MODEL G-15
VERTICAL AMMONIA
COMPRESSORS

INSTALLATION & SERVICE MANUAL

and parts catalog

TECHNICAL ASSISTANCE LINE

1-773-235-0200

Howe Corporation

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2. Introduction

2.Introduction

The Howe G-15 Vertical Ammonia Compressor is backed by 90 years of proven performance and innovation. Long known for durability and reliability, our compressors are unsurpassed in reliability and low maintenance costs.

Important Safety Information

The information found in this manual is intended for use by individuals possessing adequate backgrounds of electrical, refrigeration and mechanical experience. Any attempt to repair or make alterations to this equipment may result in personal injury or property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

Safety Symbols and What They Mean

Please read and understand this manual prior to installing or operating this compressor. You must be completely familiar with the start-up, operation and service of this flaker **before** you attempt to start, operate or adjust this piece of equipment.

The following safety symbols will alert you to any special precautions throughout this manual:

DANGER
BEWARE OF HAZARDS THAT CAN RESULT IN PERSONAL INJURY
DANGER

WARNING
"DO IT RIGHT" OR RISK SEVERE PERSONAL INJURY. **FOLLOW INSTRUCTIONS CAREFULLY**
WARNING

CAUTION
RISK OF PERSONAL INJURY OR DAMAGE TO EQUIPMENT **FOLLOW INSTRUCTIONS CAREFULLY**
CAUTION

3. Specifications

3.Specifications

Compressor Specifications

Compressor:	2-cylinder reciprocating
Bore:	5 ½"
Stroke:	5 ½"
Maximum Speed:	440 RPM
Suction Connection:	1-1/2"
Discharge connection:	1-1/4"
HP requirements:	22.14 BHP @ 440 rpm
Displacement:	66.5 cfm @ 440 rpm
Capacity:	16 TR @ 20 psi suction, 155 psi condensing, 440 rpm
Flywheel:	36 in PD, 5C groove
Shipping Weight:	1,130 lb (domestic crating) 1,330 lb (export crating)
Shipping Volume:	44.0 cu. ft.
Cylinders & Crankcase:	Cast integral of high-grade semi-steel. Cylinders bored and honed.
Crankshaft:	Ductile iron, turned and ground, drilled entire length for force feed lubrication.
Connecting Rods:	Cast steel. Steel backed, babbitt faced, precision insert type bearings. Bronze piston pin bushing.
Piston Pins:	Hardened and ground, full floating type.
Pistons:	High grade semi-steel, trunk type. Three compression rings, two oil rings.
Suction Valves:	Ring plate valves located in piston head
Discharge Valves:	Ring plate valves made of special Swedish steel, safety head type. Interchangeable with suction valves.
Crankshaft Seal:	Mechanical shaft seal.
Main Bearings:	High grade bronze backed, babbitt lined, removable sleeve type bearings.
Lubrication:	Positive internal force feed lubrication, by direct drive oil pump to main, connecting rod and piston pin bearings and seal.
Oil Filter:	Cuno type, located in crankcase.
Standard Equipment:	Valve manifold casting including 1-1/2" suction and discharge shut-off valves, 3/8" crossover valves, high pressure relief valve from high to low side, crankcase pumpout and purge valves, oil drain valve, oil pressure gauge, suction scale trap with removable monel screen.

3.Specifications

Table 1
Compressor Ratings

Speed (rpm)	Displace-ment (cfm)	CAPACITY (TONS OF REFRIGERATION) AND BRAKE HORSEPOWER AT 185 PSIG CONDENSING PRESSURE SUCTION PRESSURE/TEMPERATURE											
		psig °F	**0 -28**	**5 -17.2**	**10 -8.4**	**15 -1**	**20 5.5**	**25 11.3**	**30 16.6**	**35 21.4**	**40 25.8**	**45 30**	**50 33.8**
300	**45.35**	**TR BHP**	4.65 11.9	5.8 13.54	7.47 15.1	9.36 16.0	10.8 16.8	12.64 17.4	14.27 17.9	16.0 18.2	17.7 18.4	19.18 18.5	22.54 18.5
365	**55.18**	**TR BHP**	5.66 14.5	7.07 16.47	9.09 18.36	11.39 19.47	13.16 20.46	15.37 21.12	17.36 21.78	19.47 22.12	21.57 22.34	23.34 22.45	27.43 22.45
440	**66.5**	**TR BHP**	6.82 17.46	8.52 20.0	10.96 22.13	13.73 23.5	15.86 24.66	18.53 25.5	20.93 26.26	23.46 26.66	25.99 27.0	28.13 27.1	33.06 27.1

3.Specifications

4. Receiving and Inspection of Equipment

4.Receiving and Inspection of Equipment

Upon receipt of your compressor, you should first inspect the crate very carefully, to determine if any damage might have occurred during shipment. If you suspect any damage has occurred, it should be noted immediately on the freight bill. In addition, a written notice must be sent to the agent representing the freight carrier. The written notice should request an inspection by the agent to verify damage during shipment. If the damage was noticed after un-crating of the equipment, it is necessary to keep the original shipping container so that the carrier's agent can investigate the damage claim thoroughly.

If a repair is necessary to the compressor, you must first obtain written permission from the factory before beginning any repairs. Unauthorized work on your compressor could result in voiding the machine's warranty.

5. Installation Instructions

5.Installation Instructions

Installation Conditions

Your compressor should be installed in a dry, well-lighted room with sufficient space around the unit for inspection and service.

Adequate ventilation is necessary for trouble-free operation of your compressor. The heat given off by both the motor and compressor must be removed from the air in the room, to prevent overheating of the motor and bearings. Natural ventilation may be sufficient where there are two or more windows, and the room is large enough to ensure frequent air changes. In cases where natural ventilation is insufficient, forced ventilation by means of fans controlled by a room thermostat may be necessary. Insufficient cooling of this equipment will result in a shortened service life.

Adequate space for removal of the flywheel and crankshaft shall be provided. See Figure 1for detailed dimensions.

Locate the compressor near a floor drain.

Foundations

The compressor shall be mounted on a concrete pad approximately 6" above floor level. Anchor bolts shall be installed in the concrete pad for securing the compressor. Once the concrete is cured, set the compressor over the anchor bolts. Shim and grout as necessary to maintain level.

*****CAUTION*****
THE COMPRESSOR UNIT MUST BE LEVEL PRIOR TO OPERATION.
*****CAUTION*****

Drive Motor

The drive motor is mounted directly on a slide rail. This slide rail allows movement of the motor toward or away from the compressor to achieve correct alignment. To move the motor, loosen the four lock nuts on the slide rail, and turn the two adjusting screws.

V-Belt sheaves

The V-belt sheaves are installed as closely as possible to the compressor and motor bearings, to reduce shaft stresses. After installation, check the sheave alignment by stretching a cord across the faces of both the motor and compressor sheaves (a straight edge may be used instead). All four points of the sheaves must be in contact with the cord or straight edge.

