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(54) **SCROLL COMPONENT OF COMPRESSION MECHANISM, COMPRESSION MECHANISM, AND SCROLL COMPRESSOR**

(57) A scroll component of a compression mechanism, a compression mechanism having the scroll component, and a scroll compressor. A scroll blade (10, 20, 30, 40, 50, 60) of the scroll component comprises a compression section (102, 202, 302, 402, 502, 602) and an extension section (104, 204, 304, 404, 504, 604), which are connected to each other, wherein the compression section is located on an inner side of the extension section in a profile line direction; the radial thickness of the extension section is less than the radial thickness of the compression section; and a material-removed section (107, 207, 306, 406, 506, 606) is formed at the extension section, and a chamber constructed by the extension section is in communication with a low-pressure environment outside a compression mechanism via the material-removed section. Therefore, the effect of improving the fatigue strength is achieved.

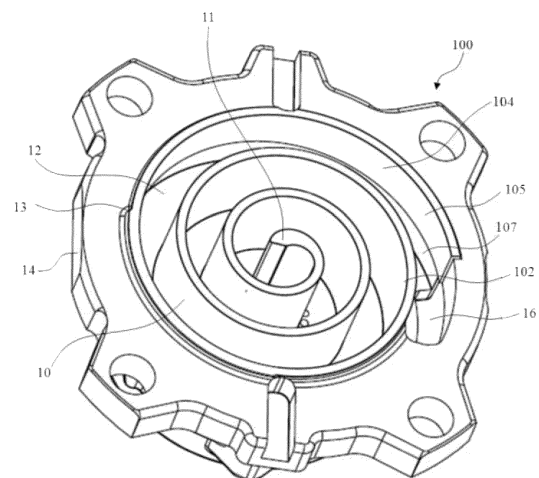


FIG. 1a

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Description

[0001] The present application claims the priority to Chinese Patent Application No. 202210416181.0, titled "SCROLL COMPONENT, COMPRESSION MECHANISM, AND SCROLL COMPRESSOR", filed with the China National Intellectual Property Administration on April 20, 2022; and the priority to Chinese Patent Application No. 202220922030.8, titled "SCROLL COMPONENT OF COMPRESSION MECHANISM, COMPRESSION MECHANISM, AND SCROLL COMPRESSOR", filed with the China National Intellectual Property Administration on April 20, 2022, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to a scroll component, and in particular, to a scroll component with high fatigue strength. In addition, the present disclosure also relates to a compression mechanism including the scroll component, and a scroll compressor including the compression mechanism.

BACKGROUND

[0003] A scroll compressor generally includes a housing, a driving mechanism accommodated in the housing, a compression mechanism driven by the driving mechanism, a main bearing seat supporting the compression mechanism, and the like. The compression mechanism generally includes an orbiting scroll and a fixed scroll engaged with each other to form a series of compression chambers for compression between the orbiting scroll and the fixed scroll. When a driving shaft of the driving mechanism rotates, the orbiting scroll may be driven by a crank pin of the driving shaft, so that the orbiting scroll can perform translational rotation relative to the fixed scroll. In other words, the axis of the orbiting scroll orbits in a circular track relative to the axis of the fixed scroll, but both the orbiting scroll and the fixed scroll themselves do not rotate around their respective axes.

[0004] During the translational motion of the orbiting scroll around the fixed scroll, a blade of the orbiting scroll and a blade of the fixed scroll are in contact with each other and sealed in a radial direction and subjected to a lateral contact force. During the translation of the orbiting scroll by one revolution, the number of contact pairs between the orbiting scroll blade and the fixed scroll blade varies between 4 and 6. Therefore, in the case that the total lateral contact force is substantially constant, when the number of contact pairs between the orbiting scroll blade and the fixed scroll blade is four, the lateral contact force shared by each contact pair is the largest, and the scroll blade is prone to failure at the contact pairs or even complete fracture. Especially for a large inverter compressor, when the rotating speed exceeds for example 6000RPM, it is particularly easy

for the scroll blade to fracture.

[0005] Therefore, there is a need for a design to improve the fatigue strength of the scroll blade, in order to solve the problem that the scroll blade fails when the scroll compressor, especially the large inverter scroll compressor has a high rotating speed.

SUMMARY

[0006] This section provides a general summary of the present disclosure, rather than a comprehensive disclosure of the full scope of the present disclosure or all features of the present disclosure.

[0007] An object of the present disclosure is to provide a scroll component, a compression mechanism including the scroll component, and a scroll compressor including the compression mechanism. A scroll blade of the scroll component includes an extension portion, which can be in contact with another scroll blade that is engaged with the scroll blade, as a result the number of contact pairs between two scroll blades engaged with each other may be increased, thereby effectively reducing the radial load borne by each contact pair and thus improving the fatigue strength of the scroll component and reducing the risk of failure of the scroll component, while the displacement and pressure ratio of the compression mechanism can be substantially not affected.

[0008] Another object of the present disclosure is to provide a scroll component, a compression mechanism including the scroll component, and a scroll compressor including the compression mechanism. The scroll blade of the scroll component not only has high fatigue strength, but also the power consumption of the scroll component is not significantly increased.

[0009] Another object of the present disclosure is to provide a scroll component, a compression mechanism including the scroll component, and a scroll compressor including the compression mechanism. The scroll component is simple in structure, easy to produce and process, and low in cost.

[0010] According to one aspect of the present disclosure, there is provided a scroll component of a compression mechanism, which includes an end plate and a scroll blade. The scroll blade is formed on one side of the end plate and extends from an approximate center of the end plate in a spiral profile line direction from an inner side to an outer side. The scroll blade includes a compression section and an extension section connected to each other, the compression section is located on an inner side of the extension section in the profile line direction, and the compression section is configured for constructing a chamber for compression operation. The extension section has a radial thickness smaller than that of the compression section, and the extension section is formed with a material-removed part, and a chamber constructed by the extension section can be communicated with a low-pressure environment outside the compression mechanism via the material-removed part.

[0011] Optionally, the scroll component is a fixed scroll, the fixed scroll further includes an outer peripheral wall provided around the scroll blade, and the extension section is provided to closely abut against a radial inner surface of the outer peripheral wall.

[0012] Optionally, the extension section is provided in a region of maximum stiffness of the outer peripheral wall.

[0013] Optionally, the outer peripheral wall is formed with an air suction window for allowing working fluid to enter the compression mechanism, and the extension section extends to the air suction window in the profile line direction, so that the outermost contact point of the scroll blade in the profile line direction is already in contact state while the innermost contact point of the scroll blade in the profile line direction is not yet out of contact state during operation of the compression mechanism.

[0014] Optionally, the material-removed part is configured as an upper side portion or a lower side portion of the extension section in an axial direction having material removed, so the scroll blade has a step shape in the axial direction.

[0015] Optionally, the angle along which the extension section extends in the profile line direction is greater than or equal to 20° and less than 120° .

[0016] Optionally, the material-removed part is configured as one or more orifices penetrating through the extension section in a thickness direction thereof, and the orifice is aligned with and communicated with a through-hole formed in the outer peripheral wall, which is in direct communication with the low-pressure environment outside the compression mechanism.

[0017] Optionally, the orifice is arranged along the profile line direction or along an axial direction, the orifice is formed as multiple circular holes or a single elongated slot.

[0018] Optionally, the material-removed part is configured as an elongated slot, which penetrates through the extension section in a thickness direction thereof and extends up to an outer end of the extension section in the profile line direction.

[0019] Optionally, the elongated slot is communicated with a communication groove formed in the outer peripheral wall, the communication groove extends outward from an outer end of the elongated slot. The outer peripheral wall is formed with an air suction window for allowing the working fluid to enter the compression mechanism, and the communication groove is configured as a through-hole directly communicated with the low-pressure environment outside the compression mechanism; or alternatively the communication groove is configured as a semi-groove that is recessed from the radial inner surface of the outer peripheral wall and communicated with the air suction window.

[0020] According to another aspect of the present disclosure, there is provided a compression mechanism including a fixed scroll and an orbiting scroll engaged with each other to form a series of compression chambers between the fixed scroll and the orbiting scroll,

wherein the fixed scroll or the orbiting scroll is configured as the scroll component described above.

[0021] Optionally, the extension section of the scroll blade of one of the fixed scroll and the orbiting scroll can come into contact with the other of the fixed scroll and the orbiting scroll, but the extension section is not used to form the compression chamber.

[0022] According to yet another aspect of the present disclosure, there is provided a scroll compressor, wherein the scroll compressor includes the compression mechanism described above.

[0023] Generally speaking, the scroll component, the compression mechanism including the scroll component, and the scroll compressor including the compression mechanism according to the present disclosure bring at least one of the following beneficial effects. Since the scroll blade of the scroll component is configured with an extension section, the extension section can increase the contact points between the scroll blade and another scroll blade engaged therewith, thereby the fatigue strength of the scroll component is improved, which is particularly suitable for a large inverter compressor with a rotating speed exceeding for example 6000RPM. The extension section of the scroll blade has a material-removed part, so that the extension section is prevented from participating in compression, and the influence on the displacement and pressure ratio of the compression mechanism is minimized. The extension section of the scroll blade is directly communicated with the low-pressure environment outside the compression mechanism via a material-removed part (such as a hole or a slot), so as to avoid increasing the compression power consumption and to further ensure the efficiency of the compressor. The scroll component with the extension section is simple in structure, easy to process and manufacture and low in production cost, and has a wide application range.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The features and advantages of one or more embodiments of the present disclosure will be more easily understood through the following description with reference to the accompanying drawings. The accompanying drawings provided herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way. The accompanying drawings are not drawn to scale, but some features may be enlarged or reduced to show details of specific components. In the accompanying drawings:

FIG. 1a is a top perspective view of a fixed scroll according to a first embodiment of the present disclosure;

FIG. 1b is a top perspective view of the fixed scroll according to the first embodiment of the present disclosure from another angle;

FIG. 2 is a longitudinal sectional view of the fixed scroll according to the first embodiment of the present disclosure;

FIG. 3a and FIG. 3b respectively show radial sectional views of a compression mechanism according to the first embodiment of the present disclosure at time T1 immediately after the compression mechanism begins to exhaust and at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust;

FIG. 4a and FIG. 4b respectively show radial sectional views of a compression mechanism in a comparative example at time T1 immediately after the compression mechanism begins to exhaust and at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust;

FIG. 5 is a top perspective view of a fixed scroll according to a second embodiment of the present disclosure;

FIG. 6 is a radial sectional view of a compression mechanism according to the second embodiment of the present disclosure;

FIG. 7 is a top perspective view of a fixed scroll according to a third embodiment of the present disclosure;

FIG. 8a and FIG. 8b respectively show radial sectional views of a compression mechanism according to the third embodiment of the present disclosure at time T1 immediately after the compression mechanism begins to exhaust and at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust;

FIG. 9 is a top perspective view of a fixed scroll according to a fourth embodiment of the present disclosure;

FIG. 10 is a top perspective view of a fixed scroll according to a fifth embodiment of the present disclosure;

FIG. 11a is a top perspective view of a fixed scroll according to a sixth embodiment of the present disclosure; and

FIG. 11b is a radial sectional view of the fixed scroll according to the sixth embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0025] Preferred embodiments of the present disclosure

are described below with reference to the accompanying drawings, the description of the embodiments are merely exemplary and do not constitute limitations on the present disclosure and its application.

[0026] Typically, a scroll compressor (hereinafter sometimes referred to as a compressor) includes: a housing; a compression mechanism consisting of a fixed scroll and an orbiting scroll; a main bearing seat; a drive shaft and a motor for driving the compression mechanism, and the like. One end of the driving shaft adjacent to the orbiting scroll is provided with an eccentric crank pin. The eccentric crank pin is inserted into a hub portion of the orbiting scroll, and an unloading bushing may be provided between the eccentric crank pin and the hub portion to provide radial flexibility for the compression mechanism. In addition, a driving bearing is also provided between the unloading bushing and the hub portion of the orbiting scroll. Driven by the motor, the driving shaft causes the orbiting scroll to perform translational rotation with respect to the fixed scroll (that is, a central axis of the orbiting scroll orbits about the central axis of the fixed scroll, but the orbiting scroll itself does not rotate around its own central axis) through the eccentric crank pin, unloading bushing and driving bearing, so as to compress a working fluid. The above-mentioned orbiting motion is realized by a cross slip ring.

