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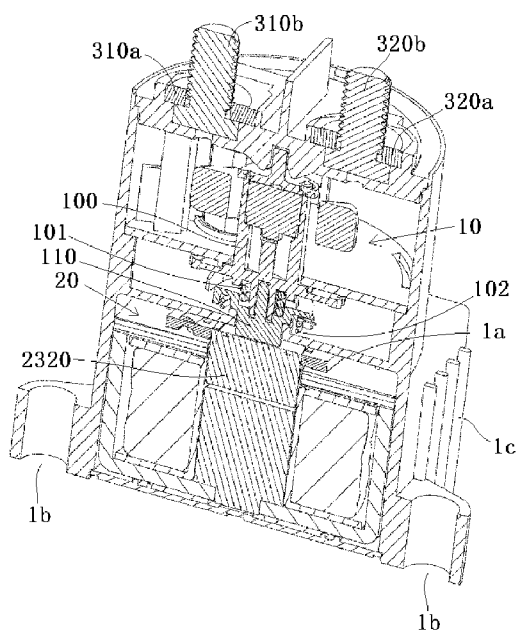


Fig. 1

(57) Abstract: A relay, comprising: a housing; an electric contact system provided in the housing and comprising a static contact with a static contact portion and a movable contact with a movable contact portion; and an electromagnetic system provided in the housing and configured to drive the movable contact to move between a closed position where the movable contact electrically contacts the static contact and an opened position where the movable contact is separated from the static contact, the electric contact system further comprises a magnetic blowing arc-extinguish device comprising a permanent magnet, the permanent magnet is statically provided near the static contact and configured to lengthen an electric arc between the static contact portion and the movable contact portion by an electromagnetic force to extinguish the electric arc. In the present disclosure, the electric arc between the static contact portion and the movable contact portion may be lengthened and extinguished by the electromagnetic force generated by the permanent magnet. Thus, it may protect the static contact and the movable contact from being burned by the electric arc.

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Relay

CROSS-REFERENCE TO RELATED APPLICATION

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This application claims the benefit of Chinese Patent Application No.201820535621.3 filed on April 16, 2018 in the State Intellectual Property Office of China, the whole disclosure of which is incorporated herein by reference.

10 BACKGROUND OF THE INVENTION

Field of the Invention

At least one embodiment of the present disclosure relates to a relay.

15

Description of the Related Art

20 An electrical contact in a switch or controller electric equipment has a phenomenon of discharging and thus generates an electric arc while the electrical contact is turned from on to off. The generated electric arc will delay the breaking of the circuit, and even burn the electrical contacts, thereby causing the electrical contacts to fuse. In more severe cases, the switch will burn and explode. Therefore, an arc extinguishing device needs to be designed to achieve efficient and reliable arc extinguishing.

25 In the related art, a common switch device, such as a high-voltage direct current relay, usually uses sealed inflated air and an additional magnetic field to laterally elongate a metal phase electric arc, and thus the electric arc is rapidly cooled, recombined and deionized in an arc extinguishing medium, which is good in arc extinguishing, but quite complicated in manufacturing, thereby increasing the cost. There is another method for extinguishing arc, in which, a strong magnetic field in the air medium is used. Since the 30 electric arc may be strongly ionized in the air medium, this kind of method is not ideal in extinguishing arc, and is easy to cause contacts to be fused, and requires sufficient internal space, thereby resulting in that the switching device cannot be miniaturized.

SUMMARY OF THE INVENTION

35 The present disclosure has been made to overcome or alleviate at least one aspect of the above mentioned disadvantages.

According to an aspect of the present disclosure, there is provided a relay, comprising: a housing; an electric contact system provided in the housing and comprising a static contact

with a static contact portion and a movable contact with a movable contact portion; and an electromagnetic system provided in the housing and configured to drive the movable contact to move between a closed position where the movable contact is in electrical contact with the static contact and an opened position where the movable contact is separated from the static contact. The electric contact system further comprises a magnetic blowing arc-extinguish device comprising a permanent magnet which is statically provided near the static contact and configured to lengthen an electric arc between the static contact portion and the movable contact portion by an electromagnetic force to extinguish the electric arc.

According to an exemplary embodiment of the present disclosure, the electric contact system further comprises an isolation arc-extinguish device adapted to push the electric arc toward the permanent magnet, so as to force the electric arc to move to the vicinity of the permanent magnet and improve an effect of magnetic blowing arc-extinguish.

According to another exemplary embodiment of the present disclosure, the electric contact system further comprises a rotating member on which the movable contact is mounted, the electromagnetic system is adapted to drive the rotating member to rotate, so as to drive the movable contact to rotate between the closed position and the opened position.

According to another exemplary embodiment of the present disclosure, the magnetic blowing arc-extinguish device further comprises a magnetic yoke, and the permanent magnet and the static contact are disposed in an accommodation space surrounded by the magnetic yoke, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the accommodation space.

According to another exemplary embodiment of the present disclosure, the isolation arc-extinguish device has an arc-extinguishing sheet, and is meshed with the rotating member, and the isolation arc-extinguish device is rotated by the rotating member; when the movable contact is rotated to the closed position, the arc-extinguishing sheet is rotated out of a contact region of the movable contact portion and the static contact portion, so as to allow the movable contact portion to electrically contact with the static contact portion; and when the movable contact is rotated to the opened position, the arc-extinguishing sheet is rotated into the contact region of the movable contact portion and the static contact portion, so as to electrically isolate the movable contact portion from the static contact portion and cut off the electric arc.

According to another exemplary embodiment of the present disclosure, while the movable contact is rotated from the connected position toward the opened position, the arc-extinguishing sheet pushes the electric arc toward the permanent magnet, so as to force the electric arc to move to the vicinity of the permanent magnet and improve the effect of magnetic blowing arc-extinguish.

According to another exemplary embodiment of the present disclosure, the electric contact system further comprises a static insulation isolating wall; when the movable contact

is rotated to the opened position, the static insulation isolating wall and the arc-extinguishing sheet bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the electric arc.

According to another exemplary embodiment of the present disclosure, the electric contact system further comprises an insulation base. The insulation isolating wall is formed on the insulation base, and the rotating member and the isolation arc-extinguish device are rotatably mounted on the insulation base.

According to another exemplary embodiment of the present disclosure, an insulation fixing wall is formed on the insulation base, and the magnetic yoke and the permanent magnet are clamped and fixed between the insulation fixing wall and the insulation isolating wall.

According to another exemplary embodiment of the present disclosure, one end of the magnetic yoke is inserted into a slot of the insulation fixing wall, and the other end of the magnetic yoke is located at a side of the static contact that is opposite to the static contact portion. The permanent magnet is embedded in a mounting chamber defined by the magnetic yoke, the insulation fixing wall and the insulation isolating wall.

According to another exemplary embodiment of the present disclosure, the static contact comprises a first static contact and a second static contact, and the movable contact is provided between the first static contact and the second static contact; the first static contact has a first static contact portion, and the second static contact has a second static contact portion. A first end of the movable contact is provided with a first movable contact portion for electrically contacting with the first static contact portion, and a second end of the movable contact is provided with a second movable contact portion for electrically contacting with the second static contact portion.

According to another exemplary embodiment of the present disclosure, the magnetic blowing arc-extinguish device comprises a first magnetic blowing arc-extinguish device and a second magnetic blowing arc-extinguish device; the first magnetic blowing arc-extinguish device comprises a first permanent magnet statically disposed in the vicinity of the first static contact to extinguish a first electric arc between the first static contact portion and the first movable contact portion; the second magnetic blowing arc-extinguish device comprises a second permanent magnet statically disposed in the vicinity of the second static contact to extinguish a second electric arc between the second static contact portion and the second movable contact portion.

According to another exemplary embodiment of the present disclosure, the first magnetic blowing arc-extinguish device further comprises a first magnetic yoke. The first permanent magnet and the first static contact are disposed in a first accommodation space surrounded by the first magnetic yoke, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the first accommodation space. The second

magnetic blowing arc-extinguish device further comprises a second magnetic yoke, and the second permanent magnet and the second static contact are disposed in a second accommodation space surrounded by the second magnetic yoke, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the second accommodation space.

According to another exemplary embodiment of the present disclosure, the isolation arc-extinguish device comprises a first isolation arc-extinguish device and a second isolation arc-extinguish device, the first isolation arc-extinguish device having a first arc-extinguishing sheet, and the second isolation arc-extinguish device having a second arc-extinguishing sheet.

According to another exemplary embodiment of the present disclosure, when the movable contact is rotated to the opened position, the first arc-extinguishing sheet is rotated into a contact region of the first movable contact portion and the first static contact portion, so as to electrically isolate the first movable contact portion from the first static contact portion and cut off the first electric arc. When the movable contact is rotated to the opened position, the second arc-extinguishing sheet is rotated into a contact region of the second movable contact portion and the second static contact portion, so as to electrically isolate the second movable contact portion from the second static contact portion and cut off the second electric arc.

According to another exemplary embodiment of the present disclosure, while the movable contact is rotated from the closed position toward the opened position, the first arc-extinguishing sheet pushes the first electric arc toward the first permanent magnet, so as to force the first electric arc to move to the vicinity of the first permanent magnet. While the movable contact is rotated from the closed position toward the opened position, the second arc-extinguishing sheet pushes the second electric arc toward the second permanent magnet, so as to force the second electric arc to move to the vicinity of the second permanent magnet.

According to another exemplary embodiment of the present disclosure, when the movable contact is rotated to the closed position, the first arc-extinguishing sheet is rotated out of the contact region of the first movable contact portion and the first static contact portion, so as to allow the first movable contact portion to electrically contact with the first static contact portion. When the movable contact is rotated to the closed position, the second arc-extinguishing sheet is rotated out of the contact region of the second movable contact portion and the second static contact portion, so as to allow the second movable contact portion to electrically contact with the second static contact portion.

According to another exemplary embodiment of the present disclosure, the insulation isolating wall comprises a first insulation isolating wall and a second insulation isolating wall. When the movable contact is rotated to the opened position, the first arc-extinguishing

sheet and the first insulation isolating wall bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the first electric arc; and when the movable contact is rotated to the opened position, the second arc-extinguishing sheet and the second insulation isolating wall bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the second electric arc.

According to another exemplary embodiment of the present disclosure, the insulation fixing wall comprises a first insulation fixing wall and a second insulation fixing wall. The first magnetic yoke and the first permanent magnet are clamped and fixed between the first insulation fixing wall and the first insulation isolating wall, and the second magnetic yoke and the second permanent magnet are clamped and fixed between the second insulation fixing wall and the second insulation isolating wall.

According to another exemplary embodiment of the present disclosure, one end of the first magnetic yoke is inserted into a slot of the first insulation fixing wall, and the other end of the first magnetic yoke is located at a side of the first static contact that is opposite to the first static contact portion. One end of the second magnetic yoke is inserted into a slot of the second insulation fixing wall, and the other end of the second magnetic yoke is located at a side of the second static contact that is opposite to the second static contact portion. The first permanent magnet is embedded in a first mounting chamber defined by the first magnetic yoke, the first insulation fixing wall and the first insulation isolating wall; and the second permanent magnet is embedded in a second mounting chamber defined by the second magnetic yoke, the second insulation fixing wall and the second insulation isolating wall.

According to another exemplary embodiment of the present disclosure, a separation wall is formed in the housing to divide an inner space of the housing into an upper space and a lower space. The electric contact system is provided in the upper space of the housing, and the electromagnetic system is provided in the lower space of the housing.

According to another exemplary embodiment of the present disclosure, the electric contact system further comprises a rotating seat and a torsion spring, the rotating seat is rotatably mounted on the separation wall, two ends of the torsion spring are connected to the rotating seat and the rotating member, respectively, so that the rotating seat and the rotating member are elastically connected together. The electromagnetic system is adapted to drive the rotating seat to rotate, and the rotating seat is adapted to drive the rotating member to rotate by the torsion spring, the torsion spring is adapted to apply a contact pressure between the movable contact portion and the static contact portion.