Realign the sheaves every time the motor is moved or belts are tightened.

5.Installation Instructions

Refrigerant Piping

CAUTION
ONLY PERSONNEL EXPERIENCED IN THE INSTALLATION OF REFRIGERATION EQUIPMENT SHOULD BE ALLOWED TO INSTALL AND SERVICE THIS EQUIPMENT.
CAUTION

Install all refrigeration piping in accordance with all applicable local, state, federal, and industry codes and regulations.

Insure that the internals of all piping and components are clean and free of dirt, slag, or other construction debris. Particles from a contaminated system can cause serious damage to this compressor and other refrigeration equipment.

Low spots in the piping system will act as traps for oil entrained in the refrigerant. Slope the suction and discharge mains away from the compressor. Take-offs from the suction and discharge mains should be made from the top of the line, so that these take-offs will not act as oil drains.

Suction Accumulator

Before operating the compressor, verify that a properly sized suction trap or accumulator has been installed in the suction line near the compressor. The suction accumulator must be sized properly, to prevent liquid refrigerant carry-over into the compressor. Any liquid entering the compressor can cause serious damage to the equipment.

Refrigerant Pressure Switches

Each compressor unit is supplied with a dual (high and low) pressure switch. The dual pressure switch will prevent operation of the compressor under abnormal conditions, preventing a malfunction of the system. Verify that these switches are set in accordance with applicable codes and regulations.

Oil Failure Switch

Each compressor unit is equipped with an oil failure switch. If necessary, adjust the switch so that the compressor will shut off when the differential between the suction pressure and oil pressure drops below 20 psi. Verify that oil and suction pressure gauges are properly calibrated.

Water-cooled jacket

The compressor is equipped with a water-cooled jacket. The jacket has two water connections; an inlet (lower connection) and outlet (upper connection). Install a hand valve on the water inlet line, and adjust the water flow so that the water outlet temperature is maintained at approximately 100°F (38°C).

Lubrication System

Recommended compressor oils are Texaco Capella WF-68, Suniso 4GS, or equal.

Never run the compressor in order to charge an empty crankcase with oil. Charging the crankcase should be accomplished with an oil-charging pump. Oil additions *may* be made with a charging pump when the compressor is in operation, provided that the crankcase pressure is not excessive.

Attach the oil fill line to the compressor charging valve, but do not tighten until oil has purged the air from the line. Open the compressor charging valve and fill the crankcase until the oil level is halfway up the sight glass.

*****CAUTION*****
SIGHT GLASS GAUGE VALVES *MUST* BE OPEN DURING OIL CHARGING.
*****CAUTION*****

6. Start & Adjust

6. Start & Adjust

Once installation has been completed, and the compressor has been properly adjusted and charged with oil, you may proceed with the check and adjust section.

Checklist

1) _____ Verify that the compressor is charged with oil. Oil level should be halfway up the sight glass.

2) _____ Open all refrigerant valves.

3) _____ Open all water valves.

4) _____ Start auxiliary equipment (fans, pumps, etc.)

5) _____ Start the compressor.

6) _____ Impose the operating load gradually, and then stop the compressor after a few minutes of operation.

7) _____ Allow the compressor to cool, and repeat step 6) as necessary, lengthening the running time until it is apparent that the compressor is operating within specifications.

8) _____ Monitor oil pressure, and adjust to 30 psi above suction pressure.

9) _____ Repeat step 8) after oil has reached normal operating temperature.

10) _____ Check alignment of the belt drive and adjust as necessary.

11) _____ Verify operation of the high-pressure switch. Shut off the air or water to the condenser to cause the discharge pressure to rise. This should cause the high-pressure switch to stop the compressor.

12) _____ Verify operation of the oil failure switch. Pull the motor leads off the bottom of the starter, and start the compressor. After a few minutes, the oil failure switch should shut down the compressor. Re-connect the motor leads, press the reset button, and start the compressor.

13) _____ After 24 hours of operation, clean the suction strainer screen. To remove the screen, unbolt the oval shaped cap at the bottom of the valve manifold casting. Repeat after one week of operation, after one month of operation, and annually thereafter.

7. Maintenance

7. Maintenance

CAUTION
ONLY PERSONNEL EXPERIENCED IN THE INSTALLATION OF REFRIGERATION EQUIPMENT SHOULD BE ALLOWED TO INSTALL AND SERVICE THIS EQUIPMENT.
CAUTION

Compressor Pump-down

To isolate the compressor for service, it is necessary to pump it down, as follows:

1. Close the low-pressure switches to keep the compressor running during pump-down (hold the spring-loaded arm up with a screwdriver).
2. When suction pressure drops to approximately 20 in Hg, stop the compressor.
3. Close the discharge stop valve.
4. Attach a purge line to remove high-pressure gas. Carefully remove the 300 psig discharge gauge, and attach a purge line.

Adding oil to the compressor

Recommended compressor oils are Texaco Capella WF-68, Suniso 4GS, or equal.

Attach the oil fill line to the compressor charging valve, but do not tighten until oil has purged the air from the line. Open the compressor charging valve and fill the crankcase until the oil level is halfway up the sight glass.

CAUTION
SIGHT GLASS GAUGE VALVES *MUST* BE OPEN DURING OIL CHARGING.
CAUTION

Alternatively, the compressor oil pump can be used to add make-up oil to the compressor. To charge using the compressor oil pump:

1. Attach a pipe nipple and hose to the ¼" angle valve at the oil pump.
2. Immerse the hose in a pail of oil.
3. Close the crankcase oil valve on the oil pump unit.
4. Open the ¼" oil charging valve.
5. When charging is complete, close ¼" oil charging valve and open the oil valve on the pump unit.

Never run the compressor in order to charge an *empty* crankcase with oil. Charging the crankcase should be accomplished with an oil-charging pump. Oil additions *may* be made with a charging pump when the compressor is in operation, provided that the crankcase pressure is not excessive.

7. Maintenance

Seasonal Shut-down and Start-up

If the refrigeration is to be shut down for any appreciable period of time, the refrigerant should be stored in the receiver to minimize stress in the piping system. To do this:

1. Close the liquid line valve at the receiver.
2. Manually open the liquid line solenoid valve.
3. Operate the system to approximately 20 in Hg, and stop the compressor.
4. Repeat pump-down until a slight (approximately 2 psig) positive pressure is maintained throughout the system.
5. Carefully check the condenser(s) and receiver for leaks.
6. Open the system's master switch.

Before start-up:

1. Inspect all water lines, wiring, evaporators, and auxiliary equipment.
2. Start the condensing water supply (if applicable).
3. Open the compressor discharge shut-off valve.
4. Close the system's master switch.
5. Open the liquid line valve.
6. Leak test the entire system.
7. Start the compressor, following the checklist on page 14.

Suction Strainer

The suction strainer should be cleaned at least annually (more often if specific conditions demand). To remove the screen, unbolt the oval shaped cap at the bottom of the valve manifold casting.

