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(71) Applicant: **Guangdong Meizhi Compressor Co., Ltd.**
Foshan, Guangdong 528333 (CN)

(72) Inventors:
- **YANG, Kaicheng**
Foshan
Guangdong 528333 (CN)
- **YU, Jijiang**
Foshan
Guangdong 528333 (CN)
- **YU, Yangbo**
Foshan
Guangdong 528333 (CN)

(74) Representative: **Zimmermann, Tankred Klaus et al**
Schoppe, Zimmermann, Stöckeler
Zinkler, Schenk & Partner mbB
Patentanwälte
Radlkoferstrasse 2
81373 München (DE)

(54) CRANKSHAFT FOR ROTARY COMPRESSOR, ROTARY COMPRESSOR AND REFRIGERATING CYCLE DEVICE

(57) A crankshaft for a rotary compressor includes: a body (1) and an eccentric portion (2), the eccentric portion (2) being fitted over the body (1), wherein at least one of a flexible structure (21) and an oil pressure surface (22) is arranged on the eccentric portion (2). The flexible structure (21) is configured to deform inwards when subject to an external force in an inward direction. The oil pressure surface (22) is configured in such a way that in a direction opposite to a rotating direction of a rotating central axis of a crankshaft (300), a distance between a front end (221) of the oil pressure surface (22) and the central axis of the eccentric portion (2) is smaller than a distance between a tail end (222) of the oil pressure surface (22) and the central axis of the eccentric portion (2). Also disclosed are a rotary compressor and a refrigerating cycle device. The crankshaft can effectively solve the problem that a rotary compressor gets stuck due to abnormal contact between a piston and an air cylinder, and a high-pressure oil wedge can be formed at a tail portion of an oil cavity, thereby increasing an inlet oil pressure, and improving the environment of lubrication between an eccentric portion and a piston.

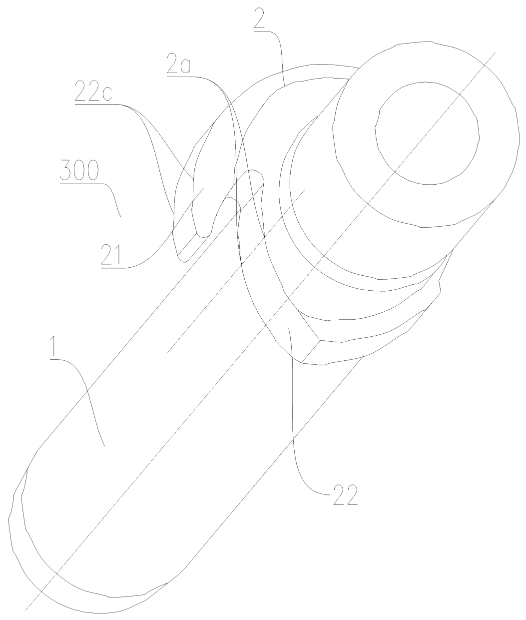

Fig. 7

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Description

FIELD

[0001] The present disclosure relates to a technical field of compressor manufacture, and specifically, to a crankshaft for a rotatory compressor, a rotatory compressor and a refrigerating cycle device.

BACKGROUND

[0002] In the related art, in order to guarantee a volumetric efficiency of a rotatory compressor, a gap exists between an inner wall of a cylinder and an outer wall of a piston. However, a compressing mechanism is usually stuck at the smallest gap if an inner radius of the cylinder deforms after assembly or impurities exist in the compressing mechanism, thus causing an abnormal blockage of rotation of the rotatory compressor.

[0003] In addition, the piston and an eccentric portion of a crankshaft are supplied with oil relying on an oil hole in the eccentric portion, so problems like a low oil pressure and a poor lubrication performance exist. Meanwhile, a contact area as well as a friction factor between the eccentric portion of the crankshaft and the inner wall of the piston is large, which causes a large input power of the rotatory compressor.

SUMMARY

[0004] The present disclosure seeks to solve one of the technical problems existing in the related art. Accordingly, a crankshaft for a rotary compressor is provided in the present disclosure, and the crankshaft is able to absorb an abnormal contact force between a piston and the crankshaft or improve a condition of lubrication between the crankshaft and the piston.

[0005] A rotary compressor having the above crankshaft is further provided in the present disclosure.

[0006] A refrigerating cycle device having the above rotary compressor is further provided in the present disclosure.

[0007] The crankshaft for the rotary compressor according to embodiments of a first aspect of the present disclosure includes a body and an eccentric portion. The eccentric portion is fitted over the body and provided with at least one of a flexible structure and an oil pressure surface, in which the flexible structure is configured to deform inwards when subject to an external force in an inward direction, and the oil pressure surface is configured in such a way that in a direction opposite to a rotating direction of a rotating central axis of the crankshaft, a distance between a front end of the oil pressure surface and the central axis of the eccentric portion is smaller than a distance between a tail end of the oil pressure surface and the central axis of the eccentric portion.

[0008] For the crankshaft configured for the rotary compressor according to embodiments of the present disclosure, when the eccentric portion is provided with the flexible structure having the above structural features, the problem that a rotary compressor gets stuck due to abnormal contact between the piston and the cylinder can be solved effectively; when the eccentric portion is provided with the oil pressure surface having the above structural features, a high-pressure oil wedge can be formed at a tail portion of the oil cavity by utilizing the rotating centrifugal force from the crankshaft rotating at a high speed, thereby increasing an inlet oil pressure, and improving the environment of lubrication between the eccentric portion and the piston.

[0009] According to an example of the present disclosure, the eccentric portion is provided with the flexible structure. The flexible structure has a first end and a second end, the first end of the flexible structure being connected to a first side wall of the eccentric portion and the second end of the flexible structure being spaced apart from the first side wall of the eccentric portion.

[0010] According to an example of the present disclosure, the oil pressure surface is formed on a second side wall, opposite to the second end of the flexible structure, of the eccentric portion.

[0011] According to an example of the present disclosure, the oil pressure surface is formed to be a smooth curved surface or a combination of a curved surface and a flat surface.

[0012] According to an example of the present disclosure, the flexible structure and the central axis of the eccentric portion are located at a same side of a central axis of the body.

[0013] According to an example of the present disclosure, the first end and the second end of the flexible structure are located at two sides of a reference plane respectively, and the reference plane is a plane formed by the central axis of the eccentric portion and the central axis of the body.

[0014] According to an example of the present disclosure, a distance d2 between the farthest point from the central axis of the eccentric portion, among intersection points of the flexible structure and the reference plane, and the central axis of the eccentric portion satisfies: $d2 \geq R0$, wherein R0 is an outer radius of the eccentric portion.

[0015] According to an example of the present disclosure, the eccentric portion is provided with the flexible structure. The flexible structure has a first end and a second end, both the first end and the second end of the flexible structure being connected to a side wall of the eccentric portion and other portions of the flexible structure except the first end and the second end being spaced apart from the side wall of the eccentric portion.

[0016] According to an example of the present disclosure, the eccentric portion is provided with the oil pressure surface, and two ends of the oil pressure surface in an axial direction of the eccentric portion are adjacent to two end faces of the eccentric portion respectively.

[0017] According to an example of the present disclosure, the two ends of the oil pressure surface adjoin the respective end faces of the eccentric portion directly.

[0018] According to an example of the present disclosure, the eccentric portion is provided with the oil pressure surface, and a communicating oil hole communicated with a central oil hole of the body is formed in the oil pressure surface.

[0019] The rotary compressor according to embodiments of a second aspect of the present disclosure includes a casing; a compressing mechanism disposed in the casing and having a working chamber; and a crankshaft for a rotary compressor according to embodiments of the first aspect of the present disclosure, in which an end of the crankshaft goes through the compressing mechanism, and the eccentric portion of the crankshaft is located in the working chamber.

[0020] For the rotary compressor according to embodiments of the present disclosure, by providing the crankshaft for the rotary compressor according to embodiments of the first aspect mentioned above, the overall performance of the rotary compressor is improved.

[0021] The refrigerating cycle device according to embodiments of a third aspect of the present disclosure includes the rotary compressor according to embodiments of the second aspect of the present disclosure.

[0022] For the refrigerating cycle device according to embodiments of the present disclosure, by providing the rotary compressor according to embodiments of the second aspect mentioned above, the overall performance of the refrigerating cycle device is improved.

[0023] Additional aspects and advantages of the present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] These and other aspects and advantages of embodiments of the present disclosure will become apparent and more readily appreciated from the following descriptions made with reference to the drawings, in which:

Fig. 1 is a schematic view of a rotary compressor according to embodiments of the present disclosure;
Fig. 2 is a sectional schematic view of a compressing mechanism shown in Fig. 1;
Fig. 3 is a partial axial view of the compressing mechanism shown in Fig. 2;
Fig. 4 is an operational schematic view of the compressing mechanism shown in Fig. 2;
Fig. 5 is another operational schematic view of the compressing mechanism shown in Fig. 2;
Fig. 6 is an assembling view of a crankshaft and a piston shown in Fig. 2;
Fig. 7 is a perspective view of a crankshaft according to a first embodiment of the present disclosure;
Fig. 8 is a front view of the crankshaft shown in Fig. 7;
Fig. 9 and Fig. 10 are two axial views of the crankshaft shown in Fig. 7;
Fig. 11 is a perspective view of a crankshaft according to a second embodiment of the present disclosure;
Fig. 12 is an axial view of the crankshaft shown in Fig. 11;
Fig. 13 is a perspective view of a crankshaft according to a third embodiment of the present disclosure;
Fig. 14 is an axial view of the crankshaft shown in Fig. 13;
Fig. 15 is a perspective view of a crankshaft according to a fourth embodiment of the present disclosure;
Fig. 16 is a perspective view of a crankshaft according to a fifth embodiment of the present disclosure;
Fig. 17 is an axial view of the crankshaft shown in Fig. 16.

Reference numerals:

[0025]

1000: rotary compressor;
100: casing;
200: compressing mechanism; 201: main bearing; 202: cylinder; 203: auxiliary bearing; 204: sliding vane; 205: piston;
300: crankshaft; 1: body; 2: eccentric portion; 2a: corresponding end face;
21: flexible structure; 211: first end; 212: second end;
22: oil pressure surface; 22a: first segment; 22b: second segment; 22c: two ends; 221: front end; 222: tail end;
23: communicating oil hole; 3: oil cavity; 3a: wedge shaped space.

DETAILED DESCRIPTION

[0026] Embodiments of the present disclosure will be described in detail in the following. Examples of the embodiments are shown in the drawings, and the same or similar elements and the elements having same or similar functions are denoted by like reference numerals throughout the descriptions. The embodiments described with reference to the drawings are illustrative, which is only used to explain the present disclosure and shouldn't be construed to limit the present disclosure.

[0027] Various embodiments and examples are provided in the following description to implement different structures of the present disclosure. In order to simplify the present disclosure, certain elements and settings will be described. However, these elements and settings are only by way of example and are not intended to limit the present disclosure. In addition, reference numerals may be repeated in different examples in the present disclosure. This repeating is for the purpose of simplification and clarity and does not refer to relations between different embodiments and/or settings. Furthermore, examples of different processes and materials are provided in the present disclosure. However, it would be appreciated by those skilled in the art that other processes and/or materials may be also applied.

[0028] A crankshaft 300 for a rotary compressor 1000 according to embodiments of a first aspect of the present disclosure is described in the following with reference to Fig. 1 to Fig. 17.

[0029] Specifically, the rotary compressor 1000 may further include a casing 100 and a compressing mechanism 200, and as shown in Fig. 1 and Fig. 2, the compressing mechanism 200 may include a main bearing 201, a cylinder 202, an auxiliary bearing 203, a sliding vane 204 and a piston 205. The main bearing 201 and the auxiliary bearing 203 are disposed onto two axial ends of the cylinder 202 respectively so as to define a working chamber together with the cylinder 202, and the crankshaft 300 goes through the main bearing 201, the cylinder 202 and the auxiliary bearing 203.

