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(54) **CIRCUIT BREAKER FOR OPTIMIZING SPACE ALLOCATION**

(57) A breaker with optimized space allocation is disclosed in the invention, the breaker comprises a first overcurrent protection pole, a second overcurrent protection pole and a leakage protection device. The first overcurrent protection pole has a first input wire terminal and a first output wire terminal, a first contact is in serial connection with the first overcurrent protection pole, the first overcurrent protection pole further includes a first operation mechanism. The second overcurrent protection pole has a second input wire terminal and a second output wire terminal, a second contact is in serial connection with the second overcurrent protection pole, the second overcurrent protection pole further includes a second operation mechanism. The leakage protection device comprises a instrument transformer, a electromagnetic release and a leakage release mechanism, the leakage protection device further comprises a test circuit having test button. The test circuit is in serial connection with the test resistor, one terminal of the test circuit is in parallel connected with the first input wire terminal, and the other terminal of the test circuit is in parallel connection with the second output wire terminal. The instrument transformer detects leakage current and initiates the electromagnetic release to release the first operation mechanism and the second operation mechanism through the leakage release mechanism, thereby the first contact and the second contact are disconnected to realize the leakage protection.

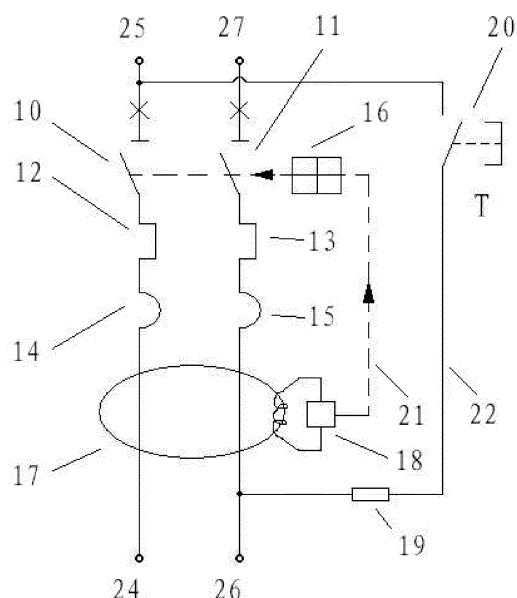


FIG 1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a breaker, more particularly, relates to a breaker with optimized space allocation. The breaker accommodates two overcurrent protection poles and a leakage protection device within a width of two modules.

2. The Related Art

[0002] Micro Circuit Breakers are normally used in buildings such as homes, offices, hotels and shopping malls. Micro Circuit Breakers provide single phase or three-phase protections smaller than 125A, such as short circuit protection, overload protection, overvoltage protection, etc.. Leakage circuit breaker is a switch, which may work automatically when the leakage current in the circuit exceeds a preset value for preventing physical shock. The leakage circuit breaker may be installed outside the breaker as a modular accessory.

[0003] The demand on the market of the breakers having various standards has been promoted by the wide application of the breakers. To make the breakers be miniaturized and multifunctional within modularized housings is the focus in the industry. According to prior art, if the breakers with different standards are used simultaneously, they will be arranged sequentially and adjacently on rails in a distribution box and make the volume of the distribution box too large.

SUMMARY

[0004] The present invention provides an internal structure layout of a breaker that optimize the space application within the breaker. Two overcurrent protection poles and a leakage protection device are accommodated within a width of two modules (36mm).

[0005] According to an embodiment of the invention, an breaker with optimized space allocation is provided, the breaker comprises a first overcurrent protection pole, a second overcurrent protection pole, and a leakage protection device.

[0006] The first overcurrent protection pole has a first input wire terminal and a first output wire terminal, the first overcurrent protection pole is in serial connection with a first contact and the first overcurrent protection pole includes a first operation mechanism. The second overcurrent protection pole has a second input wire terminal and a second output wire terminal, the second overcurrent protection pole is in serial connection with a second contact and the second overcurrent protection pole includes a second operation mechanism. The leakage protection device comprises an instrument transformer, an electromagnetic release, and a leakage release

mechanism, the leakage protection device further comprises a test circuit with a test button, the test circuit is in serial connection with a test resistor, one terminal of the test circuit is in parallel connection with the first input wire terminal, and the other terminal of the test circuit is in parallel connection with the second output wire terminal. The instrument transformer detects a leakage current and initiates the electromagnetic release to release the first operation mechanism and the second operation mechanism through the leakage release mechanism, thereby the first contact and the second contact are disconnected to realize the leakage protection.

[0007] According to one embodiment, the leakage release mechanism comprises a handle, a U-shaped rod, a lock, a link rod, a jump cue, a reset rod, a trip lever, and an elastic reed. The handle is used as a leakage indicator, and is rotatably assembled on a housing of the breaker. One end of the U-shaped rod is connected with the handle, and the other end of the U-shaped rod is connected with the lock. The lock is rotatably connected with the link rod, and the link rod is rotatably connected with the housing. The trip lever is rotatably disposed above the link rod. The reset rod is rotatably connected with the housing. The elastic reed is connected with the reset rod. The trip lever is rotatably connected with the housing.

[0008] According to one embodiment, the handle has a spring with two arms, one arm acts on the handle and the other arm acts on the housing, the spring resets the handle.

[0009] According to one embodiment, one end of U-shaped rod is disposed in a first hole of the handle, the other end of U-shaped rod is disposed in a second hole of the lock, a third hole of the lock is rotatably assembled in a shaft of the link rod, the link rod is rotatably assembled on the housing, the trip lever is disposed above the link rod and rotates around a second shaft of the link rod.

[0010] According to one embodiment, the elastic reed is fixed at the root of the reset rod.

[0011] According to one embodiment, the width of the housing of the breaker is two-module, the first overcurrent protection pole, the second overcurrent protection pole and the leakage protection device are disposed in the housing, the leakage protection device is between the first overcurrent protection pole and the second overcurrent protection pole on the width direction of the housing,

[0012] According to one embodiment, the housing of the breaker is inverted T-shaped, the first overcurrent protection pole, the second overcurrent protection pole and the leakage protection device are disposed in the housing, the housing has a first upper surface, a second upper surface, a third upper surface, a first side surface, a second side surface, a first bottom surface, a third side surface, and a fourth side surface.

[0013] According to one embodiment, the first overcurrent protection pole and the second overcurrent protection pole occupies two fifths of the width respectively and

the leakage protection device occupies one fifth of the width.

[0014] According to one embodiment, the first operation mechanism, the first output wire terminal and the first input wire terminal are disposed in the front of the housing, wherein the first operation mechanism is disposed within a space surrounded by the first upper surface, the third side surface and the fourth side surface, the first output wire terminal is disposed within a space surrounded by the first side surface, the second upper surface and the first bottom surface, the first input wire terminal is disposed within a space surrounded by the second side surface, the third upper surface and the first bottom surface. The second operation mechanism, the second output wire terminal and the second input wire terminal are disposed in the rear of the housing, wherein the second operation mechanism is disposed within a space surrounded by the first upper surface, the third side surface and the fourth side surface, the second output wire terminal is disposed within a space surrounded by the first side surface, the second upper surface and the first bottom surface, the second input wire terminal is disposed within a space surrounded by the second side surface, the third upper surface and the first bottom surface.

[0015] According to one embodiment, the first overcurrent protection pole further comprises a first arc quenching device, disposed between the first output wire terminal and the first input wire terminal, above the first bottom surface. The second overcurrent protection pole further comprises a second arc quenching device, disposed between the second output wire terminal and the second input wire terminal, above the first bottom surface.

[0016] According to one embodiment, the first arc quenching device, the second arc quenching device, and the instrument transformer are at the same height within the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the housing, and the instrument transformer occupies half of the the width the housing, or the first arc quenching device, the second arc quenching device and the electromagnetic release are at the same height in the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the housing, and the electromagnetic release occupies half of the width of the housing.

[0017] According to one embodiment, the first overcurrent protection pole is further in serial connection with a first instantaneous short-circuit protection device, disposed within a space above the first arc quenching device, on the right side of the first output wire terminal, and beneath the second upper surface. The second overcurrent protection pole is further in serial connection with a second instantaneous short-circuit protection device, disposed within a space above the second arc quenching device, in the left side of the second input wire terminal, and beneath the second upper surface.

[0018] According to one embodiment, the first instantaneous short-circuit protection device and the second

instantaneous short-circuit protection device are at the same height in the housing, the first instantaneous short-circuit protection device and second instantaneous short-circuit protection device occupied half of the width of the housing respectively.

[0019] According to one embodiment, the test resistor is disposed between the first operation mechanism and the first instantaneous short-circuit protection device, approximate to the third side surface.

[0020] According to one embodiment, the first overcurrent protection pole further comprises a first release mechanism, a contact of the first release mechanism is disposed within a space above the first arc quenching device, on the left side of the first input wire terminal, and beneath the third upper surface. The second overcurrent protection pole further comprises a second release mechanism, a contact of the second release mechanism is disposed within a space above the second arc quenching device, on the right side of the second output wire terminal, and beneath the third upper surface.

[0021] According to one embodiment, the first release mechanism, the second release mechanism, and the leakage protection mechanism are at the same height in the housing, the first release mechanism and the second release mechanism occupied two fifths of the width of the housing respectively and the leakage protection mechanism the leakage protection mechanism occupies one fifth of the width of the housing.

[0022] According to one embodiment, the first overcurrent protection pole is further in serial connection with a first long time delay overload protection device, the second overcurrent protection pole is further in serial connection with a second long time delay overload protection device.

[0023] According to one embodiment, a first area is formed by the second upper surface, the first side surface and the first bottom surface, a second area is formed by the third upper surface, the second side surface and the first bottom surface. The instrument transformer is disposed above the first bottom surface, on the right side of the first area. The electromagnetic release is disposed above the first bottom surface, on the right side of the instrument transformer. The test button is disposed beneath the first upper surface, approximate to the fourth side surface.

[0024] According to one embodiment, the leakage release mechanism is disposed beneath the first upper surface, above the first bottom surface, on the left side of the second area, and on the right side of the leakage indicator mechanism and the electromagnetic release.

[0025] According to one embodiment, the leakage protection device further comprises an leakage indicator mechanism. The leakage indicator mechanism is disposed beneath the first upper surface, approximate to the third side surface.

[0026] The breaker with optimized space allocation according to the present invention, two overcurrent protection poles and a leakage protection module are integrated

into one breaker through optimized space allocation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The above and other features, natures, and advantages of the invention will be apparent by the following description of the embodiments incorporating the drawings, wherein,

Fig. 1 discloses an electrical schematic diagram of a breaker with optimized space allocation according to an embodiment of the invention.

Fig. 2a and 2b disclose a space allocation diagram of a breaker with optimized space allocation according to an embodiment of the invention, wherein Fig. 2a is a front view of the breaker, and Fig. 2b is a rear view of the breaker.

