SECTION III - SERVICE

I. MAINTENANCE SUGGESTIONS

When first starting a compressor, it is essential that it be allowed to pick up the entire load gradually. It should be run for a few minutes only and then stopped for a cooling off period. It is then restarted and run for a longer time and again allowed to stop for a cooling off period. Each running period can be lengthened until the operator is assured that no moving parts are heating up excessively. When the compressor operates with normal running temperatures, it can be run for whatever length of time the load requires.

Careful checking of a refrigeration system for leaks and proper operation of all components upon installation will start the system on its "best foot" towards a long life of satisfactory service. In order to insure this desired trouble-free operation, however, a systematic maintenance program is a requisite. Therefore the following suggested maintenance schedule is brought to your attention:

A. Daily
Clean suction screen bag.
Discard when the bag remains clean.

B. Weekly

1. Check Halocarbon refrigerant systems for leaks with a halide torch or G. E. Leak Detector for first four weeks of operation.
2. Check oil levels.
3. Check oil pressures.
4. Check Refrigerant levels in vessels.
5. Check filters in air handling units.
6. Check low temperature coils for defrosting.
7. Check all gauge and temperature readings.

C. Monthly
Repeat the weekly schedule (steps 1 thru 7).

1. Lubricate each piece of equipment in accordance with the manufacturers instructions. As a guide, bearings requiring oil should be given attention at least once a month, and those requiring grease at least once every six months.
2. Check drive for tightness and alignment. Drives should have coupling bolts tightened.
3. Check cooling towers and evaporative condensers for scaling or algae. Check sprays and screens for clogging. Consult manufacturers of water treatment supplies for corrective measures for scaling and algae problems.
4. Check calibration and operation of all controls, particulary safety controls.

D. Yearly
Repeat the weekly schedule (steps 1 thru 7) and the monthly schedule (steps 1 thru 4).

5. Check entire system thoroughly for leaks.
6. Drain water from condensers and cooling towers and check tubes. Check carefully for damage by corrosion or scale.
7. Remove all rust from equipment, clean and paint.
8. Check motors and fans for shaft wear and end play.
9. Check operation and general condition of electrical controls.
10. Clean all water strainers.
11. Check drains to make sure water will flow away from equipment.

There are any number of reasons why leaks may develop in a refrigeration system such as drying out of valve packings, yielding of gaskets, improper replacement of valve caps, and loosening of joints due to vibration. For these reasons, the need for periodic leak testing cannot be over-emphasized. By the same token, when any service operations are performed on the system, care should be exercised to insure that all opened flanges are tightened, all plugs which were removed are replaced with Teflon tape or a suitable thread filling compound, all packing glands on valve stems tightened, and all valve caps are replaced. Then, when operation is restored, all joints opened or any valves moved during the servicing should be checked for leaks.

E. Year Around Operation

When refrigeration equipment is operated 24 hours a day all year, it is highly recommended that a yearly check of all internal compressor parts be made. While the highest material standards are maintained throughout the VMC compressors, continuous operation and any presence of dirt may prove injurious to the machine. To forestall needless shutdowns or prevent possible machine breakdowns, the machine should be opened yearly, and the condition of the valves, rings and bearings checked. In this way, a small amount of time spent checking machine conditions once a year may prevent extensive shutdowns later with subsequent product loss and expensive repairs.

F. Seasonal Operation

In those instances such as air conditioning systems where there is seasonal operation of equipment, special consideration must be given to the equipment. When the equipment is shut down for any length of time as over the winter, the

refrigerant should be "pumped down" and stored in the receiver. Experienced refrigeration personnel only should perform this operation. The receiver should never be filled to more than 80% of its capacity and after filling, it should be thoroughly checked for leaks.

When starting up a system after a seasonal shutdown, only enough refrigerant should be allowed to enter the system to pressurize it for leak testing.

In this way, any leaks that may have developed during shutdown may be found with a minimum of refrigerant loss and it cannot be emphasized too strongly the importance of checking for leaks before a system is put back into operation. Only after you are sure the system is "tight" should the full supply of refrigerant be allowed to enter. After the system has operated for several hours another leak check should be made.

G. Service Contracts

The Vilter Manufacturing Corporation offers a variety of manintenance, inspection and repair services. There are plans available for almost any need and it is highly recommended that owners avail themselves of this opportunity. If a Vilter branch office is not available in your area, other contractors and refrigeration dealers should be contacted. Provisions for a service contract should be carefully considered by the plant management. This is especially important for owners of small plants, where qualified personnel are not available to perform the preventive maintenance which is recommended to insure a realization of the long life built into each piece of Vilter equipment.

II. PREPARATION OF COMPRESSOR FOR SERVICING

The first step in servicing a compressor is to remove the refrigerant from it.

A. Removing Refrigerant from Compressor

If the compressor can be run, close the suction stop valve and allow the machine to pump itself out. Cycle the machine several times until the pressure remains constant at approximately 2 psig. On systems operating at higher suction pressure, it may be necessary to reset or block-in the low pressure cut-out so that the compressor will pull down to 2 psig. When the pressure is constant at 2 psig, stop the compressor and close the discharge valve, open the electrical disconnect switch, and pull the fuses. Do not work on the compressor until the switch is off and the fuses are pulled.

Blow off the gas caught between the discharge valves and the discharge stop valve by removing $\frac{1}{4}$" pipe plug at the stem end of the discharge stop valve.

If the compressor cannot be operated, open the disconnect switch, pull the fuse and close both suction and discharge stop valves. Then blow out the compressor by removing $\frac{1}{4}$" pipe plug at the stem end of the suction stop valve. Release the gas caught between the discharge valves and the discharge stop valve in the same manner described above. That is, by removing the $\frac{1}{4}$" pipe plug on the stem end of the discharge stop valve.

Before opening the machine, allow it to warm up to room temperature. When the unit is pumped down or where the refrigerant is allowed to blow off, the temperature of the machine drops. If the machine is opened before it has warmed up, condensation will take place on the metal surfaces. This moisture is detrimental to the operation of the compressor and can lead to system operating difficulties and rusting of parts.

B. Removing Oil From Compressors

It is not necessary to remove the oil from the compressor to service it. When oil removal is desired, proceed as follows:

The slight positive pressure in the crankcase forces the oil from the charging valve. Place a can or cans of sufficient capacity under the oil charging valve and open the valve gradually. The oil should then drain into the can. If the pressure in the crankcase had been reduced to 2 psig, there should be little foaming of the oil.

III. CYLINDER HEADS

A. Cylinder Head Removal

To remove a Cylinder Cover (Ref. 105) of a VMC 320 compressor, proceed as follows:

Remove all but two of the Cylinder Head Capscrews (Ref. 107). The two remaining should be opposite each other on the long axis of the head. See Figure 17.

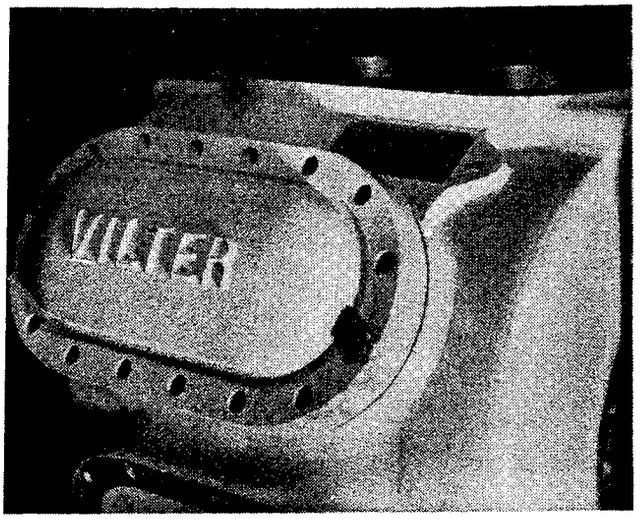
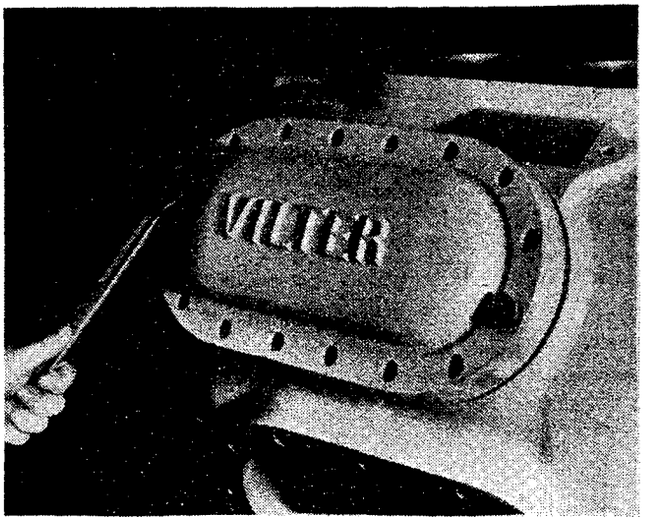


Figure 17

Slowly and alternately, loosen these two remaining capscrews making certain that the head follows. If the head remains stationary after the two capscrews have been loosened a few turns, jar it with a lead hammer or other suitable means to break the gasket seal, freeing the head. Continue to evenly loosen the capscrews, dissipating the energy of the two Safety Head Springs (Ref. 401) See Figure 18.



