

SPECIFICATION **Rotary Compressor**

The present invention relates generally to a rotary vane-type compressor which is provided
5 with an improved lubricant distribution system resulting in decreased frictional losses.

Such compressors are commonly used for apparatus such as air conditioners, refrigerators and so forth, and one of the most widely
10 employed types is the horizontal hermetic since it comprises a rotational element it needs much lubrication to reduce frictional losses and to increase efficiency.

In a hermetic ompressor in which a rotational element is horizontally disposed machine lubricant will be stored in the lower half of the hermetic enclosure. To avoid disturbing the rotational movement of the rotor the level of lubricant needs to be low enough so as not to
20 reach the lowest portion of the rotor. Since the rotational axis of the rotor requires considerable lubrication the lubricant must therefore be pumped up to it.

It is known to provide a rotary compressor of the vane or blade type with a reciprocating blade movement which provides a pumping action. For example, U.S. Patent No. 3,746,477 shows an arrangement in which a lubricant dispensing pipe is provided at the lower part of the bearings to
30 connect the blade chamber with the motor shaft. The reciprocal movement of the blade thus causes lubricant to flow in through the lubricant distribution pipe thus distributing lubricant up to the motor shaft.

This type of horizontal compressor, however, must be supplied with a check valve so that the lubricant does not return to the blade chamber. The valve mechanism tends to be complicated and unreliable.

The present invention seeks to provide an improved, simple, efficient system of lubricant distribution for a horizontal compressor.

The invention also seeks to provide a lubricant distribution system for a horizontal compressor in which it is not necessary to provide a special
45 check valve to avoid reverse flow.

According to the present invention there is provided a rotary vane type compressor including a cylinder with an eccentric rotor, and a radial
50 vane resiliently biased towards the rotor and arranged to reciprocate in a housing formed in the peripheral wall of the cylinder as the rotor rotates, so as to define chambers of varying volume between the cylinder walls, the vane and the
55 rotor, and in which a further chamber is defined between the vane and its housing walls, which chamber and vane form a lubricant pump, a conduit connecting an outlet of the lubricant pump chamber and the rotor bearing surfaces and
60 passing through a lubricant reservoir, the conduit also having an opening communicating with thue lubricant reservoir, the location of the opening relative to the outlet of the lubricant pump chamber and the magnitude of the effective area

65 being such that the opening acts as a check valve for the conduit.

A preferred embodiment of the invention comprises a horizontal vane-type rotary refrigerant compressor comprising, a hermetic casing with bottom portion thereof defining a
70 lubricant reservoir, a motor part consisting of a stator disposed fixedly on the inner wall of said hermetic casing and a rotor rotatably arranged in a spaced and concentric relationship with said stator and a rotational shaft connected with said rotor and extending horizontally along said
75 hermetic casing and a compressor part connected to said motor part by means of said rotational shaft and comprising an eccentric member integrally formed with said rotational shaft at the
80 farther end from said motor, a bearing member provided at each side of said eccentric member for supporting the rotational movement of said shaft the bearing members respectively having a
85 suction aperture and a discharge aperture in communication with said lubricant reservoir for allowing lubricant to pass therethrough, an annular member concentrically and rotatably surrounding said eccentric member and
90 positioned between said bearing members, a cylinder defining a compression chamber together with said annular member and said bearing members, a vane or blade extending radially through said cylinder having one end in contact
95 with said annular member and another end urged by a spring member in order to divide said compression chamber into a high pressure compartment and a low pressure compartment, and a pipe member having one end in
100 communication with said discharge aperture of said bearing member and another end in communication with a lubricant path leading to areas where bearing or sliding contacts exist and said pipe member further having an opening near
105 said discharge aperture of said bearing member, and said vane or blade and said bearing member define a blade chamber wherein said vane or blade sucks lubricant through said suction aperture into said blade chamber by virtue of its
110 reciprocal movement and discharges lubricant from said blade chamber through said discharge aperture into said lubricant pipe member the passage of lubricant through the discharge aperture inducing a flow of lubricant through the
115 opening into the vane and the magnitude of the effective area of the opening to that of the said discharge aperture being such that the opening acts as a check valve for the pipe member to substantially prevent reverse flow of lubricant
120 back into said blade chamber.

