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## (54) ELECTRICAL SWITCH AND SWITCHGEAR

(57) Embodiments of the present disclosure provide an electrical switch and a switchgear. The electrical switch (100) comprises: a housing (141, 142); a relay assembly arranged within the housing (141, 142) and configured to turn on and off a circuit connected to the electrical switch (100), the relay assembly comprising a first relay (110-1); and a control assembly arranged in parallel with the relay assembly in the housing (141, 142), the control assembly being configured to control the relay assembly, and the control assembly comprising a wireless communication unit (160) configured to receive signals to remotely control the relay assembly. The electrical switch according to embodiments of the present disclosure has advantages such as compact structure, simple wiring and more intelligence, and can be adapted for low-current load control.

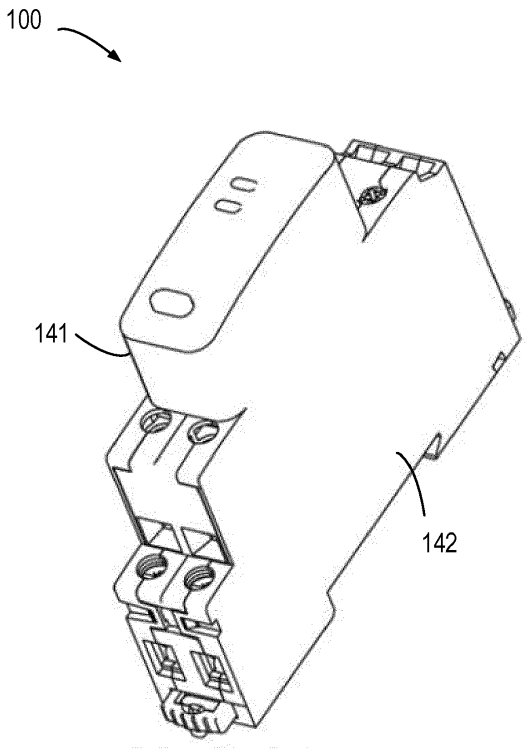


FIG. 3

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## Description

### FIELD

**[0001]** The present disclosure relates to an electrical switch, and more specifically to an electrical switch and a switchgear including the same.

### BACKGROUND

**[0002]** Electrical switches such as contactors are widely used on a variety of power distribution and power use applications. Typically, electrical switches such as contactors achieve the purpose of turning the circuit on and off by controlling contacts to close or open. In order to achieve such control, peripheral control elements need to be provided. In addition, in general applications, electrical switches such as contactors need to be able to meet needs in local control and remote control.

**[0003]** Therefore, electrical switches usually need additional control devices for control, and also need a lot of wiring to achieve the local or remote control function. This makes the size of the electrical switches too large, and the wiring complicated and not smart enough.

### SUMMARY

**[0004]** In order to address the above problems, embodiments of the present disclosure provide an electrical switch, and a switchgear including the same.

**[0005]** According to an aspect of the present disclosure, there is provided an electrical switch. The electrical switch comprises: a housing; a relay assembly arranged within the housing and configured to turn on and off a circuit connected to the electrical switch, the relay assembly comprising a first relay; and a control assembly arranged in parallel with the relay assembly in the housing, the control assembly being configured to control the relay assembly, and the control assembly comprising a wireless communication unit configured to receive signals to remotely control the relay assembly.

**[0006]** A two-module contactor with a control module is integrated into a single module by replacing the contactor's switching device with a smaller relay and using wireless communication to remotely control the relay. The overall volume of the electrical switch of the present disclosure is significantly reduced and its structure is more compact compared to conventional contactors. The structure of the single module also reduces the distance between the control assembly and the switching device, which also simplifies wiring. In some cases, a compact single-module electrical switch can be more easily mounted directly on the circuit breaker.

**[0007]** In some embodiments of the present disclosure, the control assembly is opposite to a first side of a plurality of sides of the first relay, the plurality of sides defining a thickness of the first relay. By reasonably spatially arranging the interior of the electrical switch, the thickness of the electrical switch is effectively reduced, which facilitates subsequent installation.

**[0008]** In some embodiments of the present disclosure, the electrical switch further comprises: an incoming wire and outgoing wire assembly arranged in parallel with the relay assembly in the housing, the incoming wire and outgoing wire assembly being opposite to a second side of the plurality of sides of the first relay and configured to electrically connect electrical terminals disposed on the second side with an external circuit. It is possible to, by arranging the incoming wire and outgoing wire assembly on the side of the relay provided with electrical terminals, make the incoming wire terminal and outgoing wire terminal close to the electrical terminals of the relay, reduce the required wiring, and refrain from increasing the overall thickness of the electrical switch.

**[0009]** In some embodiments of the present disclosure, the control assembly comprises a control terminal unit configured to connect a switching device external to the electrical switch to enable control of the relay assembly by the switching device. In this embodiment, in addition to being remotely controlled, the relay may be controlled by the external switch connected to the control terminal, whereby more control options are provided.

**[0010]** In some embodiments of the present disclosure, at least one of the control terminal unit and the housing is provided with a notch for accommodating a copper bus bar. With the notch being disposed, the electrical switch may avoid touching the copper bus bar connected to the circuit breaker, which facilitates the installation and insulation of the electrical switch.

**[0011]** In some embodiments of the present disclosure, the control assembly comprises: a first circuit board and a second circuit board arranged opposite to each other, board faces of the first circuit board and the second circuit board being substantially perpendicular to the first side of the first relay, to carry other elements in the control assembly. It is possible to, by providing dual circuit boards, reduce the area occupied in the plane perpendicular to the thickness direction while maintaining a large overall area of the circuit board, thereby ensuring that enough electrical and electronic elements can be carried, which improves space utilization within the module. In addition, the circuit board can be completely placed on the side of the relay without increasing the thickness of the electrical switch.

**[0012]** In some embodiments of the present disclosure, the relay assembly further comprises: a second relay, the second relay and the first relay being arranged adjacent to each other. In this embodiment, the electrical switch employing dual relays may be used not only to control single-phase power supply but also to control two-phase power supply.

**[0013]** In some embodiments of the present disclosure, the first relay and the second relay are arranged along a length direction of the first relay and the second relay. With this arrangement, less side space may be occupied when the electrical switch is mounted to the

circuit breaker.

**[0014]** In some embodiments of the present disclosure, the electrical switch further comprises: an incoming wire and outgoing wire assembly forming an L-shape with the relay assembly and configured to electrically connect electrical terminals on the relay assembly to an external circuit, the incoming wire and outgoing wire assembly comprising an incoming wire terminal and an outgoing wire terminal, the incoming wire terminal facing an inner side of the L shape and configured to be electrically connected to the circuit breaker in an inserted manner. With this arrangement, when the electrical switch is mounted on the circuit breaker, the incoming wire and outgoing wire assembly is disposed on the front side of the circuit breaker, thereby no longer occupying more side space of the circuit breaker and better facilitating electrical connection between the electrical switch and the circuit breaker.

**[0015]** In some embodiments of the present disclosure, the control assembly comprises: a first circuit board, a second circuit board and a third circuit board, configured to carry other elements in the control assembly, the first circuit board and the second circuit board being arranged on one side of the L-shape provided with the relay assembly, and the third circuit board being arranged on the other side of the L-shape provided with the incoming wire and outgoing wire assembly. In this embodiment, a plurality of circuit boards may be used to carry electrical and electronic elements for controlling the relays, and by properly arranging the circuit boards, the structure of the electrical switch may be made more compact.

**[0016]** In some embodiments of the present disclosure, the first relay and the second relay are arranged along a thickness direction of the first relay and the second relay. With this arrangement, a square-shaped electrical switch may be formed to integrally mount the electrical switch on the front side of the circuit breaker.

**[0017]** In some embodiments of the present disclosure, the electrical switch further comprises: an incoming wire and outgoing wire assembly being opposite to the side of the relay assembly provided with electrical terminals and configured to connect the electrical terminals on the relay assembly to an external circuit, the incoming wire and outgoing wire assembly comprising an incoming wire terminal and an outgoing wire terminal, the incoming wire terminal being configured to be electrically connected to the circuit breaker in an inserted manner. With this arrangement, the wiring between the incoming wire and outgoing wire assembly and the relay assembly may be simplified, and the space for insulation may be reduced.

**[0018]** In some embodiments of the present disclosure, the control assembly comprises: a first circuit board, a second circuit board and a third circuit board, configured to carry other elements in the control assembly, and arrranged together with the incoming wire and outgoing wire assembly on the same side of the relay assembly. This arrangement manner may further effectively improve wiring efficiency and space utilization.

**[0019]** In some embodiments of the present disclosure, the third circuit board comprises a through hole allowing the incoming wire terminal or the outgoing wire terminal to pass therethrough, so as to sense the current on the incoming wire terminal or the outgoing wire terminal by the third circuit board. In this embodiment, the circuit board may be arranged with space near the incoming wire and outgoing wire assembly, and the current is sensed by a current sensor provided on the third circuit board.

**[0020]** In some embodiments of the present disclosure, the wireless communication unit is configured to communicate in a Zigbee manner. In this way, the wireless communication has advantages of simplicity, efficiency and low cost.

**[0021]** In some embodiments of the present disclosure, the control assembly comprises a button that is operable by a user to control the relay assembly. In this embodiment, a control option for the user to directly operate the relay is provided.

**[0022]** In some embodiments of the present disclosure, the control assembly comprises: a metering unit configured to measure at least one of an electrical parameter and a temperature parameter of the electrical switch; and a diagnostic unit configured to determine an ON/OFF state of the electrical switch. By integrating the metering unit and the diagnostic unit into the electrical switch, a real-time state of the electrical switch can be obtained, and the control of the electrical switch can be made smarter.

**[0023]** In another aspect of the present disclosure, there is provided a switchgear which comprises the electrical switch described above. The switchgear including the above electrical switch can be adapted to control various loads, especially low-current loads that do not require frequent switching.

**[0024]** This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0025]** Through the following detailed description with reference to the accompanying drawings, the above and other features, advantages and aspects of various embodiments of the present disclosure will become more apparent. Throughout the drawings, the same reference symbols generally refer to the same elements, wherein

FIG. 1 shows an external perspective view of a conventional contactor apparatus.

FIG. 2 shows an internal perspective view of a conventional contactor apparatus after removal of a portion of a housing.

FIG. 3 shows an external perspective view of an electrical switch according to an embodiment of the present disclosure.

FIG. 4 shows an internal perspective view of an electrical switch according to an embodiment of the present disclosure after removal of the housing.

FIG. 5 shows an exploded view of an electrical switch according to an embodiment of the present disclosure.

FIGS. 6A through 6C are schematic views showing the assembling of a first and second circuit boards and a relay.

FIG. 7 shows a schematic view of the installation of an electrical switch according to an embodiment of the present disclosure.

FIG. 8 shows a comparative schematic diagram of an electrical switch according to an embodiment of the present disclosure and a conventional contactor apparatus.

FIG. 9 shows an external perspective view of an electrical switch according to another embodiment of the present disclosure.

FIG. 10 shows an internal perspective view of an electrical switch according to another embodiment of the present disclosure after removal of the housing.

FIG. 11 shows an internal exploded view of an electrical switch according to another embodiment of the present disclosure.

FIG. 12 shows a perspective view of an electrical switch mounted on a circuit breaker according to another embodiment of the present disclosure.

FIG. 13 shows an external perspective view of an electrical switch according to a further embodiment of the present disclosure.

FIG. 14 shows an internal perspective view of an electrical switch according to a further embodiment of the present disclosure after removal of the housing.

FIG. 15 shows an exploded view of an electrical switch according to a further embodiment of the present disclosure.

FIG. 16 shows an exploded view of a portion of an electrical switch according to a further embodiment of the present disclosure.

FIG. 17 shows a perspective view of an electrical switch mounted on a circuit breaker according to a further embodiment of the present disclosure.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0026]** Preferred embodiments of the present disclosure will be described as follows in greater detail with reference to the drawings. Although preferred embodiments of the present disclosure are illustrated in the drawings, it is to be understood that the present disclosure described herein can be implemented in various manners, not limited to the embodiments illustrated herein. Rather, these embodiments are provided to make the present disclosure described herein clearer and more complete and convey the scope of the present disclosure described herein completely to those skilled in the art. Those skilled in the art may obtain alternative technical solutions from the following description without departing from the spirit and scope of the disclosure.

**[0027]** As used herein, the term "comprises" and its variants are to be read as open-ended terms that mean "comprises, but is not limited to." The term "or" is to be read as "and/or" unless the context clearly indicates otherwise. The term "based on" is to be read as "based at least in part on." The term "one example embodiment" and "an example embodiment" are to be read as "at least one example embodiment." The term "another embodiment" is to be read as "at least one other embodiment." Terms "a first", "a second" and others can denote different or identical objects. The following text may also contain other explicit or implicit definitions.

**[0028]** FIG. 1 shows an external perspective view of a conventional contactor apparatus 100'. The contactor apparatus 100' comprises a contactor module 101' and a controller module 102'. The contactor module 101' and the controller module 102' are combined together by splicing. A control assembly in controller module 102' may control a contactor assembly in the contactor module 101'.

