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(54) ELECTRIC COMPRESSOR, AIR CONDITIONING SYSTEM AND VEHICLE

(57) An electric compressor (100), comprising: a shell component (102), a compression component (101) and a motor component, wherein the compression component (101) is arranged in the shell component (102) and is used for compressing a refrigerant, and the motor component is arranged in the shell component (102) and is used for driving the compression component (101) to execute compression work. The shell component (102) comprises a first shell (21), at least part of the compression component (101) is accommodated in the first shell (21), and a refrigerant discharge port (213) is formed in the first shell (21). The first shell (21) is provided with an oil separation chamber (30), an oil separation inlet (31) of the oil separation chamber (30) is in communication with an exhaust port of the compression component (101), and an oil separation outlet (33) of the oil separation chamber (30) is in communication with the refrigerant discharge port (213).

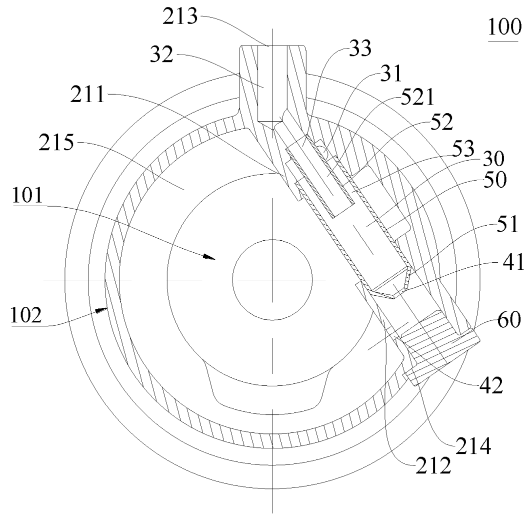

FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based on and claims priorities to Chinese patent applications Nos. 202210714055.3, 202221588899.X, 202210714054.9, and 202221588912.1 filed on June 22, 2022, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of compressor technologies, and more particularly, to an electric compressor, an air conditioning system, and a vehicle.

BACKGROUND

[0003] As a core component of a refrigeration device for a vehicle, an electric compressor is a positive displacement compressor with high efficiency, low noise, and smooth operation, and thus is widely used in an air conditioning system of the vehicle. Recently, with the development of new energy vehicles, requirements of vehicles for air conditioning compressors in terms of noise, vibration, and durability are further increased. During the use of the electric compressor such as a scroll compressor and a rolling rotor compressor, a friction pair in the electric compressor is needed to be lubricated by a lubricant to reduce the noise generated by the friction pair during operation. However, part of the lubricant flows out of the compressor together with an exhaust gas, which results in insufficient lubricant, affecting reliability of the compressor.

SUMMARY

[0004] The present disclosure aims to solve at least one of the problems in the related art to some extent. To this end, embodiments of the present disclosure is to provide an electric compressor having an oil-gas separation function, which alleviates a problem of insufficient lubricant in the electric compressor, improving reliability of the electric compressor.

[0005] Embodiments of the present disclosure further provide an air conditioning system including the above electric compressor.

[0006] Embodiments of the present disclosure further provide a vehicle including the above air conditioning system.

[0007] According to an embodiment of the present disclosure, an electric compressor is provided. The electric compressor includes a housing component, a compression component disposed in the housing component and configured to compress a refrigerant, and a motor component disposed in the housing component and configured to drive the compression component to perform a compression operation. The housing component includes a first housing, and the compression component is at least partially accommodated in the first housing. The first housing has a refrigerant discharge outlet and an oil separation chamber. The oil separation chamber has an oil separation inlet in communication with an exhaust outlet of the compression component and an oil separation outlet in communication with the refrigerant discharge outlet.

[0008] For the electric compressor according to some embodiments of the present disclosure, the first housing is fitted with an outer oil separation tube, and at least part of the oil separation chamber is formed by an inner cavity of the outer oil separation tube.

[0009] For the electric compressor according to some embodiments of the present disclosure, a tapered tube is disposed at a lower end of the outer oil separation tube, and a lower end opening of the tapered tube is formed as a first oil return hole. The first oil return hole has a smaller diameter than an inner diameter of the oil separation chamber.

[0010] For the electric compressor according to some embodiments of the present disclosure, the first housing has a mounting opening formed on an outer surface of the first housing, and the mounting opening is spaced apart from the refrigerant discharge outlet. The outer oil separation tube is adapted to be mounted in the first housing through the mounting opening along an axis of the outer oil separation tube.

[0011] For the electric compressor according to some embodiments of the present disclosure, the first housing has a first hole segment and a second hole segment that are arranged coaxially. Two axial ends of the outer oil separation tube are inserted into and engaged with the first hole segment and the second hole segment, respectively. The first hole segment and the second hole segment are spaced apart from each other by a disconnection portion. An end of the second hole segment away from the first hole segment penetrates the outer surface of the first housing to form the mounting opening.

[0012] For the electric compressor according to some embodiments of the present disclosure, the first housing has a first communication passage, and the first communication passage has an end penetrating the outer surface of the first housing to form the refrigerant discharge outlet, and another end connected to an end of the first hole segment away from the second hole segment.

[0013] For the electric compressor according to some embodiments of the present disclosure, the first housing has a second communication passage. The oil separation inlet is formed at the first hole segment, and is in communication with the exhaust outlet through the second communication passage.

[0014] For the electric compressor according to some embodiments of the present disclosure, the electric compressor further includes an inner oil separation tube located in the outer oil separation tube. A gas inlet cavity is formed between an inner wall of the outer oil separation tube and an outer wall of the inner oil separation tube. The oil separation inlet is formed at the first housing and/or the outer oil separation tube. The oil separation inlet extends in a tangential direction of the outer oil separation tube, and is in communication with the gas inlet cavity. An inner cavity of the inner oil separation tube is formed as a gas outlet cavity. The gas outlet cavity is in communication with both the refrigerant discharge outlet and the gas inlet cavity.

[0015] For the electric compressor according to some embodiments of the present disclosure, the inner oil separation tube is fitted to the first housing or connected to the outer oil separation tube, or the inner oil separation tube and the first housing are integrally formed.

[0016] For the electric compressor according to some embodiments of the present disclosure, the oil separation chamber is defined by the first housing.

[0017] For the electric compressor according to some embodiments of the present disclosure, the oil separation chamber is provided with an oil return device at a lower part of the oil separation chamber. The oil return device has a first oil return hole, and the first oil return hole has a smaller hole diameter than an inner diameter of the oil separation chamber.

[0018] For the electric compressor according to some embodiments of the present disclosure, a chamber wall of the oil separation chamber has a second oil return hole in communication with the first oil return hole.

[0019] For the electric compressor according to some embodiments of the present disclosure, an axial spacing between an upper end of the oil separation chamber and the first oil return hole is denoted as L1. An axial spacing between the oil separation inlet and the first oil return hole is denoted as L2. An inner oil separation tube is disposed in the oil separation chamber, an inner cavity of the inner oil separation tube being formed as a gas outlet cavity in communication with the oil separation outlet. An axial spacing between the inner oil separation tube and the first oil return hole is denoted as L3, where $0.2\ L1 < L3 < L2$.

[0020] For the electric compressor according to some embodiments of the present disclosure, the oil separation chamber has a flow area of S1. A first oil return hole is formed at a lower part of the oil separation chamber and has a flow area of S3. An inner oil separation tube is disposed in the oil separation chamber. An inner cavity of the inner oil separation tube is formed as a gas outlet cavity in communication with the oil separation outlet. The gas outlet cavity has a flow area of S2. S1, S2, and S3 satisfy at least one of $0.025 \le S2/S1 \le 0.45$, $0.015 \le S3/S1 \le 0.4$, and $0.15 \le S3/S2 \le 0.65$.

[0021] For the electric compressor according to some embodiments of the present disclosure, the oil separation inlet extends in a tangential direction of the oil separation chamber. An orthographic projection of the oil separation inlet on an projection surface has an area of A, and the projection surface is a plane passing through an axis of the oil separation chamber and perpendicular to an axis of the oil separation inlet is a projection surface. A part of the orthographic projection located at a side of of the oil separation chamber along the axis of the oil separation chamber has an area of B, and B/A is greater than or equal to 80%.

[0022] For the electric compressor according to some embodiments of the present disclosure, the oil separation outlet is formed at a side of the oil separation chamber in an axial direction of the oil separation chamber. An extension direction of an axis of the oil separation inlet intersects with a positive extension direction of the axis of the oil separation chamber at an angle θ, where $45° \le \theta \le 90°$. The positive extension direction is a direction directed towards the oil separation outlet in an extension direction of the axis of the oil separation chamber.

[0023] For the electric compressor according to some embodiments of the present disclosure, a first communication passage is formed at a housing wall of the first housing, and the oil separation outlet is in communication with the refrigerant discharge outlet through the first communication passage.

[0024] For the electric compressor according to some embodiments of the present disclosure, an axis of the first communication passage is a straight line. An axial length of the first communication passage is smaller than an axial length of the oil separation chamber, and the axis of the first communication passage overlaps or intersects with the axis of the oil separation chamber.

[0025] For the electric compressor according to some embodiments of the present disclosure, an axis of the first housing extends transversely. The first communication passage is located at a top of the first housing and extends vertically. The first communication passage has an upper end penetrating the top of the first housing to form the refrigerant discharge outlet. The oil separation chamber extends obliquely downwards from a lower end of the first communication passage.

[0026] According to an embodiment of the present disclosure, an air conditioning system is provided. The air conditioning system includes the electric compressor according to any of the above embodiments.

[0027] According to an embodiment of the present disclosure, a vehicle is provided. The vehicle includes a vehicle body and the air conditioning system according to any of the above embodiments. The air conditioning system is mounted at the vehicle body

[0028] Additional aspects and advantages of the present disclosure will be provided at least in part in the following description, or will become apparent at least in part from the following description, or can be learned from practicing of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

FIG. 1 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 2 is a sectional view of the electric compressor illustrated in FIG. 1 when being viewed from another perspective.

FIG. 3 is a perspective view of the electric compressor illustrated in FIG. 1.

FIG. 4 is a perspective view of a housing component according to an embodiment of the present disclosure.

FIG. 5 is a perspective view of a housing component according to another embodiment of the present disclosure.

FIG. 6 is a sectional view of a housing component according to an embodiment of the present disclosure.

FIG. 7 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 8 is a sectional view of an electric compressor according to another embodiment of the present disclosure.

FIG. 9 is a sectional view of an electric compressor according to yet another embodiment of the present disclosure.

FIG. 10 is a sectional view of an electric compressor according to still yet another embodiment of the present disclosure.

FIG. 11 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 12 is another sectional view of the electric compressor illustrated in FIG. 11.

FIG. 13 is an axonometric view of the electric compressor illustrated in FIG. 11.

FIG. 14 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 15 is another sectional view of the electric compressor illustrated in FIG. 14.

FIG. 16 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 17 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 18 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 19 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 20 is a sectional view of an electric compressor according to an embodiment of the present disclosure.

FIG. 21 is a schematic view of a vehicle according to an embodiment of the present disclosure.

[0030] Reference numerals of the accompanying drawings:

vehicle 1000;

air conditioning system 1001;

electric compressor 100;

compression component 101; exhaust outlet 11; cylinder 12; piston 13; crankshaft 14;

bearing 15; partition 16; silencer 17; through passage 18 a silencing cavity 19;

housing component 102;

first housing 21; first hole segment 211; first sub-segment 211a; second sub-segment 211b; extension segment 211c; second hole segment 212; refrigerant discharge outlet 213; mounting opening 214; accommodation chamber 215;

oil separation chamber wall 22; disconnection portion 23; mounting region 24;

oil separation chamber 30; oil separation inlet 31; first communication passage 32; oil separation outlet 33; second communication passage 34;

oil return device 40; first oil return hole 41; second oil return hole 42;

oil separation assembly 5; outer oil separation tube 50; tapered tube 51; inner oil separation tube 52; gas outlet cavity 521; gas inlet cavity 53; filter 54;

blockage 60; support 70; pressure protection device 80; plug 81; pressure relief safety valve 82.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0031] Embodiments of the present disclosure will be described in detail below with reference to examples thereof as illustrated in the accompanying drawings, throughout which same or similar elements, or elements having same or similar functions, are denoted by same or similar reference numerals. The embodiments described below with reference to the drawings are illustrative only, and are intended to explain, rather than limit, the present disclosure.

[0032] An electric compressor 100 according to embodiments of the present disclosure will be described below with reference to the accompanying drawings.

[0033] As illustrated in FIG. 1, according to the embodiments of the present disclosure, the electric compressor 100 includes a compression component 101 and a housing component 102.

[0034] As illustrated in FIG. 2, the compression component 101 includes a cylinder 12, a piston 13, and a crankshaft 14. The piston 13 is disposed in the cylinder 12. The crankshaft 14 is connected to the piston 13 for driving the piston 13 to rotate. It should be understood that the electric compressor 100 may further include a drive motor. The drive motor is configured to drive the crankshaft 14 to rotate, to allow the compression component 101 to perform a compression operation.

[0035] The housing component 102 includes a first housing 21. The compression component 101 is at least partially accommodated in the first housing 21. Therefore, structural compactness of the electric compressor 100 can be improved.

[0036] The first housing 21 has a refrigerant discharge outlet 213 and an oil separation chamber 30. The oil separation chamber 30 has an oil separation inlet 31 in communication with an exhaust outlet 11 of the compression component 101. A first communication passage 32 is formed in a housing wall of the first housing 21. The oil separation chamber 30 has an oil separation outlet 33 connected to the refrigerant discharge outlet 213 through the first communication passage 32.

[0037] It should be noted that, that "the first housing 21 has an oil separation chamber 30" should be understood in a broad sense. For example, it may mean that, as illustrated in FIG. 1 to FIG. 3, the oil separation chamber 30 is defined by an outer oil separation tube 50 fitted to the first housing 21. That is, the first housing 21 and the outer oil separation tube 50 are formed separately. Therefore, a free design of an axis and a cross-sectional area of the oil separation chamber 30 defined by the outer oil separation tube 50 is facilitated to meet different design requirements. In another embodiment, for example, it may further mean that, as illustrated in FIG. 10 and FIG. 8, the oil separation chamber 30 may be integrally formed at the first housing 21, which eliminates a need for a separate assembly of the oil separation chamber 30, facilitating a simplification of manufacturing steps.

[0038] Exemplarily, an inner chamber of the first housing 21 is formed as an accommodation chamber 215. The compression component 101 is at least partially located in the accommodation chamber 215. As illustrated in FIG. 2, the compression component 101 has a compression chamber. The compression chamber has the exhaust outlet 11. A compressed refrigerant in the compression chamber is adapted to be discharged through the exhaust outlet 11. The exhaust outlet 11 is in communication with the oil separation inlet 31 of the oil separation chamber 30. The oil separation outlet 33 of the oil separation chamber 30 is in communication with the refrigerant discharge outlet 213 through the first communication passage 32. Therefore, the refrigerant discharged from the oil separation outlet 33 of the oil separation chamber 30 flows only towards the first communication passage 32 and then is discharged from the refrigerant discharge outlet 213, instead of entering the accommodation chamber 215 and then entering the first communication passage 32.

[0039] A lubricant is required for an operation of the compression component 101. The refrigerant, when being discharged, may be mixed with the lubricant. The oil separation chamber 30 can separate the lubricant mixed in the refrigerant from the refrigerant, improving performance of the electric compressor 100.

[0040] In an actual operation of the electric compressor 100, a mixed fluid of the gaseous refrigerant discharged from the compression chamber and the lubricant is discharged through the exhaust outlet 11. The mixed fluid enters the oil separation chamber 30 through the oil separation inlet 31. Then, the mixed fluid is subjected to a gas-liquid separation in the oil separation chamber 30. That is, the gaseous refrigerant and the lubricant in the mixed fluid are separated from each other. Then, the gaseous refrigerant enters the first communication passage 32 through the oil separation outlet 33, and flows through the first communication passage 32 to be discharged from the refrigerant discharge outlet 213. In this way, an exhaust of the electric compressor 100 is realized.

[0041] Optionally, the accommodation chamber 215 may be used as a reservoir for storing the lubricant, in which case the lubricant separated by the oil separation chamber 30 may be discharged from the oil separation chamber 30 into the accommodation chamber 215. The lubricant is supplied to the compression component 101 by the reservoir, or the separated lubricant may be further supplied directly to the compression component 101 by the oil separation chamber 30 through other oil discharge paths. Therefore, an oil return of the electric compressor 100 can be achieved to ensure an efficient and reliable operation of the electric compressor 100.

[0042] Therefore, with the oil separation chamber 30, the gas-liquid separation can be performed on the mixed fluid of the refrigerant discharged from the compression chamber and the lubricant. Therefore, the exhaust and the oil return of the electric compressor 100 can be realized, ensuring the efficient and reliable operation of the electric compressor 100.

[0043] Exemplarily, when the accommodation chamber 215 is used as the reservoir for storing the lubricant, if the exhaust is first performed towards the accommodation chamber 215 of the first housing 21 through the oil separation outlet 33, a problem of an unstable exhaust pressure is likely to occur due to the lubricant. Also, the lubricant stored in the accommodation chamber 215 is likely to be taken away due to the exhaust, and thus the significance of the gas-liquid separation performed by using the oil separation chamber 30 in the early stage is lost. In this way, the efficient and reliable operation of the electric compressor 100 fails to be ensured.

[0044] In the embodiments of the present disclosure, the first communication passage 32 is formed in the housing wall (i.e., in an internal space of the housing wall) of the first housing 21, and the oil separation outlet 33 and the refrigerant discharge outlet 213 are in communication with each other through the first communication passage 32. Therefore, the gaseous refrigerant can be directly discharged through the oil separation outlet 33, the first communication passage 32, and the refrigerant discharge outlet 213, which avoids a problem that the exhaust is performed towards the accommodation chamber 215 of the first housing 21 through the oil separation outlet 33 and then is performed through the refrigerant discharge outlet 213. As a result, stability of the exhaust of the electric compressor 100 can be ensured. In addition, effects of the gas-liquid separation and the oil return of the electric compressor 100 can be ensured.

[0045] Further, the accommodation chamber 215 is formed in the first housing 21. The compression component 101 is at least partially located in the accommodation chamber 215. For example, when the electric compressor 100 is constructed as a rotor compressor, the oil separation chamber 30 cannot be coaxially arranged with the refrigerant discharge outlet 213 since a pump structure of the conventional rotor compressor allows the compression component 101 to be disposed in a center of the accommodation chamber 215. In view of the above fact, the oil separation chamber 30 of the rotor compressor is prone to problems such as being unprocessable, having a small diameter, and failing to be mounted, and thus an optimal oil separation efficiency fails to be achieved. Therefore, return oil lubrication requirements in some cases such as a high load operation condition can be hardly ensured, which is likely to result in blow-by or a refrigerant leakage, resulting in decreases in both a refrigeration capacity and a compression efficiency of the electric compressor 100, and even reliability requirements of the electric compressor 100 cannot be satisfied.

