York

6 ¾ x 5 Reciprocating Compressor

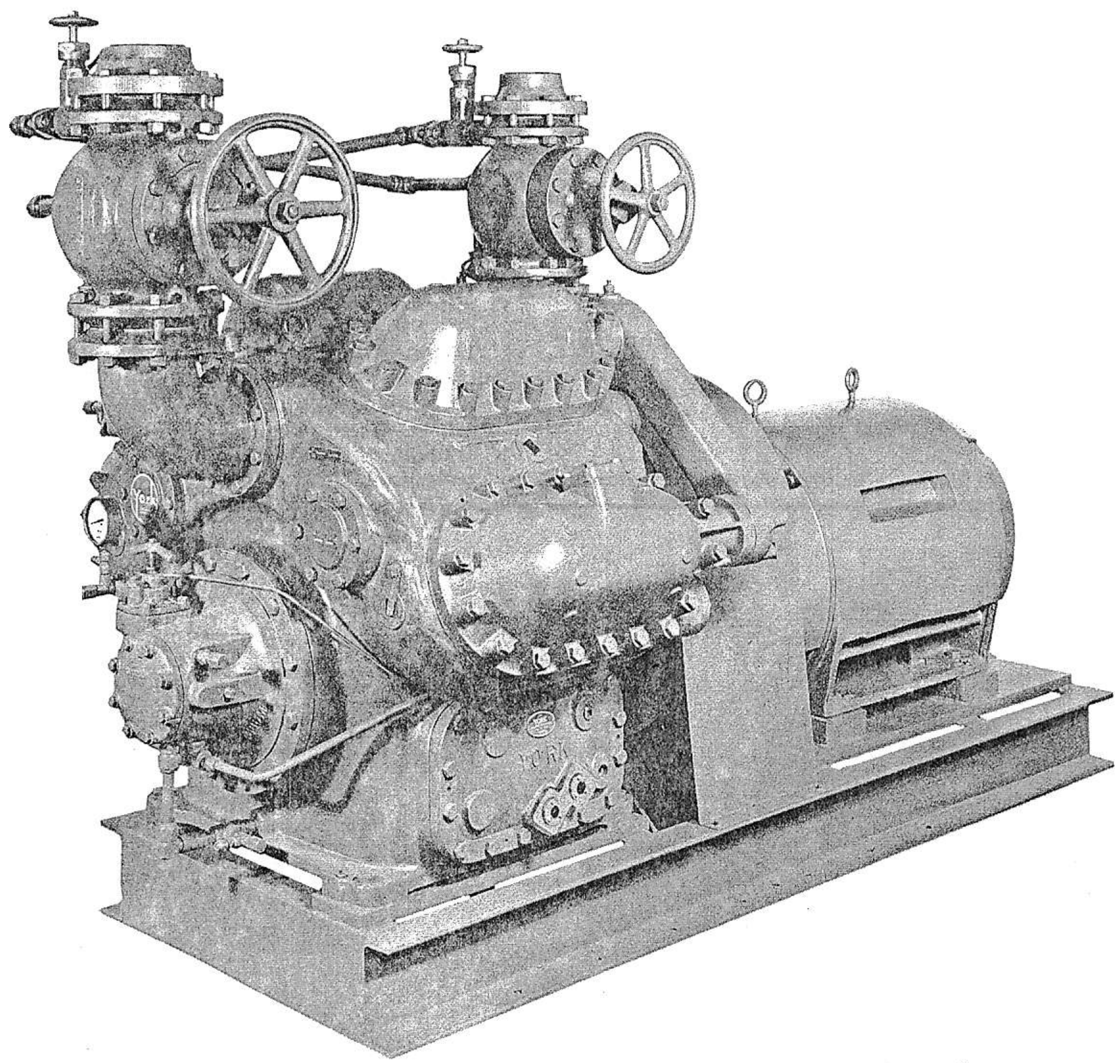
Maintenance Manual

YORK® INSTALLATION OPERATION MAINTENANCE

Supersedes: Form 255.10-N1 (3W-G) Coded 358 1168

Form 255.10-NM

COMPRESSOR UNITS
6¾″ × 5″ SINGLE STAGE
DIRECT AND V-BELT DRIVE—Y-49 AND Y-57 SERIES
REFRIGERANT-717 (ALSO R-12 and R-22)



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GENERAL DESCRIPTION

GENERAL

The York Y-49 series 6-3/4" X 5" V/W single stage open type direct drive or V-belt unit, is designed for high stage duty with remote condensing equipment of the evaporative, water or air cooled type. (See Figs. 1 and 2.) Refrigerant-717 (ammonia) is principally used in these units however, in special cases, the halocarbons and propane have also been used.

The standard direct drive compressor unit consists of a single, eight cylinder compressor, connections, stop valves, unit base, gauges with board, high pressure cutout and oil safety differential pressure cutout. The compressor on the booster type units is identical and the unit is similar and may be either belt or direct driven.

AUTOMATIC CAPACITY CONTROL SYSTEM - Unloads selected cylinders in sequence to balance pumping capacity against cooling load and permits compressor to start partially loaded. Automatic control of suction pressure or temperature can be provided.

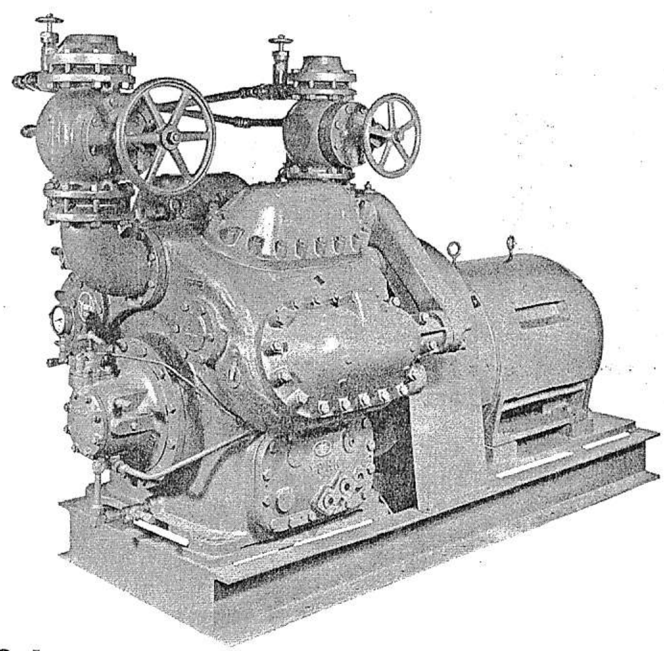


FIG. 1 Direct Drive Compressor Unit

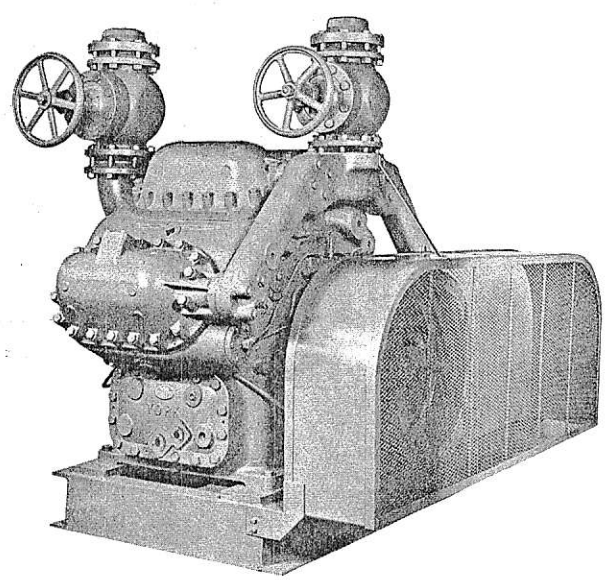


FIG. 2 Belt Drive Compressor Unit

NOMENCLATURE

A 5 8 – 9 2/5 D/B E/B

- A — Type Refrigerant: A = Ammonia, F = Refrigerant-12, FX = Refrigerant-22, P = Propane
- 5 — 5 = 6-3/4" X 5"
- 8 — Number of Cyls.
- 9 — Design Number
- 2/5 — Speed Designation: 2 = 600 rpm, 5 = 720 rpm
- D/B — D = Direct Drive, B = Belt Drive
- E/B — Type Unit: E = High Stage Compressor Unit, B = Booster Compressor Unit

SPECIFICATIONS—STANDARD UNIT

HOUSING – Close grained cast iron. Contains cylinder assemblies; suction strainer, crankcase, bearings, relief valves; equipped with hand hole plates and oil sight glasses. Removable cast alloy iron sleeves are fitted into the cylinders.

PISTONS – Cast iron double trunk slipper type babbitt faced with two chrome plated compression rings, an oil cutter ring, and a beveled ventilated oil ring.

SUCTION AND DISCHARGE VALVES – Ring plate, stainless steel with cast iron retaining plate.

CONNECTING RODS – Aluminum alloy permanent mold castings. Integral bearing in crank pin end.

CRANKSHAFT - Nodular iron; tensile strength 75,000 – 90,000 psi

SHAFT SEAL – Spring loaded carbon ring and rotating cast iron collar submerged in oil.

BEARINGS – Babbitt sleeve type load and thrust bearings.

LUBRICATION - Full forced feed to all bearing surfaces and shaft seal by a reversible gear oil pump with an external disc type filter in pump discharge, a 3 1/2 inch pressure gauge and a regulating valve.

OIL PRESSURE SAFETY SWITCH – Differential type with hand reset, integral time delay relay, not mounted.

SUCTION STRAINER – Recessed in compressor housing; fine mesh wire screen on perforated steel support.

PRESSURE RELIEF VALVE – Spring loaded ball check type between suction and discharge passages, 250 psi differential setting.

OIL LEVEL INDICATOR – Sight glasses (2).

CONTROLS – High pressure cutout, not mounted.

CAPACITY REDUCERS – Manually operated, including steel tubing, orifices, and valves.

COMPRESSOR CONNECTIONS – Suction and discharge stop valves with welding flanges.

DRIVE – Flexible coupling and flywheel with guard (direct connected). Grooved flywheel and motor pulley (belt driven).

BASE – Welded structural steel.

DISCHARGE GAS THERMOMETER – One per compressor.

GAUGE BOARD – 4 1/2 inch suction and discharge pressure gauges mounted on board.

MISCELLANEOUS - Unit painted and supplied with oil charge and tools. (See SPECIAL TOOLS).

ACCESSORIES AND MODIFICATIONS

AUTOMATIC CAPACITY REDUCTION - Electric solenoid type, oil pressure operated.

PUMPOUT AND BYPASS CONNECTIONS - Necessary valves, fittings, and pipe for cross-connections, including special suction and discharge stop valves.

GAUGE BOARD WITH L. P. CUTOUT - Made for 4 1/2 inch suction and discharge pressure gauges and high and low pressure cutouts; gauges and cutouts included.

EXPLOSION PROOF AND WEATHER PROOF CONTROLS - Kits for NEMA 3, 7 or 9 including high and low pressure cutouts and oil pressure safety switch, also capacity reduction solenoids.

VIBRATION ISOLATORS - Spring type.

CRANKCASE OIL LEVEL FLOAT

CRANKCASE HEATER - Immersion type for 115 or 230 Volt-1-50/60.

COMPRESSOR SOLE PLATE

OIL RECEIVER - May be furnished when required.

MOTORS - York can supply and mount the required motor, or will factory mount a customer-supplied motor. Direct connected motors must be short shaft. Motors for belt drive must be long shaft.

DISCHARGE LINE OIL SEPARATOR - Model DOT-14 with float for field installation.

LIMITATIONS

Minimum Compressor Speed	. . . . .	360 rpm
Maximum Compressor Speed	. . . . .	720 rpm
Maximum Operating Differential	. . . .	275 psi
Maximum Absolute Pressure Ratio	. . .	9.5 to 1
Maximum Discharge Temperature	. . .	375 F
Maximum Motor HP - Belt Drive	. . .	125
Maximum Suction Pressure	. . . .	90 lbs.

Operating Pressure Limits

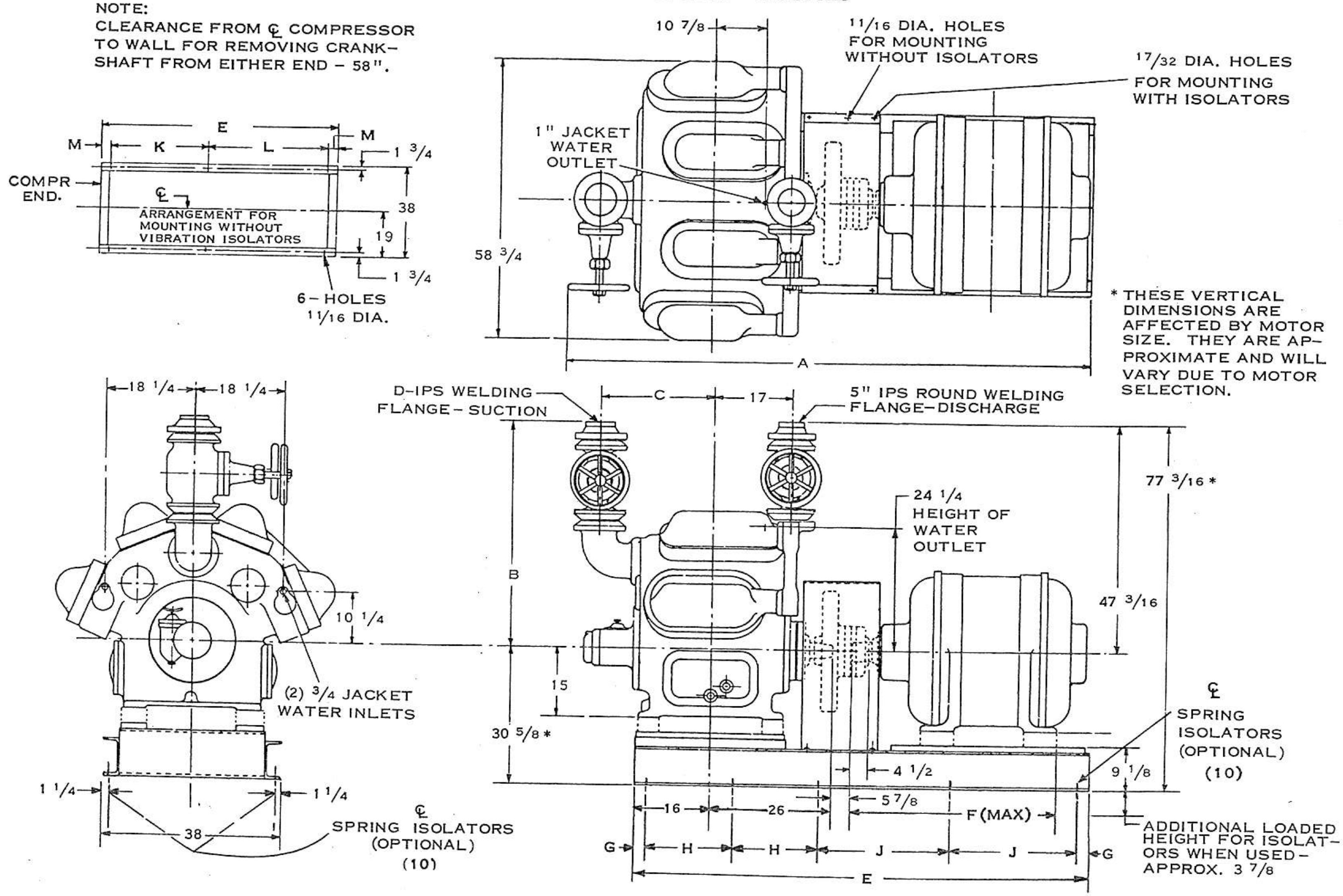
Cond. Press. Pounds Gauge	Min. Suct. Press. Pounds Gauge	Corres. Temp. F.
115	2" VAC	-31
125	0 Lbs. G	-28
135	1 Lb. G	-25
145	2 Lbs. G	-23
155	3 Lbs. G	-21
165	4 Lbs. G	-19
175	5 Lbs. G	-17
185	6 Lbs. G	-15
195	7 Lbs. G	-13
205	8 Lbs. G	-12
215	9 Lbs. G	-10
225	10 Lbs. G	- 8

PHYSICAL DATA

Model	A589-2DE	A589-5DE	A589-5BB
Drive	Direct	Direct	V-Belt
Compressor rpm	600	720	720
Motor rpm	600	720	1750
Refrigerant	- 717	- 717	- 717
No. Cylinders	8	8	8
Bore, Ins.	6 3/4	6 3/4	6 3/4
Stroke, Ins.	5	5	5
Shipping Weight (Less Motor) *	7000 Lbs.	7000 Lbs.	7300 Lbs.
Suction Connection ips.	5	6	6
Discharge Connection ips.	5	5	5
Oil Charge gal.	15	15	15
Maximum hp.	—	—	125
Motor Pulley, diam.	—	—	11
Motor Pulley, Face Width	—	—	10 3/8
Flywheel, diam.	—	—	26
Flywheel, Face Width	—	—	10 3/8
No. V-Belts, Type C Section, 162" Nominal Inside Length	—	—	10

* Standard unit - compressor, connections, valves, drive package, base and guard, oil separator, gauges, gauge board and controls.

DIMENSIONS—INCHES



	A	B	C	D	E	F(MAX.)	G	H	J	K	L	M
A589-2DE	112 3/4	45 1/16	22 3/4	5	100	51 5/8	5	18	27	42	50	4
A589-5DE	114 3/4	48 1/16	23 3/4	6	100	51 5/8	5	18	27	42	50	4
A589-2DE	117 3/4	45 1/16	22 3/4	5	105	56 5/8	2 1/2	20	30	44	52	4 1/2
A589-5DE	119 3/4	48 1/16	23 3/4	6	105	56 5/8	2 1/2	20	30	44	52	4 1/2

FIG. 3— Direct Drive Compressor Units

DIMENSION—INCHES

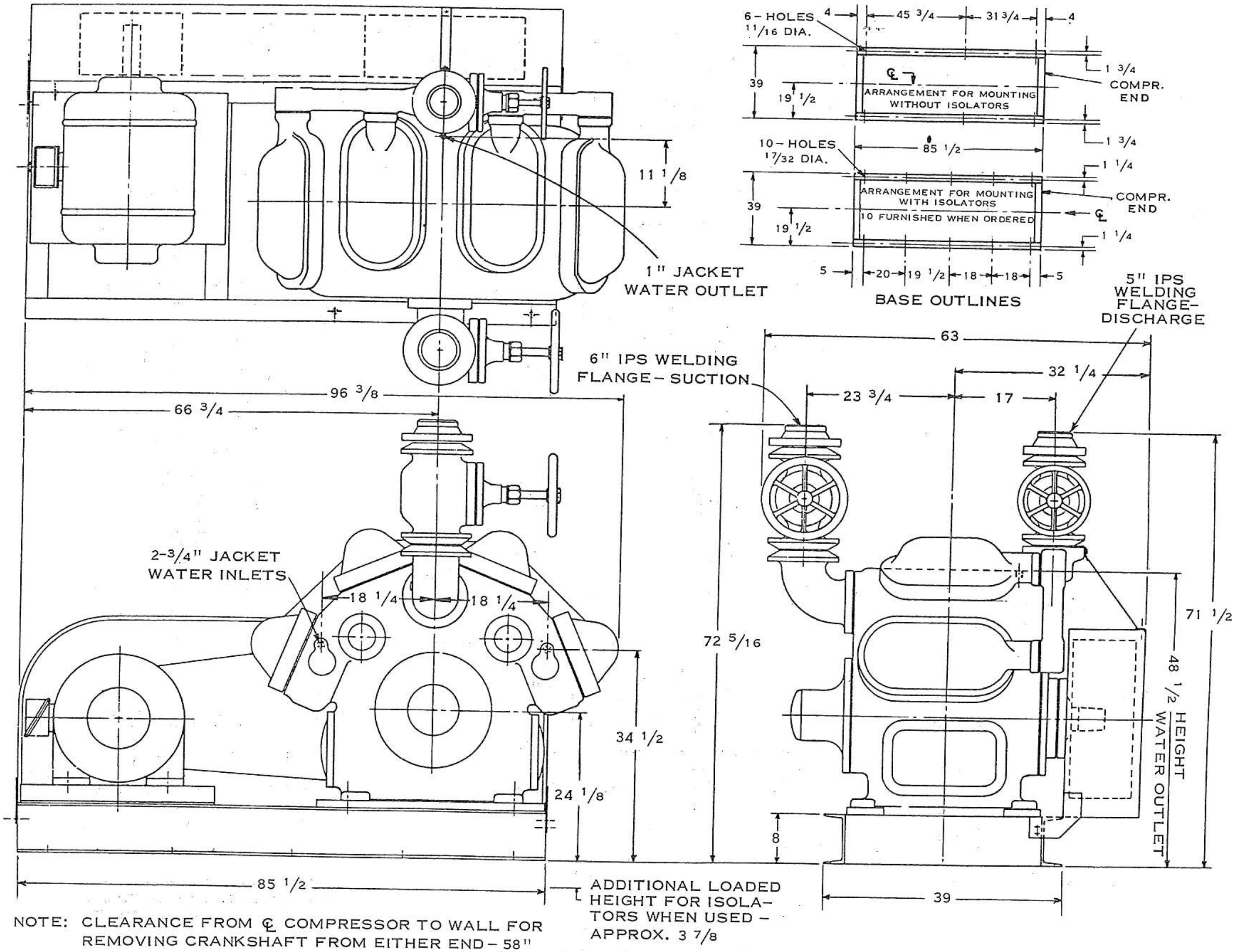


FIG. 4— V-Belt Drive Compressor Units

INSTALLATION

GENERAL

The compressor unit must be properly selected and applied in accordance with the information given in YORK Technical Manual (Form 255. 05-TM) to produce proper end results and to prevent operation with insufficient suction superheat or liquid slopover.

INTERNAL DRYNESS AND CLEANLINESS

It is essential that these compressors be installed and operated in a refrigerant piping system which is thoroughly dry and clean.

Compressors are internally clean, free of moisture and ready for satisfactory operation when they leave the factory. However, if they are installed or operated in a refrigerant system which is contaminated with moisture and/or foreign material, they may be damaged seriously. It is particularly important that all precautions be taken to prevent moisture and foreign material from entering the compressor when installing a new compressor in an existing piping system.

Water or moisture from the refrigerant system (piping, evaporators, receivers or other components) if returned to the compressor can cause possible emulsification of the lubricating oil in the crankcase. Also, dirt and foreign material should be prevented from returning to the suction strainers. It is possible for the smaller particles of foreign material to find their way thru the very fine wire mesh screen and enter the compressor where it can cause damage to bearings, shaft journals, pistons, cylinder walls and seal parts.

During installation, it is therefore necessary to make sure that all pipe and fittings are internally clean and dry, that all welded joints are made carefully to avoid loose drippings on the inside of the piping, that the system is free from leakage and that all piping and low side equipment is installed properly and in a workmanlike manner. Detailed procedures for proper installation of ammonia systems are given in York Service Manual Instruction Form 55. 60-NM1 (2A) and should be followed carefully.

INSPECTION

As soon as it is received, the unit should be inspected for any damage done in transit. If damage is evident, it should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing at once. (See York Service Policy and Procedures - Shipping Damage Claims, Form 50. 15-NM).

The Service Department at York, Pennsylvania should be notified of any claims made.

HANDLING

These units are shipped crated on skids which should not be removed until the unit has been placed in its approximate location.

LOCATION

The unit should be located in a dry and well lighted room, with sufficient space around it to allow room for inspection or service. For removing the crankshaft from either end of the compressor, the space required is shown in Fig. 3 and Fig. 4.

FOUNDATION AND MOUNTING

GROUND - If the unit is to be located on an earth floor it should be placed on a level concrete slab extending 6" to 8" above the level of the floor. (See Fig. 5.)

BASEMENT - Remove a portion of the basement floor so that a concrete base can be poured resting on the ground, extending 6" to 8" above the basement floor and having sufficient space on all sides to install corkboard as shown in Fig. 5.

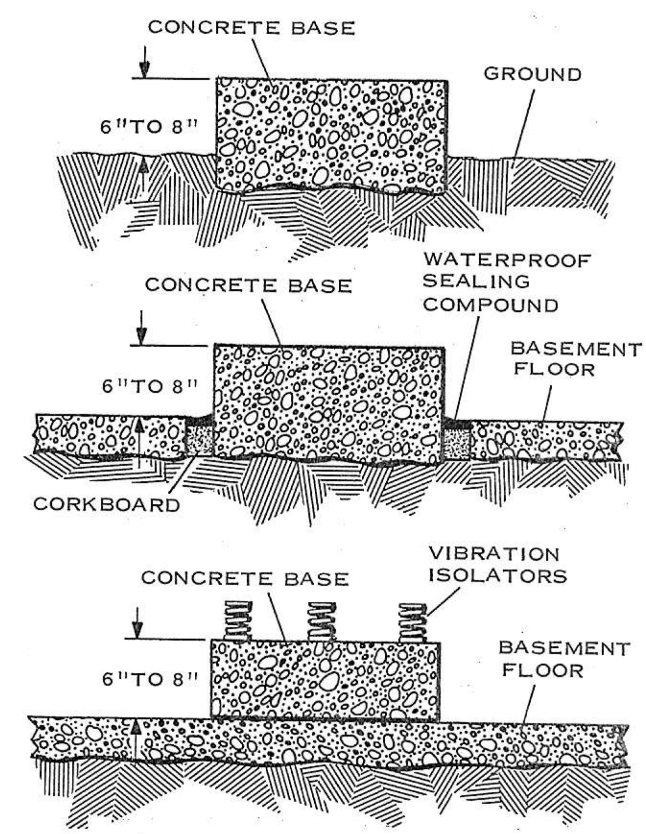


FIG. 5— Typical Unit Foundation

The unit may be mounted on any level floor capable of carrying 150% minimum of its operating weight. In general, vibration isolators are recommended for upper floor installations or for any installation where there is a possibility of objectionable noise being transmitted to the adjacent structure.

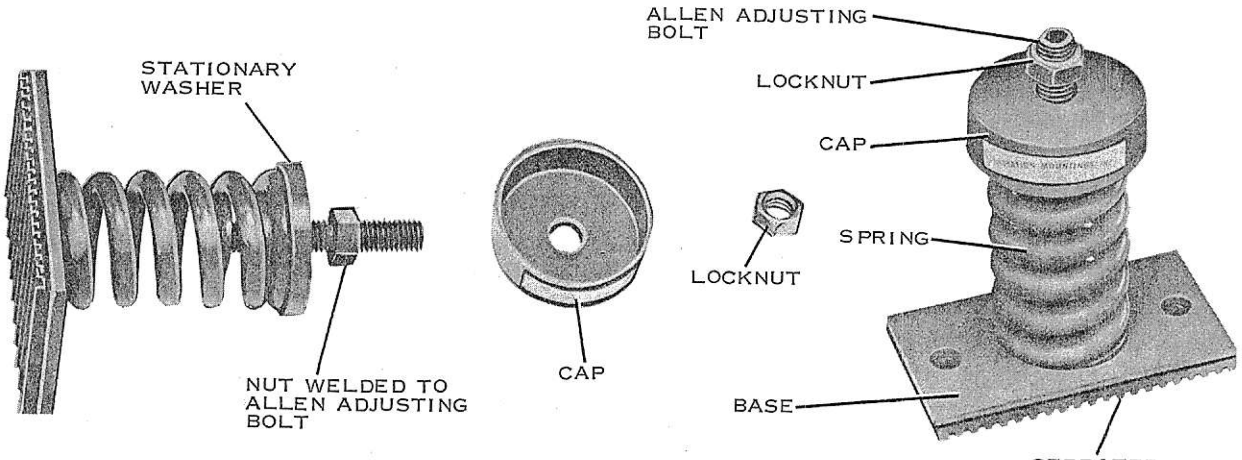


FIG. 6—Vibration Isolator

ISOLATORS

The correct quantity of vibration isolators (ten each for direct and V-belt drive units - York Part No. 028-03540) is furnished for each compressor unit when ordered. Isolator locations for the various units are shown in DIMENSIONS, Fig. 3 and Fig. 4.