[0027] The orbiting scroll includes an end plate, a hub portion formed on one side of the end plate, and a spiral scroll blade 90 formed on the other side of the end plate (see, for example, FIG. 3a). Referring to FIG. 1a and FIG. 1b, a fixed scroll 100 according to a first embodiment of the present disclosure includes an end plate 12, a spiral scroll blade 10 formed on one side of the end plate 12, and an exhaust port 18 formed at an approximate center of the end plate 12. A series of chambers for compression operation (hereinafter referred to as compression chambers) of which volumes gradually decrease from a radial outer side to a radial inner side are formed between the scroll blades 10 of the fixed scroll 100 and the scroll blades 90 of the orbiting scroll. The fixed scroll 100 further includes an outer peripheral wall 14 provided around the scroll blade 10, and an air suction window 16 is provided at the outer peripheral wall 14 and/or the end plate 12 (in FIG. 1a, the air suction window 16 includes a portion formed at the outer peripheral wall 14 and a portion formed at the end plate 12), so that the working fluid enters the compression chambers via the air suction window 16 and is discharged via the exhaust port 18 after being compressed in the compression chambers.

[0028] Specifically, referring to FIG. 1a and FIG. 1b, the scroll blade 10 extends from the approximate center of the end plate 12 in a spiral profile line direction from an inner side to an outer side, that is, an innermost end 11 of the scroll blade 10 is located at the approximate center of the end plate 12 (near the exhaust port 18), and an outermost end of the scroll blade 10 opposite to the innermost end 11 is located near a radial outer periphery of the end plate 12. In its profile line direction, the scroll

blade 10 includes a compression section 102 and an extension section 104 connected to each other, and the compression section 102 is located on an inner side of the extension section 104. The compression section 102 herein refers to a section of the scroll blade configured for constructing the chamber for compression operation, that is, the compression section 102 meshes with the scroll blade 90 of the orbiting scroll to form the compression chambers. The extension section 102 continues to extend outwardly in the profile line direction from the outermost end of the compression section 102. Therefore, the extension section 104 and a portion of the compression section 102 together form an outermost coil blade of the scroll blade 10. The outer peripheral wall 14 surrounds the outermost coil blade of the scroll blade 10.

[0029] As shown in FIG. 2, the extension section 104 is not configured to extend over the entire axial height of the compression section 102, but rather includes a material-removed part 107. Specifically, a lower portion of the extension section 104 in an axial direction has material removed to form the material-removed part 107, and an upper portion 105 of the extension section 104 in the axial direction extends from the compression section 102 to the air suction window 16. That is, the extension section 104 has an axial step part 103 in the axial direction. When the scroll blade 90 of the orbiting scroll meshes with the extension section 104 (i.e., with the upper portion 105 of the extension section 104) to form a chamber, the chamber is kept in communication with the air suction window 16 through the material-removed part 107, so that the working fluid will not be compressed, and thus the extension section will not affect the displacement and pressure ratio of the compression mechanism (i.e., the displacement and pressure ratio of the compression mechanism are only related to the compression section), and no additional compression power consumption is generated. Preferably, a radial inner surface of the extension section 104 (i.e., of the upper portion 105 of the extension section 104) is flush with a radial inner surface of the compression section 102 and maintains the same machining accuracy, thereby the smooth orbiting of the orbiting scroll relative to the fixed scroll is ensured, and the radial support of the fixed scroll to the orbiting scroll is ensured.

[0030] As shown in FIG. 1a and FIG. 1b, a thickness of the extension section 104 (i.e., a thickness of the upper portion 105 of the extension section 104) in a radial direction is smaller than that of the compression section 102, so that a step part 13 in the profile line direction is formed at a junction of a radial outer surface of the extension section 104 and a radial outer surface of the compression section 102. Thus, the extension section 104 may be provided to closely abut against a radial inner surface of the outer peripheral wall 14 so as to provide radial support for the orbiting scroll when the radial inner surface of the extension section 104 (i.e., of the upper portion 105 of the extension section 104) comes into

contact with a radial outer surface of the blade 90 of the orbiting scroll.

[0031] The operating conditions and advantages of the compression mechanism according to the first embodiment of the present disclosure will be described below with reference to FIG. 3a and FIG. 3b and in conjunction with the compression mechanism according to a comparative example shown in FIG. 4a and FIG. 4b.

[0032] FIG. 3a and FIG. 3b respectively show radial sectional views of a compression mechanism according to the first embodiment of the present disclosure at time T1 immediately after the compression mechanism begins to exhaust and at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust. During the translational rotation of the orbiting scroll around the fixed scroll, the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 come into contact with each other, and the number and position of contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 change continuously with the motion of the orbiting scroll, and the number of contact points between them is usually in a range of 4 to 6. Obviously, in the case that the operating conditions of the compression mechanism remain unchanged, the total lateral support force between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll remains essentially unchanged, so the less the number of contact points is, and the greater the radial load shared at a single contact point is. When the number of contact points between them is four, the radial load shared at a single contact point is the greatest, and the scroll component is most likely to fail at this time. As shown in FIG. 3a, at time T1 immediately after the compression mechanism begins to exhaust, the innermost contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 have just separated, and there are four contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100, as shown by the circles in the figure, and the total lateral contact force between the orbiting scroll and the fixed scroll 100 is jointly provided by these four contact points. As shown in FIG. 3b, at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust, and there are five contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100, as shown by the circles in the figure. Four contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 close to the inner side are located between the scroll blade 90 of the orbiting scroll and the compression section 102 of the scroll blade 10 of the fixed scroll 100, while the outermost contact point between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 (as shown by the circle X in FIG. 3b) is located in the extension section 104 of the scroll blade 10 of the fixed scroll 100. That is, at this moment, the scroll blade 90 of the orbiting scroll is in

contact with the upper portion 105 of the extension section 104 of the scroll blade 10 of the fixed scroll 100, and sufficient radial support is provided for the scroll blade 90 of the orbiting scroll by means of the upper portion 105 and the outer peripheral wall 14 (it may also include an outer structure of the outer peripheral wall) against which the upper portion 105 abuts.

[0033] In contrast, in the compression mechanism according to a comparative example shown in FIG. 4a and FIG. 4b, the scroll component, especially the scroll blade 10' of the fixed scroll 100', is not provided with an extension section (i.e., it includes only a compression section). As shown in FIG. 4a, at time T1 immediately after the compression mechanism begins to exhaust, the innermost contact points between the scroll blade 90' of the orbiting scroll and the scroll blade 10' of the fixed scroll 100' have just separated, and there are four contact points, as shown by the circles in the figure, between the scroll blade 90' of the orbiting scroll and the scroll blade 10' of the fixed scroll 100', and the total lateral contact force between the orbiting scroll and the fixed scroll 100 is jointly provided by these four contact points. At this time, there is no obvious difference from the radial load distribution of the compression mechanism according to the present disclosure shown in FIG. 3a. However, as shown in FIG. 4b, at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust, there are only four contact points, as shown by the solid circle in the figure, between the scroll blade 90 of the orbiting scroll and the scroll blade 10' of the fixed scroll 100'. Since the scroll blade 10' of the fixed scroll 100' does not include an extension section, there is no contact between the outermost coil blade of the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100, that is, there is no contact at the position where contact may occur in the compression mechanism according to the present disclosure as shown in FIG. 3b (as shown by the dashed circle X' in FIG. 4b). Therefore, at this time T2, the number of the contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 according to the first embodiment of the present disclosure is increased by one compared with that of the comparative example, thus the radial load shared at a single contact point is reduced, thereby improving the fatigue strength of the scroll blade and effectively avoiding the failure of the scroll component.

[0034] In the first embodiment of the present disclosure, due to the design of the extension section of the fixed scroll, the time of having four radial contact points between the scroll blade of the orbiting scroll and the scroll blade of the fixed scroll can be effectively reduced, and the outer peripheral wall of the fixed scroll is used to provide radial support for the orbiting scroll blade, thereby improving the fatigue strength of the scroll component and minimizing the risk of failure of the scroll component. It can be found through experiments that the fatigue strength of the fixed scroll according to the first embodiment of the present disclosure is improved by 18%. On

the other hand, since the extension section includes the material-removed part communicated with the air suction window, the extension section will not affect the original displacement and pressure ratio of the compression mechanism, and will not incur additional power consumption.

[0035] Preferably, in the first embodiment according to the present disclosure, the extension section 104 is provided in a region where the rigidity of the outer peripheral wall of the fixed scroll is the largest, for example, the region where the rigidity of the outer peripheral wall of the fixed scroll is the largest refers to a region where the radial thickness of the outer peripheral wall is the largest. In this region, the radial thickness of the outer peripheral wall is significantly greater than the radial thickness of the compression section 102 of the fixed scroll blade, so that the contact point between the extension section 104 and the orbiting scroll blade can bear more lateral support force than other contact point between the compression section 102 and the orbiting scroll blade, thereby improving the fatigue strength of the scroll component.

[0036] Although it is shown in FIG. 1a and FIG. 1b that the extension section 104 extends from the outermost end of the compression section 102 in the profile line direction to the air suction window 16, the extension section 104 may extend a predetermined distance in the profile line direction to be spaced apart from the air suction window 16. Preferably, in the first embodiment according to the present disclosure, the extension section 104 extends in the profile line direction at an angle greater than or equal to 20° and less than 120°, preferably greater than or equal to 24°, and more preferably greater than or equal to 60°, so as to ensure that the time that the scroll blade is prone to fatigue failure (that is, the time of having four contact points between the scroll blade of the orbiting scroll and the scroll blade of the fixed scroll) are minimized.

[0037] The material-removed part of the extension section of the scroll blade may be located on a lower side of the extension section in the axial direction or on an upper side of the extension section in the axial direction. FIG. 5 and FIG. 6 respectively illustrate a fixed scroll 200 and a compression mechanism including an orbiting scroll and the fixed scroll 200 according to a second embodiment of the present disclosure. Similar to the first embodiment according to the present disclosure, the fixed scroll 200 includes an end plate 22, a spiral scroll blade 20 formed on one side of the end plate 22, and an outer peripheral wall 24 provided around the scroll blade 20. The scroll blade 20 extends from an approximate center of the end plate 22 in a spiral profile line direction from an inner side to an outer side, and the scroll blade 20 includes a compression section 202 and an extension section 204 connected to each other in an extension direction of the profile line. Different from the first embodiment according to the present disclosure, an upper portion of the extension section 204 in an axial direction has material removed to form a material-removed part

207, and a lower portion 205 of the extension section 204 in the axial direction extends from the compression section 202 to an air suction window at the outer peripheral wall 24. That is, the extension section 204 has an axial step part 203 in the axial direction.

[0038] In the second embodiment according to the present disclosure, due to the design of the extension section of the fixed scroll 200, on the one hand, the contact between the scroll blade of the fixed scroll and the scroll blade of the orbiting scroll is increased through the lower portion 205, thus providing more radial support for the scroll blade of the orbiting scroll and effectively reducing the risk of failure of the scroll component. On the other hand, the material-removed part 207 is communicated with the air suction window, the influence of the extension section on the original displacement and pressure ratio of the compression mechanism is avoided, and additional power consumption is also avoided. That is, the second embodiment according to the present disclosure has advantages and effects similar to those of the first embodiment.

[0039] In addition, preferably, referring to FIG. 6, in the case that the extension section 204 of the fixed scroll 200 extends a long distance from the outermost end of the compression section 202 in the profile line direction, especially up to the air suction window, innermost contact points A1 and A2 between the scroll blade of the fixed scroll 200 and the scroll blade 90 of the orbiting scroll in the profile line direction are not yet out of separation state, and an outermost contact point B between the scroll blade of the fixed scroll 200 and the scroll blade 90 of the orbiting scroll in the profile line direction is already in the contact state. Therefore, during the orbiting motion of the orbiting scroll, more contact points can be generated between the scroll blade 20 of the fixed scroll 200 and the scroll blade 90 of the orbiting scroll, thereby further reducing the radial load at a single contact point and improving the fatigue strength of the scroll component.

[0040] Fig. 7 shows a fixed scroll 300 according to a third embodiment of the present disclosure, wherein, similar to the first embodiment according to the present disclosure, the fixed scroll 300 includes an end plate 32, a spiral scroll blade 30 formed on one side of the end plate 32, and an outer peripheral wall 34 provided around the scroll blade 30. There is an air suction window provided at the outer peripheral wall 34 and/or the end plate 32. The scroll blade 30 extends from an approximate center of the end plate 32 in a spiral profile line direction from an inner side to an outer side, and the scroll blade 30 includes a compression section 302 and an extension section 304 connected to each other in an extension direction of the profile line. The thickness of the extension section 304 in a radial direction is smaller than that of the compression section 302, so that a step part 33 in the profile line direction is formed at a junction of a radial outer surface of the extension section 304 and a radial outer surface of the compression section 302. Thus, the extension section 304 may be provided to closely abut against a radial

inner surface of the outer peripheral wall 34 so as to provide radial support when the extension section 304 comes into contact with the blade 90 of the orbiting scroll.

