LUBRICATION SYSTEM FOR ROTARY VANE COMPRESSORS

Filed Sept. 14, 1967

FIG. 1

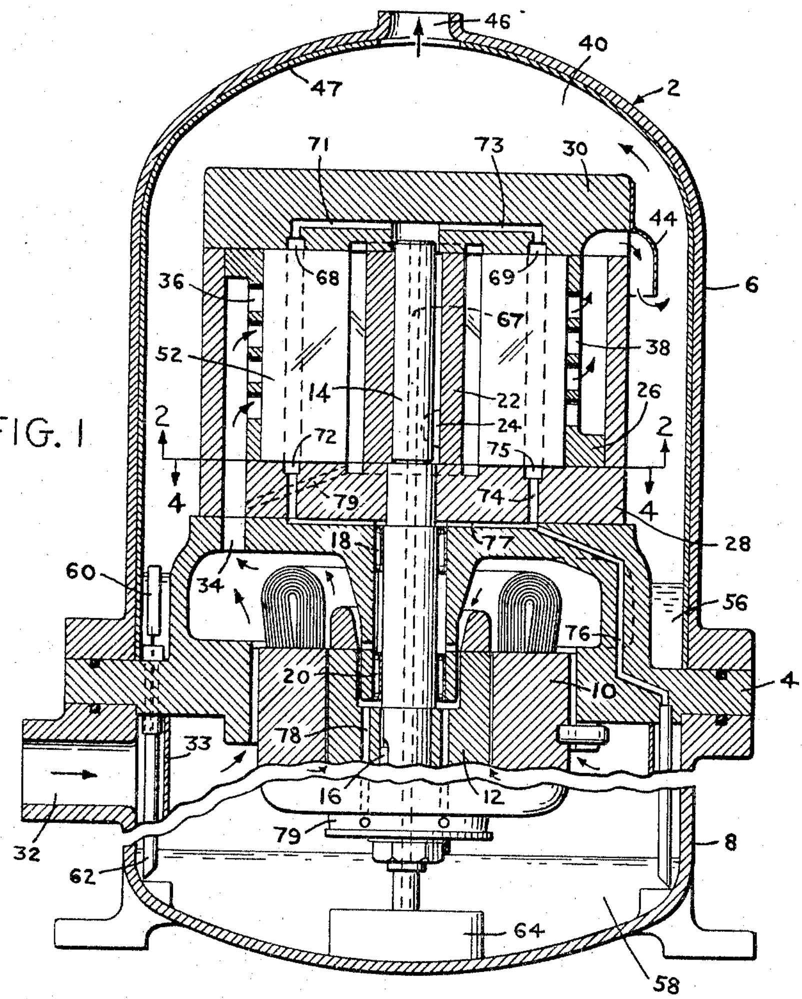

FIG. 2

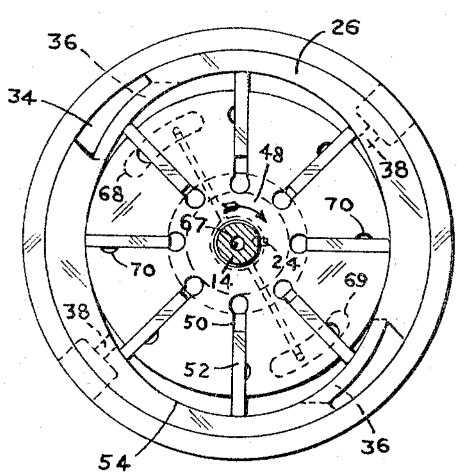

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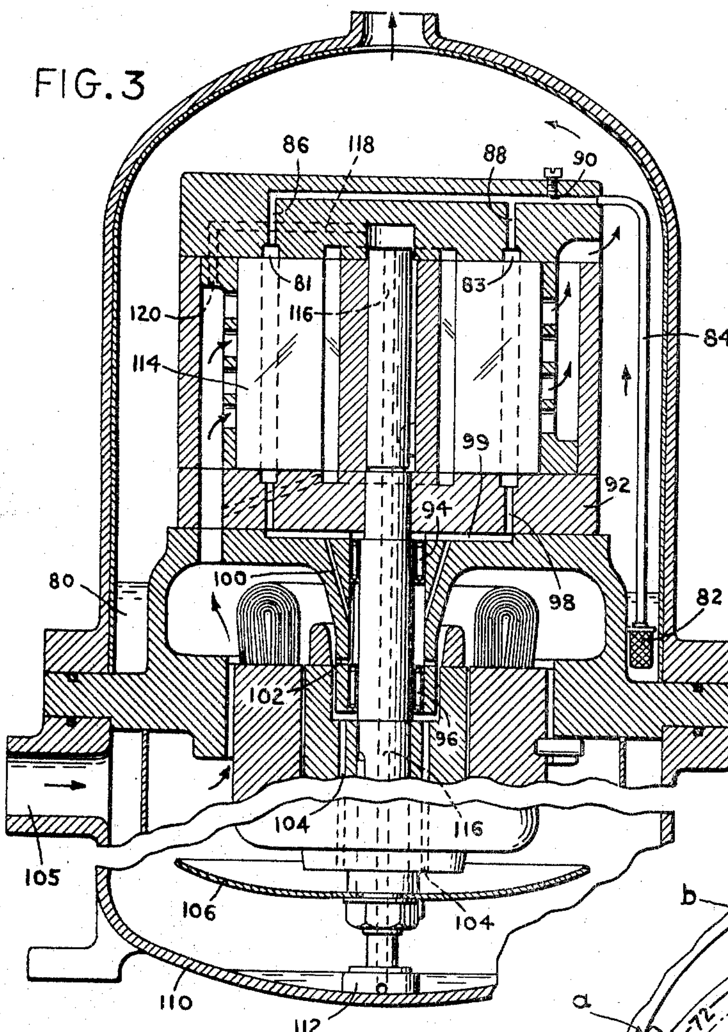
FIG. 3