Fig. 3a, 3b and 3c disclose a space allocation diagram of the middle portion of a breaker with optimized space allocation according to an embodiment of the invention, wherein Fig. 3b is an A-A cross sectional view of Fig. 3a, Fig. 3c is a B-B cross sectional view of Fig. 3a.

Fig. 4 discloses an exploded view of a breaker with optimized space allocation according to an embodiment of the invention.

Fig. 5 discloses a front view of the first overcurrent protection pole of a breaker with optimized space allocation according to an embodiment of the invention.

Fig. 6 discloses a front view of the second overcurrent protection pole of a breaker with optimized space allocation according to an embodiment of the invention.

Fig. 7 discloses a front view of a leakage protection device of the breaker with optimized space allocation according to an embodiment of the invention, wherein the leakage release mechanism is at a closing state.

Fig. 8a, 8b, and 8c disclose a structure diagram of a leakage release mechanism of a breaker with optimized space allocation according to an embodiment of the invention, wherein the leakage release mechanism is at a tripping position, Fig. 8b is a rear view of Fig. 8a, Fig. 8c is a lateral view of Fig. 8b.

Fig. 9a, 9b, and 9c disclose a structure diagram of a leakage release mechanism of a breaker with optimized space allocation according to an embodiment of the invention, wherein the leakage release mechanism is at a closing position, Fig. 9b is a rear

view of Fig. 9a.

Fig. 10 discloses a release state of a leakage release mechanism of a breaker with optimized space allocation according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0028] The present invention provides a breaker with optimized space allocation, the breaker comprises: a first overcurrent protection pole, a second overcurrent protection pole, and a leakage protection device. The first overcurrent protection pole has a first input wire terminal and a first output wire terminal, the first overcurrent protection pole is in serial connection with a first contact and the first overcurrent protection pole includes a first operation mechanism. The second overcurrent protection pole has a second input wire terminal and a second output wire terminal, the second overcurrent protection pole is in serial connection with a second contact and the second overcurrent protection pole includes a second operation mechanism. The leakage protection device comprises an instrument transformer, an electromagnetic release, and a leakage release mechanism, the leakage protection device further comprises a test circuit with a test button, the test circuit is in serial connection with a test resistor, one terminal of the test circuit is in parallel connection with the first input wire terminal, and the other terminal of the test circuit is in parallel connection with the second output wire terminal. The instrument transformer detects a leakage current and initiates the electromagnetic release to transmit a signal, the first operation mechanism and the second operation mechanism are released through the leakage release mechanism, thereby the first contact and the second contact are disconnected to realize the leakage protection.

[0029] Referring to an embodiment of the present invention, the breaker with optimized space allocation provides two overcurrent protection poles and a leakage protection device within a housing of two-module width. In order to reach the object of space saving, the arrangement of different components and the design of the housing is very important. In an embodiment, three parts of main components are disposed in a housing of two-module width (36mm): a first part is an overcurrent protection pole with a single contact, that is, the first overcurrent protection pole 6. The first overcurrent protection pole 6 comprises a first handle, a first operation mechanism, a first instantaneous short-circuit protection device, a first long time delay overload protection device, a first arc quenching device, a test resistor, and two first wire terminals. A second part is also an overcurrent protection pole with a single contact, that is, the second overcurrent protection pole 7. The second overcurrent protection pole 7 comprises a second handle, a second operation mechanism, a second instantaneous short-circuit protection device, a second long time delay overload protection device, a second arc quenching device, and two second

wire terminals. Compared with the first overcurrent protection pole 6, the second overcurrent protection pole 7 does not include a test resistor. Except for the test resistor, the remaining structure of the second overcurrent protection pole 7 is the same as that of the first overcurrent protection pole 6. The second handle, the second operation mechanism, the second instantaneous short-circuit protection device, the second long time delay overload protection device, the second arc quenching device, two second wire terminals are in mirror arrangement to the first handle, the first operation mechanism, the first instantaneous short-circuit protection device, the first long time delay overload protection device, the first arc quenching device, two first wire terminals. A third part is the leakage protection device 8. The leakage protection device 8 comprises a instrument transformer, an electromagnetic release, a leakage release mechanism, a leakage indicator mechanism and a test circuit. On the width direction of the housing, the leakage protection device 8 is disposed between the two overcurrent protection poles, that is, between the first overcurrent protection pole 6 and the second overcurrent protection pole 7.

[0030] The internal space of the within the housing of the breaker with optimized space allocation are allocated as follows:

[0031] The first overcurrent protection pole and the second overcurrent protection pole occupies two fifths of the width of the housing respectively and the leakage protection device occupies one fifth of the width of the housing.

[0032] The first release mechanism, the second release mechanism, and the leakage release mechanism are at the same height within the housing, wherein the first release mechanism and the second release mechanism occupies two fifths of the width of the housing respectively, and the leakage release mechanism occupies one fifth of the width of the housing.

[0033] The first instantaneous short-circuit protection device and the second instantaneous short-circuit protection device are disposed at the same height within the housing, the first instantaneous short-circuit protection device and second instantaneous short-circuit protection device occupies half of the width of the housing respectively.

[0034] The first arc quenching device, the second arc quenching device, and the instrument transformer are disposed at the same height within the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the housing respectively, and the instrument transformer occupies half of the width of the housing.

[0035] The first arc quenching device, the second arc quenching device and the electromagnetic release are disposed at the same height within the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the breaker respectively, and the electromagnetic release occupies half of the width of the breaker.

[0036] Referring to Fig. 1, Fig. 1 discloses an electrical schematic diagram of a breaker with optimized space allocation according to an embodiment of the invention. The breaker comprises two overcurrent protection poles. A first overcurrent protection pole is in serial connection with a first contact 10, a first instantaneous protection device 12 and a first long time delay overload protection device 14. Correspondingly, a second overcurrent protection pole is in serial connection with a second contact 11, a second instantaneous protection device 13 and a second long time delay overload protection device 15. When leakage current occurs, the leakage current will be detected by the instrument transformer 62 of the leakage protection device 8, a signal will be transmitted by the electromagnetic release 18, and the first operation mechanism 16 of the first overcurrent protection pole and the second operation mechanism 35 of the second overcurrent protection pole are released via the leakage release mechanism 21, thereby the first contact 10 and the second contact 11 are disconnected to realize the leakage protection function. The leakage protection device 8 further comprises a test circuit 22, the test circuit 22 is in serial connection with a test button 20 and a test resistor 19 (test resistor 19 is a portion of the first overcurrent protection pole 6). One terminal of the test circuit 22 is in parallel connection with the first input wire terminal 25 of the first overcurrent protection pole 6, and the other terminal of the test circuit 22 is in parallel connection with the second output wire terminal 26 of the second overcurrent protection pole 7.

[0037] Fig. 2a and 2b disclose a space allocation diagram of an breaker with optimized space allocation according to an embodiment of the invention, wherein Fig. 2a discloses a front view of the breaker, and Fig. 2b discloses a rear view of the breaker. As shown in the diagram, the housing of the breaker has an inverted T-shape, the housing comprises a first upper surface 101, a second upper surface 102, a third upper surface 103, a first side surface 104, a second side surface 105, a first bottom surface 106, a third side surface 107, and a fourth side surface 108.

[0038] As shown in Fig. 2a, the first overcurrent protection pole 6 is disposed at the frontage of the breaker (the frontage of the housing). The first operation mechanism 16 of the first overcurrent protection pole 6 is disposed within a space surrounded by the first upper surface 101, the third side surface 107, and the fourth side surface 108. The first output wire terminal 24 is disposed within a space surrounded by the first side surface 104, the second upper surface 102 and the first bottom surface 106. The first input wire terminal 25 is disposed within a space surrounded by the second side surface 105, the third upper surface 103 and the first bottom surface 106. The first arc quenching device 30 is disposed between the first output wire terminal 24 and the first input wire terminal 25, above the first bottom surface 106. The first instantaneous short-circuit protection device 28 is disposed within a space above the first arc quenching device

30, on right side of the first output wire terminal 24, and beneath the second upper surface 102. The contact of the first release mechanism 29 is disposed at a position above the first arc quenching device 30, on the left side of the first input wire terminal 25 and beneath the third upper surface 103. The test resistor 19 is disposed between the first operation mechanism 16 and the first instantaneous short-circuit protection device 28, approximate to the third side surface 107.

[0039] The second overcurrent protection pole 7 is disposed in the rear of the breaker (in the rear of the housing), as shown in Fig. 2b. The operation mechanism 35 of the second overcurrent protection pole 7 is disposed within a space surrounded by the first upper end terminal 101, the third side surface 107 and the fourth side surface 108. The second output wire terminal 26 is disposed within a space surrounded by the first side surface 104, the second upper surface 102 and the first bottom surface 106. The second input wire terminal 27 is disposed within a space surrounded by the second side surface 105, the third upper surface 103 and the first bottom surface 106. The second arc quenching device 33 is disposed between the second output wire terminal 26 and the second input wire terminal 27, above the first bottom surface 106. The second instantaneous short-circuit protection device 34 is disposed at a position above the second arc quenching device 33, on the left side of the second input wire terminal 27 and beneath the second upper surface 102. The contact of the second release mechanism 32 is disposed at a position above the second arc quenching device 33, on the right side of the second output wire terminal 26 and beneath the third upper surface 103.

[0040] Fig. 3a, 3b and 3c disclose a space allocation diagram of a middle portion of an breaker with optimized space allocation according to an embodiment of the invention, wherein Fig. 3b is an A-A cross sectional view of Fig. 3a, Fig. 3c is a B-B cross sectional view of Fig. 3a. The middle portion of the breaker, that is, the front view and the cross sectional view of the leakage protection device 8 is shown in Fig. 3. Fig. 3a is a front view the leakage protection device 8. As shown in the drawing, the leakage indicator mechanism 41 is disposed beneath the first upper surface 101 of the breaker, approximate to the third side surface 107. The test button mechanism 38 of the leakage protection device 8 is disposed beneath the first upper surface 101 of the breaker, approximate to the fourth side surface 108. The rectifier element or circuit board 64 is disposed in a first area 36 or a second area 37. The first area 36 is formed by the second upper surface 102, the first side surface 104, and the first bottom surface 106. The second area 37 is formed by the third upper surface 103, the second side surface 105 and the first bottom surface 106. The instrument transformer 17 is disposed above the first bottom surface 106, and on the right side of the first area 36. The first instantaneous short-circuit protection device 28 of the first overcurrent protection pole 6 and the second instantaneous short-circuit protection device 34 of the second overcurrent protection pole 7 are disposed between the instrument transformer 17 and the leakage indicator mechanism 41. The electromagnetic release 39 is disposed above the first bottom surface 106, on the right side of the instrument transformer 17. The leakage release mechanism 40 is disposed beneath the first upper surface 101, above the first bottom surface 106, on the left side of the second area 37, and on the right side of the following components: leakage indicator mechanism 41, the first instantaneous short-circuit protection device 28, the second instantaneous short-circuit protection device 34 and the electromagnetic release 39.

