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(54) 2P2 ANALOG-TO-DIGITAL ELECTROMAGNETIC LEAKAGE PROTECTION CIRCUIT BREAKER

(57) The present invention relates to a 2P2M electromagnetic residual current circuit breaker with overcurrent protection (RCBO), including a housing. A circuit breaker module, a current leakage protection module linked to the circuit breaker module, and a handle linkage mechanism configured to control the circuit breaker module and the current leakage protection module are disposed in the housing. The circuit breaker module includes a first pole circuit breaker protection apparatus disposed on one side of the housing. The current leakage protection module includes a current leakage protection apparatus disposed on the other side of the housing. The circuit breaker module further includes a second pole circuit breaker protection apparatus disposed in the housing and between the first pole circuit breaker protection apparatus and the current leakage protection apparatus. An inner structure of the first pole circuit breaker protection apparatus is identical to an inner structure of the second pole circuit breaker protection apparatus. The present invention has the following advantages. The 2P2M electromagnetic RCBO adopts a standard modularized layout design and has a small quantity of components, and is thus simple in manufacturing, easy to maintain and repair, and costs less.

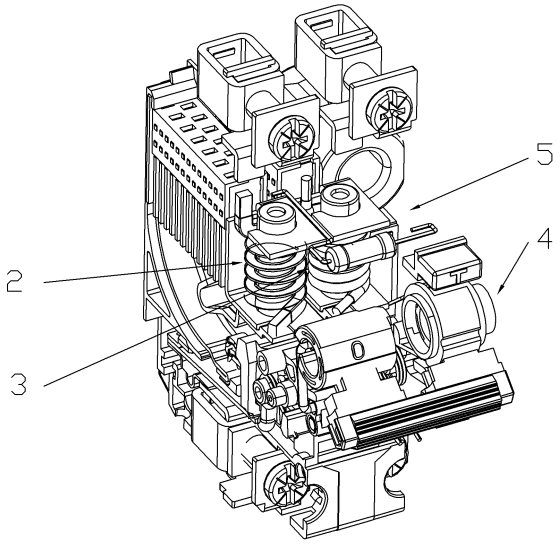

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of circuit breakers, and more particularly, to a 2P2M electromagnetic residual current circuit breaker with overcurrent protection (RCBO).

BACKGROUND

[0002] RCBO, also called earth leakage circuit breaker or ground fault circuit interrupter, is mainly used to protect a person in danger when current leakage occurs in a device, and may be used to protect a line or a motor to avoid overload or short circuit, or may be used in normal cases when a line is infrequently converted and started. The RCBO usually includes a housing. A circuit breaker apparatus and a current leakage protection apparatus are distributed in the housing. The circuit breaker apparatus is used to control connection or disconnection of a movable contact and a fixed contact when short circuit or overload occurs or a line is infrequently started. The circuit breaker apparatus usually includes an operation mechanism, a thermal tripping mechanism, an electromagnetic tripping mechanism, and an arc extinguishing system. The operation mechanism includes a handle mechanism, a contact lever, and a latch. The connection or disconnection of the movable contact and the fixed contact may be controlled through a linkage structure among the handle mechanism, the contact lever, and the latch. The latch is used to link the current leakage protection apparatus to the operation mechanism, to control the connection or disconnection of the movable contact and the fixed contact when current leakage occurs. The current leakage protection apparatus is used to control the connection or disconnection of the movable contact and the fixed contact when current leakage occurs. The current leakage protection apparatus mainly includes a control circuit board, a current leakage tripping action mechanism, and a test circuit.

[0003] The RCBO in the prior art has the following problems.

[0004] First, in overall layout, the circuit breaker apparatus occupies the upper half space, and is thus very compact in structure, has high design requirements and needs high assembly accuracy. Since the space is small, it is difficult to design an arc-extinguishing gas circuit and achieve high short-circuit breaking capability. In addition, since a left circuit breaker apparatus and a right circuit breaker apparatus are assembled and two action mechanisms are designed, the width of the thermal tripping mechanism, the operation mechanism, and the arc extinguishing system in the circuit breaker is compressed by about 18 mm at the middle for accommodating the current leakage protection apparatus. As a result, neither the left nor the right circuit breaker can be modularized and the number (quantity) of components increases. In some cases, the 2P circuit breakers are even integrated into the space of 18 mm (IP). This is difficult in manufacturing and high in process accuracy, and makes it extremely hard for separating an arc between the 2P.

[0005] Second, the circuit breaker in the prior art has a large quantity of components. When two or more existing circuit breakers are disposed, each circuit breaker is connected to a handle mechanism and a linkage mechanism for operation. As a result, there are lots of handle mechanisms and linkage mechanisms.

[0006] Third, the test circuit module in the current leakage protection apparatus in the prior art usually adopts multiple test springs and test resistors, and these components are tiled in the housing. During assembly, mounting and placement of the current leakage tripping action mechanism need to be considered, so that the overall structure of the current leakage protection apparatus is complicated and there are lots of components. Consequently, layout and assembly are complicated.

[0007] Fourth, the current leakage protection apparatus has a large quantity of components and multiple parts need to be welded, resulting in that a tripping force is great and the tripping force is likely to be unstable.

[0008] Fifth, the circuit breaker apparatus and the current leakage protection apparatus are separately provided with a handle mechanism, so that when two or more circuit breakers are disposed, a quantity of handle mechanisms also increases. In the prior art, usually one handle mechanism controls one circuit breaker operation mechanism. In this way, the quantity of the handle mechanisms increases, and when there are multiple circuit breakers, it is difficult to simultaneously control the handle mechanisms manually, and the handle mechanisms need to be closed one by one, leading to complicated operation.

SUMMARY

[0009] In order to overcome the deficiencies of the prior art, the present invention provides a 2P2M electromagnetic RCBO. The 2P2M electromagnetic RCBO adopts a standard modularized layout design and has a small quantity of components, and is thus simple in manufacturing, easy to maintain and repair, and costs less.

[0010] To achieve the foregoing objectives, the present invention provides the following technical solutions. A 2P2M electromagnetic RCBO is provided, including a housing, where a circuit breaker module, a current leakage protection module linked to the circuit breaker module, and a handle linkage mechanism configured to control the circuit breaker module and the current leakage protection module are disposed in the housing; the circuit breaker module includes a first pole circuit breaker protection apparatus disposed on one side of the housing; the current leakage protection module includes a current leakage protection apparatus disposed on the other side of the housing; the circuit breaker module further includes a second pole circuit breaker protection apparatus disposed in the housing and between the first pole

circuit breaker protection apparatus and the current leakage protection apparatus, and an inner structure of the first pole circuit breaker protection apparatus is identical to an inner structure of the second pole circuit breaker protection apparatus.

[0011] In the foregoing technical solutions, the circuit breaker adopts a modularized design, that is, two circuit breakers and one current leakage protection module are disposed in a 2P2M space (36mm). The two circuit breakers are the first pole circuit breaker protection apparatus and the second pole circuit breaker protection apparatus. Because the two pole circuit breaker protection apparatuses have totally same inner structures and components, they are highly interchangeable. In this way, assembly and maintain and repair are convenient, manufacturing is simple, and costs are less.

[0012] The foregoing 2P2M electromagnetic RCBO may further be set as follows. Each of the first pole circuit breaker protection apparatus and the second pole circuit breaker protection apparatus includes a thermal tripping mechanism, an electromagnetic tripping mechanism, and an arc extinguishing system; the first pole circuit breaker protection apparatus further includes a first connection rod, a contact lever, a first latch, and a first movable contact; a first fixed contact intermittently linked to the first movable contact is disposed on one side of the housing adjacent to the first movable contact; the second pole circuit breaker protection apparatus further includes a second latch and a second movable contact; a second fixed contact intermittently linked to the first movable contact (or the second movable contact) is disposed on one side of the housing adjacent to the second movable contact; one end of the first connection rod is linked to the handle linkage mechanism, and the other end of the first connection rod is linked to an end of the contact lever; a first hinging and linking shaft with one end hinged to the housing of the circuit breaker is disposed in the middle part of the contact lever; the first latch and the second latch are respectively hinged to two ends of the first hinging and linking shaft and are disposed on two sides of the contact lever; a second hinging and linking shaft is disposed at the other end of the contact lever opposite to the end linked to the connection rod; the middle parts of the first movable contact and the second movable contact are respectively hinged to two ends of the second hinging and linking shaft and are disposed on the two sides of the contact lever; an end of the first latch far away from the connection rod is intermittently linked to the first movable contact, and an end of the second latch far away from the connection rod is intermittently linked to the second movable contact; and a first reset spring linked to the first movable contact is sleeved on a position where the first movable contact is hinged to the second hinging and linking shaft, and a second reset spring linked to the second movable contact is sleeved on a position where the second movable contact is hinged to the second hinging and linking shaft.

