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(54) SWITCHING APPLIANCE

(57) The present disclosure relates to a switching appliance including a tripping actuator (100). The tripping actuator (100) includes an elastic lever mechanism and a limiting block (2) and can approach or go away from the elastic lever mechanism. The limiting block (2) laps the elastic lever mechanism by approaching the elastic lever mechanism and keeps it in a state of accumulating elastic potential energy, and releases the elastic lever mechanism by going away from the elastic lever mechanism. The tripping actuator (100) further includes a push rod (7) configured to be ejected out of the tripping actuator (100) by receiving push of the elastic lever mechanism and trigger the tripping mechanism (200). According to the present disclosure, a small motion stroke of the limiting block (2) can trigger a large motion stroke of a lever swinging mechanism, and even if a current flowing through an electromagnetic driving mechanism that drives the limiting block (2) is small and an electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the elastic lever mechanism.

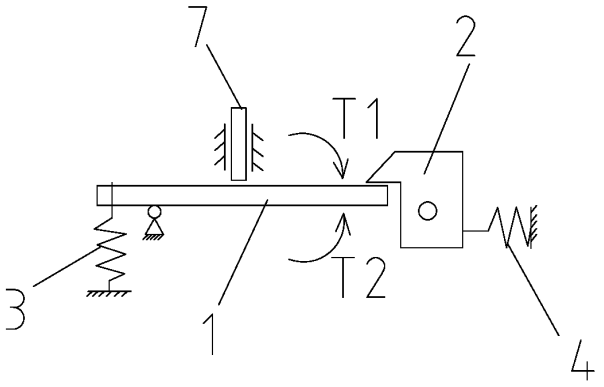

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of switching appliances, in particular to a tripping actuator applied to a switching appliance.

BACKGROUND

[0002] With the popularization of electrical equipment, people have more access to related equipment, and electrical safety is getting more and more attention. In order to effectively prevent damage of residual current to humans and equipment, residual current devices (RCDs) are widely used in important occasions, and the RCDs have residual current protection action characteristics and are independent of power supply voltage. There is a type of residual current devices called electromagnetic RCD, which can be tripped to disconnect a circuit when the residual current does not exceed 100 mA, and does not require any auxiliary power supply. The electromagnetic RCD converts the residual current to a secondary side by using a transformer; an electromagnetic tripping actuator is driven by an output of the secondary side; and in turn the tripping actuator pushes the RCD to trip so as to disconnect the circuit. In the absence of the auxiliary power supply, the residual current input by the transformer is very small, so the current on the secondary side is very small, giving a very low driving power to the electromagnetic tripping actuator. Consequently, the electromagnetic tripping actuator is required to be very sensitive.

[0003] The electromagnetic tripping actuator in the related art includes a yoke, an armature, a push rod, a tension spring, a coil, and a permanent magnet. The armature can rotate on a fulcrum to push the push rod to move upwards. When the electromagnetic tripping actuator is not working, the magnetic flux of the permanent magnet is divided into two parts - one part of the magnetic flux flows through a "permanent magnet short-circuit loop", while another part of the magnetic flux flows through a "permanent magnet working loop", which part of the magnetic flux generates a suction force of the permanent magnet greater than a force of the tension spring, so that the armature is kept in contact with the yoke. When the tripper acts, the coil generates magnetic flux to reduce the magnetic flux of the permanent magnet in the "permanent magnet working loop", and when the suction force of the permanent magnet exerted on the armature is reduced to be less than the force of the tension spring, the armature can move upwards. The electromagnetic tripping actuator in the related art needs to provide a relatively large tripping force (a push-out force of the push rod, usually in a range of 0.2N ~ 5N), but the coil can only input a small amount of energy (usually at the microvolt-ampere level, about 20μVA ~ 1000μVA). Consequently, the above-mentioned magnetic retention technology is adopted to reduce the coil energy using magnetic difference. However, the electromagnetic tripping actuator adopting the magnetic retention technology has two problems. First, the permanent magnet is easily affected by an external magnetic field, resulting in changes in magnetic properties, so that the performance of the tripper deteriorates. Second, the electromagnetic tripping actuator is poorly impact-resistant when not in operation, because the force that keeps the armature in contact with the yoke is mainly derived from a difference between the suction force of the permanent magnet and the force of the tension spring and cannot be too large; otherwise, the coil would also need to increase its input power.

SUMMARY

[0004] Accordingly, directed at the above problems, the present disclosure provides a tripping actuator with optimized structure, and a switching appliance having the tripping actuator.

[0005] The present disclosure is implemented by the following technical solutions.

