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(54) **SURGE PROTECTION DEVICE AND THERMAL TRIPPING MECHANISM THEREOF**

(57) A thermal tripping mechanism of a surge protection device comprises an elastic mechanism. Two first protection components (103) and one second protection component (108) form a Y-shaped layout and the two first protection components (103) are directly or indirectly connected to the second protection component (108) by using a thermal fusing material. The elastic mechanism comprises an elastic part (105) and a slide part (106). The elastic part (105) drives the slide part (106) to move by an elastic force. When the two first protection components (103) are both in a normal working state, the thermal fusing material does not reach a fusing temperature, the two first protection components (103) and the second protection component (108) form a conductive path, and the elastic part (105) is in an energy storage state. When at least one of the first protection components (103) is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic part (105) releases energy for driving the slide part (106) to move, and the slide part (106) moves to cut off the conductive path.

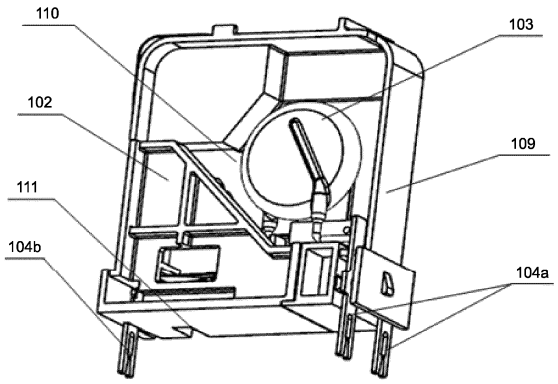

FIG 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to the field of low voltage electric apparatus, more particularly, relates to a surge protection device of a low voltage electric apparatus.

2. The Related Art

[0002] In a low voltage power distribution system, a Surge Protection Device (SPD) is usually used to protect overvoltage caused by external influence, such as lightning. A III-type surge protection device is used for a terminal electric apparatus. At present, existing III-type SPDs in the market are mainly used for providing common-mode protection. Due to the fact that common-mode protection has certain limitations, there is a demand for a surge protection device which can simultaneously provide common-mode protection and differential-mode protection.

[0003] A surge protection device with a Y-shaped layout can simultaneously provide common-mode protection and differential-mode protection. The Y-shape layout means that the surge protection device comprises two first protection components (usually voltage-sensitive resistors) and a second protection component (usually a discharge tube). The two voltage-sensitive resistors share one electrode and are connected with the discharge tube in series. The three components are connected to form a Y-shaped structure.

[0004] The key of the Y-shaped layout is the design of a thermal tripping mechanism between the two voltage-sensitive resistors and the discharge tube. The basic protection principle of the surge protection device is: when overvoltage occurs, a conductive path is turned on to discharge a current. When no overvoltage exists, almost no current flows through the conductive path. However, when the surge protection device is degraded and causes a rise in temperature, the circuit will be disconnected as well. This is a situation that the surge protection device malfunctions. The degradation of the surge protection device causes a rise in temperature, the elements of the surge protection device are heated when the temperature rises. A thermal tripping mechanism is heated and tripped, the circuit is then disconnected. The existing Y-shaped layout surge protection device uses two types of thermal tripping mechanisms: an electronic type or a mechanical type. The electronic type thermal tripping mechanism applies a temperature fuse. Although the temperature fuse has high reliability in design, but the abnormal conditions which can be handled by a single temperature fuse are very limited. The temperature fuse may be damaged and malfunctioned due to some unexpected reasons such as aging failure, then the circuit cannot be disconnected in time when elements of the surge protection component is in thermal failure. Therefore, the overall reliability of the temperature fuse is low. Further, the temperature fuse has a high welding difficulty. An ordinary welding mode may cause the temperature fuse to be accidentally fused, so that only a local welding mode such as laser welding can be adopted. As to the mechanical type thermal tripping mechanism, pins of a plurality of surge protection elements are welded together through a low melting point alloy. The number of the welding spots can be one or multiple. If one welding spot is adopted, pins of the two pressure-sensitive resistors and the pin of one discharge tube are welded at one spot, the welding difficulty is high, and it is easy to cause a "wire drawing" during a tripping process. If multiple welding spots are adopted, it is not easy to concentrate heat and the tripping performance is not stable.

SUMMARY

[0005] The present invention provides a surge protection device and a thermal tripping mechanism thereof. A Y-shaped internal layout of the surge protection device can be easily and stably realized. A common-mode protection and a differential-mode protection can be both realized.

[0006] According to an embodiment of the present invention, a thermal tripping mechanism of a surge protection device is provided. The thermal tripping mechanism comprises an elastic mechanism. Two first protection components and one second protection component form a Y-shaped layout, the two first protection components are directly or indirectly connected with the second protection component by using a thermal fusing material. The elastic mechanism comprises an elastic element and a sliding element, the elastic element drives the sliding element to move by an elastic force. When the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature, the two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state. When at least one of the first protection components is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic element releases energy for driving the sliding element to move, and the sliding element moves to cut off the conductive path.

[0007] According to an embodiment, the two first protection components are connected with the second protection component through a connection piece. The connection piece comprises a conductive material, a first end of the connection piece is provided with two branched first connection grooves, the two first connection grooves are connected with pins of the two first protection components respectively. A second end of the connection piece is provided with a second connection groove, the second connection groove is connected with a pin of the second protection component. The connection piece is

connected with at least one of the first protection component and the second protection component through a thermal fusing material. The sliding element is a sliding block, the sliding block is connected with the connection piece, the elastic element drives the sliding block to move by an elastic force.

[0008] According to an embodiment, the connection piece is elongated. The first end of the connection piece is provided with a branch portion which extends laterally. Two semicircular first connection grooves are formed on the branch portion. The second end of the connection piece is provided with a circular second connection groove. A sliding block hole is formed between the first connection groove and the second connection groove. The elastic element is a spring, one end of the spring is fixed on a shell of the surge protection device, the other end of the spring is fixed on the sliding block, and the spring is energy-stored. The sliding block moves along a sliding chute in the shell of the surge protection device, the sliding block is provided with a protrusion, the protrusion is placed in the sliding block hole of the connection piece. The spring releases energy and pulls the sliding block to drive the connection piece to move.

[0009] According to an embodiment, the sliding element is a sliding component, the sliding component is disposed within the shell of the surge protection device and moves in the shell of the surge protection device. The elastic element is connected with the sliding component, the elastic element drives the sliding component to move by an elastic force. Pins of the two first protection components and the second protection component are connected through a thermal fusing material. The two first protection components are fixedly assembled in the shell of the surge protection device, the second protection component is assembled on the sliding component and moves along with the sliding component.

[0010] According to an embodiment, the elastic element is a spring, one end of the spring is fixed within the shell of the surge protection device, the other end of the spring is fixed on the sliding component, the spring is energy-stored. A sliding groove is formed in the shell, the sliding component moves along the sliding groove. The spring releases energy and pushes the sliding component to drive the second protection component to move.

[0011] According to an embodiment, a surge protection device is provided, the surge protection device comprises a shell, first protection components, a second protection component and an elastic mechanism. A pin opening and a signal opening are provided in the outer contour of the shell. Two first protection components and one second protection component form a Y-shaped layout. A first pin of the first protection component and a first pin of the second protection component are connected with insertion pins, the insertion pins extend outside the shell through the pin opening. A second pin of the first protection component and a second pin of the second protection component are directly or indirectly by using a thermal fusing material. The elastic mechanism comprises an elastic element and a sliding element, the elastic element driving the sliding element to move by an elastic force. When the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature, the two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state. When at least one of the first protection components is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic element releases energy for driving the sliding element to move, and the sliding element moves to cut off the conductive path.

[0012] According to an embodiment, the two first protection components are connected with the second protection component through a connection piece. The connection piece comprises a conductive material and the connection piece is elongated, a first end of the connection piece is provided with a branch portion which extends laterally. Two semicircular first connection grooves are formed on the branch portion, the two first connection grooves are connected with pins of the two first protection components respectively. A second end of the connection piece is provided with a circular second connection groove, the second connection groove is connected with a pin of the second protection component. A sliding block hole is formed between the first connection groove and the second connection groove. The connection piece connected with at least one of the first protection component and the second protection component through a thermal fusing material. The elastic element is a spring and the sliding element is a sliding block, the sliding block moves along a sliding chute in the shell of the surge protection device. The sliding block is provided with a protrusion, the protrusion is placed in the sliding block hole of the connection piece. One end of the spring is fixed on a shell of the surge protection device, the other end of the spring is fixed on the sliding block. The spring is energy-stored. When the spring releases energy, the spring pulls the sliding block to drive the connection piece to move.