**[0029]** FIG. 2 further shows an internal perspective view of a conventional contactor apparatus 100' after removal of a portion of a housing. As shown in FIG. 2, a body of a conventional contactor is large in size, and already occupies most of the space within the housing of the contactor module 101'. At the same time, the controller module 102' employs a wired communication mode, and a large amount of space is reserved for the purpose of insulation and wiring. In addition, a circuit board of the controller module 102' is a single circuit board, all components are disposed flat on the circuit board, and the space utilization efficiency is low. Therefore, the large size and complicated wiring of the contactor module 100' result in requiring more installation space and more workload for wiring, and higher insulation requirements. This type of contactor is not practical for some low-current, low-load occasions.

**[0030]** The present disclosure proposes a novel elec-

trical switch. The electrical switch replaces the conventional contactor body with a small-sized relay, and the saved space is used to dispose the control assembly. At the same time, the relay in the electrical switch employs the wireless communication control mode, and greatly reduces the space for insulation and wiring. In addition, the present disclosure also optimizes an arrangement mode of the control assembly and incoming and outgoing wire terminals. Thereby, the electrical switch body and peripheral components for controlling the electrical switch body are integrated in a single module. The novel electrical switch proposed by the present disclosure has advantages such as compact structure, simple wiring and more intelligence.

**[0031]** FIG. 3 shows an external perspective view of an electrical switch 100 according to an embodiment of the present disclosure. As shown in FIG. 3, the electrical switch 100 according to an embodiment of the present disclosure is integrated as a single module structure. Compared to the contactor apparatus 100' using dual module shown in FIG. 1, the electrical switch 100 is simplified in structure and significantly reduced in size.

**[0032]** Referring to FIGS. 4 and 5, FIG. 4 shows an internal perspective view of the electrical switch 100 after removal of housings 141 and 142 of Fig. 3 according to an embodiment of the present disclosure, and FIG. 5 shows an exploded view of the electrical switch 100 according to an embodiment of the present disclosure. According to an embodiment of the present disclosure, the electrical switch 100 may comprise housings 141 and 142, a relay 110-1, and a control assembly for controlling the relay 110-1. In the embodiment of the present disclosure, the small-sized relay 110-1 replaces the conventional contactor body, and the relay 110-1 and the control assembly for controlling the relay are combined and installed in the same housing space instead of being disposed in different modules separately.

**[0033]** As an example, the housing may comprise a first housing 141 and a second housing 142. The first housing 141 and the second housing 142 may be mounted together by a fastening member such as a bolt or in any other fastening manner. The assembled first housing 141 and second housing 142 form a cavity in which the relay 110-1 and associated electrical and electronic elements may be received and secured. The first housing 141 and the second housing 142 may form a closed housing together with an incoming wire and outgoing wire assembly 150 and a control terminal unit 130 of the control assembly, and the incoming wire and outgoing wire assembly 150 and the control terminal unit 130 of the control assembly will be descried in detail later. The first housing 141 and the second housing 142 may also directly form a closed housing to enclose all elements including the incoming wire and outgoing wire assembly 150 and the control terminal unit 130 within the housing.

**[0034]** The relay 110-1 may turn on and off the circuit connected to the electrical switch 100, thereby achieving control of the load in the circuit. As an example, relay 110-1 may be a bistable relay that may have lower power consumption and be capable of withstanding a certain short circuit current. However, relay 110-1 may also be a monostable relay or any other type of relay.

**[0035]** The above control assembly may comprise any electrical and electronic element needed to control the relay 110-1. According to an embodiment of the present disclosure, the control assembly may be arranged in parallel with the relay 110-1 in the housing, and the control assembly may comprise a wireless communication unit 160 for receiving a signal to remotely control the relay 110-1.

**[0036]** In some embodiments, the wireless communication unit 160 performs wireless communication in a Zigbee communication manner. However, the wireless communication unit may also communicate in other wireless communication manners, such as WiFi, Bluetooth, and the like. Thus, the wireless communication unit 160 may receive signals to enable remote control of the relay 110-1. Compared with the contactor apparatus 100' using wired communication, the wireless communication such as Zigbee may avoid complicated wiring in the control assembly, and the simplification of the wiring further reduces the insulation requirements, which all make the control assembly need less space.

**[0037]** In addition, as an example, the control assembly may further comprise a power supply unit (not shown), a control unit (not shown), circuit boards 121 and 122, and a control terminal unit 130. A power supply unit not shown may provide a power supply to active elements in the control assembly. The control unit not shown may at least comprise a processor (such as a Central Processing Unit CPU, a Digital Signal Processing DSP, a Single-Chip Computer MCU or a Field Programmable Gate Array FPGA, etc.), and the control unit generally controls the control assembly to operate the relay 110-1. The circuit boards 121 and 122 and the control terminal unit 130 will be described in detail later. It will be appreciated that since the remote control is possible, some of the elements in the control assembly may also be arranged at positions remote from the electrical switch 100 in some cases, thereby further reducing the size of the electrical switch 100.

**[0038]** In some embodiments of the present disclosure, the control assembly is opposite to a portion of a plurality of sides of the relay 110-1 (shown by reference sign A in FIGS. 5 and 6A), the plurality of sides defining a thickness of the relay 110-1. Since the relay 110-1 has a small size, excess space can be obtained on the sides of the relay 110-1. Such an arrangement takes full advantage of the remaining space created by the size-reduced relay 110-1 while avoiding an increase in the overall thickness of the integrated electrical switch 100.

**[0039]** In some embodiments of the present disclosure, the control assembly of the electrical switch 100 may comprise circuit boards 121 and 122. The circuit boards 121 and 122 are used to carry other electrical and electronic elements of the control assembly. For exam-

ple, the circuit boards 121 and 122 may be used to carry at least one of wireless communication unit 160, the power supply unit and the control unit. The circuit boards 121 and 122 may employ a dual circuit board structure, that is, the circuit board comprises a first circuit board 121 and a second circuit board 122.

**[0040]** As shown in FIGS. 4 and 5, the first circuit board 121 and the second circuit board 122 may be arranged to face each other, and board faces of the first circuit board 121 and the second circuit board 122 are substantially perpendicular to the plurality of sides of the relay 110-1, substantially perpendicular to a thickness direction of the relay 110-1 and extend along the plurality of sides of the relay 110-1. Such an arrangement facilitates reducing the space occupied by the circuit boards in the thickness direction of the electrical switch 100.

**[0041]** In some embodiments, as shown in FIGS. 4 and 5, the wireless communication unit 160 may be arranged for example on the first circuit board 121. However, the wireless communication unit 160 may also be arranged on the second circuit board 122, and the wireless communication unit 160 may also be arranged at any suitable position on the first circuit board 121 or the second circuit board 122.

**[0042]** As an example, the first circuit board 121 may be provided with the control unit and the wireless communication unit to serve as a control circuit board, and the second circuit board 122 may be provided with the power supply unit to serve as a power supply circuit board. It may be understood that the electrical and electronic elements of the control unit, the wireless communication unit and the power supply unit may be mixedly arranged on the first circuit board 121 and the second circuit board 122 as needed, thereby not distinguishing the control circuit board and the power supply circuit board.

**[0043]** In addition, electrical and electronic elements on the first circuit board 121 and the second circuit board 122 may be arranged between the first circuit board 121 and the second circuit board 122. For example, the wireless communication unit 160 may be arranged on an inner board face of the first circuit board 121 adjacent to the second circuit board 122. However, the wireless communication unit 160 may also be arranged on an inner board face of the second circuit board 122 adjacent to the first circuit board 121. As such, the space between the first circuit board and the second circuit board may be utilized more fully. It may be understood that the electrical and electronic elements on the first circuit board 121 and the second circuit board 122 may also be arranged on outer board faces of the first circuit board 121 and the second circuit board 122 in the case where there is sufficient space.

**[0044]** The dual circuit boards 121 and 122 may reduce the area occupied in a plane perpendicular to the thickness direction, but still maintain a large overall area of the board, thereby ensuring that sufficient electrical and electronic elements may be carried. The dual circuit board structure improves the utilization of the space within the housings 141 and 142 as compared to a single circuit board.

**[0045]** FIGS. 6A through 6C are schematic views showing the assembling of the first circuit board 121, the second circuit board 122 and the relay 110-1. As an example, the first circuit board 121 and the second circuit board 122 each have a substantially L-shaped shape, and the two circuit boards are substantially the same in size and shape. The relay 110-1 has a substantially rectangular parallelepiped shape and has a plurality of sides defining a thickness, and the plurality of sides may comprise a side A and a side B.

**[0046]** FIGS. 6A through 6C show a step of placing the first circuit board 121 and the second circuit board 122 on the side A of the relay 110-1. In FIG. 6C, finally the first circuit board 121 and the second circuit board 122 are placed on the side A of the relay 110-1 where the electrical terminal 111 is not provided. The board faces of the first circuit board 121 and the second circuit board 122 are substantially perpendicular to the side A of the relay 110-1 (or the thickness direction of the relay 110-1), and the L-shaped first circuit board 121 and the second circuit board 122 mate with the side profile of relay 110-1. In FIGS. 6A through 6C, the arrangement of the L-shaped first circuit board 121 and the second circuit board 122 fully utilizes the side space of the relay 110-1, which facilitates integration of the control assembly and the relay 110-1 into a single module.

**[0047]** Returning to FIGS. 4 through 5, in some embodiments of the present disclosure, the electrical switch 100 may also comprise the incoming wire and outgoing wire assembly 150. The incoming wire and outgoing wire assembly 150 is arranged side by side with the relay 110-1 in the housings 141 and 142, the incoming wire and outgoing wire assembly 150 is opposed to another side B of the plurality of sides of the relay 110-1 (see FIGS. 5 and 6A), and the another side B is provided with an electrical terminal 111 of the relay 110-1. The incoming wire and outgoing wire assembly 150 is configured to electrically connect the electrical terminal 111 disposed on the side B with an external circuit. It is possible to, by arranging the incoming wire and outgoing wire assembly 150 at a position adjacent to the electrical terminals 111 of the relay 110-1, facilitate reducing the wiring distance between the incoming and outgoing wire terminals and the electrical terminal 111, thereby reducing the space occupied by the line insulation. At the same time, similar to the arrangement of the control assembly, the incoming wire and outgoing wire assembly 150 is arranged on the side B of the relay 110-1 to avoid increasing the overall thickness of the electrical switch 100. As an example, the incoming wire and outgoing wire assembly 150 comprises an incoming wire terminal, an outgoing wire terminal, and a frame and a bolt for securing the incoming and outgoing wire terminals. As an example, the electrical switch 100 of FIGS. 4 and 5 has a structure with two incoming wires and two outgoing wires. Howev-

er, the electrical switch 100 may also have other numbers of incoming wires and outgoing wires as needed.

**[0048]** In some embodiments of the present disclosure, the control assembly of the electrical switch 100 may further comprise a control terminal unit 130. The control terminal unit 130 is configured to connect a switching device external to the electrical switch 100 to enable control of the relay through the external switching device. Specifically, the control terminal unit 130 at least comprises a control terminal, which enables an external switching device connected to the control terminal to control a control coil of the relay 110-1. Thus, in addition to being remotely controlled by the wireless communication unit 160, the relay 110-1 in the electrical switch 100 may be controlled by an external switch connected to the control terminal unit 130. As an example, in addition to the control terminal, the control terminal unit 130 may further comprise a frame and a bolt for securing the control terminal.

**[0049]** FIG. 7 shows a schematic view of the installation of the electrical switch 100. In some embodiments of the present disclosure, the control terminal unit 130 may be provided with a notch 131 for accommodating a copper bus bar. Specifically, as shown in FIG. 7, when the electrical switch 100 and the circuit breaker (such as a miniature circuit breaker MCB) are cooperatively connected to the main circuit to control the load, and the copper bus bar connected to the circuit breaker (such as the miniature circuit breaker MCB) has a live wire terminal 201 and a neutral wire terminal 202 which are disposed in a staggered manner.

**[0050]** When the electrical switch 100 is installed, the position of the electrical switch 100 might conflict with the position of one of the live wire terminal 201 and the neutral wire terminal 202 which are disposed in a staggered manner, thereby causing the inability to mount the electrical switch 100 at a suitable position. In order to prevent the electrical switch 100 from touching the copper bus bar, the notch 131 may be provided on the control terminal unit 130 (for example, its frame).

**[0051]** In addition, it is also possible to provide a notch on the housings 141, 142, or to provide a notch on the control terminal unit 130 and the first and second housings 141, 142 at the same time. As such, a recessed space may be formed at a position where the electrical switch 100 is adjacent to the copper bus bar to accommodate the terminals of the protruding copper bus bar, so that the electrical switch 100 may avoid the live wire terminal 201 or the neutral wire terminal 202 of the copper bus bar

**[0052]** Returning to FIGS. 4 and 5, in some embodiments of the present disclosure, the control assembly of electrical switch 100 may further comprise a button 126. The button 126 can be operated by a user to control the relay 110-1. Specifically, by pressing the button 126, the user may directly control the ON and OFF of the relay 110-1. The housing 142 is provided with a hole for the button 126 through which the button 126 can protrude out of the housing and may be touched by the user. In addition to the remote control provided by the wireless communication unit 160 and the switch control provided by the control terminal unit 130, the button 126 provides a control mode in which the user may manually operate the relay directly. In addition, the control assembly of the electrical switch 100 is also provided with an indicator light 125 that is capable of indicating a status of the electrical switch 100.

