



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

(43) Date of publication:
15.05.2019 Bulletin 2019/20

(51) Int Cl.:
H01H 71/08 (2006.01)

(21) Application number: **17823582.6**

(86) International application number:
PCT/CN2017/091420

(22) Date of filing: **03.07.2017**

(87) International publication number:
WO 2018/006770 (11.01.2018 Gazette 2018/02)

(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

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(30) Priority: **06.07.2016 CN 201610527648**

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(54) **CONDUCTIVE LOOP OF CIRCUIT BREAKER**

(57) An electrical path for a circuit breaker, comprising: a first contact group and a second contact group. The first contact group comprises a first static contact (121) and a first moving contact (122), and the first static contact (121) is connected to an inlet terminal (101). The second contact group comprises a second static contact (131) and a second moving contact (132), wherein the first moving contact (122) and the second moving contact (132) are electrically connected, the second static contact (131) is connected to a trip unit (104), and the trip unit (104) is connected to an outlet terminal (105). The electrical path for a circuit breaker according to one or more embodiments of the present invention electrically connects a plurality of moving contacts (122, 132, 222). The plurality of moving contacts (122, 132, 222) are co-axially mounted, and the second static contact (131) is connected, across the second moving contact (132), to the outlet terminal (105) while ensuring insulation. Under the premise of making the overall structure of the circuit breaker compact and occupy a small space, the inlet terminal and the outlet terminal are arranged on the two sides, thereby facilitating the wiring of the circuit breaker and other electrical equipment.

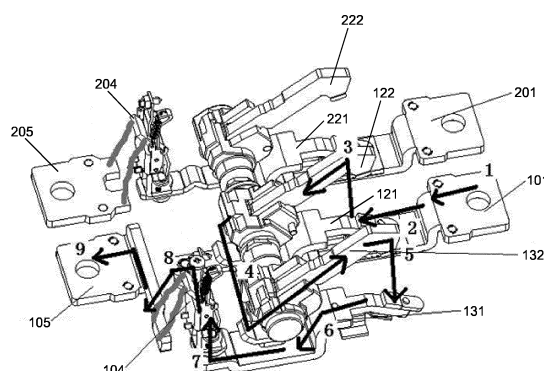


FIG 1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] Embodiments of the present invention relate to the field of low voltage electrical appliances and, more particularly, to an electrical path in which a plurality of contacts of a circuit breaker are cascade-connected.

2. The Related Art

[0002] As the photovoltaic power generation industry controls costs more and more strictly, the cost control on equipment by combiner box and inverter manufacturers is becoming more and more rigorous. The current development trend of the market is to increase the system voltage to reduce the cost of equipment. A consensus is that the voltage of photovoltaic systems will increase from the existing DC1000V to DC 1500V in the future. DC 1500V will become the mainstream voltage of the photovoltaic industry in the future. As the rated voltage increases, the rated voltage of the switching devices associated with the photovoltaic system, such as circuit breakers, also needs to be correspondingly increased. Photovoltaic dedicated direct current molded-case circuit breakers with DC1500V rated voltage will become the mainstream product of the future photovoltaic industry demand.

[0003] In order to achieve the short-circuit breaking capacity under high rated voltage, the solution for improving the rated working voltage of the DC circuit breaker is generally to adopt an external cascade method to provide multiple break points through multiple cascade-connected contacts to achieve a higher rated working voltage. However, multiple cascade-connected contacts will increase the product volume, making external wiring cumbersome, increasing product cost and assembly steps. More importantly, the use of cascade-connection of multiple contacts requires changes in the position of the inlet terminal and the position of the outlet terminal, making the collaboration of the circuit breaker with other electrical equipment more complex.

SUMMARY

[0004] Embodiments of the present invention disclose an electrical path for a circuit breaker, comprising: a first contact group and a second contact group. The first contact group comprises a first static contact and a first moving contact, and the first static contact is connected to an inlet terminal. The second contact group comprises a second static contact and a second moving contact. Wherein, the first moving contact and the second moving contact are electrically connected, the second static contact is connected to a trip unit, and the trip unit is connected to the outlet terminal.

[0005] In one embodiment, the first contact group and the second contact group are mounted coaxially, the first moving contact and the second moving contact being mounted on the same rotation shaft.

5 **[0006]** In one embodiment, the inlet terminal is located on a first side of the rotation shaft, and the contacts of the first static contact and the first moving contact are located on the first side of the rotation shaft. The contacts of the second static contact and the second moving contact are located on the first side of the rotation shaft. The outlet terminal is located on a second side of the rotation shaft. The second static contact extends from the first side of the rotation shaft to the second side of the rotation shaft around the second moving contact, and the second static contact is insulated from the second moving contact.

10 **[0007]** In one embodiment, the second static contact bypasses from below the second moving contact with an insulating spacer disposed between the second static contact and the second moving contact.

15 **[0008]** In one embodiment, an insulating spacer is provided between the second moving contact and the trip unit.

