(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 428 945 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
**16.01.2019 Bulletin 2019/03**

(21) Application number: **16893272.1**

(22) Date of filing: **24.10.2016**

(51) Int Cl.:
***H01H 71/02*** *(2006.01)* ***H01H 71/10*** *(2006.01)*

(86) International application number:
**PCT/CN2016/103022**

(87) International publication number:
**WO 2017/152627 (14.09.2017 Gazette 2017/37)**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**MA MD**

(30) Priority: **07.03.2016 CN 201610127244**

(71) Applicant: **Zhejiang Chint Electrics Co., Ltd.**
**Yueqing, Zhejiang 325603 (CN)**

(72) Inventors:
- **XIAO, Hongwei**
  **Yueqing**
  **Zhejiang 325603 (CN)**
- **LI, Jiacai**
  **Yueqing**
  **Zhejiang 325603 (CN)**
- **GUO, Dexin**
  **Yueqing**
  **Zhejiang 325603 (CN)**
- **JIANG, Huahua**
  **Yueqing**
  **Zhejiang 325603 (CN)**

(74) Representative: **Petraz, Gilberto Luigi et al**
**GLP S.r.l.**
**Viale Europa Unita, 171**
**33100 Udine (IT)**

# (54) ROTARY SHAFT DEVICE OF CIRCUIT BREAKER

(57) A rotating shaft device of a circuit breaker comprises a plurality of contact supports provided with movable contacts, and a rotating shaft being in linkage with the plurality of contact supports. An operating mechanism drives the plurality of contact supports to rotate synchronously to drive the movable contacts to be in contact with and separated from static contacts, thereby realizing switching-on and switching-off of the circuit breaker. The rotating shaft has a parallelogram radial section. Each contact support is provided with a shaft groove having a V-shaped structure in which the rotating shaft is mounted. The rotating shaft device further comprises a clamping plate provided with a fixing groove having a V-shaped structure. The fixing groove having the V-shaped structure corresponds to the shaft groove having the V-shaped structure. The contact supports are fixedly connected to the clamping plate. The rotating shaft is fixed in a space defined by the shaft groove and the fixing groove. The shaft groove is matched with two adjacent sides of the rotating shaft, and the fixing groove is matched with another two adjacent sides of the rotating shaft, such that the plurality of contact supports are in stable and firm linkage by means of the rotating shaft.

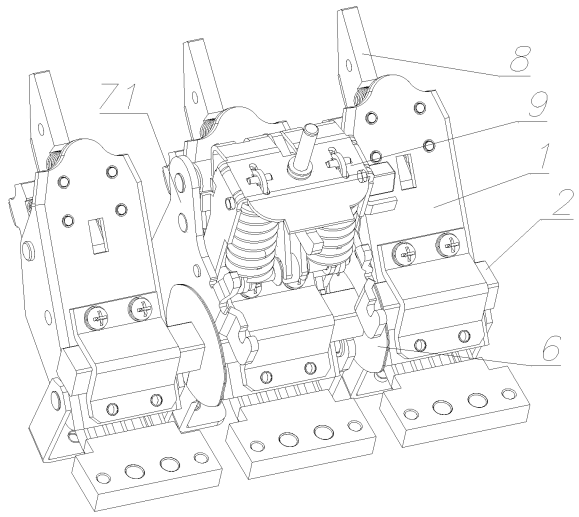


Fig. 1

EP 3 428 945 A1

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to the field of low voltage apparatuses, in particular to a circuit breaker, and more particularly to a rotating shaft device of a circuit breaker.

### BACKGROUND

**[0002]** Circuit breakers are of an important part of the electrical industry and have been widely used. When a circuit operates normally, the circuit breaker can achieve the functions of power failure, power supply and circuit conversion, etc., by powering on/off the circuit for supplying power. When the circuit is under overload, voltage loss, undervoltage or short circuit failure, the circuit breaker can automatically power off the circuit, to avoid the harms to the safety of the staff and the normal operation of the equipment caused by the circuit failure. The rotating shaft of the existing circuit breaker is fixed and riveted on a support supported by a contact by means of a clamping plate. As long as the riveting position is loose, the rotating shaft, the clamping plate and the support will be loosened, and gaps gradually occur at the mating portions thereof, which causes a change in a travel position of the contact device, thereby creating gaps at the mating portions. In addition, the transmission of a driving force between an operating mechanism and the contact support is unbalanced, which easily causes a change in the travel position of the contact device and affects the safe use of electricity by a customer.

### SUMMARY

**[0003]** An objective of the present invention is to overcome the defects of the prior art, and provide a rotating shaft device of a circuit breaker, which is simple in structure and high in reliability.

**[0004]** To fulfill said objective, the present invention adopts the following technical solution.

**[0005]** A rotating shaft device of a circuit breaker comprises a plurality of contact supports 1 provided with movable contacts 8, and a rotating shaft 2 being in linkage with the plurality of contact supports 1; an operating mechanism 9 drives the plurality of contact supports 1 to rotate synchronously to drive the movable contacts 8 to be in contact with and separated from static contacts, thereby realizing switching-on and switching-off of the circuit breaker; the rotating shaft 2 has a parallelogram radial section; each contact support 1 is provided with a shaft groove 111 having a V-shaped structure in which the rotating shaft 2 is mounted; the rotating shaft device further comprises a clamping plate 3 provided with a fixing groove 30 having a V-shaped structure; the fixing groove 30 having the V-shaped structure corresponds to the shaft groove 111 having the V-shaped structure; the contact supports 1 are fixedly connected to the clamping plate 3; the rotating shaft 2 is fixed in a space defined by the shaft groove 111 and the fixing groove 30; the shaft groove 111 is matched with two adjacent sides of the rotating shaft 2, and the fixing groove 30 is matched with another two adjacent sides of the rotating shaft 2.

**[0006]** Optionally, an interference fit is formed among the shaft groove 111, the rotating shaft 2 and the clamping plate 3.

**[0007]** Optionally, each contact support 1 comprises a bracket 10 having a U-shaped structure; the movable contacts 8 are mounted inside the bracket 10; the bracket 10 comprises two side plates 11 and a bottom plate 12 connected between the two side plates 11; each side plate 11 is symmetrically provided with mounting grooves 112 each having a V-shaped structure; a position, corresponding to each mounting groove 112, of the bottom plate 1 is provided with an opening 121 which allows the rotating shaft 2 to pass and is configured to fix the rotating shaft 2; the rotating shaft 2 is mounted outside the bottom plate 12; the mounting groove 112 and the opening 121 form the shaft groove 111 to fix the rotating shaft 2.

**[0008]** Optionally, the bottom plate 12 comprises a front bottom plate 122 and a rear bottom plate 123 which are connected between the two side plates 11; a gap is reserved at a position, where the mounting groove 112 is located, between the front bottom plate 122 and the rear bottom plate 123, and the opening 121 is formed.

**[0009]** Optionally, an extension end 124 is provided in the bottom plate 12 of each contact support 1; the extension end 124 is inclined by a certain distance from two sides, which are matched with the rotating shaft 2, of the opening 121 to the inner side of the contact support 1, respectively; the two extension ends 124 form a V-shaped structure for fixing two adjacent sides of the rotating shaft 2.

**[0010]** Optionally, the clamping plate 3 is provided with a fixing groove 30 configured to fix the rotating shaft 2 and having an integrally formed V-shaped structure; the fixing groove 30 comprises two clamping plates 31 which are connected angularly; a fixing groove 30 configured to fix the rotating shaft 2 and having a V-shaped structure is formed between the two clamping plates 31; the other ends of the two clamping plates 31 extend outwards respectively to form a mounting plate 32 that is connected to the corresponding contact support 1.