When the capscrews are loose enough to be turned by hand, or when there are only two or three threads engaged in the compressor frame, the springs will be fully opened and there should no longer be any danger of the head flying off. While supporting the head, take out the two capscrews and lift the head off. See Figure 19.

The two safety head springs may now be removed. Care should be taken when removing the heads on the side banks of the compressor so that the safety head springs do not drop off.

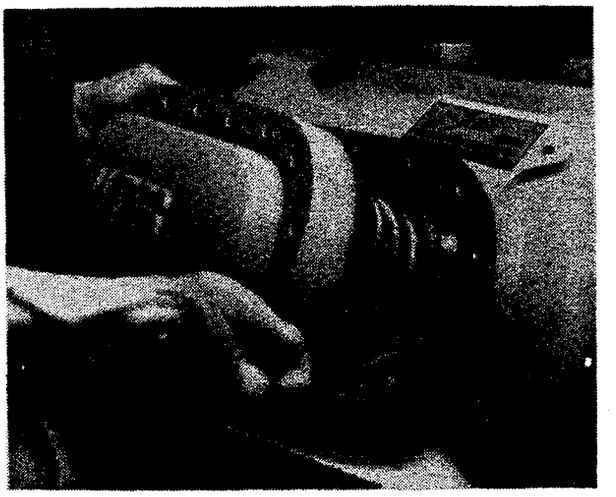


Figure 19

B. Cylinder Head Replacement

Before replacing the head inspect the gasket surfaces of both the frame and the head for burrs, dirt, gasket material or other foreign material which would prevent a tight seal. Center the two safety head springs on the discharge valve guards. With the two capscrews again in place on the head, put a new Cylinder Cover Gasket (Ref. 106) lightly coated with grease or oil, in place on the cylinder head over the capscrews. The grease will hold the gasket to the head while it is being reinstalled. Lift the head with capscrews and gaskets into place over the safety head springs. The capscrews are long enough so that two or three threads should engage with the frame when the springs are fully extended. Turn the two capscrews until their threads catch and tighten them down evenly, compressing the springs and bringing the head down to the frame. When the head is tight against the frame, insert the remaining capscrews and tighten into place.

When finally tightening all the cap screws, alternate on opposite sides in going around the head. For best results and even tightness, go around the head at least three times to a final torque value of 95 ft. lbs.

IV. DISCHARGE VALVE ASSEMBLY

A. Discharge Valve Disassembly

In order to service the discharge valves on the 300 VMC series compressors, the heads must first be removed. Refer to Part III of this section for procedure to be followed in removing the heads. Once the cylinder heads and springs have been removed, the Discharge Valve Guard and Seat Assembly (Ref. 402-407) may be taken out by lifting it off its seat. To disassemble the discharge valve assembly, remove the self-locking nut (Ref. 402) on the hexagon socket, flat head, cap screw (Ref. 407). The Discharge Valve Guard (Ref. 403) and the Discharge Valve Seat (Ref. 406) will then separate and the Discharge Valve Plate (Ref. 405) can be removed. Take the Discharge Valve Springs (Ref. 404) from their sockets in the guard.

B. Discharge Valve Assembly

Clean all parts thoroughly with a suitable parts cleaner and lightly coat with clean compressor oil before proceeding.

There are several patented cleaning agents on the market which are also suitable. One of the best and least expensive is mineral spirits. Aside from having excellent cleaning properties, this solvent leaves a thin coat of oil after evaporating, which prevents corrosion.

Hold the valve guard with the spring holes up and insert the six helical springs. Place the valve plate over the springs <u>with the lapped side up</u> so that the lapped surface of the plate will mate with the lapped surface of the seat. Position the valve seat over the valve plate with the lapped seat down. Squeeze the parts together and insert the screw. See Figure 20. Place the entire assembly in the shown position on a workbench and place a hexagon key wrench in the screw. Torque the nut in place to the value shown in Table 1, letting the hexagon key wrench bear against the workbench.

Be certain that the valve plate doesn't become "pinched" between the valve seat and the valve guard while tightening.

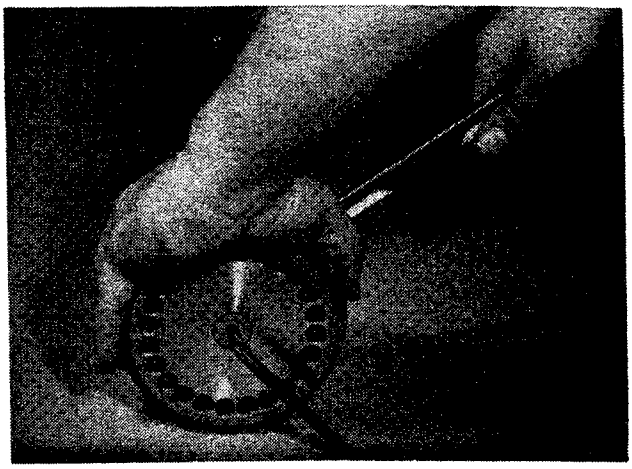


Figure 20

V. SUCTION VALVE ASSEMBLY

A. Suction Valve Disassembly

The Suction Valve Plate (Ref. 412) and Suction Valve Springs (Ref. 410) are held in place by the Suction Valve Guard (Ref. 409), which is attached to the cylinder liner assembly by six hexagon socket head cap screws (Ref. 408). See Figures 19, 21, 24 and 25.

To remove the suction valve plate when the cylinder liner assembly is not in the compressor, loosen and take out the six cap screws and lift off the suction valve guard, the suction valve plate and the "O" ring (Ref. 411). The procedure for removing the suction valve plate when the cylinder liner assembly is in the compressor is essentially the same as explained above. Extra care should be exercised however when taking the guard off to prevent any of the six suction valve springs from falling into the suction chamber.

Table 1. Torque Values - Discharge Valve Assembly

Compressor	Items 402 & 407 Sizes	Torque Value
320 VMC	1/2"-20	75 Ft. Lb.
340 VMC	5/8"-11	150 Ft. Lb.
350 VMC	1/2"-20	75 Ft. Lb.

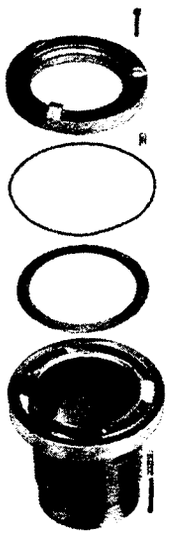


Figure 21

Suction Valve Assembly

Make sure all parts are clean and lightly coated with clean compressor oil before proceeding. To reassemble place the guard, with spring pockets up, on a flat surface. On 320, 340 and Low Suction 350ES VMC Compressors the springs are inserted into the spring pockets and care should be taken to prevent the springs from dropping out. On High Suction 350ES VMC Compressors the Suction Valve Springs are tapered, the large end is inserted into the spring pocket of the Suction Guard and the small end goes towards the Suction Valve.