These isolators consist of a spring which is welded to a flat steel base to which is attached a serrated neoprene pad. Each base is provided with 17/32" dia. holes, by means of which, the isolator may be secured to the foundation or the floor if desired. (See Fig. 6.)

To install the vibration isolators, proceed as follows:

NOTE:
The base channels on direct drive units contain holes for mounting the ten isolators furnished. (See Fig. 3.)

Isolators on all units should be located and adjusted so that the unit base is level with approximately the same spring tension on each isolator.

On belt drive units, place one isolator in each hole provided in the base (10 total). (See Fig. 4.)

1. By means of jacks, raise the equipment, one end at a time and attach the isolators to the horizontal flanges of the base channels. Insert the 1/2" Allen adjusting bolts from the bottom side of the channels and install the nuts loosely to keep the isolators in position. All isolators should be set at minimum length.

2. With an Allen set screw wrench, turn each adjusting bolt counterclockwise, compressing the isolator spring. Each bolt should be turned an equal amount, not over one full turn at a time, starting at one isolator and progressing around the base to secure even loading with the unit base level. The loaded height of each isolator with the unit level on a level floor or foundation should be approximately 3-7/8" as shown in Fig. 3 and Fig. 4. If any of the isolators should be located in a low spot in the floor or foundation, it may be necessary to insert a suitable steel shim between the neoprene pad on the isolator base and the floor or foundation

FLEXIBLE COUPLING

When these compressors are directly connected to a synchronous motor or other prime mover, a flexible coupling is used. The coupling is flexible, but this does not mean that its alignment is negligible, in fact, the better the initial alignment, the smoother the unit will run. The Thomas type 450CM flexible coupling is used for factory or field installations.

When the compressor unit motor is either supplied or installed by the factory, the flexible coupling is properly aligned and the compressor and motor doweled and secured to the base before shipment. Normally, the compressor unit is ready for operation as received unless damage has occurred during shipment. For the purpose of checking coupling alignment in the field, and to aid in the alignment procedure for field installation of a compressor motor, flexible coupling alignment procedures are given in the paragraphs that follow.

NOTE: It is recommended that flexible coupling alignment ALWAYS be rechecked in the field after the unit has been installed in final position and the piping connections made, since previous alignment may have been disrupted during shipment or installation.

ALIGNMENT PROCEDURE

1. Install the compressor flywheel. Be sure that the tapered hole for the compressor shaft and the key and keyway are clean and that the key is properly fitted.

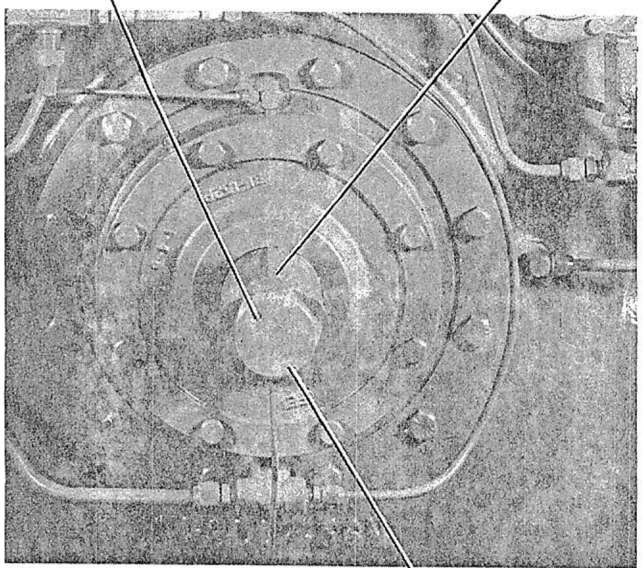


FIG. 7— Compressor - Seal End

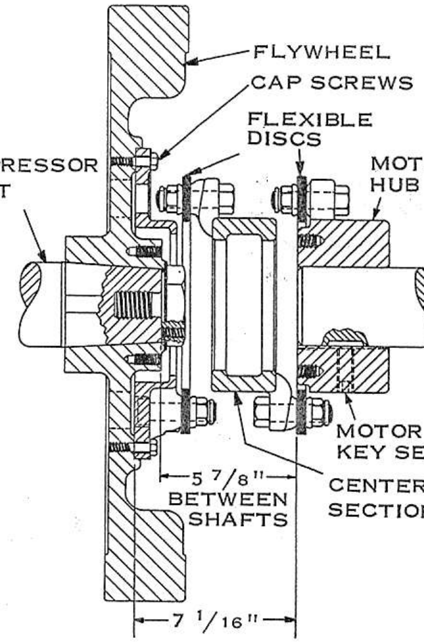


FIG. 8— Flexible Coupling and Flywheel

With the compressor flywheel, its key, the crankshaft cap screw and its washer in place, tighten the cap screw firmly. Lock it in position by tightening the hollow headless set screw located in the cap screw head. Note and mark the position of the flywheel key. (See Fig. 7.)

2. Disassemble the coupling. Note that the compressor half of the coupling is attached to the flywheel by means of cap screws and the motor half mounts on the motor shaft. (See Fig. 8.) It is important to identify the position of all parts since they must be replaced in their original order. A string or wire should be inserted and fastened through one of the bolt holes of each set of laminated rings to retain the original position of the individual discs.

3. Carefully fit the key to the motor hub and motor shaft. The key must bear on the sides and bottom of the keyway but should not bear on the top. Any burrs or bump marks should be removed with a stone or file as required. The motor hub is finish bored for .001" clearance on the motor shaft. (If the hub is supplied rough bored for field machining, finish bore to .001" clearance on the motor shaft.) If necessary, use emery cloth on the bore of the hub and on the motor shaft to remove any paint or burrs in order to obtain a smooth surface, since proper coupling assembly is dependent upon the position of this hub on its shaft.

It may be necessary to heat the motor hub so it will slide more easily on the motor shaft. Place the key in the shaft keyway and slide the heated motor hub in position, flush with the end of the motor shaft. (See Fig. 8). Tighten the set screw.

If the motor hub must be removed, use a wheel puller or the threaded holes in the face of the hub, and a piece of flat stock.

4. Assemble the compressor half coupling to the flywheel, cleaning the surfaces and removing any burrs as necessary to obtain a snug fit. Use the cap screws and lockwashers provided, pulling them down snugly, alternately and evenly.

5. Tighten the compressor mounting bolts securely.

6. Set the motor in position on the base with suitable spacing between the ends of the shafts and tighten the motor mounting bolts hand tight.

NOTE: A minimum distance between coupling flanges is required so that the coupling can be assembled or disassembled without moving the motor. (Refer to Fig. 8.)

7. ANGULAR ALIGNMENT - (Angular relationship of centerline of compressor shaft to centerline of motor shaft.) Using a dial indicator, measure the distance between the faces of the two hub flanges at four points - both sides, top and bottom, rotating the motor as required. (See Fig. 9.) Then adjust the position of the motor and use shims as necessary to obtain correct angular alignment.

NOTE: Rotate the motor half coupling (motor) 360° to locate point of minimum reading on dial; then rotate the face of the indicator and set the zero at this point. Then again rotate the motor and note the misalignment readings. Adjust motor position and place shims under the motor feet as required to bring total variation within the allowable limitations as given in the NOTE of paragraph (9) on next page.

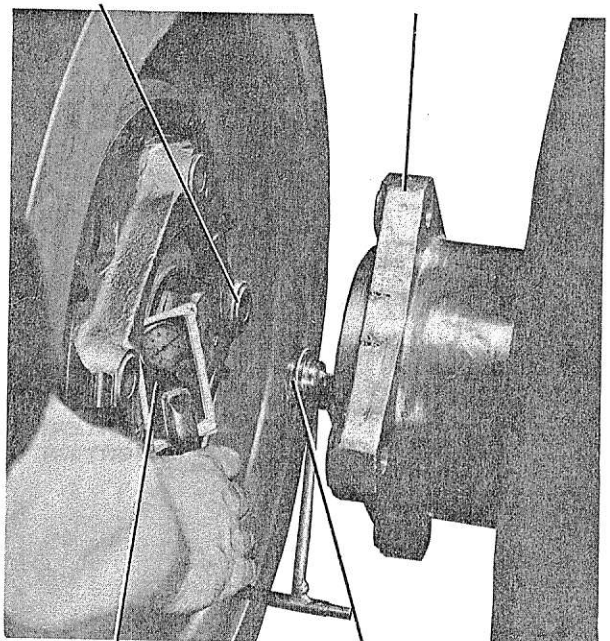


FIG. 9— Checking Angular Alignment

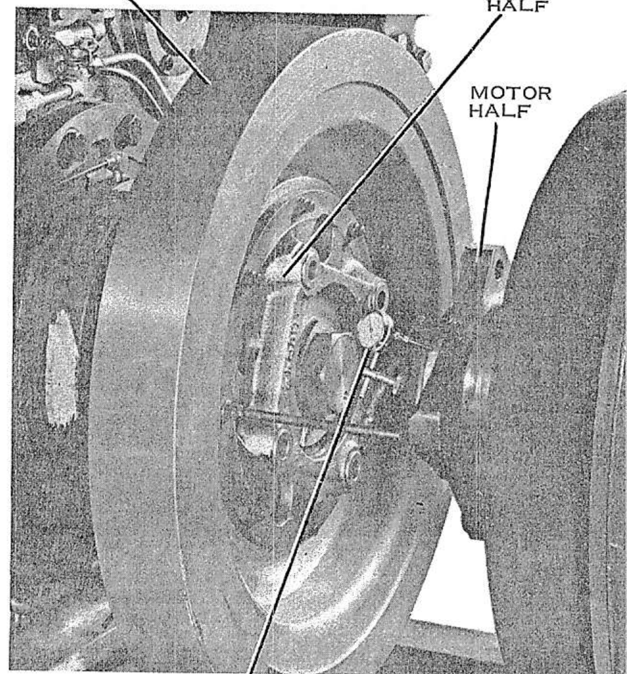


FIG. 10— Checking Parallel Alignment

8. AXIAL OR PARALLEL ALIGNMENT - Secure axial or parallel alignment by clamping the dial indicator to the motor hub with its pointer resting on the outside circumference of the compressor hub as shown in Fig. 10. Rotate the motor shaft, observing the fluctuations of the indicator pointer and adjust the position of the motor until the indicator shows minimum fluctuation while the motor shaft is rotated one full turn.

9. Repeat steps (7) and (8) until both angular and axial alignments are correct.

   NOTE: The importance of correct alignment cannot be over-emphasized. Angular alignment assures that the shafts are parallel to each other. Axial or parallel alignment assures that both shafts are in the same horizontal and vertical planes. Therefore, it is not possible to have correct coupling alignment unless both the angular and axial alignments are correct. Steps (7) and (8) must be repeated as often as necessary to adjust the position of the motor to obtain either alignment, since moving the motor to obtain axial alignment may destroy the angular alignment and vice versa.

   Dial indicator readings may be considered correct when the total variation for one revolution of the motor shaft (and coupling) is .012" or less.

10. When alignment is complete, tighten the motor mounting bolts. Then recheck the alignment to be sure it was not altered while tightening.

11. Loosen the set screws of the motor hub and slide the motor hub toward the motor. This allows space to assemble the coupling discs and center piece.

12. Rotate the motor shaft so that the two keys are 180° apart.

13. Bolt the flexible discs to the coupling hubs. Then bolt the center piece in place. (See Fig. 8)

14. Be sure the motor hub is properly placed on the motor shaft so that it does not exert any push or pull on the flexible discs. Then tighten the motor hub set screws.

15. After correct alignment has been attained the motor and compressor must be doweled to preserve correct alignment. Drill and ream any two diagonally opposite mounting feet of the compressor and motor, using the proper sized drill and reamer with respect to the dowel pins to be used. The holes should be drilled completely through the base and they should be reamed until the dowel pin drives tight when it is seated full depth.

V-BELT DRIVE

Belt driven compressor units are furnished with a matched set of 10 V-belts and the flywheels are grooved for them. Motors and motor pulleys are normally field supplied and will be of varying diameters and bores to provide for different motors and proper compressor speeds. (See PHYSICAL DATA.) Motor adjusting rails should also be field supplied with the motors to provide for adjustment of belt tension and alignment.

NOTE: If the motor has sleeve bearings, check the shaft "end-float" and establish the motor's magnetic center. Make sure to consider this when mounting the motor pulley so that the belts remain aligned when the motor is in operation.

INSTALLING MOTOR PULLEY – Proceed as follows:

1. Fit the key to its keyway in both the motor shaft and in the motor pulley. If necessary, remove any burrs, paint or foreign substances.

2. Slide the motor pulley on the motor shaft and temporarily secure the set screw(s).

SECURING THE MOTOR TO BASE – Proceed as follows:

1. Place the motor and adjusting rails on the unit base and slide the motor toward the compressor far enough to permit placing the V-belts on the pulleys without stretching. Slide the motor back to remove the slack.

2. Align the motor on the unit base, making sure the face of the motor pulley is parallel to the face of the flywheel so that final belt alignment may be made by moving the pulley back and fourth on the motor shaft. (See V-BELT ALIGNMENT AND TENSION paragraph 1.)

3. Secure the motor rails to base and the motor to the rails as necessary, depending upon the type of adjusting rails used.

V-BELT ALIGNMENT AND TENSION – Proceed as follows:

1. Aligning the V-Belt Grooves – With the V-belts in their grooves and with the slack in the belts removed, place a straight-edge on the outer face of the flywheel, extending over to the far edge of the motor pulley. Measure a distance from the straight-edge to a groove in the flywheel, then reset the pulley on the motor shaft so that the distance from the straight-edge to the corresponding groove is the same as the distance from the straight-edge to the groove in the flywheel.

2. Tighten the motor pulley on the motor shaft.

3. Adjusting the Belt Tension and Final Alignment – Since belt tension and final alignment are inter-related, tension can be measured only when the drive is in proper alignment. When more or less tension is to be applied to the V-belts, the motor must be moved toward or away from the compressor.

   To have proper belt tension, one of the center belts should have about one inch "sag" when applying thumb pressure half way between the motor pulley and the flywheel when the drive is in proper alignment. When this condition is obtained, tighten the bolts holding the motor to the base.

   IN NO CASE SHOULD THE BELTS SCREECH WHEN THE MOTOR IS STARTED.

COMPRESSOR OIL QUANTITIES

Use York ammonia compressor oil "A" or York refrigeration oil "C".

It is very important, particularly when these compressors are used for ammonia (Refrigerant-717) duty, that the crankcase(s) be kept supplied with an ample quantity of oil at all times. In an ammonia system, oil is not readily returned from the evaporator(s). Consequently, any oil that leaves the compressor crankcase(s) finds its way to the evaporator(s). When this quantity builds up too high, evaporator efficiency decreases and this oil must be drained through valves provided for the purpose. Since the oil in the evaporators comes from the compressor crankcase(s), it is important to return as large a percentage as possible before it can enter the piping system. A York DOT type discharge line oil separator should always be installed with each compressor unit to aid in the control of oil in the evaporator or evaporators.

DISCHARGE LINE OIL SEPARATOR

SINGLE COMPRESSOR APPLICATION – For a single compressor application, a DOT size 14 discharge line oil separator is recommended. The separator should be installed in the discharge line as far away from the compressor as practical.

The discharge line oil separator serves to reduce to a minimum the concentration of oil in the evaporator(s) by removing the oil from the discharge gas and returning it to the compressor crankcase. The oil thus removed never reaches the evaporator(s). For an application using a single compressor, oil returned from the discharge line oil trap can be piped directly to the compressor crankcase, using one of the plugged ips holes in the cover plate, provided a solenoid valve and timer is used to prevent the oil from returning to the crankcase for a period of 5 minutes after start-up. (See Fig. 11). This is necessary to prevent the possibility of returning liquid ammonia to the crankcase. At start up the compressor top heads, discharge line, and separator may act as condensers until they become warm. (See Fig. 24).

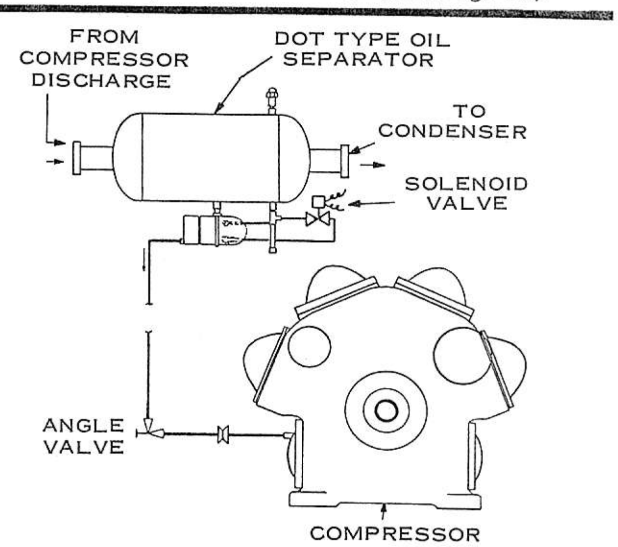


FIG. 11— Typical Discharge Line Oil Separator Conn. - Single Compr. Application

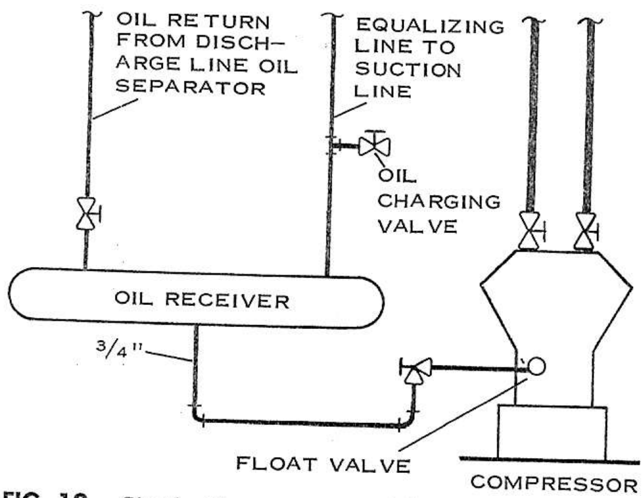


FIG. 12— Single Compressor with Oil Receiver

An alternate method is to return the oil from the separator to a receiver and to feed the oil to the crankcase in the same manner as is done with parallel installations.

To provide greater flexibility of operation, the oil return from the discharge line oil separator may be piped into an oil receiver and the oil from the receiver be piped to an oil float valve located inside the compressor in the cover plate. By this means oil is returned to the crankcase(s) in proportion to its requirement. (See Fig. 12.)

MULTIPLE COMPRESSOR APPLICATION WITH INDIVIDUAL DISCHARGE LINE OIL SEPARATORS - When more than one compressor is connected in parallel to a single system or load, each compressor can be provided with its own DOT size 14 discharge line oil separator, returning the oil direct to each crankcase, as described in SINGLE COMPRESSOR APPLICATION above. An oil receiver and float valve for each compressor may be used to provide greater flexibility of operation if desired.

MULTIPLE COMPRESSOR APPLICATION WITH SINGLE DISCHARGE LINE OIL SEPARATOR - When not more than two compressors are connected in parallel to a single system or load, one DOT size 20 discharge oil separator may be used. The separator should be placed in the discharge line beyond the "last" compressor so that when either or both of the compressors are in operation, the gas discharged must pass through the separator. (See Fig. 14.)

If a 6-3/4" x 5" should be paralleled with a 3-3/4" x 3" compressor, it is necessary that the return lines from the oil receiver be connected into the compressor crankcases so that their operating oil levels (the levels maintained by the respective crankcase float valves) are on the same plane with the bottom of the oil receiver. (See Fig. 14.) The elevation of the oil receiver is important. During operation the static head plus a small pressure difference forces oil into the crankcase. If the crankcase float should stick open, and the compressor is stopped, the pressures will equalize and the oil in the crankcase and in the receiver will find the same level. This level must be low enough to prevent damage to the compressor when starting up.

The layout drawings for the installation should be carefully followed. All piping work should conform with local codes.

To prevent transmission of compressor vibration through the refrigerant piping system, it is recommended that the suction and discharge lines (usually steel pipe and welded fittings) be run in each of 3 directions for 15 to 30 pipe diameters before securing them to a structure.

Where mounting isolators are used, the lines are to be vertical for as far as practical, then horizontal, to give the maximum amount of flexibility. The flexibility thus provided should be sufficient so that the unit may be bounced with one's weight. Flexibility must be provided in the oil line to each crankcase float when used.

CRANKCASE FLOAT VALVE

Fig. 13 shows a cross section of a compressor hand hole cover with the crankcase float valve installed.

One hand hole cover on each compressor is drilled and tapped to receive this float.

The shipping plugs in this cover are put in with while lead only. If the tapped holes are not to be used, the plugs should be removed and put back in, using a standard pipe thread compound such as Locktite or litharge and glycerine.

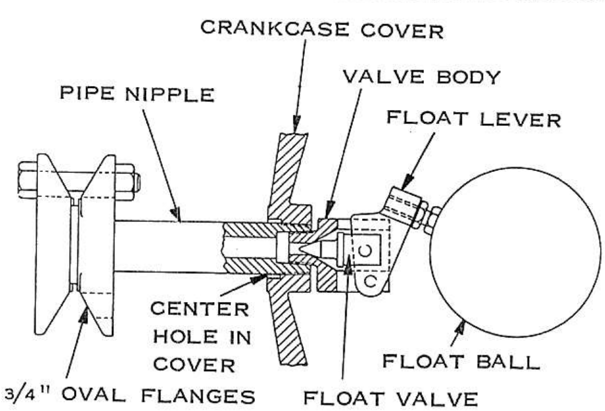
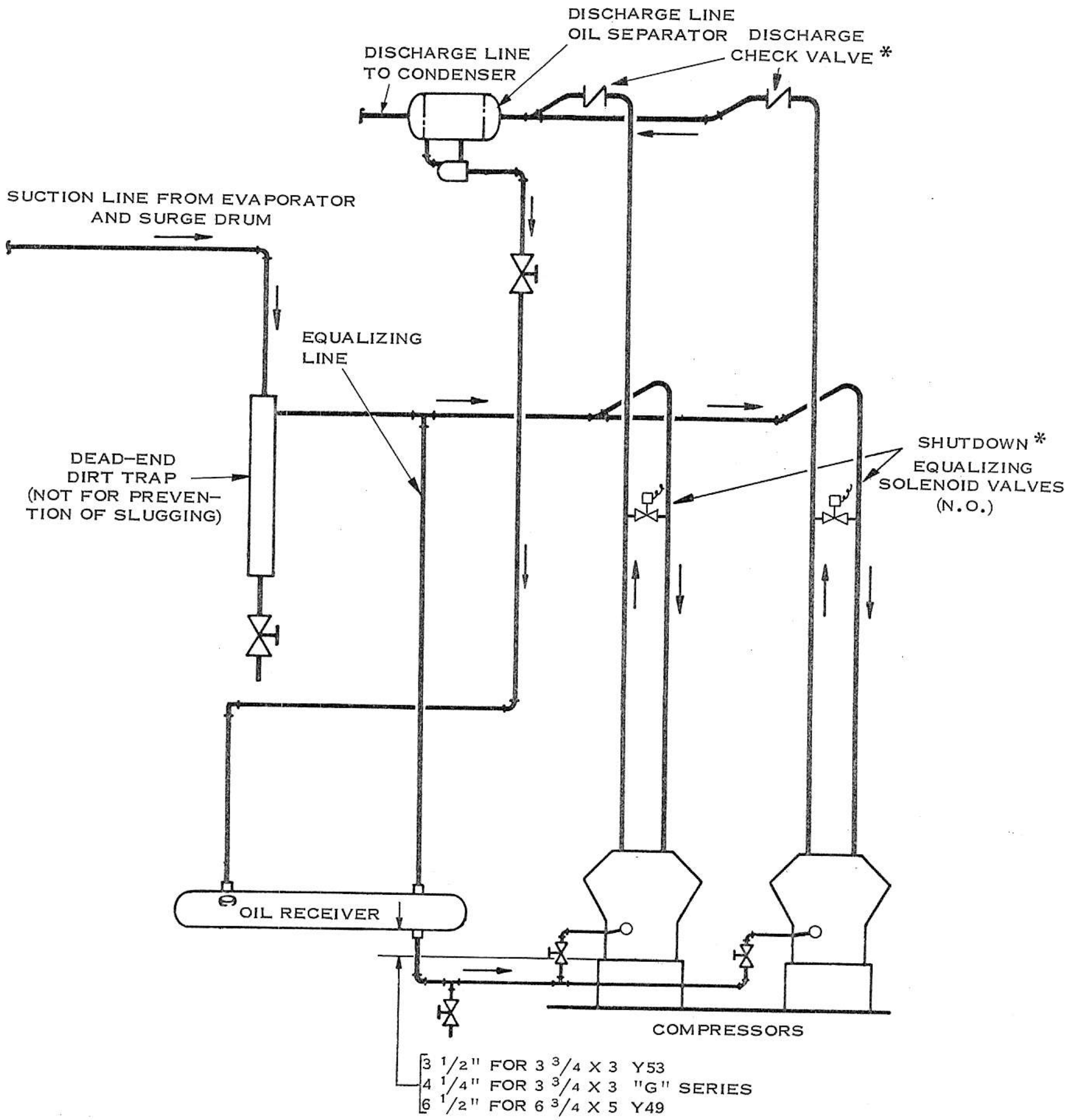


FIG. 13— Crankcase Float Valve

SUCTION MAINS

Before shipment from the factory, these compressors are given a preliminary test run, and charged with the proper amount of oil. To insure absolute cleanliness, it is important to keep the suction and discharge stop valves closed during installation, until final connections have been made.

Suction mains should be laid out with the objective of returning only clean, dry gas to the compressor. There is always the possibility of dirt and scale being carried along from the evaporators, especially where a new compressor is connected to an old system. This foreign material may collect on the bottom of the horizontal run of pipe and should be prevented from being drawn along with the suction gas to the compressor. A suction line dead end trap will prevent this material from entering the compressor. (See Fig. 14).