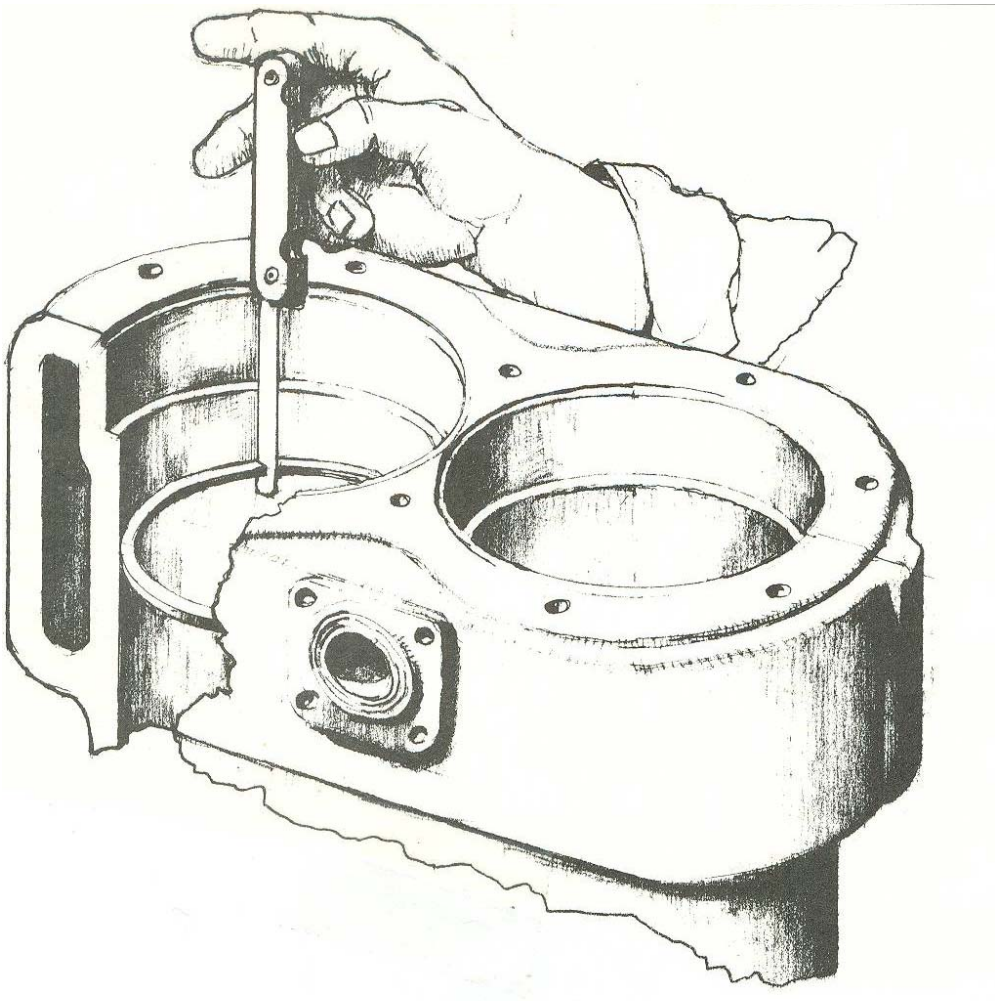
7. Maintenance

Piston Rings

Make certain cylinders and piston rings are wiped clean and dry; cylinder walls are smooth and free of burrs. Check cylinder bores with a micrometer to be sure the bores are straight and round. To replace the rings, spread them from the split until they can be lifted over the piston. Be careful when sliding the rings onto the piston, because they are brittle and may snap easily. Rock the piston and rings into the cylinder carefully to position the ring squarely.

Check end gap of ring with feeler gage as shown below. Gap should be a minimum of .025 inches.

Diagram for Checking Piston Ring Gap



8. Maintenance

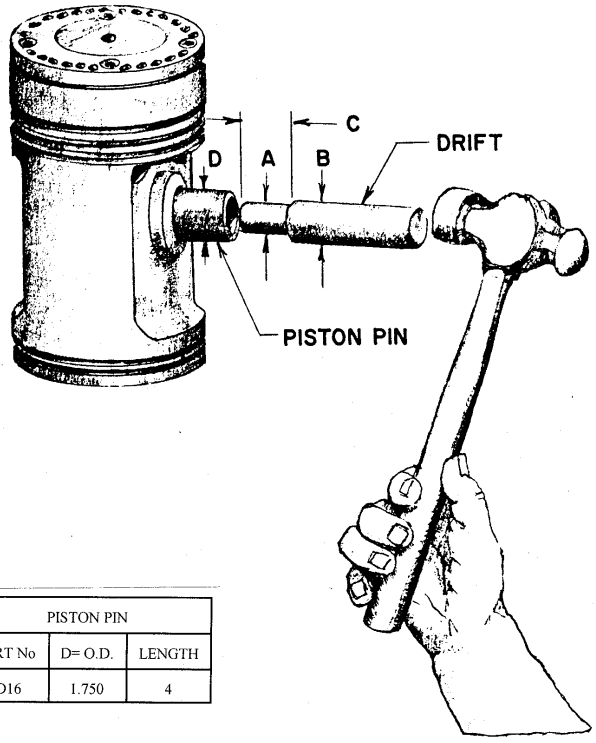
Piston and Connecting Rod

The first step in taking apart the rod assembly is to remove the nuts from the rod bearing bolts. Then remove connecting rod caps from the bolts. When handling the bearing cap, be careful not to drop or damage the bearing inserts. Make sure that the cap and connecting rod are kept together. Now push the piston and rod assembly up through the cylinder. Be careful not to nick any machined surfaces.

To remove the rod from the piston, the wrist pins must be removed. Check the wrist pin for wear before re-installing it. If the pin is loose in the piston, both the piston and the pin should be replaced. The pins are matched to the piston and are not interchangeable.

Check the inserts for wear, if the surfaces are worn the inserts must be replaced. When installing the inserts into the rod make certain that the insert seats on the crankshaft properly.

