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(54) ADJUSTABLE THERMAL TRIPPING DEVICE FOR MINIATURE CIRCUIT BREAKER

VERSTELLBARER THERMISCHER AUSLÖSUNGSMECHANISMUS FÜR
MINIATURSCHUTZSCHALTER

DISPOSITIF DE DÉCLENCHEMENT THERMIQUE RÉGLABLE POUR DISJONCTEUR MINIATURE

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(56) References cited:
CN-A- 101 364 507 CN-A- 104 465 247
CN-U- 201 594 512 CN-U- 203 491 203
CN-U- 203 826 317 CN-U- 204 303 720
CN-Y- 2 563 744 DE-A1- 10 058 068
FR-A1- 2 923 938 JP-B2- 3 794 450
US-A- 4 763 096 US-B2- 6 980 071

EP 3 242 313 B1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to the field of low-voltage electrical apparatus, more particularly, relates to a tripping device in a circuit breaker.

2. The Related Art

[0002] A circuit breaker is a main protection switch in a low-voltage power distribution network. The circuit breaker provides overload and short circuit protection for the circuit. In order to broaden the application range of the circuit breaker, it requires that a setting current of the circuit breaker shall be adjustable according to a scale of the overload current or a protection characteristic of an electric equipment. Particularly, when providing protection to an electric motor, a certain current adjusting range shall be provided in order to adapt for electric motors with different powers. The setting current shall be selected to be a value at a middle region of a rated current value of the electric motor.

[0003] In prior art, an adjustable thermal tripping device for a molded case circuit breaker is provided, however, a molded case circuit breaker is mainly applied to a large-capacity product. With the continuous development and application of household electric appliances and small-capacity products, and the assembly requirements of modularized products, the molded case circuit breaker cannot meet the requirements. In addition, although electronic tripping systems which are mostly applied has a high action precision, the requirements for the components therein are very high. It is not good in electromagnetic compatibility, and is difficult to be arranged within a limited space of a modularized product. Then it is difficult to achieve modularization and miniaturization of the circuit breaker. Further, a manufacturing cost of an electronic tripping system is high. Therefore, the application range of a circuit breaker is limited.

[0004] The Chinese application with an application number CN98115470.0 discloses a single-phase circuit breaker. The single-phase circuit breaker comprises a switch mechanism which can be enabled by an overload tripping element. The single-phase circuit breaker can be connected with other single-phase circuit breakers, when one of the circuit breakers is overloaded, all poles of all circuit breakers are disconnected. The single-phase circuit breaker can further be provided with a current range setting device consisting of an operation element and a current dial connected with the operation element. A wedge-shaped adjusting piece is arranged between the overload tripping element and a support, the support acts on the switch mechanism. The wedge-shaped adjusting piece is firmly connected with a middle guide piece through an elastic flexible spring. The middle guide piece

is arranged on a shell of the circuit breaker and can move along an action direction of the overload tripping element. According to this scheme, displacement amounts required by a bimetallic element under different working currents are compensated by the wedge-shaped adjusting piece, and an effective action force of the wedge-shaped surface acted on the overload tripping element will be reduced due to the existence of an inclined surface. The scheme uses a spring piece to drive a position of the wedge-shaped surface. The spring piece is a flexible element and is not able to accurately control a stroke of the wedge-shaped adjusting piece, so that a relatively large error exists. Each time it is rotated to a same scale, the wedge-shaped adjusting piece is at a same position, so that the tripping characteristic of the product is dramatically degraded.

[0005] The Chinese application with an application number CN03137174.4 discloses an adjustable thermal tripping assembly for a circuit breaker. When a bimetallic strip in the thermal tripping assembly actuates a tripping mechanism, a current/time characteristic value of the circuit breaker is adjusted by an adjustable adaptor comprising a first pivot element and a second pivot element that can respectively rotate about a common pivot axis. A bending of the bimetallic strip caused by an over-current causes a rotation of the first pivot element. The first pivot element is connected to a second pivot element which rotates for actuating the tripping mechanism through an engagement element extending parallel to the common pivot axis. A positioner makes the engagement element move toward or away from a common pivot axis so as to adjust a bending amount of the bimetallic strip required to actuate the tripping mechanism. According to the scheme, the adjusting device is complex in structure and various in spares, the manufacturing difficulty is greatly increased. The adjusting precision and reliability of the adjusting mechanism is influenced due to the cooperation of multiple spares. DE-A-10058068 discloses another example of adjusting mechanism of the prior art.

SUMMARY

[0006] The present invention provides a thermal adjustable tripping device which is simple in structure, small in size and suitable for a miniature circuit breaker.

[0007] According to an embodiment of the present invention, a thermal adjustable tripping device of a miniature circuit breaker is provided. The thermal adjustable tripping device is mounted in a base of a miniature circuit breaker. The thermal adjustable tripping device comprises: a tripping mechanism, a thermal deformation element and an adjusting mechanism. The tripping mechanism is provided with an extending tripping rod. The thermal deformation element is arranged close to the tripping rod and a gap is reserved between the thermal deformation element and the tripping rod. The adjusting mechanism forms a rigid element in contact with an inclined surface

for adjusting a length of the gap between the tripping rod and the thermal deformation element. A current in a loop accessed by the miniature circuit breaker enables the thermal deformation element to generate heat and deform, the deformed thermal deformation element moves towards the tripping rod, contacts with the tripping rod and pushes the tripping rod to trigger the tripping mechanism to trip. The adjusting mechanism adjusts the length of the gap between the thermal deformation element and the tripping rod to adjust a setting current in the loop.

[0008] According to an embodiment, the adjusting mechanism comprises a pushing rod, a first end of the pushing rod is in contact with the tripping rod, a second end of the pushing rod is in contact with the inclined surface. Adjusting a position where the second end of the pushing rod contacts with the inclined surface, a position of the tripping rod is adjusted accordingly by the first end of the pushing rod, so that the length of the gap between the thermal deformation element and the tripping rod is adjusted.

[0009] According to an embodiment, the adjusting mechanism comprises: an adjusting knob, a linkage piece, a pushing rod and a spring. The adjusting knob is rotatable. The linkage piece is linked with the adjusting knob, when the adjusting knob rotates, the linkage piece moves along a radial direction of the adjusting knob, the inclined surface is provided on the linkage piece and the inclined surface has different axial thicknesses along the radial direction. The pushing rod is arranged axially, a first protrusion is formed on a first end of the pushing rod, and the first protrusion contacts with the tripping rod, a second protrusion is formed on a second end of the pushing rod, and the second protrusion contacts with the inclined surface. One end of the spring is fixed on the base, and the other end of the spring is fixed on the pushing rod, the spring presses the second protrusion of the pushing rod on the inclined surface.

[0010] According to an embodiment, the adjusting knob comprises: an outer cylinder, an inner cylinder, a linkage post and a limiting piece. An outer surface of the outer cylinder is provided with an arrow groove. The inner cylinder is located on an inner side of the outer cylinder, a diameter of the inner cylinder is smaller than a diameter of the outer cylinder, the inner cylinder and the outer cylinder are concentric. The linkage post is located on an inner side of the inner cylinder, the linkage post is close to an edge of the inner cylinder, the linkage post and the inner cylinder are not concentric. The limiting piece is located on an end of the linkage post, a diameter of the limiting piece is larger than a diameter of the linkage post.

[0011] According to an embodiment, an outer side of the linkage piece is a plane, an inner side of the linkage piece forms the inclined surface. A linkage groove is provided on the linkage piece and the linkage post is located in the linkage groove. The adjusting knob rotates and the linkage post drives the linkage piece to move radially. The limiting piece limits an axial relative displacement of the adjusting knob and the linkage piece.