[0013] In the foregoing technical solutions, one connection rod and one contact lever are disposed, the first latch and the second latch are respectively linked to the two sides of the contact lever through the two ends of the first hinging and linking shaft, and further the first movable contact and the second movable contact are respectively linked to the two sides of the contact lever through the two ends of the second hinging and linking shaft. In this way, one handle may drive two movable contacts, and further, a single handle may control multiple circuit breakers. This simplifies a structure of the circuit breaker module, and reduces overall structural complicity of the circuit breaker and a quantity of components, so that costs are reduced and processing and assembly are convenient.

[0014] The foregoing 2P2M electromagnetic RCBO may further be set as follows. A relative linkage structure is disposed between the first latch and the second latch.

[0015] The foregoing 2P2M electromagnetic RCBO may further be set as follows. The relative linkage structure includes an insertion pin disposed on a side of the middle part of the second latch towards the first latch; the first latch is provided with a linkage shaft hole configured to fit with the insertion pin; and the contact lever may be driven by the connection rod to push the first latch to rotate around the first hinging and linking shaft, and the second latch follows the first latch through the insertion pin to rotate around the first hinging and linking shaft.

[0016] In the foregoing technical solutions, by disposing the relative linkage structure, the first latch may drive the second latch to work simultaneously with the handle linkage mechanism, so that a single handle may control multiple circuit breakers. In addition, because the two circuit breakers work highly simultaneously, security of the circuit breakers is enhanced.

[0017] The foregoing 2P2M electromagnetic RCBO may further be set as follows. The current leakage protection apparatus includes a current leakage tripping action mechanism and a test circuit mechanism; the test circuit mechanism includes a conductivity test torsion spring, a third hinging and linking shaft is hinged to the middle part of the conductivity test torsion spring, and an end of the third hinging and linking shaft is fixed to the housing; a test button is movably embedded in an upper part of the housing; one end of the conductivity test torsion spring extends towards the test button and abuts against the test button, and the housing is provided with a linkage hole; the other end of the conductivity test torsion spring opposite to the end abutting against the test button is embedded in the linkage hole, extends towards an outer side of the linkage hole, and is in conductive contact with the circuit breaker module; a test resistor is disposed under the test button on the housing; and the conductivity test torsion spring may be intermittently conductively connected to the test resistor through the test button.

[0018] In the foregoing technical solutions, the structure of the test circuit mechanism is improved. Compared with the test circuit module in the prior art, the test resistor

may be intermittently connected to the circuit breaker module by merely using the conductivity test torsion spring, so that the structure is simple and there are a small quantity of components. In this way, not only are mounting space and costs reduced, but also, it is easier for workers to perform overall assembly. Besides, there is no welding point in the foregoing test circuit, so that compared with the prior art in which welding is required, processing is simplified and manufacturing period is shortened.

[0019] The foregoing 2P2M electromagnetic RCBO may further be set as follows. A latching position configured to guide the conductivity test torsion spring is disposed between the test button and the third hinging and linking shaft on the housing.

[0020] In the foregoing technical solutions, the conductivity test torsion spring may be limited by disposing the latching position, so as to avoid the conductivity test torsion spring to generate a displacement, thereby improving working stability of the conductivity test torsion spring.

[0021] The foregoing 2P2M electromagnetic RCBO may further be set as follows. A mounting position for mounting the test resistor in a concealed way is disposed under the test button on the housing, and a support frame configured to fix and support a lead of the test resistor is disposed at an end of the mounting position on the housing.

[0022] In the foregoing technical solutions, the mounting position is disposed to mount the test resistor on the housing in a concealed way, so that space is properly used and overall layout of the current leakage protection apparatus is simple. The support frame is further disposed to fix a lead end of the test resistor, so that when the test button is pressed, the conductivity test torsion spring may be conductively connected to the test resistor accurately.

[0023] The foregoing 2P2M electromagnetic RCBO may further be set as follows. The handle linkage mechanism includes a first handle configured to drive the circuit breaker module to link; a fourth hinging and linking shaft hinged to the housing of the circuit breaker is linked to the middle part of the first handle, and the other end of the fourth hinging and linking shaft opposite to the end linked to the first handle is linked to a concealed handle configured to drive the current leakage protection module; and an intermittent linkage mechanism is disposed between the concealed handle and the first handle, and the concealed handle may be intermittently linked to the first handle through the intermittent linkage mechanism.

[0024] In the foregoing technical solutions, the structure of the handle is improved. Compared with the handle in the prior art, the first handle, the concealed handle, and the intermittent linkage mechanism are disposed, so that multiple circuit breakers may be controlled by controlling the first handle, and further, one handle may control two circuit breaker operation mechanisms. In this way, a quantity of operation handles is reduced, the structure is simplified, and mounting space is reduced.

[0025] The foregoing 2P2M electromagnetic RCBO may further be set as follows. The intermittent linkage mechanism includes a second handle sleeved around the periphery of the concealed handle, and the second handle is provided with an intermittent linkage area; the concealed handle is provided with a protruding block corresponding to the intermittent linkage area; and the intermittent linkage mechanism further includes a linkage rod disposed between the first handle and the second handle, and the first handle may drive the second handle to work simultaneously through the linkage rod.

[0026] In the foregoing technical solutions, the second handle may work simultaneously with the first handle through the linkage rod, so that one handle may control two circuit breakers. further, under joint action of the intermittent linkage area and the protruding block, the circuit breaker module may be intermittently linked to the current leakage protection apparatus according to an actual situation. For example, when current leakage does not occur, and the circuit breaker apparatus is normally started, the intermittent linkage area rotates in an effective rotation direction. In this case, the protruding block does not contact with the intermittent linkage area. The second handle rotates with the first handle until an end of the intermittent linkage area is adjacent to the protruding block. Once an abnormal case, for example, current leakage occurs, the current leakage protection apparatus works. The concealed handle pushes an end of the intermittent linkage area through the protruding block, so that the second handle drives the first handle to rotate and power is off, thereby protecting the circuit.

[0027] The foregoing 2P2M electromagnetic RCBO may further be set as follows. An indication block is disposed at the periphery of the first handle.

[0028] In the foregoing technical solutions, the indication block may indicate power-on or power-off, facilitating observation for people.

[0029] The present invention has the following advantages.

[0030] First, in the foregoing technical solutions, the circuit breaker adopts a modularized design, that is, two circuit breakers and one current leakage protection module are disposed in a 2P2M space (36mm). The two circuit breakers are the first pole circuit breaker protection apparatus and the second pole circuit breaker protection apparatus. Because the two pole circuit breaker protection apparatuses have totally same inner structures and components, they are highly interchangeable. In this way, assembly and maintain and repair are convenient, manufacturing is simple, and costs are less.

[0031] Second, in the foregoing technical solutions, one connection rod and one contact lever are disposed, the first latch and the second latch are respectively linked to the two sides of the contact lever through the two ends of the first hinging and linking shaft, and further the first movable contact and the second movable contact are respectively linked to the two sides of the contact lever through the two ends of the second hinging and linking

shaft. In this way, one handle may drive two movable contacts, and further, a single handle may control multiple circuit breakers. This simplifies a structure of the circuit breaker module, and reduces overall structural complicity of the circuit breaker and a quantity of components, so that costs are reduced and processing and assembly are convenient.

[0032] Third, in the foregoing technical solutions, the structure of the test circuit mechanism is improved. Compared with the test circuit module in the prior art, the test resistor may be intermittently connected to the circuit breaker module by merely using the conductivity test torsion spring, so that the structure is simple and there are a small quantity of components. In this way, not only are mounting space and costs reduced, but also, it is easier for workers to perform overall assembly. Besides, there is no welding point in the foregoing test circuit, so that compared with the prior art in which welding is required, processing is simplified and manufacturing period is shortened.

[0033] Fourth, in the foregoing technical solutions, the structure of the handle is improved. Compared with the handle in the prior art, the first handle, the concealed handle, and the intermittent linkage mechanism are disposed, so that multiple circuit breakers may be controlled by controlling the first handle, and further, one handle may control two circuit breaker operation mechanisms. In this way, a quantity of operation handles is reduced, the structure is simplified, and mounting space is reduced.

