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(54) **MAGNETIC SUSPENSION PUMP, REFRIGERATION DEVICE HAVING SAME, AND AIR CONDITIONER OUTDOOR UNIT**

(57) A magnetic suspension pump, comprising a motor, a pump, a first sealing ring, a second sealing ring and a buffering member. The motor comprises a housing and a rotating shaft; the pump comprises a pump housing and an impeller, the pump housing is fixedly connected to or integrally formed with the housing, and the impeller is coaxially and fixedly connected to the rotating shaft; the first sealing ring is disposed on the housing and/or the pump housing; the second sealing ring is disposed on the impeller and mated with the first sealing ring, and when the second sealing ring rotates, an annular groove is marked on the first sealing ring or by the first sealing ring; the buffering member is provided between the first sealing ring and the housing and/or the pump housing, and the buffering member can deform along the axial direction of the first sealing ring; the buffering member is disposed between the second sealing ring and the impeller, and the buffering member can deform along the axial direction of the second sealing ring.

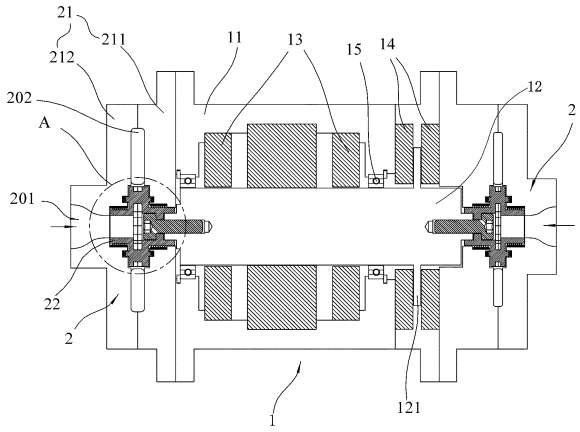

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention pertains to the field of power apparatuses, and particularly provides a magnetic suspension pump, a refrigeration device having same and an air conditioner outdoor unit.

BACKGROUND OF THE INVENTION

[0002] A magnetic suspension motor mainly includes a housing, a stator provided in the housing and fixedly connected with the housing, a rotating shaft provided in the stator, a radial magnetic suspension bearing for supporting the rotating shaft to rotate, and an axial thrust bearing for keeping an axial position of the rotating shaft. The magnetic suspension motor further includes a protective bearing provided in the housing, and the protective bearing is configured to bear the static rotating shaft. When the magnetic suspension motor works, the radial magnetic suspension bearing is electrified to separate the rotating shaft from the protective bearing and suspend the rotating shaft.

[0003] A magnetic suspension pump includes the magnetic suspension motor and a pump driven by the magnetic suspension motor. When the magnetic suspension pump is powered off, the rotating shaft rotating at a high speed loses buoyancy and impacts the protective bearing, and the protective bearing is prone to damage.

BRIEF DESCRIPTION OF THE INVENTION

[0004] An object of the present invention is to overcome at least one technical defect of a prior art, and solve a problem that a protective bearing of an existing magnetic suspension pump is prone to damage by an impact of a rotating shaft when a magnetic suspension motor is powered off.

[0005] A further object of the present invention is to prolong a service life of a first sealing ring and/or a second sealing ring.

[0006] In order to achieve the above objects, the present invention provides a magnetic suspension pump, including:

a motor including a motor housing and a rotating shaft;

a pump including a pump housing and an impeller, the pump housing and the motor housing being fixedly connected or integrally formed, and the impeller being coaxially and fixedly connected with the rotating shaft;

a first sealing ring provided on the motor housing and/or the pump housing;

a second sealing ring provided on the impeller and matched with the first sealing ring, when the second sealing ring rotates, an annular groove being scratched on the first sealing ring or by the first sealing ring; and

a buffering member, wherein the buffering member is provided between the first sealing ring and the motor housing and/or the pump housing, and the buffering member can deform along an axial direction of the first sealing ring; and/or, the buffering member is provided between the second sealing ring and the impeller, and the buffering member can deform along an axial direction of the second sealing ring.

[0007] Optionally, the buffering member is a buffering ring having an annular structure, and the buffering ring is provided between the first sealing ring and the pump housing along a radial direction of the first sealing ring; an inner circumferential surface of the buffering ring abuts against the first sealing ring, and an outer circumferential surface of the buffering ring abuts against the pump housing.

[0008] Optionally, the buffering member is a spring, and the spring is provided between the first sealing ring and the pump housing along the axial direction of the first sealing ring; the spring has one axial end connected with the first sealing ring and the other axial end connected with the pump housing.

[0009] Optionally, the spring abuts against the first sealing ring and the pump housing, and at least one spring abuts against each of two axial ends of the first sealing ring.

[0010] Optionally, the first sealing ring includes a first axial sealing ring and a first radial sealing ring, the second sealing ring includes a second axial sealing ring and a second radial sealing ring, the first axial sealing ring is matched with the second axial sealing ring, the first radial sealing ring is matched with the second radial sealing ring, and each of the first axial sealing ring and the first radial sealing ring corresponds to the buffering member.

[0011] Optionally, the first sealing ring is an annular sleeve; the second sealing ring is an annular tooth, and the annular tooth has a wedge-shaped section.

[0012] Optionally, the first sealing ring has a smaller hardness than the second sealing ring.

[0013] Optionally, the pump is a centrifugal pump.

[0014] Furthermore, the present invention provides a refrigeration device including the magnetic suspension pump according to any one of the above-mentioned technical solutions.

[0015] Further, the present invention provides an air conditioner outdoor unit including the magnetic suspension pump according to any one of the above-mentioned technical solutions.

[0016] Based on the foregoing description, it can be understood by those skilled in the art that, in the foregoing technical solution of the present invention, by providing the first sealing ring on the pump housing, providing the second sealing ring on the impeller, matching the first sealing ring with the second sealing ring, and scratching

the annular groove on one of the first sealing ring and the second sealing ring by the other, the pump housing and the impeller can be dynamically sealed by the first sealing ring and the second sealing ring, and meanwhile, the impeller can freely rotate relative to the pump housing by means of the annular groove.