20 **[0009]** Embodiments of the present invention further disclose an electrical path for a circuit breaker, comprising: a first path and a second path. The first path includes a first inlet terminal, a first contact group, a second contact group, a first trip unit, and a first outlet terminal. The first contact group comprises a first static contact and a first moving contact, and the first static contact is connected to the first inlet terminal. The second contact group comprises a second static contact and a second moving contact. The first moving contact and the second moving contact are electrically connected, the second static contact is connected to the first trip unit, and the first trip unit is connected to the first outlet terminal. The second path comprises a second inlet terminal, a third contact group, a second trip unit, and a second outlet terminal. The third contact group comprises a third static contact and a third moving contact. The third static contact is connected to the third inlet terminal, the third moving contact is connected to the second trip unit, and the second trip unit is connected to the second outlet terminal.

25 **[0010]** In one embodiment, the first contact group, the second contact group, and the third contact group are coaxially mounted, and the first moving contact, the second moving contact, and the third moving contact are mounted on the same rotation shaft.

30 **[0011]** In one embodiment, the first inlet terminal is located on a first side of the rotation shaft, and the contacts of the first static contact and the first moving contact are located on the first side of the rotation shaft. The contacts of the second static contact and the second moving contact are located on the first side of the rotation shaft. The first outlet terminal is located on a second side of the rotation shaft. The second static contact extends from the first side of the rotation shaft to the second side of

the rotation shaft around the second moving contact, and the second static contact is insulated from the second moving contact.

[0012] In one embodiment, the second static contact bypasses from below the second moving contact with an insulating spacer disposed between the second static contact and the second moving contact.

[0013] In one embodiment, an insulating spacer is provided between the second moving contact and the second trip unit.

[0014] The electrical path for a circuit breaker according to one or more embodiments of the present invention electrically connects a plurality of moving contacts. The plurality of moving contacts are coaxially mounted, and the static contacts are connected to the outlet terminal across the moving contacts while ensuring insulation. Under the premise of making the overall structure of the circuit breaker compact and occupy a small space, the inlet terminal and the outlet terminal are arranged on the two sides, thereby facilitating the wiring of the circuit breaker and other electrical equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The above and other features, natures, and advantages of the present invention will be more apparent from the following description of the embodiments with reference to the accompanying drawings, wherein,

FIG. 1 shows a structural diagram of an electrical path in accordance with an embodiment of the present invention.

FIG. 2 shows a structural diagram of a second static contact in an electrical path in accordance with an embodiment of the present invention.

FIG. 3 shows a structural diagram of a second contact group in an electrical path in accordance with an embodiment of the present invention.

FIGs. 4a, 4b, and 4c show schematic diagrams of an insulating structure of a second contact group in an electrical path in accordance with an embodiment of the present invention.

FIGs. 5a and 5b show circuit diagrams of an electrical path in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0016] Embodiments of the present invention disclose an electrical path for a circuit breaker, comprising: a first contact group and a second contact group. The first contact group comprises a first static contact and a first moving contact, and the first static contact is connected to an inlet terminal. The second contact group comprises a

second static contact and a second moving contact. The first moving contact and the second moving contact are electrically connected, the second static contact is connected to a trip unit, and the trip unit is connected to an outlet terminal. The first contact group and the second contact group are mounted coaxially, the first moving contact and the second moving contact being mounted on the same rotation shaft. The inlet terminal is located on a first side of the rotation shaft, and the contacts of the first static contact and the first moving contact are located on the first side of the rotation shaft. The contacts of the second static contact and the second moving contact are located on the first side of the rotation shaft. The outlet terminal is located on a second side of the rotation shaft. The second static contact extends from the first side of the rotation shaft to the second side of the rotation shaft around the second moving contact, and the second static contact is insulated from the second moving contact. The second static contact bypasses from below the second moving contact with an insulating spacer disposed between the second static contact and the second moving contact. An insulating spacer is disposed between the second moving contact and the trip unit.

[0017] FIG. 1 shows a structural diagram of an electrical path in accordance with an embodiment of the present invention. FIG. 1 shows an arrangement scheme for applying an electrical path according to one or more embodiments of the present invention to a circuit breaker. As shown, the electrical path of the circuit breaker comprises: a first path and a second path. The first path includes a first inlet terminal 101, a first contact group, a second contact group, a first trip unit 104, and a first outlet terminal 105. The first contact group comprises a first static contact 121 and a first moving contact 122. The first static contact 121 is connected to the first inlet terminal 101. The second contact group comprises a second static contact 131 and a second moving contact 132. The first moving contact 122 and the second moving contact 132 are electrically connected. Here, electrical connection means that the first moving contact 122 and the second moving contact 132 are electrically connected. In various embodiments, the first moving contact 122 and the second moving contact 132 may be electrically connected by a soft connection, a hard connection, or a combination of a soft connection and a hard connection. The second static contact 131 is connected to the first trip unit 104, and the first trip unit 104 is connected to the first outlet terminal 105. The second path comprises a second inlet terminal 201, a third contact group, a second trip unit 204, and a second outlet terminal 205. The third contact group includes a third static contact 221 and a third moving contact 222. The third static contact 221 is connected to the third inlet terminal 201, and the third moving contact 222 is connected to the second trip unit 204. The second trip unit 204 is connected to the second outlet terminal.