[0013] According to an embodiment, the sliding element is a sliding component, the sliding component is disposed within the shell of the surge protection device, a sliding chute is provided in the shell and the sliding component moves along the sliding chute. The elastic element is connected with the sliding component, the elastic element is a spring, one end of the spring is fixed within the shell of the surge protection device, the other end of the spring is fixed on the sliding component. Pins of the two first protection components and the second protection component are connected through a thermal fusing material. The two first protection components are fixedly assembled in the shell of the surge protection device, the second protection component is assembled on the sliding component and moves along with the sliding component. The spring is energy-stored, and when the spring releases energy, the spring pushes the sliding

component to drive the second protection component to move.

[0014] According to an embodiment, the surge protection device further comprises an indication component assembled on the shell, the indication component and the sliding element form a linkage mechanism. An indication window is formed in the outer contour of the shell, the indication component is assembled at a position corresponding to the indication window. When the sliding element is not driven by the elastic element, the indication component covers the indication window, when the sliding element is driven by the elastic element, the indication component moves away from the indication window.

[0015] According to an embodiment, a dovetail groove is formed in the bottom of the shell, the dovetail groove is gradually narrowed from top to bottom. The surge protection device is assembled in an U-shaped groove in a base, the U-shaped groove is provided with a positioning block matched with the dovetail groove. The positioning block comprises a rod portion and an end portion, the end portion is larger than the rod portion, and the end portion forms an inclined guide surface with arc surfaces on both ends.

[0016] The surge protection device of the present invention achieves a reliable and feasible Y-shaped layout of internal components through its thermal tripping mechanism, so that a III-type surge protection device can achieve common-mode protection and differential-mode protection at a same time. The thermal tripping mechanism makes all the pins of the surge protection element as close as possible under a premise of ensuring the welding stability. Therefore, the temperature is more concentrated and the product can be tripped more easily.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] 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 illustrates a structure diagram of a surge protection device according to a first embodiment of the present invention.

FIG. 2A and FIG. 2B illustrate structure diagrams of connection pieces according to different embodiments of the present invention.

FIG. 3 illustrates a structure diagram of a thermal tripping mechanism of a surge protection device according to a first embodiment of the present invention.

FIG. 4A and FIG. 4B illustrate structure diagrams of a surge protection device in a normal working position and a disconnection position according to the first embodiment of the present invention. FIG. 4A and FIG. 4B illustrate the structure of the surge protection device from the other side shown in FIG. 1.

FIG. 5A and FIG. 5B illustrate structure diagrams of a surge protection device according to a second embodiment of the present invention from different perspectives. The surge protection device shown in FIG. 5A and FIG. 5B is in an untripped state.

FIG. 6 illustrates a structure diagram of a surge protection device according to a second embodiment of the present invention. The surge protection device shown in FIG. 6 is in a tripping state.

FIG. 7 is a schematic structural diagram of a surge protection device according to a second embodiment of the present invention matching with a base.

FIG. 8 illustrates an enlarged view of a dovetail groove and a positioning block when the surge protection device according to a second embodiment of the present invention is matched with a base.

DETAILED DESCRIPTION OF EMBODIMENTS

[0018] Firstly, the term "connect" used in this specification is described herein. The specification relates to a mechanical and electrical structure, therefore, the term "connect" comprises two meanings of mechanical connection and electrical connection. A mechanical connection shall meet requirements of mechanical strength and mechanical operation, and an electrical connection shall meet requirements of electrical conduction. For a skilled person in the art, considering context, it shall be clear that each "connect" used in the specification shall refer to a mechanical connection, an electrical connection or both.

[0019] Referring to FIG. 1, FIG. 4A and FIG. 4B, a surge protection device according to a first embodiment is disclosed. FIG. 1, FIG. 4A and FIG. 4B illustrate the structure of the surge protection device according to the first embodiment from different perspectives. The surge protection device comprises: a shell, first protection components, a second protection component, a connection piece and an elastic mechanism.

[0020] According to an embodiment, the shell is formed by assembling a plurality of shell components. According to the illustrated embodiment, the shell is formed by assembling two shell components: an exterior component 109 and an interior component 102. Due to the fact that various elements are arranged within the shell, a shell body formed by assembling components enables an easier arrangement of the elements within the shell. Within the shell, an element support is formed by the interior component 102. The element support comprises a partition wall 110 (referring to FIG. 1) and a pin support 114 (referring to FIG. 3 and FIG. 4A). In an outer contour of the shell, openings are formed by the exterior component

109. The openings comprise a pin opening (not numbered) and a signal opening 111 (referring to FIG. 4B). The shell is made of an insulating material, such as plastic.

[0021] Two first protection components 103 and one second protection component 108 are disposed on the element support in the shell. According to an embodiment, the first protection component 103 is a voltage-sensitive resistor. And according to the illustrated embodiment, the first protection component 103 is disc-type voltage-sensitive resistor. The second protection component 108 is a discharge tube. The two voltage-sensitive resistors 103 are respectively assembled on the two sides of the partition wall 110. The partition wall 110 is part of the interior component 102 of the shell. The partition wall 110 is made of an insulating material and is made of the same material as the shell. Each first protection component, namely the voltage-sensitive resistor is provided with two pins. First pins of the two voltage-sensitive resistors are connected with one insertion pin respectively. The insertion pins extend out of the shell through the pin openings in the shell. According to the drawings, the insertion pin which is connected with the first pin of the voltage-sensitive resistor is numbered as 104a. The second protection component, namely the discharge tube 108 is assembled on the element support. The discharge tube is located on one side of the partition wall 110. According to the illustrated embodiment, the discharge tube is located on the side shown in FIG. 4A and FIG. 4B. The second protection component 108, namely the discharge tube is also provided with two pins. A first pin of the voltage-sensitive resistor is also connected with an insertion pin. The insertion pin extends out of the shell through the pin opening in the shell. According to the drawings, the insertion pin which is connected with the first pin of the discharge tube is numbered as 104b.

[0022] The two first protection components 103 are connected with the second protection component 108 through a connection piece 107. FIG. 2A and FIG. 2B illustrate structure diagrams of connection pieces according to different embodiments of the present invention. Although the structures and the shapes of the connection pieces shown in FIG. 2a and FIG. 2b are slightly different, both connection pieces have the following structure: a first end of the connection piece is provided with two branched first connection grooves, which are connected with second pins of the two first protection components respectively; a second end of the connection piece is provided with a second connection groove, which is connected with a second pin of the second protection component. According to the illustrated embodiment, the connection piece 107 is elongated. The first end of the connection piece is provided with a branch portion which extends laterally, two semicircular first connection grooves 116 are formed on the branch portion. The second end of the connection piece is provided with a circular second connection groove 118. A sliding block hole 117 is formed between the first connection groove and the second connection groove. FIG. 3 illustrates a structure diagram of a thermal tripping mechanism of a surge protection device according to a first embodiment of the present invention. As shown in FIG. 3, the second pins 112 of the two first protection components (voltage-sensitive resistors) located on both sides of the partition wall 110 extend downwards. A pin support 114 of the element support is used for positioning the second pin 112. The pin support 114 is in a form of two notches. The two second pins 112 are placed in the notches and the notches are used for fixing the positions of the two second pins 112. A spacing space 113 is formed between the two second pins 112. The spacing space 113 is used for accommodating the body of the connection piece 107. The two first connection grooves 116 on the connection piece are in contact with the two second pins 112. The semicircular first connection groove 116 just surrounds the second pin 112. According to the illustrated embodiment, the two first connection grooves 116 of the connecting piece are connected with the second pins 112 by using a thermal fusing material. According to an embodiment, the thermal fusing material is low temperature solder. The second pin 112 is welded in the first connection groove 116 through the low-temperature solder. The second pin of the second protection component 108 (discharge tube) is placed into the second connection groove 118. The connection between the second pin of the second protection component 108 and the second connection groove 118 is not required to be welded, only common electrical connection is required.

[0023] As shown in FIG. 4A and FIG. 4B, the surge protection device further comprises an elastic mechanism. The elastic mechanism comprises an elastic element 105 and a sliding element 106. The elastic mechanism is arranged on one side of the partition wall 110. According to the illustrated embodiment, the elastic mechanism and second protection component 108 (the discharge tube) are located on the same side, which is the side shown in FIG. 4A and FIG. 4B. The elastic element 105 is a spring, one end of the spring 105 is fixed on the shell. According to the illustrated embodiment, a protruding portion is provided on the interior component 102 for fixing one end of the spring. The other end of the spring 105 is fixed on the sliding component 106. The spring is in an energy storage state when the surge protection device works normally. The spring releases energy when tripping is needed. According to the illustrated embodiment, the spring 105 is stretched to store energy when the surge protection device works normally. A sliding chute is formed on the interior component 102 of the shell. The sliding block 106 moves along a sliding chute. The sliding block 106 is provided with a protrusion, which is placed in the sliding block hole 117 of the connection piece. When the spring 105 is retracted to release energy, the spring 105 pulls the sliding block 106, the sliding block 106 drives the connection piece 107 to move together through the coordination of the protrusion and the sliding

block hole 117.

