



OPEN-DRIVE COMPRESSORS

5F,H

Installation, Start-Up and Service Instructions

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SAFETY CONSIDERATIONS

Installation, start-up and servicing of this equipment can be hazardous due to system pressures, electrical components and equipment location.

Only trained, qualified installation and service personnel should install, start-up or service this equipment.

When working on this equipment, observe precautions in the literature, tags, stickers and labels attached to the equipment and any other safety precautions that apply.

- Follow all safety codes.
- Wear safety glasses and work gloves.
- Use care in handling, rigging and setting bulky equipment.

▲ WARNING

Before performing service or maintenance operations on unit, shut off and tag main power supply to unit. Electrical shock could cause personal injury.

INSTALLATION

Step 1 – Prepare for Installation

PREPARE EQUIPMENT ROOM — Locate compressor or condensing unit in a well ventilated area. If natural ventilation is inadequate, provide forced ventilation through ductwork. Check applicable code requirements.

Provide freeze-up protection for water-cooled condensers, water lines and accessories if freezing temperatures can occur during winter shutdown periods.

Provide sufficient clearance for removal of compressor cylinder heads and valve plates. Allow space on the oil pump end for crankshaft removal as follows:

- 5F20, 30, 40, and 60 compressors 20 in.
- 5H40, 46, 60, and 66 compressors 20 in.
- 5H80, 86, 120, and 126 compressors 30 in.

(Continued on page 10.)

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

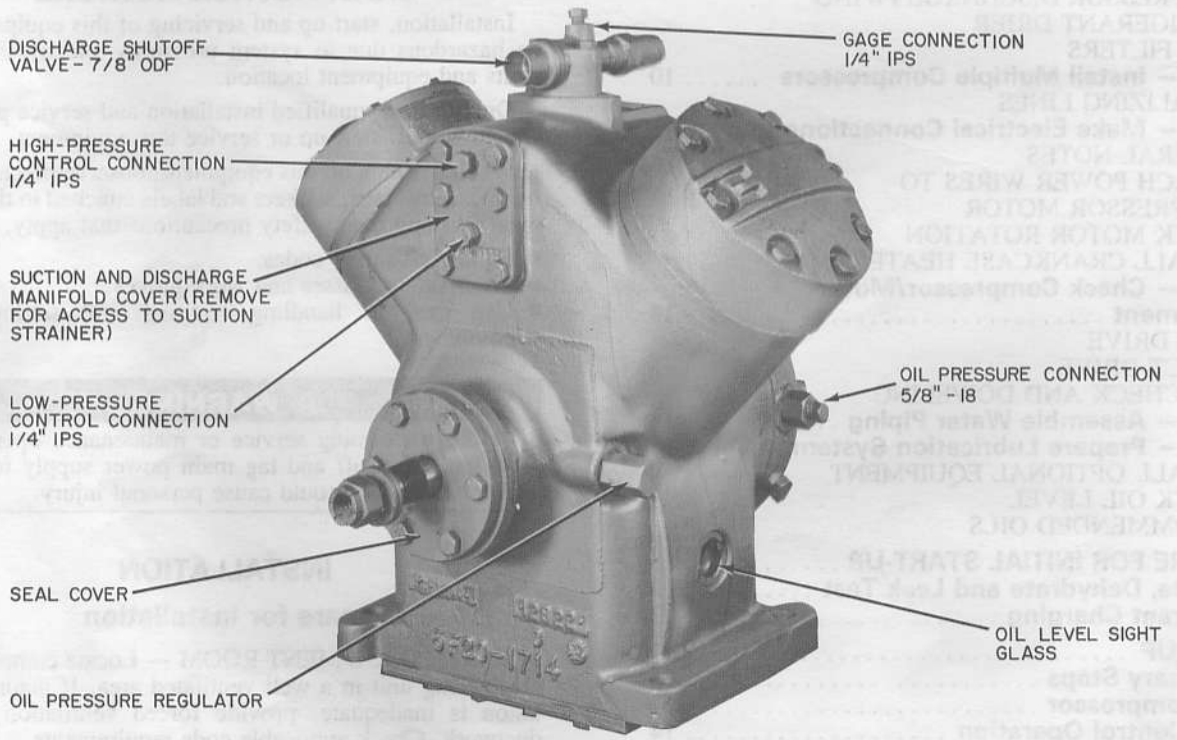
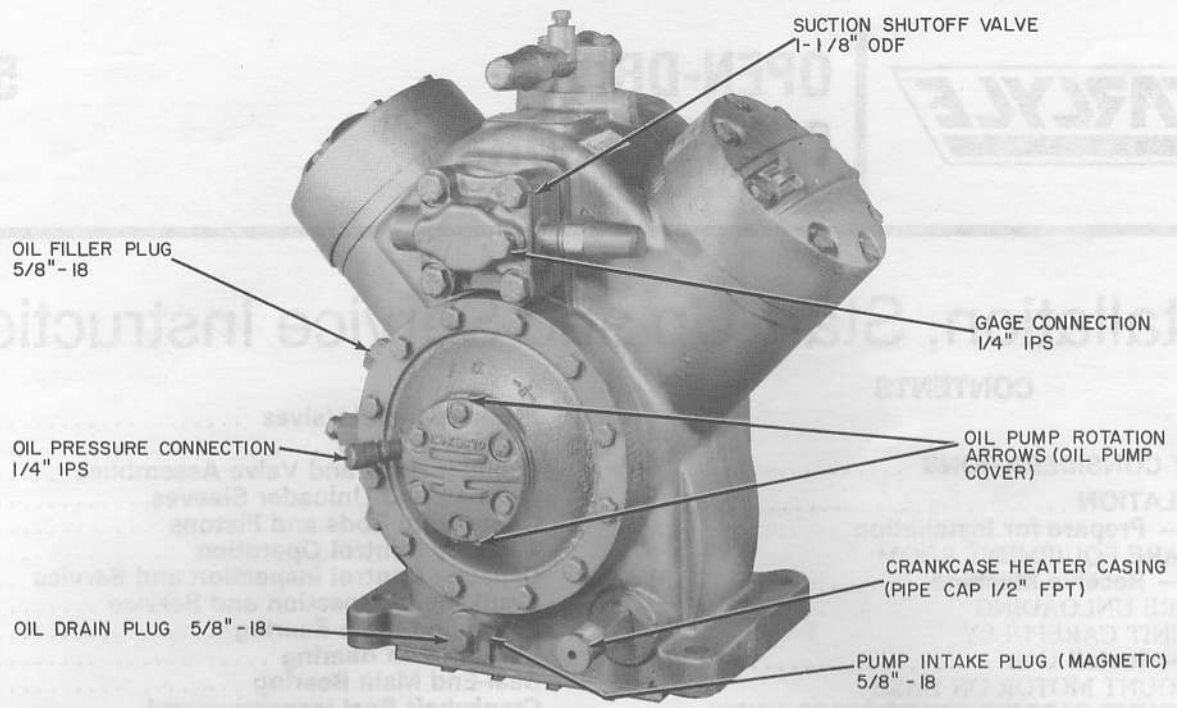


Fig. 1 - 5F20; 2-Cylinder Compressor

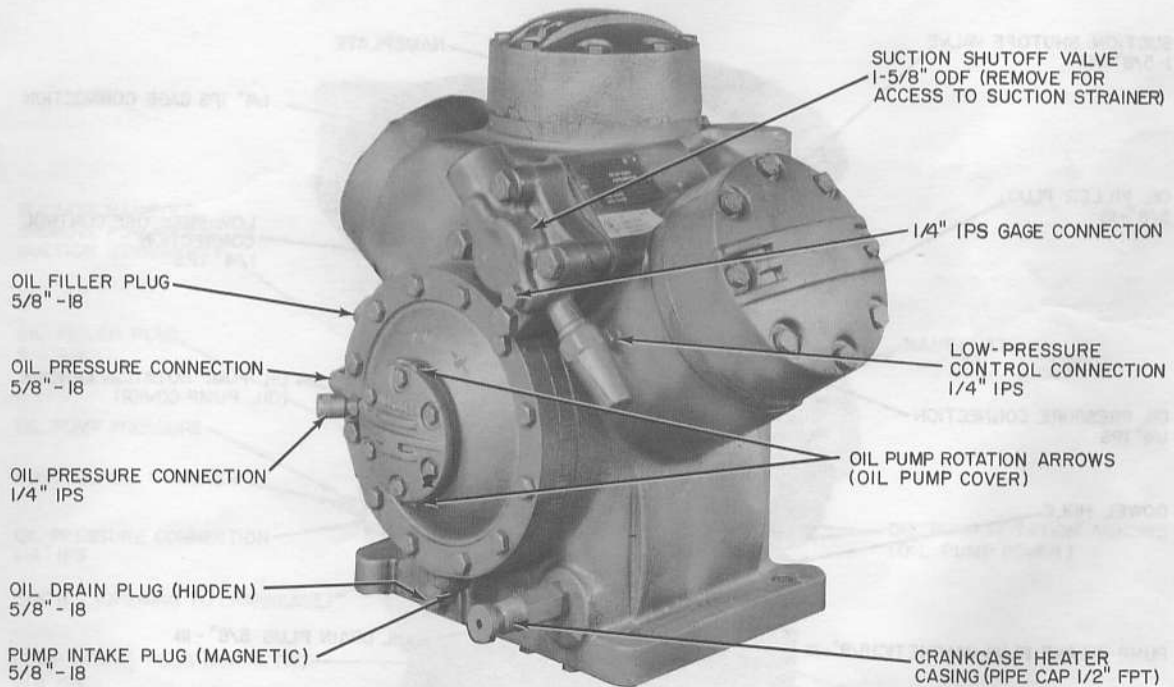
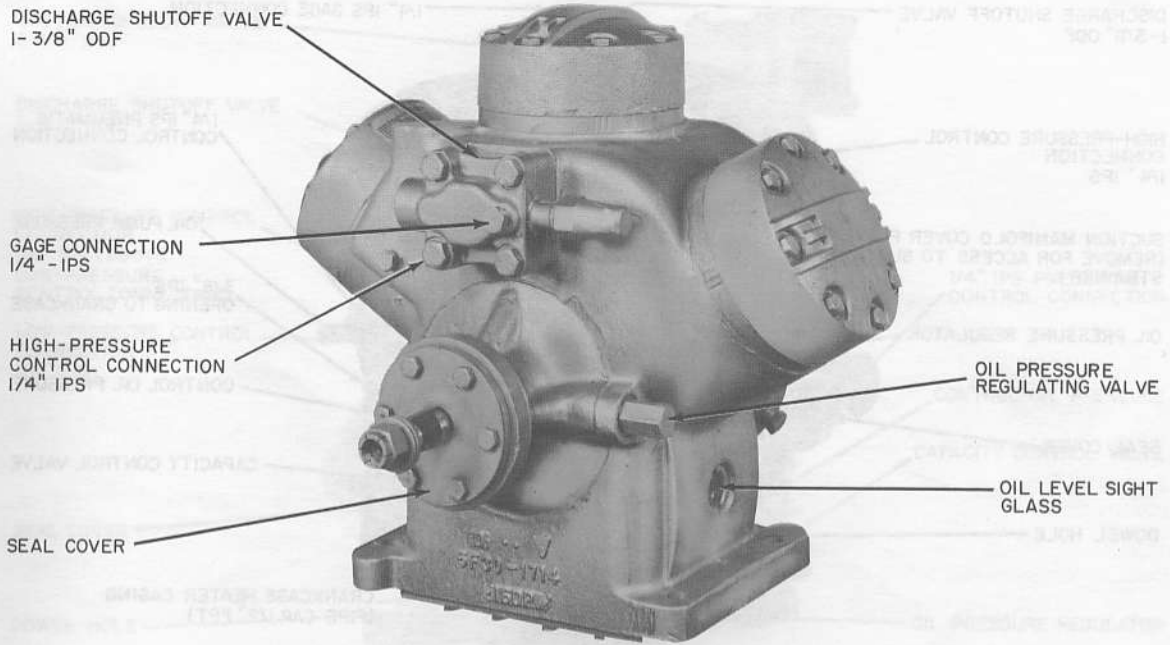


Fig. 2 - 5F30; 3-Cylinder Compressor

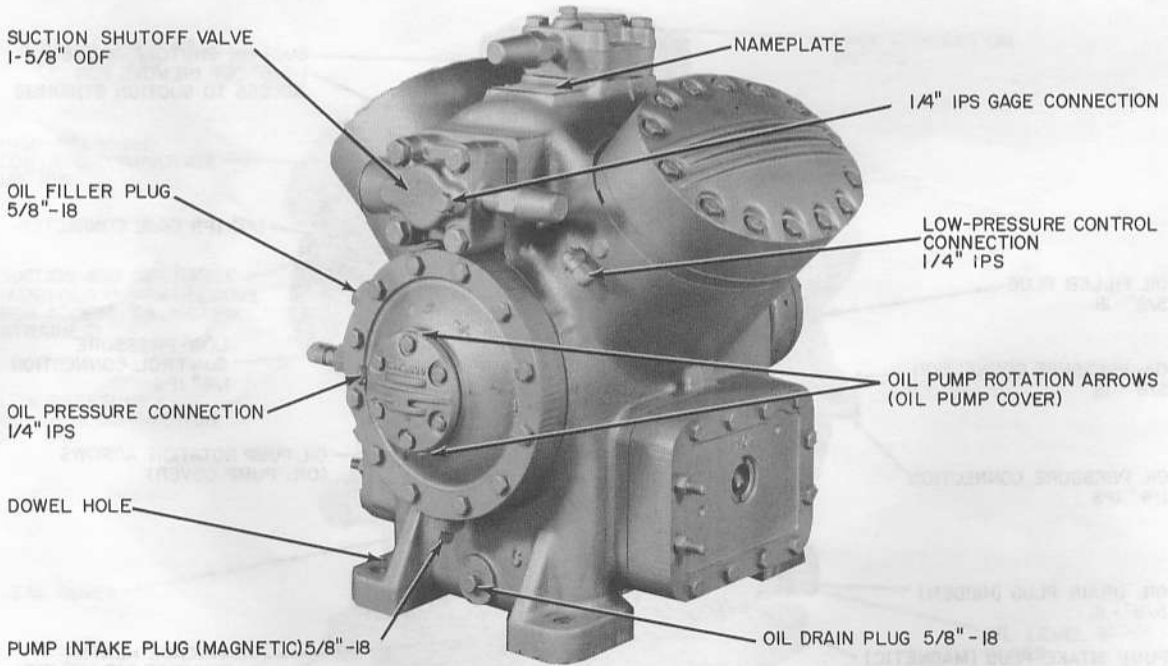
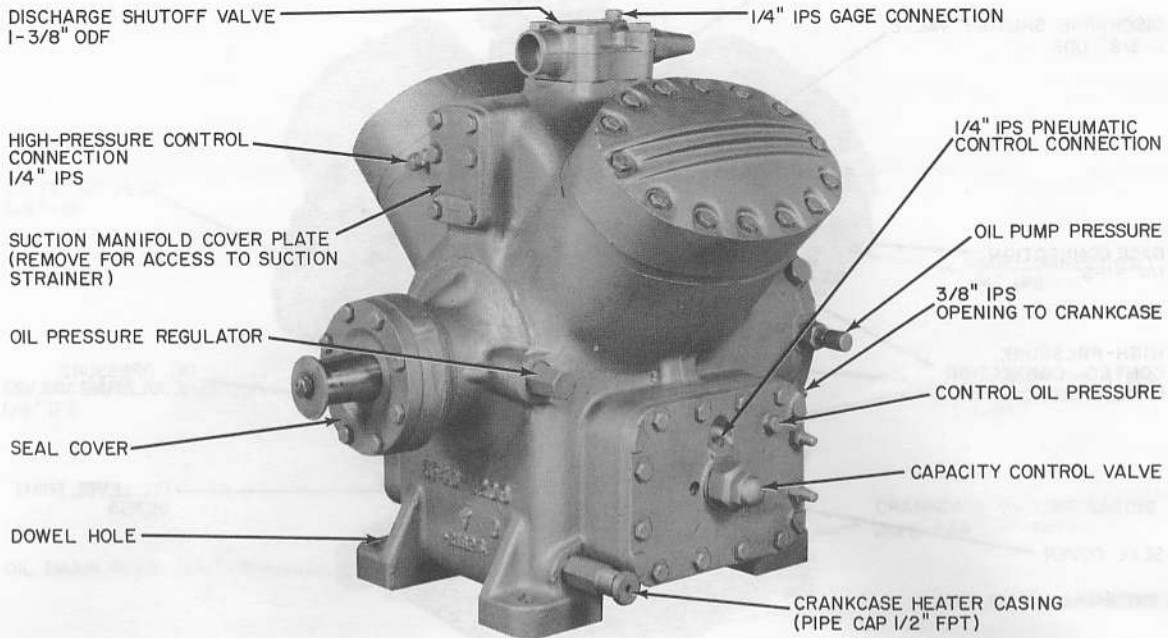


