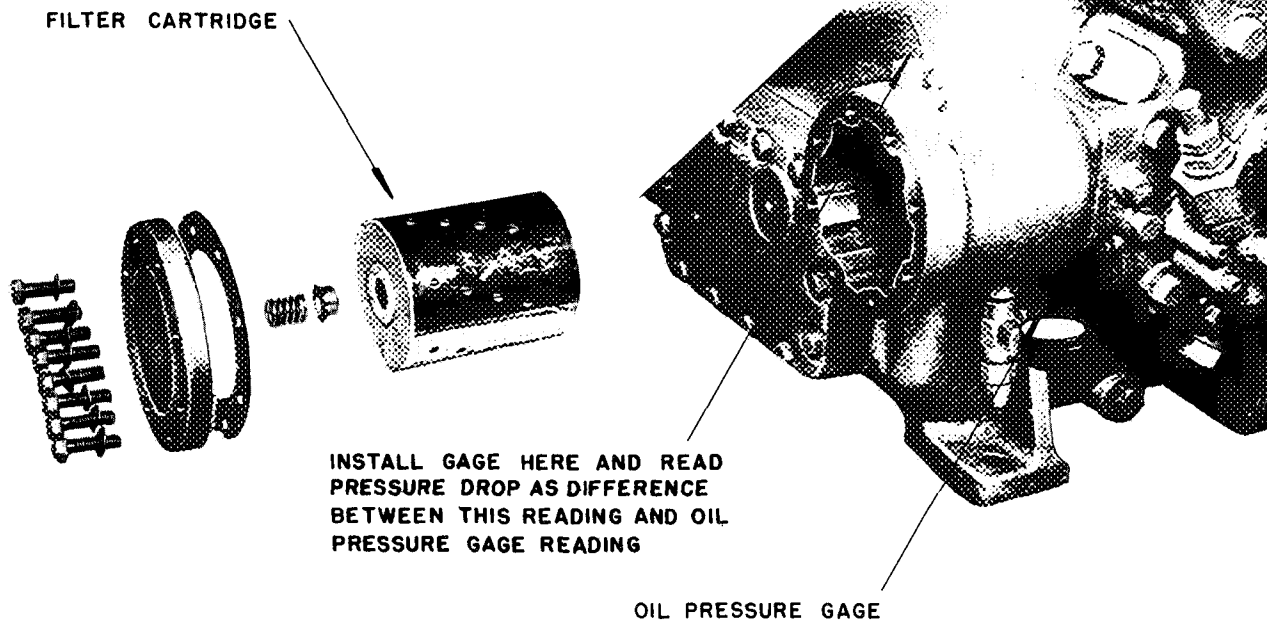


FIG. 15 - OIL FILTER 5H120

To replace the cartridge:

1. Pump down the compressor to 1 or 2 psi gauge.
2. Slowly loosen the filter cover plate bolts and allow the refrigerant to escape to the atmosphere.
3. Drain the oil into a container.
4. Remove the cover plate and replace the cartridge.

#### OIL PRESSURE REGULATOR

##### NEW TYPE

The new type, non-adjustable oil pressure regulator should be installed as a replacement on all compressors except 5F20 compressors manufactured before 1951. (See Fig. 11.) To remove the new type:

1. Remove the oil regulating valve cap.
2. Remove the oil regulating valve body with Allen wrenches. (5/16" across flats on all 5F,H compressors except 5H120; 1/2" across flats on 5H120.)

##### OLD TYPE

To remove the old type adjustable oil pressure regulator:

1. Remove the valve plug.
2. Remove the lock screw with an Allen wrench. (5/16" across flats.)
3. Remove the adjusting screw, spring, and the valve.

#### PRESSURE RELIEF VALVE

##### 5F60

5F60 compressors starting with Serial Number 9452380 have an internal relief valve that screws into the crankcase and projects up through the left bank valve plate as shown in Fig. 15A.

To disassemble remove the cylinder head. Unscrew the relief valve by inserting a large screw driver into the milled slot in the end of the relief valve.

After inspecting and reinstalling relief valve use new gaskets on the cylinder head.

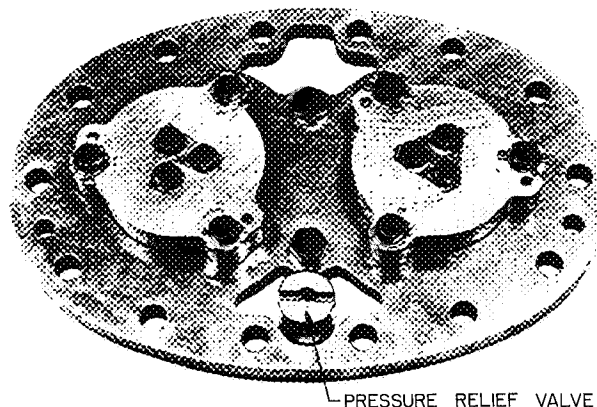


FIG. 15A - PRESSURE RELIEF VALVE

##### 5H40 AND 5H80

5H40 and 5H80 compressors have internal relief valves on the suction and discharge manifold cover at the seal end of the compressors. (See Fig. 16.)

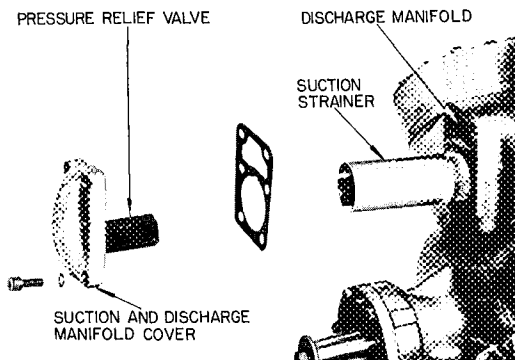


FIG. 16 - PRESSURE RELIEF VALVE AND SUCTION STRAINER OF 5H40 AND 5H80

##### 5H60

The 5H60 compressor has an internal relief valve in the wall between the suction and discharge manifolds. It is necessary to remove the external discharge manifold before the internal relief valve. (See Fig. 6 in Installation Manual for relief valve location.) The elongated socket shown in Fig. 17 makes it easy to remove the valve on compressors prior to Serial No. 510001. The slight oversize of the socket makes it possible to mount the socket and clear the lock wire

of the pressure relief valve. Compressors with Serial No. 510001 and higher will not require the special elongated socket; a standard 1-1/2" socket can be used to remove and install the new relief valves.

1-9/16" STANDARD SOCKET  
CUT IN HALF

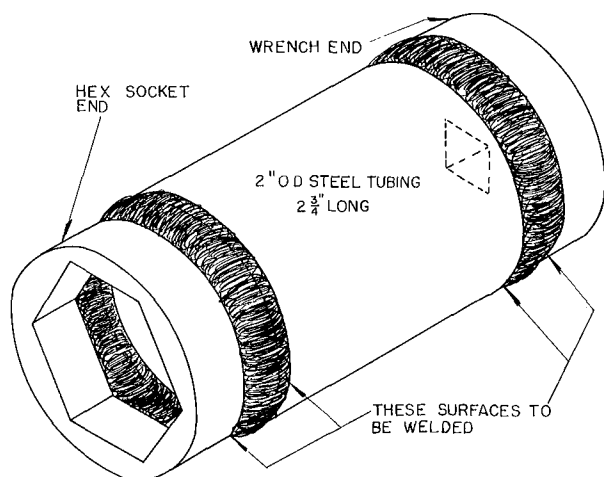


FIG. 17 - ELONGATION OF 1-9/16" SOCKET  
FOR REMOVING 5H60 PRESSURE RELIEF  
VALVE (BEFORE SERIAL 510001)

#### 5H120

The 5H120 has an external relief valve flange mounted in a bypass line. Remove the bolts from flanges on either side of the valve. (See Fig. 8 in Installation Manual.)

#### SUCTION STRAINER

##### 5F20, 5F40, AND 5H40

Remove the suction and discharge manifold cover on the seal end of the compressor and withdraw the suction strainer.

##### 5F30

Remove the suction service valve and withdraw the suction strainer.

##### 5F60 AND 5H60

Remove the suction manifolds and withdraw the two suction strainers.

##### 5H80

Remove the suction manifold cover and withdraw the suction strainer.

#### 5H120

Remove the suction manifold cover plates one at a time so as not to disturb the position of the detachable suction manifold and suction line. Withdraw the two suction strainers.

Take care to prevent damage when replacing suction strainers. If the strainer is corroded, broken, or otherwise unsuited replace with a new one. Normally it can be cleaned with solvent and replaced.

When replacing a strainer, insure that the bail is compressed by the manifold cover plate when the plate is in position. If the bail is too short, grasp the sides of the bail so as to elongate it sufficiently to be compressed by the cover. Insure that the strainer is positioned so that the bail fits between the two bosses on the inside of the cover and thus is restrained from turning.

**CAUTION:** If a felt sock filter is installed, remove it after 50 hours operation. If it is quite dirty, clean it and replace it for another 50 hours. Clean the suction strainer whenever the felt sock is removed.

#### CYLINDER HEADS

##### DISASSEMBLY

Remove the cylinder head cover, cylinder head and safety springs being careful not to drop them or damage the gasket sealing surface.

##### INSPECTION

Inspect the head to be sure it is not cracked and that the gasket sealing surfaces are satisfactory.

##### REASSEMBLY

Clean old gasket material from the valve plate. Reinstall the cylinder head with a new gasket (see Fig. 12).

#### VALVE PLATE AND SUCTION AND DISCHARGE VALVE DISCS

##### DISASSEMBLY

**NOTE:** Procure the valve retainer clips shown in Fig. 19 before proceeding.

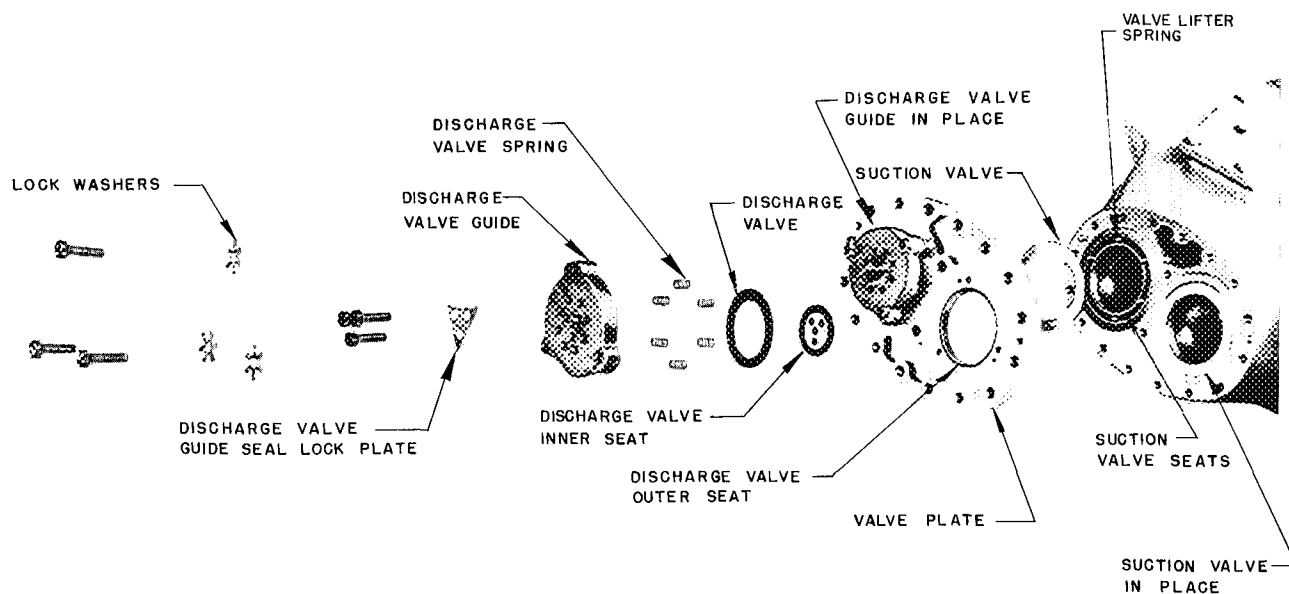


FIG. 18 - SUCTION AND DISCHARGE VALVE ASSEMBLY

1. Loosen the cap screws holding the inner discharge valve seat to the valve guide. (See Fig. 18.)
2. Loosen the cap screws holding the valve guide to the valve plate.
3. Remove the cap screws holding the valve plate to the cylinder block and remove the valve plate.
4. Remove the valve guide from the valve plate.