[0024] FIG. 4A and FIG. 4B illustrate structure diagrams of a surge protection device in a normal working position and a disconnection position respectively. During normal operation, no surge voltage exists in the circuit, so that the two voltage-sensitive resistors (the first protection components) are at normal working temperature and low-temperature solder (the thermal fusing material) is in solid state. A pin of the voltage-sensitive resistor and the first connection groove of the connection piece are connected together by the solid low-temperature solder. The spring is in a stretched state for energy storage, as shown in FIG. 4A. The pin, the voltage-sensitive resistor, the connection piece, the discharging tube and the insertion pin form an electrical path at this moment. When surge voltage occurs in the circuit, if one or both of the voltage-sensitive resistors (the first protection component) is degraded, a leakage current will increase and the temperature will rise continuously. Or when an overvoltage exceeds the expected value, the voltage-sensitive resistor and the discharge tube will be broken down and short circuit will occur, which may cause the temperature to rise sharply. The temperature rises and heats the low-temperature solder, so that the solder is melted. At this moment, the spring is not subjected to external force, and will retract under the elastic force of the spring itself. The spring drives the sliding block to move along the sliding chute, and further drives the connection piece to move. The second pin of the voltage-sensitive resistor is separated from the first connection groove of the connection piece after the connection piece moves. Then the electrical path is cut off and tripping is realized, as shown in FIG. 4B. Continue with FIG. 4B, the second pin of the discharge tube will have a certain deformation after moving along with the connection piece, so that it requires that the second pin of the discharge tube have certain toughness. Further continue with FIG. 4B, after the sliding block 106 moves, the signal opening 111 which is originally shielded by the sliding block 106 is in an open state. According to an embodiment, the signal opening 111 matches with an alarm device on the base, when the signal opening 111 is opened, the alarm device will give an alarm to inform a tripping situation.

[0025] According to the above description of the tripping process, the requirements for the material of the connection piece 107 are as follows: the connection piece 107 shall be made of conductive material, such as metal. For example, the connection piece 107 itself is made of metal. Or the connection element 107 comprises conductive material, the conductive material is disposed along the connection piece 107 and forms a conductive path between the first connection groove 116 and the second connection groove 118, so that the first protection component and the second protection component will form a conducting path when being connected with the connection piece. For example, the connection piece 107 is a circuit board containing conductive paths. The material of the connection piece is preferably heat-gathered, and the heat accumulation is beneficial to fusing of the thermal fusing material. Under the condition that other design requirements are met, the volume of the connection piece 107 shall be as small as possible, so that heat dissipation can be reduced and heat accumulation can be facilitated.

[0026] It should be understood that, although in the embodiment described above, the connection piece 107 is connected with the first protection component 103 through a thermal fusing material, while the connection piece 107 is connected with the second protection component in a common connection. The connection piece 107 can also be connected with the second protection component 108 through a thermal fusing material. In an actual application, it requires that the connection piece shall connect with at least one of the first protection component and the second protection component through a thermal fusing material.

[0027] Meanwhile, according to the above embodiment, when tripping operation is carried out, the second pin of the first protection component 103 will receive a pulling force. In order to prevent the pin from being damaged, the second pin is required to have a certain mechanical strength. Under the condition that other design requirements are met, the length of the second pin of the first protection component shall be as short as possible so as to increase the mechanical strength. The second pin of the second protection component will deform along with the movement of the connection piece, so that it requires that the second pin of the second protection component shall have enough toughness. It requires that the second pin can deform within the range of movement of the connection piece without affecting the electrical function of the second pin.

[0028] Continue with FIG. 4A and FIG. 4B, the surge protection device further comprises an indication component 101. The indication component 101 is assembled on the shell. According to the illustrated embodiment, the indication component 101 is strip-shaped and is an indication strip. An indication window 115 is formed on the outer contour of the shell, that is, on the exterior component 109. The indication component 101 is assembled at a position corresponding to the indication window 115. The indication component 101 and the sliding block 106 form a linkage mechanism. When the sliding block 106 is not pulled by the spring 105, the indication component 101 covers the indication window 115, as shown in FIG. 4A. When the sliding block 106 is pulled by the spring 105, the indication component 101 is moved away from the indication window 105, as shown in FIG. 4B. According to an embodiment, the indication component and the indication window are coated with different colors so as to indicate different states. For example, the indication component may be coated with green, and in a normal working state, the indication window is covered by the indication component and only the green indication component can be observed, which indicates that the working

state is normal. In the tripping state, the sliding block moves and the indication component linked with the sliding block also moves. The indication component is moved away from the indication window, and the indication window is exposed. The indication window may be coated with red. If a red indication window is observed, it means that the working state is abnormal and is in the tripping state.

[0029] Although the above embodiment is described in combination of a surge protection device with the above structure, it should be understood by those skilled in the art that the thermal tripping mechanism can be applied to surge protection devices with other structures. The thermal tripping mechanism should be understood to have the following design:

[0030] A thermal tripping mechanism of a surge protection device comprises a connection piece and an elastic mechanism.

[0031] Two first protection components and one second protection component form a Y-shaped layout. The two first protection components are connected with the second protection component through the connection piece.

[0032] The elastic mechanism comprises an elastic element and a sliding element. The elastic element drives the sliding element to move by an elastic force.

[0033] The connection piece comprises a conductive material, a first end of the connection piece is provided with two branched first connection grooves. The two first connection grooves are connected with pins of the two first protection components respectively. A second end of the connection piece is provided with a second connection groove. The second connection groove is connected with a pin of the second protection component. The connection piece is connected with at least one of the first protection component and the second protection component through a thermal fusing material.

[0034] The elastic mechanism comprises an elastic element and a sliding block, element. The sliding block is connected with the connection piece, the elastic element drives the sliding block to move by an elastic force.

[0035] When the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature. The two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state. When at least one of the first protection components is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic element releases energy for driving the sliding element to move, and the sliding element moves to cut off the conductive path.

[0036] The connection piece is elongated, the first end of the connection piece is provided with a branch portion which extends laterally, two semicircular first connection grooves are formed on the branch portion. The second end of the connection piece is provided with a circular second connection groove, a sliding block hole is formed between the first connection groove and the second connection groove.

[0037] The elastic element is a spring, one end of the spring is fixed on a shell of the surge protection device, the other end of the spring is fixed on the sliding block, and the spring is energy-stored. The sliding component moves along the sliding groove in the shell. The sliding block is provided with a protrusion, which is placed in the sliding block hole of the connection piece. When the spring is retracted to release energy, the spring pulls the sliding block to drive the connection piece to move.

[0038] The surge protection device according to the embodiment achieves a reliable and feasible Y-shaped layout of internal components through its thermal tripping mechanism, so that a III-type surge protection device can achieve common-mode protection and differential-mode protection at a same time. The thermal tripping mechanism uses a connection piece as auxiliary and makes all the pins of the surge protection element as close as possible under a premise of ensuring the welding stability. Therefore, the temperature is more concentrated and the product can be tripped more easily.

[0039] Referring to FIG. 5A and FIG. 5B, a surge protection device according to a second embodiment is disclosed. FIG. 5A and FIG. 5B illustrate structure diagrams of a surge protection device from different perspectives. The surge protection device comprises: a shell, first protection components, a second protection component, a sliding component and an elastic mechanism.

[0040] An element support is formed within the shell 201, the element support comprises a partition wall for separating the two first protection components (the voltage-sensitive resistors). Openings are formed in the outer contour of the shell. The openings comprise a pin opening (not numbered) and a signal opening 213 (referring to FIG. 6). The shell is made of an insulating material, such as plastic.

[0041] Two first protection components 203 and one second protection component 204 are disposed on the element support in the shell. According to an embodiment, the first protection component 203 is a voltage-sensitive resistor. And according to the illustrated embodiment, the first protection component 203 is a disc-type voltage-sensitive resistor. The second protection component 204 is a discharge tube. The two voltage-sensitive resistors 203 are respectively assembled on the two sides of the partition wall. The partition wall is part of the shell. The partition wall is made of an insulating material and is made of the same material as that of the shell. Each first protection component, namely the voltage-sensitive resistor is provided with two pins. First pins of the two voltage-sensitive resistors are connected with one insertion pin respectively. The insertion pins extend out of the shell through the pin openings in the shell. According to the drawings, the insertion pin which is connected with the first pin of the voltage-sensitive resistor is numbered as 214a. The second protection component, namely the discharge tube 204 is assembled on the slid-

ing component. The sliding component is assembled beneath the element support and the first protection component, which will be described in detail below. The second protection component 204, namely the discharge tube is also provided with two pins. A first pin of the voltage-sensitive resistor is also connected with an insertion pin. The insertion pin extends out of the shell through the pin opening in the shell. According to the drawings, the insertion pin, which is connected with the first pin of the discharge tube, is numbered as 214b.