[0018] Referring still to FIG. 1, the first contact group, the second contact group, and the third contact group

are mounted coaxially. Specifically, coaxial mounting means that the first moving contact 122, the second moving contact 132, and the third moving contact 222 are mounted on the same rotation shaft. The advantage of coaxial mounting is that it saves mounting space and makes the structure of the contact groups more compact. It should be noted that coaxial mounting here means that the first moving contact 122, the second moving contact 132, and the third moving contact 222 share the same rotation shaft, but the first moving contact 122, the second moving contact 132, and the third moving contact 222 independently rotate and do not interfere with one another. When in operation, the first moving contact 122, the second moving contact 132, and the third moving contact 222 are independent of each other and can be independently closed or opened as needed.

[0019] The first inlet terminal 101 is located on a first side of the rotation shaft. In the illustrated embodiment, the first side of the rotation shaft is the right side of the illustration and the second side of the rotation shaft is the left side of the illustration. The contacts of the first static contact 121 and the first moving contact 122 are located on the first side of the rotation shaft. The contacts of the first static contact 121 and the first moving contact 122 are silver dots. The contacts of the second static contact 131 and the second moving contact 132 are located on the first side of the rotation shaft. The contacts of the second static contact 131 and the second moving contact 132 are silver dots. The first outlet terminal 105 and the first trip unit 104 are located on the second side of the rotation shaft. Since the contacts of the second static contact 131 and the second moving contact 132 in the second contact group and the final outlet terminal of the second contact group (the outlet terminal of the second static contact) are respectively located on the two sides of the rotation shaft, the second static contact 131 needs to bypass the second moving contact 132 (the second moving contact 132 being mounted on the rotation shaft), extending from the first side of the rotation shaft to the second side of the rotation shaft. Since the second static contact 131 bypasses the second moving contact 132, insulation between the second static contact and the second moving contact is required to avoid direct connection between the two.

[0020] In the illustrated embodiment, the second static contact 131 bypasses from below the second moving contact 132 with an insulating spacer disposed between the second static contact 131 and the second moving contact 132. FIGs. 2, 3, 4a, 4b and 4c illustrate the structure of the second contact group and the manner in which the insulation is performed. Referring first to FIG. 2, FIG. 2 shows a structural diagram of a second static contact in an electrical path in accordance with an embodiment of the present invention. As shown in FIG. 2, the main body of the second static contact 131 is a concave conductive strip, and the concave portion is located below the moving contact 132 so that the second static contact 131 can bypass from below the second moving contact

132. A first end of the second static contact 131 (the left end shown in the drawing) has a contact 301 which, in one embodiment, is a silver dot. The first end of the second static contact 131 extends outward to cooperate with the contact of the second moving contact 132. A second end of the second static contact 131 is connected to the first trip unit 104, and the second end of the second static contact 131 has a hole 302. The first trip unit 104 is fixed by a fastener such as a screw and connected to the second static contact 131. The screw passes through the hole 302 and is tightened such that the first trip unit 104 is fixedly connected to the conductive strip of the second static contact 131. FIG. 3 shows a structural diagram of a second contact group in an electrical path in accordance with an embodiment of the present invention. The second static contact 131 and the second moving contact 132 form a contact on the first side (the left side shown in the drawing). The second static contact 131 bypasses from below the second moving contact 132, and the second end of the second static contact 131 is connected to the first trip unit 104.

[0021] FIGs. 4a, 4b, and 4c show schematic diagrams of an insulating structure of a second contact group in an electrical path in accordance with an embodiment of the present invention. The insulation of the second contact group comprises two parts: an insulation between the second static contact and the second moving contact, and an insulation between the second moving contact and the first trip unit. In one embodiment, the second static contact and the second moving contact are insulated from each other using a base. The base 401 is provided with two slots. The first end of the second static contact 131 enters the interior of the base from one of the slots, and the second end of the second static contact 131 enters the interior of the base from the other slot. The concave portion of the second static contact 131 is left outside the base, and a portion of a housing 402 of the base is sandwiched between the second static contact 131 and the second moving contact 132 so as to form an insulation. Both ends of the second static contact 131 enter the interior of the base to cooperate with the moving contact and the trip unit. In this embodiment, the housing of the base 401 itself serves as an isolation member insulating the second static contact from the second moving contact. In one embodiment, the second moving contact and the first trip unit are also insulated by the base. The base 401 has a partition 403 disposed between the second moving contact 132 and the first trip unit 104 to insulate the two. In this embodiment, the housing of the base 401 itself also serves as an isolation member insulating the second moving contact from the first trip unit.