[0041] Fig. 3a and Fig. 3b are cross sectional views along A-A line and B-B line of Fig. 3, it indicates explicitly the space allocation condition of three portions, such as two overcurrent protection poles and the leakage protection device disposed therebetween of the embodiment.

[0042] Referring to Fig. 3a, the first release mechanism 29 of the first overcurrent protection pole 6, the second release mechanism 32 of the second overcurrent protection pole 7, and the leakage release mechanism 40 of the leakage protection device 8 are disposed at the same height in the housing. As to the space allocation on the width of the housing, each of the first release mechanism 29 of the first overcurrent protection pole 6 and the second release mechanism 32 of the second overcurrent protection pole 7 occupies about two fifths of the width of the breaker (equal to the width of the housing), the leakage release mechanism 40 of the leakage protection device 8 occupies one fifth of the width of the breaker (the width of the housing). The first instantaneous short-circuit protection device 28 of the first overcurrent protection pole 6 and the second instantaneous short-circuit protection device 34 of the second overcurrent protection pole 7 are disposed at the same height in the housing. As to the space allocation on the width of the housing, each of the first instantaneous short-circuit protection device 28 of the first overcurrent protection pole 6 and the second instantaneous short-circuit protection device 34 of the second overcurrent protection pole 7 occupies half of the width of the breaker (the width of the housing).

[0043] The first arc quenching device 30 of the first overcurrent protection pole 6, the second arc quenching device 33 of the second overcurrent protection pole 7, and the instrument transformer 17 of the leakage protection device 8 are disposed at the same height in the housing. As to the space allocation on the width of the housing, each of the first arc quenching device 30 of the first overcurrent protection pole 6 and the second arc quenching device 33 of the second overcurrent protection pole 7 occupies one fourth of the width of the housing (the width of the breaker), and the instrument transformer 17 of the leakage protection device 8 occupies half of the width of the housing (the width of the breaker).

[0044] Referring to Fig. 3b, the first release mechanism 29 of the first overcurrent protection pole 6, the second release mechanism 32 of the second overcurrent protection pole 7 and the leakage protection mechanism 40 of

the leakage protection device 8 are disposed at the same height in the housing. As to the space allocation on the width of the housing, each of the first release mechanism 29 of the first overcurrent protection pole 6 and the second release mechanism 32 of the second overcurrent protection pole 7 occupies about two fifths of the width of the breaker (the width of the housing), and the leakage release mechanism 40 of the leakage protection device 8 occupies one fifth of the width of the breaker (the width of the housing).

[0045] The first arc quenching device 30 of the first overcurrent protection pole 6, the second arc quenching device 33 of the second overcurrent protection pole 7, and the electromagnetic release 39 of the leakage protection device 8 are disposed at the same height in the housing. As to the space allocation on the width of the housing, the first arc quenching device 30 of the first overcurrent protection pole 6 and the second arc quenching device 33 of the second overcurrent protection pole 7 occupies one fourth of the width of the housing, and the electromagnetic release of the leakage protection device 8 occupies half of the width of the housing.

[0046] Fig. 4 discloses an exploded view of a breaker with optimized space allocation according to an embodiment of the invention. The assemblies of the first overcurrent protection pole 6 are included in the first housing 1 and the second housing 2, the assemblies of the second overcurrent protection pole 7 are included in the third housing 3 and the fourth housing 4, the assemblies of the leakage protection device 8 are included in the second housing 2 and the third housing 3.

[0047] Fig. 5 discloses a front view of the first overcurrent protection pole of a breaker with optimized space allocation according to an embodiment of the invention. Wherein the first operation mechanism 16, the test resistor 19, the first output wire terminal 24, the first input wire terminal 25, the first instantaneous short-circuit protection device 28, the first release mechanism 29, the first arc quenching device 30 have been illustrated by specific elements. Compared with the space allocation diagram shown in Fig. 2a, the schematic block diagram of 2a has been substituted by specific elements in Fig. 5. However, the space allocation and the layout plan of both are the same. A coil 46 and a soft wire 44 of the first instantaneous short-circuit protection device 28 are also shown in Fig. 5.

[0048] Similar as Fig. 5, Fig. 6 discloses a front view of the second overcurrent protection pole 7 of a breaker with optimized space allocation according to an embodiment of the invention. The second operation mechanism 35, the second output wire terminal 26, the second input wire terminal 27, the second instantaneous short-circuit protection device 34, the second release mechanism 32, the second arc quenching device 33 have been illustrated by specific elements, compared with the space allocation diagram shown in Fig. 2b, the schematic block diagram of Fig. 2b has been substituted by specific elements in Fig. 6. However, the space allocation and the layout plan

of both are the same. A coil 47 and a soft wire 45 of the first instantaneous short-circuit protection device 28 are also shown in Fig. 6.

[0049] In an embodiment, the leakage release mechanism 40 of the leakage protection device 8 has three states: a tripping state, a closing state, and a releasing state. Fig. 7 discloses a front view of a leakage protection device of the breaker with optimized space allocation according to an embodiment of the invention, the leakage release mechanism is at the closing state. In Fig. 8a, 8b, and 8c, the leakage release mechanism is at a tripping position, Fig. 8b is a rear view of Fig. 8a, Fig. 8c is a lateral view of Fig. 8b. In Fig. 9a, 9b, and 9c, the leakage release mechanism is at a closing position, Fig. 9b is a rear view of Fig. 9a. In Fig. 10, the leakage release mechanism is at a releasing state.

[0050] Specifically, Fig. 8b is a left view of Fig. 8a, Fig. 8c is a rear view of Fig. 8a. As shown in the diagram, the leakage release mechanism 40 comprises a handle 50, a U-shaped rod 51, a lock 52, a link rod 54, a jump cue 56, a reset rod 61, a trip lever 59, and an elastic reed 60. The handle 50 of the leakage release mechanism 40 may be used as a leakage indicator, and may be rotatably assembled on the first shaft 74 of the third housing 3. The spring 49 of the handle 50 is disposed on the handle 50, the spring 49 has two arms, one arm functions on the handle 50, the other arm functions on the housing 3. The spring 49 is used to reset the handle 50. One end of the U-shaped rod is disposed in a first hole 71 of the handle 50, and the other end is disposed in a second hole 72 of the lock 52. Another hole on the lock 52, the third hole 73, is rotatably assembled on the shaft of the link rod 54. A hole 533 of the link rod 54 is rotatably assembled on the seventh shaft 88 of the housing 3. The trip lever 56 is rotatably disposed above the link rod 54, and may rotate around the second shaft 78 of the link rod 54. The reset rod 61 is rotatably assembled on a third shaft 84 of the housing 3, a elastic reed 60 is fixed to the root 46 of the reset rod 61, the trip lever 59 is rotatably assembled on a fourth shaft 85 of the housing 3. A torsion spring 70 is fixed on the seventh shaft 88, one arm thereof functions on the housing 3, the other arm functions on a eighth shaft 89 of the link rod 54. The torsion spring 70 produces a clockwise force on the link rod 54. The electromagnetic release 63 is fixed on a fifth shaft 86 and a sixth shaft 87 of the housing 3. It can be seen more clearly in Fig. 8c the space allocation condition among the components, such as the lock 52, link rod 54, jump cue 56, reset rod 61, trip lever 59, etc.. On the width direction, the link rod 54 and the reset rod 61 are coplanar, the jump cue 56 and the trip lever 59 are coplanar, the area of the lower portion 83 of the elastic reed 60 is larger than other positions of the reed, so that it can contact the trip lever 59 on the width direction.

[0051] At the tripping state, as shown in Figs. 8a-8c, two release surfaces of the lock 52 and jump cue 56 at can be seen under this state, the first release surface 75 and the second release surface 76 are separate. At the

closing state, the handle jacket of the breaker drives the handle 50 to overcome the force generated by the spring 49 and rotate counterclockwise. The handle 50 make the lock 52 and the jump cue 56 lock at the first release surface 75 and the second release surface 76 via the U-shaped rod 51, thereby the link rod 54 is driven to overcome the huge torsion force of the torsion spring 70 and rotated counterclockwise, the lance 81 at the lower portion of the link rod 54 hits the upper portion 80 of the reset rod 61, and drives the reset rod 61 and elastic reed 60 to rotate clockwise. The putter 79 on the electromagnetic release 63 is driven to return back to its initial position, and completes the reset of the electromagnetic release 63. At the same time, one arm 90 of the jump cue 56 drives one arm 91 of the trip lever 59, making the trip lever 59 rotate counterclockwise and resets.

[0052] When the above actions are completed, the leakage release mechanism 40 is at a closing state, as shown in Figs. 9a-9c.

[0053] When leakage current is detected by the instrument transformer 62, an action signal will be transmitted to the electromagnetic release 63 by the instrument transformer 62 to pop out the putter 79 of the electromagnetic release 63, thereby the lower portion 83 of the elastic reed 60 is hit, the hit force is transferred to a contacted convex portion 41 on the trip lever 59 via the elastic reed 60, and the trip lever 59 rotates clockwise, the lower portion 90 of the jump cue 56 will be hit by the upper portion 91 of the trip lever 59, and after a counterclockwise force acting on the jump cue 56, the first release surface (the upper release surface) 75 will be separated from the second release surface 76 of the lock 52, the release is completed by the leakage release mechanism 40, at the same time when the leakage release mechanism 40 is released, the ninth shaft 65 may be hit by the bend portion 82 of the link rod 54, the ninth shaft 65 is connected with the release rod of the first operation mechanism and the second operation mechanism of the first overcurrent protection pole and the second overcurrent protection pole of the breaker, thereby the breaker is released.

[0054] In Figs. 9a-9c, the popping out of the putter 79 of the electromagnetic release 63 is instantaneous, the U-shaped rod 51 connected with the handle cannot act instantaneously, therefore the lock 52 connected with the U-shaped rod 51 is at a temporary standstill state, while the jump cue 56 rotates counterclockwise under the momentum of the trip lever 59.

[0055] The numeral 38 in Fig. 3a indicates that the test button 55 locates at the upper surface 101 and side surface 108. The torsion spring 57 is fixed on the shaft 58 of the housing 3, one arm 68 of the torsion spring 57 is electrically connected with the second wire terminal (input wire terminal) of the second overcurrent protection pole 7 through the housing 3. The test resistor 19 is fixed inside the first overcurrent protection pole 6 (See Fig. 5), one pin of the test resistor 19 goes through the housing 2, and is fixed on a semi-pass slot 66, which locates be-

tween the area 28 (the first instantaneous short-circuit protection device 28) and the handle 50 (the leakage indicator handle), at the middle upper portion of housing 3 (See Fig. 7). Another pin of the test resistor 19 is electrically connected electrically with the coil 46 of the first instantaneous short-circuit protection device 28 of the first overcurrent protection pole 6, the coil 46 is pierced from the instrument transformer 62 via the soft wire 44 (the structure of the second instantaneous short-circuit protection device 34 and the coil 47 and the soft wire 45 are similar), and is soldered with the first wire terminal 24 (output terminal) of the first overcurrent protection pole 6. A fracture may be formed at a position 69 by another arm 67 of the torsion spring 57 and one pin of the test resistor 19.