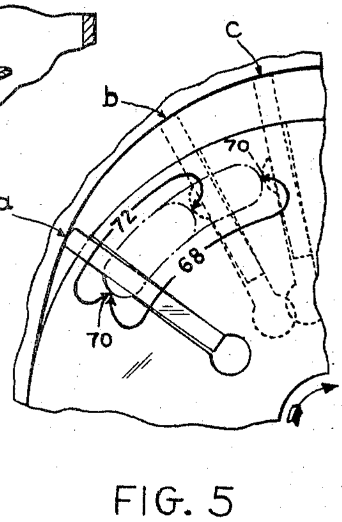


FIG. 4

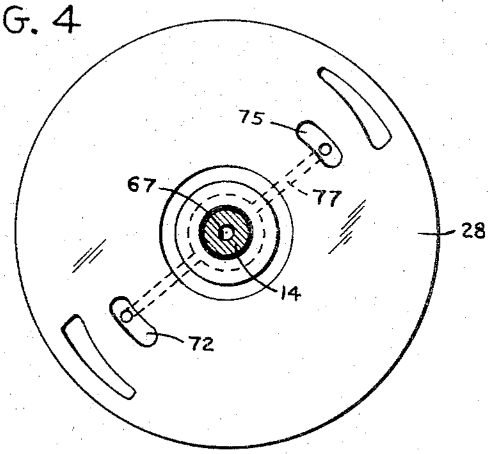


FIG. 5

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LUBRICATION SYSTEM FOR ROTARY VANE COMPRESSORS

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U.S. Cl. 230—207 2 Claims

ABSTRACT OF THE DISCLOSURE

A lubrication system for a sliding vane rotary compressor in which lubricating oil under pressure is supplied to a longitudinal groove in the trailing side of each vane slot as the vane passes the suction port so that oil will be distributed along the trailing side of the vane as the rotor turns. The oil is supplied to the grooves from an arcuate port in an end wall adjacent to the compressor suction inlet and at the same radial position as the longitudinal grooves. A corresponding drain port in the other end wall allows the grooves to be "flushed" before being refilled with oil.

Background of the invention

This invention relates to sliding vane rotary compressors and more particularly to lubricating systems for these compressors. Systems of this type may be found under U.S. Patent Classifications 230, Subclass 207, 152.

The usual methods of lubricating the vanes in a sliding vane rotary compressor is to either inject oil directly into the compression chamber or to spray oil into the suction passages. In either case, the oil tends to be thrown out against the cylinder housing wall and does not effectively lubricate the rotor slots, where lubrication is needed due to the sliding movement of the vanes in and out under high loads. Besides the poor efficiency of said vane lubricating system, the injection of oil into the compression chamber requires a controlled flow of oil to eliminate the danger of overloading and damaging the compressor.

On low speed compressors, central lubrication systems have been utilized in which oil under pressure flows through a central bore in the drive shaft and into the rotor slots filling up the space behind the vanes. The combined effect of the oil pressure and centrifugal force tends to force the lubricant outward along the slots so as to lubricate the vanes. The difficulty with these systems is that at high speed there is a tendency to develop hydraulic lock of the vanes when the vane is moving inward and the oil cannot bleed from the slot fast enough. This type of system is shown in U.S. Patent Nos. 3,016,184, 2,827,226 and 1,928,300.

Summary of the invention

This invention overcomes these difficulties in the prior art lubrication system and provides a low cost efficient lubricating system which effectively lubricates the vanes in the areas where they are in contact with the rotor slots by supplying oil directly to the space between the trailing sides of the vanes and rotor slots.