[0034] The present invention is further described in detail below with reference to the accompanying drawings and embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is a schematic diagram of an inner structure layout of an assembled 2P2M electromagnetic RCBO with its housing eliminated according to an embodiment of the present invention;

FIG. 2 is a schematic diagram of a partial structure of a circuit breaker module according to an embodiment of the present invention;

FIG. 3 is a schematic diagram of a left view of FIG. 2;

FIG. 4 is a schematic diagram of a right view of FIG. 2;

FIG. 5 is a schematic diagram of a first latch according to an embodiment of the present invention;

FIG. 6 is a schematic diagram of a second latch according to an embodiment of the present invention;

FIG. 7 is a schematic diagram of a contact lever according to an embodiment of the present invention;

FIG. 8 is a schematic diagram of a front view of an assembly state of a first pole circuit breaker protection apparatus according to an embodiment of the present invention;

FIG. 9 is a schematic structural diagram of a front view of a current leakage protection apparatus according to an embodiment of the present invention;

FIG. 10 is a schematic diagram of a front view of a test circuit mechanism according to an embodiment of the present invention;

FIG. 11 is a schematic diagram of a rear view of an assembled current leakage protection apparatus according to an embodiment of the present invention;

FIG. 12 is a schematic diagram of a handle linkage mechanism according to an embodiment of the present invention;

FIG. 13 is a schematic diagram of a second handle according to an embodiment of the present invention;

FIG. 14 is a schematic diagram of a concealed handle according to an embodiment of the present invention; and

FIG. 15 is a schematic diagram of a first handle according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0036] The technical solutions in embodiments of the present invention will be described below clearly and completely with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely a part rather than all of the embodiments of the present invention. All other embodiments derived from the embodiments in the present invention by a person of ordinary skill in the art without creative work shall fall within the protection scope of the present invention.

[0037] A 2P2M electromagnetic RCBO shown in FIG. 1 to FIG. 15 includes a housing 1. A circuit breaker module, a current leakage protection module linked to the circuit breaker module, and a handle linkage mechanism 4 configured to control the circuit breaker module and the current leakage protection module are disposed in the housing 1. The circuit breaker module includes a first pole circuit breaker protection apparatus 2 disposed on one side of the housing 1. The current leakage protection module includes a current leakage protection apparatus 5 disposed on the other side of the housing 1. The circuit breaker module further includes a second pole circuit breaker protection apparatus 3 disposed in the housing 1 and between the first pole circuit breaker protection apparatus 2 and the current leakage protection apparatus 5. An inner structure of the first pole circuit breaker protection apparatus 2 is identical to an inner structure of the second pole circuit breaker protection apparatus 3.

[0038] The first pole circuit breaker protection apparatus 2 and the second pole circuit breaker protection apparatus 3 each include a thermal tripping mechanism 6, an electromagnetic tripping mechanism 7, and an arc extinguishing system 8. The first pole circuit breaker protection apparatus 2 further includes a first connection rod 21, a contact lever 22, a first latch 23, and a first movable contact 24. A first fixed contact 25 intermittently linked to

the first movable contact 24 is disposed on a side of the housing 1 adjacent to the first movable contact 24. The second pole circuit breaker protection apparatus 3 further includes a second latch 31 and a second movable contact 32. A second fixed contact 33 intermittently linked to the first movable contact 24 (or the second movable contact 32) is disposed on a side of the housing 1 adjacent to the second movable contact 32. One end of the first connection rod 21 is linked to the handle linkage mechanism 4, and the other end of the first connection rod is linked to an end of the contact lever 22. A first hinging and linking shaft 221 with one end hinged to the housing 1 of the circuit breaker is disposed in the middle part of the contact lever 22. The first latch 23 and the second latch 31 are respectively hinged to two ends of the first hinging and linking shaft 221 and are disposed on two sides of the contact lever 22. A second hinging and linking shaft 222 is disposed on the other end of the contact lever 22 opposite to the end linked to the connection rod. The middle parts of the first movable contact 24 and the second movable contact 32 are respectively hinged to two ends of the second hinging and linking shaft 222 and are disposed on the two sides of the contact lever 22. An end of the first latch 23 far away from the connection rod is intermittently linked to the first movable contact 24, and an end of the second latch 23 far away from the connection rod is intermittently linked to the second movable contact 32. A first reset spring 26 linked to the first movable contact 24 is sleeved on a position where the first movable contact 24 is hinged to the second hinging and linking shaft 222, and a second reset spring 34 linked to the second movable contact 32 is sleeved on a position where the second movable contact 32 is hinged to the second hinging and linking shaft 222.

[0039] A relative linkage structure is disposed between the first latch 23 and the second latch 31. The relative linkage structure includes an insertion pin 311 disposed on a side of the middle part of the second latch 31 towards the first latch 23. The first latch 23 is provided with a linkage shaft hole 231 configured to fit with the insertion pin 311. The contact lever 22 is driven by the connection rod to push the first latch 23 to rotate around the first hinging and linking shaft 221, and the second latch 31 follows the first latch 23 through the insertion pin 311 to rotate around the first hinging and linking shaft 221.

[0040] Working principles of the first pole circuit breaker protection apparatus 2 and the second pole circuit breaker protection apparatus 3 are as follows. When power is on, the handle linkage mechanism 4 is pushed, and driven by the handle linkage mechanism 4 and through a flexible linkage block 12, an end of the first connection rod 21 pushes the contact lever 223 (22) to rotate. The contact lever 223 pushes the first latch 23 to rotate around the first hinging and linking shaft 22 (221). Meanwhile, the first latch 23 drives the second latch 31 through the insertion pin 311 to rotate around the first hinging and linking shaft 22. respectively driven by the first latch 23 and the second latch 31, the first movable contact 24 and the second movable contact 32 respectively contact with the first fixed contact 25 and the second fixed contact 33, so that power is on. The whole operation procedure is easy, in which one handle may drive two movable contacts, and further, a single handle may control multiple circuit breakers. This simplifies a structure of the operation mechanism, and reduces overall structural complicity of the circuit breaker and a quantity of components, so that costs are reduced and processing and assembly are convenient.

[0041] The current leakage protection apparatus 5 includes a current leakage tripping action mechanism 59 and a test circuit mechanism. The test circuit mechanism includes a conductivity test torsion spring 51. A third hinging and linking shaft 52 is hinged to the middle part of the conductivity test torsion spring 51. An end of the third hinging and linking shaft 52 is fixed to the housing 1. A test button 53 is movably embedded in an upper part of the housing 1. One end of the conductivity test torsion spring 51 extends towards the test button 53 and abuts against the test button 53. A linkage hole 54 is provided corresponding to the second reset spring 34 on the housing 1. The other end of the conductivity test torsion spring 51 opposite to the end abutting against the test button 53 is embedded in the linkage hole 54, extends towards an outer side of the linkage hole 54, and is in conductive contact with the second reset spring 34. A test resistor 55 is disposed under the test button 53 on the housing 1. The conductivity test torsion spring 51 may be intermittently conductively connected to the test resistor 55 through the test button 53. A latching position 56 configured to guide the conductivity test torsion spring 51 is disposed between the test button 53 and the third hinging and linking shaft 52 on the housing 1. A mounting position 57 for mounting the test resistor 55 in a concealed way is disposed under the test button 53 on the housing 1. A support frame 58 configured to fix and support a lead of the test resistor 55 is disposed at an end of the mounting position 57 on the housing 1.

[0042] Working principles of the test circuit mechanism are as follows. When the test button 53 is pressed, an end of the conductivity test torsion spring 51 contacts with the lead end of the test resistor 55. Because the other end of the conductivity test torsion spring 51 is conductively connected to the second reset spring 34, the test circuit is on. The test resistor 55 is intermittently connected to the circuit breaker module by merely using the conductivity test torsion spring 51, so that the structure is simple and there are a small quantity of components. In this way, not only are mounting space and costs reduced, but also, it is easier for workers to perform overall assembly.

[0043] The current leakage tripping action mechanism 59 includes a current leakage tripping device 591 mounted in the housing 1 and a first transmission rod 592 with one end intermittently linked to one side of the current leakage tripping device 591. The middle part of the first transmission rod 592 is movably hinged to the housing

1. The end of the first transmission rod 592 adjacent to the current leakage tripping device 591 abuts against and is linked to a second transmission rod 593. One end of the second transmission rod 593 is hinged to the housing 1, and the other end of the second transmission rod 593 abuts against and is linked to a third transmission rod 594. The middle part of the third transmission rod 594 is hinged to the housing 1. A current leakage tripping rod 595 is coaxially hinged to a position where the third transmission rod 594 is hinged to the housing 1. The other end of the third transmission rod 594 opposite to the end linked to the second transmission rod 593 is linked to the current leakage tripping rod 595. The current leakage tripping rod 595 is linked to a current leakage reset torsion spring 596, and two ends of the current leakage reset torsion spring 596 respectively abut against the current leakage tripping rod 595 and the first transmission rod 592. The other end of the current leakage tripping rod 595 opposite to an end connecting to the first transmission rod 592 is linked to the handle linkage mechanism 4 through the second connection rod 597. A flexible connection assembly is disposed between the current leakage tripping device 591 and the third transmission rod 594. The flexible connection assembly includes a spring 598 with two ends respectively fixed to the current leakage tripping rod 595 and the third transmission rod 594, face to face.

