# York

R Series Reciprocating Compressor

# Maintenance Manual

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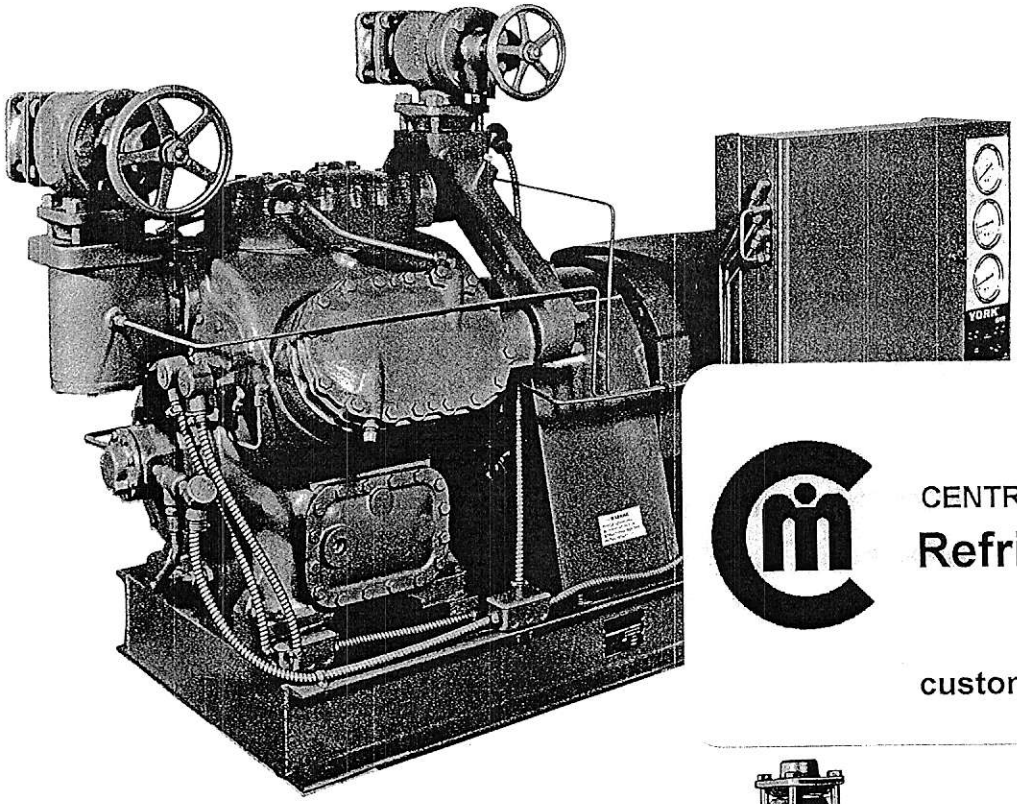
# R SERIES COMPRESSOR UNITS
## SINGLE STAGE

MAINTENANCE | Supersedes: Form 180.50-M (773) | 379 | Form 180.50-M1

## STYLE A (4-1/2'' STROKE)
## AND
## STYLE B (2-3/4'' STROKE)

## V-BELT AND DIRECT DRIVE
## REFRIGERANTS -12, -22, AND -717



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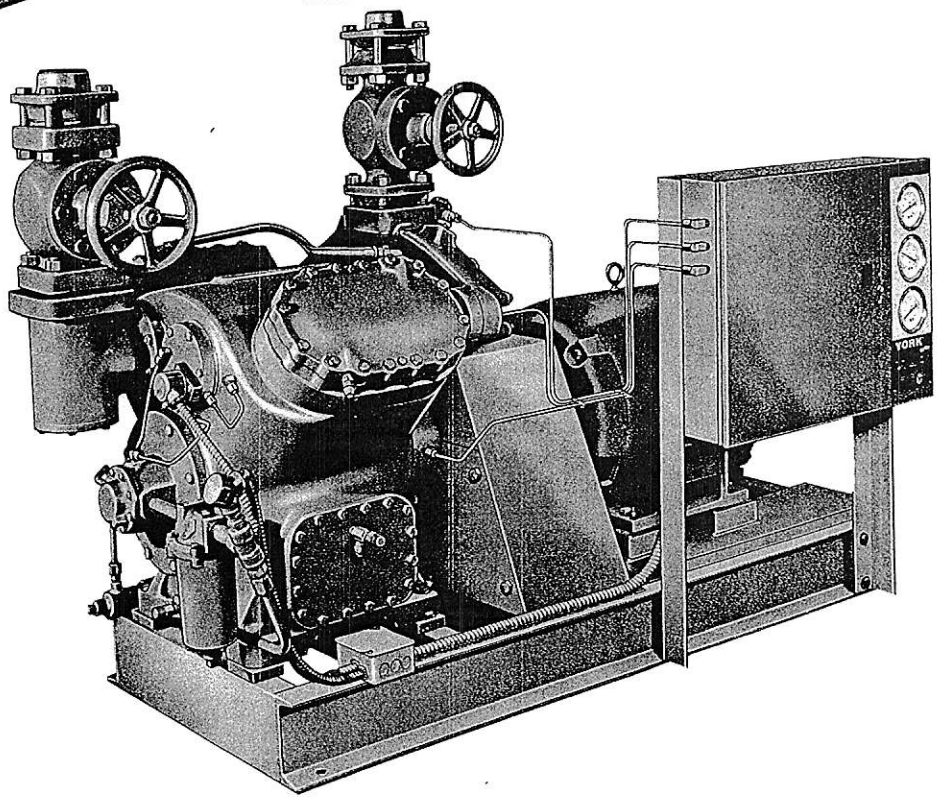

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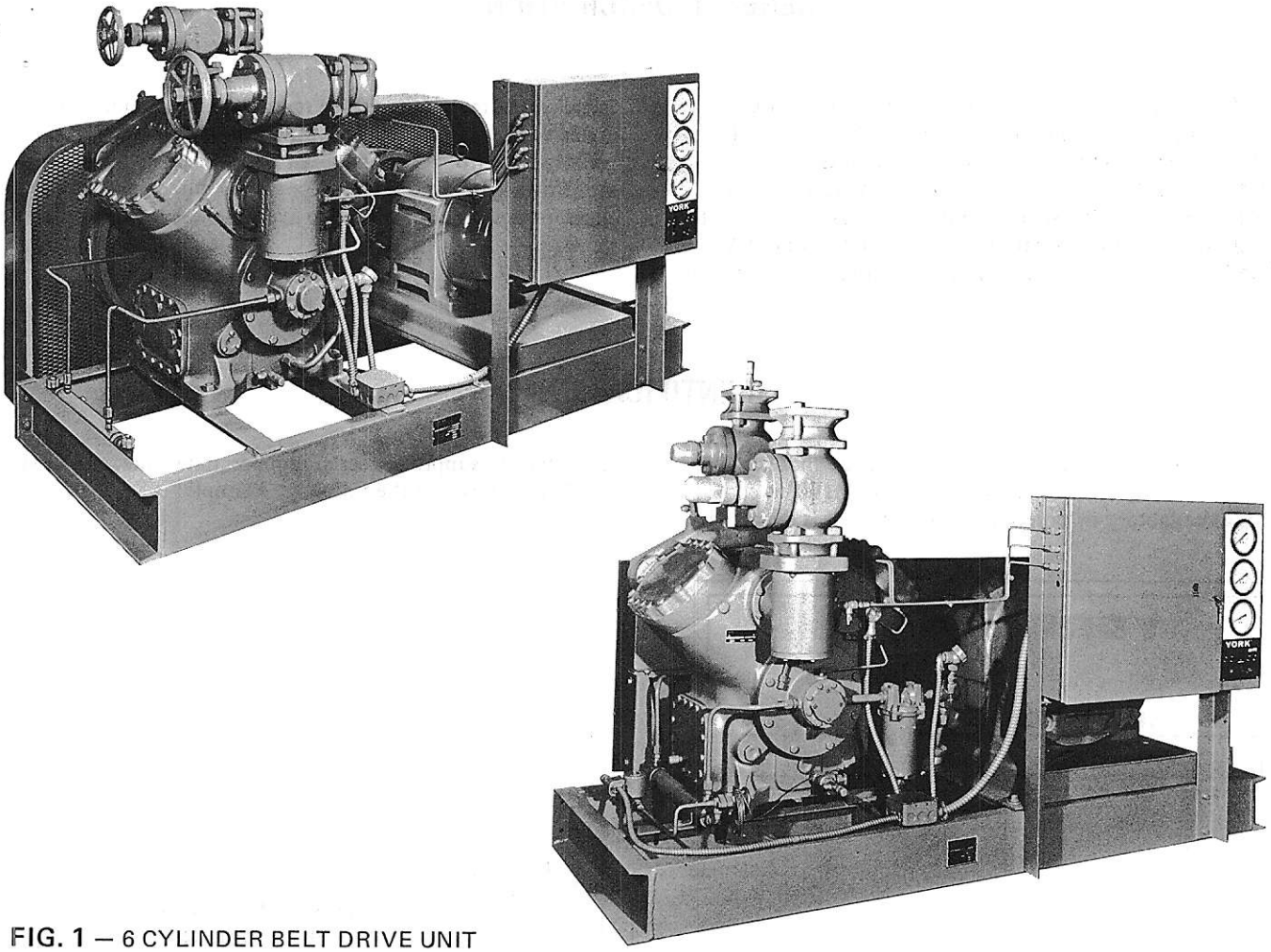


FIG. 1 — 6 CYLINDER BELT DRIVE UNIT

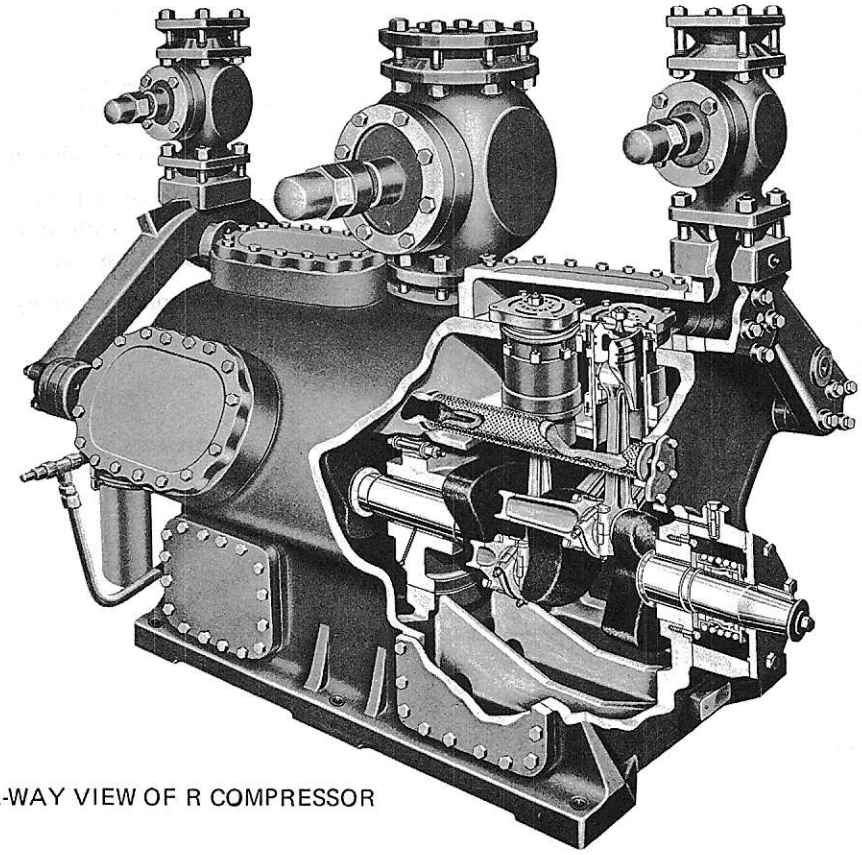


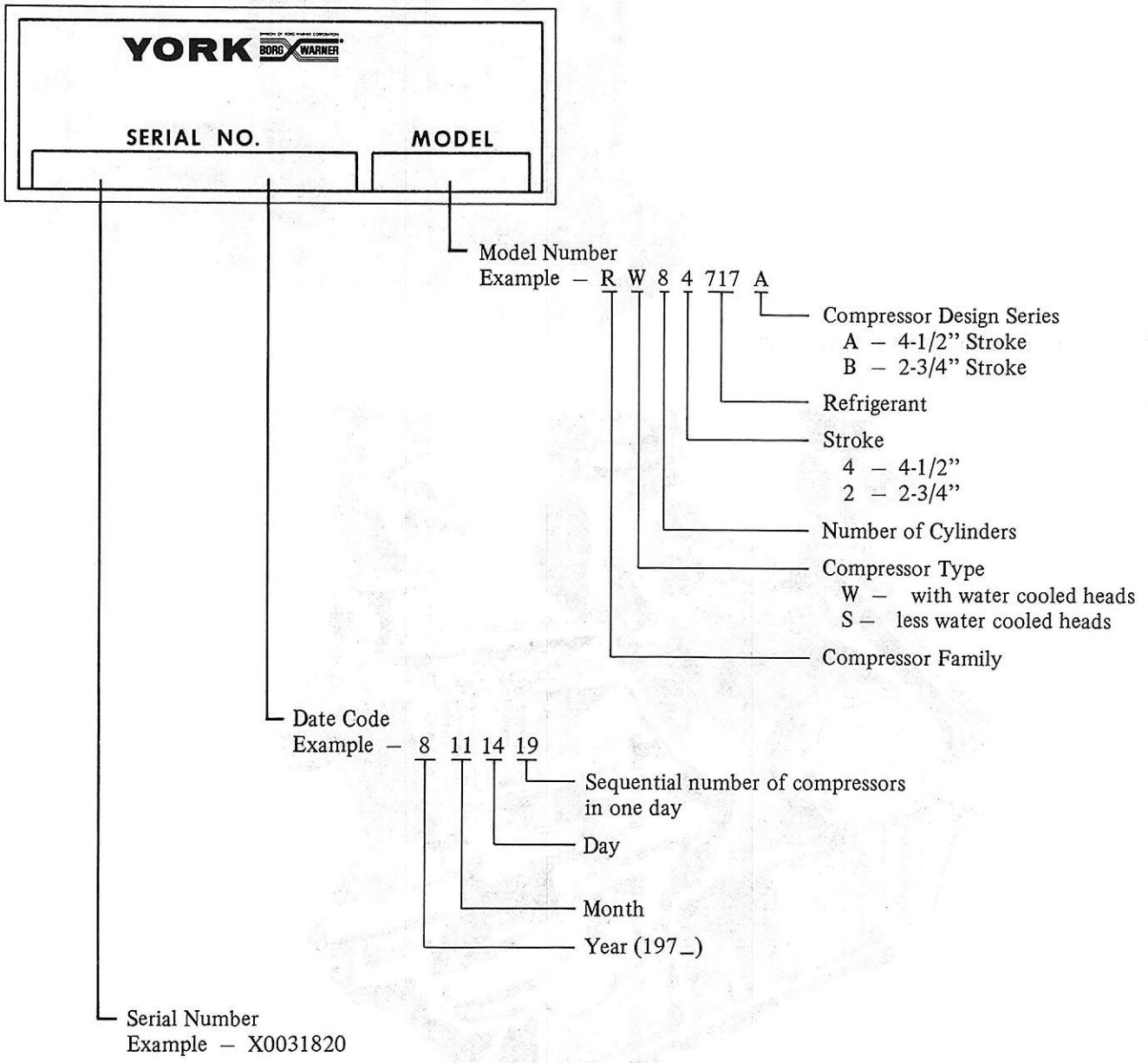
FIG. 2 — CUT-A-WAY VIEW OF R COMPRESSOR

# GENERAL DESCRIPTION

YORK R Series single-stage V/W compressor units are available for Refrigerants -12, -22, and -717 in 4, 6, 8, 12, or 16 cylinder arrangements. Style A compressors have a 3-3/4" bore x 4-1/2" stroke; Style B compressors have a 3-3/4" bore by 2-3/4" stroke. Units are available for direct or belt drive (within limitations set forth in the LIMITATIONS section of this book) offering a variety of speed combinations to match the design requirements. Standard units are assembled on a fabricated structural steel base with a NEMA-1 control panel containing gauges, safety switches, indicating lights, and relays, completely wired and piped to the compressors. Units are also available less the control panel.