[0017] It can also be appreciated by those skilled in the art that since the annular groove is scratched by the first sealing ring or the second sealing ring (specifically, when the impeller rotates), a gap between the first sealing ring and the second sealing ring is small. Therefore, when the motor is powered off, the first sealing ring and the second sealing ring can come into contact firstly, and then, the rotating shaft comes into contact with the protective bearing. When the first sealing ring and the second sealing ring contact each other, kinetic energy and momentum of the rotating shaft can be absorbed, thereby reducing the impact of the rotating shaft on the protective bearing, and effectively avoiding a risk of damage to the protective bearing.

[0018] Further, by providing the buffering member between the first sealing ring and the motor housing and/or the pump housing, and/or providing the buffering member between the second sealing ring and the impeller, when the impeller moves along the axial direction of the first sealing ring, the first sealing ring or the second sealing ring can move along with the impeller by virtue of deformation of the buffering member, a side wall of the annular groove is prevented from being continuously scratched by the first sealing ring or the second sealing ring, and then, a width of the annular groove is prevented from being increased, and the annular groove can maintain a small width, thereby guaranteeing the gap between the first sealing ring and the second sealing ring, and prolonging the service life of the first sealing ring and/or the second sealing ring.

[0019] Further, by configuring the first sealing ring as the annular tooth, the width of the annular groove can be sufficiently small, thereby reducing an amount of outward leakage of fluid in the pump housing.

[0020] Still further, by configuring the first sealing ring to include the first axial sealing ring and the first radial sealing ring and configuring the second sealing ring to include the second axial sealing ring and the second radial sealing ring, the first axial sealing ring and the second axial sealing ring can absorb an axial impact force when the rotating shaft is powered off and limit an axial displacement of the rotating shaft, the first radial sealing ring and the second radial sealing ring can absorb a radial impact force when the rotating shaft is powered off and limit a radial displacement of the rotating shaft, and therefore, the rotating shaft can be prevented from deflecting.

[0021] According to the following detailed description of specific embodiments of the present invention in conjunction with drawings, those skilled in the art will better understand the aforementioned and other objects, advantages and features of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] In order to more clearly explain the technical solution of the present invention, some embodiments of the present invention will be described hereinafter with reference to the accompanying drawings. Those skilled in the art should appreciate that components or parts with the same reference numerals are the same or similar in different drawings; the drawings of the present invention are not necessarily drawn to scale relative to each other. In the drawings:

Fig. 1 is a sectional view of a magnetic suspension pump according to some embodiments of the present invention;
Fig. 2 is an enlarged view of portion A of Fig. 1;
Fig. 3 is an enlarged view of portion B of Fig. 2;
Fig. 4 is an enlarged view of portion C of Fig. 3;
Fig. 5 is a schematic diagram of an effect of a buffering member in some embodiments of the present invention when an impeller is radially offset;
Fig. 6 is a schematic diagram of an effect of the buffering member in some embodiments of the present invention when the impeller is axially offset; and
Fig. 7 is a schematic diagram of the effect of the buffering member in some other embodiments of the present invention.

DETAILED DESCRIPTION

[0023] Reference is now made in detail to embodiments of the present invention, one or more examples of which are shown in the drawings. The embodiments are provided to explain the present invention and not to limit it. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the present invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Therefore, it is intended that the present invention covers the modifications and variations within the scope of the appended claims and their equivalents.

[0024] It should be understood by those skilled in the art that the embodiments described below are only some embodiments of the present invention and not all embodiments of the present invention, and the embodiments are intended to explain the technical principle of the present invention and not to limit the scope of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0025] It should be noted that, in the description of the present invention, directions or positional relationships indicated by terms "center", "upper", "lower", "top", "bottom", "left", "right", "vertical", "horizontal", "inner", "outer" etc. are based on directions or positional relationships

shown in the drawings, and they are used only for facilitating the description, but do not indicate or imply that a described apparatus or element must have a specific orientation or be constructed and operated in a specific orientation. Therefore, it cannot be understood as a limitation on the present invention. In addition, the terms such as "first", "second" and "third" are merely used for purposes of description and are not intended to indicate or imply relative importance.

[0026] Furthermore, it should also be noted that, in the description of the present invention, unless specified or limited otherwise, the terms "mounted", "connected", "coupled" and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements. The specific meanings of the above terms in the present invention can be understood by those skilled in the art according to specific situations.

[0027] Fig. 1 is a sectional view of a magnetic suspension pump according to some embodiments of the present invention, Fig. 2 is an enlarged view of portion A of Fig. 1, Fig. 3 is an enlarged view of portion B of Fig. 2, and Fig. 4 is an enlarged view of portion C of Fig. 3.

[0028] As shown in Fig. 1, in some embodiments of the present invention, the magnetic suspension pump includes a motor 1 and a pump 2. Preferably, the magnetic suspension pump includes two pumps 2, and the two pumps 2 are provided at two axial ends of the motor 1 respectively. Furthermore, those skilled in the art can also configure only one pump 2 for the magnetic suspension pump as required; that is, the pump 2 at the left or right of the motor 1 in Fig. 1 is omitted. Or, those skilled in the art may also connect at least two pumps 2 in series on the left or right side of the motor 1 as required.

[0029] With continued reference to Fig. 1, the motor 1 includes a motor housing 11, a rotating shaft 12, a radial magnetic suspension bearing 13, an axial magnetic suspension bearing 14, and a protective bearing 15. The rotating shaft 12 is rotatably provided in the motor housing 11, and the radial magnetic suspension bearing 13, the axial magnetic suspension bearing 14 and the protective bearing 15 are fixedly provided inside the motor housing 11.

[0030] When the motor 1 is powered on, gaps exist between the radial magnetic suspension bearing 13 and the rotating shaft 12, the axial magnetic suspension bearing 14 and the rotating shaft 12, and the protective bearing 15 and the rotating shaft 12. A radial gap between the radial magnetic suspension bearing 13 and the rotating shaft 12 is greater than a radial gap between the protective bearing 15 and the rotating shaft 12; a radial gap between the axial magnetic suspension bearing 14 and the rotating shaft 12 is greater than the radial gap between the protective bearing 15 and the rotating shaft 12, such that in a power-off state of the motor 1, the rotating shaft 12 abuts against the protective bearing 15 and does not contact the radial magnetic suspension bearing 13 and/or the axial magnetic suspension bearing 14.