[0022] Returning to FIG. 1, the electric current path in this embodiment is indicated by solid arrow lines. Since the current path of the second path is a normal path, it is not marked, and the current path of the first loop is marked. The current path of the first path is as follows:

[0023] The current enters from the first inlet terminal

(marked as 1), reaches the first moving contact through the first static contact of the first contact group (marked as 2), passes through the first moving contact (marked as 3), reaches the second moving contact through the electrical path between the first moving contact and the second moving contact (marked as 4), reaches the second static contact through the second moving contact (marked as 5), reaches the second end of the second static contact from the contact of the second static contact through the concave conductive strip (marked as 6), reaches the first trip unit from the second end of the second static contact (marked as 7), reaches the first outlet terminal through the first trip unit (marked as 8), and exits from the first outlet terminal (marked as 9).

[0024] Referring to FIGs. 5a and 5b, FIGs. 5a and 5b show circuit diagrams of an electrical path in accordance with an embodiment of the present invention. FIG. 5a is a circuit diagram of a conventional circuit breaker having dual paths. As shown in FIG. 5a, each of the two paths requires the use of two contact groups, and the two paths require a total of four contact groups. FIG. 5b is a circuit diagram of an electrical path in accordance with an embodiment of the present invention. The electrical path of the present invention uses only three contact groups. Since the contact group has a large volume and is a relatively large component in the circuit breaker, the use of one less contact group can significantly reduce the overall volume of the circuit breaker. The width of a circuit breaker using the electrical path of the present invention can be substantially reduced to 3/4 of that of a circuit breaker using a conventional electrical path.

[0025] The electrical path for a circuit breaker according to one or more embodiments of the present invention electrically connects a plurality of moving contacts. The plurality of moving contacts are coaxially mounted, and the static contacts are connected to the outlet terminal across the moving contacts while ensuring insulation. Under the premise of making the overall structure of the circuit breaker compact and occupy a small space, the inlet terminal and the outlet terminal are arranged on the two sides, thereby facilitating the wiring of the circuit breaker and other electrical equipment.

[0026] The above embodiments are provided to those skilled in the art to implement or use the present invention, and those skilled in the art can make various modifications or changes to the above embodiments without departing from the inventive concept of the present invention. The scope of protection of the present invention is therefore not limited by the above embodiments but should conform to the maximum scope of the innovative features mentioned in the claims.

Claims

1. An electrical path for a circuit breaker, comprising:

a first contact group comprising a first static con-

tact and a first moving contact, the first static contact being connected to an inlet terminal;
a second contact group comprising a second static contact and a second moving contact;
wherein

the first moving contact and the second moving contact are electrically connected, the second static contact is connected to a trip unit, and the trip unit is connected to an outlet terminal.

2. The electrical path for a circuit breaker according to claim 1, wherein the first contact group and the second contact group are coaxially mounted, and the first moving contact and the second moving contact are mounted on a same rotation shaft.

3. The electrical path for a circuit breaker according to claim 2, wherein
the inlet terminal is located on a first side of the rotation shaft, and contacts of the first static contact and the first moving contact are located on the first side of the rotation shaft;
contacts of the second static contact and the second moving contact are located on the first side of the rotation shaft;
the outlet terminal is located on a second side of the rotation shaft, the second static contact extends from the first side of the rotation shaft to the second side of the rotation shaft around the second moving contact, and the second static contact is insulated from the second moving contact.

4. The electrical path for a circuit breaker according to claim 3, wherein the second static contact bypasses from below the second moving contact, and an insulating spacer is disposed between the second static contact and the second moving contact.

5. The electrical path for a circuit breaker according to claim 3, wherein an insulating spacer is disposed between the second moving contact and the trip unit.

6. An electrical path for a circuit breaker, comprising:

a first path comprising a first inlet terminal, a first contact group, a second contact group, a first trip unit, and a first outlet terminal,

wherein the first contact group comprises a first static contact and a first moving contact, and the first static contact is connected to the first inlet terminal;
the second contact group comprises a second static contact and a second moving contact; the first moving contact and the second moving contact are electrically connected, the second static contact is connected to the first trip unit, and the first trip

unit is connected to the first outlet terminal;

a second path comprising a second inlet terminal, a third contact group, a second trip unit, and a second outlet terminal, 5
wherein the third contact group comprises a third static contact and a third moving contact, the third static contact is connected to the third inlet terminal, the third moving contact is connected to the second trip unit, and the second trip unit is connected to the second outlet terminal. 10

7. The electrical path for a circuit breaker according to claim 6, wherein the first contact group, the second contact group, and the third contact group are coaxially mounted, and the first moving contact, the second moving contact, and the third moving contact are mounted on a same rotation shaft. 15

8. The electrical path for a circuit breaker according to claim 7, wherein 20
the first inlet terminal is located on a first side of the rotation shaft, and contacts of the first static contact and the first moving contact are located on the first side of the rotation shaft; 25
contacts of the second static contact and the second moving contact are located on the first side of the rotation shaft;
the first outlet terminal is located on a second side of the rotation shaft, the second static contact extends from the first side of the rotation shaft to the second side of the rotation shaft around the second moving contact, and the second static contact is insulated from the second moving contact. 30
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9. The electrical path for a circuit breaker according to claim 8, wherein the second static contact bypasses from below the second moving contact, and an insulating spacer is disposed between the second static contact and the second moving contact. 40