**[0011]** Optionally, the middle of the movable contact 8 is rotatably mounted inside the bracket 10 of the contact support 1 through a contact shaft 131; the movable contact 8 comprises a working end 81 provided with movable contacts and a wiring end 82 for wiring; a buffer spring 132 is provided between the working end 81 and the bracket 10, and the wiring end 82 at the other end abuts against the bracket 10.

**[0012]** Optionally, the bracket 10 comprises two side plates 11 and a bottom plate 12 connected between the two side plates 11; each movable contact 8 comprises an active contact 8a and auxiliary movable contacts 8b

provided on both sides of the active contact 8a, wherein the active contact 8a and the auxiliary movable contacts 8b are mounted side by side inside the bracket 10 through the contact shaft 131, the active contact 8a is longer than each of the auxiliary movable contacts 8b, and a buffer spring 132 which is used for realizing an over-travel fit between the movable contacts and the static contacts is provided between the bottom plate 12 and one end, where a movable contact point is provided, on each of the active contact 8a and the auxiliary movable contacts 8b; when the movable contact 8 moves closer to the static contact along with the contact support 1, the active contact 8a and the auxiliary movable contacts 8b are respectively and sequentially in contact with the static contact; when closed, the active contact 8a is firstly in contact with a main static contact of the corresponding static contacts, and the auxiliary movable contacts 8b are then in contact with the auxiliary static contact of the corresponding static contacts; when disconnected, the auxiliary movable contacts 8b are separated from the auxiliary static contact, and the active contact 8a is then separated from the main static contact.

**[0013]** Optionally, the rotating shaft 2 comprises a steel square shaft core 21 and a housing 22 provided outside the shaft core 21.

**[0014]** Optionally, the operating mechanism 9 is connected to the contact supports 1 through a plurality of first connecting rods 91; the operating mechanism 9 drives the contact supports 1 to rotate by the plurality of first connecting rods 91; a supporting shaft 92 passes through one end of each of the plurality of first connecting rods 91, and an operating shaft 93 passes through the other end of each of the plurality of first connecting rods 91; one end of each of the plurality of first connecting rods 91 is connected to the corresponding contact support 1 through the supporting shaft 92, and the other end thereof is connected to the operating mechanism 9 through the operating shaft 93.

**[0015]** According to the rotating shaft device of the circuit breaker of the present invention, by providing the shaft groove having the V-shaped structure on the contact support and the fixing groove having the V-shaped structure on the clamping plate and in combination with the rotating shaft having the parallelogram radial section, the contact supports are mounted on the rotating shaft, such that the plurality of contact supports are in stable and firm linkage through the rotating shaft.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]**

Fig. 1 is a schematic structural diagram of a rotating shaft device of the circuit breaker of the present invention;

Fig. 2 is a schematic assembly diagram of the circuit breaker of the present invention;

Fig. 3 is a structural diagram of a bracket of the circuit breaker of the present invention;

Fig. 4 is a partially enlarged view of the bracket of the circuit breaker of the present invention;

Fig. 5 i a schematic structural diagram of a clamping plate of the circuit breaker of the present invention;

Fig. 6 is a sectional view of a contact support of the circuit breaker of the present invention;

Fig. 7 is a partially sectional view of a rotating shaft of the circuit breaker of the present invention;

Fig. 8 is a sectional view of the circuit breaker of the present invention;

Fig. 9 is a partially sectional view of the circuit breaker of the present invention;

Fig. 10 is a partially enlarged sectional view of an operating mechanism of the circuit breaker of the present invention;

Fig. 11 is a partially structural view of the operating mechanism of the circuit breaker of the present invention;

Fig. 12 is a structural view of a third connecting rod of the circuit breaker of the present invention.

## DETAILED DESCRIPTION

**[0017]** Specific embodiments of a rotating shaft device of a circuit breaker of the present invention will be further described below in conjunction with the embodiments provided by Figs. 1 to 12. The rotating shaft device of the circuit breaker of the present invention is not limited to the description of the following embodiments.

**[0018]** As shown in Figs. 1 and 2, the rotating shaft device of the circuit breaker of the present invention comprise a plurality of contact supports 1 provided with movable contacts 8, and a rotating shaft 2 being in linkage with the plurality of contact supports 1. An operating mechanism 9 drives the plurality of contact supports 1 to rotate synchronously to drive the movable contacts 8 to be in contact with and separated from static contacts, thereby realizing switching-on and switching-off of the circuit breaker. The rotating shaft 2 has a parallelogram radial section. Each contact support 1 is provided with a shaft groove 111 having a V-shaped structure in which the rotating shaft 2 is mounted. The rotating shaft device further comprises a clamping plate 3 provided with a fixing groove 30 having a V-shaped structure. The fixing groove 30 having the V-shaped structure corresponds to the shaft groove 111 having the V-shaped structure. The contact supports 1 are fixedly connected to the clamping plate 3. The rotating shaft 2 is fixed in a space defined by the shaft groove 111 and the fixing groove 30. The shaft groove 111 is matched with two adjacent sides of the rotating shaft 2, and the fixing groove 30 is matched with another two adjacent sides of the rotating shaft 2. By providing the shaft groove 111 having the V-shaped structure on the contact support 1 and the fixing groove 30 having the V-shaped structure on the clamping plate 3 and in combination with the rotating shaft 2 having the parallelogram radial section, the contact supports 1 are

mounted on the rotating shaft 2, such that the plurality of contact supports 1 are in stable and firm linkage through the rotating shaft 2. In the present embodiment, the radial section of the rotating shaft 2 is square, and of course, other shapes such as a rectangle or a diamond may be available.

**[0019]** As shown in Figs. 3 to 6, each contact support 1 comprises a bracket 10 having a U-shaped structure. The movable contacts 8 are mounted inside the bracket 10. The bracket 10 comprises two side plates 11 and a bottom plate 12 connected between the two side plates 11. Each side plate 11 is symmetrically provided with mounting grooves 112 each having a V-shaped structure. A position, corresponding to each mounting groove 112, of the bottom plate 1 is provided with an opening 121 which allows the rotating shaft 2 to pass and is configured to fix the rotating shaft 2. The rotating shaft 2 is mounted outside the bottom plate 12. The contact supports 1 fix the rotating shaft 2 through the mounting groove 112 and the opening 121. Specifically, the bottom plate 12 comprises a front bottom plate 122 and a rear bottom plate 123 which are connected between the two side plates 11. A gap is reserved at a position, corresponding to the mounting groove 112, between the front bottom plate 122 and the rear bottom plate 123, and the opening 121 is formed.

**[0020]** Further, in combination with Fig. 4, an extension end 124 which is configured to further fix the rotating shaft 2 is provided in the bottom plate 12 of each contact support 1. The extension end 124 is inclined by a certain distance from two sides, which are matched with the rotating shaft 2, of the opening 121 to the inner side of the contact support 1, respectively. The two extension ends 124 form a V-shaped structure for fixing two adjacent sides of the rotating shaft 2. An angle $\alpha$ at which the extension end 124 is inclined is matched with the structure of the rotating shaft 2. The two extension ends 124 may or may not intersect. The rotating shaft 2 can be more stably fixed by providing the extension ends 124 in conjunction with the mounting groove 112, such that the mechanical strength of the bottom plate 12 can be enhanced to prolong the working life of the device. In the present embodiment, the angle $\alpha$ at which the extension end 124 is inclined is preferably 45°.

**[0021]** As shown in Fig. 5, the clamping plate 3 is provided with a fixing groove 30 configured to fix the rotating shaft 2 and having an integrally formed V-shaped structure. The fixing groove 30 comprises two clamping plates 31 which are connected angularly. A fixing groove 30 configured to fix the rotating shaft 2 and having a V-shaped structure is formed between the two clamping plates 31. The other ends of the two clamping plates 31 extend outwards respectively to form a mounting plate 32 that is connected to the corresponding contact support 1. In the present embodiment, the mounting plate 32 and the bottom plate 12 are connected by threads to fix the clamping plate 3 to the contact support 1. Of course, it is also possible to mount the clamping plate 3 and the contact support 1 by means of other known connection manners.