*NOTE:

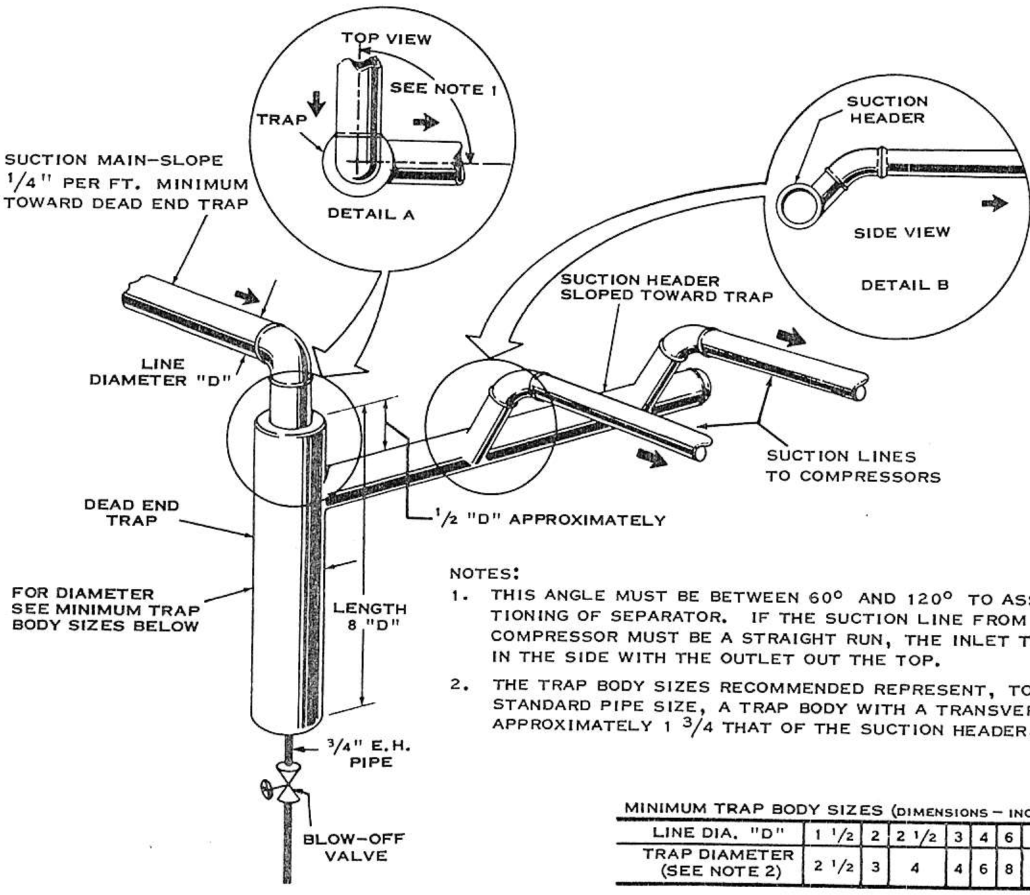
For parallel compressor application, discharge check valves should be used to prevent the flow of high pressure gas into the non-operating separator or compressor.

When a common oil separator is used the discharge check valves should be located as shown above.

When individual oil separators are used the discharge check valves should be located between each separator and the main.

To permit the discharge check valves to seat as tightly as possible, a 1/4" line between the compressor side of the discharge check valve and the suction line should be used. (See above Fig.). A normally open solenoid valve should be located in this 1/4" line and wired as shown in Fig. 24.

FIG. 14—Refrigerant and Oil Connections, Multiple Compressors



NOTES:

1. THIS ANGLE MUST BE BETWEEN 60° AND 120° TO ASSURE PROPER FUNCTIONING OF SEPARATOR. IF THE SUCTION LINE FROM EVAPORATOR TO COMPRESSOR MUST BE A STRAIGHT RUN, THE INLET TO THE TRAP MAY BE IN THE SIDE WITH THE OUTLET OUT THE TOP.
2. THE TRAP BODY SIZES RECOMMENDED REPRESENT, TO THE NEAREST STANDARD PIPE SIZE, A TRAP BODY WITH A TRANSVERSE AREA OF APPROXIMATELY 1 3/4 THAT OF THE SUCTION HEADER.

MINIMUM TRAP BODY SIZES (DIMENSIONS – INCHES IPS)

LINE DIA. "D"	1 1/2	2	2 1/2	3	4	6	8	10
TRAP DIAMETER (SEE NOTE 2)	2 1/2	3	4	4	6	8	12	14

FIG. 15— Typical Suction Main, Dead End Trap and Connections

SUCTION LINE DEAD END TRAP

Fig. 15 shows a typical suction main, dead end trap and compressor connections for two compressors. General dimensions for field construction of a dead end trap are given. The trap may be connected similarly for use with a single compressor by connecting the compressor suction line directly to the side outlet of the trap.

The suction gas returning from the system tends to drop foreign material into the dead end trap due to the 90° change in direction of its flow as shown in Detail A.

The suction outlets from all evaporators should be run up to a common level and maintainted at this level to the dead end trap without any low pockets where oil can collect.

The connections to individual compressors should slope up from the bottom of the header and be connected into it tangentially as shown in DETAIL B of Fig. 15 as shown.

PUMP-OUT AND BYPASS CONNECTIONS

When so specified, pump-out and bypass connections are assembled to the compressor at the factory. (See Fig. 16.)

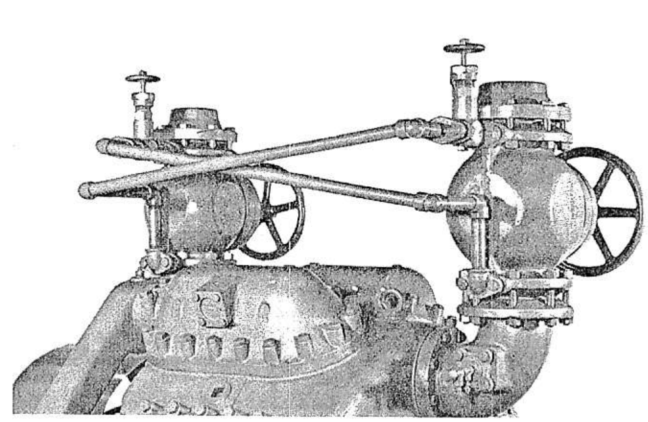


FIG. 16— Typical Pump Out and Bypass Connections

DISCHARGE GAS THERMOMETER WELL

The discharge gas manifold of each compressor is provided with two 3/4" ips plugs located at the top of the manifold, one on each side of the discharge stop valve. (See Fig. 19.) One of these plugs should be removed and the steel thermometer well furnished (in the Accessory Tool Kit) should be installed in its place. The discharge temperature thermometer should be installed in this well after all installation work has been completed, just before startup.

WATER JACKET PIPING

Connect water supply and drain lines to the water jackets. (See Figs. 3 and 4.) The water flow through the jacket should be adjusted to maintain the water temperature off at 95 F. All water connections in and out of jacket are tagged.

If the compressor unit(s) are to be installed in a location where the ambient or operating temperature can drop below 32 F, it is necessary to provide some means (either automatic or manual) of draining the water from the jackets to prevent possible damage due to freezing on the OFF cycle.

ELECTRICAL CONNECTIONS

The electrical hookup consists essentially of making the connections between the main power source and the fused disconnect switch, the across the line or step starters and the motor(s) and the safety controls (oil pressure safety switch and high and low pressure cutouts). Also the solenoid valves of the capacity control system, when ordered, must be connected. Typical wiring connections are shown in Fig. 24 in the OPERATION section of this book. If two compressors are connected in parallel, a time delay relay should be used to prevent the second compressor from starting until the first one has come up to speed.

All electrical work should be installed in accordance with local and national electrical codes.

PRESSURE CONTROLS AND GAUGE BOARDS

The H.P. Control (furnished with the special compressor tools) is a Mercoid No. 64R, York Part No. 025-04945P.

The optional L.P. Control is a Mercoid DA64-3, York Part No. 025-04944P.

Mount the optional guage board and pressure controls on a wall or other convenient location close to the unit and install the gauges. Using 1/4" seamless, annealed steel tubing, run a line from the connectors in the 1/4" capped valve in the compressor suction elbow to the suction pressure gauge. The low pressure cutout and oil pressure safety switch should be connected to the remaining open connector on the suction elbow as shown in Fig. 18 and Fig. 19. (See DIFFERENTIAL OIL PRESSURE SAFETY SWITCH.) Similarly, run 1/4" tubing from a connector placed in the 1/4" ips opening in one of the 3/4" ips plugs in the discharge manifold to a tee and the high pressure cutout and the discharge pressure gauge. (See Fig. 19.)

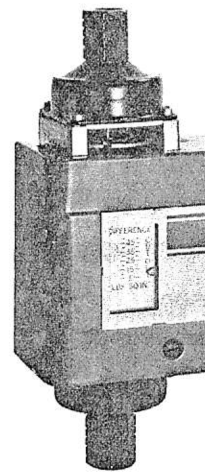


FIG. 17— Differential Oil Pressure Safety Switch

DIFFERENTIAL OIL PRESSURE SAFETY SWITCH

A differential oil pressure safety control switch, York Part No. 025-05782 is furnished with each compressor unit. (See Fig. 17.)

This control, which is shipped loose, should be mounted on a wall or other convenient location. Pressure connections should be made from the oil pump discharge to the bottom or high pressure bellows. Connect a 1/4" O.D. steel tube from the upper or low pressure bellows to the suction elbow of the compressor using the connectors provided. The low pressure cutout should also be connected into this line as explained under PRESSURE CONTROLS AND GAUGE BOARDS. (See Fig. 18 and Fig. 19.)

This control functions to shut down the compressor if for any reason, oil pressure should drop below a safe operating level. For detailed operation of this control and wiring connections see DIFFERENTIAL OIL PRESSURE SAFETY SWITCH in the OPERATION section of this book and Fig. 24.

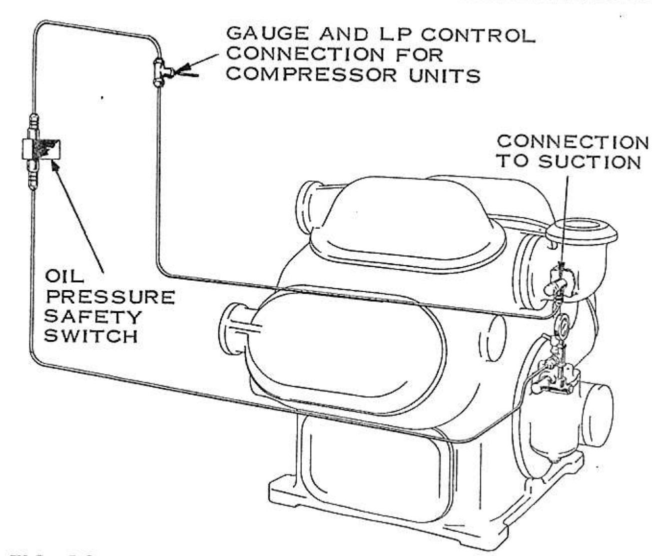


FIG. 18— Tubing Connections – Oil Pressure Safety Control

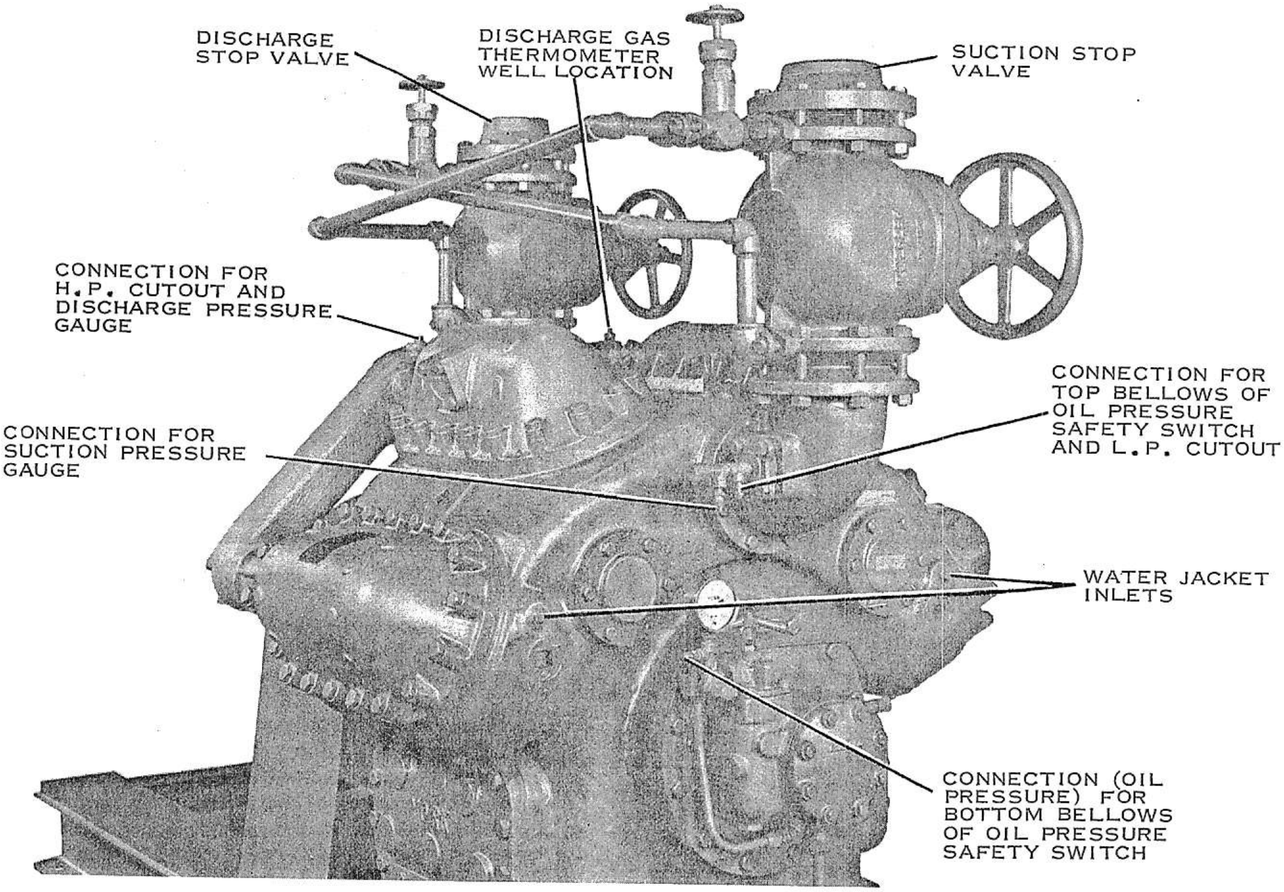


FIG. 19— Connections - Oil Pressure Safety Switch, H.P. & L.P. Cutouts, Suction & Discharge Pressure Gauges

TESTING

It is important that the ammonia piping system including the evaporator(s), the condenser, the receiver, the compressor and all interconnecting piping and valves and fittings be refrigerant tight and free from leaks, even small ones. The following considerations should be fully observed during the testing procedure:

Before ammonia is charged into the system, an air or dry nitrogen pressure test must be applied. The compressor must not be used for this purpose. Instead, an air compressor capable of pumping 300 psig. should be used. If dry nitrogen is used to build the test pressure, a pressure regulating valve on the dry nitrogen cylinder and a stop valve in the charging line between the cylinder and the refrigerant system are required. As soon as the required pressure has been created in the refrigerant system, this stop valve must be closed to guard against creating a possible excessive pressure in the system.

Minimum test pressures as follows should be used:

Low Side-evaporator(s), suction lines, liquid expansion device(s), dead end oil trap or any other low side refrigerant-containing equipment - - - 150 psig.

High Side – condenser, discharge line oil trap, discharge lines, h.p. receiver, liquid lines and any other high side refrigerant-containing equipment - - - 300 psig.

The following is a suggested procedure for applying the pressure test. It is important that the compressor suction and discharge stop valves be tightly closed during this test - otherwise scale, moisture or foreign material may enter the compressor.

1. Connect the source of test pressure to a convenient valve on the high side such as the condenser purge valve.

2. Open all system stop valves and close all oil blow-down and drain valves.

3. Introduce a test pressure of approximately 25 psig and make a rapid check for any major sources of leakage. If leakage exists, blow down the test pressure, repair the leak and re-establish the test pressure. (See BLOWDOWN PROCEDURE Following.)

4. Gradually build up the test pressure to 150 psig, repairing any major leaks that may develop with the higher pressure as explained in paragraph 3 above. When the system is free of leaks at 150 psig pressure, close off the source of test pressure, noting carefully the exact system pressure. Allow this pressure to remain for several hours, preferably overnight. Then observe the pressure on the same gauge used to obtain the previous reading. If even a slight reduction of pressure is shown, the presence of very small leaks is indicated.

5. Carefully examine all threaded, flanged, and welded joints, and valve stuffing boxes for leaks, using soap suds freely. Very small leaks that require one or two minutes to show bubbles are NOT TO BE PASSED. A few drops of glycerine in the soap suds will make the lather last longer. Repair any leaks discovered and allow the test pressure to remain on the system.

6. Close the liquid stop valve in the line leaving the condenser or hp receiver and introduce 300 psig test pressure on the high side of the system, repairing any leaks discovered. Following the procedures explained in paragraphs (3), (4) and (5) above.

NOTE: If the system contains any relief valves that would be lifted at this pressure, they should be removed and the opening in the system be plugged or capped before this pressure is applied.

Allow the test pressure to remain on both the high and the low sides of the system for blowdown purposes.

BLOWDOWN PROCEDURE – It is important that blowdown of system test pressure be done carefully since it is possible to eliminate a considerable portion of the moisture and foreign material such as welding slag, rust and dirt by this means.

With the test pressure on both sides of the system, blow it out through the oil drain and blowdown valves at low points. Open these valves wide, quickly to take full advantage of the velocity of the test pressure to sweep along moisture and foreign material and purge it from the system. Observe the quantity of foreign material and moisture removed in this manner. Build up pressure and blow it down repeatedly if required, until no further removal of moisture and foreign material is indicated.

When all leakage has been eliminated and the quantity of foreign material and moisture reduced to minimum, the system is ready for evacuating the air as explained in EVACUATING THE SYSTEM.

EVACUATING THE SYSTEM

Before charging the system with ammonia, it is first necessary to pump as great a vacuum as possible in the entire system, both to remove all air and to evaporate and expel any remaining moisture. To do this, proceed as follows:

1. Connect a vacuum pump to a convenient point in the system such as the condenser purge valve or the system charging valve.

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

3. Stop the vacuum pump, close the stop valve, and allow the vacuum to remain in the system for a sufficient length of time to assure that no leakage exists. The system is ready to be charged with ammonia.

CHARGING AMMONIA

Place an initial charge of ammonia into the system sufficient to produce a pressure of approximately 20 psig., making sure that gas only is used to break the vacuum. The York flexible charging connection, Part No. 068-04225 (3/8" size) or 068-04226 (1/2" size) is recommended for the charging procedure. For detailed information on charging ammonia, refer to Form 55.60-NM1 (Instruction 2A). With the initial charge in the system, the compressor may operated to complete the charging procedure. (See INITIAL OPERATION.)

HANDLING AMMONIA – Ammonia (Refrigerant-717) gas is poisonous if inhaled in large quantities, and in lesser quantities is irritating to the eyes, nose, and throat. Liquid ammonia when splashed in the eyes or when it contacts the skin is specially injurious. Therefore it is important to use care when charging or servicing refrigerant systems or whenever Refrigerant-717 (ammonia) is being handled.

If it is necessary for any reason to enter or to work in a room or space where the concentration of ammonia is high, a gas mask especially designed for use with ammonia should always be worn. The York Gas Mask, Part No. 026-02496, with complete instructions attached, is recommended.

TESTING FOR AMMONIA LEAKS – During the process of charging refrigerant, the system should be checked carefully for ammonia leaks. A small leak may be noticed readily by its odor, but its location may be difficult to find. Detector reagents such as sensitive paper or a sulphur taper may be used to locate the area of greatest intensity of leakage as explained in Form 55.60-NM1 (Instruction 2-A). Then for very small leaks a small quantity of oil on the joint will show the exact point of leakage.

INITIAL OPERATION

All compressors are thoroughly checked and given a running test at the factory before shipment. They are shipped with the proper quantity of oil in the crankcase. Unless damaged during shipment or installation, compressors are ready to run when received. However, it is imperative that a careful check be made before the compressor is first started and that it be watched very carefully during the initial operating period. The following items must be thoroughly checked and corrections made as required:

1. The flexible shaft coupling must be in correct alignment. If the motor was installed at the factory it was correctly aligned before shipment; however, it is necessary that a recheck be made before operation to be sure that this alignment was not disturbed. If the motor is to be installed on the job or the alignment rechecked, follow the procedure as given under FLEXIBLE COUPLING.

2. Check the crankcase oil level. The oil level is correct when the oil stands halfway between the oil sight glasses with the compressor stopped. (See COMPRESSOR OIL SYSTEM in the OPERATION section of this book.) If it is necessary to add oil, use York Ammonia Compressor Oil "A" or York Refrigeration Oil "C". Connect a York hand oil pump to the compressor oil charging valve but do not tighten the flare nut on the delivery tubing. With the bottom or suction end of the pump well submerged in oil to avoid the entrance of air, operate the pump

until oil drips from the flare nut joint, allowing the air to be expelled, and tighten the flare nut. Open the compressor oil charging valve and pump in oil until the proper level is reached. Close the compressor oil charging valve.

3. Install the discharge thermometer in its well. (See Fig. 19). Before inserting the thermometer, a small quantity of oil may be placed in the thermometer well.

4. Open the suction and discharge stop valves. Make sure that the condenser is in full operation and start the compressor.

During initial operation and until the system is fully charged with refrigerant, it may be advisable, depending upon the load, to operate the compressor at less than full capacity. (See COMPRESSOR CAPACITY CONTROL.) Allow it to run for a short time, being ready to stop it immediately if any unusual noise or other adverse condition should develop. When starting the compressor, always make sure the oil pump is functioning properly as shown by the pressure gauge in the oil supply line located adjacent to the oil filter.

NOTE: The oil pressure should never be less than 20 psi above compressor suction pressure; since 20 psi is required to actuate the unloader mechanism and to provide an adequate flow of oil through the bearings. An operating pressure of 20 to 35 psi above suction pressure is recommended for all compressor operation.

The compressor is designed for crankshaft rotation in either direction. The oil pump is installed for shaft rotation as shown on the plate at the top of the pump bearing head (clockwise facing this head). To reverse crankshaft (and oil pump) rotation refer to REPLACING THE OIL PUMP ASS'Y in the SERVICE SECTION of this book.

If the oil pressure does not build up, stop the compressor, remove the seal cap and screw in the oil pressure regulating valve stem. Then re-start the compressor. The oil pressure is increased by screwing in, and decreased by screwing out on the stem. (See Fig. 20.) The handle on top of the oil filter should be rotated from time to time to be sure the oil filter is clean. (See OIL FILTER in the OPERATION section of this book.

5. Check the operation of the safety control switches to be sure that they function to stop the compressor motor in case the settings are exceeded. (See OPERATION.)

6. With the receiver liquid outlet valve closed and the ammonia cylinder valve opened or throttled to maintain suction pressure at approximately 10 to 15 psig., continue the charging operation. Make sure that no liquid returns to the compressor - compressor suction superheat should be a minimum of 10 F. Compressor suction superheat is indicated by the difference between the temperature of the suction gas as read on a thermometer in the well in the suction inlet flange and the corresponding temperature for the pressure of the suction gas as shown in the standard pressure-temperature tables for saturated ammonia gas. Do not permit the discharge gas temperature to exceed 375°F.

7. If the compressor has been functioning satisfactorily, it is ready for continuous operation and pull down of temperatures in the evaporator(s).

8. Inspect and clean the suction strainer(s) within thirty minutes to one hour after starting initial operation. Recheck every two hours thereafter during operation until no further dirt appears. (See COMPRESSOR SUCTION STRAINERS in the SERVICE section of this book.)

NOTE: During initial pull-down of evaporator temperatures when the compressor loading is greatest and at any other time during normal operation, the compressor must be operated at suction and discharge temperatures and pressures no higher than shown in LIMITATIONS in this book.

OPERATION

COMPRESSOR OIL SYSTEM

The compressor oil system has two functions as follows:

1. Lubrication of all moving parts.
2. Furnishing hydraulic pressure for operation of compressor capacity control system. For details, see COMPRESSOR CAPACITY CONTROL.

OIL LEVEL - The correct oil level is midway between the sight glasses with the compressor stopped. During operation this level should not be higher than 1/2 the top sight glass nor lower than 1/2 the bottom glass. (See Fig. 20.)

NOTE: A change from the bullseye or rounded sight glass to the flat type has recently been made. Both types are shown in the illustrations in this book. (See also COMPRESSOR OIL SIGHT GLASSES in the SERVICE section of this book.)

YORK AMMONIA COMPRESSOR OIL "A" OR YORK REFRIGERATION OIL "C" SHOULD ALWAYS BE USED IN THESE COMPRESSORS.

LUBRICATION SYSTEM - The gear type compressor oil pump is directly connected to the crankshaft and is located externally on the rear bearing head as shown in Fig. 20.

An external suction tube connects the pump to a vortex eliminator which is located inside the crankcase at the bottom. The vortex eliminator is provided with an inlet slot which prevents the formation of a vortex, or a swirling condition of the oil, as it enters the pump suction, which could cause loss of pump discharge pressure. Mounted in a tee located in the pump suction tube is the seal capped compressor oil charging and drain valve as shown in Fig. 20. An adjustable pressure regulating valve is mounted in the oil pump discharge space in the compressor bearing head. This valve functions to relieve direct to the crankcase, a portion of the oil discharged from the pump, and by this means, to control the pressure of the oil being discharged from the pump to the bearings and oil filter. (See OIL FILTER.)

High pressure oil leaving the oil filter flows into a steel header which is screwed into the filter outlet. Mounted on this manifold is a capped angle valve into which is screwed the oil pressure gauge. Also mounted on this manifold is a cinch type connector for 5/8" OD steel tubing and a cinch type ell for 1/4" OD tubing. The 5/8" tubing runs downward, to a tee mounted on the underside of the bearing housing to feed the pump end main bearing as shown in Fig. 20. From one outlet of this tee an external steel tubing connection runs under the LH cylinder bank (containing No. 7 & 8 cylinders) to a tee under the seal end main bearing. (See Fig. 21.) From this tee, oil from the pump is fed to the seal end main bearing and the capacity control system as shown.

