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(54) **LEAKAGE PROTECTION UNIT AND RESIDUAL-CURRENT CIRCUIT BREAKER**

(57) A leakage protection unit and a residual-current circuit breaker. The leakage protection unit comprises a base (1), and a handle (2), a tripping mechanism (50), and a first electromagnetic tripper (8) that are mounted in the base (1). Both the handle (2) and the first electromagnetic tripper (8) are in linkage connection with the tripping mechanism (50), so as to respectively drive manual closing and tripping opening of the tripping mechanism (50); and in the tripping mechanism (50), a reset plate (7) and a latch (6) share a pivot shaft (R), such that when the reset plate (7) rotates to unlock the latch (6), a pushing action point of the reset plate on the latch (6) does not deviate, and the unlocking of a locking part (61) and a locked part (51) does not slide mutually, thereby improving the stability of a tripping force and the reliability of a tripping process.

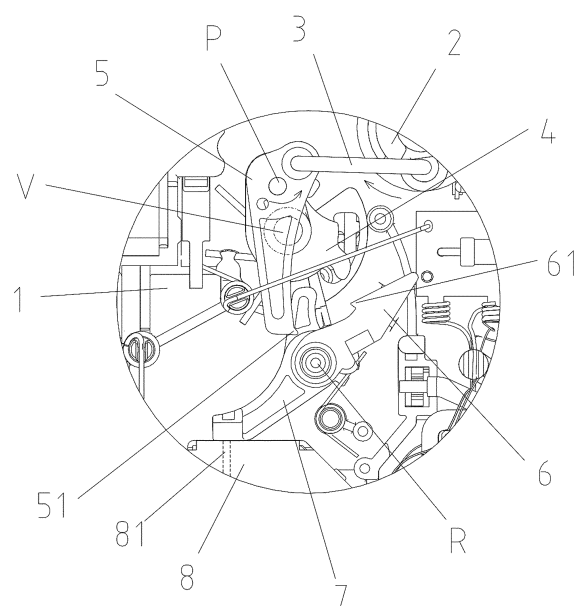


FIG. 5

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## Description

### CROSS REFERENCE

**[0001]** The present disclosure claims priority to Chinese Patent Application No. 202210590003. X, filed on May 27, 2022, which is incorporated herein by reference in its entirety.

### TECHNICAL FIELD

**[0002]** The present disclosure relates to a field of circuit breaker manufacturing technology and specifically to a residual-current circuit breaker, in particular to improvement of a leakage protection unit.

### BACKGROUND

**[0003]** A residual-current circuit breaker generally includes a circuit breaker unit and a leakage protection unit. The circuit breaker unit realizes on-off of a circuit, and overload and short-circuit protection of the circuit. The circuit breaker mechanism is driven to open through actions of a thermal tripping mechanism and an electromagnetic mechanism. The leakage protection unit detects leakage current in the circuit through a zero-sequence current transformer. Then, through signal processing of a control circuit board, a voltage output from the control circuit board causes a tripper push rod in the leakage protection unit to be pushed out (induced electromotive force induced by the zero-sequence current transformer is output to the tripper), so as to urge the tripping mechanism of the leakage protection unit to act. Finally, the circuit breaker unit is opened, thereby protecting the circuit.

**[0004]** Chinese Patent Publication No. CN107424879A discloses a leakage protection unit with a tripping action as an indefinite eccentric action, which improves a tripping action process, makes tripping more effortless, and makes the leakage protection unit safe and reliable in function. However, in subsequent research and development, it is found that in the tripping process of the product, an acting point of a thrust of a reset plate on a latch is prone to shift, so that a tripping force is prone to change, resulting in an unstable tripping force.

### SUMMARY

**[0005]** Accordingly, directed at the above problems, the present disclosure provides a leakage protection unit with an optimized structure, and further provides a residual-current circuit breaker having the leakage protection unit.

**[0006]** The present disclosure is implemented by the following technical solutions.

**[0007]** A leakage protection unit according to the present disclosure includes: a base; and a handle, a tripping

mechanism, and a first electromagnetic tripper that are installed in the base. The handle and the first electromagnetic tripper are in linkage connection with the tripping mechanism, to drive manual opening and closing and tripping opening of the tripping mechanism, respectively. The tripping mechanism includes a tripping rod, a tripping buckle, a latch, and a reset plate; the handle, the tripping rod, the latch and the reset plate are rotatably pivotally connected to the base; the latch and the reset plate share one pivot shaft; the tripping buckle is pivotally connected to the tripping rod; the handle is in linkage connection with the tripping buckle; the latch is provided with a locking part, and the tripping buckle is provided with a locked part capable of a latching fit with the locking part; and the reset plate is disposed at a side of the first electromagnetic tripper to receive a push from an output rod of the first electromagnetic tripper, so as to toggle the latch to release the latching fit.

**[0008]** In an embodiment of the present disclosure, the locking part and the locked part are J-shaped hook structures capable of being hooked with each other.

**[0009]** In an embodiment of the present disclosure, the leakage protection unit further includes a first elastic member. One end of the first elastic member acts on the base, and another end of the first elastic member acts on the reset plate, to maintain contact between the reset plate and the output rod of the first electromagnetic tripper by means of an elastic force of the first elastic member, and to realize rotation reset of the reset plate.

**[0010]** In an embodiment of the present disclosure, the leakage protection unit further includes a second elastic member and a third elastic member. One end of the second elastic member acts on the base, and another end of the second elastic member acts on the latch, to realize rotation reset of the latch. One end of the third elastic member acts on the base, and another end of the third elastic member acts on the handle, to realize rotation reset of the handle.

**[0011]** In an embodiment of the present disclosure, the reset plate is provided with a pushing part, the latch is provided with a push receiving part, and the pushing part pushes against the push receiving part, to toggle the latch by the reset plate.

**[0012]** In an embodiment of the present disclosure, the pushing part and the push receiving part are bump structures integrally formed on the reset plate and the latch, respectively.

**[0013]** In an embodiment of the present disclosure, the reset plate further includes an arc-shaped groove, the pushing part is disposed at an end of the arc-shaped groove, and the push receiving part extends into the arc-shaped groove.

**[0014]** The present disclosure has the following beneficial effects. In the tripping mechanism according to the present disclosure, the reset plate and the latch share one pivot shaft, so that when the reset plate rotates to unlock the latch, a pushing point on the latch will not shift, and there will be no mutual slippage in the unlocking

between the locking part and the locked part, thereby further improving stability of the tripping force and reliability of the tripping process.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0015]** The above and other features and advantages of the present disclosure will become more apparent by describing in detail exemplary embodiments thereof with reference to the accompanying drawings.