Fig. 3 - 5F40; 4-Cylinder Compressor

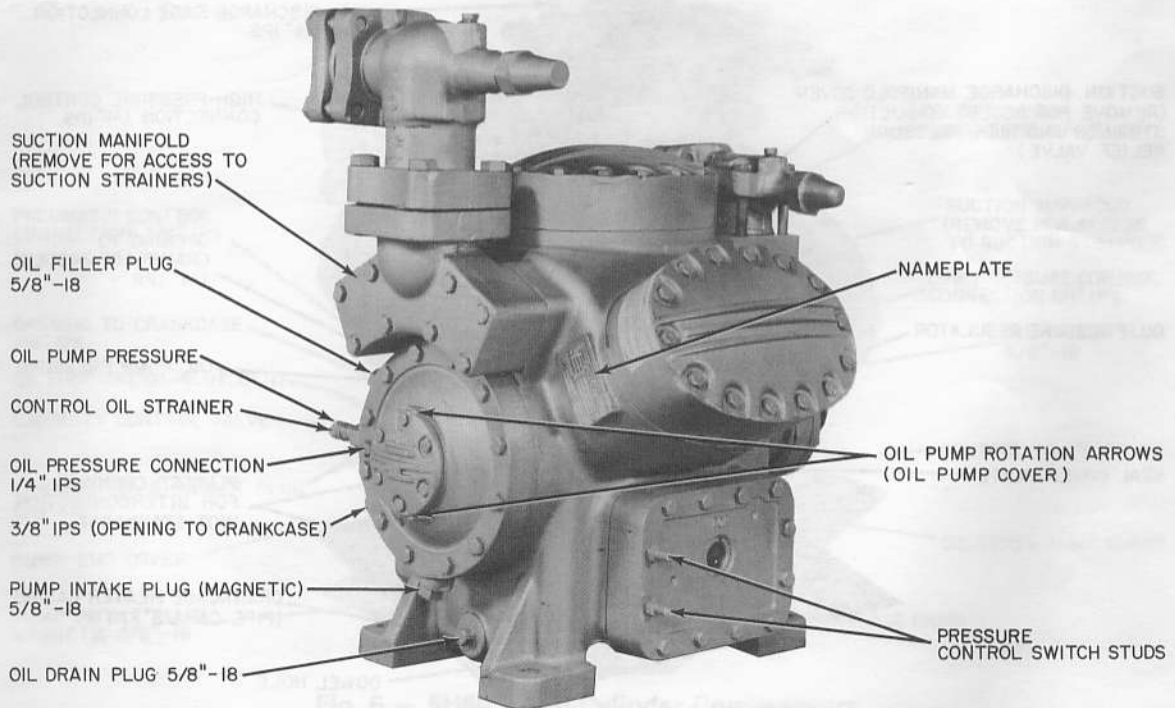
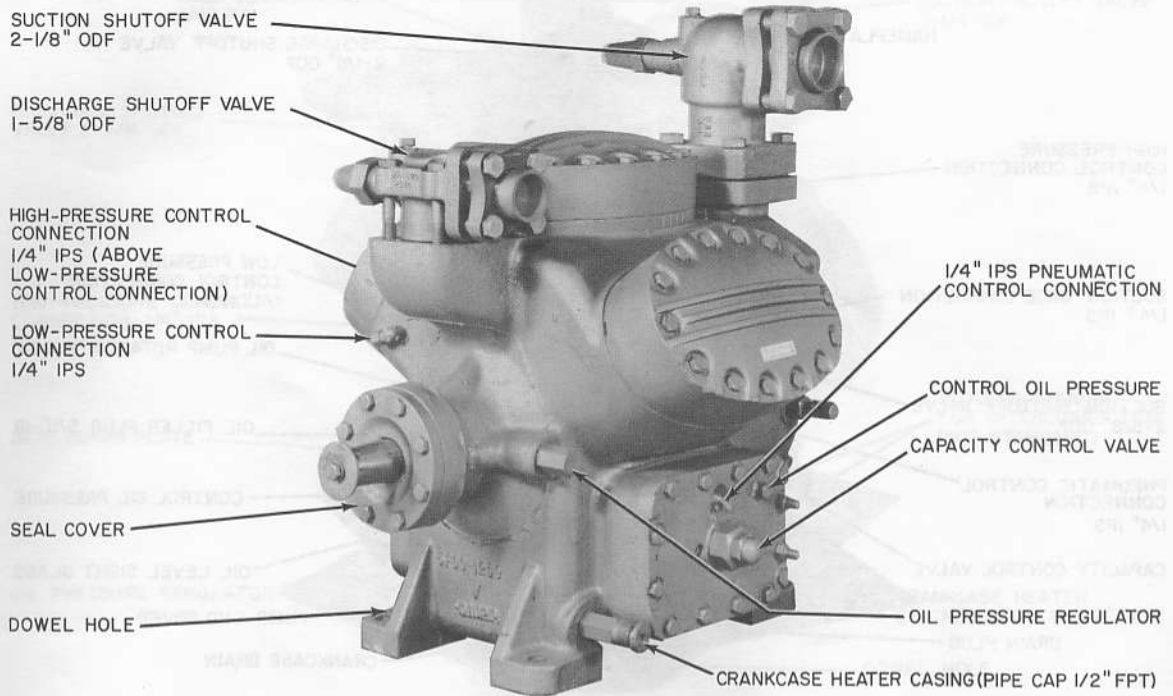


Fig. 4 - 5F60; 6-Cylinder Compressor

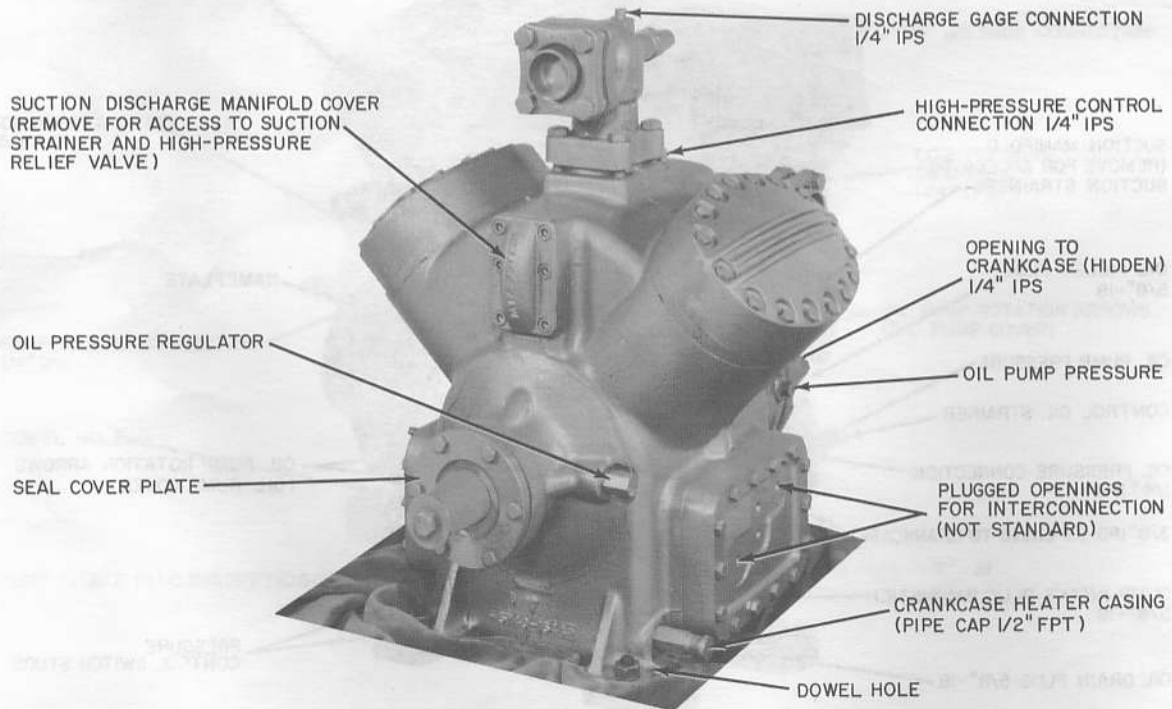
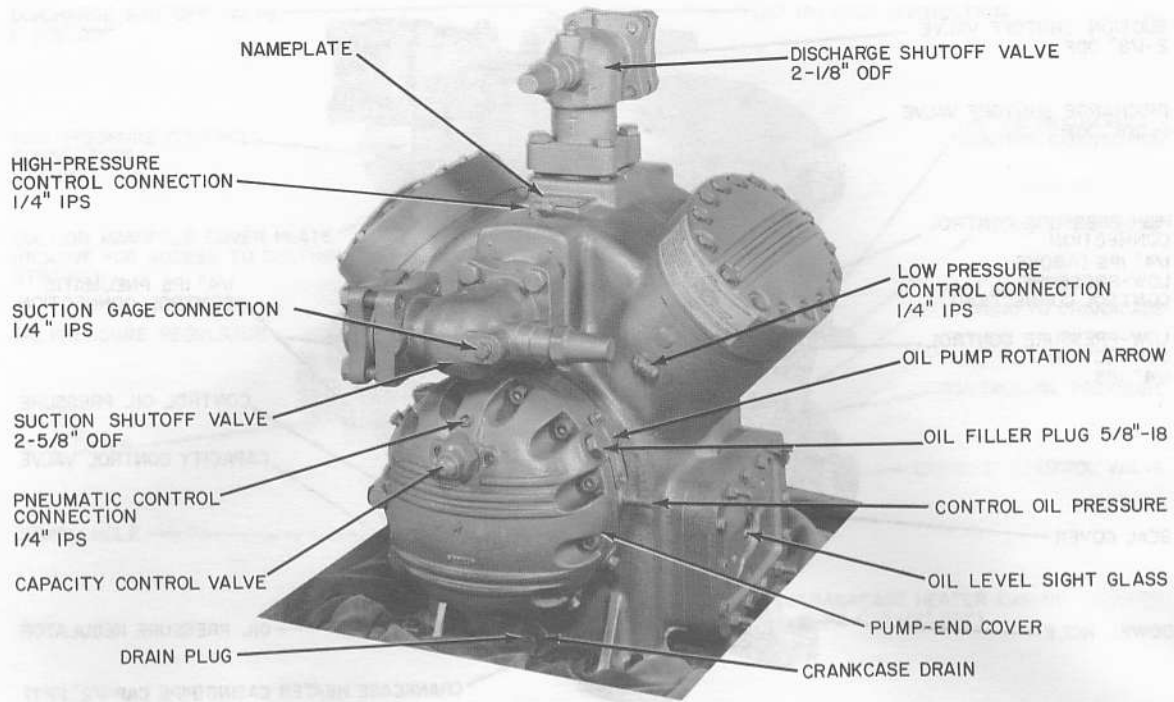