10. The electrical path for a circuit breaker according to claim 8, wherein an insulating spacer is disposed between the second moving contact and the second trip unit. 45

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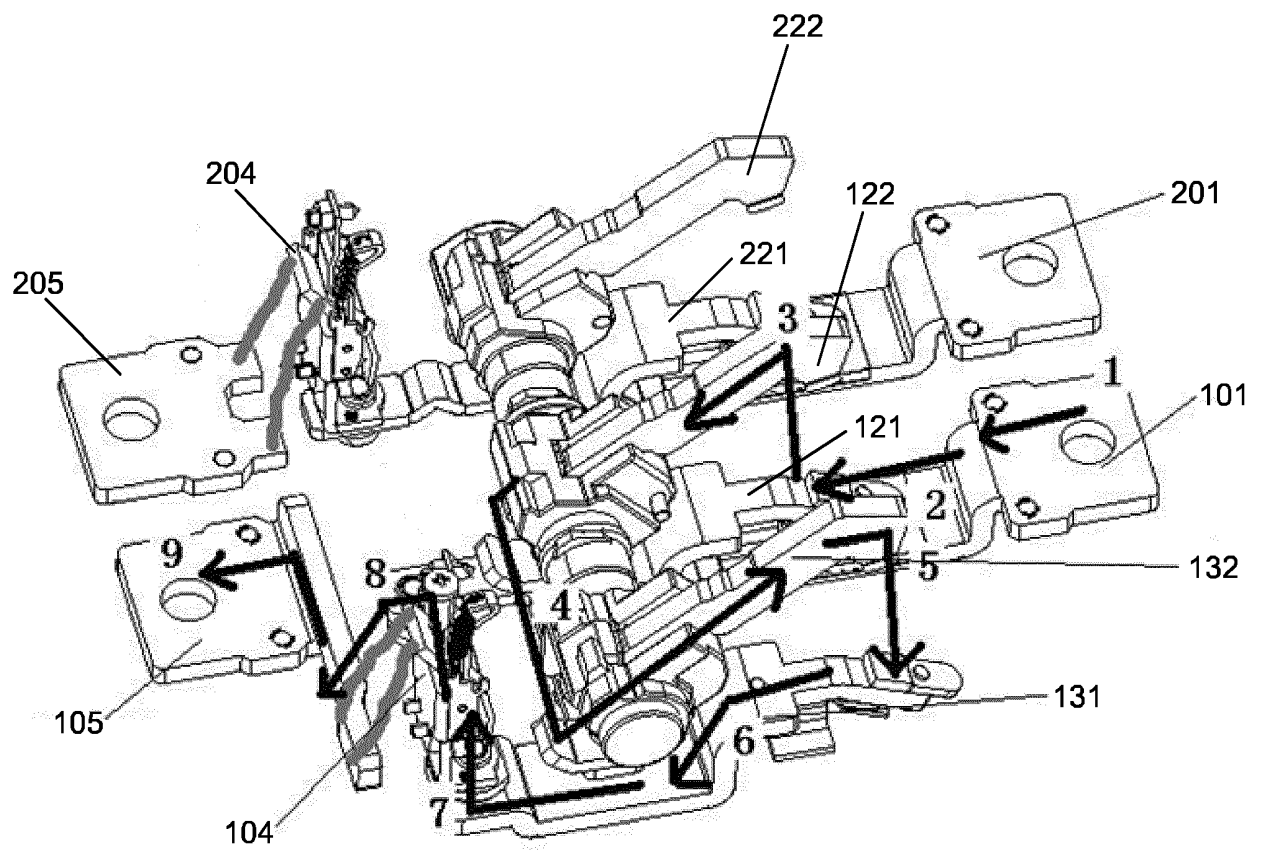


