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(54) **RESIDUAL CURRENT OPERATED CIRCUIT BREAKER**

(57) The present invention provides a residual current operated circuit breaker (100). The circuit breaker comprises: a housing (10); an electromagnetic trip apparatus and an arc extinguishing apparatus; a first operating mechanism and a second operating mechanism; a leakage trip apparatus; a first terminal assembly (71), with an installation gap being provided on one side of an installation housing, the first terminal assembly being capable of running through the installation gap and being clamped in a space formed by the first housing and the second housing; a second terminal assembly (72), being accommodated in the first accommodating chamber; a third terminal assembly (51), being accommodated in the second accommodating chamber; a flexible conductor assembly having a contact opening/closing function, being accommodated in the second accommodating chamber. A product of the residual current operated circuit breaker according to the present invention has a better protection function, a housing has a more compact structural layout, and a process of product installation and wiring is more convenient and reliable.

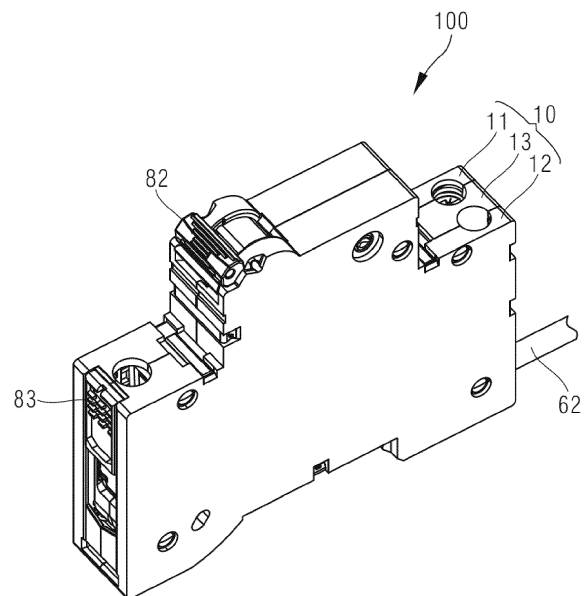


Fig. 1

**EP 3 385 974 A1**

**Description**

Cross reference to related application

5 **[0001]** This patent application claims the priority of Chinese patent application 201710221946.4 filed 6. Apr. 2017, which is herein incorporated by reference.

Technical field

10 **[0002]** The present invention relates to the field of low-voltage electricity, in particular to a residual current operated circuit breaker.

Background art

15 **[0003]** As is well known, residual current circuit breakers not only have the control, overload and short circuit protection functions of conventional miniature circuit breakers (MCB), but also have a leakage protection function, so can actively protect the safety of life and property, being able to rapidly cut off a faulty power supply within a short time, to protect the safety of people and electrical appliances.

20 **[0004]** Existing RCBOs are generally divided into the following two forms of implementation, depending on their own structural layout. RCBOs of the first type have the same width as a compact product, but because the leakage detection and N pole connection flexible conductors are located on the left side of the product, the product length is greater, so a special distribution box is still needed for installation. Moreover, since the N pole connection flexible conductor lacks the basic protection function of the RCBO, the reliability of the product is poor. RCBOs of the second type have the same dimensions as a compact product, but lack an N pole connection flexible conductor, so the product installation cost is

25 higher, and the convenience of wiring by a user has room for improvement. **[0005]** To resolve the abovementioned shortcomings, there is an urgent need for those skilled in the art to research and develop a new type of residual current operated circuit breaker.

Content of the invention

30 **[0006]** The object of the present invention is to provide a residual current operated circuit breaker; a product thereof has a better protection function, a housing has a more compact structural layout, and a process of product installation and wiring is more convenient and reliable.

35 **[0007]** The present invention provides a residual current operated circuit breaker, comprising: a housing, comprising a first housing, a second housing and an installation housing located therebetween, with a first accommodating chamber being formed between the first housing and the installation housing, and a second accommodating chamber being formed between the second housing and the installation housing; an electromagnetic trip apparatus and an arc extinguishing apparatus, disposed in the first accommodating chamber; a first operating mechanism, used for working in cooperation with the electromagnetic trip apparatus and being located on one side of the first accommodating chamber;

40 a leakage trip apparatus, disposed in the second accommodating chamber; a second operating mechanism, used for working in cooperation with the leakage trip apparatus and being located on one side of the second accommodating chamber, with actions of the first operating mechanism and the second operating mechanism being capable of realizing the opening and closing of a current loop; a first terminal assembly, which may be used for an L pole incoming line, with an installation gap being provided on one side of the installation housing, the first terminal assembly being capable of

45 running through the installation gap and being clamped in a space formed by the first housing and the second housing; a second terminal assembly, which may be used for an L pole outgoing line, being accommodated in the first accommodating chamber; a third terminal assembly, which may be used for an N pole incoming line, being accommodated in the second accommodating chamber; a flexible conductor assembly having a contact opening/closing function, which may be used for an N pole outgoing line, being accommodated in the second accommodating chamber. This design

50 can provide the user with a method of wiring that is more convenient and reliable, and on condition that it is ensured that the product has perfect safety protection, still has an optimal housing structure.