Accordingly, it is an object of this invention to provide lubrication of the vanes at a point where they contact the rotor slot without filling up the space behind the vanes.

Another object of this invention is to provide a lubrication system for a sliding vane rotary compressor in which either a low pressure pump or the compressor discharge pressure can be used as the motive force for an effective lubrication system.

It is a further object of this invention to provide a

low cost, simple lubrication system for a sliding vane rotary compressor which will insure lubrication for the trailing side of the vanes and for the vane tips.

It is a further object of this invention to provide a lubricating system for a sliding vane rotary compressor which does not require a high pressure oil pump.

It is a further object of this invention to provide a lubricating system for a sliding vane rotary compressor which supplies lubricating oil to the vanes only when they are subject to a low gas pressure so as to prevent "blowback" of oil to the pumping system due to compressed gas pressures acting on the oil supply system.

These and other objects will become more apparent from the following description of several embodiments of this invention.

Drawings

FIGURE 1 is a vertical sectional view taken through the axis of a compressor embodying this invention.

FIGURE 2 is a sectional view taken through lines 2—2 of FIGURE 1.

FIGURE 3 is a vertical sectional view taken through the axis of a compressor embodying a second embodiment of this invention.

FIGURE 4 is a sectional view taken through lines 4—4 of FIGURE 1.

FIGURE 5 is a schematic showing the relationship between the oil supply ports in the top and bottom end plates and three positions of a vane as it passes between the ports.

Referring particularly to FIGURES 1 and 2 there is shown a single stage double chamber sliding vane rotary compressor in a hermetically sealed motor compressor assembly **2**. The compressor assembly includes a main support housing **4** which cooperates with upper shell member **6** and lower shell member **8** to form a compressor section and a motor section. An electric motor stator **10** is attached to the main support housing while a motor armature **12** is attached to the drive shaft **14** by a key **16**. The armature drive shaft assembly is supported for rotary motion by the roller bearings **18** and **20**. A rotor **22** is attached to the drive shaft **14** by a key **24** for rotation in an elliptical shaped chamber formed by the housing **26**, a bottom closure plate **28** and a top closure plate **30**. The closure plates and housing are held together and fixed to the main support housing by appropriate clamping means, not shown.

Gas enters the assembly at inlet **32**, is deflected by baffle **33** and is drawn into the compressor suction **36** via passage **34** after it has circulated over the electric motor elements to provide a cooling effect. Compressed gas leaves the compressor through discharge passages **38** and flows into compartment **40** where most of the oil entrained in the gas is separated from the gas as the gas passes downward and around the deflecting member **44**. The compressed gas leaves the discharge compartment via outlet **46**. The inside of the upper shell is lined with a noise damping material **47** to reduce the noise caused by the compressor.

The rotor is driven in the direction of arrow **48** of FIGURE 2 and is furnished with radial slots **50** within which vanes **52** are freely movable so that as the rotor turns the outer ends of the vanes will tend to be held in engagement with the inner surface **54** of the elliptical cylinder **26** by centrifugal force. The compressor shown is a two chamber compressor in which there are two complete compression cycles for each cell formed between adjacent vanes as the motor makes one complete revolution in the cylinder housing. As an individual cell moves across the suction ports **36**, the cell is charged with gas at suction pressure. As the rotor continues to rotate, the effective volume of the cell is decreased so that when the gas is discharged from the cell through the discharge passages it is at a much higher pressure than the suction pressure. As the rotor continues to turn, the cell is again charged with gas at suction pressure as it passes the second suction port and the cycle is then repeated.

The lubrication system includes a first reservoir **56**, which is in the discharge chamber and therefore at compressor discharge pressure, and a second reservoir **58** which is in the motor chamber and therefore at suction pressure. Float valve assembly **60** in line **62** holds the high pressure reservoir at a predetermined level so as to maintain a liquid seal between the high pressure side of the lubrication system and the low pressure side. An oil pump **64** is adapted to pump oil from the low pressure reservoir to symmetrical arcuate ports **68** and **69** in the upper plate via central passage **67** in the drive shaft and passages **71** and **73**. The ports are located at an annular position adjacent to the suction passages. Longitudinal channels or grooves **70** extend axially along the trailing side of each slot. Each of the channels **70** registers with the ports **68** and **69** as the vane passes the suction passages. The bottom plate **28** contains cooperating arcuate ports **72** and **75** which begin at the same point as the ports in the upper plate but which are shorter than the ports in the upper plate so as to cut off communication between the ports in the bottom plate and the grooves **70** in the rotor before cutting off communication between the ports in the top plate and the grooves. This is shown schematically in FIGURE 5 which shows a port in the bottom plate superimposed over a port in the top plate and three positions of a vane as it passes these ports.