#### INSPECTION

Inspect the suction and discharge valve discs to see that they are not cracked or worn beyond the limits shown in Tables 3 and 4.

#### REASSEMBLY

1. Place the suction valve springs in the spring recesses with the large coil in full contact with the bottom.
2. Turn the crankshaft so that the pistons are below the tops of the cylinder sleeves.
3. Place the suction valve disc on the valve

springs and press it down into the recesses in the valve plate.

4. Slide the retainer clips in place as shown in Fig. 20. Locate the clips so they do not cover one of the unloader pins or springs.
5. Bolt the valve plate to the cylinder block.
6. Remove the valve clips.
7. Check the discharge valve springs to see that they are in place and properly seated.
8. Place the discharge valve disc over the springs and fit the inner seat in place over the valve disc, making sure that the valve is properly seated.
9. Hand tighten the bolts holding the inner seat to the valve guide and place the assembly on the valve plate.
10. Tighten all bolts and bend the tabs of the lock washers and lock plates.

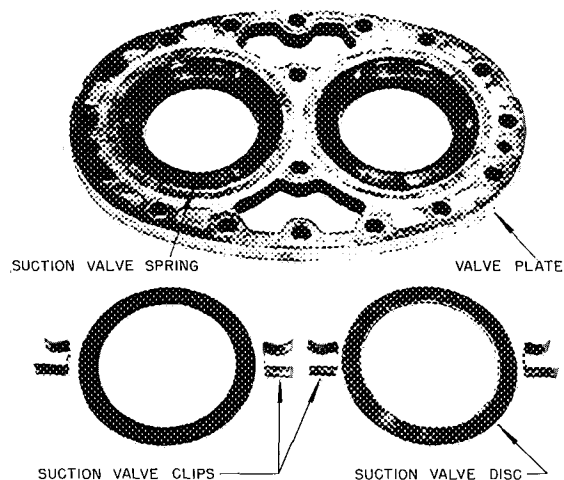


FIG. 19 - VALVE PLATE, SUCTION VALVE AND CLIPS

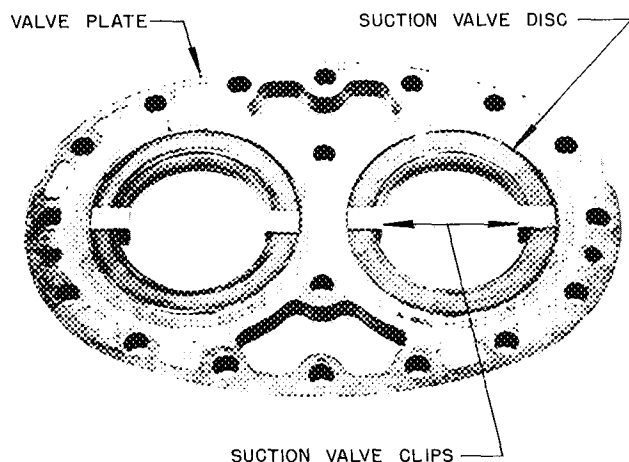


FIG. 20 - SUCTION VALVE ASSEMBLED TO VALVE PLATE WITH CLIPS

#### CYLINDER AND UNLOADER SLEEVES

#### DISASSEMBLY

1. Turn the crankshaft until the piston is in mid-position.
2. Insert a sleeve puller into the cylinder and push it down onto the top of the piston.

3. Tighten the nut on top of the sleeve puller to expand the puller in the sleeve. (See Fig. 21.)
4. Turn the crankshaft by hand. This forces the sleeve up until it can be removed.
5. Remove the unloader snap ring and sleeve (snap rings are used with 5H unloader sleeves only).

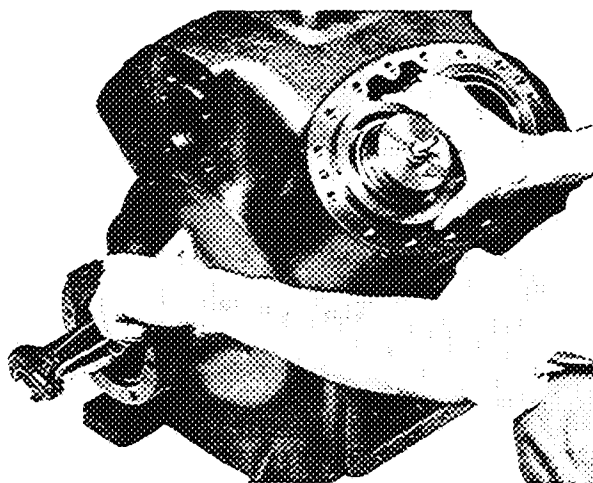


FIG. 21 - REMOVING SLEEVE

#### INSPECTION

Examine the bore of the sleeve for wear. Check the suction valve seats for scratches and wear. (See Tables 3 and 4 for wear limits.)

When new rings are being installed in a used cylinder sleeve, it is necessary to break the hard glazed surface of the cylinder sleeve in order to reduce the wearing-in period of the new rings. Break the glaze by using No. 80 emery cloth with an oscillating (up and down rotating) motion, or re-hone lightly. Clean thoroughly after breaking glaze.

Check unloader sleeves, pins and springs for wear and freedom of movement.

## REASSEMBLY

When the cylinder sleeves only are to be replaced, it is not necessary to remove the pistons and connecting rods.

1. Rotate the crankshaft so the piston is at top center.
2. Oil the piston rings and the bevelled surface at the lower edge of the cylinder sleeve.
3. Stagger the ring gaps around the piston.
4. With a turning motion, work the sleeve over the piston and rings. Compress and align each ring with the bevelled edge of the sleeve.
5. Seat the sleeve in the suction manifold partition and the cylinder deck recess.
6. Rotate the sleeve so that any two valve lifter pin holes lie equal distances from the longitudinal axis of the compressor as shown in Fig. 22. In this position the valve lifter pins

line up with the suction valve springs, and prevent undue stress on the valve disc.

7. Make sure that the valve lifter pins operate freely. Check operation of the unloader. This can be done by removing the pump end main bearing assembly and applying pressure from a refrigerant drum. Fig. 23 is a suggested arrangement.

**CAUTION:** Never operate the compressor with a valve plate off unless the cylinder sleeves are fastened in place. Cylinder sleeves can be held in place by capscrews and washers as shown in Fig. 22. The capscrews are screwed into the tapped holes normally used to hold the valve plate in place. Use plate washers large enough to extend well over the faces of both sleeves or make up steel plates for this purpose. Two washers or plates should be used on each cylinder deck.

Whenever the cylinder sleeve or valve plate is replaced the suction valve disc should also be replaced, or turned over if the reverse side is unused.

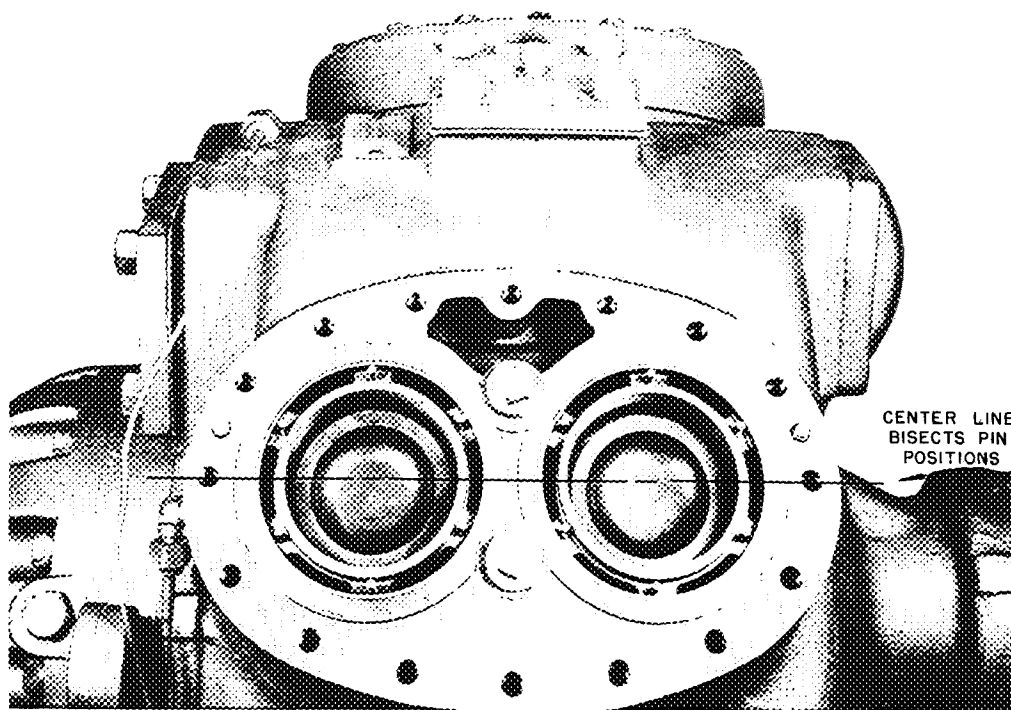


FIG. 22 - POSITION OF CYLINDER SLEEVES

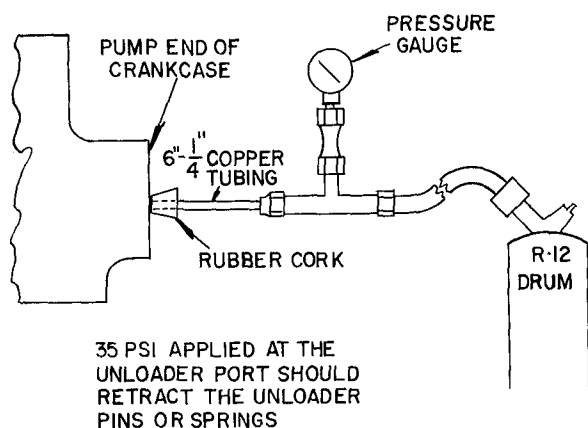


FIG. 23 - TESTING UNLOADER OPERATION

## HAND HOLE COVER OR BOTTOM PLATE

### DISASSEMBLY

1. Pump down the compressor and drain the oil.
2. Remove the bottom plate on 5F20 and 5F30 compressors or the hand hole cover on other 5 line compressors.

### INSPECTION

Clean and inspect all gasket surfaces.

### REASSEMBLY

Install new gasket and replace bottom plate or hand hole cover.

## CONNECTING RODS, CONNECTING ROD BEARING INSERTS, PISTONS, AND PISTON PINS

### DISASSEMBLY

1. Remove the cylinder head, valve plate, and hand hole cover or bottom plate.

2. Remove the connecting rod cap. Label the caps and rods so that the caps can be put back on their respective rods and the rods reinstalled in the same places on the crankshaft.
3. Remove the cylinder sleeve, connecting rod, and piston assembly together. Take care that the piston does not come through the top of the sleeve. The connecting rod will not pass through the sleeve and it is difficult to get the rings back into the cylinder without breaking them or damaging the suction valve seats.

### INSPECTION

Check the parts and crankpin journals to see that they are not worn beyond the limits given in Tables 3 and 4.

### REASSEMBLY

#### Bearing Inserts

If the bearing is damaged and the crankshaft is not worn, it is only necessary to replace the inserts. Do not file the bearing caps. Place the inserts in the connecting rod and cap so the toeing knobs on the inserts fit into the notches on the rod and cap. Lubricate the insert bearings and crankpin freely before installing the caps.

#### Piston Pins

Piston Pins are selectively fitted for a push fit. The values given below are for a dry pin:

5F	10 to 25 lb.
5H	15 to 30 lb.

The pins should therefore be reassembled in the pistons from which they were removed.

The piston pin retaining clips should be placed with the gap on the side as in Fig. 24 and be tight enough so they cannot be rotated by finger pressure.