Fig. 5 - 5H40, 46; 4-Cylinder Compressors

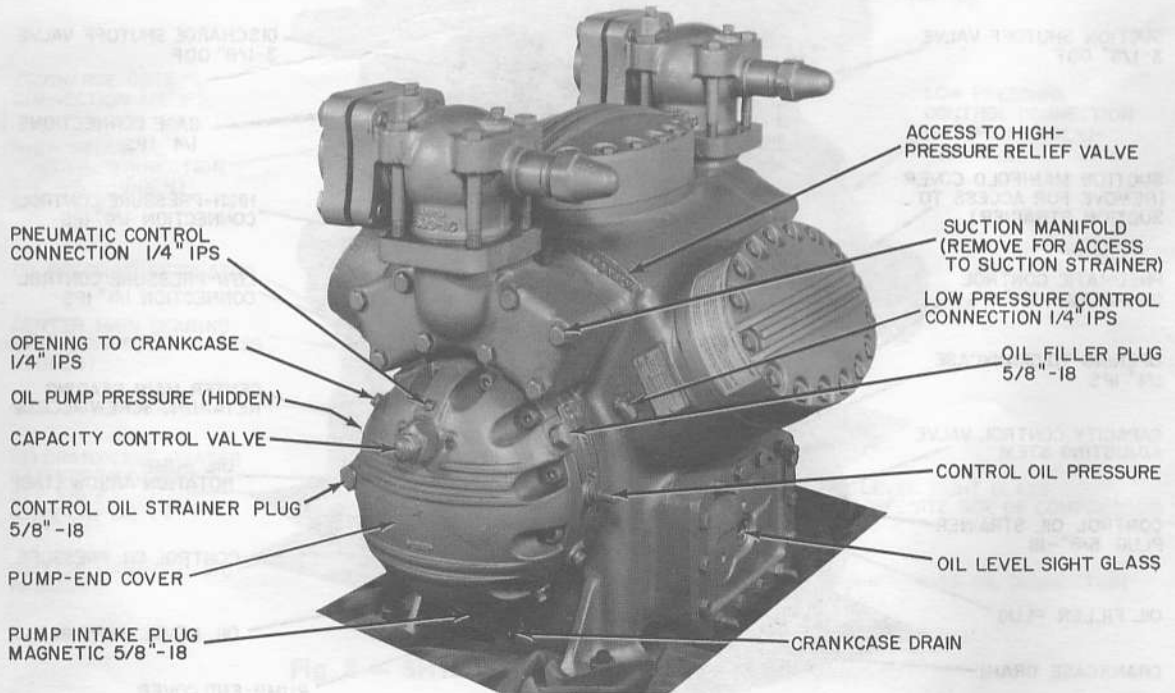
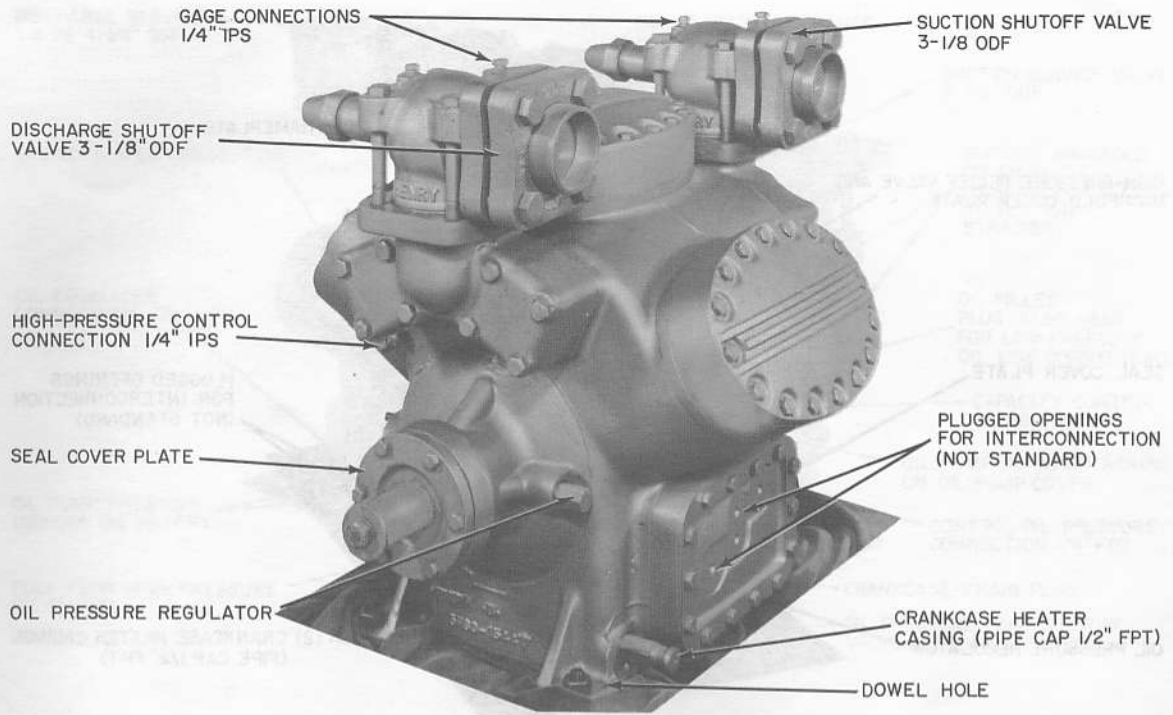


Fig. 6 - 5H60, 66; 6-Cylinder Compressors

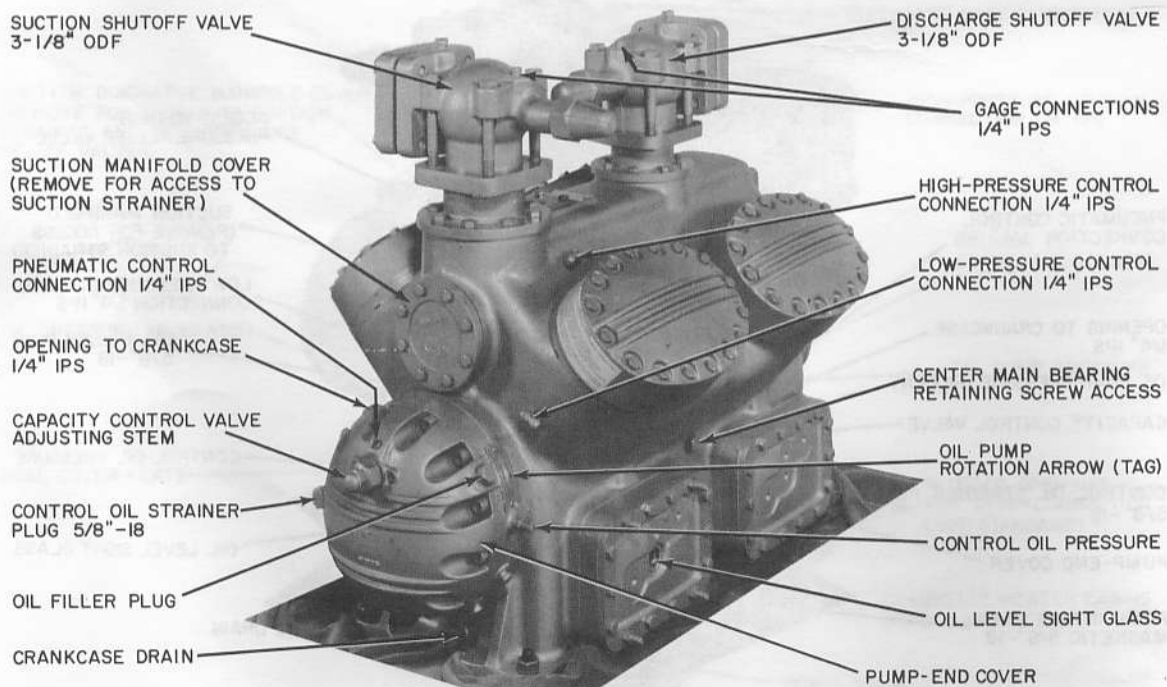
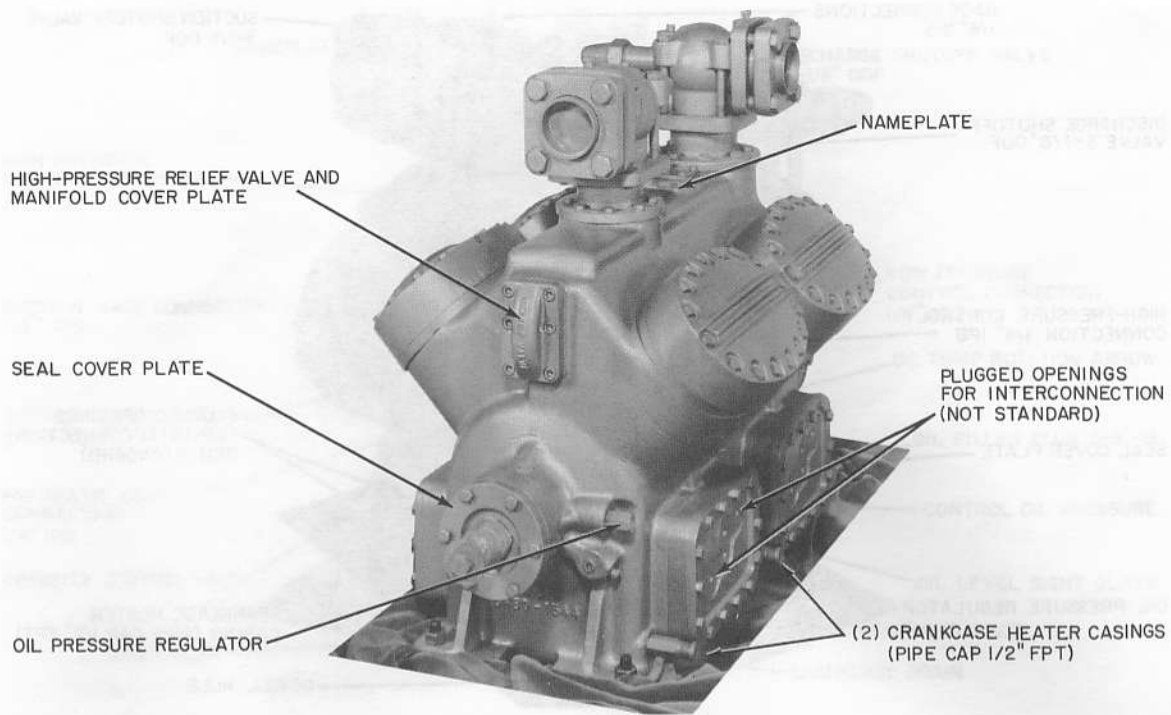


Fig. 7 - 5H80, 86; 8-Cylinder Compressors

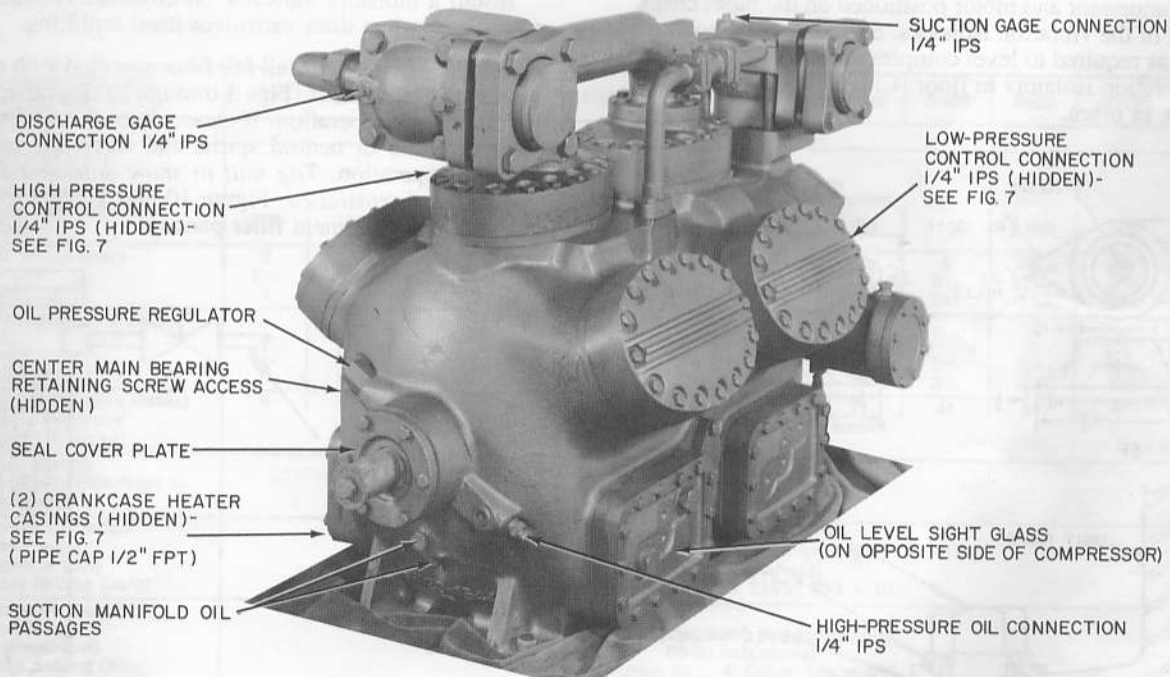
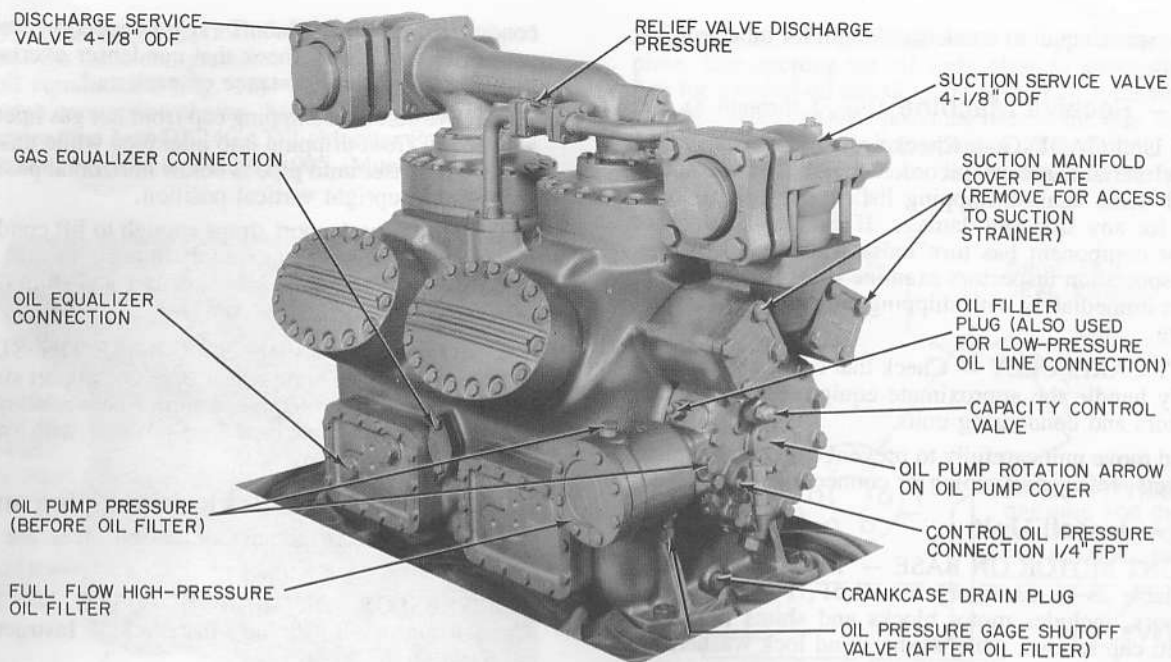


Fig. 8 - 5H120, 126; 12-Cylinder Compressors

Provide space equal to condenser length for tube removal and cleaning.

Step 2 – Receive Machine (Fig. 1 through 8)

BEFORE UNLOADING — Check unit nameplates against model and serial numbers recorded in job specifications. Check all items against shipping list, and examine items carefully for any shipping damage. If damage is found or any major component has torn loose from its anchorage, have transportation inspectors examine it before unloading. File claim immediately with shipping company for any loss or damage.

RIG UNIT CAREFULLY — Check that rigging equipment can safely handle the approximate equipment weights for compressors and condensing units.

Rig and move unit carefully to prevent damage to mounting brackets, refrigerant piping or connections.