**[0053]** In some embodiments of the present disclosure, the control assembly of electrical switch 100 further comprises a metering unit and a diagnostic unit (not shown). The metering unit may measure at least one of electrical parameter and temperature parameter of the electrical switch 100. Specifically, the metering unit may measure the voltage, current or power of the electrical switch 100 to detect the electrical state of the electrical switch 100. In addition, the metering unit may monitor the heat generation in the electrical switch 100 by measuring the temperature. These measurement results may be provided directly to the user or to other elements for control. The diagnostic unit may determine an on/off state of the electrical switch 100. For example, the diagnosis unit may judge whether the electrical switch 100 successfully performs an opening operation or a closing operation according to the measurement results of the metering unit. Thereby, the control unit of the electrical switch 100 or the user may perform the corresponding operation based on the judgment result of the diagnostic unit.

**[0054]** As shown in FIGS. 4 and 5, the electrical switch 100 may further be provided with a telescopic stopper 191 and a locking clip 192. The electrical switch 100 may be mounted for example on a DIN guide rail by the telescopic stopper 191 and the locking clip 192.

**[0055]** FIG. 8 shows a comparative schematic diagram of the electrical switch 100 and the contactor apparatus 100'. As shown in FIG. 8, the contactor apparatus 100' is formed by assembling two modules, whereas the electrical switch 100 is of a single module structure. As an example, the thickness d of the electrical switch 100 is only half of the thickness d' of the contactor apparatus 100'. However, the thickness of the electrical switch 100 may also be adjusted according to the needs of the installation. This reduction in thickness is advantageous on some occasions. For example, when the DIN guide rail is used to mount the electrical switch, the conventional mounting needs an 18mm-thick DIN guide rail-mounted contactor module and an additional 18mm-thick DIN guide rail-mounted controller module (for example, the contactor apparatus 100'), whereas the integrated electrical switch only needs an 18mm-thick DIN guide rail-mounted module (e.g. the electrical switch 100). Thus, the novel electrical switch according to an embodiment of the present disclosure effectively saves the installation space. Meanwhile, since a plurality of functions (such as wireless control, temperature control, and metering) are integrated, the electrical switch according to an embodiment of the present disclosure has simpler wir-

ing and is more intelligent in function, which improves the user's experience.

**[0056]** In some cases, the electrical switch for controlling the load may be directly mounted on the circuit breaker. However, if the size of the electrical switch is too large or multiple modules are needed to form the electrical switch, the reliability of the installation will be reduced. In addition, in some countries' power supply systems, a two-phase power supply system is used. For example, the United States generally employs a 120V two-phase power supply system, and the load might need a supply voltage of 120V, whereupon single-phase power supply may meet the need. However, in more cases, the load might need a supply voltage of 240V. In the case where the load voltage is 240V, the two phases are needed to simultaneously supply power to provide a 240V line voltage. Therefore, in some cases, an electrical switch capable of simultaneously controlling two phases of power supply is also needed. Based on this, with reference to FIGS. 9 through 17, the present disclosure further provides additional embodiments of the electrical switch 100.

**[0057]** FIGS. 9 through 12 illustrate another embodiment of the present disclosure. FIG. 9 shows an external perspective view of an electrical switch 100 according to another embodiment of the present disclosure. As shown in FIG. 9, the electrical switch 100 is integrated as a single-module structure. Like the electrical switch shown in FIG. 3, the electrical switch 100 shown in FIG. 9 has a compact external structure and a reduced size, and the electrical switch 100 is generally L-shaped so that the electrical switch 100 can be mounted on one side of front side C and lateral side D of the circuit breaker 300 (as shown in FIG. 12).

**[0058]** Referring to FIGS. 10 and 11, FIG. 10 illustrates an internal perspective view of the electrical switch 100 after removal of the housings 141 and 142 of FIG. 9, and FIG. 11 illustrates an internal exploded view of electrical switch 100 according to another embodiment of the present disclosure (not including the housings 141 and 142). The electrical switch 100 may comprise a control assembly as well as a relay assembly. The relay assembly is mainly composed of a relay, and the relay assembly and the control assembly for controlling the relay assembly are combined and mounted in the same housing space.

**[0059]** As an example, the housing may comprise a first housing 141 and a second housing 142. The assembled first housing 141 and second housing 142 form a cavity into which the relay assembly and associated electrical and electronic elements may be received and secured. The first housing 141 and the second housing 142 may form a closed housing together with the incoming wire and outgoing wire assembly 150. The first housing 141 and the second housing 142 may also directly form a closed housing to enclose other elements within the housing. The first housing 141 and the second housing 142 assembled together may be generally L-shaped to facilitate mounting the electrical switch 100 laterally on the circuit breaker 300. The specific mounting manner between the housings 141 and 142 is the same as that of the housings of FIG. 3 and will not be described in detail.

**[0060]** The relay assembly may at least comprise the relay 110-1. The relay 110-1 may be, for example, a bistable relay. The relay assembly may turn on and off the circuit connected to the electrical switch 100 to achieve control of the load in the circuit. The control assembly for controlling the relay may comprise a wireless communication unit that may receive signals to remotely control the relay assembly. In some embodiments, the wireless communication unit may communicate in a Zigbee manner. With the wireless communication manner being employed, the communication wiring within the electrical switch is greatly reduced, thereby also improving the insulation arrangement within the electrical switch, which enables the control assembly and relay assembly to be integrated into a single module. In addition, the control assembly may further comprise any electrical and electronic elements needed to control the relay assembly. For example, the control assembly may comprise a power supply unit, a control unit and a circuit board.

**[0061]** In some embodiments of the present disclosure, the relay assembly may further comprise another relay 110-2, and the relay 110-2 and the relay 110-1 are arranged adjacent to each other. The relay 110-2 may be for example a bistable relay. The electrical switch 100 with dual relays may be used to control both single-phase power supply and two-phase power supply. For example, in a 120V two-phase power supply system, when two phases of voltage need to be used to supply power for the 240V load, the two relays in the electrical switch 100 may respectively control one phase line, thereby effectively implementing load control. However, it may be understood that the number of relays used by the electrical switch 100 may also be one, or more than two (for example, three) depending on the specific needs.

**[0062]** In some embodiments of the present disclosure, the relay 110-1 and relay 110-2 may be arranged along their own length direction. As shown in FIG. 10, the relay 110-1 and the relay 110-2 are arranged in a line. When the electrical switch 100 is mounted on the circuit breaker 300, the relay assembly including the relay 110-1 and the relay 110-2 will be disposed on the side D of the circuit breaker 300 (as shown in FIG. 12). However, the side space of the circuit breaker is usually limited, so such a relay arrangement manner can occupy as little side space as possible on the circuit breaker.

**[0063]** In some embodiments of the present disclosure, the electrical switch 100 further comprises an incoming wire and outgoing wire assembly 150. The incoming wire and outgoing wire assembly 150 is formed in an L shape with the relay assembly, and configured to electrically connect the electrical terminals 111 on the relay assembly to an external circuit. The incoming wire and outgoing wire assembly 150 comprise an incoming

wire terminal 153 and an outgoing wire terminal 151. The incoming wire terminal 153 faces the inner side of the L-shape and is configured to be electrically connected to the circuit breaker 300 in an inserted manner.

**[0064]** By way of example only, the incoming wire and outgoing wire assembly 150 may comprise two incoming wire terminals 153, two outgoing wire terminals 151, a frame (which comprises terminal strips), and bolts. The frame (which comprises terminal strips) and bolts are used to fix and connect the incoming wire terminal 153 and the outgoing wire terminal 151. One end of the outgoing wire terminal 151 may be connected to the terminal strip on the frame of the incoming wire and outgoing wire assembly 150, and the other end may be connected to the electrical terminal 111 of the relay 110-1 or 110-2. One end of the incoming wire terminal 153 may be connected to the electrical terminal 111 of the relay 110-1 or 110-2, and the other end may protrude out of the housing, so as to be electrically connected to the circuit breaker 300 in an inserted manner. A relay may correspond to one incoming wire terminal and one outgoing wire terminal such that each relay of the relay assembly may be electrically connected to the external circuit to implement control function. It will be appreciated that other numbers of the incoming wire terminal and outgoing wire terminal may be selected as needed, and the frame and bolts may be omitted as needed or their functions may be achieved in other manners.

**[0065]** The incoming wire and outgoing wire assembly 150 and the relay assembly are arranged in an L-shape such that when the electrical switch 100 is mounted to the circuit breaker 300, the incoming wire and outgoing wire assembly 150 is disposed on the front side C of the circuit breaker 300 (as shown in FIG. 12). Such an arrangement no longer occupies more space on the side D of the circuit breaker 300 and better facilitates electrical connection between the electrical switch 100 and the circuit breaker 300.

**[0066]** In some embodiments of the present disclosure, the above control assembly may comprise a first circuit board 121, a second circuit board 122 and a third circuit board 123. The first circuit board 121, the second circuit board 122 and the third circuit board 123 are configured to carry other elements in the control assembly, and the first circuit board 121 and the second circuit board 122 are arranged on a side of the L shape provided with the relay assembly, and the third circuit board 123 is arranged on the other side of the L-shape provided with the incoming wire and outgoing wire assembly 150.

**[0067]** Specifically, the first circuit board 121, the second circuit board 122 and the third circuit board 123 may carry, for example, at least one of a wireless communication unit, a control unit or a power supply unit. The first circuit board 121 and the second circuit board 122 are arranged adjacent to the relay assembly. Similar to the arrangement of the first circuit board and the second circuit board in FIG. 3, the board faces of the first and second circuit boards 121, 122 are substantially perpendicular to a plurality of sides of the relays 110-1 and 110-2 (they define the thickness of the relay), or substantially perpendicular to the thickness direction of the relays 110-1 and 110-2, and extends along the plurality of sides. Such an arrangement avoids occupation of more side space of the circuit breaker. In addition, the third circuit board 123 is arranged together with the incoming wire and outgoing wire assembly 150. The third circuit board 123 may be provided with a through hole 1231 so that the incoming wire terminal 153 passes therethrough. For example, a current sensor may be disposed on the third circuit board 123 so as to sense the current on the incoming wire terminal 153. As an example, the first circuit board 121 may be a power supply circuit board, the second circuit board 122 may be a control circuit board, and the third circuit board 123 may be a microcontroller MCU circuit board. However, it may be understood that electrical and electronic elements of various functions may also be distributed mixedly on the first circuit board 121, the second circuit board 122 and the third circuit board 123 as needed.

**[0068]** FIG. 12 shows a perspective view of an electrical switch 100 mounted on a circuit breaker 300 according to another embodiment of the present disclosure. As shown in FIG. 12, the electrical switch 100 is mounted on the circuit breaker 300. The circuit breaker 300 is surrounded by the L-shaped electrical switch 100 with a portion of the electrical switch 100 located on the side D of the circuit breaker 300 and another portion located on the front side C of the circuit breaker 300. The incoming wire terminal 153 of the electrical switch 100 is inserted into the circuit breaker 300 to effect electrical connection with the circuit breaker 300. Since the relay controlled in the wireless communication manner is used to control the load, the size of the electrical switch 100 is reduced and the structure is simplified, so that the electrical switch 100 can be reliably mounted directly on the circuit breaker 300.

**[0069]** In some cases, when the circuit breaker 300 is installed into a switchgear or other switchgear, the side space of the circuit breaker 300 is usually very limited, and other devices cannot be arranged any longer. At the same time, the front space of the circuit breaker 300 is relatively abundant. Therefore, in the case where it is necessary to directly mount the electrical switch to the circuit breaker 300, more thought may be given to the front space of the circuit breaker 300.

**[0070]** FIGS. 13 through 17 illustrate a further embodiment of the present disclosure. FIG. 13 shows an external perspective view of an electrical switch 100 according to a further embodiment of the present disclosure. As shown in FIG. 13, the electric switch 100 is formed as a square shape as the whole. Such a configuration enables the electrical switch 100 to be entirely mounted on the front side of the circuit breaker 300 in an inserted manner.

**[0071]** Referring to FIGS. 14 and 15, FIG. 14 illustrates an internal perspective view of the electrical switch 100 after removal of the housings 141 and 142 of FIG. 13,

and FIG. 15 shows an exploded view of an electrical switch 100 according to a further embodiment of the present disclosure. As shown in FIGS. 14 and 15, the electrical switch 100 may comprise housings 141 and 142, a control assembly and a relay assembly. The relay assembly may comprise relays 110-1 and 110-2, and the relay assembly and the control assembly for controlling the relay assembly may be combined and mounted in the same housing space. In order to simplify the description, the same portions as the previous embodiment will not be described in detail, and the differences from the previous embodiment will be mainly described.

**[0072]** In some embodiments of the present disclosure, the relay 110-1 and the relay 110-2 comprised in the relay assembly are arranged along their own thickness direction. As shown in FIGS. 14 and 15, the relay 110-1 and the relay 110-2 may be supported and fixed by an isolation frame 155 located therebetween. In addition, the isolation frame 155 may also support and secure the incoming wire and outgoing wire assembly 150. Thereby, the entirety of the electric switch 100 is formed in a square shape instead of the L shape in the previous embodiment.

**[0073]** In some embodiments of the present disclosure, the electrical switch 100 further comprises the incoming wire and outgoing wire assembly 150. The incoming wire and outgoing wire assembly 150 is opposite to the side of the relay assembly provided with the electrical terminals 111 and is configured to electrically connect the electrical terminals 111 on the relay assembly to an external circuit. The incoming wire and outgoing wire assembly 150 comprises the incoming wire terminal 153 and the outgoing wire terminal 151. The incoming wire terminal 153 is configured to be electrically connected to the circuit breaker 300 in an inserted manner.