According to another exemplary embodiment of the present disclosure, the electric contact system further comprises a reset spring, and two ends of the reset spring are connected to the separation wall and the rotating seat, respectively, so that the separation wall and the rotating seat are elastically connected together. When a torque applied on the rotating seat by the electromagnetic system is disappeared, the reset spring drives the

rotating seat to its initial position, so that the movable contact is rapidly rotated from the closed position to the opened position.

According to another exemplary embodiment of the present disclosure, the electromagnetic system comprising: a magnetic yoke; a coil mounted in the magnetic yoke; a lower iron core accommodated in a lower portion of the coil and fixed to the magnetic yoke; a top plate located above the coil and fixed to the magnetic yoke; an upper iron core having a lower portion which is accommodated in the coil and an upper portion which passes through the top plate; an armature located above the top plate and fixedly connected to the upper iron core; and a magnetic isolation ring disposed between the upper iron core and the top plate. The upper iron core is rotatable about its central axis and connected to the rotating seat, so as to drive the rotating seat to rotate.

According to another exemplary embodiment of the present disclosure, the upper iron core is configured to be movable in a vertical direction with respect to the magnetic isolation ring, and the central axis of the upper iron core is parallel to the vertical direction.

According to another exemplary embodiment of the present disclosure, a plurality of first curved grooves are formed in a bottom surface of the armature, and a plurality of second curved grooves, corresponding to the plurality of first curved grooves respectively, are formed in a top surface of the top plate; the plurality of first curved grooves are evenly spaced around the central axis of the upper iron core; and a plurality of balls each is configured to roll in the first curved groove and the corresponding second curved groove. Each first curved groove has a depth gradually deepened from a first end to a second end thereof, such that a force applied on the armature by the ball is inclined to the central axis of the upper iron core to drive the armature to rotate around the central axis.

According to another exemplary embodiment of the present disclosure, the armature is movable between an initial position and a final position, and as the armature is moved from the initial position to the final position, the armature is moved downward for a predetermined distance in the vertical direction and rotates for a predetermined angle around the central axis.

According to another exemplary embodiment of the present disclosure, the predetermined angle is equal to a sum of a central angle of the first curved groove and a central angle of the second curved groove.

According to another exemplary embodiment of the present disclosure, when the armature is moved to the initial position, the ball is located in the first end of the first curved groove; and when the armature is moved to the final position, the ball is located in the second end of the first curved groove.

According to another exemplary embodiment of the present disclosure, each second curved groove has a depth gradually deepened from a first end to a second end thereof; and when the armature is moved to the initial position, the ball is located in the first end of the

second curved groove; and when the armature is moved to the final position, the ball is located in the second end of the second curved groove.

According to another exemplary embodiment of the present disclosure, when the armature is moved to the initial position, the first end of the first curved groove and the first
5 end of the second curved groove are adjacent to each other, while the second end of the first curved groove and the second end of the second curved groove are far away from each other; and when the armature is moved to the final position, the second end of the first curved groove and the second end of the second curved groove are adjacent to each other, while the first end of the first curved groove and the first end of the second curved groove are far
10 away from each other.

According to another exemplary embodiment of the present disclosure, a first air gap is provided between the armature and the top plate, and a second air gap is provided between the upper iron core and the lower iron core.

According to another exemplary embodiment of the present disclosure, as the armature
15 is moved from the initial position to the final position, the first air gap and the second air gap are decreased gradually; as the armature is moved from the final position to the initial position, the first air gap and the second air gap are increased gradually.

According to another exemplary embodiment of the present disclosure, the upper iron core, the second air gap, the lower iron core, the magnetic yoke, the top plate, the first air gap, and the armature are arranged to form a main magnetic circuit of the electromagnetic
20 system.

According to another exemplary embodiment of the present disclosure, when the coil is energized, the magnetic flux generated by the coil passes through the main magnetic circuit such that the lower iron core and the top plate attract the upper iron core and the armature
25 downward in the vertical direction to drive the upper iron core and the armature to move downward in the vertical direction and rotate around the central axis under the push of the balls.

According to another exemplary embodiment of the present disclosure, when the coil is energized, the armature is moved from the initial position to the final position; the coil is
30 de-energized when the armature is moved to the final position, so that the armature is moved from the final position to the initial position by a return spring.

According to another exemplary embodiment of the present disclosure, the ball comprises a spherical ball or a cylindrical ball.

According to another exemplary embodiment of the present disclosure, the coil
35 includes a support frame and a wire wound on the support frame.

According to another exemplary embodiment of the present disclosure, the upper iron core and the lower iron core are disposed in a hollow accommodation space of the support frame, and the magnetic isolation ring is supported on the upper end surface of the support

frame.

According to another exemplary embodiment of the present disclosure, air-cooling fins are formed on an outer wall of the housing to improve the heat dissipation performance of the relay and prevent the electromagnetic system from overheating.

5 According to another exemplary embodiment of the present disclosure, the relay further comprises a detection module adapted to detect a position of the movable contact and comprising a detection circuit, a movable terminal and a static terminal mounted on the housing. A pushing portion is formed on the rotating member and adapted to drive the movable terminal to move between a first position in electrical contact with the static
10 terminal and a second position separated from the static terminal. When the movable contact is rotated to the closed position, the pushing portion drives the movable terminal to the first position in electrical contact with the static terminal, so that the detection circuit is connected; and when the movable contact is rotated to the opened position, the pushing portion drives the movable terminal to the second position separated from the static terminal,
15 so that the detection circuit is disconnected.

According to another exemplary embodiment of the present disclosure, the static contact has a plate-like base fixed on a top cover of the housing; the electromagnetic system further comprises a bolt electrically connected to the base of the static contact, and the bolt is adapted to electrically connect the static contact to a power supply wire of an electric
20 equipment.

According to another exemplary embodiment of the present disclosure, an installation hole for mounting the relay is formed in a bottom portion or a side portion of the housing.

According to another exemplary embodiment of the present disclosure, the relay is a high voltage direct current relay.

25 In the above various exemplary embodiments of the present disclosure, the electric arc between the static contact portion and the movable contact portion may be lengthened and extinguished by the electromagnetic force generated by the permanent magnet. Thus, it may protect the static contact and the movable contact from being burned by the electric arc.

In some exemplary embodiments of the present disclosure, the isolation arc-extinguish
30 device pushes the electric arc toward the permanent magnet so as to force the electric arc to move to the vicinity of the permanent magnet, thereby improving an effect of magnetic blowing arc-extinguishing.

In some exemplary embodiments of the present disclosure, the armature is provided with the first curved grooves each provided with the ball. The depth of the first curved
35 groove is increased gradually from the first end to the second end thereof. Therefore, when the armature is moved downward in the vertical direction by the electromagnetic attraction force, the direction of the force applied by the balls on the armature is inclined to the vertical direction, so that the armature is driven to rotate. The electromagnetic system of the

present disclosure may have larger torque and higher efficiency with the same volume.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The above and other features of the present disclosure will become more apparent by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

Fig.1 is a cross section view of a relay according to an exemplary embodiment of the present disclosure;

10 Fig.2 is an illustrative perspective view of an electric contact system of the relay of Fig.1, in which a movable contact is in contact with a pair of static contacts;

Fig.3 is an illustrative perspective view of the electric contact system of the relay of Fig.1, in which the movable contact is separated from the pair of static contacts;

15 Fig.4 is an illustrative perspective view of an electromagnetic system of the relay of Fig.1;

Fig.5 illustrates the electromagnetic system shown in Fig.1 in which portions of a top plate and a armature are cut away and a magnetic yoke is removed to expose curved grooves and a ball accommodated therein;

20 Fig.6 shows a schematic diagram of the force applied by the ball of the electromagnetic system shown in Fig.5 on the armature;

Fig.7 is a vertical sectional view of the electromagnetic system shown in Fig.4 with the armature in its initial position; and

Fig.8 is a vertical sectional view of the electromagnetic system shown in Fig.4 with the armature in its final position.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

30 Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiment set forth herein; rather, these embodiments are provided so that the present disclosure will be thorough and complete, and will fully convey the concept of the disclosure to those skilled in the art.

35 In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are

schematically shown in order to simplify the drawing.

According to a general concept of the present disclosure, there is provided a relay, comprising: a housing; an electric contact system provided in the housing and comprising a static contact with a static contact portion and a movable contact with a movable contact portion; and an electromagnetic system provided in the housing and configured to drive the movable contact to move between a closed position where the movable contact is in electrical contact with the static contact and an opened position where the movable contact is separated from the static contact. The electric contact system further comprises a magnetic blowing arc-extinguish device comprising a permanent magnet which is statically provided near the static contact and configured to lengthen an electric arc between the static contact portion and the movable contact portion by an electromagnetic force to extinguish the electric arc.

Fig.1 is a cross section view of a relay according to an exemplary embodiment of the present disclosure.

As shown in Fig.1, in an embodiment, the relay mainly comprises a housing 1, an electric contact system 10 and an electromagnetic system 20. The electric contact system 10 is provided in the housing 1 and comprises a static contact 310, 320 with a static contact portion 311, 321 and a movable contact 400 with a movable contact portion 411, 421. The electromagnetic system 20 is provided in the housing 1 and configured to drive the movable contact 400 to move between a closed position where the movable contact 400 is in electrical contact with the static contact 310, 320 and an opened position where the movable contact 400 is separated from the static contact 310, 320.

Fig.2 is an illustrative perspective view of an electric contact system of the relay of Fig.1, in which a movable contact is in contact with a pair of static contacts; Fig.3 is an illustrative perspective view of the electric contact system of the relay of Fig.1, in which the movable contact is separated from the pair of static contacts.

As shown in Figs.2-3, in an embodiment, the electric contact system 10 further comprises a rotating member 100. The movable contact 400 is mounted on the rotating member 100 and may be rotated with the rotating member 100 between the closed position (shown in Fig.2) and the opened position (shown in Fig.3).

As shown in Fig.2, when the movable contact 400 is rotated to the closed position, the movable contact 400 brings into electrical contact with the static contact 310, 320. As shown in Fig.3, when the movable contact 400 is rotated to the opened position, the movable contact 400 is separated from the static contact 310, 320.

As shown in Figs.2-3, in an embodiment, the electric contact system 10 further comprises a magnetic blowing arc-extinguish device 610, 620, 710, 720 comprising a permanent magnet 610, 620. The permanent magnet 610, 620 is statically provided near the static contact 310, 320 and configured to lengthen an electric arc between the static contact

portion 311, 321 and the movable contact portion 411, 421 by an electromagnetic force to extinguish the electric arc.

As shown in Figs.2-3, in an embodiment, the electric contact system 10 further comprises an isolation arc-extinguish device 210, 220 adapted to push the electric arc toward the permanent magnet 610, 620, so as to force the electric arc to move to the vicinity of the permanent magnet 610, 620 and improve an effect of magnetic blowing arc-extinguish.

As shown in Figs.2-3, in an embodiment, the magnetic blowing arc-extinguish device 610, 710, 620, 720 further comprises a magnetic yoke 710, 720. The permanent magnet 610, 620 and the static contact 310, 320 are disposed in an accommodation space surrounded by the magnetic yoke 710, 720, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the accommodation space.

As shown in Figs.2-3, in an embodiment, the isolation arc-extinguish device 210, 220 has an arc-extinguishing sheet 201, 202, and is meshed with the rotating member 100. The isolation arc-extinguish device 210, 220 is rotated by the rotating member 100.