# IDENTIFICATION

Each compressor is equipped with a data plate mounted on the pump end of the compressor. (See Fig. 3). When contacting the factory or ordering renewal parts it is extremely important to supply the serial number, date code, and model number as shown in the following example:



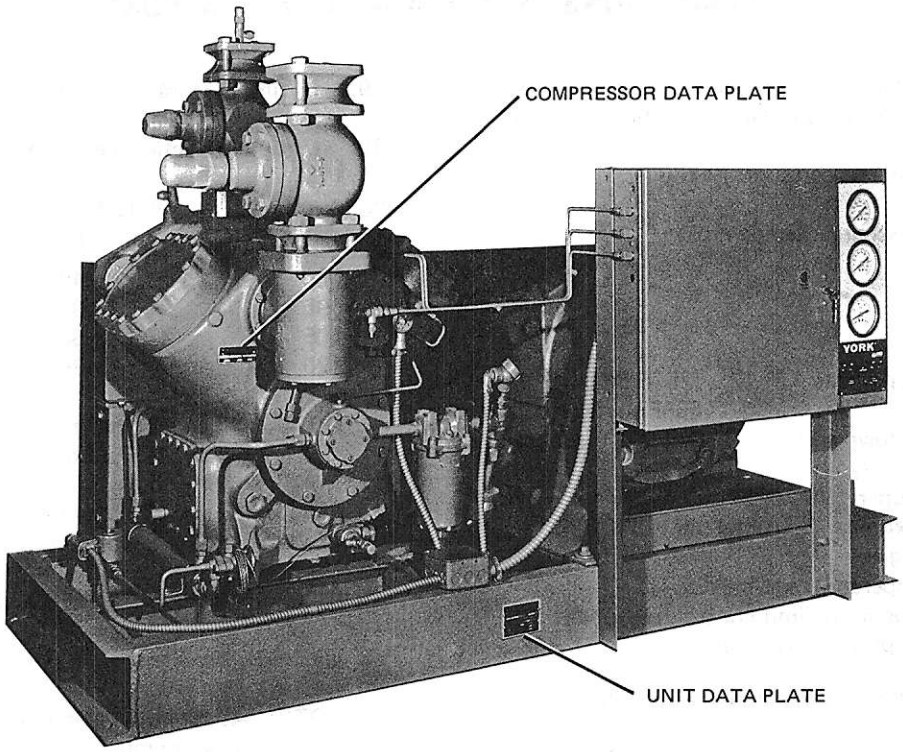



**FIG. 3** – DATA PLATE LOCATION

## PHYSICAL DATA

| Number of Cylinders | 4 | 6 | 8 | 12 | 16 |
|---|---|---|---|---|---|
| CFM Displacement | | | | | |
| Style A (1170 RPM) | 134 | 201 | 268 | 402 | 536 |
| Style B (1775 RPM) | 125 | 187 | 250 | 374 | 499 |
| Bore (Inches) | 3-3/4 | 3-3/4 | 3-3/4 | 3-3/4 | 3-3/4 |
| Stroke | | | | | |
| Style A | 4-1/2 | 4-1/2 | 4-1/2 | 4-1/2 | 4-1/2 |
| Style B | 2-3/4 | 2-3/4 | 2-3/4 | 2-3/4 | 2-3/4 |
| Suction Conn. Size (Inches) | | | | | |
| Socket Weld | 3 | 3 | 4 | 5 | 6 |
| ODF[1] | 3-1/8 | 3-1/8 | 4-1/8 | 5-1/8 | 6-1/8 |
| Discharge Conn. Size (Inches) | | | | | |
| Socket Weld | 2-1/2 | 2-1/2 | 3 | (2)2-1/2 | (2) 3 |
| ODF[1] | 2-5/8 | 2-5/8 | 3-1/8 | (2)2-5/8 | (2)3-1/8 |
| Oil Charge (Gals) | 4 | 4 | 4 | 10.5 | 10.5 |
| Operating Weight[2] (Lbs.) | | | | | |
| Belt Drive | 1950 | 2220 | 2450 | --- | --- |
| Direct Drive | 1795 | 1980 | 2200 | 4120 | 4630 |
| Shipping Weight[2] (Lbs) | | | | | |
| Belt Drive | 2117 | 2387 | 2617 | --- | --- |
| Direct Drive | 1982 | 2147 | 2367 | 4251 | 4761 |
| Bare Compressor | 1080 | 1231 | 1382 | 2550 | 2919 |
| BELT DRIVE DATA | | | | | |
| Compressor Flywheel O.D. (Inches) | | | | | |
| Style A | 20.9 | 20.9 | 20.9 | --- | --- |
| Style B | | | | | |
| Compr RPM (900 – 1200) | 20.9 | 20.9 | 20.9 | --- | --- |
| (1200 – 1800) | 13.8 | 13.8 | 13.8 | --- | --- |

[1] Available on Halocarbon Units Only
[2] Less Motor

# LIMITATIONS (STYLE A — 4-1/2'' STROKE)

The following limitations are absolute and operation beyond these limits may cause serious damage to the compressor.

1. Maximum Oil Temperature: 160°F

2. Maximum Discharge Temperature:

   Halocarbon 275°F
   Ammonia 325°F

3. Maximum Superheat:* R-12 (25°F Below 0°F suction; 65°F suction gas temp. above 0°F suction)

   *During pulldown and other temporary operation superheat may exceed 25°F as long as high oil temperature and high discharge temperature limit controls permit the compressor to operate.

   R-22 25°F
   Ammonia 25°F

4. Maximum Pressure Differential: 275 Psi

5. Maximum Condensing Temperature: R-12 150°F
   R-22 135°F
   Ammonia 120°F

6. Maximum Motor for Belt Drive: 150 HP (See Below)

7. Maximum RPM: 1200

8. Max. Compression Ratio — Halogen 14.0
   Ammonia 9.5

9. Minimum RPM: 875

10. Minimum Suction Temperatures:

| Condensing Tp, °F | R-12 & R-22** °F | Ammonia** °F |
|---|---|---|
| 90 | −40 | −15 |
| 95 | −35 | −10 |
| 105 | −30 | 0 |
| 120 | −20 | +15 |

NOTE: Oil cooling must be used for R-12 and R-22 below 20°F suction temperature.

** Compressor may run fully unloaded at these suction temperature conditions.

11. Minimum Ambient: 20°F (See note)

12. Maximum Ambient: 120°F

NOTE: At minimum ambient standby crankcase oil temperature must be maintained at 30°F above ambient.

MAXIMUM BELTED HORSE POWER

1750 RPM Motors — 4, 6 and 8 cylinder compressor

| Compressor Speed RPM | 1170 | 1040 | 910 |
|---|---|---|---|
| 4 Belt Setup | 60 | 60 | 50 |
| 8 Belt Setup | 150 | 150 | 100 |

# LIMITATIONS (STYLE B — 2-3/4'' STROKE)

The following limitations must not be exceeded when selecting a 2-3/4 inch stroke Model R Compressor or Compressor Unit.

1. Maximum Discharge Temperature. . . . . Halocarbon 275°F
   Ammonia 325°F

2. Maximum Superheat* . . . . . R-12 (25°F Below 0°F suction; 65°F suction gas temp. above 0° suction)

   *During pulldown and other temporary operation, superheat may exceed 25°F as long as high oil temperature and high discharge temperature limit controls permit the compressor to operate.

   R-22 25°F
   Ammonia 25°F

3. Maximum Pressure Differential . . . . . 275 psi

4. Max. Compression Ratio — 9.5

5. Maximum Saturated Discharge Temperature. . . . . R-12 150°F
   R-22 135°F
   Ammonia 120°F

6. Minimum Saturated Suction Temperature. . . . . See Table on page 7

7. Maximum Saturated Suction Temperature. . . . . 50°F

8. Maximum Oil Temperature. . . . . 160°F

9. Maximum Compressor Speed. . . Halocarbon 1800RPM
   Ammonia 1200RPM

10. Minimum Compressor Speed . . . 875 RPM

11. Minimum Ambient . . . . . 20°F (still air)

12. Maximum Ambient . . . . . 120°F

# LIMITATIONS (STYLE B CONTINUED)

SUCTION AND DISCHARGE TEMPERATURE LIMITATIONS

| Minimum Saturated** Suction Temperature | R-12 Maximum Saturated Discharge Temperature | R-22 Maximum Saturated Discharge Temperature | R-717 Maximum Saturated Discharge Temperature |
|---|---|---|---|
| -20°F | 105°F | 105°F | 85°F |
| -15°F | 115°F | 115°F | 95°F |
| -10°F | 120°F | 120°F | 100°F |
| -5°F | 130°F | 125°F | 110°F |
| 0°F | 140°F | 130°F | 120°F |
| 5°F | 150°F | – | – |
| 20°F | – | 135°F | – |

NOTE: Oil cooling must be used for R-22 below 20°F saturated suction temperature and all R-12 applications.
**Compressor may run fully unloaded at these saturated suction temperature conditions.

# SERVICE

## GENERAL

Service on these compressors should be attempted only by qualified service personnel, trained in the service of this type of equipment, and equipped with the proper tools and familiar with their use.

Before opening a compressor for repairs, the following paragraphs should be thoroughly checked to aid in locating and correcting the trouble:

1. Check the compressor oil level. "Full" oil quantity is indicated by an oil level showing in the upper sight glass. "Low" oil quantity is indicated by an oil level showing in the lower sight glass.

2. Check the refrigerant charge to be sure the system is fully charged. The unit sight glass should be clear and moisture indicator should show "dry".

3. Be sure the faulty operation of the unit is caused by the compressor and not some other part of the unit. Unit safety and operating controls should be checked for proper operation as explained in the INSTALLATION AND OPERATION Instruction (Form 180.50-NO - Style A) or (180.55-NM2, Style B) included with the unit.

4. Dismantle only the part of the compressor necessary to correct the fault.

5. Never open any part of a compressor which is under vacuum; be sure there is some pressure inside the compressor. If the compressor is opened while under a vacuum, moisture laden air may be drawn into the system and rapid corrosion of internal machined parts may result. The refrigerant is an excellent cleaning agent and will remove any natural protective coating from the iron or steel, leaving the raw metal exposed.

6. Internal machined parts of the compressor such as valves, pistons and crankshaft must be immediately protected as they are removed from the compressor. Coat the parts with oil and wrap them in clean paper.

7. Before removing the cylinder heads, each head should be match marked in relation to its position on the housing. When reinstalling a head, line it up with the discharge manifold and bolt the head to the manifold before bolting the head to the compressor housing.

8. Before reassembling any compressor part, it should be thoroughly cleaned by immersing or flushing it with an approved safety solvent and allowing it to dry in air without touching any wearing or contact surfaces. After it is cleaned, each part should be carefully examined to be sure it is free from cracks, flaws, bump marks, burrs or distortion and the part be oiled to prevent damage due to rusting or oxidation. New clean oil should be applied to the wearing surfaces of any part just before it is installed.

9. When assembling a compressor or compressor parts, it is essential to draw all nuts and cap screws to their proper torque, using an accurate torque wrench. TABLE 1 shows the recommended torques for this compressor. Insert all cap screws and tighten them lightly. Then, using the torque wrench, tighten one cap screw or nut first; and the opposite one next. Then tighten two more on a center line at right angles to the first two. Proceed to draw down opposite and alternate pairs around the flange of the cylinder head or bearing head until all are tightened to the proper torque.

**TABLE 1** — THREADED FASTENER TORQUES

| LOCATION | THREAD | TIGHTENING TORQUE | |
|---|---|---|---|
| | | IN. -LB. | FT. -LB. |
| Oil Pump Assembly | 8 – 32 UNC | 30 | — |
| Solenoid Valve | 1/4 – 20 UNC | 96 | 8 |
| Oil Pump Cover | 5/16 – 18 UNC | 180 | 15 |
| Main Bearing – Seal End | 3/8 – 16 UNC | — | 30 |
| Suction Elbow to Housing | 3/8 – 16 UNC | — | 30 |
| Suction Elbow Cover | 3/8 – 16 UNC | — | 30 |
| Suction Screen to Strainer Cover | 3/8 – 16 UNC | — | 30 |
| Suction Strainer Cover | 3/8 – 16 UNC | — | 30 |
| Cover Head | 3/8 – 16 UNC | — | 30 |
| Capacity Control Valve | 3/8 – 16 UNC | — | 30 |
| Seal Cover Plate | 3/8 – 16 UNC | — | 30 |
| *Discharge Valve Assembly | 3/8 – 16 UNC | | ** |
| Power Element Union | 3/8 – 24 UNC | — | 35 |
| *Connecting Rod Bolt | 3/8 – 24 UNF | 260 | 21-22 |
| Discharge Valve Screw | 3/8 – 24 UNF | — | 35 |
| *Center Bearing Spacer | 1/2 – 13 UNC | 240 | 20 |
| Center Bearing | 1/2 – 13 UNC | — | 60 |
| Top Head | 1/2 – 13 UNC | — | 75 |
| Discharge Manifold | 1/2 – 13 UNC | — | 75 |
| Bearing Head, Pump End | 1/2 – 13 UNC | — | 75 |
| Handhole Cover | 1/2 – 13 UNC | — | 75 |
| Seal Cap, Oil Relief Valve | 9/16 – 18 UNC | — | 50 |

*Critical Items – Torque Only As Specified

**15 For Original Design, 30 For Later Models (See Page 19)

## OPERATIONAL DIFFICULTIES

Faulty operation of the compressor may be caused by troubles in the refrigerant system such as faulty or incorrectly adjusted evaporator liquid expansion devices, faulty oil control or condenser troubles; all of which, are indicated by definite symptoms. These symptoms may be caused by incorrect conditions which must be corrected by a step by step procedure. TABLE 2 is a chart showing various incorrect conditions, their possible causes and corrections.

**TABLE 2** — TROUBLE DIAGNOSIS CHART

| TROUBLE | POSSIBLE CAUSE | CORRECTIVE MEASURE |
|---|---|---|
| High condensing pressure. | Air or non-condensable gas in system. | Purge air from condenser. |
| | Insufficient water or air flowing through condenser. | Increase quantity of water or air. |
| | Evaporative condenser clogged or limed. | Clean condenser water tubes. |
| | Too much liquid in receiver, condenser tubes submerged in liquid refrigerant. | Draw off liquid into service cylinder. |
| Low condensing pressure. | Too much water or air flowing through condenser. | Reduce quantity of water or air. |
| | Condensing water too cold. | Reduce quantity of water. |
| | Liquid refrigerant flooding back from evaporator. | Check expansion device adjustment, examine fastening of thermal expansion valve bulb(s). |
| | Leaky compressor discharge valve(s). | Remove heads, examine valves. Replace any found defective. |

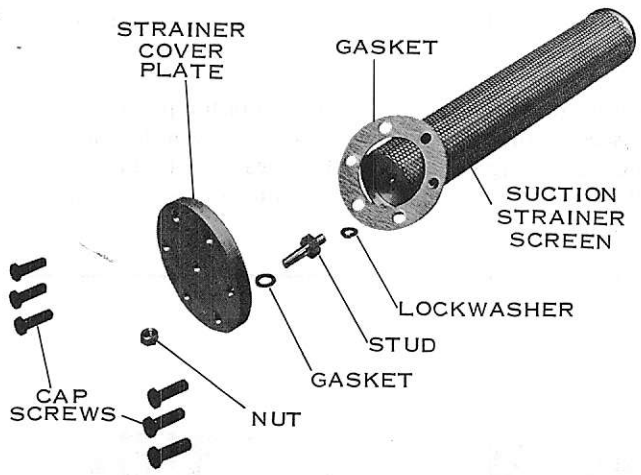



**FIG. 6 —** SUCTION STRAINER SCREEN ASSEMBLY — 12 & 16 CYLINDER COMPRESSORS

3. Remove the cover plate with the strainer screen attached. This should be done carefully, keeping the screen horizontal, to avoid the possibility of dropping particles of foreign material into the plenums in case the strainer screen is very full.

4. Clean the strainer screen thoroughly using a suitable solvent and a brush if necessary, to remove all foreign material.

5. Replace the strainer, inserting the open end of the screen carefully to be sure it enters its hole in the casting wall properly. Do not use force to enter the screen; this may distort it so that replacement is required.

6. Evacuate the compressor. See EVACUATION AFTER REPAIRS.

## COMPRESSOR OIL SYSTEM

The compressor oil supply is contained in the compressor crankcase. The crankcase contains two oil level sight glasses; "full" and "add oil" on the oil pump end of the compressor. (See Fig. 7.) "Full" oil quantity is indicated by an oil level showing in the upper sight glass. "Low" oil quantity is indicated by an oil level showing in the lower sight glass.