[0030] The crankshaft 300 for the rotary compressor 1000 according to embodiments of the first aspect of the present disclosure includes a body 1 and an eccentric portion 2. Specifically, with reference to Fig. 7, the eccentric portion 2 is fitted over the body 1. The body 1 is substantially formed in a long cylinder shape and goes through the eccentric portion 2. Here, it should be noted that, the expression "fitted over" is used to indicate a positional relationship of the eccentric portion 2 and the body 1 instead of limiting the assembling relationship between the eccentric portion 2 and the body 1. For example, the eccentric portion 2 and the body 1 may be parts processed separately and fixed together through a subsequent assembly, or the eccentric portion 2 and the body 1 may also be an integrally processed part.

[0031] With reference to Fig. 2, Fig. 3 and Fig. 6, the piston 205 is fitted over the eccentric portion 2, and the eccentric portion 2 is fitted in the working chamber. A sliding vane groove going through the cylinder 202 radially and communicating with the working chamber is formed in the cylinder 202. The sliding vane 204 is slidably disposed in the sliding vane groove, and a front end 221 of the sliding vane 204 abuts against an outer circumferential surface of the piston 205 all the time. Thus, in the rotation process of the crankshaft 300, the eccentric portion 2 is able to drive the piston 205 to roll along an inner circumferential surface of the cylinder 202 and meanwhile push the sliding vane 204 to slide inwards and outwards along a radial direction of the cylinder 202 so as to compress a refrigerant in the working chamber.

[0032] Specifically, as shown in Fig. 7 to Fig. 17, the eccentric portion 2 is provided with at least one of a flexible structure 21 and an oil pressure surface 22, that is, the eccentric portion 2 may be only provided with the flexible structure 21, or the eccentric portion 2 is only provided with the oil pressure surface 22, or the eccentric portion 2 may also be provided with both of the flexible structure 21 and the oil pressure surface 22.

[0033] The flexible structure 21 is configured to deform inwards (facing towards a central axis direction of the body 1) when subject to an external force in an inward direction. For example, in the example shown in Fig. 4, when the cylinder 202 is processed, a contour of the inner circumferential surface thereof is a curve indicated by an arrow line a1, and after the cylinder 202 is assembled and deformed, the contour of the inner circumferential surface thereof is a curve indicated by an arrow line a2. The original outer contour of the flexible structure 21 is a curve indicated by an arrow line b1, and the contour of the flexible structure 21 changes into a curve indicated by an arrow line b2 when the deformed inner circumferential surface of the cylinder 202 applies an abnormal contact force F to the piston 205 and the flexible structure 21 deforms inwards (facing towards a central axis of the piston 205). Thus, the flexible structure 21 is able to absorb, through deformation, the contact force caused by the abnormal contact of the piston 205 and the cylinder 202.

[0034] Therefore, when the eccentric portion 2 is provided with the flexible structure 21 having the structural features mentioned above, if abnormal conditions occur, such as introduction of impurities into the compressing mechanism 200, bulges formation due to the deformation of the inner circumferential surface of the cylinder 202, or the size of the parts processed out of tolerance, the flexible structure 21 is able to deform inwards so as to absorb the contact force generated by the metallic contact between the piston 205 and the inner circumferential surface of the cylinder 202, that is, the contact force, caused by a too small gap and the abnormal contact between the piston 205 and the cylinder 202, can be absorbed by the deformation of the flexible structure 21, which ensures a normal operation of the rotary compressor 1000 and prevents the problem of being stuck during the operation.

[0035] As shown in Fig. 5, the oil pressure surface 22 is configured in such a way that in a direction (for example a direction indicated by an arrow line R2 in Fig. 5) opposite to a rotating direction of a rotating central axis of the crankshaft 300, a distance L1 between a front end 221 of the oil pressure surface 22 and the central axis of the eccentric portion 2 is smaller than a distance L2 between a tail end 222 of the oil pressure surface 22 and the central axis of the eccentric portion 2. In the rotating direction of the crankshaft 300, the front end 221 of the oil pressure surface 22 is always located in front of the tail end 222 of the oil pressure surface 22.

[0036] When the eccentric portion 2 is provided with the oil pressure surface 22 having the structural features mentioned above, as an oil cavity 3 defined by the oil pressure surface 22 and the piston 205 converges gradually along the direction (for example the direction indicated by the arrow line R2 in Fig. 5) opposite to the rotating direction (for example a direction indicated by an arrow line R1 in Fig. 5) of the crankshaft 300, the lubricating oil in the oil cavity 3 can be gathered within a wedge shaped space 3a by means of a centrifugal force imposed on the lubricating oil in the oil cavity 3 due to high-speed rotation of the crankshaft 300, so that an inlet oil pressure (for example a direction indicated by an arrow p in Fig. 5) of the sliding bearing is increased, and hence the oil supply state of the eccentric portion 2 is improved, that is, the lubrication condition of the piston 205 and the eccentric portion 2 is improved.

[0037] In addition, as the eccentric portion 2 is provided with at least one of the flexible structure 21 and the oil pressure surface 22, an outer circumferential surface of the eccentric portion 2 may be formed in a non-circular shape, for example the case shown in Fig. 7, i.e. the flexible structure 21 has a first end 211 and a second end 212, the first end 211 of the flexible structure 21 is connected to a first side wall of the eccentric portion 2, and the second end 212 of the flexible structure 21 is spaced apart from the first side wall of the eccentric portion 2. Accordingly, with reference to Fig. 5, the outer circumferential surface of the eccentric portion 2 is not able to contact the inner circumferential surface of the piston 205 fully and completely, which can reduce the contact area between the eccentric portion 2 and the inner circumferential surface of the piston 205, thereby reducing friction power consumption of the contact area and improving energy efficiency of the rotary compressor 1000. It is tested that when a motor operating frequency of the rotary compressor 1000 is 60Hz, the input power can be reduced by 2%.

[0038] For the rotary compressor 1000 in which carbon dioxide serves as a refrigerant, when a test is performed under the Chinese national standard performance condition, the refrigerating capacity of the rotary compressor 1000 mounted with the crankshaft 300 in the prior art (i.e. the eccentric portion 2 is formed in a complete cylindrical shape) is 6297W, the corresponding input power of the electric motor is 1623W, and the coefficient of performance (COP) is 3.88, but the refrigerating capacity of the rotary compressor 1000 mounted with the crankshaft 300 according to embodiments of the present disclosure (for example the eccentric portion 2 has the flexible structure 21 and the oil pressure surface 22) is 6523W, the corresponding input power of the electric motor is 1598W, and the coefficient of performance (COP) is 4.08. Thus, by contrast, the refrigerating capacity of the rotary compressor 1000 mounted with the crankshaft 300 according to embodiments of the present disclosure is improved by 1.62%, the input power of the electric motor is reduced by 1.57%, and the coefficient of performance (COP) is improved by 5.21%.

[0039] With the crankshaft 300 for the rotary compressor 1000 according to embodiments of the present disclosure, when the eccentric portion 2 is provided with the flexible structure 21 having the above structural features, it is possible to effectively solve the problem that the rotary compressor 1000 gets stuck by the abnormal contact between the piston 205 and the cylinder 202 due to a small gap between an air suction side and an air discharge side of the compressing mechanism 200 or existence of impurities in the volume cavity of the compressing mechanism 200. When the eccentric portion 2 is provided with the oil pressure surface 22 having the above structural features, the oil cavity 3 between the piston 205 and the eccentric portion 2 has an gradually decreasing volume along the direction opposite to the rotating direction of the crankshaft 300, such that a high-pressure oil wedge space can be formed at a tail portion of the oil cavity 3 by utilizing the rotating centrifugal force from the high-speed rotation of the crankshaft 300 effectively, thereby increasing the inlet oil pressure, and improving the environment of lubrication between the eccentric portion 2 and the piston 205.

[0040] The crankshaft 300 for the rotary compressor 1000 according to a plurality of embodiments of the present utility model is described in the following with reference to Fig. 1 to Fig. 17.

First Embodiment

[0041] With reference to Fig. 7 to Fig. 10, the eccentric portion 2 is provided with the flexible structure 21, and the flexible structure 21 has the first end 211 and the second end 212. The first end 211 of the flexible structure 21 is connected to the first side wall of the eccentric portion 2 while the second end 212 of the flexible structure 2 is spaced apart from the first side wall of the eccentric portion 2. Specifically, the first end 211 of the flexible structure 21 is connected with the first side wall of the eccentric portion 2, and the second end 212 of the flexible structure 21 extends towards a direction away from the first side wall of the eccentric portion 2. Accordingly, when the piston 205 are in abnormal contact with the inner wall of the cylinder 202, the abnormal contact force can be absorbed through an elastic deformation of the second end 212 of the flexible structure 21, and hence the problem that the rotary compressor 1000 gets stuck is improved, and on the other hand, the flexible structure 21 in this kind of structure makes the whole outer circumferential surface of the eccentric portion 2 form a non-circular shape, so that the contact area between the piston 205 and the eccentric portion 2 can be reduced effectively, hence reducing the contact fiction power effectively, and in addition, the structure of the flexible structure 21 is simple and convenient to process.

[0042] Further, with reference to Fig. 8 to Fig. 10, the flexible structure 21 and the central axis of the eccentric portion 2 are located at a same side of a central axis of the body 1. That is, the flexible structure 21 is disposed at a side of the eccentric portion 2 farther away from the body 1, or in other word, the flexible structure 21 is located at a side, away from the central axis of the body 1, of a connecting line between the central axis of the eccentric portion 2 and the central axis of the body 1. Thus, by disposing the flexible structure 21 at the side of the eccentric portion 2 farther away from the body 1, not only the processing becomes convenient, but also the flexible structure 21 has a larger elastic deformation and has a stronger capacity to absorb the abnormal contact force.

[0043] With reference to Fig. 9 and Fig. 10, the first end 211 and the second end 212 of the flexible structure 21 are located at two sides of a reference plane (for example the plane A-A shown in Fig. 9) respectively, in which case a distance between the first end 211 of the flexible structure 21 and the reference plane is larger than 0, and a distance d1 between the second end 212 of the flexible structure 21 and the reference plane is also larger than 0, in which the reference plane is a plane defined by the central axis of the eccentric portion 2 and the central axis of the body 1. Thus, the flexible structure 21 has a relatively large length, and the elastic deformation takes places more effectively, which makes the flexible structure 21 has a stronger capacity to absorb the abnormal contact force. Certainly, the present disclosure is not limited to this; the distance d1 between the second end 212 of the flexible structure 21 and the reference plane may also be equal to 0, that is, the second end 212 of the flexible structure 21 may be flush with the reference plane.

[0044] With reference to Fig. 9, a distance d2 between the farthest point from the central axis of the eccentric portion 2, among intersection points of the flexible structure 21 and the reference plane, and the central axis of the eccentric portion 2 satisfies: $d2 \geq R0$, wherein R0 is an outer radius of the eccentric portion 2. Thus, the flexible structure 21 is away from the central axis of the eccentric portion 2 far enough, which enables more effective elastic deformation so as to absorb the abnormal contact force better.

[0045] Further, with reference to Fig. 7 and Fig. 9, the oil pressure surface 22 is formed on a second side wall, opposite to the second end 212 of the flexible structure 21, of the eccentric portion 2. Thus, the second end 212 of the flexible structure 21 is spaced apart from the first side wall of the eccentric portion 2, so the second end 212 of the flexible structure 21 is spaced apart from the oil pressure surface 22 in a direction from the inside to the outside, and hence an oil storage space is defined between the flexible structure 21 and the oil pressure surface 22. Thus, the structure of the eccentric portion 2 is simple, compact and convenient to process, which can realize three kinds of effects, namely absorbing abnormal contact force, improving lubrication effect and decreasing contact abrasion between the eccentric portion and the piston 205 reliably. Preferably, the oil pressure surface 22 may be formed to be a smooth curved surface so as to be convenient to process and manufacture as well as have a low processing cost.

[0046] With reference to Fig. 10 combined with Fig. 5, the eccentric portion 2 is provided with the oil pressure surface 22, and a communicating oil hole 23 communicated with a central oil hole of the body 1 is formed in the oil pressure surface 22, such that the lubricating oil in the central oil hole of the body 1 can be supplied into the oil cavity 3 through the communicating oil hole 23, and then flow into the wedge shaped space 3a at the tail end 222 of the oil pressure surface 22 under the action of the rotating centrifugal force of the crankshaft 300. Thus, by providing the communicating oil hole 23, it is convenient to supply the lubricating oil between the piston 205 and the eccentric portion 2. Certainly, the present disclosure is not limited to this, and the lubricating oil may be supplied between the piston 205 and the eccentric portion 2 in other ways for example through an oil supply pipe.