**[0022]** As shown in Fig. 6, the middle of the movable contact 8 is rotatably mounted inside the bracket 10 of the corresponding contact support 1 through a contact shaft 131. The movable contact 8 comprises a working end 81 provided with movable contacts and a wiring end 82 for wiring. A buffer spring 132 is provided between the working end 81 and the bracket 10, and the wiring end 82 at the other end abuts against the bracket 10. Specifically, the contact shaft 131 is provided between the two side plates 11 of the bracket 10 and passes through the movable contact 8. The buffer spring 132 is a compression spring, one end of which abuts against the working end 81 of the movable contact 8, and the other end of which abuts against the bottom plate 12 of the bracket 10. The wiring end 82 abuts against the bottom plate 12 under the spring force of the buffer spring 132 to fix the movable contact 8 in the contact support 1. The movable contacts 8 swing with the contact supports 1 to realize the contact with and the separation from the static contacts, and to realize an over-travel fit between the movable contacts and the static contacts through the buffer spring 132 provided between the working end 81 and the bottom plate 12. The wiring end 82 is connected to a wiring board 15 via a conductor 14, wherein a make-way part 14a that makes way for the shaft groove 111 and is bent away from the shaft groove 111 is provided at a position, close to the shaft groove 111, of the conductor 14.

**[0023]** Further, each movable contact 8 comprises an active contact 8a and auxiliary movable contacts 8b provided on both sides of the active contact 8a, wherein the active contact 8a and the auxiliary movable contacts 8b are mounted side by side inside the bracket 10 through the contact shaft 131, the active contact 8a is longer than each of the auxiliary movable contacts 8b, and a buffer spring 132 which is used for realizing an over-travel fit between the movable contacts and the static contacts is provided between the bottom plate 12 and one end, where a movable contact point is provided, on each of the active contact 8a and the auxiliary movable contact 8b. When the movable contact 8 moves closer to the static contacts along with the contact support 1, the active contact 8a and the auxiliary movable contacts 8b are respectively and sequentially in contact with the static contacts; when closed, the active contact 8a is firstly in contact with a main static contact of the corresponding static contacts, and the auxiliary movable contacts 8b are then in contact with the auxiliary static contact of the corresponding static contacts; when disconnected, the auxiliary movable contacts 8b are separated from the auxiliary static contacts, and the active contact 8a is then separated from the main static contact. In the present embodiment, one active contact 8a and four auxiliary movable contacts 8b are provided preferably.

**[0024]** As shown in Fig. 1, according to the rotating shaft device of the circuit breaker in the present embod-

iment, the three contact supports 1 are connected together by the rotating shaft 2. Each contact support 1 is fixedly connected to the rotating shaft 2 through the corresponding clamping plate 3. An interference fit is formed between the shaft groove 11, the rotating shaft 2 and the clamping plate 3. The contact supports 1 are mounted inside a base through a mounting frame 71 (as shown in Fig 6) and are rotatably connected to the mounting frame 71 through a mounting shaft 711. The mounting frame 71 is provided with a mounting frame opening 712 which allows the rotating shaft 2 to pass. A baffle 6 is provided at a gap between every two of the contact supports 1. In the present embodiment, the rotating shaft 2 has a square radial section. An included angle of the mounting groove 112 having the V-shaped structure, an included angle of the fixing groove 30 having the V-shaped structure and an included angle between the two extension ends 124 are 90 degrees respectively. An include angle between the side of the mounting groove 112 and the bottom plate 12 and an angle $\alpha$ at which the extension ends are inclined are 45 degrees respectively.

**[0025]** In the embodiment of the rotating shaft 2 as shown in Fig. 7, the rotating shaft 2 comprises a steel square shaft core 21 and a housing 22 provided outside the shaft core 21. By providing the steel square shaft core 21 in the rotating shaft 2, the compressive strength of the rotating shaft 2 can be improved, the driving force can be transmitted accurately and stably, and the working life can be prolonged.

**[0026]** As shown in Figs. 1 and 8, according to the rotating shaft device of the circuit breaker in the present embodiment, the three contact supports 1 are connected together by the rotating shaft 2. The operating mechanism 9 is connected to at least one contact support. The three contact supports 1 are in linkage by the rotating shaft 2. In the embodiment shown in Fig. 1, the operating mechanism 9 that drives the plurality of contact supports 1 to rotate synchronously is connected to the intermediate contact support 1 through a plurality of first connecting rods 91, and drives the contact supports 1 to rotate. The rotating shaft 2 drives the three contact supports 1 to rotate together.

**[0027]** As shown in Fig. 8, the operating mechanism 9 is connected to the contact supports 1 through a plurality of first connecting rods 91. The operating mechanism 9 drives the contact supports 1 to rotate by the plurality of first connecting rods 91. A supporting shaft 92 passes through one end of each of the plurality of first connecting rods 91, and an operating shaft 93 passes through the other end of each of the plurality of first connecting rods 91. One end of each of the plurality of first connecting rods 91 is connected to the contact support 1 through the supporting shaft 92, and the other end thereof is connected to the operating mechanism 9 through the operating shaft 93. The operating mechanism 9 drives the contact supports 1 to rotate by the plurality of first connecting rods 91 and drives the movable contact 8 thereon to swing close to or away from the static contacts, such that the driving force is transferred accurately between the operating mechanism 9 and the contact supports 1 in a balanced manner, and the potential electrical safety hazards caused by the change in the travels of the contact supports can be prevented. In the present embodiment, it is preferable that the operating mechanism 9 is connected to the contact supports 1 through two first connecting rods 91.

**[0028]** As shown in Fig. 9, the first connecting rod 91 is connected to the contact support 1 through the bracket 10. The first connecting rod 91 comprises a first connecting rod body 91a, as well as a supporting end 91b rotatably connected to the supporting shaft 92 and an operating end 91c rotatably connected to the operating shaft 93, wherein the supporting end 91b and the operating end 91c are located at both ends of the first connecting rod body 91a respectively. The first connecting rod body 91a passes through both sides of the bottom plate 12 of the bracket 10, and the supporting end 91b is inserted into the inner side of the bracket 10. The first connecting rod body 91a is connected to the supporting shaft 92 provided between the two side plates 11 of the bracket 10. A square groove 12a through which the first connecting rod body 91a passes is provided in both sides of the bottom plate 12 respectively.

**[0029]** As shown in Fig. 8 and Fig. 9, the operating mechanism 9 is provided with an operating handle 98 for driving the operating shaft 93 to move. A third connecting rod 96 and a second connecting rod 95 which are used for connecting the operating handle 98 and the operating shaft 93 are provided in the operating mechanism 9. A driving plate 98b of the operating handle 98 is matched with the third connecting rod 96. One end of the third connecting rod 96 is hinged to the second connecting rod 95, and the other end of the third connecting rod 96 is hinged to a fixed shaft 97 on the mounting frame 71. The second connecting rod 95 is hinged to a drive operating shaft 93 that is connected to the plurality of first connecting rods 91.