[0041] Different from the first embodiment according to the present disclosure, the extension section 304 is configured to extend over the entire height of the compression section 302, that is, the extension section 304 is flush with the compression section 302 and has the same axial dimension, and a radial inner surface of the extension section 304 and a radial inner surface of the compression section 302 have the same machining accuracy, the two radial inner surfaces together forms a smooth surface extending in the profile line direction. The extension section 304 includes one or more orifices 306 extending through the entire extension section 304 in the thickness direction thereof, for example, three orifices 306 are shown in FIG. 7 as being arranged in the extension direction of the profile line. These orifices 304 form material-removed parts of the extension section 304. The orifices 306 are aligned and communicated with through-holes formed in the outer peripheral wall 34. When the scroll blade 90 of the orbiting scroll engages with the extension section 304 to form a chamber (for example, referring to FIG. 8a), the chamber is in direct communication with a low-pressure environment outside the compression mechanism via the orifice 306 at the extension section 304 and the through-holes formed at the outer peripheral wall 34. In other words, the orifices 306 at the extension section 304 and the through-holes formed at the outer peripheral wall 34 together form a communication channel that communicates the chamber constructed by the extension section 304 with the external environment of the compression mechanism. Therefore, the chamber constructed by the extension section 304 will not compress the working fluid, thus it will not affect the displacement and pressure ratio of the compression mechanism (that is, the displacement and pressure ratio of the compression mechanism are only associated with the compression section), and will not generate additional compression power consumption.

[0042] The operating conditions and advantages of the compression mechanism according to the third embodiment of the present disclosure will be described below with reference to FIG. 8a and FIG. 8b.

[0043] FIG. 8a and FIG. 8b respectively show radial sectional views of a compression mechanism according to the third embodiment of the present disclosure at time T1 immediately after the compression mechanism begins to exhaust and at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust. During the translational rotation of the orbiting scroll around the fixed scroll, the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300 come into contact with each other, and the number and position of the contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 10 of the fixed scroll 100 change continuously with the motion of the orbiting scroll, and the number of contact points

between them is usually in a range of 4 to 6. As shown in FIG. 8a, at time T1 immediately after the compression mechanism begins to exhaust, the innermost contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300 have just separated, and there are four contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300, as shown by the circles in the figure, and the total lateral contact force between the orbiting scroll and the fixed scroll 300 is jointly provided by these four contact points. As shown in FIG. 8b, at time T2 when the orbiting scroll orbits 180° after the compression mechanism begins to exhaust, and there are five contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300, as shown by the circles in the figure. Four contact points between the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300 close to the inner side are located between the scroll blade 90 of the orbiting scroll and the compression section 302 of the scroll blade 30 of the fixed scroll 300, while the outermost contact point between the scroll blade 90 of the orbiting scroll and the scroll blade 30 of the fixed scroll 300 (as shown by the circle X in FIG. 8b) is located in the extension section 304 of the scroll blade 30 of the fixed scroll 300. That is, at this moment, the scroll blade 90 of the orbiting scroll is in contact with the radial inner surface of the extension section 304 of the scroll blade 30 of the fixed scroll 300, and sufficient radial support is provided for the scroll blade 90 of the orbiting scroll by means of the extension section 304 and the outer peripheral wall 34 against which the extension section 304 abuts. At the same time, the chamber formed between the extension section 304 of the fixed scroll and the scroll blade 90 of the orbiting scroll is in direct communication with a low-pressure environment outside the compression mechanism via the orifice 306 extending through the entire extension section 304 in the thickness direction thereof and the through-hole formed in the outer peripheral wall 34, so as to avoid the chamber from providing additional compression of the working fluid.

[0044] In the third embodiment according to the present disclosure, due to the design of the extension section of the fixed scroll, the time of having four contact points between the orbiting scroll and the fixed scroll can be effectively reduced, and the outer peripheral wall and the outer structure of the fixed scroll are used to provide radial support for the orbiting scroll blade, thereby improving the fatigue strength of the scroll component and minimizing the risk of failure of the scroll component. On the other hand, since the extension section includes the material-removed part which is directly communicated with the external environment of the compression mechanism, the extension section will not affect the original displacement and pressure ratio of the compression mechanism. In addition, since the extension section extends in the direction of the entire height of the compression section, the contact area between the scroll blade of the orbiting scroll and the scroll blade of the fixed scroll in

the extension section is increased, thereby providing more sufficient radial support for the scroll blade of the orbiting scroll. In the third embodiment of the present disclosure, the contact point located in the extended section can share 40% of the total lateral support force. It can be found through experiments that the fatigue strength of the fixed scroll according to the third embodiment of the present disclosure is improved by 20%.

[0045] Preferably, in the third embodiment of the present disclosure, the extension section 304 of the fixed scroll 300 does not extend to the air suction window but is spaced apart from the air suction window by a certain distance. In this embodiment, the angle along which the extension section 304 extends in the profile line direction is greater than or equal to 20° and less than 120°. Preferably, the angle along which the extension section 304 extends in the profile line direction is smaller than the angle along which the extension section 104 extends in the profile line direction in the first embodiment of the present disclosure, for example, the angle is greater than or equal to 24° and less than 60°, so as to ensure that the additional power consumption caused by the extension section is minimized while the time that the scroll blade is prone to fatigue failure is minimized.

[0046] Although it is shown in FIG. 7 that the material-removed part of the extension section 304 is configured to have three circular orifices 306 distributed in the profile line direction, it will be understood by those skilled in the art that the number, distribution positions and shapes of the orifices can be designed as required.

[0047] For example, FIG. 9 shows a fixed scroll 400 according to a fourth embodiment of the present disclosure. Similar to the third embodiment of the present disclosure, the fixed scroll 400 includes an end plate 42, a spiral scroll blade 40 formed on one side of the end plate 42, and an outer peripheral wall 44 provided around the scroll blade 40. The scroll blade 40 extends from an approximate center of the end plate 42 in a spiral profile line direction from an inner side to an outer side, and the scroll blade 40 includes a compression section 402 and an extension section 404 connected to each other in an extension direction of the profile line. Different from the third embodiment according to the present disclosure, three orifices 406 configured as material-removal portions in the extension section 404 are arranged in an axial direction. In this case, except for a small area where the orifices 40 are arranged, most areas of the extension section 404 have the same radial inner surface as the compression section 402, thus the contact area between the scroll blade of the orbiting scroll and the scroll blade of the fixed scroll in the extension section is further increased, thereby providing more sufficient radial support for the scroll blade of the orbiting scroll.

[0048] For another example, FIG. 10 shows a fixed scroll 500 according to a fifth embodiment of the present disclosure. Similar to the third embodiment of the present disclosure, the fixed scroll 500 includes an end plate 52, a spiral scroll blade 50 formed on one side of the end plate

52, and an outer peripheral wall 54 provided around the scroll blade 50. The scroll blade 50 extends from an approximate center of the end plate 52 in a spiral profile line from an inner side to an outer side, and the scroll blade 50 includes a compression section 502 and an extension section 504 connected to each other in an extension direction of the profile line. Different from the third embodiment of the present disclosure, an orifice configured as a material-removed part in the extension section 504 is formed as an elongated slot 506. The elongated slot 506 extends through the entire extension section 504 in the thickness direction of the extension section 504. The elongated slot 506 may be provided in a middle region of the extension section 504 in an axial direction, and extend outward in the profile line direction from the conjunction of the compression section 502 and the extension section 504 (that is, at a step part 53 in the profile line direction). Accordingly, the through-hole in the outer peripheral wall 54 aligned with the elongated slot 506 may also be configured in the form of a slot. In this case, a communication channel constructed by the elongated slot 506 and the through-hole in the outer peripheral wall 54 aligned with the elongated slot 506, which is used for communicating the chamber formed between the extension section 504 of the fixed scroll and the scroll blade 90 of the orbiting scroll with a low-pressure environment outside the compression mechanism, has a larger flow cross-section, so it is particularly advantageous to avoid additional compression of the working fluid by this chamber.

[0049] In addition, although shown in FIG. 10, the length of the elongated slot 506 extending in the profile line direction does not reach the total extension length of the extension section 504, that is, an outer end of the elongated slot 506 does not reach an outer end of the extension section 504 in the profile line direction, it will be understood by those skilled in the art that the elongated slot may also extend up to the outer end of the extension section or even beyond the outer end of the extension section.

[0050] A fixed scroll 600 according to a sixth embodiment of the present disclosure is shown in FIG. 11a, similar to the fifth embodiment of the present disclosure, the fixed scroll 600 includes an end plate 62, a spiral scroll blade 60 formed on one side of the end plate 62, and an outer peripheral wall 64 provided around the scroll blade 60. The scroll blade 60 extends from the approximate center of the end plate 62 in a spiral profile line direction from an inner side to an outer side, and the scroll blade 60 includes a compression section 602 and an extension section 604 connected to each other in an extension direction of the profile line. Different from the fifth embodiment of the present disclosure, the extension section 604 includes an elongated slot 606 configured as a material-removed part, which extends through the entire extension section 604 in the thickness direction of the extension section 604. The elongated slot 606 may be provided in a middle region of the extension section 604

in an axial direction, and extend in the profile line direction from the conjunction of the compression section 602 and the extension section 604 (that is, at a step part 63 in the profile line direction) up to an outer end of the extension section 604. That is, the outer end of the extension section 604 is configured in the form of a non-closed opening to form an outer end of the elongated slot 602. Accordingly, similar to the fifth embodiment of the present disclosure, the outer peripheral wall 64 may be formed with a slot-shaped through-hole that is aligned with the elongated slot 602 and has substantially the same shape, thus the chamber formed between the extension section 604 of the fixed scroll and the scroll blade 90 of the orbiting scroll is directly communicated with a low-pressure environment outside the compression mechanism, so as to avoid additional compression of the working fluid by this chamber.

[0051] Alternatively, as shown in FIG. 11a and FIG. 11b, different from the fifth embodiment of the present disclosure, the outer peripheral wall 64 may also be formed with a communication groove 646 extending outward in the profile line direction from the outer end of the elongated slot 602. The elongated slot 602 is communicated with the communication groove 646 at the outer end thereof. The communication groove 646 may be formed as a through-hole penetrating through the outer peripheral wall 64 in the thickness direction of the outer peripheral wall 64, so that the elongated slot 602 is communicated with the external environment of the compression mechanism via the communication groove 646, as shown in FIG. 11b. Alternatively, the communication groove 646 may also be formed as a semi-groove that is recessed from a radial inner surface of the outer peripheral wall 64 without penetrating through the outer peripheral wall 64 in the thickness direction, so that the elongated slot 602 is communicated with the air suction window via the communication groove 646 and communicated with the external environment of the compression mechanism via the air suction window.

[0052] In the fifth embodiment of the present disclosure, due to the design of extension section of the fixed scroll 600, on the one hand, the contact between the scroll blade of the fixed scroll and the scroll blade of the orbiting scroll is increased through the extension section, thereby providing more radial support for the scroll blade of the orbiting scroll and effectively reducing the risk of failure of the scroll component. And on the other hand, the elongated slot 606 keeps in communication with a low-pressure environment outside the compression mechanism, so the influence of the extension section on the original displacement and pressure ratio of the compression mechanism can be avoided, no additional power consumption will be generated, and it is simple to process and easy to manufacture.

[0053] The accompanying drawings only show six exemplary embodiments under the concept of the present disclosure. Those skilled in the art can understand that the present disclosure is not limited to the exemplary

embodiments described above, but also includes variations or combinations of various examples described above. For example, the material-removed part can be configured in the form of a combination of the hole and the slot, and its shape can also be designed as required. In addition, although in the exemplary embodiment of the present disclosure, the scroll component is implemented as a fixed scroll, it should be understood by those skilled in the art that the scroll component can also be implemented as an orbiting scroll, especially in the case where the material-removed part is configured as an upper side portion or a lower side portion of the extension section in an axial direction having material removed, and in the case where the material-removed part is configured as an elongated slot extending up to the outer end of the extension section.

[0054] Although various embodiments of the present disclosure have been described in detail herein, it should be understood that the present disclosure is not limited to the specific embodiments described and illustrated in detail herein, and other modifications and variations can be realized by those skilled in the art without departing from the spirit and scope of the present disclosure. All these modifications and variations fall within the scope of the present disclosure. Moreover, all members described herein can be replaced by other technically equivalent members.