Some embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is an exploded elevational view of a
125 horizontal type rotary compressor with an improved lubricant supplying system according to the invention.

Figure 2 is an enlarged and exploded partial

view of the horizontal type rotary compressor of Figure 1.

Figures 3, 4, 5 and 6 also are enlarged and exploded views of various alternative

embodiments of this invention.

In the particular embodiment depicted in the drawings it will be noted that a horizontal compressor has been selected to illustrate a preferred application of the invention.

Referring now to Figure 1 an illustrated horizontal type compressor 1 has a hermetic shell 2 which contains compressor elements. To the right of the compressor 1 is disposed a motor part 3 consisting of a stator 4 fixed to the inner wall of the hermetic shell 2, a rotor 5 provided in a concentric and spaced relationship with the stator 4 and which rotates inside the stator 4, the rotor 5 being fixed to a motor shaft 6 which extends into the left half of the horizontal hermetic shell 2 and is supported at its left-hand end by a pair of bearings 7, 8. The compressor part 9 comprises the left-hand end of the rotational shaft 6 which is provided with an integrally formed eccentric portion 10, the pair of bearings 7, 8 locating the eccentric portion 10. There is also provided between the bearings 7, 8 a cylinder 11 for accommodating the eccentric portion 10. The eccentric portion 10 is surrounded by a roller 12, an annular member which revolves around the eccentric portion 10 in a known manner.

The cylinder 11 is also provided with a blade 13 which is urged upward by a spring member 14. The blade 13 is in a continuous contact with the roller 12 and moves upward and downward in accordance with the movement of the eccentric portion 10.

The cylinder 11, the roller 12 and the bearings 7 and 8 define a compression chamber. The compression chamber is divided by the blade 13 into a suction compartment to which refrigerant is introduced and discharge compartment from which compressed refrigerant is discharged.

All the contacting surfaces between the cylinder 11 and the roller 12, the roller 12 and the pair of bearings 7 and 8 and the shaft 6, the cylinder 11 and the blade 13 and so forth, require much lubrication.

The bottom half of the hermetic enclosure provides a lubricant reservoir 15. Lubricant is stored in this reservoir to a level which is no higher than the lowest portion of the rotor 5 to avoid any possible disturbance on the rotational movement of the rotor 5.

The improved lubricant system will now be described in more detail.

The pair of bearings 7 and 8, the cylinder 11 and the blade 13 constitute a lubricant compartment 16. A suction aperture 17 is provided on the right bearing 7 allows the lubricant to flow into the compartment 16, while a discharge aperture 20 in the left bearing 8 allows the lubricant to discharge.

The bearing 8 is also provided with a lubricant dispensing pipe 18 having one end connected to the lubricant compartment 16 through the

discharge aperture 20 and the other end communicating with the rotor shaft 6 and with the aforementioned contacting surfaces.

Near the inlet end of the lubricant dispensing pipe 18 is provided an opening 19 which communicates with the external lubricant reservoir 15.

Referring now to Figure 2 there is shown an enlarged and exploded sectional view of the lubricant compartment 16 and the one end of the lubricant dispensing pipe 18.

The lubricant dispensing pipe 18 is an interference fit into a recess in the wall of the bearing 8 which communicates with a discharge opening 20. The lubricant distribution conduit 18 has a circular aperture 19 on the upper half near the open end thereof.

As illustrated in Figures 3, 4, 5 and 6 the forms of the opening may be varied. Alternatively the lubricant distribution pipe 18 may be bored right through from one side to the other as seen in Figure 4.

Figure 5 shows another embodiment in which the end of the lubrication pipe 18 is partially cut away.