**[0030]** Specifically, the third connecting rod 96 comprises a sliding end 96a that is matched with the operating handle 98, a third connecting rod rotating end 96b that is connected to the fixed shaft 97, and a driving end 96e that is hinged to the second connecting rod 95. The operating handle 98 comprises a driving rod 98a and a driving plate 98b connected to the driving rod 98a. As shown in Fig. 10, the driving plate 98b of the operating handle 98 is provided with a sliding groove 981 which is slidably matched with the third connecting rod 96, and the sliding end 96a of the third connecting rod 96 is inserted into the sliding groove 981. The fixed shaft 97 is provided between the mounting frames 71 on both sides of the operating mechanism 9. The third connecting rod 96 is mounted on the fixed shaft 97 through the rotating end 96b of the third connecting rod. The second connecting rod 95 comprises two second connecting pieces arranged in parallel. The two second connecting pieces are provided on both sides of the third connecting rod 96 and

are hinged to the driving end 96e of the third connecting rod 96 through a connecting rod shaft. The third connecting rod 96 is swingable within a gap between the two second connecting pieces. When the operating handle 98 moves, the third connecting rod 96 is pushed to move by the sliding groove 981, and the third connecting rod 96 drives the operating shaft 93 to move by the second connecting rod 95.

**[0031]** As shown in Fig. 12, the sliding end 96a of the third connecting rod 96 is located at one side of the driving end 96e, and the other side of the driving end 96e extends outwards to form an extension rod 96c. A third connecting rod make-way portion 96d is formed between the driving end 96e and the extension rod 96c.

**[0032]** As shown in Figs. 8 and 10, two springs 99 are provided between the operating handle 98 and the operating shaft 93. The two springs 99 are respectively located on both sides of the second connecting rod 95. Both ends of each of the springs 99 are connected to the operating handle 98 and the operating shaft 93 via spring plates 991, respectively. Each of the spring plates 991 comprises a spring insertion end inserted into the spring and a spring rotating end 991a for a rotational fit. A spring shaft hole 993 which is matched with the operating handle 98 and the operating shaft 93 is provided at the spring rotating end 991a. A spring plate extension end extending into the side wall of the spring 99 and used for fixing is provided on both sides of the spring insertion end respectively.

**[0033]** As shown in Fig. 9 and Fig. 11, each of the contact supports 1 is mounted inside the base through the mounting frame 71. A limiting shaft 722 is also provided in the mounting frame 71. A deflecting plate 723 rotating around the fixed shaft 97 is provided on both sides of the third connecting rod 96 respectively. Each deflecting plate 723 comprises a deflecting plate body 7231, a deflecting plate first end 7232 matched with the second connecting rod 95 and a deflecting plate second end 7233 rotating around the fixed shaft 97. A fitting surface of the deflecting plate first end 7232 and the second connecting rod 95 is of a circular arc structure. The deflecting plate second end 7233 is provided with a deflecting plate shaft hole which is rotatably matched with the fixed shaft 97. The deflecting plate second end 7233 extends towards the limiting shaft 722 to form a first extension part 7234 of the deflecting plate, which is matched with the limiting shaft 722. The end part of the first extension part 7234 is in a shape of a circular arc matched with the surface of the limiting shaft 722. The deflecting plate body 7231 extends towards the limiting shaft 722 to form a second extension part 7235 of the deflecting plate, which is located above the limiting shaft 722. A strip-like triangular protrusion 971 is provided on the surface of the connecting shaft 97.

**[0034]** The above content is a further detailed description of the present invention in conjunction with the specific preferred embodiments, and the specific embodiments of the present invention are not limited to these descriptions. For an ordinary person skilled in the art, some simple deductions or substitutions made without departing from the spirit and scope of the invention should be considered to fall into the protection scope of the present invention.

## Claims

1. A rotating shaft device of a circuit breaker, comprising a plurality of contact supports (1) provided with movable contacts (8), and a rotating shaft (2) being in linkage with the plurality of contact supports (1); an operating mechanism (9) drives the plurality of contact supports (1) to rotate synchronously to drive the movable contacts (8) to be in contact with and separated from static contacts, thereby realizing switching-on and switching-off of the circuit breaker; the rotating shaft (2) has a parallelogram radial section; each contact support (1) is provided with an shaft groove (111) having a V-shaped structure in which the rotating shaft (2) is mounted; the rotating shaft device further comprises a clamping plate (3) provided with a fixing groove (30) having a V-shaped structure; the fixing groove (30) having the V-shaped structure corresponds to the shaft groove (111) having the V-shaped structure; the contact supports (1) are fixedly connected to the clamping plate (3); the rotating shaft (2) is fixed in a space defined by the shaft groove (111) and the fixing groove (30); the shaft groove (111) is matched with two adjacent sides of the rotating shaft (2), and the fixing groove (30) is matched with another two adjacent sides of the rotating shaft (2).

2. The rotating shaft device of the circuit breaker according to claim 1, wherein an interference fit is formed among the shaft groove (111), the rotating shaft (2) and the clamping plate (3).

3. The rotating shaft device of the circuit breaker according to claim 1, wherein each contact support (1) comprises a bracket (10) having a U-shaped structure; the movable contacts (8) are mounted inside the bracket (10); the bracket (10) comprises two side plates (11) and a bottom plate (12) connected between the two side plates (11); each side plate (11) is symmetrically provided with mounting grooves (112) each having a V-shaped structure; a position, corresponding to each mounting groove (112), of the bottom plate (1) is provided with an opening (121) which allows the rotating shaft (2) to pass and is configured to fix the rotating shaft (2); the rotating shaft (2) is mounted outside the bottom plate (12); the mounting groove (112) and the opening (121) form the shaft groove (111) to fix the rotating shaft (2).

4. The rotating shaft device of the circuit breaker ac-

cording to claim 3, wherein the bottom plate (12) comprises a front bottom plate (122) and a rear bottom plate (123) connected between the two side plates (11); a gap is reserved at a position, where the mounting groove (112) is located, between the front bottom plate (122) and the rear bottom plate (123), and the opening (121) is formed.

**5.** The rotating shaft device of the circuit breaker according to claim 3, wherein an extension end (124) is provided in the bottom plate (12) of each contact support (1); the extension end (124) is inclined by a certain distance from two sides, which are matched with the rotating shaft (2), of the opening (121) to the inner side of the contact support (1), respectively; the two extension ends (124) form a V-shaped structure for fixing two adjacent sides of the rotating shaft (2).

**6.** The rotating shaft device of the circuit breaker according to claim 1, wherein the clamping plate (3) is provided with a fixing groove (30) configured to fix the rotating shaft (2) and having an integrally formed V-shaped structure; the fixing groove (30) comprises two clamping plates (31) which are connected angularly; a fixing groove (30) configured to fix the rotating shaft (2) and having a V-shaped structure is formed between the two clamping plates (31); the other ends of the two clamping plates (31) extend outwards respectively to form a mounting plate (32) that is connected to the corresponding contact support (1).

**7.** The rotating shaft device of the circuit breaker according to claim 1, wherein the middle of the movable contact (8) is rotatably mounted inside the bracket (10) of the contact support (1) through a contact shaft (131); the movable contact (8) comprises a working end (81) provided with a movable contact and a wiring end (82) for wiring; a buffer spring (132) is provided between the working end (81) and the bracket (10), and the wiring end (82) at the other end abuts against the bracket (10).

**8.** The rotating shaft device of the circuit breaker according to claim 7, wherein the bracket (10) comprises two side plates (11) and a bottom plate (12) connected between the two side plates (11); the movable contact (8) comprises an active contact (8a) and auxiliary movable contacts (8b) provided on both sides of the active contact (8a), wherein the active contact (8a) and the auxiliary movable contacts (8b) are mounted side by side inside the bracket (10) through the contact shaft (131), the active contact (8a) is longer than each of the auxiliary movable contacts (8b), and a buffer spring (132) which is used for realizing an over-travel fit between the movable contacts and the static contacts is provided between the bottom plate (12) and one end, where a movable contact point is provided, on each of the active contact (8a) and the auxiliary movable contact (8b); when the movable contact (8) moves closer to the static contacts along with the contact support (1), the active contact (8a) and the auxiliary movable contacts (8b) are respectively and sequentially in contact with the static contacts; when closed, the active contact (8a) is firstly in contact with a main static contact of the corresponding static contacts, and the auxiliary movable contacts (8b) are then in contact with the auxiliary static contact of the corresponding static contacts; when disconnected, the auxiliary movable contacts (8b) are separated from the auxiliary static contact, and the active contact (8a) is then separated from the main static contact.