[0044] Working principles of the current leakage tripping device are as follows. When, for example, current leakage occurs, the current leakage tripping device 591 drives the first transmission rod 592, and the first transmission rod 592 drives the second transmission rod 593 to rotate around a hinge axis of the second transmission rod 593. Further, an end of the second transmission rod 593 pushes the third transmission rod 594, the third transmission rod 594 presses the current leakage tripping rod 595 through the spring 598, and the current leakage tripping rod 595 drives the second latch 31. In this way, power is off.

[0045] The handle linkage mechanism 4 includes a first handle 41 configured to drive the circuit breaker module to link. A fourth hinging and linking shaft hinged to the housing 1 of the circuit breaker is linked to the middle part of the first handle 41. The other end of the fourth hinging and linking shaft opposite to the end linked to the first handle 41 is linked to a concealed handle 42 configured to drive the current leakage protection module. An intermittent linkage mechanism is disposed between the concealed handle 42 and the first handle 41. The concealed handle 42 may be intermittently linked to the first handle 41 through the intermittent linkage mechanism. The intermittent linkage mechanism includes a second handle 43 sleeved on the periphery of the concealed handle 42. The second handle 43 is provided with an intermittent linkage area 431. A protruding block 421 is disposed on the concealed handle 42 corresponding to the intermittent linkage area 431. The intermittent linkage mechanism further includes a linkage rod 44 disposed between the first handle 41 and the second handle 43. The first handle 41 may drive the second handle 43 to work simultaneously through the linkage rod 44. An indication block 45 may be disposed at the periphery of the first handle 41.

[0046] Working principles of the handle linkage mechanism 4 are as follows. When, for example, current leakage does not occur, and the circuit breaker apparatus is normally started, the first handle 41 is pushed in an effective rotation direction of the first handle 41, and the first handle 41 drives the second handle 43 to rotate through the linkage rod 44. In this case, the protruding block 421 does not contact with the intermittent linkage area 431, and the concealed handle 42 does not work, so that the current leakage protection apparatus 5 of the circuit breaker does not work. When the second handle 43 rotates with the first handle 41 to a limit, an end of the intermittent linkage area 431 is adjacent to the protruding block 421. When an abnormal case, for example, current leakage occurs, the current leakage protection apparatus 5 works to drive the concealed handle 42 to rotate in a direction opposite to the effective rotation direction of the first handle 41. The protruding block 421 pushes the end of the intermittent linkage area 431, so that the second handle 43 rotates with the concealed handle 42, and the linkage rod 44 drives the first handle 41 to rotate. In this way, power is off, and the circuit is protected. Compared with the handle in the prior art, the structure of the handle is improved. The first handle 41, the concealed handle 42, and the intermittent linkage mechanism are disposed, so that multiple circuit breakers may be controlled by controlling the first handle 41, and further, one handle may control two circuit breaker operation mechanisms. In this way, a quantity of operation handles is reduced, the structure is simplified, and mounting space is reduced.

Claims

1. A 2P2M electromagnetic residual current circuit breaker with overcurrent protection (RCBO), comprising a housing, wherein a circuit breaker module, a current leakage protection module linked to the circuit breaker module, and a handle linkage mechanism configured to control the circuit breaker module and the current leakage protection module are disposed in the housing; the circuit breaker module comprises a first pole circuit breaker protection apparatus disposed on one side of the housing; the current leakage protection module comprises a current leakage protection apparatus disposed on the other side of the housing; the circuit breaker module further comprises a second pole circuit breaker protection apparatus disposed in the housing and between the first pole circuit breaker protection apparatus and the current leakage protection apparatus, and an inner structure of the first pole circuit breaker protection apparatus is identical to an inner structure

of the second pole circuit breaker protection apparatus.

2. The 2P2M electromagnetic RCBO according to claim 1, wherein each of the first pole circuit breaker protection apparatus and the second pole circuit breaker protection apparatus comprises a thermal tripping mechanism, an electromagnetic tripping mechanism, and an arc extinguishing system; the first pole circuit breaker protection apparatus further comprises a first connection rod, a contact lever, a first latch, and a first movable contact; a first fixed contact intermittently linked to the first movable contact is disposed on one side of the housing adjacent to the first movable contact; the second pole circuit breaker protection apparatus further comprises a second latch and a second movable contact; a second fixed contact intermittently linked to the first movable contact is disposed on one side of the housing adjacent to the second movable contact; one end of the first connection rod is linked to the handle linkage mechanism, and the other end of the first connection rod is linked to an end of the contact lever; a first hinging and linking shaft with one end hinged to the housing of the circuit breaker is disposed in a middle part of the contact lever; the first latch and the second latch are respectively hinged to two ends of the first hinging and linking shaft and are disposed on two sides of the contact lever; a second hinging and linking shaft is disposed at the other end of the contact lever opposite to the end linked to the connection rod; middle parts of the first movable contact and the second movable contact are respectively hinged to two ends of the second hinging and linking shaft and are disposed on the two sides of the contact lever; an end of the first latch far away from the connection rod is intermittently linked to the first movable contact, and an end of the second latch far away from the connection rod is intermittently linked to the second movable contact; and a first reset spring linked to the first movable contact is sleeved on a position where the first movable contact is hinged to the second hinging and linking shaft, and a second reset spring linked to the second movable contact is sleeved on a position where the second movable contact is hinged to the second hinging and linking shaft.

3. The operation mechanism of the 2P2M electromagnetic RCBO according to claim 2, wherein a relative linkage structure is disposed between the first latch and the second latch.

4. The operation mechanism of the 2P2M electromagnetic RCBO according to claim 3, wherein the relative linkage structure comprises an insertion pin disposed on a side of a middle part of the second latch towards the first latch; the first latch is provided with a linkage shaft hole that fits with the insertion pin; and the contact lever is driven by the connection rod to push the first latch to rotate around the first hinging and linking shaft, and the second latch follows the first latch through the insertion pin to rotate around the first hinging and linking shaft.

5. The 2P2M electromagnetic RCBO according to claim 1, wherein the current leakage protection apparatus comprises a current leakage tripping action mechanism and a test circuit mechanism; the test circuit mechanism comprises a conductivity test torsion spring, a third hinging and linking shaft is hinged to a middle part of the conductivity test torsion spring, and an end of the third hinging and linking shaft is fixed to the housing; a test button is movably embedded in an upper part of the housing; one end of the conductivity test torsion spring extends towards the test button and abuts against the test button, and the housing is provided with a linkage hole; the other end of the conductivity test torsion spring opposite to the end abutting against the test button is embedded in the linkage hole, extends towards an outer side of the linkage hole, and is in conductive contact with the circuit breaker module; a test resistor is disposed under the test button on the housing; and the conductivity test torsion spring is intermittently conductively connected to the test resistor through the test button.

6. The 2P2M electromagnetic RCBO according to claim 5, wherein a latching position configured to guide the conductivity test torsion spring is disposed between the test button and the third hinging and linking shaft on the housing.

7. The 2P2M electromagnetic RCBO according to claim 5, wherein a mounting position for mounting the test resistor in a concealed way is disposed under the test button on the housing, and a support frame configured to fix and support a lead of the test resistor is disposed at an end of the mounting position on the housing.

8. The 2P2M electromagnetic RCBO according to claim 1, wherein the handle linkage mechanism comprises a first handle configured to drive the circuit breaker module to link; a fourth hinging and linking shaft hinged to the housing of the circuit breaker is linked to a middle part of the first handle, and the other end of the fourth hinging and linking shaft opposite to the end linked to the first handle is linked to a concealed handle configured to drive the current leakage protection module; and an intermittent linkage mechanism is disposed between the concealed handle and the first handle, and the concealed handle is intermittently linked to the first handle through the intermittent linkage mechanism.

9. The 2P2M electromagnetic RCBO according to claim 8, wherein the intermittent linkage mechanism comprises a second handle sleeved around a periphery of the concealed handle, and the second handle is provided with an intermittent linkage area; the concealed handle is provided with a protruding block corresponding to the intermittent linkage area; and the intermittent linkage mechanism further comprises a linkage rod disposed between the first handle and the second handle, and the first handle drives the second handle to work simultaneously through the linkage rod.

10. The multi-linkage handle used in the circuit breaker according to claim 9, wherein an indication block is disposed at a periphery of the first handle.