Piston Pin Installation



COMP. MODEL No.	DRIFT			PISTON PIN		
	A	B	C	PART No	D= O.D.	LENGTH
G-15	1-3/32	1-1/2	1-1/2	5D16	1.750	4

Howe G-15 Compressor Manual

9. Maintenance

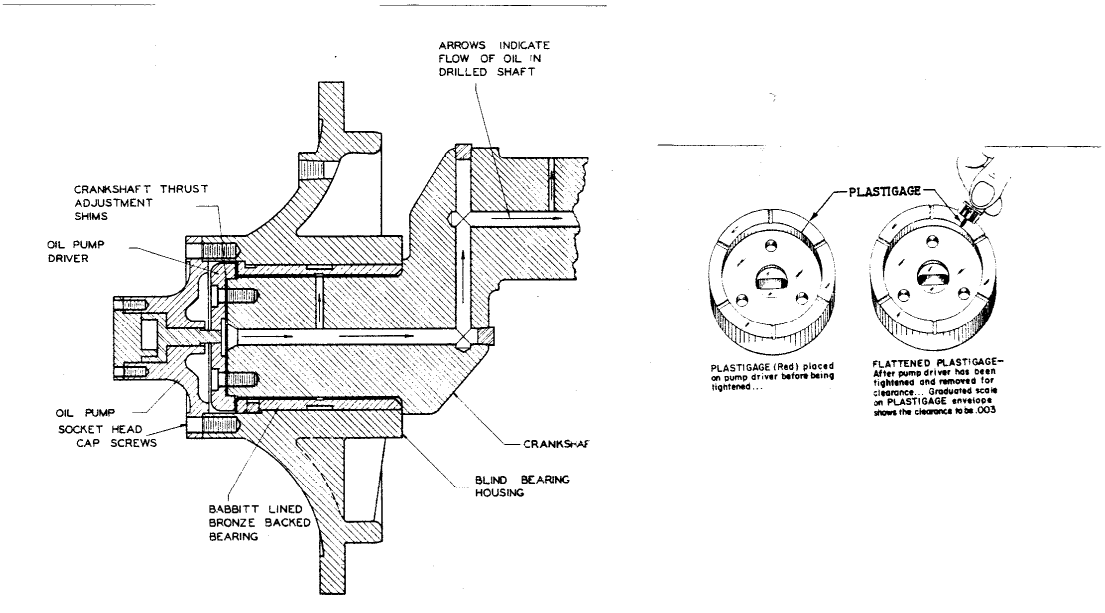
Oil Pump Housing

Remove oil pump by removing six 2" socket head cap screws. Remove oil pump driver by removing three d" socket head cap screws. In removing oil pump driver keep tract of crankshaft in thrust adjustment shims as shaft end play (.003 to .004) is important for proper operation of shaft seal at flywheel end.

To get proper clearance for shaft end play: Wipe the oil from pump driver and end of bearing. Place a piece of perfect circle type PR-1 plastigage between pump driver face & bearing end, then pull up driver tight by tightening cap screws. Remove pump driver. The flattened plastigage will be found adhering to either the pump driver of end of bearing. To determine the end play compare the width of the flattened plastigage at its widest point with the graduations on the envelope. The number within the graduation indicates the clearance in thousandths of an inch. If clearances are not with .003 - .004 remove shims to cut down clearance or add to increase clearance.

To remove blind bearing housing remove twelve e" cap screws and push off housing by using two cap screws in the tapped push-off holes. To remove bearing lining, tap lightly form inside, using block of wood. Bearing is light press fit in bearing housing.

Cross-Section of Oil Pump End of Compressor

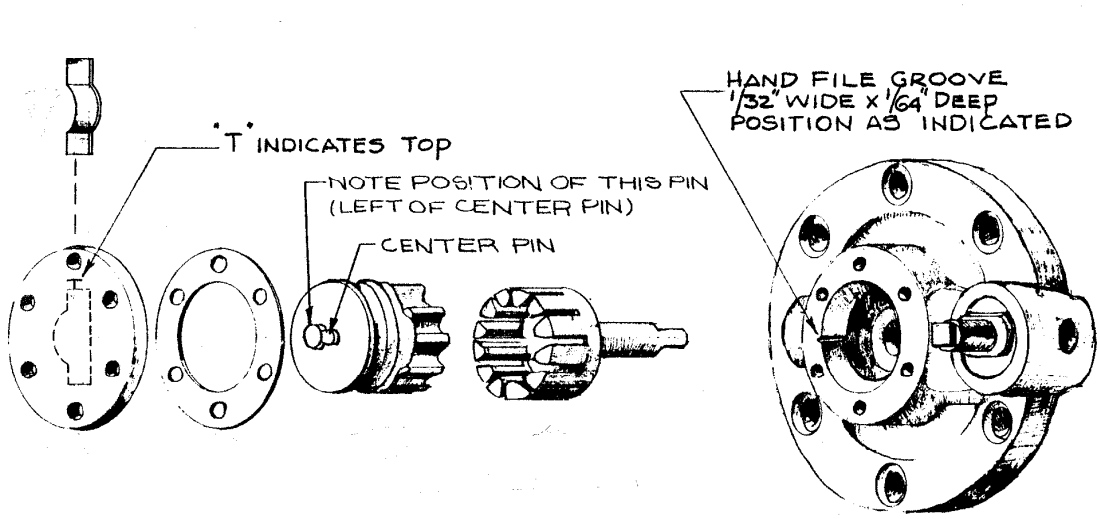


10. Maintenance

Reversible Oil Pump Assembly

It is imperative that these parts be installed exactly as shown below.

Cross-Section of Reversible Oil Pump



11. Maintenance

Shaft Seal

To remove seal: Unscrew the seal plate cap screws and remove the plate and gasket. Press the seal seat and gasket out of the plate. Remove all old seal parts from the seal chamber by pulling them off over the end of the shaft. Before installing new seal, make sure shaft end play is correct.

Make certain that the synthetic rubber seat gasket is set tightly against the shoulder of the stationary seal set and that the rounded outer edge of the gasket is at the rear. Carefully clean the counterbore in the seal plate into which the seat and gasket are to be installed. Cover the outer surface of the gasket with light oil and press seat with gasket mounted on it into the plat, seating it firmly and squarely, with the oiled surface on the gasket; these parts can be assembled with the fingers, thus requiring no special tools.

After the seat is assembled in the plate, carefully wipe the highly finished sealing surface and cover it with a film of light oil. Clean the shaft surface removing any rough spots or sharp edges which may chafe or cut the new seal parts. Cover the shaft surface with light oil.

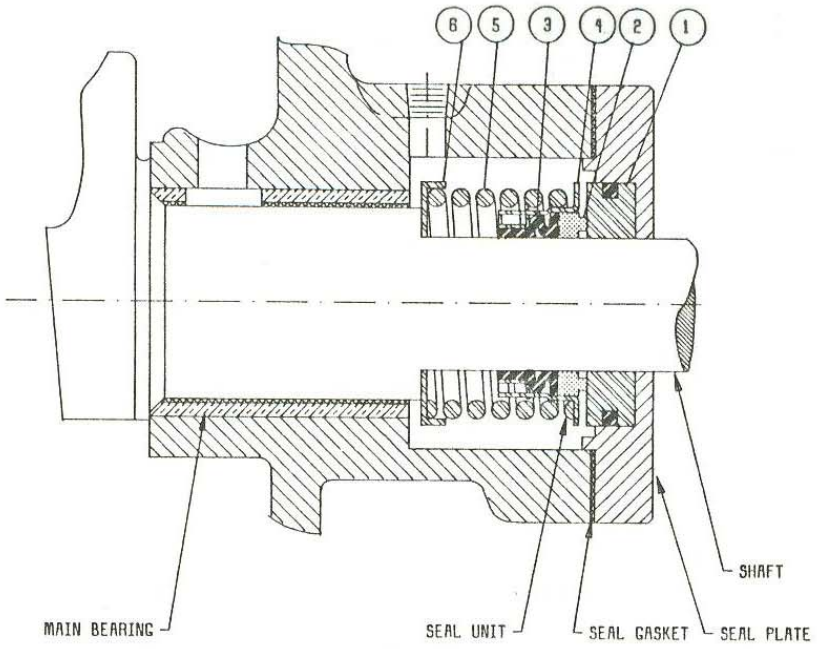
Place the seal spring with spring retainer attached to it over the end of the shaft and up against the shaft shoulder. Cover the inside surface of the synthetic rubber friction ring with light oil and place the seal ring assembly over the end of the shaft and slide it toward the compressor until the outer retaining shell touches the end of the spring it its free length. Make sure seal assembly slides freely on shaft if not, stretch retainer band either by peening or rolling it. Carefully wipe the carbon seal face and cover with light oil.