Figure 22

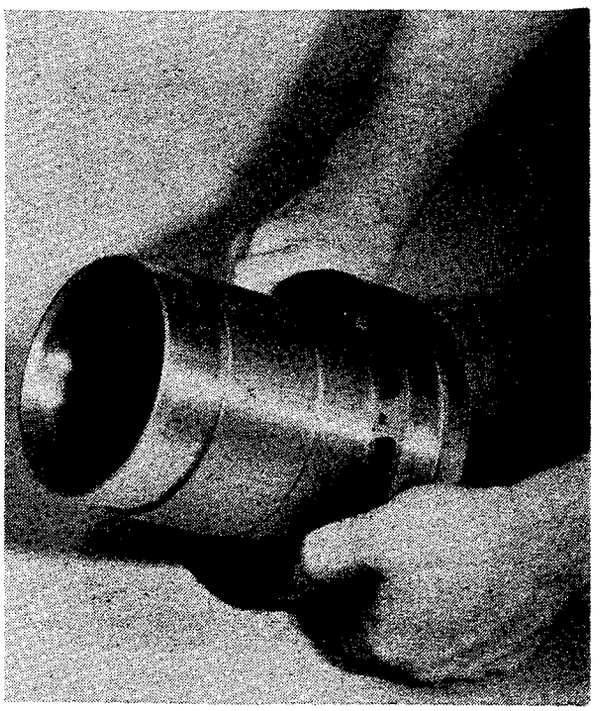


Figure 23

The Valve Spring is then secured in the guard by pushing and twisting with the tip of a finger. Then place the suction valve plate, lapped side up, on top of the springs. The valve plate should rotate freely, without binding. See figure 22.

This is so that when the liner is inverted and placed on the guard, the lapped surface of the plate will mate with the lapped seat of the liner. Invert the liner and place it on the guard. Now, pinching the two parts together, invert the entire liner assembly. See Figure 23. Tighten the six capscrews and washers, the capscrews are secured with Loctite 242 thread locker and tightened to 4 ft. lbs., making sure the suction valve plate is not "pinched" within the assembly. Place the "O" ring in its groove.

To replace the suction valve plate when the cylinder liner is in the machine, assemble the suction valve guard and suction valve springs as explained above and position the "O" ring on the guard. Then, holding the assembly as shown in Figure 24, place it on the liner and install the six capscrews and washers, the capscrews are secured with Loctite 242 thread locker and tightened to 4 ft. lbs. Again, the valve plate should be checked to make sure it is not "pinched".

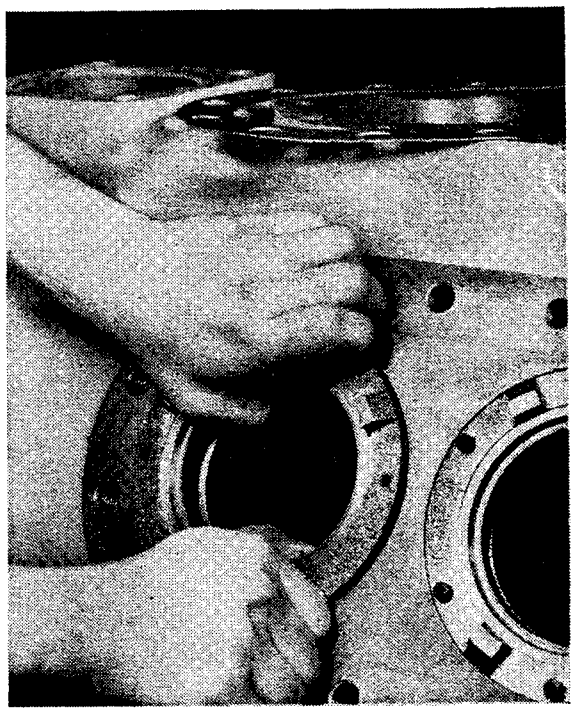


Figure 24

VI. PREPARATION FOR INTERNAL SERVICING

A. Removing Handhole Cover

If the instructions of Part II of this Scetion on Preparation of The Compressor For Servicing have been followed correctly, it should be possible to remove the Handhole Cover (Ref. 108) without incident. If not, refer to that section and pump the machine out, disconnect, and pull the fuses as instructed. If desired, the oil can be drained, but it is not necessary.

Loosen the Handhole Cover Capscrews (Ref. 110) holding the cover in place and remove all except one on the bottom and one on the top. If the gasket sticks to the cover and frame, hold the cover tightly in place and jar it loose with a lead hammer. Care must be taken while loosening the cover to see that neither of the mating surfaces are burred or damaged preventing a tight fit on reassembly. After the cover is loose, support it and remove the remaining two capscrews. Lift the cover off and lay it to one side.

B. Replacing Handhole Cover

Before the handhole cover is replaced on the machine, inspect the gasketed surfaces for burrs, dirt, gasket material or other foreign material. The surface must be thoroughly clean so that a tight seal will be assured.

Take a new handhole cover gasket (Ref. 109) and coat it lightly with grease or oil. Place capscrews through one hole on the top and bottom of the cover and slip the gasket over them. Put the cover in place against the crankcase opening, and turn the capscrews in to support the cover. Put the remaining capscrews into place and draw them up. In drawing these up, do not pull them up one at a time. Tighten each one a little at a time, alternating on opposite capscrews. Each of the capscrews should be drawn up evenly to assure a good tight joint. Go around the cover a minimum of three times for even tightness.

VII. CYLINDER LINER ASSEMBLY

A. Cylinder Liner Disassembly

To completely remove a piston, connecting rod or cylinder liner from a 300 Series VMC Compressor, it is essential that the cylinder head, safety head springs, discharge valve assembly and handhole cover all be removed. Refer to Parts III, IV, AND VI of this section for instructions.

The Cylinder Liner (Ref. 413) Piston (Ref. 512-516) and Connecting Rod (Ref. 517-522) should be removed from the machine together, as a unit. Loosen and remove the Lock Nut and Plain Nut (Ref. 517 and 518) and washers Ref. 519) on the connecting rod. It should then be possible to pull the rod cap off by hand. If not, gentle tapping with a brass or babbitt bar is permissible.

Loosen two of the screws holding the suction valve guard to the liner about four or five turns. With two screwdrivers, pry the liner out using the gap between the screws and the liner to lift with as shown in Figure 25.

Once the "O" ring has cleared the frame, the liner, piston and rod can be taken from the machine by hand, as a unit. See Figure 26. The Cylinder Liner Seat Ring (Ref. 419) can now be lifted out and the Connecting Rod Bolts (Ref. 520) can be pushed out of the rod.

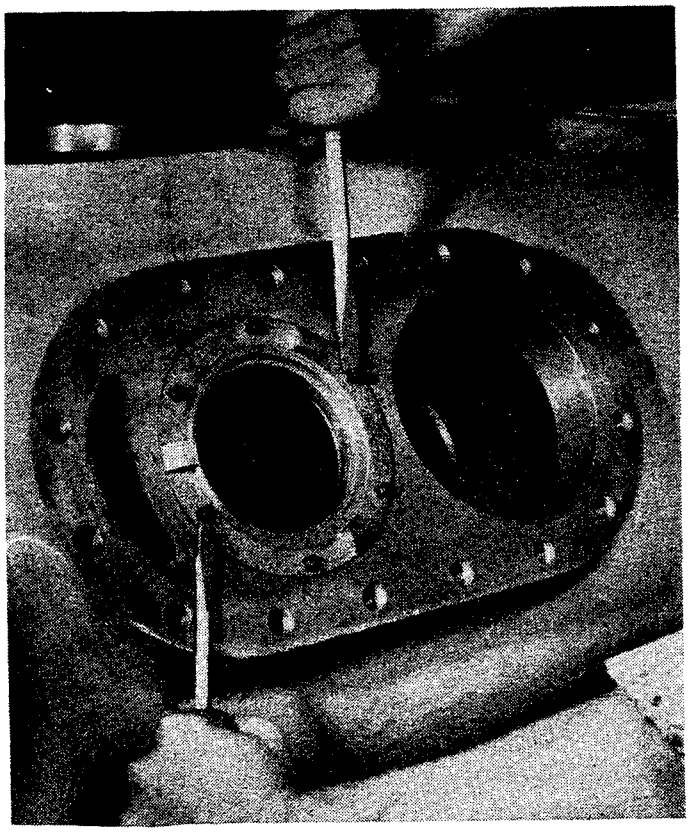


Figure 25

CAUTION:

When handling the liner with piston and rod inside, do not let the piston rise to the top of the liner or the upper compression ring of the piston will "catch" in the groove between the liner and suction valve guard. This would be harmful to the ring and would necessitate removal of the suction valve guard.

B. Cylinder Liner Assembly

(See Part VIII of this Section)

Figure 26

VIII. PISTON AND CONNECTING ROD ASSEMBLY

A. Piston and Connecting Rod Disassembly

The piston and connecting rod should be removed from the compressor with the cylinder liner assembly. Refer to Part VII of this section for the proper procedure.

Once the liner has been taken out of the machine and placed on a suitable working area the piston and connecting rod can be pulled out from the bottom of the liner. See Figure 27.