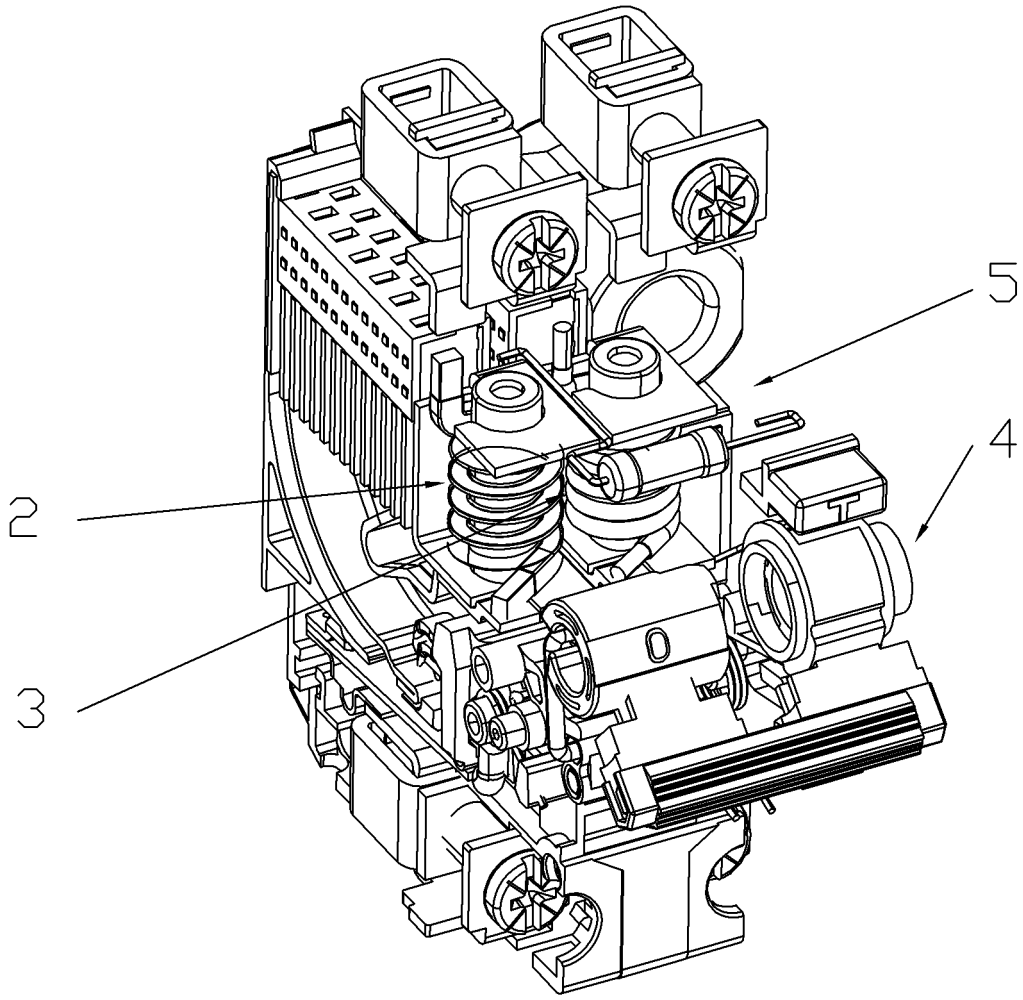

Fig. 1

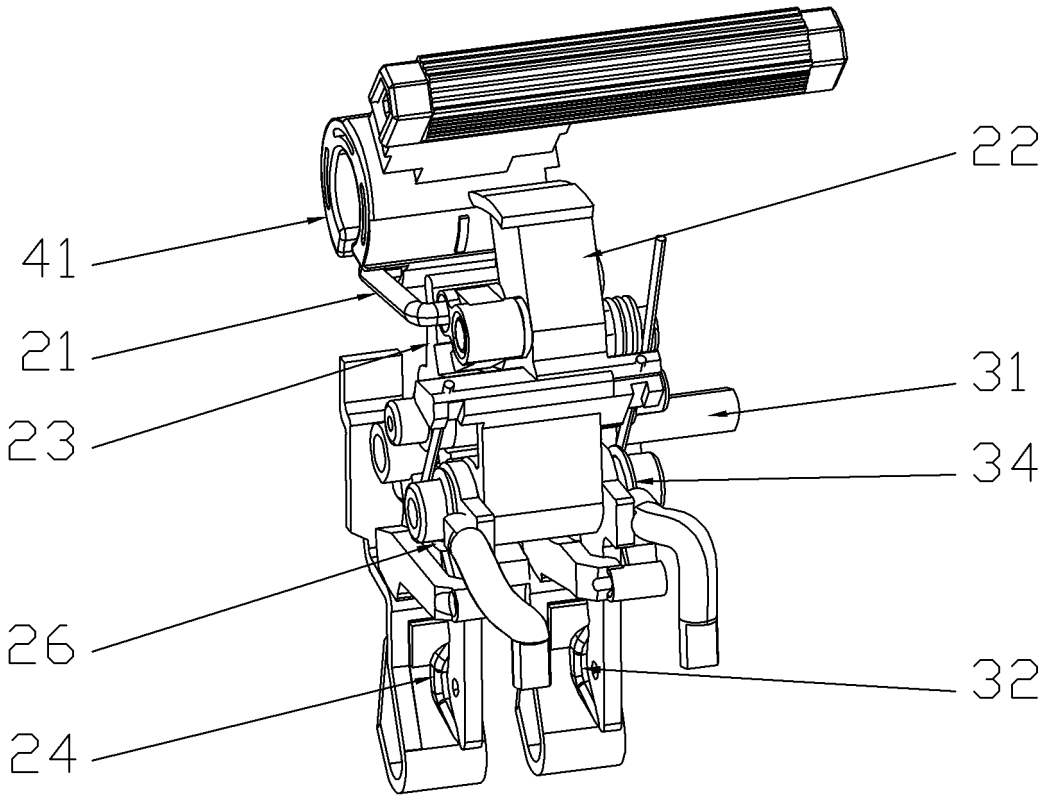

Fig. 2

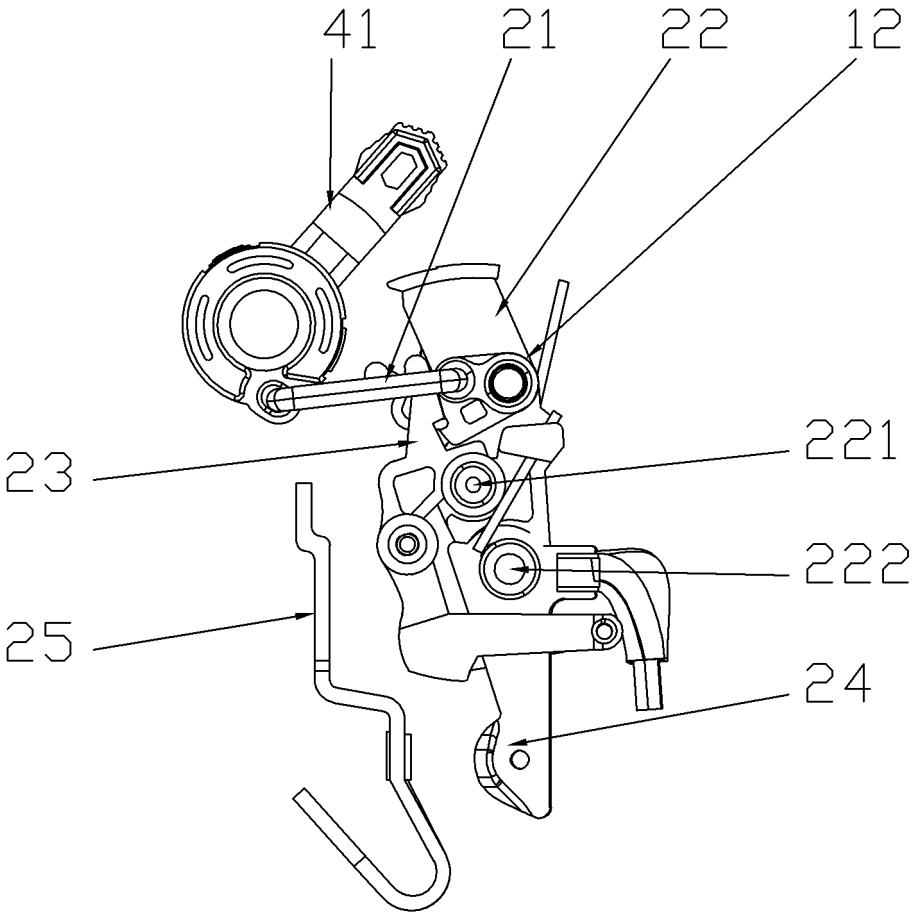

Fig. 3

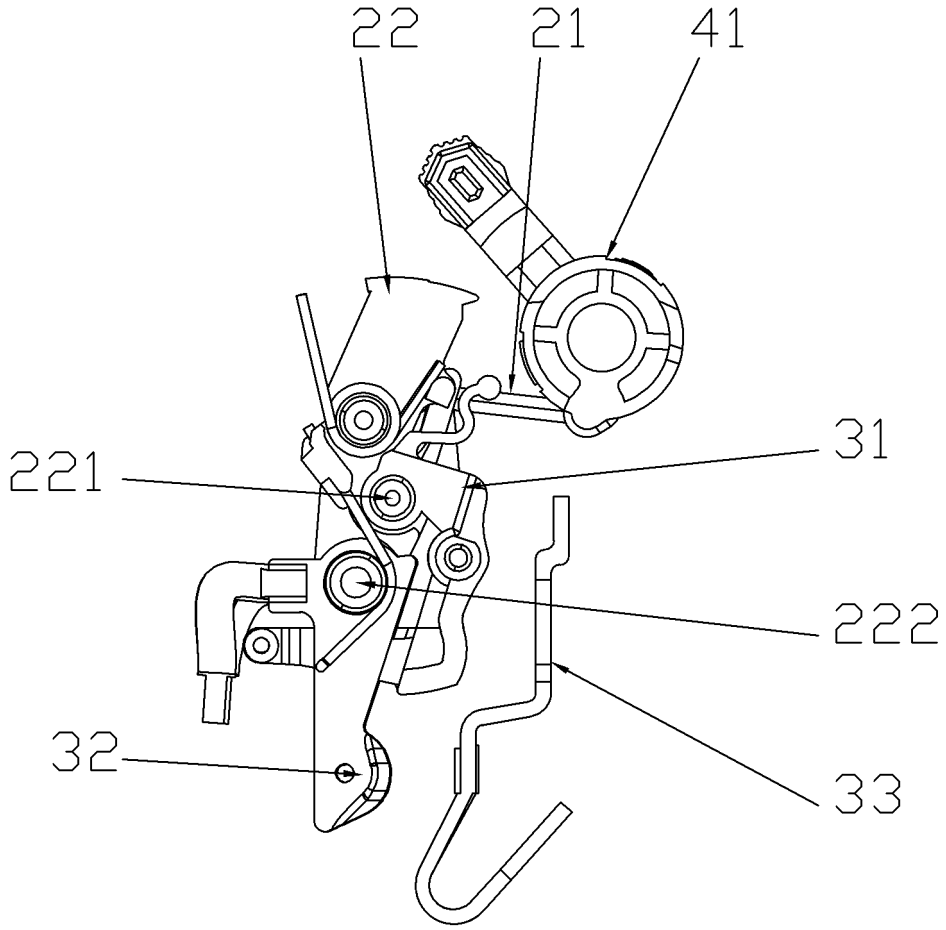

Fig. 4

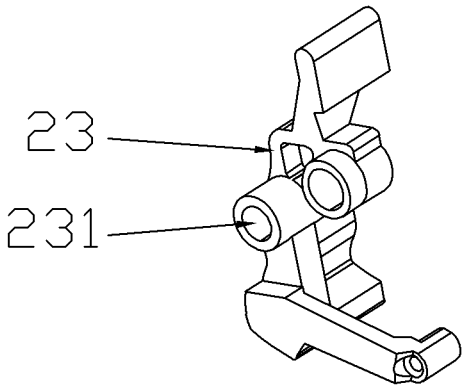

Fig. 5

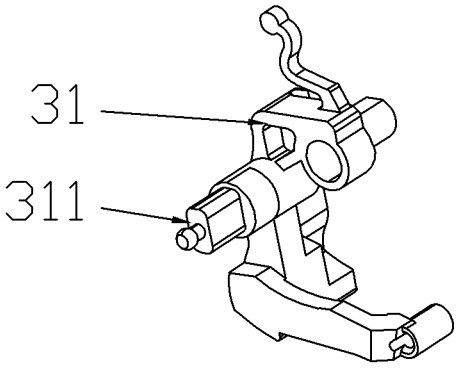

Fig. 6

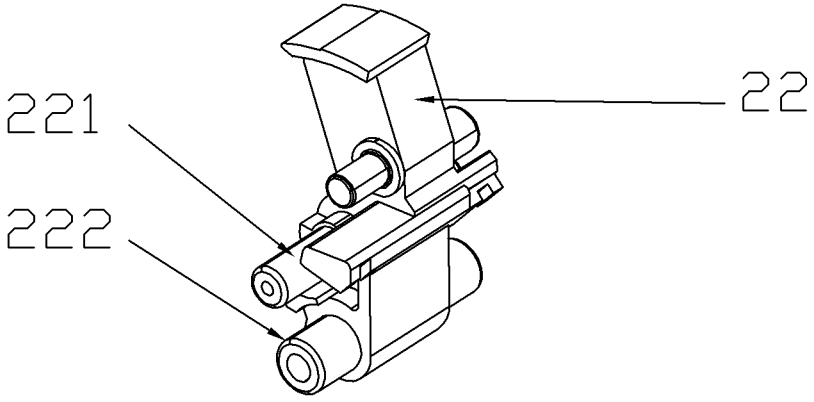

Fig. 7

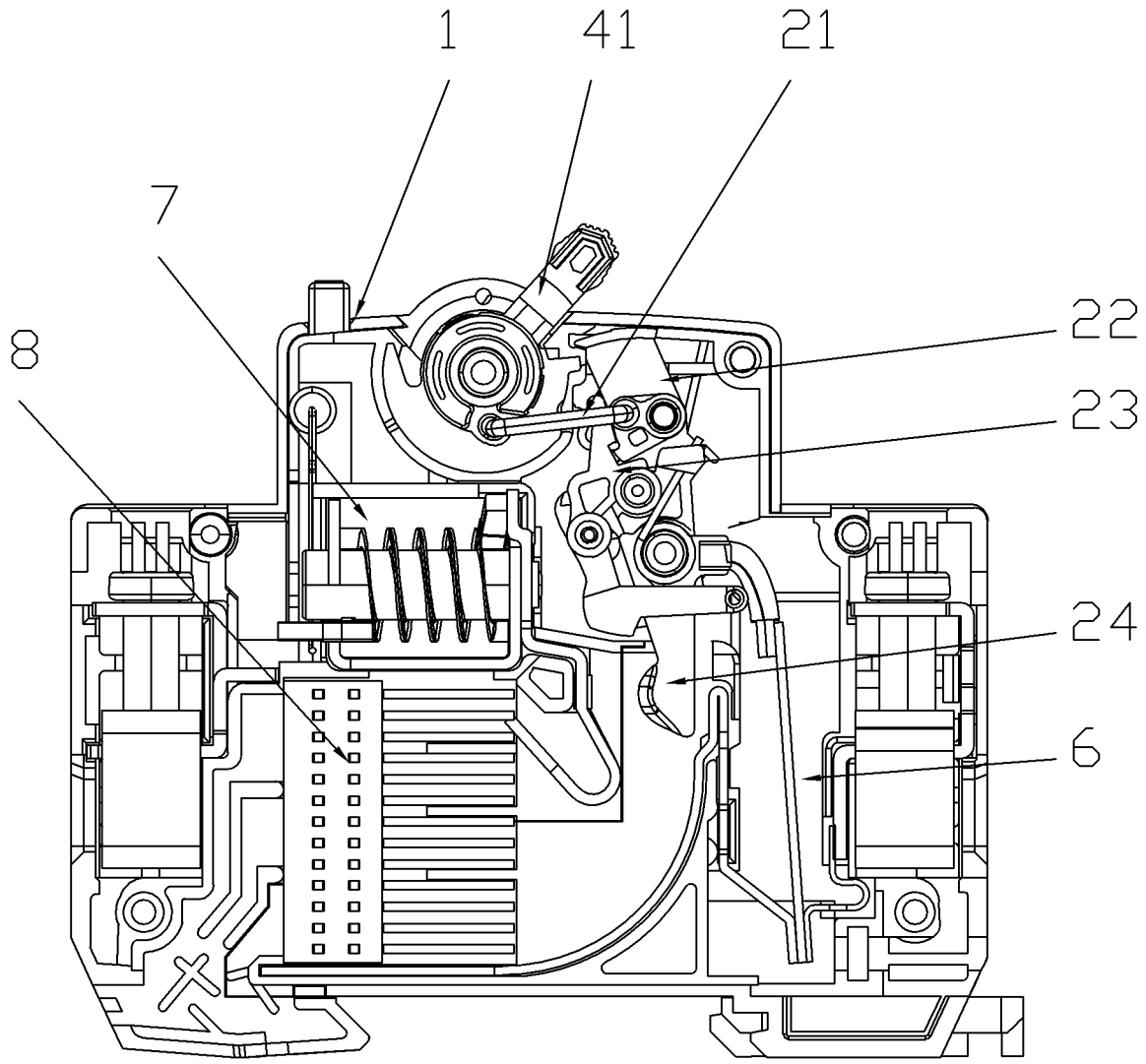

Fig. 8

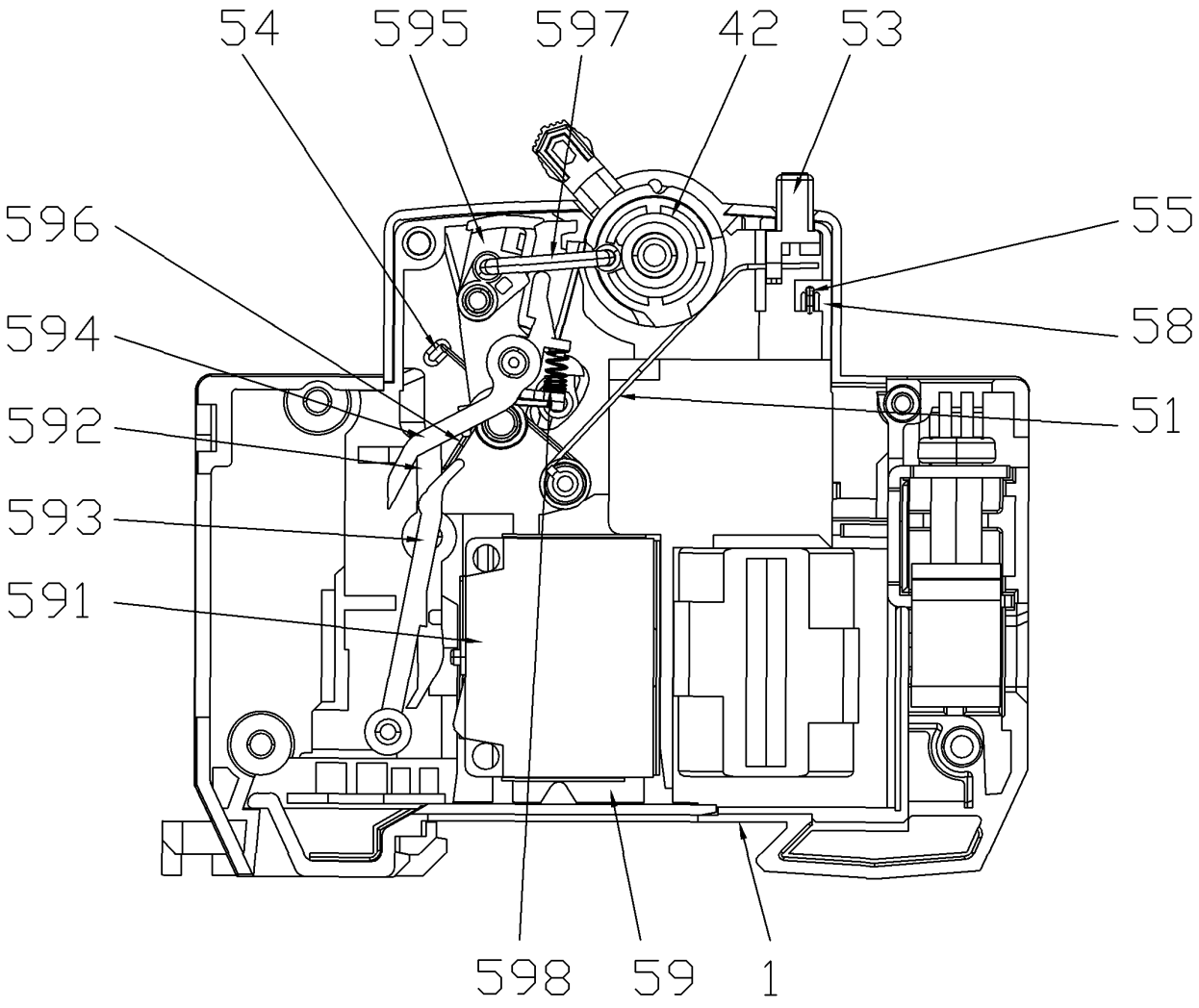

Fig. 9

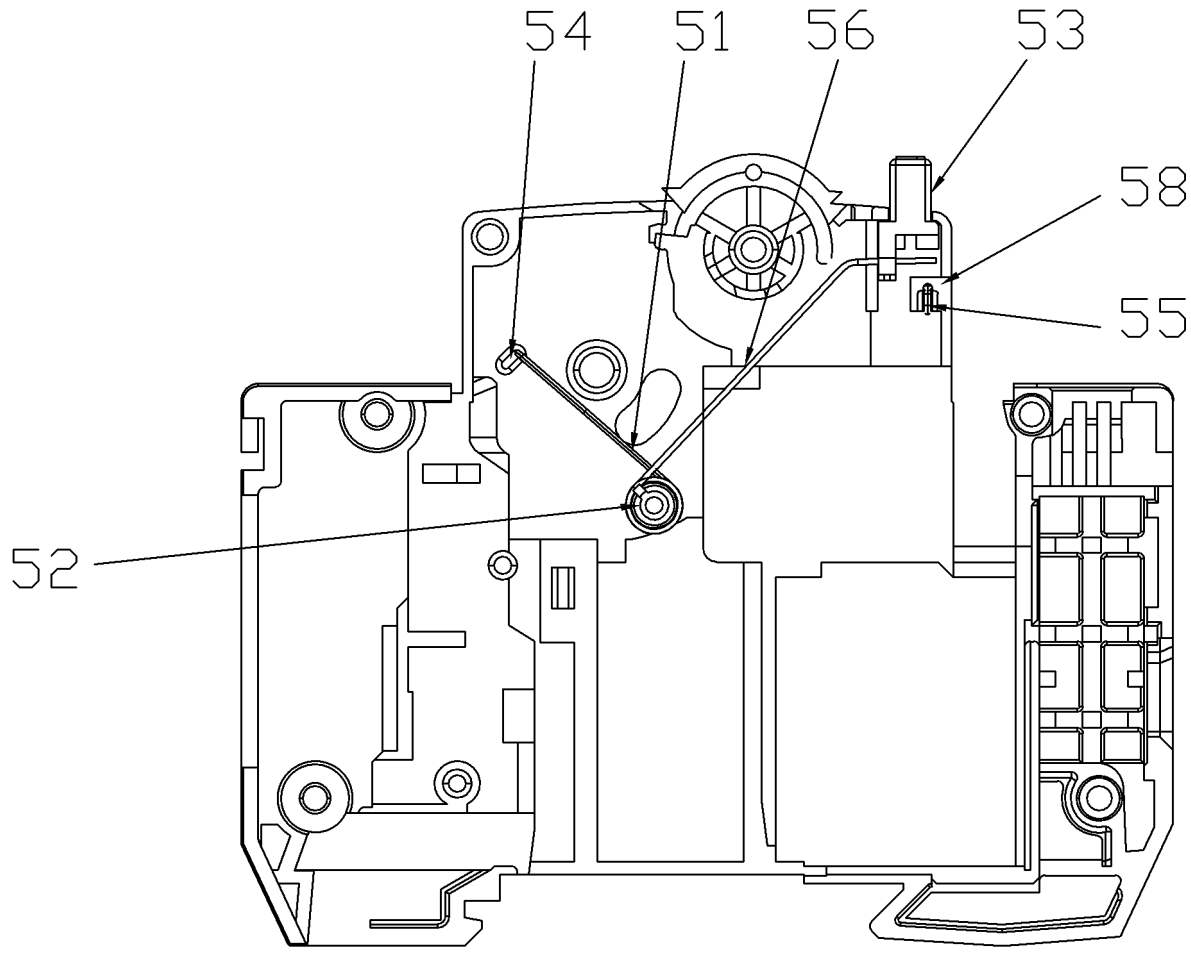

Fig. 10

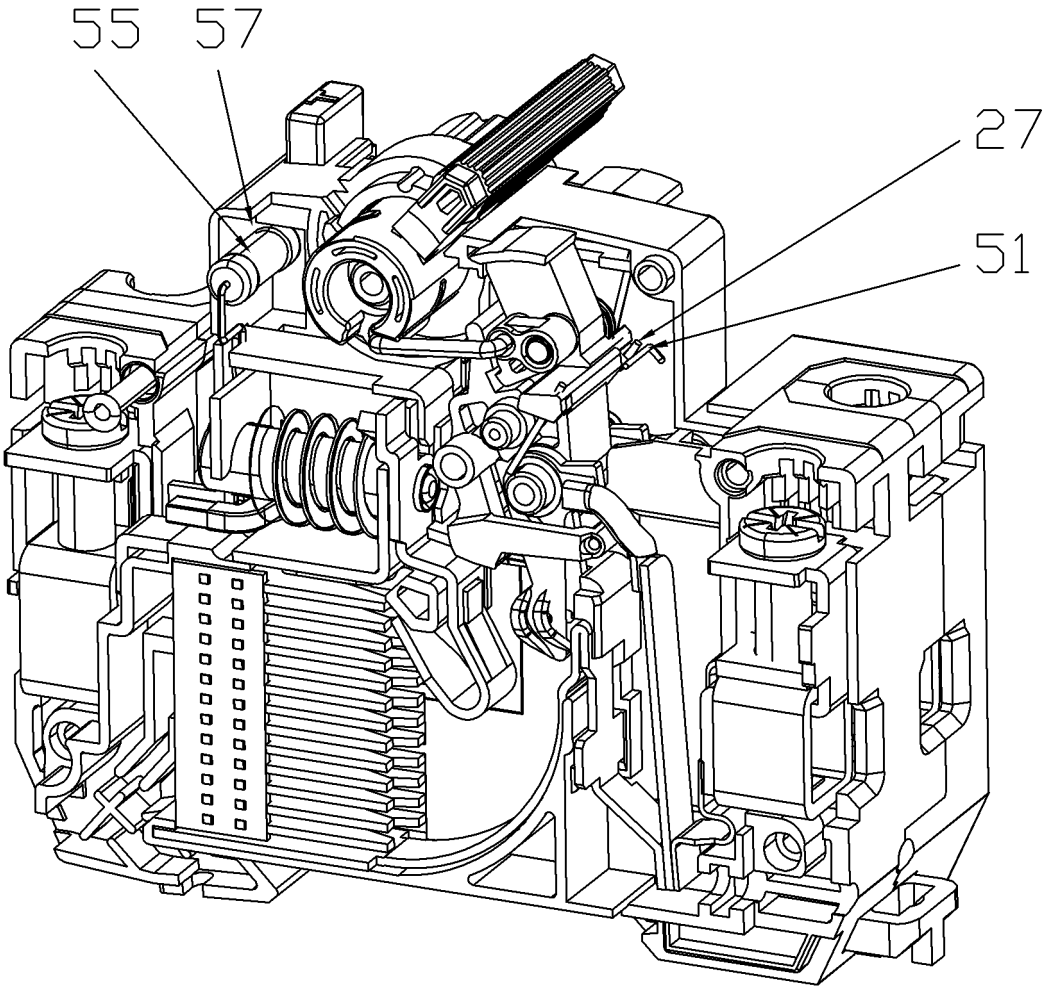

Fig. 11

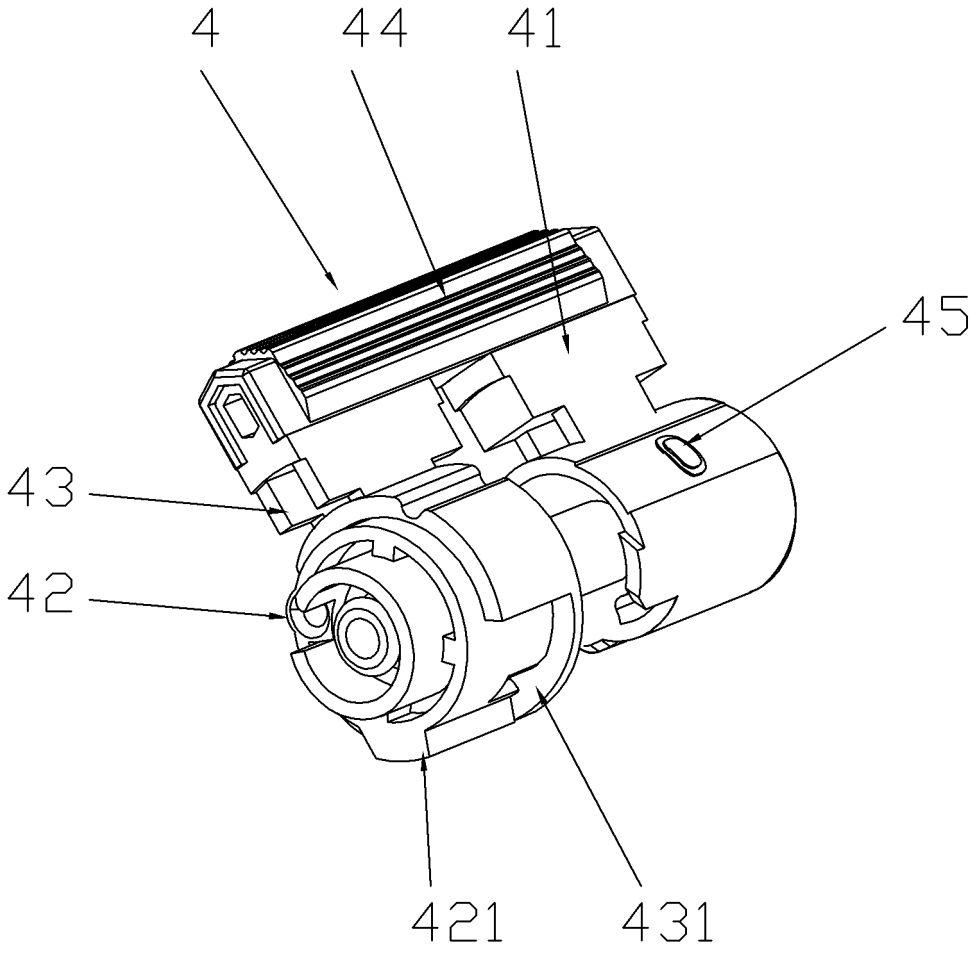