Step 3 – Install Unit

→ **TO MOUNT MOTOR ON BASE** — The motor fastening set, available as an accessory for all 5F,H base-mounted compressors, includes motor blocks and shims for motor alignment; cap screws, plate washers and lock washers for fastening motor to base; taper dowel pins for securing motor position after alignment; and beveled washers for fastening the unit base to accessory vibration isolators.

If vibration isolators are used, attach to base (Fig. 9). To avoid damaging the isolators, lift unit from ends when attaching isolators.

With compressor and motor positioned on the base, check the height of the vibration isolators. Shim between isolators and floor as required to level compressor base. When level, secure vibration isolators to floor. Check that bevel washer (Fig. 9) is in place.

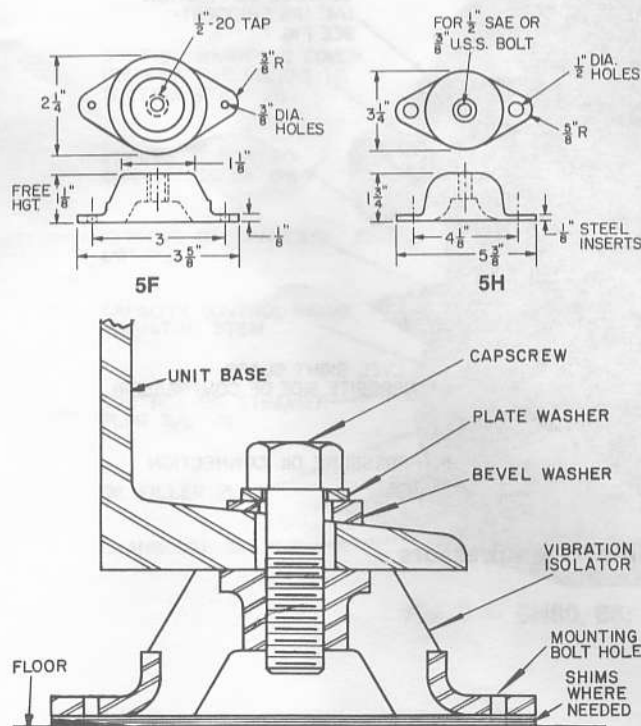


Fig. 9 – Typical Vibration Isolator Mounting

TO MOUNT CARRIER COMPRESSOR UNITS AND CONDENSER PACKAGES — Bolt the compressor's lower support straps loosely to underside of each support stand and place strips of protective material (such as Fabrica) on straps. Position condenser on stands with hot gas inlet at top of

condenser and liquid shutoff valve connection facing compressor end of base. Check that condenser overhangs support stands for same distance on each end.

Remove soldered shipping cap from hot gas inlet. To prevent solder from dripping into inlet pipe while unsoldering, rotate condenser until pipe is below horizontal position. Return inlet to upright vertical position.

Tighten lower support straps enough to lift condenser off stands. Place upper straps loosely in position with a strip of protective material between condenser and strap (5F20 and 5F30 units use lower strap only).

TO MOUNT COMPRESSOR BASE ON SUPPORT STANDS — Place compressor base on support stands with 2 extra strips of protective material between top of condenser and base. Bolt base into position with cap screws and lock washers provided.

Step 4 – Assemble Refrigerant Piping and Components — Refrigerant connection sizes are given in Table 1.

COMPRESSOR DISCHARGE PIPING — Refer to Condensing Unit Piping Installation Instructions for information.

REFRIGERANT DRIER — A replaceable-core filter drier is recommended for most systems, and is essential on all low-temperature systems. Mount the field-supplied filter drier in the liquid line. Include a shutoff valve to permit isolation of drier for servicing (Fig. 10).

Install a moisture indicator on downstream side of drier to indicate when drier cartridges need replacing.

FELT FILTERS — Install felt filter supplied with compressor in suction strainer (Fig. 3 through 8). Remove filter after 50 hours of operation. If clean, discard it; if dirty, clean with kerosene or neutral spirits and insert for another 50 hours of operation. Tag unit to show date that filter was cleaned and reinstalled. Figure 10 and Table 2 give information on replacement filter packages.

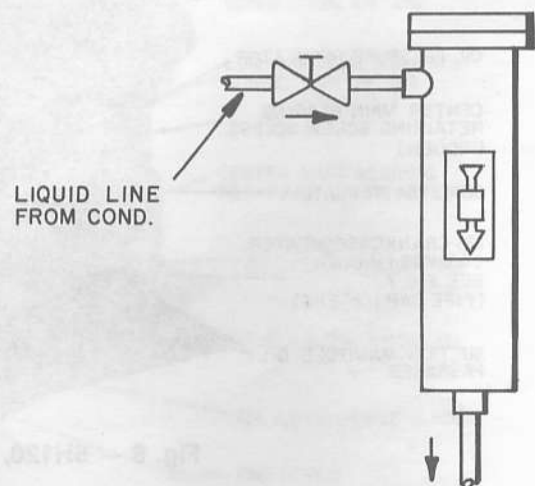


Fig. 10 – Refrigerant Filter Drier and Shutoff Valve Arrangement

Step 5 – Install Multiple Compressors

EQUALIZING LINES — Compressors operating in parallel require interconnecting lines for oil and gas pressure equalization. Special handhole cover plates, equipped with tapped holes for equalizing lines, are available as options for sizes 5F40 and 5F60, as well as for sizes 5H40 through 86 compressors (Fig. 11). An oil float system is an acceptable alternative to equalizer lines.

5H120 and 126 Compressors include factory-supplied, tapped cover plate. On these compressors, use only lower connection for oil equalization (Fig. 11). Connect gas equalizing line to flange connection shown. Mating flange for 1/8-in. line is Carrier Part No. DK24CA712 (Mueller Part No. A-5151); gasket Part No. is DK29GA005 (Mueller Part No. A-5152).

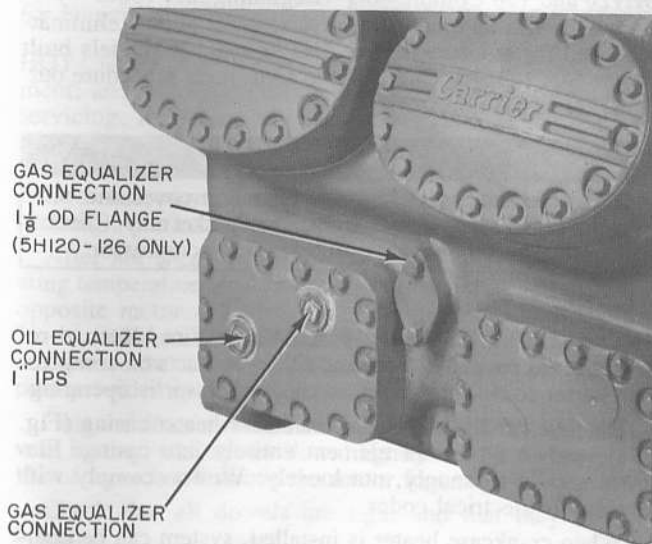


Fig. 11 – Special Hand-Hole Cover and Equalizer Connections (Typical)

5F20 and 30 Compressors have no special tapped cover plate. Use opening for oil sight glass to attach the 1/8-in. line for gas and oil equalization (Fig. 12). Accessory Package No. 06DA900072 provides two 1/8-in. line adapters to thread into the sight glass opening. If additional equalization is desired, run a 3/8-in. line to the oil-filter plug connection (Fig. 1 and 2).

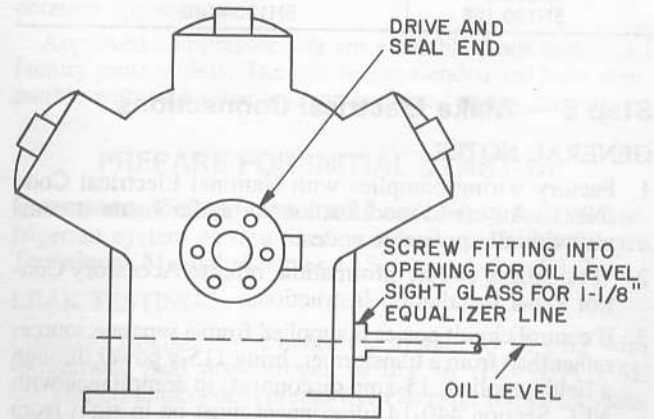


Fig. 12 – Equalizer Connections (5F20 and 30)

Table 1 – Physical Data

COMPRESSOR UNIT AND CONDENSING UNIT	5F20	5F30	5F40	5F60	5H40	5H46	5H60	5H66	5H80	5H86	5H120	5H126
REFRIGERANT	R-12, R-22, R-502											
COMPRESSOR DATA	1750											
Maximum Rpm	400 (required for proper lubrication)											
Minimum Rpm	600	700	800	900	800	800	900	900	1100	1100	900	900
Minimum Rpm Capacity Control												
Number of Cylinders	2	3	4	6	4	4	6	6	8	8	12	12
Bore (in.)	2 1/2	2 1/2	2 1/2	2 1/2	3 1/4	3 1/4	3 1/4	3 1/4	3 1/4	3 1/4	3 1/4	3 1/4
Stroke (in.)	2	2	2	2	2 3/4	3 1/16	2 3/4	3 7/16	2 3/4	3 7/16	2 3/4	3 7/16
Compressor Connections (In O.D.)												
Suction	1 1/8	1 5/8	1 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8	3 1/8	4 1/8	4 1/8
Discharge	7/8	1 3/8	1 3/8	1 3/8	2 1/8	2 1/8	3 1/8	3 1/8	3 1/8	3 1/8	4 1/8	4 1/8
Oil Charge* (pt) (See Notes)	5	5.5	12	13	18	18	21	21	41	41	61	61
Normal Oil Pressure*	45-55 psig above suction pressure											
Oil Flow Rate (gpm)†	3.0											
Oil Safety Switch												
Cut-in (psig) (See Note 2)	15 - 19.5											
Cutout (psig)	11 - 15											
High-Pressure Switch**												
Cutout Range	150-395 (adjustable) nominal											
Differential (psi)	60-150 (adjustable)											
Factory Setting (psig)	Cutout, 300 ± 15; Cut-in, 210 ± 10											
Low-Pressure Switch**												
Cutout Range	20 in. Hg vac to 60 psig (adjustable)											
Differential (psi)	60-90 (adjustable)											
Factory Setting (psig)	Cutout, 50 ± 4; Cut-in, 120 ± 6											
Low Side Maximum Pressure	245 psig											
CONDENSER DATA	5F20††	5F30††	5F40	5F60	09RH-027	09RH-043	09RH-054	09RH-070	09RH-084	09RH-097	09RH-127	
Maximum Refrigerant Storage Capacity‡ (lb)	R-12 37.2 R-502 38.2	50.7 46.4 47.9	79.4 72.8 75.0	89.6 82.0 84.6	154 139 145	212 193 199	263 239 248	238 216 223	282 257 265	358 327 337	475 432 447	
Minimum Refrigerant Operating Charge (lb)	R-12 2.0 R-22 1.8 R-502 1.9	3.0 2.7 2.9	14.0 12.7 13.1	16.0 14.5 15.0	37.0 33.0 34.4	41.0 37.0 38.2	51.0 46.0 47.3	51.0 46.0 47.3	78 71 73	100 91 94	126 114 118	
Maximum Operating Pressure Refrigerant Side	385 psig											
Water Side	250 psig											

*Nominal oil pressures shown in Physical Data table are above suction pressure, i.e., pressure differential between suction pressure and discharge pressure of oil pump.

†Oil flow rate (gpm) for 5H 12-cyl: 4.5 gpm with manual reversing oil pump; 6.0 gpm with auto. reversing oil pump.

**See Table 5 for typical pressure switch settings.

††Shell-and-coil condensers. All other 5F,H condensers are shell-and-tube.

‡Condenser storage capacity 80% filled with liquid refrigerant at 90 F.

NOTES:

- Oil flow rate is the nominal oil pump capacity.
- Oil safety switch has manual reset and time delay of 45 seconds.

Table 2 – Suction (Felt) Filter Packages

COMPRESSOR	FILTER PACKAGE PART NO.
5F40	5F40-A352
5F60	5F60-A352
5H40,46	5H40-A382
5H60,66	5H60-A382
5H80,86	5H80-A382
5H120,126	5H120-A382

Step 6 – Make Electrical Connections

GENERAL NOTES

1. Factory wiring complies with National Electrical Code (NEC). Any field modifications or additions must comply with all applicable codes.
2. *For control circuit information, refer to Accessory Control Panel Installation Instructions.
3. If control circuit power is supplied from a separate source, rather than from a transformer, bring 115-v power through a field-supplied, 15-amp disconnect, in compliance with NEC Section 440-14 (disconnect must be in sight from and readily accessible from unit).
4. Open control-power disconnect only when servicing unit. Crankcase heaters must remain energized when unit is not operating.
5. *Factory wiring is for single pumpout control. Do not use pumpout control on equipment used with DX coolers. Wiring label shows field connections used with DX cooler.
6. *Contactor C2 is used with 208-v motors, 25 through 60 hp, and 460-v motors, 50 through 150 hp.
7. *When field interlocks are used, remove jumpers between terminals 3 and 4, and between terminals 7 and 8 on TB2.

*Refers to compressor units and condensing units only.

ATTACH POWER WIRES TO COMPRESSOR MOTOR — Attach power wires in accordance with motor manufacturer's instructions and in compliance with NEC and applicable local codes.

CHECK MOTOR ROTATION — Before connecting motor to compressor, check direction of motor rotation. *Rotation must be in same direction as that indicated by arrow on compressor pump cover (or on plate attached near pump-end bearing housing).* If direction is not the same, reverse motor rotation by reversing any 2 power leads to motor.

If rotation of oil pump is reversed, reverse direction of pump rotation arrow as well. At that time make the following adjustments:

All 5F Compressors — Remove 6 cap screws from oil pump cover (Fig. 1-4). Do not damage gasket. Rotate cover 180 degrees and replace. Arrow at top of oil cover will indicate new direction of rotation.

5H40 through 86 Compressors — Drain oil below level of pump-end cover (Fig. 5-7). Remove pump-end cover to expose oil pump cover in center of main bearing housing. Rotate oil pump cover 180 degrees and replace it. Replace pump-end cover and reverse external arrow to match new direction of rotation. Proper direction can later be checked without removing pump-end cover.

5H120 and 126 Compressors (Beginning S/N 1086J---) — Supplied with automatically reversing oil pump, eliminating need for adjustment. For 5H120 and 126 models built before S/N 1086J---, follow same adjustment procedure outlined for 5F compressors.

⚠ CAUTION

If the special gasket between oil pump cover and oil pump is damaged, replace with correct gasket only. Check oil pressure immediately after starting compressor.

INSTALL CRANKCASE HEATER — Wire heater to relay or set of normally closed auxiliary contacts on compressor starter to de-energize it when compressor is operating.