As shown in Fig.2, in an embodiment, when the movable contact 400 is rotated to the closed position, the arc-extinguishing sheet 201, 202 is rotated out of a contact region of the movable contact portion 411, 421 and the static contact portion 311, 321, so as to allow the movable contact portion 411, 421 to bring into electrical contact with the static contact portion 311, 321.

As shown in Fig.3, in an embodiment, when the movable contact 400 is rotated to the opened position, the arc-extinguishing sheet 201, 202 is rotated into the contact region of the movable contact portion 411; 421 and the static contact portion 311, 321, so as to electrically isolate the movable contact portion 411, 421 from the static contact portion 311, 321 and cut off the electric arc.

As shown in Figs.2 and 3, in an embodiment, while the movable contact 400 is rotated from the connected position toward the opened position, the arc-extinguishing sheet 201, 202 pushes the electric arc toward the permanent magnet 610, 620, so as to force the electric arc to move to the vicinity of the permanent magnet 610, 620 and improve the effect of magnetic blowing arc-extinguish.

As shown in Figs.2 and 3, in an embodiment, the electric contact system 10 further comprises a static insulation isolating wall 501, 502. When the movable contact 400 is rotated to the opened position, the static insulation isolating wall 501, 502 and the arc-extinguishing sheet 201, 202 bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the electric arc.

As shown in Figs.2 and 3, in an embodiment, the electric contact system 10 further comprises an insulation base 500. The insulation isolating wall 501, 502 is formed on the insulation base 500. The rotating member 100 and the isolation arc-extinguish device 210,

220 are rotatably mounted on the insulation base 500.

As shown in Figs.2 and 3, in an embodiment, an insulation fixing wall 510, 520 is formed on the insulation base 500. The magnetic yoke 710, 720 and the permanent magnet 610, 620 are clamped and fixed between the insulation fixing wall 510, 520 and the insulation isolating wall 501, 502.

As shown in Figs.2 and 3, in an embodiment, one end 711, 721 of the magnetic yoke 710, 720 is inserted into a slot of the insulation fixing wall 510, 520, and the other end 712, 722 of the magnetic yoke 710, 720 is located at a side of the static contact 310, 320 that is opposite to the static contact portion 311, 321. The permanent magnet 610, 620 is embedded in a mounting chamber defined by the magnetic yoke 710, 720, the insulation fixing wall 510, 520 and the insulation isolating wall 501, 502.

As shown in Figs.2 and 3, in an embodiment, the static contact 310, 320 comprises a first static contact 310 and a second static contact 320, and the movable contact 400 is provided between the first static contact 310 and the second static contact 320. The first static contact 310 has a first static contact portion 311, and the second static contact 320 has a second static contact portion 321. A first end 410 of the movable contact 400 has a first movable contact portion 411 for being in electrical contact with the first static contact portion 311; and a second end 420 of the movable contact 400 has a second movable contact portion 421 for being in electrical contact with the second static contact portion 321.

As shown in Figs.2 and 3, in an embodiment, the magnetic blowing arc-extinguish device 610, 710, 620, 720 comprises a first magnetic blowing arc-extinguish device 610, 710 and a second magnetic blowing arc-extinguish device 620, 720. The first magnetic blowing arc-extinguish device 610, 710 comprises a first permanent magnet 610 statically disposed in the vicinity of the first static contact 310 to extinguish a first electric arc between the first static contact portion 311 and the first movable contact portion 411. The second magnetic blowing arc-extinguish device 620, 720 comprises a second permanent magnet 620 statically disposed in the vicinity of the second static contact 320 to extinguish a second electric arc between the second static contact portion 321 and the second movable contact portion 421.

As shown in Figs.2 and 3, in an embodiment, the first magnetic blowing arc-extinguish device 610, 710 further comprises a first magnetic yoke 710. The first permanent magnet 610 and the first static contact 310 are disposed in a first accommodation space surrounded by the first magnetic yoke 710, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the first accommodation space. The second magnetic blowing arc-extinguish device 620, 720 further comprises a second magnetic yoke 720. The second permanent magnet 620 and the second static contact 320 are disposed in a second accommodation space surrounded by the second magnetic yoke 720, so as to reduce magnetic leakage and increase an intensity of electromagnetic induction in the second

accommodation space.

As shown in Figs.2 and 3, in an embodiment, the isolation arc-extinguish device 210, 220 comprises a first isolation arc-extinguish device 210 and a second isolation arc-extinguish device 220. The first isolation arc-extinguish device 210 has a first arc-extinguishing sheet 201, and the second isolation arc-extinguish device 220 has a second arc-extinguishing sheet 202.

As shown in Fig.3, in an embodiment, when the movable contact 400 is rotated to the opened position, the first arc-extinguishing sheet 201 is rotated into a contact region of the first movable contact portion 411 and the first static contact portion 311, so as to electrically isolate the first movable contact portion 411 from the first static contact portion 311 and cut off the first electric arc.

As shown in Fig.3, in an embodiment, when the movable contact 400 is rotated to the opened position, the second arc-extinguishing sheet 202 is rotated into a contact region of the second movable contact portion 421 and the second static contact portion 321, so as to electrically isolate the second movable contact portion 421 from the second static contact portion 321 and cut off the second electric arc.

As shown in Figs.2 and 3, in an embodiment, while the movable contact 400 is rotated from the closed position toward the opened position, the first arc-extinguishing sheet 201 pushes the first electric arc toward the first permanent magnet 610, so as to force the first electric arc to move to the vicinity of the first permanent magnet 610.

As shown in Figs.2 and 3, in an embodiment, while the movable contact 400 is rotated from the closed position toward the opened position, the second arc-extinguishing sheet 202 pushes the second electric arc toward the second permanent magnet 620, so as to force the second electric arc to move to the vicinity of the second permanent magnet 620.

As shown in Fig.2, in an embodiment, when the movable contact 400 is rotated to the closed position, the first arc-extinguishing sheet 201 is rotated out of the contact region of the first movable contact portion 411 and the first static contact portion 311, so as to allow the first movable contact portion 411 to bring into electrical contact with the first static contact portion 311.

As shown in Fig.2, in an embodiment, when the movable contact 400 is rotated to the closed position, the second arc-extinguishing sheet 202 is rotated out of the contact region of the second movable contact portion 421 and the second static contact portion 321, so as to allow the second movable contact portion 421 to bring into electrical contact with the second static contact portion 321.

As shown in Figs.2 and 3, in an embodiment, the insulation isolating wall 501, 502 comprises a first insulation isolating wall 501 and a second insulation isolating wall 502.

As shown in Fig.3, in an embodiment, when the movable contact 400 is rotated to the opened position, the first arc-extinguishing sheet 201 and the first insulation isolating wall

501 bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the first electric arc.

As shown in Fig.3, in an embodiment, when the movable contact 400 is rotated to the opened position, the second arc-extinguishing sheet 202 and the second insulation isolating wall 502 bring into contact with each other or only a slit is formed therebetween, so as to accelerate the cut-off of the second electric arc.

As shown in Figs.2 and 3, in an embodiment, the insulation fixing wall 510, 520 comprises a first insulation fixing wall 510 and a second insulation fixing wall 520. The first magnetic yoke 710 and the first permanent magnet 610 are clamped and fixed between the first insulation fixing wall 510 and the first insulation isolating wall 501. The second magnetic yoke 720 and the second permanent magnet 620 are clamped and fixed between the second insulation fixing wall 520 and the second insulation isolating wall 502.

As shown in Figs.2 and 3, in an embodiment, one end 711 of the first magnetic yoke 710 is inserted into a slot of the first insulation fixing wall 510, and the other end 712 of the first magnetic yoke 710 is located at a side of the first static contact 310 that is opposite to the first static contact portion 311. One end 721 of the second magnetic yoke 720 is inserted into a slot of the second insulation fixing wall 520, and the other end 722 of the second magnetic yoke 720 is located at a side of the second static contact 320 that is opposite to the second static contact portion 321. The first permanent magnet 610 is embedded in a first mounting chamber defined by the first magnetic yoke 710, the first insulation fixing wall 510 and the first insulation isolating wall 501. The second permanent magnet 620 is embedded in a second mounting chamber defined by the second magnetic yoke 720, the second insulation fixing wall 520 and the second insulation isolating wall 502.

In the aforementioned embodiments of the present disclosure, the arc-extinguishing sheet may enable rapidly lengthen the electric arc and force the electric arc to move to the vicinity of the permanent magnet, increasing a magnetic blow-out path, while isolating an electric arc-generating path by the arc-extinguishing sheet and the insulation isolating wall, effectively improving the effect of arc extinguishing, and greatly accelerating the speed of arc extinguishing.

As shown in Fig.1, in an embodiment, a separation wall 1a is formed in the housing 1 to divide an inner space of the housing 1 into an upper space and a lower space. The electric contact system 10 is provided in the upper space of the housing 1, and the electromagnetic system 20 is provided in the lower space of the housing 1.

As shown in Figs.1-3, in an embodiment, the electric contact system 10 further comprises a rotating seat 110 and a torsion spring 101. The rotating seat 110 is rotatably mounted on the separation wall 1a. Two ends of the torsion spring 101 are connected to the rotating seat 110 and the rotating member 100, respectively, so that the rotating seat 110 and the rotating member 100 are elastically connected together. The electromagnetic system 20

is adapted to drive the rotating seat 110 to rotate. The rotating seat 110 is adapted to drive the rotating member 100 to rotate by the torsion spring 101. The torsion spring 101 is adapted to apply a contact pressure between the movable contact portion 411, 412 and the static contact portion 311, 321.

5 As shown in Figs.1-3, in an embodiment, the electric contact system 10 further comprises a reset spring 102. Two ends of the reset spring 102 are connected to the separation wall 1a and the rotating seat 110, respectively, so that the separation wall 1a and the rotating seat 110 are elastically connected together. When a torque applied on the rotating seat 110 by the electromagnetic system 20 is disappeared, the reset spring 102
10 drives the rotating seat 110 to its initial position, so that the movable contact 400 is rapidly rotated from the closed position to the opened position.

Fig.4 is an illustrative perspective view of an electromagnetic system of the relay of Fig.1; Fig.5 illustrates the electromagnetic system shown in Fig.1 in which portions of a top plate and a armature are cut away and a magnetic yoke is removed to expose curved grooves and a ball accommodated therein; Fig.7 is a vertical sectional view of the electromagnetic
15 system shown in Fig.4 with the armature in its initial position.

As shown in Figs.4-5 and 7, in an embodiment, the electromagnetic system 20 mainly comprises a magnetic yoke 2100, a coil 2200, a lower iron core 2310, a top plate 2400, an upper iron core 2320, an armature 2500, and a magnetic isolation ring 2600. The coil 2200
20 is mounted in the magnetic yoke 2100. The lower iron core 2310 is accommodated in a lower portion of the coil 2200 and fixed to the magnetic yoke 2100. The top plate 2400 is located above the coil 2200 and fixed to the magnetic yoke 2100. The upper iron core 2320 has a lower portion which is accommodated in the coil 2200 and an upper portion which passes through the top plate 2400. The armature 2500 is located above the top plate 2400
25 and fixedly connected to the upper iron core 2320. The magnetic isolation ring 2600 is disposed between the upper iron core 2320 and the top plate 2400 to electromagnetically isolate the upper core 2320 from the top plate 2400.

As shown in Figs.4-5 and 7, in an embodiment, the upper iron core 320 is configured to be movable in a vertical direction Z with respect to the magnetic isolation ring 2600. A
30 central axis R of the upper iron core 320 is parallel to the vertical direction Z.

As shown in Figs.4-5 and 7, in an embodiment, the upper iron core 2320 is rotatable about its central axis R. The upper iron core 2320 is connected to the rotating seat 110, so as to drive the rotating seat 110 to rotate.