[0012] According to an embodiment, a circular hole is provided on the base and the adjusting knob is mounted in the circular hole. A first groove is provided on the base and is close to the circular hole, the first groove is radial, the linkage piece slides in the first groove. A second groove is provided on the base at one end of the first groove, the second groove is axial, the pushing rod slides in the second groove.

[0013] According to an embodiment, the circular hole and the inner cylinder form an interference fit.

[0014] According to an embodiment, the tripping rod is U-shaped, a first arm of the tripping rod is connected with the tripping mechanism, the U-shaped vertex of the tripping rod is in contact with the second protrusion of the pushing rod, a gap is reserved between a second arm of the tripping rod and the thermal deformation element.

[0015] According to an embodiment, the thermal deformation element is a bimetallic strip, a current enables the bimetallic strip to generate heat and deform, one end of the bimetallic strip moves towards the second arm of the tripping rod, contacts with the second arm of the tripping rod and pushes the second arm of the tripping rod, and the first arm of the tripping rod triggers the tripping mechanism to trip.

[0016] According to an embodiment, the miniature circuit breaker is used for an electric motor.

[0017] The thermal adjustable tripping device of a miniature circuit breaker of the present invention uses a rigid element to adjust a distance between a thermal deformation element and a tripping rod, which can ensure that the distance between the thermal deformation element and the tripping rod is constant in each operation. Therefore, a stability of a tripping characteristic is ensured, a heating bending stroke and an action force of the thermal deformation element is increased. The thermal adjustable tripping device is simple in structure, low in manufacturing cost and small in volume. A miniature circuit breaker adopting the thermal adjustable tripping device of the present invention is suitable for an electric motor, in particular for a small-power electric motor for a household electrical appliance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] 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 an adjusting mechanism in a thermal adjustable tripping device according to an embodiment of the present invention.

FIG. 2A and 2B illustrate structural diagrams of an adjusting knob in a thermal adjustable tripping device according to an embodiment of the present inven-

tion.

FIG. 3 illustrates a structural diagram of a linkage piece in a thermal adjustable tripping device according to an embodiment of the present invention.

FIG. 4 illustrates a structural diagram of a pushing rod in a thermal adjustable tripping device according to an embodiment of the present invention.

FIG. 5 illustrates a structural diagram of a partial area of a base in a thermal adjustable tripping device according to an embodiment of the present invention.

FIG. 6 illustrates a working principle of a thermal adjustable tripping device according to an embodiment of the present invention, wherein a setting current is a large current.

FIG. 7 illustrates a working principle of a thermal adjustable tripping device according to an embodiment of the present invention, wherein a setting current is a small current.

FIG. 8 illustrates an appearance structural diagram of a thermal adjustable tripping device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0019] Basically, a thermal adjustable tripping device according to the present invention is designed to use a rigid element to adjust a gap between a tripping rod and a thermal deformation element, so as to adjust a setting current. The characteristic of the rigid element ensures that the distance between the tripping rod and the thermal deformation element be fixed after each adjustment, so that stability of the tripping characteristic can be improved.

[0020] According to an embodiment of the present invention, a thermal adjustable tripping device of a miniature circuit breaker is provided. The thermal adjustable tripping device is mounted in a base of a miniature circuit breaker. The thermal adjustable tripping device comprises: a base, a tripping mechanism, a thermal deformation element and an adjusting mechanism. The tripping mechanism is provided with an extending tripping rod. The thermal deformation element is arranged close to the tripping rod and a gap is reserved between the thermal deformation element and the tripping rod. The adjusting mechanism is used for adjusting a length of the gap between the tripping rod and the thermal deformation element. The adjusting mechanism forms a rigid element. A current in a loop accessed by the miniature circuit breaker enables the thermal deformation element to generate heat and deform, the deformed thermal deformation element moves towards the tripping rod, contacts with the tripping rod and pushes the tripping rod to trigger

the tripping mechanism to trip. The adjusting mechanism adjusts the distance between the thermal deformation element and the tripping rod to adjust a setting current in the loop.

[0021] According to the invention, the adjusting mechanism uses an inclined surface to realize adjustment of the distance. According to an embodiment, the adjusting mechanism comprises a pushing rod, a first end of the pushing rod is in contact with the tripping rod, a second end of the pushing rod is in contact with an inclined surface. Because the inclined surface is inclined, when adjusting a position where the second end of the pushing rod contacts with the inclined surface, the position of the pushing rod is adjusted and a position of the tripping rod is adjusted accordingly by the first end of the pushing rod, so that the distance between the thermal deformation element and the tripping rod is adjusted.

[0022] As shown in FIG. 1, FIG. 1 illustrates a structural diagram of an adjusting mechanism in a thermal adjustable tripping device according to an embodiment of the present invention. The adjusting mechanism comprises an adjusting knob 102, a linkage piece 103, a pushing rod 104 and a spring 105.

[0023] As shown in FIG. 2A and FIG. 2B, FIG. 2A and 2B illustrate structural diagrams of an adjusting knob in a thermal adjustable tripping device according to an embodiment of the present invention. The adjusting knob 102 is rotatable. The adjusting knob 102 comprises: an outer cylinder 122, an inner cylinder 123, a linkage post 124 and a limiting piece 125. An outer surface of the outer cylinder 122 is provided with an arrow groove 121. The inner cylinder 123 is located on an inner side of the outer cylinder 122. A diameter of the inner cylinder 123 is smaller than that of the outer cylinder 122. The inner cylinder 123 and the outer cylinder 122 are concentric. The linkage post 124 is located on an inner side of the inner cylinder 123, the linkage post 124 is close to an edge of the inner cylinder 123, the linkage post 124 and the inner cylinder are not concentric. The linkage post 124 and the inner cylinder 123 form an eccentric structure. The limiting piece 125 is located on an end of the linkage post 124, a diameter of the limiting piece 124 is larger than that of the linkage post 124. The adjusting knob 102 is mounted in a circular hole 112 provided on the base 101. The circular hole 112 is located on a front side wall of the base 101. The diameters of the circular hole 102 and the inner cylinder 123 make the circular hole and the inner cylinder form an interference fit. When mounted, the inner cylinder 123 is clamped in the circular hole 102, while the outer cylinder 122 is located outside the base 101. Because the circular hole and the inner cylinder are in interference fit, under a condition that no external force is driven, the adjusting knob 102 will not rotate by itself, so that the set parameters and the tripping performance can keep stable. The arrow groove 121 on the outer cylinder 122 has two functions. A first function is that a tool can insert into the arrow groove and rotate. When the tool is inserted into the arrow groove 121, the tool pro-

vides an external rotating force to rotate the adjusting knob 102. The other function of the arrow groove 121 is that the arrow can point to a specified numerical value, which indicates a specified setting current value. The specified setting current values can be engraved on a housing around the circular hole. The linkage post 124 and the limiting piece 125 are mainly used for cooperation with the linkage piece 103, which will be described in detail below accompanying with the linkage piece.