It is a good practice to replace the rod cap at this time to avoid possible mixing of parts. The rods and caps of all 300 Series VMC Compressors are match-marked to aid in reassembly, but it is best to keep the parts together as much as possible.

To separate the rod from the piston, the Piston Pin (Ref. 515) must be removed. This is accomplished by removing the two Piston Pin Snap Rings (Ref. 514) from the pin hole on each side of the piston with a pair of pliers and sliding the pin out. Sliding the pin out can sometimes be accomplished with "thumb pressure", but a brass rod and hammer may be used. If the Rings (Ref. 512 and 513) are to be removed, the easiest way is to wrap pieces of shim stock around the piston and carefully work the rings out of their grooves onto them. See Figure 28. They can then be worked down over the piston. Caution must be exercised to prevent breaking the rings.

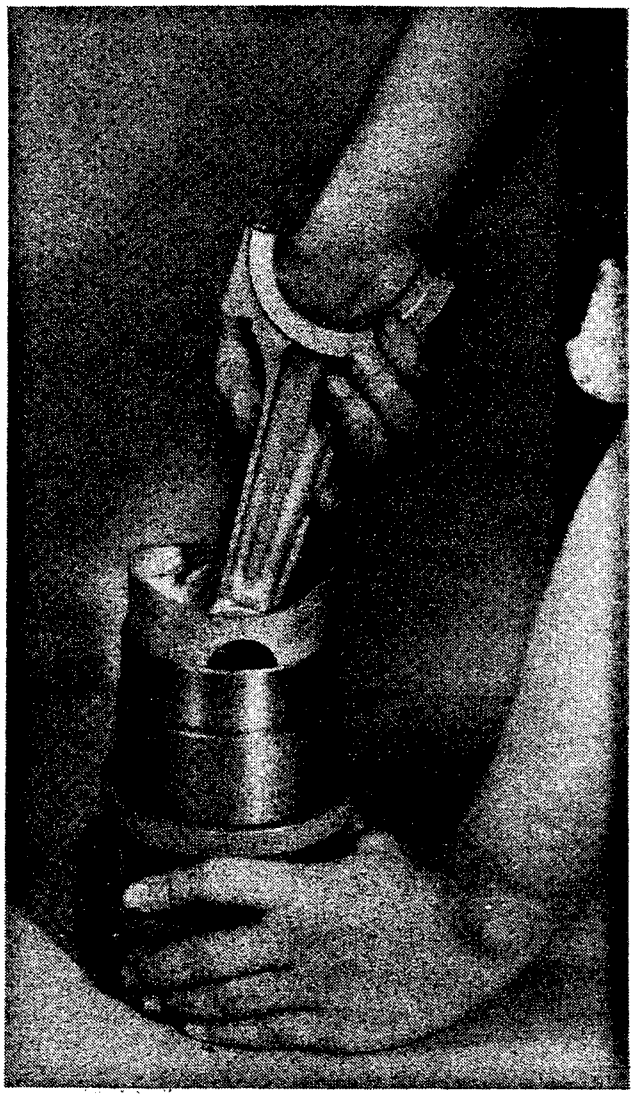


Figure 27

B. Piston and Connecting Rod Assembly

If inspection shows that the rod bearing surfaces are worn, it is necessary to replace the bearing insert. Before assembling bearing inserts by pressing into place, check to see that the notch in the rod is clear.

Caution: The bearing inserts should never be spread open by hand or any other means to provide for a tighter fit in the rod. If the bearing insert does not fit properly in the rod and falls out during the assembly, either the bearing insert or the rod is incorrectly made. Use a bearing insert that fits.

When installing the bearing insert in the connecting rod make certain there is no oil on the connecting rod or the back side of the

Figure 28

bearing insert. After the bearing inserts have been inserted into the rod and the rod cap, these parts can then be lightly coated with oil just prior to inserting the parts into the compressor. With this procedure, there will be no possibility of forming an insulating layer on the back side of the bearing insert. Such a layer would prevent a proper removal of heat that normally flows through the bearing and into the rod. Also, by lightly oiling just prior to inserting the parts into the compressor, there is less danger of dust and other dirt particles getting onto the bearing surfaces.

The piston and piston pin should also be checked for wear. If the pin is loose in the piston, both parts should be replaced. The pins are matched to the piston and are not interchangeable. Also, it is best to replace rings in sets. That is, do not use old and new rings on the same piston.

The 300 Series VMC Compressor has three rings per piston - two compression rings and one oil ring. When replacing the rings check the grooves to make sure that they are clean. Particular attention should be paid to the grooves for the oil ring so that the slots in the oil ring grooves are claer. The easiest way to replace the rings on a piston is to wrap pieces of shim stock around the piston and slide the ring over them. Care should be taken when sliding the rings onto the shim stock not to force them The rings are brittle and may snap. A tool is also available to aid in the installation of rings and should be used if available.

The two compression rings are chamferred on one side on the inner edge. When installed, the chamfer should be up, as shown in Figure 29. This chamfer allows the ring to flex on the down stroke, scraping the walls, giving a tighter seal and controlling oil loss. The oil ring can be put in either side up. Rotate the end gaps on each ring so that they are on opposite sides of the piston.

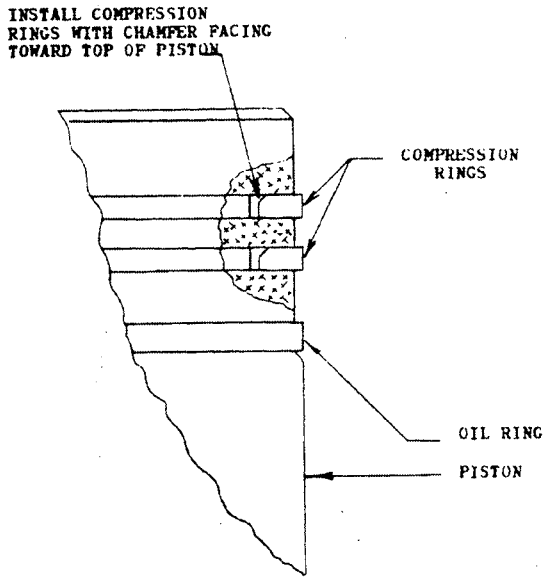


Figure 29

Invert the liner and put it on a bench or table. Lightly coat the inside surface of the liner, the outside surface of the piston and rings, and the bearing surface of the rod and rod cap with clean compressor oil. Place a ring compressor around the piston and tighten to draw the rings into their grooves. See Figure 30.

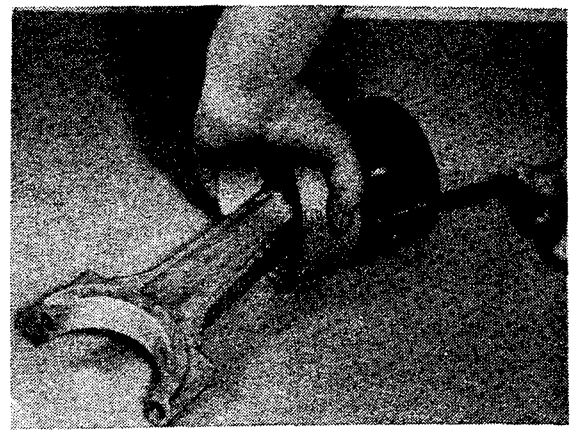


Figure 30

The piston pin should not slip easily into its hole, but it must not be driven in either. Light tapping with a block of wood and a hammer is permissible when putting the piston pin in place. Be sure the hole in the rod is aligned with the holes in the piston so the pin can slip through. When the pin is in place, install the two lock rings, one at each end of the piston pin.

If the original rods have failed requiring their replacement, check the crankshaft bearing surface. If there are any slight imperfections due to the rod failure, remove by polishing with fine crocus cloth. Then clean the bearing surface with cleaner and lightly coat with clean compressor oil.

Clean all parts with a suitable cleaner before proceeding.

Position the piston with ring compressor over the liner and tap the piston down until the rings are inside the liner. See Figure 31.

Do not push the piston all the way down into the liner or the upper compression ring will "catch" in the groove at the top of the liner.

Replace the two connecting rod bolts on the rod, making sure that the beveled part on the head of the bolt bears against the beveled portion of the rod. Insert the liner seat ring and lightly coat it, and the portions of the frame where the liner fits, with clean compressor oil. Hold the liner with piston, rod and bolts as shown in Figure 32, and place in the compressor as a unit, making sure the match number on the rod is facing the handhole side of the compressor.