**[0074]** As shown in FIGS. 14 and 15, as an example, the incoming wire and outgoing wire assembly 150 may comprise the incoming wire terminal 153 and the outgoing wire terminal 151. Further, the incoming wire and outgoing wire assembly 150 may further comprise a frame (which may comprise a terminal strip) and bolts for fixing and connecting the incoming wire terminal 153 and the outgoing wire terminal 151. FIG. 16 shows an exploded view of partial members of the electrical switch 100 according to a further embodiment of the present disclosure. To more clearly show the connection between the incoming wire and outgoing wire assembly 150 and the relay assembly, the frame and bolts of the incoming wire and outgoing wire assembly 150 are removed from FIG. 16. As shown in FIG. 16, the incoming wire terminal 153 and the outgoing wire terminal 151 are near the sides of the relays 110-1 and 110-2 provided with the electrical terminals 111, and extend in opposite directions to each other. One end of the outgoing wire terminal 151 is connected to the electrical terminal 111 of the relay 110-1 or 110-2, the other end is connected to the terminal strip on the frame of the incoming wire and outgoing wire assembly 150 (see FIGS. 14 and 15), and one end of the incoming wire terminal 153 is connected to the electrical terminal 111 of the relay 110-1 or 110-2, and the other end protrudes out of the housings 141 and 142 for insertion into the circuit breaker 300.

**[0075]** Since the incoming wire and outgoing wire assembly 150 needs to be electrically connected to the electrical terminals 111 of the relay, arranging the incoming wire and outgoing wire assembly 150 in close proximity to the electrical terminals 111 facilitates reducing the space needed by wiring and insulation, such that the electrical switch 100 is smaller in size.

**[0076]** In some embodiments of the present disclosure, the control assembly comprises a first circuit board 121, a second circuit board 122 and a third circuit board 123. The first circuit board 121, the second circuit board 122 and the third circuit board 123 are configured to carry other elements in the control assembly and are arranged on the same side of the relay assembly with the incoming wire and outgoing wire assembly 150. As shown in FIGS. 14 and 15, the first and second circuit boards 121, 122 may be arranged opposite to each other. The wireless communication unit may be disposed on the first circuit board 121, and control coils 113 of the relays 110-1 and 110-2 may be connected to the first circuit board 121. However, the wireless communication unit may also be arranged on other circuit boards and arranged at any suitable position. In addition, the third circuit board 123 may be arranged together with the incoming wire and outgoing wire assembly 150, and may be provided with a through hole 1231 allowing the outgoing wire terminal 151 to pass therethrough. For example, a current sensor may be disposed on the third circuit board 123 so that the current on the outgoing wire terminal 151 may be sensed.

**[0077]** FIG. 17 shows a perspective view of an electrical switch 100 mounted on a circuit breaker 300 according to a further embodiment of the present disclosure. As shown in FIG. 17, the electrical switch 100 is entirely plugged into the front side C of the circuit breaker 300, which avoids occupying the space on the side D of the circuit breaker 300.

**[0078]** Similar to the electrical switches shown in FIGS. 3 through 8, the electrical switches 100 shown in FIGS. 9-17 may also comprise a button (for operation by a user to control the relay), a metering unit and a diagnostic unit. The description of the electrical switches and their components of FIGS. 3 through 8 also applies to the electrical switches and their components shown in FIGS. 9 through 17, unless explicitly stated. In addition, it may be understood that the electrical switch according to the present disclosure is not limited to the number of relays and the number of incoming wires and outgoing wires used in the above embodiments, and fewer or more relays and incoming wires and outgoing wires may be selected as needed.

**[0079]** According to a further embodiment of the present disclosure, there is provided a switchgear that may comprise the electrical switch 100. Specifically, the

switchgear may be used to control the load of household appliances such as electric heaters, lighting, and the like. The household power-use environment has characteristics such as light load and infrequent switch switching. The electrical switch 100 using a relay as a switching device is well adapted for such a household load. In addition, the electrical switch 100 has advantages such as compactness, independence, remote control, simple wiring, and intelligence (wireless control, temperature protection, metering function), which improves the performance of the switching device that controls the home appliance.

**[0080]** Through the teaching given by the above depictions and related figures, many modifications and other embodiments of the present disclosure will be apparent to those skilled in the art. Therefore, it is to be appreciated that the embodiments of the present disclosure are not limited to the disclosed specific embodiments, and modifications and other embodiments are intended to be comprised within the scope of the present disclosure. In addition, while the above description and related figures have described example embodiments in the context of certain example combinations of components and/or functions, it should be appreciated that different combination forms of the components and/or functions may be provided by alternative embodiments without departing from the scope of the present disclosure. In this regard, for example, other combination forms of components and/or functions that are different from those explicitly described above are also contemplated as being within the scope of the present disclosure. Although specific terms are employed herein, they are used in a generic and illustrative sense and are not intended to be limiting.

## Claims

**1.** An electrical switch (100), comprising:

a housing (141, 142);
a relay assembly arranged within the housing (141, 142) and configured to turn on and off a circuit connected to the electrical switch (100), the relay assembly comprising a first relay (110-1); and
a control assembly arranged in parallel with the relay assembly in the hosing (141, 142), the control assembly being configured to control the relay assembly, and the control assembly comprising a wireless communication unit (160) configured to receive signals to remotely control the relay assembly.

**2.** The electrical switch (100) according to claim 1, wherein the control assembly is opposite to a first side (A) of a plurality of sides of the first relay (110-1), the plurality of sides defining a thickness of the first relay (110-1).

**3.** The electrical switch (100) according to claim 2, wherein the electrical switch further comprises:
an incoming wire and outgoing wire assembly (150) arranged in parallel with the relay assembly in the housing (141, 142), the incoming wire and outgoing wire assembly (150) being opposite to a second side (B) of the plurality of sides of the first relay (110-1) and configured to electrically connect electrical terminals (111) disposed on the second side (B) with an external circuit.

**4.** The electrical switch (100) according to claim 1 or 2, wherein the control assembly comprises:
a control terminal unit (130) configured for connecting a switching device external to the electrical switch (100) to enable control of the relay assembly by the switching device.

**5.** The electrical switch (100) according to claim 4, wherein at least one of the control terminal unit (130) and the housing (141, 142) is provided with a notch (131) for accommodating a copper bus bar.

**6.** The electrical switch (100) according to claim 2, wherein the control assembly comprises:
a first circuit board (121) and a second circuit board (122) arranged opposite to each other, board faces of the first circuit board (121) and the second circuit board (122) being substantially perpendicular to the first side (A) of the first relay (110-1), to carry other elements in the control assembly.

**7.** The electrical switch (100) according to any of claims 1 to 6, wherein the relay assembly further comprises:
a second relay (110-2), the second relay (110-2) and the first relay (110-1) being arranged adjacent to each other.

**8.** The electrical switch (100) according to claim 7, wherein the first relay (110-1) and the second relay (110-2) are arranged along a length direction of the first relay (110-1) and the second relay (110-2).

**9.** The electrical switch (100) according to claim 8, wherein the electrical switch further comprises:
an incoming wire and outgoing wire assembly (150) forming an L-shape with the relay assembly and configured to electrically connect electrical terminals (111) on the relay assembly to an external circuit, the incoming wire and outgoing wire assembly (150) comprising an incoming wire terminal (153) and an outgoing wire terminal (151), the incoming wire terminal (153) facing an inner side of the L shape and configured to be electrically connected to the circuit breaker (300) in an inserted manner.

**10.** The electrical switch (100) according to claim 9, wherein the control assembly comprises:
a first circuit board (121), a second circuit board (122) and a third circuit board (123), configured to carry other elements in the control assembly, the first circuit board (121) and the second circuit board (122) being arranged on one side of the L-shape provided with the relay assembly, and the third circuit board (123) being arranged on the other side of the L-shape provided with the incoming wire and outgoing wire assembly (150).

**11.** The electrical switch (100) according to claim 7, wherein the first relay (110-1) and the second relay (110-2) are arranged along a thickness direction of the first relay (110-1) and the second relay (110-2).

**12.** The electrical switch (100) according to claim 11, wherein the electrical switch further comprises:
an incoming wire and outgoing wire assembly (150) being opposite to a side of the relay assembly provided with electrical terminals (111) and configured to connect the electrical terminals (111) on the relay assembly to an external circuit, the incoming wire and outgoing wire assembly (150) comprising an incoming wire terminal (153) and an outgoing wire terminal (151), the incoming wire terminal (153) being configured to be electrically connected to the circuit breaker (300) in an inserted manner.

**13.** The electrical switch (100) according to claim 12, wherein the control assembly comprises:
a first circuit board (121), a second circuit board (122) and a third circuit board (123), configured to carry other elements in the control assembly, and arranged together with the incoming wire and outgoing wire assembly (150) on the same side of the relay assembly.

**14.** The electrical switch (100) according to claim 10 or 13, wherein the third circuit board (123) comprising a through hole (1231) allowing the incoming wire terminal (153) or the outgoing wire terminal (151) to pass therethrough, so as to sense the current on the incoming wire terminal (153) or the outgoing wire terminal (151) by the third circuit board (123).

**15.** The electrical switch (100) according to any of claims 1 to 14, wherein the wireless communication unit (160) is configured to communicate in a Zigbee manner.

**16.** The electrical switch (100) according to any of claims 1 to 15, wherein the control assembly comprises:
a button (126) that is operable by a user to control the relay assembly (110).

**17.** The electrical switch (100) according to any of claims 1 to 16, wherein the control assembly comprises:

a metering unit configured to measure at least one of an electrical parameter and a temperature parameter of the electrical switch (100); and
a diagnostic unit configured to determine an ON/OFF state of the electrical switch (100).