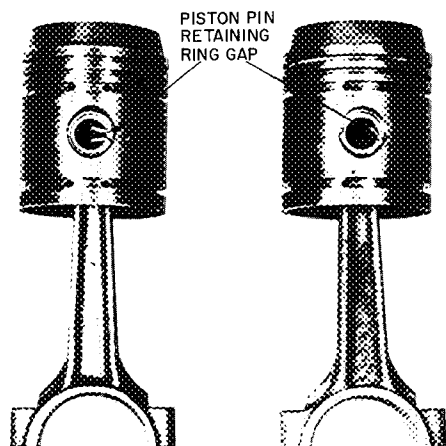


FIG. 24 - POSITION OF PISTON PIN RETAINING CLIPS

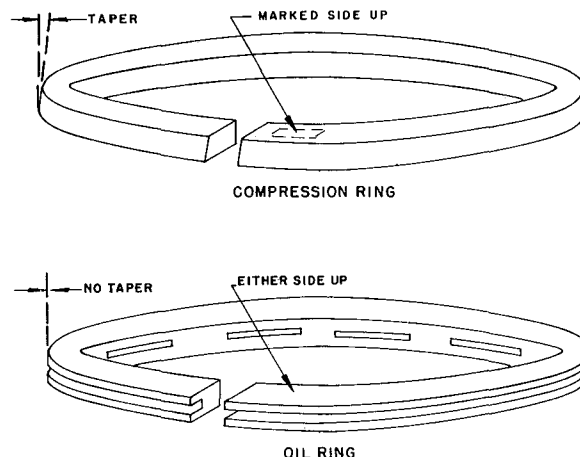


FIG. 25 - PISTON RINGS

## Rings

Taken in order from the head of the piston there are two compression rings (plain), an oil ring (vented) and a second oil ring on the piston skirt. To install the rings on the piston:

1. Insert each ring in the cylinder about 3/8" from the top and check the ring gap. It should be between .007 and .017".
2. Install the compression rings on the piston with the side marked "Top" toward the head of the piston. (See Fig. 25.) Install the oil rings with either side up. (They have no taper.)
3. Stagger the ring gaps around the piston.
4. Check the rings for free action and measure the side clearance between the ring and the piston with a feeler gauge. It should be about .001".

Install the sleeve, connecting rod, and piston assembly at the same time, making sure the piston does not come out the top of the sleeve. Turn the connecting rod and install the cap so the chamfered sides are against the radius of the crankpins. The small knobs on the rod and cap must be on the same side of the journal.

## CRANKSHAFT SEAL

When replacing a seal, the pump end bearing head assembly must be in place; otherwise, the seal will not be properly positioned on the shaft. It is also possible that the seal end bearing washer will be pushed off the retaining dowel if this is not done.

Several different type seals have been used in the 5 line compressors. The current sleeve type rotary bellows seal is supplied as a replacement for all earlier model seal assemblies.

## STATIONARY BELLOWS TYPE SEAL

### Disassembly

1. Remove the cover plate.
2. Tap the bellows frame with a plastic hammer or screwdriver handle if the pressure of the seal spring does not force the bellows clear of the housing.
3. Strip the gasket from the recess in the seal housing.
4. Remove the shaft seal shoulder and neoprene gasket. (See Fig. 26.)

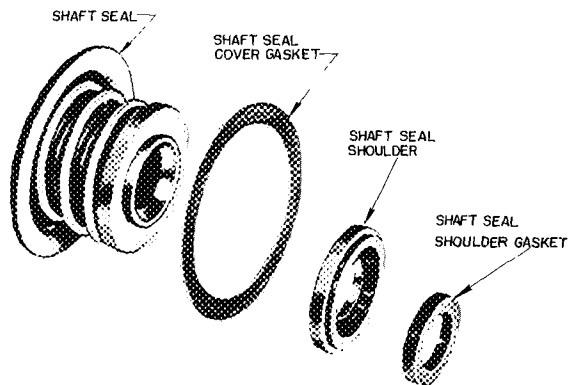
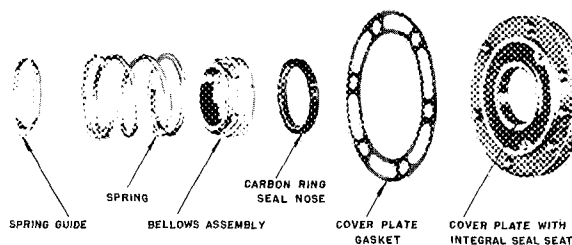


FIG. 26 - STATIONARY BELLOWS SEAL

FIG. 28 - ROTARY SEAL  
(INTEGRAL SEAL SEAT)

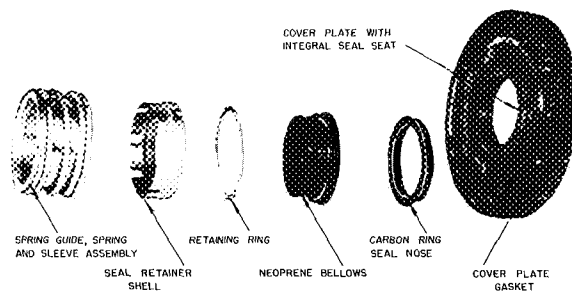
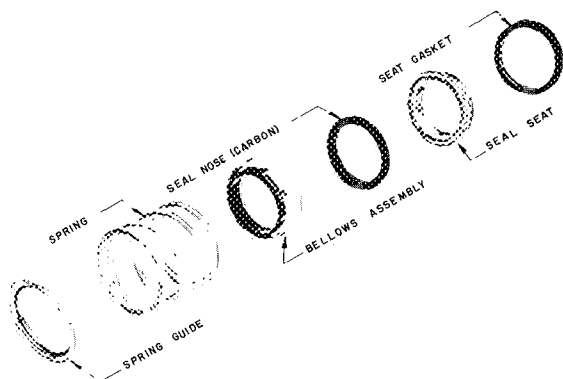
### Reassembly

Replace with the current sleeve type rotary bellows seal. (Fig. 37 and 38.) A new, matching cover plate must be used on 5F compressors when converting to rotary bellows seal.

### ROTARY BELLOWS TYPE SEALS

#### Disassembly

Remove the cover plate and seal. Be sure to remove the spring guide. (See Fig. 27 and 28.)

FIG. 29 - ROTARY SEAL - SLEEVE TYPE  
(SERVICE REPLACEMENT SEAL)FIG. 27 - ROTARY SEAL - DISASSEMBLED  
(INSERT SEAL SEAT)

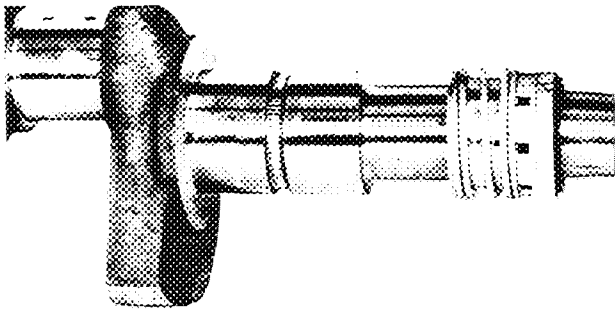
#### Inspection

Clean the seal cavity and crankshaft. Remove all burrs from the crankshaft to prevent damage to the neoprene bellows.

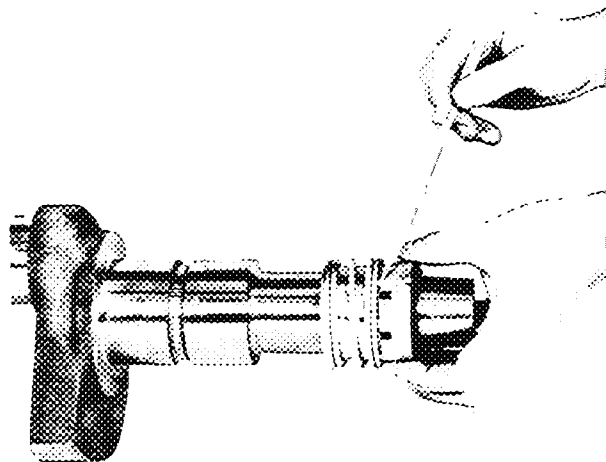
#### Assembly

Early type seals should be replaced by the sleeve type seal. If a good gasket seal cannot be made between the seal cover plate and the face of the seal housing, due to unevenness of the seal housing gasket surface, the earlier type seal cover plate with the insert seat is available and may be used; this gasket surface is on a step shoulder inside the seal cavity.

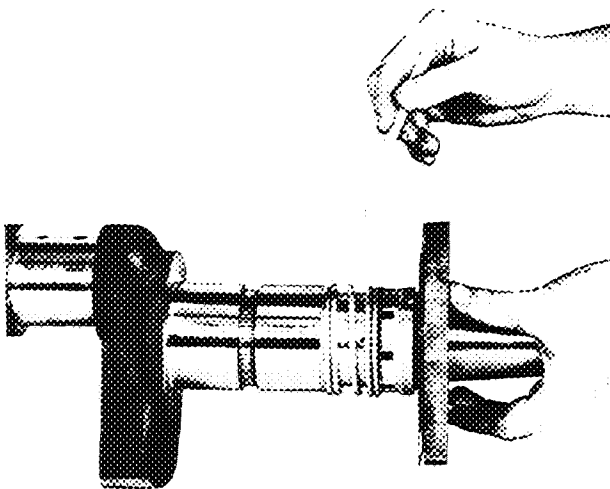
The step by step installation procedure for the sleeve type rotary seal is outlined in Fig. 30. To make it easier to see how the seal is installed the crankshaft is shown removed from the compressor.



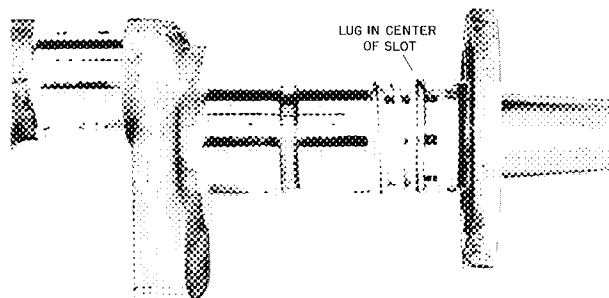
**STEP 1** - Lubricate the shaft and the neoprene bellows where it comes in contact with the shaft. Slide the seal assembly, as it is shipped from the factory, onto the shaft until the neoprene just starts to grasp the shaft.



**STEP 2** - Holding the sleeve and spring assembly, pull forward on the seal nose assembly at the same time, turning it so that the lugs on the driving band are out of the slots in the retainer shell and rest on the surface of the retainer shell as shown by the pencil.



**STEP 3** - Using the seal cover plate, push the seal assembly into its proper location on the shaft. DO NOT use cover plate bolts to push seal into position. The spring guide should be tight against the shaft shoulder as shown by the pencil. Remove the cover plate, being careful not to allow the carbon washer to become damaged. GRASP THE SEAL NOSE ASSEMBLY AND TURN IT UNTIL THE LUGS ON THE DRIVING BAND DROP BACK INTO THE SLOTS IN THE RETAINER SHELL.



**STEP 4** - Lubricate the carbon seal washer and seal seat. Re-install the seal cover plate, drawing the bolts down evenly to prevent damage to the carbon seal nose. This view shows the lugs of the driving band properly positioned in the center of the slots in the seal retainer shell. This is the correct position during operation. This prevents the seal from being used as a thrust washer under all operating conditions.

FIG. 30 - INSTALLATION OF SLEEVE TYPE ROTARY SEAL

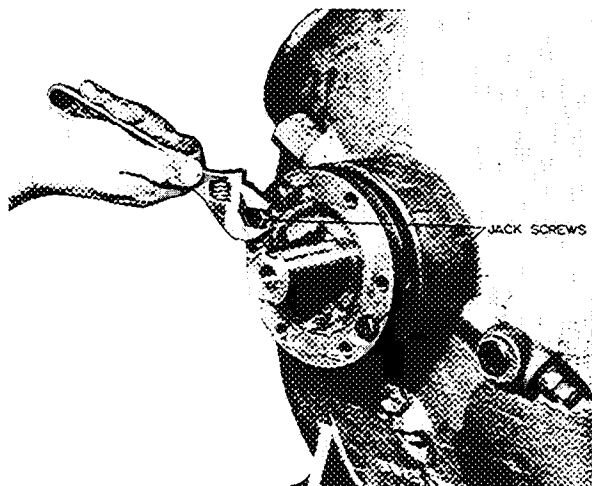


FIG. 31 - REMOVING OLD SEAL (5H120  
PRIOR TO SERIAL NO. 0452374)

The seal may leak slightly immediately after installation, but a short period of operation will correct the condition.

Carbon rings are available separately in case one is broken during installation. However, if a seal leaks, a complete new assembly must be installed.

#### CARTRIDGE TYPE SEAL (5H120 PRIOR TO SERIAL NO. 0452374)

##### Disassembly

Remove the seal cover plate capscrews and insert two of them in the threaded holes in the cover plate. Using them as jackscrews pull the cover plate and seal assembly from the shaft. (See Fig. 31.) Remove cartridge from cover plate. Retain cover plate for use with new rotary type seal.