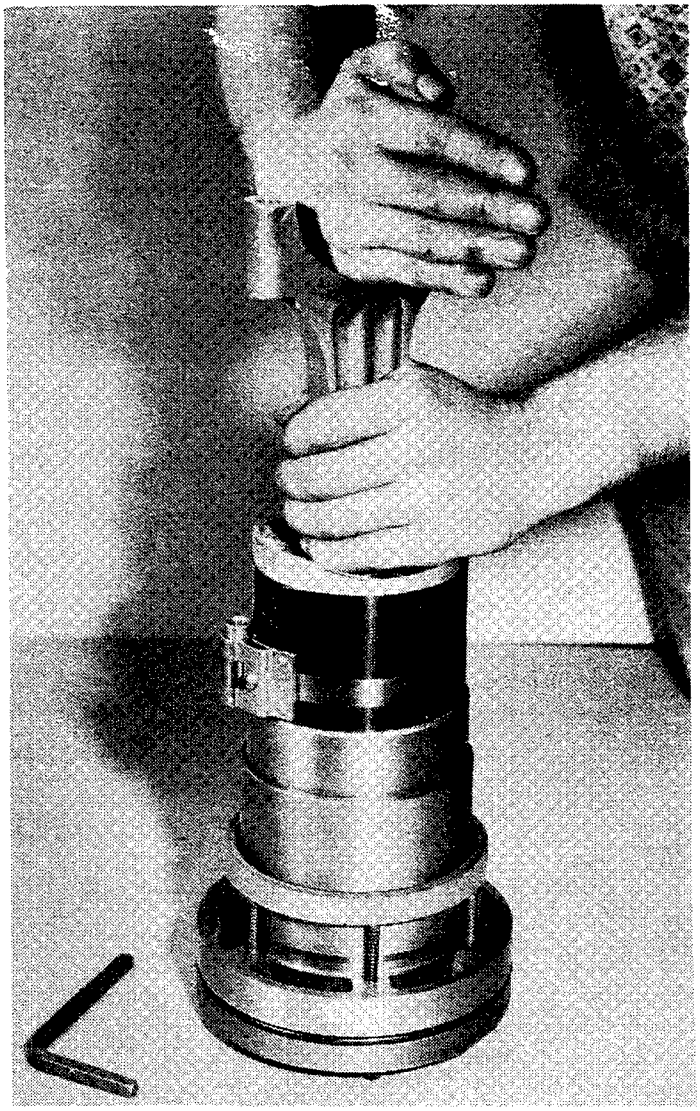


Figure 31

The liner may have to be tapped into position, but care should be taken when doing this to see that the rod is free and not bearing against the crankshaft.

Reach inside the machine and pull the connecting rod down until it seats ont the shaft, being careful not to let the connecting rod bolts hit the shaft.

Place the rod cap (with the insert bearings in place) over the bolts with the match numbers on the cap also facing the handhole side of the compressor. The cap match number should line up with the match number on the rod if the rod was correctly positioned.

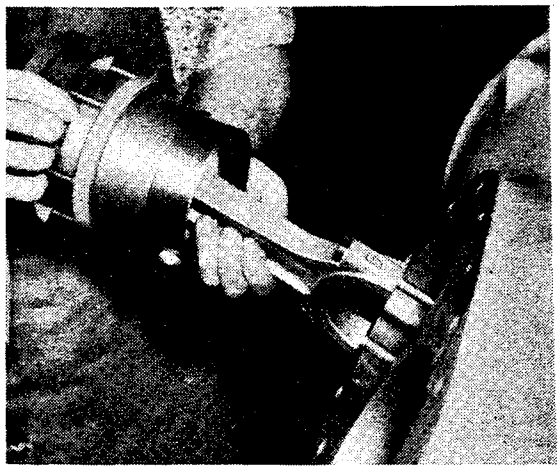


Figure 32

All 300 Series VMC connecting rod bolts are secured with one washer, one plain steel nut and one spring steel locknut (commonly referred to as a "Palnut"). The plain nut's tightening torque is 18 to 21 ft. lbs.

After a plain nut has been placed on a rod bolt and torqued to the specified value, turn a "Palnut" onto the rod bolt with the open end of the hexagon pointing away from the plain nut. (Caution - open end of "Palnut" MUST point away from plain nut). The "Palnut" should be turned until mating parts are pulled together and actual tightening just begins. Final tightening and locking is then achieved by giving the "Palnut" an additional 1/3 to 1/2 (maximum) turn. Although the plain steel nuts may be reused, new, unused "Palnuts must be used each time the connecting rods are reassembled to the crankshaft. If used "Palnuts" are installed their locking feature is lost and a loose connecting rod may result. After each rod is installed, rotate the crankshaft by hand to make sure that everything is free and that there is no binding of the rotating parts.

NOTE: A shallow tool socket (Vilter Part Number 2040A) having a 3/8" square drive for use in this assembly operation, is available. This tool allows the "Palnuts" to be gripped and tightened more conveniently.

IX. LIFT RING ASSEMBLY

A. Lift Ring Disassembly

The cylinder liner assembly must be removed from the machine and the suction valve assembly, piston, and connecting rod removed from it before the Lift Ring Assembly can be taken of off. Refer to Parts V, VII and VIII of this section for the proper procedures.

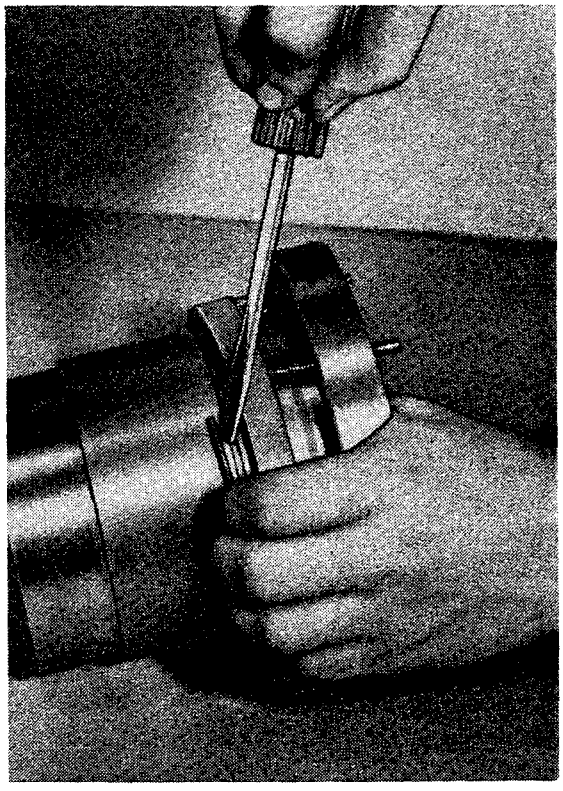


Figure 33

To remove the Lift Ring (Ref. 416) hold the liner horizontally, forcing Lift Ring back against the springs. Work the Lift Ring Retainer (Ref. 417) from its groove with a screwdriver while holding the lift ring back. See Figure 33. Once the retainer is out of its groove, slide it off the liner. The lift ring, lift pins (Ref. 415) and Unloader Ring Springs (Ref. 414) can then be removed.

300 Series VMC Compressors with single cylinder unloading will have a slightly different lift ring arrangement on one liner. A cylinder with this liner does not unload and will not have lift pins or springs. The lift ring is inverted and held firmly in place by roll pins. To disassemble this type, pull the Roll Pins (Ref. 418) from the Lift Ring with holes (Ref. 416) and remove the lift ring and ring retainer.

B. Lift Ring Assembly

With the liner inverted, place the lift pins with the springs around them in their holes. Place the lift ring on the pins with the inside shoulder towards the retainer so that the small edge will catch on the ring retainer when it is in place. Holding the lift ring back against the pins, slide the ring retainer over the liner into its groove. See Figure 34.