As shown in Figs. 5 and 7, in an embodiment, a plurality of first curved grooves 2510
35 are formed in a bottom surface of the armature 2500. A plurality of second curved grooves 2410, mated with the plurality of first curved grooves 2510 respectively, are formed in a top surface of the top plate 2400. The plurality of first curved grooves 2510 are evenly spaced around the central axis R of the upper iron core 2320. A ball 2700 is provided in each first

curved groove 2510. The ball 2700 is configured to roll in the first curved groove 2510 and the mating second curved groove 2410.

Fig.6 shows a schematic diagram of the force applied by the ball of the electromagnetic system shown in Fig.5 on the armature. Fig.8 is a vertical sectional view of the electromagnetic system shown in Fig.4 with the armature in its final position.

As shown in Figs.4-8, in an embodiment, each first curved groove 2510 has a depth gradually deepened from a first end 2510a to a second end 2510b thereof, such that a force F applied on the armature 2500 by the ball 2700 is inclined to the central axis R of the upper iron core 2320 to drive the armature 2500 to rotate around the central axis R. Thereby, as clearly shown in Fig.6, the force F applied to the armature 500 by the ball 700 may be decomposed into a first component force F1 parallel to the central axis R of the upper iron core 320 and a second component force F2 perpendicular to the central axis R of the upper iron core 320. As a result, the second component force F2 may drive the armature 500 to rotate around the central axis R.

In an exemplary embodiment of the present disclosure, the armature 2500 is movable between an initial position (the position shown in Fig.7) and a final position (the position shown in Fig.8). When the armature 2500 is moved from the initial position shown in Fig.7 to the final position shown in Fig.8, the armature 2500 is moved downward for a predetermined distance in the vertical direction Z while rotating for a predetermined angle around the central axis R.

As shown in Figs.4-8, in an embodiment, when the armature 2500 is moved from the initial position shown in Fig.7 to the final position shown in Fig.8, the armature 2500 rotates around the central axis R for the predetermined angle which is equal to the sum of central angles of the first curved groove 2510 and the second curved groove 2410. That is, when the armature 2500 is moved from the initial position shown in Fig.7 to the final position shown in Fig.8, the armature 2500 rotates around the central axis R for an arc length which is equal to the sum of arc lengths of the first curved groove 2510 and the second curved groove 2410 in the circumferential direction of the upper iron core 2320.

In one embodiment of the present disclosure, when the armature 2500 is moved to the initial position shown in Figs.5-7, the ball 2700 is located in the first end 2510a of the first curved groove 2510. When the armature 2500 is moved to the final position shown in Fig.8, the ball 2700 is located in the second end 2510b of the first curved groove 2510.

As shown in Figs.5-6, in an embodiment, each second curved groove 2410 has a depth gradually increasing from the first end 2410a to the second end 2410b thereof. As shown in Fig.7, when the armature 2500 is moved to the initial position, the ball 2700 is located in the first end 2410a of the second curved groove 2410. As shown in Fig.8, when the armature 2500 is moved to the final position, the ball 2700 is located in the second end 2410b of the second curved groove 2410.

As shown in Figs.5-6, in an embodiment, when the armature 2500 is moved to the initial position, the first end 2510a of the first curved groove 2510 and the first end 2410a of the second curved groove 2410 are adjacent to each other, while the second end 2510b of the first curved groove 2510 and the second end 2410b of the second curved groove 2410 are far away from each other.

As shown in Figs.5-6, in an embodiment, when the armature 2500 is moved to the final position, the second end 2510b of the first curved groove 2510 and the second end 2410b of the second curved groove 2410 are adjacent to each other, while the first end 2510a of the first curved groove 2510 and the first end 2410a of the second curved groove 2410 are far away from each other.

As shown in Fig.7, in an embodiment, a first air gap g1 is provided between the armature 2500 and the top plate 2400, and a second air gap g2 is provided between the upper iron core 2320 and the lower iron core 2310.

As shown in Figs.5 and 7-8, in an embodiment, as the armature 2500 is moved from the initial position to the final position, the first air gap g1 and the second air gap g2 are decreased gradually. As the armature 2500 is moved from the final position to the initial position, the first air gap g1 and the second air gap g2 are increased gradually.

As shown in Figs.7-8, in an embodiment, the upper iron core 2320, the second air gap g2, the lower iron core 2310, the magnetic yoke 2100, the top plate 2400, the first air gap g1, and the armature 2500 are arranged to form a main magnetic circuit of the electromagnetic system 20.

As shown in Fig.4, the coil 2200 has terminals 2201, 2202 adapted to be electrically connected to positive and negative electrodes of the power supply, respectively. When the coil 2200 is energized, the magnetic flux generated by the coil 2200 passes through the aforementioned main magnetic circuit. Due to the presence of the first air gap g1 and the second air gap g2, the lower iron core 2310 and the top plate 2400 respectively attract the upper iron core 2320 and the armature 2500 downward in the vertical direction Z, so that while the upper iron core 2320 and the armature 2500 are driven to move downward in the vertical direction Z, the upper iron core 2320 and the armature 2500 are rotating around the central axis R under the push of the balls 2700.

In one embodiment of the present disclosure, when the coil 2200 is energized, while the armature 2500 is moved from the initial position to the final position, the armature 2500 drives the balls 2700 to roll to the second ends 2510b, 2410b of the first curved groove 2510 and the second curved groove 2410 due to friction. When the armature 2500 is moved to the final position, the coil 2200 is de-energized so that the armature 2500 may be moved from the final position to the initial position by the return spring (not shown).

In the illustrated embodiment, as shown in Figs.7-8, when the coil 2200 is de-energized, the residual magnetic flux rapidly decreases due to the presence of the second air gap g2,

and the armature 2500 will be quickly returned to the initial position by the return spring. At the same time, due to friction, the armature 2500 drives the balls 2700 to roll to the first ends 2510a and 2410a of the first curved groove 2510 and the second curved groove 2410.

5 In an exemplary embodiment of the present disclosure, the aforementioned ball 2700 may comprises a spherical ball or a cylindrical ball.

As shown in Fig.7, in an embodiment, the coil 2200 includes a support frame 2220 and a wire 2210 wound on the support frame 2220. The upper iron core 2320 and the lower iron core 2310 are disposed in a hollow accommodation space of the support frame 2220 of the coil 2200, and the magnetic isolation ring 2600 is supported on the upper end surface of the support frame 2220 of the coil 2200.

10 In the foregoing exemplary embodiments of the present disclosure, the armature 2500 is provided with first curved grooves 2510, and the first curved groove 2510 is provided with a ball 2700. The depth of the first curved groove 2510 is deepened gradually from the first end 2510a to the second end 2510b thereof. Therefore, when the armature 2500 is moved downward in the vertical direction Z by the electromagnetic attraction force, the direction of the force applied by the balls 2700 on the armature 2500 is inclined to the vertical direction Z, so that the armature 2500 is driven to rotate. The electromagnetic system of the present disclosure may have larger torque and higher efficiency with the same size. In addition, the electromagnetic system of the present disclosure has a simple structure and a very low manufacturing cost.

As shown in Fig.1, in an embodiment, air-cooling fins 1c are formed on an outer wall of the housing 1 to improve the heat dissipation performance of the relay and prevent the electromagnetic system 20 from overheating.

Although it is not shown, in an embodiment, the relay may further comprise a detection module adapted to detect a position of the movable contact 400. The detection module may comprise a detection circuit, and a movable terminal and a static terminal which are mounted on the housing 1. A pushing portion may be formed on the rotating member 100, the pushing portion is adapted to drive the movable terminal to move between a first position in electrical contact with the static terminal and a second position separated from the static terminal. When the movable contact 400 is rotated to the closed position, the pushing portion drives the movable terminal to the first position in electrical contact with the static terminal, so that the detection circuit is connected. In this way, if the detection circuit is connected, the movable contact 400 may be judged to be in the closed position. When the movable contact 400 is rotated to the opened position, the pushing portion drives the movable terminal to the second position separated from the static terminal, so that the detection circuit is disconnected. In this way, if the detection circuit is disconnected, the movable contact 400 may be judged to be in the opened position.

As shown in Fig.1, in an embodiment, the static contact 310, 320 has a plate-like base

310a, 320a fixed on a top cover of the housing 1. The electromagnetic system 20 further comprises a bolt 310b, 320b electrically connected to the base 310a, 320a of the static contact 310, 320. The bolt 310b, 320b is adapted to electrically connect the static contact 310, 320 to a power supply wire of an electric equipment. A contact area between static
5 contact 310, 320 and the housing 1 may be increased by the plate-like base 310a, 320a and the bolt 310, 320b, thus the heat dissipation area of static contact 310, 320 may be increased.

As shown in Fig.1, in an embodiment, an installation hole 1b for mounting the relay to the electric equipment is formed in a bottom portion or a side portion of the housing 1.

In an exemplary embodiment of the present disclosure, the relay may be a high voltage
10 direct current relay.

It should be appreciated for those skilled in this art that the above embodiments are intended to be illustrated, and not restrictive. For example, many modifications may be made to the above embodiments by those skilled in this art, and various features described in different embodiments may be freely combined with each other without conflicting in
15 configuration or principle.

Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

As used herein, an element recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional
20 embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements
25 having a particular property may include additional such elements not having that property.

What is claimed is,

1. An relay, comprising:

a housing (1);

5 an electric contact system (10) provided in the housing (1) and comprising a static contact (310, 320) with a static contact portion(311, 321) and a movable contact (400) with a movable contact portion(411, 421); and

an electromagnetic system (20) provided in the housing (1) and configured to drive the movable contact (400) to move between a closed position where the movable contact (400) is in electrical contact with the static contact (310, 320) and an opened position where the
10 movable contact (400) is separated from the static contact (310, 320),

wherein the electric contact system (10) further comprises a magnetic blowing arc-extinguish device (610, 620, 710, 720) comprising a permanent magnet (610, 620) which is statically provided near the static contact (310, 320) and configured to lengthen an
15 electric arc between the static contact portion (311, 321) and the movable contact portion (411, 421) by an electromagnetic force to extinguish the electric arc.

2. The relay according to claim 1,

wherein the electric contact system (10) further comprises an isolation arc-extinguish
20 device (210, 220) adapted to push the electric arc toward the permanent magnet (610, 620), so as to force the electric arc to move to the vicinity of the permanent magnet (610, 620).

3. The relay according to claim 1 or 2,

wherein the electric contact system (10) further comprises a rotating member (100) on
25 which the movable contact (400) is mounted,

wherein the electromagnetic system (20) is adapted to drive the rotating member (100) to rotate, so that the movable contact (400) is driven to rotate between the closed position and the opened position.

30 4. The relay according to claim 3,

wherein the magnetic blowing arc-extinguish device (610, 710, 620, 720) further comprises a magnetic yoke (710, 720), the permanent magnet (610, 620) and the static contact (310, 320) being disposed in an accommodation space surrounded by the magnetic yoke (710, 720).

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5. The relay according to claim 4,

wherein the isolation arc-extinguish device (210, 220) has an arc-extinguishing sheet (201, 202), and is meshed with the rotating member (100), the isolation arc-extinguish

device (210, 220) being rotated by the rotating member (100);

when the movable contact (400) is rotated to the closed position, the arc-extinguishing sheet (201, 202) is rotated out of a contact region of the movable contact portion (411; 421) and the static contact portion (311, 321), so as to allow the movable contact portion (411, 421) to bring into electrical contact with the static contact portion (311, 321); and

when the movable contact (400) is rotated to the opened position, the arc-extinguishing sheet (201, 202) is rotated into the contact region of the movable contact portion (411; 421) and the static contact portion (311, 321), so as to electrically isolate the movable contact portion (411, 421) from the static contact portion (311, 321) and cut off the electric arc.