[0047] Specifically, as shown in Fig. 7, two ends 22c of the oil pressure surface 22 in an axial direction of the eccentric portion 2 adjoin respective corresponding end faces 2a of the eccentric portion 2 directly, which is an extreme possibility in terms of the fact that the two ends 22c of the oil pressure surface 22 in the axial direction of the eccentric portion 2 are adjacent to the respective corresponding end faces 2a of the eccentric portion 2. That is, a width of the oil pressure surface 22 in an axial direction of the body 1 is equal to a thickness of the eccentric portion 2 in the axial direction of the body 1, and the two ends 22c of the oil pressure surface 22 in the axial direction are flush with the two corresponding end faces 2a of the eccentric portion 2 in the axial direction. As a result, not only the processing is facilitated, but also the oil pressure surface 22 has a sufficiently large area, which makes the lubricating oil flow to the oil pressure surface 22 more adequately, and hence achieve a better lubrication effect.

Second Embodiment

[0048] As shown in Fig. 11 and Fig. 12, the structure in the present embodiment is substantially identical to that in the first embodiment, the same components being denoted by like reference numerals, which only differs in that the eccentric portion 2 in the present embodiment is not provided with the flexible structure 21.

Third Embodiment

[0049] As shown in Fig. 13 and Fig. 14, the eccentric portion 2 is provided with the flexible structure 21, and the flexible structure 21 has the first end 211 and the second end 212. Both the first end 211 and the second end 212 of the flexible structure 21 are connected to a side wall of the eccentric portion 2 and other portions of the flexible structure 21 except the first end and 211 the second end 212 are spaced apart from the side wall of the eccentric portion 2. In this way, a substantially crescent hollow cavity is defined between the flexible structure 21 and the side wall of the eccentric portion 2, and the hollow cavity is able to go through the eccentric portion 2 along the axial direction of the body 1. Thus, when the piston 205 are in abnormal contact with the inner wall of the cylinder 202, the portions of the flexible structure 21, except the first end 211 and the second end 212, deform elastically to absorb the contact force. As a result, the structure of the flexible structure 21 is simple and convenient to process, and the flexible structure 21 and the side wall of the eccentric portion 2 have high connection reliability and long service life.

Fourth Embodiment

[0050] As shown in Fig. 15, the structure in the present embodiment is substantially identical to that in the third embodiment, the same components being denoted by like reference numerals, which only differs in that the eccentric portion 2 in the present embodiment is provided with the oil pressure surface 22. Specifically, the eccentric portion 2 is provided with the oil pressure surface 22, the two ends 22c of the oil pressure surface 22 in the axial direction of the eccentric portion 2 are adjacent to the two end faces 2a of the eccentric portion 2 respectively, and the two ends 22c of the oil pressure surface 22 in the axial direction of the eccentric portion 2 are spaced apart from the two end faces 2a of the eccentric portion 2. That is, the two ends 22c of the oil pressure surface 22 in the axial direction of the eccentric portion 2 do not adjoin the two end faces 2a of the eccentric portion 2 directly, such that it is convenient to process and a better lubrication effect can be achieved.

Fifth Embodiment

[0051] As shown in Fig. 16 and Fig. 17, the structure in the present embodiment is substantially identical to that in the embodiment four, the same components being denoted by like reference numerals, which only differs in two aspects. In the first aspect, a shape of the flexible structure 21 in the present embodiment is different from a shape of the flexible structure 21 in the fourth embodiment. Specifically, the first end 211 and the second end 212 of the flexible structure 21 in the fourth embodiment are both connected to the side wall of the eccentric portion 2 (as shown in Fig. 15), but in the present embodiment, only the first end 211 of the flexible structure 21 is connected to the side wall of the eccentric portion 2, and the second end 212 of the flexible structure 21 is spaced apart from the side wall of the eccentric portion 2. In the second aspect, a shape of the oil pressure surface 22 in the present embodiment is different from a shape of the oil pressure surface 22 in the fourth embodiment. Specifically, the oil pressure surface 22 is formed to be a curved surface in the fourth embodiment (as shown in Fig. 15), but in the present embodiment, the oil pressure surface 22 includes two segment connected in a circumferential direction. A first segment 22a is formed to be a combination of a curved surface and a flat surface, and two ends 22c of the first segment 22a in the axial direction of the eccentric portion 2 adjoin the two end faces 2a of the eccentric portion 2 respectively. A second segment 22b is formed to be a curved surface, and two ends 22c of the second segment 22b in the axial direction of the eccentric portion 2 are adjacent to but do not adjoin the two end faces 2a of the eccentric portion 2 respectively. Thus, the oil pressure surface 22 is also convenient to process and manufacture, and the lubricating effect between the piston 205 and the eccentric portion 2 is improved. Certainly, the structure of the oil pressure surface 22 may also be designed according to the actual requirement so as to meet the actual requirement better.

[0052] With reference to Fig. 1, the rotary compressor 1000 according to embodiments of a second aspect of the present disclosure includes a casing 100, a compressing mechanism 200 and the crankshaft 300 for the rotary compressor 1000 according to embodiments of the first aspect of the present disclosure mentioned above. The compressing mechanism 200 is disposed in the casing 100 and has a working chamber, and an end of the crankshaft 300 goes through the compressing mechanism 200. Here, it should be noted that, as the structure of the rotary compressor 1000 has been described in detail above, it will not be repeated here. Other configurations (such as an electric motor) and operations of the rotary compressor 1000 according to embodiments of the present disclosure are well known to those ordinarily skilled in the art, which will not be described in detail herein.

[0053] For the rotary compressor 1000 according to embodiments of the present disclosure, by providing the crankshaft 300 for the rotary compressor 1000 according to embodiments of the above first aspect, the refrigerating capacity of the rotary compressor 1000 is improved, the input power of the electric motor of the rotary compressor 1000 is reduced, and the coefficient of performance of the rotary compressor 1000 is improved.

[0054] A refrigerating cycle device (not shown in the figures) according to embodiments of a third aspect of the present disclosure includes the rotary compressor 1000 according to embodiments of the second aspect of the present disclosure. Specifically, the refrigerating cycle device may further include a condenser (not shown in the figures), an expansion mechanism (not shown in the figures), an evaporator (not shown in the figures) and etc., in which both the rotary compressor 1000 and the expansion mechanism are connected with the condenser, and the evaporator is connected with the expansion mechanism. Other configurations and operations of the refrigerating cycle device according to embodiments of the present disclosure are well known to those ordinarily skilled in the art, which will not be described in detail herein.

[0055] For the refrigerating cycle device according to embodiments of the present disclosure, by providing the rotary compressor 1000 according to embodiments of the second aspect mentioned above, the overall performance of the refrigerating cycle device is improved.

[0056] In the specification, it should be understood that terms such as "center", "longitudinal " ,"lateral", "length", "width", "depth", "up", "down" ,"front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer" ,"clockwise", "counterclockwise", "axial direction", "radial direction", "circumferential direction" should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the present disclosure be constructed or operated in a particular orientation, so shall not be construed to limit the present disclosure.

[0057] In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature. In the description of the present disclosure, "a plurality of" means two or more than two, unless specified otherwise.

[0058] In the present disclosure, unless specified or limited otherwise, the terms "mounted," "connected," "coupled," "fixed" should be understood broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications or interaction relationships of two elements, which can be understood by those skilled in the art according to specific situations.

[0059] In the present disclosure, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on," "above," or "on top of" a second feature may include an embodiment in which the first feature is right or obliquely "on," "above," or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature "below," "under," or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below," "under," or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0060] 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. In the present specification, the illustrative statement of the terms above is not necessarily referring to the same embodiment or example. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. In addition, the different embodiments or examples as well as the features in the different embodiments or examples described in the specification can be combined or united by those skilled in the related art in the absence of contradictory circumstances.

[0061] Although embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes, alternatives, variation and modifications can be made in the embodiments without departing from spirit and principles of the present disclosure, and the scope of the present disclosure is limited by the claims and its equivalents.

Claims

1. A crankshaft for a rotary compressor, comprising:

a body; and
an eccentric portion fitted over the body and provided with at least one of a flexible structure and an oil pressure surface, wherein the flexible structure is configured to deform inwards when subject to an external force in an inward direction, and the oil pressure surface is configured in such a way that in a direction opposite to a rotating direction of a rotating central axis of the crankshaft, a distance between a front end of the oil pressure surface and the central axis of the eccentric portion is smaller than a distance between a tail end of the oil pressure surface and the central axis of the eccentric portion.

2. The crankshaft for a rotary compressor according to claim 1, wherein the eccentric portion is provided with the flexible structure;
the flexible structure has a first end and a second end, the first end of the flexible structure being connected to a first side wall of the eccentric portion and the second end of the flexible structure being spaced apart from the first side wall of the eccentric portion.

3. The crankshaft for a rotary compressor according to claim 2, wherein the oil pressure surface is formed on a second side wall, opposite to the second end of the flexible structure, of the eccentric portion.

4. The crankshaft for a rotary compressor according to claim 3, wherein the oil pressure surface is formed to be a smooth curved surface or a combination of a curved surface and a flat surface.

5. The crankshaft for a rotary compressor according to any one of claims 2-4, wherein the flexible structure and the central axis of the eccentric portion are located at a same side of a central axis of the body.

6. The crankshaft for a rotary compressor according to claim 5, wherein the first end and the second end of the flexible structure are located at two sides of a reference plane respectively, and the reference plane is a plane formed by the central axis of the eccentric portion and the central axis of the body.

7. The crankshaft for a rotary compressor according to claim 6, wherein a distance d2 between the farthest point from the central axis of the eccentric portion, among intersection points of the flexible structure and the reference plane, and the central axis of the eccentric portion satisfies: $d2 \geq R0$, wherein R0 is an outer radius of the eccentric portion.

8. The crankshaft for a rotary compressor according to claim 1, wherein the eccentric portion is provided with the flexible structure;
the flexible structure has a first end and a second end, both the first end and the second end of the flexible structure being connected to a side wall of the eccentric portion and other portions of the flexible structure except the first end and the second end being spaced apart from the side wall of the eccentric portion.

9. The crankshaft for a rotary compressor according to claim 1, wherein the eccentric portion is provided with the oil pressure surface, and
two ends of the oil pressure surface in an axial direction of the eccentric portion are adjacent to two end faces of the eccentric portion respectively.

10. The crankshaft for a rotary compressor according to claim 9, wherein the two ends of the oil pressure surface adjoin the respective end faces of the eccentric portion directly.

11. The crankshaft for a rotary compressor according to any one of claims 1-10, wherein the eccentric portion is provided with the oil pressure surface, and a communicating oil hole communicated with a central oil hole of the body is formed in the oil pressure surface.

12. A rotary compressor, comprising:

a casing;
a compressing mechanism disposed in the casing and having a working chamber; and
a crankshaft for a rotary compressor according to any one of claims 1-11, wherein an end of the crankshaft goes through the compressing mechanism, and the eccentric portion of the crankshaft is located in the working chamber.