Place the seal plate with seat mounted in it and the plate gasket over the end of the shaft and fasten it to the compressor by tightening the cap screws. Uniformly tightening the end plate cap screws moves the seal ring back along the shaft to its proper operating position and compresses the spring to its intended working length. Do not allow end plate to move backward once the seal surfaces have been brought in contact.

Remove oil pressure gauge or screw plug from top of casting directly above seal chamber and fill with oil and then re-install gauge or plug as the seal cannot operate dry without damage to same. A short "run-in" about 30 minutes is usually required to perfectly mate the running seal joint, after installation of new seal.

12. Maintenance

Cross-Section of Shaft Seal

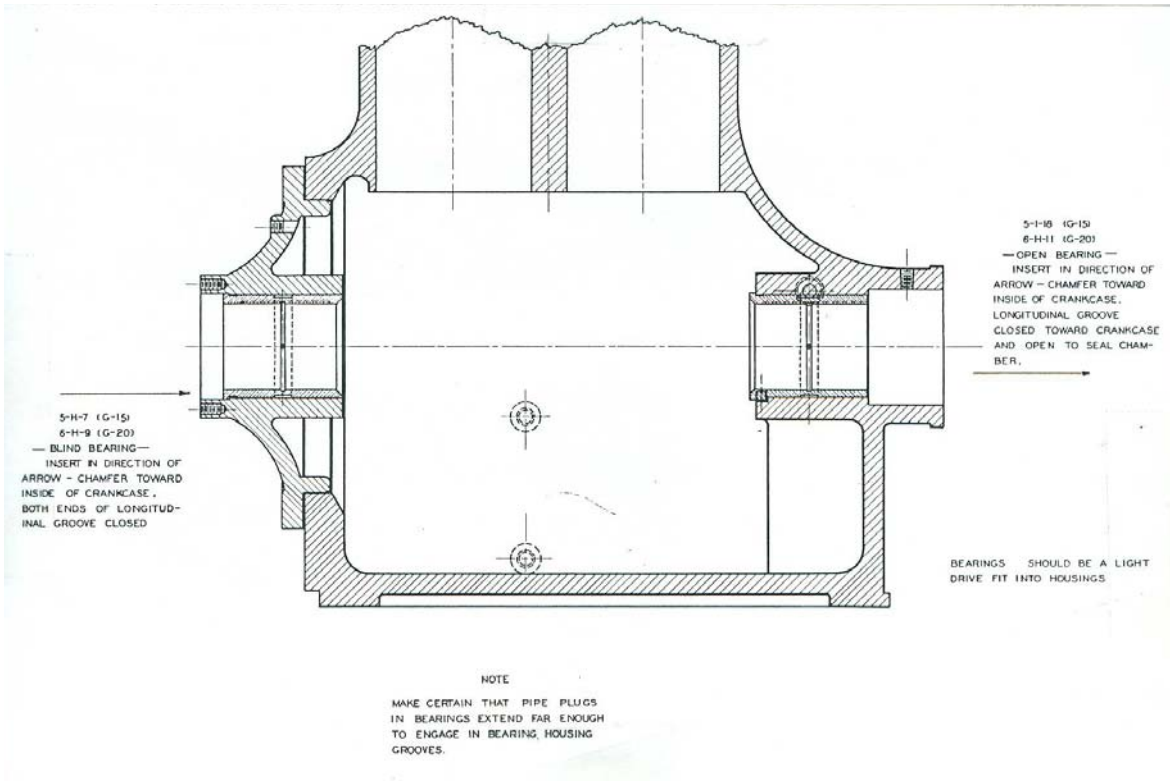


SEAL UNIT CONSISTS OF:

(1) - STATIONARY SEAT WITH O-RING
(2) - CARBON RING
(3) - RUBBER BELLOWS
(4) - RETAINER
(5) - SPRING
(6) - SPRING RETAINER