##### Assembly

Replace with current sleeve type rotary bellows seal for 5H120 compressors.

#### ROTARY TYPE SEAL (5H120 BEGINNING SER- IAL NO. 0452374)

##### Disassembly

Remove cover plate and seal from shaft. Retain cover plate for use with new seal.

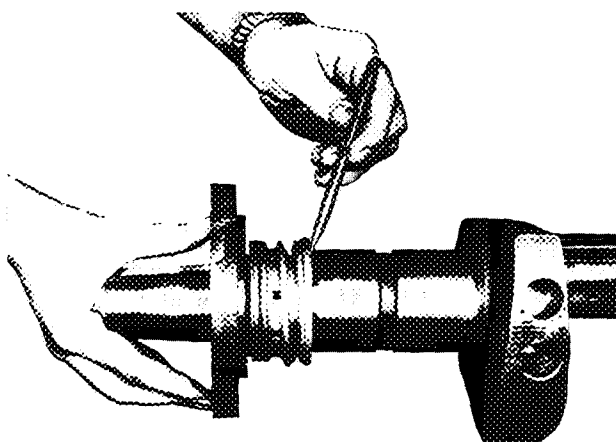


FIG. 32 - INSTALLING NEW SEAL

##### Inspection

Polish shaft with fine crocus cloth. Remove all sharp edges from the shaft and keyway to prevent damage to the neoprene bellows. Clean the seal cavity thoroughly. Inspect cover plate for scoring. Replace if scored.

##### Assembly

All 5H120 shaft seals should be replaced by this seal. To make it easier to see how the seal is installed, the crankshaft is shown removed from the compressor in Fig. 32.

The step-by-step installation procedure is outlined below:

1. Lubricate crankshaft, carbon seal washer, seal seat, and neoprene bellows where it contacts the shaft.
2. Slide the seal assembly, as shipped from the factory, onto the shaft.
3. Using the seal cover plate, push the seal assembly into position on the shaft.

**NOTE:** The shaft seal must be tight against the shaft shoulder as shown in Fig. 32.

4. Re-install seal cover plate, drawing bolts down evenly to prevent damage to carbon seal washer.

**CAPACITY CONTROL VALVE**

**EXTERNAL ADJUSTING STEM**

**Disassembly**

To remove the external adjusting stem, it is not necessary to pump down the compressor.

**Reassembly**

Install a new gasket when the new adjusting stem is installed. The 5F,H Installation Manual includes detailed instructions for adjusting the capacity control valve.

**CAPACITY CONTROL VALVE AND HYDRAULIC RELAY ASSEMBLY FOR 5F40 AND 5F60 COMPRESSOR**

**Disassembly**

The capacity control valve, hydraulic relay and piping are part of the hand hole cover. (See Fig. 33.) Remove the cover.

**Reassembly**

Clean the gasket surface, install a new gasket and a new hand hole cover with control valve and relay assembly. The capacity control valve is available as a separate parts item and may be easily installed on the original hand hole cover.

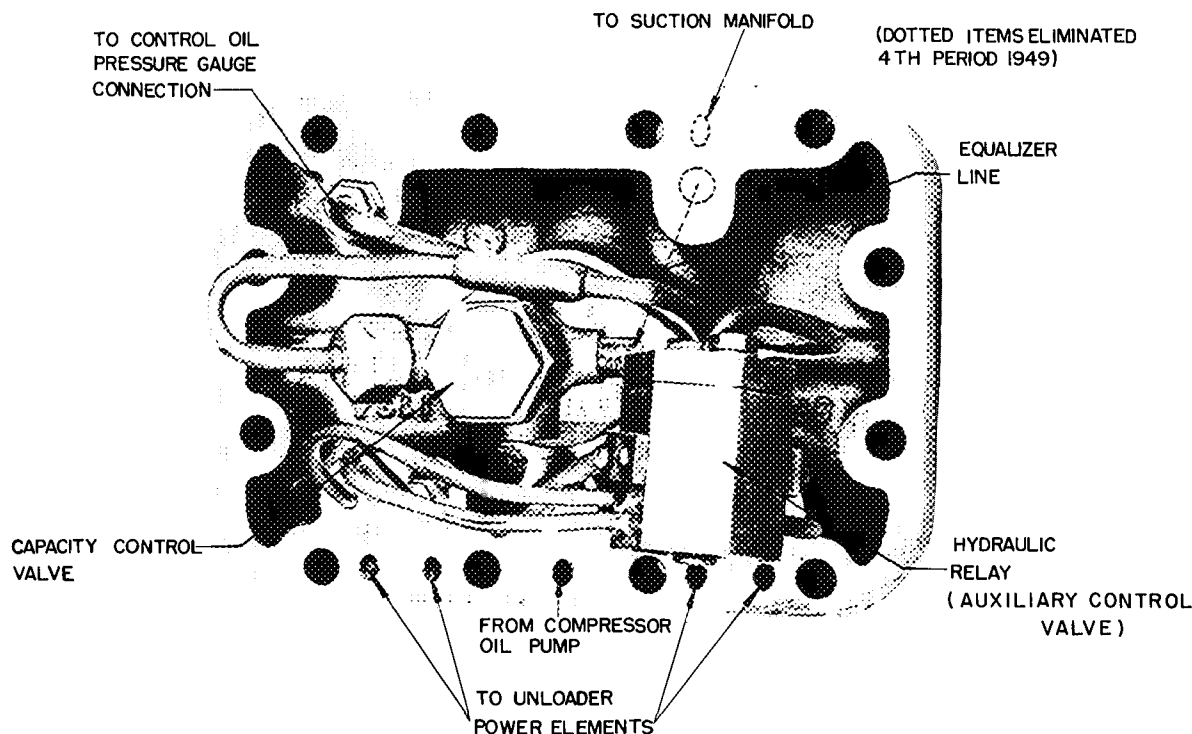
**CAPACITY CONTROL VALVE AND HYDRAULIC RELAY ASSEMBLY FOR 5H COMPRESSORS (EXCEPT 5H120)**

**Disassembly**

The capacity control valve, hydraulic relay and piping are part of the pump end cover. (See Fig. 34.) Remove the cover.

**Reassembly**

Clean the gasket surface, install a new gasket and a new pump end cover with control valve assembly. The capacity control valve is available as a separate parts item and may be easily installed on the original pump end cover.



**FIG. 33 - COMPRESSOR HAND HOLE COVER AND CONTROL**

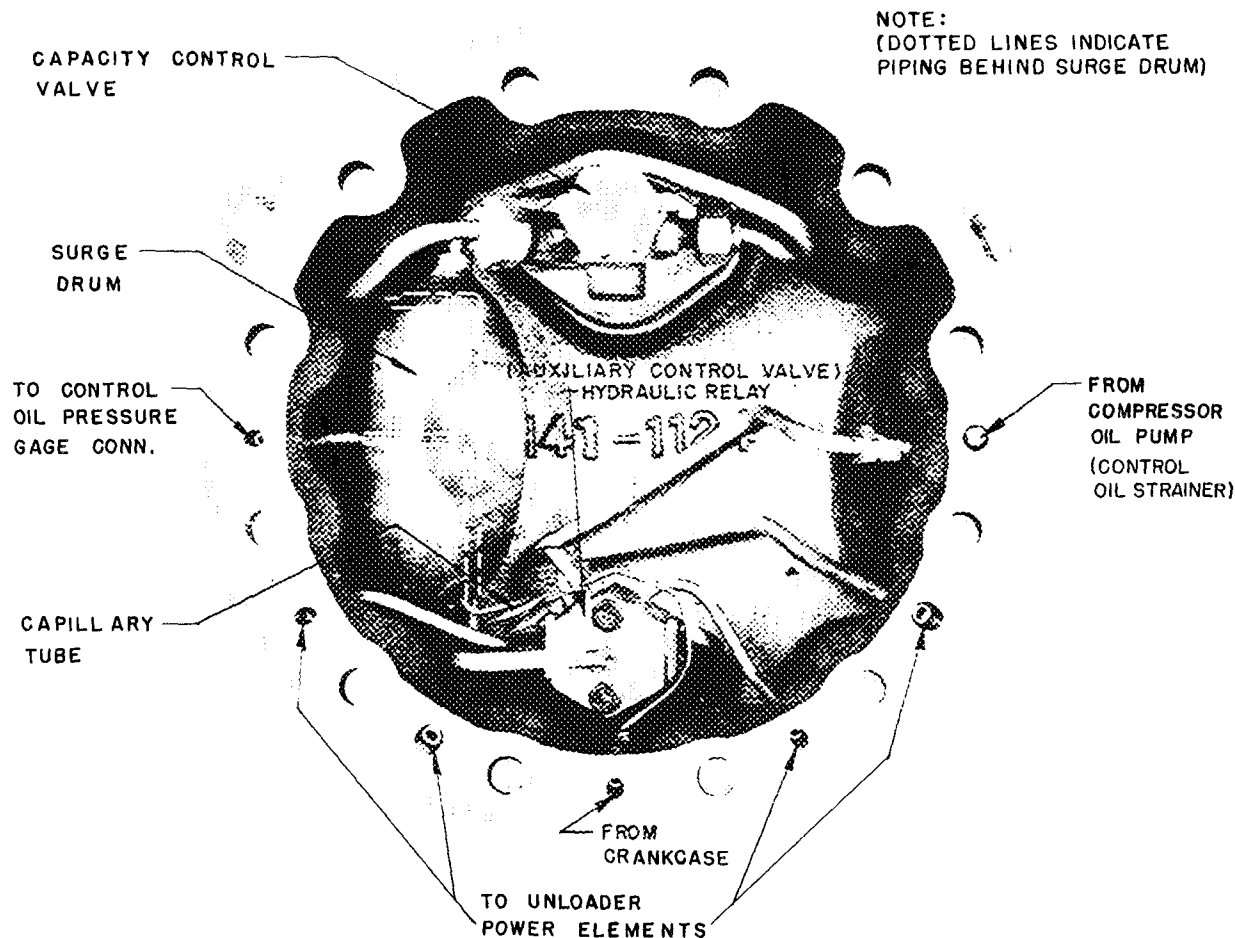


FIG. 34 - 5H PUMP END COVER AND CONTROL ASSEMBLY  
(EXCEPT 5H120)

CAPACITY CONTROL VALVE AND HYDRAULIC RELAY FOR 5H120 COMPRESSORS (PRIOR TO SERIAL NO. 0447119)

#### Disassembly

Loosen the capacity control valve and remove the pump end bearing head. Remove the capacity control valve. The hydraulic relay can also be removed by removing two 5/16" Allen head cap screws. (See Fig. 35.)

#### Reassembly

Clean the gasket surface, install a new gasket, capacity control valve, and (hydraulic relay, or auxiliary control valve) using the original pump end cover. If the complete bearing head assembly is to be changed, the new 5H120 assembly can be used, although individual parts of the new and old assemblies are not interchangeable. (See Fig. 36 for the new assembly.)

**CAPACITY CONTROL VALVE AND HYDRAULIC RELAY FOR 5H120 COMPRESSORS (BEGINNING SERIAL NO. 0447119)**

**Disassembly**

The capacity control valve, hydraulic relay, and piping are part of the pump end bearing head. (Fig. 36.) Remove the bearing head.

**Reassembly**

Clean the gasket surface, install a new gasket and the pump end bearing head with control valve assembly. The capacity control valve and hydraulic relay are available as separate parts items and may be easily installed on the original pump end bearing head.

**CONTROL OIL STRAINER**

On 5F compressors (see Fig. 10), the control oil strainer plug is on the side of the pump end bearing head. On 5H compressors (see Fig. 34), it is on the pump end cover, and on 5H120 compressors it is beneath the capacity control valve.

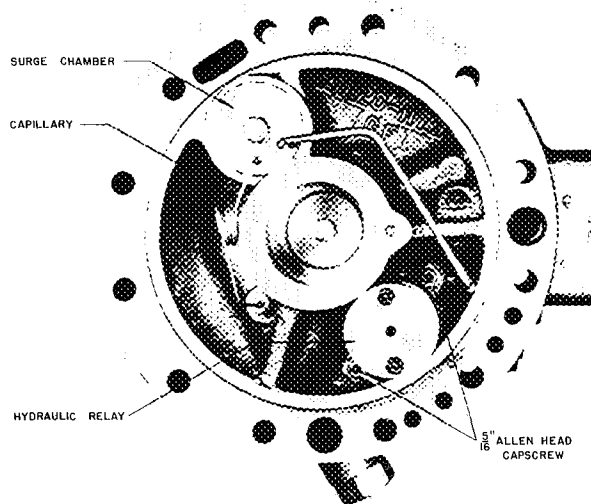
**Disassembly**

Remove the lock screw and control oil strainer.