[0006] A switching appliance according to the present disclosure includes a tripping mechanism and a tripping actuator configured to trigger the tripping mechanism. The tripping actuator includes an elastic lever mechanism and a limiting block. In a lever swinging stroke, the elastic lever mechanism includes a first stroke of accumulating elastic potential energy and a second stroke of releasing the elastic potential energy. The limiting block is configured to approach or go away from the elastic lever mechanism. The limiting block laps the elastic lever mechanism by approaching the elastic lever mechanism and keeps the elastic lever mechanism in a state of accumulating the elastic potential energy; and the limiting block releases the elastic lever mechanism by going away from the elastic lever mechanism. The tripping actuator further includes a push rod slidably arranged on a motion path of the second stroke of the elastic lever mechanism, and the push rod is configured to be ejected out of the tripping actuator by receiving push of the elastic lever mechanism and trigger the tripping mechanism.

[0007] In an embodiment, the elastic lever mechanism includes a rotating rod and an elastic member; and one end of the elastic member acts on the rotating rod, while another end of the elastic member is fixedly arranged.

[0008] In an embodiment, the tripping actuator further includes a driver configured to drive the limiting block to approach or go away from the elastic lever mechanism.

[0009] In an embodiment, the driver is a linear movement driving device or a rotation driving device.

[0010] In an embodiment, the tripping actuator further includes an elastic reset member, and the elastic reset member acts on the limiting block and is configured to reset the limiting block towards the elastic lever mechanism after the limiting block goes away from the elastic lever mechanism.

[0011] In an embodiment, the limiting block is provided with an inclined guide surface, and the inclined guide surface is configured to abut against a rotating rod of the elastic lever mechanism in the first stroke, to allow the rotating rod to pass over the inclined guide surface.

[0012] In an embodiment, the elastic reset member is a tension spring, a compression spring, a torsion spring, or a clockwork.

[0013] In an embodiment, a plane where the limiting block moves is parallel to or coincides with a plane where the elastic lever mechanism moves.

[0014] In an embodiment, a plane where the limiting block moves intersects with a plane where the elastic lever mechanism moves.

[0015] In an embodiment, the switching appliance is a low-voltage switching appliance.

[0016] The present disclosure has the following beneficial effects.

[0017] According to the present disclosure, by locking and releasing the elastic lever mechanism by the limiting block, a small motion stroke of the limiting block can trigger a large motion stroke of the rotating rod, and the limiting block can immediately trigger the rotating rod to quickly eject out the push rod only by moving a short distance. Consequently, even if a current flowing through a coil of an electromagnetic driving mechanism that drives the limiting block is small and an electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the elastic lever mechanism. The present disclosure adopts a mechanical trigger structure, so when the elastic lever mechanism is in a state of being locked by the limiting block, even if there is a large impact from the outside, the elastic lever mechanism will not be released and have strong resistance to vibration and impact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a schematic view of a switching appliance in Embodiment I of the present disclosure.

FIG. 2 is a schematic view of a tripping actuator in Embodiment I of the present disclosure, in which an elastic lever mechanism is limited to an energy-storage state by a limiting block.

FIG. 3 is a schematic view of the tripping actuator in Embodiment I of the present disclosure, in which the limiting block releases the elastic lever mechanism.

FIG. 4 is a schematic view of a tripping actuator of a switching appliance in Embodiment II of the present disclosure.

FIG. 5 is a schematic view of a tripping actuator of a switching appliance in Embodiment III of the present disclosure.

FIG. 6 is a schematic view of a tripping actuator in Embodiment IV of the present disclosure, in which a limiting block locks a rotating rod.

FIG. 7 is a schematic view of the tripping actuator in Embodiment IV of the present disclosure, in which the limiting block releases the rotating rod.

FIG. 8 is a schematic view of a tripping actuator in Embodiment V of the present disclosure, in which an elastic push rod mechanism is limited to an energy-storage state by a limiting block.

FIG. 9 is a schematic view of the tripping actuator in Embodiment V of the present disclosure, in which the limiting block releases the elastic push rod mechanism.

FIG. 10 is a schematic view of the tripping actuator in Embodiment V of the present disclosure, in which a push-pull electromagnet is also shown.

FIG. 11 is a schematic view of a tripping actuator of a switching appliance in Embodiment VI of the present disclosure.

DETAILED DESCRIPTION

[0019] To further elaborate various embodiments, the present disclosure provides accompanying drawings. These accompanying drawings are part of the present disclosure and are mainly used to illustrate the embodiments, and may be combined with relevant descriptions in the specification to explain operation principles of the embodiments. With reference to these contents, a person skilled in the art should understand other possible embodiments and advantages of the present disclosure. Components in the drawings are not drawn to scale, and similar component symbols are generally used to denote similar components.

[0020] The present disclosure will be further described in connection with the accompanying drawings and specific embodiments.