FIG. 1 is a perspective view of a residual-current circuit breaker according to an embodiment of the present disclosure;

FIG. 2 is an exploded view of a leakage protection unit of a residual-current circuit breaker according to an embodiment of the present disclosure;

FIG. 3 is a perspective view of a leakage protection unit according to an embodiment of the present disclosure;

FIG. 4 is a front view (opening) of a leakage protection unit according to an embodiment of the present disclosure;

FIG. 5 is a partially enlarged view of part A in FIG. 4; FIG. 6 is a front view (closing) of a leakage protection unit according to an embodiment of the present disclosure;

FIG. 7 is a perspective view of a circuit breaker unit according to an embodiment of the present disclosure;

FIG. 8 is a schematic view of cooperation between a circuit breaker pole latch and a tripping rod according to an embodiment of the present disclosure;

FIG. 9 is a schematic view of cooperation between a reset plate and a latch according to an embodiment of the present disclosure.

## DETAILED DESCRIPTION

**[0016]** Exemplary embodiments will now be described more comprehensively with reference to the accompanying drawings. The accompanying drawings as a part of the present disclosure are mainly used to illustrate the embodiments, and can explain the operating principles of the embodiments in conjunction with the related description in this specification. Other possible embodiments and advantages of the present disclosure will be appreciated by those skilled in the art with reference to these contents. Components in the drawings are not drawn to scale, and similar component symbols are generally used to denote similar components. The exemplary embodiments can be implemented in various forms and should not be construed as being limited to the implementations set forth herein. Although relative terms such as "up" and "down" are used in this specification to describe the relative relationship of one symbolized component to another symbolized component, these terms are used in this specification for convenience only, for

example, according to directions of examples described in the drawings. It can be understood that if a symbolized device is turned upside down, a component described as being "up" will become a component as being "down". Other relative terms such as "top" and "bottom" also have similar meanings. When a structure is "on" another structure, it may mean that the structure is integrally formed on the other structure, or that the structure is "directly" disposed on the other structure, or that the structure is "indirectly" disposed on the other structure through another structure.

**[0017]** Referring to FIGS. 1-2, as a preferred embodiment of the present disclosure, a residual-current circuit breaker is provided, including a circuit breaker unit 10 and a leakage protection unit 20 that are pole-connected side by side. The circuit breaker unit 10 is configured to implement on-off of a circuit. The leakage protection unit 20 is configured to detect a leakage current in the circuit, and push the circuit breaker unit 10 to open through an action of a tripping mechanism, thereby protecting the circuit.

**[0018]** As shown in FIG. 2-7, the leakage protection unit 20 may include a base 1, a handle 2, a tripping mechanism 50, a first electromagnetic tripper 8, a control circuit board 12, and a zero-sequence current transformer 13. The tripping mechanism 50 includes a tripping rod 4, a tripping buckle 5, a latch 6 and a reset plate 7. The handle 2, the tripping rod 4, the latch 6 and the reset plate 7 are all rotatably pivotally connected to the base 1, and the tripping buckle 5 is pivotally connected to the tripping rod 4. A pivot shaft of the tripping rod 4 with the base 1 is a shaft V, a pivot shaft of the tripping buckle 5 with the tripping rod 4 is a shaft P, and the shaft V and the shaft P are different shafts. The handle 2 is in linkage connection with the tripping buckle 5 through a connection rod 3, the latch 6 is provided with a locking part 61 (see FIG. 5), and the tripping buckle 5 is further provided with a locked part 51 that may be in a latching fit with the locking part 61. As shown in FIGS. 4-6, in an opening state of the circuit breaker (FIG. 4), the handle 2 is toggled, and the tripping buckle 5 is driven by the linkage of the connection rod 3 to rotate around the shaft P, until the locked part 51 is in the latching fit (latch locking) with the locking part 61 due to the rotation of the tripping buckle 5. At this time, the latch 6 forms a limitation on the tripping buckle 5, the locking part 61 provides a fulcrum for the tripping buckle 5, and under a continuous force of the handle 2, the tripping buckle 5 rotates along with the tripping rod 4 around the shaft V. As shown in FIG. 2, the tripping rod 4 includes a linkage connecting part 41 extending into the circuit breaker unit 10, and the linkage connecting part 41 cooperates with an operating mechanism 17 of the circuit breaker unit 10 to realize closing of the circuit breaker unit 10.

**[0019]** As shown in FIGS. 4-5, the zero-sequence current transformer 13 is configured to detect the leakage current in the circuit. When the zero-sequence current transformer 13 detects the leakage current, a signal is fed back to the control circuit board 12, the control circuit board 12 performs signal processing, and then sends an

instruction to enable the first electromagnetic tripper 8 to act. The reset plate 7 is disposed at a side of the first electromagnetic tripper 8, and when an output rod 81 of the first electromagnetic tripper 8 extends out, the reset plate 7 can be pushed to rotate. The reset plate 7 is simultaneously linked with the latch 6 and, after being pushed by the output rod 81 of the first electromagnetic tripper 8, the reset plate 7 may push against the latch 6 to toggle the latch 6 to rotate clockwise, so as to unlock the locked part 51 and the locking part 61. After the latching fit between the locked part 51 and the locking part 61 is released, the tripping mechanism 50 quickly trips and opens, and the tripping rod 4 rotates and cooperates with the operating mechanism 17 of the circuit breaker unit 10, to realize tripping and opening of the leakage protection unit 20 and the circuit breaker unit 10. Specifically, as shown in FIG. 8, the operating mechanism 17 includes a circuit breaker pole latch 170, and the circuit breaker pole latch 170 is provided with a lead-out part 171. When the tripping mechanism 50 trips, the linkage connecting part 41 of the tripping rod 4 rotates, and the lead-out part 171 is toggled to enable the circuit breaker pole latch 170 to realize tripping and opening of the circuit breaker unit 10.

**[0020]** In order to provide a reset force for each rotating component, and enable the tripping mechanism 50 to quickly trip by the reset force when the locked part 51 and the locking part 61 are unlocked, a first elastic member 70, a second elastic member 40, and a third elastic member 42 are also provided in this embodiment (see FIG. 2). As an exemplary embodiment, the first elastic member 70, the second elastic member 40, and the third elastic member 42 in this embodiment are all torsion springs. One end of the first elastic member 70 acts on the base 1, and the other end thereof acts on the reset plate 7, to maintain contact between the reset plate 7 and the output rod 81 of the first electromagnetic tripper 8 by means of its elastic force, and realize rotation reset of the reset plate 7 after quick tripping, thereby providing a reset force for the output rod 81. One end of the second elastic member 40 acts on the base 1, and the other end thereof acts on the latch 6, so as to realize rotation reset of the latch 6 after quick tripping. One end of the third elastic member 42 acts on the base 1, and the other end thereof acts on the handle 2, so as to realize rotation reset of the handle 2 after quick tripping.

**[0021]** As shown in FIG. 5, in this embodiment, the locked part 51 and the locking part 61 are J-shaped hook structures capable of being hooked with each other, so that the latching fit between the locked part 51 and the locking part 61 is more stable and reliable.

