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(54) THERMOMAGNETIC PROTECTION DEVICE, THERMAL PROTECTION COMPONENT AND MAGNETIC PROTECTION COMPONENT

(57) A thermomagnetic protection apparatus applicable to multi-pole circuit breaker. The thermomagnetic protection apparatus comprises: a housing, a multi-pole protection unit (105), an energy-storing component (106) and an adjustment component (107). The housing comprises an upper shell (101) and a base (112). The multi-pole protection unit is installed inside the housing, and comprises a plurality of thermomagnetic protection devices. Each thermomagnetic protection device corresponds to one pole of the multi-pole circuit breaker. Each thermomagnetic protection device comprises a thermal protection component (102) and a magnetic protection component (103). The multi-pole protection unit comprises a rod (501), and the rod adjusts an air gap of the magnetic protection component. The energy-storing component is installed inside the housing, and engages with the thermal protection component. When an overload current occurs, the energy-storing component is triggered by the thermal protection component and strikes an operation mechanism of the circuit breaker. The adjustment component is mounted on the housing, and engages with the rod and the energy-storing component. The adjustment component adjusts a rated overload current by means of adjusting the distance between the energy-storing component and the thermal protection component, and adjusts a rated transient current by means of adjusting the rod.

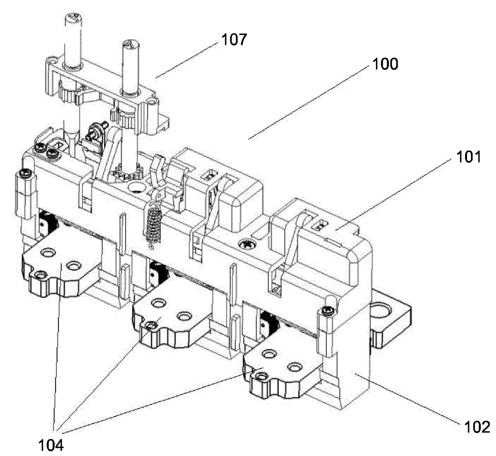

FIG 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to the field of low-voltage electric apparatus, more particularly, relates to thermomagnetic protection apparatus of switching apparatus and thermal protection component and magnetic protection component therein.

2. The Related Art

[0002] A thermomagnetic protection apparatus can provide overload current protection and short-circuit current protection. Protection of a switching apparatus, such as a circuit breaker is usually controlled by a thermomagnetic protection apparatus. The thermomagnetic protection apparatus is widely applied to small-capacity circuit breakers. For large-capacity circuit breakers with a rated current higher than 1000A, an electronic protection apparatus is usually adopted. According to the electronic protection apparatus, a current in the loop is induced by a mutual inductor and monitored by a controller. A magnetic release is used for performing a tripping operation. The thermomagnetic protection apparatus is rarely adopted for high-capacity circuit breakers with a rated current higher than 1000A.

[0003] However, considering from a perspective of market needs and usage cost, a high cost performance ratio will be obtained if the thermo magnetic protection apparatus can be adopted for high-capacity circuit breakers with a rated current higher than 1000A, and a good application market will be achieved. According to a traditional thermomagnetic protection apparatus, a thermal protection component heats a dual-metal sheet by eddy heating and a thermal deformation is generated. An operation mechanism of the circuit breaker is triggered by a force generated by the thermal deformation. A magnetic protection component adopts an electromagnet to adjust a counter force of a spring and an air gap, so that the instantaneous action multiple is adjustable. A series of action rods are used for promoting the tripping of the operation mechanism. The traditional thermal protection component of the thermomagnetic protection device adopts an eddy heating technology, which is difficult to control. There are a large number of elements and the cost advantage is poor. Further, the force generated by the deformation of the dual-metal sheet is usually small. For an operation mechanism of a large-capacity circuit breaker, as a large tripping force is required, it is very difficult for the dual-metal sheet to directly trigger the operation mechanism to trip. The traditional magnetic protection component needs to adjust a counter force of a spring and an air gap at a same time. There are two changeable parameters existed in this mode, it is difficult in design calculation and verification. Further, the counter force of the spring is relatively large so it is inconvenient for a user to adjust the counter force of the spring. In addition, the number of elements of the magnetic protection tripping component is large, and a rapid action of the circuit breaker cannot be obtained.

SUMMARY

[0004] The present invention provides a thermomagnetic protection apparatus applicable to a large capacity circuit breaker, and a thermal protection component and a magnetic protection component thereof.

[0005] According to an embodiment of the present invention, a thermomagnetic protection apparatus is disclosed. The thermomagnetic protection apparatus is applicable to a multi-pole circuit breaker, the thermomagnetic protection apparatus comprises: a housing, a multi-pole protection unit, an energy-storing component and an adjustment component. The housing comprises an upper shell and a base. The multi-pole protection unit is installed inside the housing. The multi-pole protection unit comprises a plurality of thermomagnetic protection devices. Each thermomagnetic protection device corresponds to one pole of the multi-pole circuit breaker. Each thermomagnetic protection device comprises a thermal protection component and a magnetic protection component, the multi-pole protection unit comprises a rod for adjusting an air gap of the magnetic protection component. The energy-storing component is installed inside the housing, the energy-storing component engages with the thermal protection component, when an overload current occurs, the energy-storing component is triggered by the thermal protection component and strikes an operation mechanism of the circuit breaker. The adjustment component is mounted on the housing, the adjustment component engages with the rod and the energy-storing component, the adjustment component adjusts a rated overload current by means of adjusting a distance between the energy-storing component and the thermal protection component, and adjusts a rated transient current by means of adjusting the rod.

[0006] In an embodiment, the thermomagnetic protection device is assembled by the thermal protection component and the magnetic protection component. The thermal protection component comprises a dual-metal sheet. The magnetic protection component comprises a movable iron core, a static iron core and a torsion spring, an air gap is provided between the static iron core and the movable iron core, the air gap is adjustable, the torsion spring provides a fixed inner counter force.

[0007] In an embodiment, the dual-metal sheet is bent, the dual-metal sheet is fixed on a busbar, a working surface of the dual-metal sheet is an inclined surface.

[0008] In an embodiment, the magnetic protection component comprises: a static iron core bracket, a movable iron core bracket, an adjusting support and the torsion spring. The static iron core bracket is used for installing the static iron core thereon. The movable iron core bracket is used for installing the movable iron core thereon, the movable iron core bracket is rotatably mounted on the static iron core bracket by a rotation shaft. The adjusting support is arranged on the rotation shaft, the adjusting support is in contact with the movable iron core bracket. The torsion spring is fit on the rotation shaft, one end of the torsion spring is fixed on the adjusting support, the torsion spring applies the fixed inner counter force to the movable iron core bracket through the adjusting support, the torsion spring also keeps the air gap existing between the movable iron core and the static iron core.

[0009] In an embodiment, the adjusting support is provided with a plurality of spring fixing points, one end of the torsion spring is fixed on different spring fixing points to obtain different fixed inner counter forces.

[0010] In an embodiment, the rod is provided with an inclined surface, the adjusting support is in contact with the inclined surface, wherein the adjusting support is in contact with different positions on the inclined surface, so as to obtain different air gaps between the movable iron core and the static iron core.

[0011] In an embodiment, the energy-storing component comprises an energy-storing rod, a dual-metal adjustment rod and an energy-storing spring. In normal operation, the dual-metal adjustment rod is not in contact with the dual-metal sheet, the dual-metal adjustment rod and the energy-storing rod are locked to each other, the energy-storing spring stores energy. When an overload current occurs, the dual-metal sheet is deformed and pushes the dual-metal adjustment rod and the energy-storing rod to unlock, the energy-storing spring releases energy and drives the dual-metal adjustment rod to strike the operation mechanism of the circuit breaker.

[0012] In an embodiment, the adjustment component comprises a first adjustment rod and a second adjustment rod. The first adjustment rod adjusts a distance between the dual-metal adjustment rod and the working surface of the dual-metal sheet, so as to adjust the rated overload current. The second adjustment rod adjusts the rod, so as to adjust the rated transient current by means of adjusting the air gap.

[0013] In an embodiment, the first adjustment rod and the second adjustment rod is in stepping rotation or damping rotation.

[0014] According to an embodiment, a thermal protection component is disclosed, which is applicable to a thermomagnetic protection apparatus described above. The thermal protection component comprises a dual-metal sheet, the dual-metal sheet is directly installed on a busbar, and a working surface of the dual-metal sheet is an inclined surface.

[0015] In an embodiment, the dual-metal sheet is bent to be an "L" shape, a transverse portion of the "L" shaped dual-metal sheet is directly installed on the busbar, a top end of a longitudinal portion of the "L" shaped dual-metal sheet is the working surface.

[0016] In an embodiment, the thermal protection component engages with an energy-storing component, when an overload current occurs, the thermal protection component triggers the energy-storing component and the energy-storing component strikes an operation mechanism of the circuit breaker.

[0017] In an embodiment, in normal operation, the energy-storing component is locked and a gap exists between the energy-storing component and the working surface of the dual-metal sheet; when an overload current occurs, the dual-metal sheet is deformed and is in contact with the energy-storing component, so that the energy-storing component is unlocked and acts.

[0018] In an embodiment, the energy-storing component comprises an energy-storing rod, a dual-metal adjustment rod and an energy-storing spring. The dual-metal adjustment rod is provided with a contact rod, when an overload current occurs, the working surface of the dual-metal sheet is in contact with the contact rod so as to push the dual-metal adjustment rod. The contact rod is aligned to different positions on the working surface of the dual-metal sheet, so that the gap between the contact rod and the working surface is different so as to obtain different rated overload currents.

[0019] According to an embodiment of the present invention, a magnetic protection component is disclosed, which is applicable to a thermomagnetic protection apparatus described above. The magnetic protection component comprises a movable iron core, a static iron core and a torsion spring, an air gap is provided between the static iron core and the movable iron core, the air gap is adjustable, the torsion spring provides a fixed inner counter force.

[0020] In an embodiment, the magnetic protection component comprises: a static iron core bracket, a movable iron core bracket, an adjusting support and the torsion spring. The static iron core bracket is used for installing the static iron core thereon. The movable iron core bracket is used for installing the movable iron core thereon, the movable iron core bracket is rotatably mounted on the static iron core bracket by a rotation shaft. The adjusting support is arranged on the rotation shaft, the adjusting support is in contact with the movable iron core bracket. The torsion spring is fit on the rotation shaft, one end of the torsion spring is fixed on the adjusting support, the torsion spring applies the fixed inner counter force to the movable iron core bracket through the adjusting support, the torsion spring also keeps the air gap existing between the movable iron core and the static iron core.

[0021] In an embodiment, the adjusting support is provided with a plurality of spring fixing points, one end of the torsion spring is fixed on different spring fixing points to obtain different fixed inner counter forces.

[0022] In an embodiment, two adjusting supports are provided and the two adjusting supports are arranged close to the inner sides of the two side walls of the static iron core bracket respectively. Two torsion springs are provided and are fixed by one adjusting support respectively, one end of the torsion spring is fixed on one of the spring fixing points of the adjusting support, the other end of the torsion spring is a free end. A stop block is provided on the adjusting support, the stop block is in contact with a contact surface on the movable iron core bracket.

[0023] In an embodiment, the magnetic protection component engages with a rod, and the rod is in contact with the adjusting support, the air gap is adjusted through the adjusting support.

[0024] In an embodiment, the adjusting support is provided with an extending pin, and the rod is provided with an inclined surface, the extending pin is in contact with different positions of the inclined surface, so that the adjusting support rotates about the rotation shaft, and drives the movable iron core bracket to rotate so as to adjust the air gap, a reset spring is fit on the rotation shaft, the reset spring makes the extending pin press on the inclined surface. When the rod moves, the extending pin is in contact with different positions of the inclined surfaces, the air gap is adjusted to obtain different rated transient currents.

[0025] The thermal protection component of the thermomagnetic protection apparatus of the present invention uses a dual-metal sheet to trigger an energy-storing component to perform a tripping operation. It has a single structure and a high action speed. The energy-storing component can keep a tripping force constant. The magnetic protection component of the thermomagnetic protection apparatus uses a spring to provide a fixed internal counter force, so that an air gap is the only one parameter that needs to be adjusted, a design difficulty is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The above and other features, natures, and advantages of the invention will be apparent by the following description of the embodiments incorporating the drawings, wherein,

FIG. 1 illustrates a structural diagram of a thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 2 illustrates a structural diagram of a thermal protection component of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 3A illustrates a structural diagram of a magnetic protection component of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 3B illustrates the spring fixing points of the magnetic protection component according to one embodiment.