**[0008]** According to one aspect of the present invention, the second terminal assembly is located on one side, close to the electromagnetic trip apparatus, in the first accommodating chamber.

55 **[0009]** According to another aspect of the present invention, an incoming line end of the third terminal assembly and an outgoing line end of the flexible conductor assembly are located on the same side of the housing. This design facilitates product installation and wiring, and the structural design of the housing interior is more compact, so the user has no need to use a special distribution box for installation; this helps to increase the user space utilization rate.

**[0010]** According to another aspect of the present invention, the first operating mechanism comprises a first contact

assembly and a first actuating assembly, the second operating mechanism comprises a second contact assembly and a second actuating assembly, and linked movement of the first actuating assembly and second actuating assembly may be realized by means of a drive element and an operating handle.

**[0011]** According to another aspect of the present invention, the flexible conductor assembly comprises: a connecting plate; a first connecting conductor, one end thereof being connected to a static contact in the second contact assembly, and another end thereof being connected to the connecting plate; a second connecting conductor, one end thereof being connected to the connecting plate, and another end thereof being a free connection end and extending to the outside of the housing, to save more space inside the housing; since one side of the first connecting conductor is connected to N pole moving and static contacts, an N pole connecting conductor contact opening/closing function can be realized.

**[0012]** According to another aspect of the present invention, the connecting plate is a bent structure, and is provided with a trough-shaped first bent part, with an end of the first connecting conductor being accommodated in the first bent part; and a plate-like second bent part, with an end of the second connecting conductor being crimped to the second bent part, to help enhance the reliability of structural connection.

**[0013]** According to another aspect of the present invention, a wiring capacity of the first terminal assembly is larger than a wiring capacity of the third terminal assembly; this can effectively enhance the electrical safety and reliability of the L pole wiring.

**[0014]** According to another aspect of the present invention, the first terminal assembly has a current carrying range of 6 A - 32 A, and the first terminal assembly may be connected to a common bus bar, to meet the needs of large current input at the L pole, enhancing product applicability.

**[0015]** According to another aspect of the present invention, the direction of an N pole current loop of the residual current operated circuit breaker is, in sequence, the third terminal assembly, an N pole moving contact, an N pole static contact, the first connecting conductor, the connecting plate and the second connecting conductor.

**[0016]** According to another aspect of the present invention, also included is a thermal protection assembly, being close to the arc extinguishing apparatus and located in the first accommodating chamber, for the purpose of realizing thermal protection of the circuit breaker.

#### Description of the accompanying drawings

**[0017]** The present invention is explained in detail below in conjunction with the accompanying drawings and particular embodiments. In the drawings:

Fig. 1 is a schematic diagram of the product structure of a residual current operated circuit breaker according to an embodiment of the present invention;

fig. 2 is a schematic diagram of an N pole structure of the residual current operated circuit breaker shown in fig. 1;

fig. 3 is a schematic diagram of an L pole structure of the residual current operated circuit breaker shown in fig. 1;

fig. 4 is an exploded schematic diagram of part of the structure of fig. 2; and

fig. 5 is an exploded schematic diagram of part of the structure of fig. 3.

#### Key to labels

residual current operated circuit breaker 100	second contact assembly 43
housing 10	second actuating assembly 44
first housing 11	first terminal assembly 71
second housing 12	second terminal assembly 72
installation housing 13	third terminal assembly 51
electromagnetic trip apparatus 20	flexible conductor assembly 60
first operating mechanism 21	first connecting conductor 61
first contact assembly 22	second connecting conductor 62
L pole static contact 221	connecting plate 63
L pole moving contact 222	first bent part 631
N pole static contact 431	second bent part 632
N pole moving contact 432	circuit board assembly 80

(continued)

first actuating assembly 23	drive element 81
arc extinguishing apparatus 30	operating handle 82
leakage trip apparatus 40	slider 83
second operating mechanism 42	

## Particular embodiments

**[0018]** To enable clearer understanding of the technical features, objectives and effects of the invention, particular embodiments of the present invention are now explained with reference to the accompanying drawings, in which identical labels indicate identical parts. In the drawings representing the embodiments, if the final two digits are the same, this indicates components having the same structure, or having similar structures but the same function.