13. Maintenance

Main Bearings



14. Appendix A Compressor Drawings

14Compressor Drawings

Figure 1
G-15 Compressor Dimensions

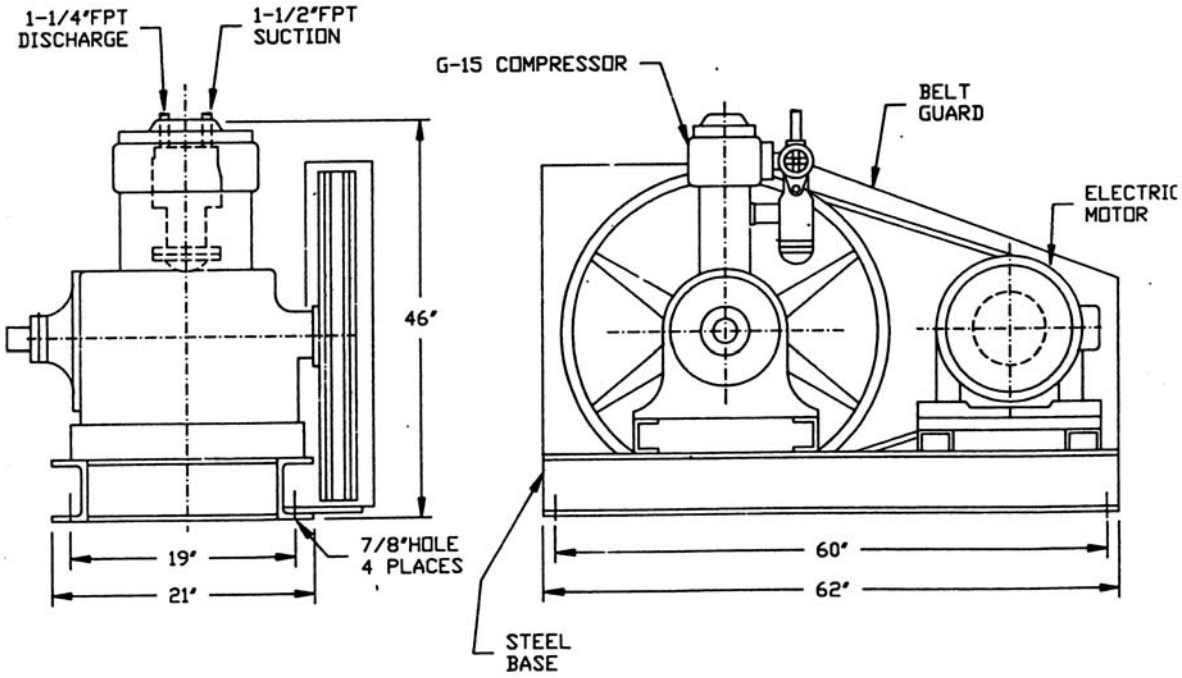
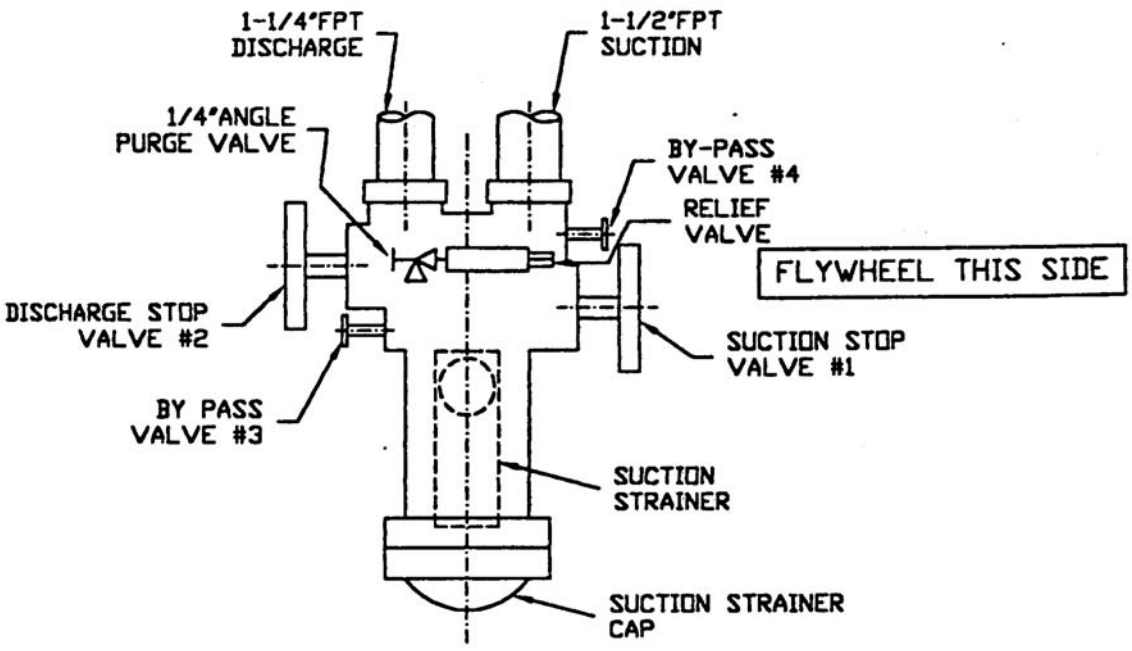


Figure 2
Valve Manifold



NOTE: (1) FOR NORMAL OPERATION SUCTION VALVE # 1
AND DISCHARGE VALVE # 2 SHOULD BE OPEN.
BY-PASS VALVES # 3 AND # 4 SHOULD BE TIGHTLY CLOSED.