[0046] In the embodiments of the present disclosure, since the first communication passage 32 is formed in the housing wall (i.e., in the internal space of the housing wall) of the first housing 21, and the oil separation outlet 33 and the refrigerant discharge outlet 213 are in communication with each other through the first communication passage 32, the oil separation outlet 33 can be prevented from being in direction communication with the refrigerant discharge outlet 213. In this way, neither a size nor a position of the refrigerant discharge outlet 213 affects the oil separation chamber 30. For example, an axis and a cross-sectional area of the first communication passage 32 can be freely designed, and the refrigerant discharge outlet 213 can also be flexibly designed, to meet different design requirements.

[0047] With the electric compressor 100 according to the embodiments of the present disclosure, the compression component 101 is at least partially accommodated in the first housing 21. For such a compact structure, the first communication passage 32 is formed in the housing wall (i.e., in the internal space of the housing wall) of the first housing 21, and the oil separation outlet 33 and the refrigerant discharge outlet 213 to be in communication with each other by the first communication passage 32. On the one hand, the exhaust towards the inner chamber of the first housing 21 through the oil separation outlet 33 can be avoided, allowing the refrigerant to be directly discharged from the refrigerant discharge outlet 213 through the first communication passage 32, ensuring a stable exhaust pressure and an overall effect of the oil-gas separation. On the other hand, the oil separation outlet 33 can be prevented from being in direct communication with the refrigerant discharge outlet 213, and thus neither the size nor the position of the refrigerant discharge outlet 213 affects the oil separation chamber 30. Therefore, both the refrigerant discharge outlet 213 and the oil separation chamber 30 can be flexibly designed, and thus designs of both the refrigerant discharge outlet 213 and the oil separation chamber 30 can meet different design requirements. In summary, the electric compressor 100 can be ensured to have sufficient return oil and a simple and reasonable structure, which is conducive to ensuring the efficient and reliable operation of the electric compressor.

[0048] In some embodiments, as illustrated in FIG. 1, the first housing 21 is fitted with an outer oil separation tube 50. At least part of the oil separation chamber 30 is formed by an inner cavity of the outer oil separation tube 50. That is, the outer oil separation tube 50 and the first housing 21 are formed separately, and the outer oil separation tube 50 is inserted into the first housing 21. Therefore, no oil separation chamber 30 needs to be machined at the first housing 21, which reduces structural requirements and wall thickness requirements of the first housing 21, enabling the first housing 21 to be flexibly designed.

[0049] Further, as illustrated in FIG. 1 and FIG. 3 to FIG. 10, a tapered tube 51 is disposed at a lower end of the outer oil separation tube 50. A lower end opening of the tapered tube 51 is formed as a first oil return hole 41, and the first oil return hole 41 has a smaller diameter than an inner diameter of the oil separation chamber 30.

[0050] For example, as illustrated in FIG. 1, an axial cross-sectional shape of a tube wall of the tapered tube 51 may be constructed as a straight line, or as illustrated in FIG. 10, the axial cross-sectional shape of the tube wall of the tapered tube 51 may be constructed as an arc line. The present disclosure is not limited in this regard.

[0051] For example, an end of the tapered tube 51 connected to the outer oil separation tube 50 has a same inner diameter as the outer oil separation tube 50. That is, the end of the tapered tube 51 connected to the outer oil separation tube 50 has the same inner diameter as the inner diameter of the oil separation chamber 30. Therefore, the lubricant can enter the tapered tube 51 along a chamber wall of the oil separation chamber 30. In addition, in a flow direction of the lubricant, the inner diameter of the tapered tube 51 gradually decreases, to form the first oil return hole 41 at an end of the tapered tube 51 away from the outer oil separation tube 50, and to allow the diameter of the first oil return hole 41 to be smaller than the inner diameter of the oil separation chamber 30.

[0052] Therefore, with the tapered tube 51, an inner wall of the tapered tube 51 with the gradually decreasing inner diameter can guide and converge the lubricant when the lubricant flows towards the first oil return hole 41. In this way, the lubricant can flow towards the first oil return hole 41 to improve reliability of the oil return, while the refrigerant is less likely to pass through the first oil return hole 41 and therefore can be discharged efficiently from the oil separation outlet 33.

[0053] In some embodiments, as illustrated in FIG. 1, the first housing 21 has a first hole segment 211 and a second hole segment 212. An upper end and a lower end of the outer oil separation tube 50 are inserted into and engaged with the first hole segment 211 and the second hole segment 212, respectively. For example, both the first hole segment 211 and the second hole segment 212 extend towards each other in one axial direction and are spaced apart from each other in one axial direction.

[0054] Therefore, the outer oil separation tube 50 can be conveniently fitted to the first housing 21. In addition, the upper end and the lower end of the outer oil separation tube 50 are inserted into and engaged with the first hole segment 211 and the second hole segment 212, respectively. That is, outer walls of the upper and lower ends of the outer oil separation tube 50 abut with inner walls of the first hole segment 211 and the second hole segment 212, respectively. On the one hand, structural stability of the outer oil separation tube 50 and sealing between the outer oil separation tube 50 and the first hole segment 211 and between the outer oil separation tube 50 and the second hole segment 212 can be enhanced. On the other hand, difficulty of fitting the outer oil separation tube 50 to the first housing 21 can be reduced, and thus structural compactness is improved.

[0055] For example, as illustrated in FIG. 1, the second hole segment 212 has a second oil return hole 42 formed on a wall surface of the second hole segment 212. The second oil return hole 42 is lower than a lower end of the tapered tube 51, and is in communication with the first oil return hole 41. Therefore, quick discharge of accumulated oil is facilitated, which improves the reliability of the oil return.

[0056] For example, the second oil return hole 42 is located downstream of the tapered tube 51 in the flow direction of the lubricant. In addition, the oil separation chamber 30 is in communication with an internal space of the second hole segment 212, and the second oil return hole 42 is in communication with the accommodation chamber 215, in such a manner that the separated lubricant in the oil separation chamber 30 can enter the accommodation chamber 215 through the first oil return hole 41 and the second oil return hole 42 in sequence, and flow back to the compression component 101 from the accommodation chamber 215. Therefore, the oil return of the electric compressor 100 is realized.

[0057] As illustrated in FIG. 1 and FIG. 3 to FIG. 5, the first housing 21 has a mounting opening 214 formed on an outer surface of the first housing 21, and the mounting opening 214 is spaced apart from the refrigerant discharge outlet 213. The outer oil separation tube 50 is adapted to be mounted in the first housing 21 through the mounting opening 214 along its own axis, i.e., the axis of the outer oil separation tube 50.

[0058] Therefore, instead of being mounted at the first housing 21 through the refrigerant discharge outlet 213, the outer oil separation tube 50 in the present disclosure is mounted at the first housing 21 through the mounting opening 214, rather than through the refrigerant discharge outlet 213. In this way, a size of the outer oil separation tube 50 is free from limitations of the size of the refrigerant discharge outlet 213. For example, the outer oil separation tube 50 still has a large size even when the refrigerant discharge outlet 213 has a small size.

[0059] Therefore, the design of the outer oil separation tube 50 and the design of the refrigerant discharge outlet 213 can both meet different design requirements, ensuring the sufficient return oil of the electric compressor 100.

[0060] Optionally, a blockage 60 may be disposed at the mounting opening 214. The blockage 60 seals the mounting opening 214. In addition, in some embodiments, the blockage 60 may further be designed to have a pressure protection function.

[0061] In other embodiments, as illustrated in FIG. 8 and FIG. 10, the oil separation chamber 30 is defined by the first housing 21. That is, the oil separation chamber 30 and the first housing 21 are integrally formed. In this way, steps of assembling the outer oil separation tube 50 are omitted and parts are therefore reduced, which lowers costs. In other words, an oil separation chamber wall 22 and the first housing 21 are integrally formed. Therefore, a need of separately forming the oil separation chamber 30 is eliminated, which is conducive to simplifying manufacturing steps, improving a manufacturing efficiency.

[0062] For example, as illustrated in FIG. 8 and FIG. 10, the first housing 21 has the oil separation chamber wall 22. The oil separation chamber 30 is formed in the oil separation chamber wall 22. Further, the oil separation inlet 31 is formed at the oil separation chamber wall 22, and is in direct or indirect communication with the exhaust outlet 11 of the compression component 101.

[0063] Further, as illustrated in FIG. 8, the oil separation chamber 30 is provided with an oil return device 40 at a lower part of the oil separation chamber 30. The oil return device 40 has the first oil return hole 41 in communication with the oil separation chamber 30. The first oil return hole 41 has a smaller hole diameter than the inner diameter of the oil separation chamber 30. Since the oil return device 40 is disposed in the oil separation chamber 30, and the hole diameter of the first oil return hole 41 at the oil return device 40 is smaller than the inner diameter of the oil separation chamber 30, guidance and convergence can be provided for the lubricant, in such a manner that the lubricant can flow towards the first oil return hole 41. As a result, the reliability of the oil return can be improved while the refrigerant is less likely to pass through the first oil return hole 41 and therefore can be discharged efficiently from the oil separation outlet 33.

[0064] It should be noted that an extension direction of the first oil return hole 41 at the oil return device 40 is not limited. For example, the first oil return hole 41 may extend in an axial direction of the oil separation chamber 30 (e.g., as illustrated in FIG. 8). Or, for example, the first oil return hole 41 may extend along a curve or a folded line, such as extending in the axial direction of the oil separation chamber 30 and then in a radial direction of the oil separation chamber 30 (e.g., illustrated in FIG. 9).

[0065] In another exemplary embodiment of the present disclosure, as illustrated in FIG. 8 and FIG. 9, the first housing 21 has a mounting opening 214 formed on the outer surface of the first housing, and the mounting opening 214 is spaced apart from the refrigerant discharge outlet 213. The mounting opening 214 may be a manufacturing opening when processing the oil separation chamber 30. The blockage 60 may be disposed at the mounting opening 214 to seal the mounting opening 214. Exemplarily, when the oil return device 40 is disposed in the oil separation chamber 30, the oil return device 40 may be spaced apart from and located above the blockage 60 (e.g., illustrated in FIG. 8), or the oil return device 40 and the blockage 60 may be integrally formed (e.g., illustrated in FIG. 9).

[0066] For example, as illustrated in FIG. 8, in the axial direction of the oil separation chamber 30, the oil return device 40 is located below and spaced apart from the oil separation outlet 33. That is, the first oil return hole 41 and the oil separation outlet 33 are spaced apart from each other in the axial direction of the oil separation chamber 30, and the first oil return hole 41 is located below the oil separation outlet 33.

[0067] It should be noted that the refrigerant is the gaseous refrigerant, and the lubricant is a liquid. Therefore, after the mixed fluid of the gaseous refrigerant and the lubricant that are discharged from the compression chamber enters the oil separation chamber 30, the lubricant flows downwardly towards the first oil return hole 41 under an action of gravity, while the gaseous refrigerant flows upwardly towards the oil separation outlet 33. As a result, a separation of the gaseous refrigerant and the lubricant is achieved. Therefore, the exhaust and the oil return of the electric compressor 100 are realized. In addition, when the oil separation inlet 31 extends in a tangential direction of the oil separation chamber 30, the fluid can further circulate in a circumferential direction. Therefore, the lubricant is thrown out of the refrigerant by a centrifugal force, which achieves the gas-liquid separation.

[0068] Of course, the present disclosure is not limited in this regard. A principle of cyclone separation may further be implemented without utilizing a tangential entry. For example, as illustrated in FIG. 10, a filter 54 may further be disposed in the oil separation chamber 30 to achieve the oil-gas separation through filtration. Of course, both the cyclone separation and the filter 54 may be employed.

[0069] For example, after the mixed fluid enters the oil separation chamber 30 along the oil separation inlet 31, the refrigerant is adapted to be discharged along the oil separation outlet 33, the first communication passage 32, and the refrigerant discharge outlet 213. Therefore, the exhaust of the electric compressor 100 is achieved. The first oil return hole 41 is in communication with the accommodation chamber 215. Therefore, the lubricant is adapted to enter the accommodation chamber 215 along the first oil return hole 41 and flow back to the compression component 101 through the accommodation chamber 215, to realize the oil return of the electric compressor 100.

[0070] Further, as illustrated in FIG. 1, FIG. 8, and FIG. 9, the chamber wall of the oil separation chamber 30 has the second oil return hole 42 in communication with the first oil return hole 41. For example, the chamber wall of the oil separation chamber 30 may have the second oil return hole 42, regardless of whether the first oil return hole 41 or the first oil return hole is defined by the oil return device 40. Relative positions of the first oil return hole 41 and the second oil return hole 42 are not limited. For example, when the first oil return hole 41 extends in the axial direction (e.g., as illustrated in FIG. 1 and FIG. 8), the second oil return hole 42 may be lower than the first oil return hole 41. For example, when the first oil return hole 41 extends in the axial direction of the oil separation chamber 30 and then extends in the radial direction of the oil separation chamber 30, the second oil return hole 42 may directly face towards the first oil return hole 41 in the radial direction. Therefore, the quick discharge of the accumulated oil can be facilitated, improving the reliability of the oil return.

[0071] For example, the second oil return hole 42 is formed at a chamber wall of the oil separation chamber 30 close to the accommodation chamber 215, and is in communication with the accommodation chamber 215. Therefore, during an actual oil return of the electric compressor 100, the separated lubricant in the oil separation chamber 30 enters the accommodation chamber 215 through the first oil return hole 41 and the second oil return hole 42 in sequence, and flows back to the compression component 101 from the accommodation chamber 215. Therefore, the oil return of the electric compressor 100 is realized.

[0072] Optionally, in the embodiments illustrated in FIG. 1 and FIG. 8, an extension direction of an axis of the first oil return hole 41 may intersect an extension direction of an axis of the second oil return hole 42, to buffer and slow down the lubricant when the lubricant passes through the first oil return hole 41 and then enters the second oil return hole 42. In this way, instability can be avoided when the lubricant enters the accommodation chamber 215 at a high flow rate.

[0073] As illustrated in FIG. 6, an axial spacing between an upper end of the oil separation chamber 30 and the first oil return hole 41 is denoted as L1. An axial spacing between the oil separation inlet 31 and the first oil return hole 41 is denoted as L2. An inner oil separation tube 52 is disposed in the oil separation chamber 30 (i.e., at least part of the inner oil separation tube 52 is located in the oil separation chamber 30). An inner cavity of the inner oil separation tube 52 is formed as a gas outlet cavity 521 in communication with the oil separation outlet 33. An axial spacing between the inner oil separation tube 52 and the first oil return hole 41 is L3.

[0074] It should be noted that, that "axial spacing" between the upper end of the oil separation chamber 30 and the first oil return hole 41 means a minimum distance between the upper end of the oil separation chamber 30 and the first oil return hole 41 in an axial extension direction of the oil separation chamber 30.

[0075] A first plane perpendicular to an axis of the oil separation chamber 30 is constructed by passing through an end point of the oil separation chamber 30 furthest from the first oil return hole 41 in a direction parallel to the axis of the oil separation chamber 30, and a second plane perpendicular to the axis of the oil separation chamber 30 is constructed by passing through an end point of the first oil return hole 41 closest to the oil separation inlet 31 at the axis of the oil separation chamber 30. The expression "an axial spacing between an upper end of the oil separation chamber 30 and the first oil return hole 41 is denoted as L1" may be interpreted as that a vertical distance between the first plane and the second plane is denoted as L1.

[0076] A third plane perpendicular to the axis of the oil separation chamber 30 is constructed by passing through an end point of the oil separation inlet 31 closest to the first oil return hole 41 in the direction parallel to the axis of the oil separation chamber 30, and the second plane perpendicular to the axis of the oil separation chamber 30 is constructed by passing through the end point of the first oil return hole 41 closest to the oil separation inlet 31 at the axis of the oil separation chamber 30. The expression "an axial spacing between the oil separation inlet 31 and the first oil return hole 41 is denoted as L2" may be interpreted as that "a vertical distance between the third plane and the second plane is denoted as L2".

[0077] A fourth plane perpendicular to the axis of the oil separation chamber 30 is constructed by passing through an end point of the inner oil separation tube 52 closest to the first oil return hole 41 in the direction parallel to the axis of the oil separation chamber 30, and the second plane perpendicular to the axis of the oil separation chamber 30 is constructed by passing through an end point of the first oil return hole 41 closest to the upper end of the oil separation chamber 30 at the axis of the oil separation chamber 30. The expression "an axial spacing between the inner oil separation tube 52 and the first oil return hole 41 is L3" may be interpreted as that a vertical distance between the fourth plane and the second plane is L3.

[0078] In some embodiments, 0.2 L1 < L3 < L2.

[0079] It should be noted that the oil separation chamber of a conventional design generally achieves a satisfactory oil separation effect under normal operation conditions, and cannot meet the requirements under an operation condition of a heavy oil separation load. It was found that a phenomenon of "secondary entrainment" occurs in the oil separation chamber 30. That is, if a position of an inlet of the inner oil separation tube 52 is improperly arranged, the lubricant which has already been separated in the oil separation chamber would be taken away again when the refrigerant is discharged.

[0080] Therefore, in the present disclosure, by controlling the axial spacing L3 between the inner oil separation tube 52 and the first oil return hole 41 to fall in the above-mentioned ratio range, the phenomenon of "secondary entrainment" in the oil separation chamber 30 can be avoided while ensuring the oil separation efficiency.

[0081] Therefore, when L1, L2, and L3 satisfy the above relationship, the stable exhaust pressure of the electric compressor 100 can be ensured, and the electric compressor 100 can have an optimal exhaust efficiency and an optimal oil return efficiency to ensure the efficient and reliable operation of the electric compressor 100. For example, an outer wall of the inner oil separation tube 52 is spaced apart from the chamber wall of the oil separation chamber 30 to form a gas inlet cavity 53. The oil separation inlet 31 extends in the tangential direction of the oil separation chamber 30.

[0082] For example, the inner oil separation tube 52 is inserted into an upper part of the outer oil separation tube 50 (or the oil separation chamber wall 22). The outer wall of the inner oil separation tube 52 is spaced apart from an inner wall of the outer oil separation tube 50 (or the oil separation chamber wall 22) to form the gas inlet cavity 53. The oil separation inlet 31 is formed at the outer oil separation tube 50 (or the oil separation chamber wall 22) and extends in the tangential direction. Further, the oil separation inlet 31 is in communication with the gas inlet cavity 53. The inner cavity of the inner oil separation tube 52 is formed as the gas outlet cavity 521. The gas outlet cavity 521 has an upper end in communication with the oil separation outlet 33 and a lower end in communication with the oil separation chamber 30.

[0083] Therefore, the mixed fluid of the refrigerant and the lubricant that are discharged from the compression component 101 enters the gas inlet cavity 53 through the exhaust outlet 11, and then the refrigerant and the lubricant of the mixed fluid are separated from each other in the gas inlet cavity 53. Then, the refrigerant enters the gas outlet cavity 521 along a lower end of the gas outlet cavity 521, moves upwards in an axial direction of the gas outlet cavity 521, enters the first communication passage 32 through the oil separation outlet 33, and then is discharged from the refrigerant discharge outlet 213, thereby achieving the exhaust of the electric compressor 100. For example, the separated lubricant flows downwards directly in the axial direction of the oil separation chamber 30, is discharged to the accommodation chamber 215 through the first oil return hole 41 and the second oil return hole 42, and flows back to the compression component 101 through the accommodation chamber 215, thereby achieving the oil return of the electric compressor 100.