Remove rubber plug from crankcase heater casing (Fig. 1-8), and insert heater element entirely into casing. Element should fit snugly, not loosely. Wire to comply with applicable electrical codes.

When crankcase heater is installed, system can be operated on single pumpout cycle, unless used with a DX cooler.

Table 3 lists crankcase heater packages. Table 4 shows corresponding relays. Use of 2 heaters on a 5H80 through 126 compressor requires only one relay.

Control circuit voltage determines relay coil voltage. This voltage must be specified when ordering relays.

See Accessory Compressor Crankcase Heater Installation Instructions for additional information.

Table 3 – 5F,H Compressor Crankcase Heater Package

COMPRESSOR	ELECTRICAL CHARACTERISTICS		PACKAGE NO.
	Volts	Watts	
5F20,30,40,60	115	100	-5-F--20---381
	230	100	-5-F--20---391
5H40,46,60,66	115	200	-5-H--40---381
	230	200	-5-H--40---391
5H80,86,120,126	115	200	-5-J--40---281
	230	200	-5-J--40---291

Table 4 – Crankcase Heater Relay (60 Hz)

CONTROL CIRCUIT VOLTAGE	PART NO.
115	HN61AJ-101
208/230	HN61AJ-108

Step 7 — Check Compressor/Motor Alignment

BELT DRIVE — See Accessory Belt Drive Package manual for installation and alignment instructions.

DIRECT DRIVE — Install and align compressor, coupling and motor as described in manual for Flexible Couplings for Direct-Drive Units.

HOT CHECK AND DOWELING — To help maintain alignment, and to ensure exact repositioning of the motor after servicing, the motor and compressor must be doweled to the base. *Install doweled only after motor/compressor alignment has been hot checked (checked after the compressor has warmed up to operating temperature after initial alignment).*

After hot check and while components are still at operating temperature, drill and ream 2 holes through diagonally-opposite motor and compressor feet and the base. Use a $\frac{9}{32}$ -in. drill and a no. 6 taper reamer. Secure the motor and compressor to the base with the no. 6 x $2\frac{1}{2}$ -in. taper dowel pins provided in the motor fastening set.

Coat the dowels with white lead or other lubricant to prevent rusting, and tap the dowel lightly into position so that $\frac{1}{16}$ of taper is left above the motor foot.

Check that all dowels are tight and that they do not bottom.

Step 8 — Assemble Water Piping — See Water-Cooled Condensers Installation Instructions and Water-Cooled Heads Installation Instructions for information.

Step 9 — Prepare Lubrication System

INSTALL OPTIONAL EQUIPMENT — Consult local Carrier representative for information on these accessories.

Oil Filter — Oil filter for 5H40 through 86 compressors is available as separate accessory package. Refer to Accessory Oil Filter Package Installation Instructions for installation procedures.

If an accessory oil cooler is also installed (see below), pipe oil filter into system as shown on diagrams in Accessory Oil Cooler Installation Instructions.

Oil Cooler — Refer to Accessory Oil Cooler Installation Instructions included with this accessory package. Adjust water flow rate through oil cooler to maintain 100 to 120 F oil temperature returning to compressor. See Scheduled Maintenance, page 17.

Oil Separator — If oil separator is used in system piping, pipe oil return line to compressor suction line. To minimize possibility of flooding compressor with oil, oil return line diameter should not exceed $\frac{1}{4}$ inch. In addition, line should have manual shutoff valve to throttle oil flow as required and to isolate separator for service.

CHECK OIL LEVEL — Check that oil level is visible at center of compressor sight glass. Compressors that use optional equipment such as filter, cooler, and oil separator described above will require a greater oil charge than listed in Table 4. Recheck oil level after operating compressor.

RECOMMENDED OILS — When additional oil or a complete oil change is required, use only the Carlyle engineering department approved, dehydrated, wax-free refrigeration grade oils noted below:

IGI Petroleum Specialties, Inc. Cryol 150
IGI Petroleum Specialties, Inc. .. Cryol 150 with additive (Akzo Chemicals, Inc. additive Syn-O-Ad (8478)
Witco Suniso 3GS

Witco — Hi ambient application,

300 viscosity Suniso 4GS
Texaco, Inc. WF32-150
Shrieve Chemical Co. (synthetic) Zerol 150

Mineral oil and synthetic oil have different characteristics. One is not necessarily better than the other. Some characteristics of the mineral oils have been found to be more favorable for use in some air conditioning and medium temperature applications.

Approved compressor oils are available from authorized factory parts outlets. The oils recommended are fully compatible with each other and can be mixed in any proportion.

PREPARE FOR INITIAL START-UP

Evacuate, Dehydrate and Leak Test the entire refrigerant system as described in Carrier Standard Service Techniques Manual, Chapter 1, Sections 1-6 and 1-7.

LEAK TESTING

Preferred Method — Charge the system to 10 psig with refrigerant. Add dry nitrogen or dry air (DO NOT USE OXYGEN) until system pressure is 150 psig. Check for leaks with a halide or electronic leak detector.

Alternate Method — Charge the system with dry nitrogen or dry air (DO NOT USE OXYGEN) to 40 psig and use soap-bubble test to find large leaks.

⚠ CAUTION

Do not use compressor to build up pressure. Do not overcharge the system.

Refrigerant Charging — Use the sight glass method to charge the system. See Section 1-8 of Carrier Standard Service Techniques Manual, Chapter 1, for details.

Charge the system to a clear sight glass while holding saturated condensing pressure constant at 125 F for air-cooled systems or 105 F for water-cooled systems. Add additional refrigerant to fill condenser subcooler coils, if required.

5F,H CONDENSING UNITS — After a clear sight glass is obtained, add charge until liquid refrigerant reaches the condenser liquid level test cock.

5F,H COMPRESSOR UNITS — See condenser data for additional charge requirements.

START-UP

Preliminary Steps

1. Energize crankcase heater for at least 24 hours before starting unit.
2. If control transformer is not used, operate electrical control circuit with main power switch OFF to ensure that field connections have been properly made.
3. Install felt sock filter for the first 50 hours of compressor operation. Remove and inspect the filter, clean it if required and replace it for another 50 hours. Remove sock when system is clean. (Not applicable for 5F20 and 5F30 units.)
4. Check that motor rotates in direction that the arrow on the compressor oil pump cover indicates. Refer to Installation, Step 5, under Check Motor Rotation.
5. Check that oil fills $\frac{1}{3}$ to $\frac{1}{2}$ of the compressor sight glass.
6. Open water supply valve to condenser. Open pressure line valve of water-regulating valve (if used). If compressor unit is equipped with air-cooled condenser, turn on condenser fan.

7. Backseat (open) compressor suction and discharge service valves. Open liquid line valve at receiver.
8. Start evaporator fan or chilled water pump.

Start Compressor — Close main power switch supplying current to the compressor motor.

Immediately recheck oil level and check oil pressure. Pressure should exceed suction pressure by 45-55 psi. *If correct pressure is not reached in 10-12 seconds, stop compressor immediately and check oil pump.*

CAUTION

If any safety device shuts down the compressor, do not reset the control more than once before determining cause of shutdown.

Check Control Operation — Refer to Carrier Standard Service Techniques Manual, Chapter 2, for complete instructions on checking electrical components.

HIGH- AND LOW-PRESSURE SWITCHES — All 5F and 5H units except 5F20 and 30 have factory-installed, automatic reset, high- and low-pressure switches. (These switches are available as accessories for 5F20 and 30 units.) Figure 13 illustrates adjustment procedures for both switches.

Check High-Pressure Switch — Throttle the condenser water on water-cooled unit or block the airflow on air-cooled unit, allowing head pressure to rise gradually. Compressor should shut off within 15 psi of cutout value listed in Table 4. Now reverse procedure; compressor should start within 10 psi of cut-in value given.

Check Low-Pressure Switch — Slowly close the suction service valve; suction pressure will decrease. Compressor should shut off within 4 psi of cutout value listed in Table 5. Reverse procedure; compressor should start within 6 psi of cut-in value given.

Table 5 — Typical Pressure Switch Settings

REFRIG- ERANT	CONDENSER	PRESSURESTAT			
		High (psig)		Low (psig)	
		Cutout	Cut-in	Cutout	Cut-in
12	Water-Cooled	175	95	16	76
	Air-Cooled	225	145	16	76
22	Water-Cooled	280	200	36	96
	Air-Cooled	325	245	36	96
502	Water-Cooled	280	200	45	105
	Air-Cooled	325	245	45	105

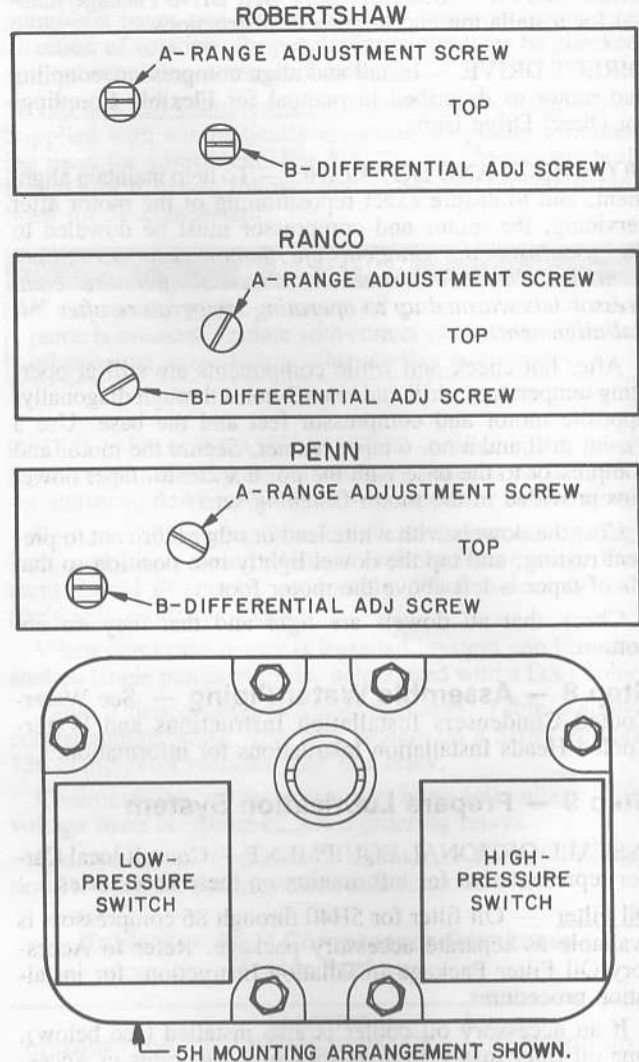
OIL PRESSURE SAFETY SWITCH — To check, move contact arm at left side of switch forward (Fig. 14). Compressor should stop in approximately 45 seconds.

If compressor continues to run, check the wiring to safety switch. If wiring is correct, switch is faulty and should be replaced.

After completing test, wait 3 minutes; then press restart button on front of safety switch and restart compressor.

Check oil level in compressor sight glass after 15-20 minutes of operation. If the oil level is low, add oil by the methods described in Carrier Standard Service Techniques Manual, Chapter 1, Section 1-11.

If an accessory oil cooler is provided, adjust the water flow as required to maintain a 100 F to 120 F crankcase return oil temperature.



Screw A raises or lowers both cutout and cut-in points by a like amount. Range and Differential scales are on the front of the switch.
 High Pressure: Set *cutout* point first, with screw A; then set *cut-in* point with screw B.
 Low Pressure: Set *cut-in* point first, with screw A; then set *cutout* point with screw B.

LOCATION AND ADJUSTMENTS

Fig. 13 — High- and Low-Pressure Switches

For additional information, see Oil Safety Switch Accessory Package Installation Instructions.

Adjust Capacity Control (if required)

5F20 AND 30 COMPRESSORS — Refer to Capacity Control Valve Installation Instructions for additional information.

5F40 AND 60, AND 5H40 THROUGH 126 COMPRESSORS — Determine the refrigerant usage:

If the system is to use R-12, replace the 11-lb range adjustment spring (Fig. 15) with the 7-lb spring supplied with compressor. A change in 1982 reversed which range-adjusting spring a customer received. The R-22/R-502 spring is now standard with the compressor. See instruction tag for spring replacement procedure.

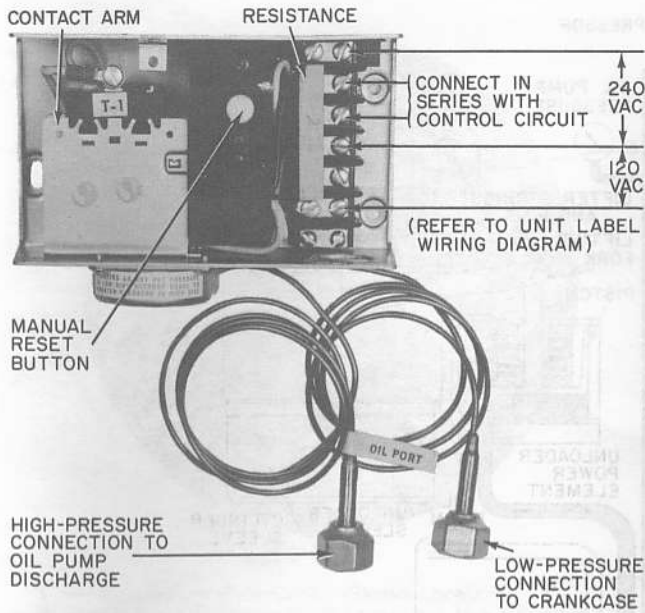
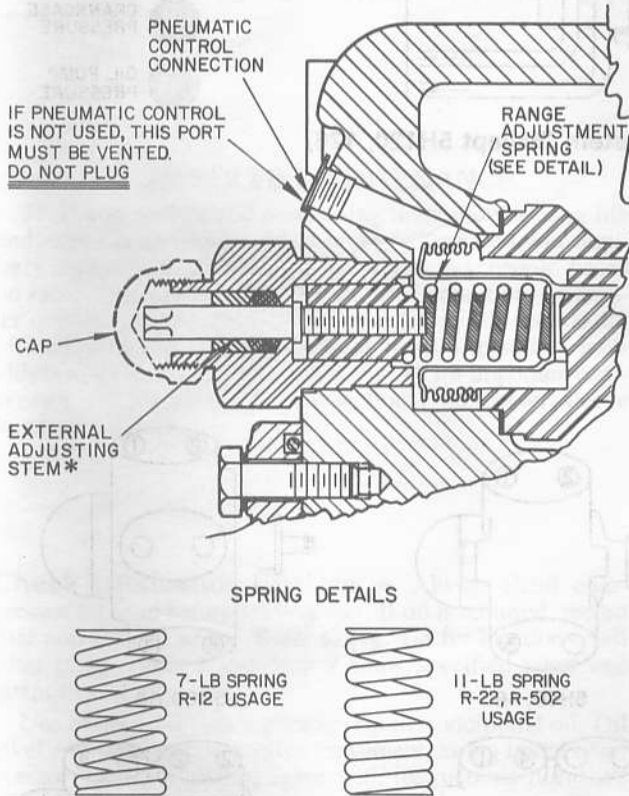


Fig. 14 - Oil Pressure Safety Switch



*When compressor is received, the capacity control adjusting stem will be backseated. (Compressor will be fully loaded under all conditions.)