Figure 3
Flywheel Mounting

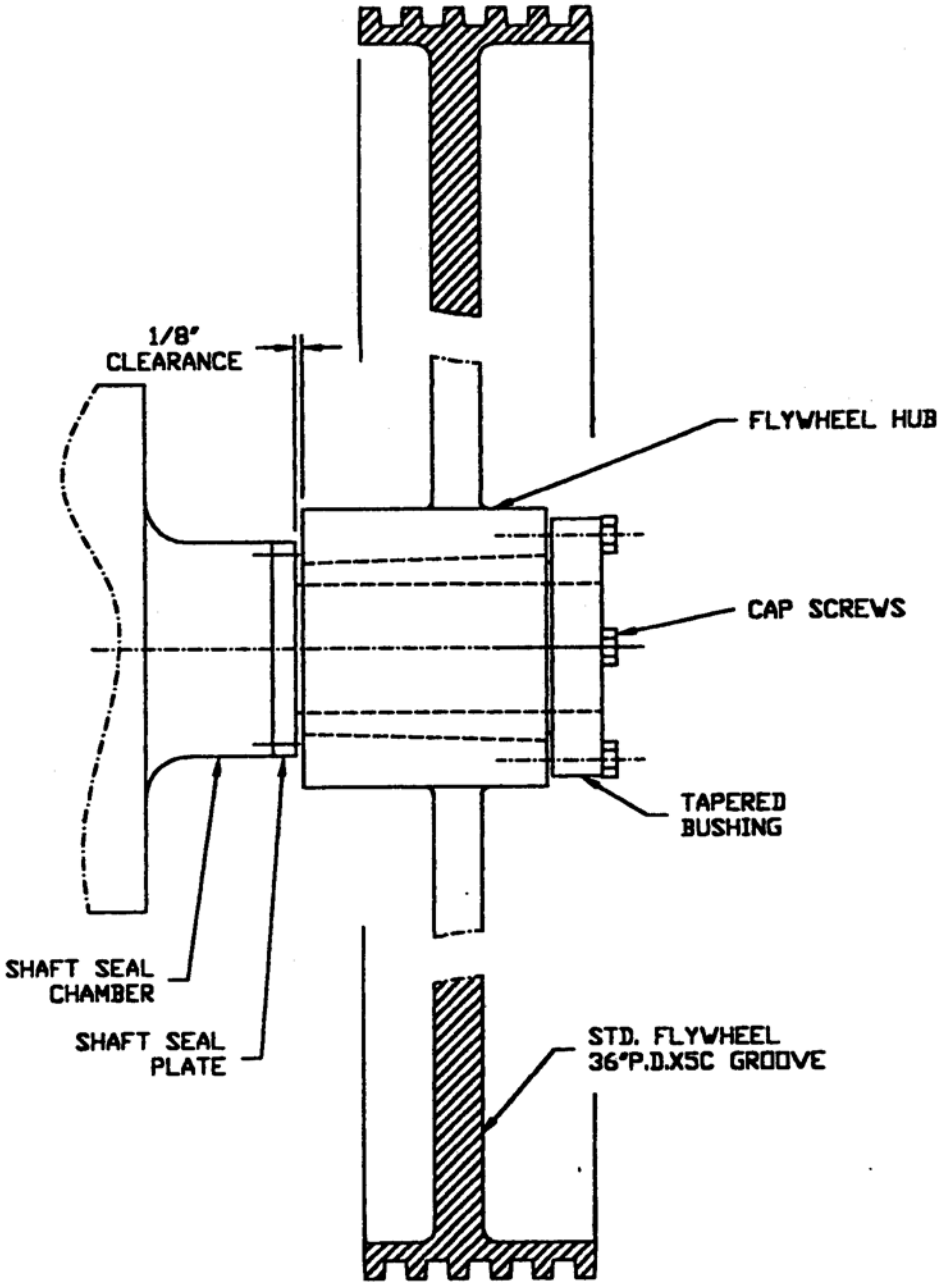


Figure 4
Main Bearing replacement

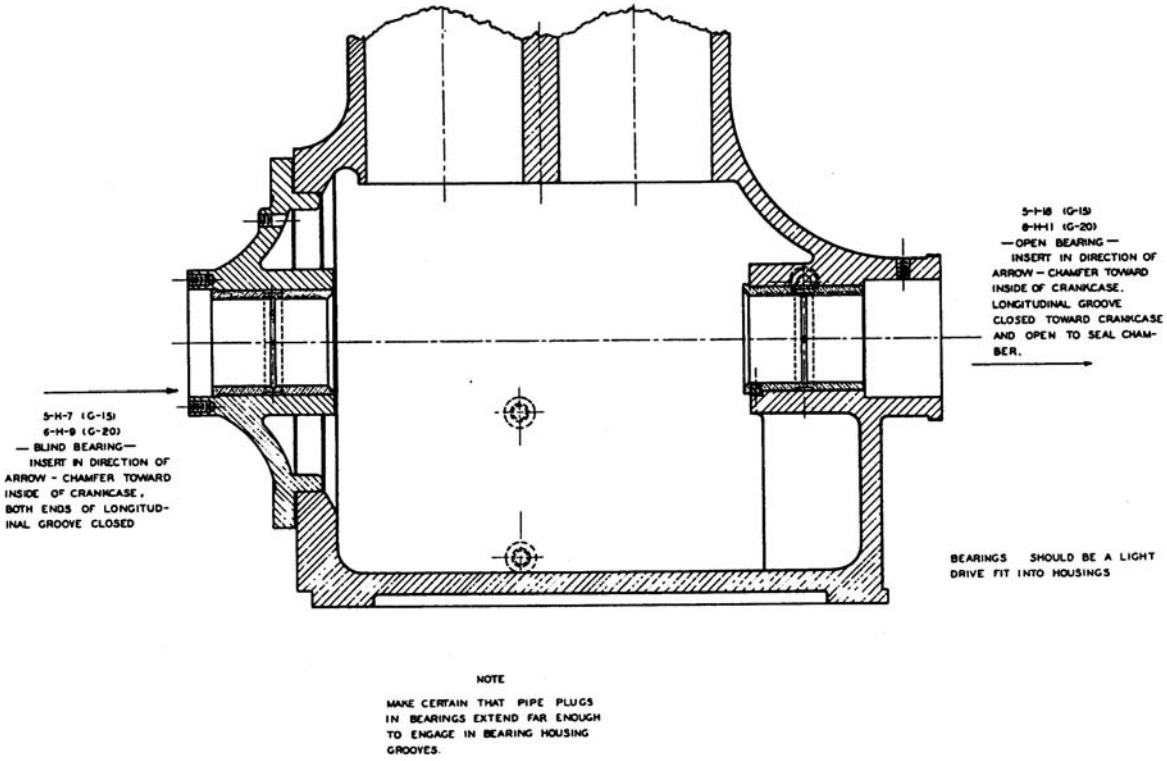
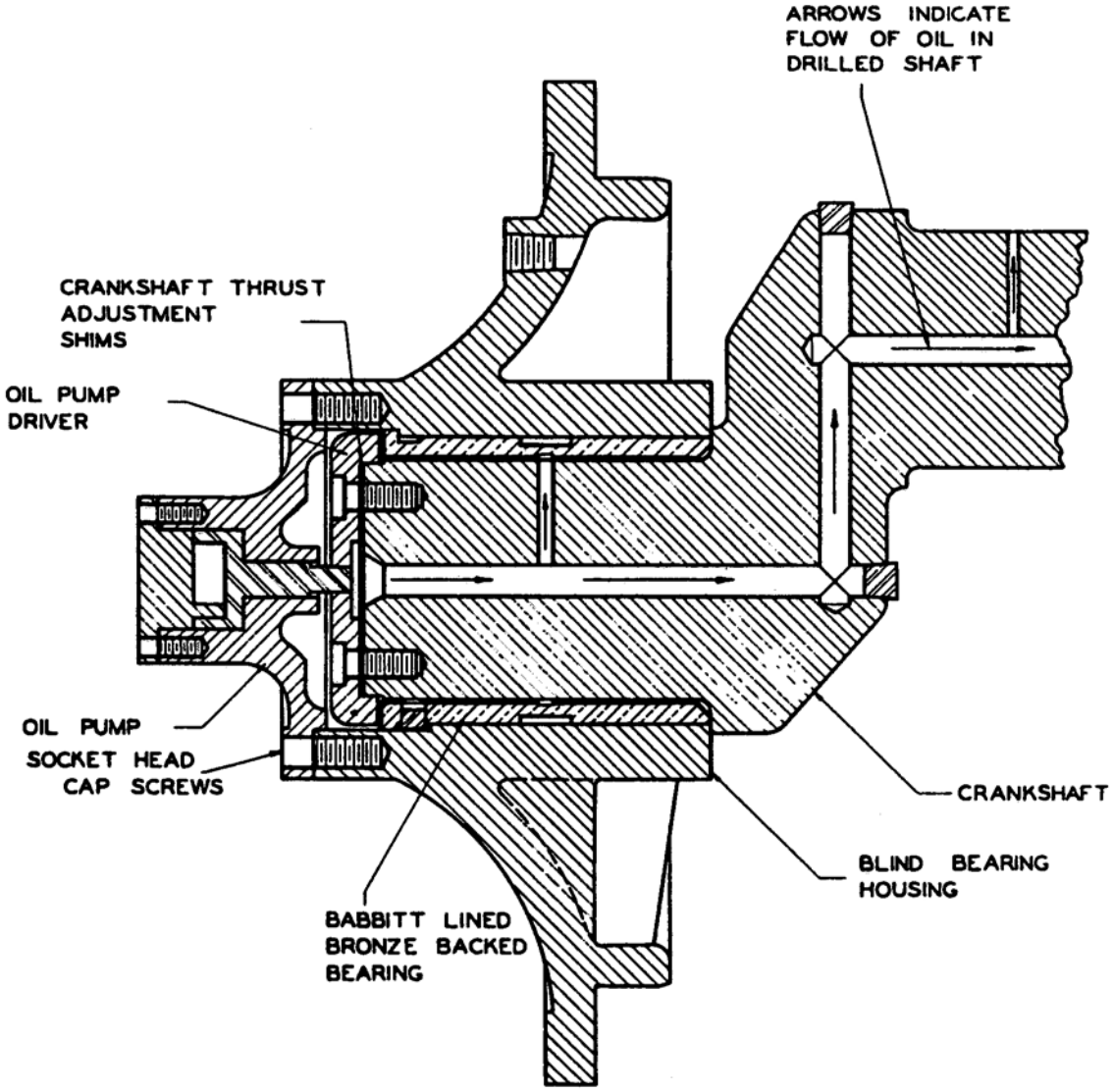
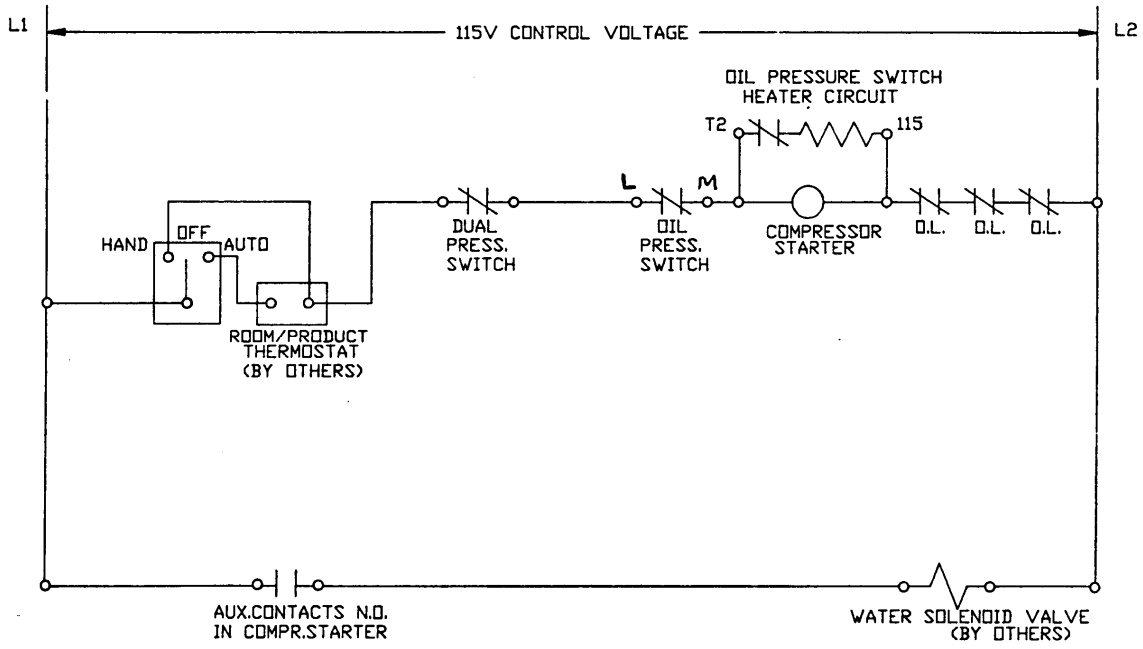