[0056] When the test button 55 is depressed, one arm 67 of the torsion spring 57 is pressed by the pressure column at the lower portion of the test button, and is contacted with the pin of the test resistor 19 disposed in the semi-pass slot 66. The test circuit 22 is turned on to form test leakage current, then the leakage release mechanism 40 is released and the breaker is disconnected.

[0057] A spring 53 is tightly hooped on a cylinder of the test button 55, when the leakage mechanism is at the closing state, the lower portion of the spring 53 is vacant; when the leakage mechanism is at the tripping state, a tiny clockwise reset force is produced for the jump cue 56 by the spring 53 on a platform 77 at right side of the jump cue 56.

[0058] In Fig. 10, the leakage release mechanism is at the release state. The respective components shown in Fig. 10 are similar as those described in Figs. 8a-8c and Figs. 9a-9c, and will not be described repeatedly.

[0059] The effect of reducing the space volume is reached by the breaker with optimized space allocation of the present invention, the internal space of the breaker has been reasonably optimized and spatially arranged to integrate two overcurrent protection poles and a leakage protection module into one breaker product.

[0060] The above embodiments are provided to those skilled in the art to realize or use the invention, under the condition that various modifications or changes being made by those skilled in the art without departing the spirit and principle of the invention, the above embodiments may be modified and changed variously, therefore the protection scope of the invention is not limited by the above embodiments, rather, it should conform to the maximum scope of the innovative features mentioned in the Claims.

Claims

1. A breaker with optimized space allocation, **characterized in that** the breaker comprises:

a first overcurrent protection pole with a first input wire terminal and a first output wire terminal,

- the first overcurrent protection pole being in serial connection with a first contact and the first overcurrent protection pole including a first operation mechanism;
- a second overcurrent protection pole with a second input wire terminal and a second output wire terminal, the second overcurrent protection pole being in serial connection with a second contact and the second overcurrent protection pole including a second operation mechanism;
- a leakage protection device comprising an instrument transformer, an electromagnetic release, and a leakage release mechanism, the leakage protection device further comprising a test circuit with a test button, the test circuit being in serial connection with a test resistor, one terminal of the test circuit being in parallel connection with the first input wire terminal, and the other terminal of the test circuit being in parallel connection with the second output wire terminal; wherein the instrument transformer detects a leakage current and initiates the electromagnetic release to release the first operation mechanism and the second operation mechanism through the leakage release mechanism, thereby the first contact and the second contact are disconnected to realize the leakage protection.
2. The breaker with optimized space allocation according to claim 1, **characterized in that** the leakage release mechanism comprises a handle, a U-shaped rod, a lock, a link rod, a jump cue, a reset rod, a trip lever, and an elastic reed;
the handle is used as a leakage indicator, and is rotatably assembled on a housing of the breaker, one end of the U-shaped rod is connected with the handle, and the other end of the U-shaped rod is connected with the lock;
the lock is rotatably connected with the link rod, and the link rod is rotatably connected with the housing;
the trip lever is rotatably disposed above the link rod;
the reset rod is rotatably connected with the housing;
the elastic reed is connected with the reset rod;
the trip lever is rotatably connected with the housing.
 3. The breaker with optimized space allocation according to claim 2, **characterized in that** the handle has a spring with two arms, one arm acts on the handle and the other arm acts on the housing, the spring resets the handle.
 4. The breaker with optimized space allocation according to claim 2, **characterized in that** one end of U-shaped rod is disposed in a first hole of the handle, the other end of U-shaped rod is disposed in a second hole of the lock, a third hole of the lock is rotatably assembled in a shaft of the link rod, the link rod is rotatably assembled on the housing, the trip lever is disposed above the link rod and rotates around a second shaft of the link rod.
 5. The breaker with optimized space allocation according to claim 2, **characterized in that** the elastic reed is fixed at the root of the reset rod.
 6. The breaker with optimized space allocation according to claim 2, **characterized in that** the width of the housing of the breaker is two-module, the first overcurrent protection pole, the second overcurrent protection pole and the leakage protection device are disposed in the housing, the leakage protection device is between the first overcurrent protection pole and the second overcurrent protection pole on the width direction of the housing,
 7. The breaker with optimized space allocation according to claim 6, **characterized in that** the housing of the breaker is inverted T-shaped, the first overcurrent protection pole, the second overcurrent protection pole and the leakage protection device are disposed in the housing, the housing has a first upper surface, a second upper surface, a third upper surface, a first side surface, a second side surface, a first bottom surface, a third side surface, and a fourth side surface.
 8. The breaker with optimized space allocation according to claim 7, **characterized in that** the first overcurrent protection pole and the second overcurrent protection pole occupies two fifths of the width respectively and the leakage protection device occupies one fifth of the width.
 9. The breaker with optimized space allocation according to claim 6, **characterized in that** the first operation mechanism, the first output wire terminal and the first input wire terminal are disposed in the front of the housing, wherein the first operation mechanism is disposed within a space surrounded by the first upper surface, the third side surface and the fourth side surface, the first output wire terminal is disposed within a space surrounded by the first side surface, the second upper surface and the first bottom surface, the first input wire terminal is disposed within a space surrounded by the second side surface, the third upper surface and the first bottom surface;
the second operation mechanism, the second output wire terminal and the second input wire terminal are disposed in the rear of the housing, wherein the second operation mechanism is disposed within a space surrounded by the first upper surface, the third side

surface and the fourth side surface, the second output wire terminal is disposed within a space surrounded by the first side surface, the second upper surface and the first bottom surface, the second input wire terminal is disposed within a space surrounded by the second side surface, the third upper surface and the first bottom surface.

10. The breaker with optimized space allocation according to claim 9, **characterized in that** the first overcurrent protection pole further comprises a first arc quenching device, disposed between the first output wire terminal and the first input wire terminal, above the first bottom surface; the second overcurrent protection pole further comprises a second arc quenching device, disposed between the second output wire terminal and the second input wire terminal, above the first bottom surface.
11. The breaker with optimized space allocation according to claim 10, **characterized in that** the first arc quenching device, the second arc quenching device, and the instrument transformer are at the same height within the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the housing, and the instrument transformer occupies half of the the width the housing; or the first arc quenching device, the second arc quenching device and the electromagnetic release are at the same height in the housing, the first arc quenching device and the second arc quenching device occupies one fourths of the width of the housing, and the electromagnetic release occupies half of the width of the housing.
12. The breaker with optimized space allocation according to claim 10, **characterized in that** the first overcurrent protection pole is further in serial connection with a first instantaneous short-circuit protection device, disposed within a space above the first arc quenching device, on the right side of the first output wire terminal, and beneath the second upper surface; the second overcurrent protection pole is further in serial connection with a second instantaneous short-circuit protection device, disposed within a space above the second arc quenching device, in the left side of the second input wire terminal, and beneath the second upper surface.
13. The breaker with optimized space allocation according to claim 12, **characterized in that** the first instantaneous short-circuit protection device and the second instantaneous short-circuit protection device are at the same height in the housing, the first instantaneous short-circuit protection device

and second instantaneous short-circuit protection device occupied half of the width of the housing respectively.

14. The breaker with optimized space allocation according to claim 12, **characterized in that** the test resistor is disposed between the first operation mechanism and the first instantaneous short-circuit protection device, approximate to the third side surface.
15. The breaker with optimized space allocation according to claim 14, **characterized in that** the first overcurrent protection pole further comprises a first release mechanism, a contact of the first release mechanism is disposed within a space above the first arc quenching device, on the left side of the first input wire terminal, and beneath the third upper surface; the second overcurrent protection pole further comprises a second release mechanism, a contact of the second release mechanism is disposed within a space above the second arc quenching device, on the right side of the second output wire terminal, and beneath the third upper surface.
16. The breaker with optimized space allocation according to claim 15, **characterized in that** the first release mechanism, the second release mechanism, and the leakage protection mechanism are at the same height in the housing, the first release mechanism and the second release mechanism occupied two fifths of the width of the housing respectively and the leakage protection mechanism the leakage protection mechanism occupies one fifth of the width of the housing.
17. The breaker with optimized space allocation according to claim 2, **characterized in that** the first overcurrent protection pole is further in serial connection with a first long time delay overload protection device; the second overcurrent protection pole is further in serial connection with a second long time delay overload protection device.
18. The breaker with optimized space allocation according to claim 2, **characterized in that** a first area is formed by the second upper surface, the first side surface and the first bottom surface, a second area is formed by the third upper surface, the second side surface and the first bottom surface; the instrument transformer is disposed above the first bottom surface, on the right side of the first area; the electromagnetic release is disposed above the first bottom surface, on the right side of the instrument transformer; the test button is disposed beneath the first upper

surface, approximate to the fourth side surface.

19. The breaker with optimized space allocation according to claim 2, **characterized in that** the leakage release mechanism is disposed beneath the first upper surface, above the first bottom surface, on the left side of the second area, and on the right side of the leakage indicator mechanism and the electromagnetic release.
20. The breaker with optimized space allocation according to claim 2, **characterized in that** the leakage protection device further comprises an leakage indicator mechanism; the leakage indicator mechanism is disposed beneath the first upper surface, approximate to the third side surface.

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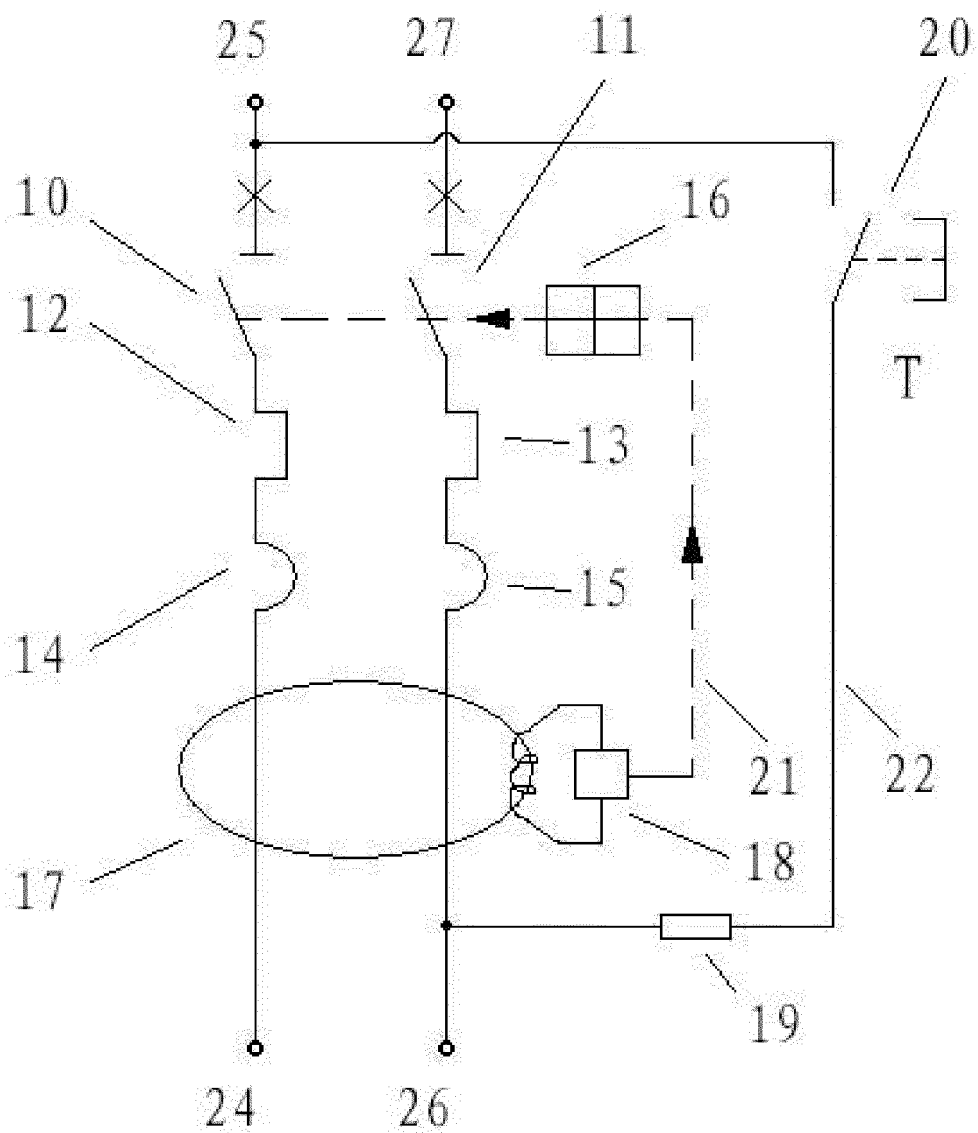