FIG. 3C illustrates the spring fixing points of the magnetic protection component according to another embodiment.

FIG. 4 illustrates a structural diagram of the thermal protection component and the magnetic component of the thermomagnetic protection apparatus after being assembled

FIG. 5 illustrates an assembly structure of a plurality of thermomagnetic protection devices and a base of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 6 illustrates a structural diagram of an upper shell and a base of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 7 illustrates a schematic diagram of adjusting an air gap between a static iron core and a movable iron core of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 8A, FIG. 8B and FIG. 8C illustrate structural diagrams of an energy-storing component of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 9A and FIG. 9B illustrate structural diagrams of an adjustment component of the thermomagnetic protection apparatus according to an embodiment of the present invention.

FIG. 10A and FIG. 10B illustrate structural diagrams of an adjustment component according to another embodiment.

FIG. 11A and FIG. 11B illustrate an assembly structure of an adjustment component of the thermomagnetic protection apparatus according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0027] The present invention discloses a thermomagnetic protection apparatus applicable to a multi-pole circuit breaker, which can enable the multi-pole circuit break to trip. FIG. 1 illustrates a structural diagram of a thermomagnetic protection apparatus according to an embodiment of the present invention. As shown in FIG. 1, the thermomagnetic protection apparatus comprises: an upper shell 101, a base 112, a multi-pole protection unit 105 comprising a plurality of thermomagnetic protection devices 104, an energy-storing component 106 and an adjustment component 107. The upper shell 101 and the base 112 assemble to form a housing of the thermomagnetic protection apparatus. The multi-pole protection unit

105, the energy-storing component 106 and the adjustment component 107 are installed in the housing formed by the upper shell 101 and the base 112. Each thermomagnetic protection device 104 is installed on one pole of the circuit breaker and corresponds to one phase of circuit. Each thermomagnetic protection device 104 is assembled by a thermal protection component 102 and a magnetic protection component 103. The plurality of thermomagnetic protection devices 104 are disposed on the base 112 to form the multi-pole protection unit 105. The multi-pole protection unit 105 comprises a rod 501 for adjusting an air gap between a static iron core and a movable iron core of the magnetic protection component 103. The energy-storing component is mounted on the upper shell 101. The energy-storing component comprises an energy-storing rod 602, a dual-metal adjustment rod 601, an energy-storing spring and an adjustment screw 604. The energy-storing component 106 engages with the thermal protection component 102. The adjustment component 107 comprises a first adjustment rod 171 and a second adjustment rod 172. The first adjustment rod 171 engages with the energy-storing component 106 and the thermal protection component 102 for adjusting a rated overload current. The second adjustment rod 172 engages with the rod 501 for adjusting a rated transient current by means of adjusting the air gap.

[0028] As shown in FIG. 2, FIG. 2 illustrates a structural diagram of a thermal protection component of the thermomagnetic protection apparatus. The thermal protection component 102 comprises a dual-metal sheet 121. The dual-metal sheet 121 is bent to be an "L" shape. A bottom portion of the dual-metal sheet 121, that is, a transverse portion of the "L" shaped dual-metal sheet is directly installed on a busbar 123 through a screw 124. A top portion of the dual-metal sheet 121, that is, a top end of a longitudinal portion of the "L" shaped dual-metal sheet forms a contact end. A contact surface 122 of the contact end is an inclined surface. The inclined surface 122 acts as the working surface of the dual-metal sheet 121, so that an overload protection factor is adjustable.

[0029] As shown in FIG. 3A, FIG. 3A illustrates a structural diagram of a magnetic protection component of the thermomagnetic protection apparatus. The magnetic protection component 103 comprises: a static iron core 302, a movable iron core 302, a static iron core bracket 305, a movable iron core bracket 301, a rotation shaft 304, adjusting supports 306, 307, torsion springs 308, 310 and a reset spring 309. The static iron core 303 is formed by a lamination of multi layers of magnetic conductive sheets, and is installed on the static iron core bracket 305. The static iron core 303 and the static iron core bracket 305 are both in a framework shape with a through hole formed in the middle. The through hole is used for the busbar 123 to pass through. The movable iron core 302 is installed on the movable iron core bracket 301. The movable iron core bracket 301 is rotatably mounted on the static iron core bracket 305 by the rotation shaft 304. The movable iron core bracket 301 and the movable iron core 302 can rotate about the rotation shaft 304 with respect to the static iron core bracket 305 and the static iron core 303 . The adjusting supports 306, 307 are arranged close to the inner sides of the two side walls of the static iron core bracket 305 respectively. The adjusting supports 306, 307 are also installed on the rotation shaft 304 and also rotate about the rotation shaft 304. The adjusting supports 306, 307 are provided with a respective extending pin 306H, 307H which extends vertically. The adjusting supports 306, 307 are provided with a group of spring fixing points 306B, 307B. The groups of spring fixing points 306B, 307B comprise a plurality of spring fixing points respectively. The groups of spring fixing points 306B, 307B are formed at a bent position of the adjusting supports 306, 307 respectively and are corresponding to each other. The torsion spring 308 is fit on the rotation shaft 304, and is fixed by the adjusting support 306. One end of the torsion spring 308 is fixed on one of the spring fixing points 306B of the adjusting support 306, the other end of the torsion spring 308 is a free end. Similarly, the torsion spring 310 is fit on the rotation shaft 304, and is fixed by the adjusting support 307. One end of the torsion spring 310 is fixed on one of the spring fixing points 307B of the adjusting support 307, the other end of the torsion spring 310 is a free end. Stop blocks 306G, 307G are provided on the adjusting supports 306, 307 (refer to FIG. 7). The stop blocks 306G, 307G are in contact with a contact surface 301G on the movable iron core bracket 301 respectively, so that the adjusting supports 306, 307 apply a force to the movable iron core bracket 301. The movable iron core bracket 301 obtains a fixed inner counter force through the symmetrically arranged adjusting supports 306, 307 and the symmetrically arranged torsion springs 308, 310. Different fixed inner counter forces can be obtained by adjusting different spring fixing points on the adjusting supports 306, 307 that one end of the torsion spring 308, 310 is fixed on. FIG. 3B and FIG. 3C illustrate different embodiments of the spring fixing points. According to the embodiment of the spring fixing points shown in FIG. 3B, two steps in an up and down arrangement are respectively formed at bent positions of the adjusting supports 306, 307, and one spring fixing point is arranged on each step, which are numbered as 306B1, 306B2, 307B1 and 307B2 in the drawings respectively. According to the embodiment of the spring fixing points shown in FIG. 3C, three steps in an inclined arrangement are respectively formed at bent positions of the adjusting supports 306, 307, and one spring fixing point is arranged on each step, which are numbered as 306B1, 306B2, 306B3, 307B1, 307B2 and 307B3 in the drawings respectively. A reset spring 309 is fit on the rotation shaft 304, the reset spring 309 is a torsion spring with frame type long pins. The reset spring 309 is arranged between the adjusting supports 306, 307. One frame type long pin of the reset spring 309 is in contact with the movable iron core bracket 301, and the other frame type long pin is fixed on the thermal protection component 102. A rotation air gap 311 exists between the static iron core 303 and the movable iron core 302 in the assembled magnetic protection component 103.

[0030] As shown in FIG. 4, FIG. 4 illustrates a structural diagram of the thermal protection component and the magnetic component of the thermomagnetic protection apparatus after being assembled. The thermal protection component 102 and the magnetic protection component 103 are assembled, the busbar 123 passes through the through holes in the middle of the static iron core 303 and the static iron core bracket 305, the dual-metal sheet 121 passes between the rotation shaft 304 and the movable iron core bracket 301. One frame type long pin of the reset spring 309 is fixed on the thermal protection component 102. As shown in the drawings, the frame type long pin is embedded into a gap formed by the busbar 123 and the transverse portion of the dual-metal sheet 121. The thermal protection component 102 and the magnetic protection component 103 are assembled to form the thermomagnetic protection device 104, which is used for a certain pole of the multi-phase circuit breaker and corresponds to a certain phase of circuit.

[0031] As shown in FIG. 5, FIG. 5 illustrates an assembly structure of a plurality of thermomagnetic protection devices and a base of the thermomagnetic protection apparatus. FIG. 5 is a view shown from a backside of FIG. 1. A plurality of thermomagnetic protection devices 104 are installed on the base 112 through screws to form the multi-pole protection unit 105. The multi-pole protection unit 105 engages with a multi-pole circuit breaker. Each thermomagnetic protection device 104 corresponds to one pole of the multi-pole circuit breaker and is used for one phase of circuit. The multi-pole protection unit 105 comprises a rod 501. The rod 501 is mounted in a guide slot formed after assembly of the upper shell 101 and the base 112. As shown in FIG. 6, the upper shell 101 and the base 112 assemble to form the housing. Guide slots 101A and 101B are formed in the housing. The rod 501 slides in the guide slots 101A and 101B. Slope structures are formed on the rod 501 at positions corresponding to the respective thermomagnetic protection devices 104. Each slope structure comprises two inclined surfaces 502 and 503, which correspond to the adjusting supports 306 and 307 of each thermomagnetic protection device 104 respectively. The inclined surface 502 corresponds to the adjusting support 306, and the extending pin 306H of the adjusting support 306 is in contact with the inclined surface 502. The inclined surface 503 corresponds to the adjusting support 307, and the extending pin 307H of the adjusting support 307 is in contact with the inclined surface 503. The reset spring 309 generates a torque and drives the adjusting supports 306, 307 to rotate towards the rod 501. Under the action of the reset spring 309, the extending pins 306H, 307H of the adjusting supports 306, 307 always press on the inclined surfaces 502, 503 and keep a certain pressure. FIG. 7 illustrates a schematic diagram of adjusting the air gap 311 between the static iron core and the movable iron core. As shown in FIG. 7, the reset spring 309 makes the extending pines 306H, 307H always press on the inclined surfaces 502, 503. When the rod 501 moves, contact positions of the extending pins 306H, 307H and the inclined surfaces 502, 503 are changed. Such a change in positions causes the extending pins 306H, 307H to drive the adjusting supports 306, 307 to rotate about the rotation shaft 304. As one of the pins of the torsion springs 308 and 310 is fixed on the adjusting supports 306, 307, rotation of the adjusting supports 306, 307 will drive the torsion springs 308, 310 to rotate. The torsion springs 308, 310 drive the movable iron core bracket 301 to rotate about the rotation shaft 304, so that the air gap 311 between the movable iron core 302 and the static iron core 303 is changed. Therefore, the adjustment of the air gap 311 can be realized by moving the rod 501 along the guide grooves 101a and 101b. Continue with FIG. 5, a gear member 504 is provided on the rod 501. The rod 501 can be driven to move along the guide grooves 101a and 101b through the gear member 504.

[0032] FIG. 8A, FIG. 8B and FIG. 8C illustrate structural diagrams of an energy-storing component of the thermomagnetic protection apparatus. FIG. 8B is a cross-sectional view of portion A in FIG. 8A. FIG. 8C is a cross-sectional view of the B in FIG. 8A. FIG. 8A is a view shown from a backside of FIG. 1. The energy-storing component is mounted on the upper shell 101. The energy-storing component comprises an energy-storing rod 602, a dual-metal adjustment rod 601, an energy-storing spring and an adjustment screw 604. The energy-storing springs are multiple, comprising an energy-storing spring 603 and an energy-storing spring 610. The dual-metal adjustment rod 601 spans the whole upper shell 101 and is engaged with the plurality of poles of the multi-pole circuit breaker. Contact rods 601B are provided on the dual-metal adjustment rod 601 at positions corresponding to the respective poles of the multi-pole circuit breaker. Each contact rod 601B corresponds to one thermomagnetic protection device 104, the contact rod 601B is engaged with the dual-metal sheet 121 of the thermal protection component in the thermomagnetic protection device 104. The contact rod 601B engages with the inclined surface 122 at the top end of the dual-metal sheet 121. In normal operation, the contact rod 601B is spaced from the inclined surface 122. When an overload occurs, the dual-metal sheet is deformed so that the inclined surface 122 is in contact with the contact rod 601B. The dual-metal adjustment rod 601 further comprises a locking rod 601A. The locking rod 601A enables the dual-metal adjustment rod 601 and the energy-storing rod 602 be connected in a form of a latch. As shown in FIG. 8C, the locking rod 601A and a locking surface 602A of the energy-storing rod 602 form the latch. An adjustment screw 604 is used for adjusting a latch amount of the locking rod 601A and the locking surface 602A. When the adjustment screw 604 is rotated, a contact surface between the locking rod 601A and the locking surface 602A, that is, the latch amount is changed. The energy-storing spring 603 is connected to the dual-metal adjustment rod 601. When the dual-metal sheet 121 is heated and deformed, it will push the contact rod 601B and drive the dual-metal adjustment rod 601 to rotate about its rotation center 601C. After the dual-metal adjustment rod 601 rotates, the locking rod 601A is unlocked with the locking surface 602A. After unlocking, the energy-storing spring 603 drives the dual-metal adjustment rod 601, and with the engagement of the energy-storing spring 610, the operation mechanism of the circuit breaker is striken by the dual-metal adjustment rod 601, so that the operation mechanism is tripped and an overload protection is achieved. According to the energy-storing component of the present invention, the dual-metal sheet 121 functions as a trigger, and the striking action is driven by the energy-storing springs 603 and 610, then the operation force for striking the operation mechanism is stable.