[0024] FIG. 3 illustrates a structural diagram of a linkage piece in a thermal adjustable tripping device according to an embodiment of the present invention. The linkage piece 103 is linked with the adjusting knob 102. When the adjusting knob 102 rotates, the linkage piece moves along a radial direction of the adjusting knob. The inclined surface is provided on the linkage piece 103 and the inclined surface has different axial thicknesses along the radial direction. For convenience of description, the adjusting knob is used as a reference to define two directions. One is a radial direction of the adjusting knob, namely the direction parallel to the cylindrical surface of each cylinder of the adjusting knob. The other is the axial direction of the adjusting knob, that is, the direction parallel to the axis of the cylinder of the adjusting knob. The "radial direction" in this specification refers to the radial direction of the adjusting knob, and the "axial" direction of the adjusting knob refers to the axial direction of the adjusting knob. As shown in FIG. 3, an outer side (the back side shown in FIG. 3) of the linkage piece 103 is a plane, an inner side (the front side shown in FIG. 3) of the linkage piece 103 forms the inclined surface 131. The inclined surface 131 has different axial thicknesses along the radial direction. It should be noted that the inclined surface 131 is a working inclined surface, while the inclined surface 133 is only designed for matching with the shape of the inclined surface 131. The inclined surface 133 does not have any practical significance. In different embodiment, the inclined surfaces 133 may have different sizes, or even no inclined surface 133 is provided. A linkage groove 132 is provided on the linkage piece 103. The linkage post 124 of the adjusting knob 102 is located in the linkage groove 132. Since the linkage post 124 is eccentric relative to the center of the adjusting knob 102, when the adjusting knob rotates, the linkage post 124 will generate a radial displacement and drives the linkage piece 103 to move radially. The function of the linkage post 124 is in linkage with the linkage piece 103, so it is not necessary that the linkage post 124 must be cylindrical as shown in the drawings. Making the linkage post 124 to be cylindrical is a good choice because the linkage post 124 will also generate a relative rotation in the linkage groove 132 of the linkage piece 103 during the displacement process, however, it is not a must. A diameter of the linkage post 124 is matched with a diameter of the linkage groove 132. The limiting piece 125 is used for limiting an axial relative displacement of the adjusting knob 102 and the linkage piece 103, so that a diameter of the limiting piece 125 is larger than the diameter of the

linkage post, and also larger than the diameter of the linkage groove 132. It should be noted that the "diameter" used herein has a broad meaning. It refers to a radial dimension, even an irregular shape shall have a measurable radial dimension. Although the illustrated limiting piece 125 is also cylindrical, this is not a must.

[0025] FIG. 4 illustrates a structural diagram of a pushing rod in a thermal adjustable tripping device according to an embodiment of the present invention. As shown in FIG. 1 and FIG. 4, the pushing rod 104 is arranged axially. A second protrusion 142 is formed on a second end of the pushing rod 104, and the second protrusion 142 contacts with the inclined surface 131. A first protrusion 141 is formed on a first end of the pushing rod 104, and the first protrusion 141 contacts with the tripping rod. As shown in the drawings, the second protrusion 142 and the first protrusion 141 are not in a same line with the body of the pushing rod 104, a certain radial deviation exists. Such a design is associated with the mounting position of the pushing rod 104 in the base 101, which will be described in detail below. The first end of the pushing rod 104 is further provided with an end surface 143, which is used for mounting the spring 105.

[0026] One end of the spring 105 is fixed on the base 101, and the other end of the spring 105 is fixed on the pushing rod 104. According to the illustrated embodiment, the other end of the spring 105 is fixed on the end surface 143. The spring 105 presses the second protrusion 142 of the pushing rod 104 against the inclined surface 131. Due to the existence of the spring 105, the second protrusion 142 of the pushing rod 104 is always meshed with the inclined surface 131.

[0027] Referring to FIG. 5, FIG. 5 illustrates a structural diagram of a partial area of a base in a thermal adjustable tripping device according to an embodiment of the present invention. As shown in FIG. 5, a circular hole 112 is provided on the base 101 and the circular hole is on a front side wall of the base 101. A diameter of the circular hole 112 and that of the inner cylinder 123 make the circular hole 112 and the inner cylinder 123 form an interference fit. The adjusting knob 102 is mounted in the circular hole 112. A first groove 114 is provided on the base 101 and is close to the circular hole 112, the first groove is radial. The linkage piece 103 is mounted in the first groove 114 and slides therein. A second groove 111 is provided on the base 101 at one end of the first groove 114, the second groove 111 is axial. The pushing rod 104 is mounted in the second groove 111 and slides therein. According to the embodiment shown in FIG. 5, a spring groove 113 is also provided in a tail section of the second groove 111. The spring groove 113 is used for accommodating the spring 105. Two ends of the spring 105 are fixed on the end surface 143 of the pushing rod 104 and a wall of the spring groove 113 respectively.

[0028] FIG. 6 and FIG. 7 illustrate a working principle of a thermal adjustable tripping device according to an embodiment of the present invention. FIG. 6 and FIG. 7 correspond to different setting currents, FIG. 6 corre-

sponds to a large setting current while FIG. 7 corresponds to a small setting current.

[0029] As shown in FIG. 6 and FIG. 7, the adjusting knob 102, the linkage piece 103, the pushing rod 104 and the spring 105 are mounted in the circular hole, the first groove, the second groove and the spring groove on the base 101 respectively. The linkage piece 103 can move radially and the pushing rod 104 can move axially. The tripping mechanism 106 is located on a side of the adjusting mechanism. A tripping rod 161 of the tripping mechanism 106 extends to a tail end in axial direction of the adjusting mechanism. The tripping rod 161 is U-shaped or is similar to a U shape. A first arm of the tripping rod 161 is connected with the tripping mechanism 106. The U-shaped vertex of the tripping rod is in contact with the first protrusion 141 of the pushing rod 104. A gap is reserved between the second arm of the tripping rod 161 and the thermal deformation element 107. The thermal deformation element 107 is located within the base 101. In one embodiment, the thermal deformation element 107 is a bimetallic strip. A current in a loop accessed by the miniature circuit breaker enables the bimetallic strip to generate heat and deform. One end of the deformed bimetallic strip 107 moves towards the second arm of the tripping rod 161 and contacts with the second arm of the tripping rod 161. Because the U-shaped vertex of the tripping rod 161 is pressed by the first protrusion 141 of the pushing rod 104, when the bimetallic strip 107 continues to deform, one end of the bimetallic strip will continue to move and push the second arm of the tripping rod 161. And the tripping rod 161 will rotate by taking the U-shaped vertex as a supporting point. The first arm of the tripping rod 161 acts and triggers the tripping mechanism 106 to trip and cut off the circuit. After the circuit is cut off, the bimetallic strip is gradually cooled and restored to the original shape.

[0030] Continue with FIG. 6 and FIG. 7, when the adjusting knob 102 is rotated, due to the eccentric structure of the linkage post 124, the linkage post 124 will drive the linkage piece 103 to generate a radial displacement. Because the pushing rod 104 can only move axially and cannot move radially, and the second protrusion 142 of the pushing rod 104 is pressed on the inclined surface 131 by the spring 105, when the linkage piece 103 moves radially, the second protrusion 142 will contact with different positions of the inclined surface 131. The inclined surface 131 has different axial thicknesses in different positions, which is equivalent to an axial movement of the pushing rod 104. Because the pushing rod 104 is rigid, the first protrusion 141 at the first end of the pushing rod 104 also moves axially. The first protrusion 141 will push the U-shaped vertex of the tripping rod 161 to move axially, and accordingly, a distance between the second arm of the tripping rod 161 and one end of the bimetallic strip 107 is changed. As shown in the drawings, the pushing rod 104 is arranged close to a side wall of the base 101, and there is a radial deviation between the second protrusion 142 and the body of the pushing rod 104, so

that the second protrusion 142 can be in contact with an entire area of the inclined surface 131 to obtain a larger adjusting range. According to the illustrated embodiment, the first protrusion 141 also has a certain radial deviation with the body of the pushing rod 104. According to the embodiment shown in FIG. 6, the second protrusion 142 of the pushing rod 104 is in contact with a thin portion of the inclined surface 131, the distance between the second arm of the tripping rod 161 and one end of the bimetallic strip 107 is large, and a large setting current is correspondingly set. That is, a large current is required to make the bimetallic strip generate a large bending deformation, then the tripping mechanism will be tripped by the tripping rod. According to the embodiment shown in FIG. 7, the second protrusion 142 of the pushing rod 104 is in contact with the thickest portion of the inclined surface 131, and the distance between the second arm of the tripping rod 161 and one end of the bimetallic strip 107 is small, and a small setting current is correspondingly set. That is, it only requires a small current, then the bimetallic strip generates a small bending deformation and the tripping rod will trigger the tripping mechanism to trip.