FIG 1

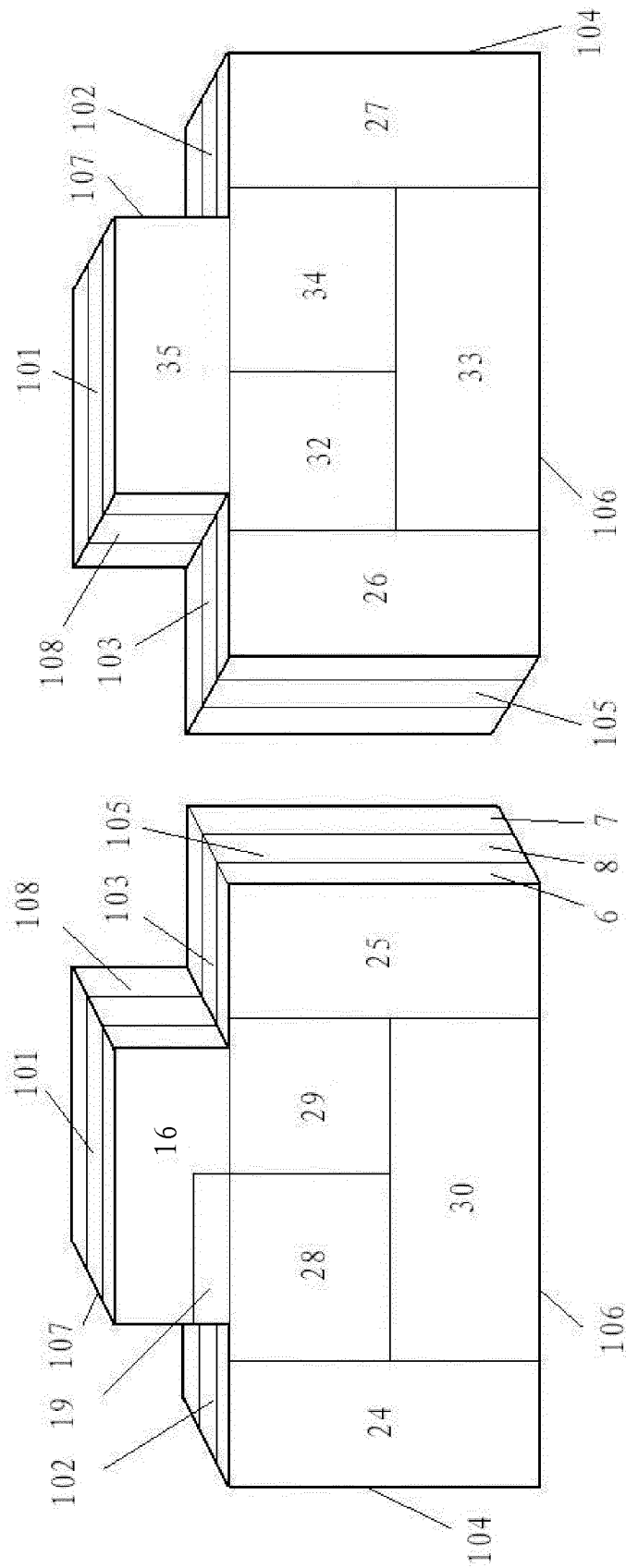


FIG 2

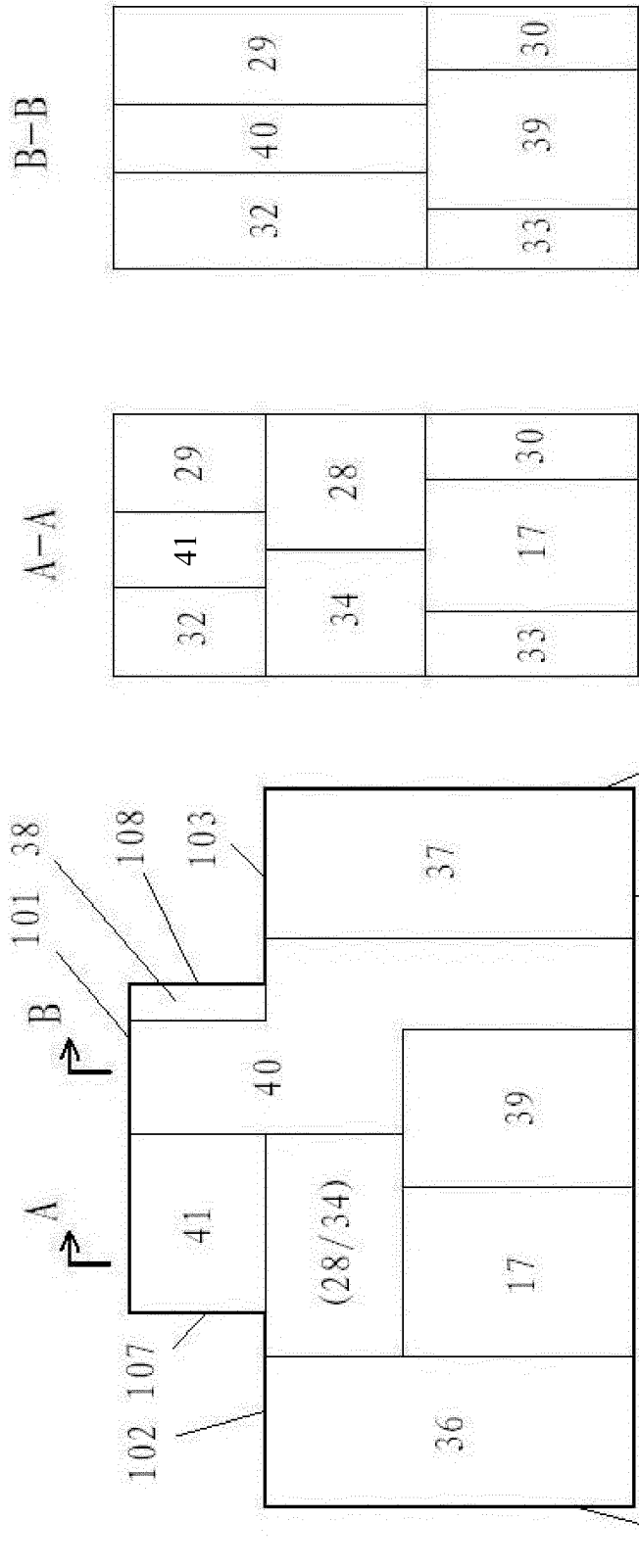


FIG 3a

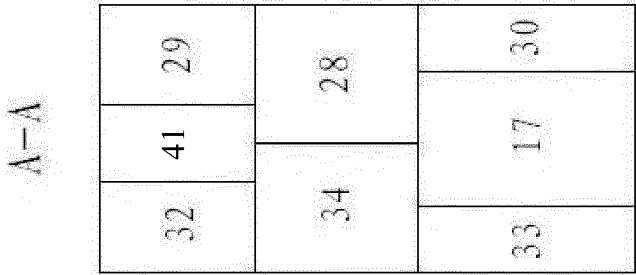


FIG 3b

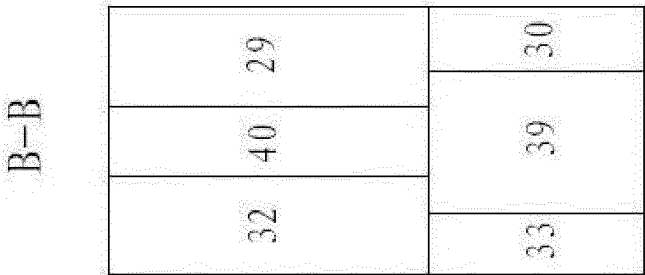


FIG 3c

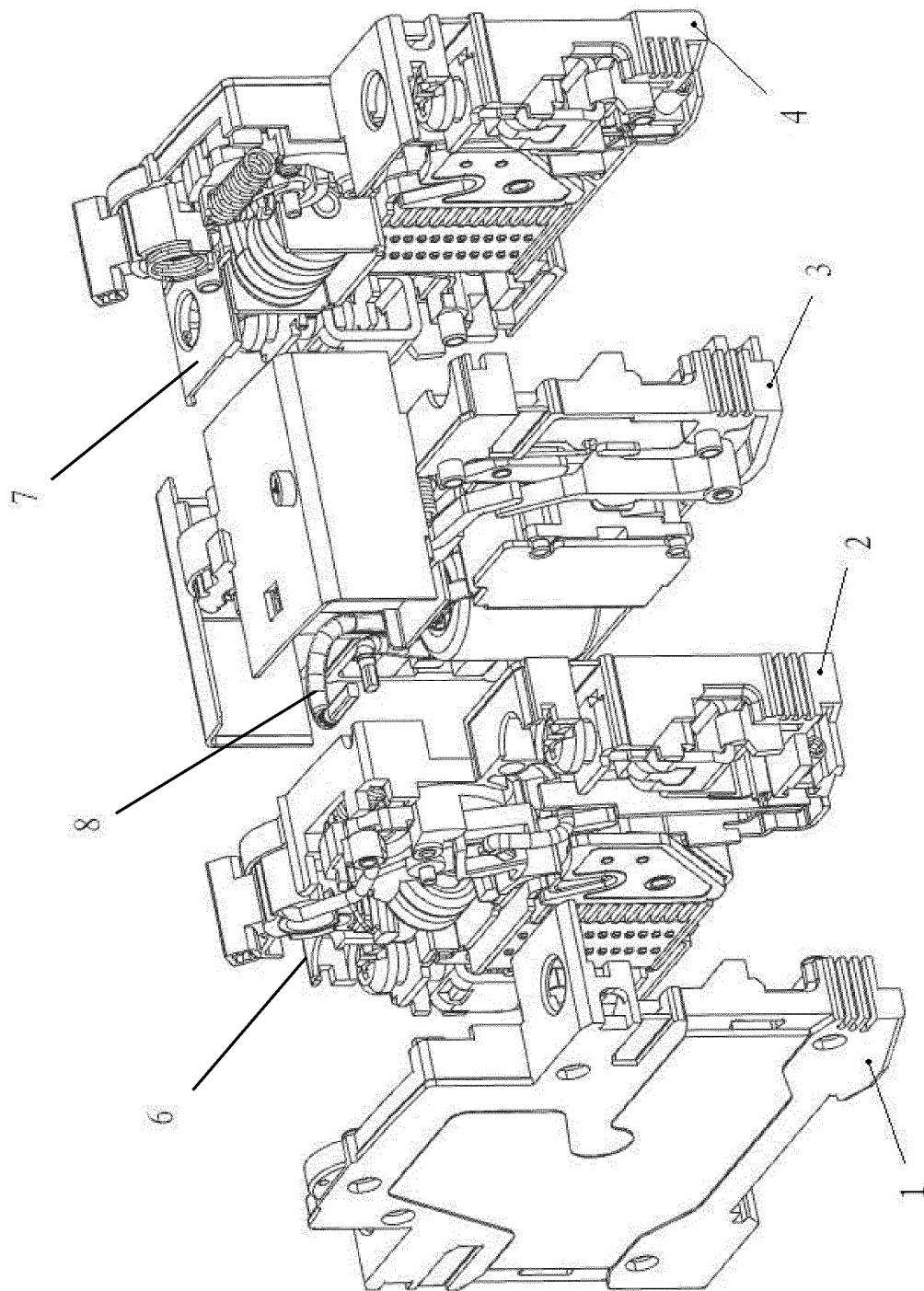
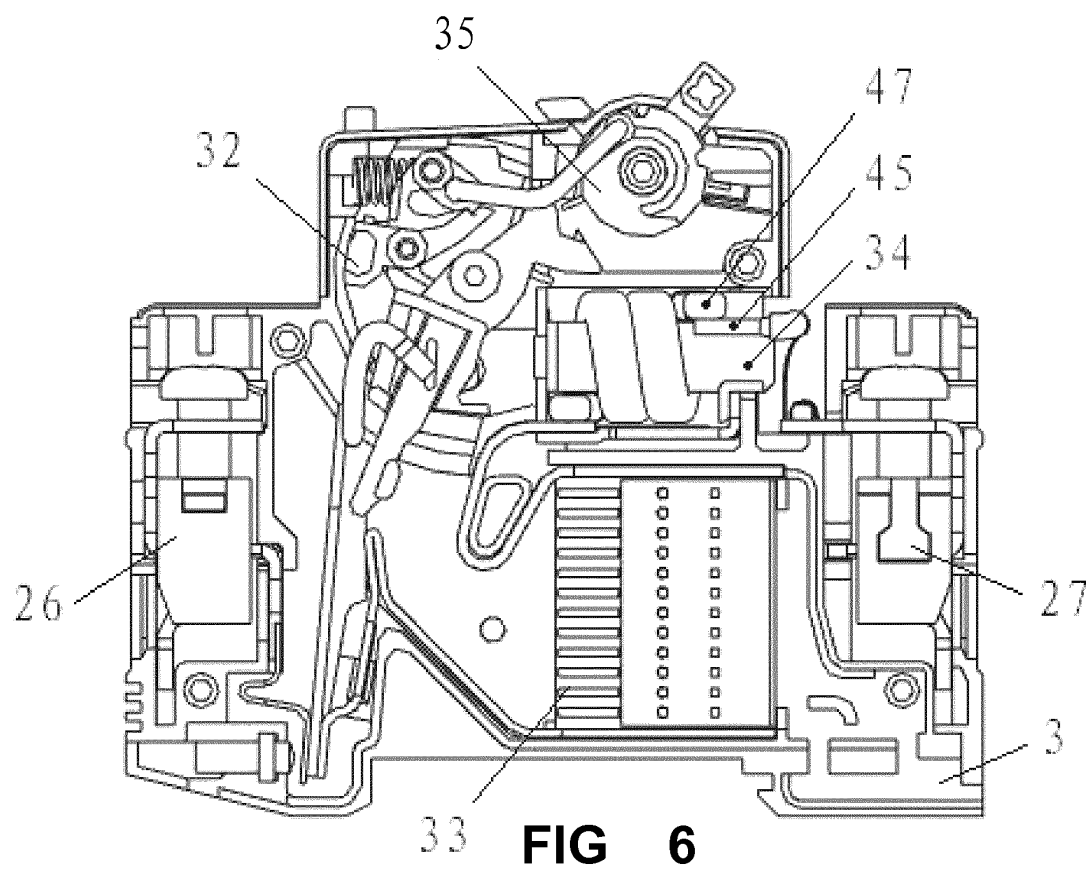
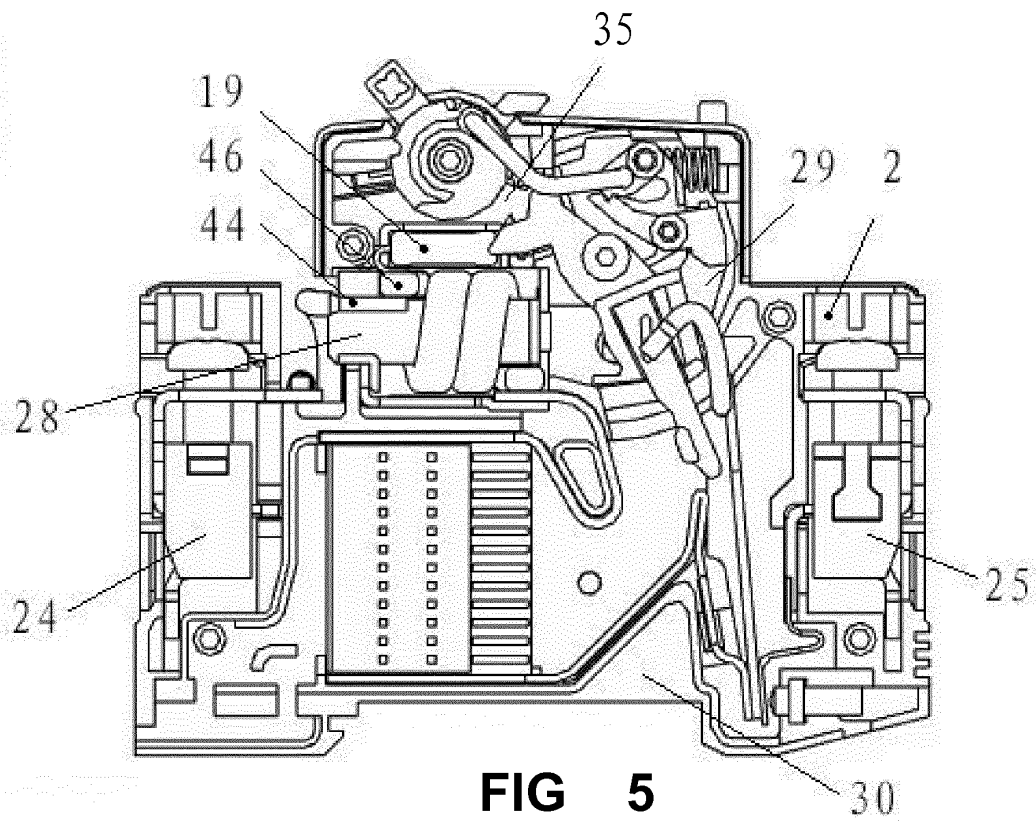


