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(54) **ROTARY MECHANISM**

(57) A rotary mechanism, comprising a housing (11), a rotary member (110) and a discharge member (130); an oil and gas mixture is contained in the housing (11); the rotary member (110) is provided in the housing (11) and is rotatable about a rotation axis to drive the oil and gas mixture to form a cyclone flow, whereby under a centrifugal force, the oil content in the oil and gas mixture is smaller as it approaches the rotary member (110); and the discharge member (130) is provided on the housing (11) and extends radially inwardly from the housing (11) to a position where the oil content is equal to or less than a preset amount.

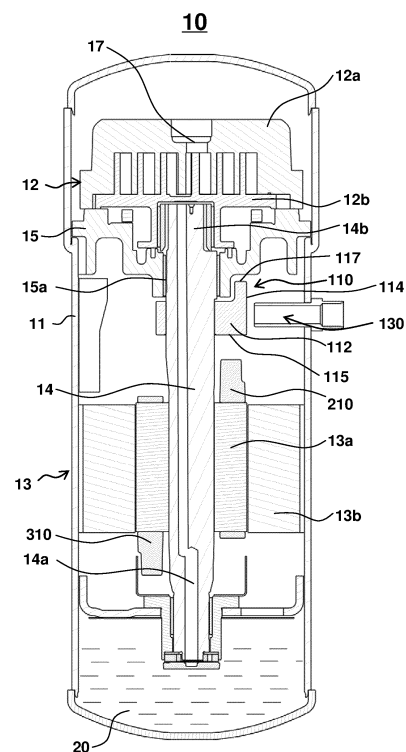


Figure 1

Description

[0001] The present disclosure claims the priority to Chinese Patent Applications No. 201710701301.0 and No. 201721025170.0 titled "ROTARY MACHINERY" and filed on August 16, 2017 with the China National Intellectual Property Administration, the disclosures of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a rotary machinery.

BACKGROUND

[0003] The contents of this section only provide background information related to the present disclosure, which may not necessarily constitute the prior art.

[0004] A compressor (for example, a scroll compressor, a rotor compressor or the like) typically includes a compression mechanism, a drive shaft and a motor. The drive shaft is supported by a bearing in a bearing housing and is driven to rotate by the motor. The rotation of the drive shaft further drives the movable components of the compression mechanism (for example, an orbiting scroll of the scroll compressor, a rotor of the rotor compressor or the like) to move so as to compress working fluid (for example, refrigerant). Each of movable components of the compressor (for example, the orbiting scroll of the scroll compressor, the rotor of the rotor compressor, the bearing or the like) needs to be lubricated by lubricating oil to maintain the operation stability and reliability of the movable component and the entire compressor. Therefore, a lubricating oil circulation system for the compressor is an important part of the compressor.

[0005] When the compressor is operated, the lubricating oil is transported from an oil pool to each movable component of the compressor under differential pressure or by an oil pumping mechanism, for example, to lubricate each component so as to maintain the normal operation of each movable component, and finally returns to the oil pool. In addition, during circulation of the lubricating oil, it may also take away impurities between the contact surfaces of components to reduce abrasion, and heat generated by each component due to friction or current.

[0006] During the circulation of the lubricating oil, some of the lubricating oil will exit from the compressor along with the working fluid. If the amount of the lubricating oil exiting from the compressor is too large, the amount of the lubricating oil in the oil pool will gradually decrease after the compressor is operated for a period of time, that is, the oil level will be lowered, resulting in insufficient lubricating oil in the compressor for maintaining the normal operation of the movable components and thus abnormal operation of the compressor. Therefore, it is very important to maintain the level of the oil pool in the compressor. On the other hand, the lubricating oil discharged from the compressor along with the working fluid will also adhere to, for example, coils of condensers and evaporators, thereby affecting the heat exchange efficiency of the working fluid with the ambient air. Therefore, it is necessary for the compressor to properly control the lubricating oil circulation rate (also called an oil circulation rate). Here, the oil circulation rate may be understood as the (mass) ratio of the lubricating oil contained in unit working fluid discharged from the compressor.

[0007] In order to control the oil circulation rate, an oil-gas separating device may be disposed in the compressor. However, since the internal space of the compressor casing is limited, it is desired to provide a compressor with a simple structure and small space occupation, and capable of efficiently controlling the oil circulation rate.

SUMMARY

[0008] An object of the present disclosure is to provide a rotary machinery with a simple structure and small space occupation and capable of efficiently controlling the oil circulation rate.

[0009] Another object of the present disclosure is to provide a compressor with simplified manufacture and assembly and low cost and capable of reasonably controlling the oil circulation rate of the compressor.

[0010] According to an aspect of the present disclosure, there is provided a rotary machinery including a casing, a rotating member, and a discharge member. The casing contains an oil-gas mixture therein. The rotating member is disposed in the casing and is rotatable around a rotating axis to drive the oil-gas mixture to form a cyclone flow, whereby under a centrifugal force, an oil content in the oil-gas mixture decreases as it approaches the rotating member. The discharge member is disposed on the casing and extends radially inward from the casing to a position where the oil content is less than or equal to a predetermined content. The rotating machinery according to the present disclosure can well control the lubricating oil circulation rate.

[0011] In some embodiments, a predetermined distance exists between an end portion of the discharge member located inside the casing and an outer peripheral surface of the rotating member, the ratio of the predetermined distance to the diameter of a circular discharge passage of the discharge member is less than 1.5.

[0012] In some embodiments, the ratio of the predetermined distance to the diameter of the circular discharge passage

of the discharge member is greater than 0.25.

[0013] In some embodiments, the ratio of the predetermined distance to the diameter of the circular discharge passage is between 0.4 and 0.5.

[0014] In some embodiments, the rotating member has a first axial end surface and a second axial end surface in an axial direction, and the discharge member is positioned between a first axial position and a second axial position. If the discharge member is in the first axial position, a one radial side of the discharge passage of the discharge member is located axially outside of the first axial end surface and the other radial side opposite to the one radial side of the discharge passage is aligned with the first axial end surface. If the discharge member is in the second axial position, the other radial side of the discharge passage is located axially outside of the second axial end surface and the one radial side of the discharge passage is aligned with the second axial end surface.

[0015] In some embodiments, the discharge member is positioned to be substantially aligned with an axial central portion of the rotating member.

[0016] In some embodiments, an end portion of the discharge member adjacent to the rotating member linearly extends in a horizontal direction perpendicular to the rotating axis, and an end surface of the end portion is oriented obliquely with respect to an outer peripheral surface of the rotating member.

[0017] In some embodiments, an end portion of the discharge member adjacent to the rotating member is bent in a circumferential direction of the rotating member and / or in a vertical direction parallel to the rotating axis

[0018] In some embodiments, a discharge opening of the discharge member is oriented to face a downstream side of a rotating direction of the rotating member, and the oil-gas mixture in the casing enters the discharge member via the discharge opening.

[0019] In some embodiments, the rotating member has a first axial end surface and a second axial end surface in an axial direction, and the discharge member is positioned axially outside of the first axial end surface or of the second axial end surface, and an end portion of the discharge member located in the casing extends inward to be flush with an outer peripheral surface of the rotating member or to be radially inside of the outer peripheral surface of the rotating member.

[0020] In some embodiments, the rotating member is in the form of a cam, an eccentric part, or a counterweight, and the discharge member is in the form of a discharge pipe or a discharge passage.

[0021] In some embodiments, the rotatory machinery further includes a compression mechanism, a drive shaft, and a motor. The compression mechanism is located in the casing and is configured to compress working fluid. The drive shaft is adapted to drive the compression mechanism. The motor includes a stator and a rotor rotatable with respect to the stator and configured to drive the drive shaft to rotate. The rotating member is disposed on the drive shaft or disposed on the rotor.

[0022] In some embodiments, the rotating member is located between the compression mechanism and the motor or between the motor and an oil sump.

[0023] In some embodiments, the rotary machinery is a high side scroll compressor.