Fig. 12

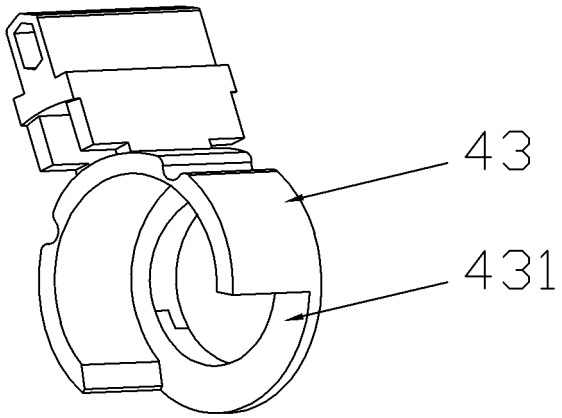

Fig. 13

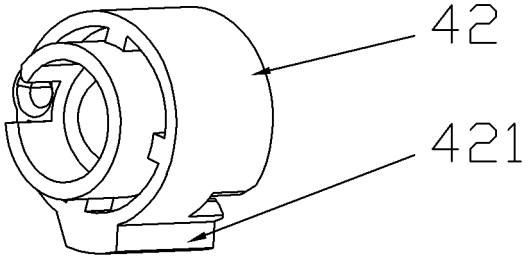

Fig. 14

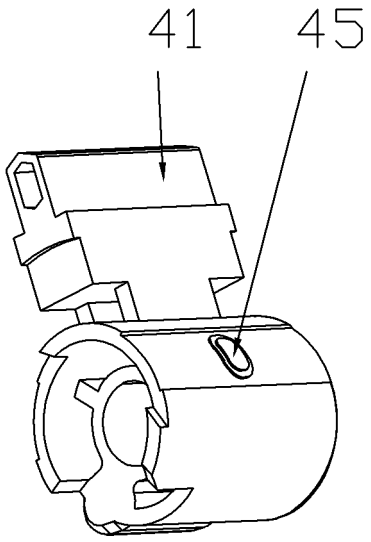

Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/114976

A. CLASSIFICATION OF SUBJECT MATTER

H01H 71/00(2006.01)i; H01H 71/10(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H71/-,H01H9/-

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

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

VEN; CNABS; CNTXT; WOTXT; USTXT; EPTXT: 断路器, 漏电, 两极, 多极, 2P, 同步, 联动, 触头, L极, N极, Leakage, breaker, switch, Linkage, pole