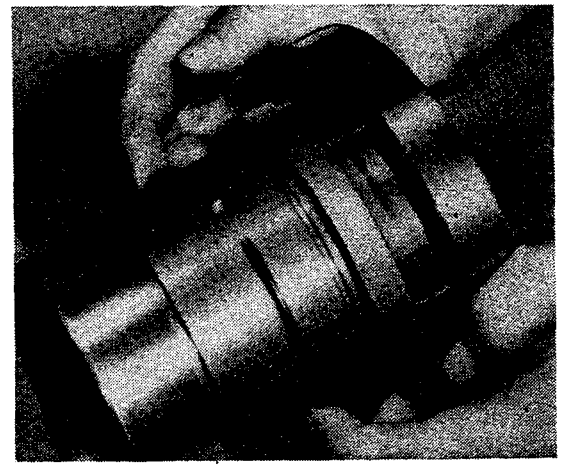


Figure 34

To reassemble the lift ring components of a non-unloading cylinder, invert the liner and place on a bench. Replace the ring retainer. Invert the lift ring with holes so that the smaller inside diameter is up. Hold the lift ring with holes in place against the ring retainer and drive the roll pins in, being careful not to drive them against the liner.

X. CRANKCASE OIL SCREEN ASSEMBLY

A. Crankcase Oil Screen Disassembly

To remove the Crankcase Oil Screen (Ref. 111) for cleaning or replacement, the handhole cover must first be removed. Refer to Part VI of this section for the proper method. When this has been accomplished, remove the Crankcase Oil Screen Hold Down Spring (Ref. 112) by snapping it out of the holes in the crankcase ribs. Pull the screen from the oil connecting pipe and remove. To clean the screen most effectively, wash it in mineral spirits and blow clean with an air hose.

B. Crankcase Oil Screen Assembly

Position the screen on the connecting pipe inside the compressor.

and neoprene bellows should also be replaced each time the seal is removed.

Before the seal is replaced, inspect all the oil holes on the crankshaft to make sure they are not plugged and clean the surface of the floating seat with a soft lintless cloth. Coat the entire seat with clean compressor oil. After the sealing surface of the seat has been cleaned, care must be taken not to touch it with the fingers. Clean the Shaft Seal Cover and place the floating seat in its recess in the cover, taking care not to damage the "O" ring as the seat is inserted and making certain that the polished side of the floating seat mates with the carbon washer. Both the seat and the recess should be oiled for easier fitting when doing this. Check to see that all surfaces are clean and free from any foreign material.

Place the spring holder and spring in position on the shaft. Place the neoprene bellows and retainer on the shaft and slide on as far as the retainer will go. Extra care should be taken when doing this not to cut the bellows on the edges of the keyway. Coat the bellows assembly and the shaft liberally with oil. Clean the carbon seal ring thoroughly with suitable cleaner and inspect it for wear, cracks or dirt.

Once the sealing surface is clean, do not touch it with fingers. Coat the sealing surface of the carbon ring lightly with clean compressor oil and place it in position on the shaft with its notches aligned with the notches in the retainer.

In order to properly position the seal, place the shaft seal cover without a gasket over the shaft and insert two cap screws, one on each side, (See Figure 36). Be careful to hold the cover firmly in place while installing and tightening the two cap screws. If the cover is allowed to back out, there is a possibility that when the carbon ring is pushed back in, misalignment of the carbon ring along with possible breakage may occur. After tightening the two cap screws, wait 30 minutes for the neoprene bellows to adhere to the shaft.

Remove the shaft seal cover. If the carbon ring adheres to the floating seat and comes out with the shaft seal cover, carefully remove the carbon ring and reinstall the seal retainer. Lightly coat a new shaft seal cover gasket (Ref. 209) with oil and place it in position on the cover. Reinstall the cover, using the same care to firmly hold the cover in place while installing all of the cover cap screws.

After the cap screws have been installed, tighten them up evenly so that the cover is pulled squarely against the machine. Go around the bolts at least three times to make sure the cover is drawn up tightly and evenly. The final torque should be 20 to 22 ft. lbs.

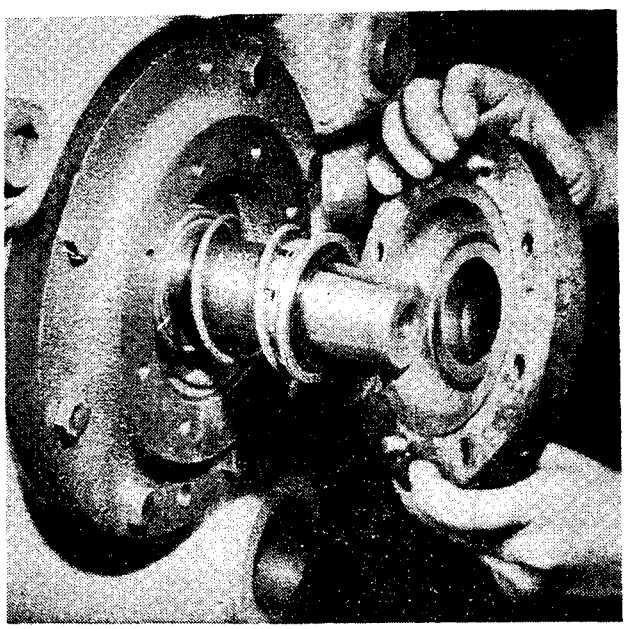


Figure 36

XIII. OIL PUMP ASSEMBLY

A. Oil Pump Disassembly

To remove the Oil Pump Assembly (Ref. 322), prepare the compressor for internal servicing as outlined in Part VI of this section. Loosen and remove the four Oil Pump Cap Screws (Ref. 324) holding the pump to the bearing housing. Gently rock the pump up and down to break the gasket seal and remove the pump.

B. Oil Pump Assembly

Inspect the gasket surfaces of the bearing housing and oil pump, making sure they are clean and free of dirt and burrs. Lightly oil a new Oil Pump Gasket (Ref. 323) and position it on the pump making certain that no part of the pump inlet and outlet is covered by the gasket. Place two cap screws through mounting holes in the pump and through the gasket. Position the pump on the housing and tighten in place using all four cap scres, making sure that the pump is not put in upside down and that the drive key is properly positioned on the shaft. The "S" should be to the left when the pump is properly positioned.

XIV. CRANKSHAFT ASSEMBLY

A. Introduction

The crankshaft (Ref. 201) of the 300 Series VMC Compressor can be removed from either end of the machine. However, it is recommended that it always be removed from the suction end. The motor will not have to be moved if the shaft is withdrawn from the suction end and there is more room to work at the suction end.

B. Removing The Crankshaft

To remove the crankshaft from the suction end, first remove the oil pump as outlined in Part XIII of this section. Also remove all pistons and connecting rods according to Part VII of this section and the shaft seal according to Part XII of this section.

Loosen and remove all the Rear Bearing Housing Cap Screws (Ref. 325) holding the Rear Bearing Housing (Ref. 301) to the frame. Place two of the cap screws in the jack screw holes at the top and bottom of the housing. Turn these down until the gasket seal is broken.

If the rear bearing (Ref. 204) is not frozen to the shaft, continue to back the rear bearing housing from the frame keeping the shaft in place. When the rear bearing housing is free, slide it off the shaft. The shaft will then be supported by the Front End Bearing (Ref. 204) only, which is permissible without damage to the bearing. With one hand in the handhole on the center of the crankshaft and one hand outside on the end of it, slowly draw the crankshaft out of the front or seal end bearing. See Fig. 37.

When the shaft is free, balance the counterweight portion of it on the pump end or rear bearing housing surface of the compressor. Remove the shaft from the pump end of the compressor, now using both hands at the outside. See Fig. 38.

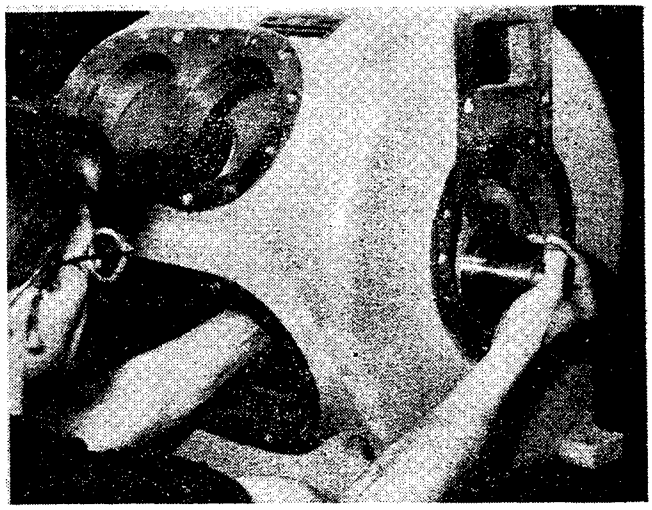


Figure 37

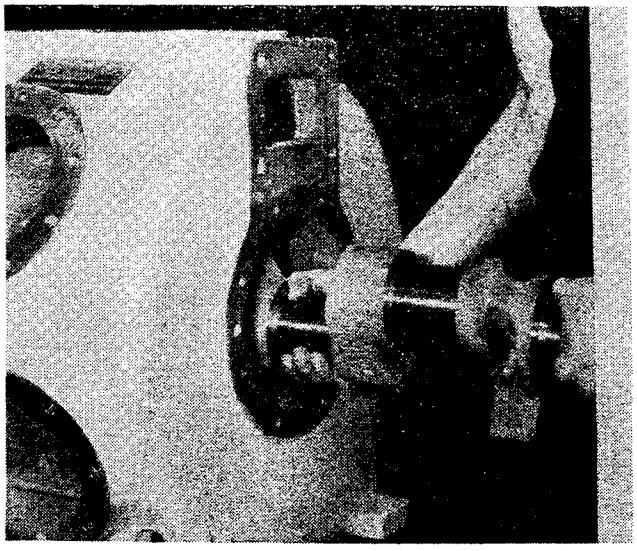


Figure 38

The Thrust Washer (Ref. 202) and Rear Bearing Housing Shims (Ref. 203) can now be removed by lifting them from their recess in the rear housing.