[0024] In the above structure, since the rotating member in the rotatory machinery may drive the oil-gas mixture surrounding it to form a cyclone flow when the rotating member rotates, the lubricating oil may be separated from the oil-gas mixture under the centrifugal force before the oil-gas mixture exits from the compressor, so as to well control the lubricating oil circulation rate. On one hand, the oil level of the oil pool in the compressor may be maintained at a desired level. On the other hand, the amount of the lubricating oil exiting from the compressor and entering the compressor system may be reduced, for example, the amount of the lubricating oil entering the heat exchanger may be reduced, thereby improving the overall working efficiency of the compressor system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The features and advantages of one or more embodiments of the present disclosure will become more readily understood from the following description with reference to the accompanying drawings in which:

Figure 1 is a longitudinal sectional view of a compressor including an oil-gas separating device according to an embodiment of the present disclosure;

Figure 2 is a schematic cross-sectional view of the oil-gas separating device of the compressor of Figure 1;

Figure 3 is a schematic view of the oil-gas separating device of Figure 1, illustrating different radial positions of a discharge pipe with respect to a counterweight;

Figure 4 is a schematic view of the oil-gas separating device of Figure 1, illustrating different axial positions of the discharge pipe with respect to the counterweight;

Figures 5 and 6 are schematic views of a compressor having an oil-gas separating device located at different positions;

Figure 7 is a graph illustrating a distance between the discharge pipe and the counterweight and a circulation rate;

Figure 8a is a cross sectional view illustrating the oil-gas distribution of the oil-gas separating device according to the present disclosure;

Figure 8b is a cross-sectional view illustrating the oil-gas distribution of the oil-gas separating device in a comparison example;

Figure 9 is a schematic view similar to Figure 2, illustrating one modification of the discharge pipe; and

Figure 10 is a schematic longitudinal sectional view of the oil-gas separating device of the compressor, illustrating another modification of the discharge pipe.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] The following description of the preferred embodiments is merely exemplary and is by no means intended to limit the present disclosure and its application or usage. The like reference numerals are used to designate like components throughout the drawings, and the description of the construction of the like components will not be repeatedly described.

[0027] For ease of description, in the case where a certain component can rotate around a rotating axis, the "longitudinal direction" or "axial direction" mentioned for the component herein refers to the direction parallel to the rotating axis, and the "radial direction" mentioned for the component herein refers to the direction perpendicular to the rotating axis. "First" and "second" and other words mentioned herein are only used to distinguish different components and are not used to indicate order or other meanings.

[0028] Hereinafter, an oil-gas separating device and a compressor including the oil-gas separating device according to the present disclosure will be described with reference to the accompanying drawings. A high side vertical scroll compressor is illustrated in the figures. However, it should be understood that the present disclosure is also applicable to other types of compressors, such as a horizontal scroll compressor, a rotor compressor, and a piston compressor.

[0029] Referring to Figure 1, the compressor 10 includes a casing 11, and a compression mechanism 12, a motor 13 and a drive shaft (also referred to as a rotating shaft or a crankshaft) 14 which are disposed in the casing 11.

[0030] The motor 13 includes a stator 13b fixed to the casing 11 and a rotor 13a located at the inner side of the stator 13b and fixed to the drive shaft 14. When the motor 13 is started, the rotor 13a rotates and drives the drive shaft 14 to rotate with it.

[0031] The drive shaft 14 is fitted with the compression mechanism 12 so as to drive the compression mechanism 12 to compress the working fluid (usually gaseous) when the drive shaft 14 rotates. In the scroll compressor 10 shown in the figures, an eccentric crank pin 14b of the drive shaft 14 is fitted in an orbiting scroll 12b of the compression mechanism 12 to drive the orbiting scroll 12b to rotate.

[0032] The compressor 10 further includes a main bearing housing 15 fixed to the casing 11. The main bearing housing 15 rotatably supports the drive shaft 14 via the main bearing 15a, and supports the compression mechanism 12, particularly the orbiting scroll component 12b.

[0033] The compression mechanism 12 includes a non-orbiting scroll component 12a fixed to the casing 11 or the main bearing housing 15, and the orbiting scroll component 12b movable with respect to the non-orbiting scroll component 12a. Driven by the drive shaft 14, the orbiting scroll component 12b orbits relative to the non-orbiting scroll component 12a (that is, the central axis of the orbiting scroll component moves around the central axis of the non-orbiting scroll component, but the orbiting scroll component itself does not rotate around its own central axis). A series of compression chambers whose volume gradually decreases from the radial outer side to the radial inner side are formed between the spiral vanes of the non-orbiting scroll component 12a and the spiral vanes of the orbiting scroll component 12b. The working fluid is compressed in these compression chambers, and then discharged through a discharge hole 17 of the compression mechanism 12. The discharge hole 17 of the compression mechanism 12 is generally disposed at approximately the center of the end plate of the non-orbiting scroll component 12a.

[0034] During the operation of the scroll compressor, a centrifugal force or centrifugal torque generated by the rotation of the eccentric component causes the compressor to vibrate. Generally, a counterweight is disposed on a rotating component to provide a reverse centrifugal force or centrifugal torque to counteract the imbalance generated by the eccentric component. In the compressor 10 shown in Figure 1, a counterweight 110 is fixed on the outer peripheral surface of the drive shaft 14 and is adjacent to the main bearing housing 15; a counterweight 210 is disposed on an end surface of the rotor 13a of the motor 13 facing the compression mechanism 12; and a counterweight 310 is disposed

on an end surface of the rotor 13a of the motor 13 facing away from the compression mechanism 12. Although the compressor in the figure includes three counterweights, it should be understood that the number of counterweights may vary according to specific application requirements.

[0035] In the example of the compressor shown in Figure 1, an oil sump 20 for storing lubricating oil is disposed at the bottom of the compressor casing 11. The drive shaft 14 may be formed therein with a passage 14a extending substantially along the axial direction of the drive shaft 14. The lubricating oil in the oil sump 20 is supplied to each bearing of the compressor, the bearing surface of the main bearing housing 15 and the orbiting scroll component 12b, the compression mechanism and the like through this passage 14a. After various components of the compressor are lubricated, the lubricating oil returns to the oil sump 20.

[0036] As shown in Figure 1, the compressor 10 is a high side scroll compressor. A discharge pipe (a discharge member) 130 is disposed on the casing 11. The low pressure working fluid is directly supplied into a suction chamber or a low pressure chamber of the compression mechanism 12 through an intake pipe (not shown) and a suction hole (not shown) of the compression mechanism, and then is compressed and discharged from the discharge hole 17 of the compression mechanism 12 into a space surrounded by the casing 11 of the compressor. In the illustrated example, the discharge pipe 130 is hermetically installed in the casing 11 to discharge the compressed gas out of the compressor 10. During the operation of the compressor, the working fluid discharged from the discharge hole 17 is mixed with lubricating oil, and the lubricating oil supplied from the passage 14a of the drive shaft 14 is distributed in a space within the compressor casing 11 in the form of oil mist, due to the movement of the orbiting scroll component 12b, the rotor 13a of the motor 13, and the like. Therefore, the high pressure working fluid to be discharged through the discharge pipe 130 out of the compressor often contains lubricating oil, and thus it is necessary to control the amount of lubricating oil in the working fluid discharged out of the compressor via the discharge pipe 130, thereby controlling the oil circulation rate (OCR) of the entire compressor.

[0037] In order to well control the oil circulation rate (OCR) of the compressor, an oil-gas separating device may be disposed in the compressor 10. However, the additional oil-gas separating device requires a certain space and complicates the manufacturing and assembly process. Especially when the internal space of the compressor is limited, it is not suitable to additionally install the oil-gas separating device.

[0038] In order to overcome the above problem, the inventors of the present disclosure have conceived a solution in which the lubricating oil may be separated from the high pressure working fluid with a centrifugal force by using members that already exist in the compressor and only by reasonably configuring the relative positional relationship between the members, and the working fluid containing a reduced content of lubricating oil or even containing no lubricating oil is discharged, thereby reasonably controlling the oil circulation rate (OCR) of the compressor. Such a solution can significantly reduce the number of parts, save installation space, and simplify the assembly process, thereby greatly reducing costs.

[0039] The oil-gas separating device according to an embodiment of the present disclosure will be described below with reference to Figures 1 and 2. As shown in the figures, the oil-gas separating device includes the counterweight 110 and the discharge pipe 130. The counterweight 110 is fixed to the outer peripheral surface of the drive shaft 14 and may be rotated together with the drive shaft 14. In this example, the rotating axis of the counterweight 110 is also the rotating axis of the drive shaft 14, that is, the longitudinal central axis of the drive shaft 14. The discharge pipe 130 is located outside the counterweight 110 in the radial direction and is fixed on the casing 11 hermetically.