FIG 1

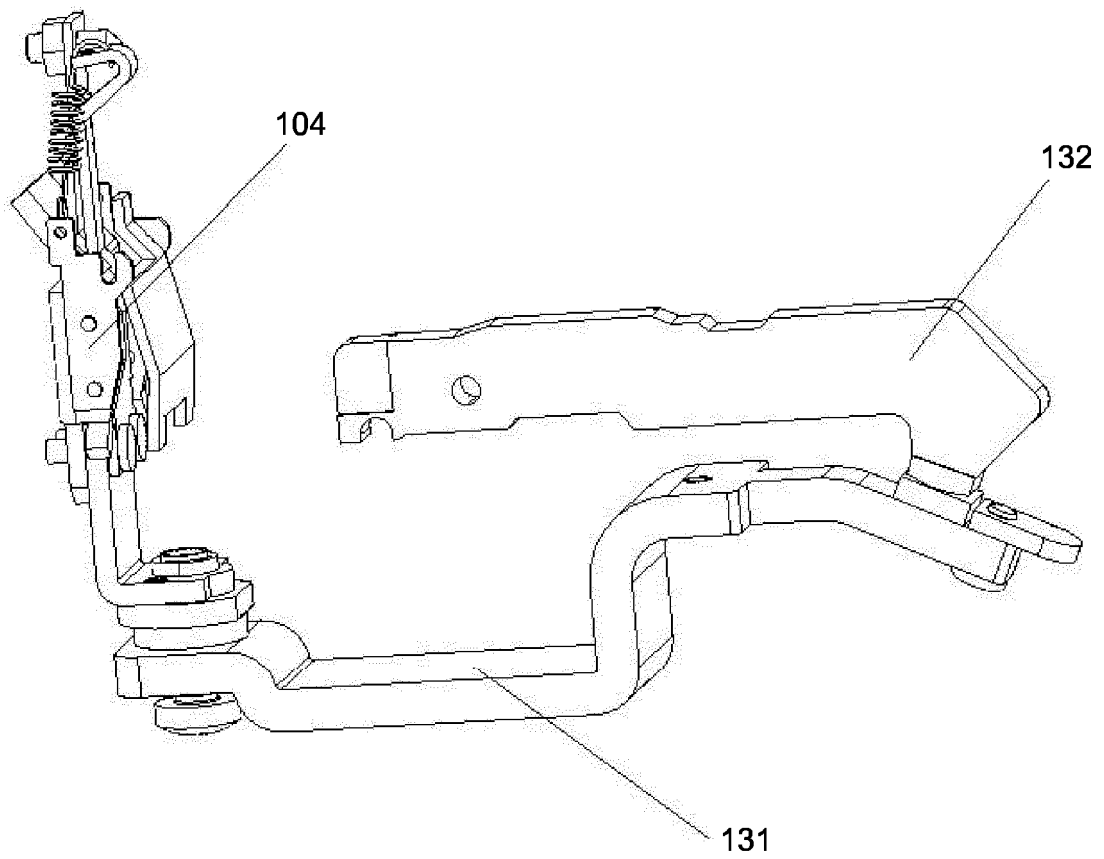


FIG 3

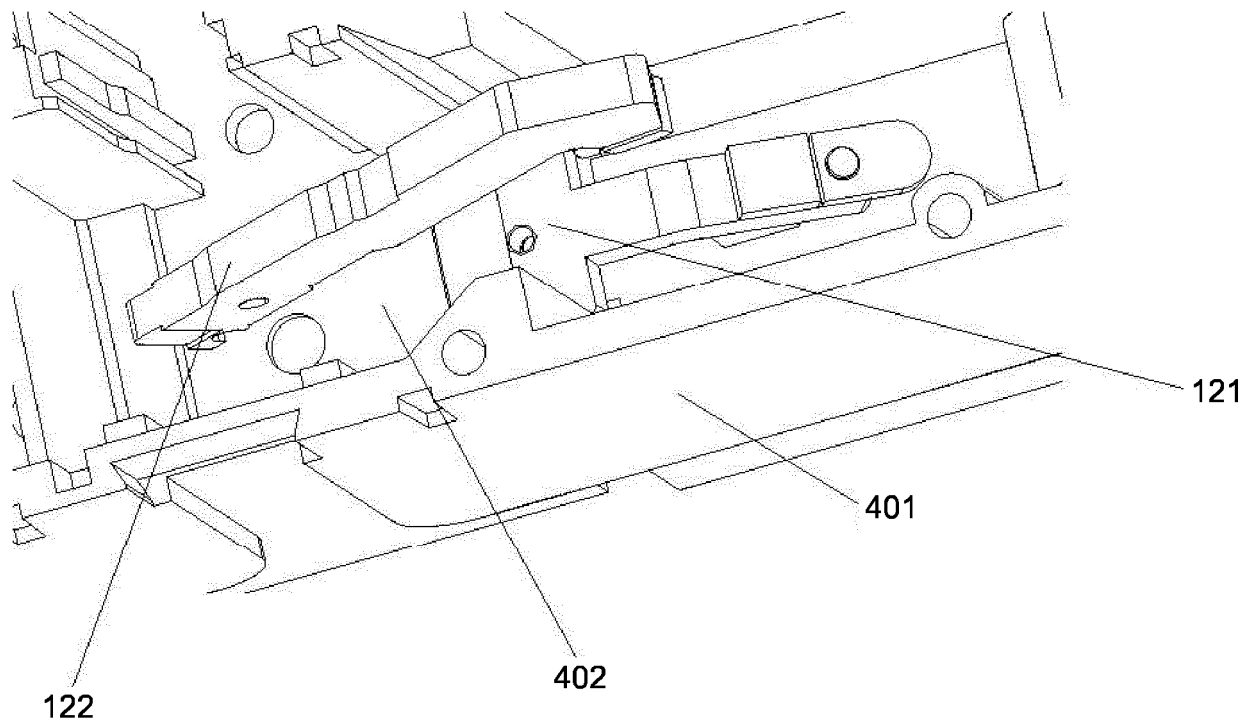


FIG 4a

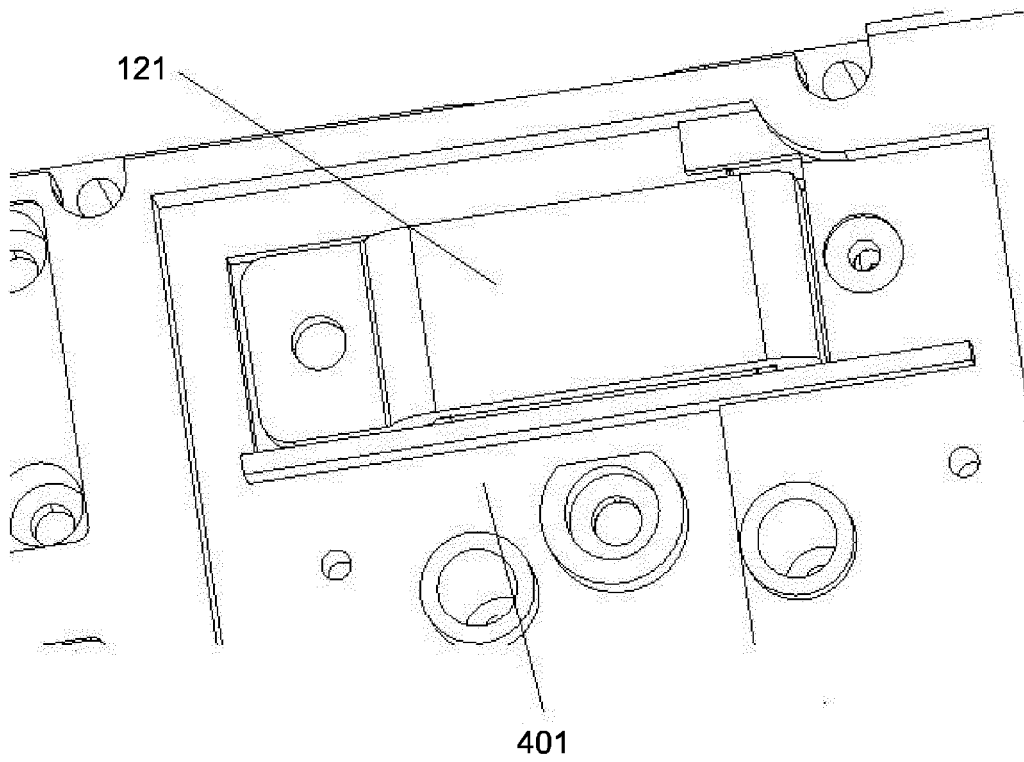


FIG 4b

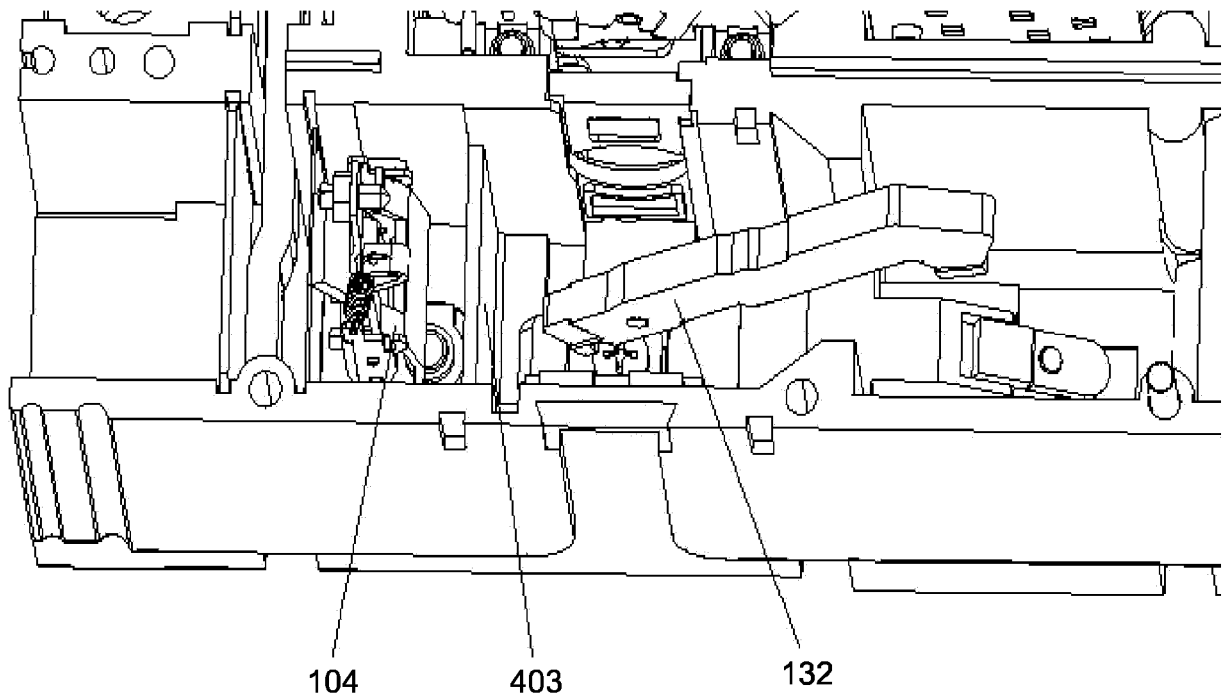


FIG 4c

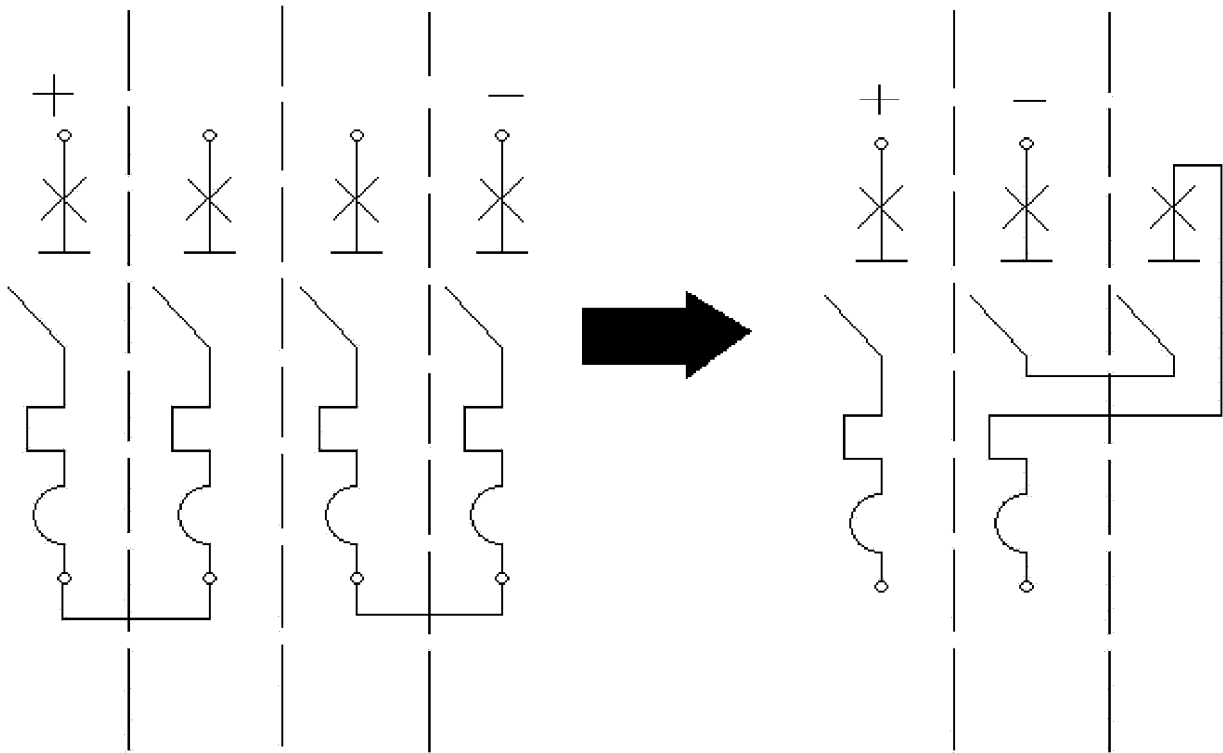


FIG 5a

FIG 5b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/091420

A. CLASSIFICATION OF SUBJECT MATTER

H01H 71/08 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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: breaker, mov+, fix+, contact?, multi w break+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 105914109 A (SEARI ELECTRICAL APPARATUS TECHNOLOGY CO., LTD. et al.) 31 August 2016 (31.08.2016) description, paragraphs [0001]-[0031], claims 1-10, and figures 1-5	1-10