Fig. 15 - Capacity Control Valve

An external adjusting stem (Fig. 15) sets the control point (suction pressure at which first step of cylinder unloading occurs). The control point is adjustable as follows:

- R-22 and R-502 0 to 85 psig
- R-12 0 to 50 psig

One full clockwise turn of adjusting stem will raise the control point approximately 6 psig with R-12, or 10 psig with R-22 and R-502.

Control oil pressure is an indication of cylinder loading condition (Table 6). Refer to Fig. 3-8 for location of control oil-pressure connection. See Accessory Unloader Package Installation Instructions for additional information.

See Fig. 16 for Capacity Control System, and Fig. 17 for unloading sequence.

Table 6 - Control Oil Pressures for Cylinder Loading and Unloading

COMPRESSOR	STEP*	APPROXIMATE CONTROL OIL PRESS. (psig)	
		Loading	Unloading
5F20	1	19.8	13.0
5F30	1	30.0	20.2
	2	19.8	13.0
5F40,60; 5H40,46, 60,66,80, 86,120,126	1	30.0	19.0
	2	26.0	16.0
	3	23.0	12.0
	4	20.0	9.0

*Capacity Control reduction steps.

To Adjust Control Point

1. Impose an artificial load on the compressor until suction pressure exceeds control point.
2. Slowly close suction valve to lower compressor suction pressure to control point pressure.
3. When at control point pressure, turn external adjusting stem clockwise until first step of unloading takes place, as indicated by changes in control oil pressure, current draw and sound of compressor.

Control point is now set. Reopen suction service valve. Compressor will be fully loaded when suction pressure is 3 psig (4 psig with R-22 and R-502) above control point, and will be fully unloaded when suction pressure is 4 psig (7 psig with R-22 and R-502) below control point.

5F20 AND 30 COMPRESSORS - Two capacity control packages are available as accessories. One is suitable for R-12 applications; the other for R-22 and R-502 applications.

The adjusting stem (Fig. 15) is shipped in a backseated (fully counterclockwise) position. Compressor will be fully loaded under all conditions. Adjust the capacity control set point by the same 3-step procedure described above for 5F40 and 60, and 5H40 through 126 compressors.

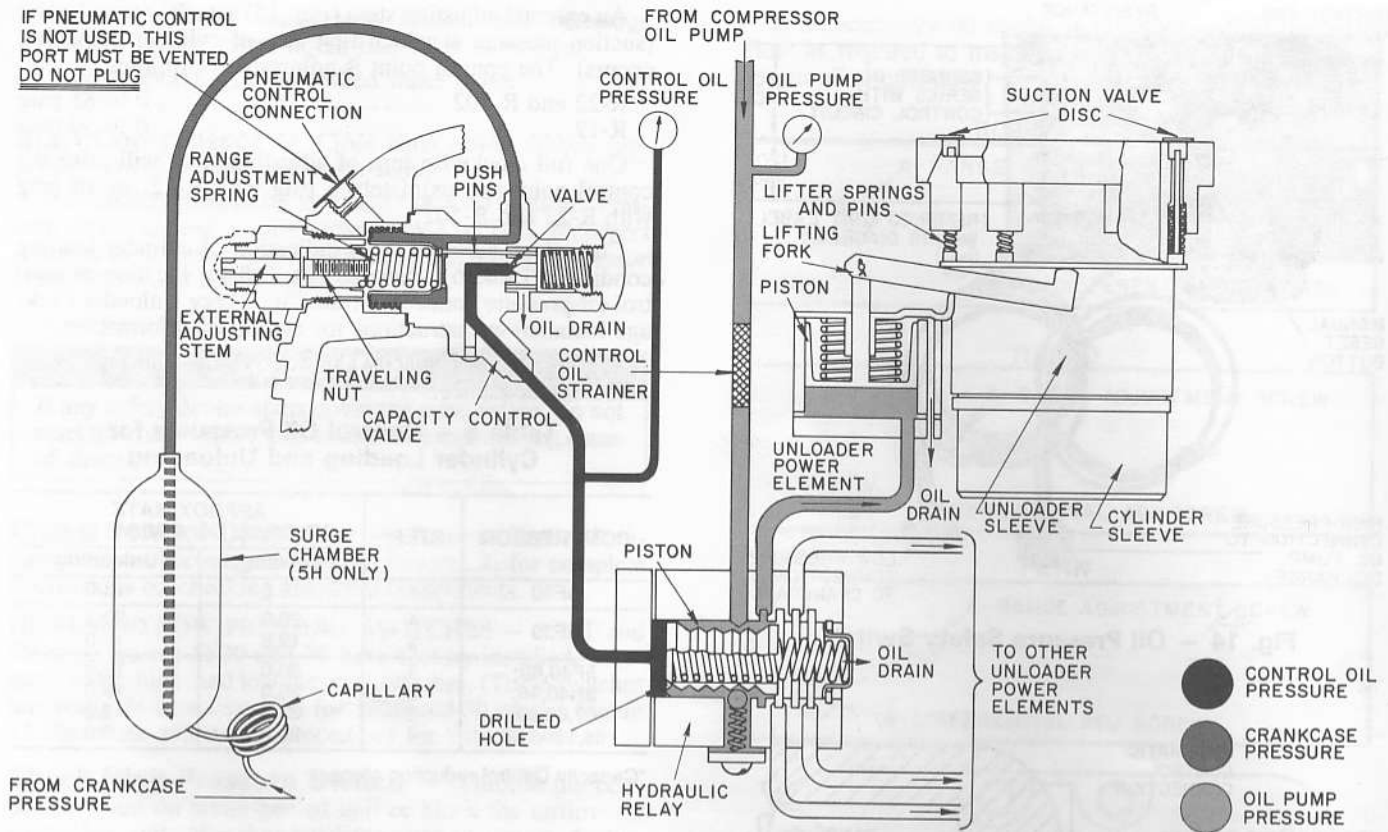


Fig. 16 - 5F,H Capacity Control System (Except 5H120, 126)

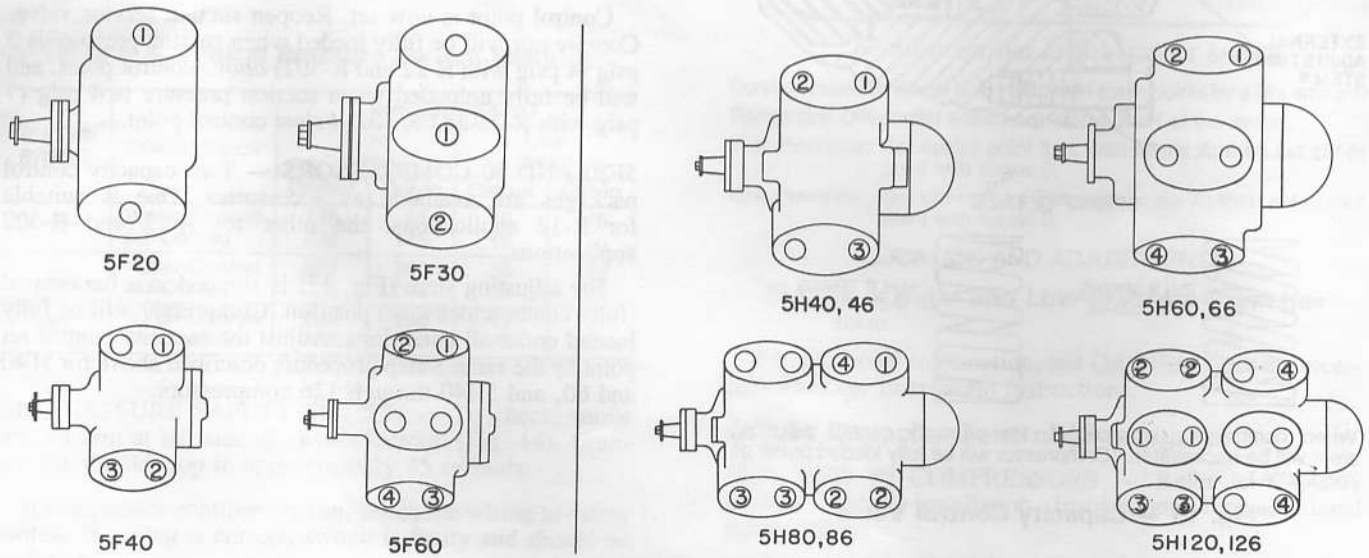
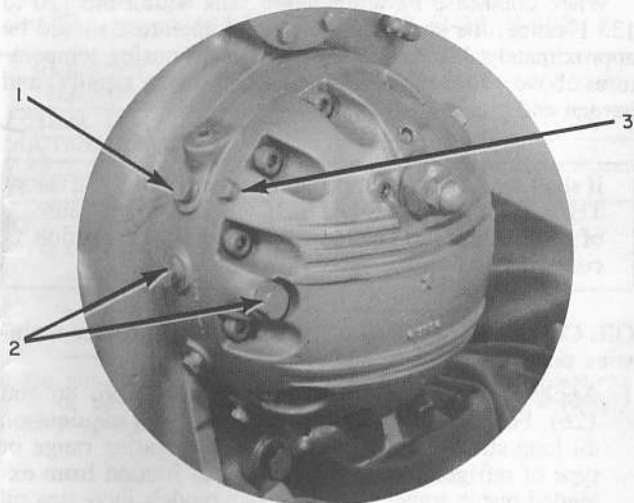
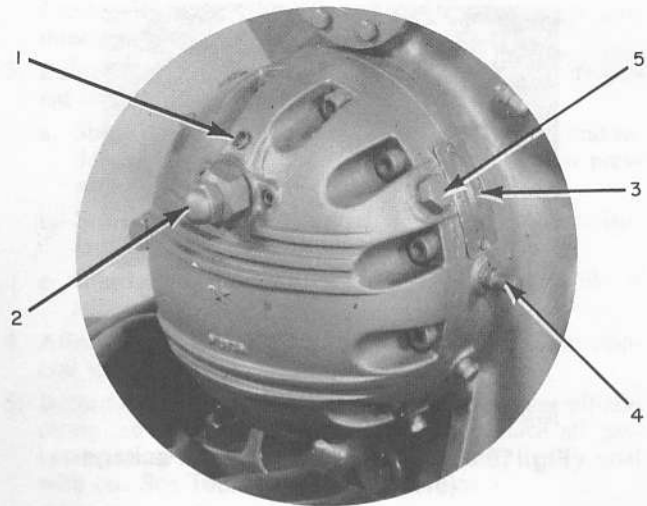


Fig. 17 - Cylinder Unloading Sequence



LEFT SIDE

- 1 — Connection to Oil Cooler (Sleeve Location)
- 2 — Oil Pump Pressure (Both Locations). Use either for High-Side Oil Pressure Switch Connection
- 3 — Opening to Crankcase (Low-Side Oil Pressure Switch Connection)



RIGHT SIDE

- 1 — Pneumatic Control Connection
- 2 — Capacity Control Valve
- 3 — Oil Pump Rotation Arrow
- 4 — Capacity Control Oil Pressure
- 5 — Oil Fill Plug

Fig. 18 — Typical 5H40 through 5H86 Compressor Pump-End Connections

SCHEDULED MAINTENANCE

5F,H compressor and condensing units provide long life and dependable service when properly operated and regularly maintained. Establish a maintenance schedule based on factors such as operating hours, load conditions and water quality. Maintenance schedules listed in this section are offered as guides. Modify them as needed to satisfy individual machine requirements. See Fig. 18 for important compressor service locations, connections, oil cooler sleeve location.

Check Lubrication System — Always check compressor oil level before starting unit. If oil is required, record date and amount added. Refer to Fig. 1-8 for location of oil filter plug. Table 1 and Step 9 show specified types and quantities of oil.

Use of accessory oil separator requires additional oil. Oil level and separator float valve movement during initial compressor operation should agree with instructions furnished with the oil separator.

OIL FILTER MAINTENANCE — A bleed-type, high-pressure, disposable filter is available as an accessory for 5H40 through 5H86 compressors (Fig. 19). Replace oil filter after the first 50 hours of operation, or whenever the oil is changed or becomes dirty.

Check yearly for clogged filter, indicated by a greater than normal difference between oil pressure ahead of filter and after filter. When this difference exceeds 5 psig, change filter as follows:

1. Close oil-line shutoff valves on each side of filter (Fig. 19).
2. Disconnect oil lines at filter connections.
3. Loosen filter bracket; remove and replace filter body.

Refer to Accessory Oil Filter Instructions for additional information.

The full-flow oil filter, on 5H120 and 5H126 compressors only, contains a replaceable cartridge. Replace the filter cartridge after the first 100 hours of compressor operation. After the initial filter change, check yearly for filter clogging. If the pressure difference across the filter exceeds 5 psig, pump down the compressor and then remove the cartridge. Figure 20 (B) illustrates complete filter assembly (not shown in Fig. 20 [A]).

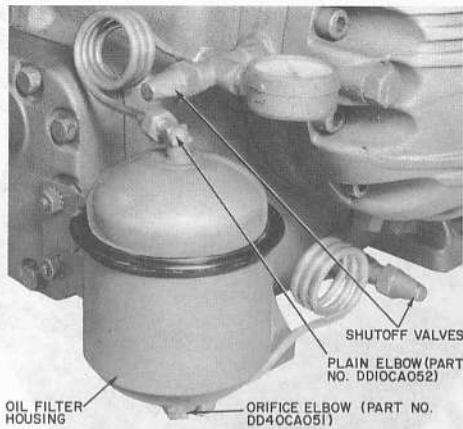


Fig. 19 — Oil Filter Accessory Package (5H40 through 5H86)

CHECK OIL AND SHAFT SEAL TEMPERATURE — The normal operating temperature of the oil in the crankcase ranges from 100 F to 135 F when fully loaded. Do not permit maximum oil temperature to exceed 150 F. Conditions under which such excessive temperatures could occur include situations where the compressor operates in a fully unloaded condition for an extended period, because the compressor would not be able to remove all of the heat generated by compression and friction. In such situations, use an oil cooler to maintain safe operating temperatures. Refer to 5F,H Application Data for more information.