[0031] With continued reference to Fig. 1, the rotating shaft 12 is provided with a thrust disc 121, and one axial magnetic suspension bearing 14 is provided on each of two sides of the thrust disc 121. When the motor 1 is energized, gaps exist between the thrust disc 121 and the two axial magnetic suspension bearings 14.

[0032] It should be noted that, in the present invention, each of the radial magnetic suspension bearing 13 and the axial magnetic suspension bearing 14 includes a coil and/or a member capable of generating a magnetic force when energized. Since the radial magnetic suspension bearing 13 and the axial magnetic suspension bearing 14 are common parts in the art and are commercially available, they are not explained too much in the present disclosure.

[0033] With continued reference to Fig. 1, the pump 2 includes a pump housing 21 and an impeller 22. The pump housing 21 and the motor housing 11 are fixedly connected or integrally manufactured, and the impeller 22 is coaxially and fixedly connected with the rotating shaft 12. The rotating shaft 12 drives the impeller 22 to rotate synchronously when rotating. Further, the pump housing 21 is provided with an inlet 201 and an outlet 202. The rotating impeller 22 creates a negative pressure within the pump housing 21, thereby forcing ambient fluid into the pump housing 21 from the inlet 201 and forcing fluid within the pump housing 21 out of the pump housing 21 from the outlet 202.

[0034] Although not shown in the drawings, in some embodiments of the present invention, the pump 2 is a centrifugal pump and the impeller 22 is a centrifugal impeller. Certainly, those skilled in the art can also configure the pump 2 as a plunger pump, a gear pump, a vane pump, a rotor pump or other pumps in any form in other embodiments of the present invention as required.

[0035] With continued reference to Fig. 1, the pump housing 21 includes an inner volute 211 and an outer volute 212. The inner volute 211 and the outer volute 212 are fixedly connected together by screws or bolts, and the inner volute 211 and the motor housing 11 are fixedly connected together by screws or bolts.

[0036] As shown in Figs. 2 and 3, in some embodiments of the present invention, the magnetic suspension pump further includes a first sealing ring 3, a second sealing ring 4 and a buffering member 5. The first sealing ring 3 and the second sealing ring 4 are matched with each other, the first sealing ring 3 is provided on the motor housing 11 and/or the pump housing 21, the second sealing ring 4 is provided on the impeller 22, and when the second sealing ring 4 rotates, an annular groove 6 is scratched on the first sealing ring 3 or by the first sealing ring 3. The buffering member 5 is provided between the first sealing ring 3 and the motor housing 11 and/or the pump housing 21, and the buffering member 5 can de-

form along an axial direction of the first sealing ring 3; and/or the buffering member 5 is provided between the second sealing ring 4 and the impeller 22, and the buffering member 5 can deform along an axial direction of the second sealing ring 4.

[0037] Furthermore, those skilled in the art can also provide the first sealing ring 3 on the impeller 22 and provide the second sealing ring 4 on the pump housing 21 as required.

[0038] Further, those skilled in the art may also provide a buffering member 5 between the second sealing ring 4 and the pump housing 21, or provide the buffering member 5 only between the second sealing ring 4 and the pump housing 21 as required.

[0039] Preferably, as shown in Figs. 2 and 3, the first sealing ring 3 includes a first radial sealing ring 31 and a first axial sealing ring 32, the second sealing ring 4 includes a second radial sealing ring 41 and a second axial sealing ring 42, the first radial sealing ring 31 is matched with the second radial sealing ring 41, and the first axial sealing ring 32 is matched with the second axial sealing ring 42.

[0040] Further preferably, as shown in Figs. 2 and 3, the inner volute 211 and the outer volute 212 are provided with the first radial sealing ring 31 and the first axial sealing ring 32 respectively. Furthermore, those skilled in the art may also provide the first radial sealing ring 31 and the first axial sealing ring 32 only on the inner volute 211 or the outer volute 212 as required; or, the first radial sealing ring 31 is provided on one of the inner volute 211 and the outer volute 212, and the first axial sealing ring 32 is provided on the other of the inner volute 211 and the outer volute 212.

[0041] As can be seen from the drawings, a plurality of second radial sealing rings 41 and a plurality of second axial sealing rings 42 are provided, such that the first radial sealing ring 31 corresponds to the plurality of second radial sealing rings 41, and the first axial sealing ring 32 corresponds to the plurality of second axial sealing rings 42. It can be appreciated by those skilled in the art that the correspondence of the first sealing ring 3 to a plurality of second sealing rings 4 can reduce stress between the second sealing rings 4 and the first sealing ring 3, so as to prevent the second sealing rings 4 and the first sealing ring 3 from excessively abrading each other. Furthermore, the correspondence of the first sealing ring 3 to the plurality of second sealing rings 4 can form multiple seals between the second sealing rings 4 and the first sealing ring 3, thereby preventing leakage of the fluid in the pump housing 21.

[0042] Although not shown in the drawings, the first sealing ring 3 is an annular sleeve, or the first sealing ring 3 is composed of a plurality of semi-annular structures. That is, the first radial sealing ring 31 and/or the first axial sealing ring 32 are annular sleeves, or the first sealing ring 3 is composed of the plurality of semi-annular structures.

[0043] Further, although not shown in the drawings, the second sealing ring 4 is an annular tooth; that is, both the second radial sealing ring 41 and the second axial sealing ring 42 are annular teeth. Preferably, the annular tooth has a wedge-shaped section (as shown in Fig. 4).

[0044] Preferably, the second radial sealing ring 41 and the second axial sealing ring 42 are integrally formed on the impeller 22. Or, those skilled in the art may also fix the second radial sealing ring 41 and the second axial sealing ring 42 to the impeller 22 by a threaded connection, welding, interference fit, screw connection, or the like, and selectively provide the buffering member 5 between the second radial sealing ring 41 and the impeller 22 and/or between the second axial sealing ring 42 and the impeller 22, as required.

[0045] Further, in some embodiments of the present invention, a hardness of the first sealing ring 3 is smaller than a hardness of the second sealing ring 4, such that the second sealing ring 4 can scratch a shallow scratch, i.e., the annular groove 6, on the first sealing ring 3 when rotating with the impeller 22 (as shown in Fig. 4).