PX	CN 205863109 U (SEARI ELECTRICAL APPARATUS TECHNOLOGY CO., LTD. et al.) 04 January 2017 (04.01.2017) description, paragraphs [0001]-[0031], claims 1-10, and figures 1-5	1-10
X	CN 102456515 A (BEIJING PEOPLE'S ELECTRIC PLANT CO., LTD.) 16 May 2012 (16.05.2012) description, paragraphs [0021]-[0023] and [0025], and figures 1, 3-5, 10 and 11	1-10
X	CN 201829430 U (BEIJING PEOPLE'S ELECTRIC PLANT CO., LTD.) 11 May 2011 (11.05.2011) description, paragraphs [0021]-[0023] and [0025], and figures 1, 3-5, 10 and 11	1-10

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

* Special categories of cited documents:	"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
"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	"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
"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)	"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
"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	"&" document member of the same patent family

Date of the actual completion of the international search

17 August 2017

Date of mailing of the international search report

28 September 2017

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/091420

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 102592903 A (BEIJING PEOPLE'S ELECTRIC PLANT CO., LTD.) 18 July 2012 (18.07.2012) the whole document	1-10
A	EP 1126486 A1 (SERD) 22 August 2001 (22.08.2001) 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/CN2017/091420

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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CN 201829430 U	11 May 2011	None	
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