[0084] In some embodiments, the oil separation chamber 30 has a flow area of S1. The first oil return hole 41 is formed at a lower part of the oil separation chamber 30 and has a flow area of S3. The inner oil separation tube 52 is disposed in the oil separation chamber 30 (i.e., the at least part of the inner oil separation tube 52 is located in the oil separation chamber 30). The inner cavity of the inner oil separation tube 52 is formed as the gas outlet cavity 521 in communication with the oil separation outlet

33. The gas outlet cavity 521 has a flow area of S2. S1, S2, and S3 satisfy at least one of $0.025 \leq S2/S1 \leq 0.45$, $0.015 \leq S3/S1 \leq 0.4$ and $0.15 \leq S3/S2 \leq 0.65$.For example, the valve of S2/S1 may be 0.025, 0.035, 0.045, 0.055, 0.1, 0.15, 0.25, 0.3, 0.35, the value of S3/S1 may be 0.015, 0.025, 0.03, 0.04, 0.05, 0.15, 0.2, 0.3, 0.38, and 0.4, and S3/S2 may be 0.15, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.6, 0.62, and 0.65.

[0085] By controlling a ratio of the flow area S2 of the gas outlet cavity 521 to the flow area S1 of the oil separation chamber 30 to satisfy the above range of values, a satisfactory centrifugal separation efficiency can be achieved, further meeting use requirements under the operation condition of the heavy oil separation load.

[0086] By controlling a ratio of the flow area S3 of the first oil return hole 41 to the flow area S1 of the oil separation chamber 30 to satisfy the above range of values, a cross-section of the first oil return hole 41 can be ensured to generate a sufficient pressure drive force by making full use of an influence of a pressure distribution of a centrifugal flow field. In this way, the separated lubricant can be ensured to be smoothly discharged through the first oil return hole 41, further meeting the use requirements under the operation condition of the heavy oil separation load.

[0087] By controlling a ratio of the flow area S3 of the first oil return hole 41 to the flow area S2 of the gas outlet cavity 521 to satisfy the above range of values, a failure of an oil separation resulted from blow-by of the first oil return hole 41 can be avoided, further meeting the use requirements under the operation condition of the heavy oil separation load.

[0088] That is, the flow area S1 of the oil separation chamber 30, the flow area S2 of the gas outlet cavity 521, and the flow area S3 of the first oil return hole 41 should satisfy any one, two, or three of the above conditions. In this way, the stable exhaust pressure of the electric compressor 100 can be ensured, and the electric compressor 100 can have the optimal exhaust efficiency and the optimal oil return efficiency, which further meets the use requirements under the operation condition of the heavy oil separation load, ensuring the efficient and reliable operation of the electric compressor 100.

[0089] It should be noted that the above-mentioned inner oil separation tube 52 may be fitted to the first housing 21. For example, the inner oil separation tube 52 is inserted into the first housing 21, or the inner oil separation tube 52 is connected to the outer oil separation tube 50 (the inner oil separation tube 52 and the outer oil separation tube 50 are assembled with each other or integrally formed), or the inner oil separation tube 52 and the first housing 21 are integrally formed. The present disclosure is not limited in this regard.

[0090] In some embodiments, the axis of the first oil return hole 41 overlaps with or is parallel to the axis of the oil separation chamber 30. Therefore, the separated lubricant can easily flow directly towards the first oil return hole 41 along the axis of the oil separation chamber 30, which facilitates an increase in the flow rate of the lubricant, improving the oil return efficiency of the electric compressor 100.

[0091] In some embodiments, as illustrated in FIG. 3 to FIG. 5, the oil separation inlet 31 extends in the tangential direction of the oil separation chamber 30. As illustrated in FIG. 1 to FIG. 6, an orthographic projection of the oil separation inlet 31 on an projection surface has an area of A, and the projection surface is a plane passing through the axis of the oil separation chamber 30 and perpendicular to an axis of the oil separation inlet 31 is a projection surface. A part of the orthographic projection of the oil separation inlet 31 on the projection surface located at a side of the oil separation chamber along the axis of the oil separation chamber 30 has an area of B, and B/A is greater than or equal to 80%. Therefore, a large enough inlet diameter and a sufficient tangential rotational force can be ensured to improve an efficiency of the cyclone separation of the refrigerant and the lubricant, improving the exhaust efficiency and the oil return efficiency. In addition, the refrigerant flowing into the oil separation inlet 31 can be ensured to tangentially enter the oil separation chamber 30 in a same direction to reach a critical separation speed of lubricant particles. Therefore, an effective centrifugal separation flow field pattern can be formed to ensure the efficiency of the cyclone separation of the refrigerant and the lubricant.

[0092] In some embodiments, as illustrated in FIG. 2 and FIG. 3, the first housing 21 has a second communication passage 34. The second communication passage 34 has an end in communication with the exhaust outlet 11 of the compression component 101 and another end in communication with the oil separation inlet 31.

[0093] Therefore, the second communication passage 34 can provide guidance for the mixed fluid discharged from the exhaust outlet 11. In this way, the mixed fluid of the gaseous refrigerant and the lubricant that are discharged from the compression component 101 can be discharged through the exhaust outlet 11, flows towards the oil separation inlet 31 through the second communication passage 34, and then enters the oil separation chamber 30, thereby achieving the separation.

[0094] Of course, the present disclosure is not limited in this regard. For example, in other embodiments, as illustrated in FIG. 7 and FIG. 8, the first housing 21 may have no second communication passage 34. In this case, the exhaust outlet 11 of the compression component 101 may be in communication with the accommodation chamber 215, and the accommodation chamber 215 is in communication with the oil separation inlet 31. Therefore, the exhaust outlet 11 of the compression component 101 can also be in communication with the oil separation inlet 31.

[0095] Optionally, as illustrated in FIG. 1, the oil separation inlet 31 may be formed at the first hole segment 211. Therefore, the oil separation inlet 31 and the first hole segment 211 of the first housing 21 are integrally formed, which eliminates a need of forming the oil separation inlet 31 at the outer oil separation tube 50. Further, a height of the oil separation inlet 31 and a length for the oil-gas separation can be increased, improving the effect of the oil-gas separation.

[0096] In some embodiments, as illustrated in FIG. 4 and FIG. 5, the oil separation outlet 33 is formed at a side of the oil separation chamber 30 away from the first oil return hole 41 in an axial direction of the oil separation chamber 30. An extension direction of an axis of the oil separation inlet 31 intersects with a positive extension direction of the axis of the oil separation chamber 30 at an angle θ, where $45° \leq \theta \leq 90°$, and the positive extension direction is a direction directed towards the oil separation outlet 33 in an extension direction of the axis of the oil separation chamber 30.

[0097] It should be noted that the lubricant separated by the oil separation chamber 30 is attached to an inner wall of the oil separation chamber 30, and flows to a bottom of the oil separation chamber 30 under the action of gravity and accumulates at the bottom of the oil separation chamber 30. In a state of a low flow volume or a system of a small oil circulation rate, an unsmooth oil return is likely to occur. In addition, it was found through calculations and analysis that when the angle θ is too small, a tangential component of the flow rate of the lubricant at the oil separation inlet 31 is also too small, and thus a critical separation speed of the lubricant cannot be reached, which is likely to result in the failure of the oil separation.

[0098] However, in the present disclosure, by controlling the angle θ at which the axial extension direction of the oil separation inlet 31 intersects with the positive extension direction of the axis of the oil separation chamber 30, and setting the angle θ to satisfy the relationship of $45° \leq \theta \leq 90°$, an oil return capacity of an inner wall surface of the oil separation chamber 30 can be improved with an axial component of a velocity of the lubricant when entering the oil separation inlet 31, ensuring that the separated lubricant can be quickly discharged from the first oil return hole 41. Therefore, the reliable operation of the electric compressor 100 can be ensured.

[0099] For example, the angle θ between the axial extension direction of the oil separation inlet 31 and the positive extension direction of the axis of the oil separation chamber 30 is equal to 90°, as illustrated in FIG. 4. Alternatively, the angle θ between the axial extension direction of the oil separation inlet 31 and the positive extension direction of the axis of the oil separation chamber 30 is equal to 60°. Alternatively, the angle θ between the axial extension direction of the oil separation inlet 31 and the positive extension direction of the axis of the oil separation chamber 30 is equal to 80°, as illustrated in FIG. 5.

[0100] Therefore, when the angle θ between the axial extension direction of the oil separation inlet 31 and the positive extension direction of the axis of the oil separation chamber 30 satisfies the above-mentioned range of values, it can be ensured that the refrigerant, after entering the gas outlet cavity 521 along the lower end of the gas outlet cavity 521 moves upwards in the axial direction of the gas outlet cavity 521, enters the first communication passage 32 through the oil separation outlet 33, and then is discharged from the refrigerant discharge outlet 213. Therefore, the exhaust of the electric compressor 100 can be realized, thereby improving the exhaust efficiency of the electric compressor 100.

[0101] In some embodiments, as illustrated in FIG. 1, and FIG. 3 to FIG. 8, an axis of the first communication passage 32 is a straight line. An axial length of the first communication passage 32 is smaller than an axial length of the oil separation chamber 30. The axis of the first communication passage 32 overlaps or intersects with the axis of the oil separation chamber 30.

[0102] Therefore, manufacturing and a formation of the first communication passage 32 are facilitated. In addition, the axial length of the first communication passage 32 is smaller than the axial length of the oil separation chamber 30, which is conducive to realizing miniaturization of the electric compressor 100. The axis of the first communication passage 32 overlaps or intersects with the axis of the oil separation chamber 30, which facilitates a reduction of losses of the exhaust pressure during the exhaust of the electric compressor 100, facilitating an improvement of the exhaust efficiency.

[0103] In some embodiments, as illustrated in FIG. 1 to FIG. 3, an axis of the first housing 21 extends transversely. The first communication passage 32 is located at a top of the first housing 21 and extends vertically. The first communication passage 32 has an upper end penetrating the top of the first housing 21 to form the refrigerant discharge outlet 213. The oil separation chamber 30 extends obliquely downwards from a lower end of the first communication passage 32.

[0104] For example, as illustrated in FIG. 5, the first communication passage 32 has the upper end penetrating the top of the first housing 21 to form the refrigerant discharge outlet 213, facilitating the manufacturing and the formation of the refrigerant discharge outlet 213. Also, the oil separation chamber 30 extends obliquely downwards from the lower end of the first communication passage 32 in a direction away from the second communication passage 34, to allow the oil separation chamber 30 to avoid a part of the compression component 101 extended into the accommodation chamber 215, in such a manner that an interference between the accommodation chamber 215 and the compression component 101 is avoided. As a result, a layout is reasonable layout. Further, the extension direction of the oil separation chamber 30 is substantially the same as a gravity direction of the lubricant, in such a manner that the separated lubricant can flow quickly towards the first oil return hole 41 along the oil separation chamber 30 under the action of gravity of the separated lubricant, which can improve the oil return efficiency of the electric compressor 100.

[0105] Alternatively, as illustrated in FIG. 4, the first communication passage 32 is located obliquely above the compression component 101, and the axis of the first communication passage 32 extends vertically. The oil separation chamber 30 extends vertically downwards from the lower end of the first communication passage 32. The oil separation chamber 30 is located at a side surface of the compression component 101. In this case, avoidance of the compression component 101 can also be realized. In this way, the extension direction of the oil separation chamber 30 is substantially the same as the gravity direction of the lubricant, in such a manner that the separated lubricant can flow quickly towards the first oil return hole 41 along the oil separation chamber 30 under the action of gravity of the separated lubricant, which is conducive to improving the oil return efficiency of the electric compressor 100.

[0106] It should be noted that the compression component 101 according to the embodiments of the present disclosure is a rotary compression mechanism, and a specific composition of the rotary compression mechanism is not limited. The rotary compression mechanism may be a single-cylinder compression mechanism or a multi-cylinder compression mechanism. In addition, the electric compressor 100 may be a horizontal compressor having a central axis extending in the transverse direction or in a direction slightly inclined to a horizontal line. For example, the electric compressor 100 may further be a vertical compressor having a central axis extending vertically or in a direction slightly inclined to a vertical line.

[0107] For example, in the example illustrated in FIG. 2, the compression component 101 is a double-cylinder compression mechanism. The double-cylinder compression mechanism includes two cylinders 12, two pistons 13, two bearings 15, a partition 16, and a silencer 17. The two cylinders 12 are spaced apart from each other in an axial direction. The partition 16 is sandwiched between the two cylinders 12. The two bearings 15 are disposed at two sides of the two bearings 15. The piston 13 is disposed in each cylinder 12. A crankshaft 14 penetrates the two pistons 13 to drive each of the two pistons 13 to roll in a corresponding one of the two cylinders 12 for compression. Each bearing 15 has the exhaust outlet 11 in communication with an inner cavity of the cylinder 12.

[0108] The housing component 102 further includes a support 70. The first housing 21 has a closed axial end and an open axial end closed by the support 70. An axial direction of the first housing 21 is the same as an axial direction of the compression component 101, both of which are a transverse direction. A silencing cavity 19 is formed between one of the two bearings 15 close to the support 70 and the support 70. An exhaust outlet 11 at the one of the two bearings 15 close to the support 70 is in communication with the silencing cavity 19. A silencing cavity 19 is also formed between another one of the two bearings 15 and the silencer 17. An exhaust outlet 11 at the other one of the two bearings 15 is in communication with the silencing cavity 19. A through passage 18 penetrating the two cylinders 12, the two bearings 15, and the partition 16 is formed by the two cylinders 12, the two bearings 15, and the partition 16. The silencing cavities 19 formed at two sides of the through passage 18 are in communication with each other through the through passage 18. The silencing cavity 19 defined by the support 70 and the oil separation inlet 31 are in communication with each other through the second communication passage 34 or the accommodation chamber 215.

[0109] The present disclosure further provides an air conditioning system 1001.

[0110] As illustrated in FIG. 21, the air conditioning system 1001 according to the embodiments of the present disclosure includes the electric compressor 100 according to any of the above embodiments.

[0111] With the air conditioning system 1001 according to the embodiments of the present disclosure, the first communication passage 32 is formed at the electric compressor 100 of the air conditioning system 1001. On the one hand, the exhaust towards the inner chamber of the first housing 21 through the oil separation outlet 33 can be avoided, to allow the refrigerant to be directly discharged from the refrigerant discharge outlet 213 through the first communication passage 32, ensuring the stable exhaust pressure and the overall effect of the oil-gas separation. On the other hand, the oil separation outlet 33 can be prevented from being in direct communication with the refrigerant discharge outlet 213, in such a manner that neither the size nor the position of the refrigerant discharge outlet 213 affects the oil separation chamber 30. Therefore, both the refrigerant discharge outlet 213 and the oil separation chamber 30 can be flexibly designed to enable the designs of both the refrigerant discharge outlet 213 and the oil separation chamber 30 to meet different design requirements. Therefore, the electric compressor 100 can be ensured to have the sufficient return oil and the simple and reasonable structure, which is conducive to ensuring the efficient and reliable operation of the electric compressor.

[0112] The present disclosure further provides a vehicle 1000.

[0113] As illustrated in FIG. 21, the vehicle 1000 according to the embodiments of the present disclosure includes a vehicle body and the air conditioning system 1001 according to the above embodiments. The air conditioning system 1001 is mounted at the vehicle body.

[0114] With the vehicle 1000 according to the embodiments of the present disclosure, the first communication passage 32 is formed at the electric compressor 100 of the air conditioning system 1001 of the vehicle 1000. On the one hand, the exhaust towards the inner chamber of the first housing 21 through the oil separation outlet 33 can be avoided to allow the refrigerant to be directly discharged from the refrigerant discharge outlet 213 through the first communication passage 32, ensuring the stable exhaust pressure and the overall effect of the oil-gas separation. On the other hand, the oil separation outlet 33 can be prevented from being in direct communication with the refrigerant discharge outlet 213, in such a manner that neither the size nor the position of the refrigerant discharge outlet 213 affects the oil separation chamber 30. Therefore, both the refrigerant discharge outlet 213 and the oil separation chamber 30 can be flexibly designed to enable the designs of both the refrigerant discharge outlet 213 and the oil separation chamber 30 to meet different design requirements. Therefore, it is ensured that the electric compressor 100 has the sufficient return oil and the simple and reasonable structure, which is conducive to ensuring the efficient and reliable operation of the electric compressor.

[0115] The housing component 102 for the electric compressor according to the embodiments of the present disclosure will be described below with reference to the accompanying drawings.

[0116] As illustrated in FIG. 11 to FIG. 13, according to the embodiments of the present disclosure, the housing component 102 for the electric compressor includes a first housing 21 and an oil separation assembly 5. A refrigerant discharge outlet 213 is formed at the first housing 21. The first housing 21 has a mounting region 24. The oil separation assembly 5 includes an outer oil separation tube 50 and an inner oil separation tube 52. An outer oil separation tube 50 is fitted to the mounting region 24. The inner oil separation tube 52 is located in the outer oil separation tube 50. A gas inlet cavity 53 is formed between the inner wall of the outer oil separation tube 50 and the outer wall of the inner oil separation tube 52. An oil separation inlet 31 is formed at the first housing 21 and/or the outer oil separation tube 50. The oil separation inlet 31 extends in a tangential direction of the outer oil separation tube 50 and is in communication with the gas inlet cavity 53. The inner cavity of the inner oil separation tube 52 is formed as a gas outlet cavity 521. The gas outlet cavity 521 is in communication with both a refrigerant discharge outlet 213 and the gas inlet cavity 53.

[0117] Therefore, by forming the gas inlet cavity 53 in the oil separation assembly 5, a high-pressure refrigerant can flow into the gas inlet cavity 53 of the oil separation assembly 5 to undergo the gas-liquid separation without a need to reserve a manufacturing space for the gas inlet cavity 53 on the first housing 21. Therefore, it is conducive to reducing a thickness of the first housing 21, allowing the first housing 21 to be flexibly designed.

[0118] For example, in the embodiments illustrated in FIG. 11 to FIG. 13, the electric compressor 100 is provided with a compression component 101 and a housing component 102. The compression component 101 is mounted at an inner cavity of the housing component 102. The compression component 101 is configured to suck the low-pressure refrigerant from outside the housing component 102 and compress the low-pressure refrigerant. The compressed high-pressure refrigerant can be discharged from the exhaust outlet 11 of the compression component 101 and flow towards the inner cavity of the housing component 102. As illustrated in FIG. 12, the housing component 102 includes the first housing 21 and the oil separation assembly 5. The axis of the first housing 21 extends in the transverse direction (i.e., in the horizontal direction or in a substantially horizontal direction). The mounting region 24 is formed in the first housing 21 and extends vertically or in a direction inclined to the vertical direction. The oil separation assembly 5 is mounted in the mounting region 24 along an axial direction of the oil separation assembly 5. The refrigerant discharge outlet 213 is formed at the outer surface of the first housing 21. The mounting region 24 and an outer side of the first housing 21 are in communication with each other through the refrigerant discharge outlet 213.