*NOTE: Use YORK Compressor Oil Type "C" in all R Series Compressors.*

A fine mesh oil strainer screen* with an internal vortex eliminator is located on the pump suction inside of the compressor crankcase. (See Fig. 8.) The strainer screen prevents the entrance of foreign material into the lubrication system. The vortex eliminator prevents the forming of a vortex, or a swirling action of the oil as it enters the pump suction, which could cause loss of oil pump discharge pressure. The strainer is connected to the oil pump by an external suction tube. A high oil temperature cutout is located in the suction tube. (See Fig. 7.) It will stop the compressor if the oil temperature reaches 160°F.

The internal gear type oil pump is designed to operate in either direction. It is directly driven by the compressor crankshaft and is located externally on the rear bearing head. (See Fig. 7.)

Oil under pressure leaves the oil pump in each of the following three ways. (See Figs. 7 & 9.)

1. An external oil line from the top of the oil pump housing directs oil to the capacity control solenoid valves. (See COMPRESSOR CAPACITY CONTROL)

2. An external oil line from the side of the oil pump housing directs oil to the compressor shaft seal. (On R-717 units this line is connected to a water cooled oil cooler so that all oil flowing to the shaft seal flows through the oil cooler.) From the shaft seal cavity, oil flows to the shaft seal end bearing and through internal passages in the compressor crankshaft to lubricate the connecting rods (and center main bearing on 12 and 16 cylinder compressors). An oil pressure regulating valve on top of the shaft seal housing re-

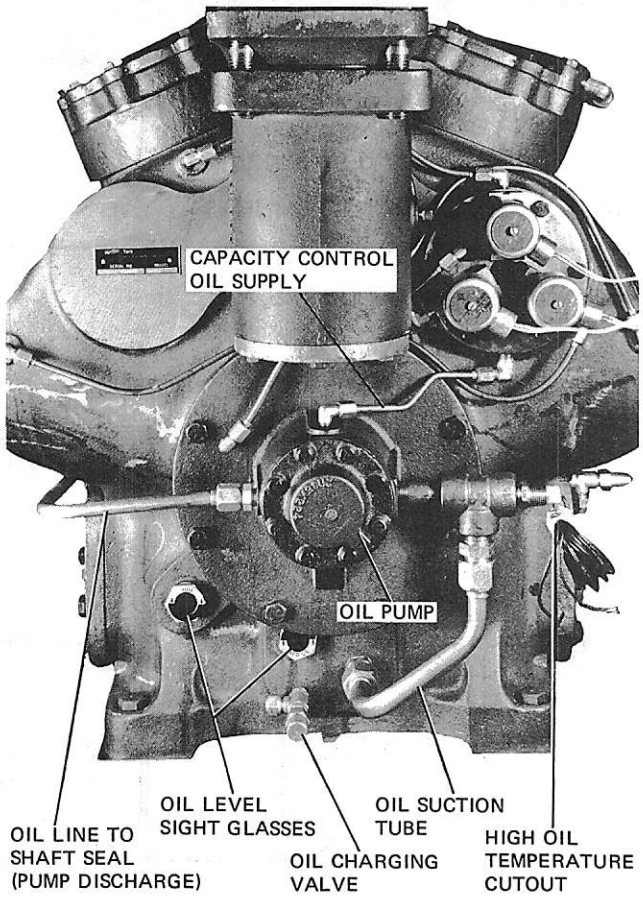


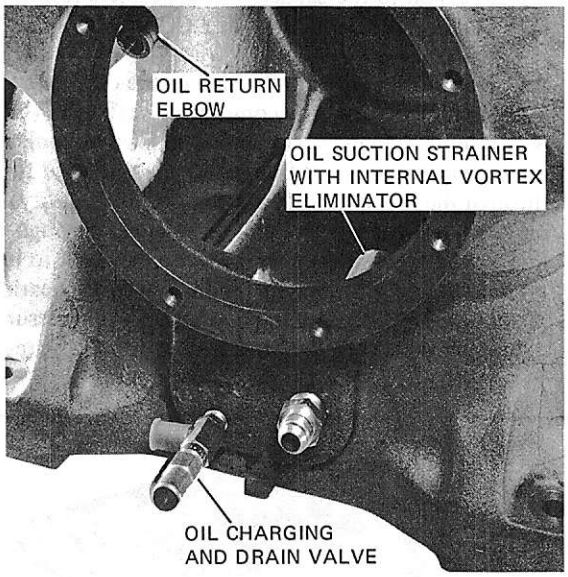

**FIG. 7 —** COMPRESSOR OIL PUMP — EARLY STYLE A COMPRESSOR

*On later model Style A compressors and all Style B compressors the internal strainer screen is replaced by an external oil filter. (See Fig. 8)

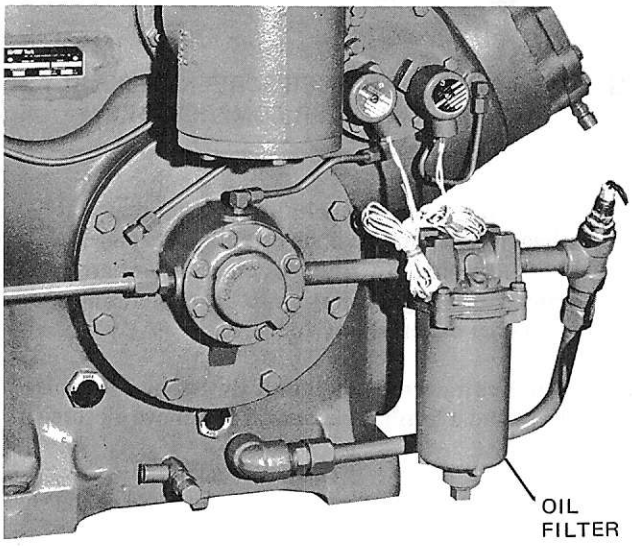
lieves oil pressure to the crankcase. (On 12 and 16 cylinder models, a restrictor orifice in the center main bearing housing meters the return of oil to the crankcase.)

3. Oil from the oil pump flows directly into the pump end bearing and into internal passages in the compressor crankshaft to lubricate the connecting rods (and center main bearing on 12 and 16 cylinder compressors).

Lubrication of the cylinder walls and piston pin is accomplished by the spray from the spaces between the connecting rod bearing and between these bearings and the cheeks of the crankpin as some of the pressurized oil leaves these bearings.




EARLY STYLE A MODELS




LATER STYLE A & ALL STYLE B MODELS

**FIG. 8** — OIL SUCTION STRAINER

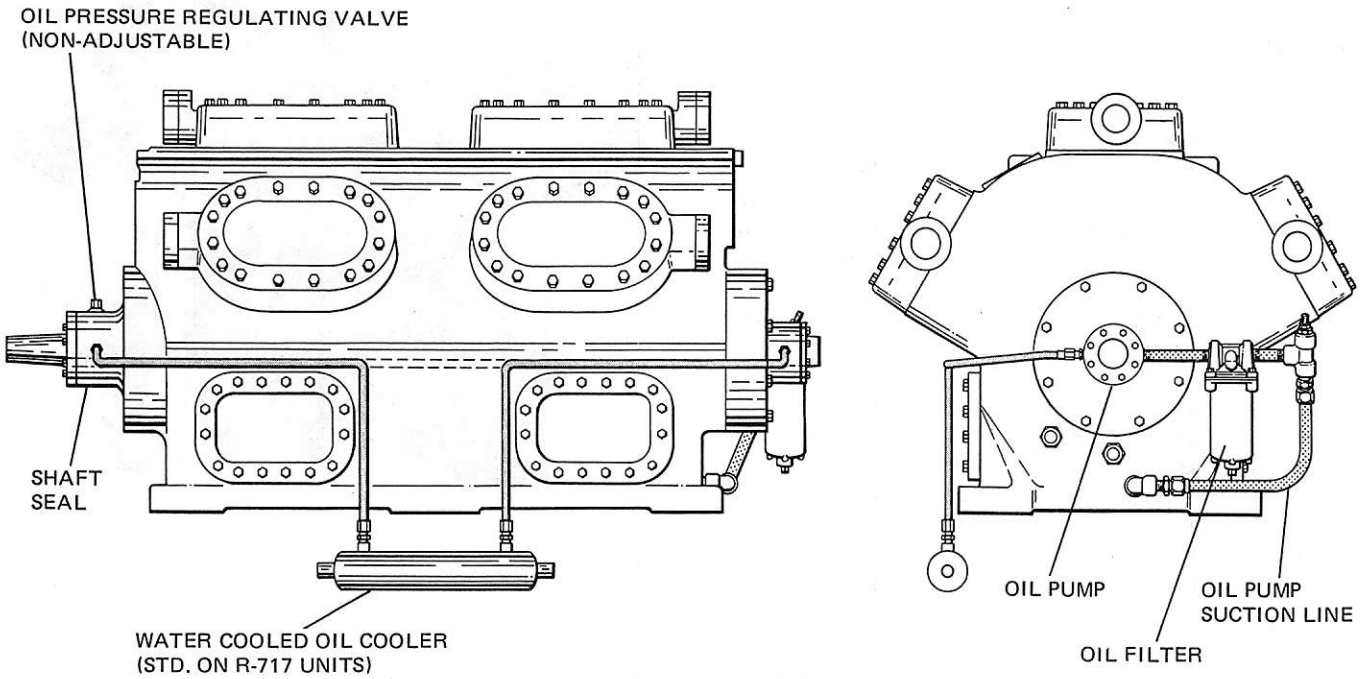



**FIG. 9** — COMPRESSOR LUBRICATION CIRCUIT

TABLE 2 — CONTINUED

| TROUBLE | POSSIBLE CAUSE | CORRECTIVE MEASURE |
|---|---|---|
| High suction pressure. | Overfeeding of expansion device. | Regulate expansion valve, check bulb attachment and superheat adjustment. |
| | Leaky suction or discharge valves. | Remove head, examine valves and replace if worn. |
| | Malfunction of compressor capacity control system. | Check capacity control system. |
| | Excess load. | Reduce load to normal. |
| Low suction pressure. | Restricted liquid line, or suction strainer screens. | Pump down, remove restriction, examine and clean screens. |
| | Insufficient refrigerant in system. | Check for refrigerant shortage. |
| | Too much oil in system. | Remove oil. |
| | Improper adjustment of expansion valve(s) or liquid control device(s). | Adjust device(s) for proper superheat — approximately 10°F. |
| | Expansion valve power element dead or weak. | Replace expansion valve or power element. |
| Compressor will not run. | Electric power cut off. | Check power supply. |
| | Fuses blown. | Test fuses and renew if necessary. |
| | Overload devices tripped. | Check overload devices and find cause of overload. |
| | Low voltage. | Check voltage (should be within 10% of nameplate rating). |
| | Trouble in starting switch or control circuit. | Close switch manually to test power supply. If OK check control circuit including temperature and pressure controls and capacity control device. |
| | Seized compressor. | Repair or rebuild compressor. |
| Compressor runs continuously with insufficient reduction of load temperatures. | Shortage of refrigerant. | Repair leak and recharge system. |
| | Individual cylinders not loading. | Check and correct pumping ability of individual cylinders — replace suction and/or discharge valves and parts as needed. |
| | | Check and correct capacity control system. |
| | Incorrect control switch settings. | Reset control switches or replace. |
| Compressor short cycles or stops on high pressure cutout. | Presence of air or foul gas. | Purge condenser. |
| | Insufficient water or air flowing through condenser, clogged condenser. | Check water or air flow. Check for scaled or fouled tubes in water cooled condenser. In evaporative type, check for fouled surfaces and insufficient air or spray water. |
| | | In air cooled type, check for fouled surfaces, or lack of air flow. |
| Compressor stops on Oil Failure Switch | Plugged Oil Strainer. | Clean oil strainer. |

## VENTING THE COMPRESSOR

If the compressor is to be opened for repairs, the refrigerant may be removed as follows:

1. Close the suction and discharge stop valves.
2. Close the valve in the return line from the oil separator.
3. Vent the compressor and allow the gas to bleed off slowly to atmosphere.

   NOTE: When it is desired to blow down R-717 gas and neutralize the odor, this can be done by using a rubber hose and passing the gas through water.

4. Before disassembly work of any kind is started, pull the motor main disconnect switch and de-energize the control circuit.
5. After any part of the compressor has been opened for repairs or inspection, all air must be removed to avoid buildup of moisture before refrigerant is again admitted to the compressor. (See EVACUATION AFTER REPAIRS).

## COMPRESSOR SUCTION STRAINER (4, 6 & 8 CYLINDER COMPRESSORS)

The 4, 6 and 8 cylinder R Series compressors are equipped with a suction strainer located inside the suction elbow. (See Fig. 4). To remove the suction strainer screen for cleaning or replacement, proceed as follows:

1. Vent the compressor. (See Venting the Compressor.)
2. Remove the cap screws from the strainer cover located on the bottom of the suction elbow.
3. Remove the strainer screen.
4. Clean the strainer screen thoroughly, using a suitable solvent and brush if necessary, to remove all foreign material.
5. Inspect the strainer cover gasket and replace if necessary.
6. Replace the strainer, open end up.
7. Replace the strainer cover and gasket. Tighten the 6 screws by drawing down opposite and alternate pairs.
8. Evacuate the compressor. See EVACUATION AFTER REPAIRS.

## COMPRESSOR SUCTION STRAINER (12 & 16 CYLINDER COMPRESSORS)

The 12 and 16 cylinder R Series compressors are equipped with suction strainers located inside of the compressor housing. (See Figs. 5 & 6.) The 12 cylinder models have

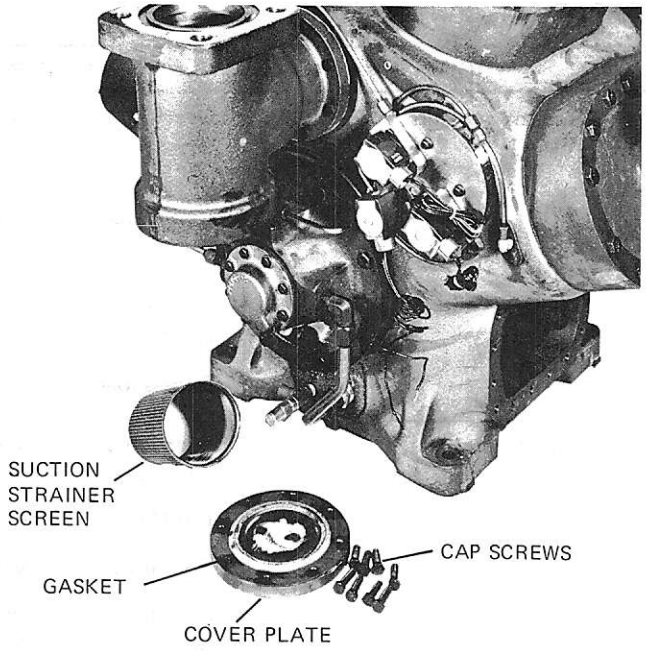



**FIG. 4 –** SUCTION STRAINER – 4, 6 & 8 CYLINDER COMPRESSOR

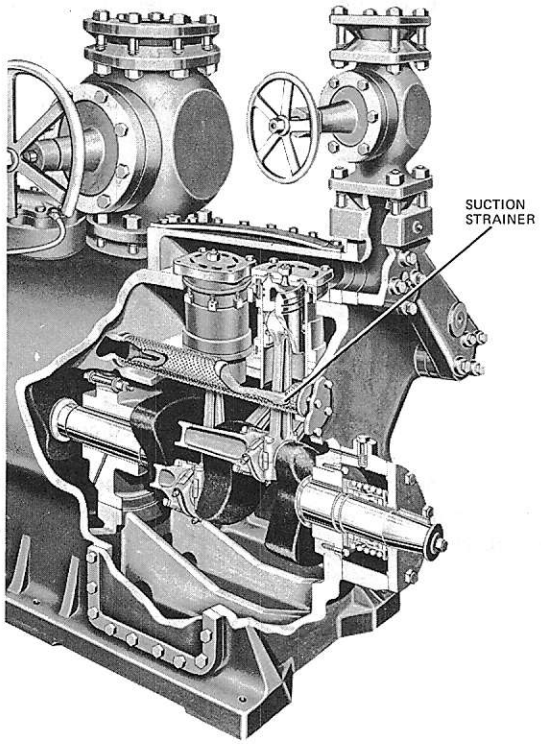



**FIG. 5 –** SUCTION STRAINER LOCATION – 12 & 16 CYLINDER COMPRESSOR

one suction strainer on each end of the compressor; the 16 cylinder models have two suction strainers on each end. To remove the suction strainer screens for cleaning or replacement, proceed as follows:

1. Vent the compressor. (See Venting the Compressor.)
2. Remove the cap screws which hold the strainer cover plate to the compressor housing.