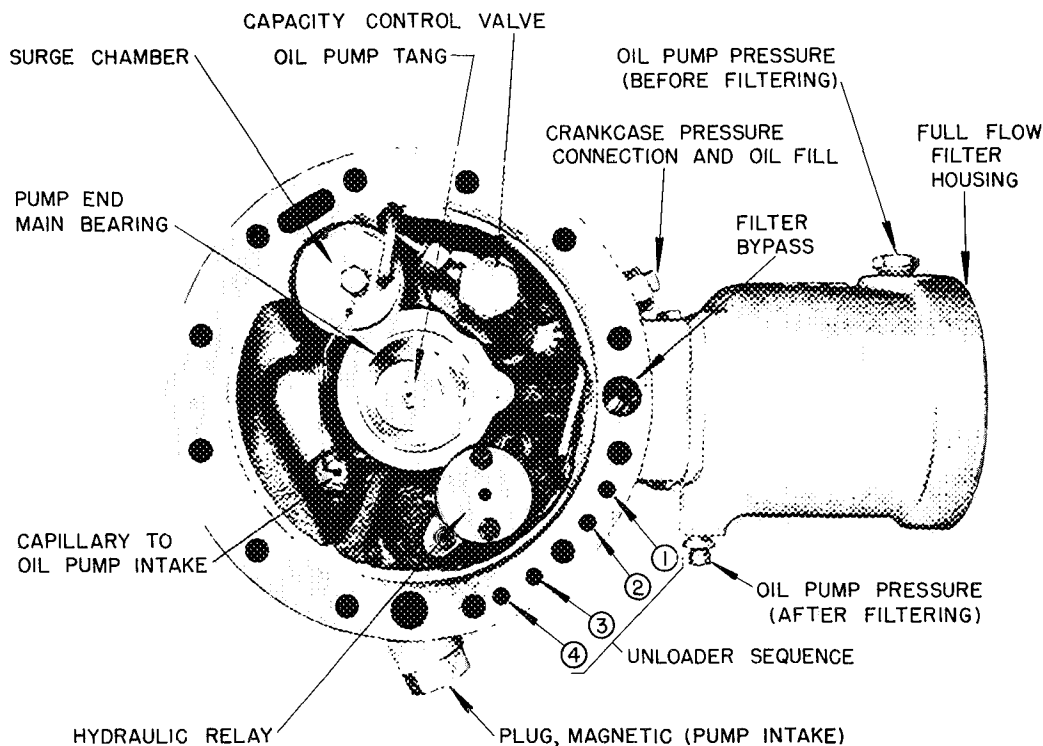
(No lock screw on 5H120.) Use a hooked piece of wire to pull out the strainer.

**Reassembly**

Install a new strainer, replace the lock screw and the control oil plug.



**FIG. 35 - 5H120 PUMP END BEARING HEAD ASSEMBLY (PRIOR TO SERIAL NO. 0447119)**



**FIG. 36 - 5H120 PUMP END BEARING HEAD ASSEMBLY (BEGINNING SERIAL NO. 0447119)**

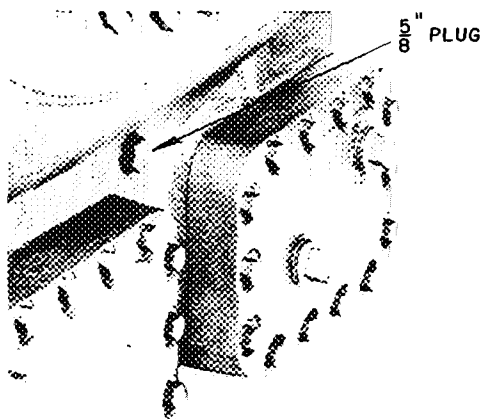


FIG. 37 - 5H80, 120 CENTER MAIN BEARING HOUSING LOCKSCREW LOCATION

#### CRANKSHAFT

#### DISASSEMBLY

1. Remove the cylinder heads, valve plates, connecting rods, cylinder sleeves, and pump end main bearing head.
2. For the 5H80 and 5H120, remove the center main bearing lock screw located beneath the plug shown in Fig. 37. On the 5H120 disconnect the oil line to the center main bearing housing.
3. Remove the crankshaft through the pump end of the crankcase, tapping the seal end of the shaft with a wooden or rubber mallet.

#### INSPECTION

Inspect the crankshaft to see that the journals are within the limits given in Tables 3 and 4. Connecting rod inserts and main bearings can be purchased for crankshafts reground .010" to .020" undersize. A worn crankshaft suitable for regrounding to .010" or .020" undersize can be exchanged for a factory reground crankshaft and bearings.

Factory reground crankshafts are stamped on both ends with the letter "A" if .010" undersize or "B" if .020" undersize.

If a crankshaft is reground locally, be sure to hold the throw dimensions given in Table 5 and keep the radius at the ends of the journals at 1/16".

TABLE 5 - MAXIMUM THROW DIMENSIONS FOR 5F AND 5H COMPRESSORS

5F Compressors	1.001
5H Compressors	1.376"

Tables 3 and 4 give the factory maximum and minimum diameters for journals. To get the maximum and minimum for an undersize shaft, subtract the amount of undersize from these values. For example, the factory tolerance for the 5H40 seal end journal is 2.6225" to 2.6235". A crankshaft reground to .010" undersize is then held between 2.6125" and 2.6135".

For future identification, stamp locally ground crankshafts with the letter "A" or "B" according to the undersize. The letters should also be stamped on the pump end bearing head next to the oil pressure gauge connection.

#### REASSEMBLY

When a crankshaft is reground, it is necessary to remove the plugs and clean the oil passages. Tighten the plugs before installing the crankshaft.

On the 5H120:

1. Install the headed dowel key so that its axis is parallel to the axis of the shaft. It must be positioned so that the chamfered edge is toward the radius on the crankshaft journal. (See Fig. 38.)
2. Install the oil recovery impeller, making certain that the key lines up with the keyway; otherwise, the head of the key may gouge out the aluminum keyway. The impeller must fit the key snugly, or it will loosen and become noisy.
3. Install the steel thrust washer so the dowel pin hole fits over the dowel in the crankcase.

#### MAIN BEARINGS

Pullers are available for replacing main bearings in 5 Line Compressors. The outside diameter of the puller shoulder fits through the seal end bearing housing of the size compressor it was designed for. Table 6 gives the puller size to be used with each compressor.

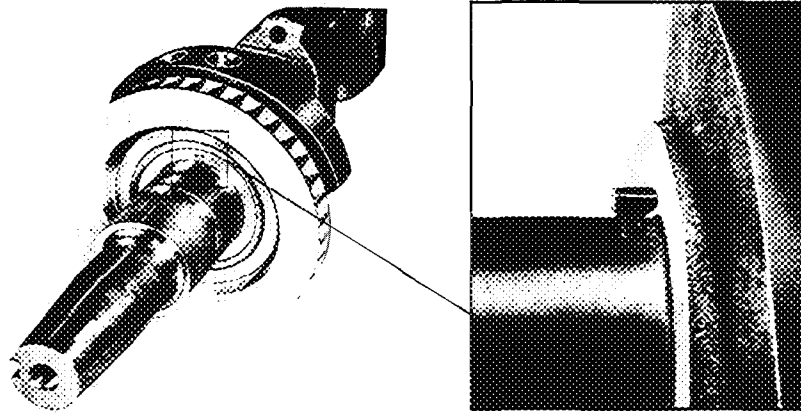


FIG. 38 - CENTRIFUGAL OIL SEPARATOR (5H120 ONLY)

TABLE 6 - PULLER SIZES TO BE USED WITH COMPRESSORS

COMPRESSOR	PULLER SIZE
5F20 & 5F30	5F20
5F40, 5F41, 5F60, & 5F61	5F40
All 5H Freon and Ammonia Compressors	5H40

On the 5F40, 5F60 and all 5H compressors, the seal end main bearing is larger than the pump end main bearing. The pullers for these are step cut to fit both bearings, standard and undersized. (See Fig. 39.) The side of the puller shoulder is marked "B" for undersized bearings. Fig. 40, 41 and 42 show how the puller is used on seal end bearings.

The puller cannot be used to pull pump end bearings but the puller shoulder is used to press a new pump end bearing in place as described under "Pump End Main Bearing."

#### CENTRIFUGAL OIL SEPARATOR (5H120 ONLY)

The Centrifugal oil separator is shrink-fitted on the crankshaft. It can be removed by heating to 180 F or more, such as by immersion in oil or hot water. If water is used, insure that all traces are removed before re-assembly. Use of a torch on the impeller is not recommended. (See Fig. 38.)

#### PUMP END MAIN BEARING

##### DISASSEMBLY

1. Remove the pump end main bearing head (on

the 5H40, 5H60, and 5H80 remove the pump end cover first).

2. Chisel out the bearing, being careful not to damage the pump drive or bearing housing.

##### INSPECTION

Inspect the bearing housing and gasket surfaces. Remove any burrs.

##### REASSEMBLY

1. Lubricate the outside of the bearing with heavy grease.
2. Line up the hole in the bearing with the oil port in the housing. Using the puller shoulder and a jackscrew or press, press the bearing in place. Let the bearing protrude above the housing  $3/32'' \pm 1/64''$  so that it will support the bronze bearing washer. (See Fig. 43.)
3. Install new gaskets along with the pump end bearing head. Be sure the notch in the bronze bearing washer is properly positioned around the dowel pin.

#### SEAL END MAIN BEARING

##### DISASSEMBLY

Figures 40, 41 and 42 show the puller being used to remove and install the seal end main bearing. The puller shoulder is threaded and acts as a traveling nut. Friction should keep the puller shoulder from turning with the bolt unless the threads are damaged. If they are damaged, use a  $3/4''$ -16 nut between the thrust washer and bolt head. Hold the bolt head stationary and turn the nut.