**[0022]** Particularly importantly, in this embodiment, the reset plate 7 and the latch 6 share one pivot shaft R. Since a rotation center of the reset plate 7 and a rotation center of the latch 6 coincide, when the reset plate 7 rotates to unlock the latch 6, a pushing point on the latch 6 will not shift, and there will be no mutual slippage in the unlocking between the locked part 51 and the locking part 61, thereby further improving stability of the tripping force

and reliability of the tripping process.

**[0023]** FIG. 9 shows a specific structure of cooperation between the reset plate 7 and the latch 6. The reset plate 7 is provided with a pushing part 71, and the latch 6 is provided with a push receiving part 62. After the reset plate 7 receives a push from the output rod 81 of the first electromagnetic release 8 and then rotates around the pivot shaft R, the pushing part 71 can push against the push receiving part 62, to toggle the latch 6 to rotate, thereby realizing unlocking between the locked part 51 and the locking part 61.

**[0024]** In this embodiment, the pushing part 71 and the push receiving part 62 are bump structures integrally formed on the reset plate 7 and the latch 6 respectively, which facilitates production and manufacturing. In other embodiments, the pushing part 71 and the push receiving part 62 may be any shape capable of abutting against each other, such as a plate shape or a rod shape. Further, as shown in FIG. 9, the reset plate 7 further includes an arc-shaped groove 72, the pushing part 71 is disposed at an end of the arc-shaped groove 72, and the push receiving part 62 extends into the arc-shaped groove 72, so that during assembly, relative positions of the reset plate 7 and the latch 6 may be established to a certain extent by fitting the push receiving part 62 with the arc-shaped groove 72, thereby ensuring the co-axiality of the two during assembly.

**[0025]** Although the present disclosure has been specifically shown and described in connection with the preferred embodiments, it should be understood by those skilled in the art that various changes made to the present disclosure in form and detail without departing from the spirit and scope of the present disclosure as defined by the appended claims fall into the protection scope of the present disclosure.

**[0026]** It should be understood that the present disclosure does not limit its application to the detailed structures and arrangements of components presented herein. The present disclosure may have other embodiments and be realized and performed in a variety of ways. The foregoing variations and modifications fall into the scope of the present disclosure. It should be understood that the present disclosure as disclosed and defined in this specification extends to all alternative combinations of two or more individual features mentioned or apparent in the text and/or in the drawings. All of these various combinations constitute a plurality of alternative aspects of the present disclosure. The embodiments described in this specification elaborate the best ways known for realizing the present disclosure and will enable those skilled in the art to utilize the present disclosure.

## Claims

1. A leakage protection unit, comprising:

a base; and

- a handle, a tripping mechanism, and a first electromagnetic tripper that are all installed on the base,  
 wherein the handle and the first electromagnetic tripper are in linkage connection with the tripping mechanism, to drive manual opening and closing and tripping opening of the tripping mechanism, respectively,  
 the tripping mechanism comprises a tripping rod, a tripping buckle, a latch, and a reset plate; the handle, the tripping rod, the latch and the reset plate are rotatably pivotally connected to the base; the latch and the reset plate share one pivot shaft; the tripping buckle is pivotally connected to the tripping rod; the handle is in linkage connection with the tripping buckle; the latch is provided with a locking part, and the tripping buckle is provided with a locked part capable of a latching fit with the locking part; and the reset plate is disposed at a side of the first electromagnetic tripper to receive a push from an output rod of the first electromagnetic tripper, so as to toggle the latch to release the latching fit.
2. The leakage protection unit according to claim 1, wherein the locking part and the locked part are J-shaped hook structures capable of being hooked with each other.
3. The leakage protection unit according to claim 1, further comprising a first elastic member, wherein one end of the first elastic member acts on the base, and another end of the first elastic member acts on the reset plate, to maintain contact between the reset plate and the output rod of the first electromagnetic tripper by means of an elastic force of the first elastic member, and to realize rotation reset of the reset plate.
4. The leakage protection unit according to claim 1, further comprising a second elastic member, wherein one end of the second elastic member acts on the base, and another end of the second elastic member acts on the latch, to realize rotation reset of the latch.
5. The leakage protection unit according to claim 1, further comprising a third elastic member, wherein one end of the third elastic member acts on the base, and another end of the third elastic member acts on the handle, to realize rotation reset of the handle.
6. The leakage protection unit according to any one of claims 1 to 5, wherein the reset plate is provided with a pushing part, the latch is provided with a push receiving part, and the pushing part pushes against the push receiving part, to toggle the latch by the reset plate.
7. The leakage protection unit according to claim 6, wherein the pushing part is a bump structure integrally formed on the reset plate.
8. The leakage protection unit according to claim 6, wherein the push receiving part is a bump structure integrally formed on the latch.
9. The leakage protection unit according to claim 7, wherein the reset plate further comprises an arc-shaped groove, the pushing part is disposed at an end of the arc-shaped groove, and the push receiving part extends into the arc-shaped groove.
10. A residual-current circuit breaker, comprising:  
 a circuit breaker unit; and  
 a leakage protection unit according to any one of claims 1 to 9.