**18.** A switchgear, comprising the electrical switch according to any of claims 1-17.

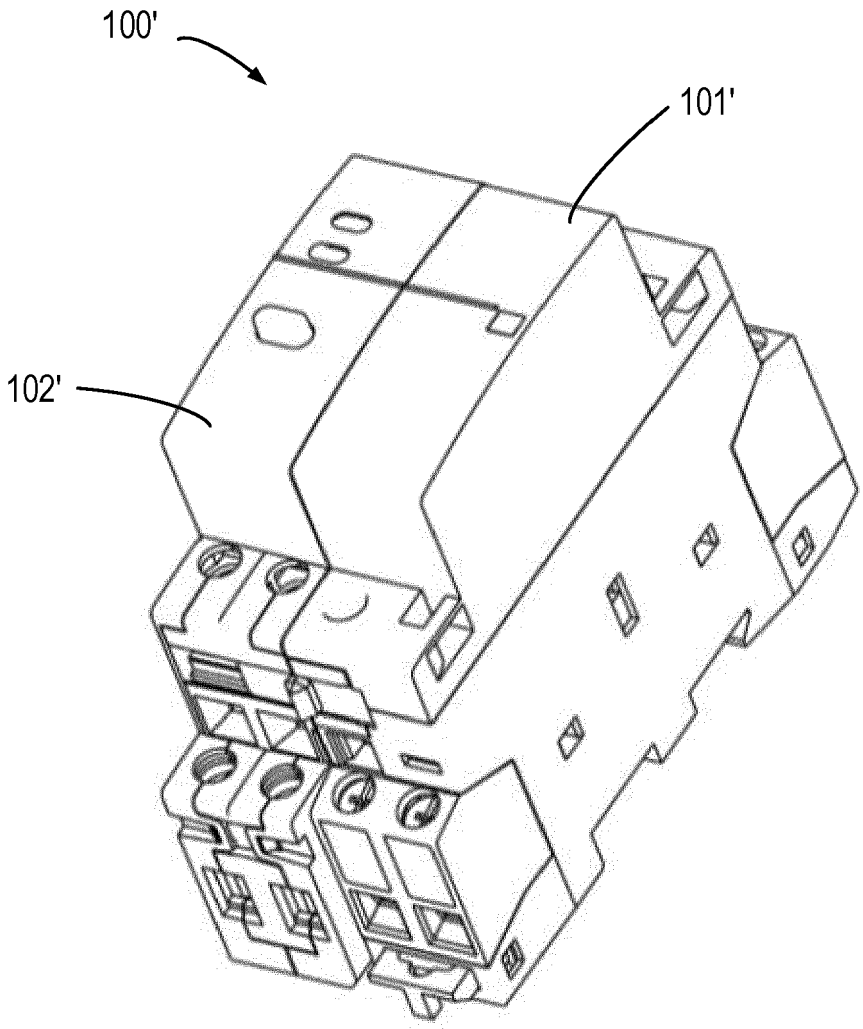


FIG. 1

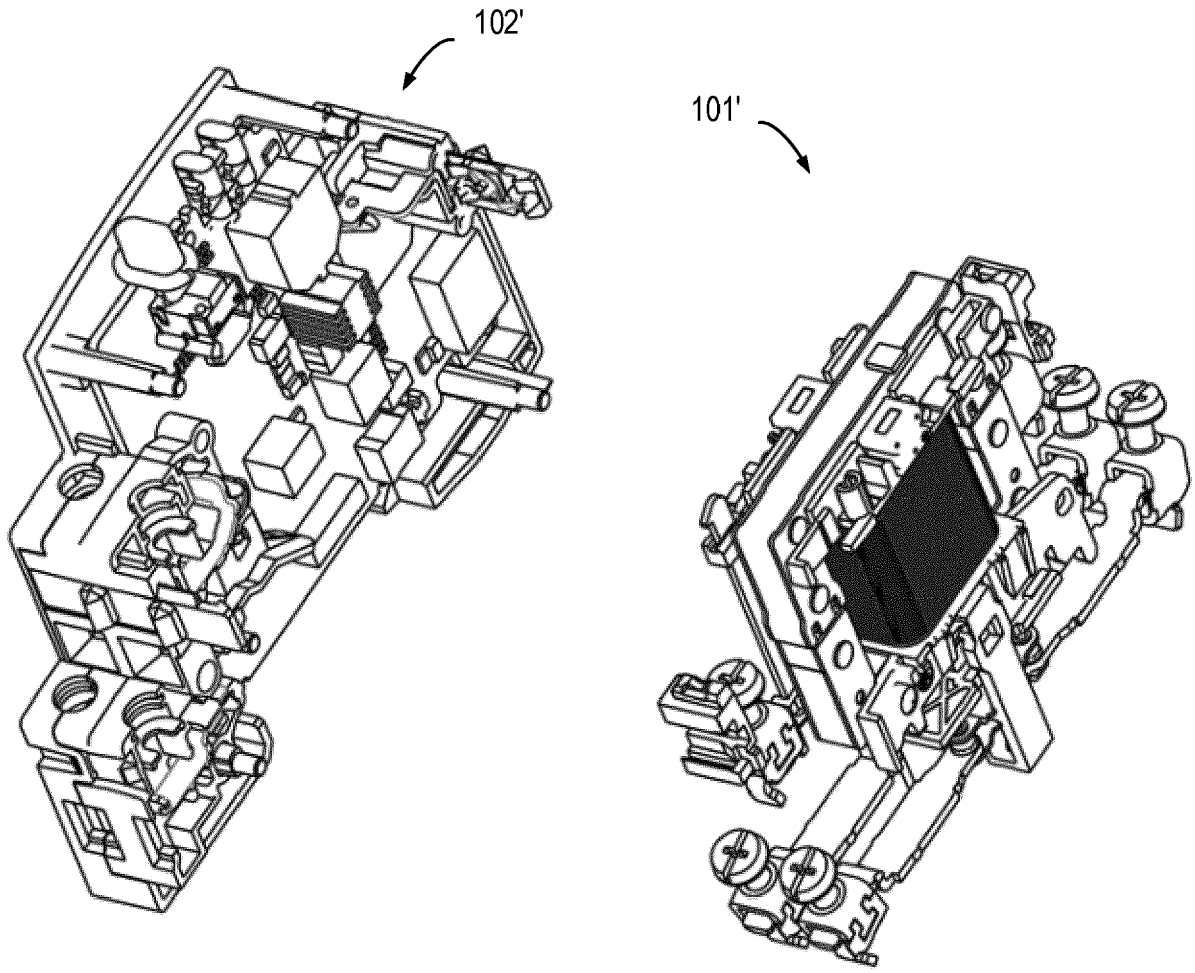


FIG. 2

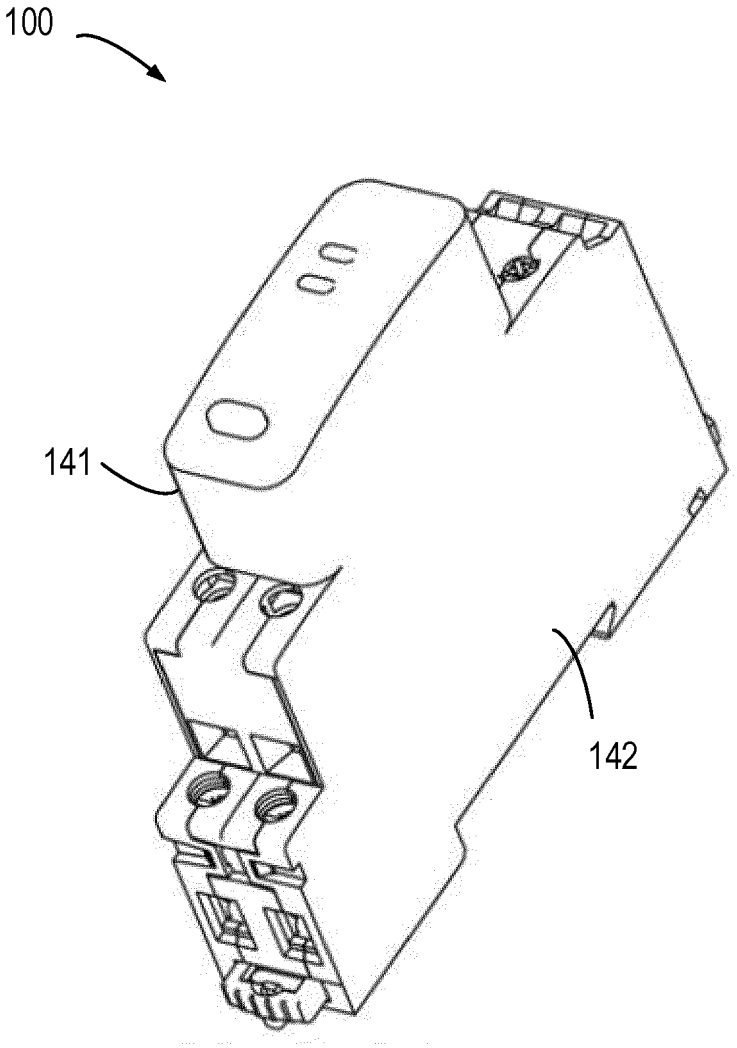


FIG. 3

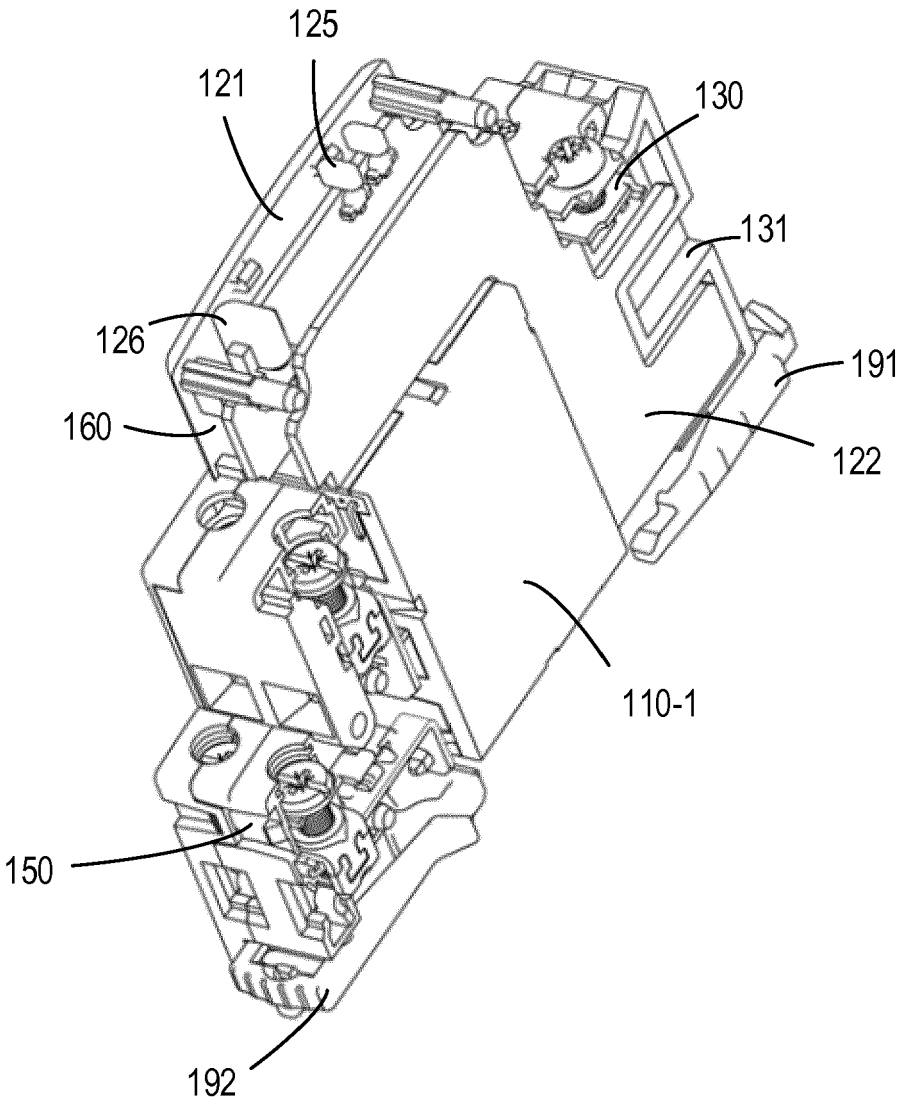


FIG. 4

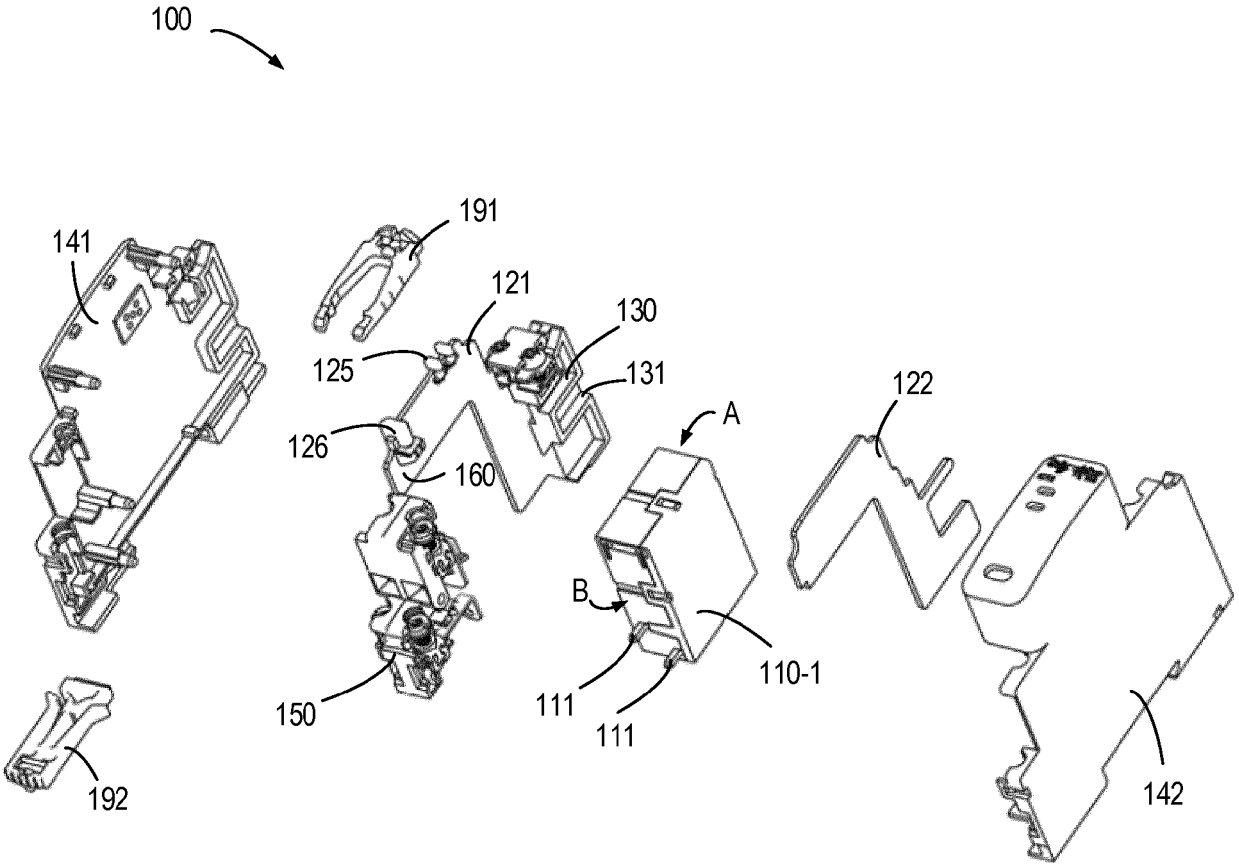
100
141
191
121
130
125
131
126
160
A
122
B
110-1
150
111
111
192
142