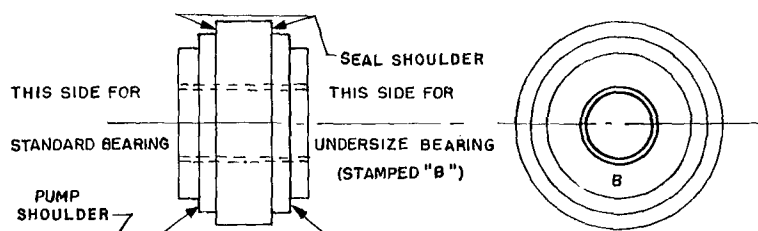


FIG. 39 - PULLER SHOULDER

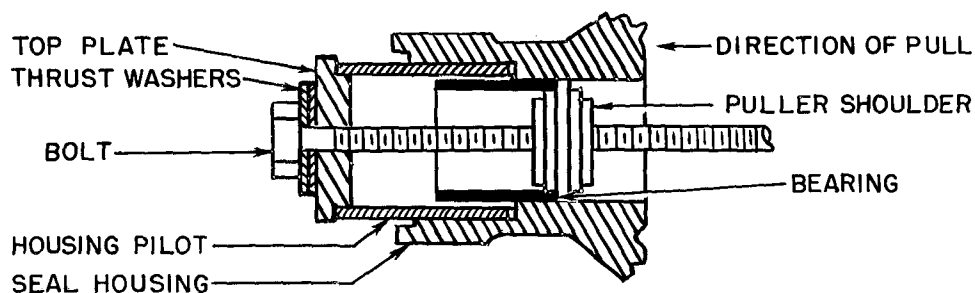


FIG. 40 - USING THE BEARING PULLER TO REMOVE A 5H SEAL-END MAIN BEARING

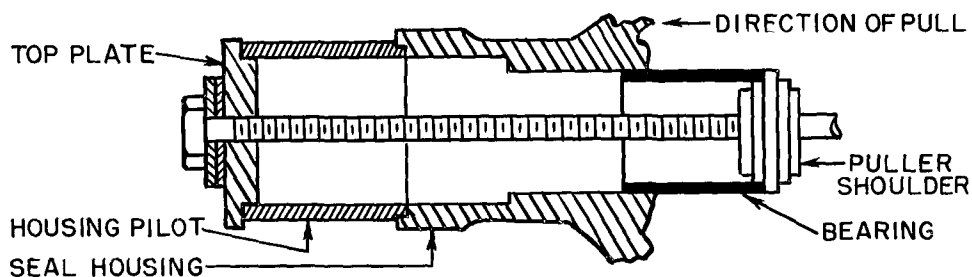


FIG. 41 - USING THE BEARING PULLER TO INSTALL A 5F40 OR 5F60 SEAL-END MAIN BEARING

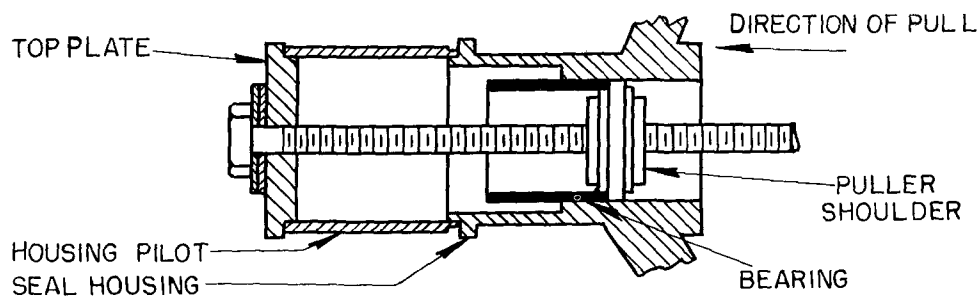


FIG. 42 - USING THE BEARING PULLER TO REMOVE A 5F20 OR 5F30 SEAL-END MAIN BEARING

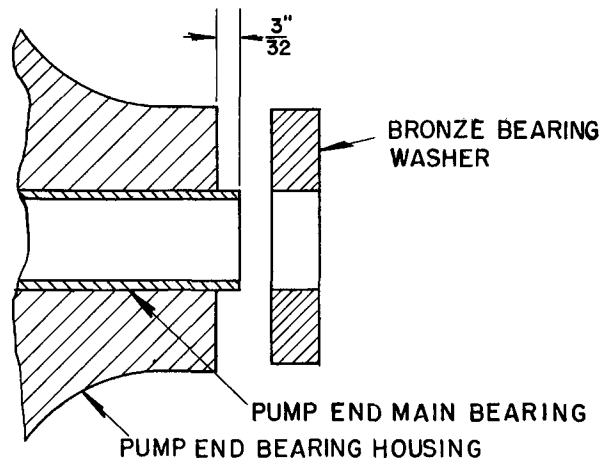


FIG. 43 - PUMP END MAIN BEARING POSITION

#### INSPECTION

If a burr or sharp edge is accidentally formed in the bearing housing, remove it and clean the housing before replacing the bearing.

#### REASSEMBLY

To replace the bearing:

1. Lubricate the outside of the bearing with heavy grease.
2. Position the bearing so the chamfered edge (notched edge) enters the bearing housing first and the oil holes in the bearing and housing are in line.
3. Pull the bearing into the housing with the puller until it is positioned as shown in Fig. 44. The edge of the bearing is  $\frac{1}{32}$ " below the surface of the bronze bearing washer.
4. Look through the oil pressure regulator opening in the crankcase to see that the oil passage to the bearing is not blocked.
5. Check to see that the relief groove in the bearing is at the top.
6. Blow out the oil groove in the bearing housing, and the oil line to it, in compressor models so equipped.

The main bearings and connecting rod bearings

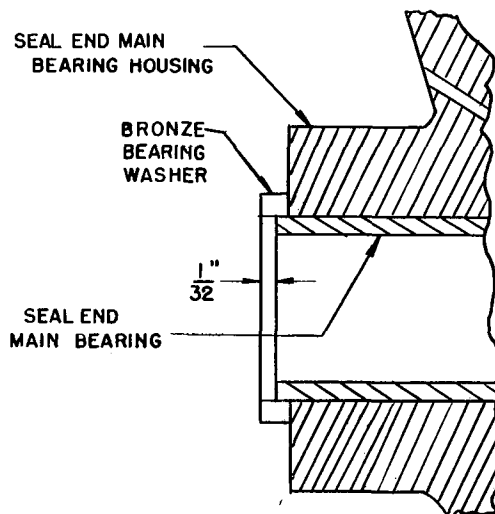


FIG. 44 - SEAL END MAIN BEARING POSITION

are precision made and should not be reamed, bored, or shimmed.

#### CENTER MAIN BEARING (5H80 AND 5H120)

#### DISASSEMBLY

1. Disconnect the oil line to the center main bearing housing (5H120 only).
2. Remove the  $\frac{5}{8}$ " plug on the side of the crankcase. (See Fig. 37.)
3. Remove the hollow lock screw with an Allen Wrench.
4. Loosen the cone point lock screw with an Allen Wrench until the bearing assembly can be slid from its support.
5. Remove the crankshaft and bearing assembly, at the same time tapping the seal end of the shaft with a wooden or rubber mallet.
6. Remove the screws and take apart the bearing housing. Mark the parts so they can be reassembled in the same relative position. (See Fig. 45.)

#### INSPECTION

Inspect the bearing to see that it is within the tolerances given in Table 4.

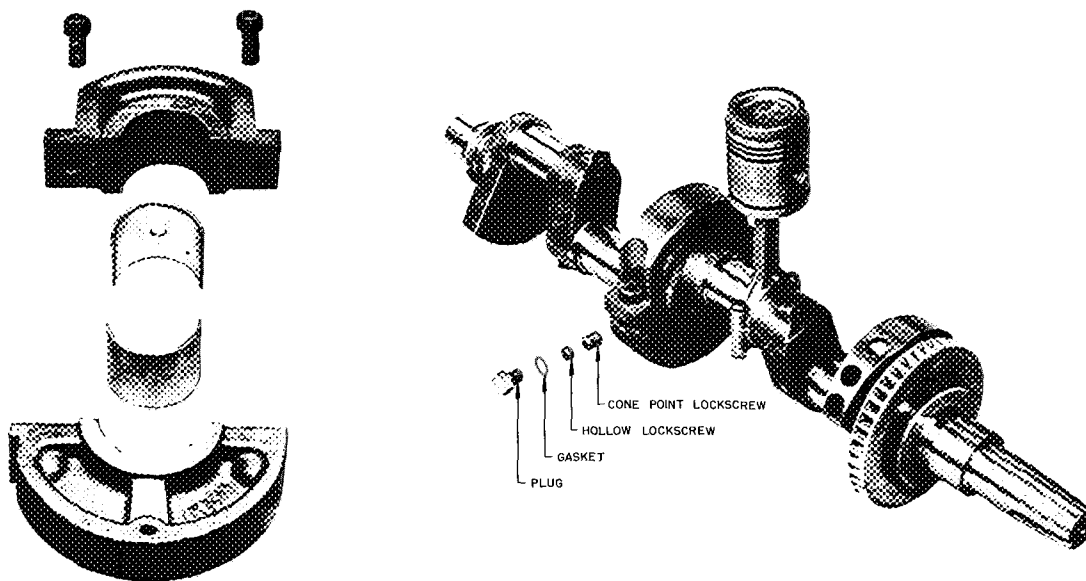


FIG. 45 - CENTER MAIN BEARING (5H120)

## REASSEMBLY

1. Install new bearing inserts.
2. Assemble the bearing housing on the crankshaft, being sure to lock the bolts that hold the bearing housing together.
3. Install the crankshaft, bearing and lock screws.

## OIL PUMP

## DISASSEMBLY

1. Drain oil below the level of the bearing head.
2. 5H40, 5H60 and 5H80 compressors only:

Remove end bell assembly.

3. Remove bearing head.
4. Remove pump cover and gasket.
5. Remove pump from bearing head.

## INSPECTION

Inspect the bushing and bearing head for scoring. If bushing is scored, replace when reassembling the pump. Replace the complete bearing head and oil pump assembly if bearing head is scored. Attempting to clean a lightly scored bearing head can seriously effect pump operation and cause a repeat failure of the new pump.

Inspect the pump cover on 5H120 compressors for scoring. Pump covers are not included in the kit, and a new cover must be ordered separately if needed. All other 5F and 5H pump kits include the cover.

Inspect new pump parts to insure that pump is free of burrs and free running. Pump may have a slight drag but must not bind in operation.

## REASSEMBLY

**CAUTION:** End play is a critical factor in proper pump operation. Extreme care should be taken to insure proper end play.

1. Install new bushing (if necessary) by pressing bushing into bearing head from bearing end with small end toward pump. Bushing oil groove must be located at top of bearing head.
2. Insure sufficient clearance for pump by tapping bushing lightly toward bearing end of bearing head.
3. Place a 0.001 inch circular shim against bushing and install pump.
4. Install new gasket and pump cover and tighten bolts.

**NOTE:** Torque 1/4 inch studs from 12 to 16 ft. lbs. and 5/16 inch studs from 16 to 20 ft. lbs.

5. Tap bushing toward pump until it seats against shim.

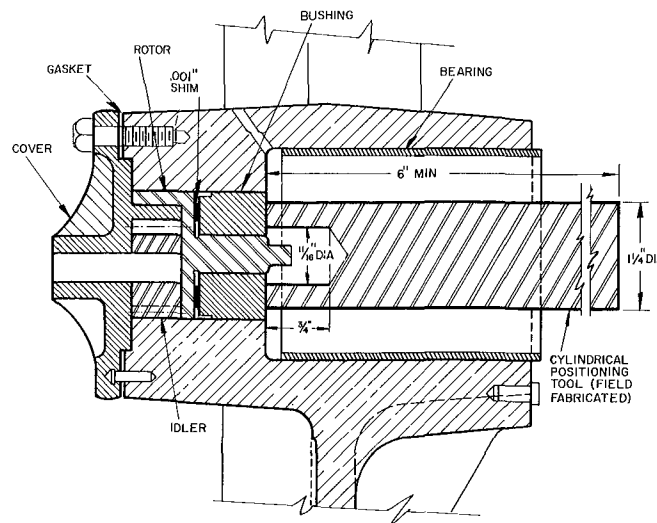


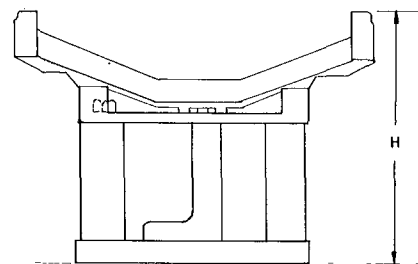
FIG. 46 - SETTING OIL PUMP END PLAY TYPICAL  
5F,H BEARING HEAD (5H40 SHOWN)

**NOTE:** A cylindrical positioning tool (field fabricated) should be used to provide equal pressure around bushing and prevent cocking.

6. Remove cover, gasket, rotor, and shim.
7. Insure that bushing is square in bore using a depth gauge.
8. Liberally apply oil to pump parts.
9. Replace pump, gasket and cover.

**NOTE:** Use same gasket and tighten to same torque as in step 4 to insure proper end play.

10. Check to see that pump does not bind in operation.
11. Install bearing head on compressor.
12. Insure that oil pump has proper rotation if pump is of manual reversing type.
13. 5H40, 5H60, and 5H80 compressors only:  
Replace end bell assembly.
14. Refill compressor with oil of same specifications as that removed.
15. Check the oil pressure immediately when putting compressor into operation. Pump should prime in approximately 8-12 seconds. If pressure is not reached in this time, stop compressor and check oil pump.



$$H = 2 \frac{15}{32} + \frac{1}{64} - 0 \text{ for 5 F; } H = 3 \frac{7}{16} + \frac{1}{64} - 0 \text{ for 5H}$$

FIG. 47 - UNLOADER FORK HEIGHT FOR  
5F AND 5H POWER ELEMENTS

#### UNLOADER POWER ELEMENT

##### DISASSEMBLY

1. Remove the cylinder head, valve plate, hand hole cover, connecting rod, piston and cylinder sleeve.
2. Reach in through the hand hole in the crankcase and remove the two Allen head cap screws that hold the unloaders in position.

##### INSPECTION

Check the unloader fork height of the new unloader power element as shown in Fig. 47. Take the measurement from the base to the highest point on the fork arms. This insures even contact with the unloader sleeve.