If the pump end bearing is frozen to the crankshaft, draw the rear bearing housing from the frame as explained above, letting the shaft follow. Before the housing is completely free, however, be certain that the shaft is supported inside the machine so that undue stress is not imposed on the seal end bearing when the front housing is completely free. Remove the crankshaft, with housing attached, as explained above.

If the front bearing is frozen to the shaft, a wheel-puller can be used or the shaft may be withdrawn from the seal end of the machine in essentially the same manner as explained above.

C. Bearing Removal

The main bearings of the 300 VMC Series Compressor are pressed into the front and rear housings at the factory. If inspection reveals that either the front bearing or the rear bearing are badly worn and need replacement they may be replaced only if adequate facilities exist to remove the bearing and press-fit the new bearing into the housing without damaging the bearing housing or the bearing

The rear or pump end bearing housing is removed in conjunction with removing the crankshaft as explained above. Once the shaft has been removed, the front end housing can be taken off. Loosen and remove the eight Front Bearing Housing Capscrews (Ref. 207) holding the front housing to the frame and insert two of them in the jack screw holes at the top and bottom of the housing. Pull the housing from the frame by turning the jack screws until the gasket seal is broken, while supporting the housing at the bottom.

Pull the housing from the compressor and remove the Thrust Washer (Ref. 202) by lifting it from the housing.

D. Crankshaft Replacement

The general procedure for installing a crankshaft is to (a) install the front or seal end bearing, (b) insert the crankshaft, and (c) check shaft end-play clearance and install rear or pump end bearing.

- To Install Front Bearing

Inspect the gasket surfaces of both the front housing and the compressor frame, making certain that they are clean and free of burrs. Lightly coat a new Bearing Housing Gasket (Ref. 206) with grease or compressor oil and place it on the housing. Insert two capscrews in the housing and insert the housing in the frame. It may be necessary, when replacing the housing, to tap it in with a lead hammer.

Replace the remaining capscrews and tighten all of them evenly, going around the housing at least three times. The final torque should be 50 to 60 ft. lbs. Insert a thrust washer in the housing from inside the machine so that the smooth side of the washer with the six oil grooves will face the shoulder of the shaft and coat its surface with clean compressor oil. Also coat the bearing surface with oil.

- To Insert Crankshaft

After the seal or front end bearing has been replaced, according to instructions above, the crankshaft may be installed. Lubricate all bearing surfaces of the crankshaft. Place the crankshaft partially in the machine with the counterweight resting on the compressor frame.

With one hand supporting the shaft through the handhole and one hand on the end of the shaft, guide the seal end of the shaft into the seal end bearing.

Be very careful when doing this, not to hit the bearing with the end of the shaft causing scratches or raising burrs on the soft bearing surface.

Push the shaft all the way into the bearings, so that the shoulder of the shaft is against the thrust washer, allowing it to be supported by the seal end bearing only. No blocking or support is necessary.

3. Adjusting Shaft End-Play and Installing Rear Bearing.

If the main bearings, crankshaft, and thrust washers have not been replaced, the Rear Bearing Housing Shims (Ref. 203) originally on the machine should still be adequate to provide the proper end clearance but should still be checked as explained below. However, if any replacements of the above parts has been made, a new adjustment is probably necessary.

The shims used in this procedure are .010" and .015" thick. They fit into a recess in the rear bearing housing. Clean this recess thoroughly with a suitable cleaner. Take three clean, .015" shims and place them in the rear bearing housing. Place a thrust washer in place over them so that the smooth side of the washer with the six oil grooves will face the shaft. Grease or oil each of the four pieces lightly so they will adhere to each other and keep their place in the housing. Coat the bearing with clean compressor oil. Carefully position the housing over the shaft and into the compressor frame, tapping lightly with a babbitt bar if necessary. Insert two capscrews on opposite sides of the housing and tighten them down, evenly, so that the housing is drawn tightly against the frame.

Crankshaft end play adjustment and measurement must be made with no connecting rods attached and with the seal removed. When these conditions are met, push the shaft against the pump end thrust washer and measure the distance between the shoulder of the shaft and the seal end thrust washer with a feeler gauge. Then push the shaft against the seal end thrust washer and measure the distance between the shoulder of the shaft and the pump end thrust washer. The measurement should be the same in both cases and should be taken around the circumference of the shaft to account for any irregularities on the thrust washers.

The clearance should be .010" to .020" for all models of the VMC Series 300 compressors. This clearance may be adjusted by varying the number and thickness of the shims in the rear housing. If the clearance is greater than .020", increase the thickness of the shims and if the clearance is less than .010", decrease the thickness of the shims. Of course the crankshaft must be removed and replaced, as explained above, for each adjustment.

After the proper number and thickness of shims has been determined, tighten the remaining capscrews in the rear bearing housing, evenly, going around the housing at least three times for even tightness.

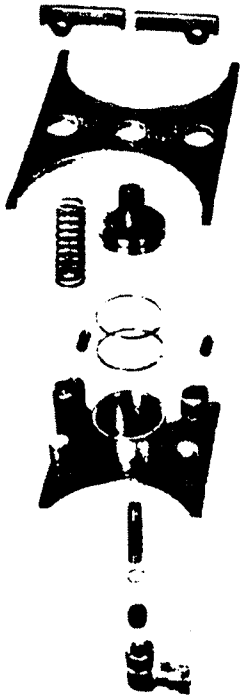


Figure 39

XV. CAPACITY REDUCTION MECHANISM

A. Capacity Reduction Mechanism Disassembly

Before the Capacity Reduction Mechanism Assembly (Ref. 501-511) shown in Figure 39 can be removed, refer to Parts II, III, IV, VI and VII of this section for properly removing parts which must first be taken out.

Reach inside the machine, loosen the fittings which connects the internal capacity connections to the Capacity Reduction Mechanism and pull the connection free. Remove the elbow and washer from the pipe nipple. Next with a small pipe wrench remove the pipe nipple from the Capacity Reduction Mechanism. The capacity reduction mechanism can now be lifted out of the compressor.

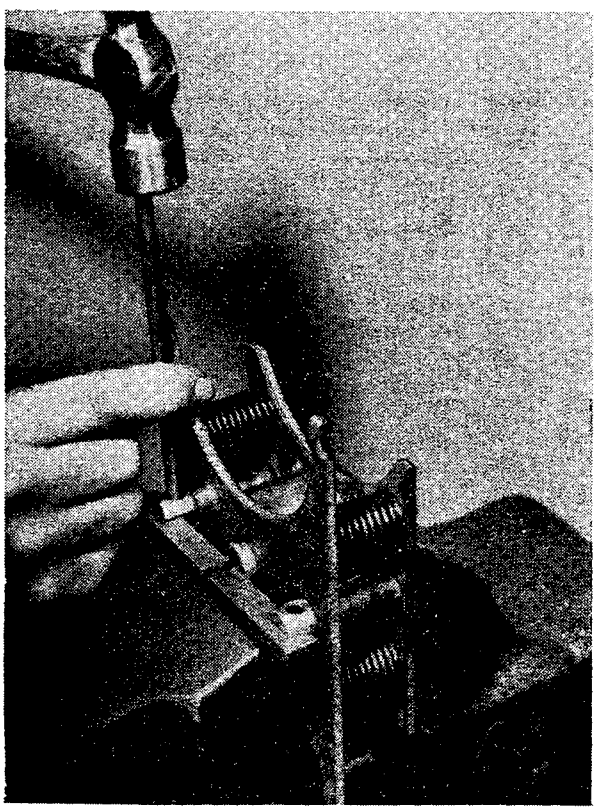
To further disassemble this mechanism, a bench vise of C-clamps are essential. With the aid of a vise, preferably, squeeze the Yoke Guide (Ref. 511) and Yoke (Ref. 506) together until the Rolls Pins (Ref. 504) can be driven out, see Figure 40.