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 112951665 A (ETMAN ELECTRIC (CHANGZHOU) CO., LTD.) 11 June 2021 (2021-06-11) claims 1-10	1-10
X	CN 211150442 U (SHANGHAI LIANGXIN ELECTRICAL CO., LTD.) 31 July 2020 (2020-07-31) description, paragraphs 41-48, figures 1-5	1, 5-10
Y	CN 211150442 U (SHANGHAI LIANGXIN ELECTRICAL CO., LTD.) 31 July 2020 (2020-07-31) description, paragraphs 41-48, figures 1-5	2-4
Y	CN 207149499 U (ZHEJIANG KAIFA ELECTRIC CO., LTD.) 27 March 2018 (2018-03-27) description, paragraphs 18-23, figures 1-5	2-4
A	CN 212136379 U (CNC TRIC GROUP ZHEJIANG TECHNOLOGY CO., LTD.) 11 December 2020 (2020-12-11) entire document	1-10
A	CN 205542641 U (ZHEJIANG PEOPLE ELECTRIC APPLIANCE CO., LTD.) 31 August 2016 (2016-08-31) entire document	1-10

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2021	**07 December 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/114976

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 112951665 A	11 June 2021	None	
CN 211150442 U	31 July 2020	None	
CN 207149499 U	27 March 2018	None	
CN 212136379 U	11 December 2020	None	
CN 205542641 U	31 August 2016	None	

Form PCT/ISA/210 (patent family annex) (January 2015)