6. The relay according to claim 5,

wherein while the movable contact (400) is rotated from the connected position toward the opened position, the arc-extinguishing sheet (201, 202) pushes the electric arc toward the permanent magnet (610, 620), so as to force the electric arc to move to the vicinity of the permanent magnet (610, 620).

7. The relay according to claim 6,

wherein the electric contact system (10) further comprises a static insulation isolating wall (501, 502),

wherein when the movable contact (400) is rotated to the opened position, the static insulation isolating wall (501, 502) and the arc-extinguishing sheet (201, 202) bring into contact with each other or only a slit is formed therebetween.

8. The relay according to claim 7,

wherein the electric contact system (10) further comprises an insulation base (500), on which the insulation isolating wall (501, 502) is formed, and the rotating member (100) and the isolation arc-extinguish device (210, 220) are rotatably mounted.

9. The relay according to claim 8,

wherein an insulation fixing wall (510; 520) is formed on the insulation base (500), and the magnetic yoke (710, 720) and the permanent magnet (610, 620) are clamped and fixed between the insulation fixing wall (510, 520) and the insulation isolating wall (501, 502).

10. The relay according to claim 9,

wherein one end (711, 721) of the magnetic yoke (710, 720) is inserted into a slot of the insulation fixing wall (510, 520), and the other end (712, 722) of the magnetic yoke (710, 720) is located at a side of the static contact (310, 320) that is opposite to the static contact portion (311, 321); and

wherein the permanent magnet (610, 620) is embedded in a mounting chamber defined by the magnetic yoke (710, 720), the insulation fixing wall (510, 520) and the insulation isolating wall (501, 502).

5 11. The relay according to claim 10,

wherein the static contact (310, 320) comprises a first static contact (310) and a second static contact (320), the movable contact (400) being provided between the first static contact (310) and the second static contact (320);

wherein the first static contact (310) has a first static contact portion (311), and the
10 second static contact (320) has a second static contact portion (321); and

wherein a first end (410) of the movable contact (400) is provided with a first movable contact portion (411) for being in electrical contact with the first static contact portion (311), and a second end (420) of the movable contact (400) is provided with a second movable contact portion (421) for being in electrical contact with the second static contact portion
15 (321).

12. The relay according to claim 11,

wherein the magnetic blowing arc-extinguish device (610, 710, 620, 720) comprises a first magnetic blowing arc-extinguish device (610, 710) and a second magnetic blowing arc-extinguish device (620, 720);
20

wherein the first magnetic blowing arc-extinguish device (610, 710) comprises a first permanent magnet (610) statically disposed in the vicinity of the first static contact (310) to extinguish a first electric arc between the first static contact portion (311) and the first movable contact portion (411); and

25 wherein the second magnetic blowing arc-extinguish device (620, 720) comprises a second permanent magnet (620) statically disposed in the vicinity of the second static contact (320) to extinguish a second electric arc between the second static contact portion (321) and the second movable contact portion (421).

30 13. The relay according to claim 11,

wherein the first magnetic blowing arc-extinguish device (610, 710) further comprises a first magnetic yoke (710), the first permanent magnet (610) and the first static contact (310) being disposed in a first accommodation space surrounded by the first magnetic yoke (710);

wherein the second magnetic blowing arc-extinguish device (620, 720) further
35 comprises a second magnetic yoke (720), the second permanent magnet (620) and the second static contact (320) being disposed in a second accommodation space surrounded by the second magnetic yoke (720).

14. The relay according to claim 13,

wherein the isolation arc-extinguish device (210, 220) comprises a first isolation arc-extinguish device (210) having a first arc-extinguishing sheet (201), and a second isolation arc-extinguish device (220) having a second arc-extinguishing sheet (202).

5

15. The relay according to claim 14,

wherein when the movable contact (400) is rotated to the opened position, the first arc-extinguishing sheet (201) is rotated into a contact region of the first movable contact portion (411) and the first static contact portion (311), so as to electrically isolate the first
10 movable contact portion (411) from the first static contact portion (311) and cut off the first electric arc; and

wherein when the movable contact (400) is rotated to the opened position, the second arc-extinguishing sheet (202) is rotated into a contact region of the second movable contact portion (421) and the second static contact portion (321), so as to electrically isolate the
15 second movable contact portion (421) from the second static contact portion (321) and cut off the second electric arc.

16. The relay according to claim 15,

wherein while the movable contact (400) is rotated from the closed position toward the
20 opened position, the first arc-extinguishing sheet (201) pushes the first electric arc toward the first permanent magnet (610), so as to force the first electric arc to move to the vicinity of the first permanent magnet (610); and

wherein while the movable contact (400) is rotated from the closed position toward the
opened position, the second arc-extinguishing sheet (202) pushes the second electric arc
25 toward the second permanent magnet (620), so as to force the second electric arc to move to the vicinity of the second permanent magnet (620).

17. The relay according to claim 16,

wherein when the movable contact (400) is rotated to the closed position, the first
30 arc-extinguishing sheet (201) is rotated out of the contact region of the first movable contact portion (411) and the first static contact portion (311), so as to allow the first movable contact portion (411) to bring into electrical contact with the first static contact portion (311);

wherein when the movable contact (400) is rotated to the closed position, the second
35 arc-extinguishing sheet (202) is rotated out of the contact region of the second movable contact portion (421) and the second static contact portion (321), so as to allow the second movable contact portion (421) to bring into electrical contact with the second static contact portion (321).

18. The relay according to claim 17,

wherein the insulation isolating wall (501, 502) comprises a first insulation isolating wall (501) and a second insulation isolating wall (502);

5 wherein when the movable contact (400) is rotated to the opened position, the first arc-extinguishing sheet (201) and the first insulation isolating wall (501) bring into contact with each other or only a slit is formed therebetween;

wherein when the movable contact (400) is rotated to the opened position, the second arc-extinguishing sheet (202) and the second insulation isolating wall (502) bring into
10 contact with each other or only a slit is formed therebetween.

19. The relay according to claim 18,

wherein the insulation fixing wall (510, 520) comprises a first insulation fixing wall (510) and a second insulation fixing wall (520), the first magnetic yoke (710) and the first
15 permanent magnet (610) being clamped and fixed between the first insulation fixing wall (510) and the first insulation isolating wall (501), and the second magnetic yoke (720) and the second permanent magnet (620) being clamped and fixed between the second insulation fixing wall (520) and the second insulation isolating wall (502).

20. The relay according to claim 19,

wherein one end (711) of the first magnetic yoke (710) is inserted into a slot of the first insulation fixing wall (510), and the other end (712) of the first magnetic yoke (710) is located at a side of the first static contact (310) that is opposite to the first static contact portion (311);

25 wherein one end (721) of the second magnetic yoke (720) is inserted into a slot of the second insulation fixing wall (520), and the other end (722) of the second magnetic yoke (720) is located at a side of the second static contact (320) that is opposite to the second static contact portion (321);

wherein the first permanent magnet (610) is embedded in a first mounting chamber defined by the first magnetic yoke (710), the first insulation fixing wall (510) and the first
30 insulation isolating wall (501);

wherein the second permanent magnet (620) is embedded in a second mounting chamber defined by the second magnetic yoke (720), the second insulation fixing wall (520) and the second insulation isolating wall (502).

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21. The relay according to any one of claims 3-20,

wherein a separation wall (1a) is formed in the housing (1) to divide an inner space of the housing (1) into an upper space and a lower space, the electric contact system (10) being

provided in the upper space of the housing (1), and the electromagnetic system (20) being provided in the lower space of the housing (1).

22. The relay according to claim 21,

5 wherein the electric contact system (10) further comprises a rotating seat (110) and a torsion spring (101), the rotating seat (110) is rotatably mounted on the separation wall (1a), two ends of the torsion spring (101) are connected to the rotating seat (110) and the rotating member (100), respectively, so that the rotating seat (110) and the rotating member (100) are elastically connected together; and

10 wherein the electromagnetic system (20) is adapted to drive the rotating seat (110) to rotate, the rotating seat (110) is adapted to drive the rotating member (100) to rotate by the torsion spring (101), and the torsion spring (101) is adapted to apply a contact pressure between the movable contact portion (411, 412) and the static contact portion (311, 321).

15 23. The relay according to claim 21 or 22,

wherein the electric contact system (10) further comprises a reset spring (102), two ends of the reset spring (102) being connected to the separation wall (1a) and the rotating seat (110), respectively, so that the separation wall (1a) and the rotating seat (110) are elastically connected together; and

20 wherein when a torque applied on the rotating seat (110) by the electromagnetic system (20) is disappeared, the reset spring (102) drives the rotating seat (110) to its initial position, so that the movable contact (400) is rapidly rotated from the closed position to the opened position.

25 24. The relay according to claim 23,

wherein the electromagnetic system (20) comprising:

a magnetic yoke (2100);

a coil (2200) mounted in the magnetic yoke (2100);

30 a lower iron core (2310) accommodated in a lower portion of the coil (2200) and fixed to the magnetic yoke (2100);

a top plate (2400) located above the coil (2200) and fixed to the magnetic yoke (2100);

an upper iron core (2320) having a lower portion which is accommodated in the coil (2200) and an upper portion which passes through the top plate (2400);

35 an armature (2500) located above the top plate (2400) and fixedly connected to the upper iron core (2320); and

a magnetic isolation ring (2600) disposed between the upper iron core (2320) and the top plate (2400),

wherein the upper iron core (2320) is rotatable about a central axis (R) thereof and

connected to the rotating seat (110), so as to drive the rotating seat (110) to rotate.

25. The relay according to claim 24,

5 wherein the upper iron core (2320) is configured to be movable in a vertical direction (Z) with respect to the magnetic isolation ring (2600), and the central axis (R) of the upper iron core (320) is parallel to the vertical direction (Z).

26. The relay according to claim 25,

10 wherein a plurality of first curved grooves (2510) are formed in a bottom surface of the armature (2500), and a plurality of second curved grooves (2410), mated with the plurality of first curved grooves (2510), respectively, are formed in a top surface of the top plate (2400);

wherein the plurality of first curved grooves (2510) are evenly spaced around the central axis (R) of the upper iron core (2320);

15 wherein a plurality of balls (2700) each is configured to roll in the first curved groove (2510) and the mating second curved groove (2410); and

wherein each first curved groove (2510) has a depth gradually deepened from a first end (2510a) to a second end (2510b) thereof, such that a force (F) applied on the armature (2500) by the ball (2700) is inclined to the central axis (R) of the upper iron core (2320) to
20 drive the armature (2500) to rotate around the central axis (R).

27. The relay according to claim 26,

wherein the armature (2500) is movable between an initial position and a final position, and as the armature (2500) is moved from the initial position to the final position, the
25 armature (2500) is moved downward for a predetermined distance in the vertical direction (Z) and rotates for a predetermined angle around the central axis (R).

28. The relay according to claim 27,

30 wherein the predetermined angle is equal to a sum of a central angle of the first curved groove (2510) and a central angle of the second curved groove (2410).

29. The relay according to claim 27,

wherein when the armature (2500) is moved to the initial position, the ball (2700) is located in the first end (2510a) of the first curved groove (2510); and when the armature
35 (2500) is moved to the final position, the ball (2700) is located in the second end (2510b) of the first curved groove (2510).

30. The relay according to claim 29,

wherein each second curved groove (2410) has a depth gradually deepened from a first end (2410a) to a second end (2410b) thereof; and

wherein when the armature (2500) is moved to the initial position, the ball (2700) is
5 located in the first end (2410a) of the second curved groove (2410); and when the armature (2500) is moved to the final position, the ball (2700) is located in the second end (2410b) of the second curved groove (2410).