In an extreme case as shown in Figure 6 the end of the lubricant distribution pipe 18 may be separated from the bearing 8, but of course the pipe end must face the discharge opening 20.

The mode of operation of the present will now be explained. As the shaft 6 rotates the eccentric portion 10 and the roller 12 also rotate and the blade 13 reciprocates in a known manner.

As the blade 13 ascends upwards lubricant primarily flows into the lubricant chamber 16 through the suction aperture 17. When the blade 13 descends downwards lubricant flows out from the chamber 16 through the discharge aperture 20, flowing into the lubricant distribution pipe 18, then up to the region of metal to metal contact.

It is found that when the blade 13 moves downwards and lubricant is pumped up through the lubricant distribution pipe 18 there is relatively a small amount of lubricant leakage through the opening 19, but when the blade 13 is on its way upwards and lubricant tends to return to the chamber 16, however, there is a comparatively large amount of lubricant flow through the opening 19.

This may be partly attributable to the difference in the flow resistances between the opening 19 and the discharge aperture 20.

Accordingly the opening 19 functions as a check valve, thus eliminating the necessity of employing any valve means.

The relationship in the embodiment in Figure 2 between the dimensions of the diameter d of the discharge aperture 20 and the inner diameter D of the lubricant dispensing pipe 18 is such that $D/d=1.5$, but this ratio may vary.

The inner diameter D of the lubricant distribution pipe 18 should be at least as large as the diameter of the discharge aperture 20 so as to maintain a minimum initial velocity of lubricant to

force the lubricant up through the lubricant pipe 18.

At the same time the opening 19 formed in the lubricant pipe 18 should be substantially large enough to allow lubricant to flow through it during reverse lubricant flow, and to induce lubricant therethrough during the normal pumping stroke.

In a case of the embodiment in Figure 6, the lubricant distribution pipe 18 can be completely separated from the bearing 8.

The distance H between the lubricant pipe 18 and the bearing 8 should be kept appropriate to maintain the escape and induction operation for lubricant. For this purpose the lubricant pipe 18 is desirably supported somehow by a supporting member.

The embodiment illustrated in Figure 4, which includes a lubricant distribution pipe 18 with an inner diameter $D=3\text{mm}$, with two round openings having a diameter of 2.4mm , and bearing 8 with a discharge aperture 20 which has a diameter of 2mm , provides a lubricant supply capacity of about 400 cc/min .

In the embodiment of Figure 6 with $D=3\text{mm}$, $d=2\text{mm}$, and $H=3\text{mm}$, the capacity of distributing lubricant amounted to about 200 cc/min . It is known that for the purpose of lubricating the mechanical elements of a compressor the circulating quantity of lubricant should be not less than 100 cc/min . Accordingly it will be understood that the dispensing capacity of 200 cc/min more than satisfies the minimum desired level for machine lubrication.

The distance H in the embodiment shown in Figure 6 is determined by the relationships between the individual dimensions of D, d and other factors. Generally speaking, however, there is a tendency that the lubricant dispensing capacity increases as H increases from zero, continues to increase until it peaks, and then begins decreasing.

Similar relationships can be derived between the radial distances of the centers of the discharge aperture 20 and the lubricant dispensing pipe 18. When they are in or near a coaxial relationship the lubricant dispensing capacity peaks to a maximum value and as the distance between the two centers increases the capacity decreases.

It will be found that because of the self-generated oscillation of the motor the center of the free-end of the lubricant pipe 18 may be subject to movement so it needs to be fixed to any nearby part.

Claims

1. A rotary vane type compressor including a cylinder with an eccentric rotor, and a radial vane resiliently biased towards the rotor and arranged to reciprocate in a housing formed in the peripheral wall of the cylinder as the rotor rotates, so as to define chambers of varying volume between the cylinder walls, the vane and the rotor, and in which a further chamber is defined

between the vane and its housing walls, which chamber and vane form a lubricant pump, a conduit connecting an outlet of the lubricant pump chamber and the rotor bearing surfaces and passing through a lubricant reservoir, the conduit also having an opening communicating with the lubricant reservoir, the location of the opening relative to the outlet of the lubricant pump chamber and the magnitude of the effective area of the opening relative to that of the said outlet being such that the opening acts as a check valve for the conduit.