With a brass rod and hammer drive the roll pins out of the arm pins. Lift the Yoke Arms (Ref. 505) out and release the vise slowly, dissipating the energy of the springs. Remove the mechanism from the vise and lift the yoke off. The Yoke Springs (Ref. 507) can now be taken from the guide posts and the Piston Assembly (Ref. 508 and 509) can be pulled out. The Piston Rings (Ref. 508) can be snapped out by hand if necessary.

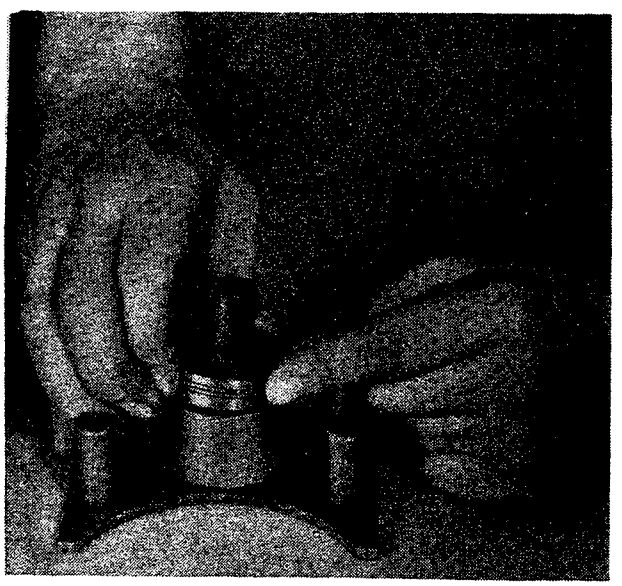
B. Capacity Reduction Mechanism Assembly

Clean all parts thoroughly with a suitable cleaner before proceeding. Replace the piston rings by sliding them into their groove on the piston, if the piston is equipped with cast iron piston rings make sure the ring gaps are opposite each other on the piston. Coat the piston and piston cylinder lightly with clean compressor oil. Replace the piston in the cylinder by tipping the piston slightly on one side, catching the rings in the cylinder, and by gradually working them in towards the opposite side, see Figure 41.

Replace the four yoke springs and position the yoke over the guide posts, with the raised portions up. Holding the assembly together, place it in a vise and squeeze the yoke and yoke guide towards each other, exposing the roll pin holes. Replace the yoke arms by holding them in place and driving the roll pins in with a brass rod and hammer. Remove the mechanism from the vise and place it in the compressor. Tighten the 1/8" nipple into place from inside the machine, replace the hold down spring, and tighten the bushing and fitting onto the nipple. Insert the connecting line back into the fitting and tighten.



Removing Roll Pins
Figure 40



Replacing Piston
Figure 41

XVI. SAFETY VALVE

A. Safety Valve Removal

Remove the Discharge Valve (Ref. 121) from the machine. The Safety Valve (Ref. 124) is located directly behind it. With a 1-3/4" socket wrench and extension, loosen and remove the safety valve from the compressor.

B. Safety Valve Setting

The valve is set to a relief differential pressure of 300 pounds. This valve setting is made at the factory and should not be adjusted in the field.

C. Safety Valve Replacement

Clean the safety valve with a suitable parts cleaner and put thread sealing compound on the first few threads of the valve. With a socket wrench and extension tighten the valve into place. Replace the compressor discharge valve.

XVII. OIL RELIEF VALVE

Oil relief is provided via a spring loaded ball which rests in a machined seat in the bearing housing.

The oil relief mechanism in early model 320 VMC compressors was non-adjustable. Later models (represented by serial numbers 1368 thru 1825), featured an adjustable oil relief in which pressure on the spring loaded ball could be regulated via an adjustable set screw.

320 VMC compressors with serial number above 1825, feature an adjustable oil relief valve consisting of a valve body, valve body gasket, adjustable stem, packing set, stop rings, valve gland, and a valve cap with gasket.
Note: Adjustable types are interchangeable, but the early non-adjustable type is not interchangeable.

A. Adjustment

Remove oil relief valve cap (Ref. 314) and its gasket (Ref. 313). Oil pressure is increased by turning the valve stem (Ref. 308) clockwise and decreased by turning the stem counter-clockwise. An integral valve stem collar prevents the stem from being turned out too far.

To provide quick response of the compressor unloader mechanism, it is recommended that the oil relief valve be set to maintain 40 psi net oil pressure. Net oil pressure should be held between 35 psi and 50 psi.
Note: Net oil pressure is calculated by subtracting the compressor suction pressure from the oil pressure gauge reading while the compressor is running.

B. Disassembly

Remove the whole valve assembly (Ref. 307) from the bearing housing, using a 1-1/8" wrench. Lift the oil relief spring (Ref. 305) and the steel ball (Ref. 304) out with a magnet. To disassemble the valve:

1. Remove the valve cap (Ref. 314) and its gasket (Ref. 313). Also remove the large external gasket (Ref. 306) from the lower part of the valve body (Ref. 309).
2. Completely remove the valve stem (Ref. 308) from the body.
3. Unscrew the valve gland (Ref. 312) from the upper end of the valve body. Remove the four teflon packing rings (Ref. 311) and two steel stop rings (Ref. 310).

After the valve has been disassembled, inspect all parts of the oil relief mechanism, paying particular attention to the gaskets. Replace worn parts with new ones where necessary. Before reassembling the oil relief mechanism, be sure to clean all parts with a suitable refrigeration cleaner.

C. Assembly

First, make sure that the oil passage ways in the rear bearing housing are clear. Then proceed to reassemble the oil relief mechanism as follows:

1. Drop the steel ball into the oil relief hole in the bearing housing.
2. Reassemble the oil relief valve as follows:
   a) Insert the valve stem into the valve body, turning the stem until the integral stem collar butts loosely against the valve body.
   b) Assemble the packing set, stop rings, and threaded valve gland on the valve stem in the following sequence:
      1. Steel stop ring.
      2. Solid teflon male adapter ring (flat side down).
      3. Three cupped teflon packing rings (cupped side down).
      4. Steel stop ring.
      5. Threaded valve gland (wrench flats up).
   c) Press the packing and stop rings into the valve body. Then tighten the valve gland.
   d) Place the oil relief spring over the valve stem, slip on a new valve body gasket, and apply teflon tape to the external threads on the lower part of the valve body.
   e) Place the valve in the oil relief hole in the bearing housing and tighten with a 1-1/8" wrench.
   f) Before starting the compressor, it would be well to turn the valve stem in (clockwise) to ensure positive oil pressure.
   g) After desired net oil pressure is attained, seat the valve cap gasket in the valve cap and screw the cap onto the top of the valve body to protect the assembly.

C. Assembly (Continued)

a) Insert the valve stem into the valve body, turning the stem until the integral stem collar butts loosely against the valve body.

b) Assemble the packing set, stop rings, and threaded valve gland on the valve stem in the following sequence:

1. Steel stop ring.
2. Solid teflon male adapter ring (flat side down).
3. Three cupped teflon packing rings (cupped side down).
4. Steel stop ring.
5. Threaded valve gland (wrench flats up).

c) Press the packing and stop rings into the valve body. Then install the valve gland and tighten.

d) Slip on a new valve body gasket, and apply teflon tape to the external threads on the lower part of the valve body.

e) Place the valve in the oil relief hole in the bearing housing and tighten.

2A. On Compressors above the following Serial Numbers 320 VMC S/N 5797, 340 VMC S/N 12162, 350ES VMC S/N 30522, the following assembly procedure should be used;

a) Screw valve stem into housing.

b) Then place one of the packing washers on valve stem, then place packing on stem followed by the other packing washer.

c) Then insert packing gland and tighten.

3. Before starting the compressor, it would be well to turn the valve stem in (clockwise) to ensure positive oil pressure.

4. After the oil is warm and desired net oil pressure is attained, seat the valve cap gasket in the valve cap and screw the cap onto the top of the valve body to protect the assembly.