**[0019]** To make the drawings appear uncluttered, only those parts relevant to the present invention are shown schematically in the drawings; they do not represent the actual structure thereof as a product. Furthermore, to make the drawings appear uncluttered for ease of understanding, in the case of components having the same structure or function in certain drawings, only one of these is drawn schematically, or only one is marked.

**[0020]** As used herein, "top", "bottom", "front", "rear", "left" and "right" etc. are merely used to indicate a positional relationship between relevant parts, not to define their absolute positions.

**[0021]** As used herein, "first" and "second" etc. are merely used to differentiate between parts, not to indicate their order or degree of importance, etc.

**[0022]** As used herein, "parallel" and "perpendicular" etc. are not strict limitations in the mathematical and/or geometric sense, but include errors which can be understood by those skilled in the art and are permitted in manufacture or use, etc.

**[0023]** Referring to fig. 1, this shows a residual current operated circuit breaker according to an embodiment of the present invention; the residual current operated circuit breaker 100 comprises a housing 10. The housing 10 comprises a first housing 11, a second housing 12 and an installation housing 13. The installation housing 13 is located between the first housing 11 and the second housing 12. A first accommodating chamber is formed between the first housing 11 and the installation housing 13; a second accommodating chamber is formed between the second housing 12 and the installation housing 13. The residual current operated circuit breaker 100 has a first current loop and a second current loop, wherein the first current loop is located in the first accommodating chamber, and the second current loop is located in the second accommodating chamber.

**[0024]** Referring to figs. 2 and 3, the residual current operated circuit breaker 100 further comprises an electromagnetic trip apparatus 20, an arc extinguishing apparatus 30, a first operating mechanism 21, a leakage trip apparatus 40 and a second operating mechanism 42. Specifically, the electromagnetic trip apparatus 20 and the arc extinguishing apparatus 30 are disposed in the first accommodating chamber. The first operating mechanism 21 is used for working in cooperation with the electromagnetic trip apparatus 20 and is located on one side of the first accommodating chamber; the action of the first operating mechanism 21 can realize opening and closing of the first current loop, for the purpose of realizing overcurrent protection of the residual current operated circuit breaker 100; the arc extinguishing apparatus 30 facilitates rapid extinguishing of an arc. The leakage trip apparatus 40 is disposed in the second accommodating chamber; the second operating mechanism 42 is used for working in cooperation with the leakage trip apparatus 40 and is located on one side of the second accommodating chamber; the action of the second operating mechanism 42 can realize opening and closing of the second current loop, for the purpose of realizing leakage protection of the residual current operated circuit breaker 100. In order to realize a thermal protection function, the residual current operated circuit breaker 100 of the present invention also comprises a thermal protection assembly 31 formed of a bimetallic strip, which is close to the arc extinguishing apparatus 30 and located in the first accommodating chamber, and a circuit board assembly 80 for detection and control signal output, disposed in the second accommodating chamber.

**[0025]** Referring to figs. 4 and 5, in order to satisfy wiring functions of an L pole and an N pole, the residual current operated circuit breaker of the present invention also comprises a first terminal assembly 71 which may be used for an L pole incoming line, a second terminal assembly 72 which may be used for an L pole outgoing line, and a third terminal assembly 51 which may be used for an N pole incoming line. It is worth pointing out that compared with a terminal assembly in the prior art, the first terminal assembly 71 of the present invention is of large size; in order to satisfy reliability of installation of the first terminal assembly 71 without increasing the size of the housing, preferably, an installation gap is provided on one side of the installation housing 13, and the first terminal assembly 71 can run through the installation gap and be clamped in the space formed by the first housing 11 and the second housing 12. The second terminal assembly 72 is accommodated in the first accommodating chamber, and the third terminal assembly 51 is accommodated in the second accommodating chamber. Preferably, the second terminal assembly 72 is located on one side, close to the electromagnetic trip apparatus, in the first accommodating chamber.

5 [0026] In particular, a wiring capacity of the first terminal assembly 71 is larger than a wiring capacity of the third terminal assembly 72. Since the first terminal assembly 71 of the present invention replaces a small terminal assembly used in the prior art, the use of a large terminal assembly with a larger wiring capacity can effectively enhance the electrical safety and reliability of L pole wiring. According to a preferred embodiment of the present invention, the first terminal assembly 71 has a current carrying range of 6 A - 32 A. The first terminal assembly 71 is optionally connected to a common bus bar; an L pole incoming line end may be connected to a conductor of larger cross section, to meet the needs of large current input at the L pole, enhancing product applicability, and increasing product competitiveness more effectively. Optionally, a slider 83 is also disposed on one side of the housing 10 of the present invention, close to the first terminal assembly 71; the slider 83 can avoid the need for a user's finger to come into contact with electrified components, in order to effectively protect the user's personal safety, and also facilitates the task of removably connecting the circuit breaker to a corresponding rail in a flexible manner.