[0033] FIG. 9A and FIG. 9B illustrate structural diagrams of an adjustment component of the thermomagnetic protection apparatus. FIG. 11A and FIG. 11B illustrate an assembly structure of the adjustment component. As shown in the drawings, the adjustment component 107 is installed on the base of the circuit breaker. The adjustment component comprises a mounting bracket 173, a first adjustment rod 171 and a second adjustment rod 172. The first adjustment rod 171 and the second adjustment rod 172 are rotatably mounted on the mounting bracket 173. Gaskets 705 are provided at a joint of the first adjustment rod 171 and the mounting bracket 173, and a joint of the second adjustment rod 172 and the mounting bracket 173. The first adjustment rod 171 is provided with a first adjustment gear 704 in the middle, a first protrusion 708 in the center of the bottom, and a conical protrusion 701 at the bottom. A positioning rod is provided at the conical end of the conical protrusion 701. As shown in FIG. 8A, a bracket 161 is mounted on the upper shell 101, and the bracket 161 is provided with a mounting hole 605 at a bent portion. The first protrusion 708 of the first adjustment rod 171 is mounted in the mounting hole 605 to form a rotation pair. The positioning rod on the conical protrusion 701 of the first adjustment rod 171 is inserted into an adjustment groove 601F of the dual-metal adjustment rod 601. The second adjustment rod 172 is provided with a second adjustment gear 703 in the middle, a third adjustment gear 702 at the bottom, and a second protrusion 707 in the center of the bottom. As shown in FIG. 8A, a mounting hole 606 is provided on the upper shell 101. The second protrusion 707 of the second adjustment rod 171 is mounted in the mounting hole 606 to form a rotation pair. The third adjustment gear 702 of the second adjustment rod is meshed with the gear member 504 on the rod 501. For the purpose of a more accurate rotation of the first adjustment rod 171 and the second adjustment rod 172, a stepping support is provided on the mounting bracket 173. Both ends of the stepping support are tooth-shaped ends. The tooth-shaped end 706 is in contact with and meshed with the first adjustment gear 704, and the tooth-shaped end 705 is in contact with and meshed with the second adjustment gear 705. When the first adjustment rod 171 or the second adjustment rod 172 rotates, the tooth-shaped ends and the adjustment gears enable the adjustment rod to rotate in a stepping mode by one tooth one time.

[0034] FIG. 10A and FIG. 10B illustrate structural diagrams of an adjustment component according to another embodiment. According to this embodiment, the first adjustment rod 171 and the second adjustment rod 172 adopt a damping rotation mode. Compared with the embodiment shown in FIG. 9A and FIG. 9B, the difference of the embodiment shown in FIG. 10A and FIG. 10B is that no stepping support is arranged. A clamping point manner is applied so that interference fit is generated between a cylindrical surface of the rod body of the adjustment rod and a through hole of the mounting bracket. As shown in the drawings, mounting holes 174 are provided in the mounting bracket 173, and the first adjustment rod 171 and the second adjustment rod 172 pass through the mounting holes. A plurality of clamping points 710 are provided in the mounting holes 174. Inner diameters of the mounting holes 714 are slightly larger than the outer diameters of the rod bodies 720 of the first adjustment rod 171 and the second adjustment rod 172, while inner diameters formed by the plurality of clamping points 710 are slightly smaller than the outer diameters of the rod bodies 720. Therefore, interference fit is formed between the clamping point 710 and the rod body 720, and an effect of damping rotation is achieved. It should be noted that it is not required that the diameters of the first adjustment rod 171 and the second adjustment rod 172 be equal, it is only required that the diameters of the first adjustment rod 171 and the second adjustment rod 172 be matched with the size of a corresponding mounting hole 174.

[0035] As shown in FIG. 11A and FIG. 11B, the adjustment component 107 is respectively engaged with the gear member 504 and the dual-metal adjustment rod 601, so as to realize adjustment of a rated overload current and a rated transient current. The positioning rod on the conical protrusion 701 of the first adjustment rod 171 is inserted into the adjustment groove 601F of the dual-metal adjustment rod 601. When the first adjustment rod 171 is rotated, the positioning rod of the conical protrusion 701 is driven to move, and the positioning rod drives the dual-metal adjustment rod 601 to transversely move through the adjustment groove 601F. Because the working surface of the dual-metal sheet 121 is the inclined surface 122, after the dual-metal adjustment rod 601 moves transversely, a distance F between the contact rod 601B and the inclined surface 122 is changed. The scale of the rated overload current can be adjusted when the distance F is changed. A third adjustment gear 702 of the second adjustment rod 172 is engaged with the gear member 504 on the rod 501. When the second adjustment rod 172 is rotated, it drives the rod 501 to transversely move through the engagement of the gears. The size of the air gap between the movable iron core and the static iron core is adjusted when the rod 501 moves transversely, and a change of the size of the air gap can adjust the scale of the rated transient current.

[0036] The thermal protection component of the thermomagnetic protection apparatus of the present invention uses a dual-metal sheet to trigger an energy-storing component to perform a tripping operation. It has a single structure and a high action speed. The energy-storing component can keep a tripping force constant. The magnetic protection component of the thermomagnetic protection apparatus uses a spring to provide a fixed internal counter force, so that an air gap is the only one parameter needs to be adjusted, a design difficulty is reduced.

[0037] The above embodiments are provided to those skilled in the art to realize or use the invention, under the condition that various modifications or changes being made by those skilled in the art without departing the spirit and principle of the invention, the above embodiments may be modified and changed variously, therefore the protection scope of the invention is not limited by the above embodiments, rather, it should conform to the maximum scope of the innovative features mentioned in the Claims.

Claims

1. A thermomagnetic protection apparatus, wherein the thermomagnetic protection apparatus is applicable to a multi-pole circuit breaker, the thermomagnetic protection apparatus comprises:

a housing comprising an upper shell and a base;
a multi-pole protection unit installed inside the housing, the multi-pole protection unit comprises a plurality of thermomagnetic protection devices, each thermomagnetic protection device corresponds to one pole of the multi-pole circuit breaker, each thermomagnetic protection device comprises a thermal protection component and a magnetic protection component, the multi-pole protection unit comprises a rod for adjusting an air gap of the magnetic protection component;
an energy-storing component installed inside the housing, the energy-storing component engages with the thermal protection component, when an overload current occurs, the energy-storing component is triggered by the thermal protection component and strikes an operation mechanism of the circuit breaker;
an adjustment component mounted on the housing, the adjustment component engages with the rod and the energy-storing component, the adjustment component adjusts a rated overload current by means of adjusting a distance between the energy-storing component and the thermal protection component, and adjusts a rated transient current by means of adjusting the rod.

2. The thermomagnetic protection apparatus according to claim 1, wherein the thermomagnetic protection device is assembled by the thermal protection component and the magnetic protection component;
the thermal protection component comprises a dual-metal sheet;
the magnetic protection component comprises a movable iron core, a static iron core and a torsion spring, the air gap is provided between the static iron core and the movable iron core, the air gap is adjustable, the torsion spring provides a fixed inner counter force.

3. The thermomagnetic protection apparatus according to claim 2, wherein the dual-metal sheet is bent, the dual-metal sheet is fixed on a busbar, a working surface of the dual-metal sheet is an inclined surface.

4. The thermomagnetic protection apparatus according to claim 2, wherein the magnetic protection component comprises:

a static iron core bracket for installing the static iron core thereon;
a movable iron core bracket for installing the movable iron core thereon, the movable iron core bracket is rotatably mounted on the static iron core bracket by a rotation shaft;
an adjusting support arranged on the rotation shaft, the adjusting support is in contact with the movable iron core bracket;
the torsion spring fit on the rotation shaft, one end of the torsion spring is fixed on the adjusting support, the torsion spring applies the fixed inner counter force to the movable iron core bracket through the adjusting support, the torsion spring also keeps the air gap existing between the movable iron core and the static iron core.

5. The thermomagnetic protection apparatus according to claim 4, wherein the adjusting support is provided with a plurality of spring fixing points, one end of the torsion spring is fixed on different spring fixing points to obtain different fixed inner counter forces.

6. The thermomagnetic protection apparatus according to claim 4, wherein the rod is provided with an inclined surface, the adjusting support is in contact with the inclined surface, wherein the adjusting support is in contact with different positions on the inclined surface, so as to obtain different air gaps between the movable iron core and the static iron core.

7. The thermomagnetic protection apparatus according to claim 6, wherein the energy-storing component comprises an energy-storing rod, a dual-metal adjustment rod and an energy-storing spring;
in normal operation, the dual-metal adjustment rod is not in contact with the dual-metal sheet, the dual-metal adjustment rod and the energy-storing rod are locked to each other, the energy-storing spring stores energy;
when an overload current occurs, the dual-metal sheet is deformed and pushes the dual-metal adjustment rod and the energy-storing rod to unlock, the energy-storing spring releases energy and drives the dual-metal adjustment rod to strike the operation mechanism of the circuit breaker.

8. The thermomagnetic protection apparatus according to claim 7, wherein the adjustment component comprises a first adjustment rod and a second adjustment rod;
the first adjustment rod adjusts a distance between the dual-metal adjustment rod and the working surface of the dual-metal sheet, so as to adjust the rated overload current;
the second adjustment rod adjusts the rod, so as to adjust the rated transient current by means of adjusting the air gap.

9. The thermomagnetic protection apparatus according to claim 8, wherein the first adjustment rod and the second adjustment rod is in stepping rotation or damping rotation.

10. A thermal protection component applicable to a thermomagnetic protection apparatus according to claim 1, wherein the thermal protection component comprises a dual-metal sheet, the dual-metal sheet is directly installed on a busbar, and a working surface of the dual-metal sheet is an inclined surface.

11. The thermal protection component according to claim 10, wherein the dual-metal sheet is bent to be an "L" shape, a transverse portion of the "L" shaped dual-metal sheet is directly installed on the busbar, a top end of a longitudinal portion of the "L" shaped dual-metal sheet is the working surface.

12. The thermal protection component according to claim 10, the thermal protection component engages with an energy-storing component, when an overload current occurs, the thermal protection component triggers the energy-storing component and the energy-storing component strikes an operation mechanism of the circuit breaker.

13. The thermal protection component according to claim 12, wherein in normal operation, the energy-storing component is locked and a gap exists between the energy-storing component and the working surface of the dual-metal sheet; when an overload current occurs, the dual-metal sheet is deformed and is in contact with the energy-storing component, so that the energy-storing component is unlocked and acts.

14. The thermal protection component according to claim 13, wherein the energy-storing component comprises an energy-storing rod, a dual-metal adjustment rod and an energy-storing spring;
the dual-metal adjustment rod is provided with a contact rod, when an overload current occurs, the working surface of the dual-metal sheet is in contact with the contact rod so as to push the dual-metal adjustment rod;
the contact rod is aligned to different positions on the working surface of the dual-metal sheet, so that the gap between the contact rod and the working surface is different so as to obtain different rated overload currents.