31. The relay according to claim 30,

10 wherein when the armature (2500) is moved to the initial position, the first end (2510a) of the first curved groove (2510) and the first end (2410a) of the second curved groove (2410) are adjacent to each other, while the second end (2510b) of the first curved groove (2510) and the second end (2410b) of the second curved groove (2410) are far away from each other; and

15 wherein when the armature (2500) is moved to the final position, the second end (2510b) of the first curved groove (2510) and the second end (2410b) of the second curved groove (2410) are adjacent to each other, while the first end (2510a) of the first curved groove (2510) and the first end (2410b) of the second curved groove (2410) are far away from each other.

20

32. The relay according to claim 31,

wherein a first air gap (g1) is provided between the armature (2500) and the top plate (2400), and a second air gap (g2) is provided between the upper iron core (2320) and the lower iron core (2310).

25

33. The relay according to claim 32,

wherein, as the armature (2500) is moved from the initial position to the final position, the first air gap (g1) and the second air gap (g2) are decreased gradually; and

wherein as the armature (2500) is moved from the final position to the initial position,
30 the first air gap (g1) and the second air gap (g2) are increased gradually.

34. The relay according to claim 32 or 33,

wherein the upper iron core (2320), the second air gap (g2), the lower iron core (2310), the magnetic yoke (2100), the top plate (2400), the first air gap (g1), and the armature (2500)
35 are arranged to form a main magnetic circuit of the electromagnetic system (20).

35. The relay according to claim 34,

wherein when the coil (2200) is energized, the magnetic flux generated by the coil (2200) passes through the main magnetic circuit such that the lower iron core (2310) and the top plate (2400) attract the upper iron core (2320) and the armature (2500) downward in the vertical direction (Z) to drive the upper iron core (2320) and the armature (2500) to move downward in the vertical direction (Z) and rotate around the central axis (R) under the push of the balls (2700).

36. The relay according to claim 34 or 35,

wherein when the coil (2200) is energized, the armature (2500) is moved from the initial position to the final position; and

wherein the coil (2200) is de-energized when the armature (2500) is moved to the final position, so that the armature (2500) is moved from the final position to the initial position by a return spring.

37. The relay according to any one of claims 31-36, wherein the ball (2700) comprises a spherical ball or a cylindrical ball.

38. The relay according to any one of claims 31-37,

wherein the coil (2200) includes a support frame (2220) and a wire (2210) wound on the support frame (2220).

39. The relay according to claim 38,

wherein the upper iron core (2320) and the lower iron core (2310) are disposed in a hollow accommodation space of the support frame (2220), and the magnetic isolation ring (2600) is supported on the upper end surface of the support frame (2220).

40. The relay according to any one of claims 1-39,

wherein air-cooling fins (1c) are formed on an outer wall of the housing (1).

41. The relay according to any one of claims 3-40,

wherein the relay further comprises a detection module adapted to detect a position of the movable contact (400) and comprising a detection circuit, a movable terminal and a static terminal mounted on the housing (1);

wherein a pushing portion is formed on the rotating member (100) and adapted to drive the movable terminal to move between a first position in electrical contact with the static terminal and a second position separated from the static terminal;

wherein when the movable contact (400) is rotated to the closed position, the pushing

portion drives the movable terminal to the first position in electrical contact with the static terminal, so that the detection circuit is connected;

wherein when the movable contact (400) is rotated to the opened position, the pushing portion drives the movable terminal to the second position separated from the static terminal,
5 so that the detection circuit is disconnected.

42. The relay according to any one of claims 1-41,

wherein the static contact (310, 320) has a plate-like base (310a, 320a) fixed on a top cover of the housing (1);

10 wherein the electromagnetic system (20) further comprises a bolt (310b, 320b) electrically connected to the base (310a, 320a) of the static contact (310, 320), the bolt (310b, 320b) being adapted to electrically connect the static contact (310, 320) to a power supply wire of an electric equipment.

15 43. The relay according to any one of claims 1-42,

wherein an installation hole (1b) for mounting the relay is formed in a bottom portion or a side portion of the housing (1).

20 44. The relay according to any one of claims 1-43, wherein the relay is a high voltage direct current relay.