10 [0027] In order to enable the user to manage and use the circuit breaker more easily, the residual current operated circuit breaker of the present invention differs from the prior art in that an N pole outgoing line is realized by means of a flexible conductor assembly 60, and the flexible conductor assembly 60 has a contact opening/closing function, thereby being able to enhance the electrical safety and reliability of an N pole current loop. Referring to figs. 2 and 4, the flexible conductor assembly 60 is accommodated in the second accommodating chamber. According to a preferred embodiment of the present invention, an incoming line end of the third terminal assembly 51 and an outgoing line end of the flexible conductor assembly 60 are located on the same side of the housing 10; this design facilitates product installation and wiring, and increases user space utilization rate. Since the structural design of the housing interior is more compact, the overall length of the circuit breaker product is unchanged, so the user has no need to use a special distribution box for installation, and the convenience of product installation is increased effectively. Moreover, since a flexible conductor is used to replace a wiring terminal, processing technology can be simplified, effectively reducing the production cost of the product.

15 [0028] Referring to figs. 2 and 3, furthermore, the first operating mechanism 21 comprises: a first contact assembly 22 and a first actuating assembly 23. The second operating mechanism 42 comprises a second contact assembly 43 and a second actuating assembly 44. More specifically, the action of the first contact assembly 22 and the first actuating assembly 23 can realize the opening and closing of an L pole current loop. The action of the second contact assembly 43 and the second actuating assembly 44 can realize the opening and closing of the N pole current loop. Linked movement of the first actuating assembly 23 and second actuating assembly 44 may be realized by means of a drive element 81 and an operating handle 82.

20 [0029] As shown in fig. 4, according to a preferred embodiment of the present invention, the flexible conductor assembly 60 comprises a connecting plate 63, a first connecting conductor 61 and a second connecting conductor 62. Specifically, one end of the first connecting conductor 61 is connected to a static contact 431 in the second contact assembly 43; another end of the first connecting conductor 61 is connected to the connecting plate 63. One end of the second connecting conductor 62 is connected to the connecting plate 63; another end of the second connecting conductor 62 is a free connection end and extends to the outside of the housing 10. Referring to figs. 2 and 3, the direction of the L pole current loop of the present invention is, in sequence, the first terminal assembly 71, an L pole moving contact 222, an L pole static contact 221 and the second terminal assembly 72. The direction of the N pole current loop is, in sequence, the third terminal assembly 51, an N pole moving contact 432, the N pole static contact 431, the first connecting conductor 61, the connecting plate 63 and the second connecting conductor 62. With such a design, since one side of the first connecting conductor 61 is connected to the N pole moving and static contacts 432 and 431, the flexible conductor assembly 60 has a contact opening/closing function. Compared with the prior art, the protection function and reliability of the N pole of the circuit breaker of the present invention are therefore vastly improved.

25 [0030] Referring to fig. 4, preferably, in a schematic embodiment, in order to save space inside the housing and enhance installation reliability, the connecting plate 63 may have a bent structure, and can be stably engaged in an installation groove formed jointly by multiple limiting ribs on an inner surface of the housing. Preferably, the connecting plate 63 is also provided with a first bent part 631 and a second bent part 632. To enhance the stability of electrical connection, the first bent part 631 may be trough-shaped, and an end of the first connecting conductor 61 can be accommodated in the trough-shaped first bent part 631. The second bent part 632 may be plate-like, and an end of the second connecting conductor 62 is crimped to the plate-like second bent part 632. It is worth pointing out that the shape and structure of the connecting plate 63 are not unique; those skilled in the art could make various changes and substitutions according to actual needs when the same functions can be realized, without departing from the scope of protection of the present invention.

30 [0031] The residual current operated circuit breaker according to the present invention can provide the user with a method of wiring that is more convenient and reliable, and on condition that it is ensured that the product has perfect safety protection, still has an optimal housing structure, effectively saving installation space for the user, and at the same time, since a flexible conductor is used to replace a wiring terminal, the processing technology of the product can be simplified, and the product cost is reduced.

[0032] As used herein, "schematic" means "serving as an instance, example or illustration". No drawing or embodiment described herein as "schematic" should be interpreted as a more preferred or more advantageous technical solution.

[0033] It should be understood that although the description herein is based on various embodiments, it is by no means the case that each embodiment contains just one independent technical solution. Such a method of presentation is adopted herein purely for the sake of clarity. Those skilled in the art should consider the description in its entirety. The technical solutions in the various embodiments could also be suitably combined to form other embodiments capable of being understood by those skilled in the art.

[0034] The series of detailed explanations set out above are merely particular explanations of feasible embodiments of the present utility model, which are not intended to limit the scope of protection thereof. All equivalent embodiments or changes made without departing from the artistic spirit of the present utility model shall be included in the scope of protection thereof.