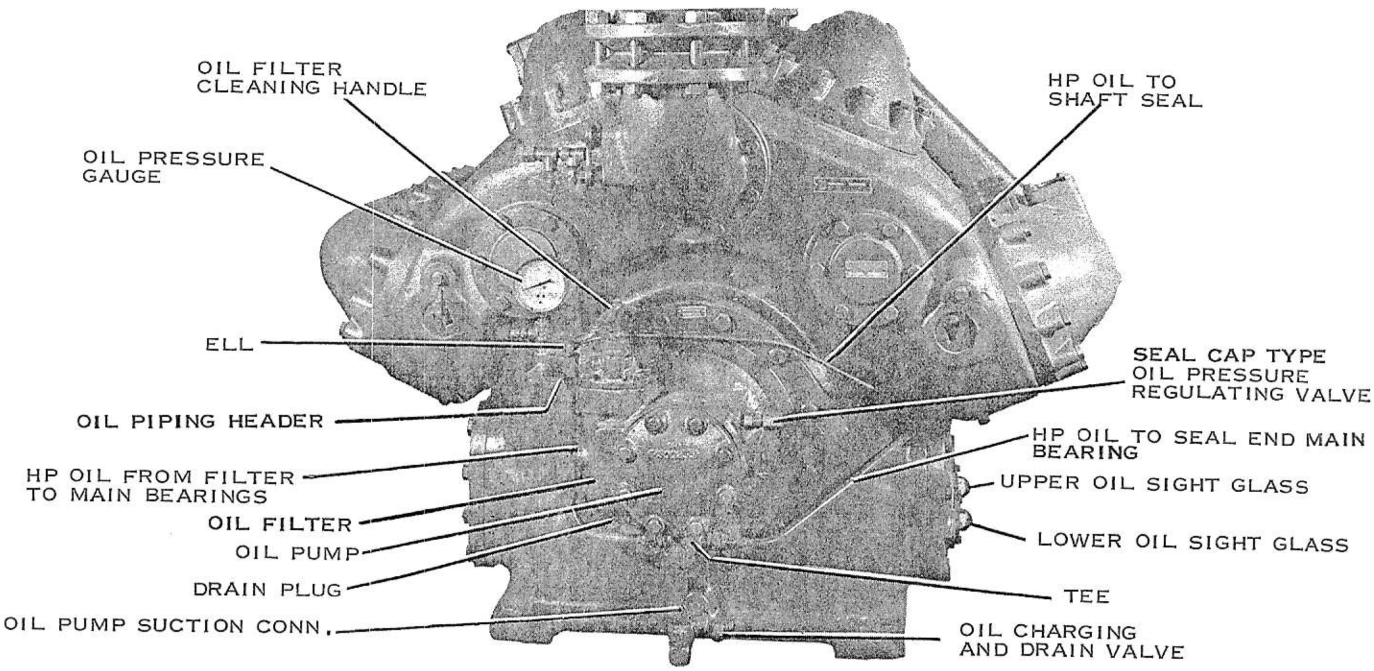


FIG. 20—Oil Piping - Pump End

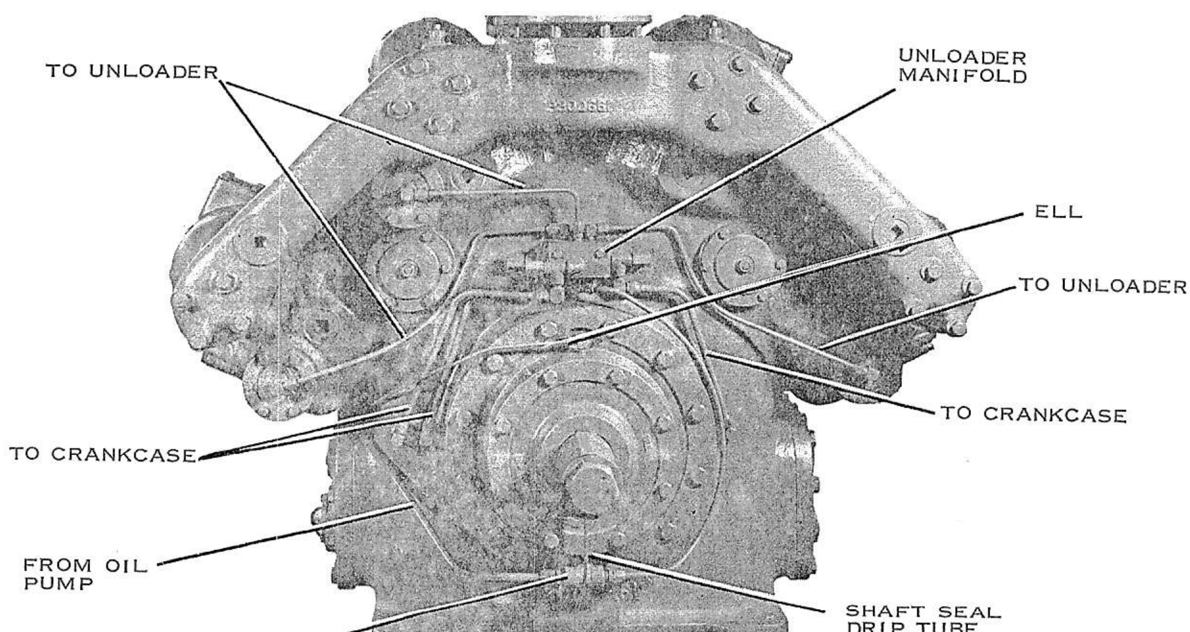
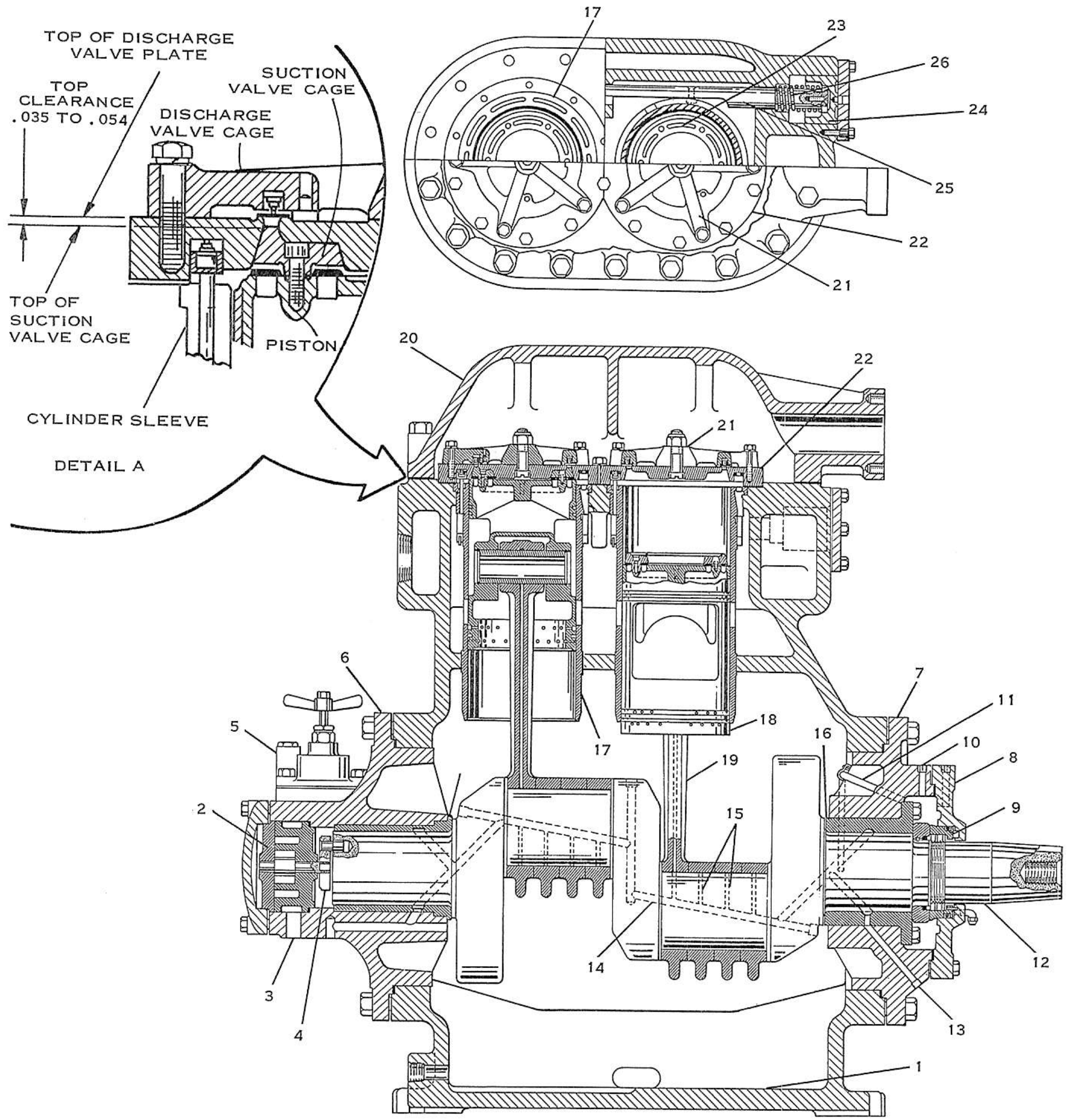


FIG. 21—Oil Piping - Seal End



LEGEND

1. COMPRESSOR HOUSING	14. DRILLED OIL WAYS IN CRANKSHAFT
2. OIL PUMP	15. DRILLED OIL FEEDS TO CONNECTING ROD BEARINGS
3. OIL PUMP SUCTION CONNECTION	16. MAIN (CRANKSHAFT) BEARINGS
4. OIL PUMP CRANK	17. CYLINDER SLEEVE
5. OIL FILTER	18. PISTON ASSEMBLY
6. OIL PUMP BEARING HEAD	19. CONNECTING ROD ASSEMBLY
7. SHAFT SEAL (THRUST) BEARING HEAD	20. TOP HEAD
8. SHAFT SEAL COVER PLATE	21. DISCHARGE VALVE CAGE
9. SHAFT SEAL ASSEMBLY	22. DISCHARGE VALVE PLATE
10. OIL FEED TO SHAFT SEAL	23. SUCTION VALVE CAGE
11. OIL RETURN – SHAFT SEAL TO CRANKCASE	24. UNLOADER PISTON
12. CRANKSHAFT	25. UNLOADER PUSH ROD
13. OIL FEED TO SEAL END (THRUST) BEARING	26. UNLOADER PUSH ROD SPRING

FIG. 22—Sectional View

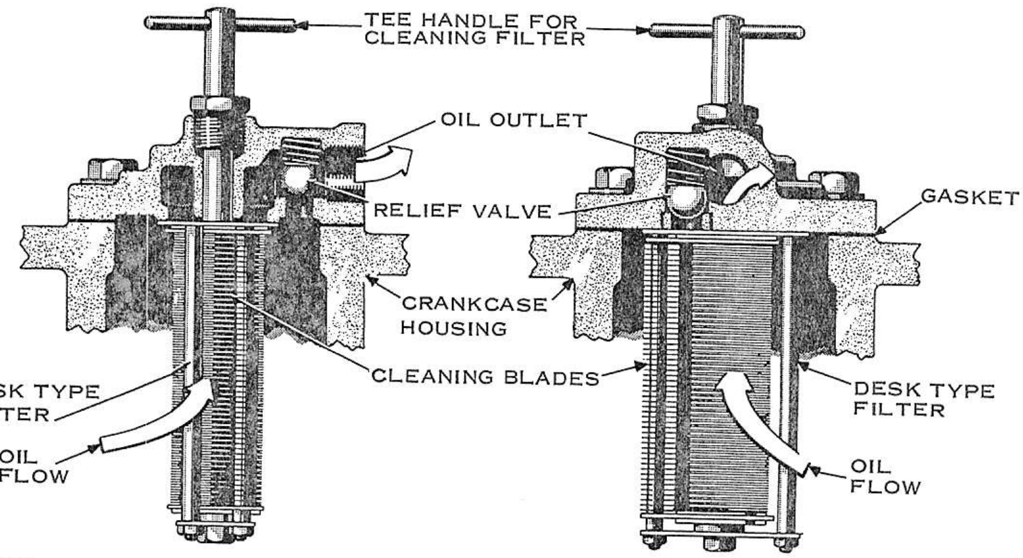


FIG. 23— Oil Filter

Oil is fed to the shaft seal by means of a separate tubing connection direct from the 1/4" cinch type ell in the oil header to a similar ell mounted at the top of the shaft seal bearing head as shown in Fig. 21. An oil level is maintained in the shaft seal space by means of an overflow tube which leads from the upper part of this space to the compressor crankcase. The rotating shaft seal parts are thus submerged in oil at all times. (See Fig. 22, Item 11).

Oil is fed to internal compressor parts as shown by Fig. 22. By means of drilled holes in the bearing heads HP oil from the pump is conducted to each main bearing. Circular grooves in the inner surfaces of these bearings conduct the oil to drilled passages in the seal and pump ends of the crankshaft as shown. These passages connect with drilled passages and four radially drilled holes in each crankpin to conduct the oil to the crank end connecting rod bearings. A drilled passage extends through the length of each connecting rod, enabling oil under pressure to be delivered to each piston pin when the drilled passages in the crankpin and the connecting rod bearing coincide during rotation of the shaft.

Cylinder walls are lubricated by a combination of splash and spray oil from the spaces between connecting rod bearings.

OIL FILTER

The oil filter consists of a cylindrical housing which is part of the oil pump bearing head casting. (See Fig. 20 and Fig. 23.) A large opening is drilled through the metal wall which separates the oil pump discharge space from the interior of the oil filter housing. Bolted to the top of this housing is the oil filter assembly consisting of a removable flange type cover provided with a relief valve, an ips outlet connection and a set of spacers, stationary cleaning blades and discs provided with openings for the passage of oil. Also provided is a refrigerant-tight spindle by means of which the discs and spacers may be rotated for the purpose of cleaning the filter as shown in Fig. 23. The stack of discs and spacers are attached to the bottom of the flange cover by means of rods and the entire assembly; held in position in the filter housing when the top cover is bolted on. (See Fig. 23.)

High pressure oil from the compressor oil pump fills the annular space between the filter housing and the disc assembly, flowing radially inward through the spaces between discs, the latter being constructed and arranged to prevent the passage of extremely small particles of foreign material. The oil then flows upward through the openings in the discs and leaves the filter at the top. The relief valve is provided with a spring which holds the ball tightly seated until the pressure drop through the disc assembly is 15 psi or more. If this occurs, the ball lifts from its seat, allowing oil to by-pass the disc assembly and flow to the compressor bearings. When the tee handle at the top of the filter (and the disc assembly) is rotated in either direction, the stationary cleaning blades cause foreign material to be removed from the disc assembly. This material will collect at the bottom of the filter housing.

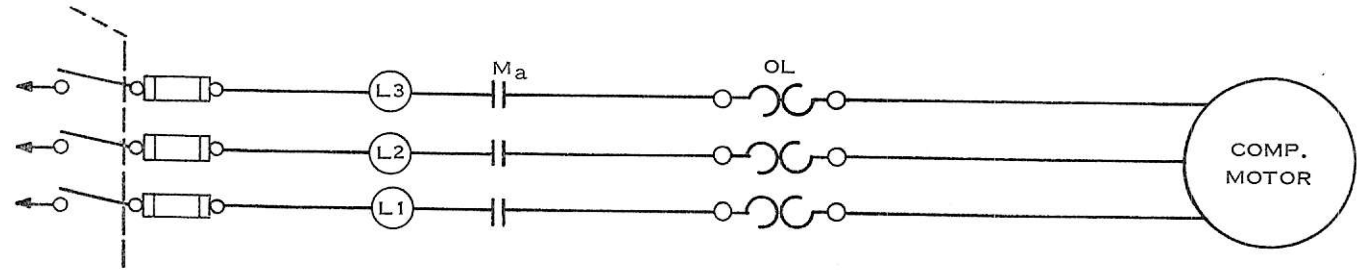
The tee handle should be rotated one or two full turns daily to prevent the filter assembly from becoming plugged. If the handle should turn hard at any time, do not use a wrench to free it - instead move it back and forth until it can be rotated through a complete revolution. Tightness of this sort indicates that excessive quantities of foreign material may be returning from the system or that the filter handle has not been rotated frequently enough.

The disc assembly should be removed and all foreign material be cleaned from the bottom of the filter housing after about 30 days of operation of a new compressor. Refer to CRANKCASE OIL FILTER in the SERVICE section of this instruction.

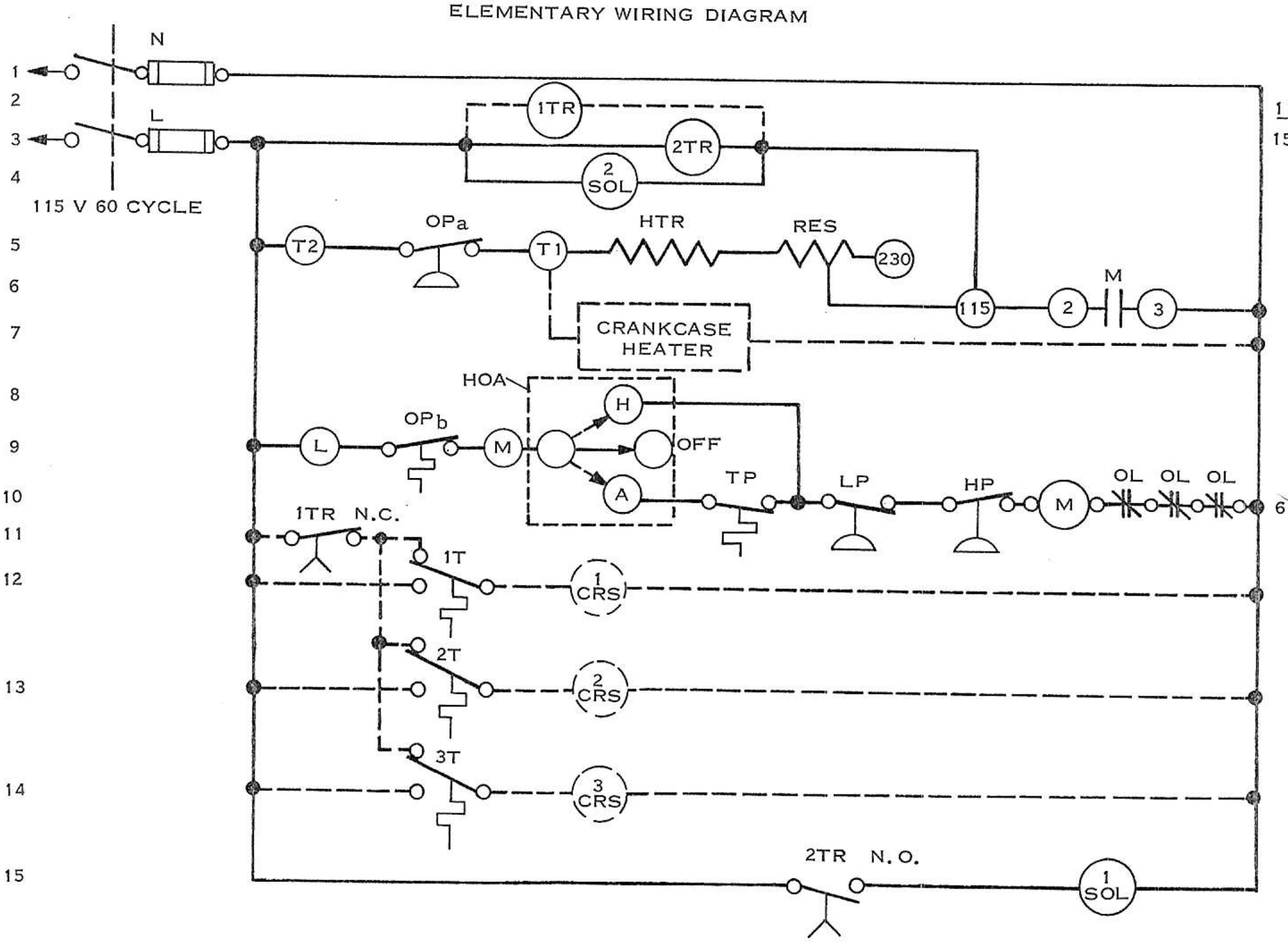
OIL PUMP

The oil pump, see Fig. 20 and Fig. 34 is of the internal gear type designed to operate under either direction of rotation. For further detail on the oil pump see OIL PUMP in the SERVICE section of this book.

TYPICAL MOTOR CONNECTIONS



ELEMENTARY WIRING DIAGRAM

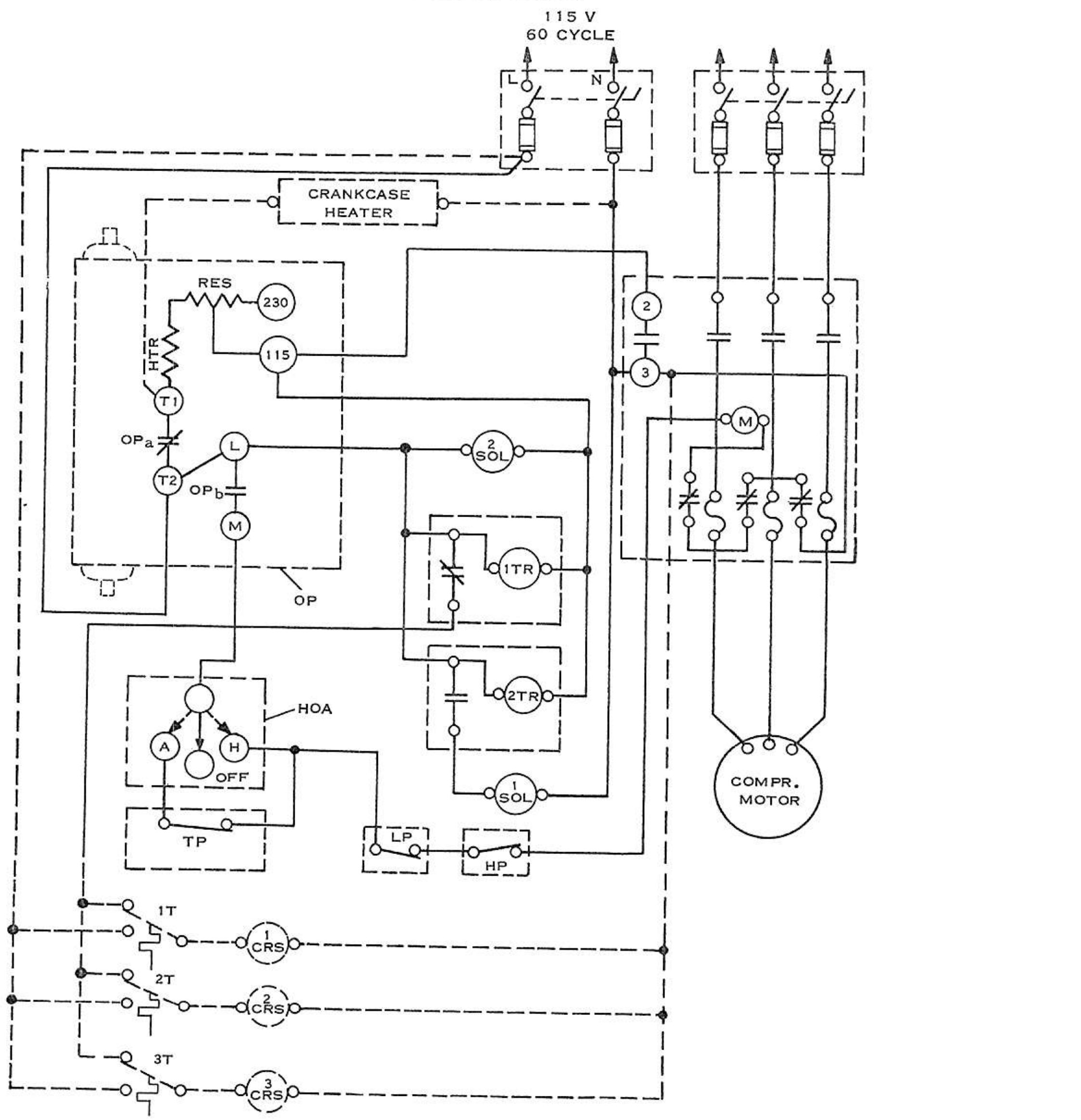


NOTES:

1. LOCATE FUSED DISCONNECT SWITCH FOR CONTROL POWER ADJACENT TO MAIN DISCONNECT SWITCH.
2. CRANKCASE HEATER MUST BE DE-ENERGIZED BEFORE OPENING COMPRESSOR.
3. ITEMS SHOWN BY BROKEN LINES INDICATE OPTIONS.
4. NUMBERS ALONG LEFT SIDE OF ELEMENTARY DIAGRAM DESIGNATE LINE IDENTIFICATION ONLY, – NOT TERMINAL MARKINGS. NUMBERS ALONG RIGHT SIDE OF ELEMENTARY DIAGRAM DESIGNATE LOCATION OF RELAY CONTACTS. AN UNDERLINED NUMBER REPRESENTS A NORMALLY CLOSED CONTACT.

FIG. 24— Suggested Wiring Diagram - Across The Line Start - 115/120 V. Separate Control Circuit

CONNECTION DIAGRAM



NOTE: JUMPER BETWEEN TERMINAL T2 AND L ON OIL FAILURE SWITCH MUST BE ADDED IN FIELD.

LEGEND

OP	OIL PRESSURE SAFETY SWITCH – FACTORY SET TO CUT OUT AT 10 PSIG, CUT IN AT 16 PSIG – MANUAL RESET
OPa	OIL PRESSURE CONTACT OF OP
OPb	SAFETY CONTACT OF OP
HTR	HEATER ELEMENT OF OP
RES	DROPPING RESISTOR OF OP
LP	LOW PRESSURE CUTOUT – AVAILABLE AS OPTION, CUT OUT SETTING FIELD SET – AUTOMATIC RESET
HP	HIGH PRESSURE CUTOUT – FACTORY SET TO CUT OUT AT 225 PSIG (R717) – MANUAL RESET
OL	MOTOR STARTER OVERLOADS
1TR	TIME DELAY RELAY WITH 3 MINUTE TIMED OPEN CONTACT (ON DELAY – REQUIRED ONLY WITH CAPACITY CONTROL SOLENOIDS
2TR	TIME DELAY RELAY WITH 5 MINUTE TIMED CLOSED CONTACT (ON DELAY)
1CRS	CAPACITY CONTROL SOLENOID VALVE } AVAILABLE AS OPTION
2CRS	CAPACITY CONTROL SOLENOID VALVE } AVAILABLE AS OPTION
3CRS	CAPACITY CONTROL SOLENOID VALVE } AVAILABLE AS OPTION
1SOL	SOLENOID VALVE (NORMALLY CLOSED) – OIL RETURN LINE
2SOL	SOLENOID VALVE (NORMALLY OPEN) – EQUALIZING LINE – MULTIPLE COMPRESSOR APPLICATION
M	MOTOR STARTER COIL
Ma	MOTOR STARTER CONTACTS
1T–2T–3T	TEMPERATURE OR PRESSURE OPERATED LOADING SWITCHES
HOA	HAND–OFF–AUTOMATIC SWITCH
TP	TEMPERATURE OR PRESSURE CONTROLLER (FIELD INSTALLED)

FIG. 24— (CONT'D)

OPERATING SEQUENCE (See Fig. 24)

When the hand-off-automatic switch is turned to the auto position, a circuit is completed to energize the compressor motor starter provided the following conditions exist:

1. Starter overloads OL are closed.
2. High Pressure Cutout (HP) and Low Pressure Cutout (LP) are closed.
3. Contact OPb (on Oil Pressure Failure Switch) is closed. (Oil failure has not occurred - For detailed explanation of function of Oil Failure Switch see DIFFERENTIAL OIL PRESSURE SAFETY SWITCH below. Additional information on this switch is given in the INSTALLATION Section of this book.)

After the auxiliary contact of the motor starter closes (line 6) it energizes relay 1TR (field furnished) and allows its contact (line 11) to remain closed for three minutes. This energizes the capacity control solenoid valves (1CRS, 2CRS, 3CRS) and keeps the compressor unloaded. At the end of the 3 minute timing cycle 1TR contact (line 11) opens and allows the capacity control solenoid valve to be operated by the capacity control device.

In order to prevent the possible return of condensed liquid ammonia to the crankcase from the oil separator at start-up, a normally closed solenoid valve should be installed in the oil return line. (See Fig. 11). At start-up the relay 2TR (field furnished) is energized, which allows its contact (line 15) to remain open and prevents the opening of the solenoid valve 1 Sol. At the end of the 3 minute timing cycle 2TR contact (line 15) closes, which opens solenoid valve 1 Sol.

On multiple compressor application the N.O. solenoid valve 2 Sol (field furnished) opens on shut down. (See Fig. 14)

DIFFERENTIAL OIL PRESSURE SAFETY SWITCH

OPERATION - To provide proper lubrication, compressor oil pressure must be higher than crankcase, or suction pressure when the compressor is in operation. The oil pressure safety switch is operated by the "net oil pressure" which is the difference between compressor oil pressure and crankcase or suction pressure. When this "net oil pressure" reaches a pre-determined minimum, indicating insufficient oil pressure for safe compressor operation, the switch functions to stop the compressor.