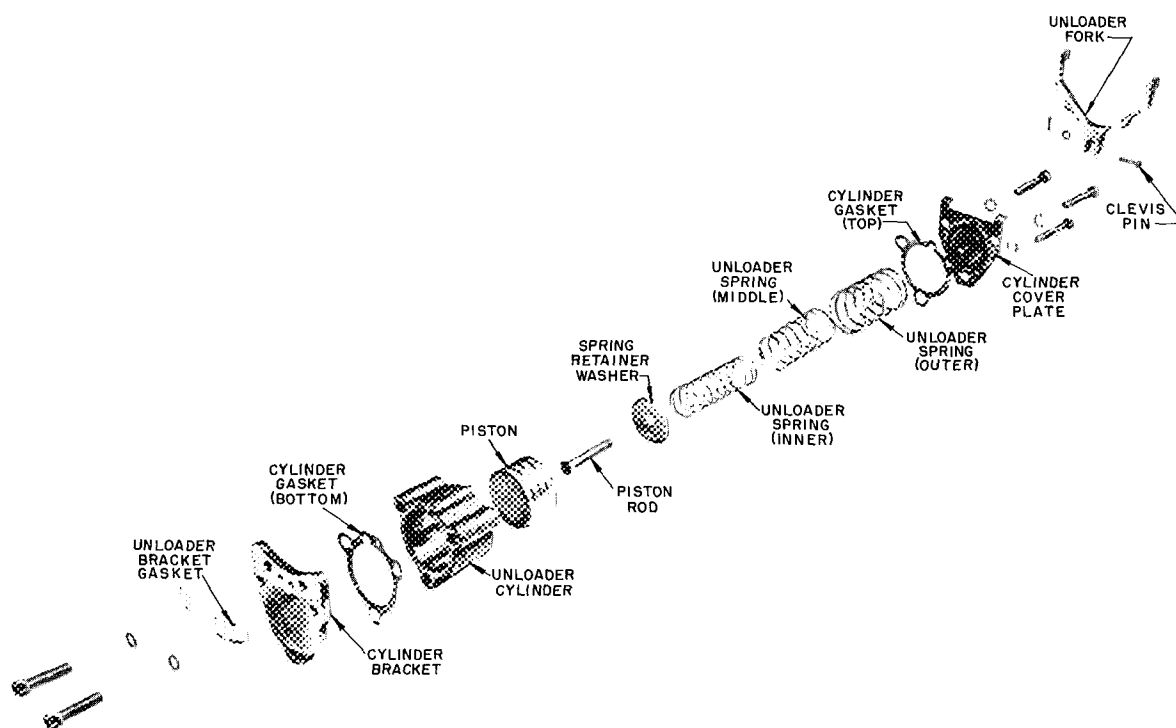


FIG. 48 - UNLOADER POWER ELEMENT

## REASSEMBLY

Install the new power element, being sure to place a new gasket between it and the crankcase. If an unloader power element is disassembled, refer to Fig. 48 for proper alignment of component parts.

## OIL RETURN CHECK VALVE

## DISASSEMBLY

5F20 and 5F30

The disc type oil return check valves are on the underside of the partition between the suction manifold and the crankcase, one on each side of the compressor. Remove them either through the bottom of the crankcase or through the pump end of the compressor when the pump end bearing is removed.

5H120

The 5H120 does not have an oil return check valve. Oil is returned by a centrifugal oil recovery impeller (see Fig. 38).

All Other 5F and 5H Compressors

On all other 5 Line compressors the leaf type

check valve (Fig. 49) is on the top center of the hand hole opening. It is easily removable when the cover is off.

## OIL SCREEN

## DISASSEMBLY

1. Remove the hand hole cover or bottom plate.
2. Remove lock retaining wire and cap screws.
3. Remove the oil screen.

## INSPECTION

Inspect the screen for holes and dirt. Clean it with clear gasoline, benzine or kerosene.

Older model compressors had a sheet metal shroud over the screen which should be omitted on reassembly. During flooded conditions gas tends to form under the shroud, causing the pump to vapor lock.

## REASSEMBLY

1. Fasten oil screen in place with cap screws.
2. Install lock retaining wire.

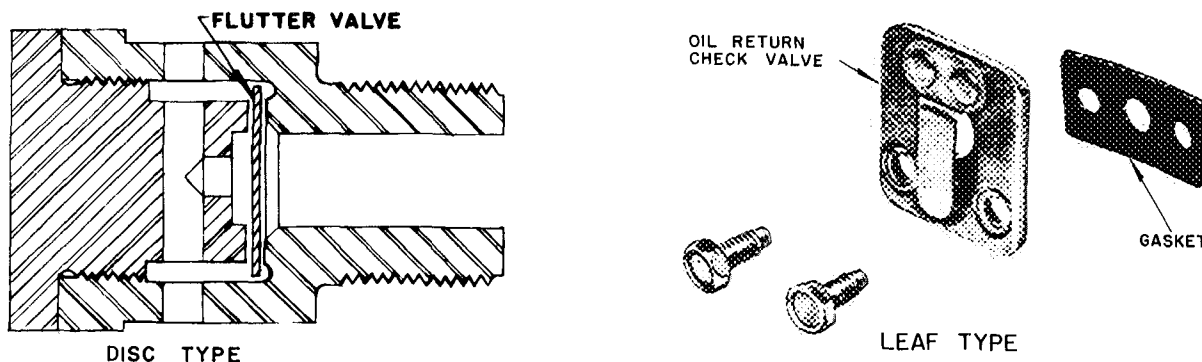


FIG. 49 - OIL RETURN CHECK VALVES

### CONDENSER MAINTENANCE

#### EFFECT OF CONDENSER ON HEAD PRESSURE

The normal head pressure for an installation is determined when the job is engineered. Too great a variation from normal may be caused by:

1. Incorrect adjustment of the water regulating valve.
2. Non-condensable gases.
3. Incorrect refrigerant charge.
4. Scaled condenser tubes.

#### HOW TO ADJUST WATER REGULATING VALVE

The water regulating valve should not be adjusted to compensate for high head pressures caused by fouled condenser tubes, excess refrigerant or the presence of non-condensables. It should be set to maintain the most economical head pressure as determined by the design engineer, based on the relative cost of water and electricity in a given area. Due to changes in water temperatures, it may be necessary to adjust the valve seasonally. After adjusting for the economical head pressure, the machine should be shut down. The water regulating valve should shut off the flow of water in a few minutes. If it does not, it will be necessary to raise the head pressure setting.

#### HOW TO PURGE NON-CONDENSABLE GASES

Purge non-condensable gases through the purge

cock. On 5F20 and 5F30 condensers, it is near the top front end of the shell. On other 5F and all 5H condensers it is on the top of the condenser.

#### HOW TO TEST REFRIGERANT CHARGE

Test the refrigerant charge by opening the liquid level test cock. If the charge is sufficient, liquid will flow. If overcharge is suspected, reduce the charge and recharge until liquid starts to flow from the test cock.

#### HOW TO INSPECT AND CLEAN THE CONDENSER

##### INSPECTION

5F and 5H condensers, except the shell and coil type, can be inspected on the water side by removing the heads. It is not necessary to pump down.

1. Shut off the machine.
2. Shut off the condenser water supply and disconnect the inlet and outlet piping.
3. Close the angle valve connecting the water regulating valve capillary to the condenser and disconnect the tubing from the valve.
4. Remove the drain plugs from the bottoms of the heads and the vent plug from the top of the front head and drain the water.
5. Remove the head bolts and heads.

A "Micro-Baffle" pass partition gasket made of soft metal seals the water passes. (See Fig. 50.) When replacing a damaged gasket be sure to get the new one in the correct position.

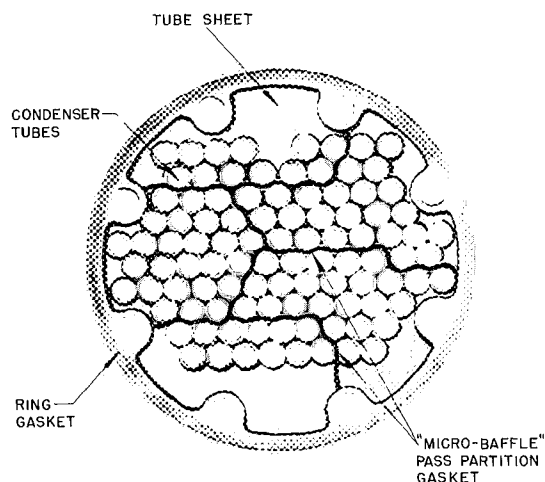


FIG. 50 - LOCATION OF PASS PARTITION (TYPICAL)

#### LEAKS

With the heads removed, test the tubes and tube sheet for leaks with a Halide leak detector. If the heads are not removable, leaks can be detected by testing the water for traces of refrigerant.

#### CLEANING THE TUBES OF A SHELL AND TUBE CONDENSER

To clean the tubes, use a special nylon brush (available from the Carrier Service Department) or a similar brush attached to a rod. If hard scale has formed, the coils should be cleaned chemically. Do not use brushes that will scrape and scratch the tubes. Experience has shown that once the tubing has been scratched, corrosion takes place which results in pitting of the tubes. This is less likely to occur with chemical cleaning.

Flush water through the coils while brushing. The results are best if the brush is turned with a slow speed electric drill.

It is also possible to clean the tubes by using air pressure to force rubber plugs through the tubing.

After the tubes are cleaned, install the heads, connect the water lines and flush the condenser to remove any remaining sediment.

#### CLEANING SHELL AND COIL CONDENSERS

The simplest method of cleaning 5F20 and 5F30 shell and coil condensers is with inhibited acid. Use an inhibited hydrochloric acid solution such as "Oakite #32." Handle the acid with the usual precautions because it will stain the hands and clothing and attack concrete. If the inhibitor is not present it will attack steel. Where splashing may occur, cover the surfaces with burlap or boards.

Gas coming from the vent pipe during cleaning is not harmful, but take care to prevent liquid from being carried over by the gas.

The solution acts more readily if it is warm, but a cold solution and a longer time does just as thorough a job.

#### THE GRAVITY FLOW METHOD OF CLEANING

The gravity flow method of cleaning is shown in Fig. 51.

Do not add the solution more rapidly than the vent can exhaust the gases generated by the chemical action. When the condenser is full, allow the solution to remain overnight. Drain the condenser and flush it with clean water.

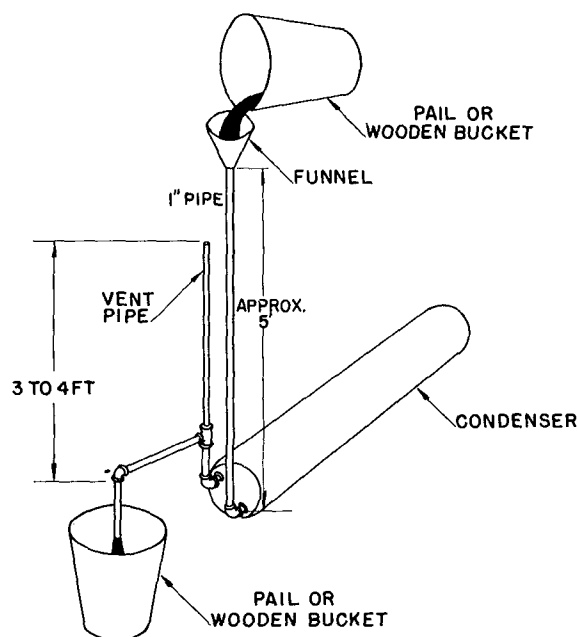


FIG. 51 - GRAVITY CIRCULATION

# THE FORCED CIRCULATION METHOD OF CLEANING

The forced circulation method of cleaning is shown in Fig. 52.

Fully open the vent pipe valve while the condenser is being filled with solution. It may be closed when the condenser is full and the pump is operating.

The valve in the supply line can be used to regulate the flow of solution to the condenser. If the pump is the non-overloading type, the valve may be fully closed when the pump is running, should it be necessary.

For the average scale deposit, allow the solution to remain in the condenser overnight. For heavy deposits, allow twenty-four hours. Drain the condenser and flush it with clean water.

## REPAIR

The shell and tube condensers, 5F40 and larger, are equipped with rolled-in tubes. Tools are available for replacing the tubes in case of leakage.