[0040] The counterweight 110 has an outer peripheral surface 111 adjacent to and facing the discharge pipe 130, and a first axial end surface 115 and a second axial end surface 117 opposite to each other. Referring to Figures 1, 2 and 3, the counterweight may have a radial protrusion 112 protruding radially outward, and an axial protrusion 114 extending axially from the second axial end surface 117. It should be understood that the structure of the counterweight (especially the position, size and number of the protrusions) may vary according to the specific application. For example, the counterweight may have only one of a radial protrusion and an axial protrusion. Additionally or alternatively, the counterweight may have an axial protrusion extending axially from the first axial end surface.

[0041] When the counterweight 110 rotates with the drive shaft 14, the radial protrusion 112 and the axial protrusion 114 of the counterweight 110 may agitate the oil-gas mixture surrounding them and discharged from the discharge hole 17 and force the oil-gas mixture surrounding them to form a cyclone flow. Under centrifugal force, the lubricating oil in the oil-gas mixture is thrown radially outward to the casing 11 and flows down along the casing 11 back into the oil sump 20 under gravity. In this way, the content of lubricating oil in the oil-gas mixture close to the counterweight 110 is low, while the content of lubricating oil in the oil-gas mixture close to the casing 11 is high. The content of the lubricating oil in the oil-gas mixture increases in a direction from the counterweight 110 to the casing 11. The content of lubricating oil in the oil-gas mixture on the radial inner side of the cyclone flow is smaller than the content of lubricating oil in the oil-gas mixture on the radial outer side of the cyclone flow. Therefore, the inventors propose positioning an end portion of the discharge pipe provided inside the casing within the area of the cyclone flow generated by the rotation of the counterweight, and particularly within the radial inner side of the cyclone flow. The desired content of the lubricating oil in the oil-gas mixture to be discharged may be predetermined according to a desired oil circulation rate. Then, the position

of the discharge pipe may be determined according to the predetermined desired content (also referred to as a "predetermined content"). That is, the discharge pipe may be extended radially inward from the casing to a position where the content of the lubricating oil in the oil-gas mixture is less than or equal to the predetermined content.

[0042] It should be understood that the inventive concept of the present disclosure is based on the principle that the cyclone flow generated by the rotation of counterweight 110 causes the gradient change in the content of lubricating oil between the counterweight 110 and the casing 11 and the relative positional relationship between the discharge pipe 130 and the counterweight 110 is determined to obtain the desired and reduced oil circulation rate. In some of conventional compressors, due to installation requirements, a length of the discharge pipe may extend into the compressor casing. In this case, the extension length of the discharge pipe only needs to meet the installation requirements, and thus the extension end of the discharge pipe tends to be closer to the compressor casing. In addition, in some of conventional compressors, since the lubricating oil flows along the inner surface of the compressor casing, a length of the discharge pipe may also extend into the compressor casing to prevent the lubricating oil from flowing into the discharge pipe. However, the setting of the extension length of the discharge pipe in the conventional compressor has nothing to do with the rotation of the counterweight, the cyclone flow generated by the rotation of counterweight, and the like.

[0043] In one embodiment, between the casing 11 and the counterweight 110, the discharge pipe 130 may be positioned closer to the counterweight 110 according to the inventive concept of the present disclosure. Preferably, the discharge pipe 130 is disposed adjacent to the counterweight 110, that is, positioned at a predetermined distance from the outer peripheral surface of the counterweight 110 to discharge the working fluid containing a reduced content of lubricating oil, or even containing no lubricating oil, as required.

[0044] Referring to Figures 2 and 3, the discharge pipe 130 is a circular tubular member and has a circular discharge passage 133. The discharge pipe 130 also has an end surface 131 adjacent to the counterweight 110. In other words, the end surface 131 of the discharge pipe 130 located inside the casing extends inward from a wall of the casing to the vicinity of the counterweight 110. There is a distance L between the end surface 131 of the discharge pipe 130 and the outer peripheral surface 111 of the counterweight 110. It is desirable that the distance L can both facilitate the discharge of the working fluid via the discharge pipe 130 and ensure a lower content of lubricating oil contained in the discharged working fluid. The distance L may be determined according to the working conditions, for example, the rotating speed of the counterweight 110, the ambient pressure, the distance from the counterweight 110 to the casing 11, the content of lubricating oil in the working fluid discharged via the discharge hole 17, and the desired content of lubricating oil in the working fluid to be discharged via the discharge pipe 130 and the like. The distance L may be predetermined or may vary according to the operation condition of a compressor. Preferably, it is desirable that the end surface 131 of the discharge pipe 130 is as close as possible to the outer peripheral surface 111 of the counterweight 110 to provide a better oil-gas separating effect, and it is also desirable that the distance between the end surface 131 of the discharge pipe 130 and the outer peripheral surface 111 of the counterweight 110 should not be too small to disadvantageously reduce a flow area of the discharge pipe 130.

[0045] "Lower content of lubricating oil" or "reduced content of lubricating oil" or the like mentioned herein refers to that the content of lubricating oil in the working fluid discharged via the discharge pipe 130 is less than the content of lubricating oil in the working fluid in the compressor casing 11 and is within a suitable range of lubricating oil circulation rate (OCR). For the convenience of description, "the working fluid in the compressor casing" is referred to as "the working fluid before separating" or "oil-gas mixture", and "the working fluid discharged via the discharge pipe 130" is referred to as "the separated working fluid" herein.

[0046] In the example of Figure 3, if it is assumed that the diameter of the circular discharge passage 133 is D, a ratio L/D of the distance L to the diameter D may be less than about 1.5. In some examples, the ratio L/D of the distance L to the diameter D may be greater than about 0.25. In some examples, the ratio L/D of the distance L to the diameter D may be between about 0.25 and 1.25, between about 0.4 and 1, between about 0.4 and 0.75, preferably between about 0.4 and 0.5. More preferably, the ratio of the distance L to the diameter D may be about 0.5. Referring to Figure 7, a graph showing the distance between the discharge pipe and the counterweight versus the circulation rate when a compressor is operated at 5400 RPM (revolutions per minute) is illustrated. In Figure 7, the abscissa represents the radial distance L between the end surface of the discharge pipe and the outermost peripheral surface of the counterweight, where D represents the inner diameter of the discharge pipe; the ordinate represents an oil circulation rate OCR of the compressor. As illustrated in Figure 7, in a case that L is about $1/2 D$, the oil circulation rate of the compressor is the lowest, about 1.08%. For the compressor in the prior art, when the compressor is operated at 5400 RPM, its oil circulation rate exceeds 5%. In contrast, in the present disclosure, by providing the discharge pipe near the counterweight, that is, by setting the distance between the discharge pipe and the counterweight within a certain range, the oil circulation rate of the compressor can be significantly reduced, which achieves significantly unexpected technical effects.

[0047] The conventional compressor and the compressor according to the present disclosure are tested by the inventors, and test results are listed in the following table. The test is performed on one set of conventional compressors (C1) and three sets of compressors of the present disclosure (T1, T2, and T3) under different working conditions (different rotating speeds of the counterweight), and in the test, the ratio of the distance L to the diameter D is 0.4 in the compressor

of the present disclosure. Test results in the table are the content of lubricating oil in the separated working fluid. In the conventional compressor C1, the discharge pipe extends into the compressor casing only for convenience of assembly, but is far away from the counterweight, that is, the distance between the discharge pipe and the counterweight is far greater than the inner diameter of the discharge pipe.

Rotating Speed (RPM)	T1	T2	T3	C1
3600	0.42%	0.41%	0.37%	1.29%
5400	0.96%	1.13%	0.57%	5.54%
6000	1.77%	1.77%	1.24%	7.56%

[0048] It can be known from the above test and the test results in the table that the content of lubricating oil in the working fluid discharged from the compressor according to the present disclosure is significantly lower than the content of lubricating oil in the working fluid discharged from the conventional compressor. The test results show that the liquid-gas separating device of the present disclosure can efficiently separate lubricating oil from the oil-gas mixture. Therefore, the compressor of the present disclosure significantly reduces the lubricating oil circulation rate (OCR). Such a result cannot be expected from the conventional compressor in the art, before the present invention is made.