FIG. 5

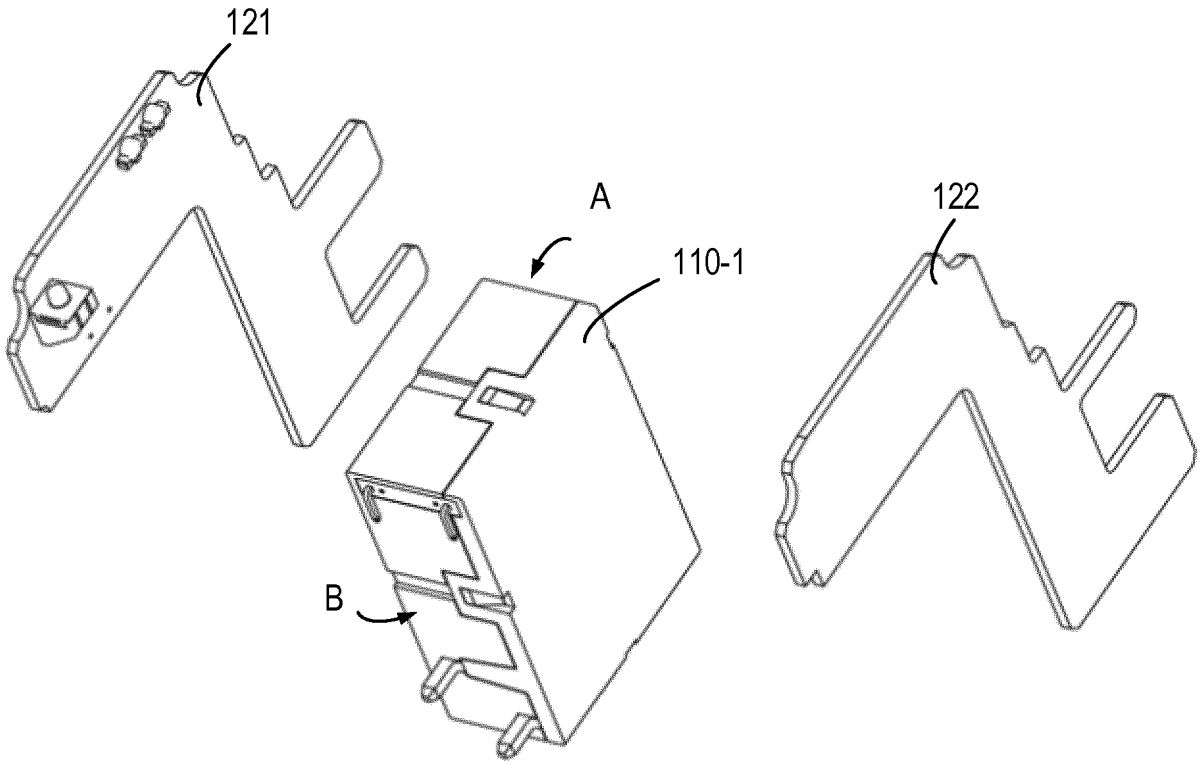


FIG. 6A

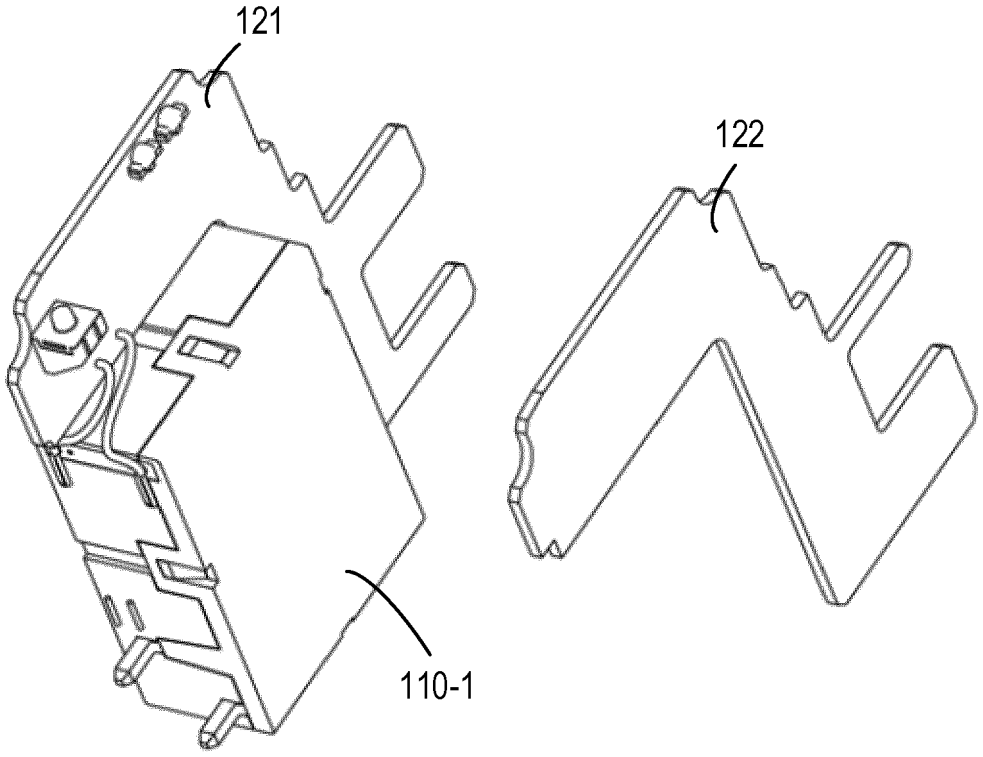


FIG. 6B

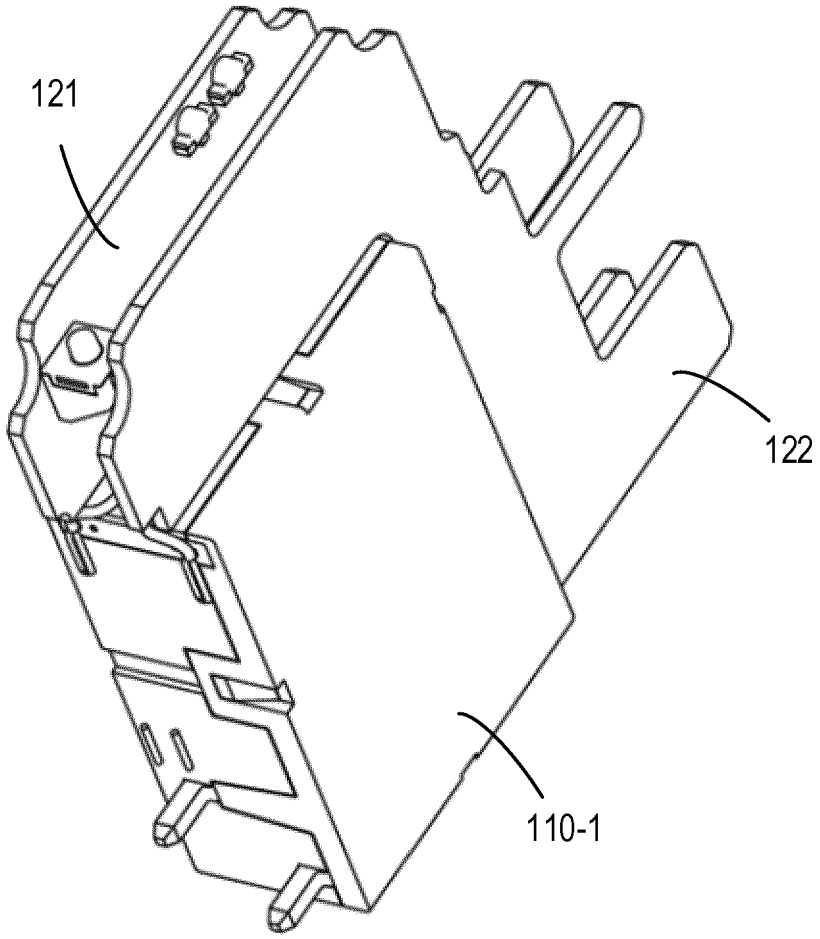


FIG. 6C

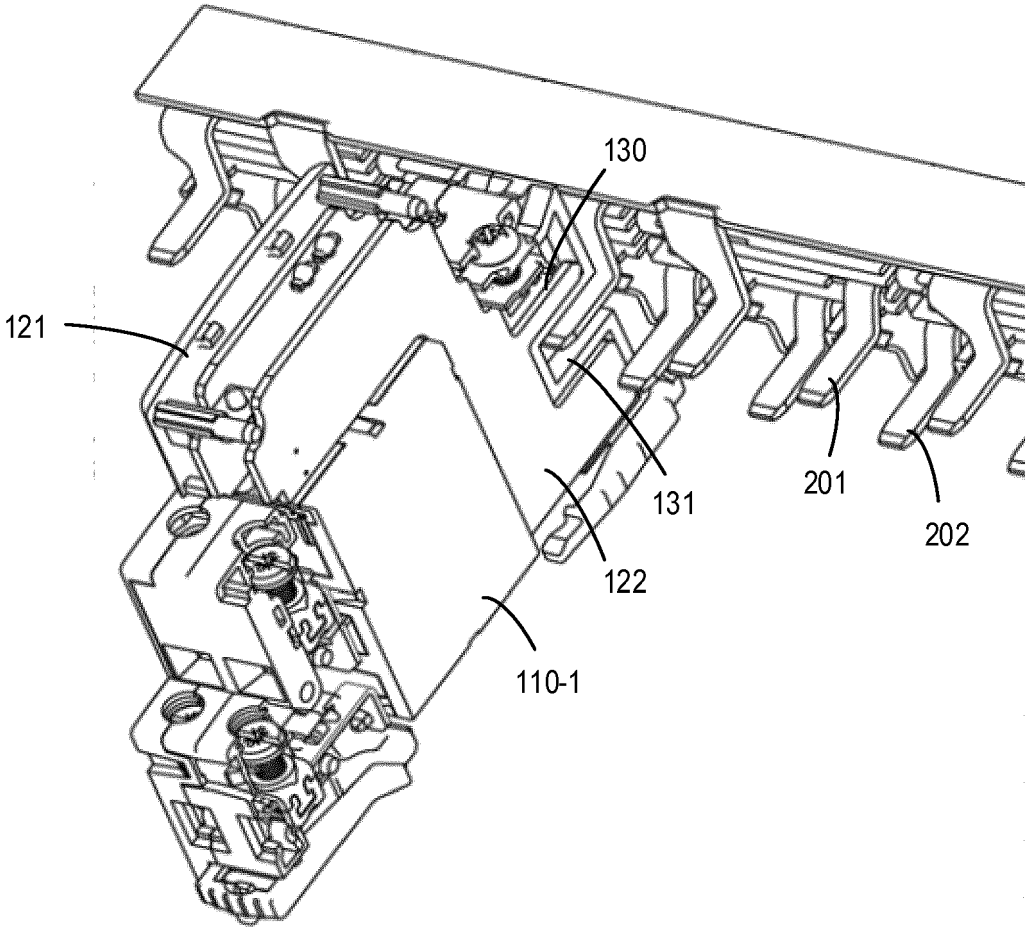


FIG. 7

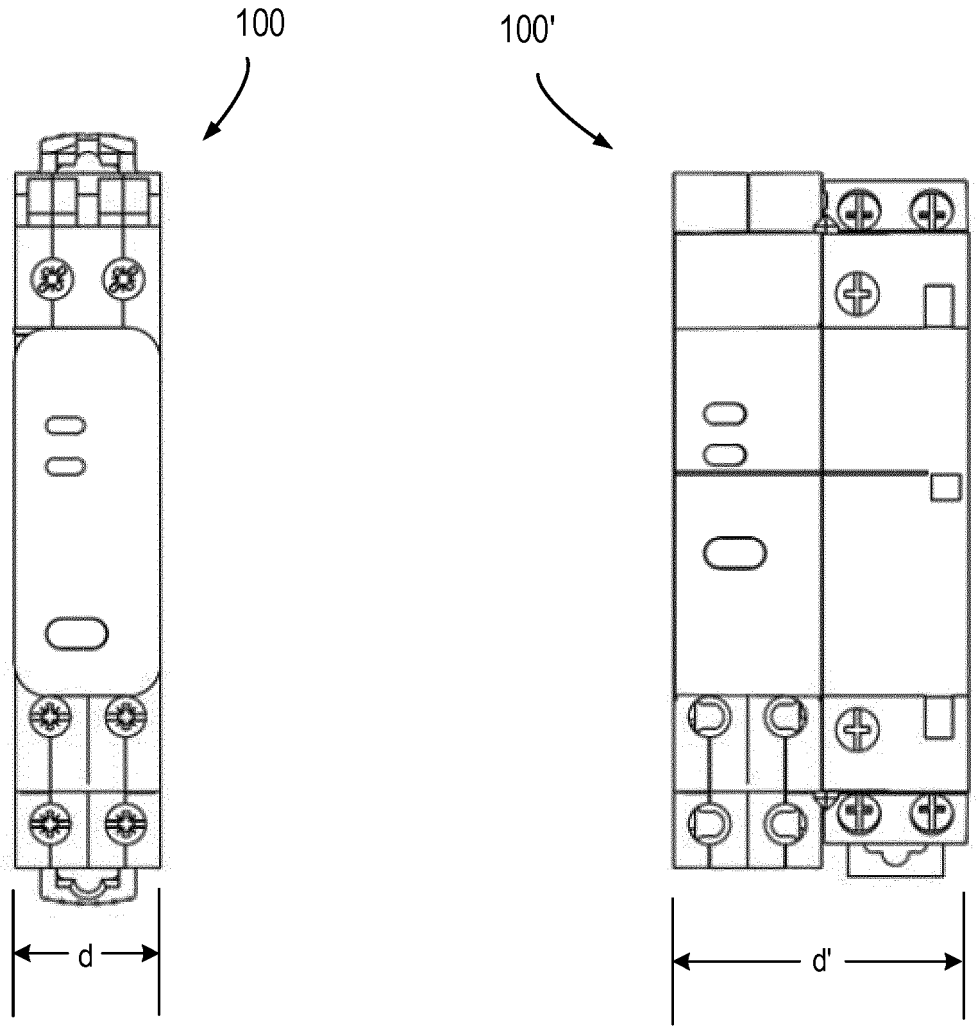


FIG. 8

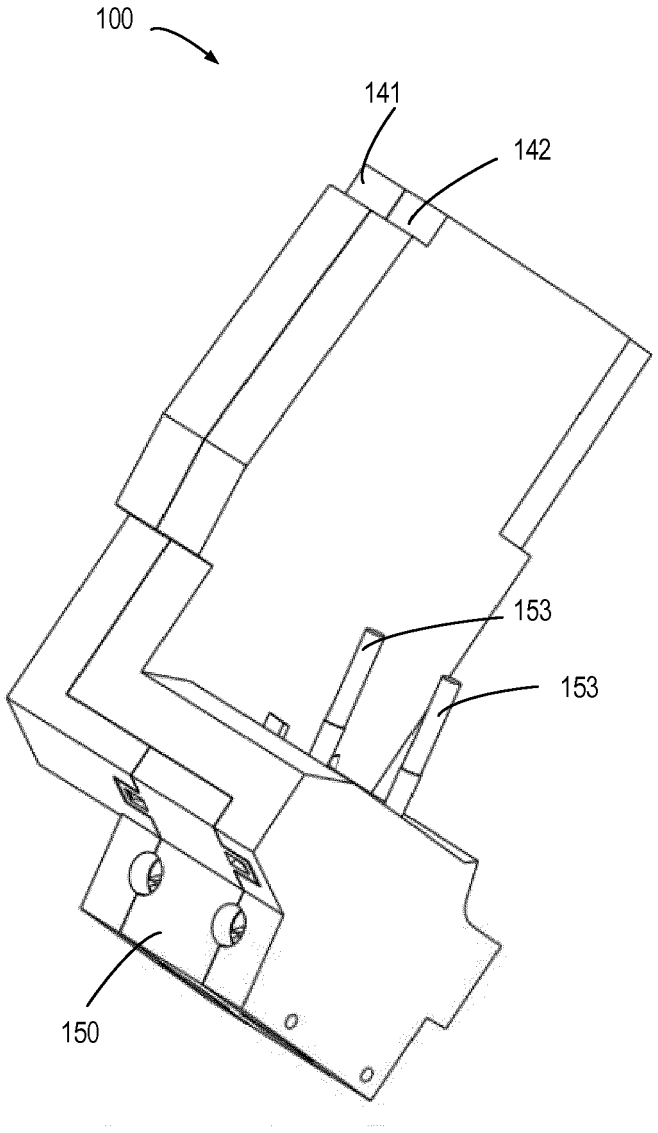


FIG. 9

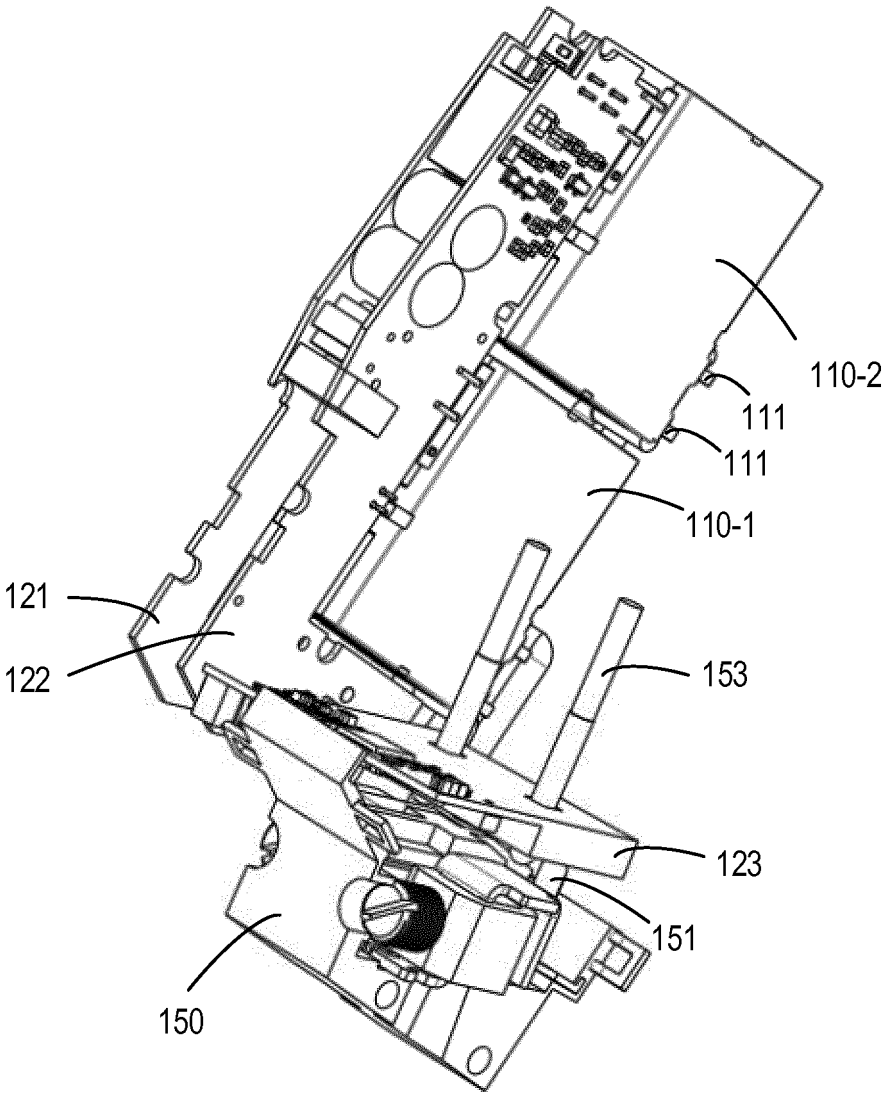


FIG. 10

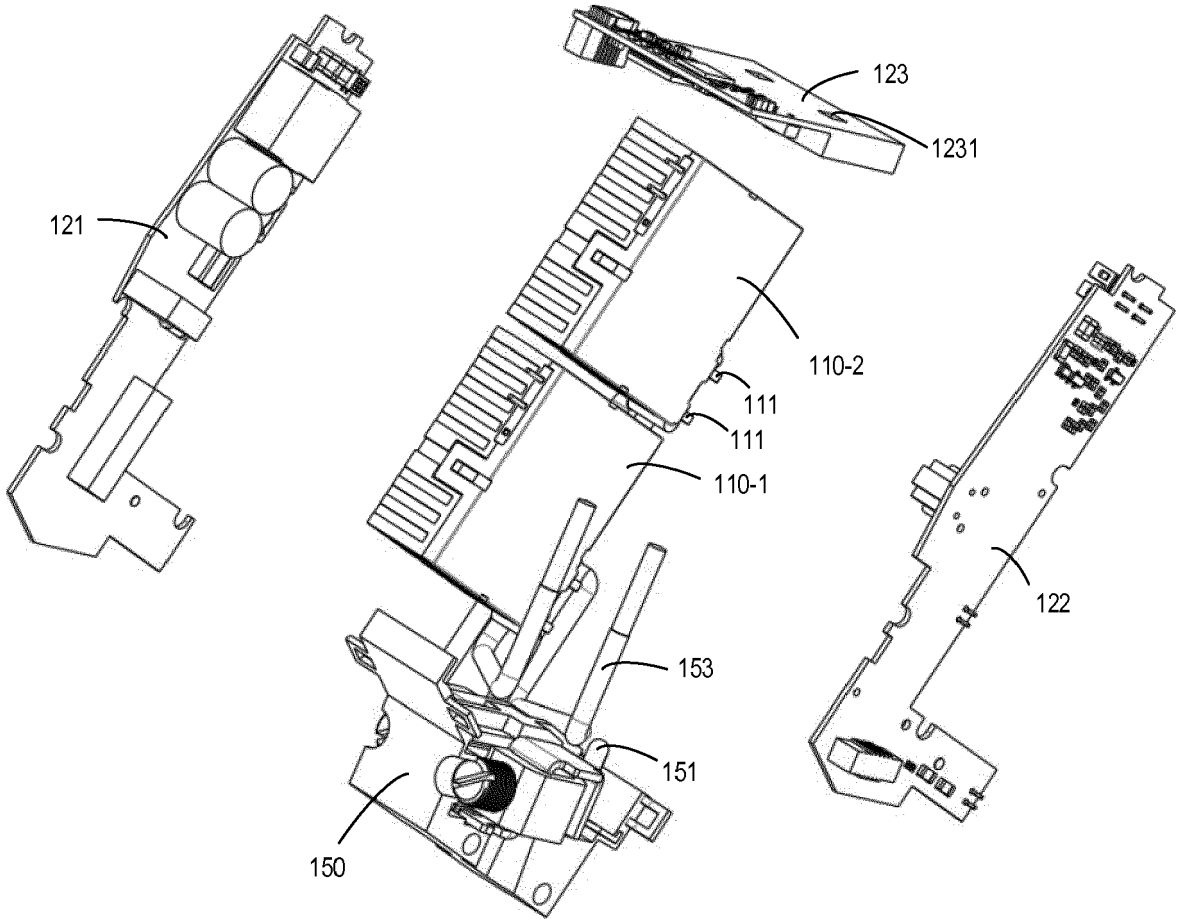


FIG. 11

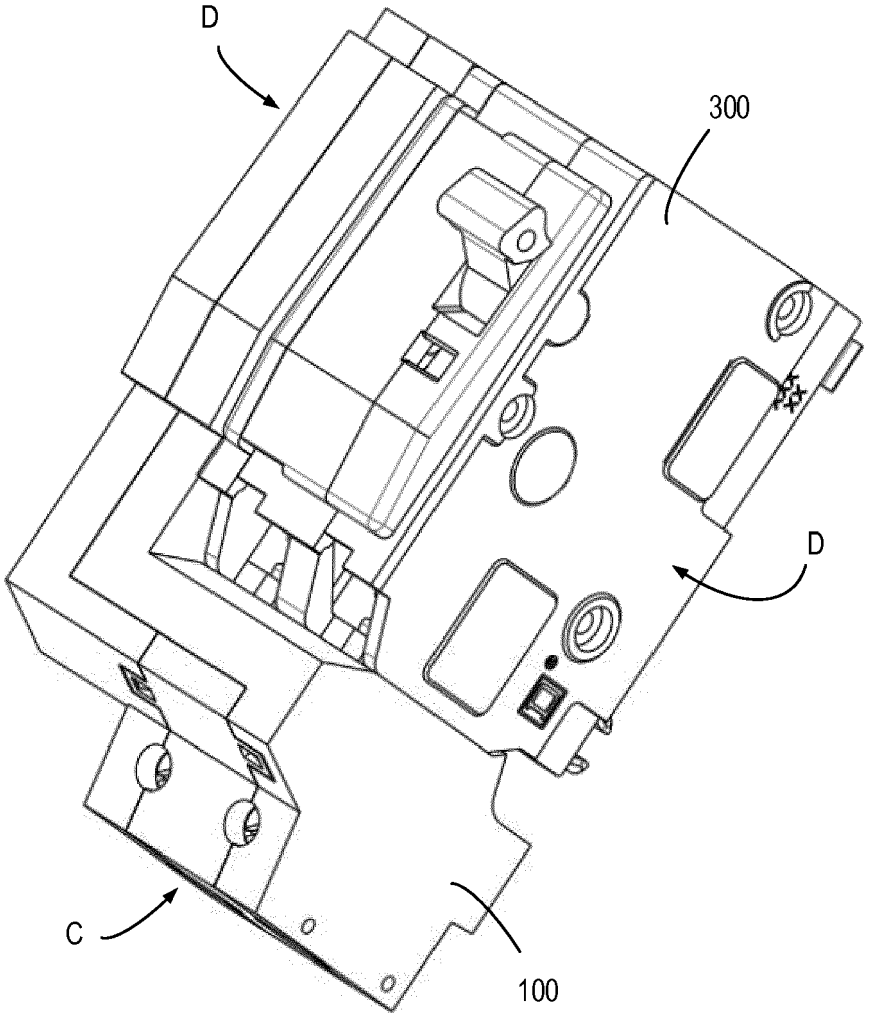


FIG. 12

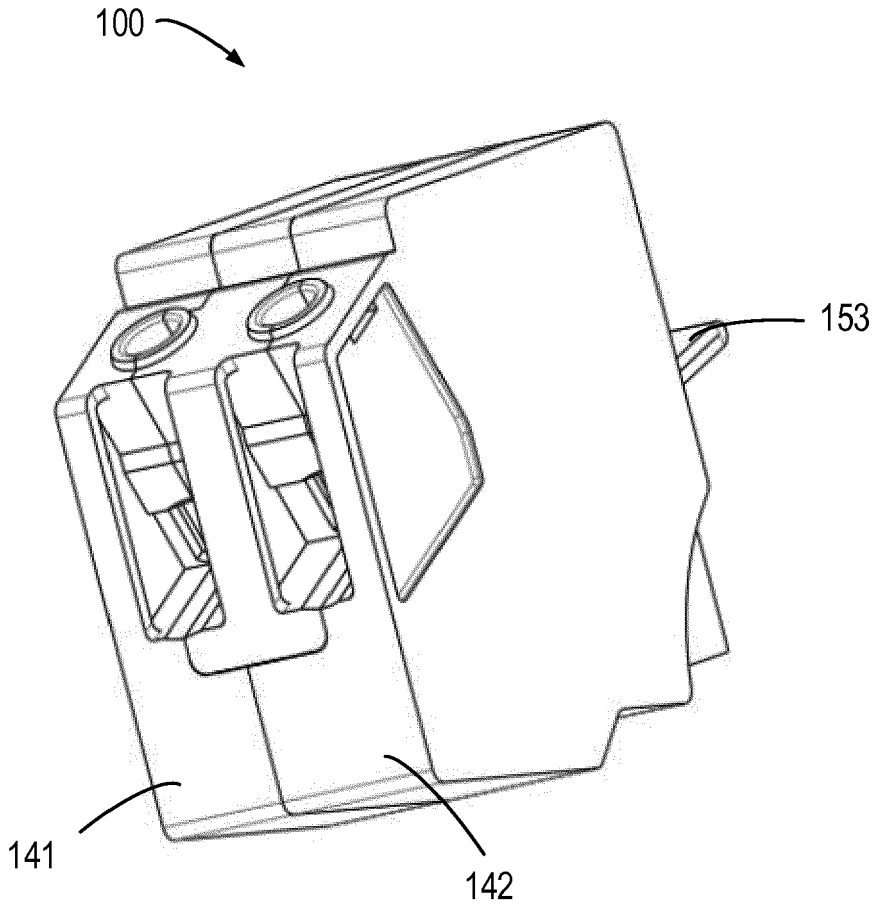


FIG. 13

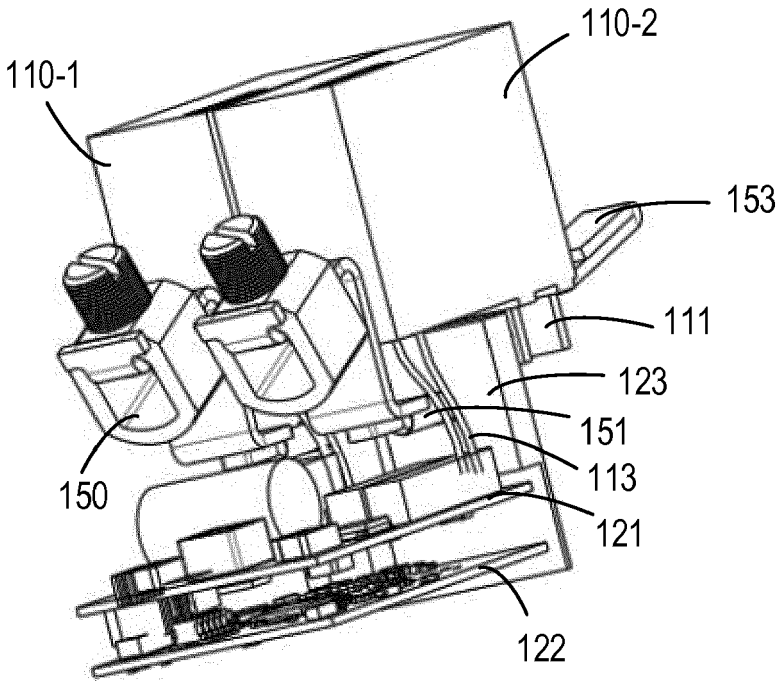


FIG. 14

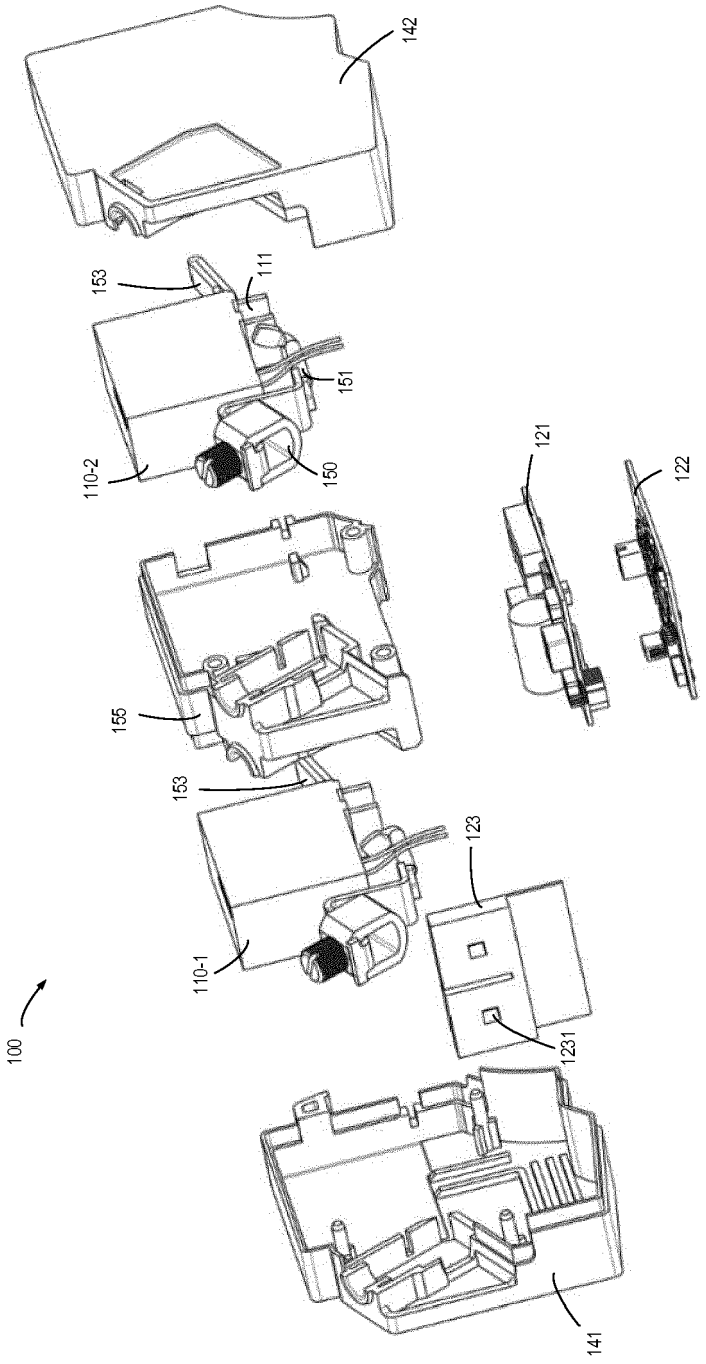


FIG. 15

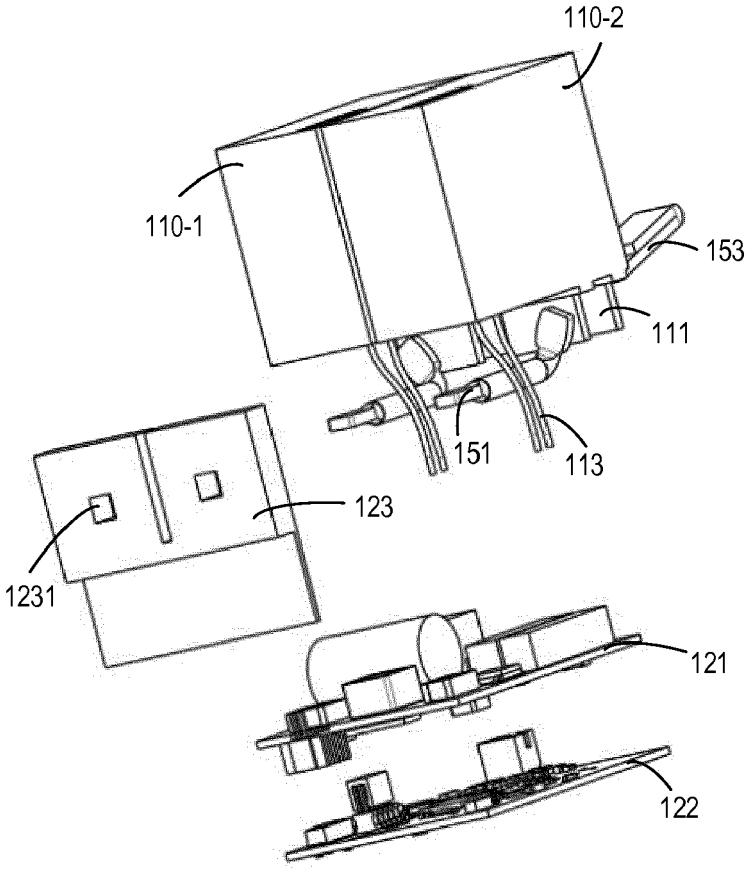


FIG. 16

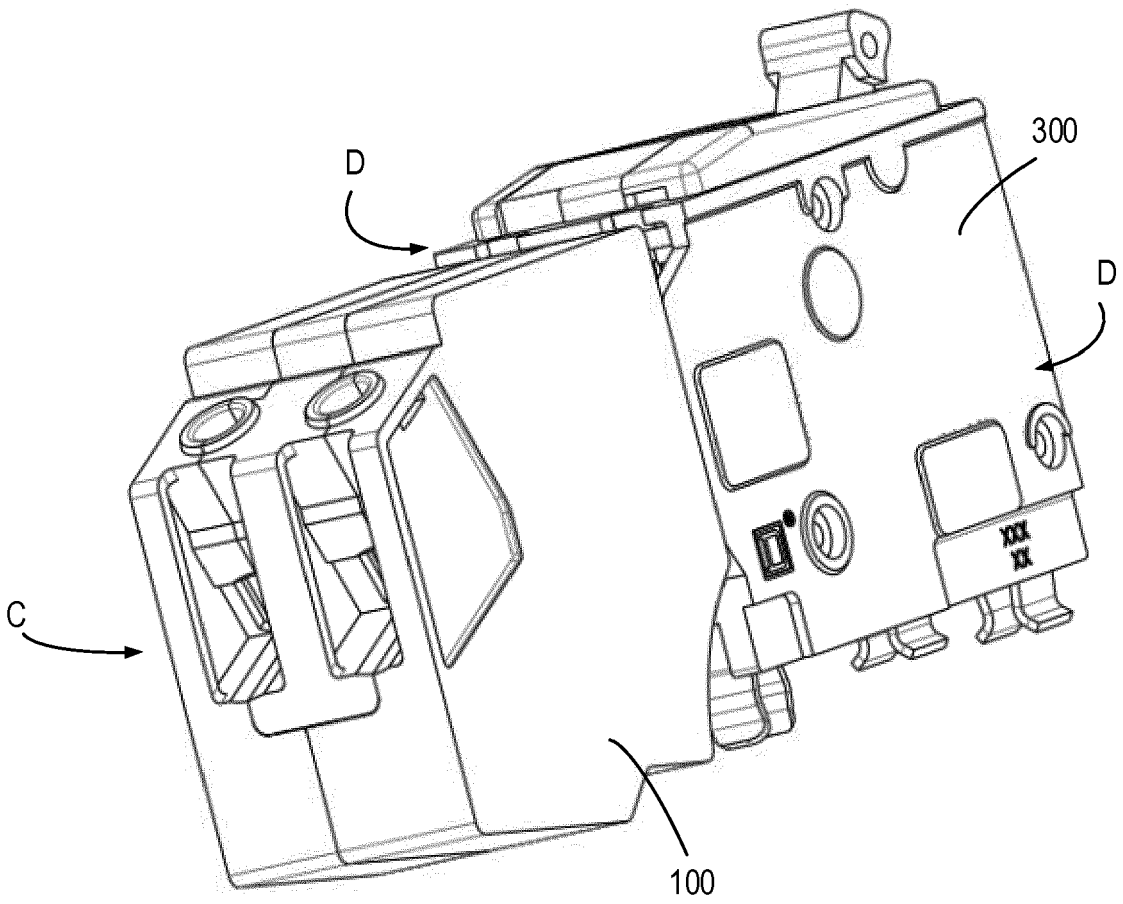


FIG. 17