## Claims

1. A residual current operated circuit breaker (100), comprising:

a housing (10), comprising a first housing (11), a second housing (12) and an installation housing (13) located therebetween, with a first accommodating chamber being formed between the first housing (11) and the installation housing (13), and a second accommodating chamber being formed between the second housing (12) and the installation housing (13);

an electromagnetic trip apparatus (20) and an arc extinguishing apparatus (30), disposed in the first accommodating chamber;

a first operating mechanism (21), used for working in cooperation with the electromagnetic trip apparatus (20) and being located on one side of the first accommodating chamber;

a leakage trip apparatus (40), disposed in the second accommodating chamber;

a second operating mechanism (42), used for working in cooperation with the leakage trip apparatus (40) and being located on one side of the second accommodating chamber, with actions of the first operating mechanism (21) and the second operating mechanism (42) being capable of realizing the opening and closing of a current loop;

a first terminal assembly (71), which may be used for an L pole incoming line, with an installation gap being provided on one side of the installation housing (13), the first terminal assembly (71) being capable of running through the installation gap and being clamped in a space formed by the first housing (11) and the second housing (12);

a second terminal assembly (72), which may be used for an L pole outgoing line, being accommodated in the first accommodating chamber;

a third terminal assembly (51), which may be used for an N pole incoming line, being accommodated in the second accommodating chamber;

a flexible conductor assembly (60) having a contact opening/closing function, which may be used for an N pole outgoing line, being accommodated in the second accommodating chamber.

2. The residual current operated circuit breaker as claimed in claim 1, wherein the second terminal assembly (72) is located on one side, close to the electromagnetic trip apparatus (20), in the first accommodating chamber.

3. The residual current operated circuit breaker as claimed in claim 1, wherein an incoming line end of the third terminal assembly (51) and an outgoing line end of the flexible conductor assembly (60) are located on the same side of the housing (10).

4. The residual current operated circuit breaker as claimed in claim 1, wherein the first operating mechanism (21) comprises a first contact assembly (22) and a first actuating assembly (23), the second operating mechanism (42) comprises a second contact assembly (43) and a second actuating assembly (44), and linked movement of the first actuating assembly (23) and second actuating assembly (44) may be realized by means of a drive element (81) and an operating handle (82).

5. The residual current operated circuit breaker as claimed in claim 4, wherein the flexible conductor assembly (60) comprises:

a connecting plate (63);

**EP 3 385 974 A1**

a first connecting conductor (61), one end thereof being connected to a static contact (431) in the second contact assembly (43), and another end thereof being connected to the connecting plate (63);  
a second connecting conductor (62), one end thereof being connected to the connecting plate (63), and another end thereof being a free connection end and extending to the outside of the housing (10).