[0049] Reference may also be made to Figures 8a and 8b. Figure 8a is a cross sectional view illustrating the oil-gas distribution of the oil-gas separating device according to the present disclosure; and Figure 8b is a cross sectional view illustrating the oil-gas distribution of the oil-gas separating device in a comparison example. As can be seen from Figure 8b, there is a region with higher lubricating oil content at the vicinity of the outer peripheral surface of the counterweight, and there is also a region with higher lubricating oil content at the vicinity of the compressor casing, and the content of lubricating oil contained in the working fluid discharged from the discharge pipe is higher. In contrast, in Figure 8a, the region with higher lubricating oil content is concentrated at the vicinity of the casing. Therefore, a smaller content of lubricating oil is contained in the working fluid discharged from the discharge pipe adjacent to the counterweight, thereby reducing the oil circulation rate of the compressor.

[0050] In the compressor of the present disclosure, the counterweight is used as an active rotating member, and when it rotates, oil-gas mixture surrounding it is forced to form a cyclone flow, whereby throwing radially outward the lubricating oil with a larger specific gravity under the action of centrifugal force. Therefore, the working fluid close to the counterweight contains therein less lubricating oil, and is easily discharged from the discharge pipe disposed close to the counterweight.

[0051] In another embodiment, the end surface 131 of the discharge pipe 130 may not be parallel to the outer peripheral surface 111 of the counterweight 110 in the direction of the rotating axis of the counterweight 110, but may face the counterweight 110 and is oblique with respect to the outer peripheral surface 111 of the counterweight 110. In an alternative embodiment, a discharge opening of the discharge pipe 130 may be oriented to face the downstream side in the rotating direction of the counterweight, and oil-gas mixture inside the compressor casing enters the discharge pipe via the discharge opening and is discharged from the compressor via the discharge pipe. In this way, the amount of lubricating oil entering the discharge pipe 130 can be decreased, and a better oil-gas separating effect can be implemented.

[0052] In some examples, the discharge pipe 130 may linearly extend from the compressor casing in a horizontal direction perpendicular to the direction of the rotating axis of the counterweight 110. The end surface 131 of the discharge pipe 130 is oriented toward the outer peripheral surface 111 of the counterweight 110 and is oblique with respect to the outer peripheral surface 111 of the counterweight 110. In this case, the angle between the end surface 131 of the discharge pipe 130 and the central longitudinal axis of the discharge pipe 130 is greater than 0 degree but less than 90 degrees.

[0053] In other examples, an end portion of the discharge pipe 130 adjacent to the counterweight 110 may be bent in a circumferential direction of the counterweight 110 and / or in a vertical direction parallel to the rotating axis of the counterweight 110. That is, the discharge pipe 130 may include a bent end portion located in the casing. The bent end portion may be a curved arc shape or may be bent at a constant angle.

[0054] As illustrated in Figure 9, a bent end portion 230 of the discharge pipe 130 is bent in the circumferential direction of the counterweight 110. In one example, a discharge opening at the end surface 231 of the bent end portion 230 may face downstream in the rotating direction of the counterweight 110. Therefore, a better oil-gas separating effect can be achieved.

[0055] As illustrated in Figure 10, a bent end portion 330 of the discharge pipe 130 is bent in a vertical direction parallel to the rotating axis of a counterweight 110. In the illustrated example, an end surface 331 of the bent end portion 330 may be oriented downward. In an alternative example, the end surface 331 of the bent end portion 330 may be oriented downward or may be oriented in any other suitable direction capable of reducing the amount of the lubricating oil entering

the discharge pipe.

[0056] In the axial direction of the illustrated compressor, the discharge pipe 130 may be positioned within a range of a cyclone flow caused by the rotation of the counterweight 110. In the example illustrated in Figure 4, the discharge pipe 130 may be positioned between a first axial position P1 and a second axial position P2. In the first axial position P1, the discharge pipe 130 is located on an axial outer side of a first axial end surface 115 of a counterweight 110 and is substantially aligned with the first axial end surface 115. In other words, in the first axial position P1, one radial side of a discharge passage 133 of the discharge pipe 130 is located axially outside of the first axial end surface 115, and the other radial side opposite to the one radial side of the discharge passage 133 is substantially aligned with the first axial end surface 115. According to the orientation in Figure 4, in the first axial position P1, the discharge pipe 130 is located below the first axial end surface 115 of the counterweight 110 in the axial direction, and an axially uppermost portion of the discharge passage of the discharge pipe 130 is substantially aligned with the first axial end surface 115. In the second axial position P2, the discharge pipe 130 is located on an axial outer side of the second axial end surface 117 of the counterweight 110 and is substantially aligned with the second axial end surface 117. In other words, in the second axial position P2, said other radial side of the discharge passage of the discharge pipe 130 is located axially outside of the second axial end surface 117, and said one radial side of the discharge passage is substantially aligned with the second axial end surfaces 117. According to the orientation in Figure 4, in the second axial position P2, the discharge pipe 130 is located above the second axial end surface 117 of the counterweight 110 in the axial direction, and an axially lowermost portion of the discharge passage of the discharge pipe 130 is substantially aligned with the second axial end surface 117.

[0057] According to the idea of the present disclosure, the discharge pipe 130 may also be positioned on an axial outer side of the first axial position P1 or an axial outer side of the second axial position P2 (that is, lower than the first axial position P1 or higher than the second axial position P2) and may further extend inward in the radial direction, for example, to be flush with the outer peripheral surface 111 of the counterweight 110, or even to a radial inside of the outer peripheral surface 111 of the counterweight 110. Due to the cyclone flow caused by the rotation of the counterweight 110, the working fluid discharged from the discharge pipe 130 can still maintain a lower oil circulation rate (OCR).

[0058] In the embodiments illustrated in Figures 1 to 4, the counterweight 110 is disposed on the outer peripheral surface of the drive shaft 14. However, it should be understood that the oil-gas separating device may include a counterweight disposed on any other suitable rotating members and a discharge pipe. For example, as illustrated in Figure 5, an oil-gas separating device may include a counterweight 210 disposed on an end surface 1301 of a rotor 13a of a motor 13 facing the compression mechanism. Referring to Figure 6, an oil-gas separating device may include a counterweight 310 disposed on an end surface 1302 of the rotor 13a of the motor 13 facing away from the compression mechanism. The mutual positional relationship and dimensional relationship between the discharge pipe 130 and the counterweight may be appropriately set with reference to the above description.

[0059] In the embodiments illustrated in Figures 1 to 4, the oil-gas separating device is disposed between the main bearing housing 15 and the motor 13. However, it should be understood that the oil-gas separating device may be disposed in any suitable position of an internal space defined by the compressor casing 11. For example, as illustrated in Figure 6, the oil-gas separating device may be located between the motor 13 and the oil sump 20.

[0060] It can be understood that the counterweight may have any suitable structure, as long as the counterweight can rotate and force the oil-gas mixture surrounding it to form a cyclone flow. For example, the counterweight may have a constant radial dimension or a variable radial dimension, and / or may have a constant axial dimension or a variable axial dimension. The counterweight may have a cylindrical outer peripheral surface, a tapered outer peripheral surface, or any other outer peripheral surfaces with suitable shape capable of implementing the above effect. Depending on specific applications, the counterweight illustrated in the figure may be replaced by a cam, an eccentric part, or any other suitable members capable of implementing the above effect.

[0061] Similarly, the discharge pipe may have any suitable structure and / or number, as long as it can facilitate the discharge of the working fluid. For example, the discharge pipe may include a flared end portion. The discharge pipe may include an end portion disposed obliquely with respect to the outer peripheral surface of the counterweight. For example, an end portion of the discharge pipe adjacent to the counterweight is obliquely downward, which may facilitate the outflow of the lubricating oil on the inner wall of the discharge pipe. The compressor in the figure includes one discharge pipe; however, the number of discharge pipes may be plural. Depending on the specific applications, the discharge pipe illustrated in the figure may also be replaced by a discharge passage disposed in a fixed structure.

[0062] Although some embodiments and variations of the present disclosure have been described in detail, it should be understood by those skilled in the art that the present disclosure is not limited to the embodiments and variations described above and illustrated in figures but may include other various possible variations and combinations. For example, the oil-gas separating device may have no a bottom portion, thus the lubricating oil may be dropped directly into the oil sump along the wall. Other variations and modifications can be implemented by those skilled in the art without departing from the essence and scope of the present disclosure. All the variations and modifications are within the scope of the present disclosure. Moreover, all of the members described herein may be replaced by other technically equivalent

members.