[0046] In order to achieve the above object, the first sealing ring 3 in the present invention may be made of any feasible material, such as epoxy resin, phenolic resin, or the like.

[0047] Preferably, when the magnetic suspension pump according to the present invention is assembled, the first sealing ring 3 and the second sealing ring 4 are in transition fit. When the magnetic suspension pump is energized, the rotating shaft 12 drives the impeller 22 and the second sealing ring 4 to rotate, and a circumferential edge of the rotating second sealing ring 4 scratches the shallow scratch, i.e., the annular groove 6, on the first sealing ring 3 (as shown in Fig. 4).

[0048] It can be appreciated by those skilled in the art that since the annular groove 6 on the first sealing ring 3 is scratched by the rotating second sealing ring 4, a gap between the first radial sealing ring 31 and the second radial sealing ring 41 and a gap between the first axial sealing ring 32 and the second axial sealing ring 42 are sufficiently small (even 0 in some regions). In other words, the annular groove 6 is created to accommodate operation of the magnetic suspension pump, which not only saves a production cost, but also allows the second sealing ring 4 to be sufficiently tightly fitted with the first sealing ring 3 to achieve a good sealing effect on the pump 2, as compared to an annular groove machined by mechanical equipment.

[0049] Based on the foregoing description, it can be understood by those skilled in the art that, in the present invention, the annular groove 6 is scratched on the first sealing ring 3 during the rotation of the second sealing ring 4, such that a pressure generated when the first sealing ring 3 comes into contact with the second sealing ring 4 is almost zero, and therefore, the second sealing ring 4, the impeller 22 and the rotating shaft 12 can rotate freely relative to the first sealing ring 3. Therefore, the first sealing ring 3 and the second sealing ring 4 of the present invention also improve a sealing performance of

the pump 2 and prevent leakage (including external leakage and internal leakage) of the fluid compressed in the pump 2 on the premise of guaranteeing low resistance operation of the magnetic suspension pump.

[0050] Further, in the present invention, by configuring the first sealing ring 3 to include the first radial sealing ring 31 and the first axial sealing ring 32 and configuring the second sealing ring 4 to include the second radial sealing ring 41 and the second axial sealing ring 42, the first radial sealing ring 31 and the second radial sealing ring 41 can absorb a radial impact force when the rotating shaft 12 is powered off and limit a radial displacement of the rotating shaft 12, the first axial sealing ring 32 and the second axial sealing ring 42 can absorb an axial impact force when the rotating shaft 12 is powered off and limit an axial displacement of the rotating shaft 12, and therefore, the rotating shaft 12 can be prevented from deflecting.

[0051] Furthermore, in other embodiments of the present invention, those skilled in the art may provide only the first radial sealing ring 31 and the second radial sealing ring 41, or only the first axial sealing ring 32 and the second axial sealing ring 42, on the pump 2 as required.

[0052] As shown in Figs. 2 and 3, in some embodiments of the present invention, the buffering member 5 is a buffering ring 51 having an annular structure. The buffering ring 51 is provided between the first sealing ring 3 and the pump housing 21 in the radial direction of the first sealing ring 3. An inner circumferential surface of the buffering ring 51 abuts against the first sealing ring 3, and an outer circumferential surface of the buffering ring 51 abuts against the pump housing 21.

[0053] Specifically, at least one buffering ring 51 is provided between the first radial sealing ring 31 and the pump housing 21, and at least one buffering ring 51 is provided between the first axial sealing ring 32 and the pump housing 21. Or, those skilled in the art may provide the buffering ring 51 only between the first radial sealing ring 31 and the pump housing 21, or only between the first axial sealing ring 32 and the pump housing 21, as required.

[0054] Further, in some embodiments of the present invention, the buffering ring 51 is made of an elastic material, such that the buffering ring 51 can be deformed along the axial direction and/or the radial direction of the first sealing ring 3. The elastic material may be any feasible material, such as rubber, silicone, plastic, or the like.

[0055] Next, the deformation of the buffering ring 51 will be described in detail with reference to Figs. 5 and 6. Fig. 5 is a schematic diagram of an effect of the buffering member in some embodiments of the present invention when the impeller is radially offset, and Fig. 6 is a schematic diagram of an effect of the buffering member in some embodiments of the present invention when the impeller is axially offset.

[0056] As shown in Fig. 5, when the impeller 22 moves radially from a normal rotation position (position coaxial with the protective bearing 15) in a direction indicated by the arrow in Fig. 5, the second radial sealing ring 41 presses the first radial sealing ring 31 in the radial direction thereof, and therefore, the first radial sealing ring 31 presses the corresponding buffering ring 51 in the direction indicated by the arrow in Fig. 5, thereby deforming (i.e., thinning) a corresponding part of the buffering ring 51 in the radial direction. Meanwhile, the second axial sealing ring 42 presses the first axial sealing ring 32 in the axial direction thereof (specifically, a circumferential edge of the second axial sealing ring 42 presses the side wall of the annular groove 6 on the first axial sealing ring 32), and therefore, the first axial sealing ring 32 presses the corresponding buffering ring 51 in the direction indicated by the arrow in Fig. 5, thereby deforming a corresponding part of the buffering ring 51 in the axial direction.

[0057] As shown in Fig. 6, when the impeller 22 moves axially from the normal rotation position in a direction indicated by the arrow in Fig. 6, the second radial sealing ring 41 presses the first radial sealing ring 31 in the axial direction thereof (specifically, a circumferential edge of the second radial sealing ring 41 presses the side wall of the annular groove 6 on the first radial sealing ring 31), and therefore, the first radial sealing ring 31 presses the corresponding buffering ring 51 in the direction indicated by the arrow in Fig. 6, thereby deforming a corresponding part of the buffering ring 51 in the axial direction. Meanwhile, the second axial sealing ring 42 presses the first axial sealing ring 32 in the radial direction thereof, and therefore, the first axial sealing ring 32 presses the corresponding buffering ring 51 in the direction indicated by the arrow in Fig. 6, thereby deforming and thus thinning a corresponding part of the buffering ring 51 in the radial direction.