[0031] FIG. 8 illustrates an appearance structural diagram of a thermal adjustable tripping device according to an embodiment of the present invention. When assembled, the adjusting knob 102 can be seen on a housing of the base 101, numerical values can be added to the periphery of the adjusting knob 102, and the numerical value represents the adjusting range of the setting current.

[0032] The thermal adjustable tripping device of a miniature circuit breaker of the present invention is suitable for an electric motor, in particular for a small-power electric motor for a household electrical appliance.

[0033] The thermal adjustable tripping device of a miniature circuit breaker of the present invention uses a rigid element to adjust a distance between a thermal deformation element and a tripping rod, which can ensure that the distance between the thermal deformation element and the tripping rod is constant in each operation. Therefore, a stability of a tripping characteristic is ensured, a heating bending stroke and an action force of the thermal deformation element is increased. The thermal adjustable tripping device is simple in structure, low in manufacturing cost and small in volume. A miniature circuit breaker adopting the thermal adjustable tripping device of the present invention is suitable for an electric motor, in particular for a small-power electric motor for a household electrical appliance.

Claims

1. A thermal adjustable tripping device of a miniature circuit breaker, wherein the thermal adjustable tripping device is mounted in a base (101) of a miniature circuit breaker, the thermal adjustable tripping de-

vice comprising:

a tripping mechanism (106) with an extending tripping rod (161);
 a thermal deformation element (107) arranged close to the tripping rod (161), a gap being reserved between the thermal deformation element and the tripping rod (161);
 wherein a current in a loop accessed by the miniature circuit breaker enables the thermal deformation element (107) to generate heat and deform, the deformed thermal deformation element (107) moves towards the tripping rod (161), contacts with the tripping rod (161) and pushes the tripping rod (161) to trigger the tripping mechanism (106) to trip, **characterised by** comprising:

an adjusting mechanism having a pushing rod (104) in contact with an inclined surface (131) for adjusting a length of the gap between the tripping rod (161) and the thermal deformation element (107),
 the adjusting mechanism adjusting the length of the gap to adjust a setting current in the loop.

2. The thermal adjustable tripping device of a miniature circuit breaker according to claim 1, wherein the adjusting mechanism comprises a pushing rod (104), a first end of the pushing rod (104) is in contact with the tripping rod (161), a second end of the pushing rod (104) is in contact with the inclined surface (131), adjusting a position where the second end of the pushing rod (104) contacts with the inclined surface (131), a position of the tripping rod (161) is adjusted accordingly by the first end of the pushing rod (104), so that the length of the gap between the thermal deformation element (107) and the tripping rod (161) is adjusted.

3. The thermal adjustable tripping device of a miniature circuit breaker according to claim 2, wherein the adjusting mechanism further comprises:

an adjusting knob (102) which is rotatable;
 a linkage piece (103) linked with the adjusting knob (102), when the adjusting knob (102) rotates, the linkage piece (103) moves along a radial direction of the adjusting knob (102), the inclined surface (131) is provided on the linkage piece (103) and the inclined surface (131) has different axial thicknesses along the radial direction; and
 a spring (105), one end of the spring (105) being fixed on the base (101), and the other end of the spring (105) being fixed on the pushing rod (104), the spring (105) presses the second pro-

trusion (142) of the pushing rod (104) on the inclined surface (131),

wherein the pushing rod (104) is arranged axially, a first protrusion (141) is formed on a first end of the pushing rod (104), and the first protrusion (141) contacts with the tripping rod (161), a second protrusion (142) is formed on a second end of the pushing rod (104), and the second protrusion (142) contacts with the inclined surface (131).

4. The thermal adjustable tripping device of a miniature circuit breaker according to claim 3, wherein the adjusting knob (102) comprises:

an outer cylinder (122), an outer surface of the outer cylinder (122) being provided with an arrow groove (121);

an inner cylinder (123) located on an inner side of the outer cylinder (122), a diameter of the inner cylinder (123) being smaller than a diameter of the outer cylinder (122), the inner cylinder (123) and the outer cylinder (122) being concentric;

a linkage post (124) located on an inner side of the inner cylinder (123), the linkage post (124) being close to an edge of the inner cylinder (123), the linkage post (124) and the inner cylinder (123) being not concentric;

a limiting piece (125) located on an end of the linkage post (124), a diameter of the limiting piece (125) being larger than a diameter of the linkage post (124).

5. The thermal adjustable tripping device of a miniature circuit breaker according to claim 4, wherein an outer side of the linkage piece (103) is a plane, an inner side of the linkage piece (103) forms the inclined surface (131), a linkage groove (132) is provided on the linkage piece (103) and the linkage post (124) is located in the linkage groove (132), the adjusting knob (102) rotates and the linkage post (124) drives the linkage piece (103) to move radially, the limiting piece (125) limits an axial relative displacement of the adjusting knob (102) and the linkage piece (103).

6. The thermal adjustable tripping device of a miniature circuit breaker according to claim 5, wherein a circular hole (112) is provided on the base (101) and the adjusting knob (102) is mounted in the circular hole (112);
 a first groove (114) is provided on the base (101) and is close to the circular hole (112), the first groove (114) is radial, and the linkage piece (103) slides in the first groove (114);
 a second groove (111) is provided on the base (101) at one end of the first groove (114), the second

groove (111) is axial, and the pushing rod (104) slides in the second groove.

7. The thermal adjustable tripping device of a miniature circuit breaker according to claim 6, wherein the circular hole (112) and the inner cylinder (123) form an interference fit. 5
8. The thermal adjustable tripping device of a miniature circuit breaker according to claim 6, wherein the tripping rod (161) is U-shaped, a first arm of the tripping rod (161) is connected with the tripping mechanism (106), the U-shaped vertex of the tripping rod (161) is in contact with the second protrusion (142) of the pushing rod (104), and a gap is reserved between a second arm of the tripping rod (161) and the thermal deformation element (107). 10 15
9. The thermal adjustable tripping device of a miniature circuit breaker according to claim 8, wherein the thermal deformation element (107) is a bimetallic strip, a current enables the bimetallic strip (107) to generate heat and deform, one end of the bimetallic strip moves towards the second arm of the tripping rod (161), contacts with the second arm of the tripping rod (161) and pushes the second arm of the tripping rod (161), and the first arm of the tripping rod (161) triggers the tripping mechanism (106) to trip. 20 25 30
10. The thermal adjustable tripping device of a miniature circuit breaker according to any of claims 1-9, wherein the miniature circuit breaker is used for an electric motor. 35

Patentansprüche

1. Thermische verstellbare Auslösungsvorrichtung für einen Miniatorschutzschalter, wobei die thermische verstellbare Auslösungsvorrichtung in einer Basis (101) eines Miniatorschutzschalters montiert ist, wobei die thermische verstellbare Auslösungsvorrichtung aufweist: 40 45

einen Auslösungsmechanismus (106) mit einem sich erstreckenden Auslösungsstift (161); ein Wärmeverformungselement (107), das nahe dem Auslösungsstift (161) angeordnet ist, wobei ein Spalt zwischen dem Wärmeverformungselement und dem Auslösungsstift (161) freibleibt; 50

wobei ein Strom in einer Schleife, auf die der Miniatorschutzschalter zugreift, ermöglicht, dass das Wärmeverformungselement (107) Wärme erzeugt und sich verformt, sich das verformte Wärmeverformungselement (107) in Richtung des Auslösungsstifts (161) bewegt, mit 55

dem Auslösungsstift (161) in Kontakt kommt und gegen den Auslösungsstift (161) drückt, um dem Auslösungsmechanismus (106) zum Auslösen zu triggern,

dadurch gekennzeichnet, dass sie aufweist:

einen Verstellmechanismus mit einem Drückstift (104) in Kontakt mit einer geneigten Fläche (131) zum Verstellen einer Länge des Spalts zwischen dem Auslösungsstift (161) und dem Wärmeverformungselement (107), wobei der Verstellmechanismus die Länge des Spalts zum Verstellen eines Einstellstroms in der Schleife verstellt.

2. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 1, bei der der Verstellmechanismus einen Drückstift (104) aufweist, ein erstes Ende des Drückstifts (104) mit dem Auslösungsstift (61) in Kontakt ist, ein zweites Ende des Drückstifts (104) mit der geneigten Fläche (131) in Kontakt ist, eine Position, in der das zweite Ende des Drückstifts (104) mit der geneigten Fläche (131) in Kontakt kommt, verstellt wird, eine Position des Auslösungsstifts (161) von dem ersten Ende des Drückstifts (104) entsprechend verstellt wird, so dass die Länge des Spalts zwischen dem Wärmeverformungselement (107) und dem Auslösungsstift (161) verstellt wird. 20 25 30 35
3. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 2, bei der der Verstellmechanismus ferner aufweist:

einen Verstellknopf (102), der drehbar ist; ein mit dem Verstellknopf (102) verbundenes Verbindungsstück (103), wobei wenn sich der Verstellknopf (102) dreht, bewegt sich das Verbindungsstück (103) in einer radialen Richtung des Verstellknopfs (102), wobei die geneigte Fläche (131) an dem Verbindungsstück (103) vorgesehen ist und hat die geneigte Fläche (131) in der radialen Richtung unterschiedliche axiale Dicken hat; und eine Feder (105), wobei ein Ende der Feder (105) auf der Basis (101) befestigt ist und das andere Ende der Feder (105) an dem Drückstift (104) befestigt ist, wobei die Feder (105) den zweiten Vorsprung (142) des Drückstifts (104) gegen die geneigte Fläche (131) drückt, wobei der Drückstift (104) axial angeordnet ist, ein erster Vorsprung (141) an einem ersten Ende des Drückstifts (104) ausgebildet ist und der erste Vorsprung (141) mit dem Auslösungsstift (161) in Kontakt kommt, ein zweiter Vorsprung (142) an einem zweiten Ende des Drückstifts

(104) ausgebildet ist und der zweite Vorsprung (142) mit der geneigten Fläche (131) in Kontakt kommt.

4. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 3, bei der der Verstellknopf (102) aufweist:

einen Außenzylinder (122), wobei eine Außenfläche des Außenzylinders (122) mit einer pfeilartigen Nut (121) versehen ist;
einen Innenzylinder (123), der sich auf einer Innenseite des Außenzylinders (122) befindet, wobei ein Durchmesser des Innenzylinders (123) kleiner ist als ein Durchmesser des Außenzylinders (122), wobei der Innenzylinder (123) und der Außenzylinder (122) konzentrisch sind;
einen Verbindungsstab (124), der sich auf einer Innenseite des Innenzylinders (123) befindet, wobei der Verbindungsstab (124) nahe an einem Rand des Innenzylinders (123) ist, wobei der Verbindungsstab (124) und der Innenzylinder (123) nicht konzentrisch sind;
ein Begrenzungsstück (125), das sich an einem Ende des Verbindungsstabs (124) befindet, wobei ein Durchmesser des Begrenzungsstücks (125) größer ist als ein Durchmesser des Verbindungsstabs (124).

5. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 4, bei der

eine Außenseite des Verbindungsstücks (103) eine Ebene ist, eine Innenseite des Verbindungsstücks (103) die geneigte Fläche (131) bildet, eine Verbindungsnut (132) auf dem Verbindungsstück (103) ausgebildet ist und sich der Verbindungsstab (124) in der Verbindungsnut (132) befindet, sich der Verstellknopf (102) dreht und der Verbindungsstab (124) das Verbindungsstück (103) derart antreibt, dass es sich radial bewegt, das Begrenzungsstück (125) eine axiale relative Verschiebung des Verstellknopfs (102) und des Verbindungsstücks (103) begrenzt.

6. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 5, bei der

ein kreisförmiges Loch (112) auf der Basis (101) vorgesehen ist und der Verstellknopf (102) in dem kreisförmigen Loch (112) montiert ist;
eine erste Nut (114) auf der Basis (101) vorgesehen ist und nahe dem kreisförmigen Loch (112) ist, die erste Nut (114) radial ist und das Verbindungsstück (103) in der ersten Nut (114) gleitet;
eine zweite Nut (111) auf der Basis (101) an einem Ende der ersten Nut (114) vorgesehen ist, die zweite

Nut (111) axial ist und der Drückstift (104) in der zweiten Nut gleitet.

7. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 6, bei der das kreisförmige Loch (112) und der Innenzylinder (123) einen Passsitz bilden.

8. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 6, bei der der Auslösungsstift (161) U-förmig ist, ein erster Arm des Auslösungsstifts (161) mit dem Auslösemechanismus (106) verbunden ist, der U-förmige Vertex des Auslösungsstifts (161) mit dem zweiten Vorsprung (142) des Drückstifts (104) in Kontakt ist und ein Spalt zwischen einem zweiten Arm des Auslösungsstifts (161) und dem Wärmeverformungselement (107) freibleibt.

9. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach Anspruch 8, bei der das Wärmeverformungselement (107) ein bimetallischer Streifen ist, ein Strom ermöglicht, dass der bimetallische Streifen (107) Wärme erzeugt und sich verformt, sich ein Ende des bimetallischen Streifens in Richtung des zweiten Arms des Auslösungsstifts (161) bewegt, mit dem zweiten Arm des Auslösungsstifts (161) in Kontakt kommt und gegen den zweiten Arm des Auslösungsstifts (161) drückt und der erste Arm des Auslösungsstifts (161) den Auslösemechanismus (106) zum Auslösen triggert.

10. Thermische verstellbare Auslösungsvorrichtung eines Miniatorschutzschalters nach einem der Ansprüche 1-9, bei der der Miniatorschutzschalter für einen Elektromotor verwendet wird.

Revendications

1. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature, dans lequel le dispositif de déclenchement thermique réglable est monté dans une base (101) d'un disjoncteur miniature, le dispositif de déclenchement thermique réglable comprenant

un mécanisme de déclenchement (106) muni d'une tige de déclenchement extensible (161);
un élément de déformation thermique (107) disposé près de la tige de déclenchement (161), un espace étant réservé entre l'élément de déformation thermique et la tige de déclenchement (161);
dans lequel un courant dans une boucle accessible par le disjoncteur miniature permet à l'élé-

ment de déformation thermique (107) de générer de la chaleur et de se déformer, l'élément de déformation thermique (107) déformé se déplace vers la tige de déclenchement (161), vient en contact avec la tige de déclenchement (161) et pousse la tige de déclenchement (161) pour déclencher le mécanisme de déclenchement (106), **caractérisé en ce qu'il comprend :**

- un mécanisme de réglage ayant une tige de poussée (104) en contact avec une surface inclinée (131) pour régler une longueur de l'espace entre la tige de déclenchement (161) et l'élément de déformation thermique (107),
le mécanisme de réglage réglant la longueur de l'espace pour régler un courant de réglage dans la boucle.
2. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 1, dans lequel
le mécanisme de réglage comprend une tige de poussée (104), une première extrémité de la tige de poussée (104) est en contact avec la tige de déclenchement (161), une seconde extrémité de la tige de poussée (104) est en contact avec la surface inclinée (131), le réglage d'une position dans laquelle la seconde extrémité de la tige de poussée (104) est en contact avec la surface inclinée (131), une position de la tige de déclenchement (161) est réglée en conséquence par la première extrémité de la tige de poussée (104), de sorte que la longueur de l'espace entre l'élément de déformation thermique (107) et la tige de déclenchement (161) soit réglée.
3. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 2, dans lequel le mécanisme de réglage comprend en outre :
un bouton de réglage (102) qui est rotatif ;
une pièce de liaison (103) reliée au bouton de réglage (102), lorsque le bouton de réglage (102) tourne, la pièce de liaison (103) se déplace dans une direction radiale du bouton de réglage (102), la surface inclinée (131) est prévue sur la pièce de liaison (103) et la surface inclinée (131) a différentes épaisseurs axiales dans la direction radiale ; et
un ressort (105), une extrémité du ressort (105) étant fixée sur la base (101), et l'autre extrémité du ressort (105) étant fixée sur la tige de poussée (104), le ressort (105) presse la seconde saillie (142) de la tige de poussée (104) sur la surface inclinée (131),
dans lequel la tige de poussée (104) est disposée axialement, une première saillie (141) est

formée sur une première extrémité de la tige de poussée (104), et la première saillie (141) est en contact avec la tige de déclenchement (161), une seconde saillie (142) est formée sur une seconde extrémité de la tige de poussée (104) et la seconde saillie (142) est en contact avec la surface inclinée (131).

4. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 3, dans lequel le bouton de réglage (102) comprend :
un cylindre extérieur (122), une surface extérieure du cylindre extérieur (122) étant munie d'une rainure en forme de flèche (121) ;
un cylindre intérieur (123) situé sur un côté intérieur du cylindre extérieur (122), un diamètre du cylindre intérieur (123) étant inférieur à un diamètre du cylindre extérieur (122), le cylindre intérieur (123) et le cylindre extérieur (122) étant concentriques ;
un montant de liaison (124) situé sur un côté intérieur du cylindre intérieur (123), le montant de liaison (124) étant proche d'un bord du cylindre intérieur (123), le montant de liaison (124) et le cylindre intérieur (123) étant non concentriques ;
une pièce de limitation (125) située sur une extrémité du montant de liaison (124), un diamètre de la pièce de limitation (125) étant supérieur à un diamètre du montant de liaison (124).
5. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 4, dans lequel un côté extérieur de la pièce de liaison (103) est un plan, un côté intérieur de la pièce de liaison (103) forme la surface inclinée (131), une rainure de liaison (132) est prévue sur la pièce de liaison (103) et le montant de liaison (124) est situé dans la rainure de liaison (132), le bouton de réglage (102) tourne et le montant de liaison (124) entraîne la pièce de liaison (103) à se déplacer radialement, la pièce de limitation (125) limite un déplacement axial relatif du bouton de réglage (102) et de la pièce de liaison (103).
6. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 5, dans lequel
un trou circulaire (112) est prévu sur la base (101) et le bouton de réglage (102) est monté dans le trou circulaire (112) ;
une première rainure (114) est prévue sur la base (101) et est proche du trou circulaire (112), la première rainure (114) est radiale et la pièce de liaison (103) coulisse dans la première rainure (114) ;
une seconde rainure (111) est prévue sur la base (101) à une extrémité de la première rainure (114),

la seconde rainure (111) est axiale et la tige de poussée (104) coulisse dans la seconde rainure.

7. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 6, dans lequel le trou circulaire (112) et le cylindre intérieur (123) forment un ajustement serré. 5

8. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 6, dans lequel la tige de déclenchement (161) est en forme de U, un premier bras de la tige de déclenchement (161) est relié au mécanisme de déclenchement (106), le sommet en forme de U de la tige de déclenchement (161) est en contact avec la seconde saillie (142) de la tige de poussée (104) et un espace est réservé entre un second bras de la tige de déclenchement (161) et l'élément de déformation thermique (107). 10
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9. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon la revendication 8, dans lequel l'élément de déformation thermique (107) est une bande bimétallique, un courant permet à la bande bimétallique (107) de générer de la chaleur et de se déformer, une extrémité de la bande bimétallique se déplace vers le second bras de la tige de déclenchement (161), vient en contact avec le second bras de la tige de déclenchement (161) et pousse le second bras de la tige de déclenchement (161), et le premier bras de la tige de déclenchement (161) déclenche le mécanisme de déclenchement (106). 25
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10. Dispositif de déclenchement thermique réglable pour un disjoncteur miniature selon l'une quelconque des revendications 1 à 9, dans lequel le disjoncteur miniature est utilisé pour un moteur électrique. 35

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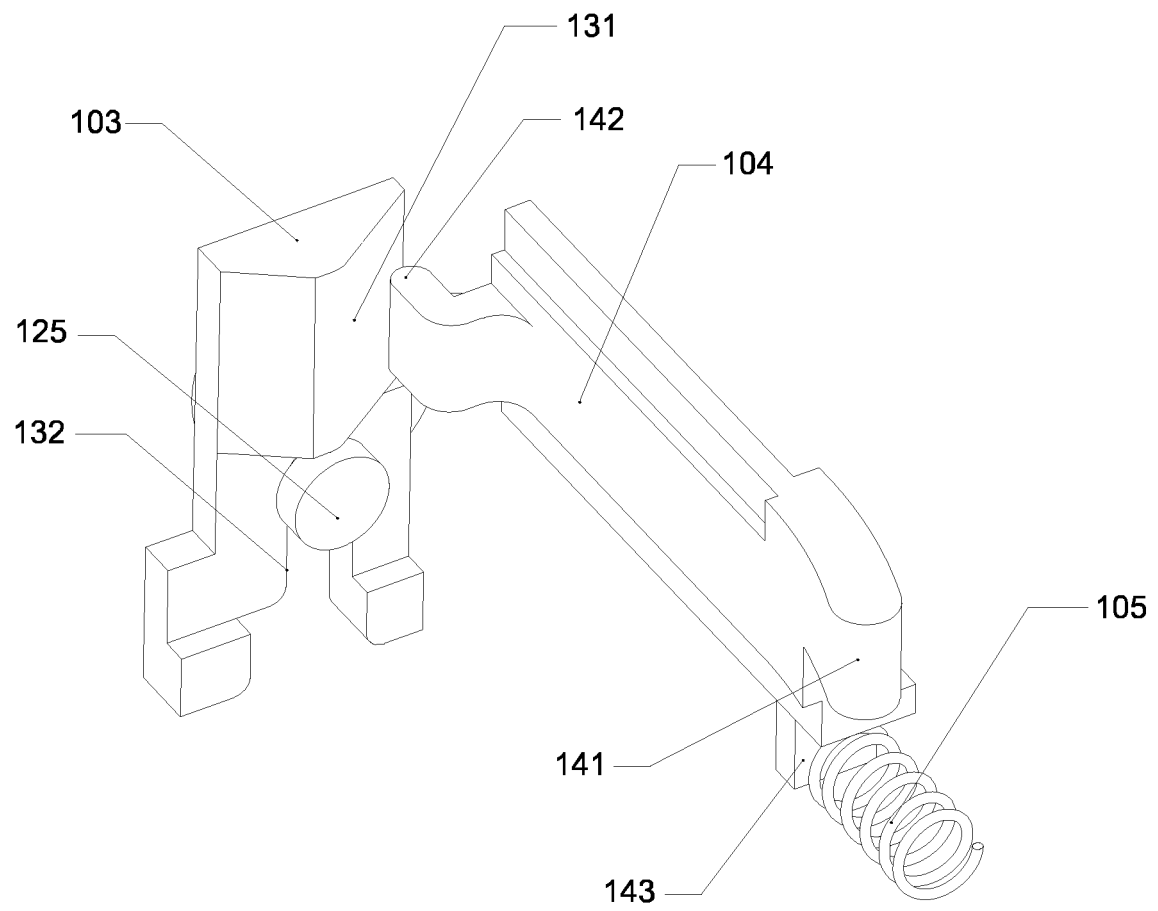