[0119] As illustrated in FIG. 11 and FIG. 12, the oil separation assembly 5 includes an outer oil separation tube 50 and an inner oil separation tube 52. The outer oil separation tube 50 is constructed into a tubular structure. An outer diameter of the outer oil separation tube 50 is equal to a diameter of the mounting region 24. An outer wall of the outer oil separation tube 50 can be supported at the inner wall of the mounting region 24 to be fixed in the mounting region 24. The inner oil separation tube 52 is adapted to be extended into the inner cavity of the outer oil separation tube 50. The inner oil separation tube 52 is constructed into a tubular structure with a relatively small diameter. In this way, the outer wall of the inner oil separation tube 52 can be spaced apart from the inner wall of the outer oil separation tube 50 to form the gas inlet cavity 53 in an annular shape between the inner oil separation tube 52 and the outer oil separation tube 50.

[0120] As illustrated in FIG. 12, the oil separation inlet 31 may be formed at the first housing 21. Alternatively, as illustrated in FIG. 16, the oil separation inlet 31 may be formed at the outer oil separation tube 50. Alternatively, the oil separation inlet 31 may be formed at each of the first housing 21 and the outer oil separation tube 50. The oil separation inlet 31 of the first housing 21 directly faces towards the oil separation inlet 31 of the outer oil separation tube 50 and is in communication with the oil separation inlet 31 of the outer oil separation tube 50. The oil separation inlet 31 extends in the tangential direction of the outer oil separation tube 50. The gas inlet cavity 53 and the exhaust outlet 11 of the compression component 101 are in communication with each other through the oil separation inlet 31. In this case, the gas outlet cavity 521 may be formed at the inner cavity of the inner oil separation tube 52. The gas outlet cavity 521 has the upper end configured to be in communication with the refrigerant discharge outlet 213 and the lower end configured to be in communication with the gas inlet cavity 53. In addition, the first oil return hole 41 is formed at the lower end of the outer oil separation tube 50. The gas inlet cavity 53 and an oil return passage of the compression component 101 are in communication with each other through the first oil return hole 41.

[0121] During a specific operation process, when the electric compressor 100 is powered for normal operation, the low-pressure refrigerant can be sucked by the compression component 101 and converted into the high-pressure refrigerant through a compression of the compression component 101. The compression component 101 of the electric compressor 100 is adapted to discharge the compressed high-pressure refrigerant into the gas inlet cavity 53 through the oil separation inlet 31. The high-pressure refrigerant flowing into the gas inlet cavity 53 can move around the inner oil separation tube 52 in the gas inlet cavity 53 to achieve the gas-liquid separation. The separated gaseous refrigerant is discharged out of the first housing 21 from the refrigerant discharge outlet 213 through the gas outlet cavity 521. The separated lubricant can flow towards the first oil return hole 41 along the inner wall of the outer oil separation tube 50, and flow into the compression component 101 from the oil return passage.

[0122] With the housing component 102 for the electric compressor according to the embodiments of the present disclosure, the mounting region 24 is formed at the first housing 21. The oil separation assembly 5 is mounted in the mounting region 24. In addition, the gas inlet cavity 53 is formed in the oil separation assembly 5, in such a manner that the high-pressure refrigerant can flow into the gas inlet cavity 53of the oil separation assembly 5 through the oil separation inlet 31 and undergo the gas-liquid separation in the gas inlet cavity 53, without reserving the manufacturing space for the gas inlet cavity 53 on the first housing 21. Therefore, it is conducive to reducing the thickness of the first housing 21, allowing the first housing 21 to be flexibly designed.

[0123] In some embodiments of the present disclosure, the outer surface of the first housing 21 has the mounting opening 214 spaced apart from the refrigerant discharge outlet 213. The mounting opening 214 corresponds to the mounting region 24, and is in communication with the mounting region 24. The oil separation assembly 5 is adapted to be mounted in the mounting region 24 along the axis of the outer oil separation tube 50 through the mounting opening 214.

[0124] For example, as illustrated in FIG. 12 and FIG. 13, the first housing 21 may have the mounting region 24 extending in the vertical direction or in the direction inclined to the vertical direction. A part of the first housing 21 located at an upper end of the mounting region 24 has the refrigerant discharge outlet 213. The mounting region 24 has a lower end with the mounting opening 214. The mounting opening 214 is spaced apart from the refrigerant discharge outlet 213. The mounting region 24 and the outer side of the first housing 21 are in communication with each other through the mounting opening 214. The mounting opening 214 has a size greater than or equal to a diameter of the oil separation assembly 5 in such a manner that the oil separation assembly 5 can be mounted upwardly into the mounting region 24 through the mounting opening 214.

[0125] In some embodiments of the present disclosure, a blockage 60 or a pressure protection device 80 is disposed at the mounting opening 214.

[0126] For example, as illustrated in FIG. 15 and FIG. 16, after the oil separation assembly 5 is mounted, the mounting opening 214 can be sealed through insertion and engagement of the blockage 60 into the mounting opening 214 to prevent the oil separation assembly 5 from being separated from the mounting region 24. Therefore, the oil separation assembly 5 can be mounted in the mounting region 24 from the mounting opening 214 outside the refrigerant discharge outlet 213, in such a manner that a size of the oil separation assembly 5 is free from a limitation of the size of the refrigerant discharge outlet 213, which facilitates a flexible arrangement of the refrigerant discharge outlet 213.

[0127] For example, as illustrated in FIG. 19 and FIG. 20, after the oil separation assembly 5 is mounted, the mounting opening 214 can be sealed through insertion and engagement of the pressure protection device 80 into the mounting opening 214. The pressure protection device 80 may be designed in accordance with a shape of the mounting opening 214. When the oil separation assembly 5 is mounted to the mounting region 24, the pressure protection device 80 may be mounted at the mounting opening 214 to seal the mounting region 24. The pressure protection device 80 may include a pressure relief safety valve 82. When a pressure in the mounting region 24 is high, the pressure relief safety valve 82 is opened to allow the mounting region 24 and the outer side of the first housing 21 to be in communication with each other. In this way, the high-pressure refrigerant in the mounting region 24 can escape out of the first housing 21. As a result, the lubricant can be prevented from flowing out through the refrigerant discharge outlet 213.

[0128] For example, as illustrated in FIG. 19, the pressure protection device 80 may further include a plug 81 configured to be engaged into and fixed at the mounting opening 214. The plug 81 has an airflow passage that allows the mounting region 24 and the outer side of the first housing 21 to be in communication with each other. The pressure relief safety valve 82 is adapted to be mounted in the airflow passage of the plug 81, and is adapted to allow the mounting region 24 and the outer side of the first housing 21 to be in communication with each other when the mounting region 24 has an excessive pressure. It should be understood that by mounting the pressure relief safety valve 82 at the plug 81, mounting stability of the pressure relief safety valve 82 and reliability of the housing component 102 can be improved. Alternatively, as illustrated in FIG. 20, the plug 81 and the pressure relief safety valve 82 may be integrally formed.

[0129] In some embodiments of the present disclosure, the first communication passage 32 is formed at the first housing 21. The first communication passage 32 has an end penetrating the outer surface of the first housing 21 to form the refrigerant discharge outlet 213 and another end in communication with the gas outlet cavity 521.

[0130] For example, as illustrated in FIG. 11 to FIG. 13, the axis of the first housing 21 may extend in the transverse direction. The first communication passage 32 is located at the top of the first housing 21 and extends in the vertical direction. The first communication passage 32 has the upper end penetrating the top of the first housing 21 to form the refrigerant discharge outlet 213 and the lower end configured to be in communication with the gas outlet cavity 521, in such a manner that the gas outlet cavity 521 and the outer side of the first housing 21 can be in communication with each other through the first communication passage 32. In this way, when the gas-liquid separation of the high-pressure refrigerant is completed in the gas inlet cavity 53, the separated gaseous refrigerant can flow towards the gas outlet cavity 521, and then flow out of the first housing 21 along the gas outlet cavity 521 through the first communication passage 32.

[0131] It should be understood that by forming the first communication passage 32, a problem that the refrigerant flows from the gas outlet cavity 521 into the inner chamber of the first housing 21 and then is discharged from the refrigerant discharge outlet 213 can be solved, thereby improving stability of the exhaust pressure and the result of the gas-liquid separation, and preventing the gas outlet cavity 521 from being in direct communication with the refrigerant discharge outlet 213. Therefore, neither the size nor the position of the refrigerant discharge outlet 213 is affected by the oil separation assembly 5, which is conducive to meeting different design requirements.

[0132] In some embodiments of the present disclosure, the axis of the first communication passage 32 is a straight line. The axial length of the first communication passage 32 is smaller than the axial length of the outer oil separation tube 50. The axis of the first communication passage 32 overlaps or intersects with the axis of the outer oil separation tube 50.

[0133] For example, as illustrated in FIG. 12 and FIG. 13, the axis of the first communication passage 32 may be constructed as a straight line to construct the first communication passage 32 into a columnar shape. Further, the axial length of the first communication passage 32 may be set as smaller than the axial length of the outer oil separation tube 50, and thus the axial length of the first communication passage 32 is relatively short, which allows a flow distance of the refrigerant in the first communication passage 32 to be relatively short. Therefore, manufacturing of the first communication passage 32 is facilitated, the losses of the exhaust pressure are reduced, and a high exhaust efficiency is achieved.

[0134] For example, the axis of the first communication passage 32 may be set to overlap with the axis of the outer oil separation tube 50, in such a manner that the axial direction of the gas outlet cavity 521 overlaps with the axial direction of the first communication passage 32. In this way, when the gas-liquid separation of the high-pressure refrigerant is completed in the gas inlet cavity 53, the separated refrigerant can sequentially flow through the gas outlet cavity 521 and the first communication passage 32 in a same direction to the outer side of the first housing 21. Therefore, the losses of the exhaust pressure are small, and the exhaust efficiency is high. Alternatively, the axis of the first communication passage 32 may be set as intersecting the axis of the outer oil separation tube 50. In this way, when the axis of the refrigerant discharge outlet 213 penetrates the compression component 101, the axis of the oil separation assembly 5 can avoid the compression component 101 to avoid interference between the oil separation assembly 5 and the compression component 101, which is conducive to improving operation stability of the oil separation assembly 5.

[0135] In some embodiments of the present disclosure, the inner oil separation tube 52 is fitted to the first housing 21 or connected to the outer oil separation tube 50, or the inner oil separation tube 52 and the first housing 21 are integrally formed. For example, as illustrated in FIG. 12 to FIG. 16, an upper end of the inner oil separation tube 52 may be set to offset from the outer oil separation tube 50 along an axis, in such a manner that an outer wall of the upper end of the inner oil separation tube 52 can be supported at the inner wall of the mounting region 24. In this way, the oil separation assembly 5 can be stably mounted through fixing both the outer oil separation tube 50 and the inner oil separation tube 52 to the mounting region 24 of the first housing 21. Or, as illustrated in FIG. 18, the inner oil separation tube 52 may be disposed at the inner cavity of the outer oil separation tube 50, while the upper end of the inner oil separation tube 52 may be connected to an upper end of the outer oil separation tube 50, to allow the inner oil separation tube 52 and the outer oil separation tube 50 to be integrally formed. In this way, the oil separation assembly 5 can be conveniently mounted through fixing the outer oil separation tube 50 in the mounting region 24 of the first housing 21. Or, as illustrated in FIG. 17, FIG. 19, and FIG. 20, the outer oil separation tube 50 may be connected to the lower end of the first communication passage 32, to allow the inner oil separation tube 52 and the first housing 21 to be integrally formed. In this way, the oil separation assembly 5 can be conveniently mounted through mounting the outer oil separation tube 50 in the mounting region 24 of the first housing 21.

[0136] In some embodiments of the present disclosure, the mounting region 24 includes a first hole segment 211 and a second hole segment 212 that are arranged coaxially. Two axial ends of the outer oil separation tube 50 are inserted into and engaged with the first hole segment 211 and the second hole segment 212, respectively. The first hole segment 211 and the second hole segment 212 are spaced apart from each other by a disconnection portion 23.

[0137] For example, as illustrated in FIG. 12, two ends of the mounting region 24 in an axial direction of the mounting region 24 may be defined as the first hole segment 211 and the second hole segment 212. An axial direction of the first hole segment 211 overlaps with an axial direction of the second hole segment 212. The first hole segment 211 and the second hole segment 212 are spaced apart from each other by the disconnection portion 23. In this way, when the outer oil separation tube 50 extends to the mounting region 24, the two axial ends of the outer oil separation tube 50 can be inserted into and engaged with the first hole segment 211 and the second hole segment 212, respectively, to mount the outer oil separation tube 50 in the mounting region 24. In addition, a central part of the outer oil separation tube 50 in the axial direction may be exposed from the disconnection portion 23.

[0138] It should be understood that by dividing the mounting region 24 into the first hole segment 211 and the second hole segment 212 spaced apart from each other, the first housing 21 can have a hollow cavity at the disconnection portion 23, which is conducive to reducing a wall thickness of the first housing 21, thereby reducing a weight of the first housing 21. Therefore, a lightweight design is achieved, lowering costs of the first housing 21.

[0139] In some embodiments of the present disclosure, an end of the first hole segment 211 away from the second hole segment 212 is in communication with the refrigerant discharge outlet 213. An end of the second hole segment 212 away from the first hole segment 211 penetrates the outer surface of the first housing 21 to form the mounting opening 214. The oil separation assembly 5 is adapted to be inserted into the second hole segment 212 and the first hole segment 211 through the mounting opening 214 along the axis of the outer oil separation tube 50.

[0140] For example, as illustrated in FIG. 12, an upper end part of the mounting region 24 may be defined as the first hole segment 211, and a lower end part of the mounting region 24 may be defined as the second hole segment 212. An upper end of the first hole segment 211 is configured to be in communication with the refrigerant discharge outlet 213. A lower end of the second hole segment 212 penetrates the outer surface of the first housing 21 to form the mounting opening 214. The oil separation assembly 5 may extend into the mounting space through the mounting opening 214 in the axial direction of the oil separation assembly 5. In this way, an upper end of the oil separation assembly 5 can be engaged with the first hole segment 211, and a lower end of the oil separation assembly 5 can be engaged with the second hole segment 212, achieving mounting of the oil separation assembly 5.

[0141] Through the above arrangements, the oil separation assembly 5 can be mounted in the mounting region 24 through the mounting opening 214 outside the refrigerant discharge outlet 213. In this way, the size of the oil separation assembly 5 is free from the limitation of the size of the refrigerant discharge outlet 213. In addition, the mounting region 24 is simple in design and easy to be processed, and occupies a small space of the first housing 21, which facilitates a flexible arrangement of the first housing 21.

[0142] In some embodiments of the present disclosure, the first communication passage 32 is formed at the first housing 21. The first communication passage 32 has the end penetrating the outer surface of the first housing 21 to form the refrigerant discharge outlet 213, and the other end connected to the end of the first hole segment 211 away from the second hole segment 212.

[0143] For example, as illustrated in FIG. 11 to FIG. 13, the axis of the first housing 21 may extend in the transverse direction. The first communication passage 32 is located at the top of the first housing 21 and extends in the vertical direction. The first communication passage 32 has the upper end penetrating the top of the first housing 21 to form the refrigerant discharge outlet 213 and the lower end configured to be in communication with the upper end of the first hole segment 211, in such a manner that the gas outlet cavity 521 and the outer side of the first housing 21 can be in communication with each other through the first communication passage 32. In this way, when the gas-liquid separation of the high-pressure refrigerant is completed in the gas inlet cavity 53, the separated refrigerant can flow towards the gas outlet cavity 521, and then flow out of the first housing 21 through the first communication passage 32 from the gas outlet cavity 521.

[0144] It should be understood that with the first communication passage 32, the end of the first hole segment 211 away from the second hole segment 212 is spaced apart from the refrigerant discharge outlet 213, in such a manner that a center line and a cross section of the first communication passage 32 can be freely designed. In addition, in a case where the axis of the first communication passage 32 does not overlap with the axis of the oil dispensing assembly 5, the axis of the oil dispensing assembly 5 can avoid the axis of the compression component 101 when the axis of the refrigerant discharge outlet 213 penetrates the compression component 101, to avoid the interference between the oil separation assembly 5 and the compression component 101.

[0145] In some embodiments of the present disclosure, the first hole segment 211 is a variable cross-section hole and includes a first sub-segment 211a and a second sub-segment 211b. The first sub-segment 211a has a smaller diameter than a diameter of the second sub-segment 211b. Further, the first sub-segment 211a is located at a side of the second sub-segment 211b away from the second hole segment 212. An axial end of the outer oil separation tube 50 is inserted into and engaged with the second sub-segment 211b. An axial end of the inner oil separation tube 52 is inserted into and engaged with the first sub-segment 211a. Or, the first sub-segment 211a has an extension segment 211c at an end of the first sub-segment 211a close to the second hole segment 212. The extension segment 211c serves as the inner oil separation tube 52. Or, the inner oil separation tube 52 is connected to the outer oil separation tube 50.

[0146] For example, as illustrated in FIG. 12, the first hole segment 211 may be divided into the first sub-segment 211a and the second sub-segment 211b in an axial direction of the first hole segment 211. The first sub-segment 211a is formed at an upper end of the second sub-segment 211b. The diameter of the first sub-segment 211a is set to be smaller than the diameter of the second sub-segment 211b, to design the first hole segment 211 as the variable cross-section hole. The diameter of the second sub-segment 211b is set to be equal to a diameter of the outer oil separation tube 50, in such a manner that the outer oil separation tube 50 can be inserted into and engaged with the second sub-segment 211b.

[0147] The upper end of the inner oil separation tube 52 may be set to offset from the outer oil separation tube 50 along the axis, in such a manner that the upper end of the inner oil separation tube 52 can be inserted into and engaged with the first sub-segment 211a. In this way, the oil separation assembly 5 can be stably mounted through insertion and engagement of the outer oil separation tube 50 and the inner oil separation tube 52 into the second sub-segment 211b and the first sub-segment 211a, respectively. Or, as illustrated in FIG. 17, FIG. 19, and FIG. 20, the first sub-segment 211a may have the extension segment 211c at the lower end of the first sub-segment 211a. The extension segment 211c, which serves as the inner oil separation tube 52, extends into the second sub-segment 211b and is spaced apart from an inner wall of the second sub-segment 211b. Therefore, when the outer oil separation tube 50 is inserted into and engaged with the second sub-segment 211b, the extension segment 211c may extend into the inner cavity of the outer oil separation tube 50, and thus the oil separation assembly 5 can be mounted conveniently. Or, as illustrated in FIG. 18, the inner oil separation tube 52 may be disposed at the inner cavity of the outer oil separation tube 50. In addition, the upper end of the inner oil separation tube 52 is connected to the upper end of the outer oil separation tube 50, in such a manner that the inner oil separation tube 52 and the outer oil separation tube 50 are integrally formed. In this way, the oil separation assembly 5 can be conveniently mounted through insertion and engagement of the outer oil separation tube 50 into the second sub-segment 211b.