13. A refrigerating cycle device, comprising a rotary compressor according to claim 12.

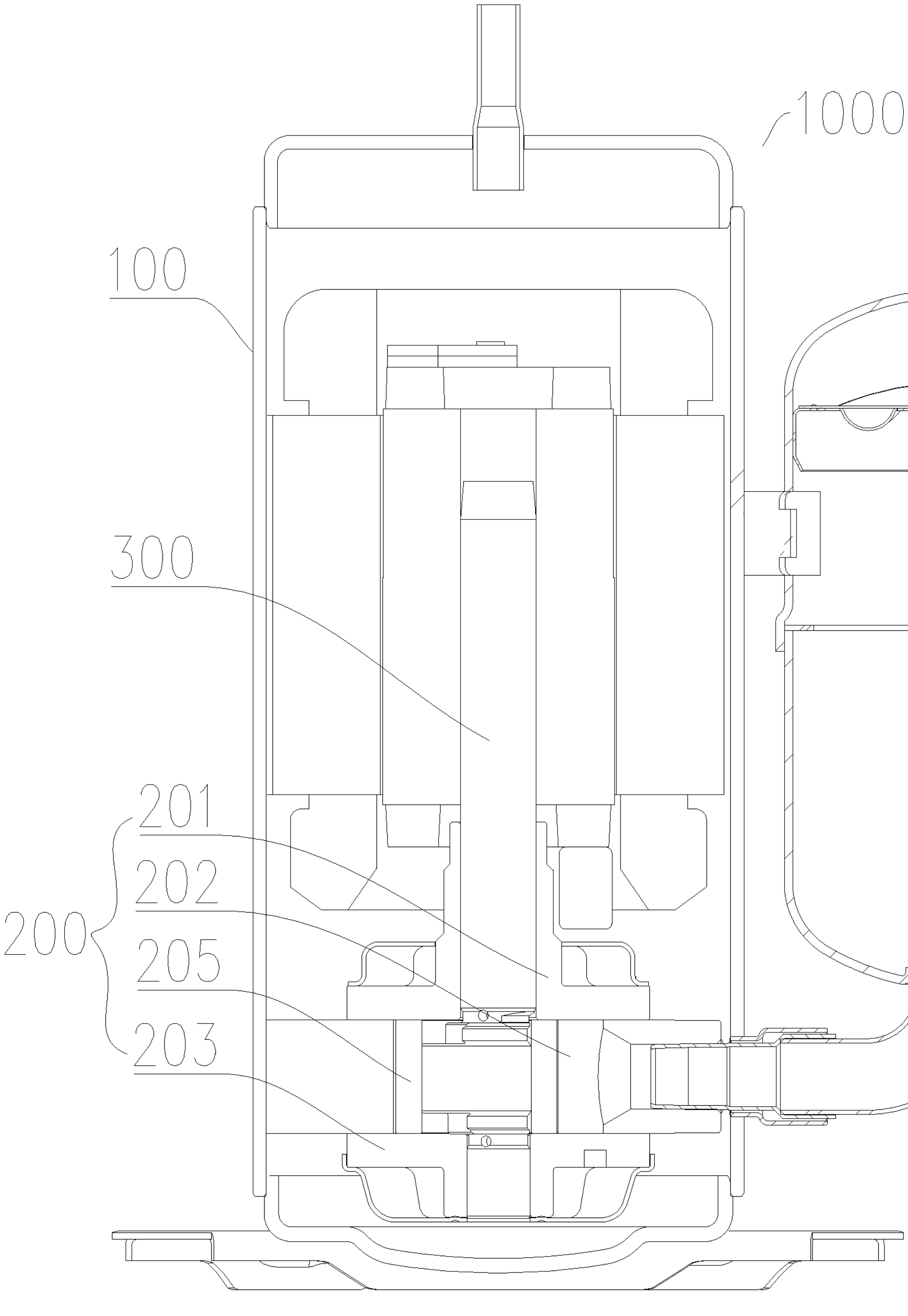

Fig. 1

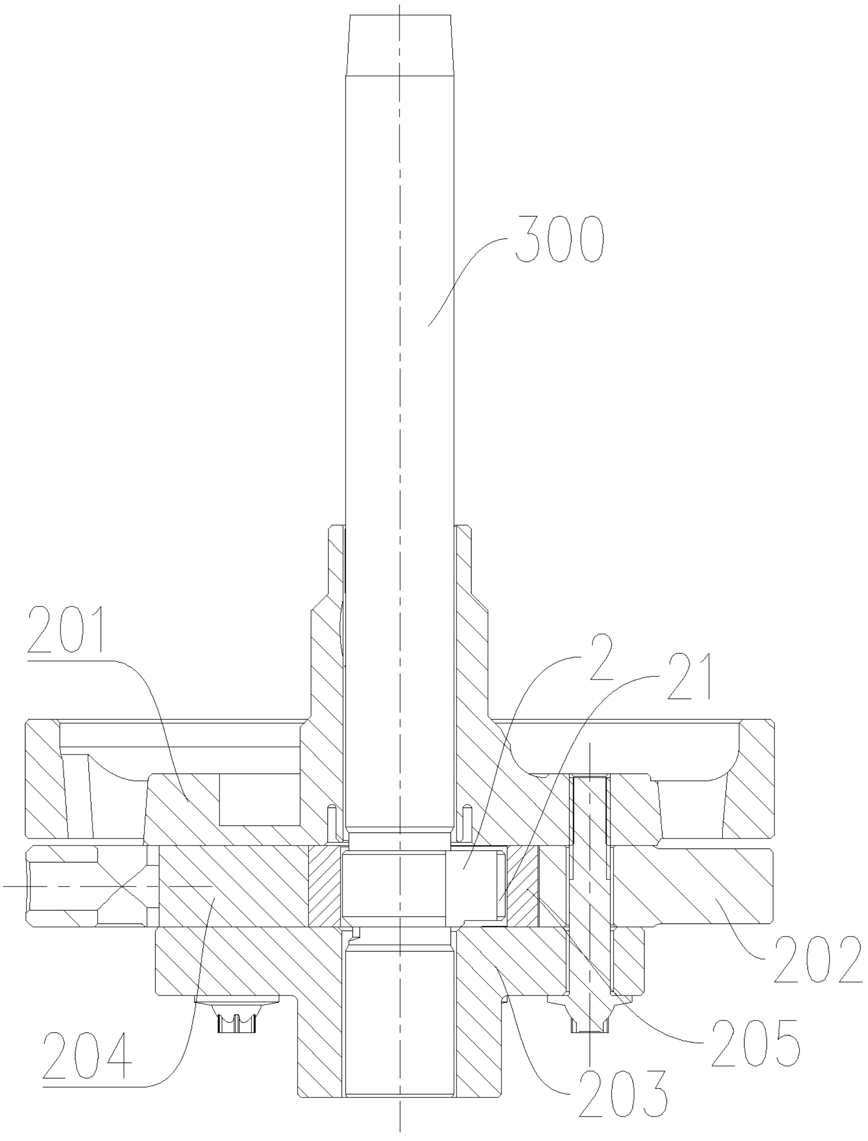

Fig. 2

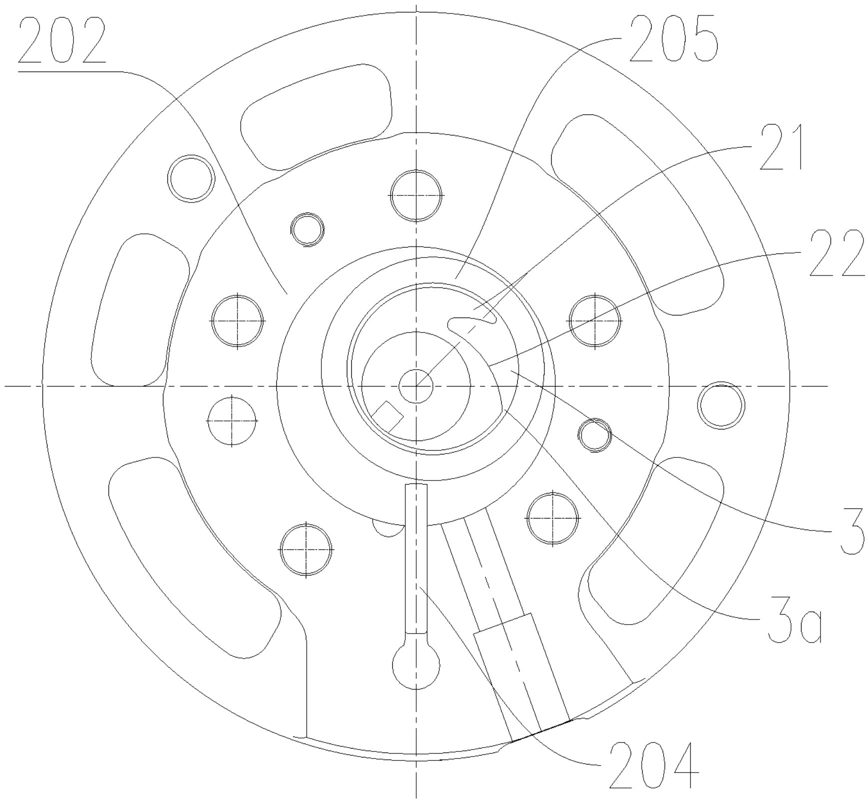

Fig. 3

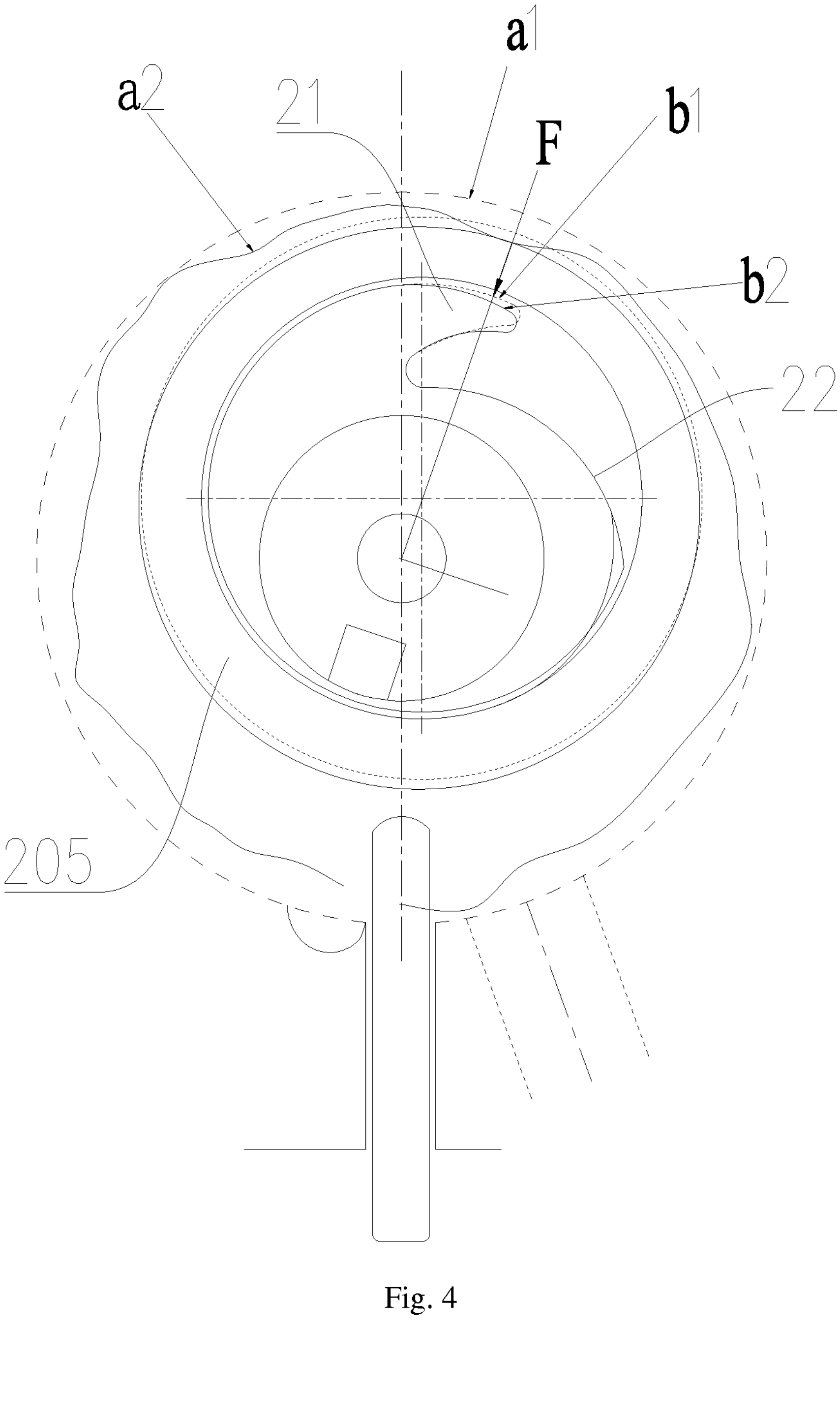

Fig. 4

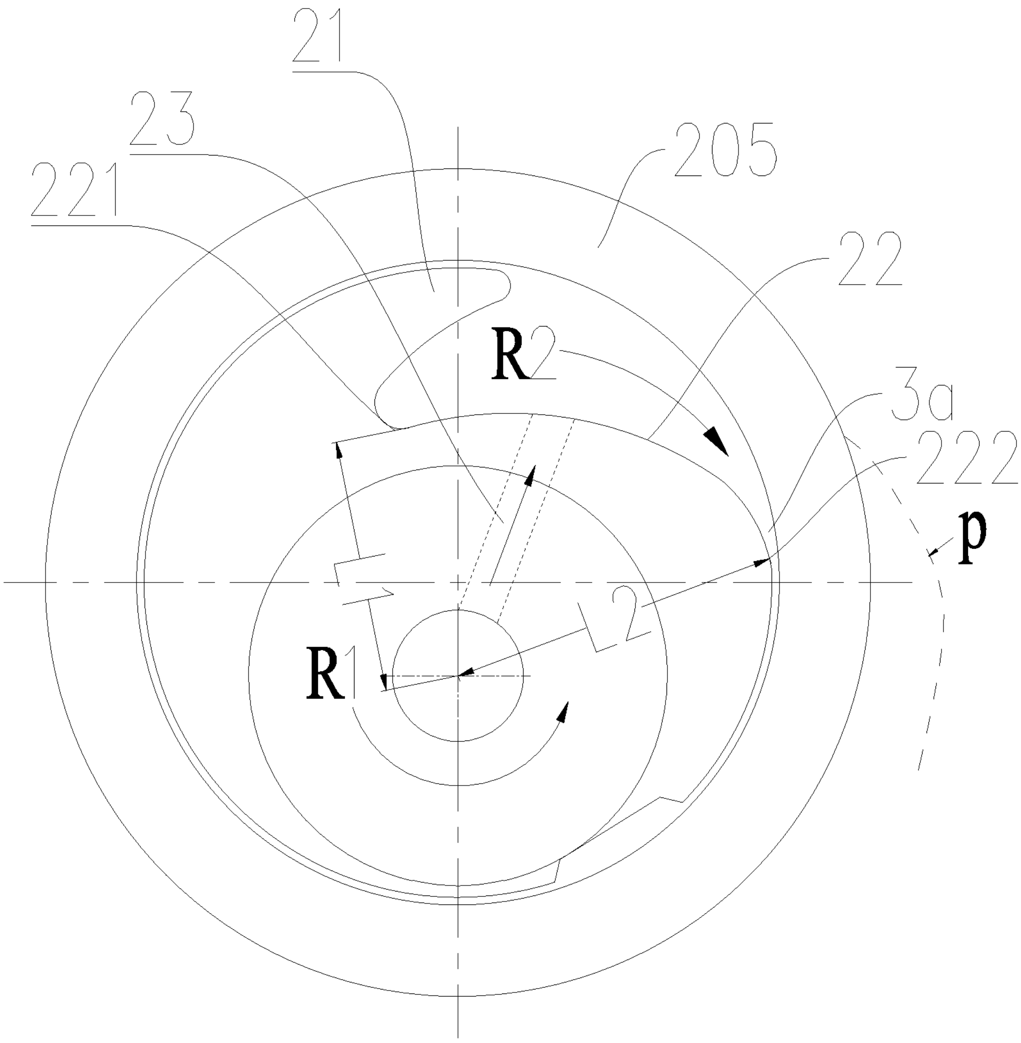

Fig. 5

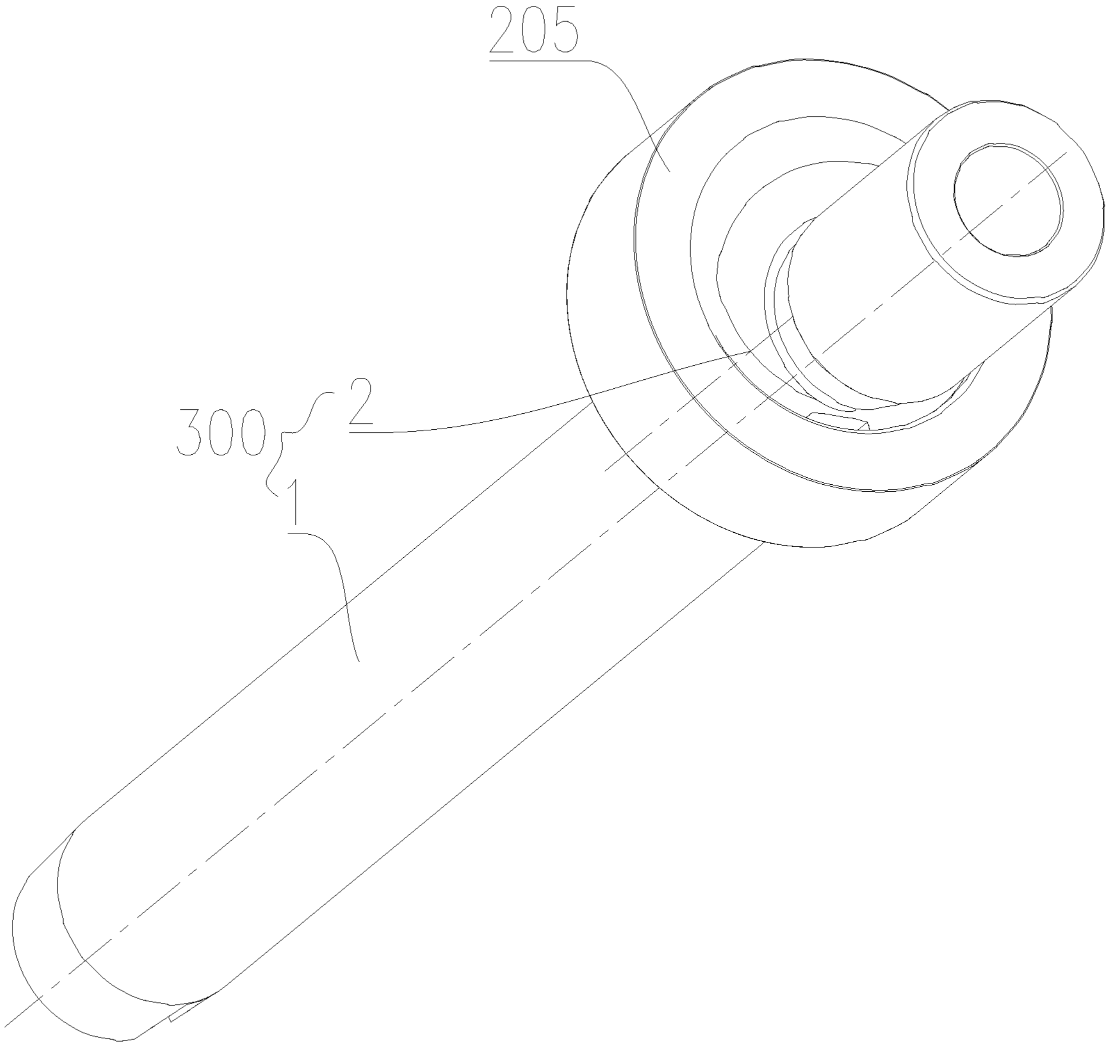

Fig. 6

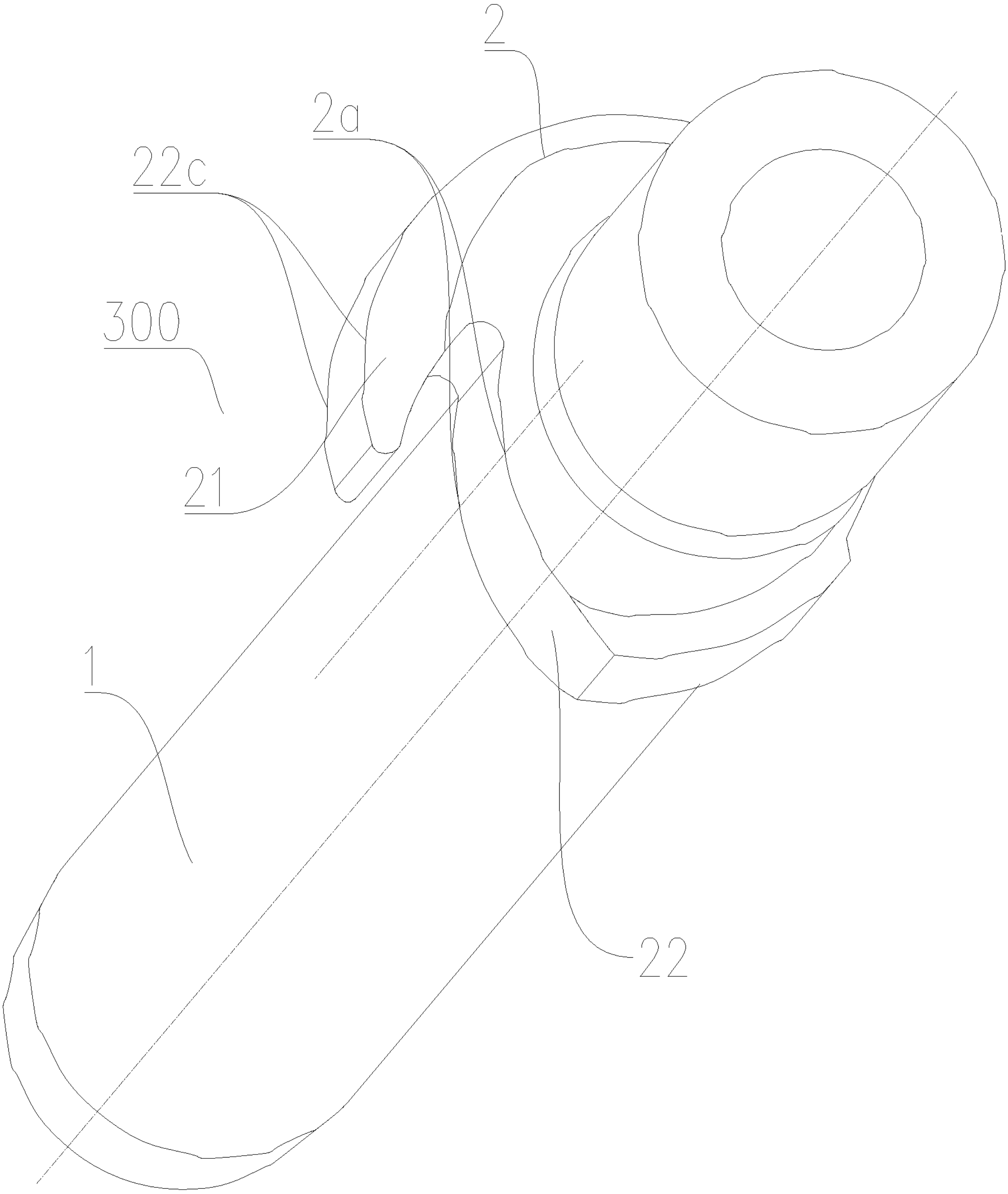

Fig. 7

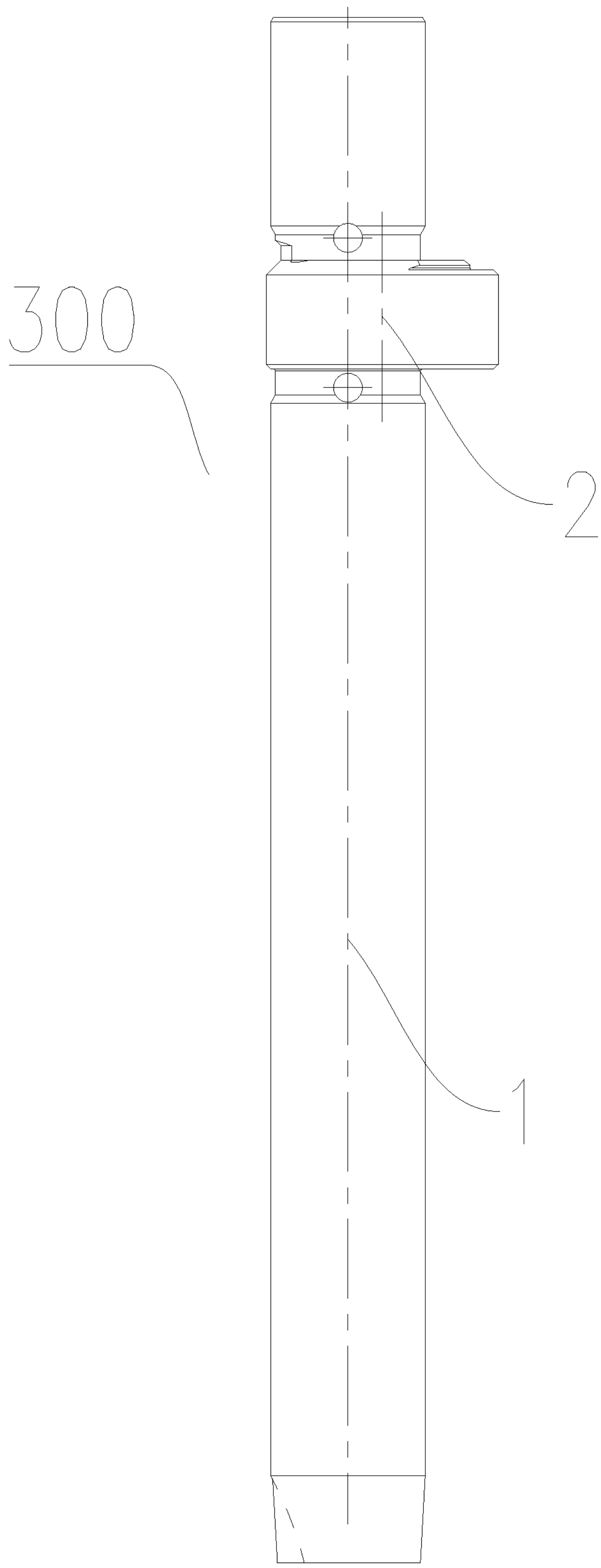

Fig. 8

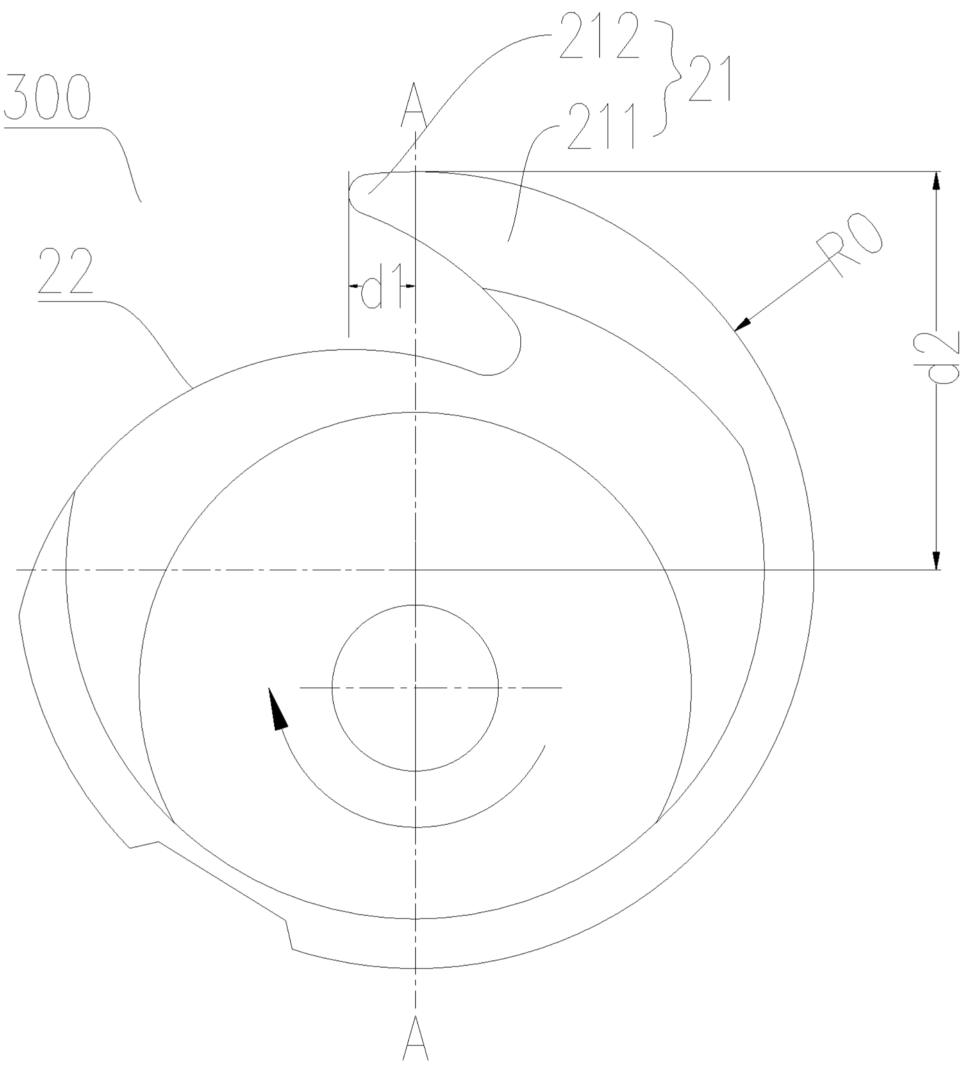

Fig. 9

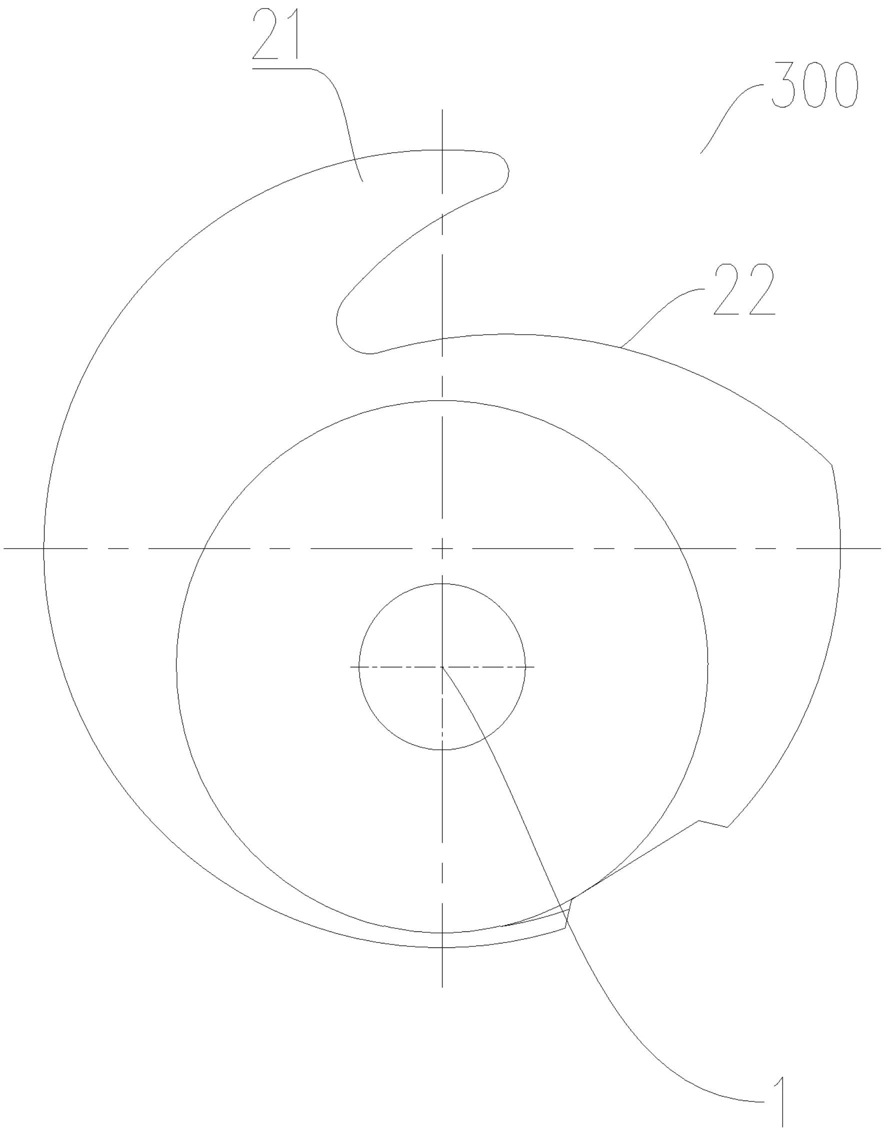

Fig. 10

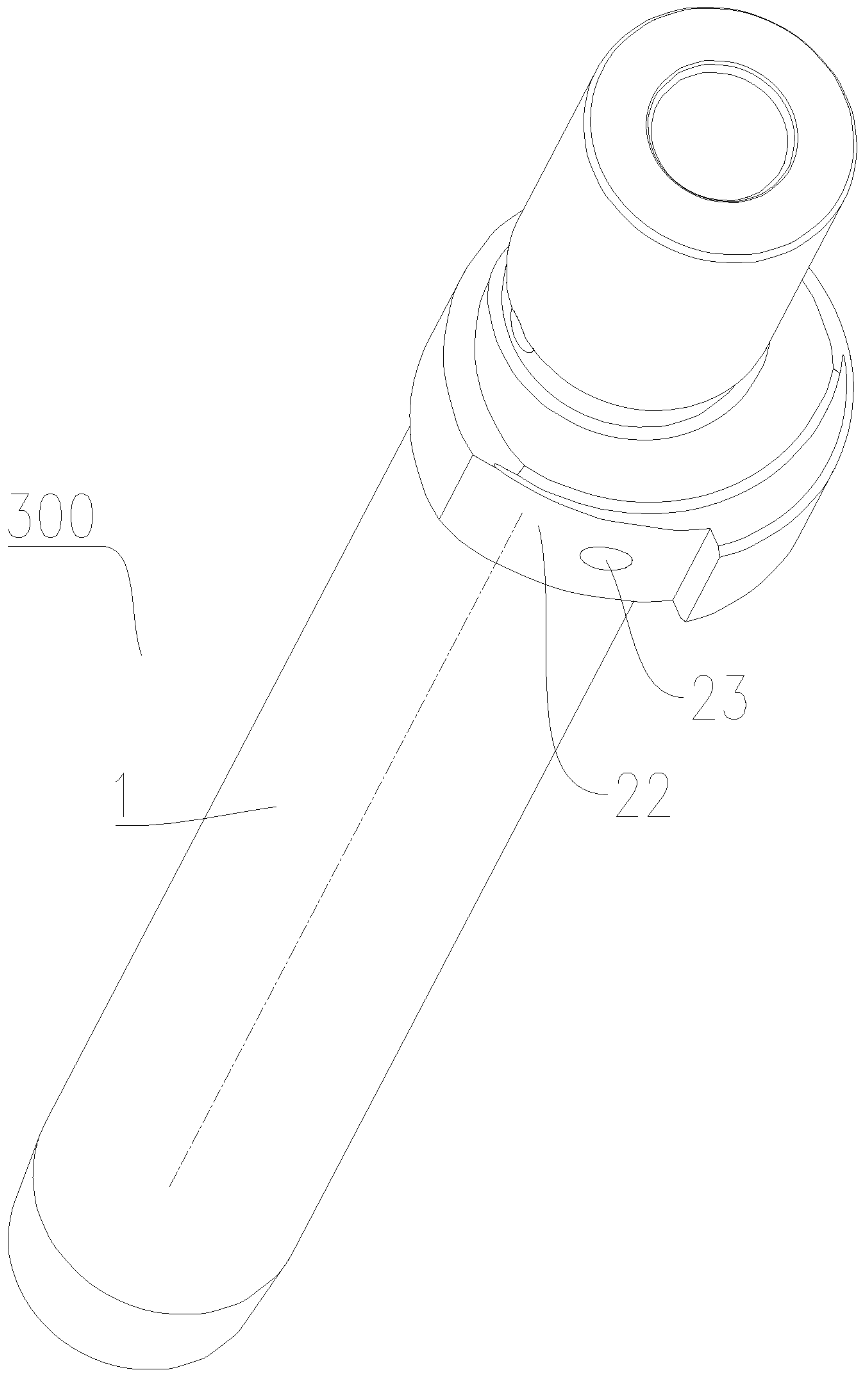