DRAWINGS

1/8

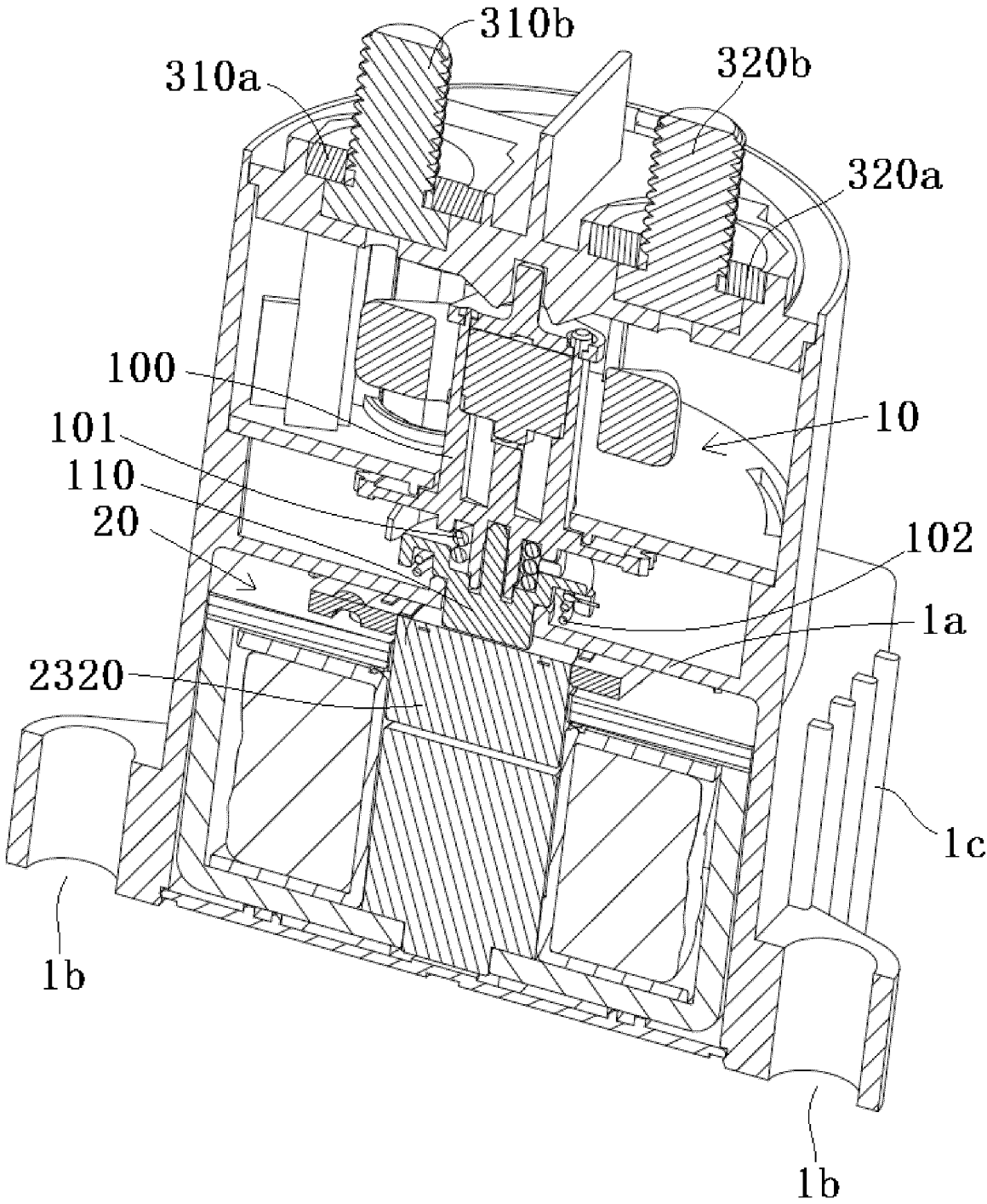


Fig.1

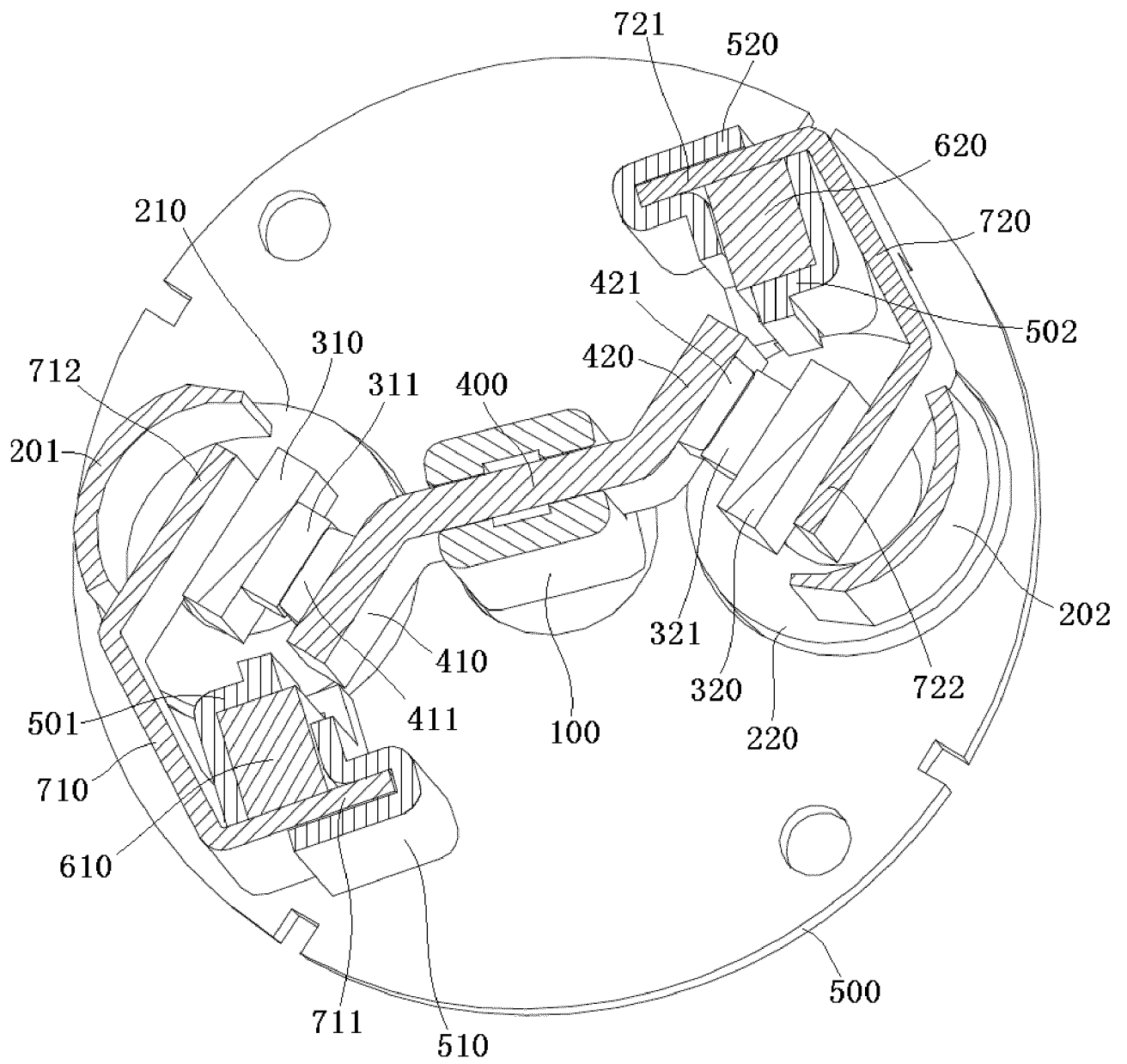


Fig.2

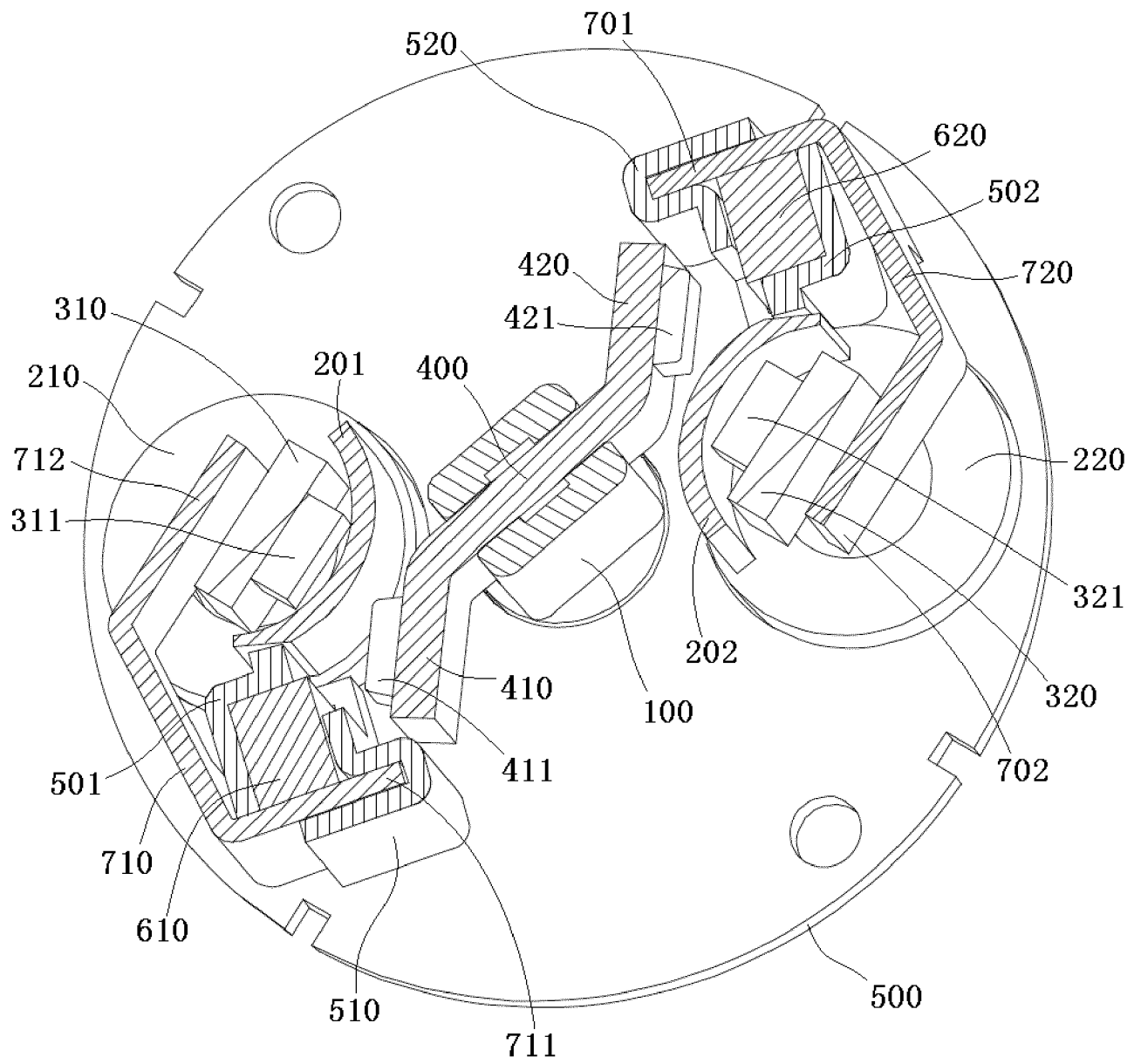


Fig.3

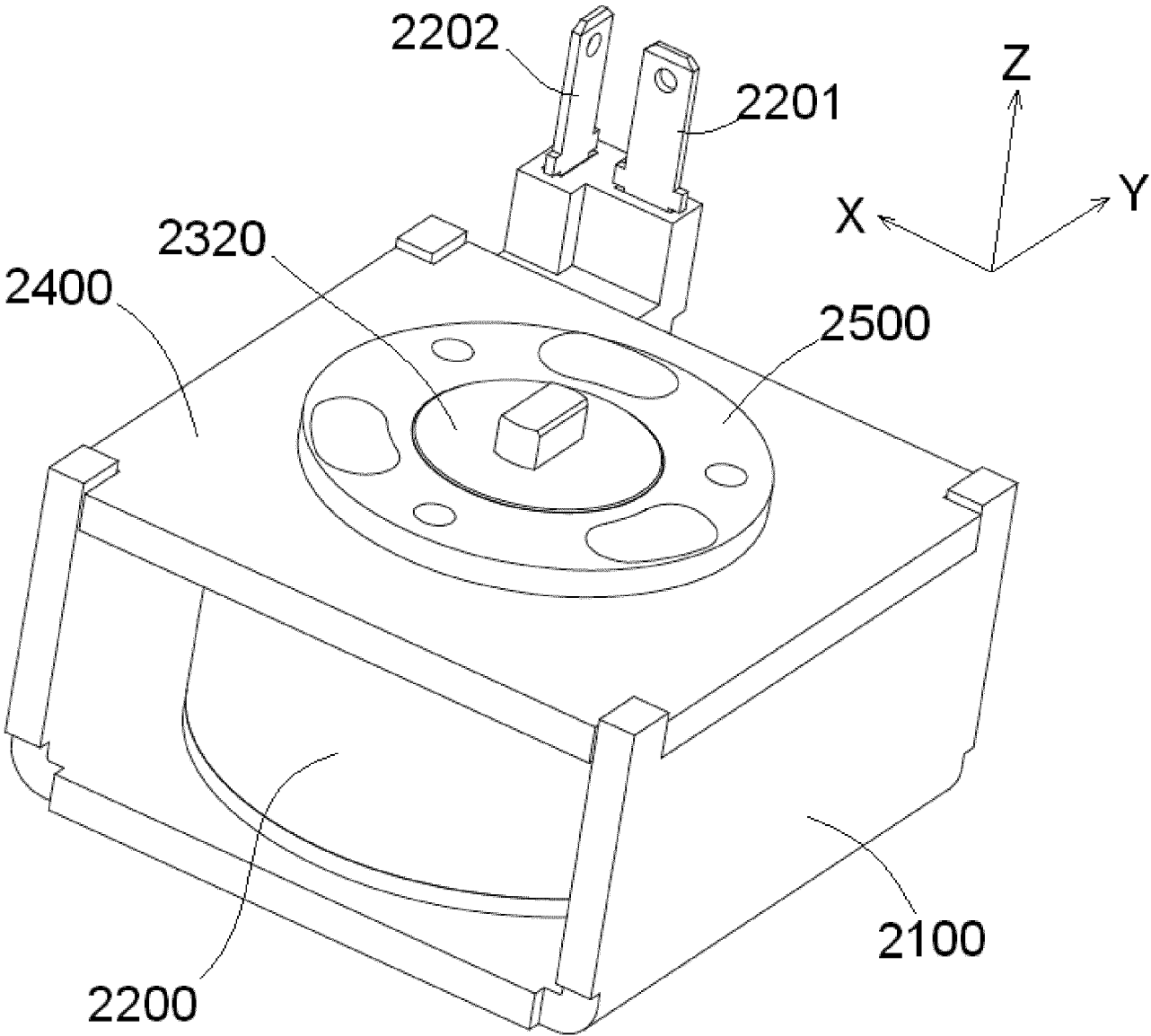


Fig.4

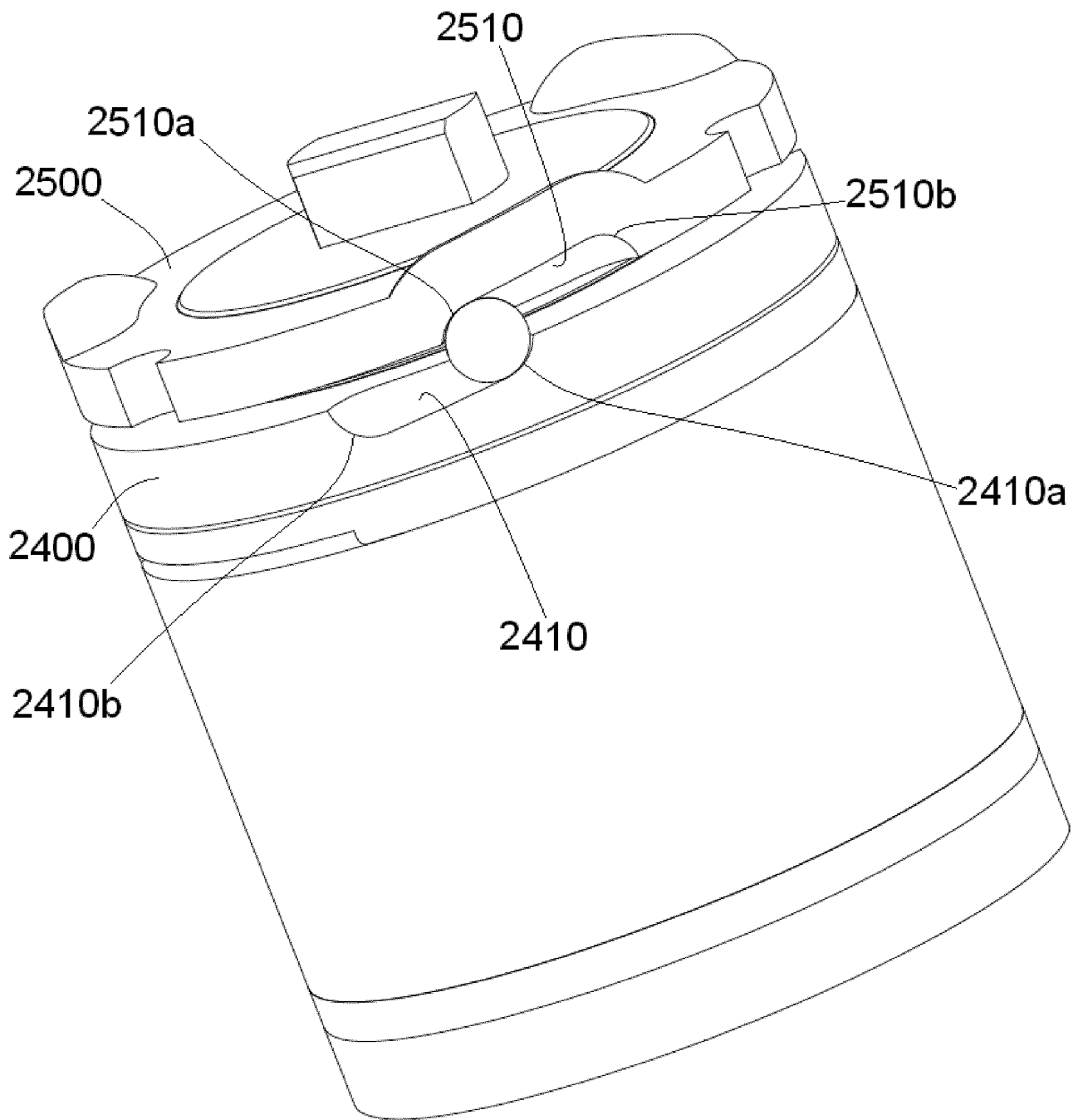


Fig.5

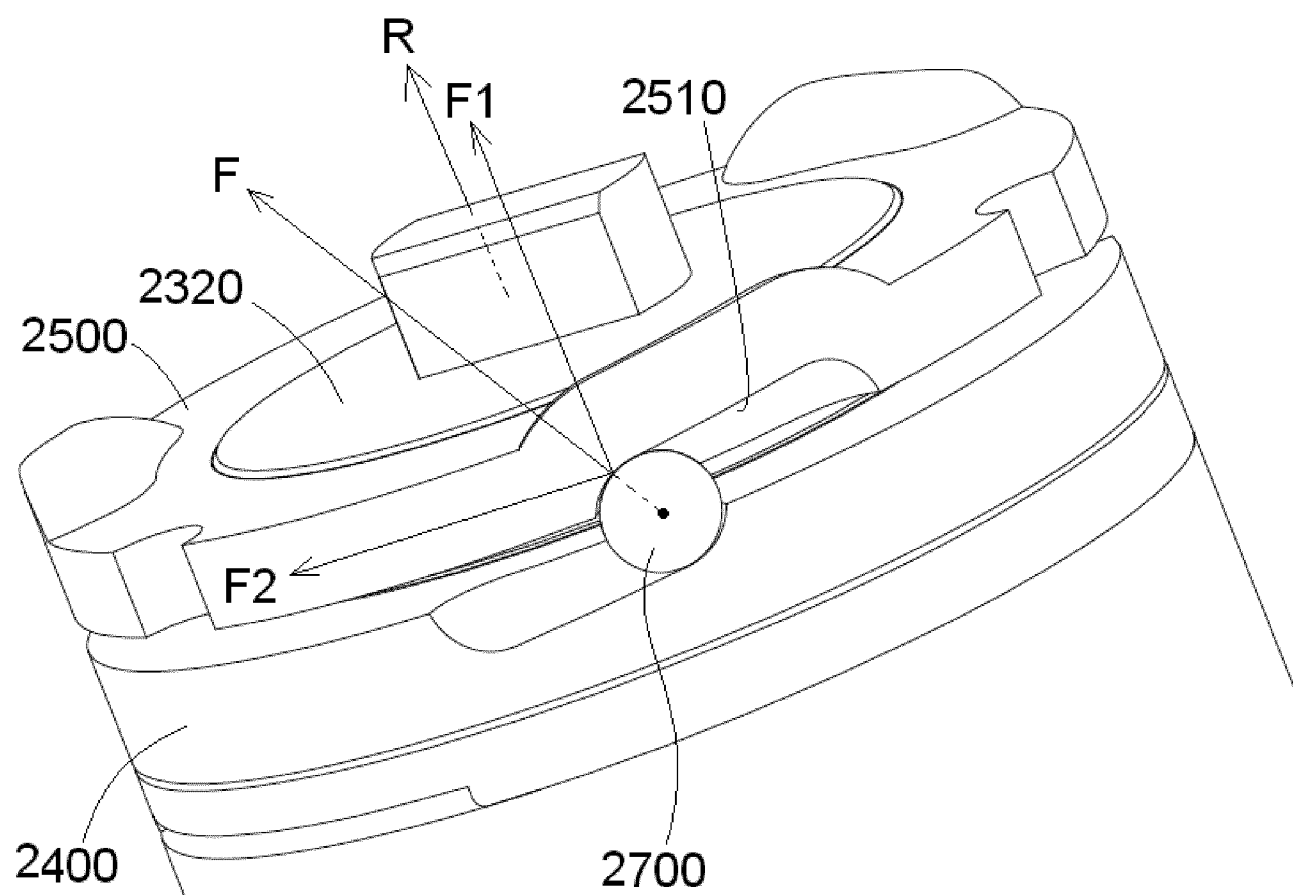


Fig.6

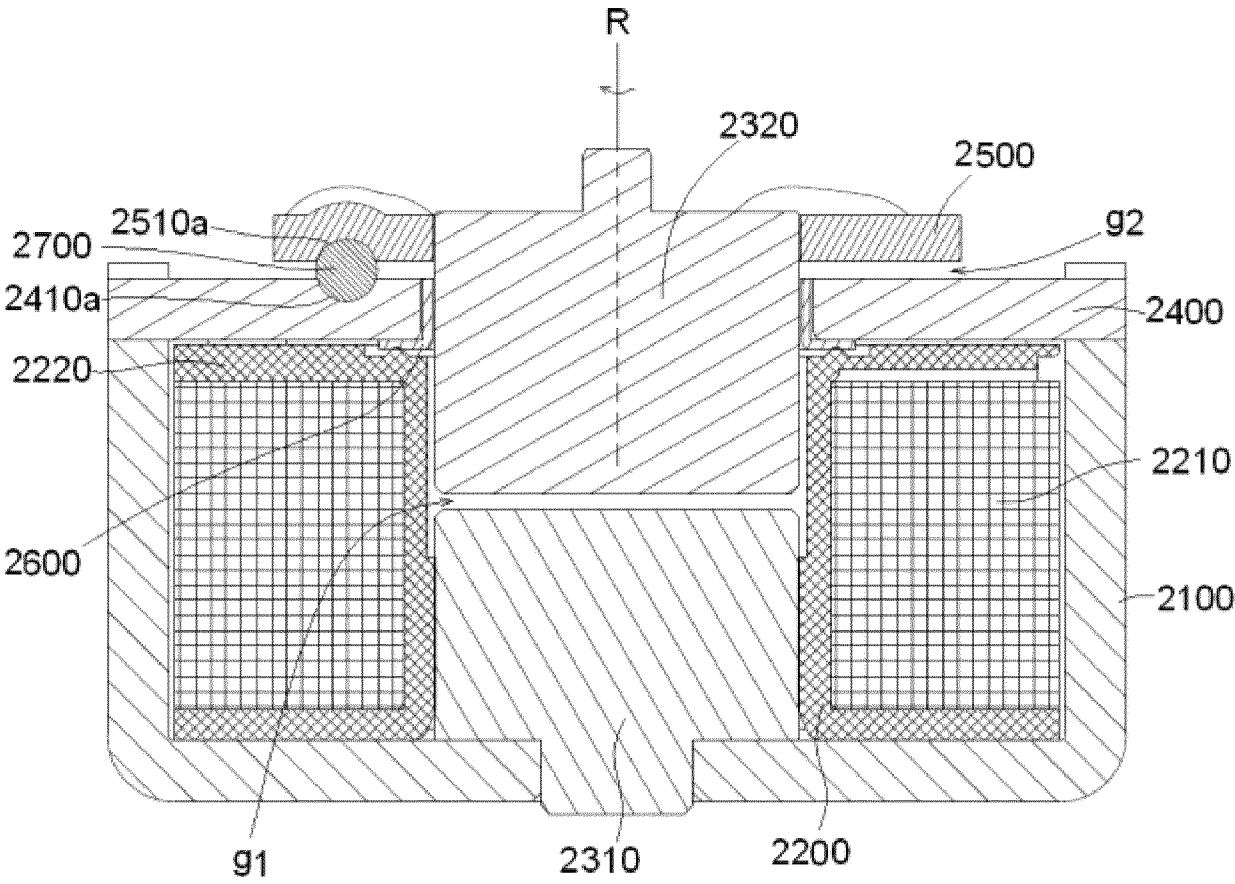


Fig.7

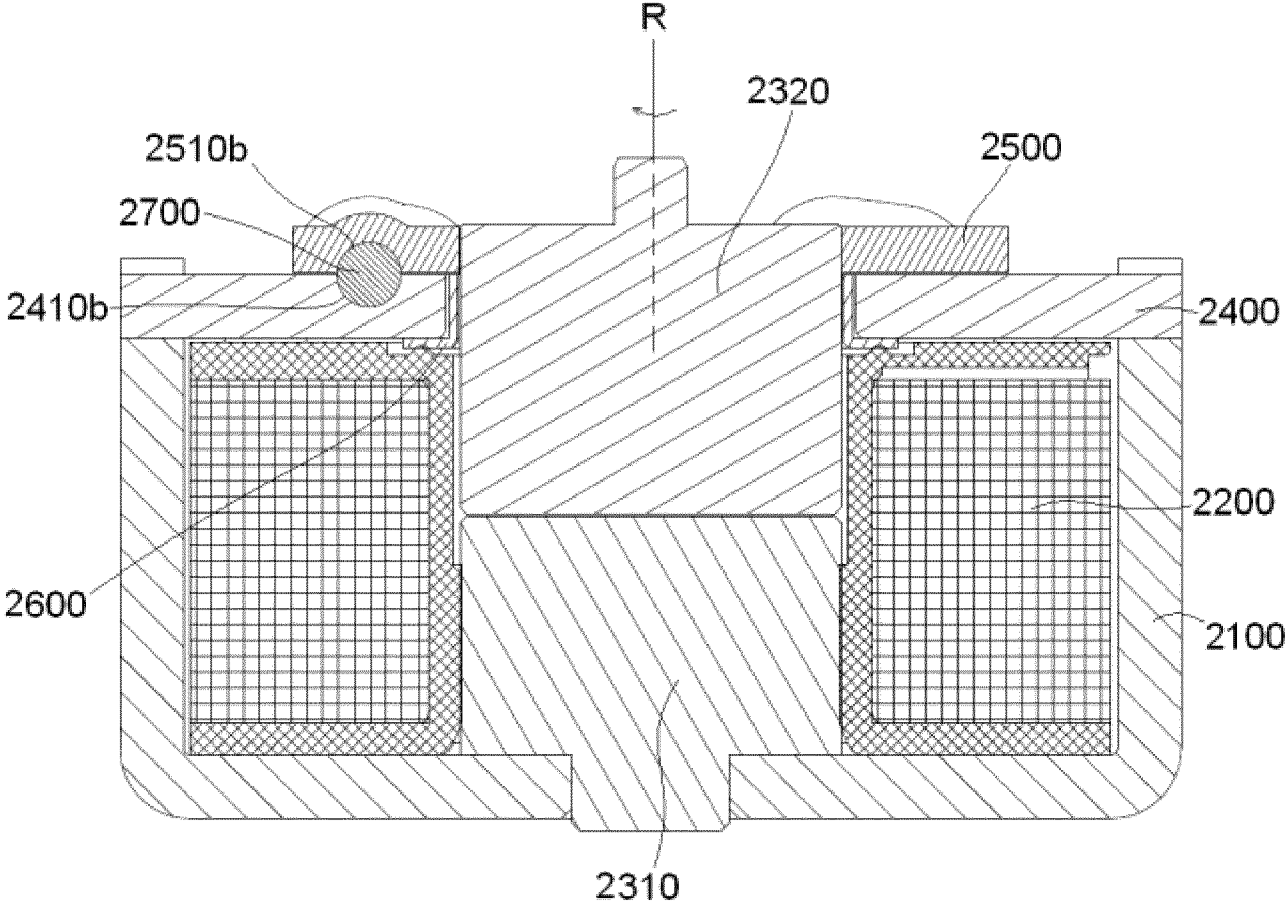


Fig.8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/059241

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01H1/20 H01H9/32 H01H9/44 H01H50/38
ADD.

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)
H01H

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/246403 A1 (ENGWALD MANUEL [DE]) 4 September 2014 (2014-09-04)	1,3,4, 21-23,44
Y	paragraphs [0002], [0004]; figures -----	5,24-39
X	US 5 416 455 A (MOLDOVAN PETER K [US] ET AL) 16 May 1995 (1995-05-16)	1-4, 21-23, 40-44
Y	column 1, lines 5-35	5
A	column 5, lines 12-17 figures	6-20
X	US 3 194 918 A (MUSCANTE ANTHONY J ET AL) 13 July 1965 (1965-07-13)	1,3,4, 21-23,44
Y	column 1, line 10 - line 28; figures -----	5,24-39
	----- -/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

3 July 2019

Date of mailing of the international search report

12/07/2019

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2019/059241

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	the whole document	7,8,14, 15,18
Y	----- CN 207 124 166 U (TE ELECTRONIC SHENZHEN CO LTD) 20 March 2018 (2018-03-20)	24-39
A	the whole document	
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L	figures 4,5	
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