[0042] The sliding component 202 is assembled within the shell 201 and moves in the shell. The second protection component 204 (the discharging tube) is assembled on the sliding component 202 and moves along with the sliding component. According to the illustrated embodiment, a sliding chute is provided in the shell 201 and the sliding component 202 moves along the sliding chute. The chute is located beneath the element support and the two first protection component 203 (the voltage-sensitive resistor), so that the sliding component 202 and the second protection 204 (the discharging tube) are also located beneath the voltage-sensitive resistor. The second pin 208 of the second protection component 204 extends upwards. The elastic element 205 is connected with the sliding component 202, the elastic element 205 drives the sliding component 202 to move by an elastic force. According to the illustrated embodiment, the elastic element 205 is a spring. One end of the spring is fixed on a shell 201, the other end of the spring is fixed on the sliding component 202. The spring is energy-stored; when the spring releases energy, the spring pulls the sliding block to drive the connection piece to move. The spring is in an energy storage state when the surge protection device works normally. The spring releases energy when tripping is needed. According to the illustrated embodiment, the spring 205 is compressed to store energy when the surge protection device works normally. When the spring 205 is released to release energy, the spring 205 pushes the sliding component 202, the sliding component 202 drives the second protection component 204 to move together.

[0043] Continue with FIG. 5A and FIG. 5B, second pins 207 of the two first protection components 203 (voltage-sensitive resistors) are bent. A transverse portion of the second pin 207 forms a transverse spacing structure. The transverse spacing structure means that the two second pins 207 are bent from a vertical direction to a horizontal direction, and a gap is reserved between the two second pins 207.A second pin 208 of the second protection component 204 (the discharge tube) is placed in the middle of the transverse spacing structure. In addition, the second pin of the discharge tube and the second pin of the voltage-sensitive resistor are welded together through a thermal fusing material. According to an embodiment, the thermal fusing material is a low melting point alloy, such as low-temperature solder. The second pin 208 of the second protection component is welded together through a low melting point alloy and the transverse spacing structure formed by two second pins 207 of the first protection component.

[0044] Referring to FIG. 5A, FIG. 5B and FIG. 6, a tripping process of the surge protection device is as follows:

[0045] FIG. 5A and FIG. 5B illustrate structure diagrams of a surge protection device in normal operation state from different perspectives. FIG. 6 illustrates a structure diagram of a surge protection device in a tripping state. During normal operation, no surge voltage exists in the circuit, so that the two voltage-sensitive resistors (the first protection components) are at normal working temperature and low-temperature solder (the thermal fusing material) is in solid state. A pin of the voltage-sensitive resistor and a pin of the discharge tube are connected together by the solid low-temperature solder. The spring is in a compressed state for energy storage, as shown in FIG. 5A and FIG. 5B. The pin, the voltage-sensitive resistor, the discharging tube and the insertion pin form an electrical path at this moment. When one or both of the voltage-sensitive resistors (the first protection component) is degraded, a leakage current will increase and the temperature will rise continuously. Or when an overvoltage exceeds the expected value, the voltage-sensitive resistor and the discharge tube will be broken down and short circuit will occur, which may cause the temperature to rise sharply. The temperature rises and heats the low-temperature solder, so that the solder is melted after reaching fusing temperature. At this moment, the spring is not subjected to external force, and will release under the elastic force of the spring itself. The spring drives the sliding component to move along the sliding chute, and the discharging tube disposed in the sliding component moves together with the sliding component. The second pin of the discharging tube is separated from the second pin of the voltage-sensitive resistor. The electrical path is cut off and tripping is realized, as shown in FIG. 6. Continue with FIG. 6, after the sliding component 202 moves, the signal opening 213, which is originally shielded by the sliding component 202, is in an open state. According to an embodiment, the signal opening 213 matches with an alarm device on the base, when the signal opening 213 is opened, the alarm device will give an alarm to inform a tripping situation.

[0046] Referring to FIG. 7 and FIG. 8, in order to facilitate cooperation of the surge protection device and the base, a structure for matching with the base is further designed on the shell of the surge protection device according to the present invention. FIG. 7 is a schematic structural diagram of a surge protection device according to a second embodiment of the present invention matching with a base. The shell 201 of the surge protection device is assembled in a U-shaped groove in a base 211. A dovetail groove 206 is formed in the bottom of the shell 201, two side walls of the dovetail groove are gradually narrowed from top to bottom, forming inward-retracting inclined surfaces. The U-shaped groove of the base is provided with a positioning block 212 matched with the dovetail groove. FIG. 8 illustrates an enlarged view of a

dovetail groove and a positioning block when the surge protection device according to a second embodiment of the present invention is matched with a base. As shown in FIG. 8, the positioning block 212 comprises a rod portion and an end portion, the end portion is larger than the rod portion, and the end portion forms an inclined guide surface with arc surfaces on both ends. The inclined guide surface of the end portion is matched with the inward-retracting inclined surface of the dovetail groove 206, guiding the shell 201 to be assembled in the U-shaped groove of the base. After the shell 201 is assembled in place, the end of the positioning block 212 clamps the dovetail groove 206, so that the surge protection device is firmly assembled on the base. When the surge protection device needs to be taken out, the positioning block 212 may have a certain deformation, as shown by the dotted lines in FIG. 8. The positioning block 212 will be opened outwards, so that the dovetail groove 206 will be withdrawn from the two positioning blocks 212, so that the surge protection device can be taken down from the base.

[0047] Although the above embodiment is described in combination of a surge protection device with the above structure, it should be understood by those skilled in the art that the thermal tripping mechanism can be applied to surge protection devices with other structures. The thermal tripping mechanism should be understood to have the following design:

[0048] A thermal tripping mechanism of a surge protection device comprises an elastic element and a sliding component;

[0049] The sliding component is disposed within the shell of the surge protection device and moves in the shell of the surge protection device.

[0050] The elastic element is connected with the sliding component, the elastic element drives the sliding element to move by an elastic force.

[0051] Two first protection components and one second protection component form a Y-shaped layout. The two first protection components are connected with the second protection component by using a thermal fusing material.

[0052] The two first protection components are fixedly assembled in the shell of the surge protection device, the second protection component is assembled on the sliding component and moves along with the sliding component.

[0053] When the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature. The two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state. When at least one of the first protection components is in an abnormal working state, the temperature rises, the thermal fusing material reaches the fusing temperature and is fused. The elastic element releases energy and drives the sliding component and the second protection component to move. The conductive path is cut off.

[0054] The elastic element is a spring, one end of the spring is fixed on the shell of the surge protection device, the other end of the spring is fixed on the sliding component. The spring is compressed to store energy. A sliding chute is provided in the shell, the sliding component can slide along the sliding chute. When the spring releases to release energy, the spring pushed the sliding component to drive the second protection component to move.

[0055] The surge protection device according to the second embodiment achieves a reliable and feasible Y-shaped layout of internal components through its thermal tripping mechanism, so that a III-type surge protection device can achieve common-mode protection and differential-mode protection at a same time. A dovetail groove is formed in the bottom of the shell of the surge protection device, and the dovetail groove is matched with a positioning block on the base, so that the surge protection device and the base are reliable in connection and convenient to assemble and disassemble.

[0056] 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 thermal tripping mechanism of a surge protection device, comprising an elastic mechanism;
   two first protection components and one second protection component forming a Y-shaped layout, the two first protection components being directly or indirectly connected with the second protection component by using a thermal fusing material;
   the elastic mechanism comprising an elastic element and a sliding element, the elastic element driving the sliding element to move by an elastic force;
   wherein when the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature, the two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state; when at least one of the first protection components is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic element releases energy for driving the sliding element to move, and the sliding element moves to cut off the conductive path.

2. The thermal tripping mechanism of a surge protection device according to claim 1, wherein the two first

protection components are connected with the second protection component through a connection piece;
the connection piece comprises a conductive material, a first end of the connection piece is provided with two branched first connection grooves, the two first connection grooves are connected with pins of the two first protection components respectively, a second end of the connection piece is provided with a second connection groove, the second connection groove is connected with a pin of the second protection component, wherein the connection piece is connected with at least one of the first protection component and the second protection component through a thermal fusing material;
wherein the sliding element is a sliding block, the sliding block is connected with the connection piece, the elastic element drives the sliding block to move by an elastic force.