15. A magnetic protection component applicable to a thermomagnetic protection apparatus according to claim 1 wherein the magnetic protection component comprises a movable iron core, a static iron core and a torsion spring, an air gap is provided between the static iron core and the movable iron core, the air gap is adjustable, the torsion spring provides a fixed inner counter force.

16. The magnetic protection component according to claim 15, wherein the magnetic protection component comprises:

a static iron core bracket for installing the static iron core thereon;
a movable iron core bracket for installing the movable iron core thereon, the movable iron core bracket is rotatably mounted on the static iron core bracket by a rotation shaft;
an adjusting support arranged on the rotation shaft, the adjusting support is in contact with the movable iron core bracket;
the torsion spring fit on the rotation shaft, one end of the torsion spring is fixed on the adjusting support, the torsion spring applies the fixed inner counter force to the movable iron core bracket through the adjusting support, the torsion spring also keeps the air gap existing between the movable iron core and the static iron core.

17. The magnetic protection component according to claim 16, wherein the adjusting support is provided with a plurality of spring fixing points, one end of the torsion spring is fixed on different spring fixing points to obtain different fixed inner counter forces.

18. The magnetic protection component according to claim 16, wherein
two adjusting supports are provided and are arranged close to the inner sides of the two side walls of the static iron core bracket respectively;
two torsion springs are provided and are fixed by one adjusting support respectively, one end of the torsion spring is fixed on one of the spring fixing points of the adjusting support, the other end of the torsion spring is a free end;
a stop block is provided on the adjusting support, the stop block is in contact with a contact surface on the movable iron core bracket.

19. The magnetic protection component according to claim 16, wherein the magnetic protection component engages with a rod, and the rod is in contact with the adjusting support, the air gap is adjusted through the adjusting support.

20. The magnetic protection component according to claim 19, wherein
the adjusting support is provided with an extending pin, and the rod is provided with an inclined surface, the extending pin is in contact with different positions of the inclined surface, so that the adjusting support rotates about the rotation shaft, and drives the movable iron core bracket to rotate so as to adjust the air gap, a reset spring is fit on the rotation shaft, the reset spring makes the extending pin press on the inclined surface;
when the rod moves, the extending pin is in contact with different positions of the inclined surfaces, the air gap is adjusted to obtain different rated transient currents.

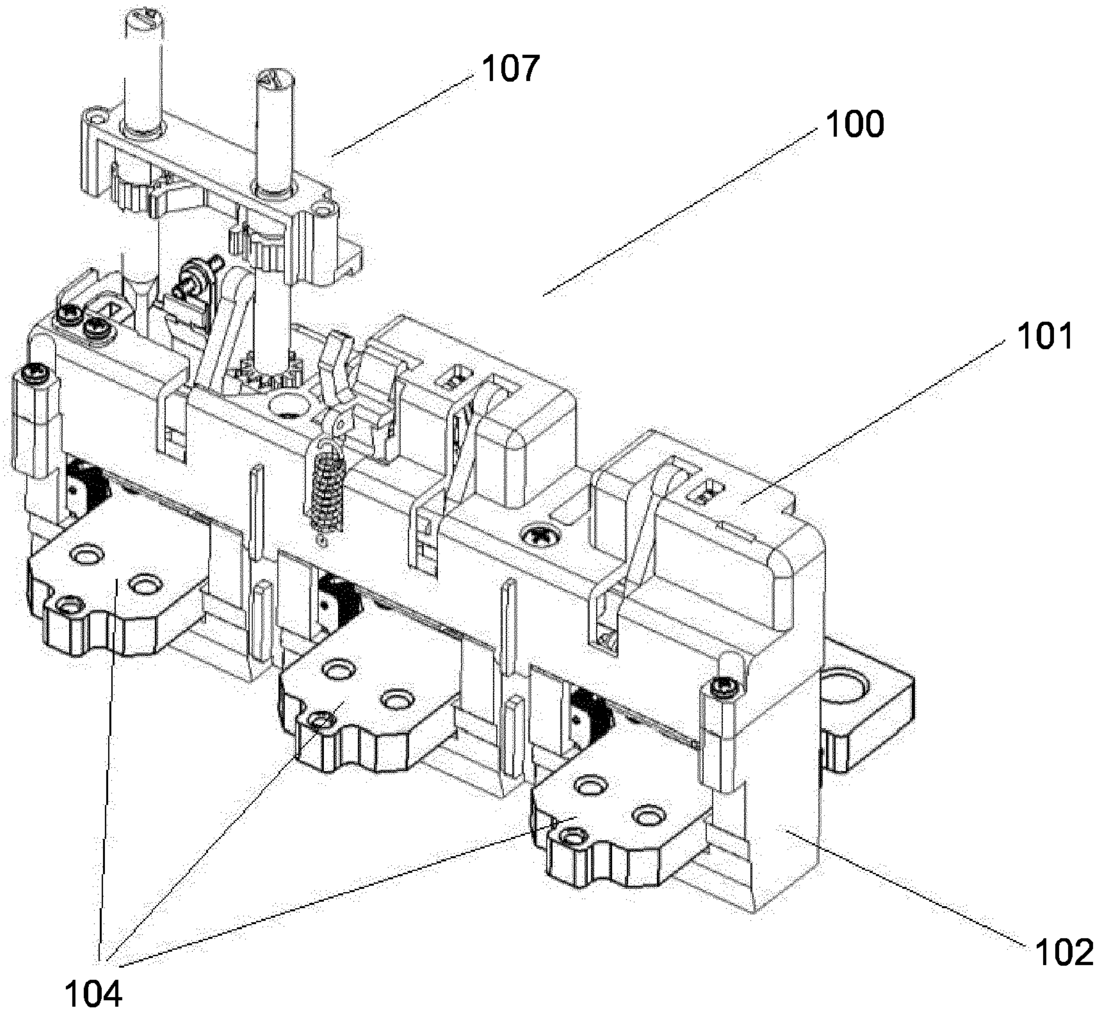

FIG 1

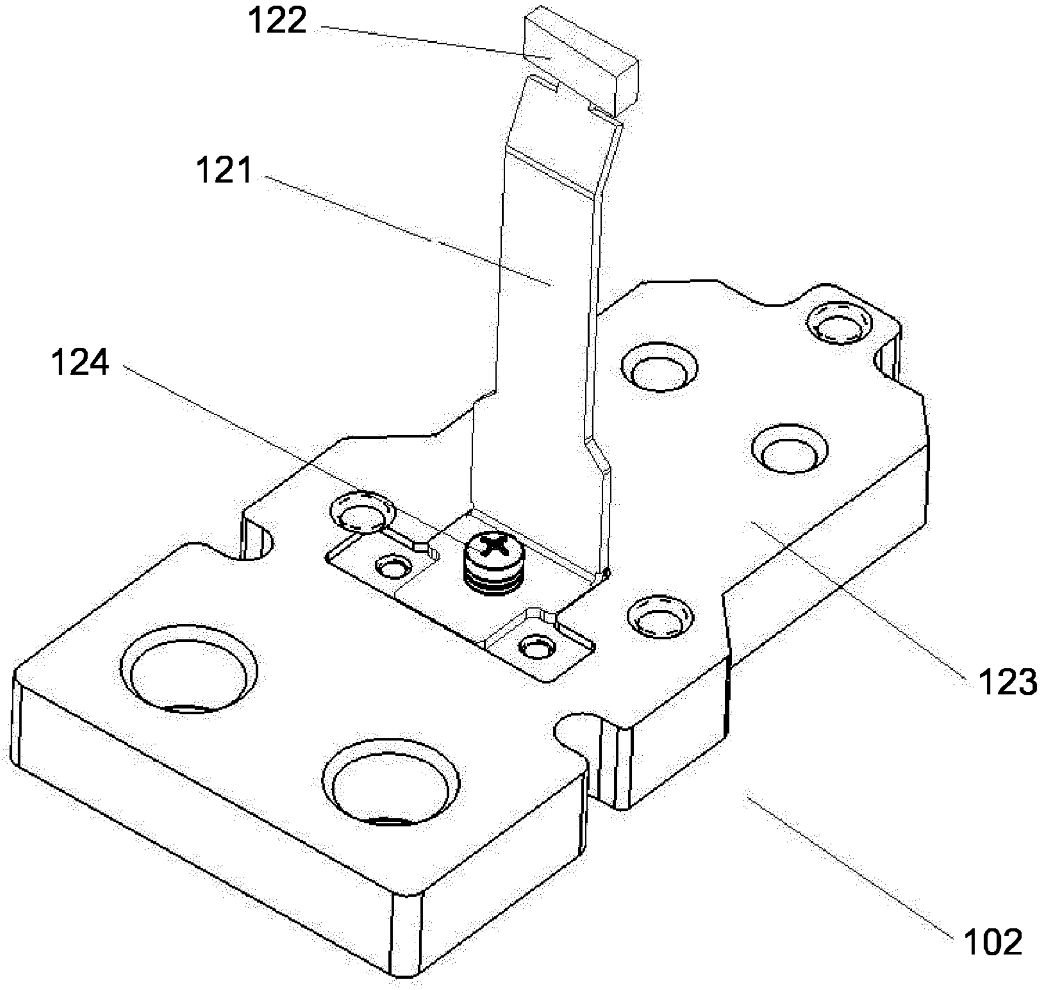

FIG 2

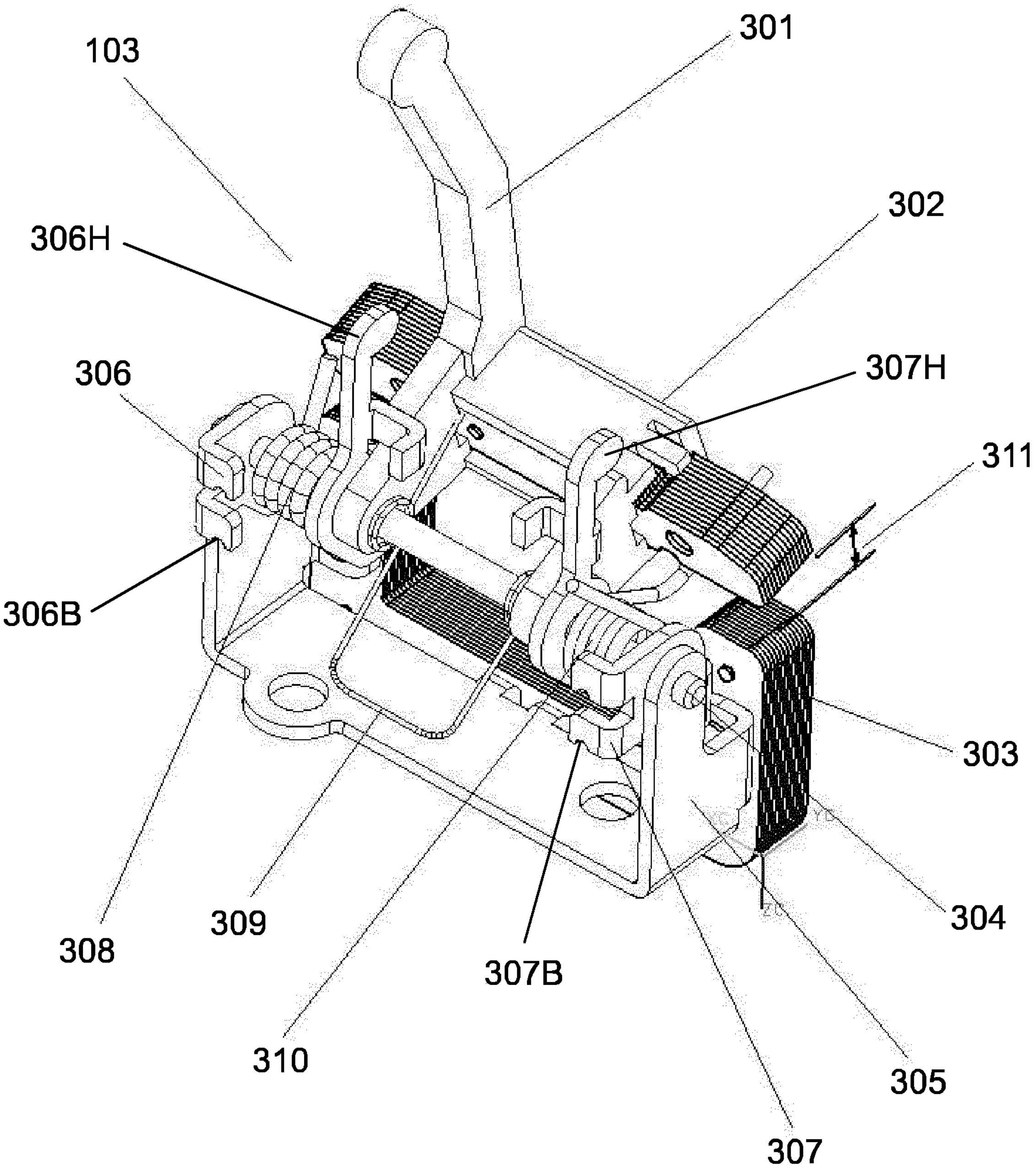
103
301
302
306H
306
307H
311
306B
303
308
309
307B
304
310
305
307