[0148] In some embodiments of the present disclosure, the first housing 21 has the second communication passage 34. The oil separation inlet 31 is formed at the first hole segment 211. The oil separation inlet 31 and the exhaust outlet 11 of the compression component 101 of the electric compressor 100 are in communication with each other through the second communication passage 34.

[0149] For example, as illustrated in FIG. 11 to FIG. 13, the first housing 21 may have the second communication passage 34 arranged in the transverse extension. The second communication passage 34 has an end connected to the first hole segment 211. The oil separation inlet 31 is formed at the first hole segment 211 in a tangential direction of the first hole segment 211. The second communication passage 34 has another end configured to be in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100 to allow the first hole segment 211 to be in communication with a vent hole of the compression component 101. In this way, in a case where the electric compressor 100 is powered for normal operation, when the low-pressure refrigerant is sucked by the compression component 101 and converted into the high-pressure refrigerant after being compressed, the high-pressure refrigerant can flow to the second communication passage 34 from the exhaust outlet 11 of the compression component 101 and flow into the gas inlet cavity 53 along the second communication passage 34, to undergo the gas-liquid separation in the gas inlet cavity 53.

[0150] It should be understood that, since the gas inlet cavity 53 and the exhaust outlet 11 of the compression component 101 are in communication with each other through the second communication passage 34, the high-pressure refrigerant flowing out of the compression component 101 can flow into the gas inlet cavity 53, which is conducive to improving flow stability of the high-pressure refrigerant, improving the result of the gas-liquid separation for the refrigerant.

[0151] In some embodiments of the present disclosure, as illustrated in FIG. 14, the inner chamber of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. In conjunction with FIG. 15 to FIG. 20, the oil separation inlet 31 is formed at the first hole segment 211 or the outer oil separation tube 50 and is in communication with the accommodation chamber 215. For example, the accommodation chamber 215 may be a high-pressure cavity.

[0152] For example, as illustrated in FIG. 14, the inner chamber of the first housing 21 may be formed as the accommodation chamber 215. The accommodation chamber 215 is in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The oil separation inlet 31 is in communication with the accommodation chamber 215. The accommodation chamber 215 may further serve as the reservoir for the lubricant. The accommodation chamber 215 and the compression component 101 are in communication with each other through the oil return passage. In this way, when the electric compressor 100 is powered for normal operation, the low-pressure refrigerant can be sucked by the compression component 101, and is converted into the high-pressure refrigerant after being compressed. The high-pressure refrigerant can flow into the accommodation chamber 215 from the exhaust outlet 11 of the compression component 101. Part of the separated lubricant flows into the accommodation chamber 215. In addition, the high-pressure refrigerant can flow from the oil separation inlet 31 into the gas inlet cavity 53 to undergo the gas-liquid separation. The separated refrigerant can flow through the gas outlet cavity

521 to be discharged out of the first housing 21 from the refrigerant discharge outlet 213, and then flow from the first oil return hole 41 into the accommodation chamber 215. In addition, the lubricant in the accommodation chamber 215 can flow into the compression component 101 from the oil return passage.

[0153] For example, as illustrated in FIG. 15, the first hole segment 211 of the first housing 21 may have the oil separation inlet 31. In the tangential direction of the outer oil separation tube 50, the oil separation inlet 31 is positioned opposite to the inner oil separation tube 52 in an axial direction. Or, the outer oil separation tube 50 may have the oil separation inlet 31 in the tangential direction of the outer oil separation tube 50. The oil separation inlet 31 is positioned opposite to the inner oil separation tube 52 in the axial direction. Therefore, the oil separation inlet 31 can be flexibly arranged, which is conducive to meeting different practical needs.

[0154] It should be understood that with the accommodation cavity 215 in communication with both the oil separation inlet 31 and the exhaust outlet 11 of the compression component 101, the high-pressure refrigerant flowing out of the exhaust outlet 11 can flow into the gas inlet cavity 53 after flowing through the accommodation chamber 215, which is conducive to extending a flow path of the high-pressure refrigerant and attenuating fluctuations of the high-pressure refrigerant in the gas inlet cavity 53, improving the result of the gas-liquid separation.

[0155] The housing component 102 for the electric compressor according to some specific embodiments of the present disclosure will be described below.

[0156] In some embodiments, as illustrated in FIG. 11 to FIG. 13, the housing component 102 includes the first housing 21 and the oil separation assembly 5. The axis of the first housing 21 extends in the transverse direction. The mounting region 24 is formed in the first housing 21. Also, the mounting region 24 is divided into the first hole segment 211 and the second hole segment 212 that are spaced apart in an up-down direction. The first hole segment 211 and the second hole segment 212 are coaxially arranged. The first hole segment 211 includes the first sub-segment 211a and the second sub-segment 211b. The first sub-segment 211a has the smaller diameter than the second sub-segment 211b to construct the first hole segment 211 as the variable cross-section hole. The lower end of the second hole segment 212 is opened outwardly to form the mounting opening 214. The oil separation assembly 5 may be mounted in the mounting region 24 through the mounting opening 214 along the axis of the oil separation assembly 5 (i.e., the axis of the outer oil separation tube 50). In addition, after the oil separation assembly 5 is mounted, the blockage 60 may be mounted in the mounting opening 214 to seal the mounting opening 214.

[0157] The oil separation assembly 5 includes the outer oil separation tube 50 and the inner oil separation tube 52. The outer oil separation tube 50 is constructed into a cylindrical tubular structure. The outer oil separation tube 50 has the upper end configured to be inserted into and engaged with the second sub-segment 211b of the first hole segment 211, and the lower end configured to be inserted into and engaged with the second hole segment 212, to fix the outer oil separation tube 50 in the mounting region 24. The outer oil separation tube 50 is constructed into the cylindrical tubular structure with a small diameter. The inner oil separation tube 52 has the upper end inserted into and engaged with the first sub-segment 211a of the first hole segment 211, and the lower end extending into the inner cavity of the outer oil separation tube 50. The outer wall of the inner oil separation tube 52 is spaced apart from the inner wall of the outer oil separation tube 50 to form the annular gas inlet cavity 53 between the inner oil separation tube 52 and the outer oil separation tube 50. The gas outlet cavity 521 in communication with the gas inlet cavity 53 is formed at the inner cavity of the inner oil separation tube 52. Further, the first oil return hole 41 in communication with the oil return passage is formed at the lower end of the outer oil separation tube 50. The first housing 21 has the first communication passage 32 located at the top of the first housing 21 and extending in the vertical direction. The first communication passage 32 has the upper end penetrating the top of the first housing 21 to form the refrigerant discharge outlet 213, and the lower end in communication with the gas outlet cavity 521.

[0158] The first housing 21 further has the second communication passage 34. The second communication passage 34 extends in the transverse direction. The second communication passage 34 has an end in communication with an inner cavity of the second sub-segment 211b to form the oil separation inlet 31 at the second sub-segment 211b. The oil separation inlet 31 extends in the tangential direction of the outer oil separation tube 50. The second communication passage 34 has another end configured to be in communication with the exhaust outlet 11 of the compression component 101.

[0159] During a specific operation process, when the electric compressor 100 is powered for normal operation, the low-pressure refrigerant can be sucked by the compression component 101 and converted into the high-pressure refrigerant through the compression of the compression component 101. The compression component 101 is adapted to introduce the high-pressure refrigerant into the second communication passage 34 through the exhaust outlet 11. The high-pressure refrigerant flows along the second communication passage 34 and is discharged into the gas inlet cavity 53 through the oil separation inlet 31. The high-pressure refrigerant flowing into the gas inlet cavity 53 can move around the inner oil separation tube 52 in the gas inlet cavity 53 to realize the gas-liquid separation. The separated gaseous refrigerant flows through the gas outlet cavity 521 and the first communication passage 32 to be discharged out of the first housing 21 from the refrigerant discharge outlet 213. The separated lubricant can flow towards the first oil return hole 41 along the inner wall of the outer oil separation tube 50 to flow into the compression component 101 from the oil return passage.

[0160] The embodiments illustrated in FIG. 14 and FIG. 15 and the above embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 14 and FIG. 15, the inner chamber of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The first hole segment 211 of the first housing 21 has the oil separation inlet 31 in communication with the accommodation chamber 215. The accommodation chamber 215 may further serve as the reservoir for the lubricant. The accommodation chamber 215 and the inner cavity of the compression component 101 are in communication with each other through the oil return passage. In this way, when the electric compressor 100 is powered for normal operation, the low-pressure refrigerant can be drawn in by the compression component 101, and is converted into the high-pressure refrigerant after being compressed. The high-pressure refrigerant can flow into the accommodation chamber 215 from the exhaust outlet 11 of the compression component 101. Part of the separated lubricant flows into the accommodation chamber 215. In addition, the high-pressure refrigerant can flow from the oil separation inlet 31 into the gas inlet cavity 53 to undergo the gas-liquid separation. The separated refrigerant can flow through the gas outlet cavity 521 to be discharged out of the first housing 21 from the refrigerant discharge outlet 213, and flow from the first oil return hole 41 into the accommodation chamber 215. In addition, the lubricant in the accommodation chamber 215 can flow into the compression component 101 from the oil return passage.

[0161] The embodiment illustrated in FIG. 16 and the above embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 16, the inner chamber of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The outer oil separation tube 50 has the oil separation inlet 31 in the tangential direction of the outer oil separation tube 50. The oil separation inlet 31 is in communication with the accommodation chamber 215. The accommodation chamber 215 may further serve as the reservoir for the lubricant. The accommodation chamber 215 and the compression component 101 are in communication with each other through the oil return passage. In this way, when the electric compressor 100 is powered for normal operation, the low-pressure refrigerant can be sucked by the compression component 101, and is converted into the high-pressure refrigerant after being compressed. The high-pressure refrigerant can flow into the accommodation chamber 215 from the exhaust outlet 11 of the compression component 101. Part of the separated lubricant flows into the accommodation chamber 215. In addition, the high-pressure refrigerant can flow from the oil separation inlet 31 into the gas inlet cavity 53 to undergo the gas-liquid separation. The separated refrigerant can flow through the gas outlet cavity 521 to be discharged out of the first housing 21 from the refrigerant discharge outlet 213, and flow from the first oil return hole 41 into the accommodation chamber 215. In addition, the lubricant in the accommodation chamber 215 can flow into the compression component 101 from the oil return passage.

[0162] The embodiment illustrated in FIG. 17 and the embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 17, the first sub-segment 211a may have the extension segment 211c at the lower end of the first sub-segment 211a. The extension segment 211c extends into the second sub-segment 211b and is spaced apart from the inner wall of the second sub-segment 211b. The extension segment 211c serves as the inner oil separation tube 52. When the outer oil separation tube 50 is inserted into and engaged with the second sub-segment 211b, the extension segment 211c extends into the inner cavity of the outer oil separation tube 50 to form the gas inlet cavity 53. The inner cavity of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The first hole segment 211 of the first housing 21 has the oil separation inlet 31. The oil separation inlet 31 is positioned opposite to the inner oil separation tube 52 in the axial direction and in communication with the accommodation chamber 215. The accommodation chamber 215 can further serve as the reservoir for the lubricant. The accommodation chamber 215 and the compression component 101 are in communication with each other through the oil return passage.

[0163] The embodiment illustrated in FIG. 18 and the above embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 18, the inner oil separation tube 52 is disposed at the inner cavity of the outer oil separation tube 50. In addition, the upper end of the inner oil separation tube 52 is connected to the upper end of the outer oil separation tube 50, in such a manner that the inner oil separation tube 52 and the outer oil separation tube 50 are integrally formed. In this way, the oil separation assembly 5 can be mounted through insertion and engagement of the outer oil separation tube 50 into the second sub-segment 211b.

[0164] The embodiment illustrated in FIG. 19 and the above embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 19, the lower end of the second hole segment 212b is opened outwardly to form the mounting opening 214. The oil separation assembly 5 may be mounted at the mounting region 24 through the mounting opening 214 along the axis of the oil separation assembly

5. In addition, after the oil separation assembly 5 is mounted, the pressure protection device 80 may be mounted in the mounting opening 214. The pressure protection device 80 includes the pressure relief safety valve 82 and the plug 81 that are assembled with each other. The plug 81 is engaged with and fixed at the mounting opening 214. The plug 81 has the airflow passage that allows the mounting region 24 and the outer side of the first housing 21 to be in communication with each other. The pressure relief safety valve 82 is adapted to be mounted in the airflow passage of the plug 81, and is adapted to enable the mounting region 24 and the outer side of the first housing 21 to be in communication with each other when the mounting region 24 has an excessive pressure.

[0165] The first sub-segment 211a has the extension segment 211c at the lower end of the first sub-segment 211a. The extension segment 211c extends into the second sub-segment 211b and is spaced apart from the inner wall of the second sub-segment 211b. The extension segment 211c serves as the inner oil separation tube 52. When the outer oil separation tube 50 is inserted into and engaged with the second sub-segment 211b, the extension segment 211c extends into the inner cavity of the outer oil separation tube 50 to form the gas inlet cavity 53. The inner cavity of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The first hole segment 211 of the first housing 21 has the oil separation inlet 31. The oil separation inlet 31 is positioned opposite to the inner oil separation tube 52 in the axial direction and in communication with the accommodation chamber 215. The accommodation chamber 215 can further serve as the reservoir for the lubricant. The accommodation chamber 215 and the compression component 101 are in communication with each other through the oil return passage.

[0166] The embodiment illustrated in FIG. 20 and the above embodiments illustrated in FIG. 11 to FIG. 13 have the following differences. In some embodiments, as illustrated in FIG. 20, the lower end of the second hole segment 212b is opened outwardly to form the mounting opening 214. The oil separation assembly 5 may be mounted at the mounting region 24 through the mounting opening 214 along the axis of the oil separation assembly 5. In addition, after the oil separation assembly 5 is mounted, the pressure protection device 80 may be mounted in the mounting opening 214. The pressure protection device 80 includes the pressure relief safety valve 82 and the plug 81 that are integrally formed. The pressure relief safety valve 82 is adapted to be mounted in the mounting opening 214 through the plug 81, and is adapted to allow the mounting region 24 and the outer side of the first housing 21 to be in communication with each other when the mounting region 24 has an excessive pressure.

[0167] The first sub-segment 211a has the extension segment 211c at the lower end of the first sub-segment 211a. The extension segment 211c extends into the second sub-segment 211b and is spaced apart from the inner wall of the second sub-segment 211b. The extension segment 211c serves as the inner oil separation tube 52. When the outer oil separation tube 50 is inserted into and engaged with the second sub-segment 211b, the extension segment 211c extends into the inner cavity of the outer oil separation tube 50 to form the gas inlet cavity 53. The inner cavity of the first housing 21 is formed as the accommodation chamber 215 in communication with the exhaust outlet 11 of the compression component 101 of the electric compressor 100. The first hole segment 211 of the first housing 21 has the oil separation inlet 31. The oil separation inlet 31 is positioned opposite to the inner oil separation tube 52 in the axial direction and in communication with the accommodation chamber 215. The accommodation chamber 215 can further serve as the reservoir for the lubricant. The accommodation chamber 215 and the compression component 101 are in communication with each other through the oil return passage.

[0168] The present disclosure further provides the electric compressor 100.

[0169] As illustrated in FIG. 11, the electric compressor 100 according to the embodiments of the present disclosure includes a housing component 102, a compression component 101, and a motor component. The housing component 102 includes the housing component 102 for the electric compressor according to any of the above embodiments. The compression component 101 is disposed in the housing component 102 and configured to compress the refrigerant. The refrigerant compressed by the compression component 101 is adapted to be discharged from the refrigerant discharge outlet 213 through the oil separation assembly 5. The motor component is disposed in the housing component 102 and configured to drive the compression component 101 to perform the compression operation.

[0170] For example, the electric compressor 100 is provided with the compression component 101, the housing component 102, and the motor component. According to the embodiment illustrated in FIG. 12, the housing component 102 includes the first housing 21 and the oil separation assembly 5. The axis of the first housing 21 extends in the transverse direction (i.e., the horizontal direction). The mounting region 24 is formed in the first housing 21. The oil separation assembly 5 extends into the mounting region 24 in the axial direction of the oil separation assembly 5. The refrigerant discharge outlet 213 is formed at the outer surface of the first housing 21. The mounting region 24 and the outer side of the first housing 21 are in communication with each other through the refrigerant discharge outlet 213.

[0171] The oil separation assembly 5 includes the outer oil separation tube 50 and the inner oil separation tube 52. The outer oil separation tube 50 is constructed to have the tubular structure. The outer diameter of the outer oil separation tube 50 is equal to the diameter of the mounting region 24. The outer wall of the outer oil separation tube 50 can be supported at the inner wall of the mounting region 24 to be fixed in the mounting region 24. The inner oil separation tube 52 is adapted to extend into the inner cavity of the outer oil separation tube 50. The inner oil separation tube 52 is constructed to have the tubular structure with the relatively small diameter. In this way, the outer wall of the inner oil separation tube 52 can be spaced apart from the inner wall of the outer oil separation tube 50 to form the gas inlet cavity 53 in the annular shape between the inner oil separation tube 52 and the outer oil separation tube 50.

[0172] The compression component 101 is adapted to be mounted at the inner cavity of the first housing 21 and is configured to draw in and compress the low-pressure refrigerant. The exhaust outlet 11 is formed at the compression component 101, and thus the compressed high-pressure refrigerant can be discharged from the exhaust outlet 11. As illustrated in FIG. 12, the oil separation inlet 31 may be formed at the first housing 21. Or, as illustrated in FIG. 16, the oil separation inlet 31 may be formed at the outer oil separation tube 50. Or, the oil separation inlet 31 may be formed at each of the first housing 21 and the outer oil separation tube 50. The oil separation inlet 31 of the first housing 21 is directly opposite to and in communication with the oil separation inlet 31 of the outer oil separation tube 50. The oil separation inlet 31 extends in the tangential direction of the outer oil separation tube 50. The gas inlet cavity 53 and the exhaust outlet 11 of the compression component 101 are in communication with each other through the oil separation inlet 31. In this case, the gas outlet cavity 521 may be formed at the inner cavity of the inner oil separation tube 52. The gas outlet cavity 521 has the upper end configured to be in communication with the refrigerant discharge outlet 213 and the lower end configured to be in communication with the gas inlet cavity 53. In addition, the first oil return hole 41 is formed at the lower end of the outer oil separation tube 50. The gas inlet cavity 53 and the oil return passage of the compression component 101 are in communication with each other through the first oil return hole 41. In addition, the motor component may be mounted at the inner cavity of the first housing 21 and spaced apart from the compression component 101. The motor component is configured to drive the compression component 101 to compress the refrigerant that is drawn in.