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 19 21 0897

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y | EP 2 731 121 A2 (ROCKWELL AUTOMATION TECH INC [US]) 14 May 2014 (2014-05-14)<br>* paragraphs [0031], [0032], [0052]; figures 1,4 *<br>----- | 1-6, 16-18<br>7-15 | INV. H01H50/04 |
| X<br>Y | CN 108 717 919 A (ZHEJIANG X&Z ELECTRIC CO LTD) 30 October 2018 (2018-10-30)<br>* figures 2,6 *<br>----- | 1<br>7-15 | |
| X | EP 3 357 786 A2 (VOLKERRAIL NEDERLAND BV [NL]) 8 August 2018 (2018-08-08)<br>* paragraph [0028] *<br>----- | 1 | |
| A | EP 2 793 246 A1 (ABL IP HOLDING LLC [US]) 22 October 2014 (2014-10-22)<br>* the whole document *<br>----- | 1 | |

| TECHNICAL FIELDS SEARCHED (IPC) |
|---|
| H01H |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 2 March 2020 | Simonini, Stefano |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 21 0897

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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02-03-2020

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 2731121 A2 | 14-05-2014 | CN 103811230 A | 21-05-2014 |
| | | EP 2731121 A2 | 14-05-2014 |
| | | US 2014124262 A1 | 08-05-2014 |
| CN 108717919 A | 30-10-2018 | NONE | |
| EP 3357786 A2 | 08-08-2018 | EP 3357786 A2 | 08-08-2018 |
| | | NL 2020390 A | 14-08-2018 |
| EP 2793246 A1 | 22-10-2014 | CA 2849515 A1 | 19-10-2014 |
| | | EP 2793246 A1 | 22-10-2014 |
| | | US 2014312998 A1 | 23-10-2014 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82