3. The thermal tripping mechanism of a surge protection device according to claim 2, wherein
the connection piece is elongated, the first end of the connection piece is provided with a branch portion which extends laterally, two semicircular first connection grooves are formed on the branch portion, the second end of the connection piece is provided with a circular second connection groove, a sliding block hole is formed between the first connection groove and the second connection groove;
the elastic element is a spring, one end of the spring is fixed on a shell of the surge protection device, the other end of the spring is fixed on the sliding block, and the spring is energy-stored;
the sliding block moves along a sliding chute in the shell of the surge protection device, the sliding block is provided with a protrusion, the protrusion is placed in the sliding block hole of the connection piece;
the spring releases energy and pulls the sliding block to drive the connection piece to move.

4. The thermal tripping mechanism of a surge protection device according to claim 1, wherein
the sliding element is a sliding component, the sliding component is disposed within the shell of the surge protection device and moves in the shell of the surge protection device;
the elastic element is connected with the sliding component, the elastic element drives the sliding component to move by an elastic force;
pins of the two first protection components and the second protection component are connected through a thermal fusing material;
the two first protection components are fixed assembled in the shell of the surge protection device, the second protection component is assembled on the sliding component and moves along with the sliding component.

5. The thermal tripping mechanism of a surge protection device according to claim 4, wherein
the elastic element is a spring, one end of the spring is fixed within the shell of the surge protection device, the other end of the spring is fixed on the sliding component, the spring is energy-stored;
a sliding groove is formed in the shell, the sliding component moves along the sliding groove;
the spring releases energy and pushes the sliding component to drive the second protection component to move.

6. A surge protection device, comprising:

a shell, wherein a pin opening and a signal opening are provided in the outer contour of the shell;
two first protection components and one second protection component forming a Y-shaped layout, wherein a first pin of the first protection component and a first pin of the second protection component are connected with insertion pins, the insertion pins extend outside the shell through the pin opening, a second pin of the first protection component and a second pin of the second protection component are directly or indirectly by using a thermal fusing material;
an elastic mechanism comprising an elastic element and a sliding element, the elastic element driving the sliding element to move by an elastic force;
wherein when the two first protection components are both in a normal working state, the thermal fusing material does not reach a fusing temperature, the two first protection components and the second protection component form a conductive path, and the elastic element is in an energy storage state; when at least one of the first protection components is in an abnormal working state, the thermal fusing material reaches the fusing temperature and is fused, the elastic element releases energy for driving the sliding element to move, and the sliding element moves to cut off the conductive path.

7. The surge protection device according to claim 6, wherein
the two first protection components are connected with the second protection component through a connection piece;
the connection piece comprises a conductive material and the connection piece is elongated, a first end of the connection piece is provided with a branch portion which extends laterally, two semicircular first connection grooves are formed on the branch portion, the two first connection grooves are connected with pins of the two first protection components respectively, a second end of the connection piece is provided with a circular second connection groove,

the second connection groove is connected with a pin of the second protection component, a sliding block hole is formed between the first connection groove and the second connection groove, wherein the connection piece connected with at least one of the first protection component and the second protection component through a thermal fusing material; the elastic element is a spring and the sliding element is a sliding block, the sliding block moves along a sliding chute in the shell of the surge protection device, the sliding block is provided with a protrusion, the protrusion is placed in the sliding block hole of the connection piece; one end of the spring is fixed on a shell of the surge protection device, the other end of the spring is fixed on the sliding block; the spring is energy-stored; when the spring releases energy, the spring pulls the sliding block to drive the connection piece to move.

8. The surge protection device according to claim 6, wherein
the sliding element is a sliding component, the sliding component is disposed within the shell of the surge protection device, a sliding chute is provided in the shell and the sliding component moves along the sliding chute;
the elastic element is connected with the sliding component, the elastic element is a spring, one end of the spring is fixed within the shell of the surge protection device, the other end of the spring is fixed on the sliding component;
pins of the two first protection components and the second protection component are connected through a thermal fusing material;
the two first protection components are fixed assembled in the shell of the surge protection device, the second protection component is assembled on the sliding component and moves along with the sliding component; the spring is energy-stored, and when the spring releases energy, the spring pushes the sliding component to drive the second protection component to move.

9. The surge protection device according to claim 6, further comprising:

an indication component assembled on the shell, the indication component and the sliding element forming a linkage mechanism;
an indication window formed in the outer contour of the shell, the indication component being assembled at a position corresponding to the indication window, wherein when the sliding element is not driven by the elastic element, the indication component covers the indication window, when the sliding element is driven by the elastic element, the indication component moves away from the indication window.

10. The surge protection device according to claim 6, wherein
a dovetail groove is formed in the bottom of the shell, the dovetail groove is gradually narrowed from top to bottom;
the surge protection device is assembled in a U-shaped groove in a base, the U-shaped groove is provided with a positioning block matched with the dovetail groove;
the positioning block comprises a rod portion and an end portion, the end portion is larger than the rod portion, and the end portion forms an inclined guide surface with arc surfaces on both ends.