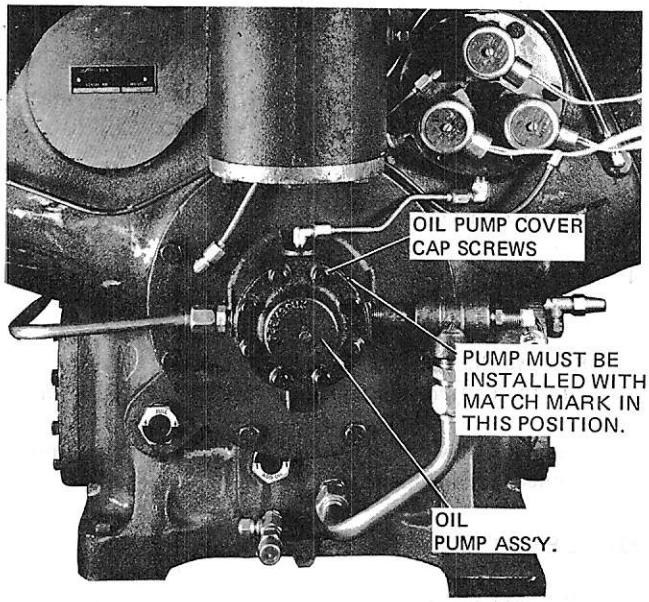



**FIG. 10** – OIL PUMP END OF COMPRESSOR – EARLY STYLE A COMPRESSOR

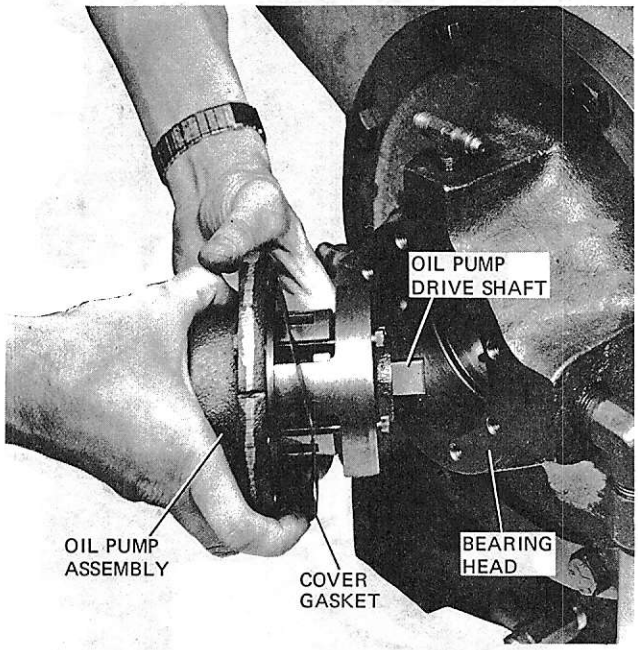



**FIG. 11** – REMOVING OIL PUMP

## COMPRESSOR OIL PUMP (See Fig. 10 & 11)

If it becomes necessary to replace the oil pump, a complete new pump assembly should be installed. To replace the oil pump proceed as follows:

1. Vent the compressor as explained in VENTING THE COMPRESSOR.
2. Remove the oil pump cover cap screws and remove the oil pump assembly from the bearing head.
3. Install the new oil pump assembly using a new gasket. Be sure that the flat end of the pump drive shaft engages the slot in the end of the compressor crankshaft and that the match mark on the oil pump cover is at the 1:30 position. (See Fig. 10.)
4. Tighten the pump cover cap screws evenly by drawing down opposite and alternate pairs. (See Table 1.)
5. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## OIL COOLER SOLENOID (See Fig. 12)

R Series halocarbon compressors operating at suction temperatures below +20°F require the use of an oil cooler.* The oil cooler is mounted in one of the compressor cover plates. If it becomes necessary to replace the solenoid coil proceed as follows:

1. Place the unit switch in the "OFF" position.
2. Remove the conduit and wires from the solenoid valve.

*Later Style A models and all Style B models require the use of the oil cooler on all R-12 applications also.

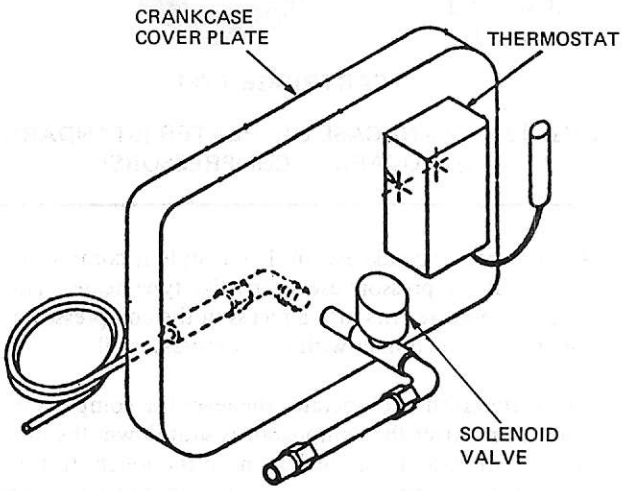


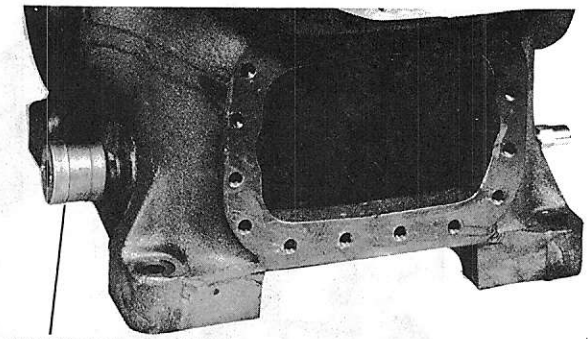

**FIG. 12** –OIL COOLER (HALOCARBON COMPRESSORS)

3. Remove the screw from the top of the valve and remove the coil.
4. Install the new coil and reconnect the wiring and conduit.

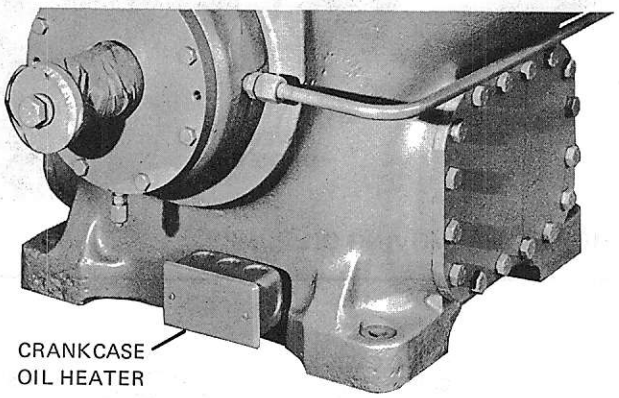
## CRANKCASE OIL HEATER (See Fig. 13)

R Series halocarbon compressors are furnished with crankcase oil heaters. 4, 6, and 8 cylinder models have one heater located on the shaft seal end of the compressor. 12 and 16 cylinder models have two heaters, one in each end of the compressor housing.

Heaters are of 2 different designs. Early Style A compressors used an immersion type heater which was in contact with




IMMERSION TYPE




CARTRIDGE TYPE

**FIG. 13** —CRANKCASE OIL HEATER (STANDARD ON HALOCARBON COMPRESSORS)

the compressor crankcase oil. Later Style A compressors, and all Style B compressors use a cartridge type heater. The cartridge type heater fits into a recess in the compressor housing; it is not in contact with the compressor oil.

The heater(s) should operate whenever the compressor is shut down. After the compressor is shut down, the bottom of the crankcase should feel warm to the touch. If it is not, an electrical continuity test should be made to determine if the heater is operating.

If replacement of the heater is required, proceed as follows:

IMMERSION TYPE

1. Vent the compressor as explained under VENTING THE COMPRESSOR. Drain the oil from the crankcase.
2. Disconnect the electrical wires from the heater(s).
3. Unscrew the heater from the compressor housing. Due to the small amount of available wrench clearance, it may be necessary to loosen the circular base of the heater terminal box to secure a firm grip on the heater with a suitable wrench. A considerable amount of force may be necessary to loosen the heater from the compressor.
4. Clean the threads on the housing and on the new heater with an approved safety solvent. Apply LOCTITE to the male threads of the heater body and screw the heater in tightly.
5. Connect the electrical wires, charge the compressor with oil (see PHYSICAL DATA) and evacuate. (See EVACUATION AFTER REPAIRS.)

CARTRIDGE TYPE

1. Remove the cover from the electrical connection box and disconnect the heater wires.
2. Remove the electrical box and the fitting that is screwed into the compressor housing, and remove the heater.
3. Insert the new heater, replace the electrical box, and reconnect the heater wires.

## OIL LEVEL SIGHT GLASSES (See Fig. 7)

Each R Series compressor is equipped with 2 oil level sight glasses located on the pump end of the compressor. If the sight glasses become broken or damaged they must be replaced. Proceed as follows:

1. Vent the compressor as explained in VENTING THE COMPRESSOR.
2. Drain the oil level below the sight glass that is to be replaced.
3. Remove the damaged sight glass.
4. Clean the threads in the housing and on the new sight glass with an approved safety solvent.
5. Apply LOCTITE to the threads of the sight glass and screw it into the compressor housing using a socket wrench. Do not over-tighten as this may crack the glass.
6. Fill the crankcase with clean oil and evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## OIL STRAINER (See Fig. 9)

Early design Style A compressors are equipped with an oil strainer with an internal vortex eliminator located inside of the compressor crankcase on the oil pump end.

The oil strainer consists of a large area wire mesh cylinder with sheet metal ends and an internal spring to prevent collapse of the strainer screen if it should become coated with foreign material. The strainer is fastened to the end of the vortex eliminator with a machine screw. The compressor oil strainer may be removed as follows:

1. Vent the compressor as explained in VENTING THE COMPRESSOR.
2. Drain the oil, remove the cover plate and clean the crankcase. (On 12 and 16 cylinder models remove a cover plate nearest to the pump end of the compressor.)
3. Remove the machine screw that holes the strainer screen

to the end of the vortex eliminator and remove the strainer from the vortex eliminator.

4. Clean the strainer thoroughly using an approved safety solvent. If the strainer is damaged in any way it must be replaced.

5. Re-install the strainer and tighten the screw in the end of the vortex eliminator.

6. Install the cover plates using new gaskets and fill the crankcase with new oil.

7. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## OIL FILTER (AND HEATER) See Fig. 9

Later design Style A compressors and all Style B compressors are furnished with an external oil filter located on the pump end of the compressor. An oil filter heater is used on halocarbon units only. The oil filter heater is located in a well in the bottom of the filter; it is not in contact with the oil. It is energized on compressor shutdown.

To replace the oil filter heater proceed as follows:

1. Disconnect the heater wires, remove the fitting that is screwed into the filter housing, and remove the heater.

2. Insert the new heater, replace the fitting and reconnect the heater wires.

OIL FILTER

The oil filter is equipped with a cleanable type filter cartridge. To clean the cartridge proceed as follows:

1. Vent the compressor as explained under VENTING THE COMPRESSOR.

2. Remove the 4 cap screws in the top of the filter housing that hold the tank, and remove the filter.

3. Clean the cartridge and the inside of the filter tank using an approved safety solvent.

4. Re-install the filter and tank using a new gasket if necessary, and evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## SHAFT SEAL (See Figs. 14 and 15)

The R Series compressor is equipped with a bellows type shaft seal. This seal consists basically of a rotating lapped carbon seal ring (which seals against the lapped surface of the stationary seal cover plate), a Teflon*shield, a neoprene bellows, and a spring-loaded retainer assembly. Spring pressure seals the neoprene bellows to the compressor crankshaft causing the entire seal assembly to rotate with the crankshaft. An oil line taken directly form the compressor oil pump assures that the seal operates flooded in oil at all times. The shaft seal cavity is fitted with an oil pressure relief valve to relieve oil back to the compressor crankcase.

## REPLACING THE SHAFT SEAL

To replace the R Series compressor shaft seal proceed as follows:

1. Vent the compressor as explained in VENTING THE COMPRESSOR.

2. Rotate the crankshaft so that the keyway is at the top. Remove the compressor half of the flexible coupling or the drive belt pulley. Remove the crankshaft key.

3. Loosen the seal cover cap screws to allow the oil to drain from the seal cavity. Place a container under the seal cavity to prevent this oil from dripping on the foundation or floor.

4. Remove the eight cap screws holding the seal cover plate and the seal spacer to the compressor housing. Remove the seal cover plate being careful not to damage the crankshaft. The seal spacer is positioned by 2 roll pins and need not be removed.

5. Using the YORK seal puller (Part No. 364-37059) pull the seal assembly out of the compressor. Note: Be sure to pull the seal assembly by the back flange.

6. Inspect the shaft seal oil supply line and fittings to see that they are not plugged or restricted

7. To install the new seal assembly, oil the crankshaft and the neoprene bellows well and slide the retainer assembly with the neoprene bellows in place onto the crank-

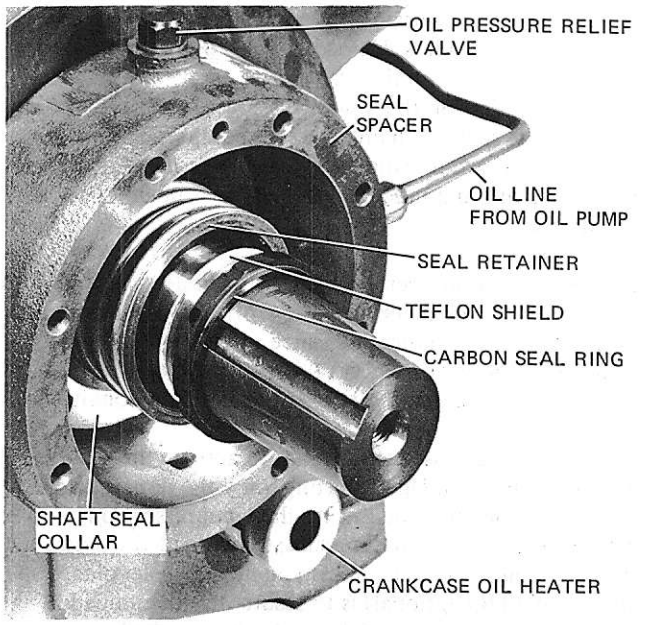



FIG. 14 —COMPRESSOR SHAFT SEAL

* Du PONT trademark

shaft until it contacts the shaft seal collar. Compress the retainer assembly to see that it operates freely.

8. Oil the Teflon shield and carbon seal ring and carefully place the carbon seal ring with the Teflon shield in position inside the retainer assembly. Be sure the notches on the O.D. of the carbon seal ring match the projections on the I.D. of the retainer assembly and that the lapped surface faces outward.

9. When installing a new carbon ring, always install a new cover plate. Apply oil to the lapped faces of the carbon seal ring and the seal cover plate.

10. Install the gasket, seal cover plate and cap screws. Note that the lapped surface of the cover plate will contact the lapped surface of the carbon seal ring before the cover plate will contact the seal spacer. Tighten the cap screws evenly by drawing down opposite and alternate pairs. (See Table 1.)

11. Re-install the drive components.

12. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

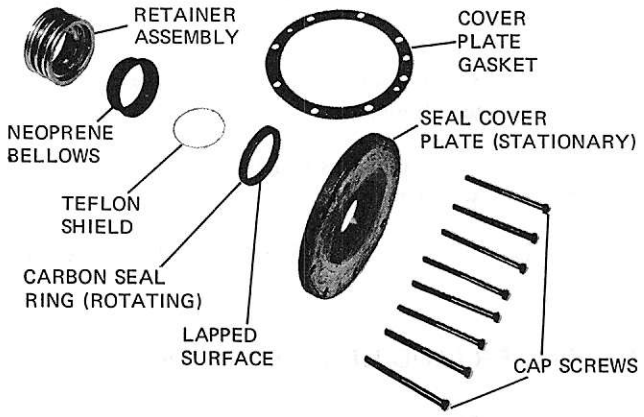



**FIG. 15** – COMPRESSOR SHAFT SEAL – EXPLODED VIEW

## COMPRESSOR CAPACITY CONTROL

### GENERAL

The function of the compressor capacity control system is to automatically adjust the compressor pumping capacity to balance with the cooling load at a predetermined suction pressure or thermostat temperature setting. The capacity control system is actuated by means of high pressure oil from the compressor oil pump. The capacity control system consists basically of three parts; solenoid valves, mounting plate for the solenoid valves, and unloader power elements. The function of these items is explained in the following OPERATION section.