When crankcase oil temperature falls within the 120 to 135 F range, the shaft seal housing temperature should be approximately 140 to 150 F. Shaft seal housing temperatures above 170 F may cause shaft seal to age rapidly, and harden and crack. Therefore:

If shaft seal housing temperature exceeds 170 F, STOP THE COMPRESSOR. DO NOT restart until the cause of overheating has been identified, and the condition corrected.

OIL COOLER USAGE — The accessory oil cooler maintains safe operating oil temperatures when:

1. Applying long stroke compressors (5H46, 66, 86 and 126). For added reliability, an oil cooler is required on all long stroke models regardless of operating range or type of refrigerant. Additional heat of friction from extended piston travel on long stroke models increases oil temperatures.
2. The suction gas becomes highly superheated (Table 7).
3. a. The compression ratio exceeds 5:1 on R-22 systems.
b. Application data indicates the need for an oil cooler for R-12 and R-502 systems. The compression ratio can be determined from the following formula:

$$\text{Compression Ratio} = \frac{\text{Absolute Discharge Pressure}}{\text{Absolute Suction Pressure}}$$

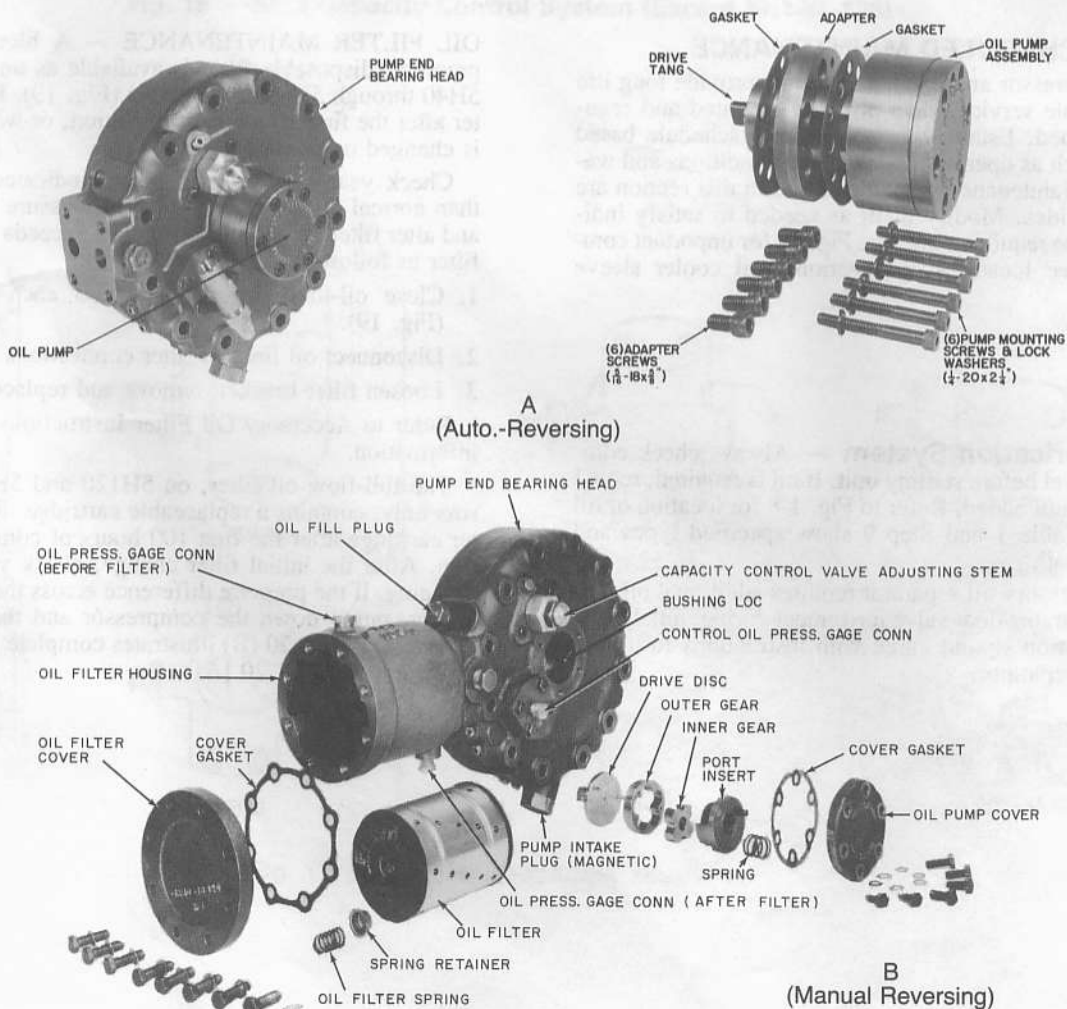


Fig. 20 — Oil Pump and Filter Assembly (5H120, 126)

Table 7 — Actual Suction Gas Temperature Limits (F), R-12, R-22, R-502

SAT. SUCT TEMP (F)	-60	-50	-40	-30	-20	-10	0 to 50
ACTUAL SUCTION GAS TEMP (F)	R-12	—	—	35	45	55	65
	R-502	25	35	45	55	65	75
	R-22	See Note 1					

NOTES:

1. For continuous operation with R-22:

SAT. SUCT TEMP (F)	MAX. SUPERHEAT (F)
-40 to 40	25
40 to 50	15

2. Do not operate unloaders at saturated suction temperatures at or below 0°F without prior approval from Carrier/Carlyle Engineering.

4. The compressor operates fully unloaded for prolonged periods. Under these conditions, suction gas levels may not suffice to remove the heat of compression and friction. This condition can occur in any application, but is most likely in low-temperature systems or variable-volume applications that use hot-gas bypass to maintain specified conditions under low evaporator load. Refer to 5F,H Application Data for additional information.

Adjust water flow rate through oil cooler to maintain 100 to 120 F oil temperature returning to compressor. Crankcase temperature must remain below 140 F; shaft seal temperature at the seal housing should not exceed 170 F.

Tables 8 and 9 list maximum working pressures for oil and water and estimated water flow rates for various oil cooler/compressor combinations. For additional information, see Accessory Oil Cooler Installation Instructions.

Table 8 — Oil Cooler Maximum Working Pressure

OIL	150 psig
WATER	150 psig

Table 9 — Oil Cooler Estimated Water Flow Rates

COMPRESSOR	GPM*
5F	1/4-1
5H40-66	1-2
5H80,86	1 1/2-3
5H120,126	2-4

*Flow rate based on 80 F entering water.

Check Water-Cooled Heads — To prevent oil breakdown and sludge formation, the discharge gas temperature must remain below 275 F. Water-cooled cylinder heads are available as an accessory for this purpose. See Accessory Water-Cooled Head Package Installation Instructions for additional information.

SERVICE

Service and repair of Carrier reciprocating compressors and other refrigeration components should be performed only by fully trained and qualified personnel.

Service Notes

- Compressor components are shown in normal order of removal from compressor (Fig. 21 and 22).
- For replacement items, use Carrier specified parts. See

Carrier 5F,H Specified Parts list for compressor part interchangeability.

- Before servicing compressor, pump down the refrigerant as follows:
 - Start compressor, close suction service valve, and reduce crankcase pressure to 2 psig. (Bypass low pressurestat with jumper.)
 - Stop compressor; close discharge service valve to isolate it from system.
 - Bleed any residual refrigerant. Drain oil if necessary.
- After disassembly, clean all parts with solvent. Use mineral spirits, white gasoline or naphtha.
- Before assembly, coat all parts with compressor oil and clean and inspect all gasket surfaces. Replace all gaskets with new, factory-made gaskets, and lightly coat with oil. See Table 10 for torque values.
- After reassembly, evacuate compressor and open suction and discharge valves. Restart compressor and adjust refrigerant charge.

Lubrication System

OIL PUMPS

5F compressors. See Fig. 23 and 25.

5H40-86 compressors. See Fig. 24 and 25.

5H120,126 compressors, with automatically reversing oil pump. See Fig. 20(A).

5H120,126 compressors, with manually reversing oil pump. See Fig. 20(B) and 26.

5H120 and 126 Compressor Oil Pump History Reference

TYPE	FIG.	DATE MANUFACTURED	SERIAL NO. BREAK
Auto.-Reversing	20(A)	1960 through 1968 and Starting March 1986	From 0447119 to A901765 and Starting 1086J01967
Manually Reversing	20(B)	Starting 1969 and Ending March 1986	Starting A901765 and Ending 1086J---

NOTE: By itself, the automatic reversing oil pump cannot be installed in place of the manually reversing oil pump or vice versa. The complete bearing head assembly with the oil pump (auto. or manual) is interchangeable as a complete assembly.

MANUALLY REVERSING OIL PUMP

Oil Pump Inspection — See Fig. 20B, 23 and 24 for 5F and 5H manually reversing oil pumps. Also refer to 5H120, 126 auto.-reversing oil pump section.

Drain oil below level of pump-end bearing head. Remove bearing head. Complete end-bell assembly must be removed to access bearing head assembly with oil pump on 5H40 through 86 models. Check oil pump rotor for end play. Maximum allowable movement of rotor is 0.0025. If there is excessive end play, reposition oil pump bushing in bearing head as described below.

Turn rotor. If there is more than a slight drag, remove pump cover and disassemble oil pump checking all parts for wear and damage. Inspect oil pump bushing for scoring. Replace bushing if scored. If bearing head is scored, replace complete bearing head and oil pump assembly.

Oil Pump Bushing Installation — See Fig. 25 and 26. Position the bushing oil groove at top (running from 12:00 to 6:00) when the bearing head is installed. Press new bushing into the pump-end bearing head from the inner side of the head with the chamfered end entering first.

Oil Pump Bushing Position

1. a. **5F20-60 and 5H40-86.** See Fig. 25. Place 0.001-in. circular field fabricated shim against bushing and install pump. Shim between bushing and oil pump rotor. Complete assembly of oil pump with gasket and cover.
 - b. **5H120,126.** See Fig. 26. Place 0.015-in. (1/64-in.) shim between port insert and oil pump cover. Complete assembly of oil pump and pump cover without using pump cover.
2. Tap bushing with suitable cylindrical positioning tool to seat it against shim. See typical arrangement shown in Fig. 25.

⚠ WARNING

Oil pump assembly must be flush with coverplate surface, but *must not* protrude beyond bearing head surface.

3. a. **5F20-60 and 5H40-86.** See Fig. 25. Disassemble oil pump and remove shim. Reassemble oil pump. Check for binding.
 - b. **5H120,126.** Remove oil pump cover and shim. Reassemble pump cover with gasket. Check for binding.
4. Install bearing head on compressor. Line up tang on oil pump rotor shaft with slot in end of crankshaft. Check oil pump for proper direction of rotation.
5. Refill compressor oil to proper level. Observe oil pressure when starting compressor. Correct oil pressure should be 45-55 psig above suction pressure.

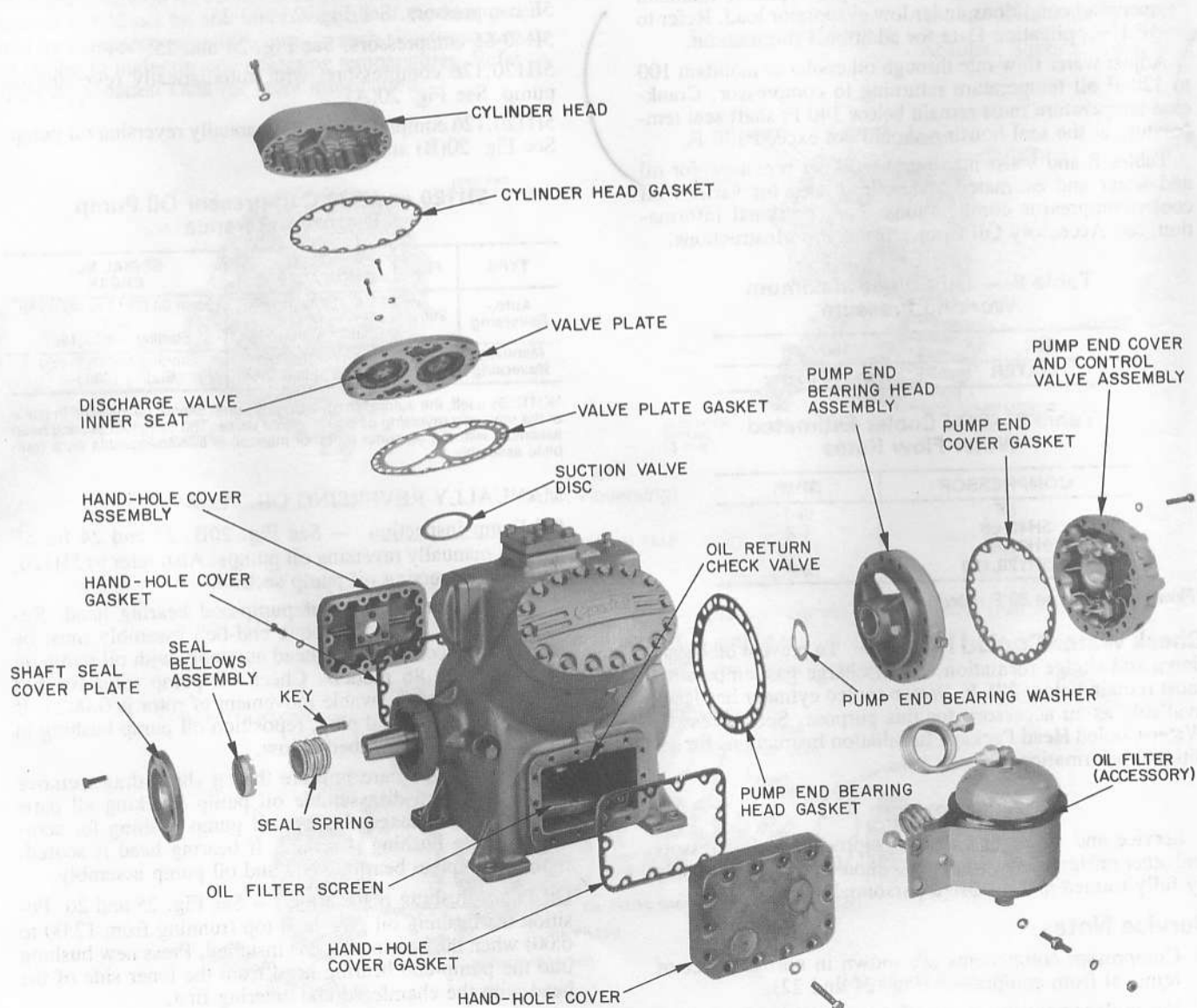


Fig. 21 — 5H Compressor External Components

AUTO. REVERSING OIL PUMP

Oil Pump Inspection — See Fig. 20(A) for 5H120 and 126 for automatic reversing oil pumps.

1. Drain oil below level of pump-end bearing head.
2. Remove bearing head from compressor.
3. Remove oil pump and adapter from bearing head.
4. Check all parts for wear and damage.