**9.** The rotating shaft device of the circuit breaker according to claim 1, wherein the rotating shaft (2) comprises a steel square shaft core (21) and a housing (22) provided outside the shaft core (21).

**10.** The rotating shaft device of the circuit breaker according to claim 1, wherein the operating mechanism (9) is connected to the contact supports (1) through a plurality of first connecting rods (91); the operating mechanism (9) drives the contact supports (1) to rotate by the plurality of first connecting rods (91); a supporting shaft (92) passes through one end of each of the plurality of first connecting rods (91), and an operating shaft (93) passes through the other end of each of the plurality of first connecting rods (91); one end of each of the plurality of first connecting rods (91) is connected to the contact support (1) through the supporting shaft (92), and the other end thereof is connected to the operating mechanism (9) through the operating shaft (93).

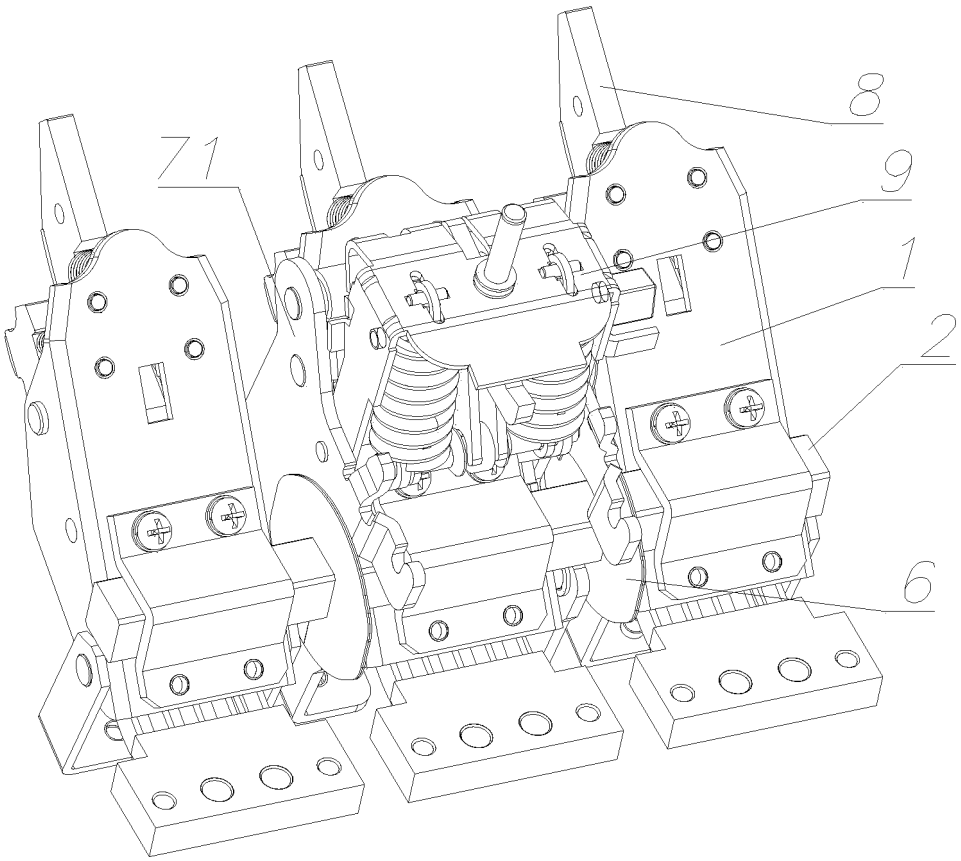