Capacity control is obtained by loading or unloading one or more pairs of cylinders. Unloading is accomplished by lifting and holding the suction valve off its seat. The gas drawn into the cylinders on the downstroke of the piston, is pumped back into the suction chamber of the compressor housing, without compression, when the piston returns on its upstroke. Loading and unloading of cylinders must follow a definite sequence.

On each compressor, certain banks of cylinders are not equipped with unloaders. (See Fig. 16.) This prevents the possibility of overheating, since a definite minimum volume of cool refrigerant gas flows through the compressor at all times during operation, regardless of load conditions.

The R compressor uses oil pressure to actuate the cylinder loading mechanism. Upon starting, only the non-unloading cylinder will be pumping gas. As the compressor comes up to speed and develops oil pressure, the unloaded cylinders will be capable of loading in response to the solenoids. The purpose of 1TR (optional) is to assure that the unloaded cylinders do not load until the motor has reached operating speed.

### OPERATION (See Fig. 17)

High pressure oil from the compressor oil pump flows to the solenoid mounting plate where internal passages distribute it to the individual 3-way capacity reduction solenoid valves. If the solenoid valves are not energized, the oil flows to the unloader power elements. The unloader power elements are screwed into the compressor housing between the suction gas chamber and the top heads. This element consists of a stationary piston and a movable cylinder. The movable cylinder engages a shoulder on the spring-loaded unloader ring which is free to move up and down on the cylinder sleeve. When oil pressure is admitted to the power element, the movable cylinder pushes the unloader sleeve down and allows the lift pins to retract and permit the suction valve to seat and operate normally. The cylinder is now pumping (or loaded).

If the solenoid valves are energized, the oil pressure to the unloader power element is relieved and the oil flows back to the crankcase. Since there is no oil pressure to the unloader power element, the spring loaded unloader ring moves up, and by means of lift pins, raises the suction valve off its seat. In this position the cylinder is not pumping (is unloaded).

The solenoid mounting plate is stamped 1, 2 (and 3) adjacent to the solenoid valves. (See Fig. 18.) When wiring the compressor unit, the capacity control solenoid valves should be wired so that solenoid #1 is de-energized first, solenoid #2 is de-energized second, and solenoid #3 is de-energized last. They should be energized in the reverse order. This will assure that the compressor cylinders load (and unload) in the proper sequence.

## MANUAL CAPACITY CONTROL (Not available on Style B)

When the compressor is equipped for manual capacity control operation, the routing of the oil to the unloader power elements is controlled by means of a knob as shown in Fig. 19. The knob replaces the solenoid valves. This knob has four positions. Reading clockwise around its dial, they are:

U – Fully Unloaded (3-steps of unloading)
2 – Two steps of Unloading
1 – One step of Unloading
L – Fully Loaded

It is important that the unloader knob always be positioned with its pointer at the U (fully unloaded) position when the compressor is started. Compressor LOADING may be increased, after the motor is up to speed, by moving the knob clockwise progressively to the 2, 1 and L positions, but should be moved only one step at a time. This procedure should be followed in reverse order to UNLOAD the compressor.

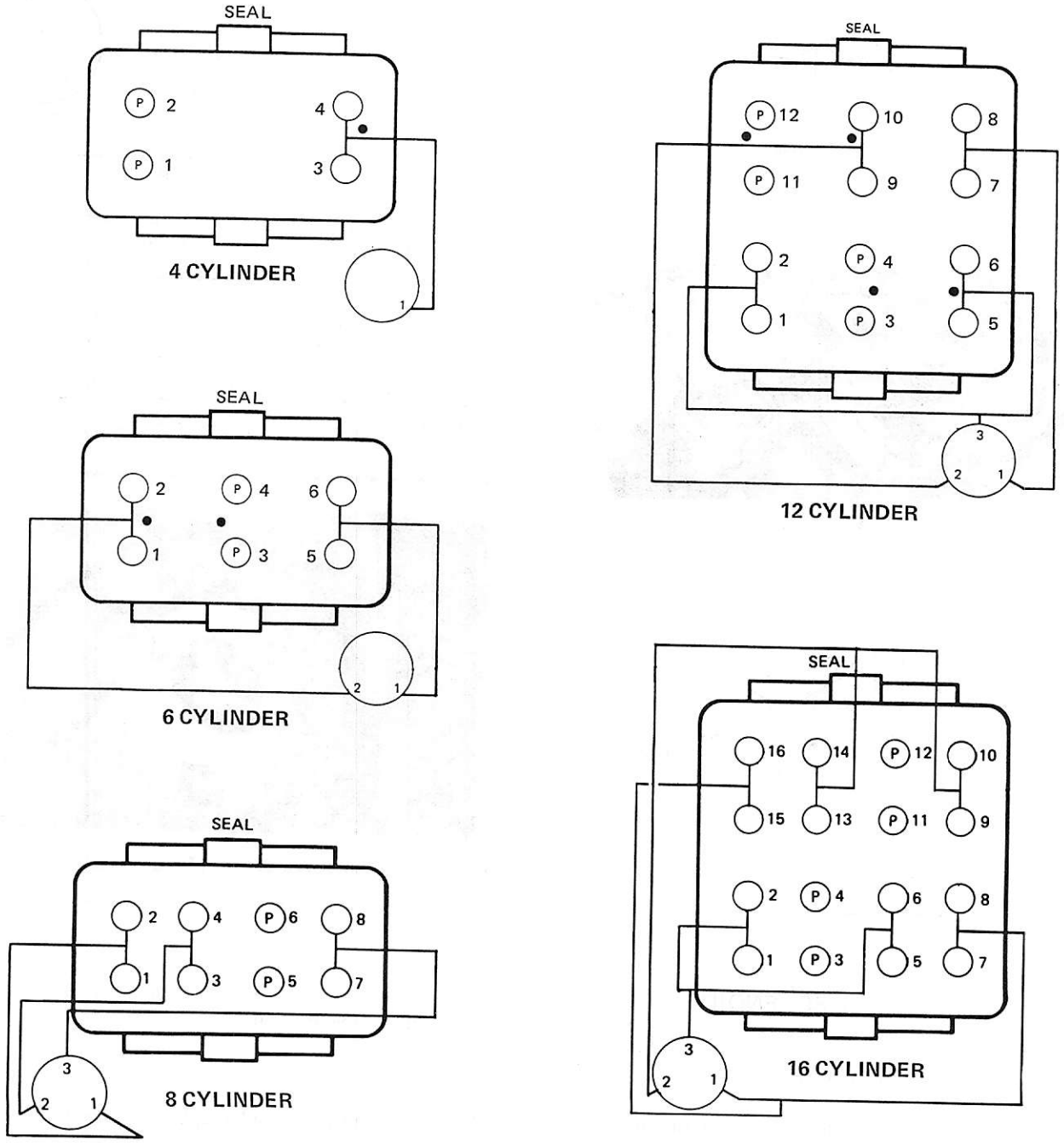
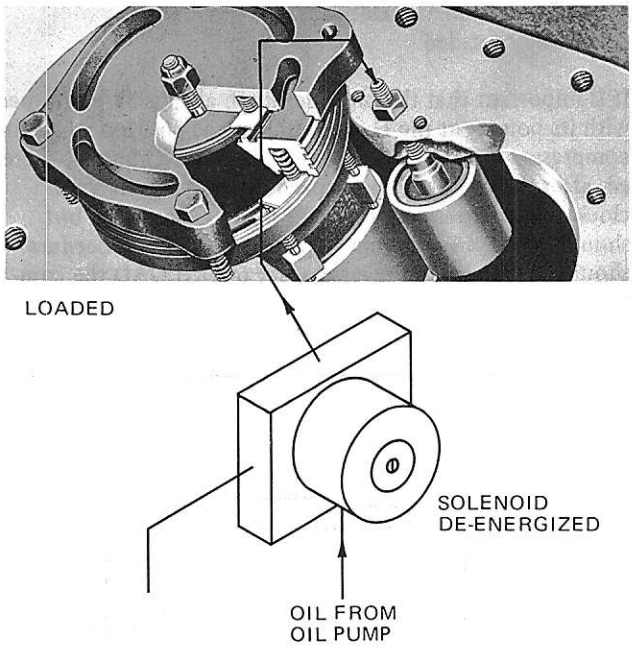



FIG. 16 – SOLENOID ARRANGEMENT AND PIPING

P – PERMANENTLY LOADED
• – RELIEF VALVE



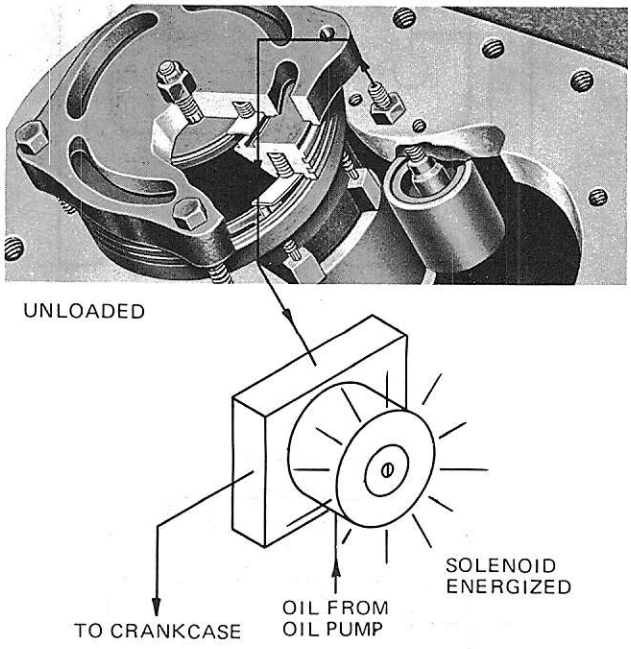
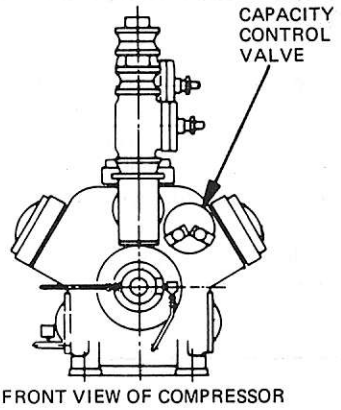
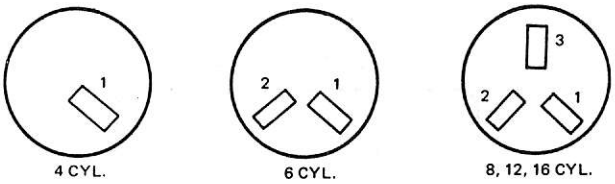




**FIG. 17** — SOLENOID CAPACITY CONTROL




| No. Compr. Cyl. | No. Fully Loaded Compr. Cyl. | Min. % Full Load Cap. | Capacity Steps | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| | | | % Full Load Cap. | % Full Load Cap. | % Full Load Cap. | % Full Load Cap. |
| 4 | 2 | 50 | 100 | 50 | | |
| 6 | 2 | 33-1/3 | 100 | 66-2/3 | 33-1/3 | |
| 8 | 2 | 25 | 100 | 75 | 50 | 25 |
| 12 | 4 | 33-1/3 | 100 | 66-2/3 | 50 | 33-1/3 |
| 16 | 4 | 25 | 100 | 75 | 50 | 25 |

**FIG. 18** — ARRANGEMENT OF SOLENOID VALVES

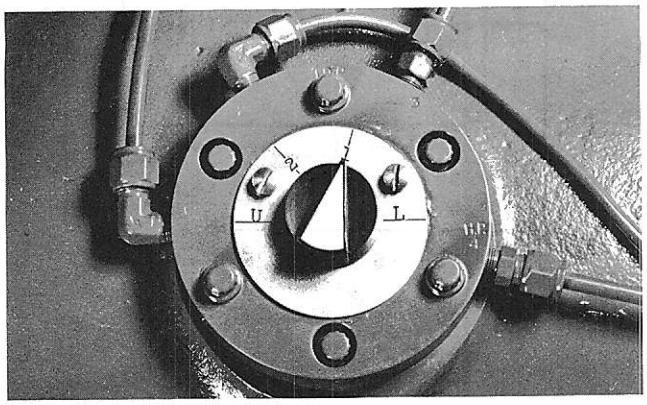


**FIG. 19** — MANUAL CAPACITY CONTROL KNOB

## CAPACITY CONTROL SOLENOIDS

Normally, the coil is the only part of the solenoid valve that requires replacement. To replace the coil proceed as follows:

1. Place the unit switch in the "OFF" position.
2. Remove the conduit and the wires from the solenoid valve.
3. Remove the screw from the top center of the valve and remove the coil.
4. Install the new coil.

If the solenoid valve must be replaced proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR)

2. Remove the solenoid coil as described above.

3. Remove the bolts holding the valve to the mounting plate.

4. Install a new valve using a new gasket. Be careful not to bend the valve core.

5. Re-install the solenoid coil.

6. Evacuate the compressor. (See EVACUATION AFTER REPAIRS)

## DISCHARGE MANIFOLD & TOP HEADS

Before repair work or inspection can be performed on the internal compressor parts, it is necessary to remove the discharge manifold(s) and top heads. To remove the manifold(s) and top heads proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR)

2. Identify the cylinder heads before they are removed from the housing so that they may be replaced on the same cylinder banks from which they were removed.

3. If the compressor is equipped with water-cooled top heads remove the water piping.

4. Support the discharge manifold and unbolt it from the cylinder heads. Note the location of the spacer collars.

5. Remove the cylinder heads (and water heads if used) and lay them aside, being careful not to damage the machined surfaces.

6. When reassembling a top head be sure to line it up with the discharge manifold first, and bolt it snugly before bolting the head to the compressor housing.

## INDICATION OF FAULTY COMPRESSOR VALVE OPERATION

The operator soon becomes accustomed to the sound of the compressor when it is running under normal conditions. As long as the compressor runs normally, and the sound does not change, it can safely be assumed that the compressor is operating properly. Any unusual noise within the compressor should be investigated immediately.

External indications of trouble within compressor are as follows:

1. When operating on suction pressure control, long "on" cycles with short "off" periods may indicate leaking or broken compressor valves.

2. A definite rise in temperature of the discharge gas may indicate defective suction or discharge valves, or a leaking relief valve, or both.

3. Failure to pull down is a possible indication of a broken suction or discharge valve, or both.

4. The operator should feel the heads periodically to check for hot spots or one particular head which is running hot. Check where the heads bolt to the discharge manifold. If this condition occurs, it is an indication of broken or leaking valves within that bank of cylinders.

If leaking or broken valves are suspected, the heads should be removed and the valves should be examined for breakage.

*NOTE: Some cylinders are permanently loaded. (See Fig. 16.) This prevents the possibility of overheating, since a definite minimum volume of cool refrigeratn gas flows through the compressor at all times during operation, regardless of load conditions. The permanently loaded cylinders do not have unloader sleeves, unloader device, or lift pins.*

## SUCTION & DISCHARGE VALVES (See Figs. 20 to 25)

The discharge valve cage and suction valve plate for later Style A and all Style B compressors have been re-designed. The changes involved and means of identification are as follows:

1. Discharge Valve Cage (See Fig. 20) – The thickness has been increased 1/8". The valve cage will have four larger core ports rather than 8 small ports. The discharge valve cage for RW (ammonia) compressors will have a bevel cut from its 4 corners as a means of identification. The length of the discharge valve cage assembly center bolt has been increased 1/8". The specified torque for the 4 valve cage hold down bolts has been increased to 30 ft. lb.

2. Suction Valve Plate (See Fig. 21) – Valve plate thickness has been increased .020". The valve plate for RW


**FIG. 20** – DISCHARGE VALVE CAGE

(ammonia) compressors will have 1 groove in the circumference for identification. The valve plate for RS (halocarbon) compressors will have 2 grooves in the circumference for identification. Gaskets (Part No. 064-21704) which fit between the compressor housing and the cylinder sleeve, and between the cylinder sleeve and the suction valve plate have been eliminated. When replacing old suction valve plates with new plates be sure to discard existing gaskets (Part No. 064-21704).