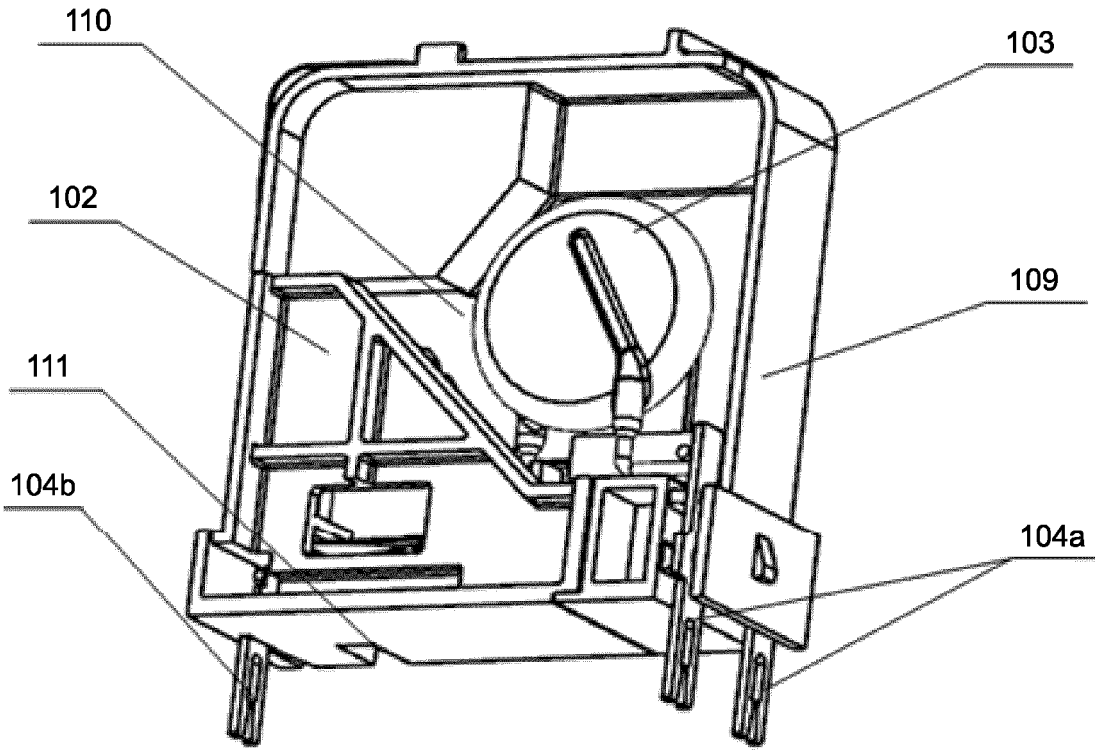

FIG 1

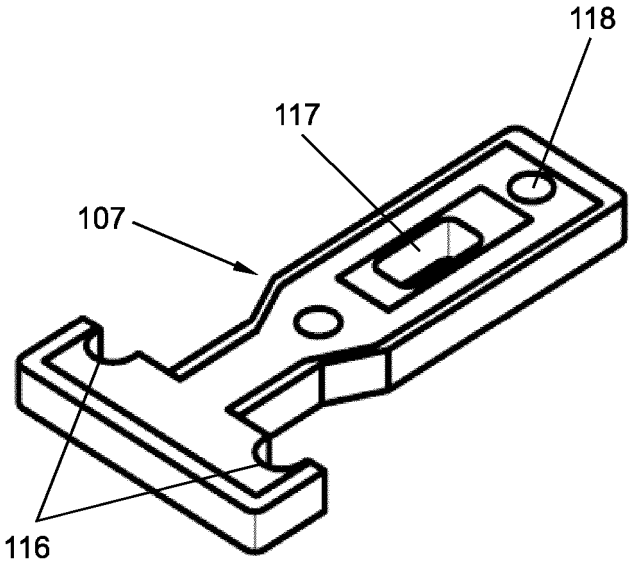

FIG 2A

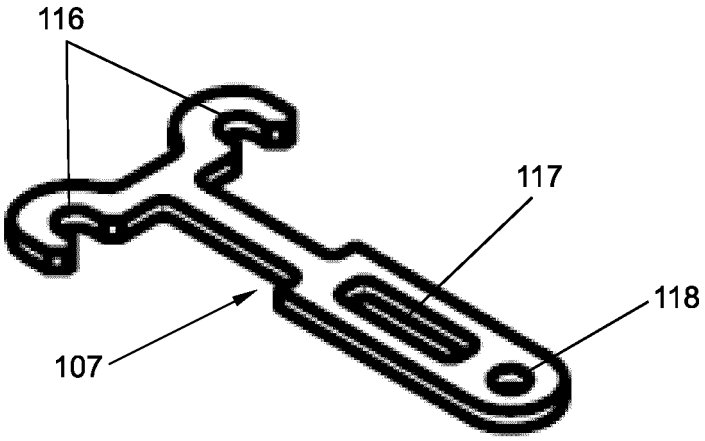

FIG 2B

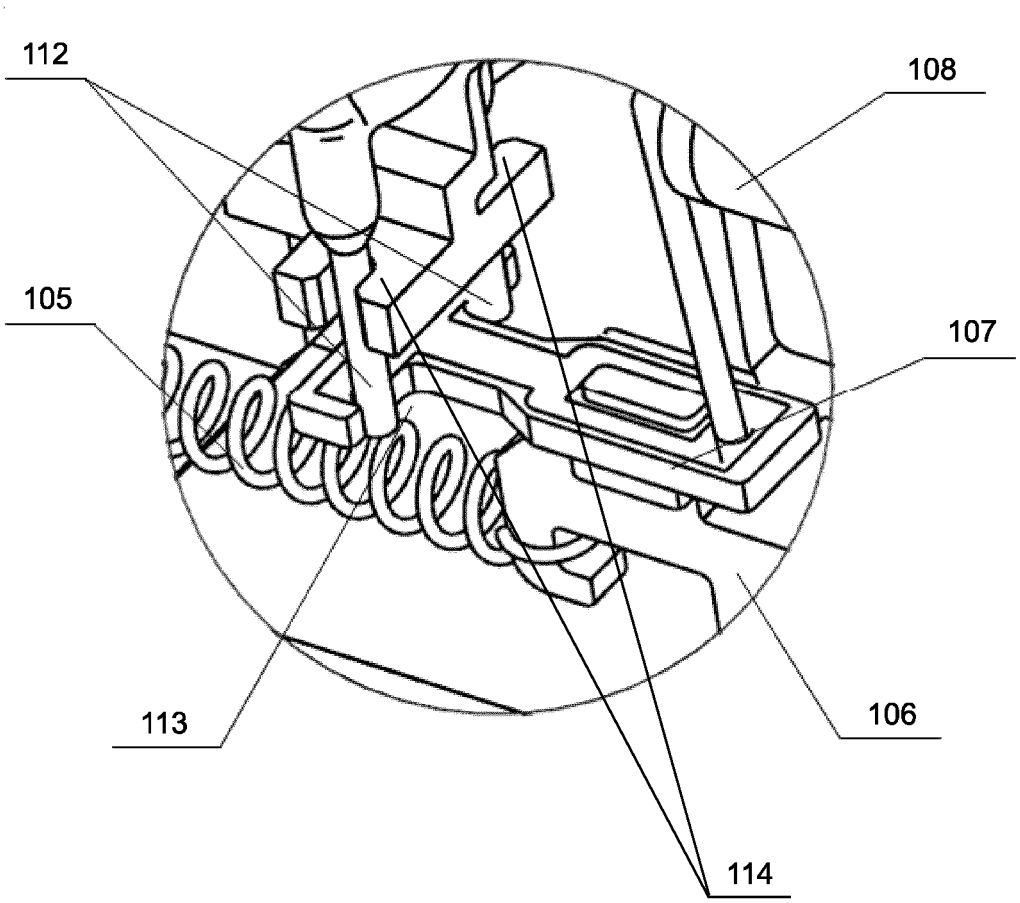

FIG 3

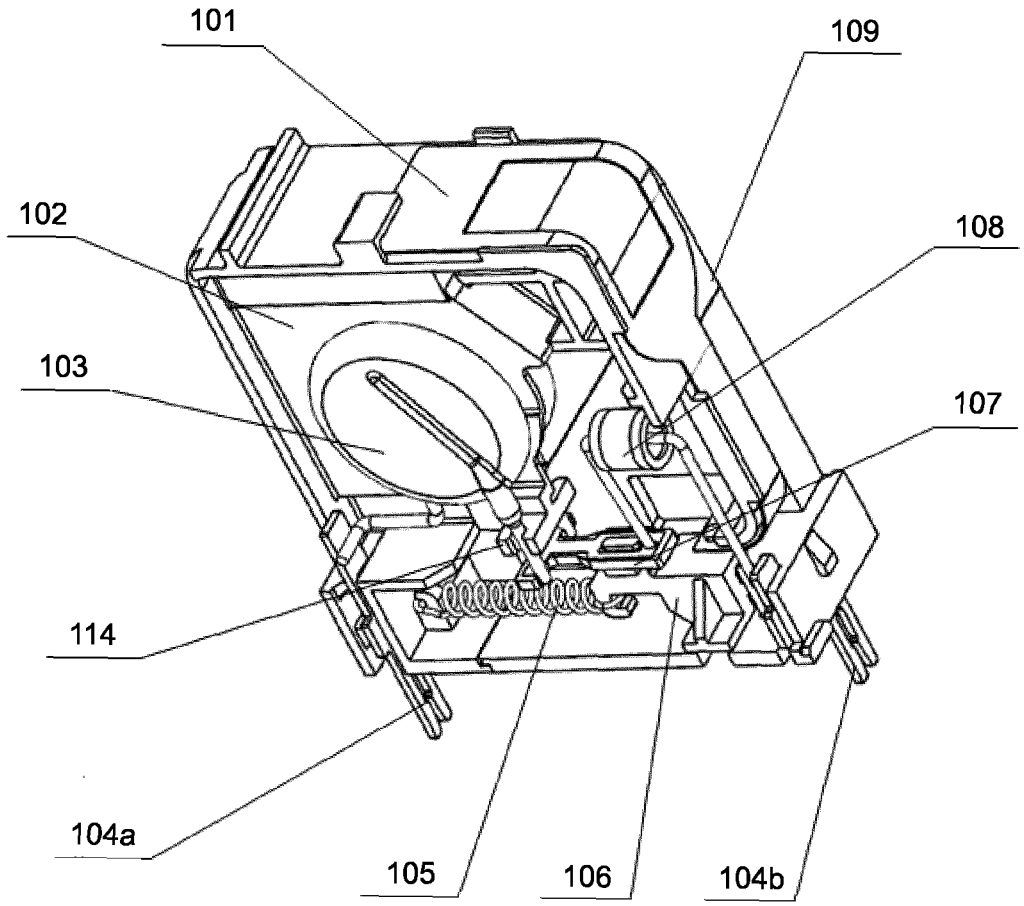

FIG 4A

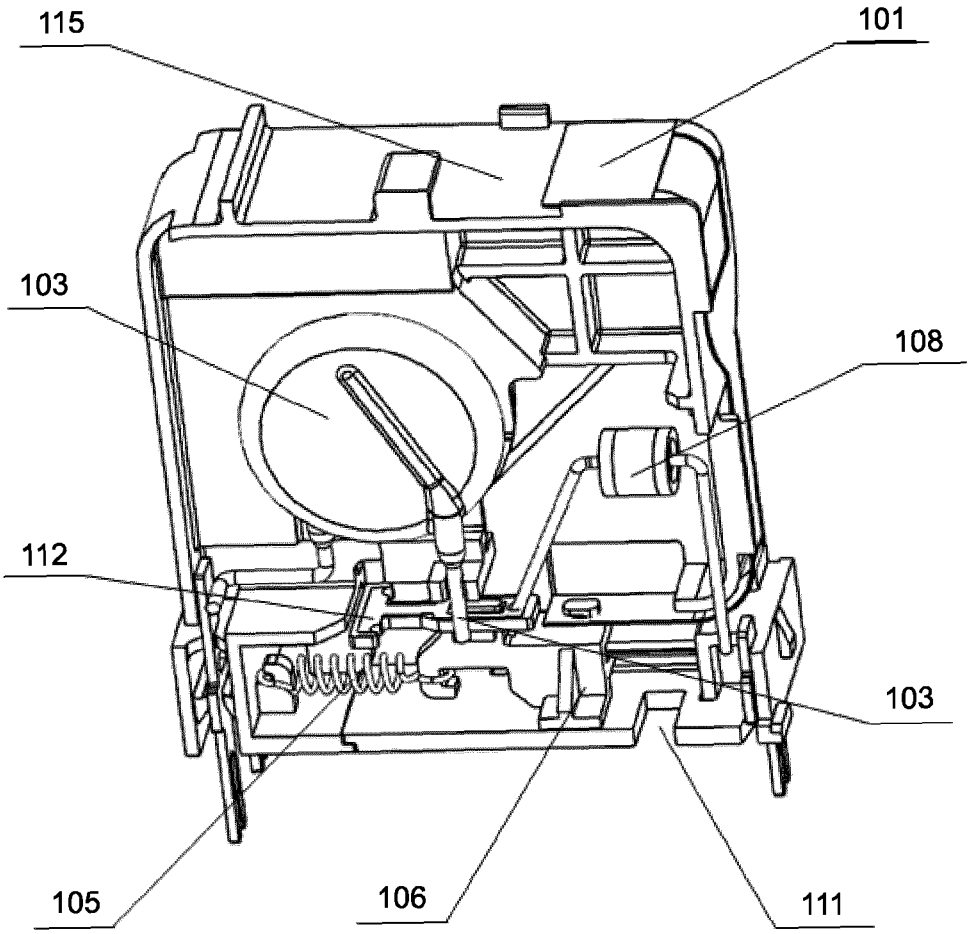

FIG 4B

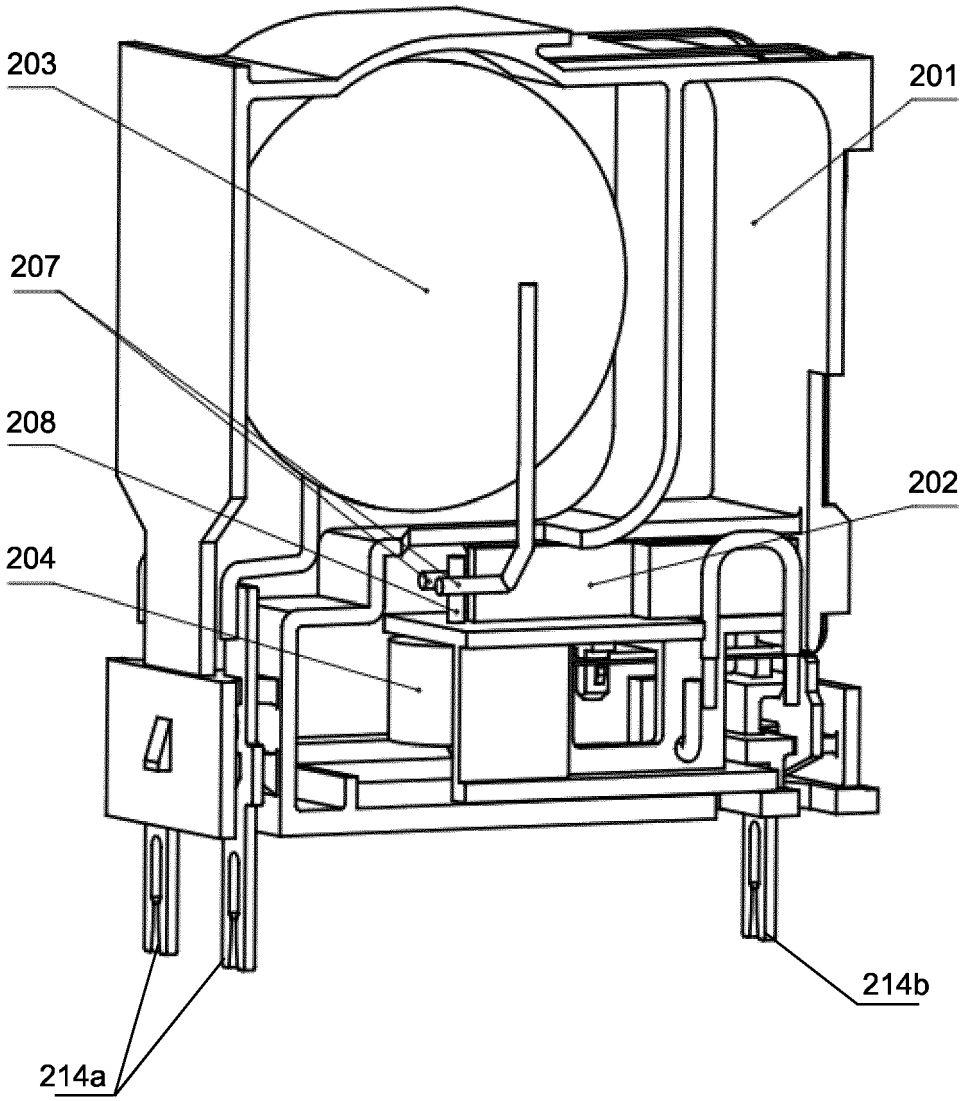

FIG 5A

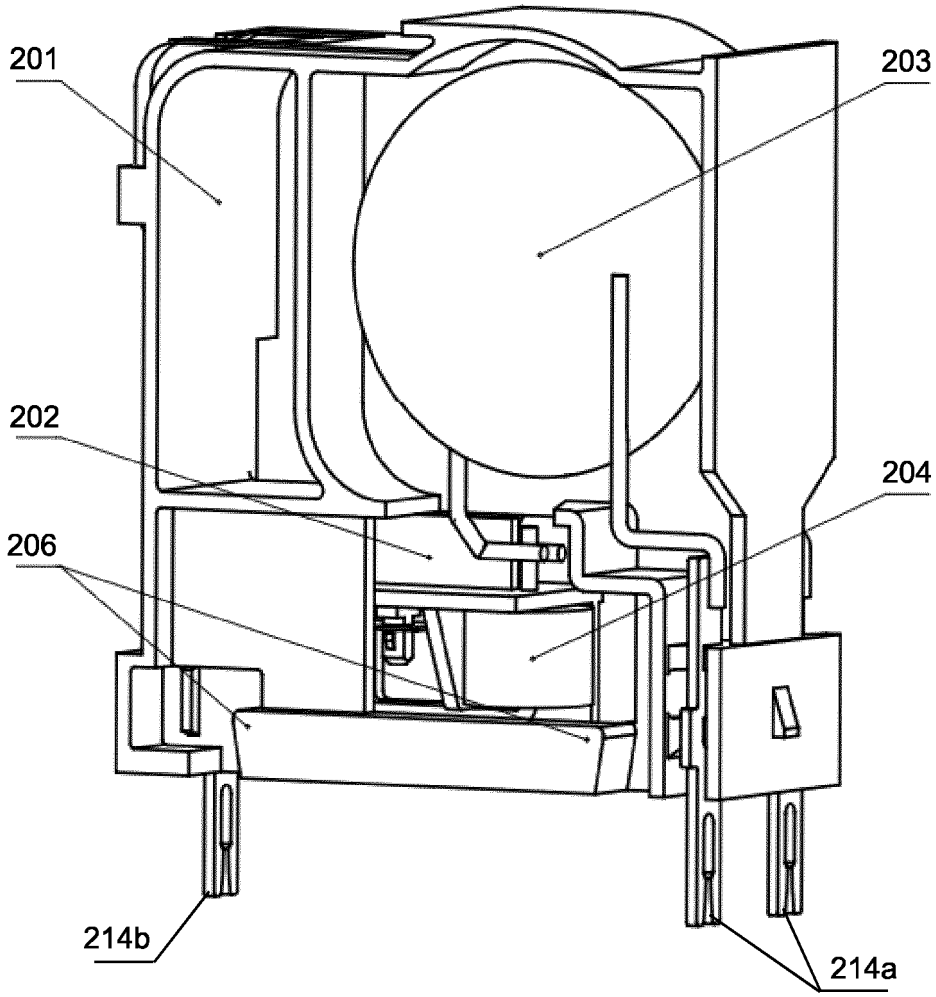

FIG 5B

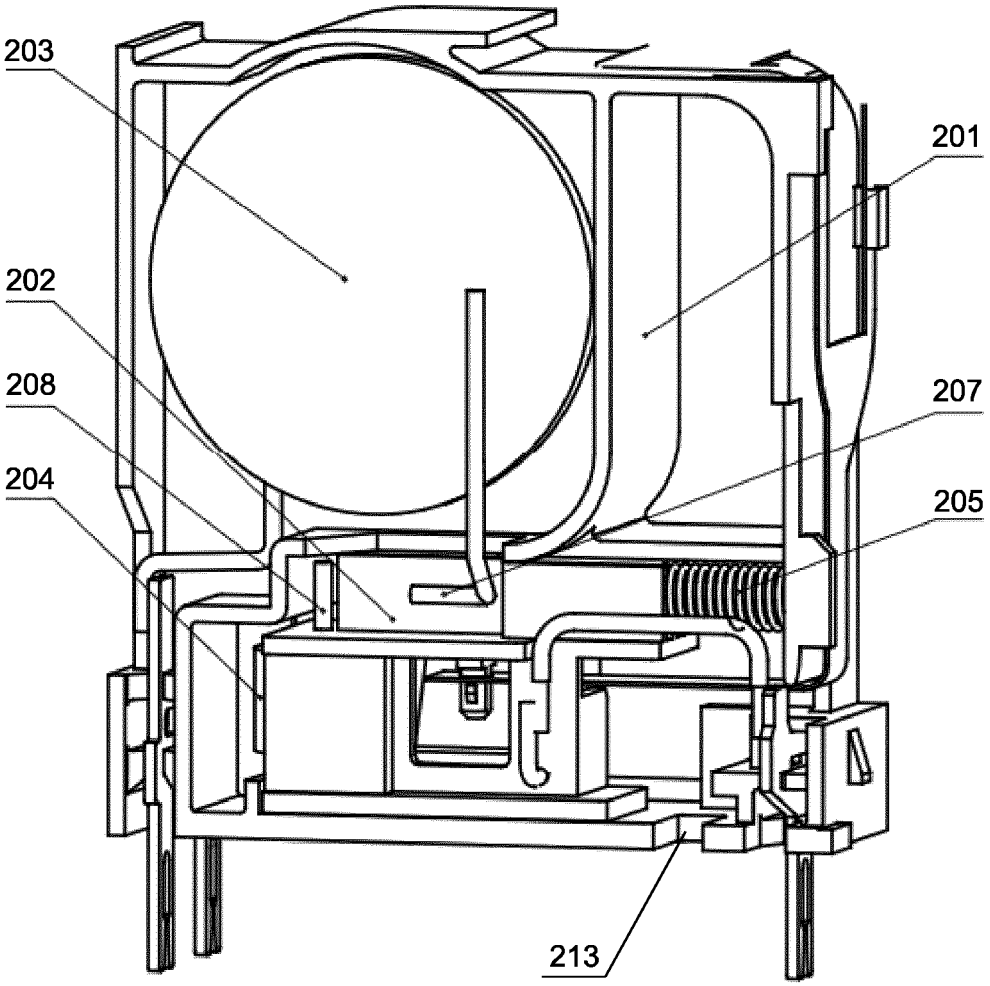

FIG 6

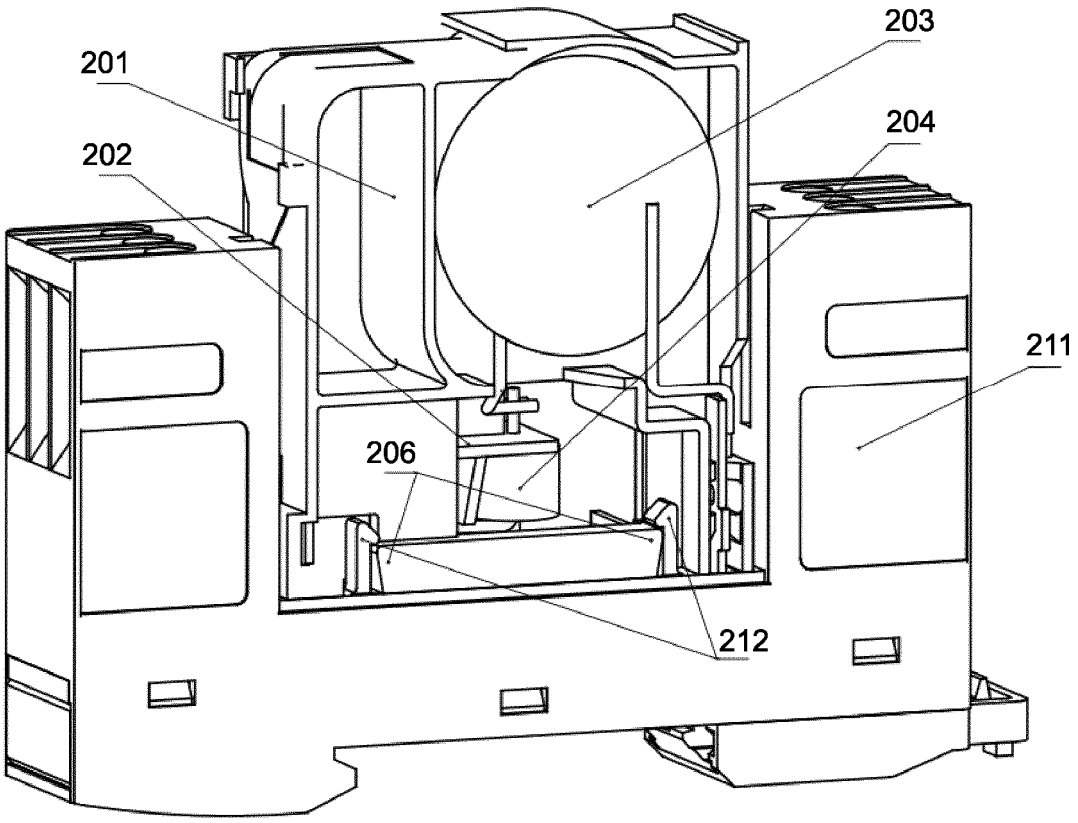

FIG 7

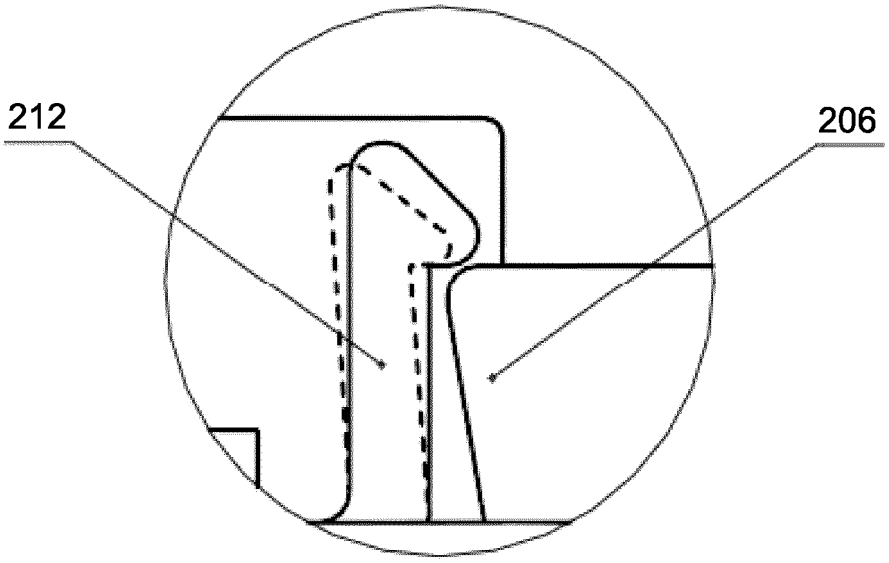

FIG 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/096199

A. CLASSIFICATION OF SUBJECT MATTER

H01H 71/20 (2006.01) i; H01H 71/04 (2006.01) i; H01H 83/10 (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)

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)