Fig. 11

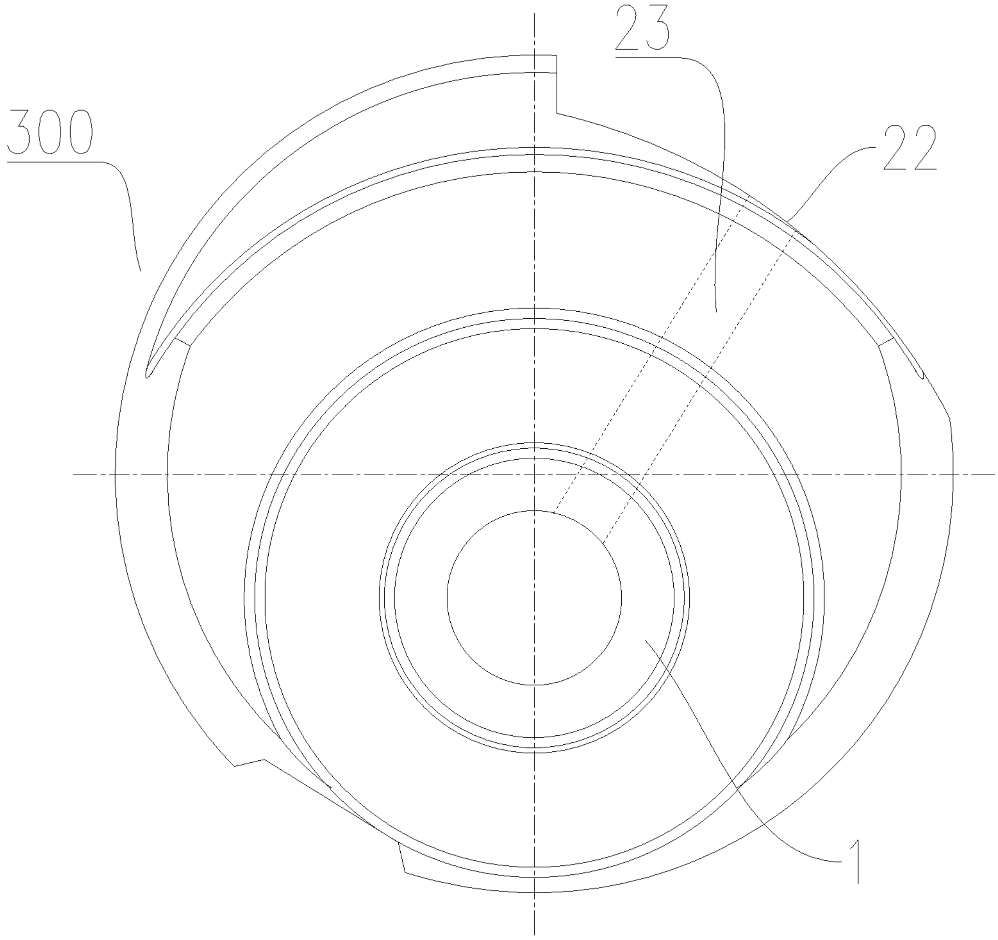

Fig. 12

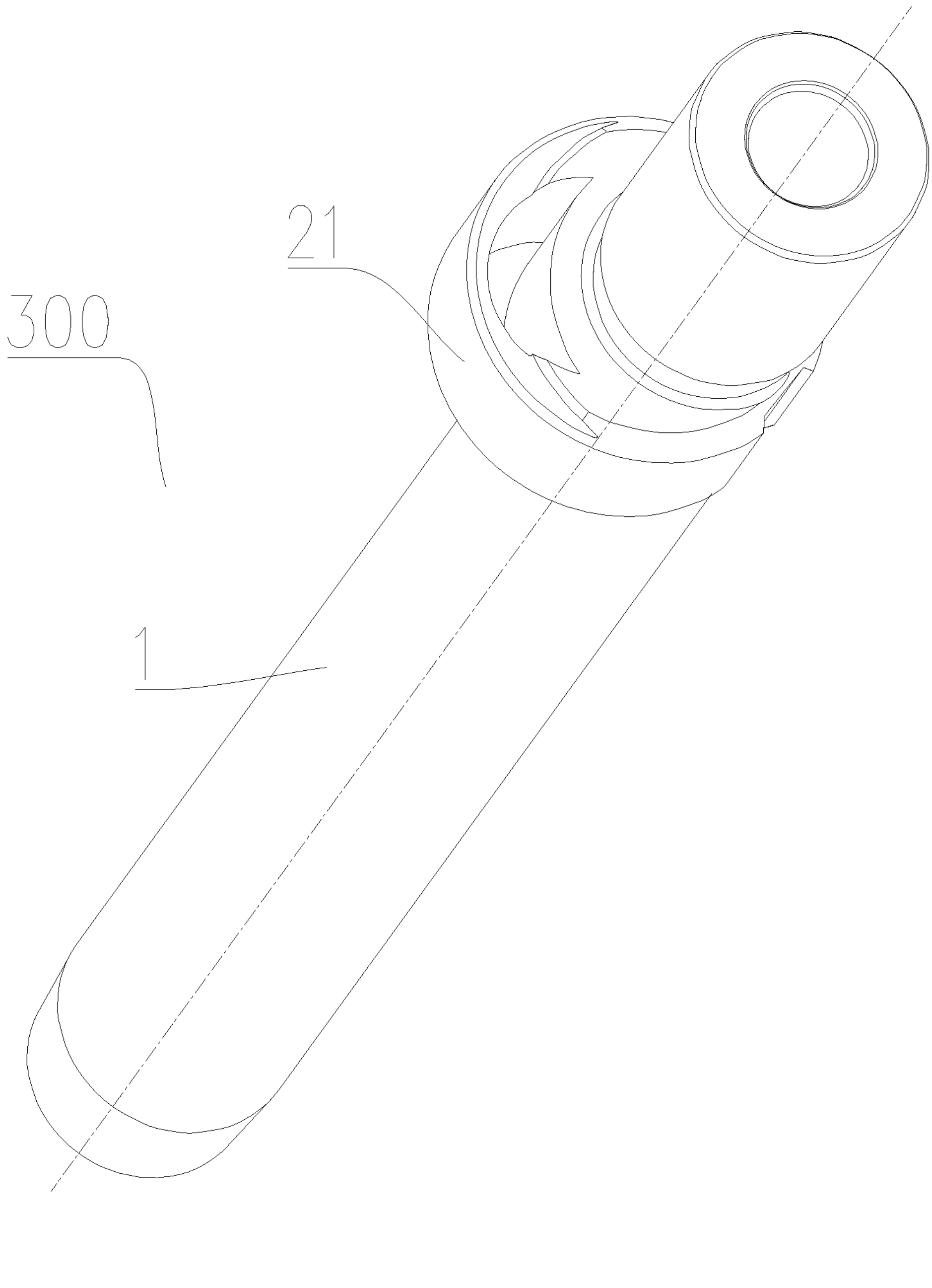

Fig. 13

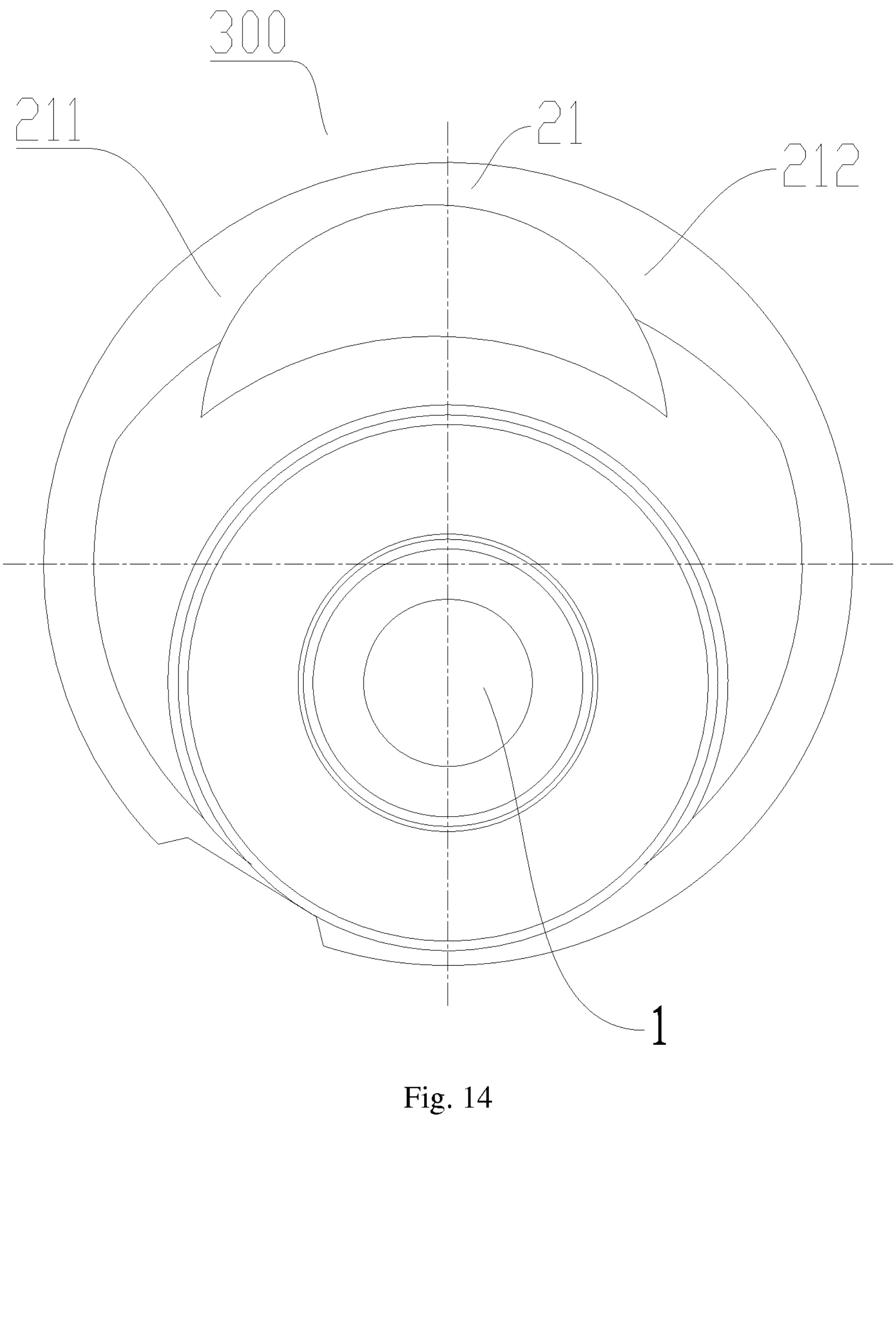

Fig. 14

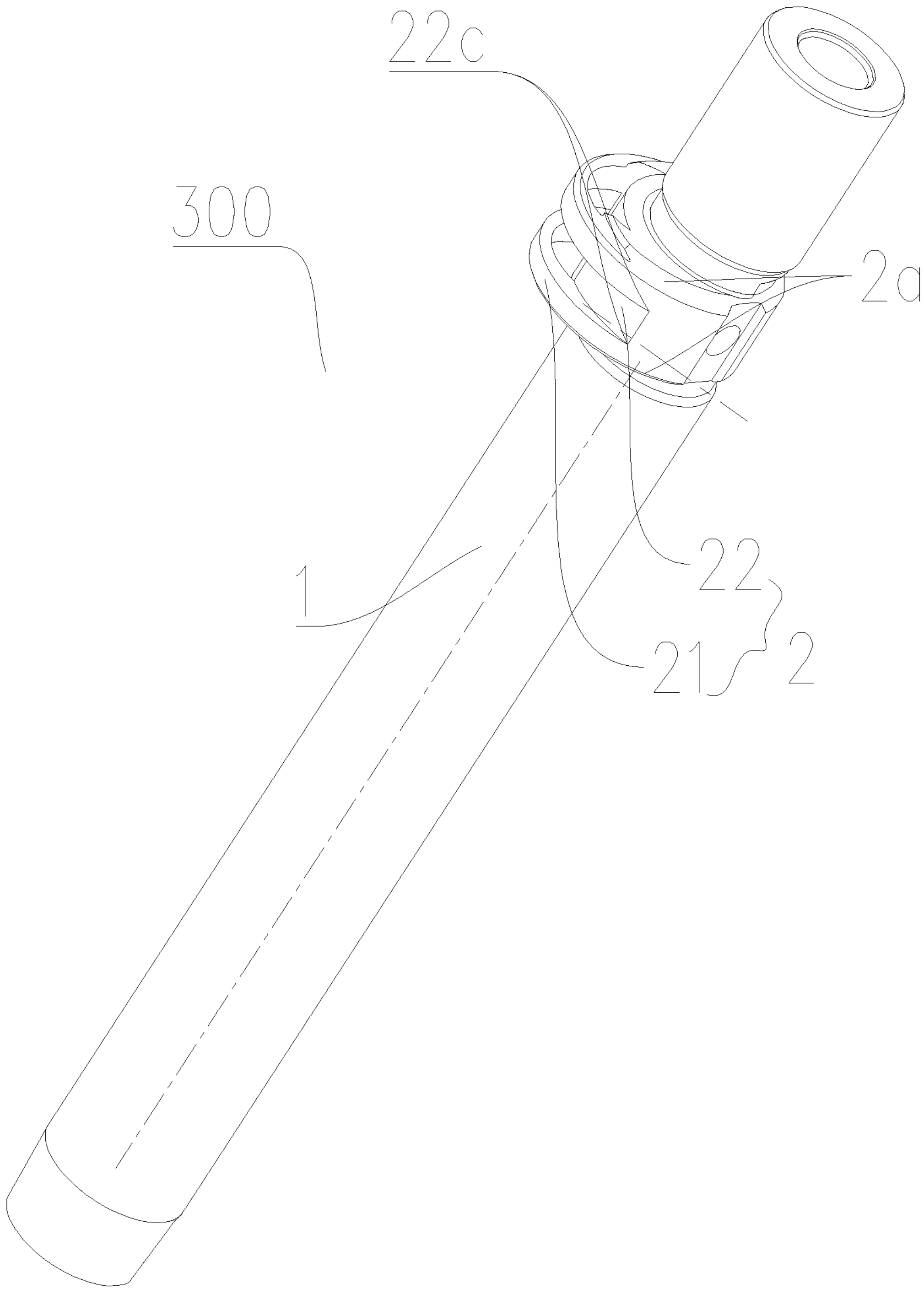

Fig. 15

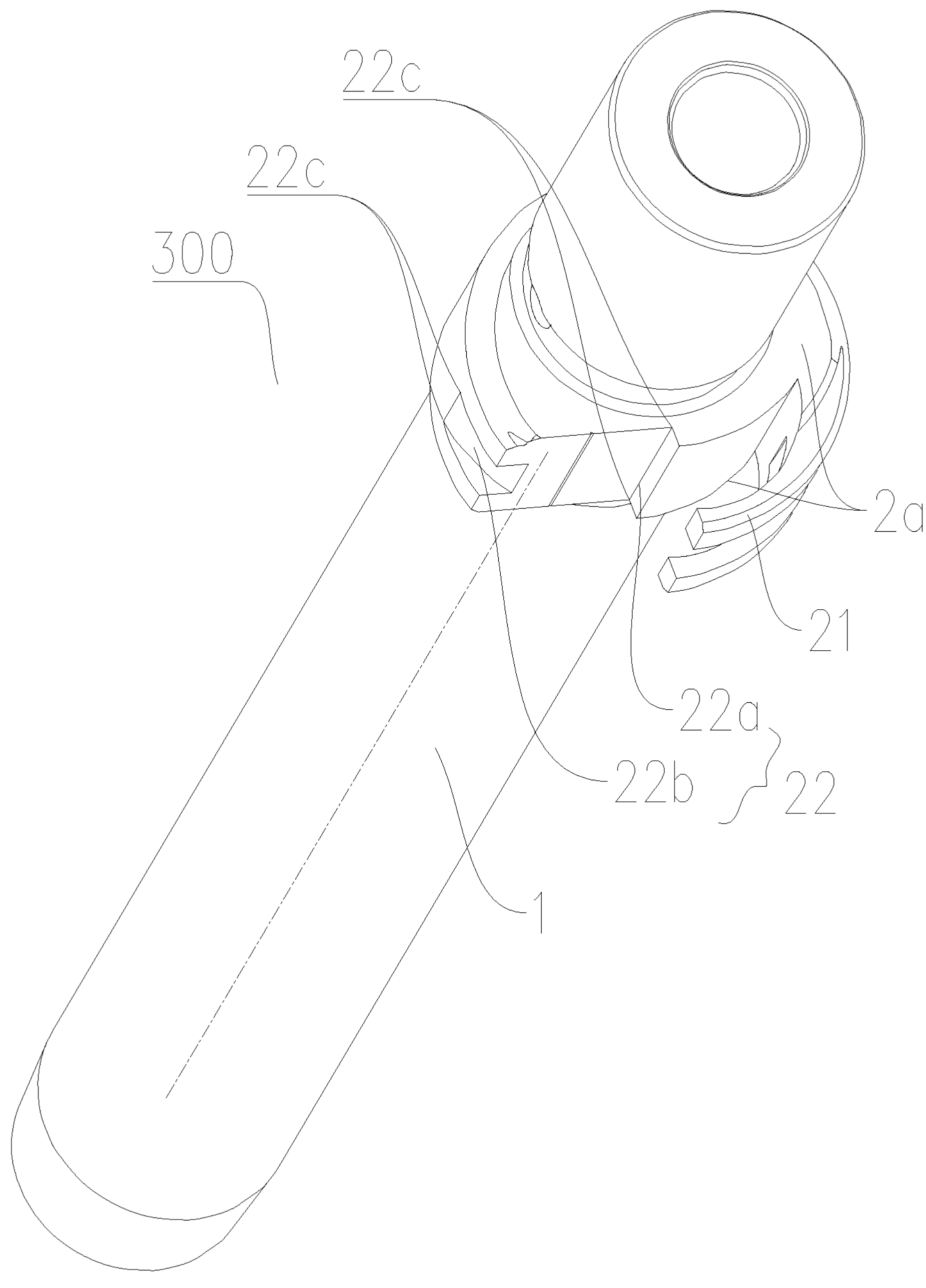

Fig. 16

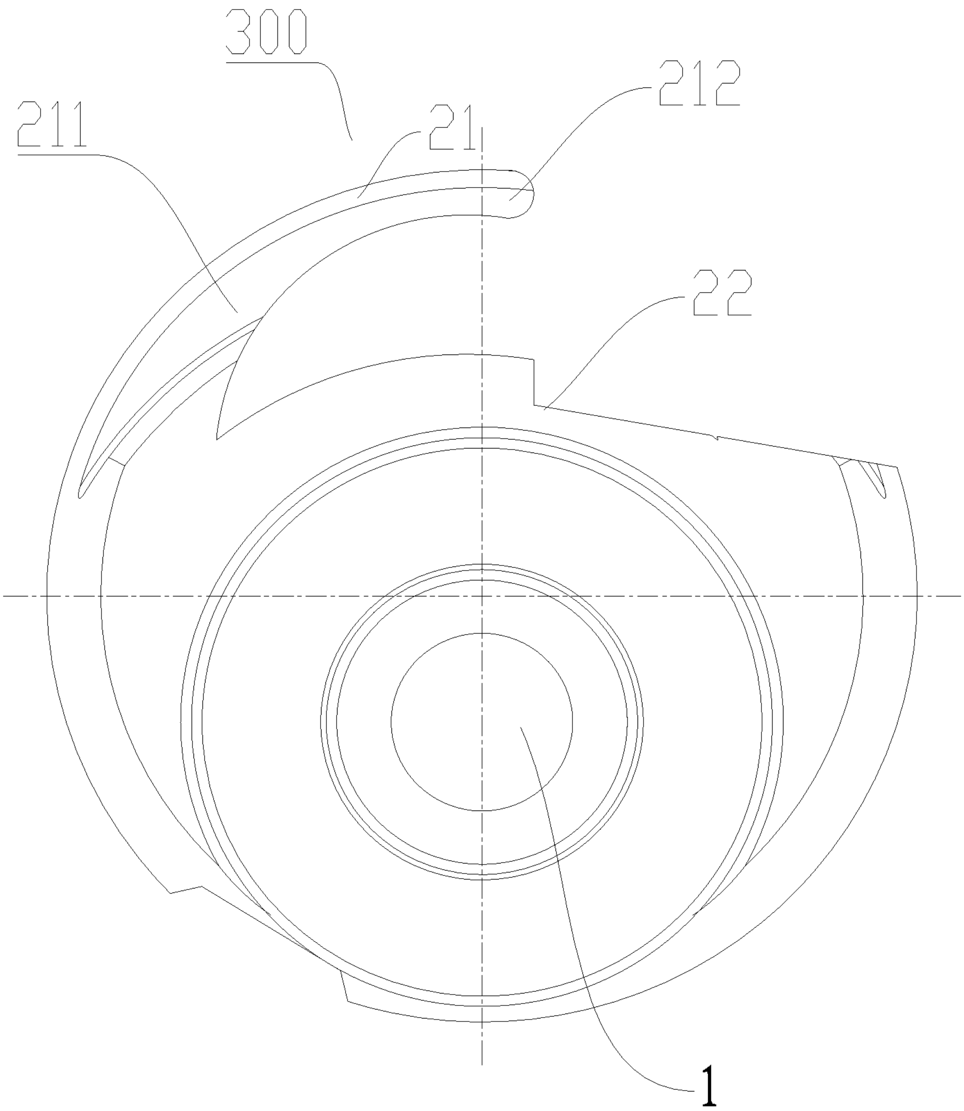

Fig. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/078608

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/02 (2006.01) i; F04C 29/00 (2006.01) i; F04C 18/356 (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)

F04C

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)