[0173] During a specific operation process, when the electric compressor 100 is powered for normal operation, the compression component 101 can draw in the low-pressure refrigerant from the outer side of the first housing 21. The motor component applies torque to the compression component 101, in such a manner that the low-pressure refrigerant can be compressed by the compression component 101 to form the high-pressure refrigerant. The compression component 101 of the electric compressor 100 is adapted to discharge the high-pressure refrigerant outwardly through the exhaust outlet 11 to enable the high-pressure refrigerant to flow into the gas inlet cavity 53 through the oil separation inlet 31. The high-pressure refrigerant flowing into the gas inlet cavity 53 can move around the inner oil separation tube 52 in the gas inlet cavity 53 to achieve the gas-liquid separation. The separated gaseous refrigerant is discharged out of the first housing 21 through the gas outlet cavity 521 from the refrigerant discharge outlet 213. The separated lubricant can flow towards the first oil return hole 41 along the inner wall of the outer oil separation tube 50, and then flow into the compression component 101 from the oil return passage.

[0174] With the electric compressor 100 according to the embodiments of the present disclosure, the mounting region 24 is formed at the first housing 21. The oil separation assembly 5 is mounted in the mounting region 24. In addition, the gas inlet cavity 53 is formed in the oil separation assembly 5, in such a manner that the high-pressure refrigerant can flow into the gas inlet cavity 53 of the oil separation assembly 5 through the oil separation inlet 31 and undergo the gas-liquid separation in the gas inlet cavity 53, without reserving the manufacturing space for the gas inlet cavity 53 on the first housing 21, which is conducive to reducing the thickness of the first housing 21, allowing the first housing 21 to be flexibly designed. Therefore, a realization of a flexible design of the electric compressor 100 can be facilitated.

[0175] The present disclosure further provides an air conditioning system 1001.

[0176] As illustrated in FIG. 21, the air conditioning system 1001 according to the embodiments of the present disclosure includes the electric compressor 100 according to any of the above embodiments. The mounting region 24 is formed at the first housing 21. The oil separation assembly 5 is mounted in the mounting region 24. In addition, the gas inlet cavity 53 is formed in the oil separation assembly 5, in such a manner that the high-pressure refrigerant can flow into the gas inlet cavity 53 of the oil separation assembly 5 through the oil separation inlet 31 and undergo the gas-liquid separation in the gas inlet cavity 53, without reserving the manufacturing space for the gas inlet cavity 53 on the first housing 21, which is conducive to reducing the thickness of the first housing 21, allowing the first housing 21 to be flexibly designed. Therefore, the realization of the flexible design of the electric compressor 100 can be facilitated, which improves feasibility of a layout of the air conditioning system 1001.

[0177] The present disclosure further provides a vehicle 1000.

[0178] As illustrated in FIG. 21, the vehicle 1000 according to the embodiments of the present disclosure includes the vehicle body and the air conditioning system 1001 according to any of the above embodiments. The air conditioning system 1001 is mounted at the vehicle body. The mounting region 24 is formed at the first housing 21. The oil separation assembly 5 is mounted in the mounting region 24. In addition, the gas inlet cavity 53 is formed in the oil separation assembly 5, in such a manner that the high-pressure refrigerant can flow into the gas inlet cavity 53 of the oil separation assembly 5 through the oil separation inlet 31 and undergo the gas-liquid separation in the gas inlet cavity 53, without reserving the manufacturing space for the gas inlet cavity 53 on the first housing 21, which is conducive to reducing the thickness of the first housing 21, allowing the first housing 21 to be flexibly designed. Therefore, the realization of the flexible design of the electric compressor 100 can be facilitated, which improves the feasibility of the layout of the air conditioning system 1001, improving overall performance of the vehicle 1000.

[0179] It should be noted that in the present disclosure, specific types of the vehicle 1000 are not limited. For example, the vehicle 1000 may be a conventional fuel vehicle or a new energy vehicle. The new energy vehicle includes, but is not limited to, a pure electric vehicle, a plug-in hybrid electric vehicle, a hybrid vehicle, a fuel cell electric vehicle, a hydrogen engine vehicle, or the like.

[0180] In some embodiments, the new energy vehicle may be a pure electric vehicle with a motor as a main driving force. In other embodiments, the new energy vehicle may further be a hybrid vehicle having both an internal combustion engine and a motor serving as main driving forces simultaneously. For the internal combustion engine and the motor that provide the driving forces for the new energy vehicle according to the above-mentioned embodiments, the internal combustion engine may be fuelled by petrol, diesel, hydrogen, or the like, while the motor may be powered by a traction battery, a hydrogen fuel cell, or the like. The present disclosure is not limited in this regard. It should be noted that, while an exemplary description of structures such as the new energy vehicle is provided herein, the scope of the present disclosure is not limited to the exemplary description.

[0181] In the description of the present disclosure, it should be understood that, the orientation or the position indicated by terms such as "center", "longitudinal", "lateral", "length", "width", "thickness", "over", "below", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "anti-clockwise", "axial", "radial", and "circumferential" should be construed to refer to the orientation and the position as shown in the drawings, and is only for the convenience of describing the present disclosure and simplifying the description, rather than indicating or implying that the pointed device or element must have a specific orientation, or be constructed and operated in a specific orientation, and therefore cannot be understood as a limitation of the present disclosure.

[0182] In addition, the terms "first" and "second" are only used for descriptive purposes, and cannot be understood as indicating or implying relative importance or implicitly indicating the number of indicated technical features. Therefore, the features associated with "first" and "second" may explicitly or implicitly include one or more of the features. In the description of the present disclosure, "plurality" means two or more, unless otherwise specifically defined.

[0183] In the present disclosure, unless otherwise clearly stipulated and limited, terms such as "mount", "connect", "connect to", "fix", and the like should be understood in a broad sense. For example, it may be a fixed connection or a detachable connection or connection as one piece; mechanical connection or electrical connection; direct connection or indirect connection through an intermediate; internal communication of two components or the interaction relationship between two components. For those skilled in the art, the specific meaning of the above-mentioned terms in the present disclosure can be understood according to specific circumstances.

[0184] In the present disclosure, unless expressly stipulated and defined otherwise, the first feature "on" or "under" the second feature may mean that the first feature is in direct contact with the second feature, or the first and second features are in indirect contact through an intermediate. Moreover, the first feature "above" the second feature may mean that the first feature is directly above or obliquely above the second feature, or simply mean that the level of the first feature is higher than that of the second feature. The first feature "below" the second feature may mean that the first feature is directly below or obliquely below the second feature, or simply mean that the level of the first feature is smaller than that of the second feature.

[0185] Reference throughout this specification to "an embodiment", "some embodiments", "an example", "a specific example", or "some examples" means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. The appearances of the above phrases in various places throughout this specification are not necessarily referring to the same embodiment or example. Further, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. In addition, different embodiments or examples and features of different embodiments or examples described in the specification may be combined by those skilled in the art without mutual contradiction.

[0186] Although the embodiments of the present disclosure have been shown and described above, it should be understood that the above-mentioned embodiments are exemplary and should not be construed as limiting the present disclosure. Those skilled in the art can make changes, modifications, substitutions, and alternations to the above-mentioned embodiments within the scope of the present disclosure.

Claims

1. An electric compressor, comprising:

   a housing component;
   a compression component disposed in the housing component and configured to compress a refrigerant; and
   a motor component disposed in the housing component and configured to drive the compression component to perform a compression operation,
   wherein the housing component comprises a first housing, the compression component being at least partially accommodated in the first housing, the first housing having a refrigerant discharge outlet and an oil separation chamber, and the oil separation chamber having an oil separation inlet in communication with an exhaust outlet of the compression component and an oil separation outlet in communication with the refrigerant discharge outlet.

2. The electric compressor according to claim 1, wherein the first housing is fitted with an outer oil separation tube, at least part of the oil separation chamber being formed by an inner cavity of the outer oil separation tube.

3. The electric compressor according to claim 2, wherein a tapered tube is disposed at a lower end of the outer oil separation tube, a lower end opening of the tapered tube being formed as a first oil return hole, the first oil return hole having a smaller diameter than an inner diameter of the oil separation chamber.

4. The electric compressor according to claim 2 or 3, wherein:

   the first housing has a mounting opening formed on an outer surface of the first housing, the mounting opening being spaced apart from the refrigerant discharge outlet; and
   the outer oil separation tube is adapted to be mounted in the first housing through the mounting opening along an axis of the outer oil separation tube.

5. The electric compressor according to claim 4, wherein:

   the first housing has a first hole segment and a second hole segment that are arranged coaxially;
   two axial ends of the outer oil separation tube are inserted into and engaged with respective ones of the first hole segment and the second hole segment;
   the first hole segment and the second hole segment are spaced apart from each other by a disconnection portion; and
   an end of the second hole segment away from the first hole segment penetrates the outer surface of the first housing to form the mounting opening.

6. The electric compressor according to claim 5, wherein the first housing has a first communication passage, wherein the first communication passage has an end penetrating the outer surface of the first housing to form the refrigerant discharge outlet, and another end connected to an end of the first hole segment away from the second hole segment.

7. The electric compressor according to claim 5 or 6, wherein:

   the first housing has a second communication passage; and
   the oil separation inlet is formed at the first hole segment, and is in communication with the exhaust outlet through the second communication passage.

8. The electric compressor according to any one of claims 2 to 7, further comprising an inner oil separation tube located in the outer oil separation tube, wherein:

   a gas inlet cavity is formed between an inner wall of the outer oil separation tube and an outer wall of the inner oil separation tube;
   the oil separation inlet is formed at the first housing and/or the outer oil separation tube;
   the oil separation inlet extends in a tangential direction of the outer oil separation tube, and is in communication with the gas inlet cavity;
   an inner cavity of the inner oil separation tube is formed as a gas outlet cavity; and
   the gas outlet cavity is in communication with both the refrigerant discharge outlet and the gas inlet cavity.

9. The electric compressor according to claim 8, wherein:

   the inner oil separation tube is fitted to the first housing or connected to the outer oil separation tube; or
   the inner oil separation tube and the first housing are integrally formed.

10. The electric compressor according to claim 1, wherein the oil separation chamber is defined by the first housing.

11. The electric compressor according to claim 10, wherein the oil separation chamber is provided with an oil return device at a lower part of the oil separation chamber, the oil return device having a first oil return hole, the first oil return hole having a smaller hole diameter than an inner diameter of the oil separation chamber.

12. The electric compressor according to claim 3 or 11, wherein a chamber wall of the oil separation chamber has a second oil return hole in communication with the first oil return hole.

13. The electric compressor according to claim 3 or 11, wherein:

an axial spacing between an upper end of the oil separation chamber and the first oil return hole is denoted as L1;
an axial spacing between the oil separation inlet and the first oil return hole is denoted as L2;
an inner oil separation tube is disposed in the oil separation chamber, an inner cavity of the inner oil separation tube being formed as a gas outlet cavity in communication with the oil separation outlet; and
an axial spacing between the inner oil separation tube and the first oil return hole is denoted as L3, where $0.2\ L1 < L3 < L2$.

14. The electric compressor according to claim 1, wherein:

the oil separation chamber has a flow area of S1;
a first oil return hole is formed at a lower part of the oil separation chamber and has a flow area of S3;
an inner oil separation tube is disposed in the oil separation chamber;
an inner cavity of the inner oil separation tube is formed as a gas outlet cavity in communication with the oil separation outlet; and
the gas outlet cavity has a flow area of S2,
wherein S1, S2, and S3 satisfy at least one of $0.025 \leq S2/S1 \leq 0.45$, $0.015 \leq S3/S1 \leq 0.4$, and $0.15 \leq S3/S2 \leq 0.65$.

15. The electric compressor according to any one of claims 1 to 14, wherein:

the oil separation inlet extends in a tangential direction of the oil separation chamber;
an orthographic projection of the oil separation inlet on a projection surface has an area of A, the projection surface being a plane passing through an axis of the oil separation chamber and perpendicular to an axis of the oil separation inlet; and
a part of the orthographic projection located at a side of the oil separation chamber along the axis of the oil separation chamber has an area of B, wherein B/A is greater than or equal to 80%.

16. The electric compressor according to any one of claims 1 to 15, wherein:

the oil separation outlet is formed at a side of the oil separation chamber in an axial direction of the oil separation chamber; and
an extension direction of an axis of the oil separation inlet intersects with a positive extension direction of the axis of the oil separation chamber at an angle θ, where $45° \leq \theta \leq 90°$,
wherein the positive extension direction is a direction directed towards the oil separation outlet in an extension direction of the axis of the oil separation chamber.

17. The electric compressor according to claim 1, wherein a first communication passage is formed at a housing wall of the first housing, the oil separation outlet being in communication with the refrigerant discharge outlet through the first communication passage.

18. The electric compressor according to claim 17, wherein:

an axis of the first communication passage is a straight line;
an axial length of the first communication passage is smaller than an axial length of the oil separation chamber; and
the axis of the first communication passage overlaps or intersects with an axis of the oil separation chamber.

19. The electric compressor according to claim 18, wherein:

an axis of the first housing extends transversely;
the first communication passage is located at a top of the first housing and extends vertically;
the first communication passage has an upper end penetrating the top of the first housing to form the refrigerant discharge outlet; and
the oil separation chamber extends obliquely downwards from a lower end of the first communication passage.

20. An air conditioning system, comprising the electric compressor according to any one of claims 1 to 19.

21. A vehicle, comprising:

a vehicle body; and

the air conditioning system according to claim 20, the air conditioning system being mounted at the vehicle body.

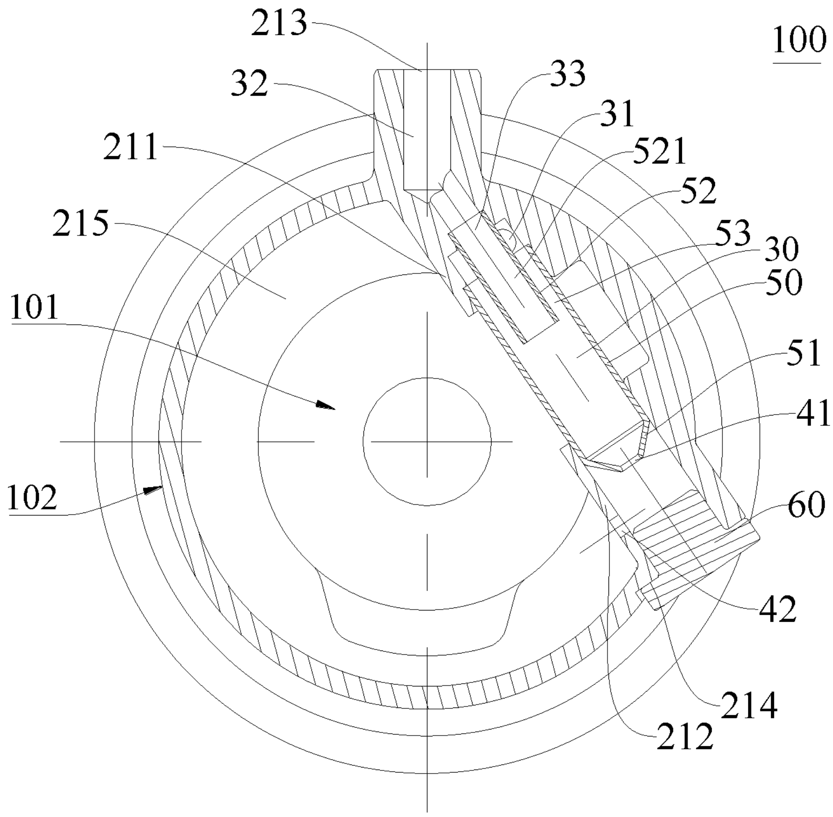
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FIG. 1

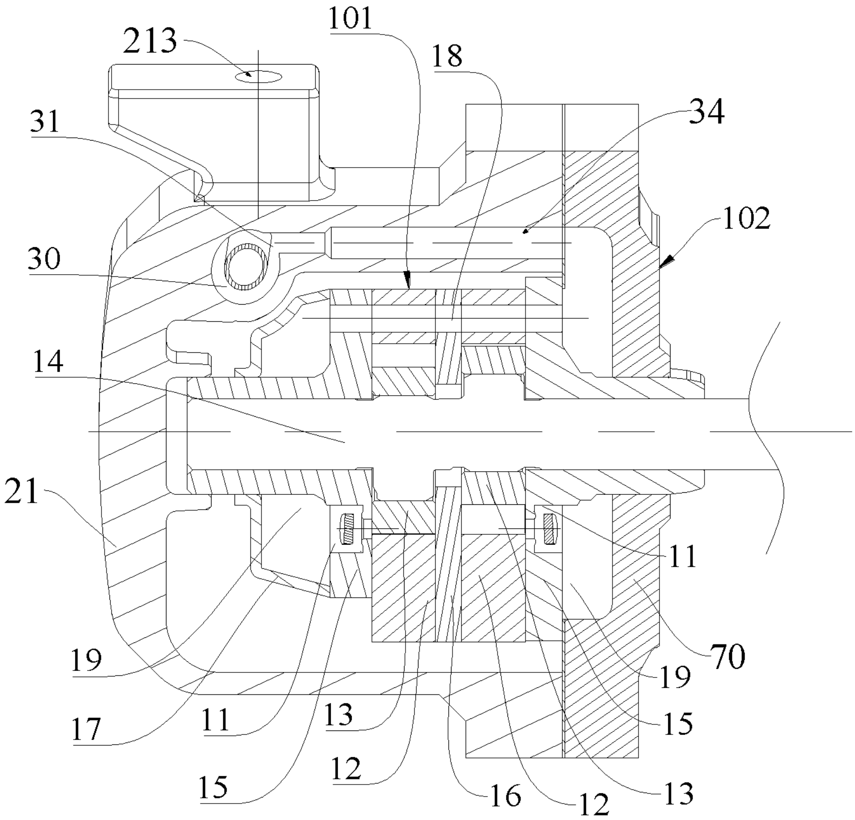
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FIG. 2

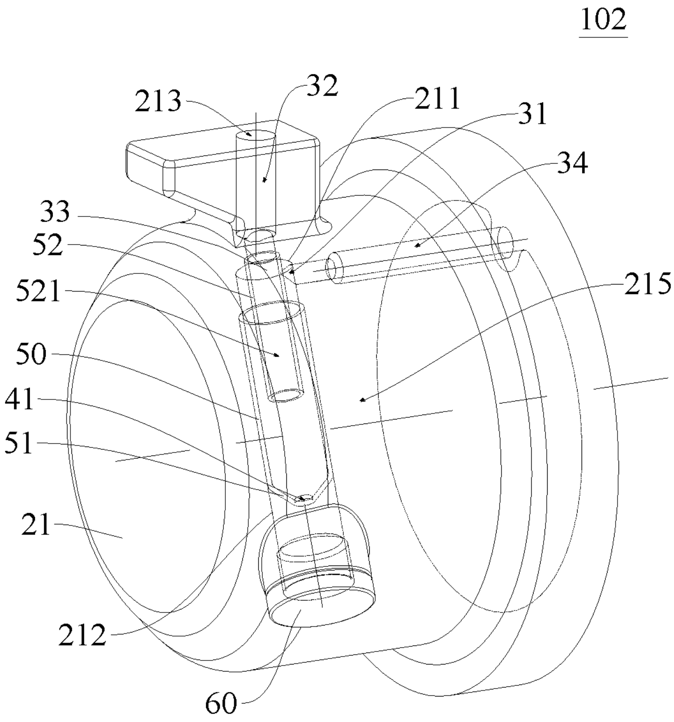
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FIG. 3