Claims

1. A rotary machinery, comprising:

a casing containing an oil-gas mixture therein,
a rotating member (110) disposed in the casing and rotatable around a rotating axis to drive the oil-gas mixture to form a cyclone flow, whereby under a centrifugal force, an oil content in the oil-gas mixture decreases as it approaches the rotating member; and
a discharge member (130) disposed on the casing and extending radially inward from the casing to a position where the oil content is less than or equal to a predetermined content.

2. The rotary machinery as claimed in claim 1, wherein a predetermined distance (L) exists between an end portion of the discharge member located inside the casing and an outer peripheral surface of the rotating member, the ratio of the predetermined distance (L) to the diameter (D) of a circular discharge passage (133) of the discharge member (130) is less than 1.5.

3. The rotary machinery as claimed in claim 2, wherein the ratio of the predetermined distance (L) to the diameter (D) of the circular discharge passage (133) of the discharge member (130) is greater than 0.25.

4. The rotary machinery as claimed in claim 3, wherein the ratio of the predetermined distance (L) to the diameter (D) of the circular discharge passage is between 0.4 and 0.5.

5. The rotary machinery as claimed in claim 1, wherein the rotating member has a first axial end surface (115) and a second axial end surface (117) in a direction of the rotating axis, and the discharge member is positioned between a first axial position (P1) and a second axial position (P2), wherein, if the discharge member is in the first axial position (P1), one radial side of the discharge passage of the discharge member is located axially outside of the first axial end surface and the other radial side opposite to the one radial side of the discharge passage is aligned with the first axial end surface, and if the discharge member is in the second axial position (P2), the other radial side of the discharge passage is located axially outside of the second axial end surface and the one radial side of the discharge passage is aligned with the second axial end surface.

6. The rotary machinery as claimed in claim 5, wherein the discharge member is positioned to be substantially aligned with an axial central portion of the rotating member.

7. The rotary machinery as claimed in claim 1, wherein an end portion of the discharge member adjacent to the rotating member linearly extends in a horizontal direction perpendicular to the rotating axis, and an end surface of the end portion is oriented obliquely with respect to an outer peripheral surface of the rotating member.

8. The rotary machinery as claimed in claim 1, wherein an end portion of the discharge member adjacent to the rotating member is bent in a circumferential direction of the rotating member and / or in a vertical direction parallel to the rotating axis.

9. The rotary machinery as claimed in claim 1, wherein a discharge opening of the discharge member is oriented to face a downstream side of a rotating direction of the rotating member, and the oil-gas mixture in the casing enters the discharge member via the discharge opening.

10. The rotary machinery as claimed in claim 1, wherein the rotating member has a first axial end surface (115) and a second axial end surface (117) in an axial direction, and the discharge member is positioned axially outside of the first axial end surface (115) or of the second axial end surface (117), and an end portion of the discharge member located in the casing extends inward to be flush with an outer peripheral surface of the rotating member or to be radially inside of the outer peripheral surface of the rotating member.

11. The rotary machinery as claimed in claim 1, wherein the rotating member is in the form of a cam, an eccentric part or a counterweight, and the discharge member is in the form of a discharge pipe or a discharge passage.

12. The rotary machinery as claimed in any one of claims 1-11, further comprising:

5 a compression mechanism (12) located in the casing and configured to compress working fluid;
a drive shaft (14) adapted to drive the compression mechanism; and
a motor (13) comprising a stator and a rotor rotatable with respect to the stator and configured to drive the drive
shaft to rotate;
wherein the rotating member is disposed on the drive shaft or disposed on the rotor.

10 13. The rotary machinery as claimed in claim 12, wherein the rotating member is located between the compression
mechanism and the motor or between the motor and an oil sump.

14. The rotary machinery as claimed in claim 12, wherein the rotary machinery is a high side scroll compressor.

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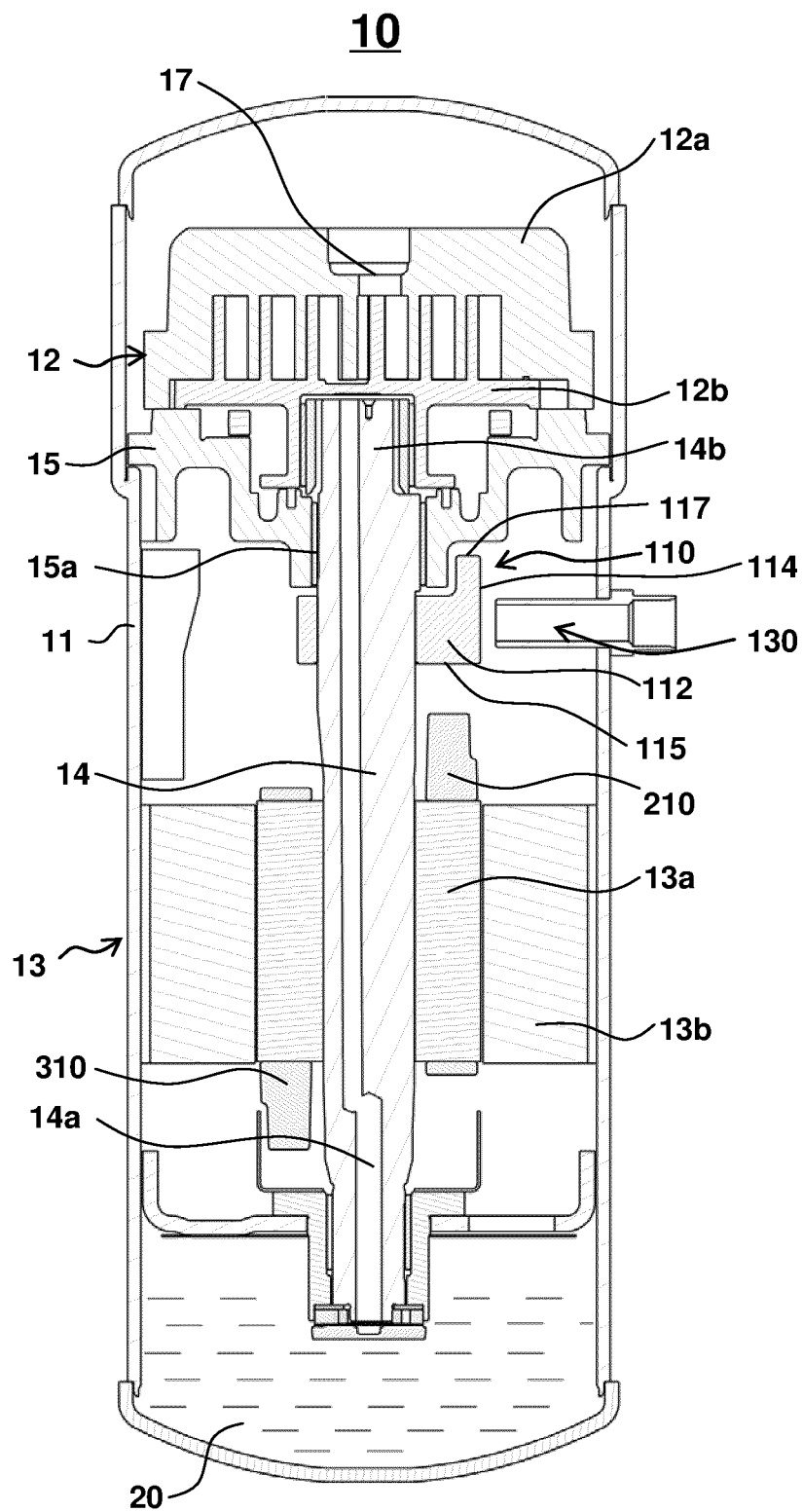