The normally closed contact OPA, (Fig. 24) of the safety switch closes when the "net oil" pressure decreases (oil pressure drops) and opens when it increases. The switch is factory set to close this contact at 10 psi net oil pressure and to open it at 15 psi. Contact OPA is wired in series with the

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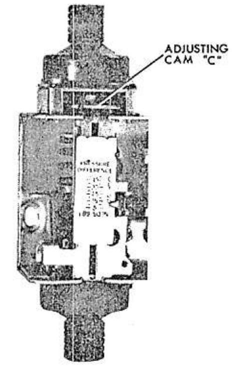


FIG. 25—Differential Oil Pressure Safety Switch

heater HTR, which reacts upon contact OPB causing it to open in approximately 45 seconds, which stops the compressor motor. After heater HTR cools down, which requires approximately 5 minutes, contact OPB can be closed to restore the motor circuit by pushing the reset button which protrudes through the safety switch cover. In a normal start, compressor oil pressure is built up in less than 45 seconds, establishing a net oil pressure of more than 15 psi which opens contact OPA, preventing heater HTR from warming up, and permitting the compressor to continue to run. If, during operation, the oil pressure should drop and decrease the net oil pressure to less than 10 psi, contact OPA will close, energizing the heater HTR, which will cause contact OPB to open and stop the compressor. In this case, contact OPB will have to be reset manually before the compressor motor can be restarted.

ADJUSTMENT - Changes in the cut-out point settings are made by adjusting cam "C" (Fig. 25.) Turning cam "C" clockwise (viewed from top) raises cut-out settings, and turning cam "C" counterclockwise lowers cut-out settings.

TESTING - After the control has been installed, the time delay should be tested, to assure that all wiring is properly connected. To make this test, proceed as follows:

Pull the disconnect switch and remove the cover from the control. Connect a jumper between the T2 and T1 terminals. Close the switch and start the compressor running. The time delay switch should stop the compressor in approximately 60 seconds.

After testing, remove the jumper, replace the control cover, and close the disconnect switch. Depress the re-set button.

APPLYING SWITCH TO COMPRESSORS IN OPERATION - When applying the oil pressure safety switch to compressors already in operation, be careful to connect the lower or high pressure bellows to the oil pump discharge line BETWEEN THE FILTER AND THE BEARINGS. (See Fig. 19.)

COMPRESSOR CAPACITY CONTROL

GENERAL - Economy of operation is achieved by varying the compressor capacity in accordance with the load. When system suction pressure rises due to higher refrigeration load, the compressor should be operated at full or higher capacity and power consumption increases. As the load (and suction pressure) are reduced, less pumping capacity is needed and the number of pumping cylinders can be reduced, with a corresponding reduction in power consumption. As the number of pumping cylinders is increased, the compressor (and the cylinder banks and cylinders involved) are said to be loaded. As the number of pumping cylinders is reduced, the compressor, (and the cylinder banks and cylinders involved) are said to be unloaded. Cylinders are always loaded or unloaded in pairs, one bank at a time. (See Fig. 26).

PRINCIPLE OF OPERATION - Unloading of an individual cylinder is accomplished by hydraulic

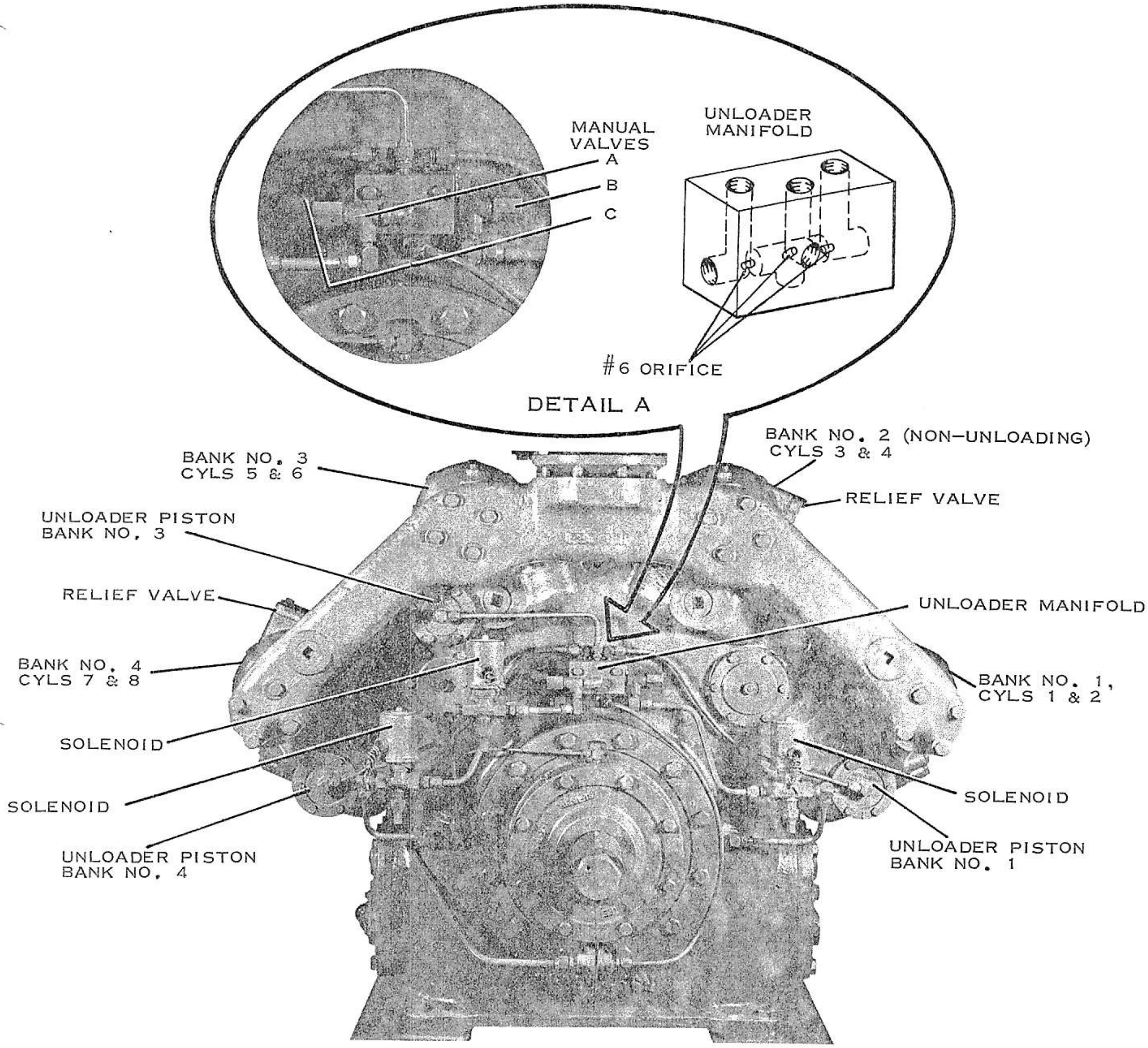
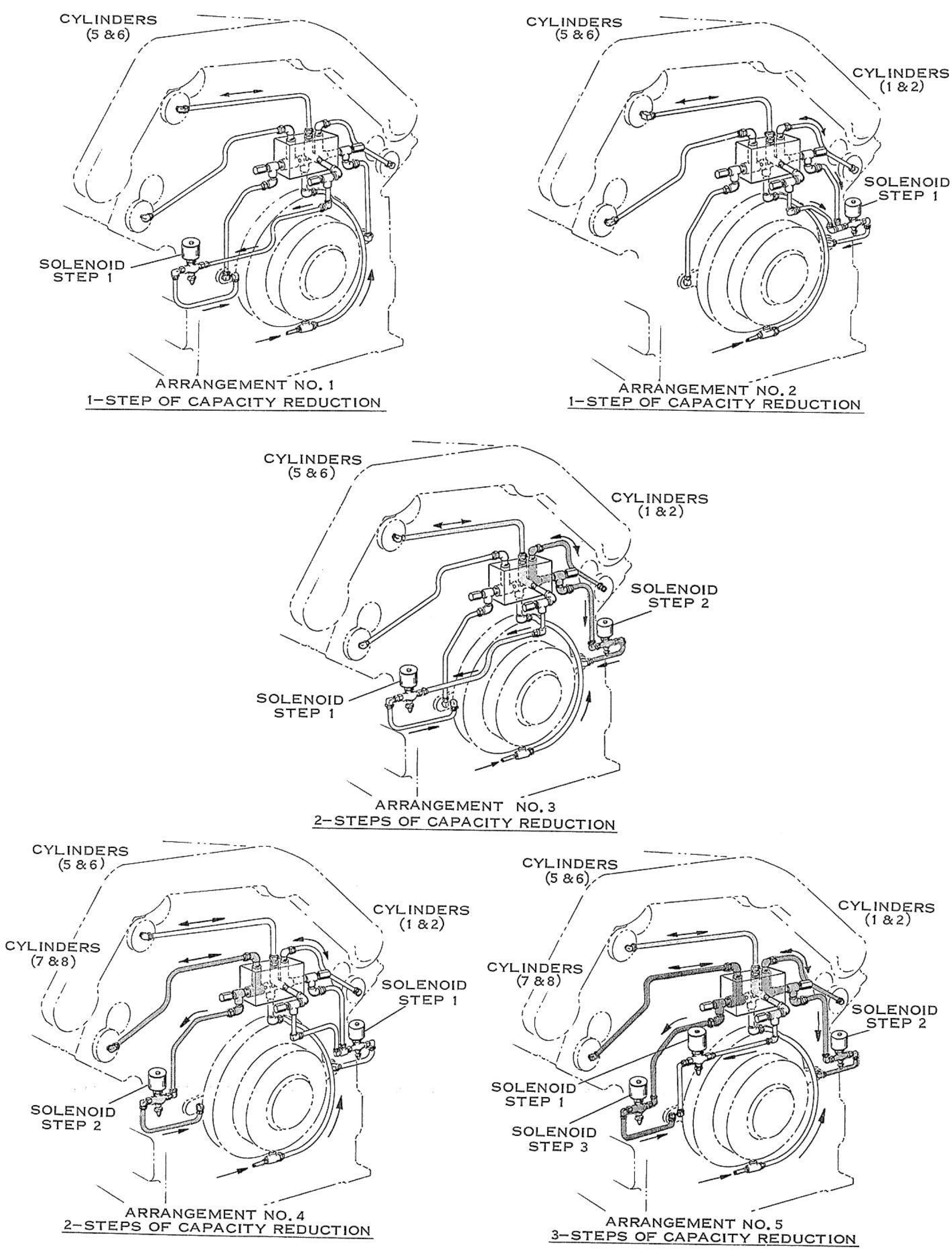


FIG. 26— Capacity Control Oil Piping

(compressor oil) pressure which lifts the unloader ring from its seat on the flange at the top of the cylinder sleeve. This ring is lifted by means of a rotatable cam ring and lift pins as explained below and in CYLINDER SLEEVES AND UNLOADER MECHANISM in the SERVICE section of this book. When a cylinder is loaded (unloader ring down or seated) the refrigerant gas within the cylinder is compressed as the piston moves upward and is moved through the discharge valve to the compressor discharge outlet and on to the condenser. When the cylinder is unloaded (unloader ring up or off its seat) the refrigerant gas on the upward stroke of the piston is not compressed and flows directly back into the suction plenum and that cylinder is not pumping. Loading and unloading therefore are determined by the position of the unloader cam ring.

The cam ring is rotated by a push rod which is moved inward by compressor oil pressure to load cylinders and returned outward by spring pressure to unload cylinders. (Each push rod actuates the cam rings of two adjacent cylinders or one bank. With the compressor stopped and the oil pressure at zero psi differential, the cam rings of all unloading type cylinders are rotated by their push rod springs in a direction to cause the lift pins to ride upward on the inclined surfaces of these rings, thereby lifting all unloader rings. THE COMPRESSOR THEREFORE ALWAYS STARTS UNLOADED.

No. 2 bank of cylinders (cylinders No. 3 & 4, Fig. 26.) is not equipped with cam rings or unloader mechanism and is designated as a fully loaded or non-unloading-type. By this means, a minimum quantity of suction gas is always kept flowing through the compressor, which is required to prevent overheating. The remaining banks No. 1, No. 3 and No. 4 are designated as unloading type banks.



NOTE: SOLENOID ENERGIZED-CYLINDERS UNLOADED

FIG. 27— Automatic Capacity Control Solenoid Arrangements

TABLE 1—MANUAL CAPACITY CONTROL - PREFERRED SEQUENCE OF CYLINDER UNLOADING *

%-Capacity Reduction Available	Hand Operated Valves	Capacity Reduction Steps (See Fig. 26) 1		2		3	
		% of Full Load Capacity	Cylinders Unloaded	% of Full Load Capacity	Cylinders Unloaded	% of Full Load Capacity	Cylinders Unloaded
25%	A	75%	(5&6)	-	-	-	-
25%, 50%	A, B	75%	(5&6)	50%	(5&6)(1&2)	-	-
25%, 50%, 75%	A, B, C	75%	(5&6)	50%	(5&6)(1&2)	25%	(5&6)(1&2)(7&8)

TABLE 2—AUTOMATIC CAPACITY CONTROL - PREFERRED SEQUENCE OF CYLINDER UNLOADING *

Piping Arrange-ment No.	%-Capacity Reduction Available	Quan. of Solenoid Valves	Capacity Reduction Steps (See Figs. 26 and 27) 1		2		3	
			% of Full Load Capacity	Cylinders Unloaded	% of Full Load Capacity	Cylinders Unloaded	% of Full Load Capacity	Cylinders Unloaded
1	25%	1	75%	(5&6)	-	-	-	-
2	50%	1	50%	(5&6)(1&2)	-	-	-	-
3	25%, 50%	2	75%	(5&6)	50%	(5&6)(1&2)	-	-
4	50%, 75%	2	50%	(5&6)(1&2)	25%	(5&6)(1&2)(7&8)	-	-
5	25%, 50%, 75%	3	75%	(5&6)	50%	(5&6)(1&2)	25%	(5&6)(1&2)(7&8)

* Reverse this sequence when loading cylinders.

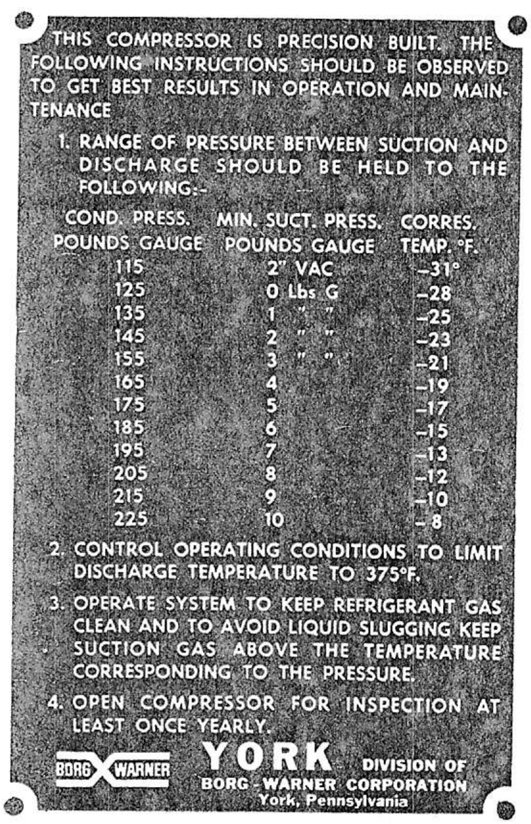


FIG. 28— Operating Pressure Limits

At the outer end of each push rod is mounted a piston located in an unloader cylinder to which compressor oil pressure can be fed, and from which, this pressure can be released. (See Figs. 26 and 45). When oil pressure is applied to this piston, its bank of cylinders becomes loaded - when this oil pressure is released, its bank of cylinders is unloaded as previously explained. A minimum oil pressure of 20 psi is required to actuate the unloader mechanisms.

MANUAL CAPACITY CONTROL - HP oil from the compressor pump is fed from the tee which feeds the shaft seal main bearing through an external oil line to the steel manifold located above the shaft seal. (See Fig. 26). This manifold is made with drilled holes and orifices to feed oil to, and to return it from, the unloader pistons. With the manual seal capped capacity selector valves (A), (B) and (C), (DETAIL A, Fig. 26) in their closed positions, oil is delivered to the pistons of all unloader push rods as soon as compressor oil pressure is built up and the corresponding banks of cylinders become LOADED. When any of these valves is opened, the HP oil returns through the tubing connections direct to the crankcase. Since the flow of oil to the associated unloader piston is restricted by the orifice in the steel manifold, oil pressure on that unloader piston is relieved and the associated bank of cylinders becomes UNLOADED as previously explained. Compressor capacity should always be reduced by unloading cylinders in a definite order and increased by loading cylinders in the reverse order as shown in Table 1.

AUTOMATIC CAPACITY CONTROL - For automatic capacity control, one, two or three factory installed solenoid valves per compressor are furnished as ordered. These valves are installed in 5 different combinations in the oil return lines from the unloader piston cylinder between the seal capped manual capacity selector valves and the crankcase as shown in Figs. 26 & 27. With the seal capped capacity selector valves open and the solenoid valves wired to control as indicated, compressor capacities may be controlled as shown in Table 2. The solenoid valves may be piloted by pressure or temperature switches. When two control steps are required for two banks of cylinders, and a choice is presented, the switches should be set so that the cylinder banks are unloaded in the sequence shown in Table 2.

OPERATING PRESSURE LIMITS (See Fig. 28).

Each of these compressors is supplied with an information plate which is attached to one of the cylinder heads. This plate shows limitations in operating condensing pressure, suction pressure, and corresponding suction gas temperatures. The limitations given in this table insure a compression ratio of 9.5 to 1 or less and should not be exceeded. Maximum discharge temperature is 375° F.

SERVICE

GENERAL

This instruction covers Y-49 & Y-57 series compressors. For SERVICE and/or RENEWAL PARTS for earlier design compressors refer to Form 3W-D (Coded 463).

Before dismantling a compressor for repairs, observe the following precautions:

1. Be sure the faulty operation of the plant is caused by the compressor and not some other part of the plant.

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

3. If compressor is equipped with crankcase heater be sure heater is de-energized before opening compressor.

4. Never open any part of a compressor which is under a vacuum; be sure there is some pressure inside as indicated by a reading above zero on the gauge. The remaining few pounds of pressure (and odor) can be eliminated by attaching a length of rubber tubing to a suitable valved opening and blowing it down into a pail of water. (See PUMPING OUT THE COMPRESSOR.)

5. Internal machined parts of the compressor such as valves, pistons, shaft seal and crankshaft, when removed from a compressor must be protected from damage due to crushing or scratching. They should be coated with oil, wrapped in clean paper and stored in a safe place.

6. 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. New clean oil should be applied to the wearing surfaces of any part just before it is installed. Gaskets should be coated with a thin mixture of graphite and oil before assembly.

7. 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 3 shows the recommended torques for this compressor. Insert all cap screws and tighten them lightly. Then, using the torque wrench, tighten one screw first; and the opposite screw 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.

OPERATIONAL DIFFICULTY

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 trouble; 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 4 is a chart showing various incorrect conditions, their causes and corrections.

TABLE 3— TORQUE VALUES - CAP SCREWS AND NUTS

Location	Type	Thread Size	Torque - Ft. Lbs. (Lubricated)
Seal Cover	Cap Screw, Hex Head	5/8"-11NC	130.0
Sight Glass	Cap Screw, Hex Head	1/4"-20NC	7.0
Disch. Valve Plate	Cap Screw, Hex Head	1/2"-20NF	80.0
Disch. Valve Cage	Cap Screw, Hex Head	7/16"-20NF	45.0
Disch. Valve Cage Bolt	Bolt, Slotted Head	3/4"-16NF	260.0
Suction Valve Plate	Cap Screw, Socket Head	1/4"-28NF	9.0
Strainer Cover Plate (Pump End)	Cap Screw, Hex Head	5/8"-11NC	130.0
Hand Hole Cover Plate	Cap Screw, Hex Head	3/4"-10NC	230.0
Top Head Bolts	Cap Screw, Hex Head	3/4"-10NC	230.0
Conn. Rod	Cap Screw, Nut	5/8"-18NF	41.6
Seal Bearing Head	Cap Screw, Socket Head	3/4"-10NC	230.0
Oil Pump Bearing Head	Cap Screw, Hex Head	3/4"-10NC	230.0
Coupling to Flywheel	Cap Screw, Hex Head	3/8"-24NC	35.0

TABLE 4—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 bulbs.
	Leaky compressor discharge valves.	Remove heads, examine valves. Replace any found defective.
High suction pressure.	Overfeeding of expansion valve.	Regulate expansion valve, check bulb attachment.
	Leaky suction or discharge valves.	Remove head, examine valves and replace if worn.
	Excess load.	Reduce load to normal.
	Malfunction of compressor capacity control.	Check compressor capacity control system.
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.
	Seized compressor.	Repair or rebuild compressor.

TABLE 4 (CONT'D)— TROUBLE DIAGNOSIS CHART

Trouble	Possible Cause	Corrective Measure
Compressor runs continuously with insufficient reduction of load temperatures.	Shortage of refrigerant.	Repair leak and recharge system.
	Cylinders not loading.	Check and correct pumping ability of individual cylinders - replace suction and/or discharge valves and parts as needed.
		Check capacity controller and capacity control hand operated and solenoid valves.
	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.
Insufficient oil return from DOT separator to crankcase.	Erratic operation of float valve. Plugged equalizer or bleeder hole in float valve.	Dismantle, clean parts and properly re-assemble float valve.
Compressor stops on oil failure switch.	Insufficient oil pressure.	Adjust pressure regulating valve, dismantle and clean oil filter.

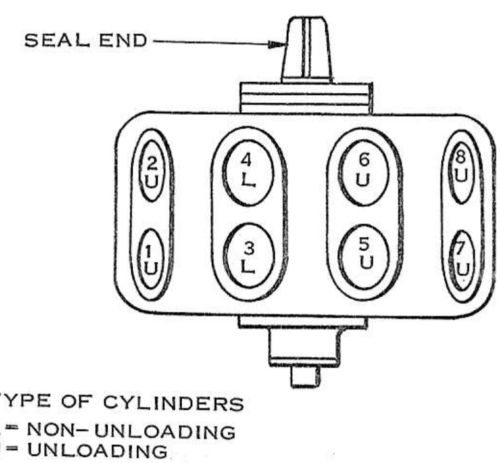


FIG. 29— Cylinder Numbering - Unloading and Non-unloading Type Cylinders

PUMPING OUT FOR REPAIRS

Before opening any part of a mechanical cooling plant for repairs, the refrigerant must be transferred from the part to be opened to another part of the system which is not to be opened. In some cases, the refrigerant must be removed from the system.

PUMPING OUT THE COMPRESSOR - If the compressor only is to be opened, it will only be necessary to pump out the compressor. Proceed as follows:

1. Close the suction stop valve.
2. Open the discharge stop valve two turns of the stem.
3. Operate the compressor until 15 to 25 inches vacuum on the suction pressure gauge is obtained, placing a jumper across the terminals of the low pressure cutout to prevent stopping before a low vacuum is reached.
4. Stop the compressor, and close the discharge stop valve. Allow the compressor to remain off for a short period of time and observe the suction pressure gauge for rise in pressure. Repeat the pumpdown procedure explained in paragraph 3 above to attain minimum rise in suction pressure. When the compressor is stopped for the last time, make sure that the suction and discharge stop valves are tightly closed and that the electrical feed to the motor is shut off to prevent accidental operation and to prevent energizing the crankcase heater if used.

5. Close the 1/4" valve in the line leading to the discharge pressure gauge. Remove the gauge line from the valve and attach in its place a suitable length of rubber tubing.

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

   Submerge the rubber tubing in a pail of water and blow down the refrigerant pressure remaining in the top heads.

6. Before disassembly work of any kind is started, pull the compressor motor main disconnect switch and de-energize the control circuit.

PUMPING OUT THE SYSTEM – If any part of the system (other than the compressor) is to be opened, the refrigerant charge may be pumped into the condenser or receiver as follows:

1. Close the receiver, or condenser liquid stop valve.

2. Run the compressor until the suction pressure is approximately 3 psig, placing a jumper across the terminals of the low pressure cutout if necessary; then stop the compressor. Repeat this step until all the liquid is evaporated.

3. Be sure that a slight pressure exists, within the system, before opening any part of the system to the atmosphere. This pressure may be blown down into a pail of water by means of an appropriate blowdown valve to neutralize the ammonia odor. Do not open any part of the system while it is under a vacuum.

If the condenser is to be opened for repairs, the entire refrigerant charge should be removed from the system or by means of a suitable piping arrangement or pumpout and by-pass valves, be transferred to the low pressure side of the system if feasible.

COMPRESSOR SUCTION STRAINERS

These compressors are equipped with 2 suction strainers. The strainers are located in the suction plenum, at the oil pump end of the compressor just under the strainer cover plate. (See Fig. 30.)

CLEANING THE SUCTION STRAINER SCREEN – To remove any suction strainer for cleaning or replacement, proceed as follows: (See Fig. 31.)

1. Pump out the compressor (See PUMPING OUT FOR REPAIRS).

2. Remove the suction strainer screen cover plate on the oil pump end of the compressor and the nut from the stud in the cover at the shaft seal end (See Fig. 30.)

3. Pull out the strainer screen through the oil pump end cover plate opening. This should be done carefully, keeping the screen horizontal, to avoid the possibility of dropping particles of foreign material, 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 threaded stud end of the screen carefully. Make sure the gasket is on the stud and that it enters its hole in the cover plate properly. Do not use force to enter the screen. This may distort it so that replacement is required.

If a new strainer screen is to be installed, remove the threaded stud from the old screen and transfer it to the new screen. Use a new gasket on the stud and be sure to draw the nut tight to prevent leakage. (See Fig. 30.)