CNABS, CNKI, DWPI, SIPOABS: crankshaft, oil pressure, rotar+, compressor?, crank?, shaft?, flex+, eccentric+, flex+, elastic+, spring+, oil, pressor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 104819155 A (GUANGDONG MEIZHI COMPRESSOR CO., LTD.), 05 August 2015 (05.08.2015), see claims 1-13	1-13
E	CN 204627989 U (GUANGDONG MEIZHI COMPRESSOR CO., LTD.), 09 September 2015 (09.09.2015), see claims 1-13	1-13
A	CN 1896531 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 17 January 2007 (17.01.2007), see description, page 5, lines 11-20, and figures 4-6	1-13
A	CN 101799012 A (FOSHAN GUANGDONG AIR CONDITIONING CO., LTD.), 11 August 2010 (11.08.2010), see the whole document	1-13
A	CN 103047140 A (MA, Yanxiang), 17 April 2013 (17.04.2013), see the whole document	1-13
A	JP 2006125384 A (SAMSUNG ELECTRONICS CO., LTD.), 18 May 2006 (18.05.2006), see the whole document	1-13
A	KR 20050070856 A (LG ELECTRONICS INC.), 07 July 2005 (07.07.2005), see the whole document	1-13

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 January 2016 (26.01.2016)	**19 February 2016 (19.02.2016)**

Name and mailing address of the ISA/CN:	Authorized officer
State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	**CHEN, Fei** Telephone No.: (86-10) **62085141**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/078608

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 104819155 A	05 August 2015	None	
CN 204627989 U	09 September 2015	None	
CN 1896531 A	17 January 2007	None	
CN 101799012 A	11 August 2010	CN 101799012 B	28 September 2011
CN 103047140 A	17 April 2013	None	
JP 2006125384 A	18 May 2006	KR 20060038163 A	03 May 2006
		CN 100410539 C	13 August 2008
		US 7354250 B2	08 April 2008
		JP 4101826 B2	18 June 2008
		US 2006093503 A1	04 May 2006
		CN 1766338 A	03 May 2006
		KR 100765161 B1	15 October 2007
KR 20050070856 A	07 July 2005	KR 100531271 B1	28 November 2005

Form PCT/ISA/210 (patent family annex) (July 2009)