CNABS; CNTXT; CNKI; DWPI; SIPOABS: energy storage; surge, thunder, lightning, spring, elastic, fuse, trip, release, store, energy, indicate, show, display, protect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 204257557 U (SEARI ELECTRICAL APPARATUS TECHNOLOGY CO., LTD. et al.), 08 April 2015 (08.04.2015), claims 1-10, description, paragraphs [0022]-[0042], and figures 1-4B	1-10
PX	CN 104392868 A (SEARI ELECTRICAL APPARATUS TECHNOLOGY CO., LTD. et al.), 04 March 2015 (04.03.2015), claims 1-10, description, paragraphs [0026]-[0062], and figures 1-8	1-10
X	CN 203166500 U (PHOENIX CONTACT ASIA-PACIFIC (NANJING) CO., LTD. et al.), 28 August 2013 (28.08.2013), description, paragraphs [0019]-[0024], and figures 1-4	1, 6, 9
A	CN 101908760 A (SUN, Weiwei), 08 December 2010 (08.12.2010), the whole document	1-10
A	US 6430017 B1 (PASS & SEYMOUR INC.), 06 August 2002 (06.08.2002), the whole document	1-10

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"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

"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
01 March 2016 (01.03.2016)	**08 March 2016 (08.03.2016)**
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 **QIN, Chen** Telephone No.: (86-10) **62412169**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/096199

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 204257557 U	08 April 2015	None	
CN 104392868 A	04 March 2015	None	
CN 203166500 U	28 August 2013	None	
CN 101908760 A	08 December 2010	None	
US 6430017 B1	06 August 2002	CA 2244804 A1	10 May 1999
		MX 9809335 A1	01 January 2000

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