[0058] Based on the foregoing description, it can be understood by those skilled in the art that due to the arrangement of the buffering ring 51, when the impeller 22 moves along the radial direction or the axial direction thereof, the first radial sealing ring 31 and the first axial sealing ring 32 can move together with the impeller 22 by means of the deformation of the buffering member 51, the side walls of the annular grooves 6 on the second radial sealing ring 41 and the second axial sealing ring 42 are prevented from being further scratched by the first radial sealing ring 31 and the first axial sealing ring 32, and a width of the annular groove 6 is prevented from being increased, such that the annular groove 6 can maintain a small width, thereby guaranteeing the gap between the first sealing ring 3 and the second sealing ring 4, and prolonging a service life of the first sealing ring 3.

[0059] It can also be understood by those skilled in the art that since the buffering ring 51 can absorb impacts of the rotating shaft 12 and the impeller 22 during the deformation, the buffering ring 51 can reduce an impact of the rotating shaft 12 on the protective bearing 15, thereby prolonging a service life of the protective bearing 15.

[0060] Fig. 7 is a schematic diagram of the effect of the buffering member in some other embodiments of the

present invention.

[0061] In some other embodiments of the present invention, as shown in Fig. 7, the buffering member 5 is a spring 52, the spring 52 is provided between the first sealing ring 3 and the pump housing 21 in the axial direction of the first sealing ring 3, and one axial end of the spring 52 is connected with the first sealing ring 3 and the other axial end of the spring 52 is connected with the pump housing 21. The connection may be a hook connection or abutment.

[0062] Specifically, the spring 52 abuts against the first sealing ring 3 and the pump housing 21, and at least one spring 52 abuts against each of two axial ends of the first sealing ring 3.

[0063] More specifically, one spring 52 abuts against each of two axial ends of the first radial sealing ring 31, and the end of the spring 52 apart from the first radial sealing ring 31 abuts against the pump housing 21. One spring 52 abuts against each of two axial ends of the first axial sealing ring 32, and the end of the spring 52 apart from the first axial sealing ring 32 abuts against the pump housing 21. Or, those skilled in the art may configure only one spring 52 for the first radial sealing ring 31 and/or the first axial sealing ring 32, fixedly connect one end of the spring 52 to the first radial sealing ring 31 and/or the first axial sealing ring 32, and fixedly connect the other end of the spring 52 to the pump housing 21, as required.

[0064] Preferably, the first radial sealing ring 31 is slidable relative to the pump housing 21 in the axial direction thereof, and the first axial sealing ring 32 is also slidable relative to the pump housing 21 in the axial direction thereof.

[0065] Further, when the impeller 22 is radially offset from a working position (where a rotation center of the impeller is coaxial with a rotation center of the protective bearing 15), the second axial sealing ring 42 presses the first axial sealing ring 32 in the axial direction thereof (specifically, the circumferential edge of the second axial sealing ring 42 presses the side wall of the annular groove 6 on the first axial sealing ring 32), and therefore, the first axial sealing ring 32 presses the corresponding spring 52 to compress the spring 52.

[0066] When the impeller 22 is axially offset from the working position, the second radial sealing ring 41 presses the first radial sealing ring 31 in the axial direction thereof (specifically, the circumferential edge of the second radial sealing ring 41 presses the side wall of the annular groove 6 on the first radial sealing ring 31), and therefore, the first radial sealing ring 31 presses the corresponding spring 52 to compress the spring 52.

[0067] Furthermore, in other embodiments of the present invention, those skilled in the art may configure the buffering member 5 as any other feasible structure as required, for example, a plurality of arc-shaped plate-like members which are provided between the first sealing ring 3 and the pump housing 21 in the radial direction of the first sealing ring 3. An inner circumferential surface of each plate-like member abuts against the first sealing ring 3 and an outer circumferential surface of each plate-like member abuts against the pump housing 21.

[0068] Further, although not shown in the drawings, still further embodiments of the present invention further provide a refrigeration device including the magnetic suspension pump according to any one of the foregoing embodiments. In these embodiments of the present invention, the magnetic suspension pump is used as a compressor of the refrigeration device for compressing a refrigerant. The refrigeration device includes a refrigerator, a freezer and/or a cooler.

[0069] Still further, although not shown in the drawings, still further embodiments of the present invention further provide an air conditioner outdoor unit including the magnetic suspension pump according to any one of the foregoing embodiments. In these embodiments of the present invention, the magnetic suspension pump is used as a compressor of the air conditioner outdoor unit for compressing a refrigerant.

[0070] So far, the technical solutions of the present invention have been described in connection with the foregoing embodiments, but it is easily understood by those skilled in the art that the scope of the present invention is not limited to these specific embodiments. Those skilled in the art may split and combine the technical solutions in the above embodiments and may also make equivalent changes or substitutions for the related technical features without departing from the technical principle of the present invention, and any change, equivalent substitution, improvement, etc. made within the technical idea and/or technical principle of the present invention fall within the protection scope of the present invention.

Claims

1. A magnetic suspension pump, comprising:

a motor comprising a motor housing and a rotating shaft;

a pump comprising a pump housing and an impeller, the pump housing and the motor housing being fixedly connected or integrally formed, and the impeller being coaxially and fixedly connected with the rotating shaft;

a first sealing ring provided on the motor housing and/or the pump housing;

a second sealing ring provided on the impeller and matched with the first sealing ring, when the second sealing ring rotates, an annular groove being scratched on the first sealing ring or by the first sealing ring; and

a buffering member, wherein the buffering member is provided between the first sealing ring and the motor housing and/or the pump housing, and the buffering member can deform along an axial direction of the first sealing ring; and/or, the buffering member is provided between the second

sealing ring and the impeller, and the buffering member can deform along an axial direction of the second sealing ring.

2. The magnetic suspension pump according to claim 1,

wherein the buffering member is a buffering ring having an annular structure, and the buffering ring is provided between the first sealing ring and the pump housing along a radial direction of the first sealing ring; and
an inner circumferential surface of the buffering ring abuts against the first sealing ring, and an outer circumferential surface of the buffering ring abuts against the pump housing.

3. The magnetic suspension pump according to claim 1,

wherein the buffering member is a spring, and the spring is provided between the first sealing ring and the pump housing along the axial direction of the first sealing ring; and
the spring has one axial end connected with the first sealing ring and the other axial end connected with the pump housing.