2. A vane type compressor according to claim 1, further including a hermetic housing, the lower part of which constitutes the lubricant reservoir.

3. A vane type compressor according to claim 1 or claim 2 further comprising a pair of bearings supporting the rotor shaft and locating the eccentric, the bearings also forming walls for the lubricant pump chamber.

4. A vane-type compressor according to claim 3 in which the end of the conduit which communicates with the lubricant pump chamber is located in a recess in the external wall of one of the bearings, and a bore connects the recess with the pump chamber, the said bore having a diameter d which is smaller than the internal diameter D of the conduit.

5. A vane-type compressor according to claim 4 in which the ratio D/d is at least 1.5.

6. A vane-type compressor according to any preceding claim in which the said opening comprises an aperture in the wall of the conduit.

7. A vane-type compressor according to any of claims 1 to 5 in which the opening comprises a gap between the end of the conduit and the outlet of the pump chamber.

8. A horizontal vane-type rotary refrigerant compressor comprising, a hermetic casing with bottom portion thereof defining a lubricant reservoir, a motor part consisting of a stator disposed fixedly on the inner wall of said hermetic casing and a rotor rotatably arranged in a spaced and concentric relationship with said stator and a rotational shaft connected with said rotor and extending horizontally along said hermetic casing and a compressor part connected to said motor part by means of said rotational shaft and comprising an eccentric member integrally formed with said rotational shaft at the farther end from said motor, a bearing member provided at each side of said eccentric member for supporting the rotational movement of said shaft for bearing members respectively having a suction aperture and a discharge aperture in communication with said lubricant reservoir for allowing lubricant to pass therethrough, an annular member concentrically and rotatably surrounding said eccentric member and positioned between said bearing members, a cylinder defining a compression chamber together with said annular member and said bearing members, a vane or blade extending radially through said cylinder having one end in contact with said annular member and another end urged by a spring



15

force the lubricant up through the lubricant pipe 18.

At the same time the opening 19 formed in the lubricant pipe 18 should be substantially large enough to allow lubricant to flow through it during reverse lubricant flow, and to induce lubricant therethrough during the normal pumping stroke.

In a case of the embodiment in Figure 6, the lubricant distribution pipe 18 can be completely separated from the bearing 8.

The distance H between the lubricant pipe 18 and the bearing 8 should be kept appropriate to maintain the escape and induction operation for lubricant. For this purpose the lubricant pipe 18 is desirably supported somehow by a supporting member.

The embodiment illustrated in Figure 4, which includes a lubricant distribution pipe 18 with an inner diameter $D=3\text{mm}$, with two round openings having a diameter of 2.4mm , and bearing 8 with a discharge aperture 20 which has a diameter of 2mm , provides a lubricant supply capacity of about 400 cc/min .

In the embodiment of Figure 6 with $D=3\text{mm}$, $d=2\text{mm}$, and $H=3\text{mm}$, the capacity of distributing lubricant amounted to about 200 cc/min . It is known that for the purpose of lubricating the mechanical elements of a compressor the circulating quantity of lubricant should be not less than 100 cc/min . Accordingly it will be understood that the dispensing capacity of 200 cc/min more than satisfies the minimum desired level for machine lubrication.

The distance H in the embodiment shown in Figure 6 is determined by the relationships between the individual dimensions of D, d and other factors. Generally speaking, however, there is a tendency that the lubricant dispensing capacity increases as H increases from zero, continues to increase until it peaks, and then begins decreasing.

Similar relationships can be derived between the radial distances of the centers of the discharge aperture 20 and the lubricant dispensing pipe 18. When they are in or near a coaxial relationship the lubricant dispensing capacity peaks to a maximum value and as the distance between the two centers increases the capacity decreases.