## FREEZING PROTECTION

If the ambient temperature is below 32 F, freezing can be prevented by one of two methods:

1. Draining all water from the equipment.
2. Adding antifreeze to the water.

## DRAINING WATER

When the system is shut down for the winter, drain the condenser and water lines. The method

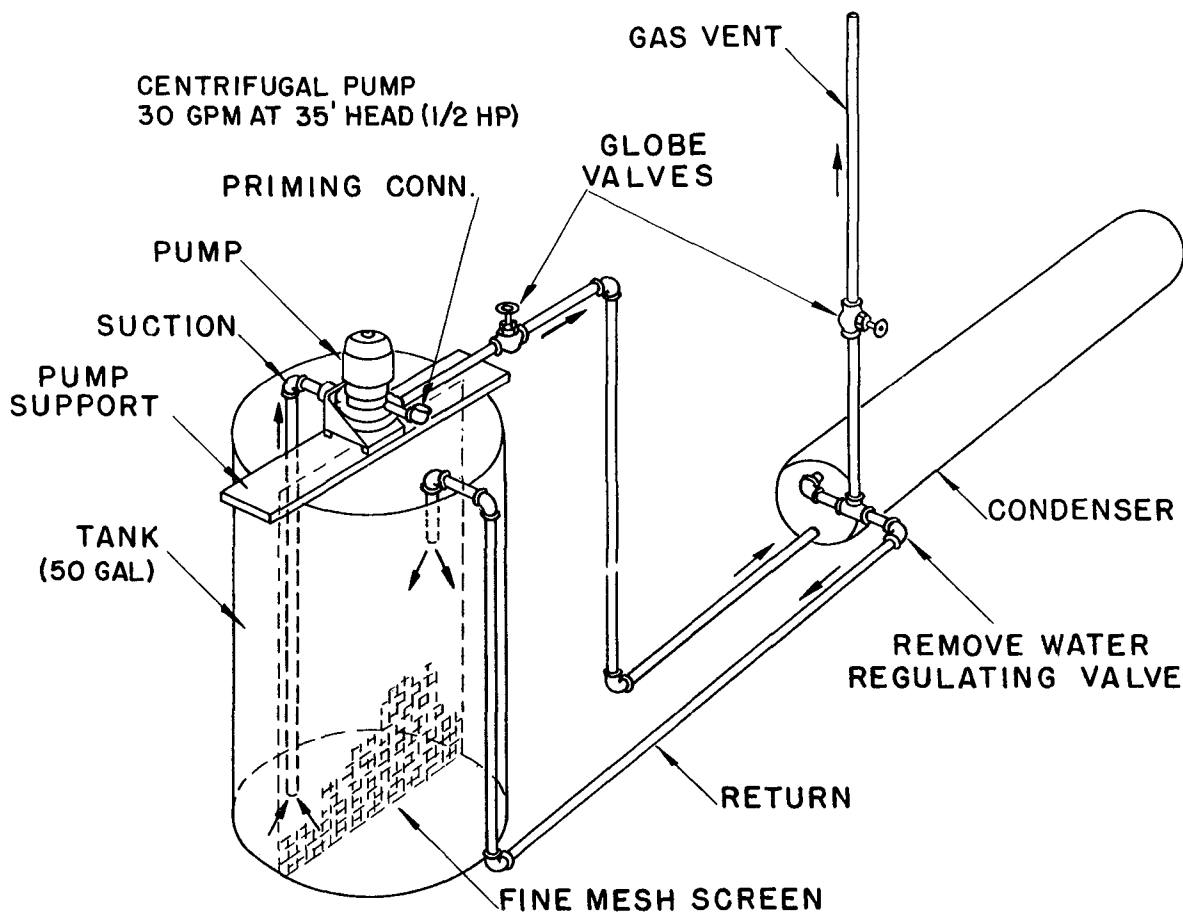


FIG. 52 - FORCED CIRCULATION

for shell and tube condensers is given under "How to Inspect and Clean the Condensers."

The shell and coil condensers of the 5F20 and 5F30 are drained by disconnecting the water lines.

Use compressed air to remove any remaining water. Use air inlet and outlet connections at least as large as the water supply connections and an air supply that can deliver at least 150 cfm at 1/2 to 1 psi. This will remove the residual water from three full length coils.

Blowing should be continued for at least 1/2 hour. If possible, it should be 15 minutes through the supply and 15 minutes through the return.

#### ADDING ANTIFREEZE TO THE WATER

A safe antifreeze that meets code and Underwriter requirements may be circulated with the residual water in the system. The antifreeze may be drained and re-used until it is diluted to the minimum safe limit.

#### REMOVAL OF THE CONDENSER

Before removing the condenser, it is first necessary to remove all of the refrigerant. Rapid removal of the refrigerant may freeze the condenser. Therefore, drain the water and take the precautions discussed under "Freezing Protection." Refrigerant may then be removed by one of the following methods:

1. Purge it to the atmosphere.
2. Connect a refrigerant drum to the gauge port of the liquid shutoff valve and cool it to a lower temperature than that of the condenser, by means of cracked ice or cold water. The refrigerant boils out of the condenser and recondenses in the drum.
3. Use a small, fractional horsepower condensing unit to pump gas from the condenser water regulating valve connection into a refrigerant drum.

## TROUBLE DIAGNOSIS CHART

A. STARTING TROUBLES		
OBSERVATION	POSSIBLE CAUSE	REMEDY
1. Compressor will not start	Power off	Check main switch, fuses and wiring.
	Thermostat set too high	Reset.
	Thermal overload switch open	Reset manually.
	Oil safety switch	Reset manually.
	Dirty contacts	Clean the contacts on all switches and controls.
	Loose electrical connections or faulty wiring	Tighten connections. Check wiring and rewire if necessary.
	Compressor motor burned out	Check and replace if defective.
	Solenoid valve closed	Check for burned out holding coil. Replace if defective.
	Evaporator fan off	Check fuses, overload. Start up.
	Evaporative condenser or cooling tower fan or pump not operating	Check fuses, overloads and controls. Re-start.

## B. ERRATIC OPERATION

OBSERVATION	POSSIBLE CAUSE	REMEDY
2. Compressor cycles intermittently	Low pressure switch erratic in operation	Check tubing to switch to see if clogged.  Check setting of switch. It may be too high.
	Insufficient refrigerant in system	Add refrigerant.
	Capacity control setting incorrect	Reset.
	Thermostat differential too narrow	Reset.
	Suction valve closed or throttled	Open.
3. Compressor continually cycles on dual pressurestat	Dirt or restriction in tubing to pressurestat	Check and clean tubing.
	Faulty pressurestat	Repair or replace.
	Condenser capacity reduced by refrigerant over-charge accompanied by high discharge pressure	Remove excess refrigerant.
	Insufficient water flowing through condenser or clogged condenser	Adjust water regulating valve to condenser. Clean condenser.
	Discharge or suction shut-off valve not fully open	Open valves.
	Air in system	Purge.
	Water pumps not operating.	Check and start.

**C. OPERATING PRESSURES TOO HIGH OR TOO LOW**

OBSERVATION	POSSIBLE CAUSE	REMEDY
4. High discharge pressure	Condenser inlet temperature too high	1. Increase quantity by adjusting water regulating valve. 2. Obtain source of colder water.
	Insufficient water flowing through condenser	1. Readjust water regulating valve. 2. Increase water supply main to condenser.
	Plugged or scaled tubes in condenser	Clean tubes.
	Discharge shut-off valve partially closed	Open the valve.
	Too much refrigerant	Remove excess.
	Air in system	Purge.
5. Low discharge pressure	Excessive water flow through condenser	Adjust water regulating valve.
	Suction shut-off valve partially closed	Open the valve.
	Leaky compressor suction valves	Pump down, remove the cylinder head, examine valve discs and valve seats, replace if necessary.
	Worn piston rings	Replace if worn.
6. Flooding	Defective or improperly set expansion valve	Reset to 5°-6° superheat.
7. Low suction pressure	Insufficient refrigerant in system	Add refrigerant.
	Excessive superheat	Reset expansion valves.

## D. SYSTEM NOISES

OBSERVATION	POSSIBLE CAUSE	REMEDY
8. Compressor noisy	Loose or misaligned coupling	Check alignment and tightness.
	Insufficient clearance between piston and valve plate	Replace worn parts.
	Motor or compressor bearings worn	Replace bearings.
	Loose or misaligned belts	Check alignment and tension. Belt slack should be at the top.
	Loose foundation bolts or hold down bolts	Tighten bolts.
	Foundation improperly isolated	Check foundation to see if any part of it extends down to main floor.
	Improper support or isolation of piping	Provide sufficient right angle bends in piping to absorb vibration and support firmly with suitable hangers.
	Slugging due to floodback of refrigerant	<ol style="list-style-type: none"> <li>1. Check setting of expansion valve.</li> <li>2. Check thermal bulb for looseness and correct location.</li> <li>3. Loop suction lines to prevent floodback on "off" cycle.</li> </ol>
	Hydraulic knock due to excess of oil in circulation	<ol style="list-style-type: none"> <li>1. Remove excess oil.</li> <li>2. Check expansion valve for floodback.</li> </ol>
	Noise level varies with unloading due to defective valve lifter mechanism	<ol style="list-style-type: none"> <li>1. Replace stuck lifter pins.</li> <li>2. Check unloader fork for alignment.</li> <li>3. Check power element for stuck piston.</li> <li>4. Leakage of oil at tube connection to power element.</li> <li>5. Check amount of valve pin lift above valve seat. It should be at least .33" for 5F &amp; .125" for 5H.</li> </ol>

## D. SYSTEM NOISES (CONTINUED)

OBSERVATION	POSSIBLE CAUSE	REMEDY
9. Pipe rattle	Inadequately supported piping or loose pipe connections	Support pipes or check pipe connections.
	No muffler in discharge line or improperly located	Install or move muffler closer to compressor.
10. Hissing	Insufficient refrigerant flow through expansion valves	Add refrigerant.
	Clogged liquid line strainer	Clean.

## E. UNLOADER TROUBLES

OBSERVATION	POSSIBLE CAUSE	REMEDY
11. Compressor will not unload	Capacity control valve inoperative	Repair.
	Unloader element stuck	Repair.
	Hydraulic relay stuck	Replace control cover assembly.
	Plugged pressure line to power element	Clean out line.
	External adjusting stem damaged	Replace.

## E. UNLOADER TROUBLES (CONTINUED)

OBSERVATION	POSSIBLE CAUSE	REMEDY
12. Compressor will not load	Low oil pressure (below 45 psi net)	See Item 14.
	Capacity control valve stuck open	Repair or replace.
	Unloader element stuck	Repair.
	Broken pressure line to power element	Repair.
	Plugged pressure line to power element	Clean out.
	External adjusting stem damaged	Replace.
	Control oil strainer blocked	Clean or replace.
	Bellows of control valve leaking	Remove thread protector and leak test. Replace valve body if bellows leaks.
	Pipe plug installed in pneumatic connection	<b>REMOVE</b> - This connection must be free to breathe.
	Foaming in crankcase due to oil dilution	Examine expansion valve and piping for cause of flooding.
13. Rapid unloader cycling	Hydraulic relay stuck	Replace control cover assembly.
	Oversized expansion valve causing excessive fluctuation in suction pressure	Re-size expansion valve.
	Partially plugged control oil strainer	Clean or replace.
	Low oil pressure (below 45 psi net)	See Item 14.

**F. MISCELLANEOUS TROUBLES**

OBSERVATION	POSSIBLE CAUSE	REMEDY
14. Oil pressure lower than normal or no oil pressure	Low oil charge	Add oil.
	Faulty oil gauge	Check and replace.
	Defective oil pressure regulator	Repair or replace.
	Clogged oil suction strainer	Clean.
	Broken oil pump tang	Replace pump assembly.
	Clogged oil line	Remove obstruction.
	Worn oil pump	Replace pump assembly.
	Worn compressor bearings	Replace.
15. Cold compressor	Liquid carrying over from evaporator	Check refrigerant charge and expansion valves.
16. Low crankcase oil level	Oil return check valve stuck closed	Repair or replace.
17. Cylinders and crankcase sweating	Too much oil in circulation	Remove oil from compressor.
	Floodback	Check refrigerant charge and expansion valves.
18. High crankcase temperature (should be 105 F - 180 F at seal housing)	Liquid line strainer clogged	Clean.
	Excessive superheat	Reset expansion valves.
	Compression ratio too high	Recheck design.
	Discharge temperature should not exceed 275 F	See Application Section of Sales and Engineering Book.
	Leaking suction or discharge valves	Replace.

# FILING INSTRUCTIONS

BOOK	MAJOR TAB	MINOR TAB	THIS ISSUE	SUPERSEDES
Applied Equipment (Installation and Service)	Reciprocating Compressors and Condensing Units	Reciprocating - Open	5F, H-61PD1 1-52 9-61	5F, H-55PD2 1, 54-124 1955