Figure 1

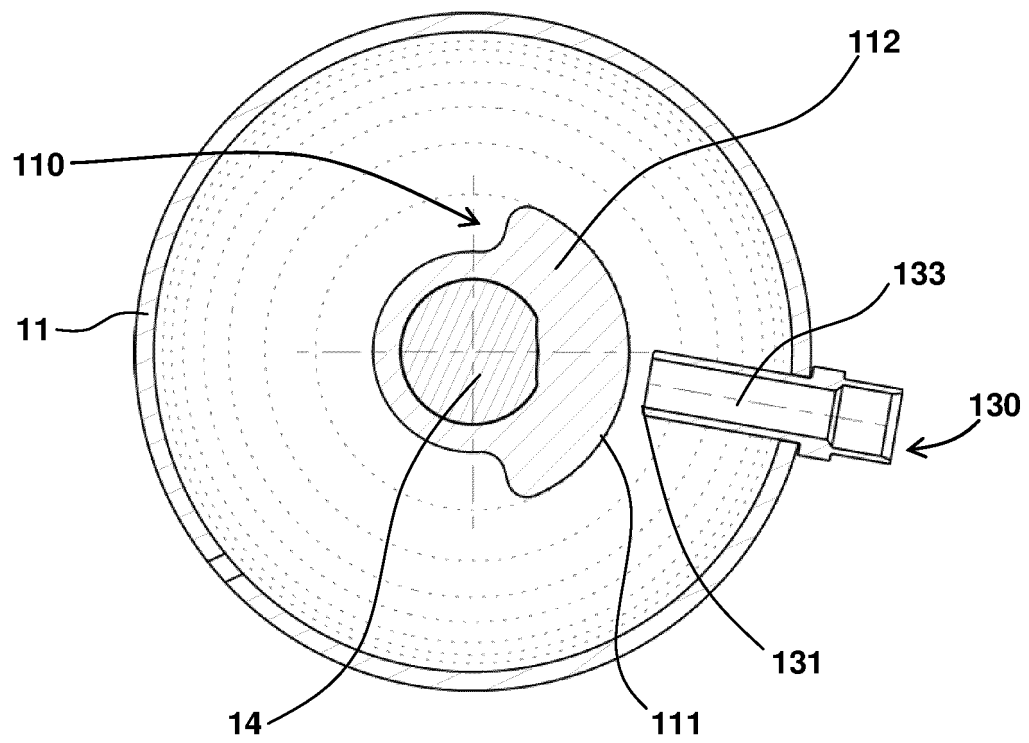


Figure 2

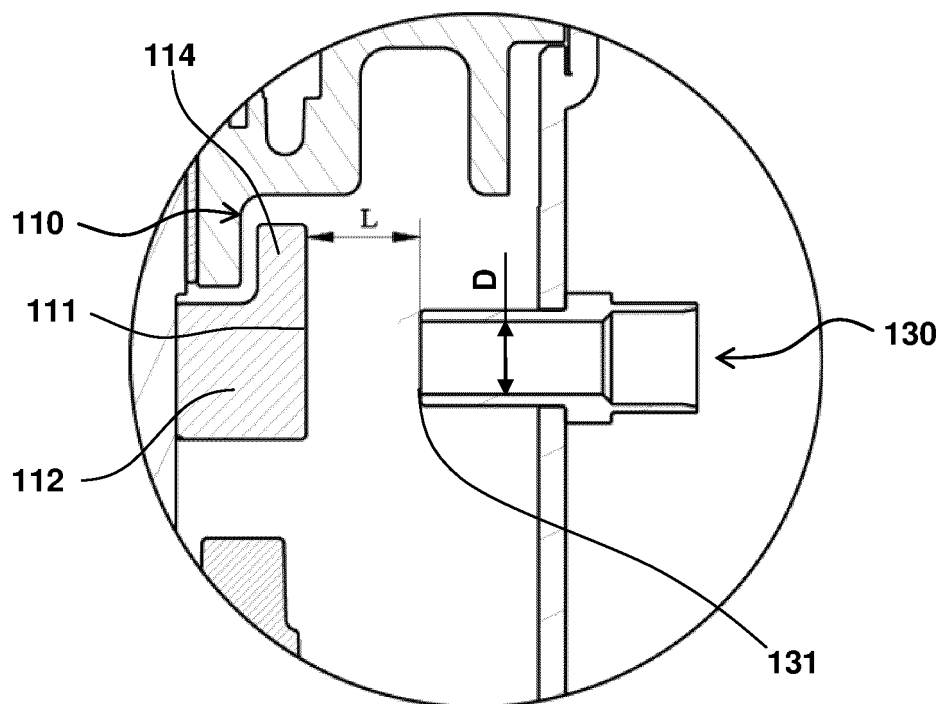


Figure 3

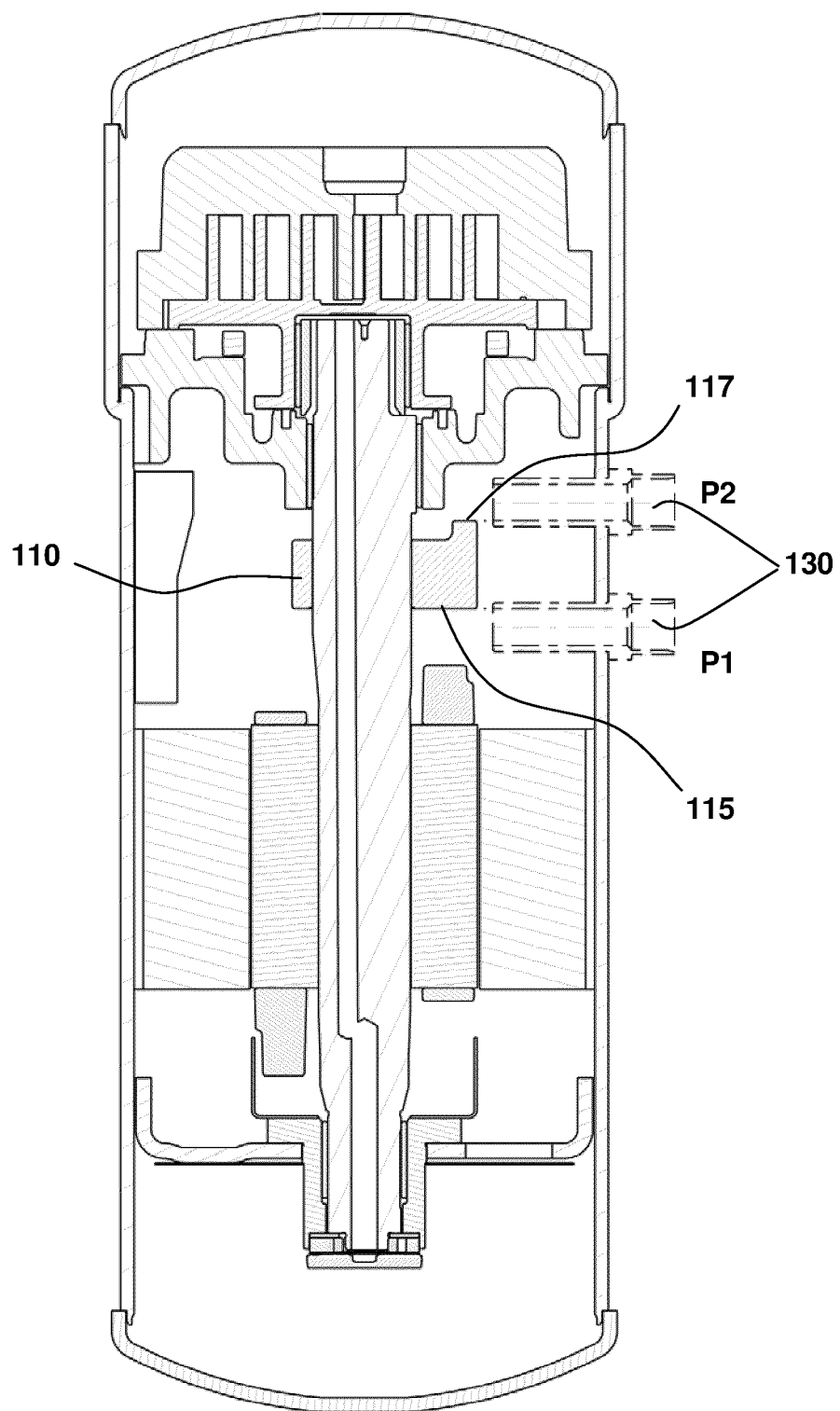


Figure 4

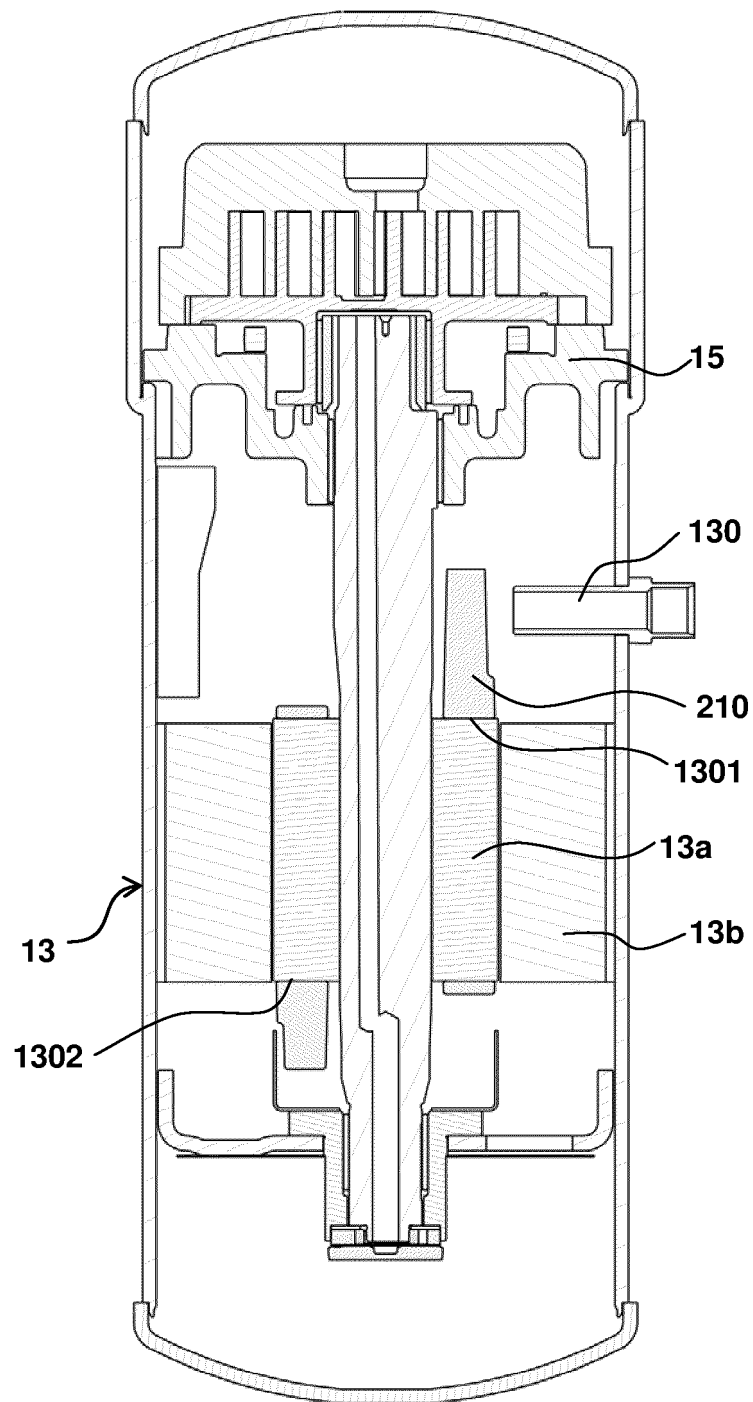


Figure 5

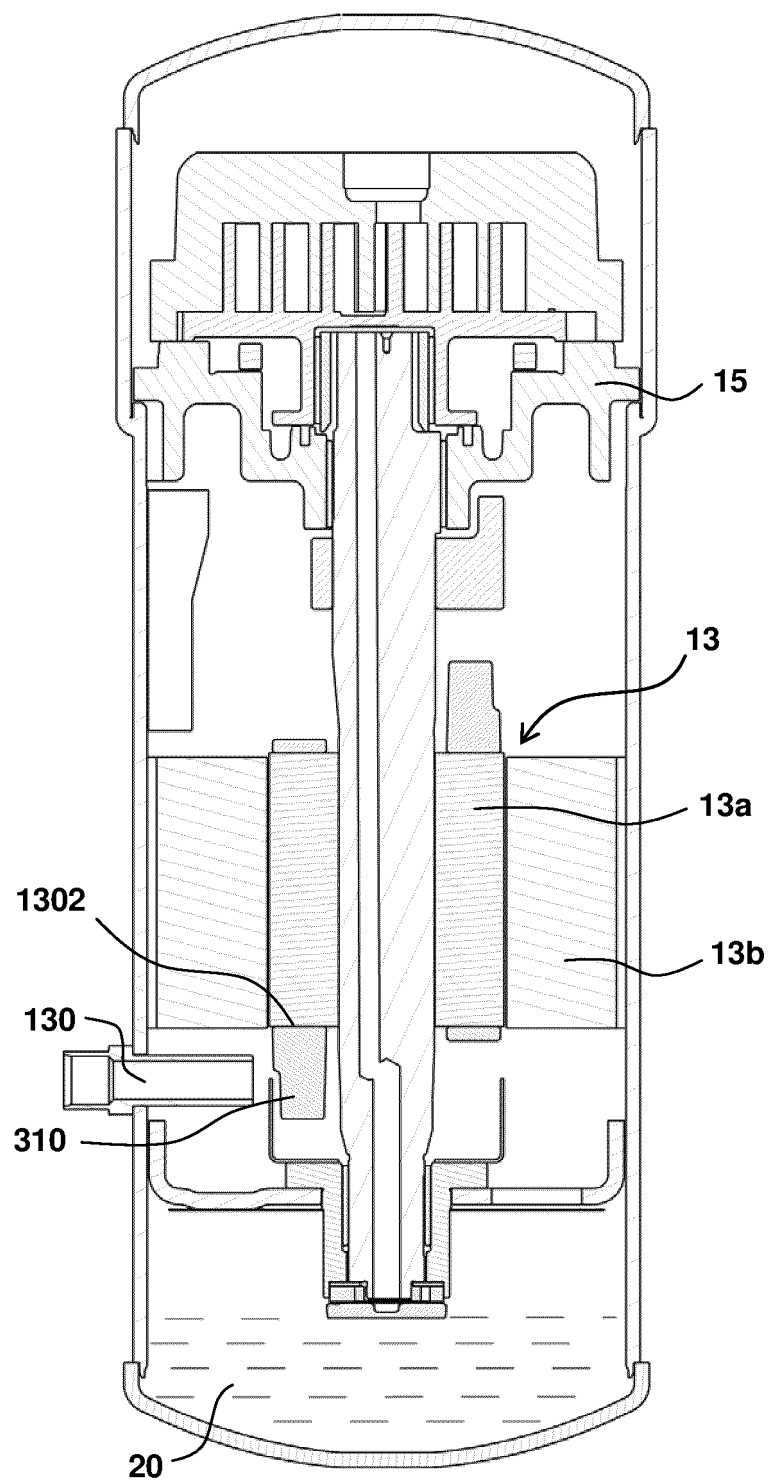


Figure 6

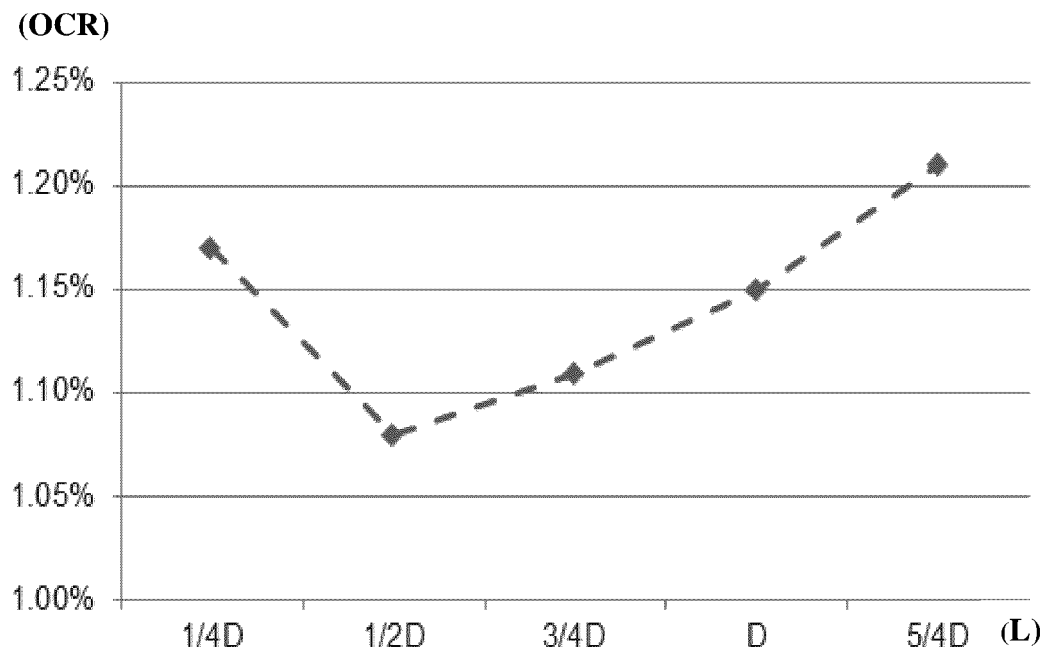


Figure 7

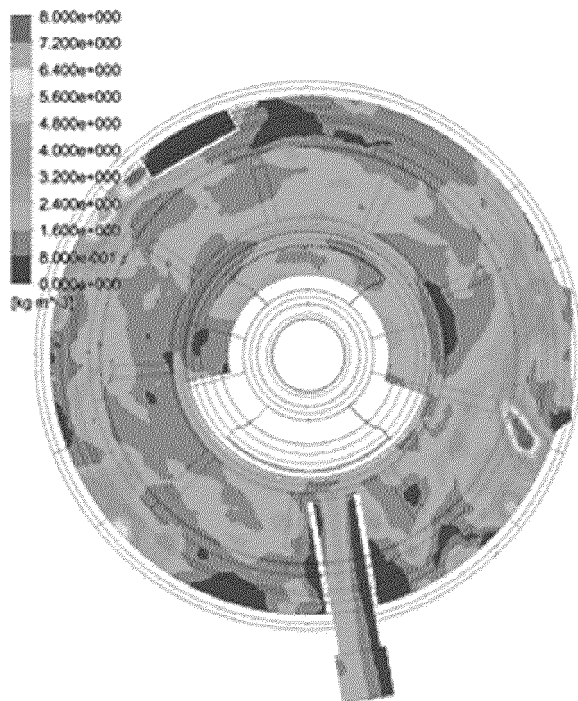


Figure 8a

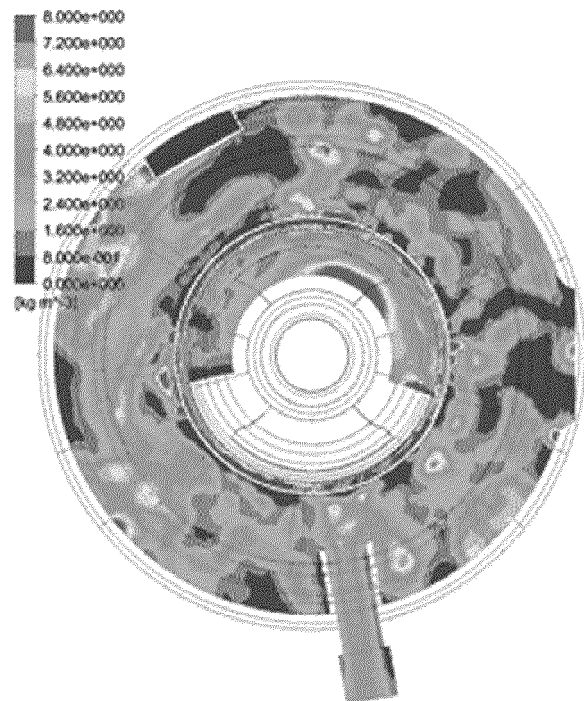


Figure 8b

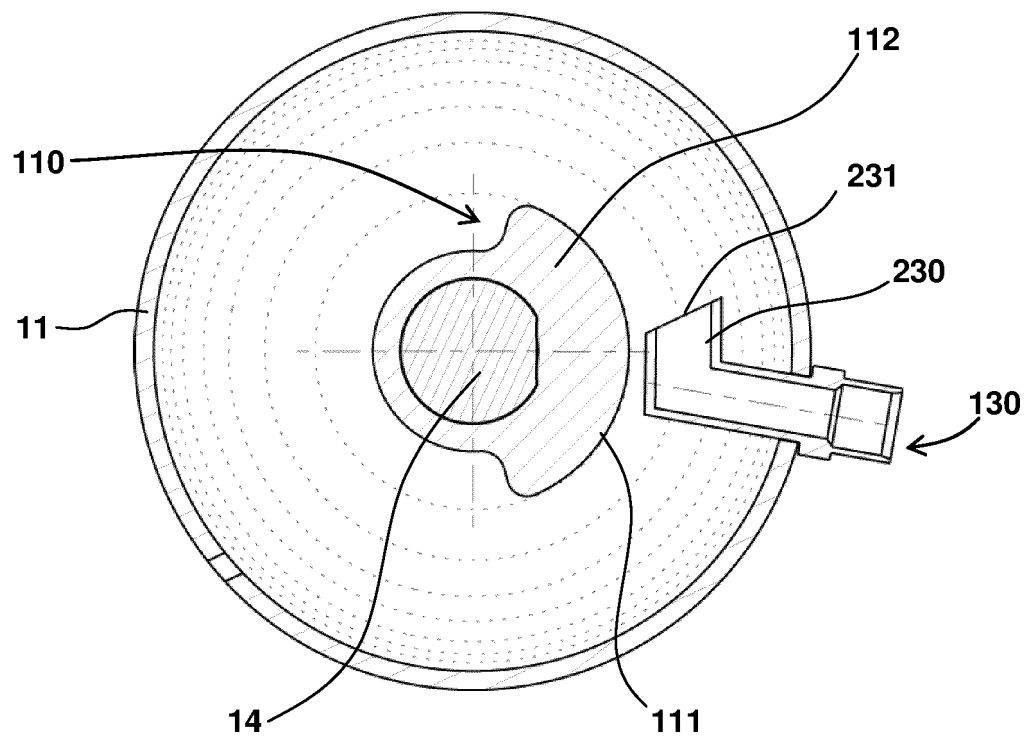


Figure 9

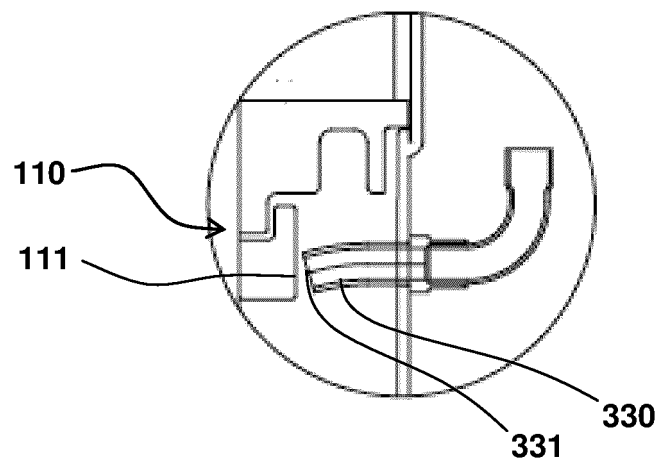


Figure 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/096240

5	A. CLASSIFICATION OF SUBJECT MATTER		
	F04C 29/02(2006.01)i		
	According to International Patent Classification (IPC) or to both national classification and IPC		
	B. FIELDS SEARCHED		