It will be found that because of the self-generated oscillation of the motor the center of the free-end of the lubricant pipe 18 may be subject to movement so it needs to be fixed to any nearby part.

Claims

1. A rotary vane type compressor including a cylinder with an eccentric rotor, and a radial vane resiliently biased towards the rotor and arranged to reciprocate in a housing formed in the peripheral wall of the cylinder as the rotor rotates, so as to define chambers of varying volume between the cylinder walls, the vane and the rotor, and in which a further chamber is defined

between the vane and its housing walls, which chamber and vane form a lubricant pump, a conduit connecting an outlet of the lubricant pump chamber and the rotor bearing surfaces and passing through a lubricant reservoir, the conduit also having an opening communicating with the lubricant reservoir, the location of the opening relative to the outlet of the lubricant pump chamber and the magnitude of the effective area of the opening relative to that of the said outlet being such that the opening acts as a check valve for the conduit.

2. A vane type compressor according to claim 1, further including a hermetic housing, the lower part of which constitutes the lubricant reservoir.

3. A vane type compressor according to claim 1 or claim 2 further comprising a pair of bearings supporting the rotor shaft and locating the eccentric, the bearings also forming walls for the lubricant pump chamber.

4. A vane-type compressor according to claim 3 in which the end of the conduit which communicates with the lubricant pump chamber is located in a recess in the external wall of one of the bearings, and a bore connects the recess with the pump chamber, the said bore having a diameter d which is smaller than the internal diameter D of the conduit.

5. A vane-type compressor according to claim 4 in which the ratio D/d is at least 1.5.

6. A vane-type compressor according to any preceding claim in which the said opening comprises an aperture in the wall of the conduit.

7. A vane-type compressor according to any of claims 1 to 5 in which the opening comprises a gap between the end of the conduit and the outlet of the pump chamber.

8. A horizontal vane-type rotary refrigerant compressor comprising, a hermetic casing with bottom portion thereof defining a lubricant reservoir, a motor part consisting of a stator disposed fixedly on the inner wall of said hermetic casing and a rotor rotatably arranged in a spaced and concentric relationship with said stator and a rotational shaft connected with said rotor and extending horizontally along said hermetic casing and a compressor part connected to said motor part by means of said rotational shaft and comprising an eccentric member integrally formed with said rotational shaft at the farther end from said motor, a bearing member provided at each side of said eccentric member for supporting the rotational movement of said shaft for bearing members respectively having a suction aperture and a discharge aperture in communication with said lubricant reservoir for allowing lubricant to pass therethrough, an annular member concentrically and rotatably surrounding said eccentric member and positioned between said bearing members, a cylinder defining a compression chamber together with said annular member and said bearing members, a vane or blade extending radially through said cylinder having one end in contact with said annular member and another end urged by a spring



* C L M S *

GB 2 059 510 B

4

4

member in order to divide said compression chamber into a high pressure compartment and a low pressure compartment, and a pipe member having one end in communication with said discharge aperture of said bearing member and another end in communication with a lubricant path leading to areas where bearing or sliding contacts exist and said pipe member further having an opening near said discharge aperture of said bearing member, and said vane or blade and said bearing member define a blade chamber wherein said vane or blade sucks lubricant through said suction aperture into said blade chamber by virtue of its reciprocal movement and discharges lubricant from said blade chamber through said discharge aperture into said lubricant pipe member the passage of lubricant

20 through the discharge aperture inducing a flow of lubricant through the opening into the vane and the magnitude of the effective area of the opening to that of the said discharge aperture being such that the opening acts as a check valve for the pipe member to substantially prevent reverse flow of lubricant back into said blade chamber.

25 9. A horizontal type compressor according to claim 8 wherein said pipe member has one end communicated with said lubricant path and another end facing said discharge aperture of said bearing in a spaced relationship.

30 10. A rotary vane-type compressor substantially as herein described with reference to Figures 1 and 2, or Figures 3 or Figure 4, or Figure 5, or Figure 6 of the accompanying drawings.