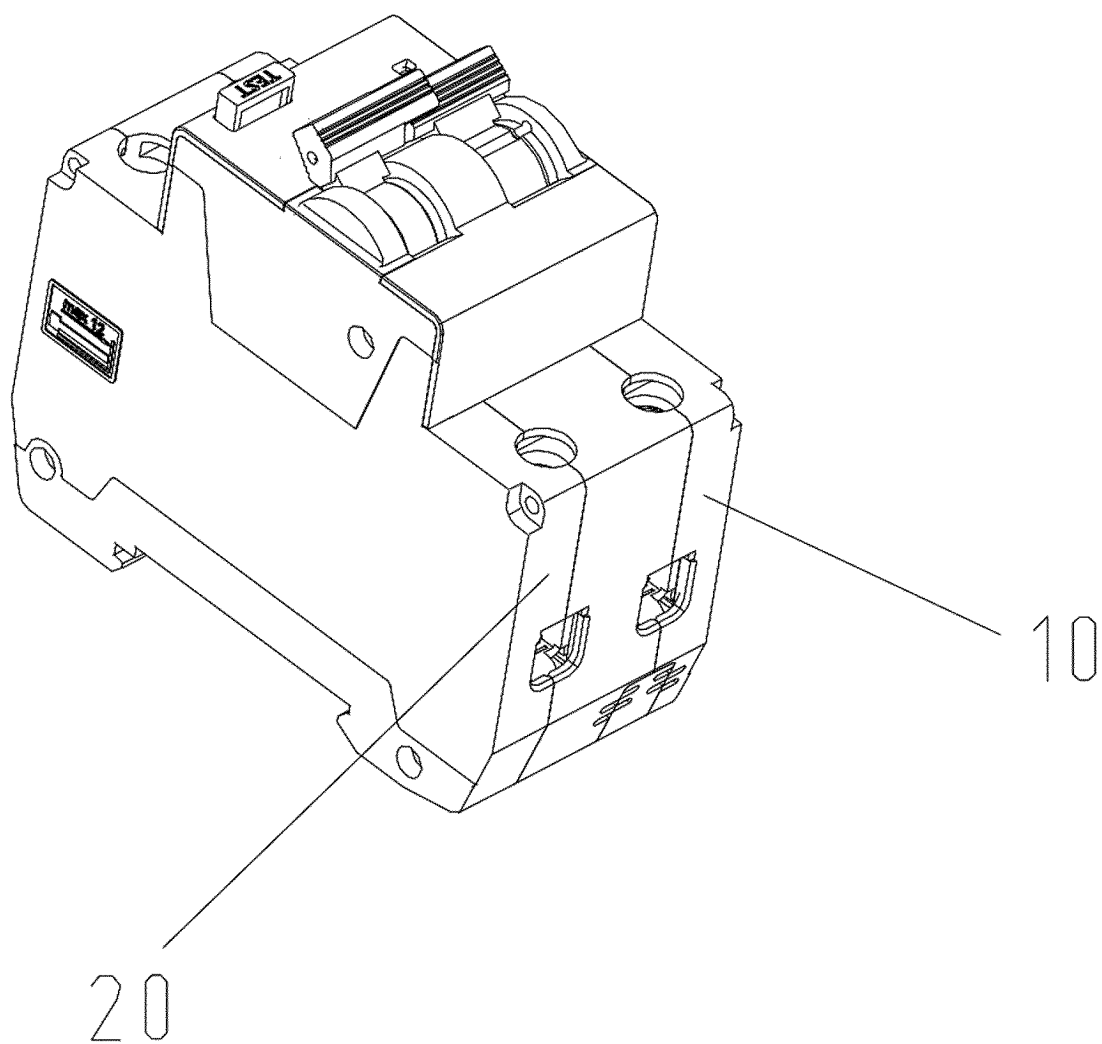


FIG. 1

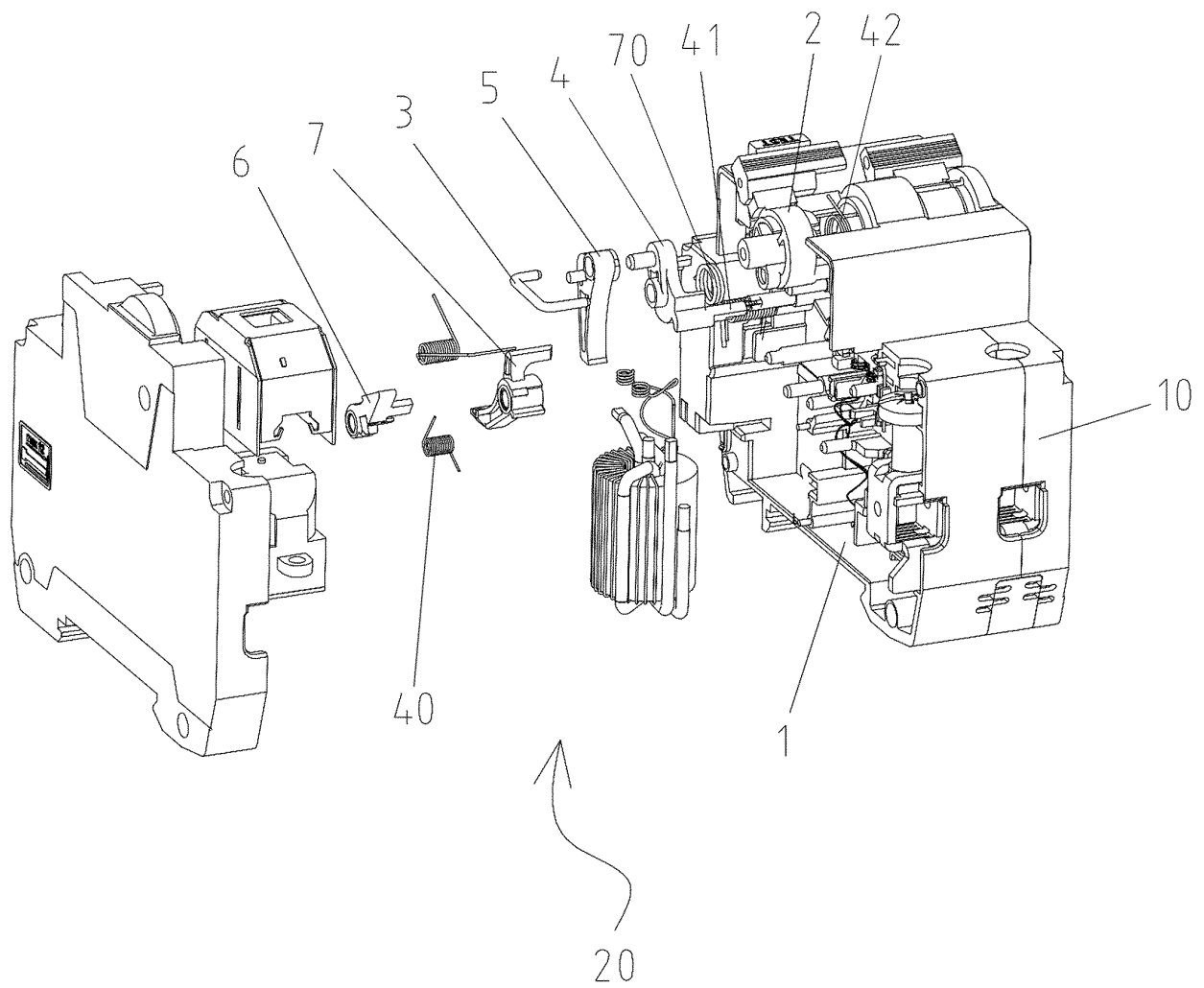


FIG. 2

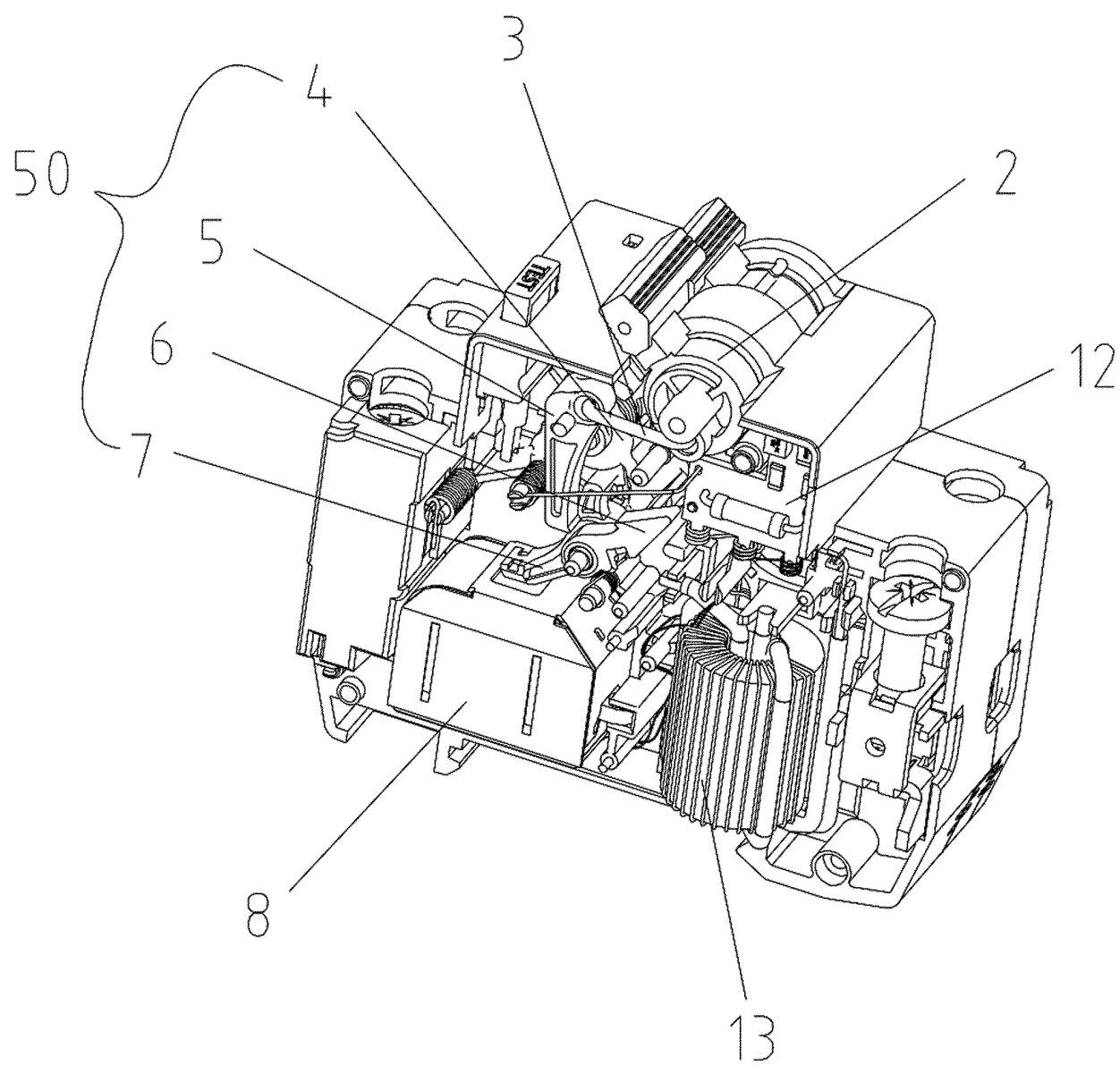


FIG. 3

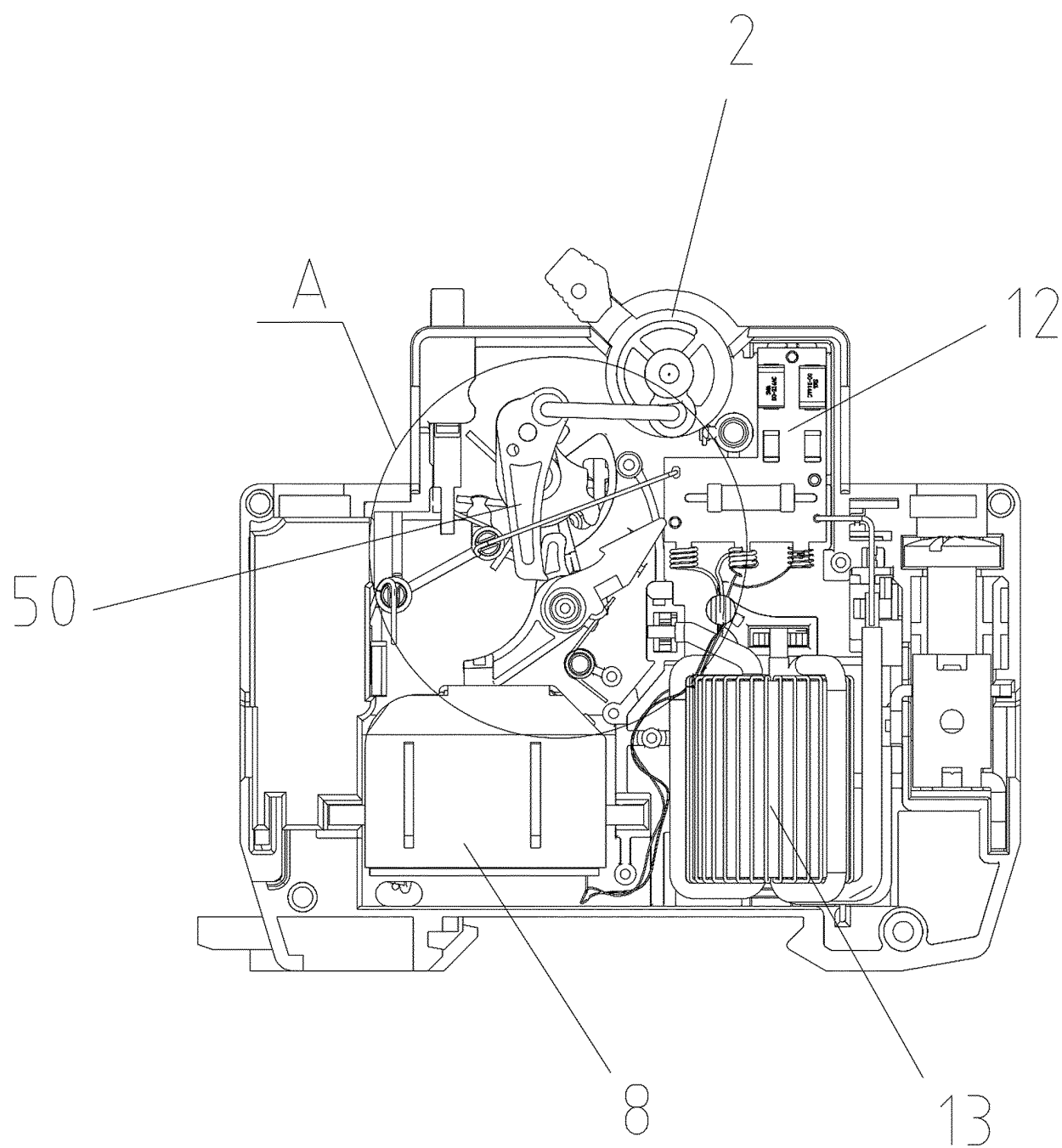


FIG. 4

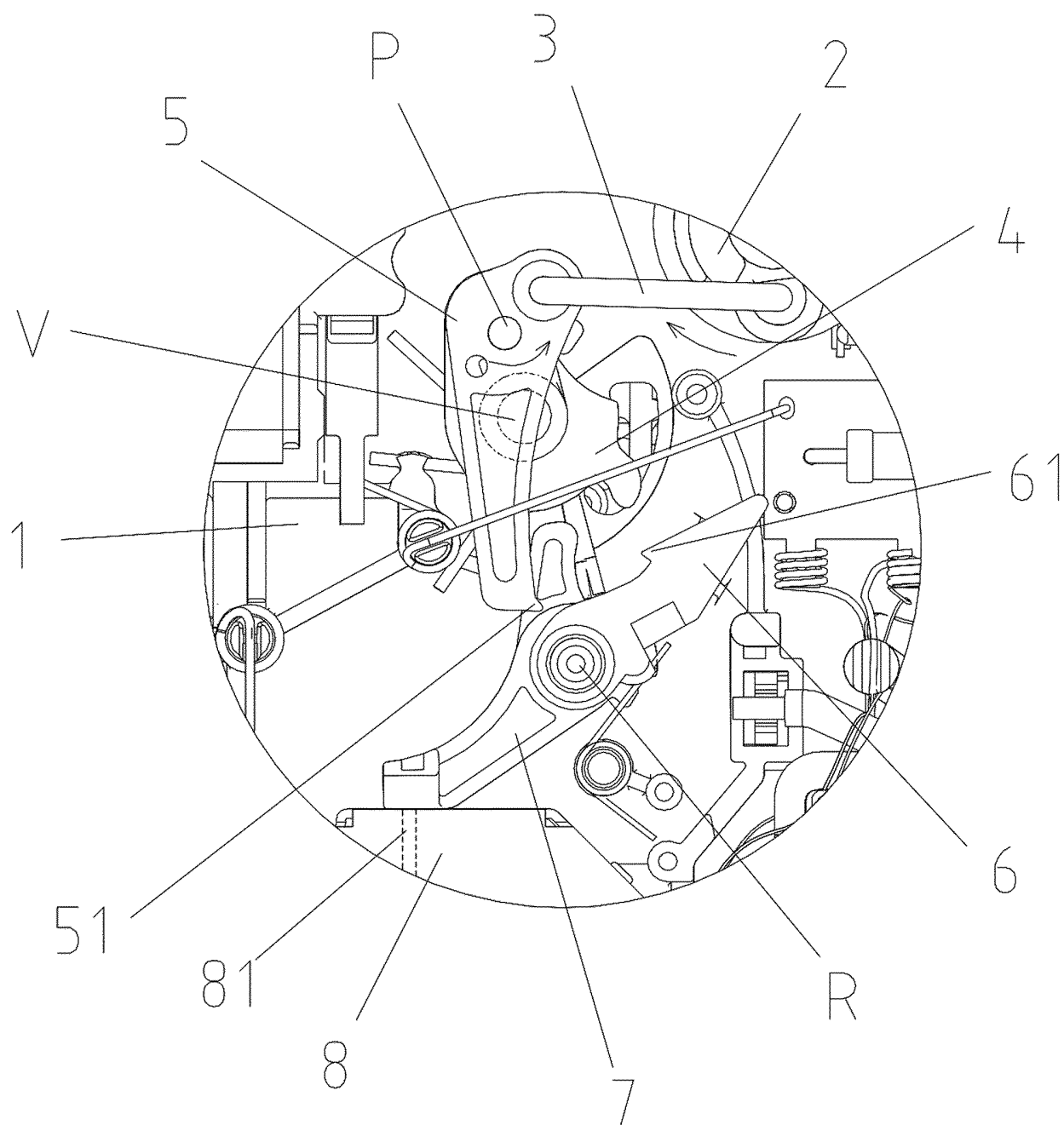


FIG. 5

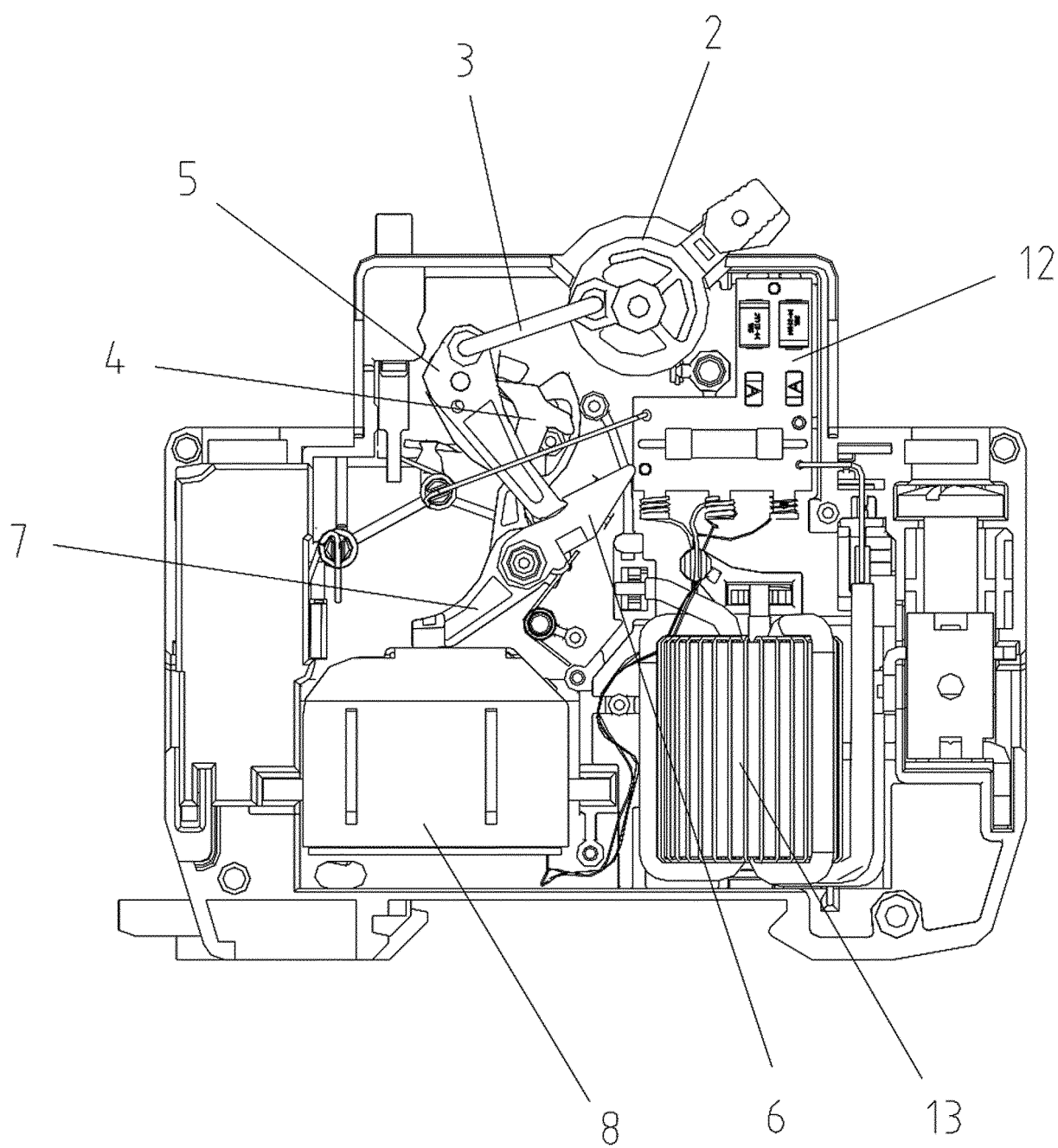


FIG. 6

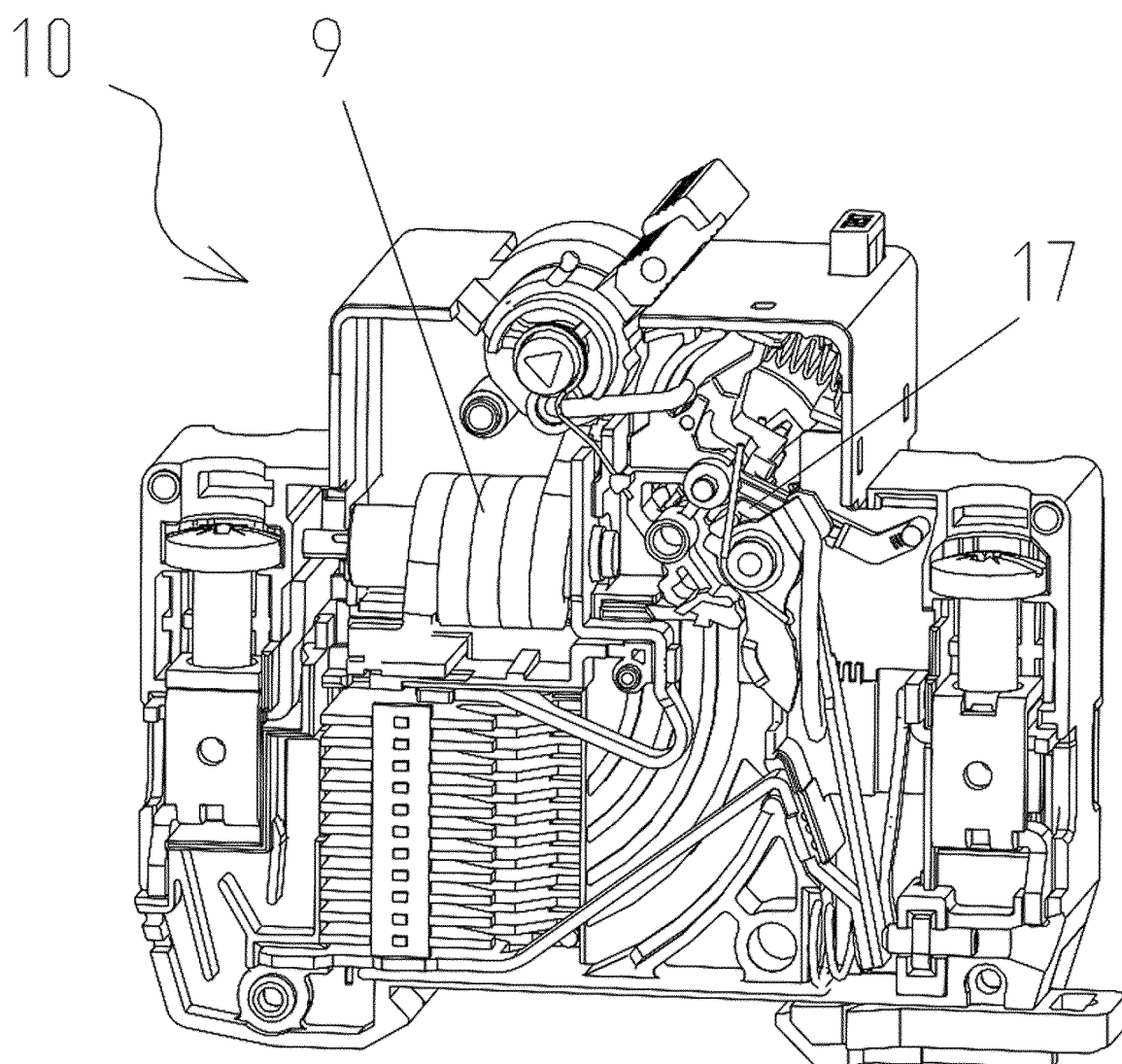


FIG. 7

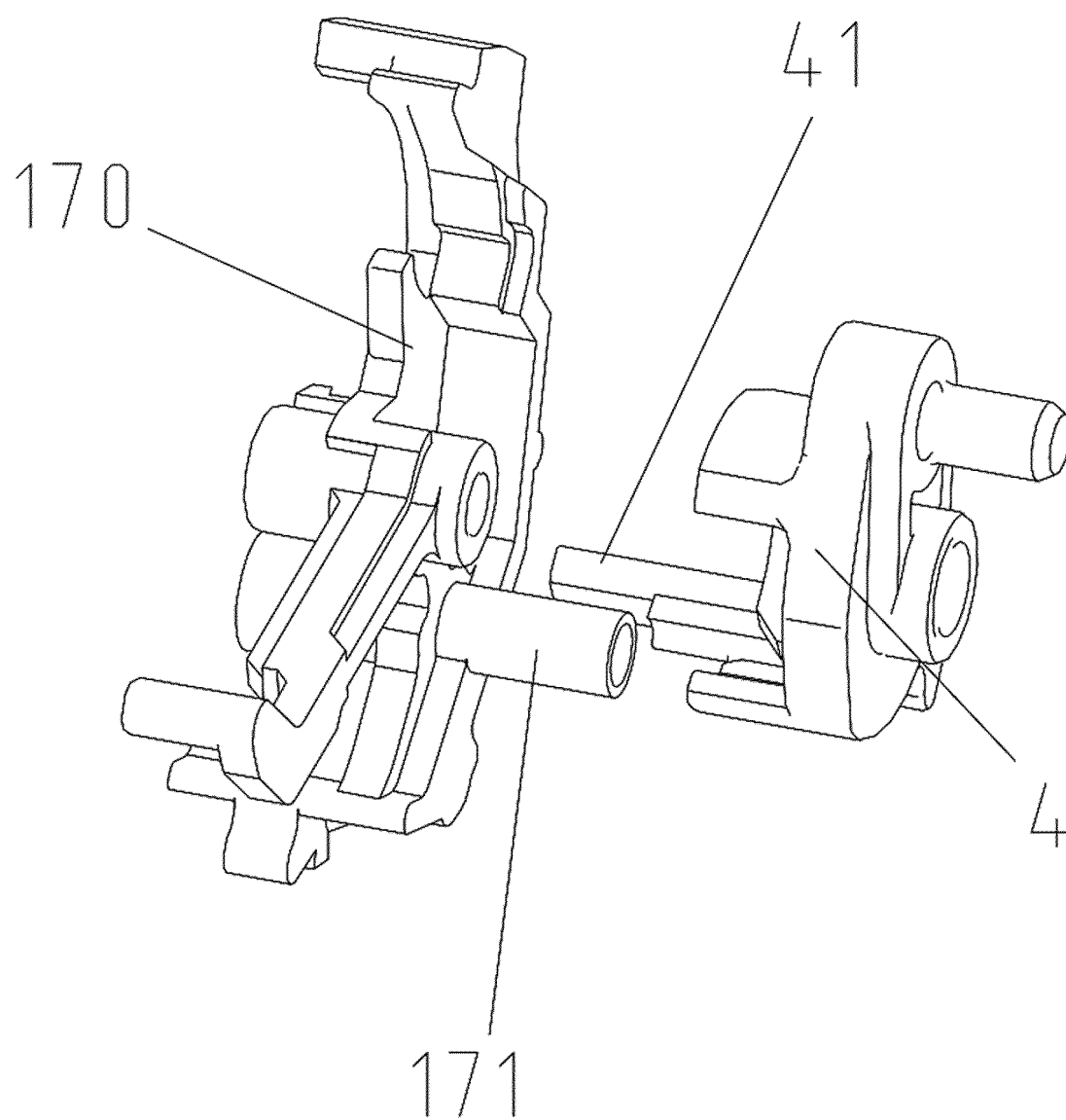


FIG. 8

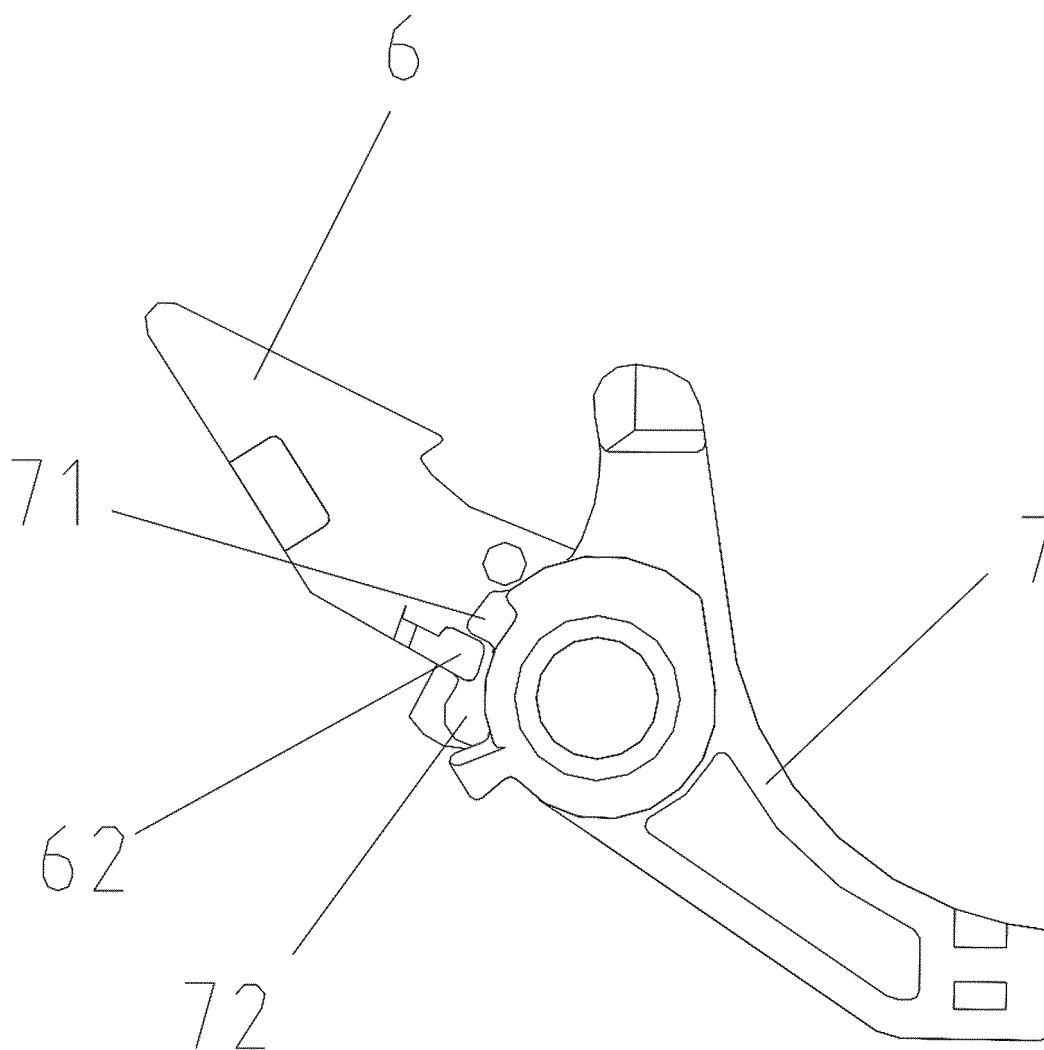


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/090952

**A. CLASSIFICATION OF SUBJECT MATTER**

H01H71/12(2006.01)i; H01H71/24(2006.01)i

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

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN, CNABS, CNTXT, WOTXT, EPTXT, USTXT, CNKI, IEEE: 断路器, 漏电, 脱扣, 同轴, 共轴, 合用, breaker, leakage, tripper, share shaft, same shaft, combined shaft

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                              | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Date of the actual completion of the international search<br><b>20 June 2023</b>                                                                                                               | Date of mailing of the international search report<br><b>23 June 2023</b> |
| Name and mailing address of the ISA/CN<br><b>China National Intellectual Property Administration (ISA/CN)<br/>China No. 6, Xitucheng Road, Jimenqiao, Haidian District,<br/>Beijing 100088</b> | Authorized officer<br><br>Telephone No.                                   |

**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2023/090952**

| Patent document<br>cited in search report |            |   | Publication date<br>(day/month/year) | Patent family member(s) |           |    | Publication date<br>(day/month/year) |
|-------------------------------------------|------------|---|--------------------------------------|-------------------------|-----------|----|--------------------------------------|
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Form PCT/ISA/210 (patent family annex) (July 2022)

**REFERENCES CITED IN THE DESCRIPTION**

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