Fig. 1

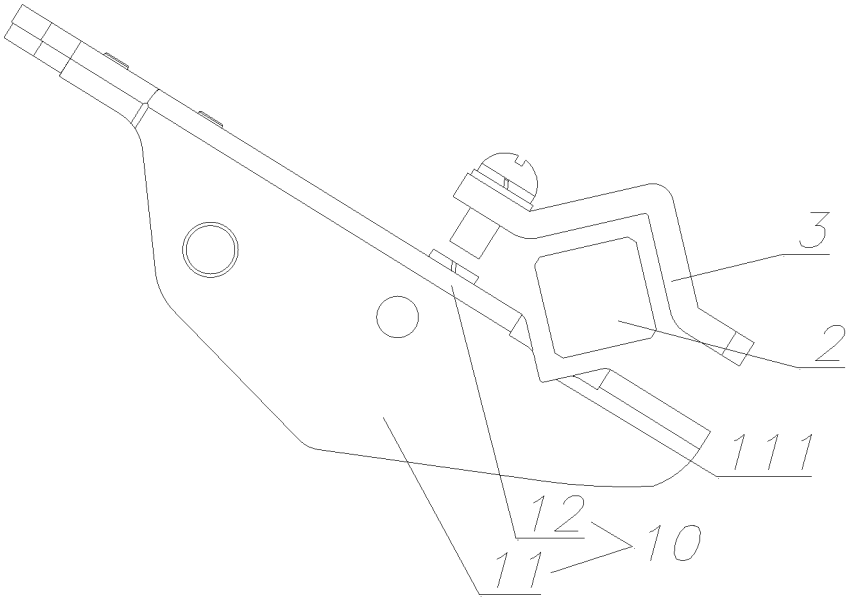


Fig. 2

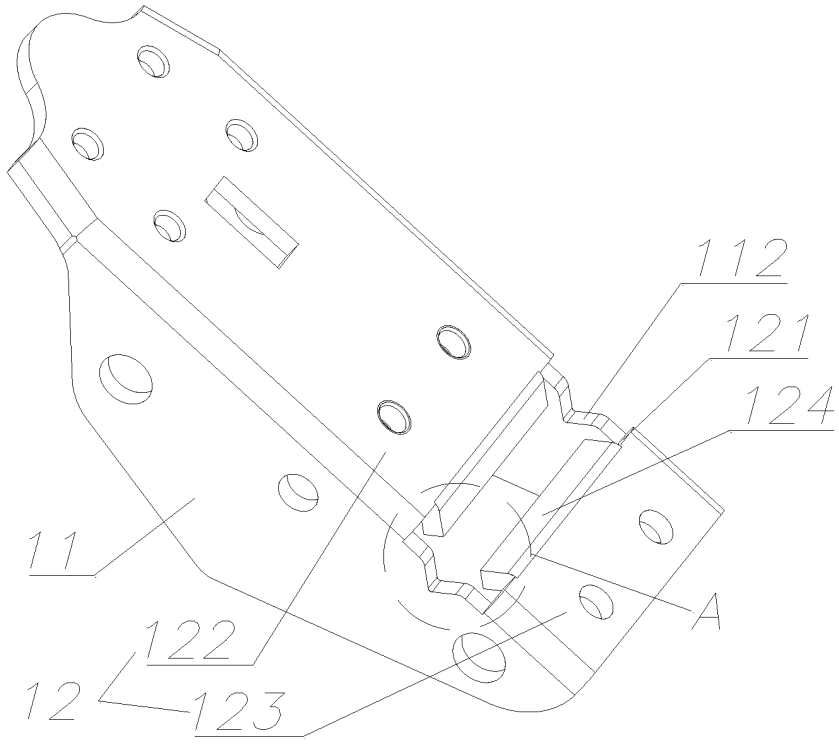


Fig. 3

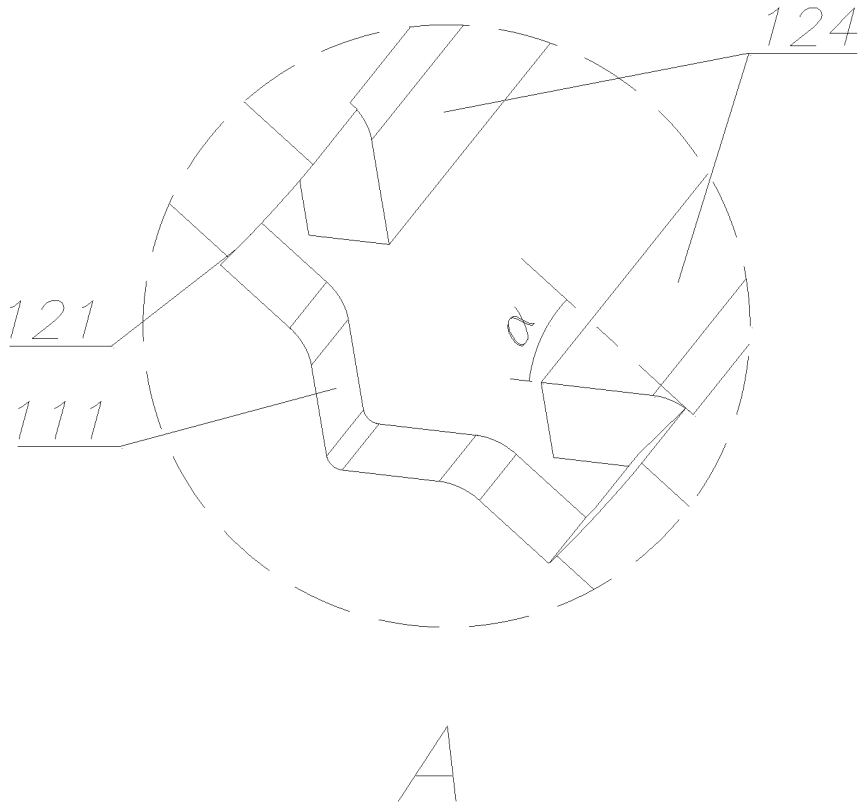


Fig. 4

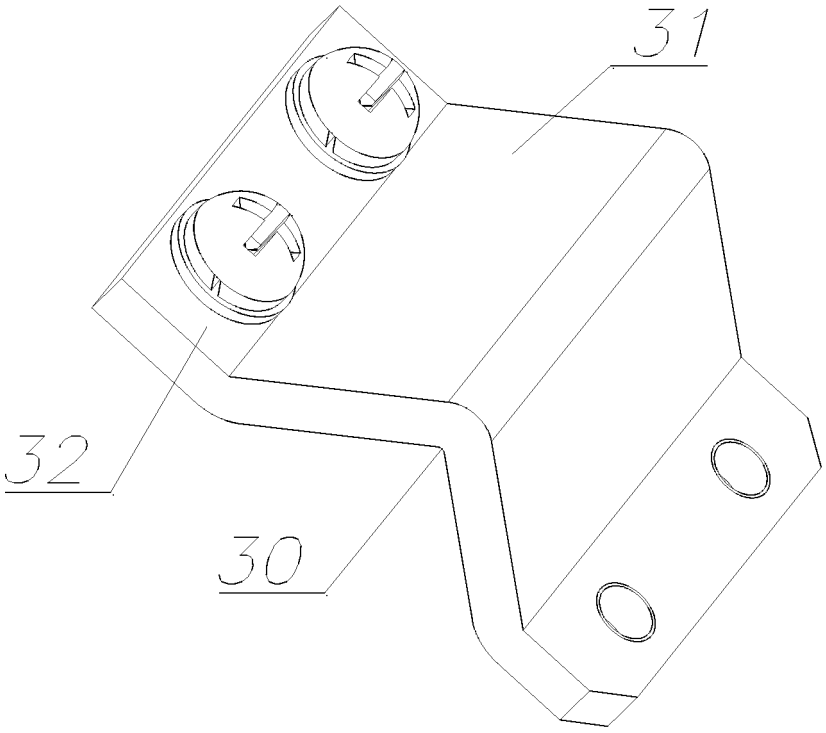


Fig. 5

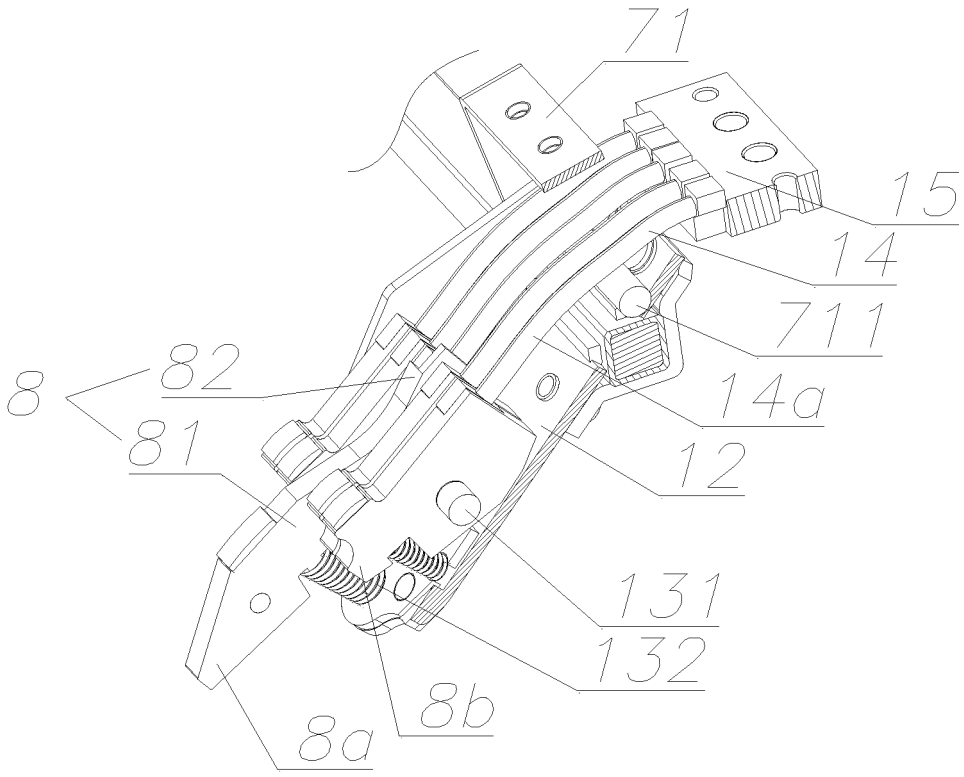


Fig. 6

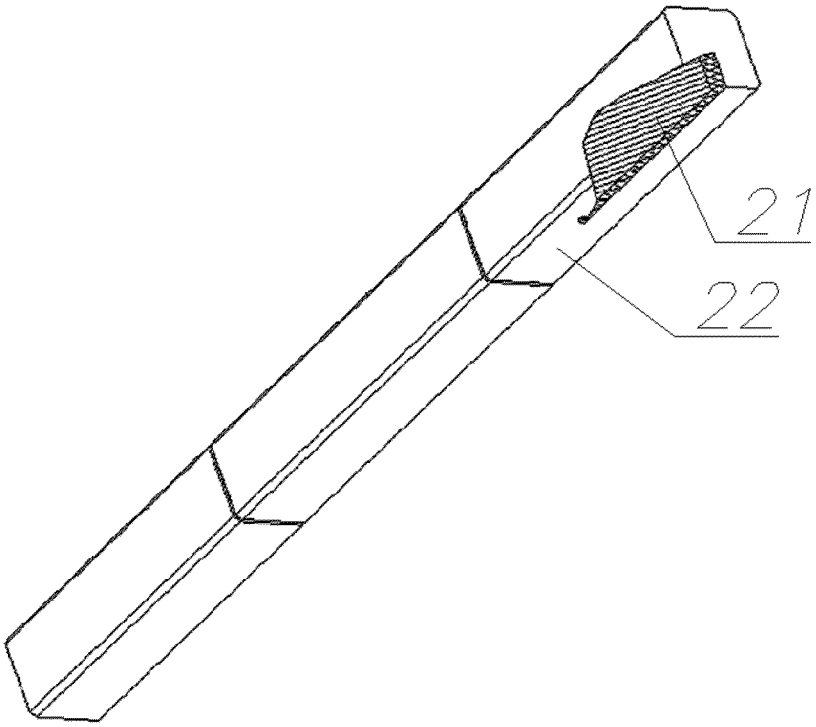


Fig. 7

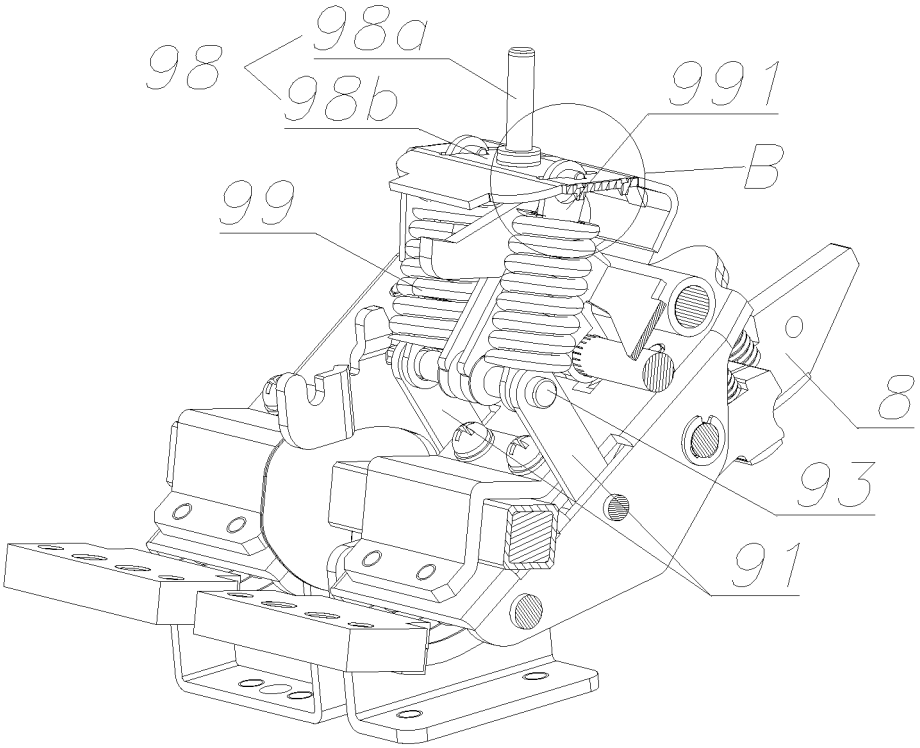


Fig. 8

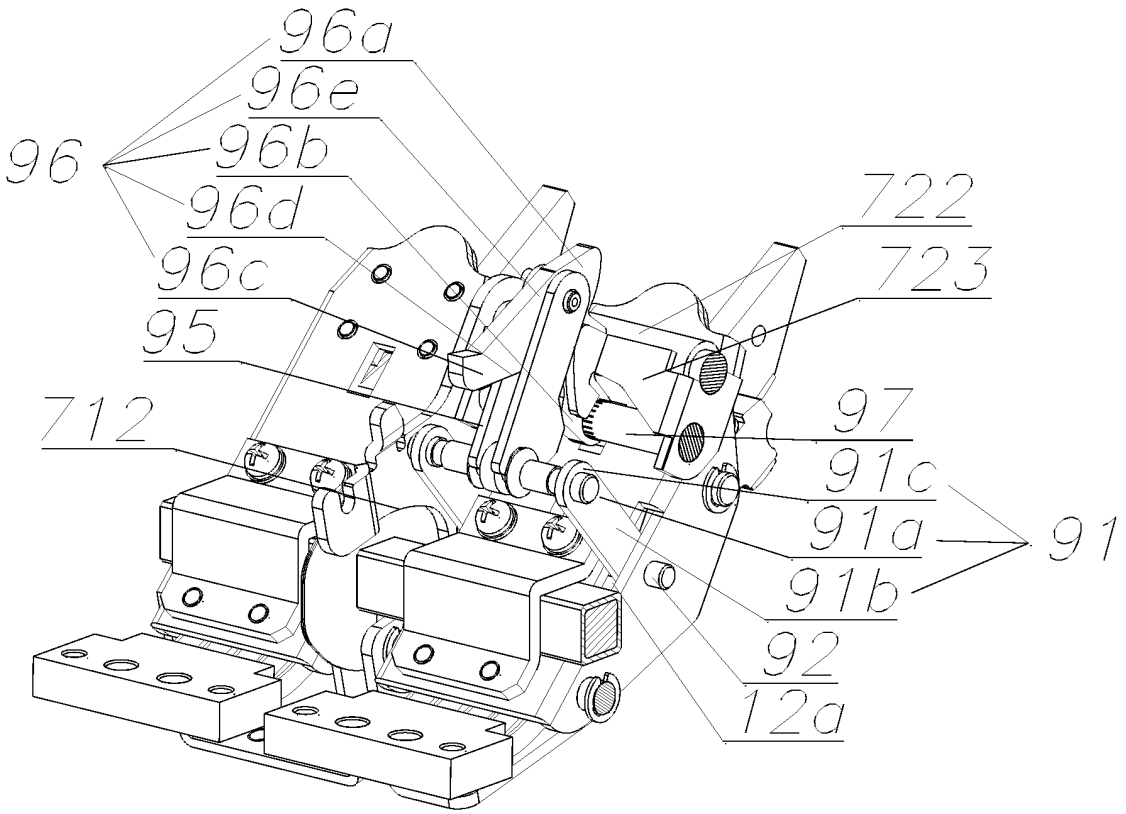
96a
96e
96
96b
96d
96c
95
712
722
723
97
91c
91a
91
91b
92
12a