FIG 1

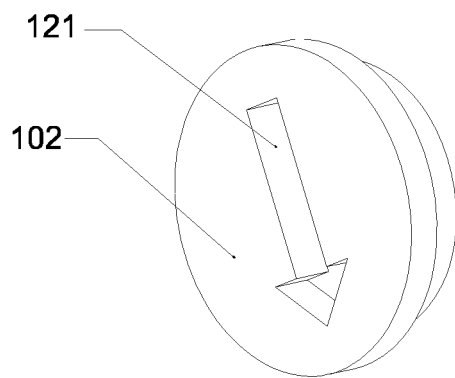


FIG 2A

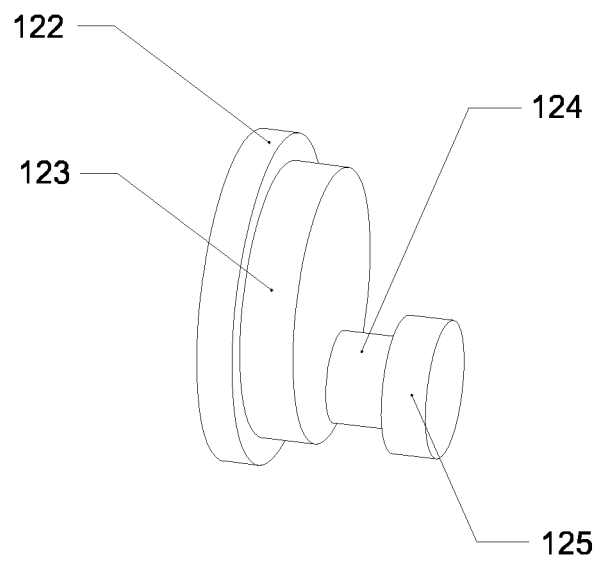


FIG 2B

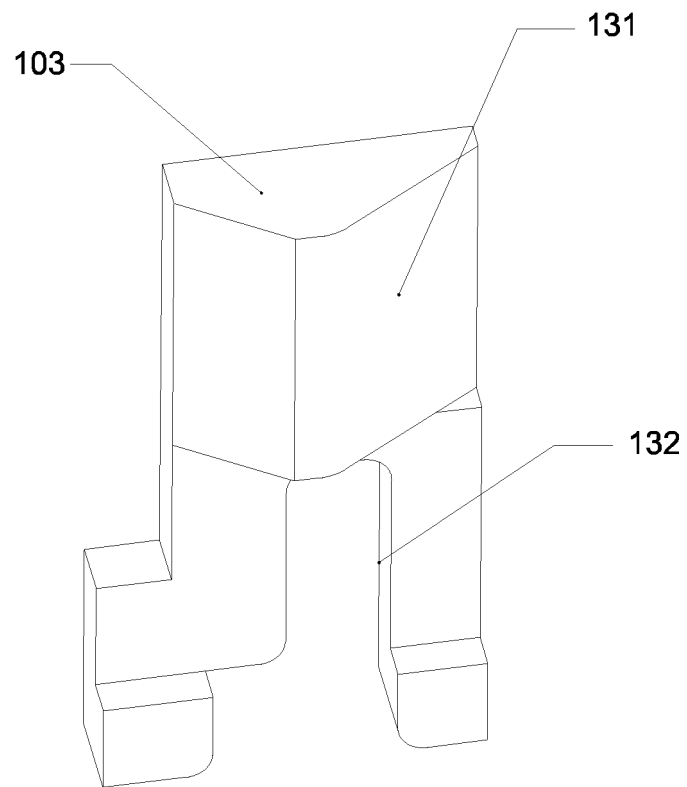


FIG 3

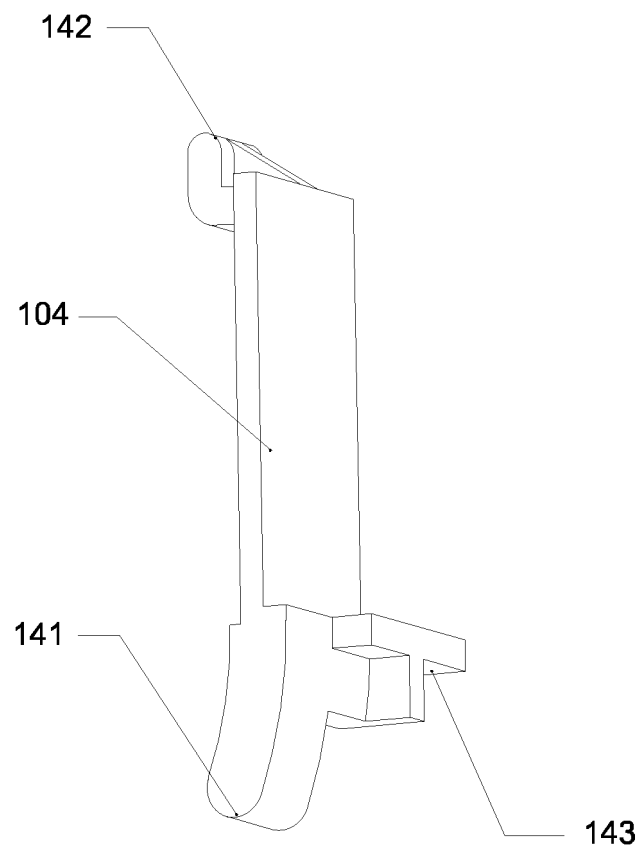


FIG 4

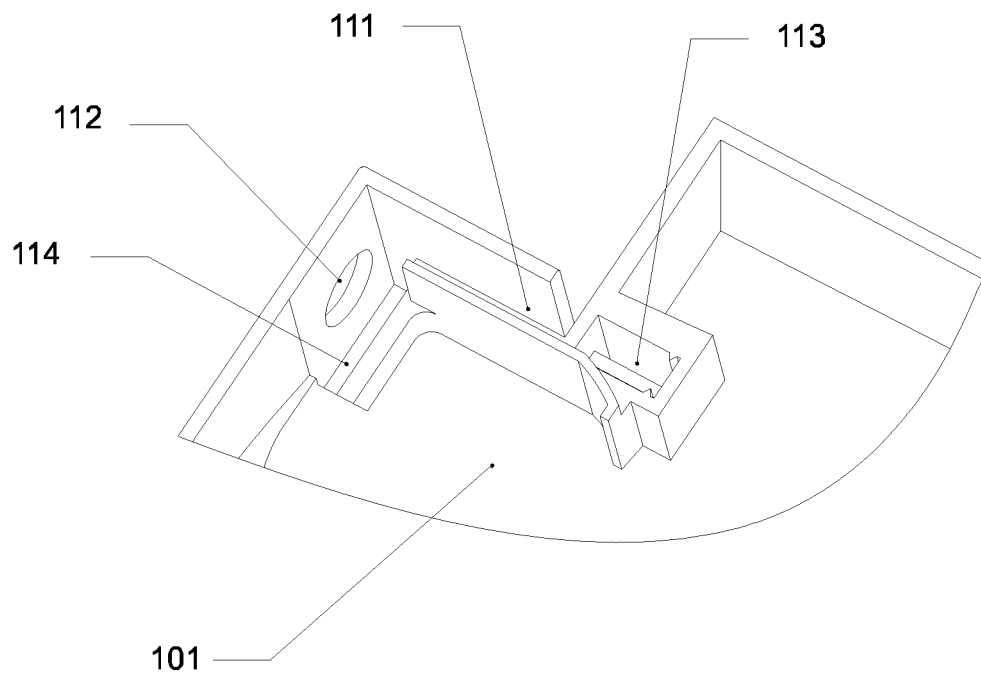


FIG 5