- 5
6. The residual current operated circuit breaker as claimed in claim 5, wherein the connecting plate (63) is a bent structure, and is provided with a trough-shaped first bent part (631), with an end of the first connecting conductor (61) being accommodated in the first bent part (631); and
- 10 a plate-like second bent part (632), with an end of the second connecting conductor (62) being crimped to the second bent part (632).
7. The residual current operated circuit breaker as claimed in claim 1, wherein a wiring capacity of the first terminal assembly (71) is larger than a wiring capacity of the third terminal assembly (72).
- 15
8. The residual current operated circuit breaker as claimed in claim 1, wherein the first terminal assembly (71) has a current carrying range of 6 A - 32 A, and the first terminal assembly (71) may be connected to a common bus bar.
9. The residual current operated circuit breaker as claimed in claim 1, wherein the direction of an N pole current loop of the residual current operated circuit breaker (100) is, in sequence, the third terminal assembly (51), an N pole moving contact (432), an N pole static contact (431), the first connecting conductor (61), the connecting plate (63) and the second connecting conductor (62).
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10. The residual current operated circuit breaker as claimed in claim 1, further comprising a thermal protection assembly (31), being close to the arc extinguishing apparatus (30) and located in the first accommodating chamber.
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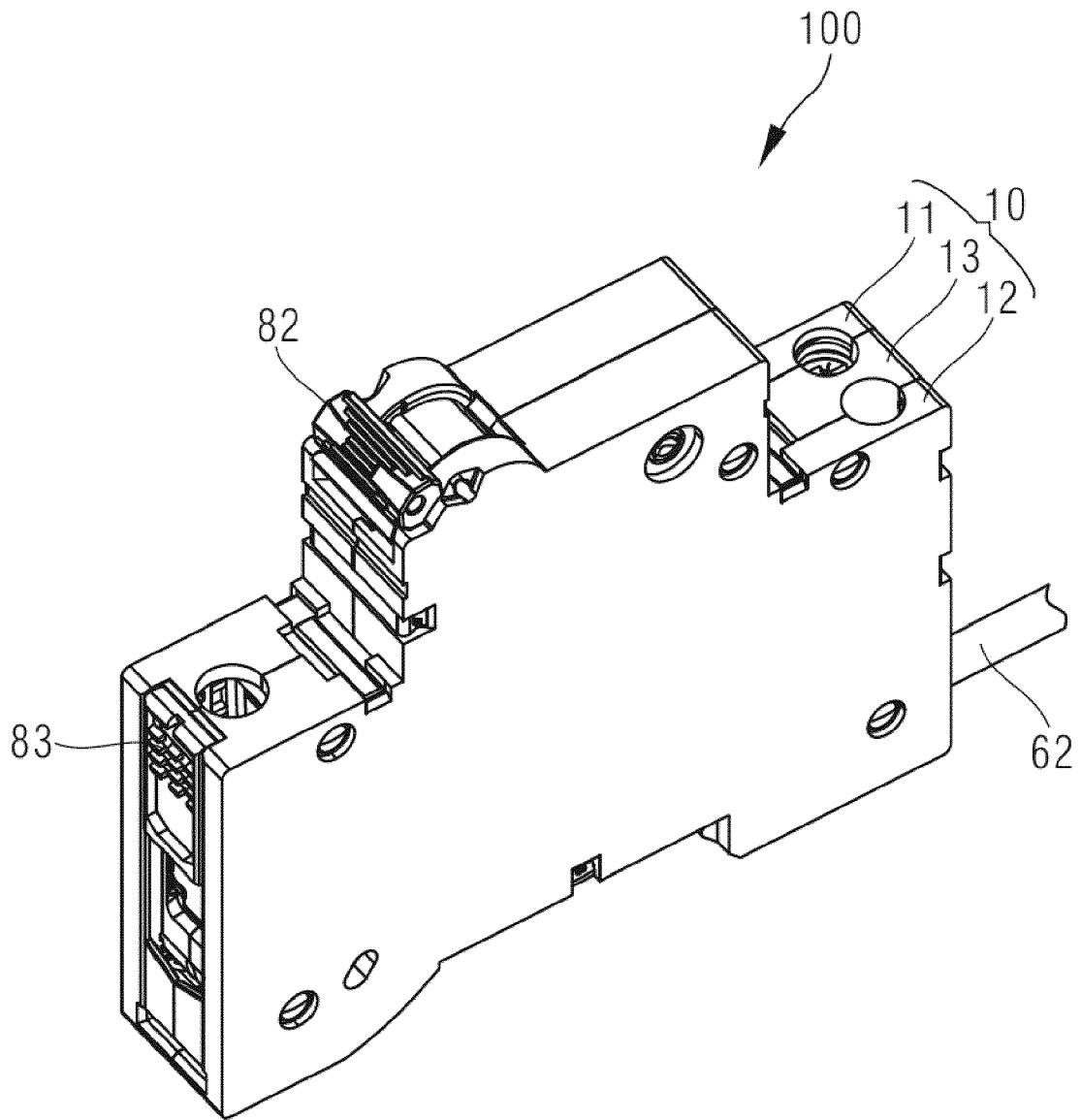