Claims

1. A scroll component of a compression mechanism, comprising:

an end plate (12, 22, 32, 42, 52, 62);
a scroll blade (10, 20, 30, 40, 50, 60) formed on one side of the end plate and extending from an approximate center of the end plate in a spiral profile line direction from an inner side to an outer side,

characterized in that the scroll blade comprises a compression section (102, 202, 302, 402, 502, 602) and an extension section (104, 204, 304, 404, 504) connected to each other, the compression section is located on an inner side of the extension section in the profile line direction, and the compression section is configured for constructing a chamber for compression operation,

the extension section has a radial thickness smaller than that of the compression section, and the extension section is formed with a material-removed part, and a chamber constructed by the extension section can be communicated with a low-pressure environment outside the compression mechanism via the material-removed part.

2. The scroll component of the compression mechanism according to claim 1, wherein the scroll component is a fixed scroll (100, 200, 300, 400, 500, 600), the fixed scroll further comprises an outer peripheral wall (14, 24, 34, 44, 54, 64) provided around the scroll blade, and the extension section is provided to closely abut against a radial inner surface of the outer peripheral wall.
3. The scroll component of the compression mechanism according to claim 2, wherein the extension section is provided in a region of maximum stiffness of the outer peripheral wall.
4. The scroll component of the compression mechanism according to claim 2, wherein the outer peripheral wall is formed with an air suction window for allowing working fluid to enter the compression mechanism, and the extension section extends to the air suction window in the profile line direction, so that the outermost contact point of the scroll blade in the profile line direction is already in contact state while the innermost contact point of the scroll blade in the profile line direction is not yet out of contact state during operation of the compression mechanism.
5. The scroll component of the compression mechanism according to any one of claims 1 to 4, wherein the material-removed part (107, 207) is configured as an upper side portion or a lower side portion of the extension section (104, 204) in an axial direction having material removed, so that the scroll blade has a step shape in the axial direction.
6. The scroll component of the compression mechanism according to any one of claims 1 to 4, wherein the angle along which the extension sections (104, 204) extend in the profile line direction is greater than or equal to 20° and less than 120°.
7. The scroll component of the compression mechanism according to claim 2 or 3, wherein the material-removed part is configured as one or more orifices (306, 406, 506) penetrating through the extension section (304, 504, 604) in a thickness direction thereof, and the orifice is aligned and communicated with a through-hole formed in the outer peripheral wall (34, 44, 54), which is in direct communication with the low-pressure environment outside the compression mechanism.
8. The scroll component of the compression mechanism according to claim 7, wherein the orifice is arranged along the profile line direction or along an axial direction, the orifice is formed as multiple circular holes or a single elongated slot.

9. The scroll component of the compression mechanism according to any one of claims 2 to 4, wherein the material-removed part is configured as an elongated slot (606), which penetrates through the extension section (604) in a thickness direction thereof and extends up to an outer end of the extension section (604) in the profile line direction. 5
10. The scroll component of the compression mechanism according to claim 9, wherein the elongated slot (606) is communicated with a communication groove (646) formed in the outer peripheral wall (64), the communication groove (646) extends outward from an outer end of the elongated slot (606); the outer peripheral wall is formed with an air suction window for allowing working fluid to enter the compression mechanism; and the communication groove (646) is configured as a through-hole directly communicated with the low-pressure environment outside the compression mechanism, or alternatively the communication groove (646) is configured as a semi-groove which is recessed from the radial inner surface of the outer peripheral wall and communicated with the air suction window. 10
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11. A compression mechanism, comprising a fixed scroll and an orbiting scroll engaged with each other to form a series of compression chambers between the fixed scroll and the orbiting scroll, **characterized in that** the fixed scroll or the orbiting scroll is configured as the scroll component according to any one of claims 1 to 10. 30
12. The compression mechanism according to claim 11, wherein the extension section of the scroll blade of one of the fixed scroll and the orbiting scroll can come into contact with the other of the fixed scroll and the orbiting scroll, but the extension section is not used to form the compression chamber. 35
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13. A scroll compressor, **characterized in that** it comprises the compression mechanism according to claim 11 or 12. 45
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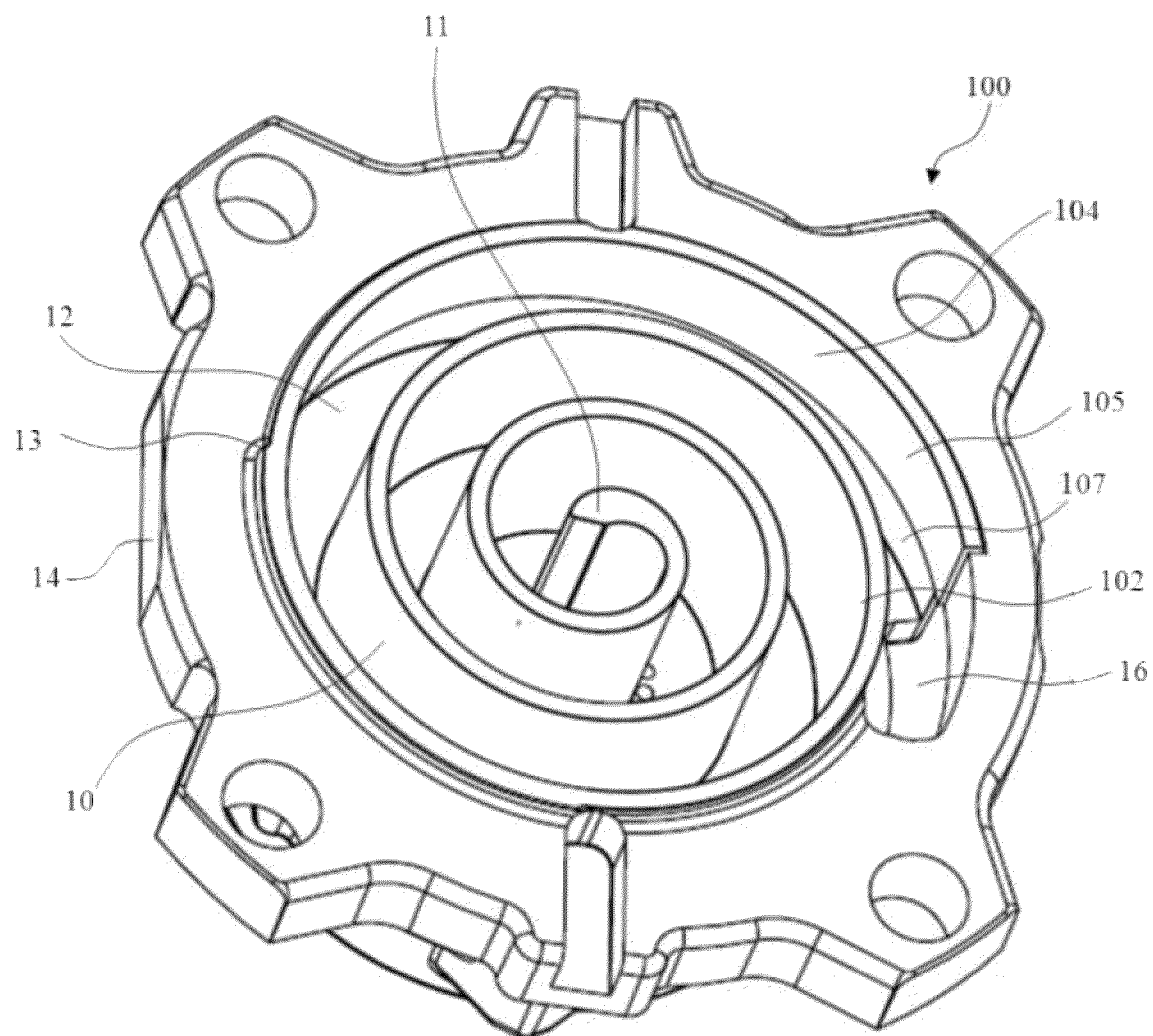