FIG 4



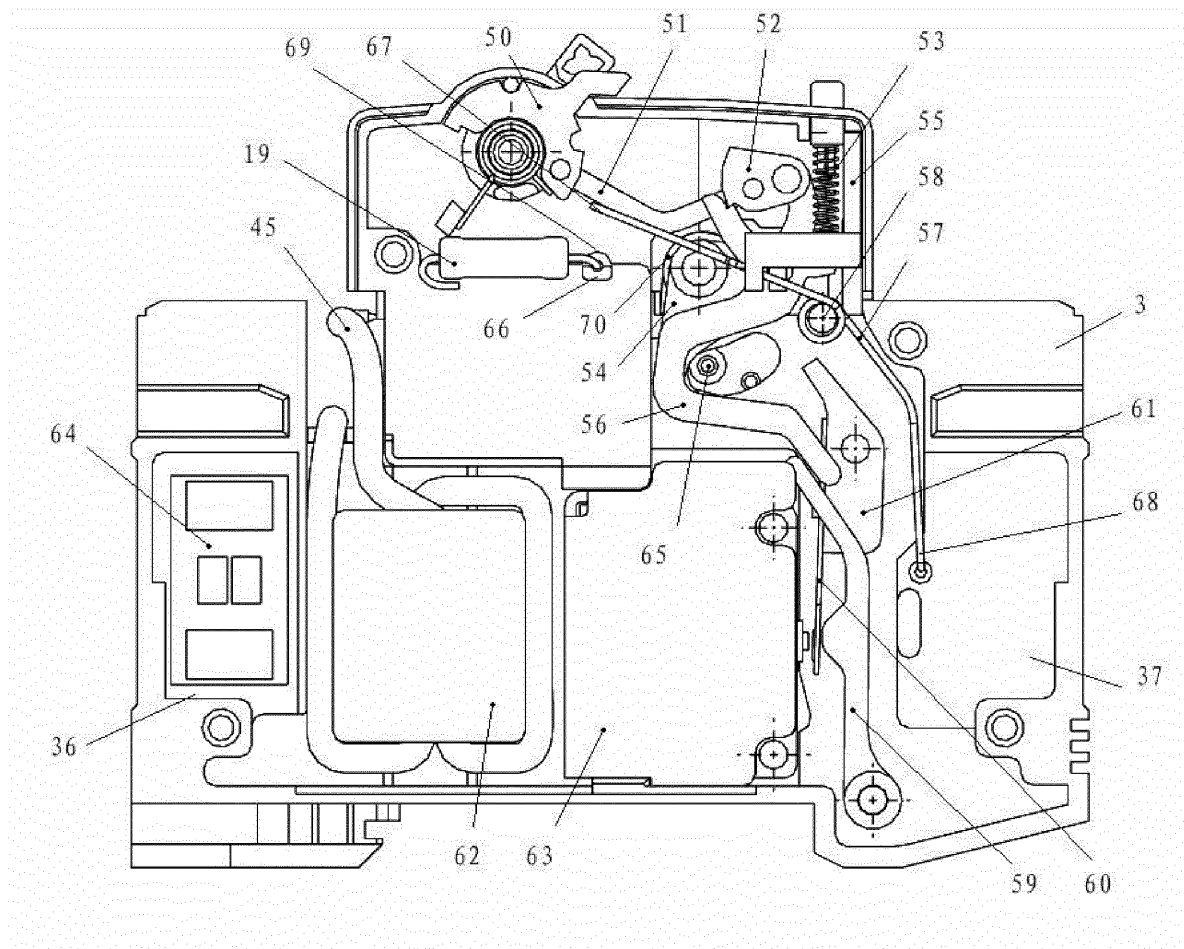
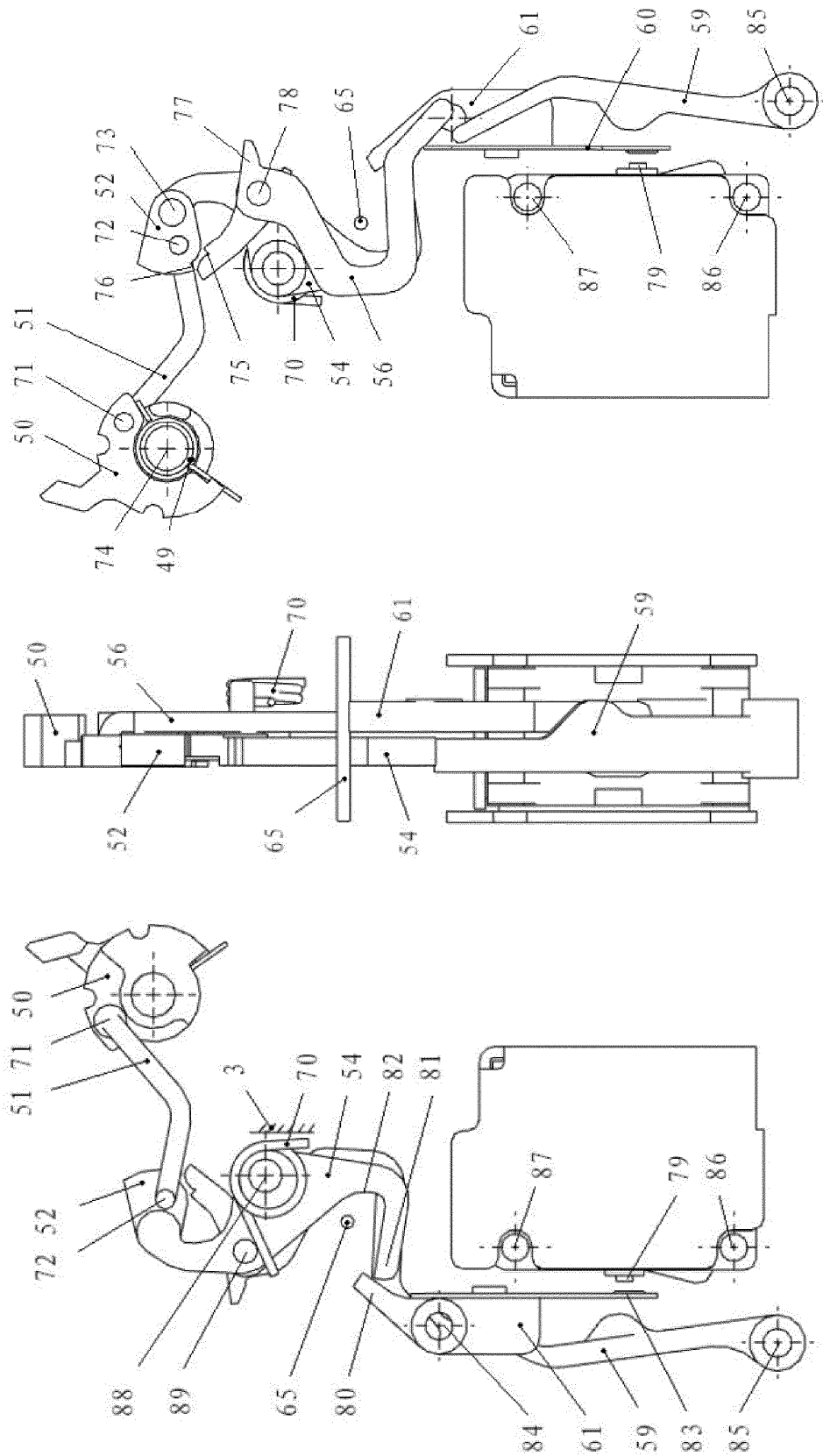