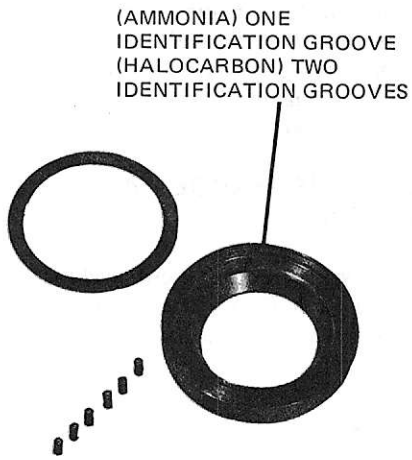



**FIG. 21** — SUCTION VALVE PLATE

To remove the suction and discharge valve assemblies proceed as follows:

1. Vent the compressor as explained in VENTING THE COMPRESSOR.
2. Remove the discharge manifold and top heads. (See DISCHARGE MANIFOLD and TOP HEADS.)
3. On unloading type cylinders remove the oil line that crosses the discharge valve cage.
4. Remove the 4 screws that hold the discharge valve cage assembly to the compressor housing and remove the discharge valve cage assembly from the compressor. Note that the unloader lift pins will raise the suction and discharge valve asemblies as the bolts are loosened.
5. Slide your fingers inside and under the suction valve and remove the suction valve and cage.

DISCHARGE VALVE REPLACEMENT

1. Remove the self-locking nut from the center bolt in the discharge valve cage assembly. Note that an Allen wrench will be required to keep the bolt from turning as the nut is removed.
2. Completely disassemble the discharge valve cage and

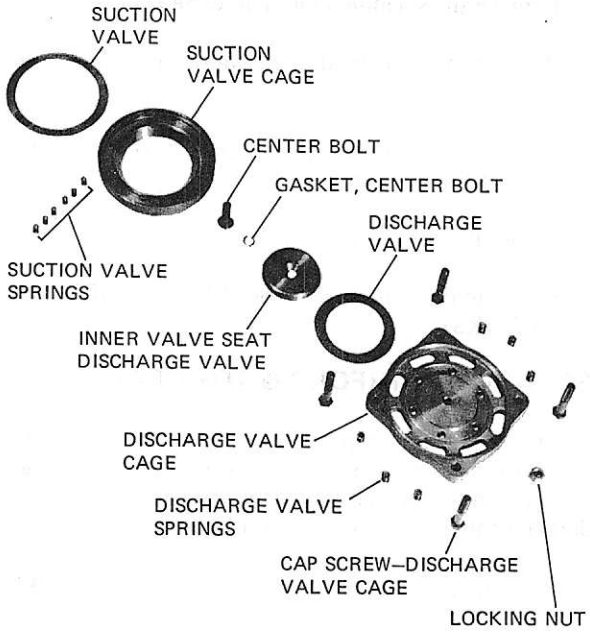



**FIG. 22** — SUCTION AND DISCHARGE VALVES — EXPLODED VIEW (ORIGINAL DESIGN)

**FIG. 23** — SUCTION VALVE ASSEMBLY (NEW DESIGN)

thoroughly examine all parts. Make sure the valve seats and ring valve are free of cracks, nicks or burrs and replace if necessary.

3. Place the discharge valve cage upside down on a clean smooth surface and place the six springs in their pockets.
4. Center the discharge valve on the springs. Install as originally removed, mating the seats; do not turn over.
5. Insert the center bolt, with gasket, through the inner valve seat and discharge valve cage. Turn the self locking nut on the bolt, hand tight.
6. Make sure the valve operates freely, then tighten the self-locking nut to 35 ft. lb. Check valve operation again after tightening nut.

SUCTION VALVE REPLACEMENT

1. Remove the suction valve from the suction valve cage.

2. If necessary, the valve springs may be removed.

3. Inspect all parts for breakage, cracks, nicks, or burrs and replace if necessary.

4. Place the suction valve cage upside down on a clean smooth surface and insert the six helical springs, large end first, into their pockets.

5. Place the suction valve on the springs. Install as originally removed, mating the seats; do not turn over. Two clips as shown in Fig. 25 should be made and slipped over the suction valve and cage. Be sure valve operates freely.

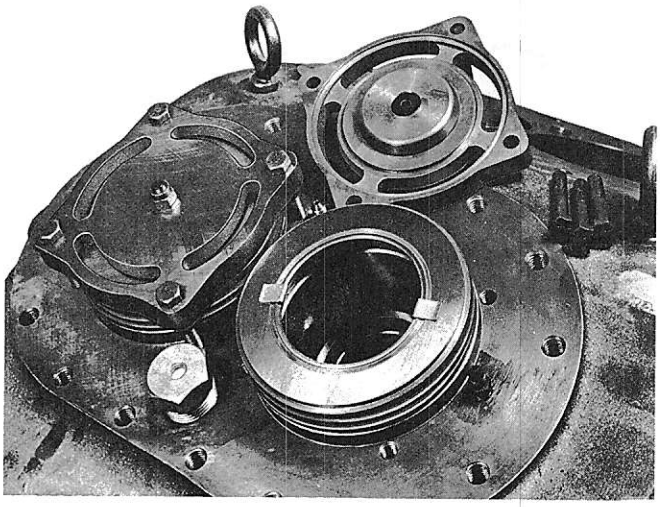


**FIG. 24** – SUCTION AND DISCHARGE VALVE ASSEMBLIES (NEW DESIGN)

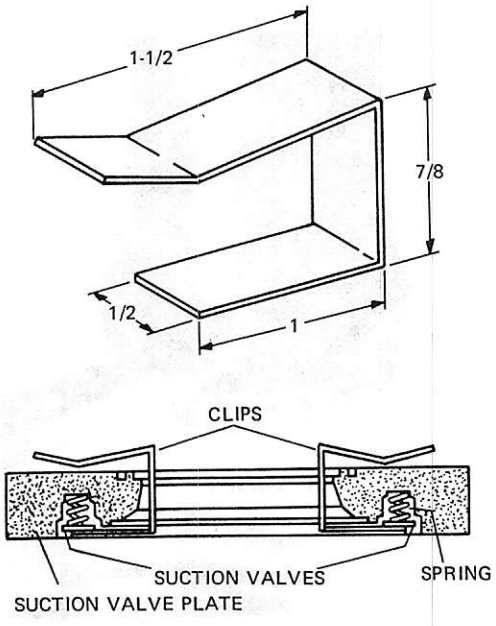



**FIG. 25** – SUCTION VALVE RETAINING CLIPS

INSTALLING SUCTION AND DISCHARGE VALVE ASSEMBLIES

1. Be sure the gasket is in place on top the cylinder sleeve and place the suction valve assembly, with clips in place, on top of the gasket.

*NOTE: If the compressor is a later design Style A or a Style B, no gasket is used.*

2. Press the suction valve assembly down firmly against the spring pressure and remove the two clips. Do not release pressure.

3. While still maintaining pressure with one hand as described in Step 2 above, slide the discharge valve assembly in place on top of the suction valve assembly.

4. Place two opposite bolts in the discharge valve cage and tighten finger tight. Insert the remaining two bolts and draw down opposite pairs of bolts evenly.

*NOTE: If the compressor is an original design Style A, torque the bolts to 15 ft. lb. If the compressor is a later design Style A or a Style B, torque the bolts to 30 ft. lb. DO NOT OVERTIGHTEN.*

5. On unloading type cylinder banks install the unloader oil line that crosses the discharge valve cage. Note that the longer leg of this oil line is fastened to the unloader power element (between the two cylinders).

6. Place the compressor top heads and water jackets, if used, using new gaskets if necessary, on the respective cylinders banks from which they were removed. Insert two bolts loosely to hold the head in place.

7. Bolt the discharge manifold to the top heads and the top heads to the compressor as described in DISCHARGE MANIFOLD and TOP HEADS.

## CYLINDER SLEEVES & UNLOADER SLEEVES (See Figs. 26 – 28)

REMOVAL

To remove the cylinder sleeves and unloader sleeves proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.)

2. Remove the discharge manifold, top heads, discharge valve and suction valve assemblies following the respective procedures outlined in the preceding sections of this manual.

3. On permanently loaded cylinders (see Fig. 16) the cylinder sleeve can be lifted from the compressor.

4. On unloading type cylinders it is necessary to rotate the cylinder sleeve assembly approximately 180° until the flat surfaces of the unloader sleeve and the unloader ring are aligned with the unloader power element.

An index mark is stamped on the top edge of the unloader sleeve to indicate the position of the flat surface. This index mark can be seen by using a flashlight and looking down into the suction gas openings in the cylinder sleeve.

DIS-ASSEMBLY OF CYLINDER SLEEVE

1. Place the cylinder sleeve assembly upside down on a workbench being careful not to damage the machined surfaces on the top of the cylinder sleeve.

2. Compress the unloader ring against the unloader sleeve and install the unloader sleeve clips (Part No. 064-37002) as shown in Fig. 27. Remove the retaining ring and carefully remove the unloader sleeve clips. Be careful the coil springs are not lost.

3. Examine all parts for wear and replace as necessary.

CYLINDER SLEEVE ASSEMBLY

To assemble the cylinder sleeve proceed as follows:

1. If removed, insert the unloader lift pins, lift pin springs, and retainers. Note that the retainer groove is not in the center of the lift pin. When installing the lift pins, the "long end" of the pin goes up, toward

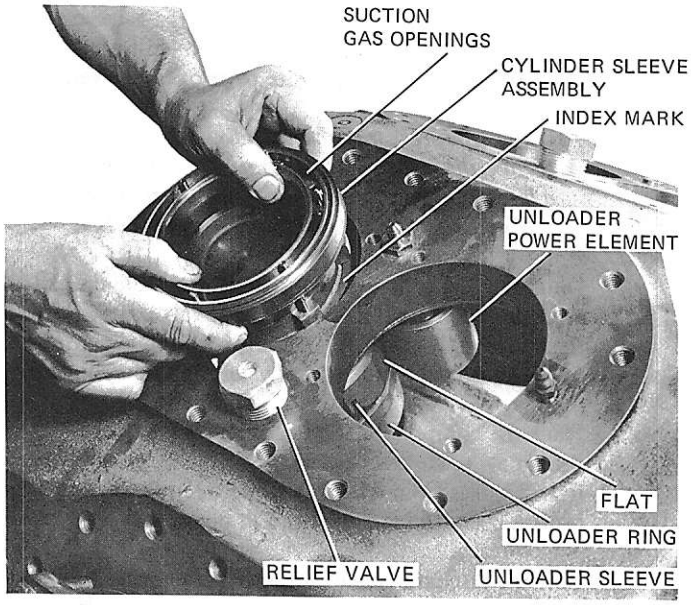



FIG. 26 – REMOVING CYLINDER & UNLOADER SLEEVES

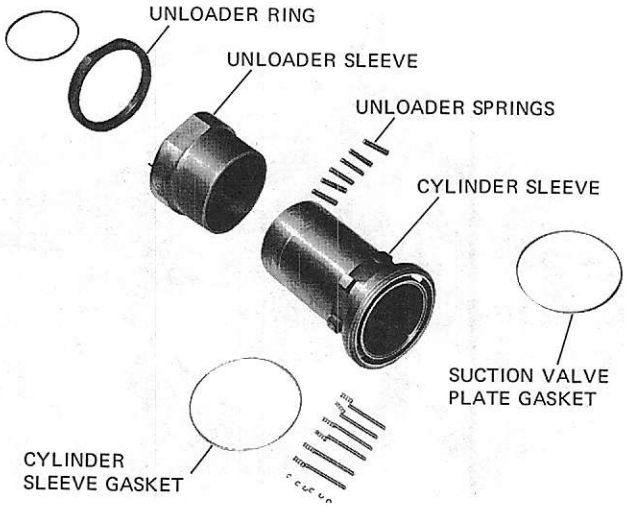



FIG. 28 – UNLOADING CYLINDER SLEEVE – EXPLODED VIEW

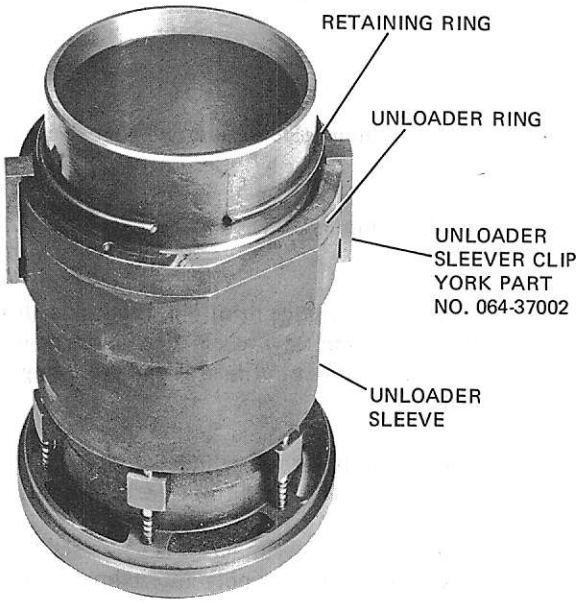



FIG. 27 – UNLOADER SLEEVE CLIPS

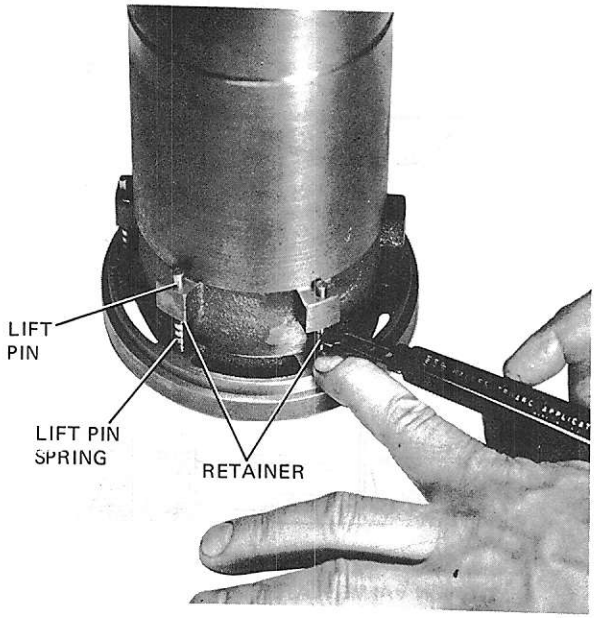



FIG. 29 – INSTALLING LIFT PINS

the top of the cylinder sleeve. A Waldes Truarc Applicator #CR–018 (.015") should be used for installing the retainers.

2. Place the cylinder sleeve with the lift pins installed, upside down on a table being careful not to damage the machined surfaces on the top of the cylinder sleeve.

3. Apply clean compressor oil to the outside of the cylinder sleeve.

4. Slide the unloader sleeve down over the cylinder sleeve until it rests on the lift pins. Note that the raised shoulder on the unloader sleeve should be toward the bottom of the cylinder sleeve.

5. Insert the unloader springs in the pockets in the unloader sleeve.

6. Slide the unloader ring over the cylinder sleeve. Note that a roll pin in the unloader sleeve fits into a hole in the unloader ring; and the flats on the unloader ring and unloader sleeve must be aligned.

7. Slide the retainer ring over the cylinder sleeve.

8. Place a valve plate on the table with the spring pockets up. Place the partially assembled cylinder sleeve assembly on top of the valve plate so that the lift pins fit into the spring pockets.

9. Place a spare unloader sleeve or unloader ring over the cylinder sleeve assembly and force it down against the retainer ring until the retainer ring snaps into the groove on the cylinder sleeve. Remove the spare unloader sleeve or unloader ring. Check that the unloader ring snaps back over the retainer ring.

INSTALLING CYLINDER SLEEVES

After assembling the cylinder sleeves and unloader sleeves as described above, the cylinder sleeve may be installed as follows:

1. Install the cylinder sleeve assemblies in the unloading type cylinders first, leaving the non-unloading type cylinders until last.

2. Be sure the gasket that fits between the cylinder sleeve flange and the compressor housng is in place.

*NOTE: If the compressor is a later design Style A or a Style B, no gasket is used.*

3. Apply clean compressor oil to the inside of the cylinder sleeve assembly. Slide the cylinder sleeve assembly over the piston and into the compressor housing. Be sure the flat on the unloader sleeve is aligned with the unloader power element. Be sure the cylinder sleeve fits squarely and firmly into the housing.