COMPRESSOR OIL SYSTEM

The compressor oil system has two functions as follows:

1. Lubrication of all moving parts.

2. Furnishing hydraulic pressure for operation of cylinder unloading system.

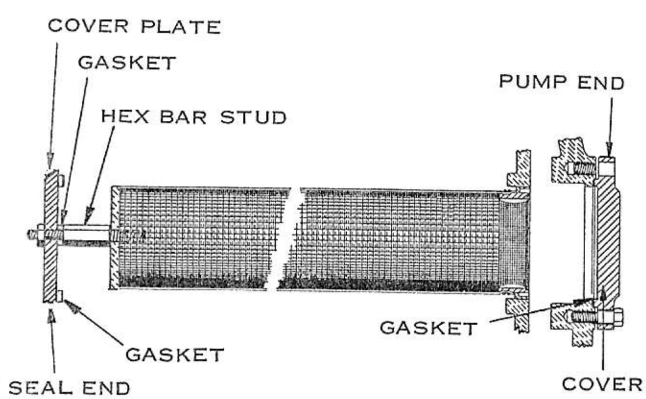


FIG. 30—Suction Strainer

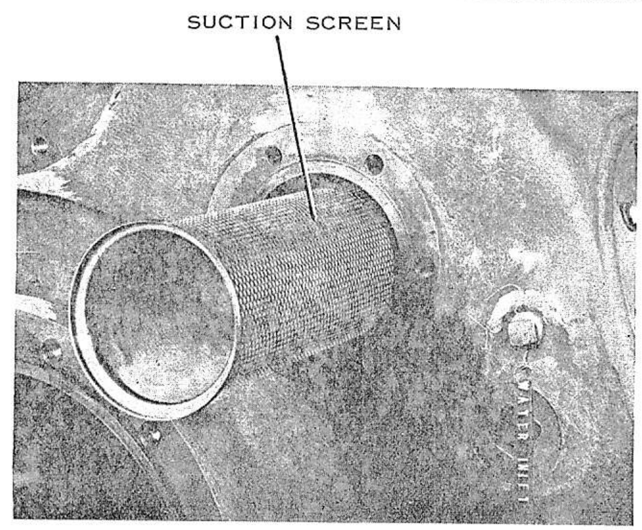


FIG. 31—Suction Strainer Partially Removed

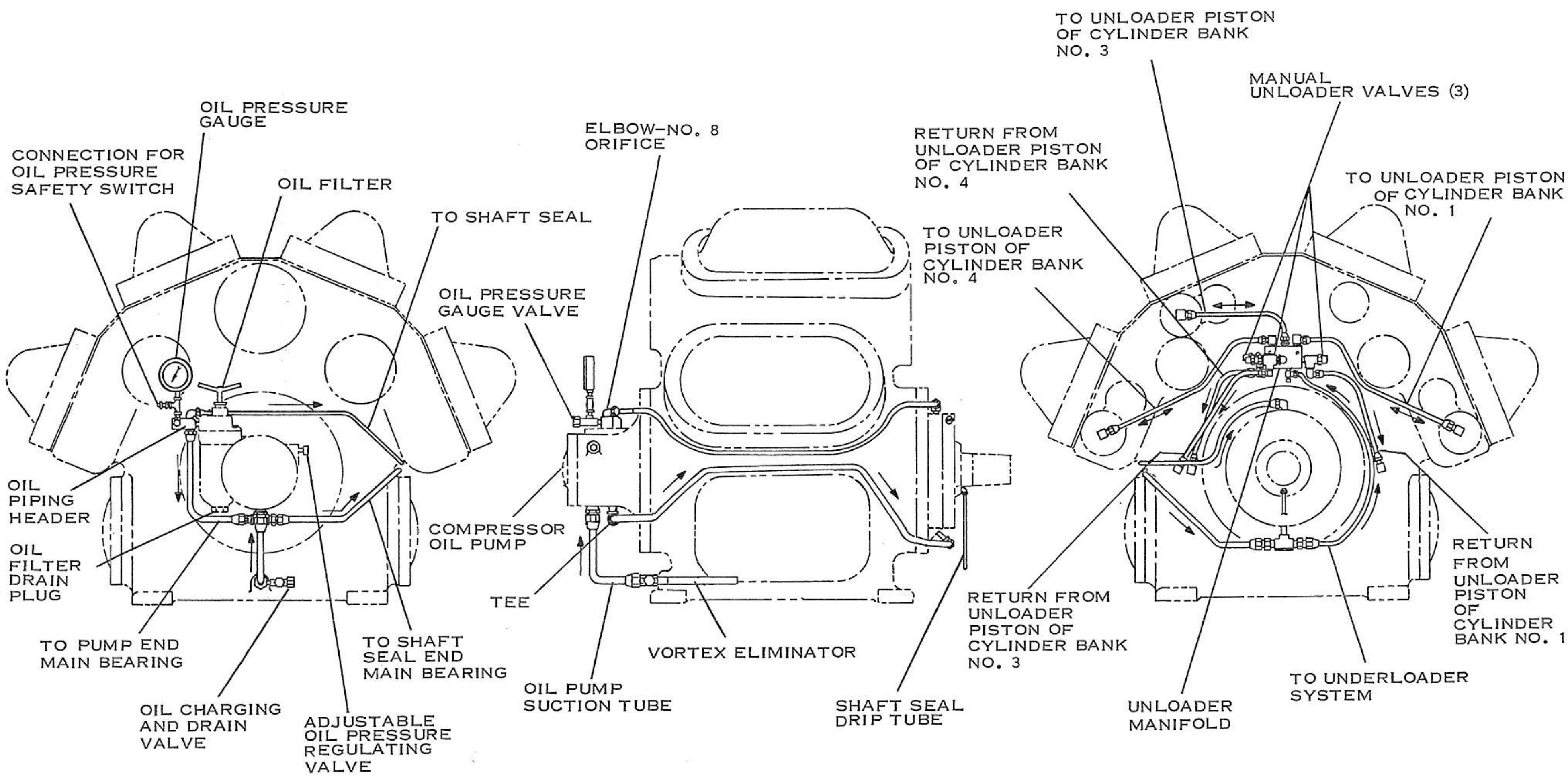


FIG. 32— Compressor External Oil Circulating System

LUBRICATION SYSTEM – See Fig. 32 - The compressor oil supply is contained in the crankcase which is provided with two oil sight glasses (located in one crankcase cover plate) to permit a visual check of the oil level.

YORK AMMONIA COMPRESSOR OIL "A" OR YORK REFRIGERATION OIL "C" SHOULD ALWAYS BE USED IN THESE COMPRESSORS.

The internal gear type compressor oil pump, which is designed to operate with either clockwise or counterclockwise compressor rotation, is directly connected to the crankshaft and is located externally on the rear bearing head. (See Fig. 32.)

An external suction tube connects the pump to a vortex eliminator which is located inside the crankcase at the bottom. The vortex eliminator is provided with an inlet slot which prevents the formation of a vortex, or a swirling condition of the oil, as it enters the pump suction, which could cause loss of pump discharge pressure. Mounted in an externally positioned tee located between the vortex eliminator and the pump suction tube is the seal capped compressor oil charging and drain valve as shown. An adjustable pressure regulating valve is mounted in the oil pump discharge space in the compressor bearing head. This valve functions to relieve direct to the crankcase, a portion of the oil discharged from the pump, and by this means, to control the pressure of the oil being discharged from the pump as shown in Fig. 32.

LUBRICATION, MAIN BEARINGS, OIL PUMP END & SHAFT SEAL (THRUST) END – Oil under pressure leaves the oil pump and flows internally through the pump housing into a disc type oil filter which is mounted in the oil pump, main bearing head. (See Fig. 32 and OIL FILTER.) Oil discharged from the filter enters a header, into one side of which, is screwed an angle type seal capped valve. Attached to this valve is the oil pressure gauge. From the other outlet of this header, the oil flows to a tee which is screwed into the oil pump end bearing head at the bottom, supplying oil to this bearing. From the other outlet of this tee, oil is piped externally around the compressor crankcase to a tee in the shaft seal (thrust) end bearing head at the bottom, supplying oil to this bearing. From the other outlet of this tee, oil is piped to the capacity control manifold to supply hydraulic pressure to operate the cylinder unloaders.

The thrust bearing functions as the crankshaft journal bearing and thrust bearing; the thrust surface positions the crankshaft longitudinally in the compressor housing and takes the thrust forces imposed upon the shaft due to the differences between crankcase and atmospheric pressures. Radial grooves for oil are provided on the inner or thrust surface which is in contact with the crankshaft shoulder.

LUBRICATION, CYLINDER WALLS, CONNECTING ROD AND PISTON PIN BEARINGS – Oil under pressure is fed into the main bearings and is conducted through drilled oilways in the crankshaft to the crankpins as shown in Fig. 22. The crankpin is provided with one radially drilled hole (which connects with the drilled oilway in the crankshaft) for each connecting rod bearing. The piston pin bearings are lubricated through the rifle drilled holes in the connecting rods which line up with the radially drilled holes in the crankpins.

Lubrication of the cylinder walls is accomplished by the spray from the spaces between the connecting rod bearings and between these bearings and the cheeks of the crankpin as some of the pressurized oil leaves these bearings. Excess oil on the cylinder sleeve walls is removed by the action of the cutter ring and the beveled ring and communicating holes drilled in the piston skirt. A portion of the oil passes upward through the compression rings during operation. This oil is removed from the compressor discharge gas by the DOT type oil separator, from which it is returned to the compressor crankcase.

LUBRICATION, SHAFT SEAL – Oil under pressure is piped directly from the oil piping header on the oil filter to the shaft seal, through an external oil line around the compressor crankcase and enters at the top of the bearing head as shown in Fig. 34. This oil fills the shaft seal plenum to lubricate the shaft seal surfaces and to maintain suitable operating temperatures. With the plenum filled, excess oil is returned to the compressor crankcase through a 1/4" overflow tube at the top of the plenum. (See Fig. 33.)

THE COMPRESSOR OIL LEVEL IS CORRECT WHEN THE OIL STANDS AT THE HALFWAY POINT BETWEEN THE UPPER AND LOWER SIGHT GLASSES WITH THE COMPRESSOR NOT IN OPERATION. (See Fig. 20.)

SHAFT SEAL

The compressor shaft seal consists basically of a cast iron shaft seal collar which rotates with the crankshaft and a carbon shaft seal ring which remains stationary in the shaft seal cover plate. (See Fig. 22 and Fig. 33.) Refrigerant gas or oil is sealed within the compressor and air is prevented from entering it by means of a film of oil between the accurately finished running faces of the shaft seal collar and the shaft seal ring whether the compressor is running or stopped.

The crankshaft is provided with a shoulder, which, when the compressor is assembled, is positioned at the outer edge of the compressor thrust bearing. (See Fig. 33.) The inner edge of the cast iron shaft seal collar seats against this shoulder and lateral movement of the collar is prevented by two seal collar nuts. The collar is locked to the shaft by a steel ball. Passage of refrigerant gas or oil through the space between the shaft seal collar and the crankshaft is controlled by the shaft seal packing. The packing is compressed around the shaft by the shaft seal packing ring which is positioned by the shaft seal collar nuts.

The carbon shaft seal ring fits in a recess in the shaft seal cover plate. Passage of refrigerant gas or oil through the space between the ring and cover plate is controlled by the "O" ring gasket. The collar can move laterally in the cover plate, its running face being always kept in contact with the face of the shaft seal collar by means of sixteen helical springs which fit in pockets in the cover plate. A roll pin is fitted to both the cover plate and seal ring to prevent rotation of the seal ring.

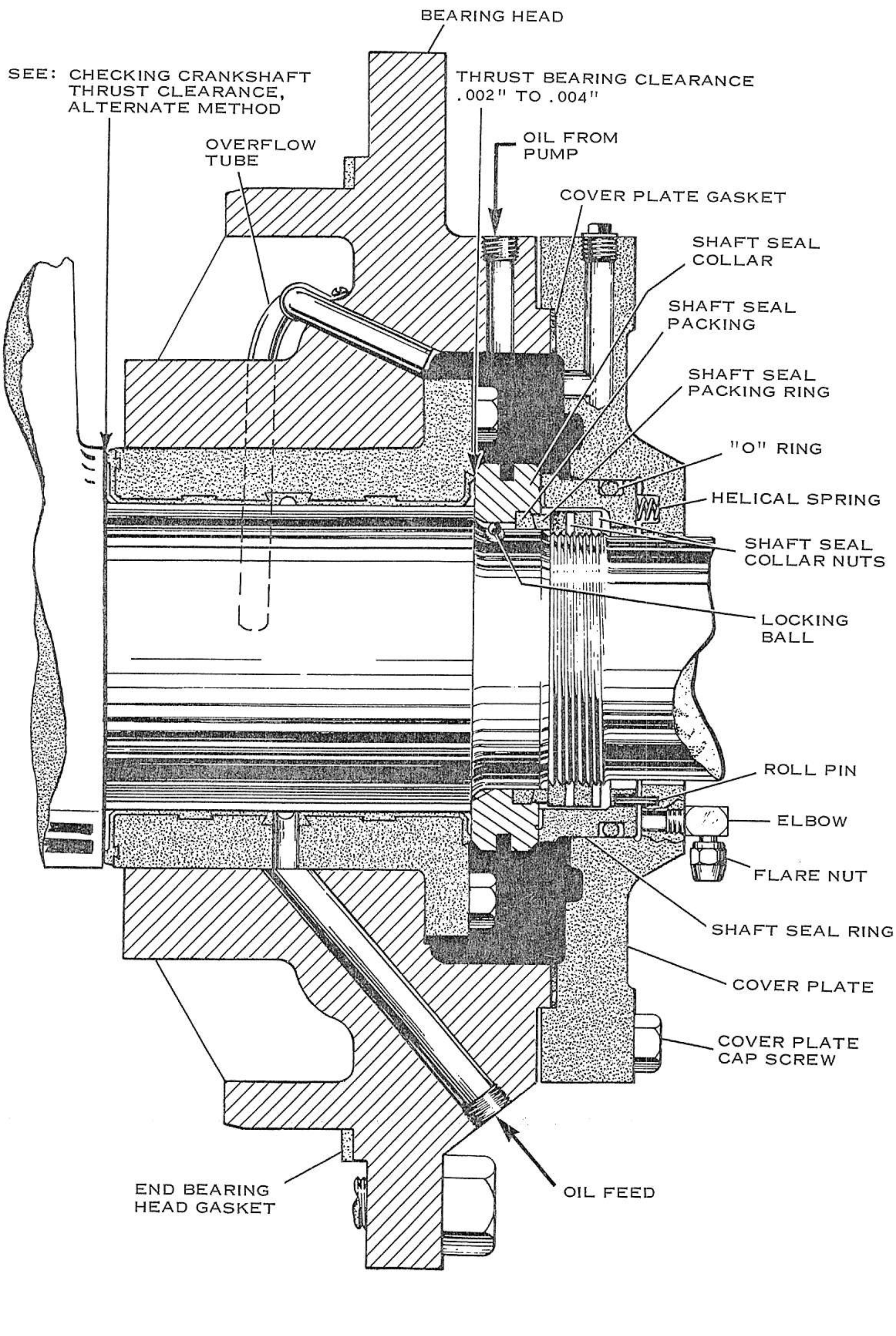


FIG. 33— Cross Section of Thrust Bearing and Shaft Seal

Oil is fed to the shaft seal plenum through the passage, Fig. 33,and returned to the crankcase through the overflow tube in the bearing head above the shaft seal assembly as shown. The shaft seal space or plenum is thus kept flooded with oil during operation and remains partially filled when the compressor is stopped, assuring a film of oil between the running faces of the shaft seal collar and shaft seal ring at all times. To maintain this necessary oil film, a small quantity of oil must pass through the seal. This quantity may vary with the individual compressor and with the cleanliness of the refrigerant system in which the compressor is installed. When the compressor is first started, a seal may pass up to 10 to 15 drops per minute, but the rate should reduce to a few drops per minute or less, (which may be considered normal), within a short operating period. There should be no leakage of refrigerant or oil during shutdown. An oil drip tube is attached to the elbow in the cover plate to conduct any oil passed by the shaft seal to a can which should be placed under the tube. (See Fig. 32.)

REPLACING THE SHAFT SEAL - To replace the Y-57 style compressor shaft seal, proceed as follows: (See Fig. 33). To replace Y-49 style compressor shaft seal refer to DESIGN HISTORY.

1. Pump out and vent the compressor. (See PUMPING OUT FOR REPAIRS.)

2. Rotate the crankshaft so that the crankshaft keyway (and the locking ball for the shaft seal collar are at the top). Remove the compressor flywheel and flexible coupling half or the drive belt pulley. Also remove the key from the crankshaft keyway. (See FLEXIBLE COUPLING or BELT DRIVE in the INSTALLATION section of this instruction.)

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

4. Remove the cover plate cap screws and slide the cover plate and carbon shaft seal ring off the crankshaft as one unit. (See Fig. 33.) Place the outside of the cover plate downward and remove the shaft seal ring, and its rubber "O" ring gasket. Remove the sixteen helical shaft seal springs.

5. Using the spanner wrench, (York Part No. 064-03306, supplied in the tool kit with the compressor), carefully remove the two shaft seal collar nuts. Remove the shaft seal packing ring. Remove the shaft seal collar using two screw drivers to pry it outward. The shaft seal packing will be removed with the collar. Take care not to damage the shaft or lose the ball. Remove the collar locking ball from its pocket in the crankshaft. After a thorough cleaning with solvent, examine the running faces of the shaft seal collar and the seal ring for marks, grooves, scratches, cracks or excessive wear. These are indications of the need for replacement of these parts. When replacement of either the carbon shaft seal ring or the cast iron shaft seal collar is required, it is recommended that both the seal ring and seal collar be replaced as an assembly. When shaft seal parts are reassembled, always use a new O-ring and new shaft seal packing.

6. Before shaft seal parts are installed it is necessary that all parts, and the shaft and shaft seal cavity, be thoroughly clean. Use an approved safety solvent for this purpose and a brush to apply it to seal cavity surfaces rather than a cloth. Seal parts should be rinsed in solvent and allowed to dry in air. Avoid damage to the shaft seal ring and collar, using particular care with the precision finished running faces.

7. Inspect the shaft seal oil feed line and fittings to see that they are not plugged or restricted. Check also the overflow tube in the bearing head to be sure it is not obstructed. (See Fig. 33.)

8. Place the shaft seal collar locating ball in its pocket in the crankshaft. Slide the shaft seal collar in position on the shaft, making sure that the recess in the inner bore of the collar fits over the locating ball.

9. Pull the crankshaft outward as far as it will go. Slip the shaft seal packing over the threaded portion of the shaft and into position just entering the shaft seal collar.

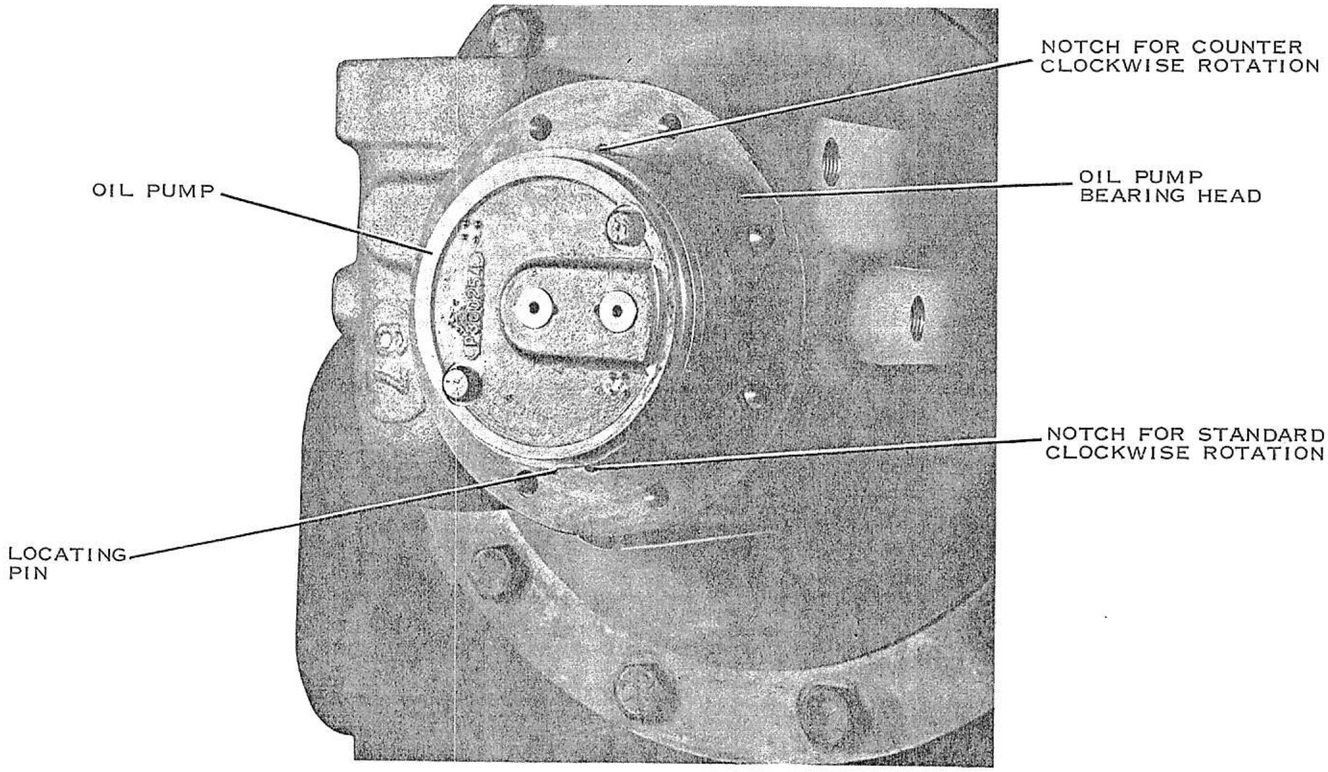
10. Place the shaft seal packing ring on the shaft with the flat side against the packing. Use only one shaft seal packing nut and tighten it against the packing ring until the packing is fully seated in the shaft seal collar.

11. Remove the packing nut and packing ring. Turn the packing ring around so the beveled edge is against the shaft seal packing. Using the spanner wrench, tighten the shaft seal collar nut securely. The second nut will serve to lock the assembly in position. The packing MUST be compressed tightly to prevent refrigerant leakage.

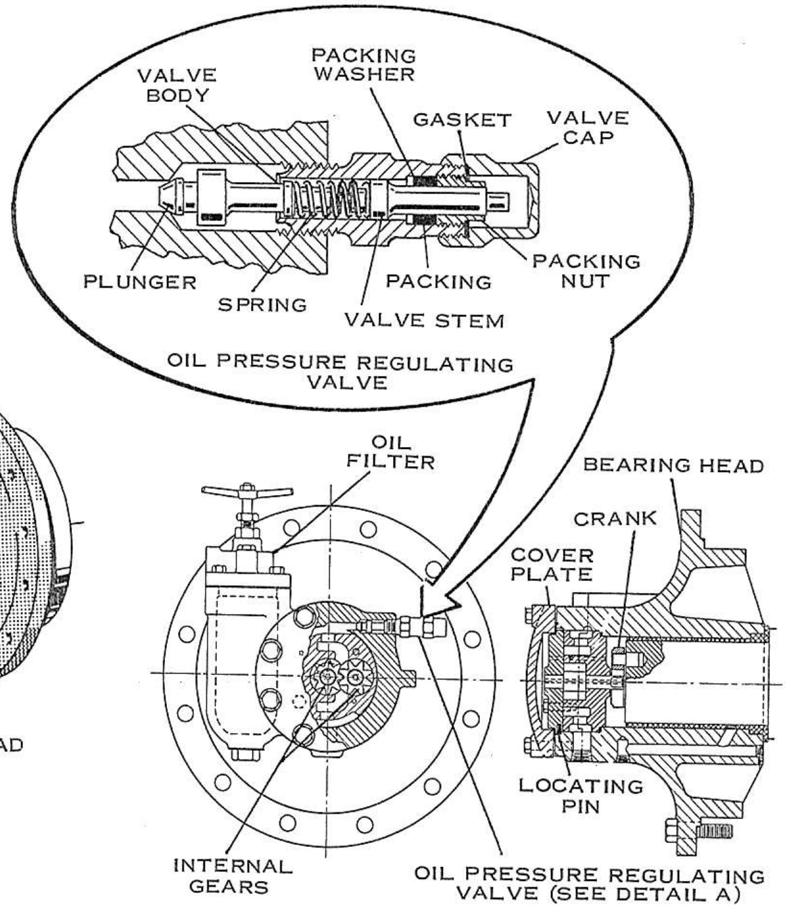
12. Check the thrust clearance of the crankshaft. This clearance must be .002" to .004". This can be checked by moving the crankshaft all the way out (against the thrust bearing) and inserting a feeler gauge between the thrust bearing and the shaft seal collar with this collar locked in place by the shaft seal collar nuts. (See Fig. 33.)

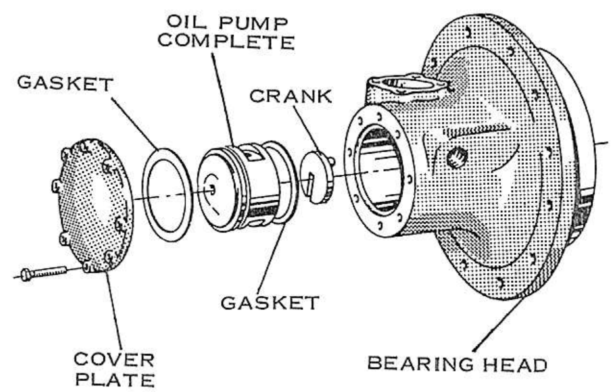
13. Place the cover plate on a horizontal surface with the spring holes face up. Place the sixteen helical springs in these holes.

14. Place the O-ring in its recess on the outside of the shaft seal ring, oil the ring and place this assembly in the cover plate being cautious not to cut or jam the O-ring. Be sure that the locking pin in the cover plate enters its hole in the shaft seal ring and that the springs are properly seated. Depress the shaft seal ring to be sure that it is free to move. Using a new gasket, make sure it is thoroughly seated in the cover plate by tapping it into the groove, if necessary.



OIL PUMP PARTIALLY REMOVED





EXPLODED VIEW OF OIL PUMP AND BEARING HEAD

CROSS SECTION OF OIL PUMP AND BEARING HEAD

FIG. 34— Oil Pump Assembly

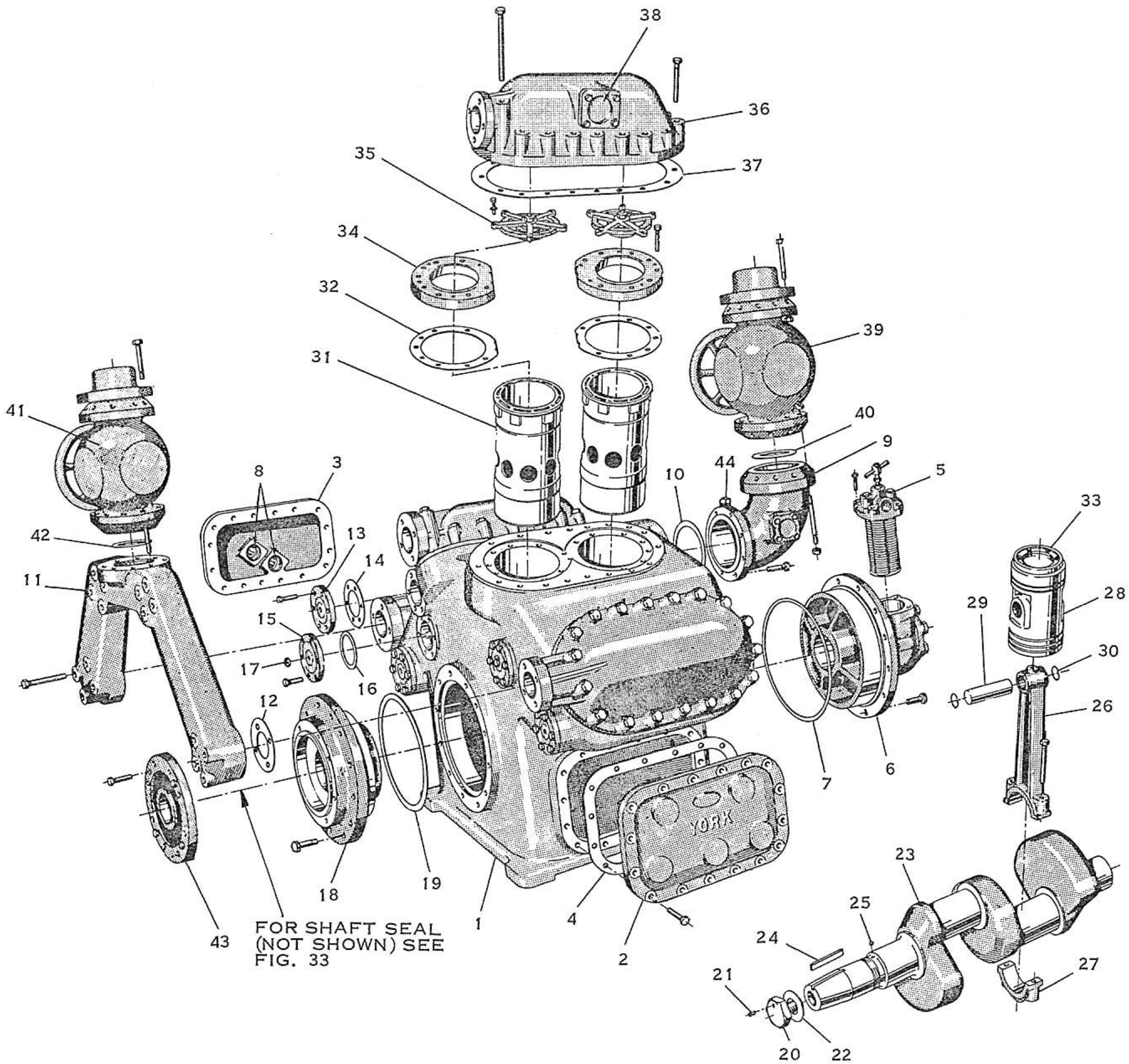


FIG. 35— Compressor, Exploded View

ITEM NO.	PART NAME
1	COMPRESSOR HOUSING
2	HAND HOLE COVER, PLAIN
3	HAND HOLE COVER, WITH SIGHT GLASSES
4	HAND HOLE COVER GASKET
5	OIL FILTER
6	BEARING HEAD, OIL PUMP END
7	BEARING HEAD GASKET
8	OIL SIGHT GLASSES
9	SUCTION ELBOW
10	SUCTION ELBOW GASKET
11	DISCHARGE MANIFOLD
12	DISCHARGE MANIFOLD GASKET
13	UNLOADER COVER
14	UNLOADER COVER GASKET
15	SUCTION STRAINER COVER
16	SUCTION STRAINER COVER GASKET
17	SUCTION STRAINER STUD NUT
18	BEARING HEAD, SEAL END
19	BEARING HEAD GASKET
20	FLYWHEEL BOLT
21	FLYWHEEL BOLT SET SCREW
22	FLYWHEEL BOLT WASHER
23	CRANKSHAFT
24	CRANKSHAFT KEY
25	SEAL COLLAR BALL
26	CONNECTING ROD
27	CONNECTING ROD EEARING CAP
28	PISTON
29	PISTON PIN
30	PISTON PIN LOCKING SPRING
31	CYLINDER SLEEVE
32	VALVE PLATE GASKET (COPPER)
33	SUCTION VALVE CAGE
34	DISCHARGE VALVE PLATE
35	DISCHARGE VALVE CAGE
36	CYLINDER HEAD
37	CYLINDER HEAD GASKET
38	RELIEF VALVE
39	SUCTION STOP VALVE
40	SUCTION STOP VALVE GASKET
41	DISCHARGE STOP VALVE
42	DISCHARGE STOP VALVE GASKET
43	SHAFT SEAL COVER PLATE
44	SUCTION THERMOMETER WELL

15. Make sure the contact surfaces of the shaft seal collar and shaft seal ring are free from all foreign particles. Apply oil to these surfaces.