Fig. 9

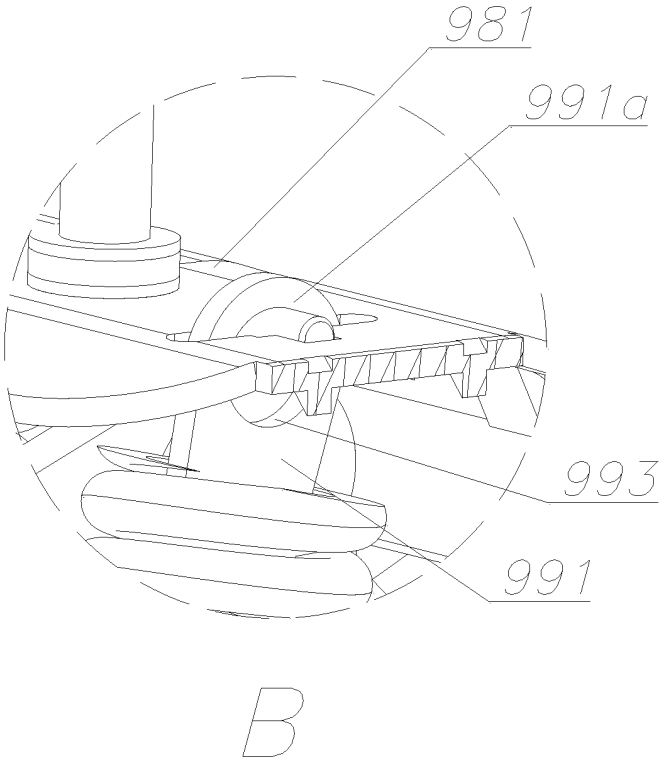
981
991a
993
991
B

Fig. 10

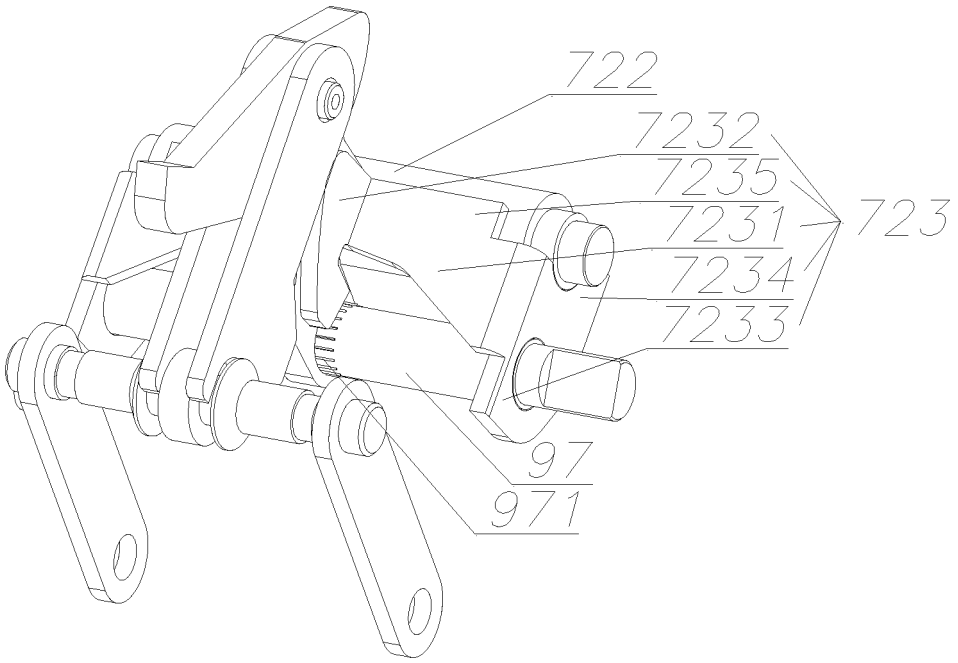


Fig. 11

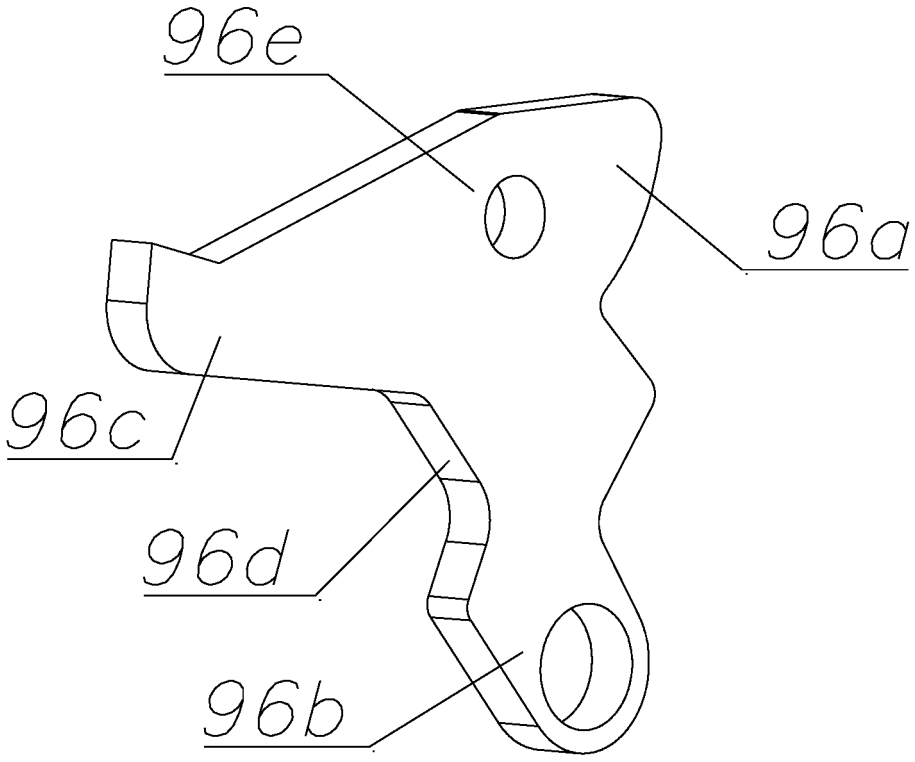


Fig. 12

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2016/103022**

**A. CLASSIFICATION OF SUBJECT MATTER**

H01H 71/02 (2006.01) i; 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)

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, CNPAT, CNKI: ZHEJIANG CHINT ELECTRICS CO., LTD.; breaker, switch, linkage, synchronous rotation, rod, contact, V, groove, multistage, interlink, link, lock, break, shaft, multipole

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| PX | CN 205542633 U (ZHEJIANG CHINT ELECTRICS CO., LTD.), 31 August 2016 (31.08.2016), claims 1-10 | 1-10 |
| A | CN 201804806 U (SHANGHAI LIANGXIN ELECTRICAL CO., LTD.), 20 April 2011 (20.04.2011), description, paragraphs 20-25, and figures 1-3 | 1-10 |
| A | CN 202145435 U (FUSHUN FUCI SWITCH MANUFACTURING CO., LTD.), 15 February 2012 (15.02.2012), the whole document | 1-10 |
| A | CN 204834540 U (YUEQING JIALING ELECTRICAL APPLIANCE CO., LTD.), 02 December 2015 (02.12.2015), the whole document | 1-10 |
| A | EP 2763154 A1 (SEARI ELECTRIC TECHNOLOGY CO., LTD. et al.), 06 August 2014 (06.08.2014), the whole document | 1-10 |
| A | CN 201556580 U (CHANGSHU SWITCHGEAR MFG. CO., LTD. (FORMER CHANGSHU SWITCHGEAR PLANT)), 18 August 2010 (18.08.2010), the whole document | 1-10 |

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

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 18 January 2017 (18.01.2017) | **25 January 2017 (25.01.2017)** |
| Name and mailing address of the ISA/CN:<br>State Intellectual Property Office of the P. R. China<br>No. 6, Xitucheng Road, Jimenqiao<br>Haidian District, Beijing 100088, China<br>Facsimile No.: (86-10) 62019451 | Authorized officer<br>**YAN, Chao**<br>Telephone No.: (86-10) **010-62414233** |

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

## INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/103022

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | CN 2845154 Y (SHANGHAI ELECTRICAL APPARATUS RESEARCH INSTITUTE (GROUP) CO., LTD.), 06 December 2006 (06.12.2006), the whole document | 1-10 |

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

# INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
**PCT/CN2016/103022**

| Patent Documents referred in the Report | Publication Date | Patent Family | Publication Date |
|---|---|---|---|
| CN 205542633 U | 31 August 2016 | None | |
| CN 201804806 U | 20 April 2011 | None | |
| CN 202145435 U | 15 February 2012 | None | |
| CN 204834540 U | 02 December 2015 | None | |
| EP 2763154 A1 | 06 August 2014 | CN 103021745 A | 03 April 2013 |
| | | WO 2013044765 A1 | 04 April 2013 |
| CN 201556580 U | 18 August 2010 | None | |
| CN 2845154 Y | 06 December 2006 | None | |

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