Fig. 1

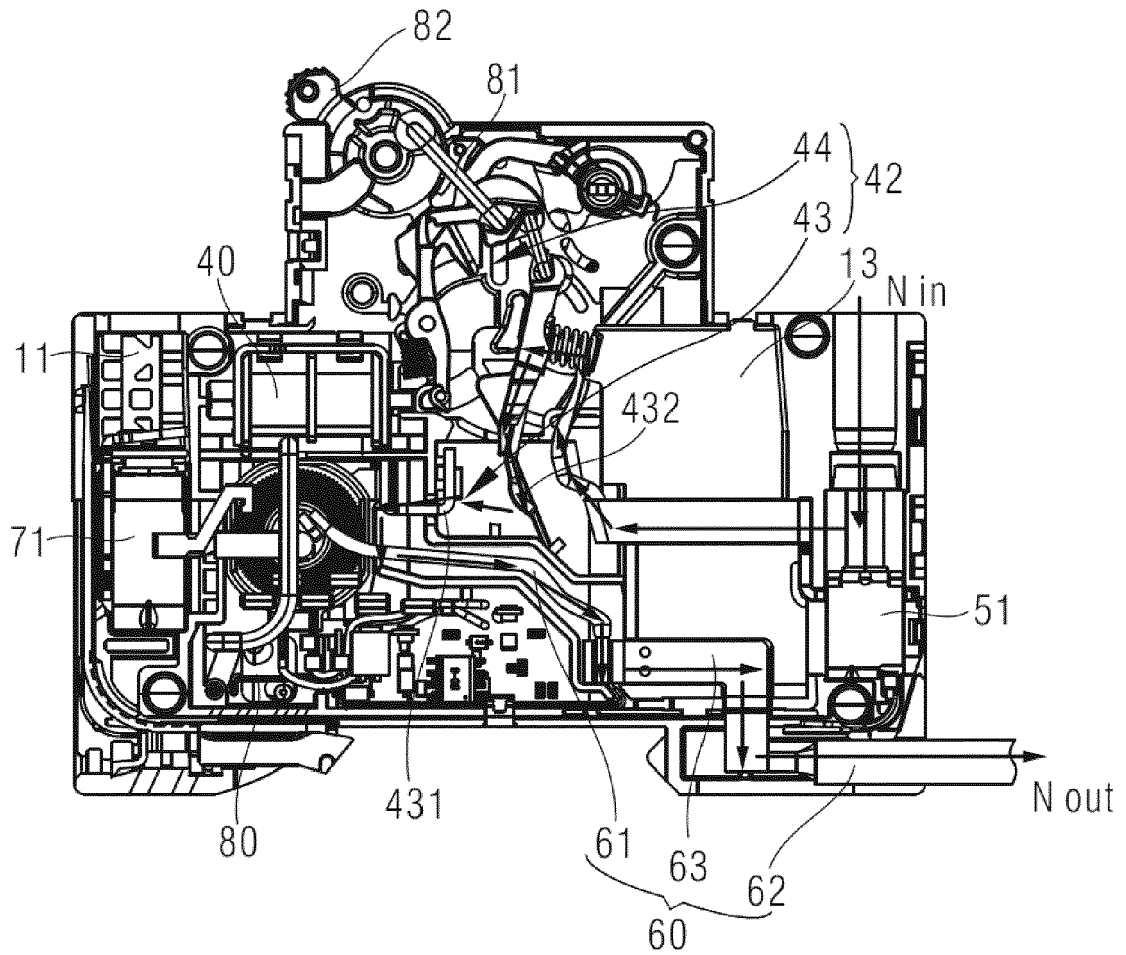


Fig. 2



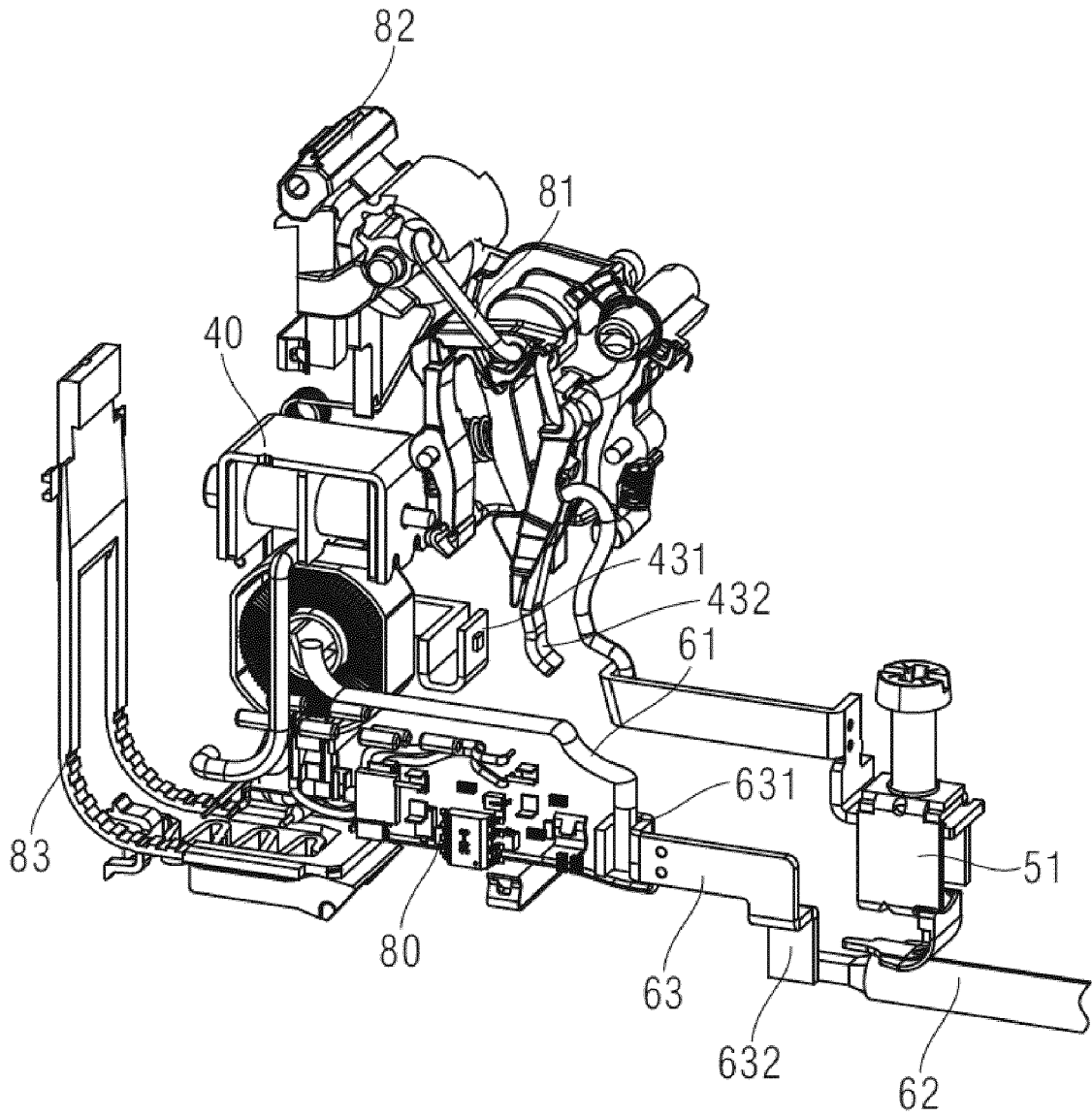


Fig. 4

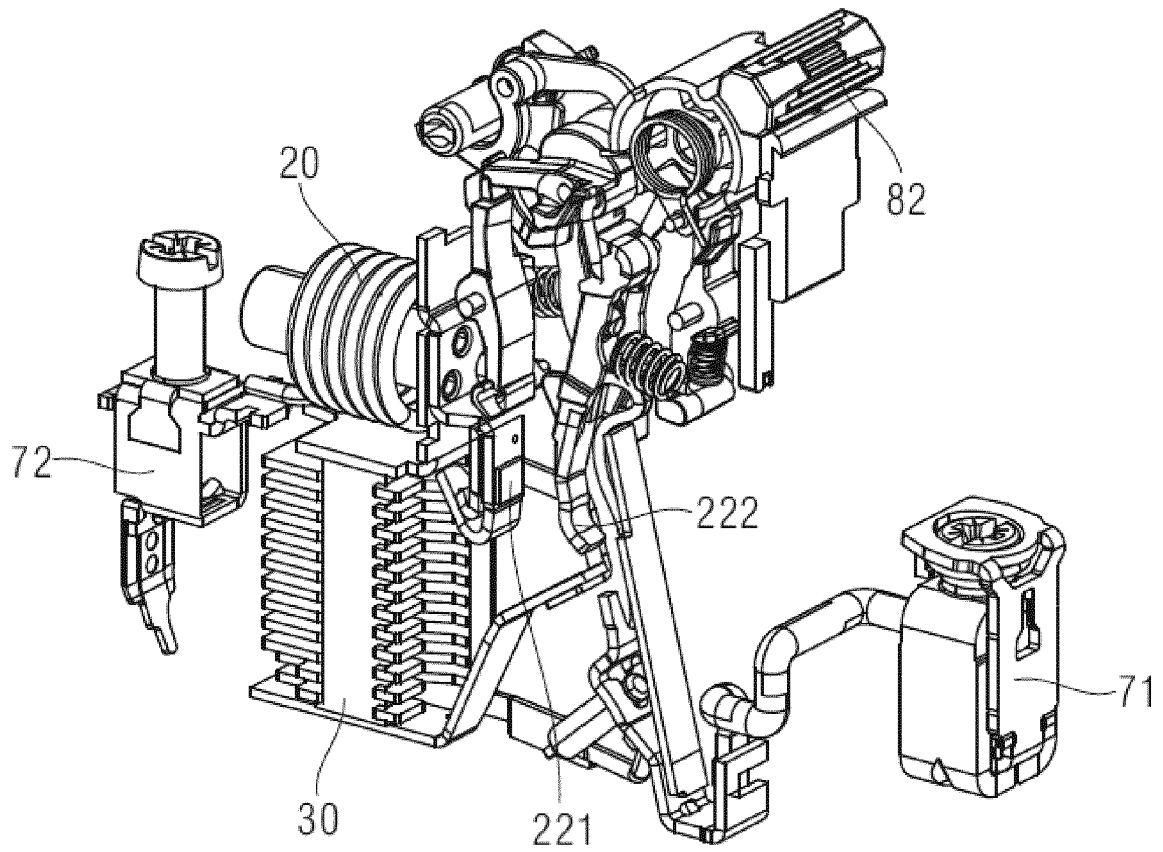


Fig. 5



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Application Number  
EP 18 16 5872

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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