16. Assemble the cover plate assembly, with gasket in position, to the bearing head using the cap screws. Draw them up evenly and tighten to the proper torque. (See Table 3.)

17. Re-assemble the crankshaft key and the flexible coupling or belt drive as required.

18. Evacuate the air from the compressor. (See EVACUATION AFTER REPAIRS.)

OIL FILTER

To clean the oil filter, proceed as follows:

1. Pump out and vent the compressor. (See PUMPING OUT FOR REPAIRS.)

2. Remove the four cap screws and pull the complete disc assembly out of the bearing head.

3. Thoroughly wash the disc assembly in an approved safety solvent. Do Not disassemble the disc assembly. In normal usage, this cleaning procedure is recommended at six month intervals.

4. The filter is equipped with a removable plug at the bottom by means of which the oil and foreign material may be drained periodically.

5. Evacuate the air from the compressor. (See EVACUATION AFTER REPAIRS.)

REPLACING THE OIL PUMP ASSEMBLY

If it becomes necessary to replace the oil pump, a complete new pump assembly should be installed. To replace the oil pump, refer to Fig. 34 and proceed as follows:

1. Pump out and vent the compressor. (See PUMPING OUT FOR REPAIRS.)

2. Remove the eight hex head cap screws which secure the oil pump cover to the bearing head.

3. Pull out the oil pump assembly, the cover gasket, the rear oil pump gasket and the oil pump crank.

4. Make sure the pump cavity in the bearing head is clean and all the oil passageways are free of dirt.

5. Install the oil pump crank and rotate the compressor crankshaft so the slot in the crank is pointing downward. Place the rear oil pump gasket in the bearing head.

6. With the locating pin in the oil pump pointing down, turn the pump shaft so the flat on the shaft aligns with the slot in the crank.

7. Carefully slide the pump into the bearing head and place the cover gasket in position.

8. Bolt the cover plate in position.

9. Evacuate the air from the compressor. (See EVACUATION AFTER REPAIRS.)

If the compressor is to operate in the opposite direction from standard, (clockwise pump end). remove the oil pump cover plate and pull out the oil pump about 1/2", so the locating pin is free of its slot. Rotate the pump 180 degrees so that the pin aligns with the slot in the top of the housing. Push the pump back into position and replace the cover. The pump is now ready to operate on reversed direction of rotation.

CYLINDER HEADS

To remove and replace cylinder heads, refer to Fig. 35 and proceed as follows:

1. Pump out the compressor. (See PUMPING OUT FOR REPAIRS.)

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 and be re-installed in their original positions. This is important since certain heads contain relief valves and the heads must therefore be replaced in their original locations.

3. Support the discharge manifold before unbolting the cylinder head(s).

4. Two threaded holes are supplied in each cylinder head for eyebolts to lift the heads with a hoist. Lift the head(s) from the compressor and lay them aside, taking care not to damage the machined surfaces.

5. When reassembling a head, be sure to line it up and bolt it to the discharge manifold (See Table 3) before bolting it to the compressor housing. On cylinder heads with relief valves, make sure the gas relief passage lines up with the passage in the head gasket and the compressor housing.

6. Bolt the heads to the compressor housing using the proper procedure as outlined in paragraph 7 GENERAL in the SERVICE section of this instruction.
NOTE: The unloader cover plate on cylinder bank No. 3 is ground off on top so it does not interfere with the discharge manifold. Make sure it is always replaced in its original position.

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

PRESSURE RELIEF VALVES

Cylinder heads on cylinder banks 2 and 4 (See Fig. 26) contain pressure relief valves. The valves are the spring loaded ball check type, set to open at 250 psi. differential. They allow discharge gas to escape to the suction side of the compressor.

If a relief valve is not "holding", it can not be repaired and must be replaced with a new valve.

REPLACING PRESSURE RELIEF VALVES - To replace pressure relief valves, proceed as follows:

1. Remove the relief valve cover plate and gasket from the cylinder head.

2. Use the relief valve socket wrench (York Part No. 068-02949, supplied in the tool kit with the compressor) and remove and discard the faulty pressure relief valve.

3. Place a few drops of oil on the threads of the new pressure relief valve and screw it into place.

4. Examine the cover plate gasket and replace if necessary.

5. Install the relief valve cover plate.

SUCTION AND DISCHARGE VALVE OPERATION

On the down-stroke of the piston, suction gas enters the cylinder through the holes in the cylinder sleeve. The gas passes up through the piston and suction valves. On the up-stroke of the piston, the gas is compressed and passes through the discharge valve into the top head.

When the cylinder is operated unloaded the unloader push rod rotates the com ring raising the lift pins which force the unloader ring off its seat. Discharge gas then flows around the unloader ring and directly into the suction plenum.

DISCHARGE VALVES

GENERAL – This compressor has two types of discharge valve plates, unloading and non-unloading.

Non-unloading cylinders (See Fig. 36.)

The discharge valves are of the ring plate type, made of tempered steel and held in position by a cast iron discharge valve cage. The discharge valve of each cylinder is identical to the large suction valve (See Fig. 38). Each discharge valve is held in position in the discharge valve cage by twelve conical springs and the inner valve seat. The valve has two ears on the inside diameter that rest against two guide pins located in the bottom of the valve cage to prevent the valve from rotating. The valve seals against the machined surfaced of the discharge valve plate and the inner valve seat.

Unloading cylinders (See Fig. 37.)

Fig. 37 shows a discharge valve plate for an unloading type cylinder. The unloader ring fits into a groove machined into the bottom of the valve plate and is actuated by the three unloader lift pins which raise the ring from its seat during partial capacity operation. Six conical springs placed in holes in the unloader ring assure that the unloader ring seals tightly against the accurately machined top surface of the cylinder sleeve. These conical springs also assure constant contact between the lift pins and the unloader cam ring. A small pressure equalizing hole in the groove in the valve plate assures positive seating of the unloader ring.

REPLACING DISCHARGE VALVES
(See DESIGN HISTORY)

There are two methods of replacing discharge valves. The Preferred Method, using a York discharge valve cage tool Part No. 364-28635 and

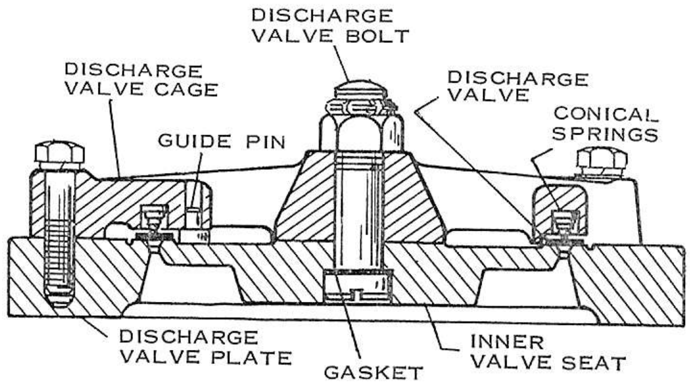


FIG. 36— Discharge Valve Cage and Valve Plate - Non-Unloading Cylinders

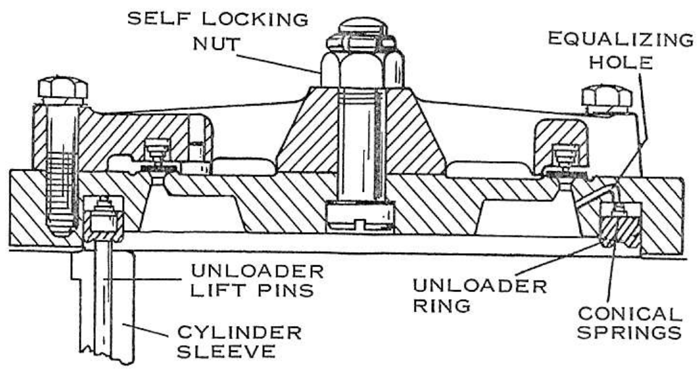


FIG. 37— Discharge Valve Cage and Valve Plate - Unloading

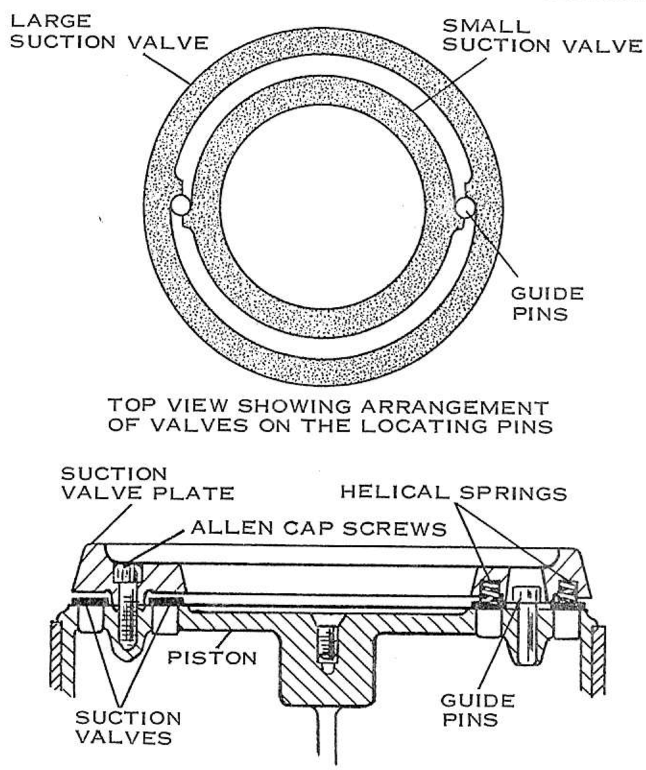


FIG. 38— Suction Valve Cage and Valves

an Alternate Method, to be used only when the discharge valve cage tool is not available.

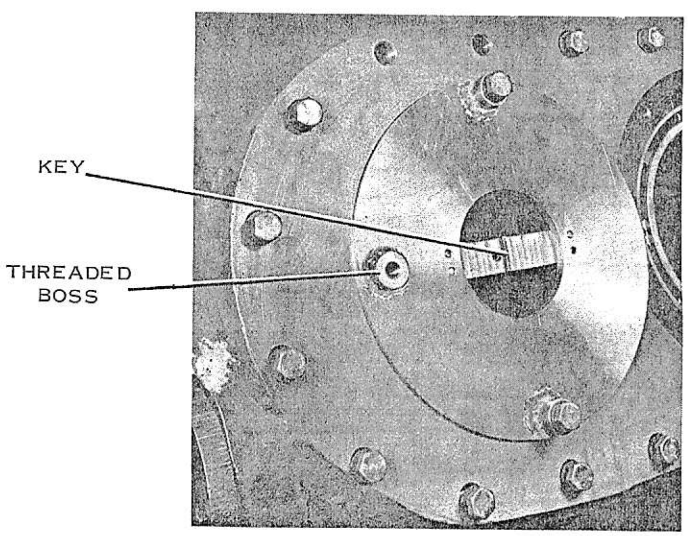
Preferred Method:

1. Before removing the discharge valve cage, loosen (about one turn) the large self locking nut holding the assembly together. This will allow easier disassembly of the valve cage when it is removed from the compressor.
2. Remove the discharge valve cage from the compressor.
3. Remove the discharge valve plate, (See REPLACING DISCHARGE VALVE PLATES) but leave the copper gasket in place. If the discharge valve plate is the unloading type, take care not to drop the unloader ring and springs.
4. Lower the piston to the bottom of its stroke.
5. Refer to Fig. 39. Place the discharge valve cage tool on the compressor in place of the valve plate and secure with two cap screws from the discharge valve plate. (Leave the copper gasket in place to protect the machined surface of the compressor from any damage by the discharge valve cage tool.) Do not use either of the two tapped holes between the cylinders, since they are not on the same bolt circle as the other holes.
6. Place the discharge valve cage on the discharge valve cage tool, making sure the key fits in the slot of the discharge valve cage bolt.
7. Secure one of the five legs of the discharge valve cage to the threaded boss on the tool. Use one of the discharge valve cage cap screws.
8. Remove the self locking nut.
9. Completely disassemble the discharge valve cage and thoroughly examine all parts. Make sure the valve seats and ring valve are free of all cracks, nicks and burrs and replace if necessary. Make sure the two guide pins are secure in the discharge valve cage.
10. Turn the discharge valve cage upside down on a clean smooth surface and place the twelve conical springs in their holes, large end first.
11. Place the discharge ring valve on the springs and make sure the ears on the valve are against the guide pins and the valve moves up and down freely.
12. Insert the slotted bolt, with washer, through the inner valve seat and discharge valve cage. Turn the self locking nut on the bolt, hand tight.
13. Using both hands, hold the discharge valve cage assembly together, turn it over and place it on the discharge valve cage tool. Make sure the key in the discharge valve cage tool fits into the slot of the discharge valve cage bolt.
14. Using one of the discharge valve cage cap screws, secure one of the five legs of the discharge valve cage to the threaded boss on the tool.
15. Fully tighten the self locking nut as shown in Fig. 39 (260 Ft. Lbs.). Make sure the valve operates freely when assembled.
16. Remove the assembled discharge valve cage from the discharge valve cage tool and remove the tool from the compressor.
17. Replace the discharge valve plate (See REPLACING DISCHARGE VALVE PLATES).

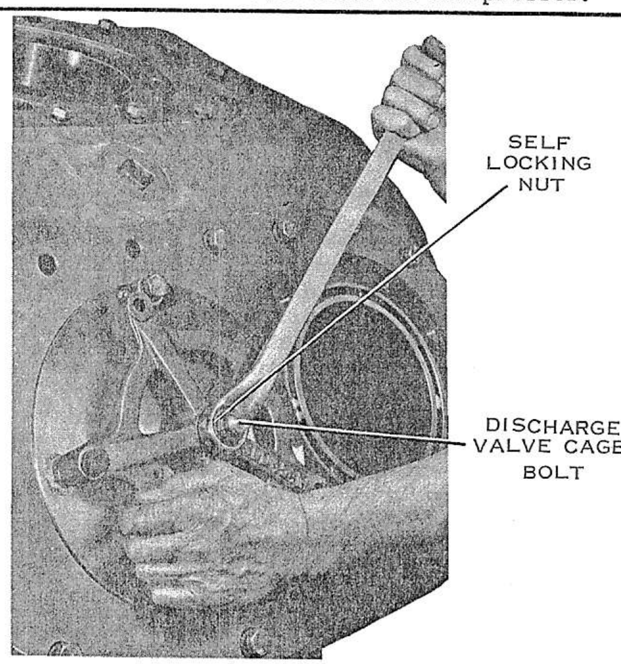
    Position the discharge valve cage on the compressor and secure with the five cap screws.

Alternate Method:

1. Before removing the discharge valve cage, loosen (about one turn) the large self locking nut holding the assembly together. This will allow easier disassembly of the valve cage when it is removed from the compressor.



Discharge Valve Cage Tool Installed On Compressor



Discharge Valve Cage Being (Assembled) or (Disassembled)

FIG. 39— Discharge Valve Cage Tool

2. Remove the discharge valve cage from the compressor.

3. Place a piece of flat tempered steel in a vise as shown in Fig. 40. Make sure it fits snugly in the slot of the discharge valve cage bolt.

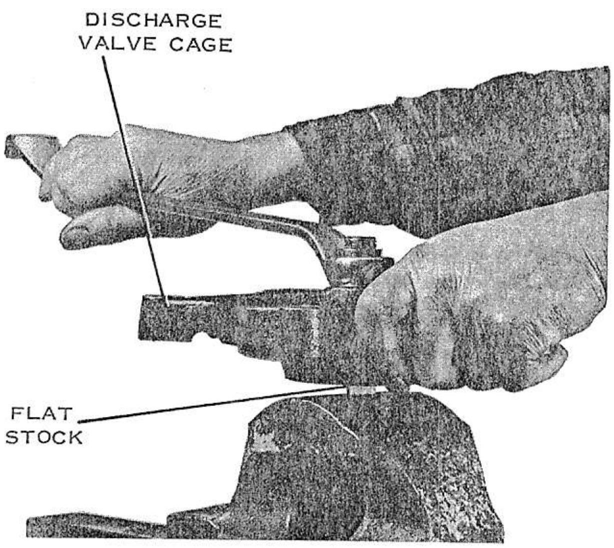


FIG. 40— Alternate Method Of Disassembling Discharge Valve Cage

4. Hold the slotted bolt of the discharge valve cage firmly on the flat steel as shown in Fig. 40 and remove the self locking nut.

5. Completely disassemble the discharge valve cage and thoroughly examine all parts. Make sure the valve seats and ring valve are free of all cracks, nicks and burrs and replace if necessary. Make sure the two guide pins are sucure in the discharge valve cage.

6. Turn the discharge valve cage upside down on a clean smooth surface and place the twelve conical springs in their holes, large end first.

7. Place the discharge ring valve on the springs and make sure the ears on the valve are against the guide pins and the valve moves up and down freely.

8. Insert the discharge valve cage bolt, with washer, through the inner valve seat and the discharge valve cage. Hold the bolt on the flat steel secured in a vise as shown in Fig. 41 and begin to tighten the nut.

9. Hold the assembly securely and fully tighten the self locking nut. (260 Ft. Lbs.) Make sure the valve operates freely when assembled.

10. Position the discharge valve cage on the compressor and secure with the five cap screws.

REPLACING DISCHARGE VALVE PLATES - To replace discharge valve plates, proceed as follows:

1. Remove the discharge valve cage.

2. Remove the cap screws holding the discharge valve plate.

3. Lift the discharge valve plate just enough to get your fingers under the unloader ring. Hold the unloader ring in place and remove the discharge valve plate assembly. Non unloading cylinders do not have unloader rings.

4. Remove the copper discharge valve plate gasket.

5. Completely disassemble the discharge valve plate and thoroughly examine all parts. Make sure the unloader ring is free from all cracks, nicks and burrs and replace it if necessary.

6. Refer to Fig. 37 and make sure the pressure equalizing hole in the discharge valve plate is not clogged.

7. Place the unloader ring on a smooth, clean surface and insert the six conical springs in their holes, large end first.

8. Oil the unloader ring and assemble it and the discharge valve plate.

9. Examine the copper discharge valve plate gasket. Make sure it is not damaged or over-compressed. Replace if necessary. Note gasket for non unloading cylinders is wider than gasket for unloading cylinders.

10. Clasp both hands around the discharge valve plate, holding the unloader ring in place with your fingers.

11. Place the discharge valve plate in position on the compressor. The unloader lift pins will push up on the unloader ring, giving sufficient space to remove your fingers.

12. Hold the discharge valve plate in position and tighten all cap screws evenly.

SUCTION VALVES

GENERAL - The suction valves are of the ring plate type, made of tempered steel. The valves are assembled on top of each piston as shown in Fig. 38. Each piston assembly contains two suction valves, ten suction valve springs, one cast iron valve cage, two guide pins and six Allen cap screws and lock washers. The entire assembly is bolted to the top of the cast iron, double-trunk, slipper type, babbitt faced piston. The two suction valves are prevented from rotating by two guide pins in the top of the piston. The large valve has two ears on the inside diameter which rest against the guide pins. On the small valve, two ears are located on the outside diameter and rest against the opposite side of the same pins. Both suction valves are held in position by the suction valve cage.

REPLACING THE SUCTION VALVES - To replace the suction valves, proceed as follows:

In order to remove and replace suction valves, it is necessary to use two valve clips. These clips may be obtained from the factory, York Part No. 064-28630 or can be fabricated in the field as shown in Fig. 41.

1. Remove the discharge valve cage and discharge valve plate.

2. Rotate the compressor until the piston desired is at the top of its stroke.

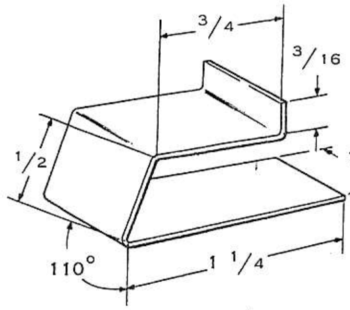


FIG. 41 — Suction Valve Clip

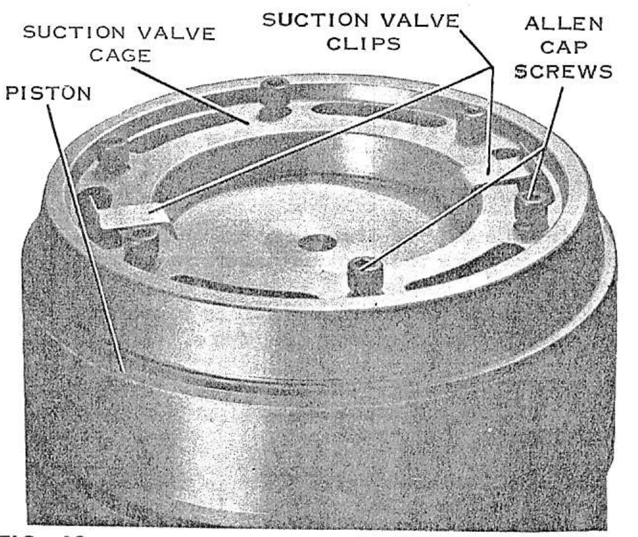


FIG. 42— Suction Valve Clips Installed On Suction Valve Cage

3. Partially loosen the allen cap screws holding the suction valve cage and insert the clips over the valve cage as shown in Fig. 42 making sure that the clips engage the suction valves.

4. Remove the allen cap screws holding the suction valve cage and remove the cage and valves.

5. Completely disassemble the suction valve cage and thoroughly examine all parts. Make sure the valve seats and ring valves are free of all cracks, nicks and burrs and replace if necessary. Make sure the two guide pins are secure in the piston.

6. Turn the suction valve cage upside down on a smooth, clean surface and insert the ten valve springs. Align the ring valves so that the ears of the large ring valve are adjacent to the ears of the small ring valve, since when the cage is turned over, the guide pins on the piston must fit between the ears.

7. Press the valves against their springs and place the clips over the suction valve cage and valves as shown in Fig. 42.

8. Turn the valve cage over and place it on top of the piston, making sure that the ears of the large ring valve rest against one side of the guide pins and the ears of the small ring valve rest against the opposite side as shown in Fig. 38.

9. Start one or two of the allen cap screws and then remove the clips.

10. Fully tighten the valve cage to the piston and make sure the valves operate freely.

PISTON AND CONNECTING ROD ASSEMBLIES

The piston and connecting rod assembly consists of the following items (assembled):

Piston Assembly - consisting of piston, piston pin and its locking rings and piston rings.

Connecting Rod Assembly - consisting of connecting rod, connecting rod bolts and self locking nuts and the connecting rod lower half.

REMOVING THE PISTON AND CONNECTING ROD ASSEMBLIES - To remove piston and connecting rod assemblies, proceed as follows:

Pistons should be marked so that they may be replaced in their original positions.

1. Drain the oil from the crankcase.

2. Remove the crankcase cover plates, cylinder heads, discharge valve cage, and discharge valve plate.

3. Rotate the crankshaft so that the piston is at the bottom of its stroke.

4. Remove the self locking nuts from the connecting rod bolts, and remove the lower half of the connecting rod bearing, observing carefully the identification number stamped on it.

5. Pull the piston and connecting rod assembly upward and lift it out. A 1/4" - 20 screw or eyebolt inserted in the tapped hole in the piston top will aid in the lifting procedure. Note that the identification number stamped on the upper half of the rod bearing matches the number stamped on the lower half. These numbers should always match and should face toward the middle of the compressor from each end of the crankshaft. Loosely assemble the lower half bearing to its connecting rod so that it will not be misplaced or damaged.

6. Remove the piston and connecting rod assemblies, one set at a time, repeating the above steps for each cylinder.

7. If the piston and connecting rod must be disassembled, select a clean, smooth surface upon which to work. It is also desirable to lay a piece of cardboard or heavy paper on the working surface.

8. Disassemble each piston assembly if required as follows:

    a. Remove the piston pin locking springs with needle type pliers and push the piston pin out of the piston and the small end of the connecting rod.

    NOTE: Only a small amount of clearance between the piston pin and its holes in the connecting rod and the bosses of the piston is permissible. (See Table 5.) When the

TABLE 5— MANUFACTURING TOLERANCES

Piston	Diam. – Top	6.7370 + .0000 / − .0010
Piston	– Bottom	6.7340 + .0000 / − .0010
Piston	Wrist Pin Hole	2.0000 + .0003 / − .0000
Cyl. Diam.		6.7500 ± .0005
Wrist Pin Diam.		2.000 + .0000 / − .0003
Connecting Rod	Wrist Pin Hole	2.0005 + .0003 / − .0000
Connecting Rod	Crank End Hole	4.7530 + .0015 / − .0000
Connecting Rod	Crank End Width	1.6200 + .0000 / − .0020
Crankshaft	Seal End	4.7500 ± .0005
Crankshaft	Pump End	4.500 ± .0005
Crankshaft	Crank Pin	4.7500 + .0000 / − .0010
Crankshaft	Width Between Cheeks	6.5200 + .0050 / − .0000
Bearings	Seal End	4.7560 ± .0010
Bearings	Pump End	4.5035 ± .0007

piston and connecting rod assembly is removed from the compressor, this clearance may be checked by holding the top of the piston downward against a flat, solid surface to keep the piston stationary, and sliding the connecting rod back and forth on its piston pin. When the clearance is correct the rod can be moved back and forth freely from one piston boss to the other with no rocking or angular movement. If such movement exists, wear is indicated and the old piston assembly should be replaced.

b. Using strips of brass shim stock or equal, carefully remove the piston rings.