10	Minimum documentation searched (classification system followed by classification symbols)		
	F04C		
	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
	CNABS; CNTXT; CNKI; VEN; JPTXT: 旋转, 油, 离心, 排, 配重, 平衡重, 平衡块, 高压, 高背压, rotat+, rotary, oil, centrifug+, discharg+, exhaust+, balanc+, weight, high, back, pressure		
	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	PX	CN 207437367 U (EMERSON CLIMATE TECHNOLOGIES (SUZHOU) CO., LTD.) 01 June 2018 (2018-06-01) claims 1-14	1-14
25	X	JP H0626484 A (DAIKIN IND. LTD.) 01 February 1994 (1994-02-01) description, paragraphs 14-29, and figures 1 and 2	1-14
	X	JP H01300085 A (MATSUSHITA REFRIGERATION) 04 December 1989 (1989-12-04) description, page 3, upper left-hand column, line 6 to lower right-hand column, and figures 1 and 2	1-14
30	A	CN 1712725 A (LG ELECTRONICS (TIANJIN) ELECTRICAL APPLIANCES CO., LTD.) 28 December 2005 (2005-12-28) entire document	1-14
35			
40	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
45			
50	Date of the actual completion of the international search		Date of mailing of the international search report
	11 September 2018		27 September 2018
55	Name and mailing address of the ISA/CN		Authorized officer
	State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China		
	Facsimile No. (86-10)62019451		Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

International application No.

PCT/CN2018/096240

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN	207437367	U	01 June 2018	None	
JP	H0626484	A	01 February 1994	None	
JP	H01300085	A	04 December 1989	None	
CN	1712725	A	28 December 2005	None	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- CN 201721025170 [0001]