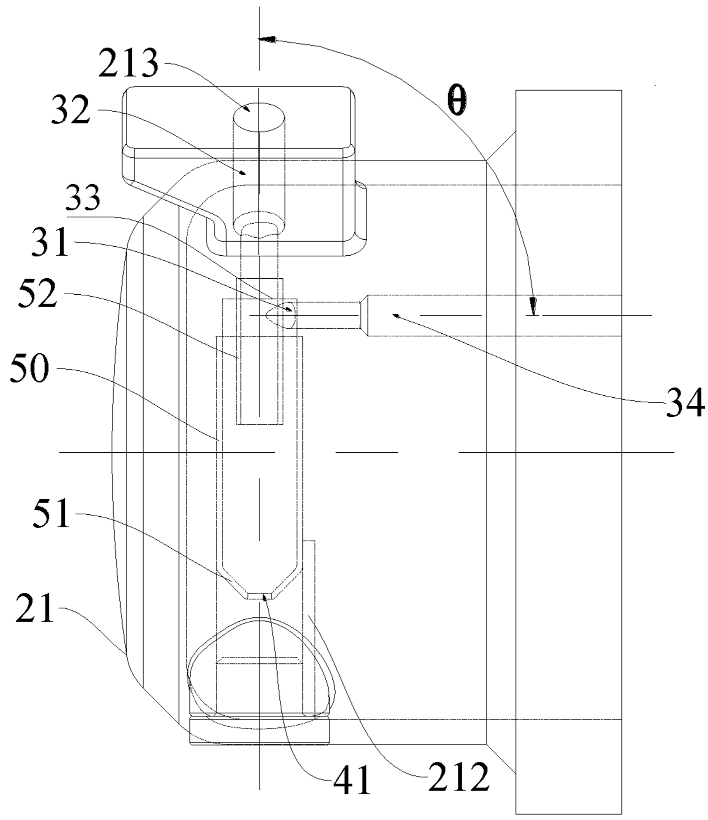
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FIG. 4

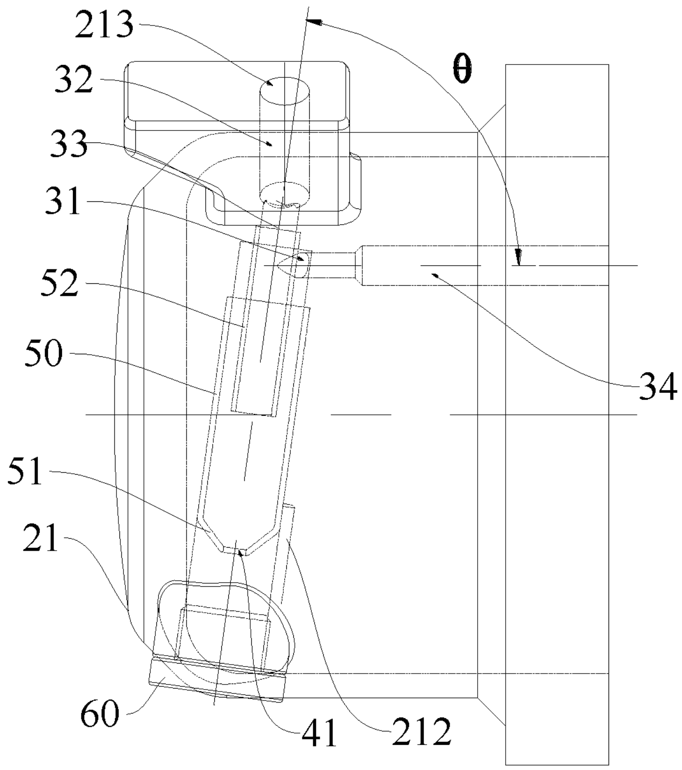
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FIG. 5

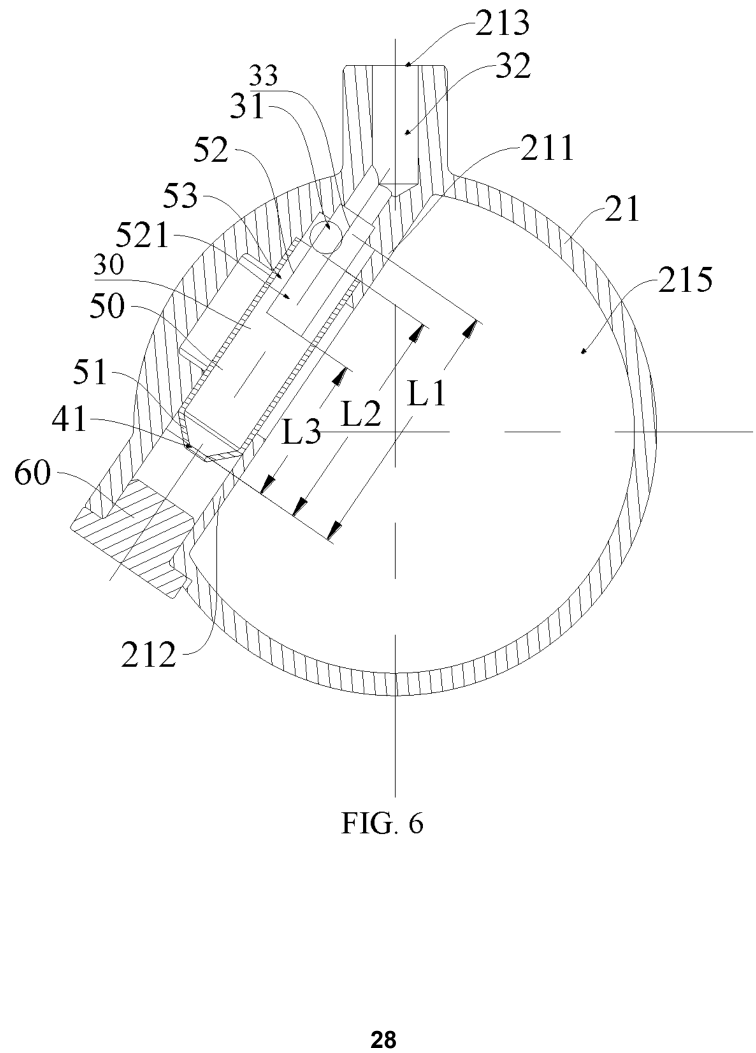
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FIG. 6

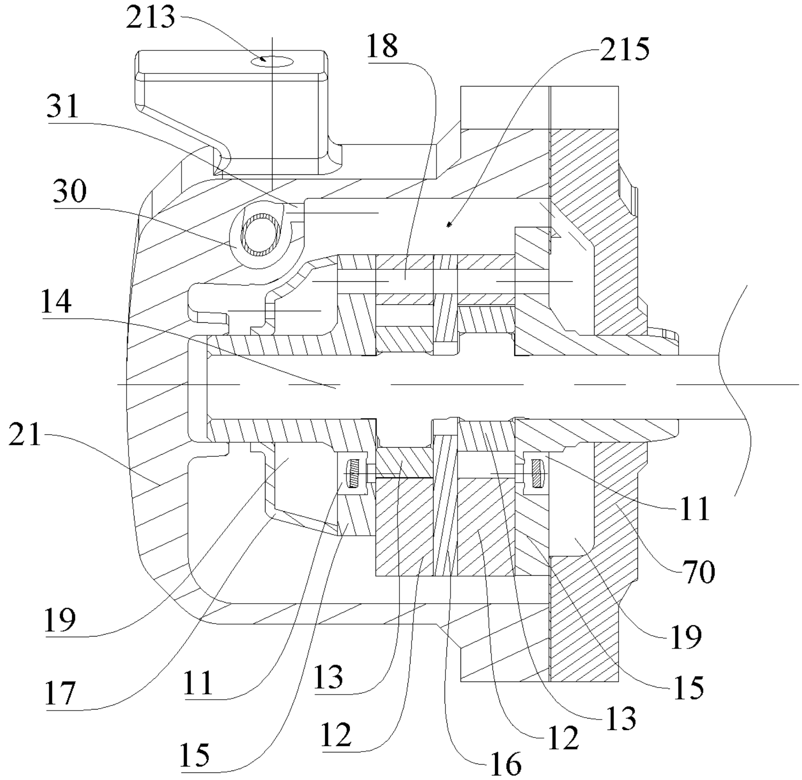
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FIG. 7

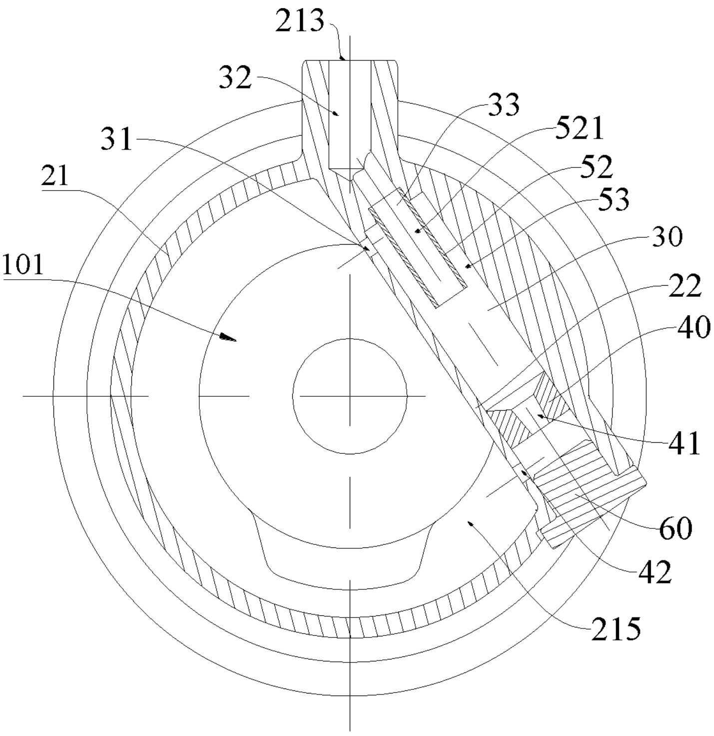
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FIG. 8

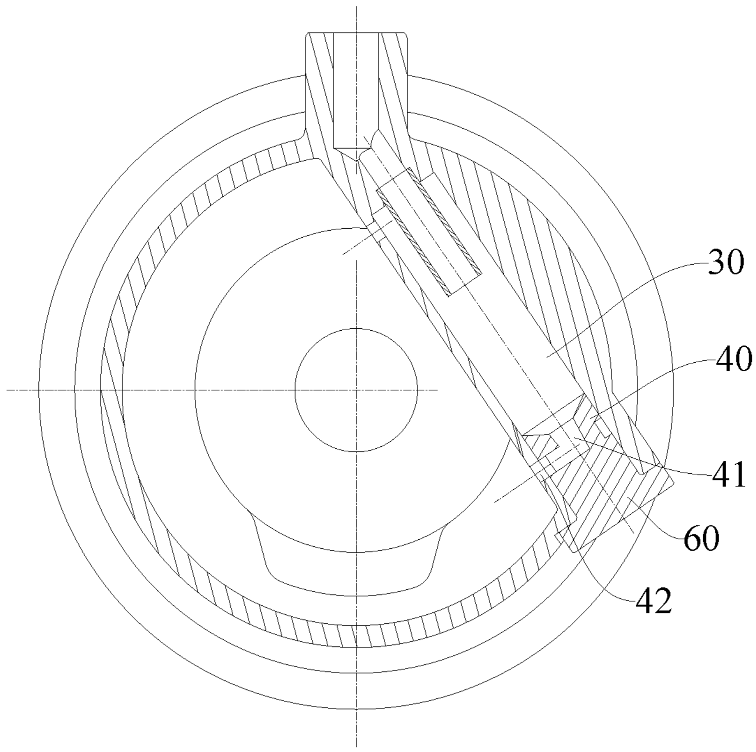

FIG. 9

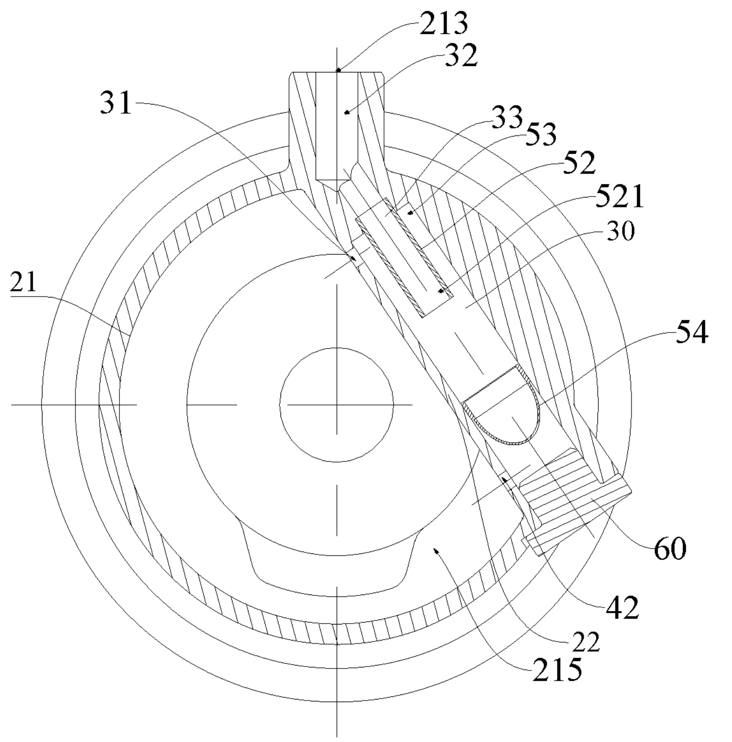

FIG. 10

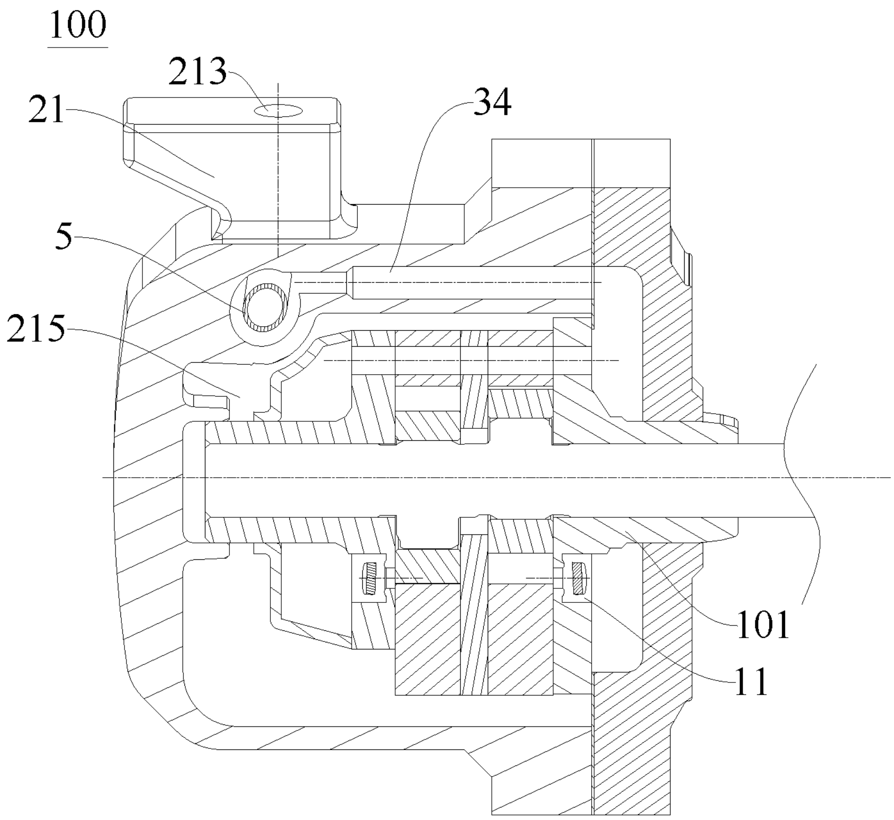
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FIG. 11

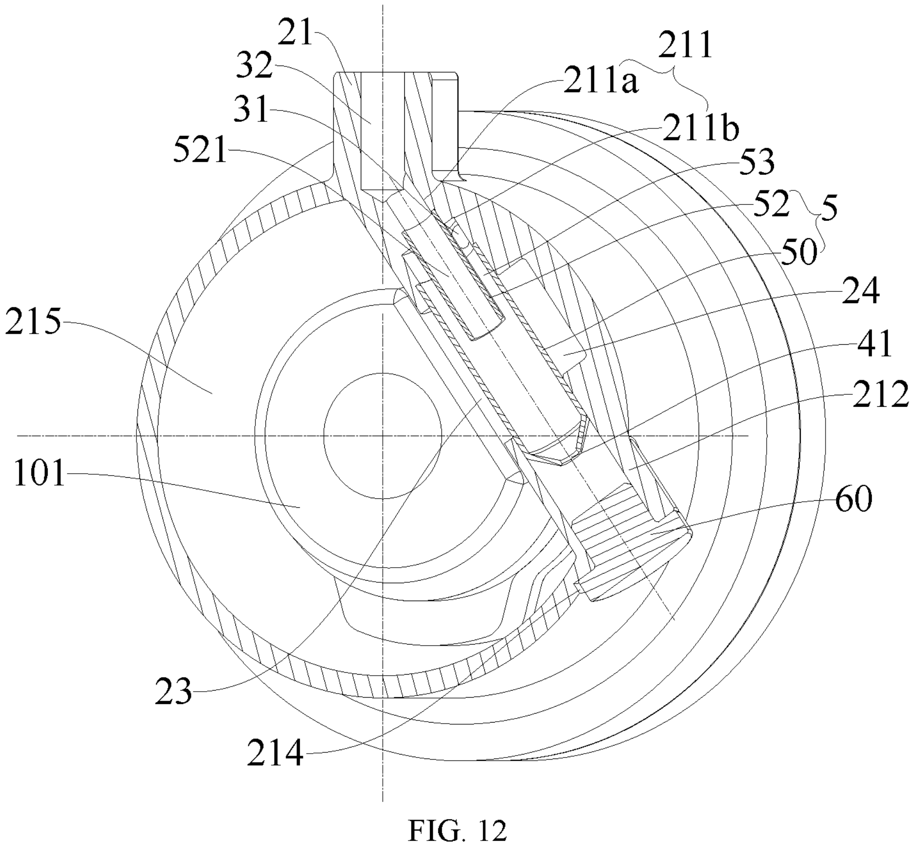
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FIG. 12