4. Using two hands as shown in Fig. 30, lift the unloader power element cylinder and rotate the cylinder sleeve assembly so that the unloader power element rests on the raised shoulder of the unloader sleeve as shown in Fig. 31. Rotate the cylinder sleeve assembly so that the flat on the unloader sleeve is 180° away from the power element.

5. Install the remaining cylinder sleeve assemblies, one at a time, leaving the permanently loaded cylinders until last.

6. Re-install the suction and discharge valves, top heads and discharge manifold(s) as explained in the preceding sections.

7. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

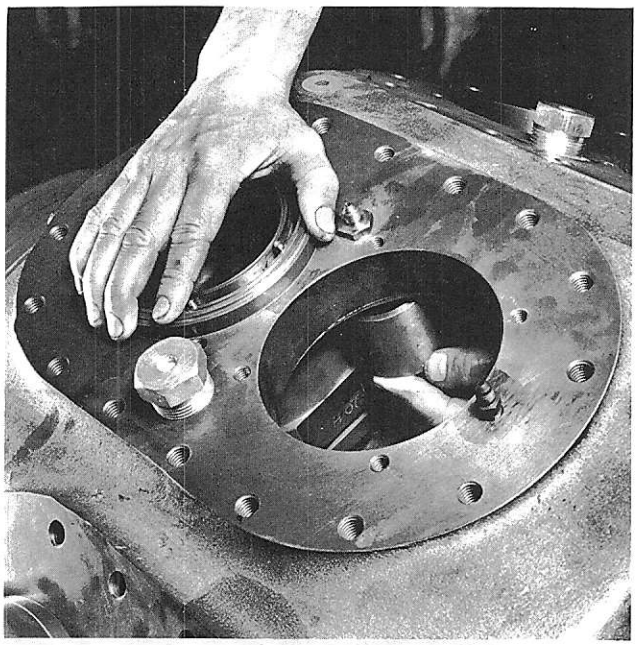


**FIG. 30 —** INSTALLING CYLINDER SLEEVE AND UNLOADER SLEEVE

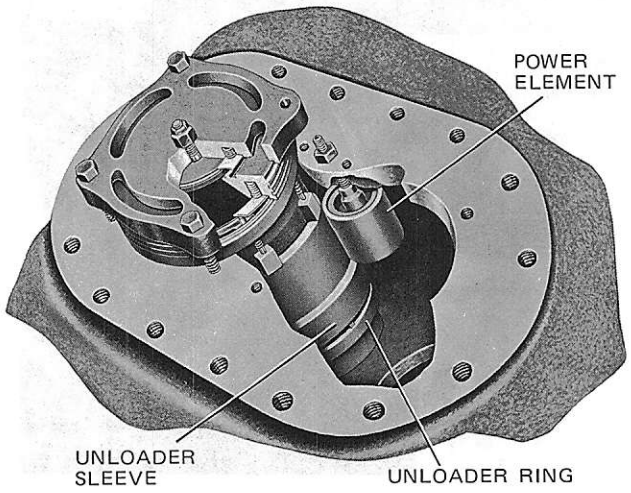



**FIG. 31 —** UNLOADING TYPE CYLINDER

## UNLOADER POWER ELEMENTS

The unloader power elements are screwed into the compressor housing between the suction gas chamber and the top heads. This element consists of a stationary piston inside of a movable cylinder. If a power element becomes defective it cannot be repaired, it must be replaced. To replace a defective power element proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.)
2. Remove the discharge manifold, top heads, discharge valve and suction valve assemblies, and cylinder sleeve following the respective procedures outlined in the preceding sections of this manual.
3. The unloader power element can now be removed as shown in Fig. 32. A 3/4" wrench, cut off as shown, will facilitate removal.
4. Install the new unloader power element using a new gasket. Tighten as specified in Table 1.
5. Re-install the cylinder sleeve assemblies, suction and discharge valve assemblies, top heads and discharge manifold(s) as explained in the preceding sections.
6. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

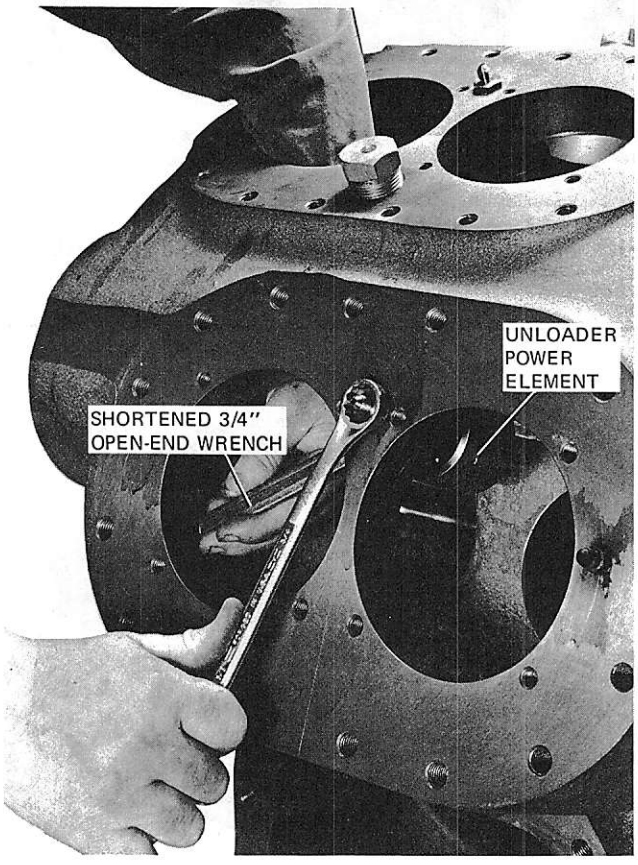



FIG. 32 – INSTALLING UNLOADER POWER ELEMENT

## HIGH PRESSURE RELIEF VALVES

All R Series Compressors are equipped with internal high pressure relief valves. Quantities are as follows:

| No. of Cylinders | No. of Relief Valves |
|---|---|
| 4 | 1 |
| 6 | 2 |
| 8 | 2 |
| 12 | 4 |
| 16 | 4 |

The relief valves are located beneath the compressor top heads as shown in Fig. 16. They are factory set to relieve abnormally high discharge pressure back to the suction side of the compressor at 300 psi differential. If leakage of the valve is suspected, it should be replaced.

To replace the high pressure relief valve when the compressor is not open for repairs or inspection, proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.)
2. Disconnect the discharge manifold from the proper top head and remove the top head.
3. Unscrew the leaking relief valve and screw in the new valve.
4. Reassemble the top head and the discharge manifold.
5. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## PISTONS AND CONNECTING RODS

### REMOVAL

To remove the pistons and connecting rods, refer to Figs. 33, 34 and 35 and proceed as follows:

*NOTE: The width of the connecting rods at their large end, is greater than the inside diameter of the cylinder sleeve. Before a piston and connecting rod assembly can be removed from the compressor housing, the cylinder sleeve must first be removed. Then the piston and connecting rod assembly can be pulled outward from the compressor.*

1. Vent the compressor and drain the oil from the crankcase. (See VENTING THE COMPRESSOR.)
2. Remove the suction and discharge valve assemblies. Allow the cylinder sleeve and unloader sleeve to remain in place in the housing.
3. Remove the crankcase hand hole cover plate(s).
4. With the cylinder sleeves in place, rotate the crankshaft to a position that will permit ready access to the connecting rod bolts to be removed. Loosen the nuts and remove the lower half of the connecting rod bearing. Note the identification number stamped on the half-bearing just removed.

5. Using care to make certain that the upper half of the connecting rod bearing remains in place on its crankpin, rotate the crankshaft to the point where the piston is very near the top of its stroke.

6. Remove the cylinder sleeve and unloader sleeve. (See paragraphs 3 and 4 under CYLINDER SLEEVES AND UNLOADER SLEEVES.)

7. Lift out the piston and its connecting rod. Note that the identification number stamped on the upper half of the rod bearing, matches the number on the lower half of the rod bearing. These numbers should ALWAYS match.

*CAUTION: Never rotate the crankshaft when one or more piston and connecting rod assemblies are in place unless the related cylinder sleeve or sleeves are in their proper position in the compressor housing. If this caution is not observed, serious damage could occur. Make certain also that when the bottom half of the rod bearing has been removed and it is necessary to rotate the crankshaft, that the upper half of the rod bearing does not leave its proper place on its crankpin.*

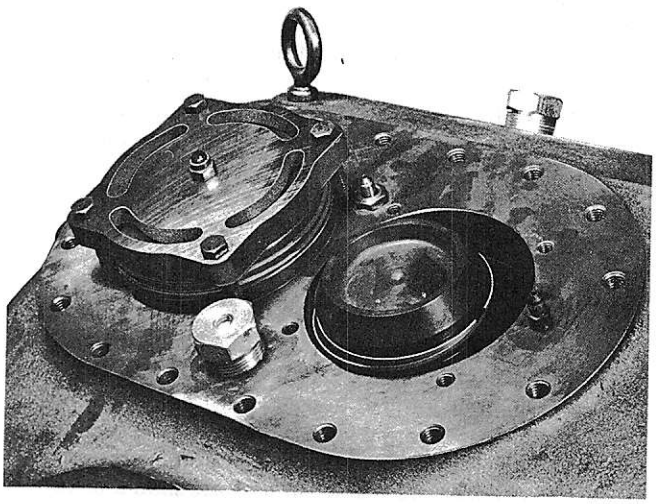


**FIG. 33** — REMOVING PISTON AND CONNECTING RODS

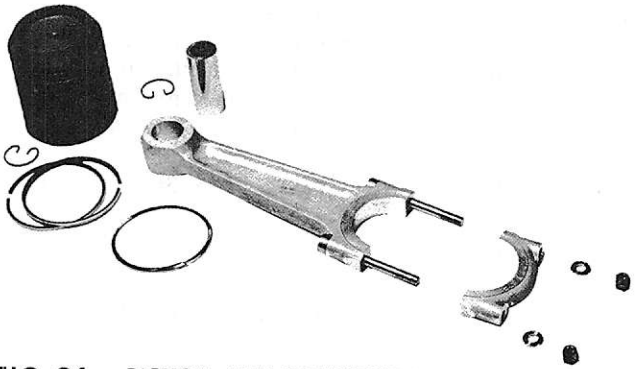


**FIG. 34** — PISTON AND CONNECTING ROD — STYLE A COMPRESSORS

8. Remove piston assemblies ONE AT A TIME, repeating the above steps (4) through (7) for each piston assembly. Proceed to step (9).

9. Remove the piston pin retaining rings.

10. Push the piston pin out of the piston.

11. Remove the piston rings.

12. Clean, dry and oil all parts.

INSTALLATION

To install the piston and connecting rod assemblies, proceed as follows:

1. R compressor pistons are of 3 different designs as follows:

   A. The very earliest design Style A compressors used a piston with 2 identical piston rings. (See Fig.35, Detail A.) When replacing rings on this style piston, the rings should be changed to the arrangement described in paragraph B, below.

   B. Later Style A compressors used a piston with 1 plain ring, 1 step gap ring, and 1 retainer ring as shown in Fig. 35, Detail B.

      When installing the rings use a ring expander and spread the rings only enough to slide them over the piston. Install the ring in the bottom groove first. This is the thicker of the two rings and has plain ends. The dot on the ring must face toward the top of the piston. Next install the ring in the top groove. This is the ring with the "step gap" and must be installed with the dot on the ring facing the top of the piston. Install the retainer ring in the top groove on top of the piston ring. Be sure the ring is turned as hown in Fig. 35, Detail B. Be sure the ends of the retainer ring butt and do not overlap. This may be checked by attempting to compress the top piston ring. If the top piston ring compresses freely the retainer ring is properly installed.

   C. The latest Style A compressors and all Style B compressors use a piston with 2 plain rings and 1 oil ring. (See Fig. 35, Detail C.) Style A compressors use a cast iron piston; Style B compressors use an aluminum piston. When installing the rings use a ring expander and spread the rings only enough to slide them over the piston. Install the oil ring in the bottom groove first. This is the beveled ring and must be installed as shown in Fig. 35, Detail C. Next, install the rings in the top grooves. Be sure the dot on the rings is toward the top of the piston. Check that all rings compress freely.

2. Set the piston with its top surface down on a bench. Apply clean compressor oil to the piston and connecting rod. Insert the small end of the rod into the piston

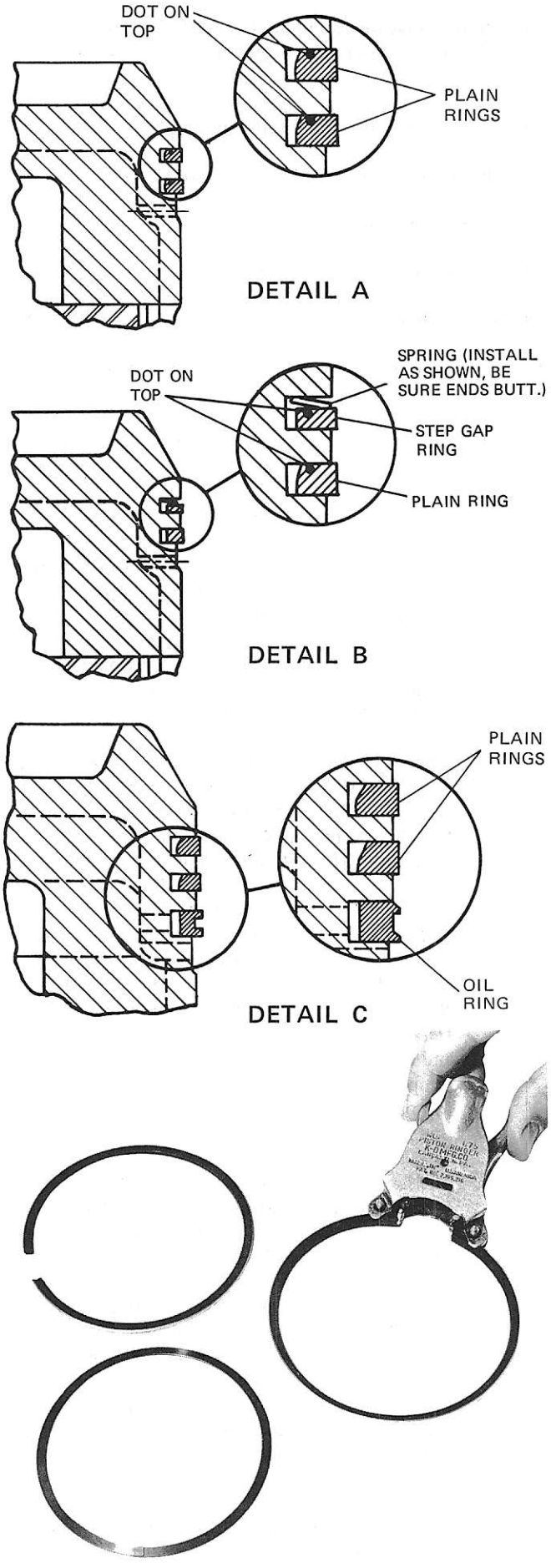



FIG. 35 — INSTALLING PISTON RINGS

and slide the piston pin into position. The pin is a sliding fit into the piston and rod. Install the retaining rings in each side of the piston.

3. Cylinder sleeves and piston assemblies, when re-used, should be installed in their original locations in the compressor housing.

   Remove the lower half of the connecting rod bearing, allowing the connecting rod bolts to remain in position. Check to see that the numbers on the two halves of the bearing are matched and that they are on the same side of the connecting rod. Apply a few drops of oil to the crankpin. Insert the piston and connecting rod assembly through the cylinder bore and carefully position the upper half of the connecting rod bearing on its crankpin. Insert the unloader sleeve and cylinder sleeve. (See INSTALLING CYLINDER SLEEVES.)

4. Install the lower half of the connecting rod bearing as described in step (3) above. Using an accurate torque wrench tighten the nuts evenly to a torque of 260 inch pounds. Hand turn the crankshaft to be sure there is no binding. Install all piston assemblies, turning the shaft after each rod is installed, to be sure that no binding exists.

5. Make sure that the compressor crankcase is clean. Install the crankcase hand hole cover plates. Fill the crankcase to the proper level with new oil.

6. Re-install the suction and discharge valves and the compressor top heads, making sure they are in their original locations and reconnect the discharge manifold and top heads, using new gaskets as required.

7. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

## MAIN BEARINGS

The main or crankshaft bearings must be handled with care to avoid dents and scratches. They are finished to exact tolerances and replacement bearings must not be scraped or fitted. If one main bearing must be replaced the other bearing or bearings should be removed for careful examination. If any signs of wear are visible, all bearings should be replaced. It is recommended that the oil be drained from the compressor crankcase and new oil installed when one or more main bearings require replacement. On the 4, 6 and 8 cylinder compressors main bearings can be replaced without removing the crankshaft. On the 12 and 16 cylinder compressors it is necessary that the connecting rods be removed, and that the crankshaft with the center main bearing must be removed from the compressor as a unit.

PUMP END MAIN BEARING (SEE FIGS. 36, 37 & 38)

To replace the compressor pump end main bearing proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.)
2. Drain the oil from the crankcase.
3. Remove the oil pump. (See COMPRESSOR OIL PUMP.)

4. Disconnect the capacity control oil lines, the oil supply tube, and the oil line feeding the shaft seal.

5. Remove the bearing head cap screws and remove the bearing head from the compressor.

6. Using the Bearing Removal Tool (York Part No. 364-37051) remove the bearing from the bearing head.

7. Clean the bearing head thoroughly using an approved safety solvent.

8. Apply clean compressor oil to the outside of the new bearing. Using the Bearing Removal Tool, pull the new bearing into the bearing head, taking care that the bearing enters the bearing head squarely. Continue to pull the bearing into the bearing head until the bearing is 1/16" below the surface on the inboard end of the bearing head.

9. Inspect the journal on the end of the crankshaft to see that it is clean and free of nicks or burrs.

10. Oil the journal on the crankshaft and the inside of the bearing.

11. Reassemble the bearing head to the compressor using a new gasket. (See Table 1 for cap screw torques.) Rotate the crankshaft to see that no binding exists.

12. Reassemble the oil pump and connect the oil lines and capacity control lines.

13. Fill the compressor with new oil.

14. Evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

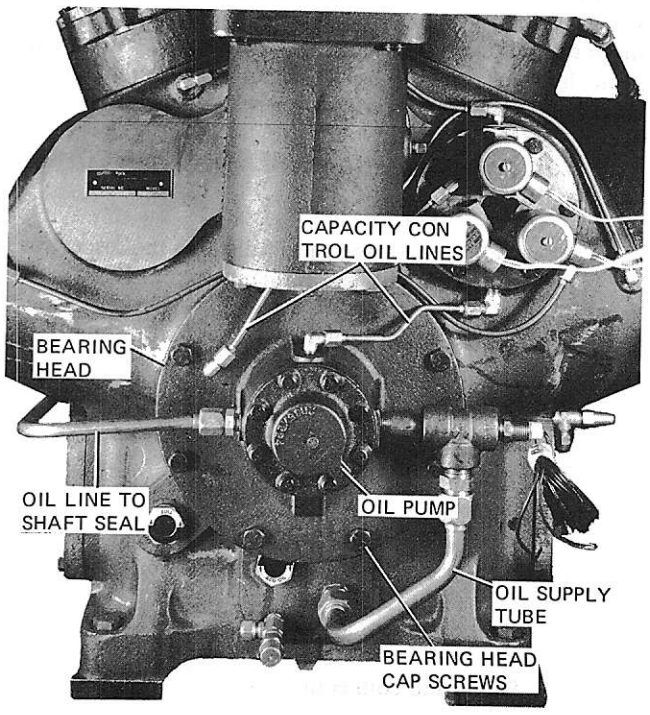



FIG. 36 — OIL PUMP BEARING HEAD

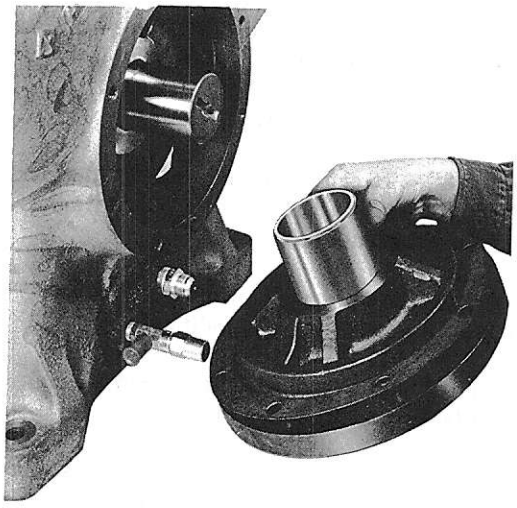


FIG. 37 — PUMP END BEARING HEAD AND BEARING

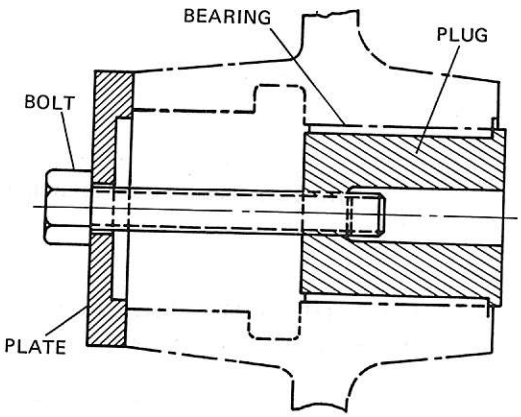



FIG. 38 — BEARING REMOVAL TOOL

SHAFT SEAL END BEARING (SEE FIGS. 39 & 40)

To replace the compressor shaft seal end bearing proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.)

2. Drain the oil from the crankcase.

3. Rotate the crankshaft so that the keyway is at the bottom. Remove the flexible coupling or the compressor flywheel and the key.

4. Remove the compressor shaft seal. (See REPLACING THE SHAFT SEAL.) Remove the shaft seal spacer. This is positioned on the compressor by 2 roll pins.

5. Using the retaining ring pliers as shown in Fig. 39, remove the retaining ring, taking care that the compressor crankshaft is not marked or damaged in any way.

6. Remove the shaft seal collar and the locking ball. Use care when removing the ball so that it is not lost.

7. Remove the bearing cap screws.

8. Using (2) 3/8" – 16 cap screws inserted into the jacking holes in the bearing flange, carefully remove the bearing from the compressor.

9. Inspect the journal on the end of the crankshaft to see that it is clean and in good condition.

10. Oil the journal on the crankshaft and the inside and outside surfaces of the new bearing.

11. Slide the new bearing on to the crankshaft being careful to avoid damage. As the bearing is being inserted, raise the shaft as necessary to take the weight off the bearing. Note that the bearing must be turned to the proper position for the four bolt holes in the bearing flange to align with the holes in the compressor housing.

12. Insert the four bearing cap screws and flat washers. Tighten the cap screws to the proper torque. (See Table 1.)

13. Install the locking ball, shaft seal collar, and retaining ring. Use care when installing the retaining ring so that the crankshaft is not damaged.

14. Install the shaft seal spacer and shaft seal. (See REPLACING THE SHAFT SEAL.) Rotate the crankshaft to see that no binding exists.

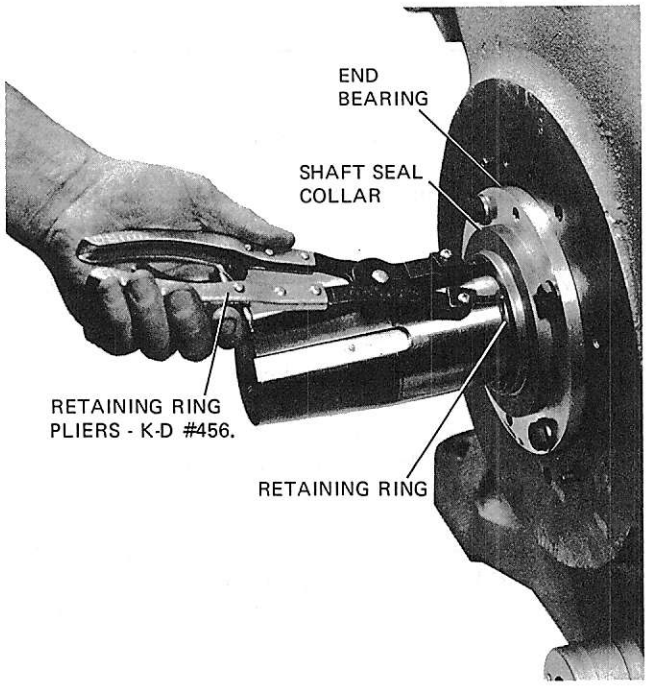



**FIG. 39** – REMOVING CRANKSHAFT RETAINING RING

15. Re-connect the oil supply line.

16. Install the drive components, fill the compressor with new oil, and evacuate the compressor. (See EVACUATION AFTER REPAIRS.)

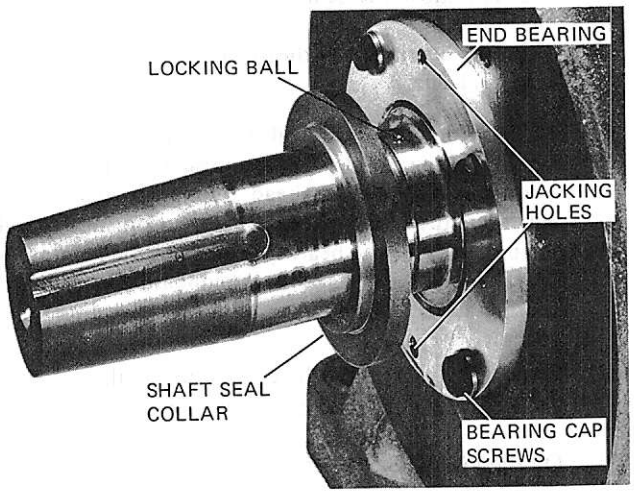



**FIG. 40** – SEAL END BEARING

CENTER MAIN BEARING – 12 AND 16 CYLINDER MODELS (See Fig. 41)

The center main bearing on 12 and 16 cylinder models is a two-piece steel backed babbit type which fits into a spider type shell, cast in two halves, which bolt together on the crankshaft journal. The shell of the upper half is provided with a cast boss which extends to either side of the shell. This boss is split vertically and is provided with a longitudinal hole for the locking bolt and two cone-shaped sleeves which can be forced into the hole when the nut is drawn up to expand the top half and lock the bearing into position in the housing bore. To replace the center main bearing on the 12 and 16 cylinder compressor proceed as follows:

1. Vent the compressor. (See VENTING THE COMPRESSOR.

2. Remove the following parts following the respective procedures outlined in this manual.

   a. Crankcase cover plates

   b. Shaft seal

   c. Discharge manifolds

   d. Top heads

   e. Suction and discharge valve assemblies

   f. Cylinder sleeve assemblies

   g. Piston and connecting rods

   h. Pump end bearing head

3. Remove or loosen the bearing lock bolt and the two cone-shaped sleeves in the top half to free the center main bearing assembly from the compressor housing or crankcase bore.

4. Remove the center main bearing dowel pin. This pin is provided with a hole tapped 1/4" – 20 for inserting a threaded rod about 10" long for the purpose of pulling out the dowel pin. Note that a pipe plug is inserted in the dowel pin hole from the outside of the compressor housing – this plug must be removed to gain access to the dowel pin. (See Fig. 41).

5. With the bearing loosened from its bore in the compressor housing the crankshaft with center main bearing attached should be moved carefully out of the compressor housing through the oil pump end, using a rod slipped into the threaded hole for the flexible coupling cap screw. Avoid any contact of the crankshaft with the compressor housing.

6. Rest the shaft on wood blocks, remove the four bolts, nuts and lockwashers which hold the two halves of the bearing together and remove the complete bearing. Remove the two babbit bearings from the bearing housing. Examine the crankshaft journal carefully; if signs of wear or roughness are present, replace the crankshaft or hone the journal to satisfactory condition. Check to be sure the oil hole and orifice are open in the bottom half of the bearing housing.

7. Place the new babbit bearings into the two halves of the bearing housing taking care that the tab on the bearing fits into the notch on the bearing housing. Oil the crankshaft journal and install the new main bearing assembly on the center journal on the crankshaft, making sure that the bottom half is turned so that the oil drain hole faces the oil pump end when the shaft is installed and that the four nuts and lockwashers are tightened to the proper torque values (60 ft. lbs.) as shown in TABLE 1. Rotate the bearing to be sure no binding exists. Put the bearing locking bolt, the two coneshaped sleeves and the nut and lockwasher in position in the hole in the top half of the bearing loosely.

8. Place the crankshaft (and center main bearing assembly) into the compressor housing from the oil pump end, and carefully lift the shaft into position and enter the bearing in its bore in the housing. Move the shaft and bearing into position, checking with the dowel pin on the threaded rod until the dowel pin seats in its hole in the shell of the lower half of the bearing. Tap the dowel pin lightly and remove the threaded rod and install the pipe plug in the hole in the housing, using an approved thread sealing compound.

9. Install the shaft seal end bearing. (See Shaft Seal End Bearing.) Rotate the crankshaft as this bearing is installed to be sure there is no binding. Install the pump end bearing and bearing head. (See Pump End Main Bearing.) Turn the crankshaft again to see that no binding

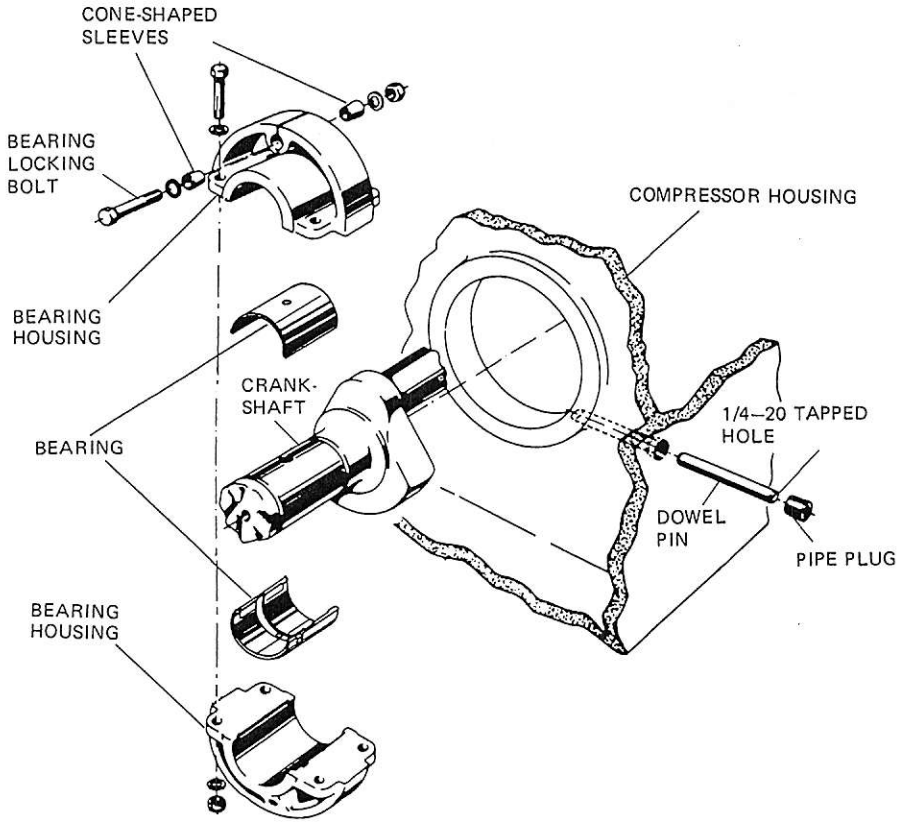



FIG. 41 – CENTER MAIN BEARING – 12 & 16 CYLINDER COMPRESSORS

exists. Tighten the center main bearing locking bolt to the required torque (20 ft. lbs. – See TABLE 1) and lock this bearing securely in position. Turn the crankshaft to be sure no binding exists.

10. Fill the crankshaft with oil to the bottom of the cover plate holes and reassemble the flexible coupling, evacuate the air from the compressor, admit the refrigerant and test for leaks. (See EVACUATION AFTER REPAIRS.) With the hand oil pump YORK Part No. 470-10654, attached to the compressor oil charging valve, pump in sufficient oil to being the level to the halfway point on the upper oil sight glass.

## EVACUATING AFTER REPAIRS

If the compressor was opened for repairs or inspection, the air should be evacuated as follows, before opening the suction and discharge stop valves for normal operation.

1. Connect a vacuum pump to one of the plugged holes in the discharge manifold.

2. With the vacuum line shut-off valve open, run the vacuum pump until at least 28" of vacuum is reached.

3. Stop the vacuum pump, close the shut-off valve, and open the compressor suction and discharge stop valves before operating the compressor.

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