4. The magnetic suspension pump according to claim 3,
wherein the spring abuts against the first sealing ring and the pump housing, and at least one spring abuts against each of two axial ends of the first sealing ring.

5. The magnetic suspension pump according to any one of claims 2 to 4,

wherein the first sealing ring comprises a first axial sealing ring and a first radial sealing ring;
the second sealing ring comprises a second axial sealing ring and a second radial sealing ring;
the first axial sealing ring is matched with the second axial sealing ring;
the first radial sealing ring is matched with the second radial sealing ring; and
each of the first axial sealing ring and the first radial sealing ring corresponds to the buffering member.

6. The magnetic suspension pump according to any one of claims 1 to 4,

wherein the first sealing ring is an annular sleeve; and
the second sealing ring is an annular tooth, and the annular tooth has a wedge-shaped section.

7. The magnetic suspension pump according to any one of claims 1 to 4,
wherein the first sealing ring has a smaller hardness than the second sealing ring.

8. The magnetic suspension pump according to claim 7,
wherein the pump is a centrifugal pump.

9. A refrigeration device comprising the magnetic suspension pump according to any one of claims 1 to 8.

10. An air conditioner outdoor unit comprising the magnetic suspension pump according to any one of claims 1 to 8.

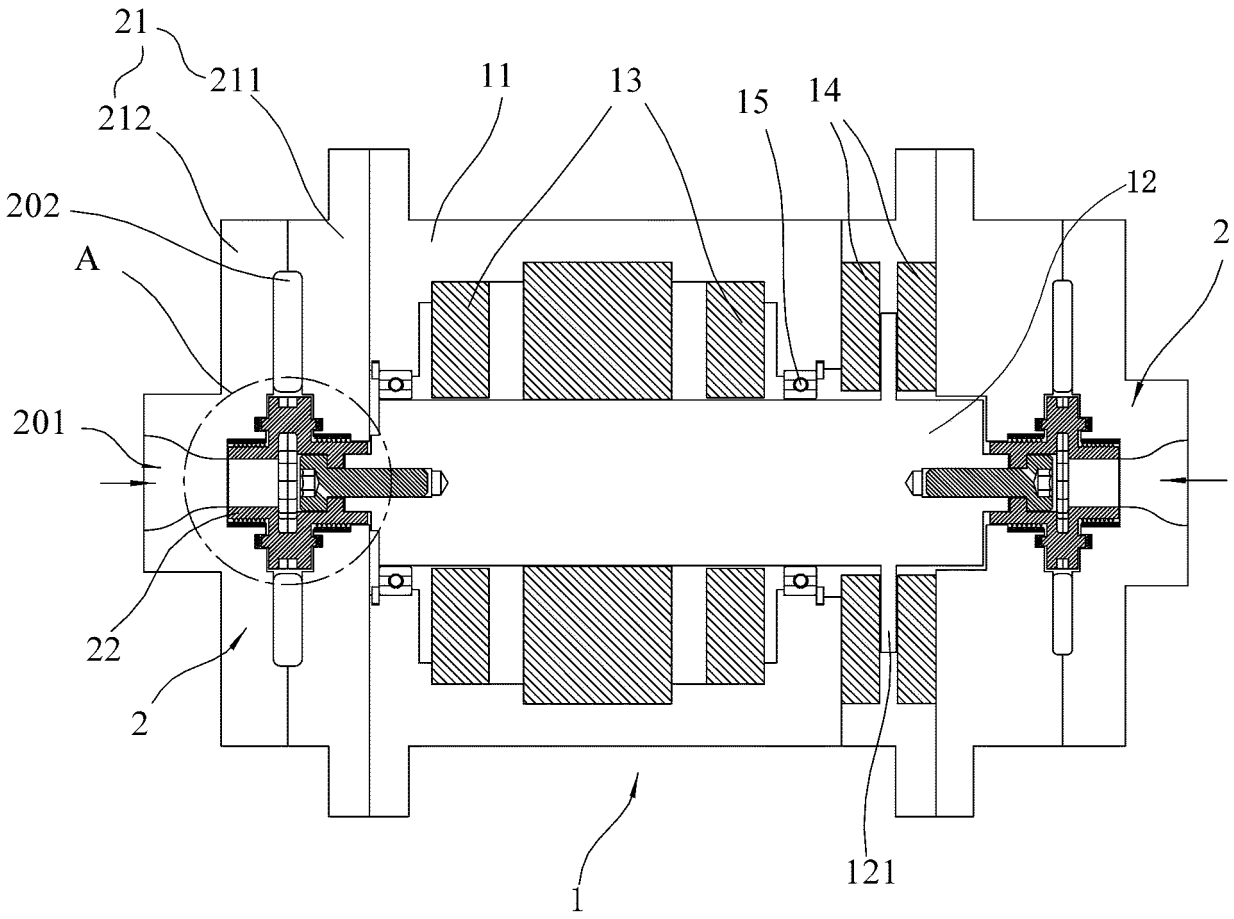

Fig. 1

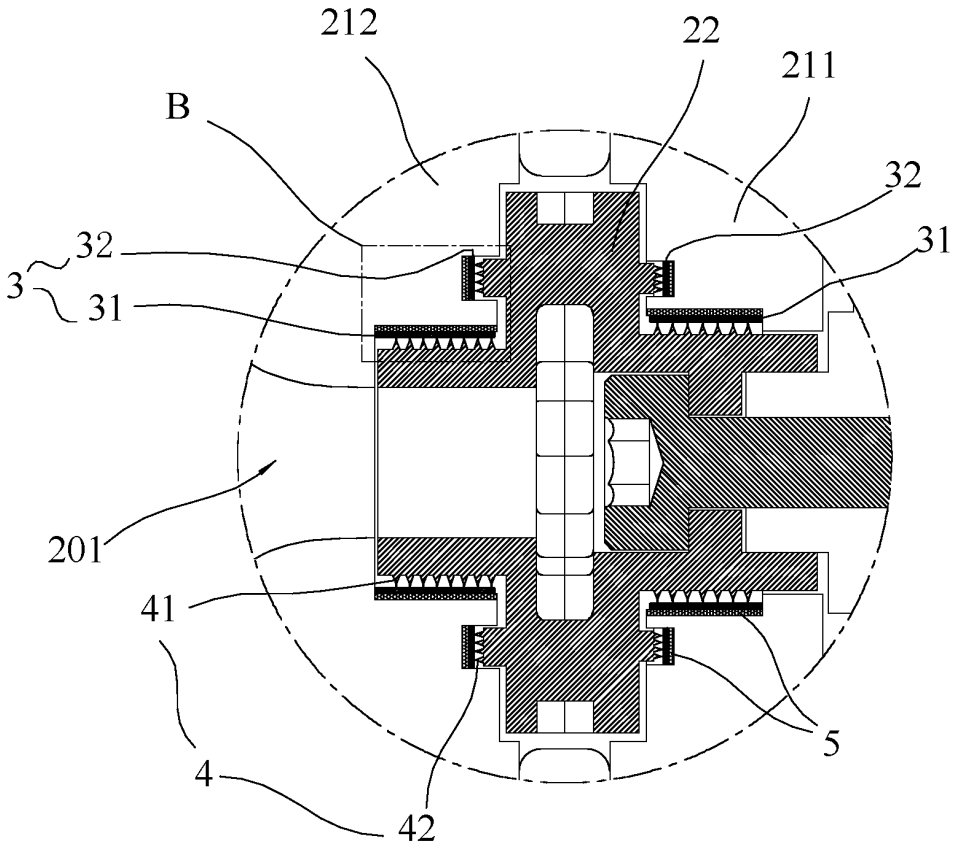

Fig. 2

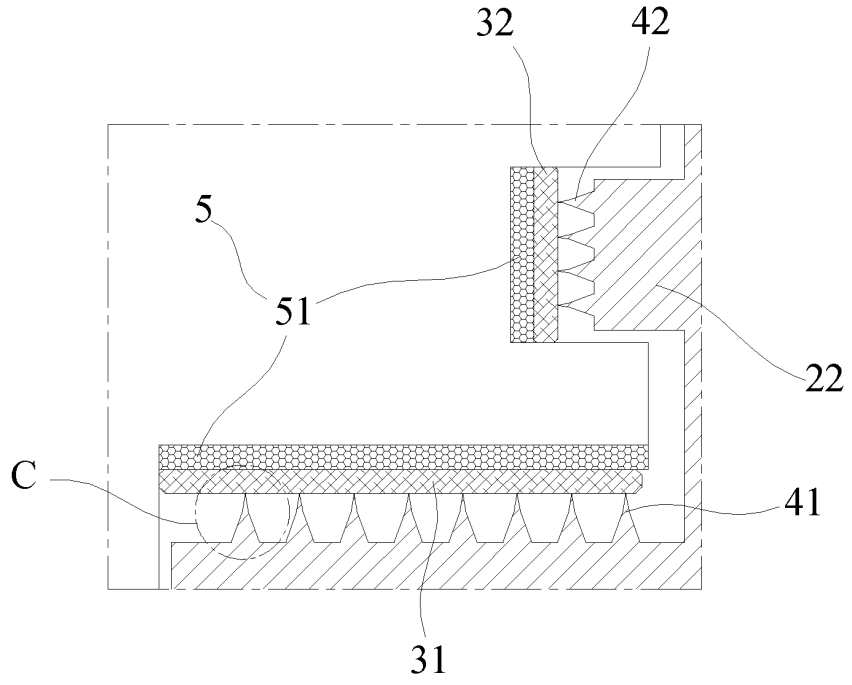

Fig. 3

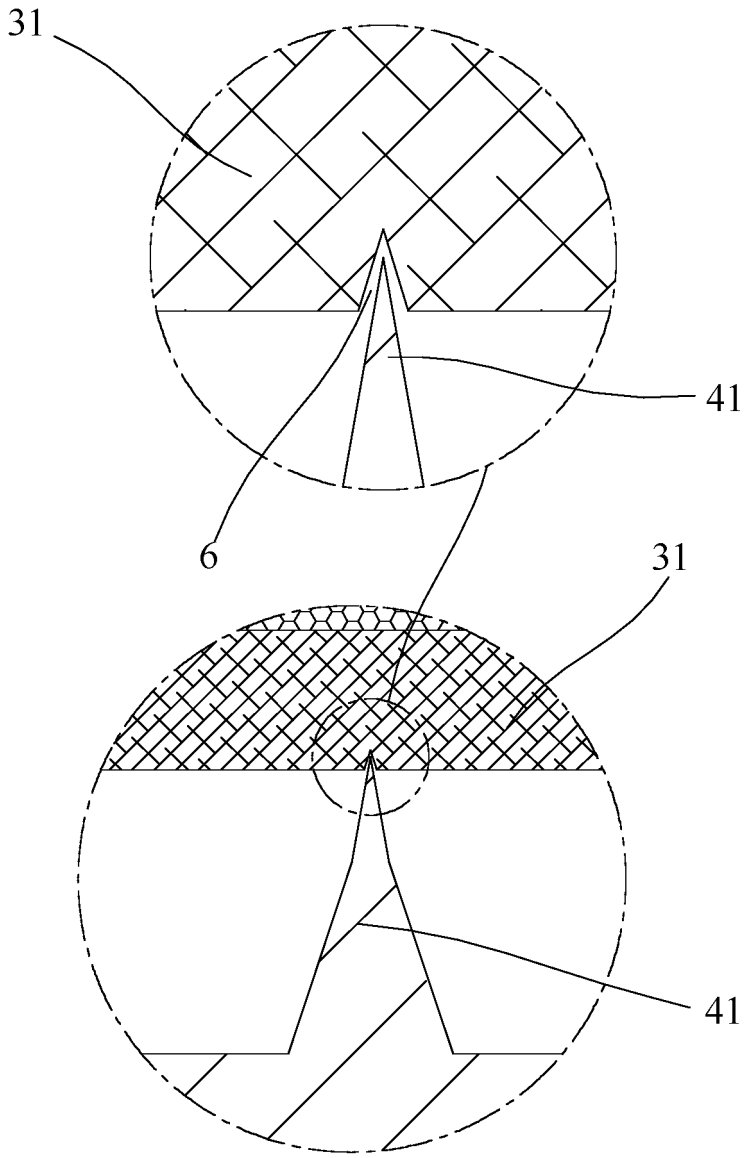

Fig. 4

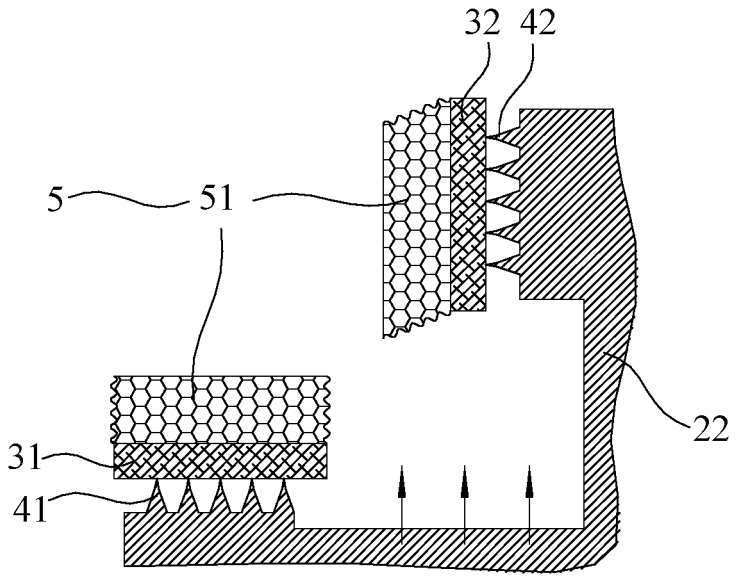

Fig. 5

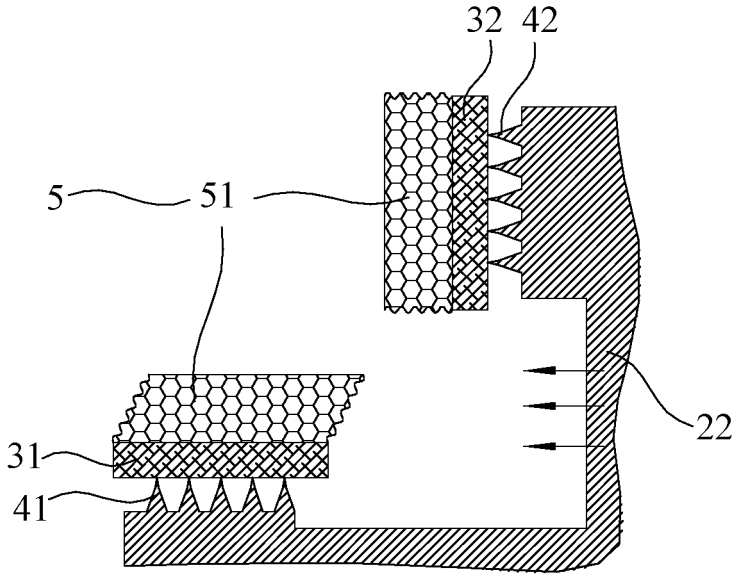

Fig. 6

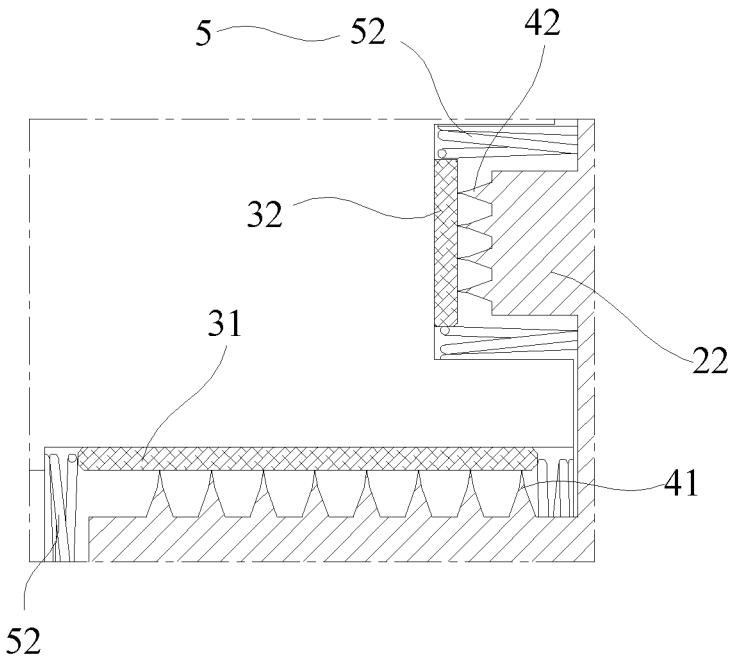

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/098940

A. CLASSIFICATION OF SUBJECT MATTER

F04D 17/08(2006.01)i; F04D 29/08(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)

F04D

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

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

CNTXT; ENTXTC; CNKI: 压缩机, 泵, 密封, 叶轮, 环形槽, 缓冲, 形变, 弹簧, 梳齿; VEN; EPTXT; WOTXT; USTXT: pump, compressor, sealing, depress, concave, groove, blade wheel, buffer, spring, comb.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113864211 A (QINGDAO HAIER INTELLIGENT TECHNOLOGY RESEARCH AND DEVELOPMENT CO., LTD. et al.) 31 December 2021 (2021-12-31) claims 1-10	1-10
A	CN 112780584 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 11 May 2021 (2021-05-11) description, paragraphs 25-42, and figures 1-5	1-10
A	CN 101892989 A (XIAN HANGTIAN PUMP INDUSTRY CO., LTD.) 24 November 2010 (2010-11-24) description, paragraphs 41-44, and figures 1-8	1-10
A	CN 104806560 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 29 July 2015 (2015-07-29) entire document	1-10
A	CN 104100540 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 15 October 2014 (2014-10-15) entire document	1-10
A	JP 2001107891 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 17 April 2001 (2001-04-17) entire document	1-10

☐ 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
09 August 2022	**29 August 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/098940

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 113864211 A	31 December 2021	None	
CN 112780584 A	11 May 2021	CN 214533602 U	29 October 2021
CN 101892989 A	24 November 2010	CN 101892989 B	09 May 2012
CN 104806560 A	29 July 2015	CN 104806560 B	27 October 2017
CN 104100540 A	15 October 2014	None	
JP 2001107891 A	17 April 2001	None	

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