FIG 3A

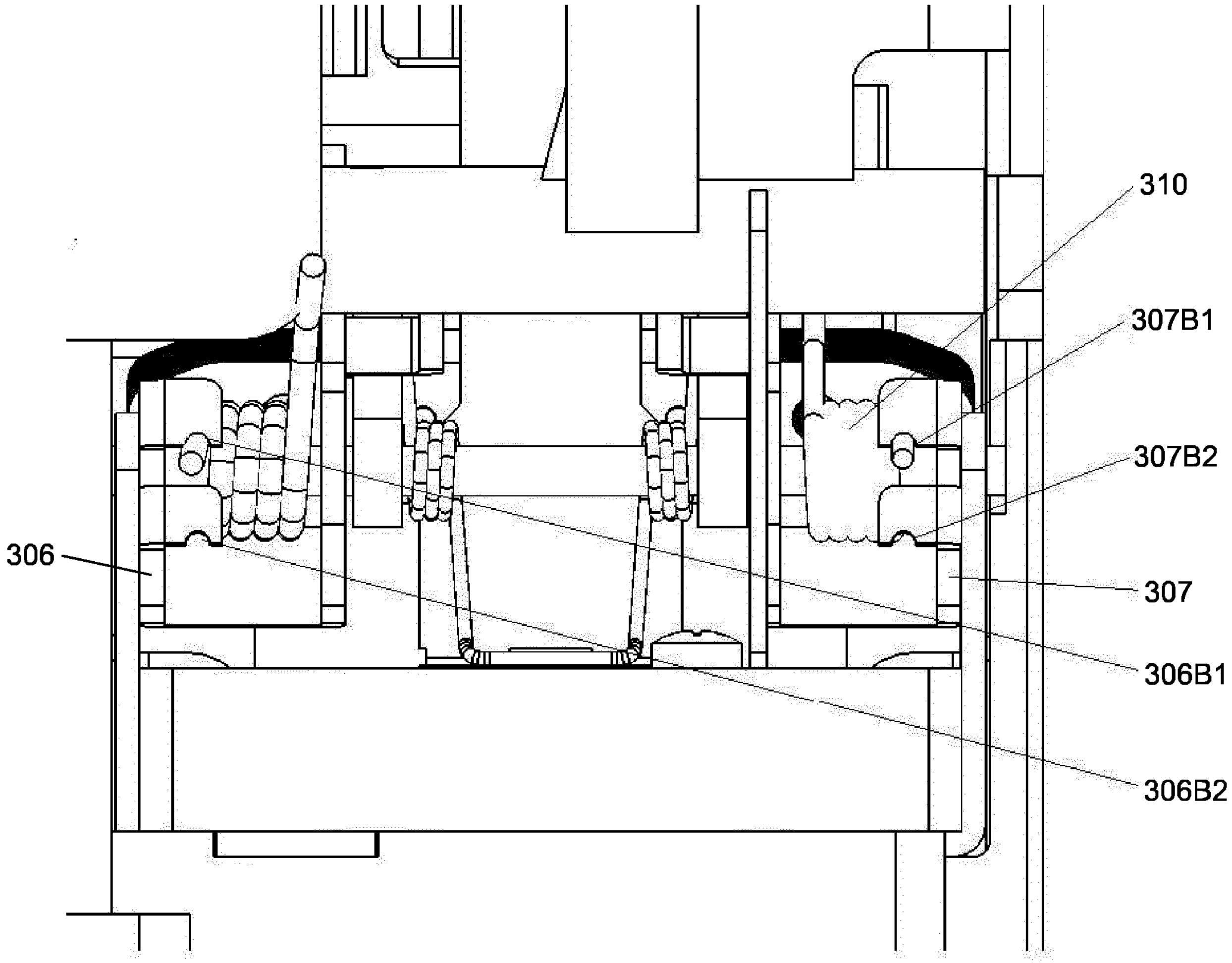

FIG 3B

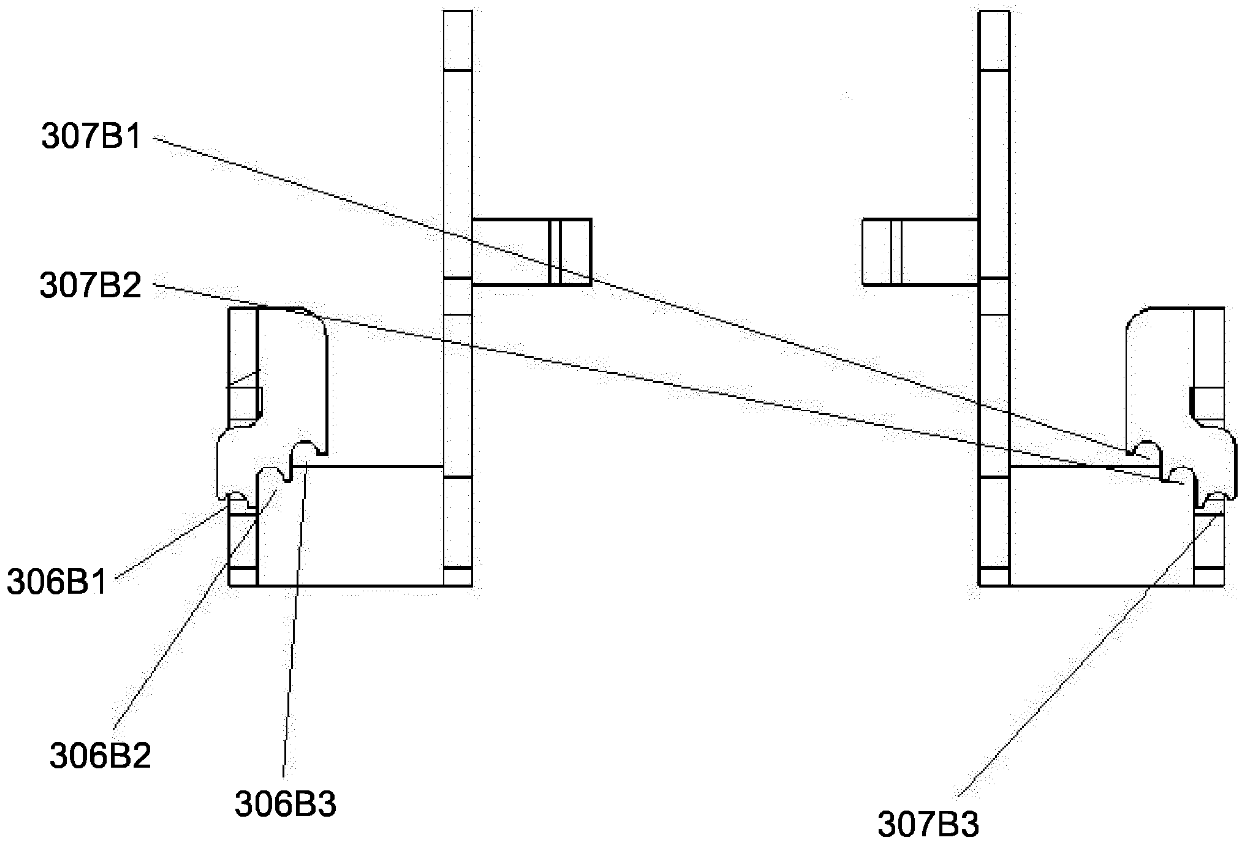

FIG 3C

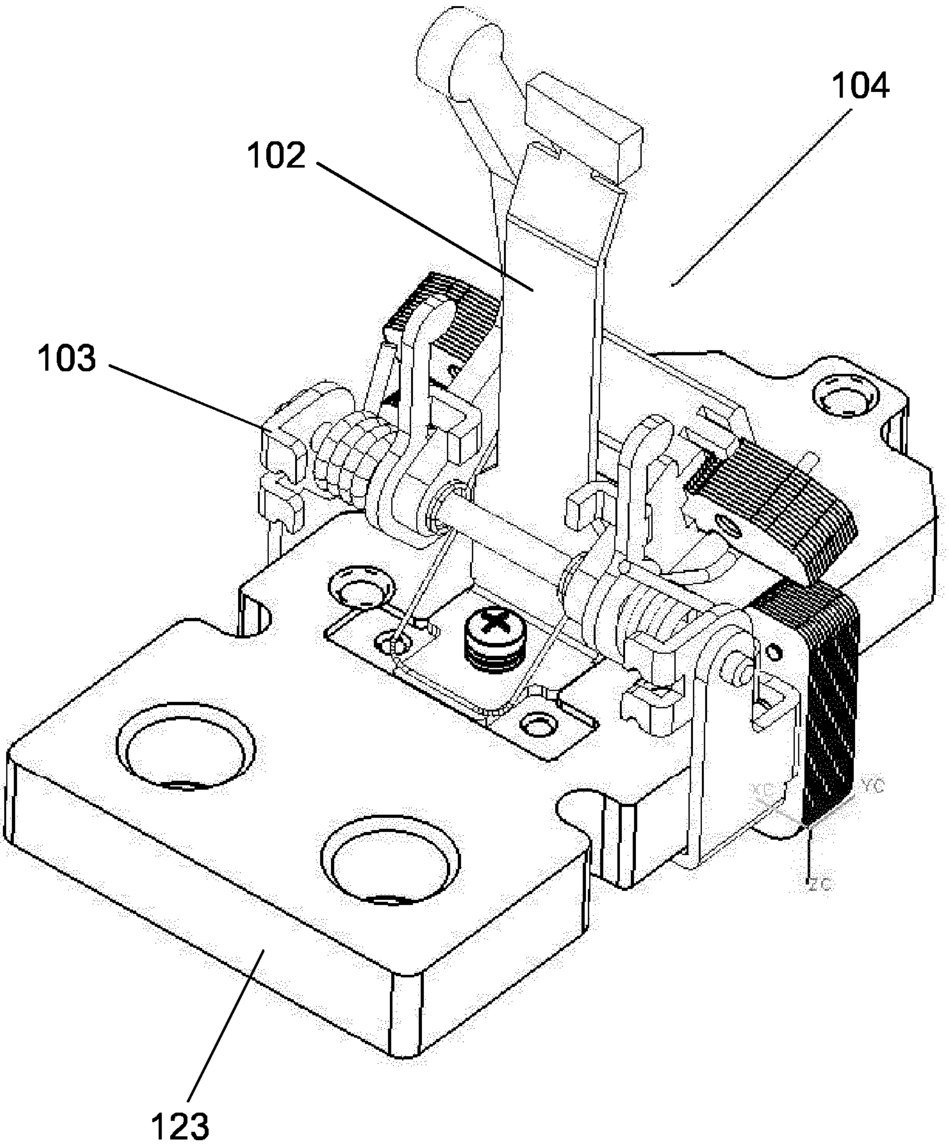

FIG 4

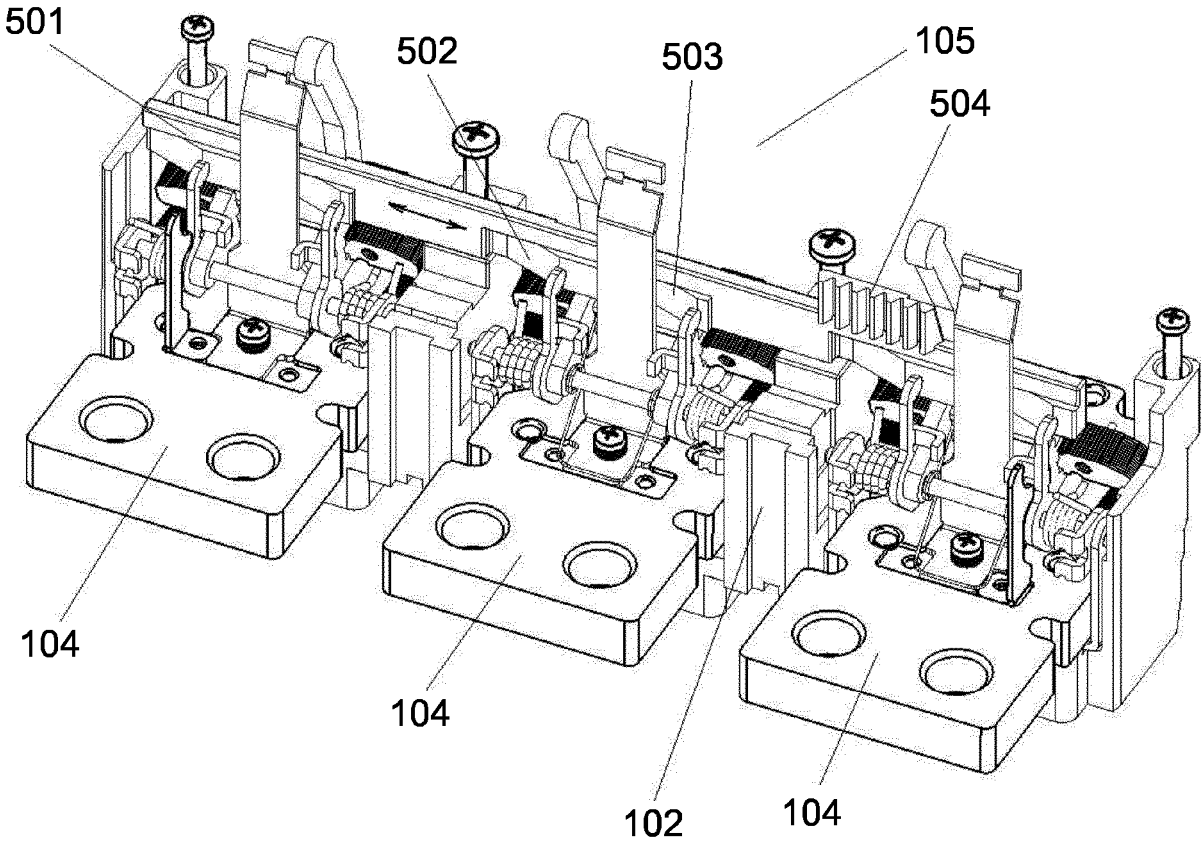

FIG 5

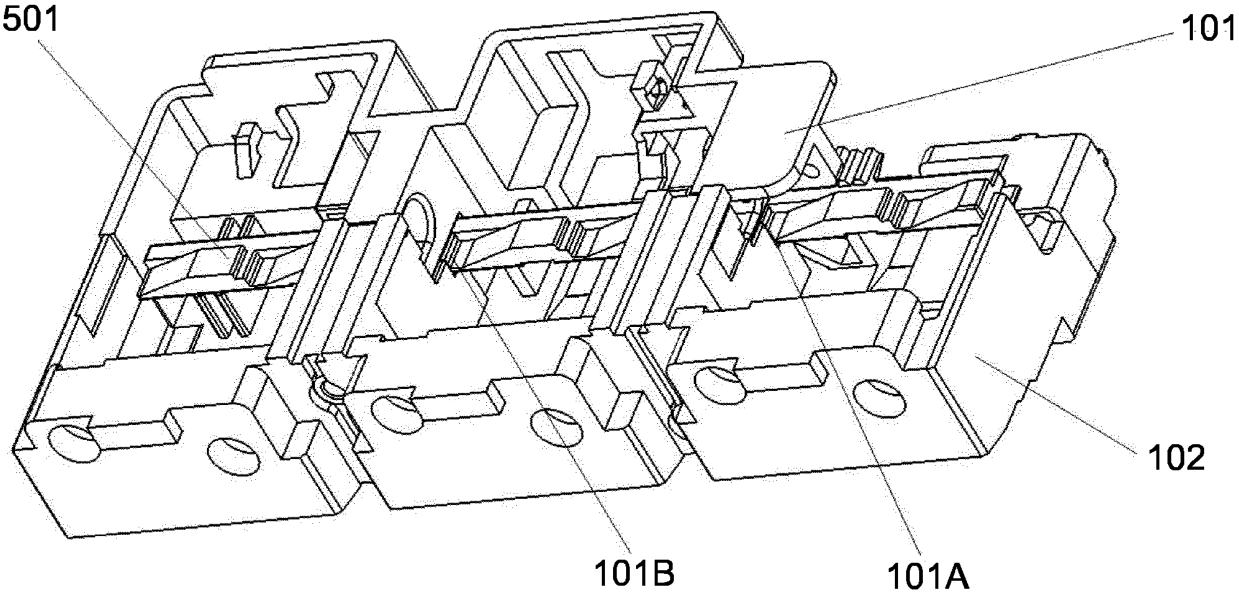

FIG 6

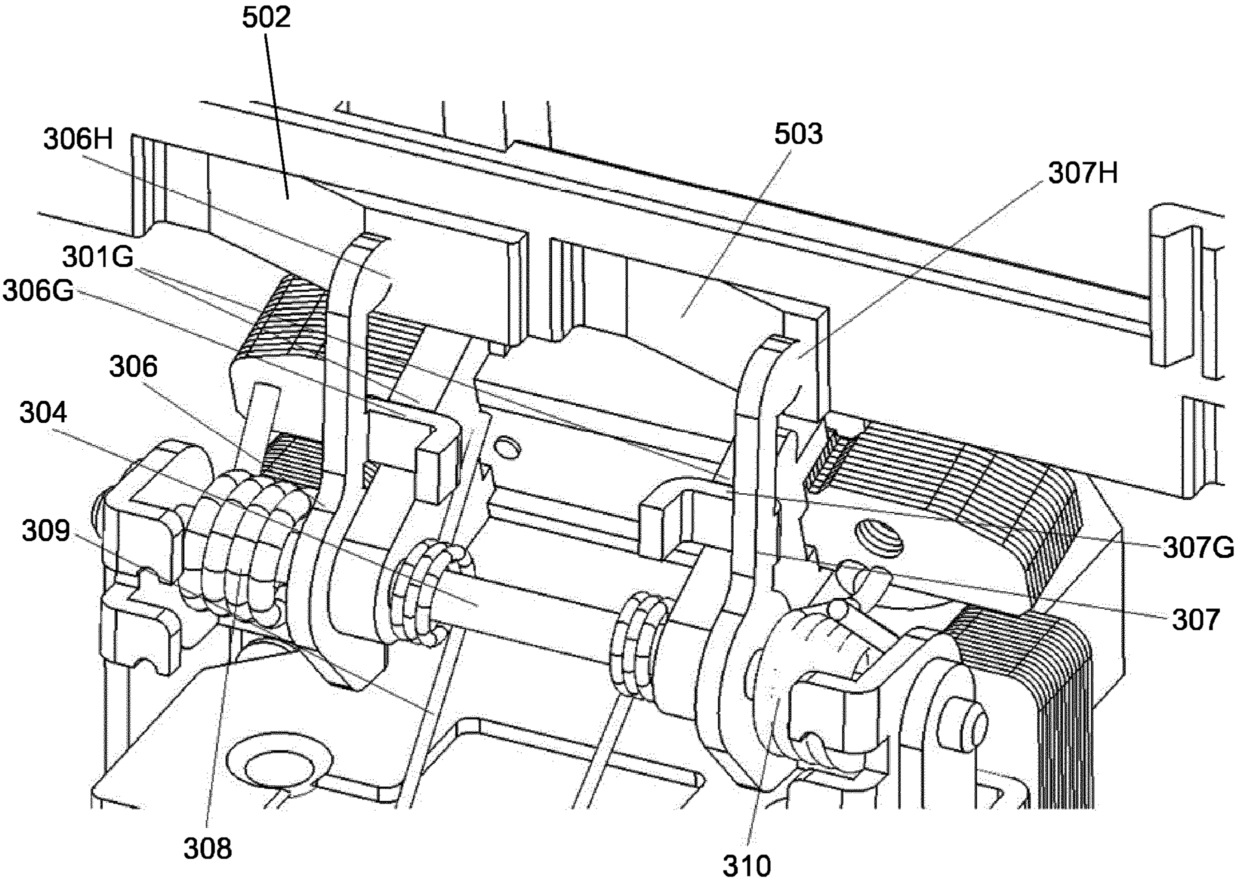

FIG 7

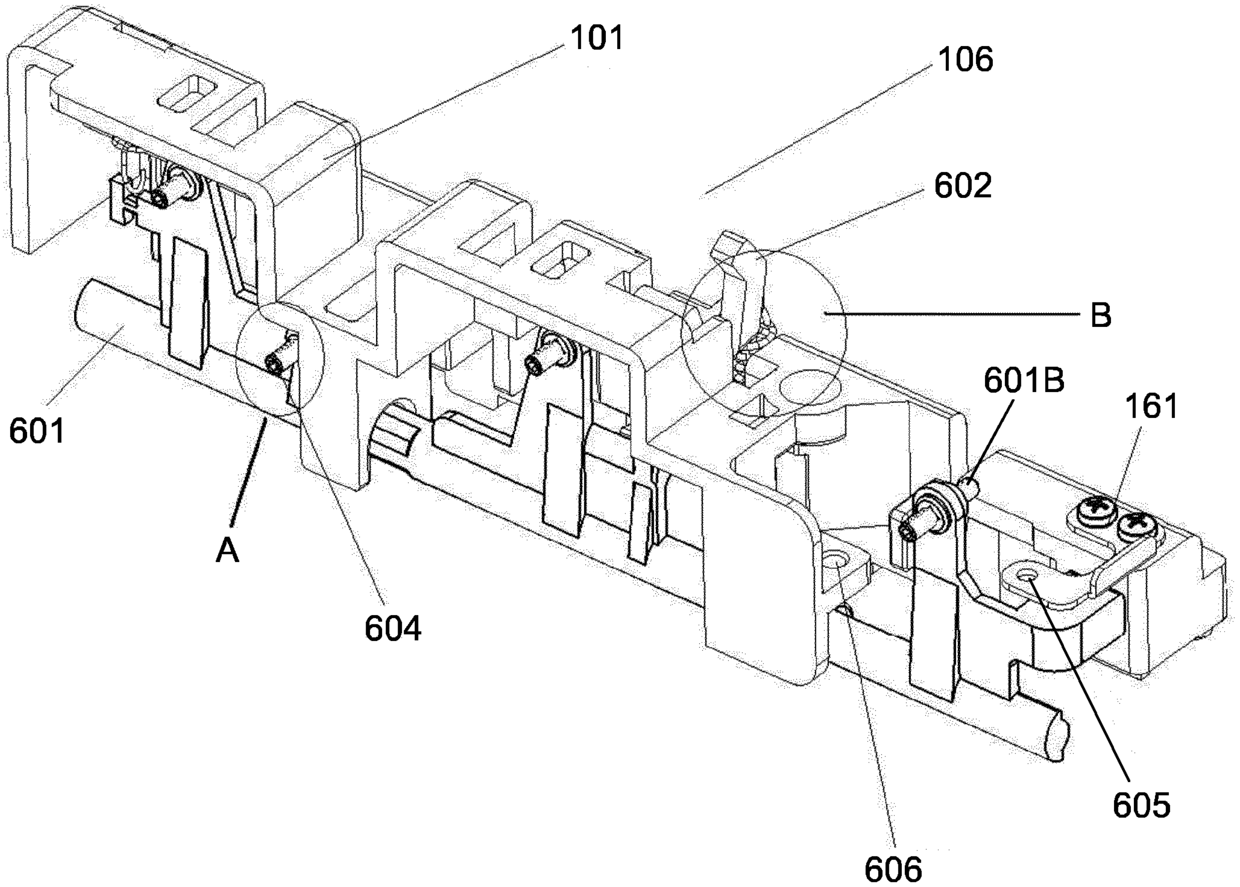

FIG 8A

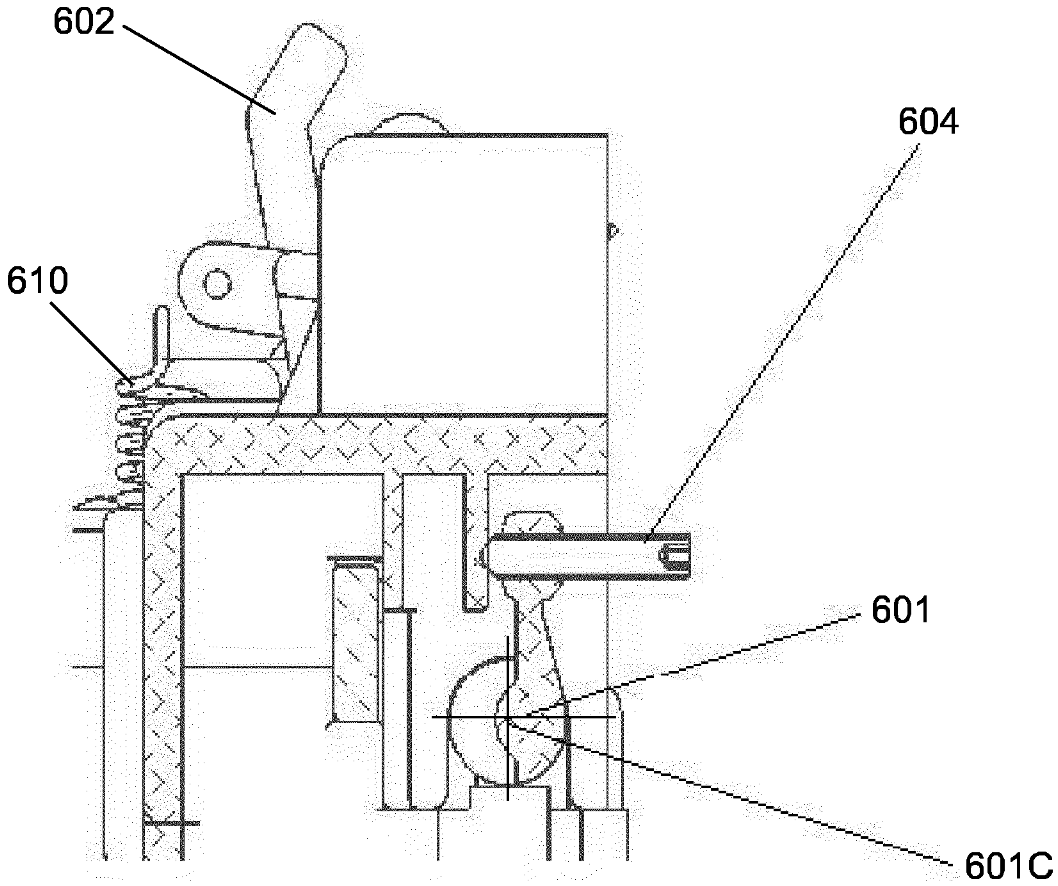

FIG 8B

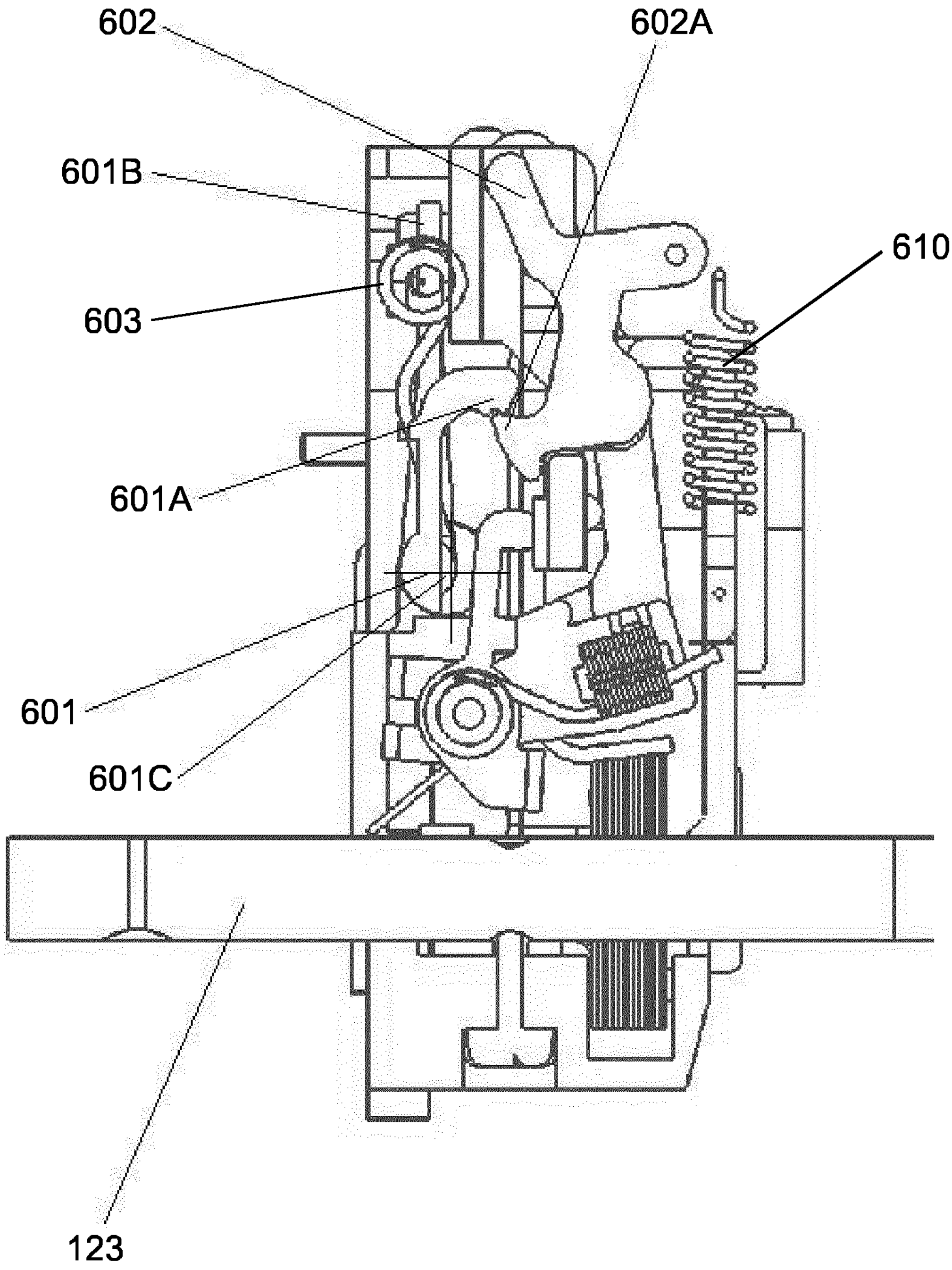

FIG 8C

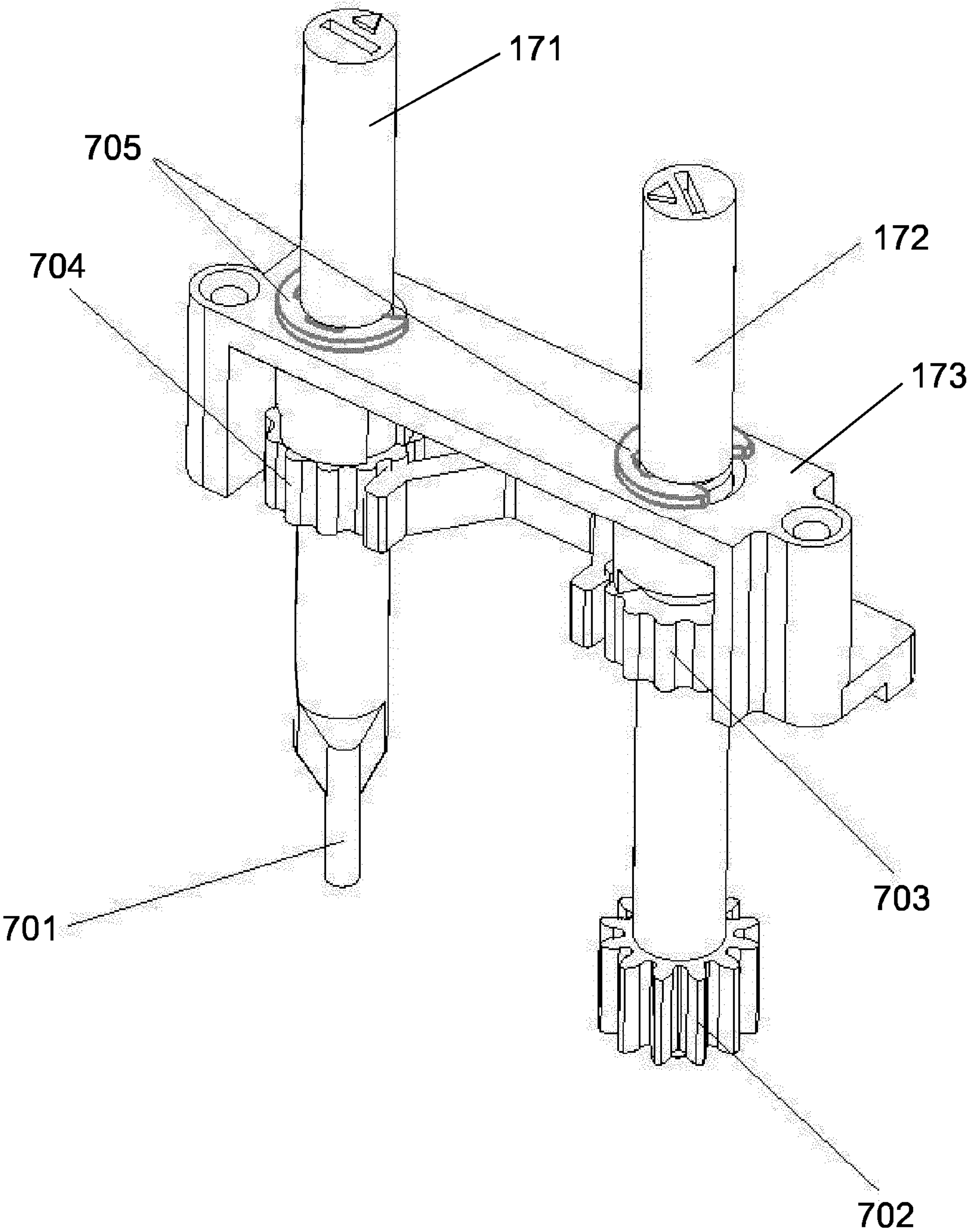

FIG 9A

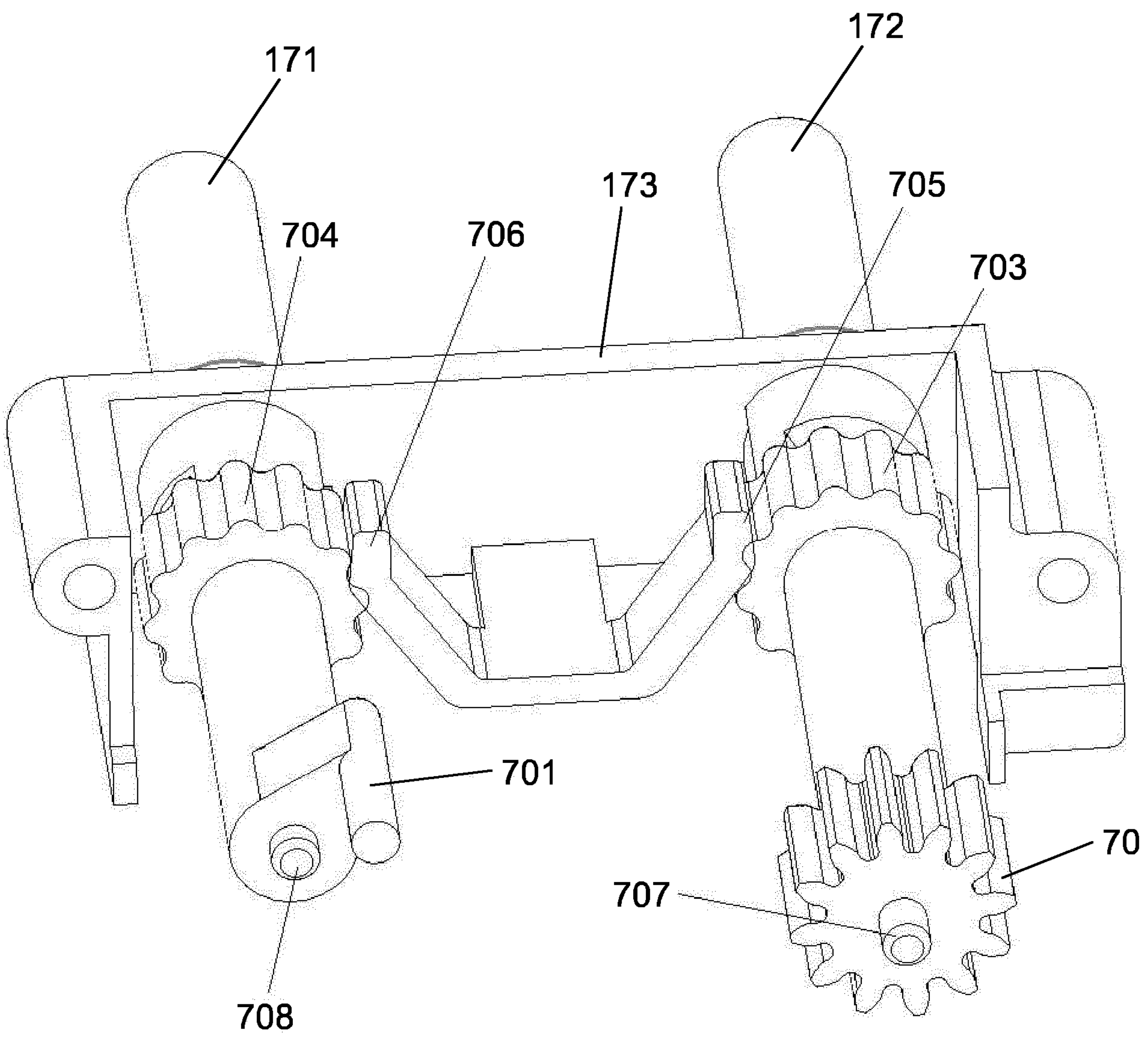