INSTALLING PISTON AND CONNECTING ROD ASSEMBLIES – Make sure that the piston ring grooves are clean and free of burrs; check the fit of each ring by inserting it in its groove in the piston and rolling it around the entire groove circumference.

1. Using the strips of brass shim stock or equal, slide the second (from the top) compression ring over the first groove and place it in its groove. Slide the top ring into position in its groove, invert the piston and place the ventilated oil cutter ring into its groove in the bottom of the piston skirt. Place the beveled oil ring in its groove at the bottom of the piston with its greatest width downward away from the piston top (beveled edge of the ring toward the top of the piston). (See Fig. 43.) This assures that oil on the cylinder walls is "scraped" or moved downward toward the crankcase rather than upward.

2. With the top of the piston placed downward on a clean surface, insert the piston pin into one of the holes in the piston and push it inward using thumb or hand pressure until it just protrudes from the boss on the inside of the piston. Place a few drops of oil on the bearing surface in the small end of the connecting rod, insert this end of the rod in the piston and push the pin through the rod bearing and into the remaining piston pin boss. Center the piston pin and insert the piston pin locking springs.

3. Turn the piston rings so that the open ends or gaps are equally spaced or approximately 90° apart and oil the piston. Also, place a few drops of clean oil on the crankshaft crankpin.

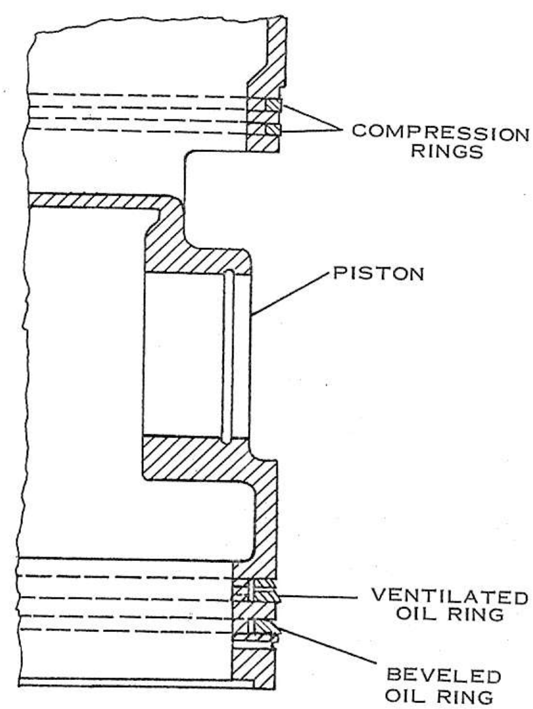


FIG. 43— Piston Ring Arrangement

4. With the crankshaft turned so that the appropriate crankpin is down, insert the connecting rod and piston assembly through the funnel ring, (York Part No. 064-01456 supplied in the tool kit with the compressor) placed on the top of the cylinder sleeve with its larger diameter opening upward. The piston rings will be compressed by the funnel ring as the piston is pushed downward into the cylinder sleeve. (See Fig. 44.) Guide the connecting rod into position on the crankpin using care to prevent it from becoming fouled in the openings in the cylinder sleeve.

5. Place the bearing cap on the connecting rod, making sure that the identification marks match and are in their proper positions as described in paragraph (5) of REMOVING THE PISTON AND CONNECTING ROD ASSEMBLIES and tighten the self-locking nuts to the proper torque - 41.6 ft. lbs. (See Table 3.) Assemble in a similar manner the cylinder sleeve and the piston assembly in the remaining cylinder of the bank.

6. Check the piston top clearance. Turn the crankshaft until the piston to be checked is at the top of its stroke. With the discharge valve cage removed, measure the distance from the top of the discharge valve plate to the top of the suction valve cage using a depth micrometer. Proper clearance should be .035" to .054". (Refer to Fig. 22.)

7. Install the discharge valve cage assemblies for this bank of two cylinders and rotate the crankshaft by hand to be sure that no binding exists. Repeat this procedure for all of the piston and connecting rod assemblies of the compressor.

8. Check clearnace between the connecting rod and crankpin bearing cheeks, after all four connecting rods have been assembled to the crankpin. Total clearance should not be more than .040".

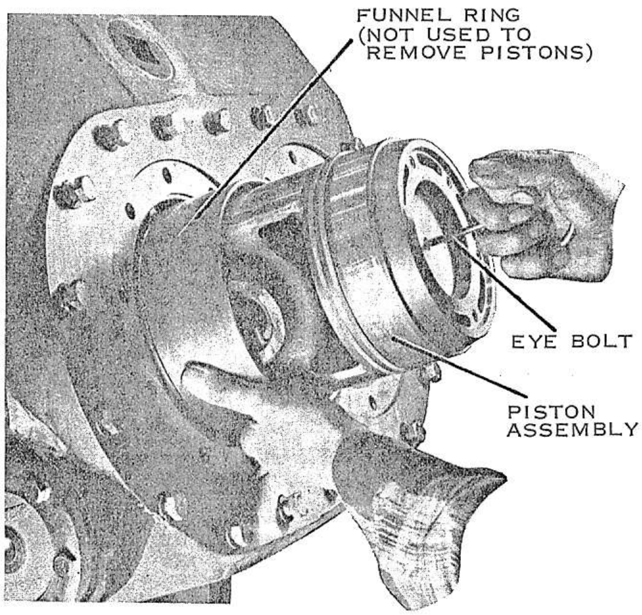


FIG. 44— Installing Piston and Connecting Rod Assembly in Cylinder

CYLINDER SLEEVES AND UNLOADER MECHANISM

REMOVING CYLINDER SLEEVES - To remove the cylinder sleeves, proceed as follows:

1. Remove the three unloader lift pins. (Matched Sets - Do not Mix).
2. Remove the oil piping to the unloader cover plate. Carefully remove the unloader cover plate so that the unloader piston, under tension from its spring, does not come out. (See Fig. 45.)
3. Partially remove (about half way) the unloader piston and push rod. This will free the unloader cam ring on both cylinder sleeves.
4. Remove the cylinder sleeves from the compressor. If necessary, tap the bottom of a sleeve with a brass rod to start it. The unloader push rod may now be removed.
5. Examine the cylinder sleeve. Make sure it is not damaged and that the unloader cam ring moves freely. Check that the cam ring support and retaining ring are secure. Replace the cylinder sleeve if necessary.
6. If the cam ring or cam ring support is to be removed, refer to Fig. 46 and place the cylinder sleeve upside down.
7. Using a pair of pliers, remove one roll pin from the cam ring support. Turn the cam ring support until the space left by removing the roll pin is aligned with the "gap" in the retaining ring.
8. Use a screwdriver, pry the end of the retaining ring over the first roll pin on the right. Turn the cam ring support clockwise, forcing the retaining ring out of its groove. Remove the ring.
9. Slide the cam ring support and cam ring off of the cylinder sleeve.
10. Examine the cylinder sleeve, cam ring and support ring. Make sure they are all free of damage and free of all nicks, scratches and burrs. Replace parts, if necessary.
11. To assemble the cam ring, repeat steps 6 through 7 in reverse order, making sure to replace the roll pin removed in step 7.

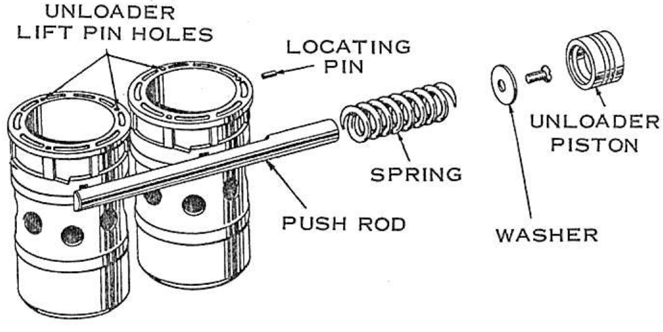
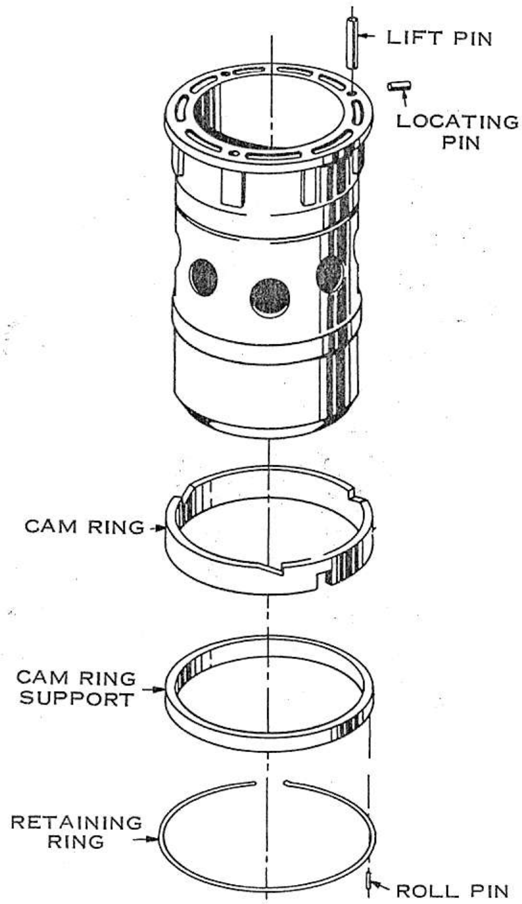
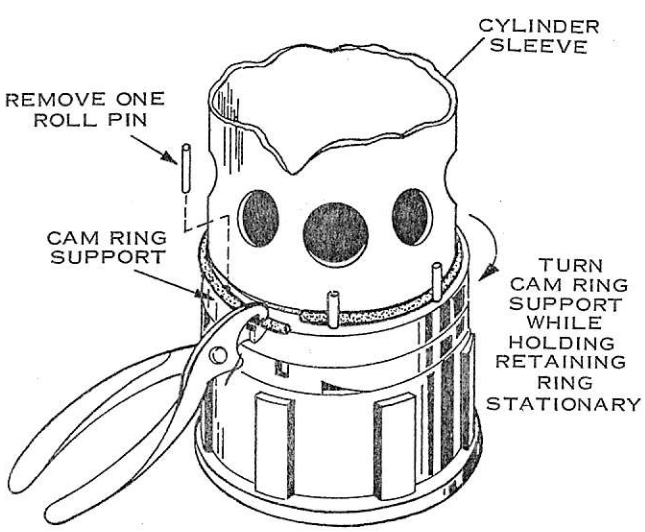


FIG. 45— Unloader Mechanism



EXPLODED VIEW



REMOVING CAM RING SUPPORT

FIG. 46— Cylinder Sleeve, Unloader Mechanism

NOTE: The unloaders are designated as either right or left-hand. Actually, all parts of the unloader mechanism are interchangeable with the exception of the cam rings; which have cams sloped in opposite directions. The "hand" is determined by the position of the unloader rod in respect to the cylinders when one is looking at the seal end of the compressor. When the unloader rod is to the left of the cylinders the mechanism is a left hand one.

REPLACING CYLINDER SLEEVE – To replace the cylinder sleeves, proceed as follows:

1. Make sure the unloader cam ring moves freely around the cylinder sleeve and that the cam ring support and retaining ring are secure.
2. Insert the unloader push rod into position about 3/4 of the way.
3. Visually align the notch in the unloader cam ring with the ball on the unloader push rod, while lowering the sleeve into the housing, so that when the unloader push rod is inserted fully, the ball will fit into the notch.
4. Insert the cylinder sleeve into final position. Make sure the cylinder locating pin (Fig. 46.) is aligned with the notch in the compressor housing.
5. Insert the 3 unloader lift pins with their beveled edges down into the holes in the cast bosses on the cylinder sleeve.
6. Press the unloader piston and push rod fully into position and move it in and out by hand to make sure the unloader mechanism is working properly.
7. Install the unloader cover plate and reconnect the unloader oil piping.

REPLACING THE CRANKSHAFT BEARINGS

The main or crankshaft bearings are made of aluminum alloy and should be handled with care to avoid dents and scratches. They are finished to exact tolerances and replacement bearings should not require scraping or fitting in the field. If one main bearing must be replaced, the other bearing should be removed for careful examination. If any signs of wear are visible, both 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. The compressor main bearings can be replaced without removing the connecting rods if feasible.

The oil pump end and the shaft seal end main bearing can be replaced as described below. The oil should be drained from the crankcase, and if required, the refrigerant pumped out and the crankcase vented. (See PUMPING OUT FOR REPAIRS.)

OIL PUMP END MAIN BEARING – To replace the oil pump end main bearing, proceed as follows: (See Figs. 32, 34 and 47.)

1. Remove the compressor oil pump assembly and its drag crank. (See REPLACING THE OIL PUMP ASSEMBLY.)
2. Remove the oil pump suction and discharge tubing connections which are attached to fittings in the bearing head.
3. Remove the bearing head cap screws and loosen

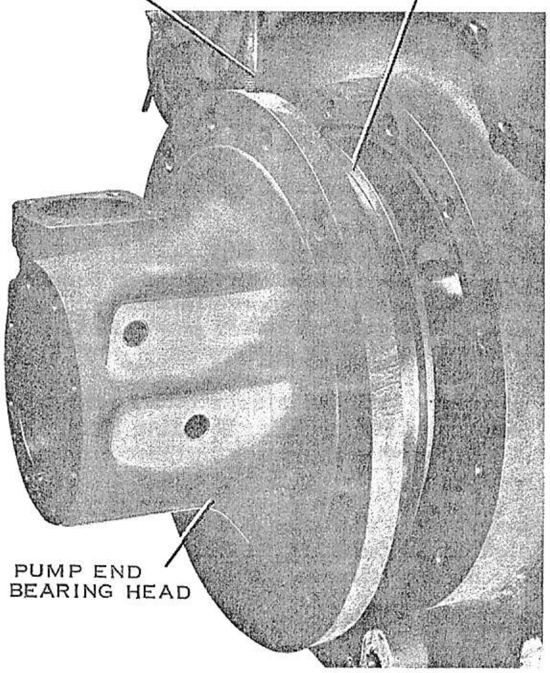


FIG. 47— Main Bearing Oil Pump End

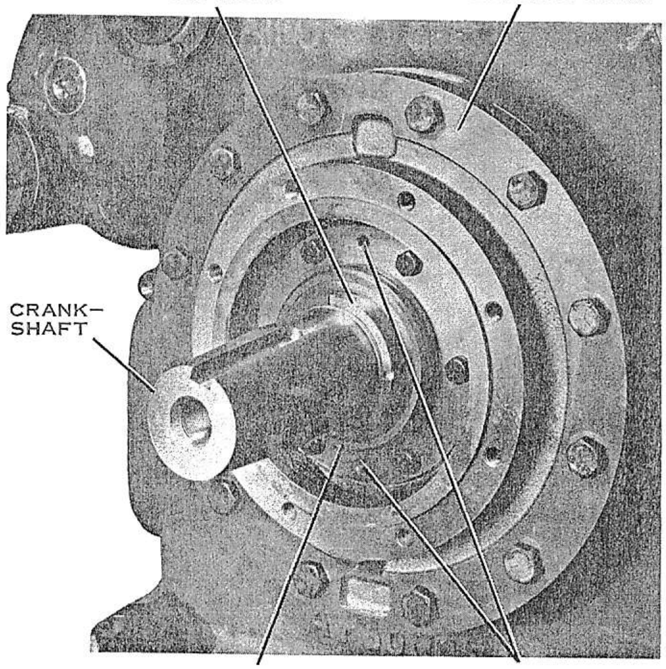


FIG. 48— Thrust Bearing

and remove the bearing head with the bearing in place. Support the end of the crankshaft, or jack it up through one of the cover plates, with a 2 × 4 or other suitable means, to keep the excess weight off of the main (thrust) bearing. Examine the crankshaft journal carefully; if signs of wear or roughness are present, replace the crankshaft (See REPLACING CRANKSHAFT) or hone the journal to satisfactory condition.

4. Remove the bearing from the bearing head, clean the head with an approved safety solvent and make sure that the drilled oilway in the head is open and clean, blowing it out, if required.

5. Carefully install the new bearing in the bearing head, making sure that the roll pin in the bearing head fits properly in the hole in the bearing flange and that the flange rests against the bearing head.

6. Oil the shaft journal or bearing and install the bearing head with the bearing in position using a new bearing head gasket if the original one is not in good condition, following the above steps (1) to (5) in reverse order. Rotate the crankshaft to be sure that no binding exists.

7. Check the crankshaft thrust clearance. (See CHECKING CRANKSHAFT THRUST CLEARANCE.)

SHAFT SEAL END MAIN (THRUST) BEARING – To remove the shaft seal end or thrust bearing proceed as follows: (See Fig. 32 and Fig. 48.)

1. Remove the compressor drive. (See FLEXIBLE COUPLING or BELT DRIVE in the INSTALLATION section of this book.)

2. Remove the shaft seal collar and locating ball. (See REPLACING THE SHAFT SEAL.)

3. Remove the cap screws and lockwashers which secure the main (thrust) bearing to the compressor bearing head and use two of these screws in the tapped holes in the bearing flange to jack out the bearing. It may be necessary to use an upward force on the crankshaft end or jack it up through one of the cover plates, to take the weight off the bearing so that it may be pulled all the way out of the bearing head. Examine the crankshaft journal carefully; if signs of roughness or wear are present, replace the crankshaft or hone the journal to satisfactory condition.

4. Make sure that the drilled oilway in the bearing head and the external tee through which oil is fed to the bearing and unloader manifold are open and clean. Clean the bearing and bearing head. Oil the shaft journal or bearing and install the new bearing carefully to avoid damage. Make sure that the oil hole drilled in the bearing sleeve is at the BOTTOM, to register with the oilway. As the bearing is being inserted, raise the shaft if necessary to take the weight off, so that it may be slipped into position readily. Insert the cap screws and lockwashers and draw them to the proper torque. (See TABLE 3.) Rotate the crankshaft to be sure no binding exists.

5. Refer to REPLACING THE SHAFT SEAL and install the shaft seal ball, shaft seal collar and shaft seal retaining ring. Check the crankshaft thrust clearance. (See CHECKING CRANKSHAFT THRUST CLEARANCE.)

6. Complete the installation of the shaft seal and reinstall the flexible coupling or belt drive.

REPLACING COMPRESSOR CRANKSHAFT

1. Refer to CYLINDER HEADS, REMOVING AND REPLACING VALVE ASSEMBLIES, PISTON AND CONNECTING ROD ASSEMBLIES, REPLACING THE CRANKSHAFT BEARINGS and CYLINDER SLEEVES.

2. Remove the cylinder heads, discharge valve assemblies and piston and connecting rod assemblies and cylinder sleeves.

3. Lay a 2" × 6", or other suitable, timber in the crankcase, parallel to the crankshaft centerline and block it up solidly against the crankshaft. Remove both main bearing heads.

4. The crankshaft may be removed from either end of the compressor. Two men are required for this operation.

5. Slide the crankshaft, on the 2" × 6", partially out of the compressor housing, taking care not to damage the main bearing head openings or the crankshaft journal. If a chain hoist or crane are available, attach a sling around the crankshaft and lift it completely out of the compressor housing. Otherwise the two men must lift the crankshaft out.

6. Thoroughly examine the new crankshaft, making sure it is free of all burrs and thoroughly clean. Blow out all oil passages with air pressure.

7. To install the new crankshaft, repeat steps 1 through 5 in reverse order, taking care not to damage any of the crankshaft bearing journals.

CHECKING CRANKSHAFT THRUST CLEARANCE

To prevent possible damage to parts, a small amount of longitudinal clearance (thrust clearance) between the outer shoulders of the crankshaft and the flanges of the pump and seal end main bearings is provided. This clearance may be checked as follows:

1. Install the shaft seal locating ball, the shaft seal collar and its retaining ring. (See REPLACING THE SHAFT SEAL.)

2. Pull the crankshaft outward (toward the shaft seal end) against the thrust face of the seal end main bearing.

3. Insert a feeler gauge between the inner face of the shaft seal collar and the outer face of the flange on the shaft seal end main bearing. This clearance must be between .002" and .004". (See Fig. 33.)

ALTERNATE METHOD – If the compressor crankcase cover plates have been removed for inspection or repairs, and the crankshaft is therefore readily accessible, the thrust clearance may also be checked by inserting the feeler gauge between the inside surface of the thrust bearing and the mating machined surface of the crankshaft. The crankshaft must be moved all the way toward the oil pump end to check thrust clearance at this point. (See Fig. 49.)

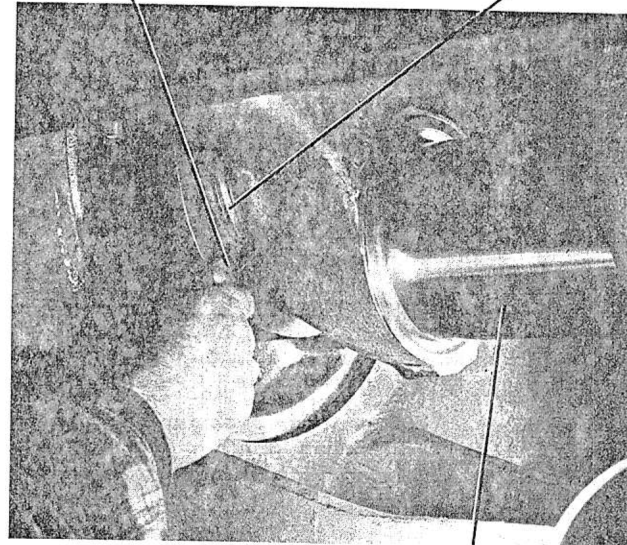


FIG. 49— Alternate Method of Checking Thrust Bearing Clearance

EVACUATION AFTER REPAIRS

If any part of the refrigerant system other than the compressor (piping, evaporators, condenser) was opened for repairs and the refrigerant charge stored in the receiver, the entire system should be evacuated using a vacuum pump as described in EVACUATING THE SYSTEM before releasing the ammonia charge from the receiver.

COMPRESSOR ONLY

If the compressor only was opened, the air should be pumped out before opening the suction and discharge stop valves.

To pump out the compressor, proceed as follows:

1. Loosen the flare nut and remove the tubing connection which feeds the discharge pressure gauge from the gauge valve. Open the valve wide.

2. Place an electrical jumper across the terminals of the low pressure cutout switch to prevent compressor shut-down when a vacuum is reached.

3. Operate the compressor 10 to 15 seconds at one time, until the suction pressure has reached 15 to 25 inches vacuum.

4. Stop the compressor, open the compressor suction valve and admit refrigerant to blow gas through the compressor valves and purge any

air which remains above the discharge valves out through the open discharge pressure gauge valve.

5. Close the gauge valve and re-connect the tubing connection which feeds the discharge pressure gauge. Open the suction and discharge stop valves before operating the compressor.

IDENTIFICATION PLATES

In order that compressor units and compressors may be properly identified in the field and to facilitate ordering parts and identifying compressors for possible future field design changes, the following identification or nameplates are used.

COMPRESSOR NAMEPLATE – This plate provides the following information on the compressor only:

1. SERIAL NO. (Example – R007184, etc.) In this number the letter (R) signifies year of manufacture.
2. COMPRESSOR MODEL (Example A589-5BE, etc. See NOMENCLATURE.)

   Items 1 and 2 above are both on the same nameplate, which is located to the right of the oil pump on the suction strainer coverplate.

Note that the COMPRESSOR NUMBER (Example 290 etc.) is stamped in the compressor housing before painting. This number is located on the housing, at the top, adjacent to the suction stop valve elbow.

REPLACEMENT PARTS – When ordering replacement parts for the compressor, the compressor SERIAL NO. and compressor MODEL and the quantity of parts must be given.

SPECIAL TOOLS

An Accessory Tool Kit is shipped with each compressor or series of compressors. The following parts are included in the kit:

Part No.	Description
064-01456	Funnel Ring
026-03840	Disch. Temp. Thermometer (Range 200 F To 500 F) and Hdwe. for Mtg.
025-04945	High Pressure Cutout (NEMA 1)
025-10623	High Pressure Cutout (NEMA 3, 7 & 9)
068-02949	Socket Wrench (Relief Valve)
025-05782	Oil Failure Pressure Switch (NEMA 1)
025-06100	Oil Failure Pressure Switch (NEMA 3, 7 & 9)
023-01306	Flare Union 1/4" SAE x 1/4" MPT
021-05675	Flare Nut - 1/4"
064-03306	Spanner Wrench (Shaft Seal)
029-08012	Spanner Wrench Handle

The following tools are not shipped with the compressor and must be ordered separately when required:

Part No.	Description
364-28635	Discharge Valve Cage Tool
064-28630	Suction Valve Clip (2 - Required)

HALOCARBON COMPRESSORS

These compressors are supplied, on special order, for halocarbon or propane operation. They are identical to ammonia compressors with the following exceptions:

1. The halocarbon suction and discharge valve cages provide higher lift. They are identified by the letter "F" stamped on top of each valve cage in place of the "A" on ammonia valve cages. The valves are the same.
2. Halocarbon compressors are supplied with a crankcase heater.
3. The "O"-ring on the shaft seal ring is of a different composition and is identified by a red paint dot on its outside diameter. The ammonia "O"-ring is identified by a blue paint dot.
4. The suction and discharge stop valves are seal cap type and do not have hand wheels.

The basic OPERATION and SERVICE procedures of these compressors are identical, except for the above mentioned items and PUMPING OUT FOR REPAIRS.

DESIGN HISTORY

SHAFT SEAL

The procedure outlined in the SERVICE SECTION for REPLACING THE SHAFT SEAL covers compressors that are factory equipped with the Y-57 shaft seal.

Early production models were equipped with Y-49 style diaphragm seal. These models can be identified by an external, cylindrical oil reservior. If it becomes necessary to replace the shaft seal in one of these models order the Y-57 style Shaft Seal Kit from the Renewal Parts List (Form 255.10-RP). Follow the procedure outlined in Instruction (Form 225.10-N1.1) included with the kit. If after converting to the new style seal, seal failure still occurs check to be sure that the plug with "O" rings inserted in the oil return passage to the crankcase is not leaking.

Note: After conversion is made, future seal repairs require Y-57 style Shaft Seal parts.

DISCHARGE VALVES

The procedure outlined in the Service Section for Replacing Discharge Valves covers compressors equipped with the new style valve cage and inner valve seat. This design has the guide pin pressed into the valve cage. Compressors built since May 1965 with Compressor Number 63 - Serial Number RX077540 or higher are equipped with the new parts.

Compressors with Compressor Numbers lower than 63 and Serial Numbers lower than RX077540 are equipped with the old design valve cage and inner valve seat. This design had the valve guide pins pressed into the inner valve seat. These valve cages, guide pins and inner valve seats are no longer available. If any of the 3 above mentioned parts are required for replacement all parts (valve cage, guide pins and inner valve seal) must be replaced. (Recommendations would be to order new discharge valve cage assemblies. This improvement prevents the guide pins from being pushed out of the discharge valve seats due to slight liquid slopover.)

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