FIG. 1a

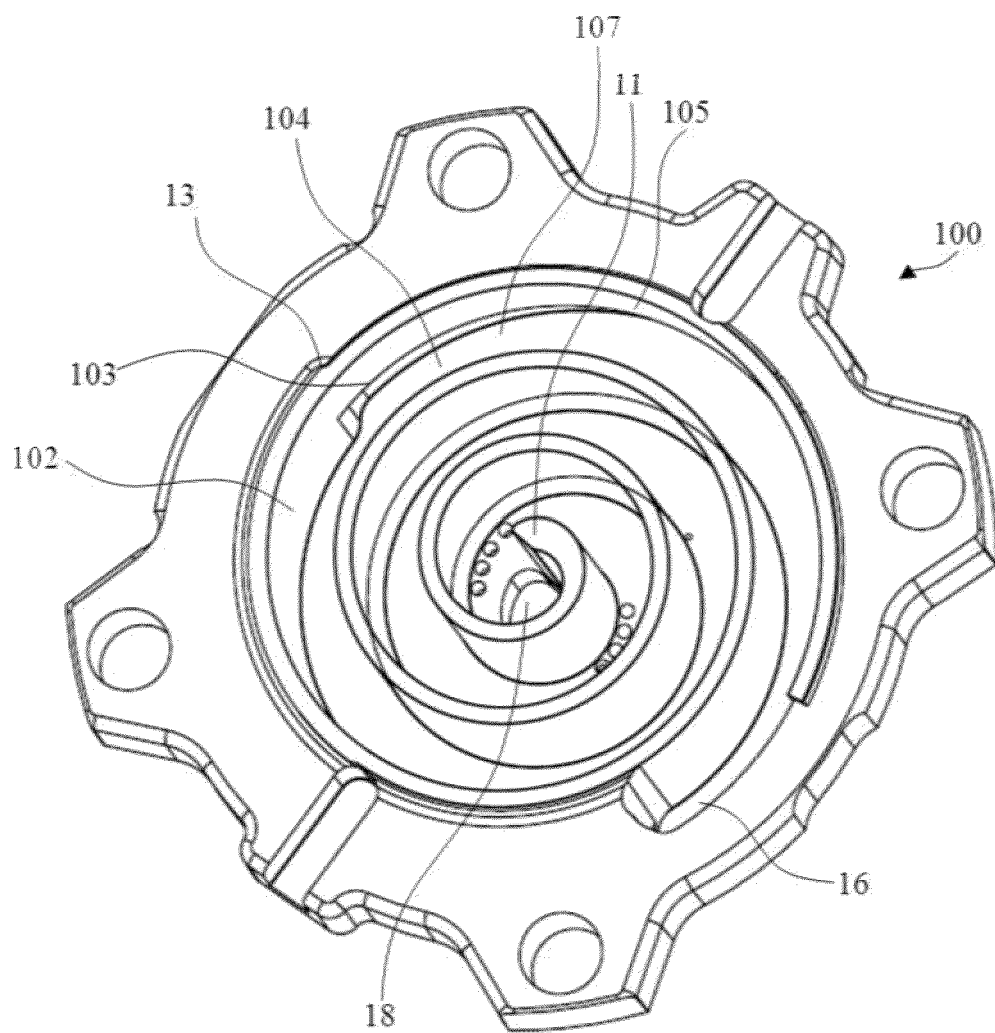


FIG. 1b

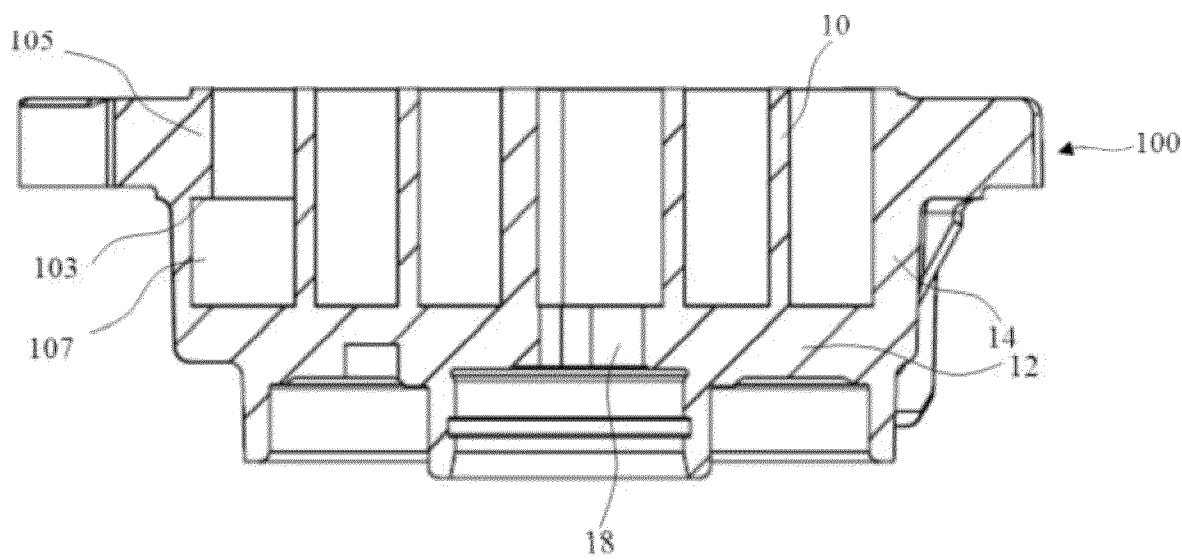


FIG. 2

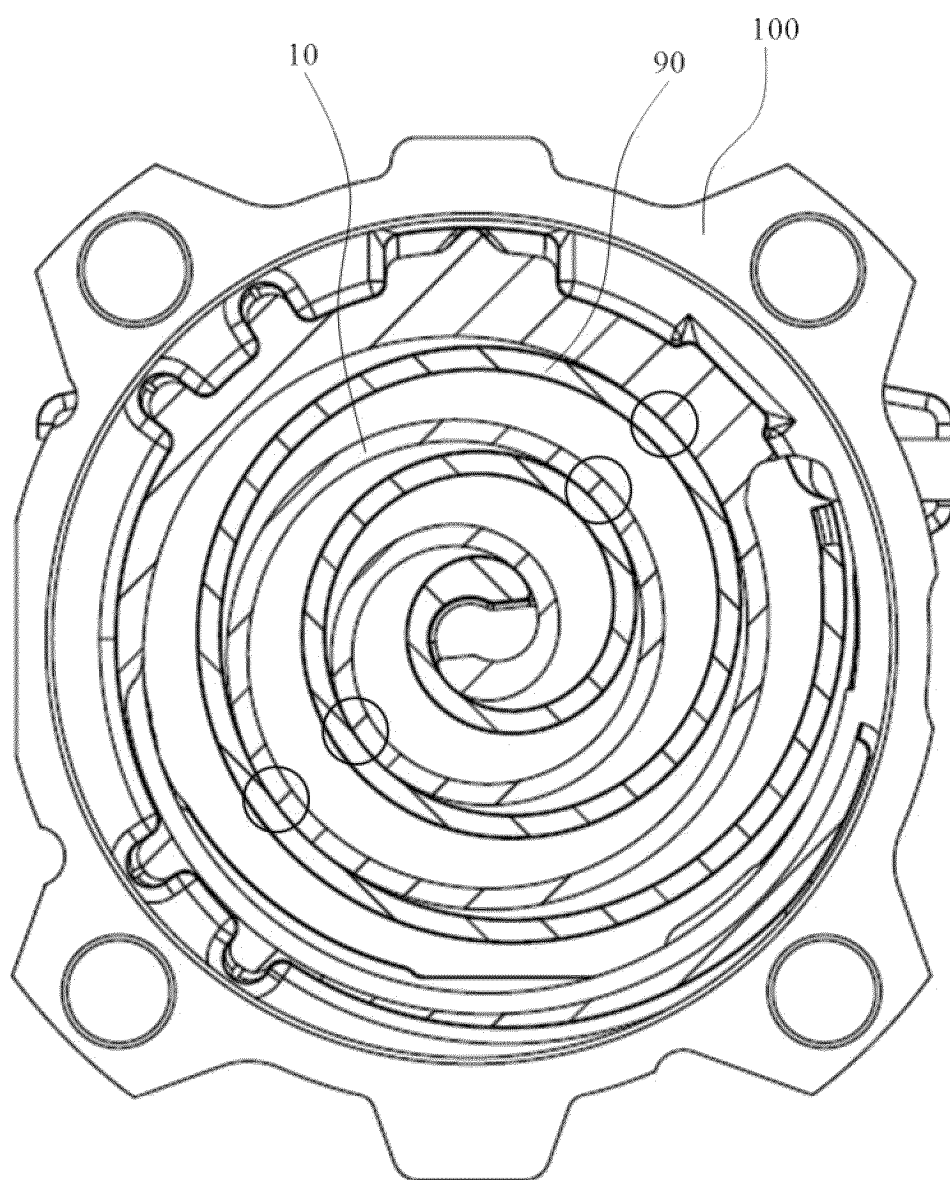


FIG. 3a

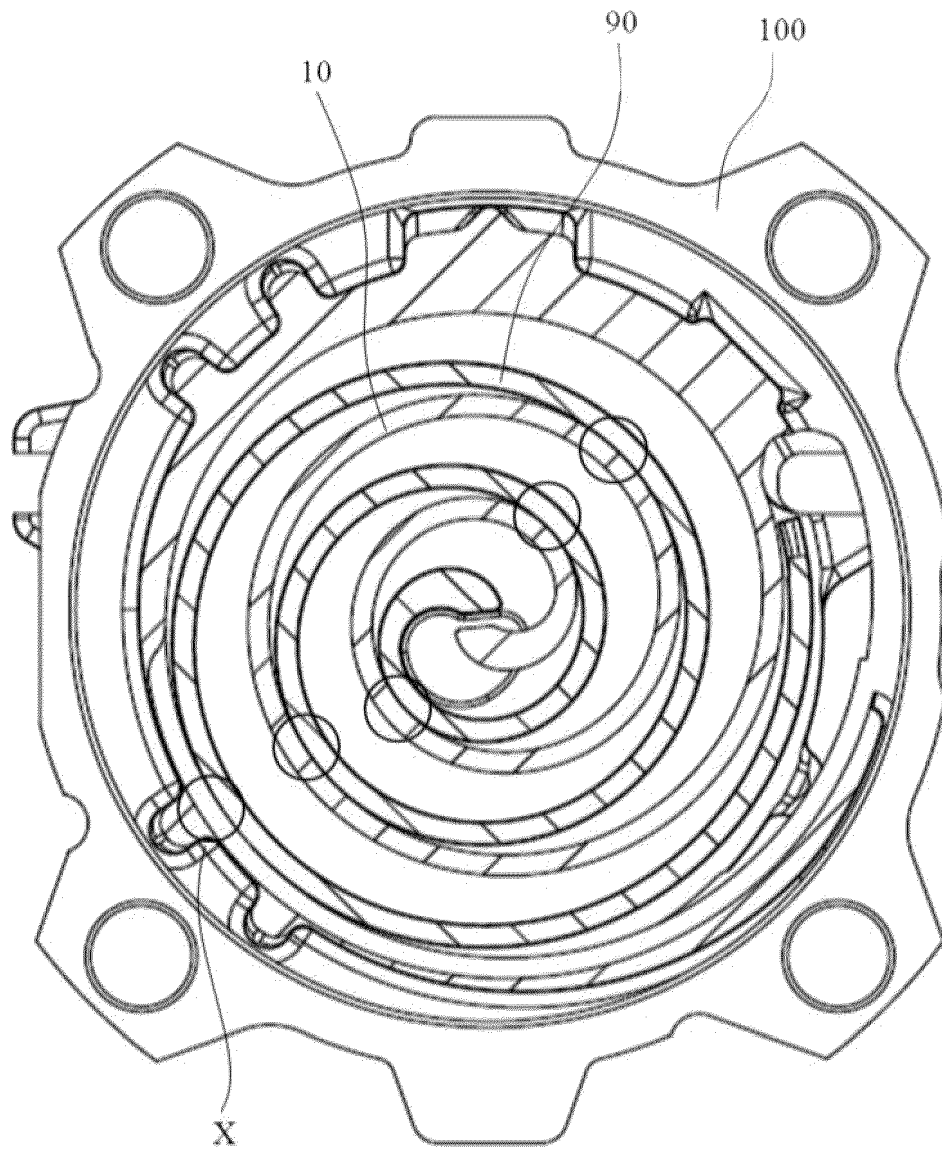


FIG. 3b

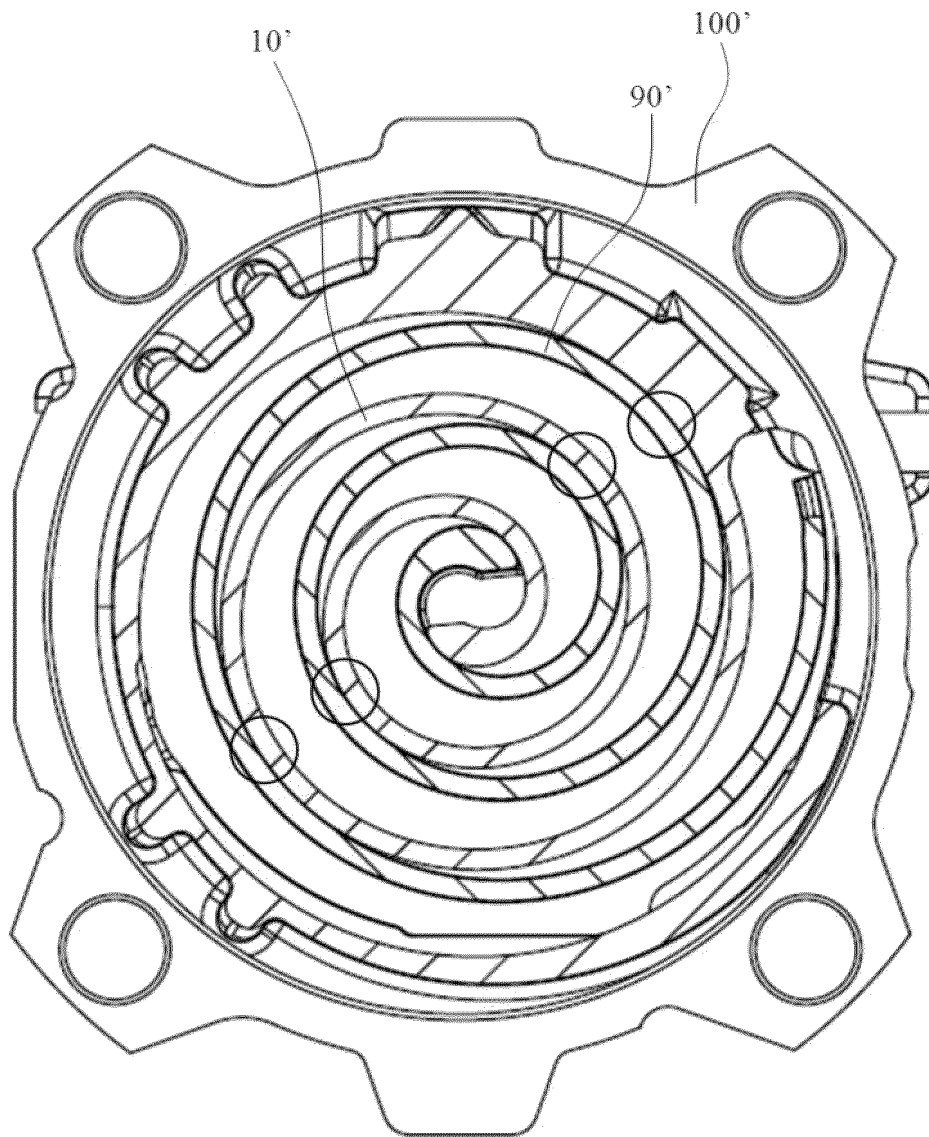


FIG. 4a

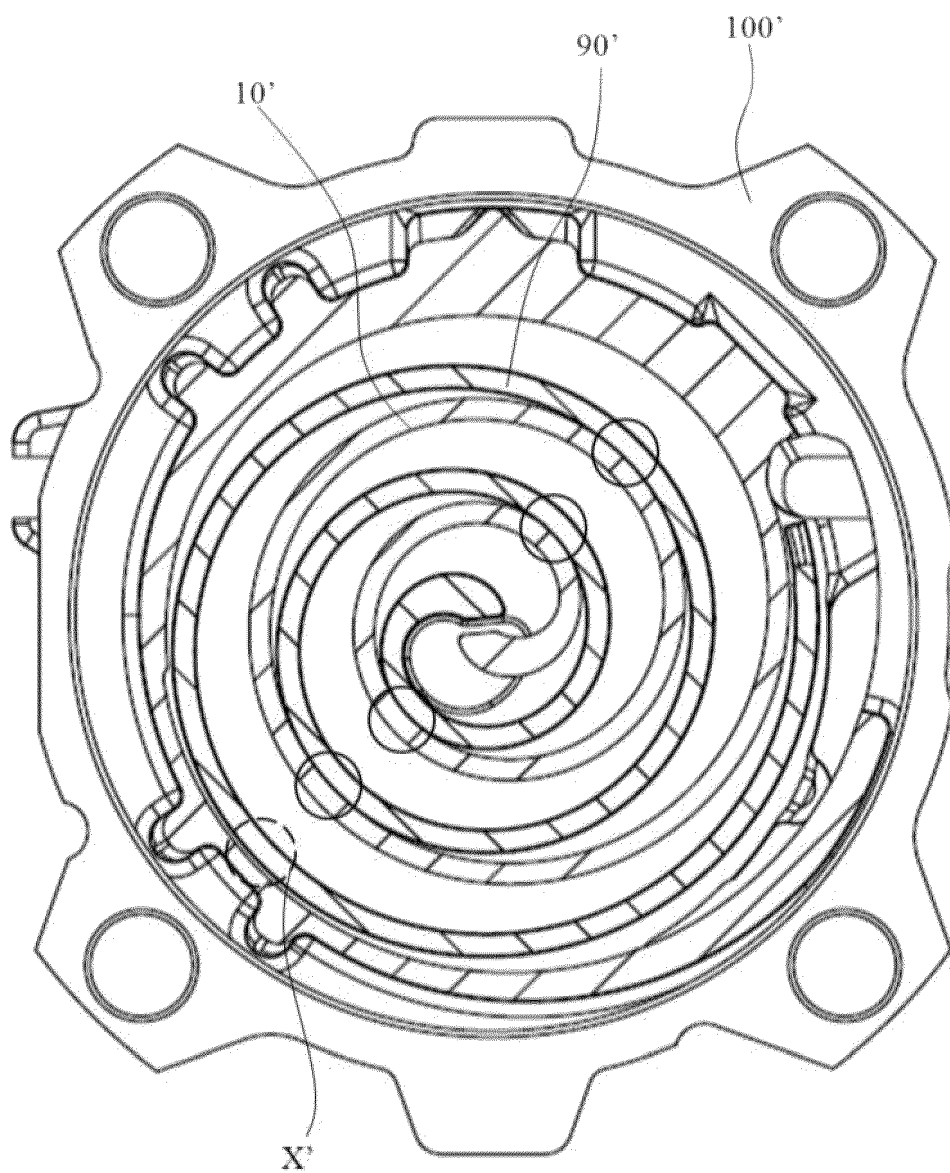


FIG. 4b

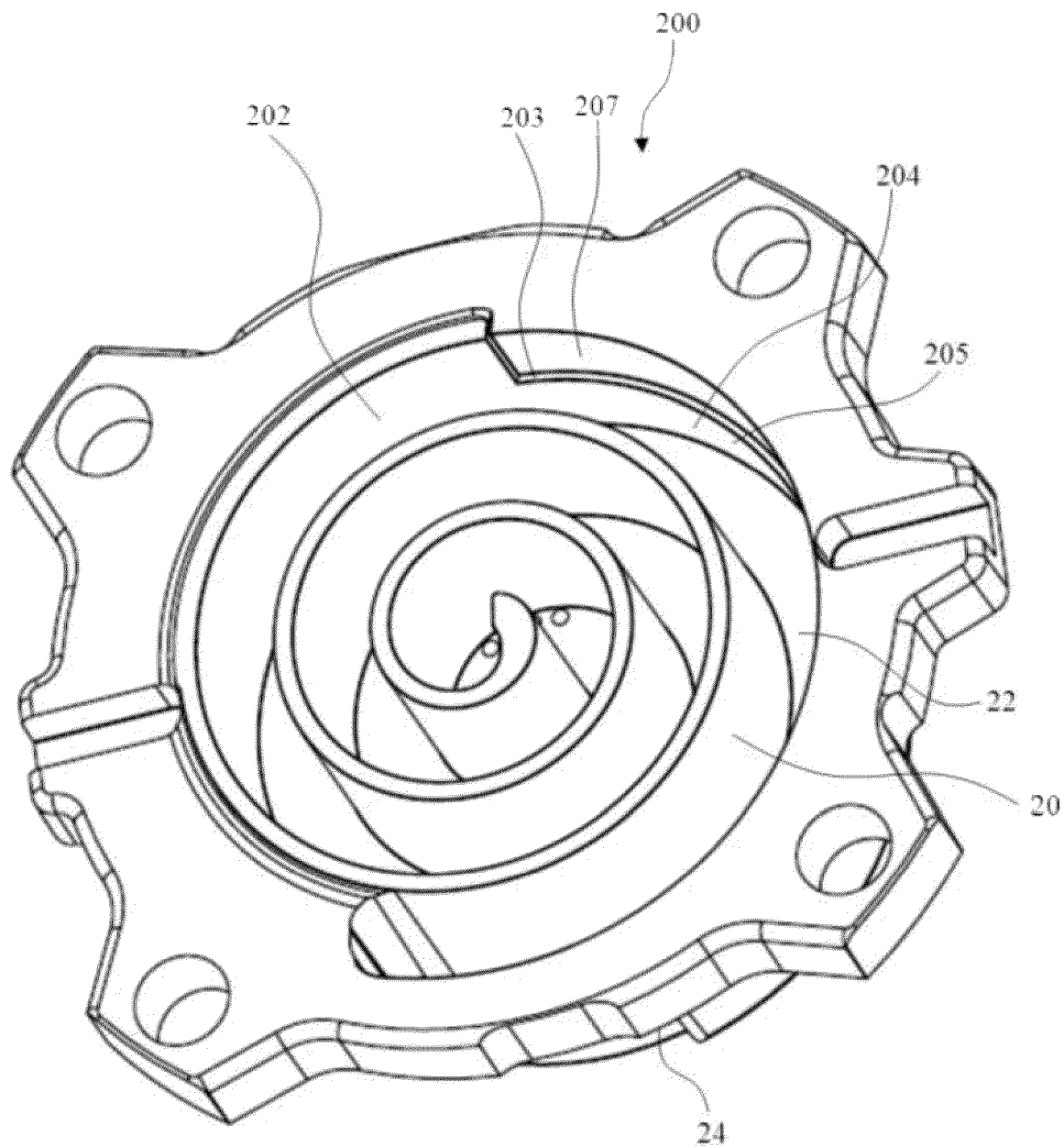


FIG. 5

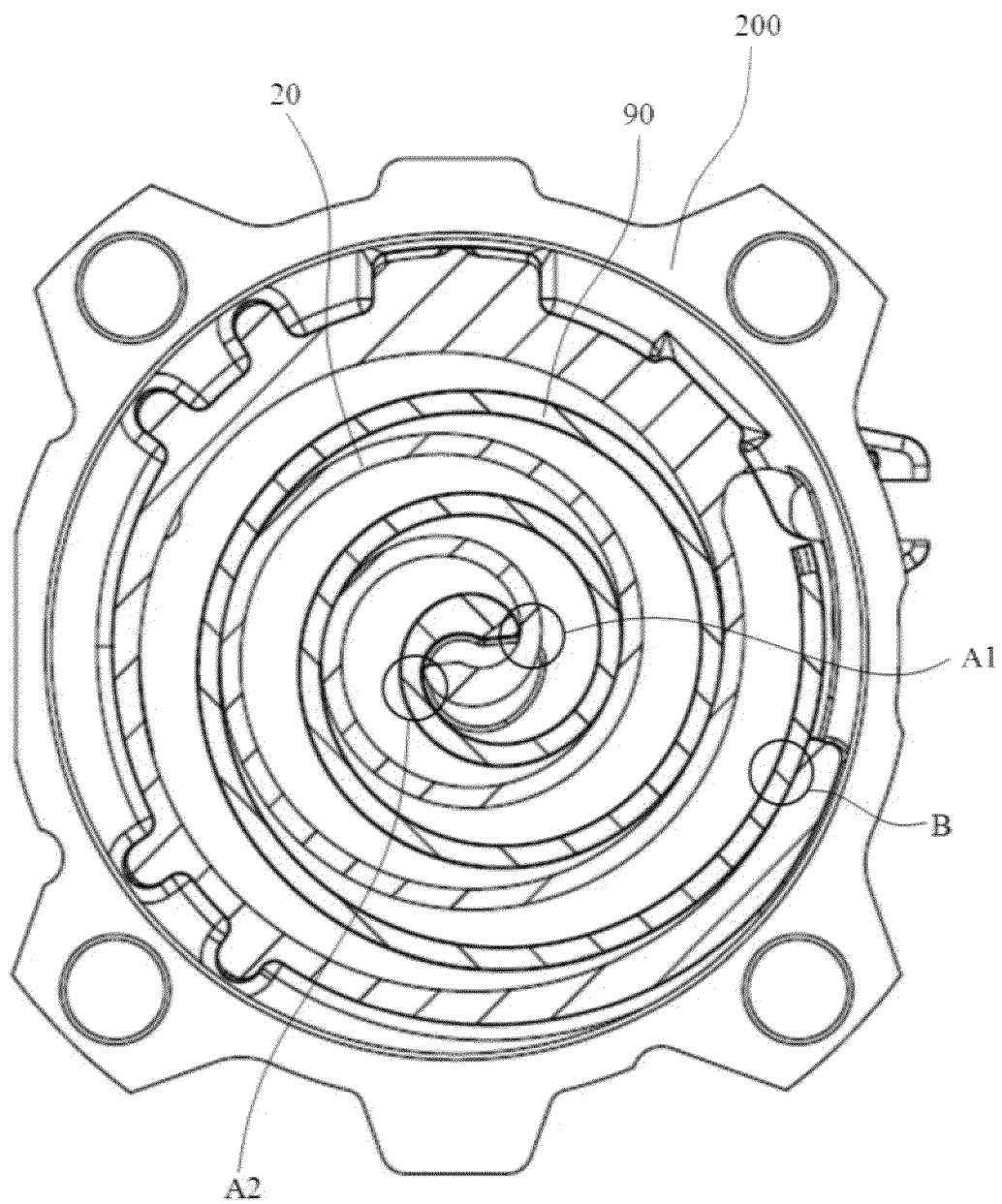


FIG. 6

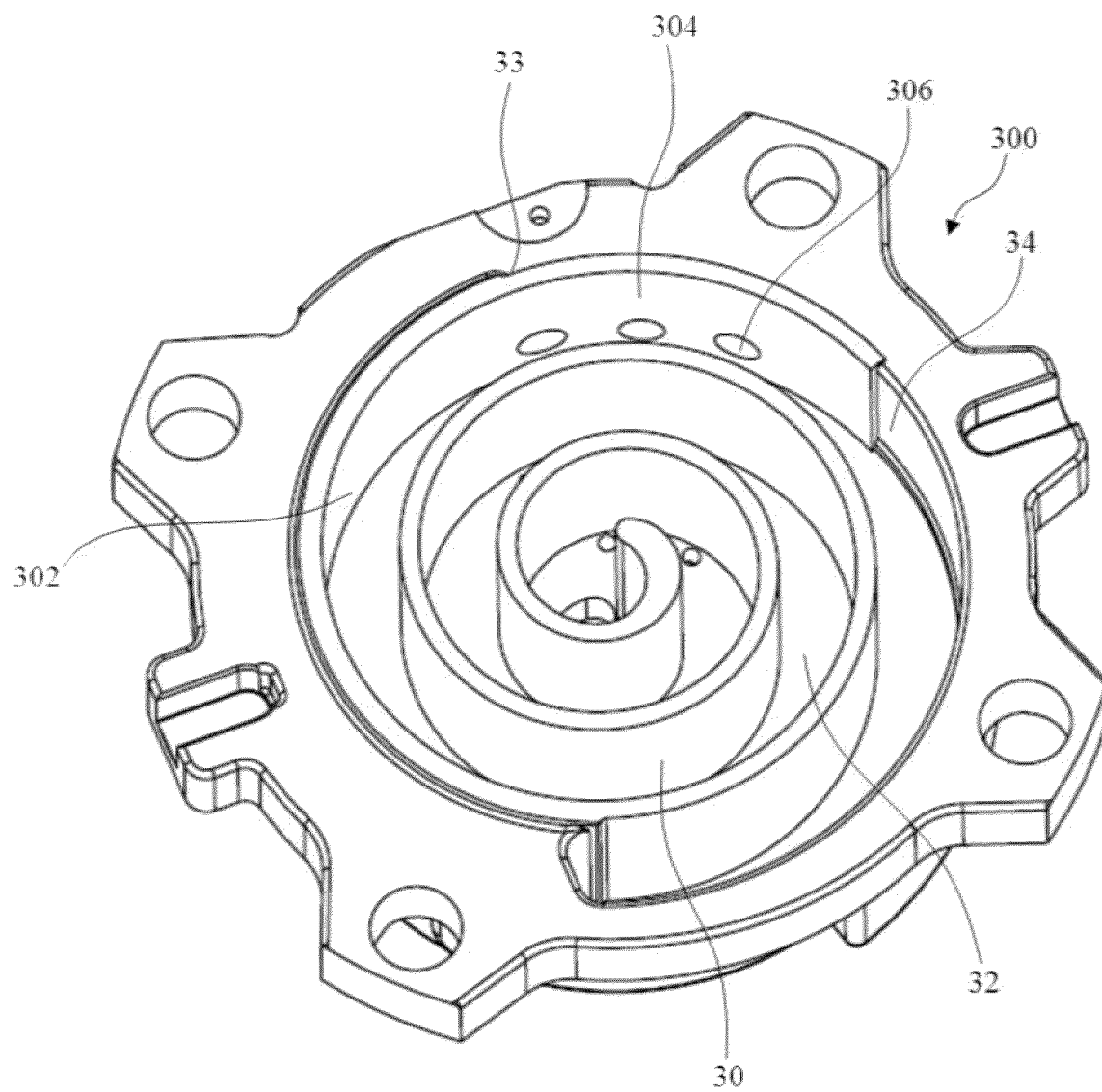


FIG. 7

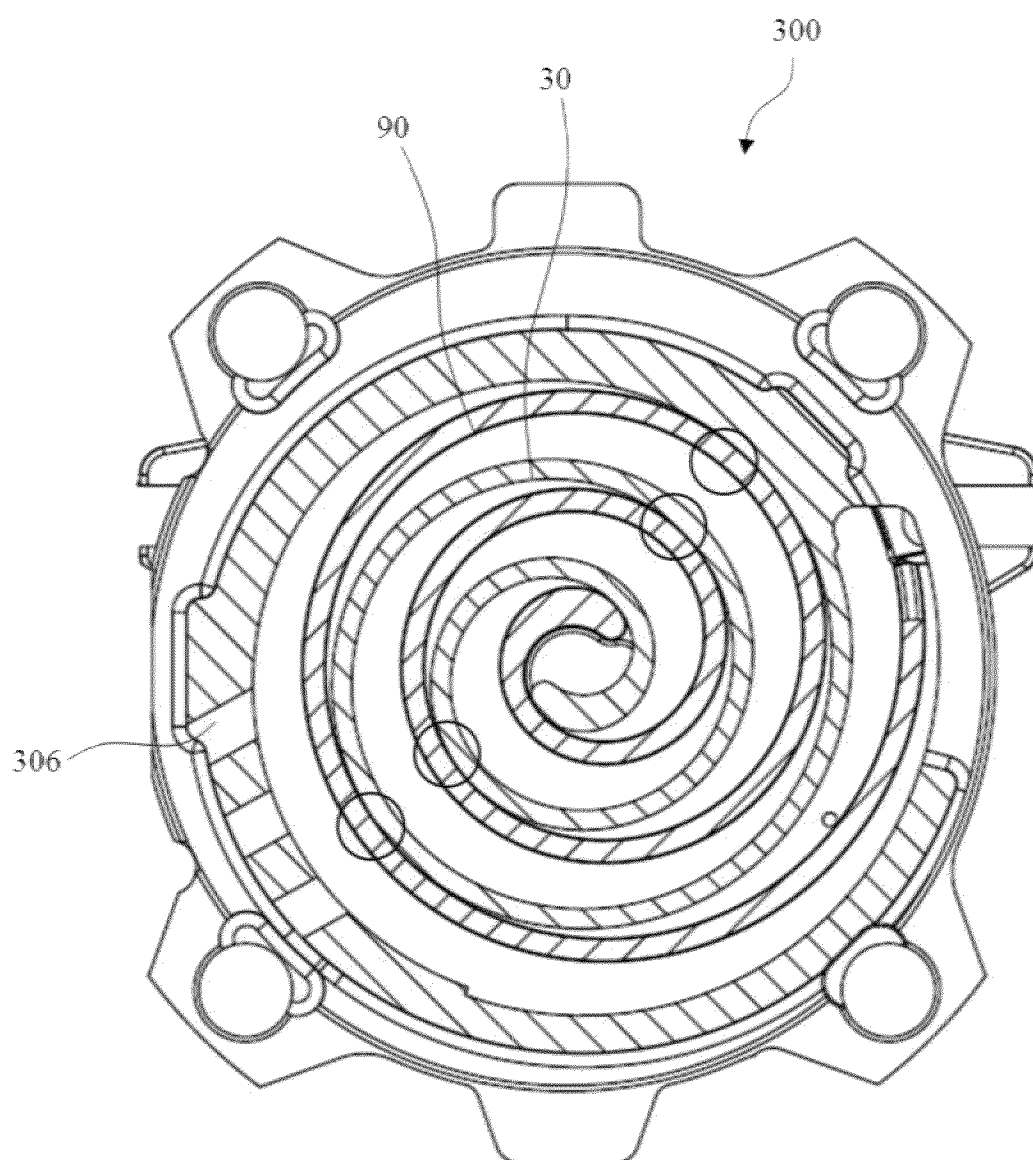


FIG. 8a

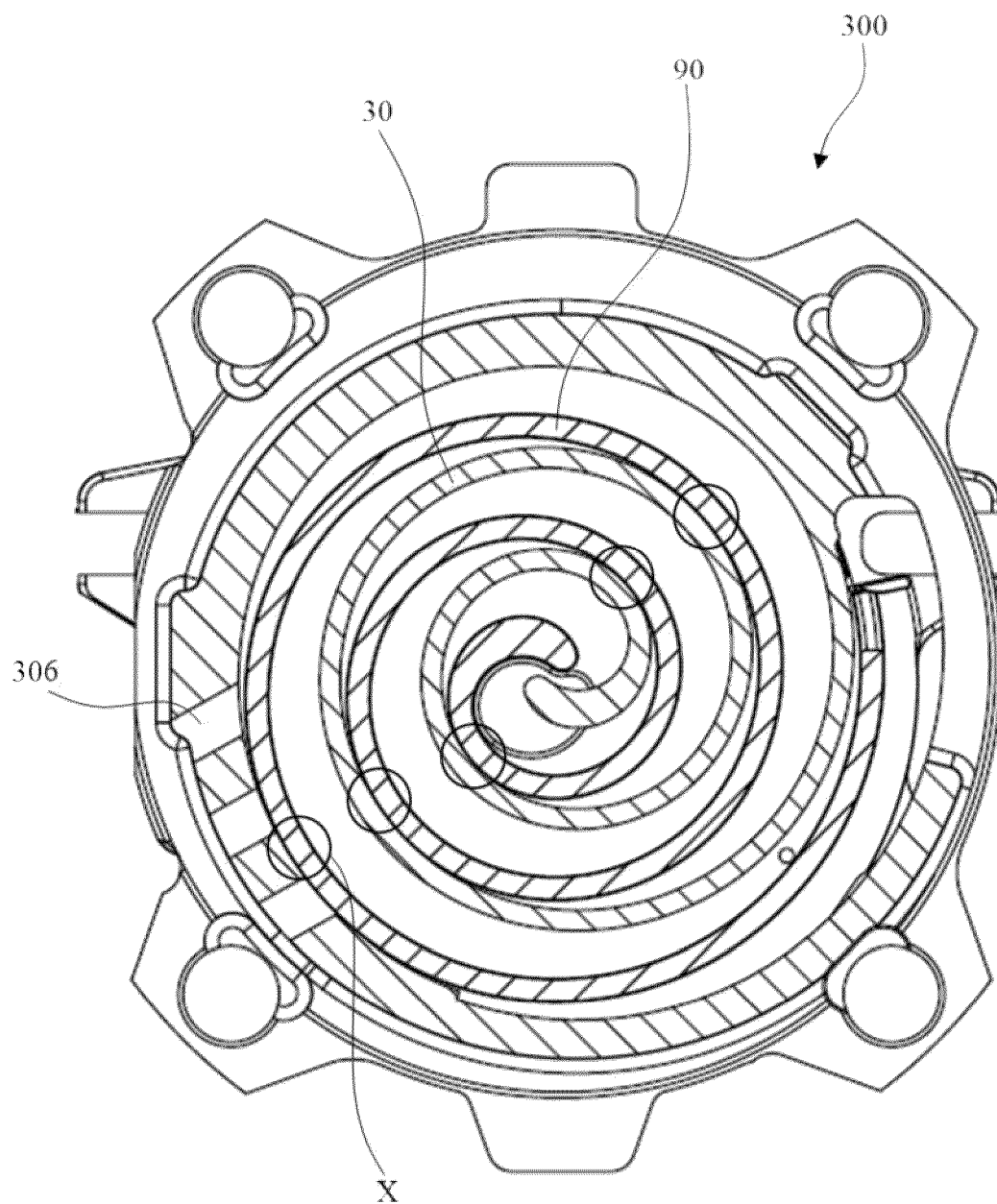


FIG. 8b

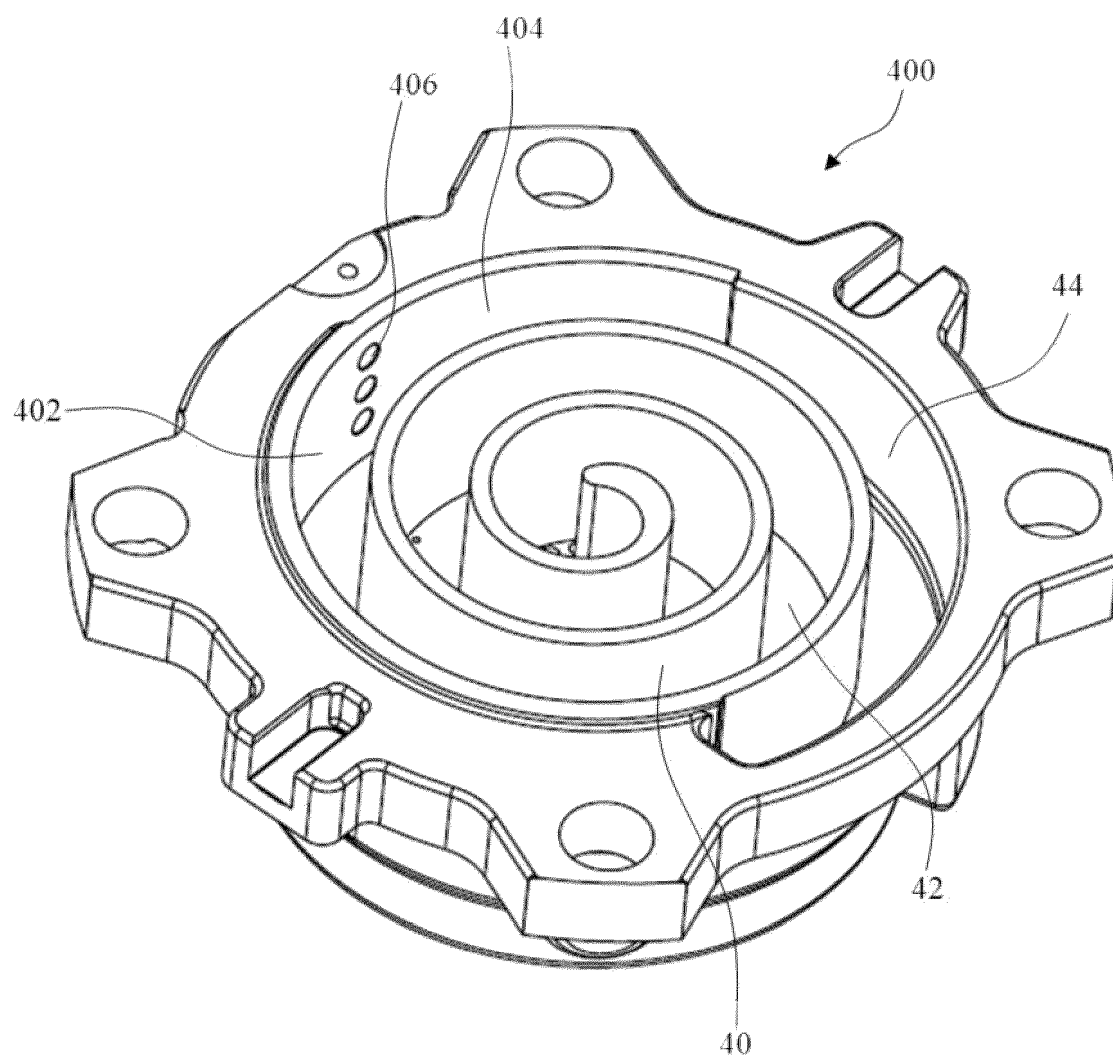