Figure 5
Cross-Section of Oil Pump



14Compressor Drawings

Typical Wiring diagram



15. Appendix B
Parts List

HOWE®

Replacement Parts for

MODEL G-15
VERTICAL AMMONIA COMPRESSORS

Effective January 1, 2002

Table 2 Replacement Parts for Model G-15 Compressors

Part Description	Part Number
Cylinder Head	5A12
Discharge Valve Unit (includes Seats, Cages, Plates, and Springs)	5C19 (2)
Discharge Valve Seat	5C12 (2)
Discharge Valve Cage	5C20 (2)
Discharge Valve Plates	5C14 (2)
Discharge Valve Spring	5C5 (6)
Discharge Valve Spring Pad	6C11 (6)
Gauge Glass	4Q107
O-Rings	4Q120 (2)
Gauge Glass Valve (Upper)	5O21
Gauge Glass Valve (Lower)	5O22
Safety Head Spring	5B4 (2)
Piston Unit – Standard	5D14 (2)
Piston Unit – Oversized (includes Suction Valve Unit)	5D14OS (2)
Piston Body – Standard	5D13 (2)
Piston Body – Oversized	5D13OS (2)
Suction Valve Cage	5D12 (2)
Suction Valve Plates	5C14 (2)
Socket Head Cap Screw	5D5 (6)
Wrist Pin – Standard	5D16 (2)
Wrist Pin – Oversized	5D16OS (2)
Piston Pin Lock Rings	5D15 (4)
Crankshaft	5G6-1
Blind Bearing Unit (includes Bearing Lining)	5H8
Blind Bearing Body	5H6
Blind Bearing Lining	5H7
Open Bearing Lining	5I19
Shims (for Shaft end play adjustment)	5L5
Shaft Seal Unit	5I20
Shaft Seal Plate	5I15
Valve Stem for Oil Pressure Regulator	3J2
Valve Guide for Oil Pressure Regulator	3J3
Valve Spring for Oil Pressure Regulator	3J4
Valve Cap for Oil Pressure Regulator	3J5

Part Description	Part Number
Valve Gasket for Oil Pressure Regulator	3J6
Oil Pump Unit	5L13
Oil Pump Body	5L1
Oil Pump Driving Flange	5L2
Oil Pump Gear Assembly (reversible)	5L3-1
Viking Pump Gasket	5L17-2
Oil Pump Valve Stem	5L6
Oil Pump Valve Packing Gland	5L7
Oil Pump Valve Packing Gland Washer	5L8
Oil Pump Valve Packing	5L9 (3)
Oil Filter Valve Head	5M10
Oil Filter Cartridge	5M14
Connecting Rod Unit (includes Wrist Pin Bushing)	5R15 (2)
Piston Pin Bushing	5R12 (2)
Connecting Rod Bearing Inserts (includes 2 halves)	5R14 (2)
Valve Manifold Unit	5Y25
Valve Manifold Body	5Y24
3/8” Valve Bonnet Assembly	4Y3 (2)
1 ½” Valve Bonnet Assembly	5Y2-8 (2)
Scale Trap Cap	5Y11
Scale Trap Screen	4Y2
Relief Valve Unit	5X
Compression Ring	5D22 (6)
Compression Ring – Oversized *(20, 40, 60, 80, 100)	5D24* (4)
Oil Ring	5D23 (4)
Oil Ring – Oversized *(20, 40, 60, 80, 100)	5D25* (4)
Cylinder Head Gasket (one piece)	5A13
Cylinder Head Gasket (two piece)	5A7 (2)
Blind Bearing Gasket	5H9
Seal Gasket	5I16
Oil Pump Gasket	5L4
Oil Filter Gasket	5M13
3/8” Valve Bonnet Gasket	4Y4 (2)
1 ½” Valve Bonnet Gasket	5Y9 (2)
Valve Manifold Suction Flange Gasket	5Y14

Part Description	Part Number
Valve Manifold Discharge Flange Gasket	5Y13
Valve Manifold Scale Trap Gasket	5Y15
Valve Manifold Relief Valve Gasket	5Y26
Ring Guide	5U

Figure 6
G-15 Cross-Section