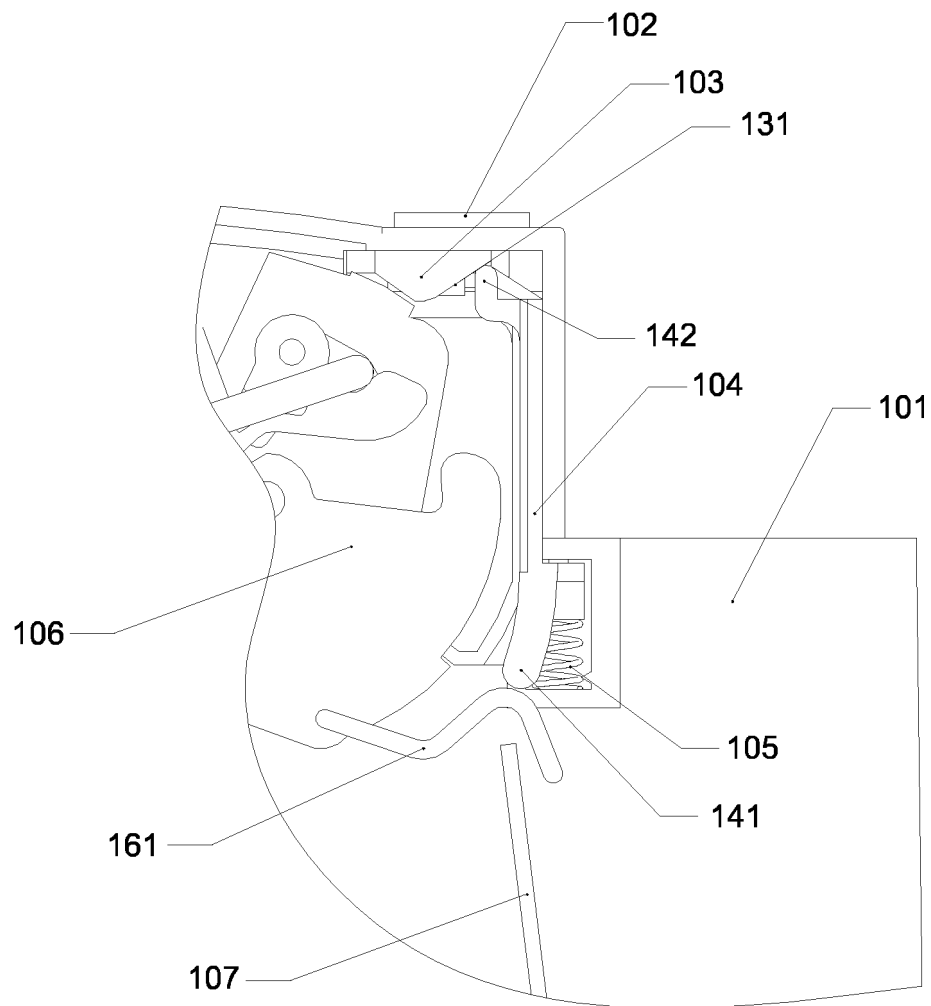


FIG 6

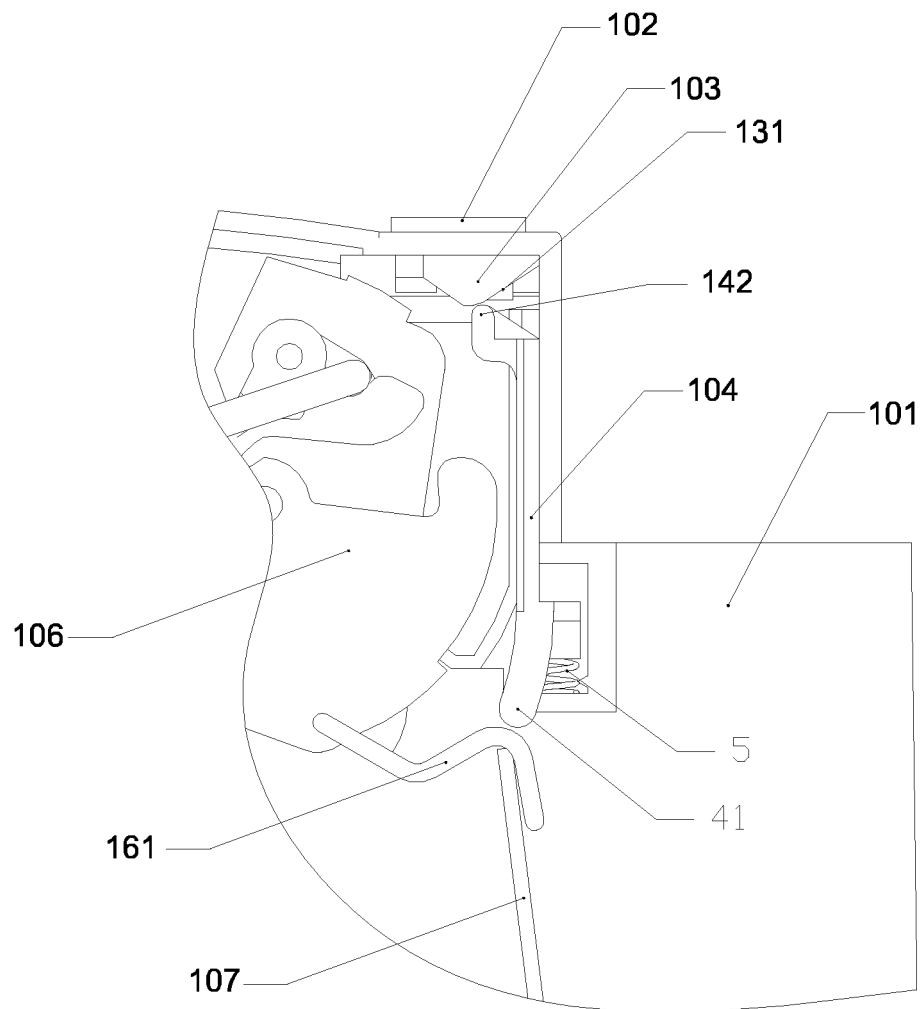


FIG 7

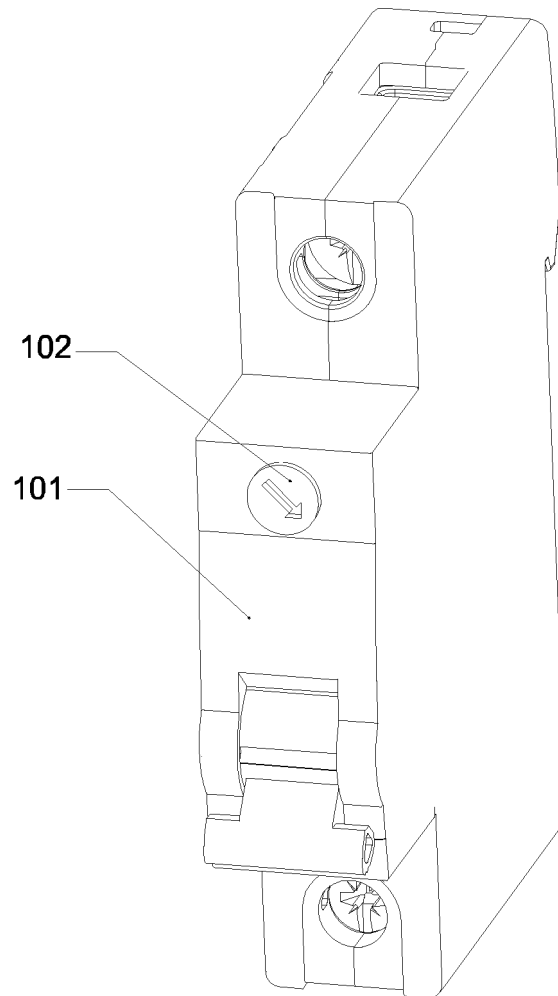


FIG 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 98115470 [0004]
- CN 03137174 [0005]
- DE 10058068 A [0005]