Pump Installation

1. Using a new gasket, mount bearing head on compressor. Tighten the 1/2-13 cap screws to 80 lb-ft.
2. Put a drop of thread sealing compound (Loctite 601 or equivalent) on each of the 5/16-18 adapter mounting screws

3. Be sure there are no nicks or burrs on oil pump or bores in adapter and bearing head. Slide oil pump through adapter and into bearing head bore, allowing enough clearance to tighten adapter mounting screws with an Allen wrench. *The clearance between oil pump housing and bores in adapter and bearing head is necessarily very close. DO NOT USE FORCE and do not attempt to change the clearance.*

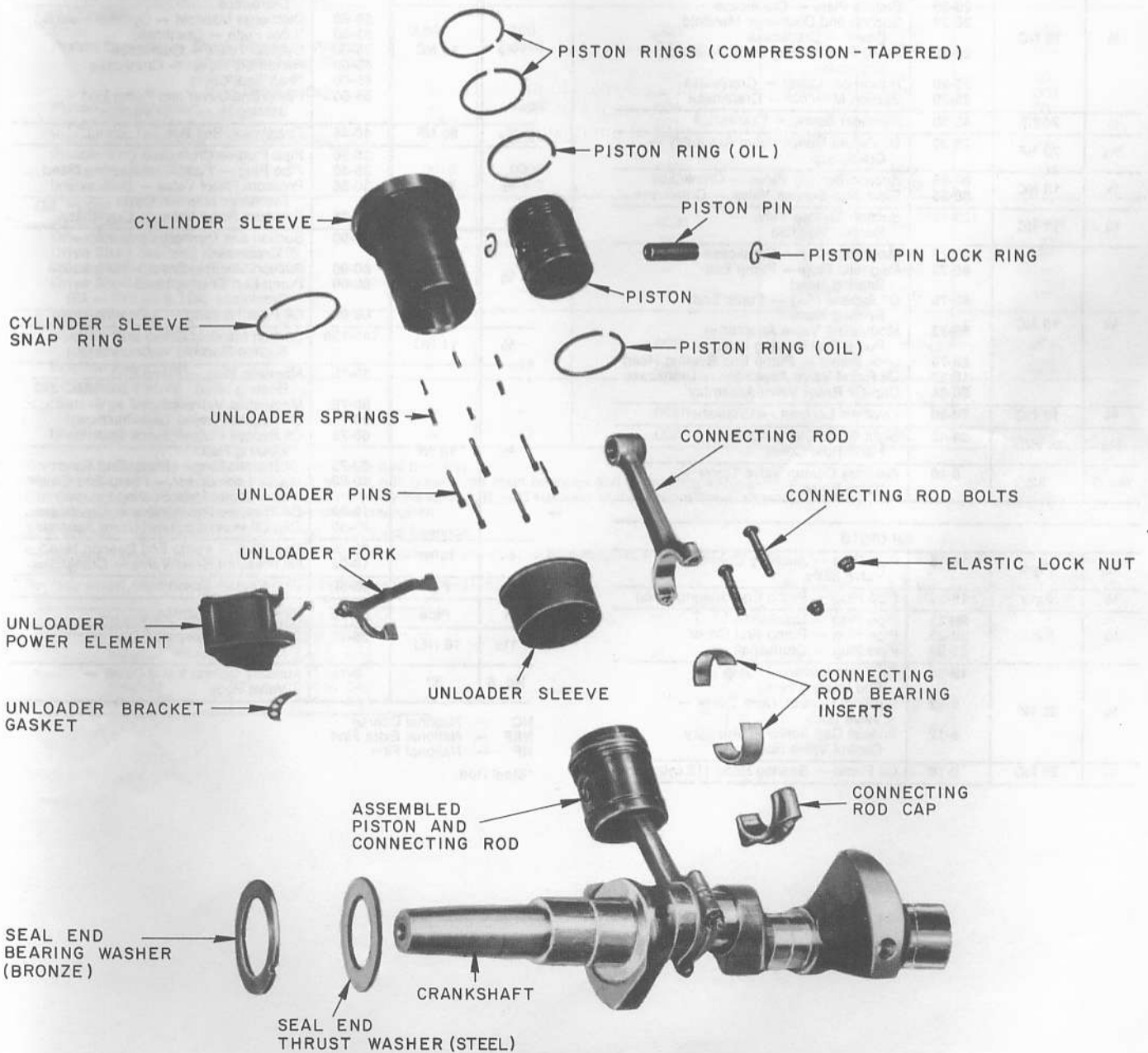


Fig. 22 — 5H Compressor Internal Components

Table 10 – Torque Values

5F UNITS			
SIZE DIAM (in.)	THREADS PER IN.	TORQUE RANGE (lb-ft)	USAGE
1/4	Pipe	20-25	Pipe Plug – Pump End Bearing Head
		20-25	Pipe Plug – Crankshaft
		20-25	Pipe Plug – Suction and Discharge Manifold Cover
1/4	28 NF	10-15	Unloader Power Element Assembly – Crankcase
		10-15	Unloader Cylinder Cover Plate – Unloader Cylinder Bracket
		12-15	Discharge Valve Cap Screw – Inner Seat
		12-15	Discharge Valve Guide Assembly – Valve Plate
		12-15	Oil Pump Cover – Pump End Bearing Head
		10-12	Auxiliary Control Valve Cover – Valve Body
5/16	24 NF	22-25 15-20	Connecting Rod Bolt – Locknut Capacity Control Valve – Hand-Hole Cover
3/8	Pipe	30-35	Pipe Plug – Pump End Bearing Head
3/8	16 NC	25-29	Cylinder Head – Crankcase
		25-29	Shaft Seal Cover Plate – Crankcases
		25-29	Bottom Plate – Crankcase
		25-29	Suction and Discharge Manifold Cover – Crankcase
		25-29	Pump End Bearing Head Assembly – Crankcase
		25-29	Hand-Hole Cover – Crankcase
3/8	24 NF	45-50	Flywheel Screw – Crankshaft
7/16	20 NF	25-30	Oil Return Check Valve Assembly – Crankcase
1/2	13 NC	80-85 80-85	Suction Service Valve – Crankcase Discharge Service Valve – Crankcase
5/8	11 NC	120-130	Suction Service Valve – Suction Manifold
5/8	18 NC	60-75	Magnetic Plug – Crankcase
		60-75	Magnetic Plug – Pump End Bearing Head
		60-75	Oil Bypass Plug – Pump End Bearing Head
		60-75	Modulating Valve Adapter – Pump End Bearing Head
		60-75	Lock Screw – Pump End Bearing Head
		18-22 50-60	Oil Relief Valve Assembly – Crankcase Cap-Oil Relief Valve Assembly
3/4	10 NC	70-80	Flywheel Locknut – Crankshaft
1 1/2	18 NEF	34-45	Sight Glass Clamping Gland – Hand-Hole Cover
No. 6	32	8-10	Auxiliary Control Valve Cover – Valve Body

5H UNITS

1/16	Pipe	10-15	Pipe Plug – Auxiliary Control Valve Body
1/8	Pipe	15-20	Pipe Plug – Pump End Bearing Head
1/4	Pipe	20-25	Pipe Plug – Crankcase
		20-25	Pipe Plug – Pump End Cover
		20-25	Pipe Plug – Crankshaft
1/4	28 NF	12-16	Oil Pump Cover – Pump End Bearing Head
		8-12	Auxiliary Control Valve Cover – Valve Body
		8-12	Special Cap Screw – Auxiliary Control Valve Body
1/4	20 NC	8-10	Oil Pump – Bearing Head (12 cylinder)

5H UNITS (cont)			
SIZE DIAM (in.)	THREADS PER IN.	TORQUE RANGE (lb-ft)	USAGE
5/16	18 NC	16-20	Oil Pump Cover – Pump End Bearing Head
		16-20	Capacity Control Valve – Pump End Bearing Head
		16-20	Auxiliary Control Valve – Pump End Bearing Head
		16-20 18-24	Manifold Cover Plate – Crankcase Oil Pump Adapter (12 cylinder)
5/16	24 NF	18-22	Unloader Power Element – Crankcase
		18-22	Capacity Control Valve – Pump End Cover
		18-22	Discharge Valve Guide Assembly – Valve Plate
		18-22 18-22	Discharge Valve Guide – Inner Seat Cylinder Bracket
3/8	Pipe	30-35 30-35	Pipe Plug – Pump End Bearing Head Pipe Plug – Crankshaft
3/8	16 NC	25-29	Capillary Tube Assembly – Pump End Bearing Head
		28	Connecting Rod Bolt (Aluminum Rod)
7/16	14 NC	35-60	Suction and Discharge Manifold Cover – Crankcase
		55-60	Discharge Manifold – Cylinder Heads
		55-60	Valve Plate – Crankcase
		55-60	Cylinder Head – Crankcase
		53-60	Hand-Hole Cover – Crankcase
		55-60 55-60	Shaft Seal Cover Pump End Cover and Pump End Bearing Head – Crankcase
7/16	20 NF	40-45	Connecting Rod Bolt – Locknut*
1/2	Pipe	35-50	Pipe Plug – Crankcase
		35-40	Pipe Plug – Pump End Bearing Head
		30-35	Pressure Relief Valve – Suction and Discharge Manifold Cover
1/2	13 NC	30-35	Pressure Relief Valve – Crankcase
		80-90	Suction and Discharge Manifold – Crankcase
		80-90 80-90	Suction Manifold Cover – Crankcase Pump End Bearing Head – Crankcase
5/8	11 NC	140-150	Oil Filter Housing – Bearing Head
5/8	18 NF	60-75	Suction Manifold Cover and Suction Manifold – Crankcase
		60-75	Magnetic Plug – Pump End Bearing Head
		60-75	Modulating Valve Adapter – Crankcase
		60-75	Oil Bypass Plug – Crankcase
		60-75	Oil Bypass Plug – Pump End Bearing Head
		60-75 80-90	Oil Bypass Plug – Pump End Cover Hollow Lock Screw – Pump End Cover and Center Main Bearing Housing
7/8	14 NF	18-22	Oil Pressure Relief Valve – Crankcase
		80-90	Cap-Oil Pressure Relief Valve Assembly
3/4	Pipe	45-50	Seal Plug – Pump End Bearing Head Oil Pressure Relief Valve – Crankcase
1	Pipe	50-55	Pipe Plug – Crankcase
1 1/2	18 NEF	35-45	Sight Glass Clamping Gland – Hand-Hole Cover
No. 6	32	8-10	Auxiliary Control Valve Cover – Valve Body

NC – National Coarse
NEF – National Extra Fine
NF – National Fine

*Steel Rod.

Table 11 – Wear Limits; 5F,H Compressors

COMPRESSOR PART	COMPRESSOR					
	5F20,30,40,60			5H40,46,60,66,80,86,120,126		
	Factory Tolerances (in.)		Maximum Allowable Wear (in.)	Factory Tolerances (in.)		Maximum Allowable Wear (in.)*
	Max	Min		Max	Min	
SEAL END†						
Main Bearing Diameter – 5F20, 30	1.6264	1.6250	.002	2.6278	2.6250	.001
– 5F40, 60	2.0636	2.0618	.001	–	–	–
Journal Diameter – 5F20, 30	1.6240	1.6233	.003	2.6235	2.6225	.002
– 5F40, 60	2.061	2.060	.002	–	–	–
PUMP END†						
Main Bearing Diameter – 5F20, 30	1.6264	1.6250	.002	2.2530	2.2502	.001
(Assembled) – 5F40, 60	1.6264	1.6250	.001	–	–	–
Journal Diameter	1.6240	1.6233	.002	2.249	2.249	.002
CENTER (5H80,86,120,126)†						
Main Bearing Diameter	–	–	–	2.6264	2.6250	.001
Main Bearing Thickness	–	–	–	–	.0942	.001
Journal Diameter	–	–	–	2.6235	2.6225	.002
CONNECTING ROD†						
Bearing Diameter	1.6255	1.6245	.002	2.2505	2.2495	.002
Bearing Thickness	–	.06225	.001	–	.06225	.001
Crankpin Diameter	1.6240	1.6233	.003	–	2.248	.002
Seal End Bearing Washer Thickness	.131	.129	**	.188	.186	**
Seal End Thrust Washer Thickness	.157	.155	**	.188	.186	**
Pump End Bearing Washer Thickness	.131	.129	**	.188	.186	**
CYLINDERS						
Bore	2.501	2.500	.003	3.2515	3.2505	.003
Piston Diameter – Steel, Standard Stroke	–	2.4980	.003	3.2485	3.2480	.003
– Aluminum, Long Stroke	–	–	–	3.241	3.240	.003
Body	–	–	–	3.235	3.232	.003
Ring Groove (OD)	–	–	–	–	.9998	.001
Piston Pin Diameter	–	.7498	.001	–	–	.001
Piston Pin Bushing	.7500	–	.001	1.000	–	.001
Piston Ring End Gap (compression and oil)	.009	.004	.030	.017	.007	.030
Piston Ring Side Clearance	–	–	–	–	–	–
Compression Side	.0015	.0005	.003	.0015	.0005	.003
Oil Side	.0012	.0002	–	.0012	.0002	–
OIL PUMP						
Axial Clearance	.0015	.0005	.0025	.0015	.0005	.0025
Drive Shaft Diameter	.4361	.4356	–	.4361	.4356	–
Drive Shaft Bushing Diameter (10)	.4375	–	–	.4375	.4370	–
Drive Shaft Diameter (5H120 & 126)	–	–	–	.6250	.6240	–
Drive Shaft Bushing Diameter (ID – 5H120 & 126)	–	–	–	.6270	.6260	–
SUCTION VALVE						
Suction Valve (Disc (depth of wear below face)	–	–	.005	–	–	.005
Suction Valve Seat	–	.012	.002	–	.012	.002
DISCHARGE VALVE						
Discharge Valve Disc (depth of wear below face)	–	–	.005	–	–	.005
Discharge Valve Seat	–	.012	.002	–	.012	.002

→ *Same wear allowance applies to undersized shafts and bearings.
 → †Remanufactured service compressors can be built with undersized main bearings and connecting-rod bearings. Compressors with undersized bearings are identified by the letter A, B, or C stamped on the compressor nameplate after the model number, and on both ends of the crankshaft.
 A = .010-in., B = .020-in., C = .030-in. undersized bearings.

Replacement bearing heads for compressors with undersized shafts must be field-modified with proper undersized bearing.

**Replace thrust and bearing washers when end clearance exceeds maximum listed:

CRANKSHAFT END CLEARANCE (in.)	
5F20-5F60	.011 to .035
5H40,46	.010 to .036
5H60,66	.011 to .037
5H80,86	.014 to .042
5H120,126	.014 to .044

MIN PLT. THICKNESS
 5H40 .552
 5H46 .585