FIG. 9

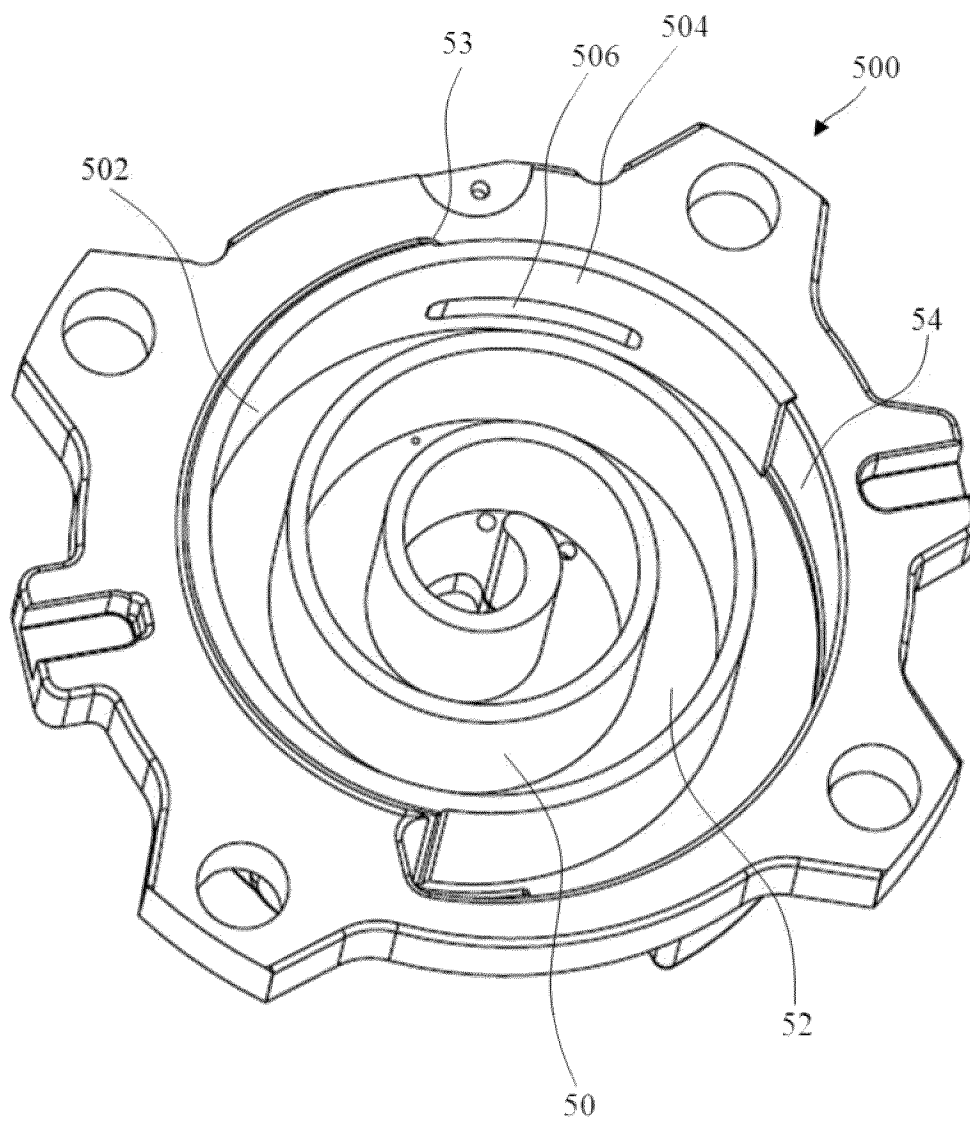


FIG. 10

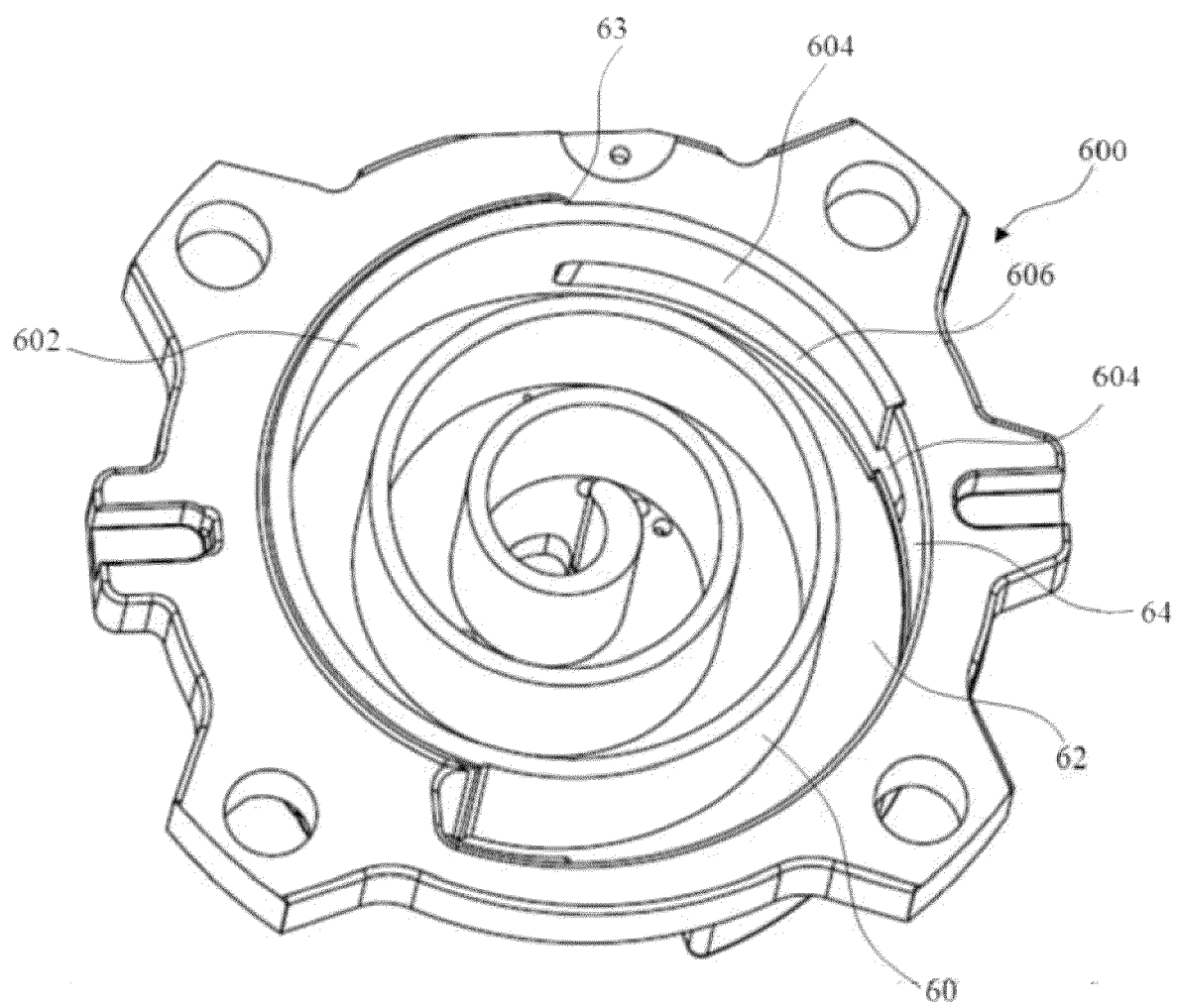


FIG. 11a

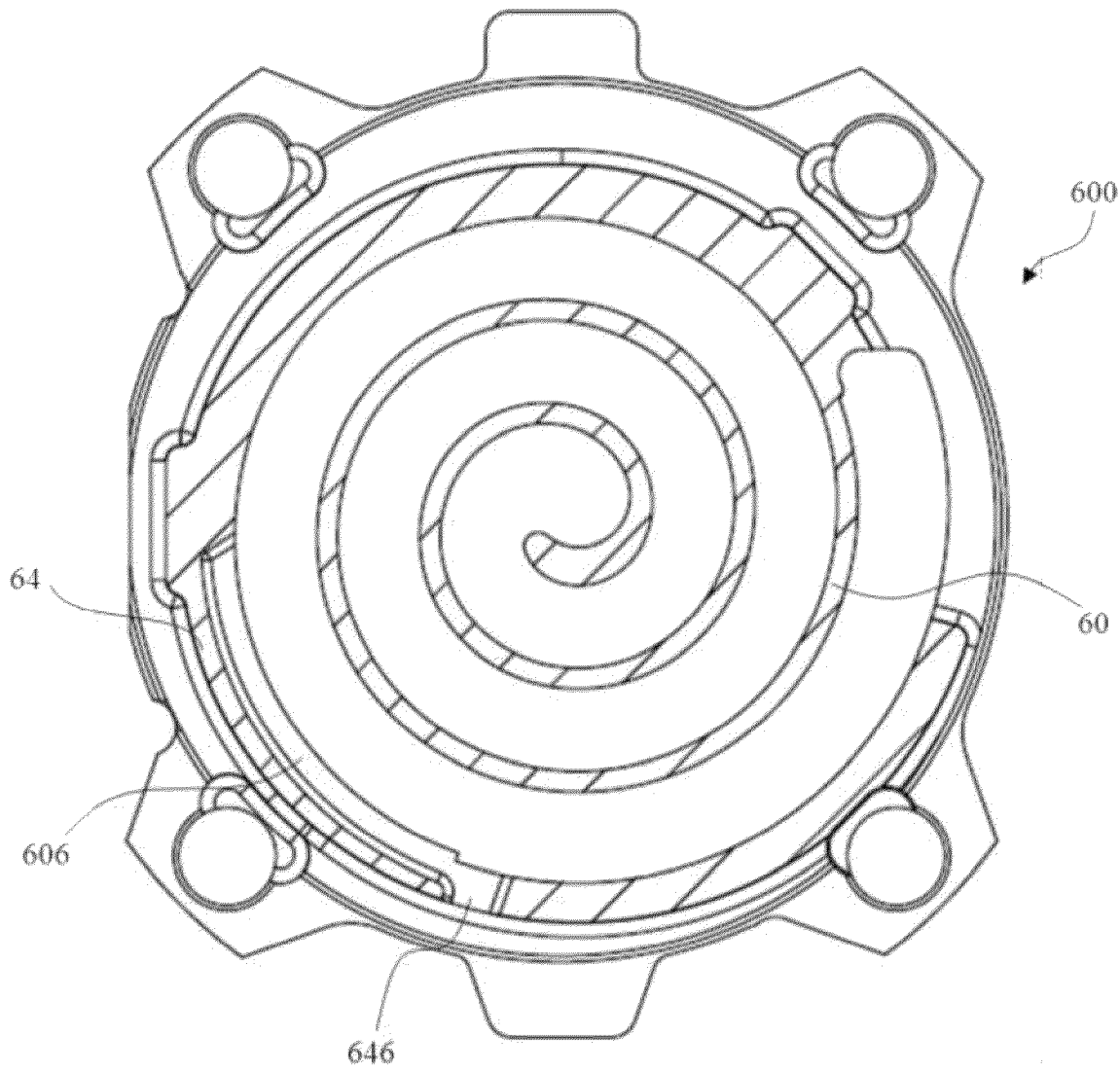


FIG. 11b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/089235

A. CLASSIFICATION OF SUBJECT MATTER

F04C18/02(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: F04C18,F04C29

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, CJFD, ENTXTC, WPABS: 涡卷, 涡旋, 叶片, 接触, 抵靠, 抵压, 数量, 个数, 面积, 疲劳, 强度, 吸气, 进气, scroll, contact+, point, area, fatigue, strength, inlet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 217926287 U (EMERSON CLIMATE TECHNOLOGIES (SUZHOU) CO., LTD.) 29 November 2022 (2022-11-29) claims 1-15	1-13
A	CN 210599396 U (LG ELECTRONICS INC.) 22 May 2020 (2020-05-22) description, paragraphs 0059-0161, and figures 3-7	1-13
A	US 2021010473 A1 (LG ELECTRONICS INC.) 14 January 2021 (2021-01-14) entire document	1-13
A	CN 103032323 A (LG ELECTRONICS INC.) 10 April 2013 (2013-04-10) entire document	1-13
A	JP 2000170671 A (TOKICO LTD.) 20 June 2000 (2000-06-20) entire document	1-13
A	JP 2010048226 A (SANDEN CORP.) 04 March 2010 (2010-03-04) entire document	1-13

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

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“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

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“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

15 June 2023

Date of mailing of the international search report

25 June 2023

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/089235

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		EP 3567253 A1	13 November 2019
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JP 2010048226 A	04 March 2010	None	

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

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- CN 202220922030 [0001]