FIG 9B

FIG 10B

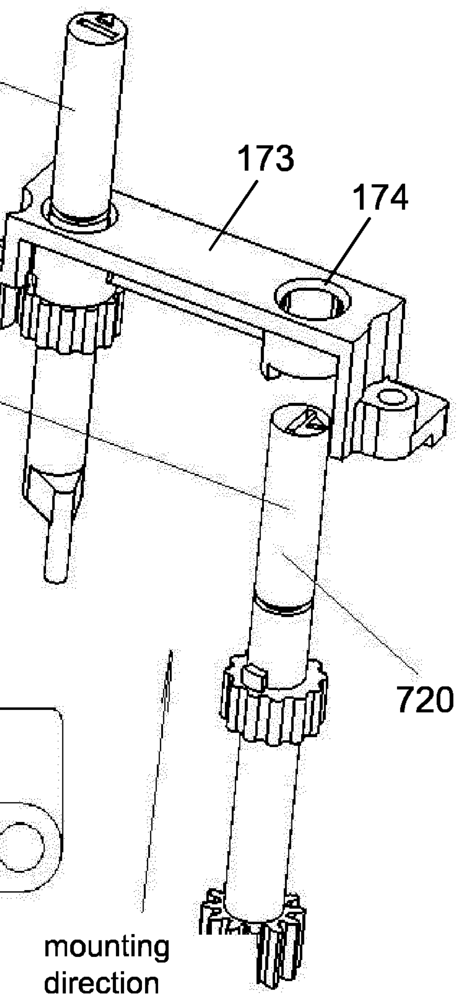

FIG 10A

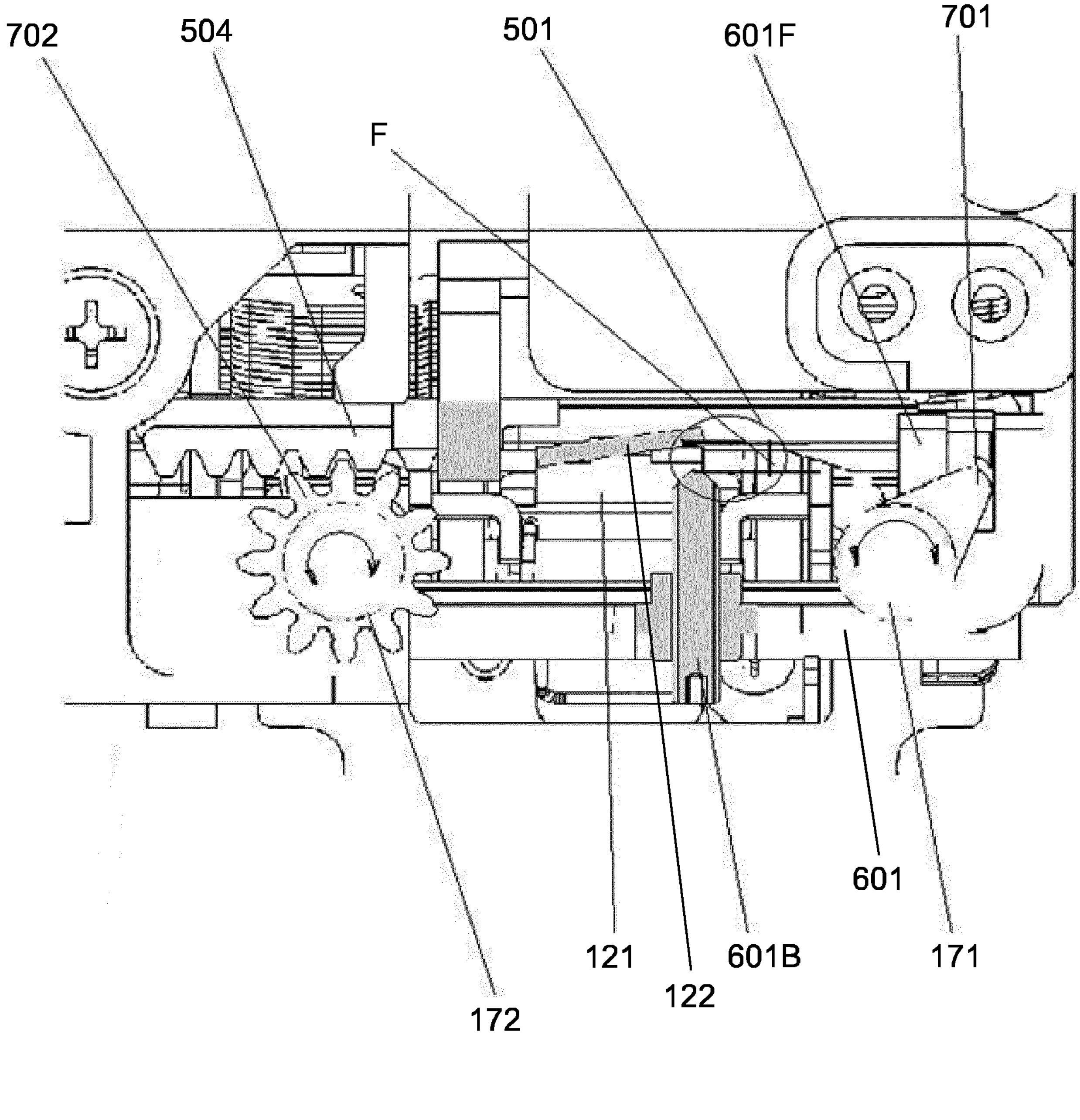

FIG 11A

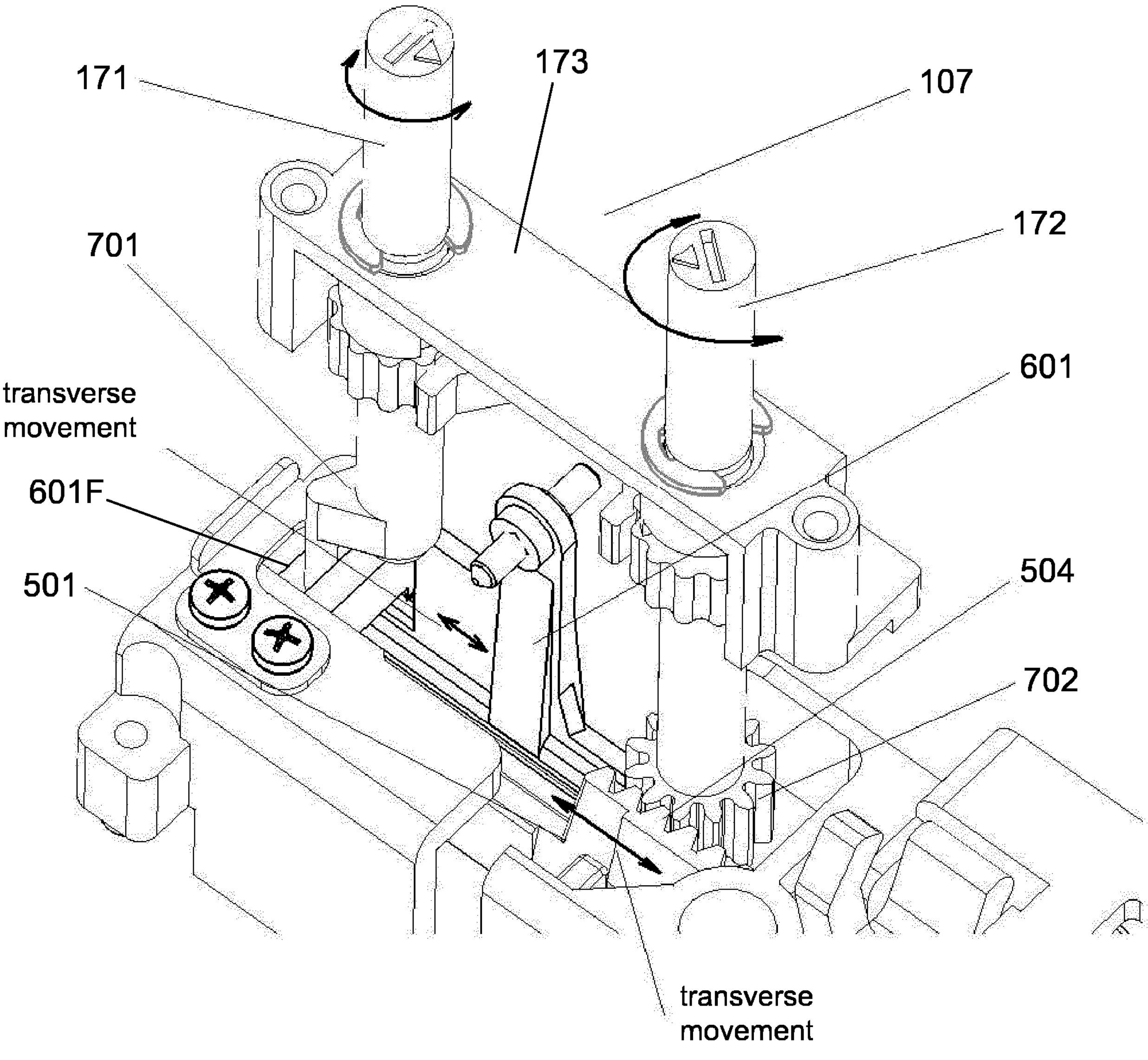
171
173
107
172
701
601
transverse movement
601F
501
504
702
transverse movement

FIG 11B

INTERNATIONAL SEARCH REPORT	International application No. PCT/CN2016/079969

A. CLASSIFICATION OF SUBJECT MATTER

H01H 71/10 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: 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)

WPI EPODOC VEN CNABS CNTXT: breaker, thermal, magnetic, protection, overload, current, short, current, adjust, change, bimetal, distance

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201594512 U (JUBANG ELECTRIC CO., LTD.) 29 September 2010 (29.09.2010) description, page 2 to page 4	1-3, 10-13, 15
A	CN 202084494 U (ZHEJIANG GACIA ELECTRICAL APPLIANCES CO.) 21 December 2011 (21.12.2011) the whole document	1-20
A	US 6407653 B1 (EATON CORPORATION) 18 June 2002 (18.06.2002) the whole document	1-20
A	US 6255925B1 (SIEMENS ENERGY & AUTOMATION INC.) 03 July 2001 (03.07.2001) the whole document	1-20

☐ 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
29 June 2016	22 July 2016
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer WANG, Xiaoyan Telephone No. (86-10) 62411731

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/079969

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 201594512 U	29 September 2010	None	
CN 202084494 U	21 December 2011	None	
US 6407653 B1	18 June 2002	None	
US 6255925 B1	03 July 2001	None	

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