Ports **72** and **75** drain into low pressure reservoir **58** via oil return lines **74** and **76**. Lubricating oil flows to the bearings **18** and **20** via lines **77**. Lubricating oil coming from the bearings flows down lines **78** and is thrown out into the suction gas stream by a spinner **79** where it is carried into the suction of the compressor to provide additional lubrication.

It will be apparent that the pump **64** will keep the arcuate ports **68** and **69** in the top plate supplied with oil at all times while lines **74** and **76** will drain the ports **72** and **75** in the lower plate. Referring to FIGURE 5 particularly, it will be seen that as rotor groove **70** first registers with the ports 68 and 72 (position *a*) lubricating oils will flow from the upper port through the groove and back to drain via the lower port and drain passages. This will fill the groove **70** with a fresh supply of relatively cool oil. As the rotor continues to turn, the lower port will be cut off while the upper port continues to supply oil to the groove to insure that it is filled with oil (position *b*) until the upper port is also closed off (position *c*). As the rotor moves from the suction area into the compression portion of the cycle both the upper and lower ports are closed to prevent the high pressure in the cells between the vanes from acting against the pump pressure. As the rotor continues to turn, the oil in groove **70** will be distributed along the trailing side of the vane. Some oil will be thrown out and will flow to the tips of the vanes to seal and lubricate between the vane tips and the cylinder wall. Some oil will flow inward and will get behind the vane where it will eventually discharge into the suction line via passage **79**. It will be apparent that this lubrication cycle will repeat itself for each vane as it passes the suction ports.

FIGURE 4 is a sectional view showing the arcuate ports **72** and **75** in the bottom plate **28** and the passages **77** for supplying oil to the roller bearings **18** and **20**.

FIGURE 3 shows another embodiment of the invention which differs from that shown in FIGURE 1 primarily in the means for supplying lubricating oil to the longitudinal grooves in the rotor. The basic compressor operation is identical to that shown in FIGURE 1 and it will not be described in detail.

In this embodiment lubricating oil is supplied to the ports in the upper plate from a lubricating oil reservoir

80 maintained in the high pressure chamber. This reservoir will be at a pressure equal to the compressor discharge pressure which provides a convenient source of oil under high pressure. The oil is supplied to the upper ports **81** and **83** via filter **82** and passages **84**, **86** and **88**. Restriction **90** limits the maximum flow of oil. Oil being drained from the ports in the bottom plate **92** in the lower plate is fed to the bearings **94** and **96** via lines **98**, **99** and **100**. The radial holes **102** provide a bypass for preventing a buildup of oil around the lower bearing **96**. Passages **104** allow the oil to flow down to spinner **106** which causes the oil to be thrown out and into the flow path of suction gas entering the compressor at inlet **105**. A portion of the oil will be picked up by the suction flow and will be carried directly into the inlet. Some oil will not be picked up by the gas stream and will collect at the bottom of the motor housing **110**. A small pump **112** pumps this oil directly into the inlet chamber **114** via passages **116**, **118** and **120**.

Since the oil which drained into the motor housing can only be returned to the high pressure side of the system by being carried in the gas stream entering the compressor, there is a double lubrication effect, with the same oil which is supplied to the grooves in the rotor slots being carried back through the compressor along with the gas stream. It is therefore necessary to limit the flow of oil to the grooves. In the embodiment shown in FIGURE 1 any excess oil supplied to the slots is merely recirculated whereas in the embodiment of FIGURE 3 excess oil which passes through the grooves must become part of the gas flow entering the compressor at the same rate so as to maintain the reservoir in the high pressure side of the system.

Although a compressor embodying this invention has many applications, it can be used to particular advantage in a compression refrigeration cycle in which the gas being compressed is a refrigerant, such as Freon R–12 and R–22.

What is claimed is:

1. A lubricating system for a sliding vane rotary compressor of the type having a slotted rotor with a plurality of vanes movable inward and outward thereof, a casing for the rotor having a cylindrical wall for guiding the vanes in their in and out movement, end walls closing the cylinder and circumferentially spaced gas inlet and outlet ports in the cylinder wall, the lubricating system comprising:
   - (a) an axially extending groove in the trailing side of each vane slot;
   - (b) an arcuate port in each end wall adjacent the suction inlet and at the same radial position as the grooves in the rotor slots so that each groove will pass between the ports as the rotor turns;
   - (c) means for supplying lubricating oil under pressure to the port in one end wall; and
   - (d) means for draining oil from the port in the other end wall; whereby

     each groove will be flushed and resupplied with oil each time it passes the inlet port.

2. The lubricating system as defined in claim **1** wherein the arcuate port being supplied oil is longer than the arcuate port being drained of oil so that the grooves in the trailing sides of the slots will be completely filled with oil after passing between the ports in the end walls.

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U.S. Cl. X.R.

230—139, 152