FIG 7



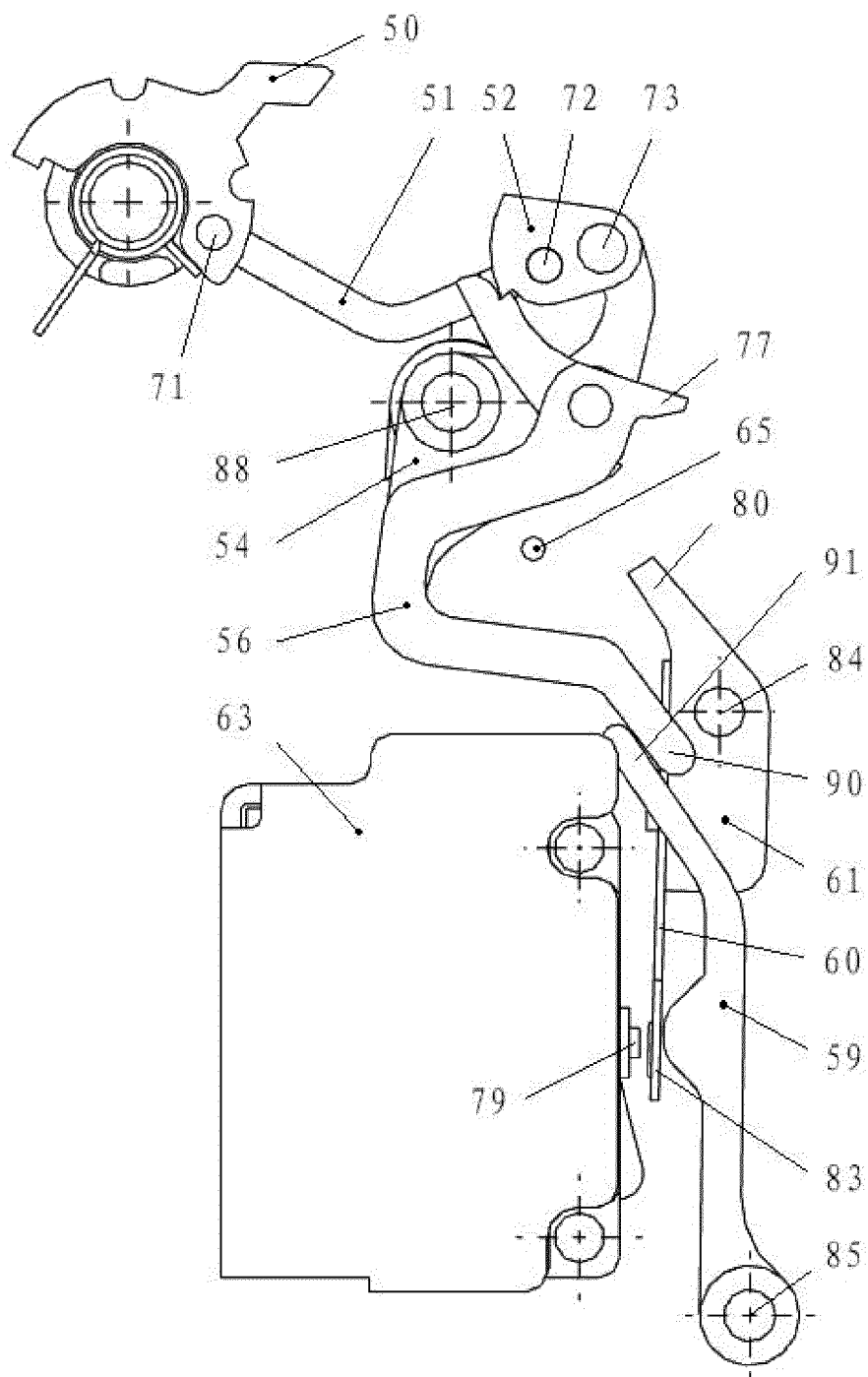


FIG 9a

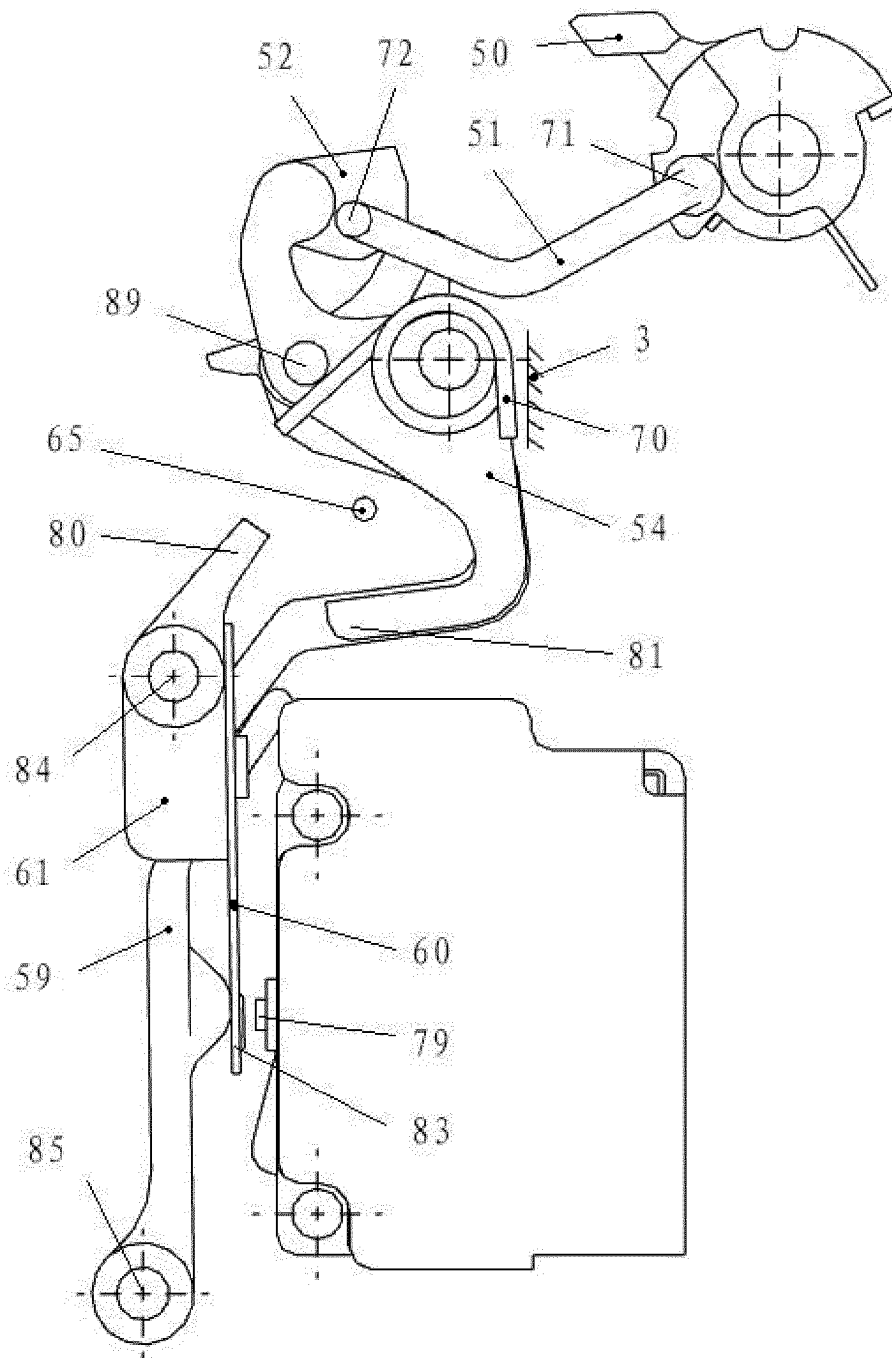


FIG 9b

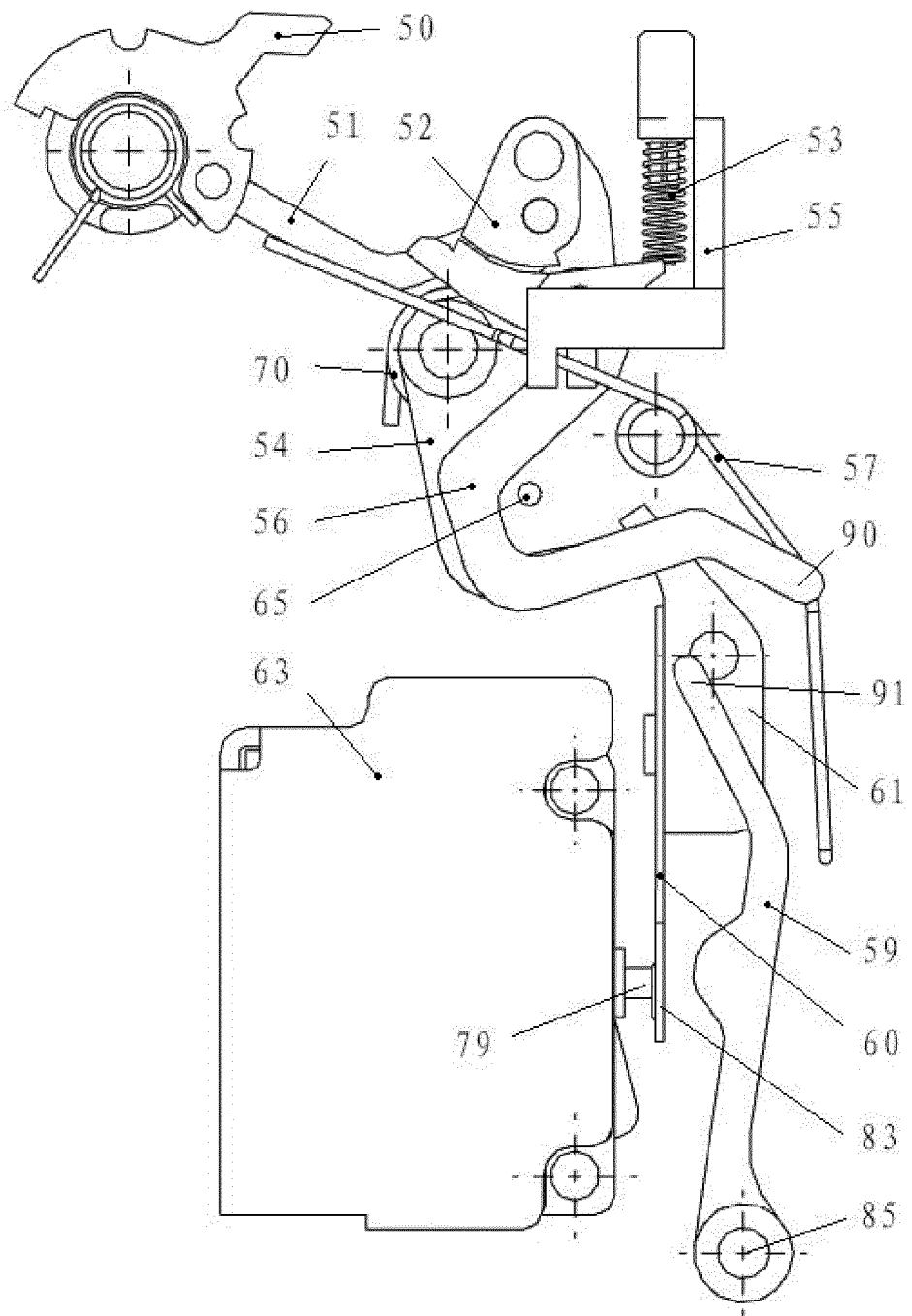


FIG 9c

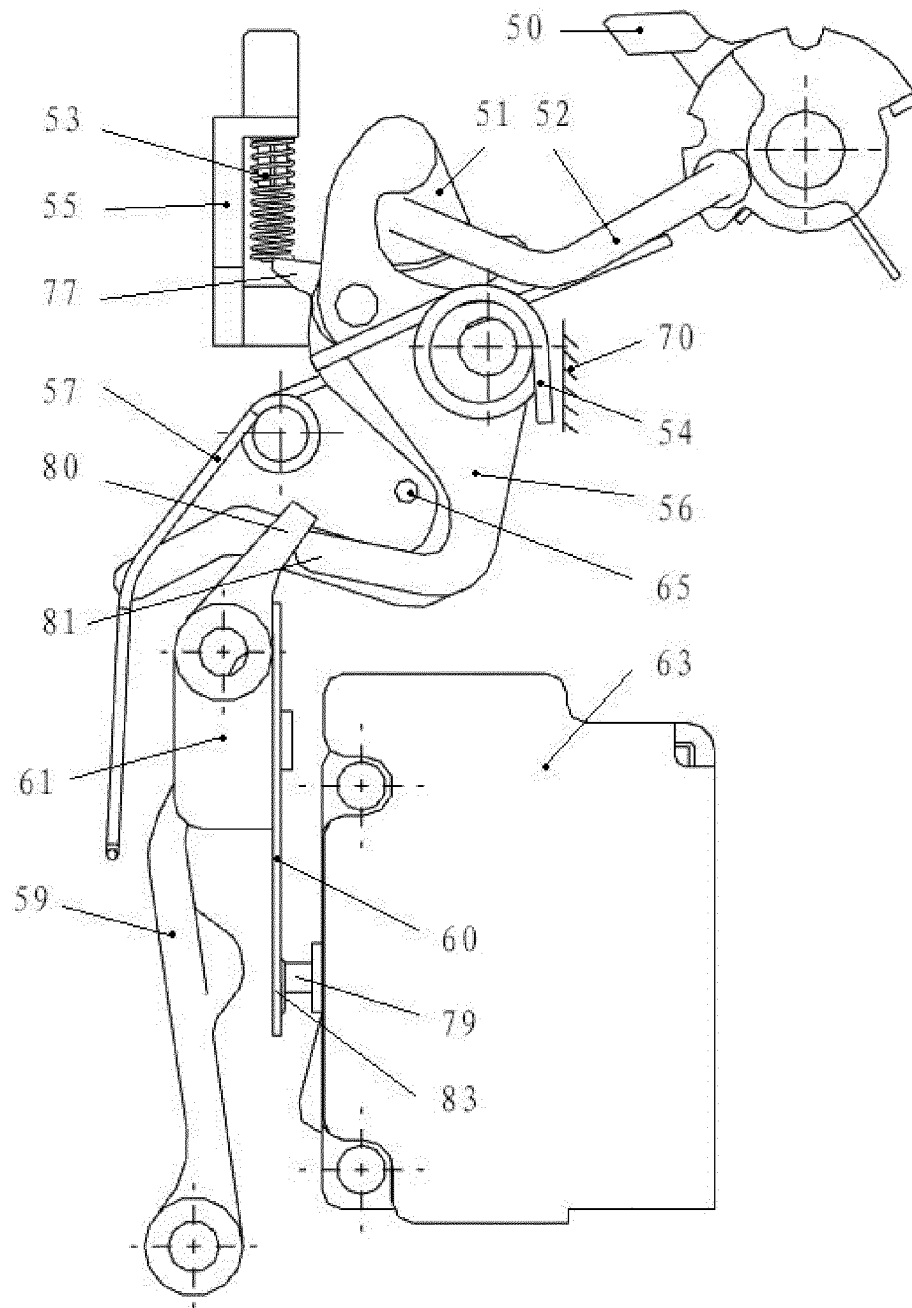


FIG 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/072078

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01H

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

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

WPI; EPODOC; CNPAT; CNKI: experiment, operating mechanism, leakage tripping; leakage, overcurrent, overload, switch, breaker, switchgear, trip, U, lock, latch, reset, rod, spring

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 202102998 U (SEARIELECTRIC TECHNOLOGY CO., LTD. et al.), 04 January 2012 (04.01.2012), description, paragraphs [0027]-[0051], and figures 1-10	1-20
PX	CN 202142482 U (SEARIELECTRICAL APPARATUS TECHNOLOGY CO., LTD. et al.), 08 February 2012 (08.02.2012), description, paragraphs [0027]-[0051], and figures 1-10	1-20
Y	CN 2307363 Y (WANG, Xinqian), 10 February 1999 (10.02.1999), description, page 2, the last paragraph to page 3, paragraph 1, and figures 1-6	1
A		2-20
Y	CN 201069746 Y (ZHEJIANG ZHIMING ELECTRIC IMP. & EXP. CO., LTD.), 04 June 2008 (04.06.2008), description, page 3, paragraph 1 to page 5, paragraph 1, and figures 1-3	1
A		2-20
A	CN 1196565 A (MITSUBISHI ELECTRIC CORP.), 21 October 1998 (21.10.1998), the whole document	1-20

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search
03 May 2012 (03.05.2012)Date of mailing of the international search report
31 May 2012 (31.05.2012)Name and mailing address of the ISA/CN:
State Intellectual Property Office of the P. R. China
No. 6, Xitucheng Road, Jimenqiao
Haidian District, Beijing 100088, China
Facsimile No.: (86-10) 62019451

Authorized officer

RAN, ChunyanTelephone No.: (86-10) **62411745**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2012/072078

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 202102998 U	04.01.2012	None	
CN 202142482 U	08.02.2012	None	
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		KR 19980079889 A	25.11.1998
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		CN 1061773 C	07.02.2001
		ID 20176 A	22.10.1998

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/072078

A. CLASSIFICATION OF SUBJECT MATTER

H01H 83/04 (2006.01) i

H01H 71/24 (2006.01) i