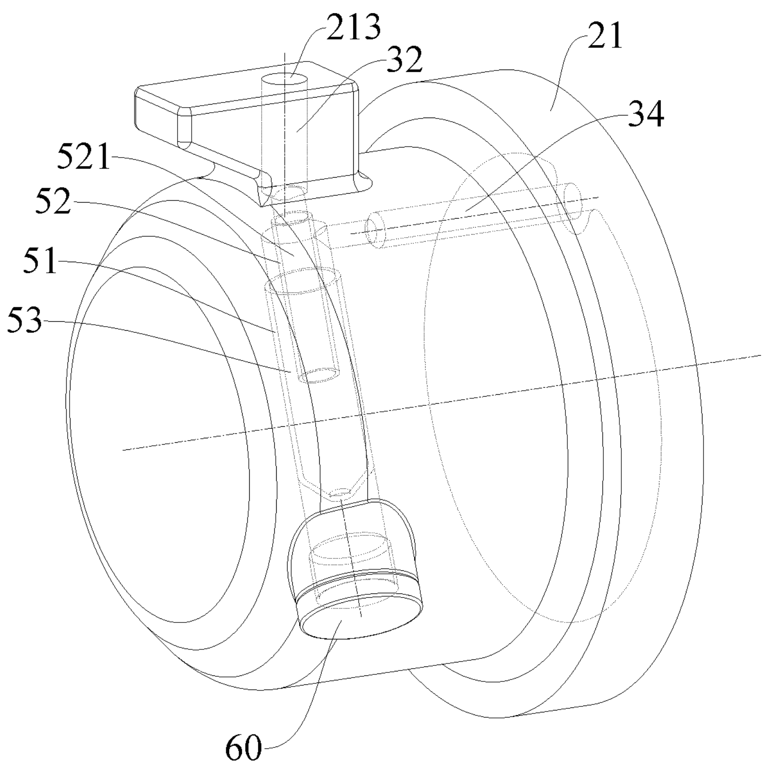

FIG. 13

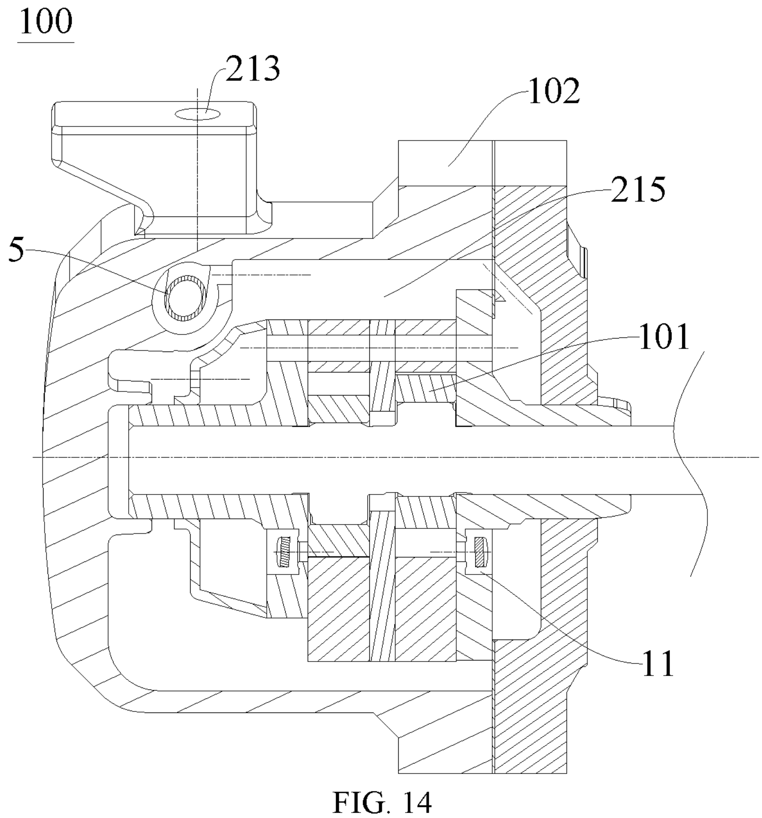

FIG. 14

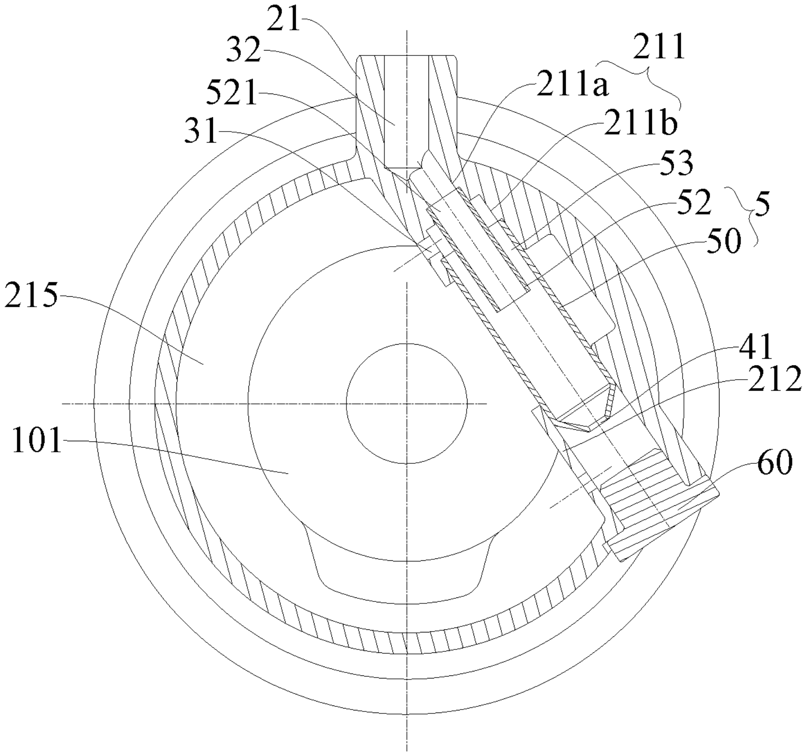
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FIG. 15

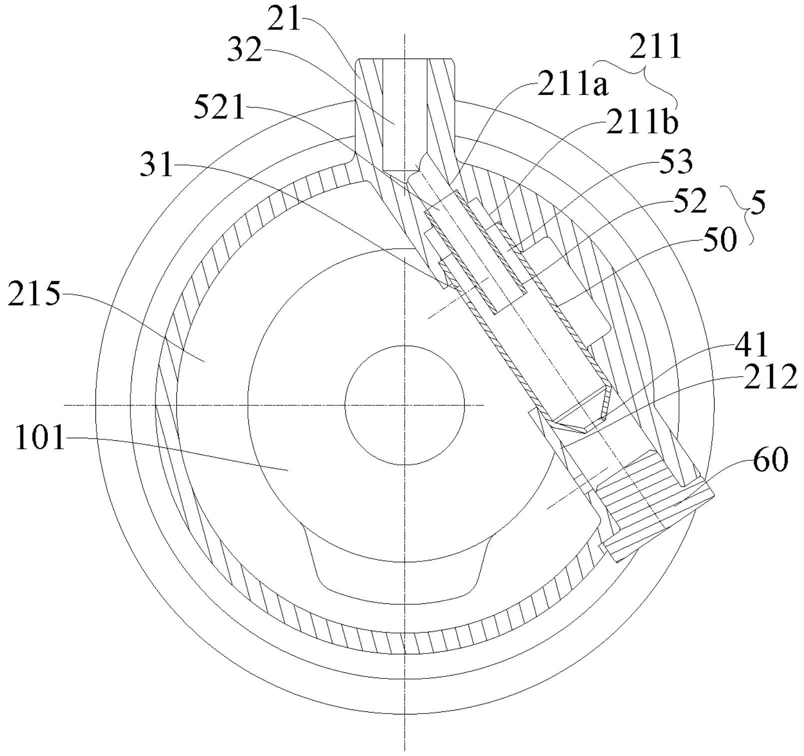
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FIG. 16

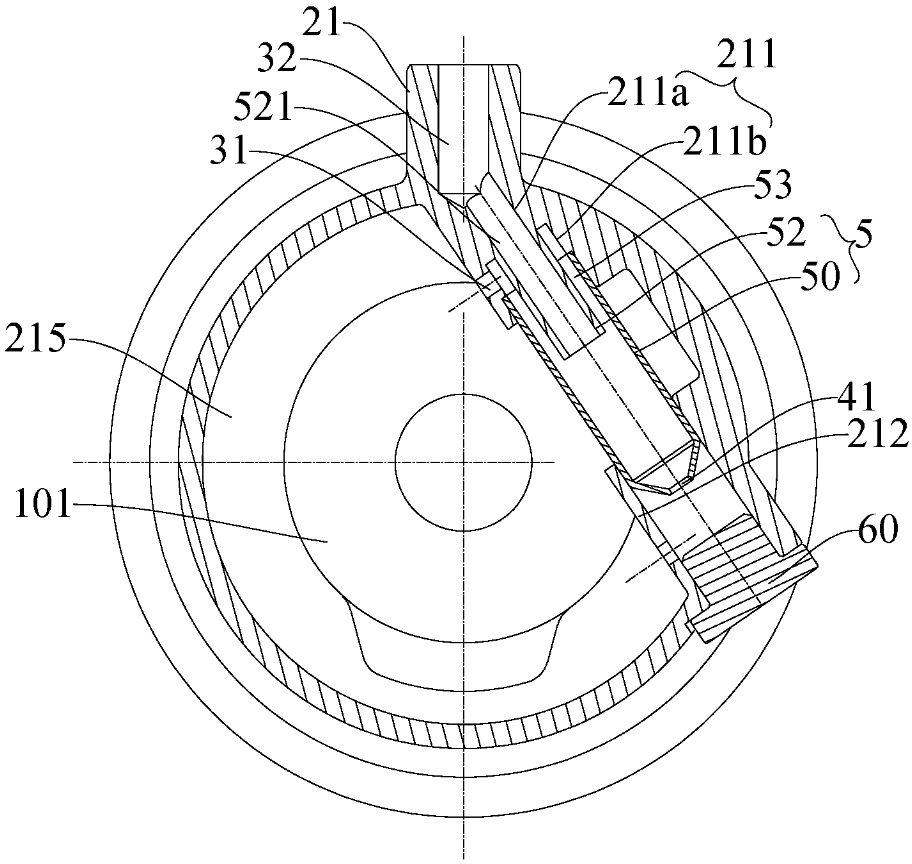
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FIG. 17

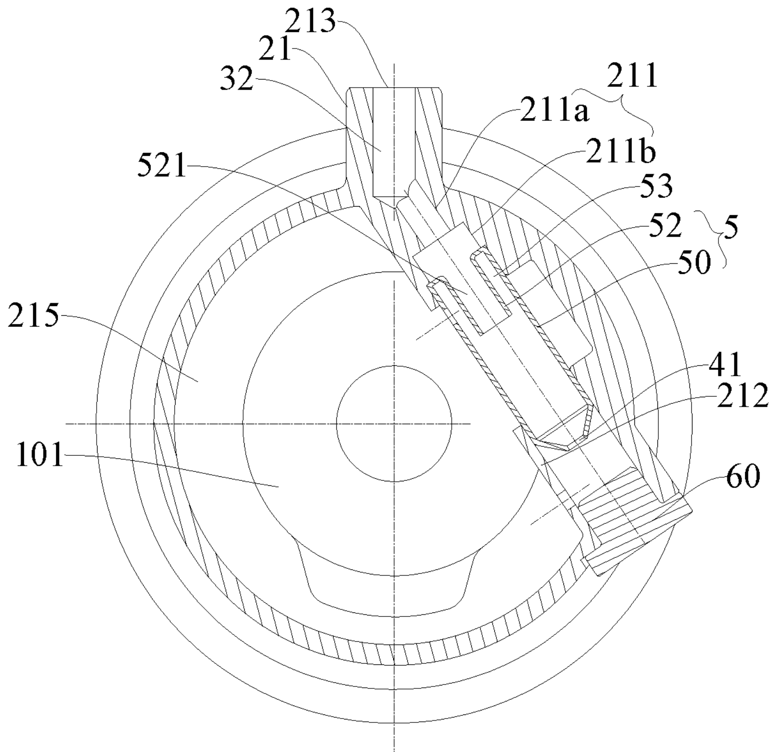
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FIG. 18

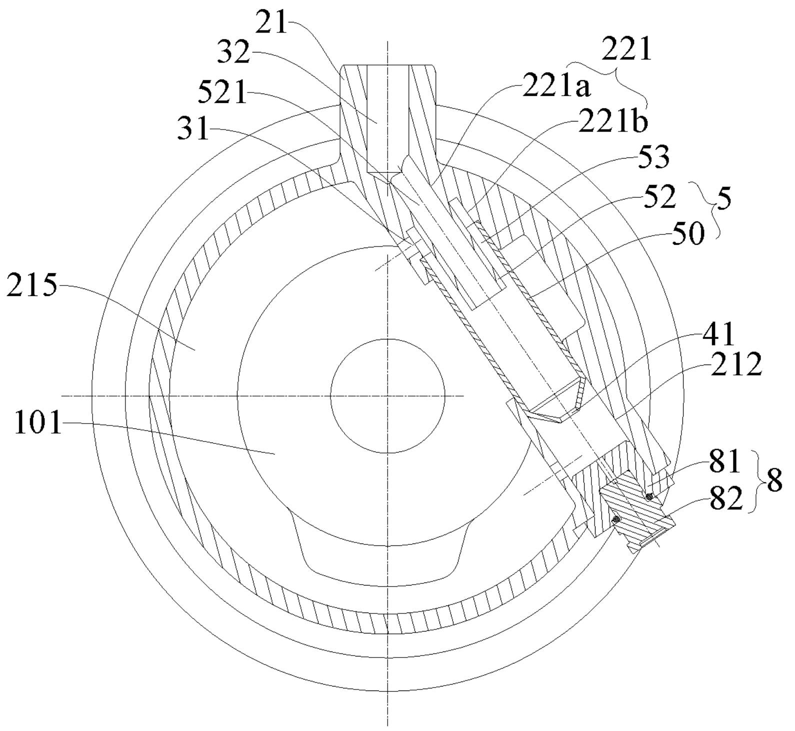
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FIG. 19

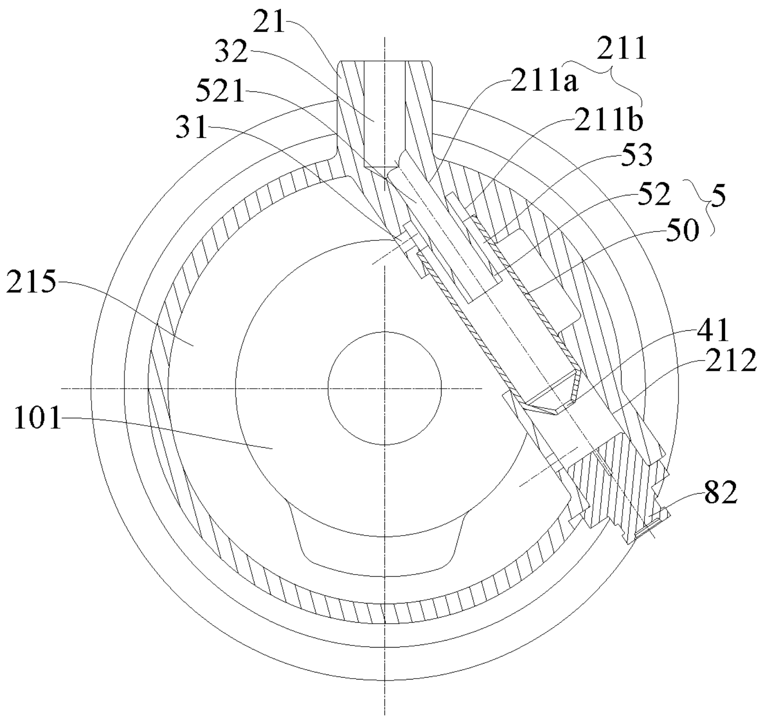
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FIG. 20

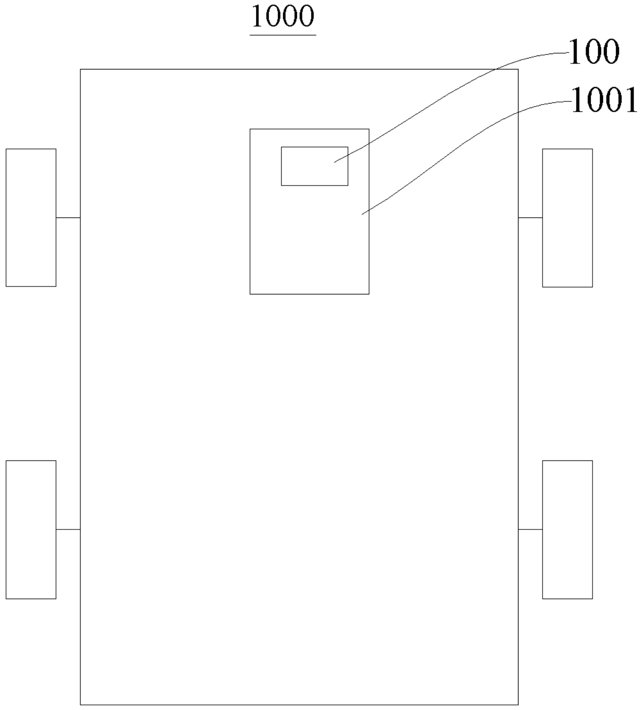

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/081738

A. CLASSIFICATION OF SUBJECT MATTER

F04C23/02(2006.01)i；F04C29/02(2006.01)i；F04C29/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:F04C,F04B,F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT, VEN, CNKI: 压缩机, 壳, 油分, 分离, compressor, housing, oil w separator, separat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 218325285 U (ANHUI WELLING AUTO PARTS CO., LTD.) 17 January 2023 (2023-01-17) claims 1-15, and figures 1-10	1-11, 17-21
PX	CN 218325274 U (ANHUI WELLING AUTO PARTS CO., LTD.) 17 January 2023 (2023-01-17) claims 1-16, and figures 1-10	1-21
X	CN 110259686 A (GUANGDONG WEILING AUTOMOBILE PARTS CO., LTD.) 20 September 2019 (2019-09-20) description, paragraphs [0065]-[0144], and figures 1-24	1-21
A	US 2022112897 A1 (GUANGDONG MEIZHI PRECISION-MANUFACTURING CO., LTD.) 14 April 2022 (2022-04-14) entire document	1-21
A	WO 2022001019 A1 (GUANGDONG MEIZHI PRECISION-MANUFACTURING CO., LTD.) 06 January 2022 (2022-01-06) entire document	1-21

☐ 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
- "D" document cited by the applicant in the international application
- "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

Date of the actual completion of the international search	Date of mailing of the international search report
06 June 2023	**18 June 2023**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/081738

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	218325285	U	17 January 2023	None			
CN	218325274	U	17 January 2023	None			
CN	110259686	A	20 September 2019	None			
US	2022112897	A1	14 April 2022	WO	2022001019	A1	06 January 2022
				EP	3964712	A1	09 March 2022
				EP	3964712	A4	10 August 2022
WO	2022001019	A1	06 January 2022	None			

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202210714055 **[0001]**
- CN 202221588899X **[0001]**
- CN 202210714054 **[0001]**
- CN 202221588912 **[0001]**