Embodiment I

[0021] Referring to FIG. 1, as a preferred embodiment of the present disclosure, a switching appliance is provided; more specifically, a low-voltage circuit breaker is provided, including a tripping mechanism 200 and a tripping actuator 100 for triggering the tripping mechanism 200. The tripping actuator 100 includes an outer housing and an elastic lever mechanism disposed within the outer housing. As shown in FIGS. 2 and 3, the elastic lever mechanism specifically includes a rotating rod 1 and an elastic member 3. In this embodiment, the outer housing of the tripping actuator 100 serves as a support body; the rotating rod 1 is rotatably connected within the outer housing, and the rotating rod 1 can swing around its fulcrum in a first direction T1 (e.g., a clockwise direction) and a second direction T2 (e.g., a counterclockwise direction), the first direction T1 and the second direction T2 being opposite to each other. The elastic member 3 is a tension spring in this embodiment; and one end of the elastic member 3 acts on the rotating rod 1 while another

end of the elastic member 3 is fixed at a certain point within the outer housing. When the rotating rod 1 swings in the first direction T1, the elastic member 3 is stretched to store energy; conversely, the elastic member 3 can release energy to pull the rotating rod 1 to move in the second direction T2. A stroke of the rotating rod 1 swinging in the first direction T1 is defined as a first stroke of the elastic lever mechanism, and the first stroke enables the elastic lever mechanism to enter a state of accumulating elastic potential energy. A stroke of the rotating rod 1 swinging in the second direction T2 is defined as a second stroke of the elastic lever mechanism, and the second stroke is a swinging stroke of the elastic lever mechanism after the elastic lever mechanism releases the elastic potential energy.

[0022] The tripping actuator 100 further includes a limiting block 2, and in this embodiment, the limiting block 2 is disposed within the outer housing. A driver is drivingly connected to the limiting block 2. For example, in this embodiment, the driver may be a push-pull electromagnet, and an iron core of the push-pull electromagnet is fixedly connected to the limiting block 2, so that the limiting block 2 can be driven to move reciprocally when the iron core moves reciprocally under the action of an electromagnetic force generated by the coil, in which a movement path of the limiting block 2 is configured to be close to or away from the rotating rod 1. As shown in FIG. 2, when approaching the rotating rod 1, the limiting block 2 can lap the limiting rotating rod 1 and keep the elastic lever mechanism in the state of accumulating elastic potential energy. As shown in FIG. 3, when going away from the rotating rod 1, the limiting block 2 can release the elastic lever mechanism, so that the rotating rod 1 rapidly swings in the direction T2.

[0023] The tripping actuator 100 further includes a push rod 7, the push rod 7 is slidably disposed on a motion path along which the elastic lever mechanism performs the second stroke. In this embodiment, the push rod 7 is slidably connected to the outer housing of the tripping actuator 100. When the rotating rod 1 swings in the second direction T2, the rotating rod 1 pushes the push rod 7 to slidably eject out of the outer housing of the tripping actuator 100, and the tripping mechanism 200 is triggered by means of outward ejection of the push rod 7, to implement quick tripping of the switching appliance.

[0024] In this embodiment, by locking and releasing the elastic lever mechanism by the limiting block 2, a small motion stroke of the limiting block 2 can trigger a large motion stroke of the rotating rod 1, and the limiting block 2 can immediately trigger quick ejection of the rotating rod 1 and the push rod 7 only by moving a short distance. Consequently, even if the current flowing through the coil of the push-pull electromagnet is small and the electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the elastic lever mechanism. In addition, the present disclosure adopts a mechanical trigger structure, so when the elastic lever mechanism is in a state of being locked by the limiting block 2, even if there is a large impact from the outside, the elastic lever mechanism will not be released and have strong resistance to vibration and impact.

[0025] The limiting block 2 is movable in this embodiment, and may also be rotatable in other embodiments, as long as the limiting block 2 can kinetically approach or go away from the rotating rod 1. Moreover, in other embodiments, the driver may also adopt other rotation driving devices or movement driving devices, such as motors, cylinder and other forms of electromagnetic driving structures different from the push-pull electromagnet.

[0026] In this embodiment, the limiting block 2 abuts against the rotating rod 1 to realize ejection locking of the rotating rod 1. In other embodiments, the limiting block 2 and the rotating rod 1 may adopt other coupling connection cooperation structures, as long as the limiting block 2 in a locking position can form a coupling effect with the rotating rod 1 to prevent a motion of the rotating rod 1 in the second direction T2. For example, in another embodiment, the limiting block 2 is fixedly provided with a magnetic attraction portion; the rotating rod 1 is fixedly provided with a magnetic attraction cooperating portion; and the magnetic attraction portion of the limiting block 2 in the locking position forms magnetic attraction cooperating fixation with the magnetic attraction cooperating portion of the rotating rod 1.

[0027] As the tripping mechanism 200 is reset after being tripped, the push rod 7 also moves to be reset. In this embodiment, an elastic reset member 4 is further provided; the limiting block 2 is movably connected to the outer housing; one end of the elastic reset member 4 acts on the limiting block 2, while another end acts on the outer housing. The elastic reset member 4 can store energy when the limiting block 2 goes away from the rotating rod 1 to assist in resetting the limiting block 2. Under the action of the elastic reset member 4, the limiting block 2 always has a tendency to approach the rotating rod 1. Consequently, in this embodiment, the limiting block 2 is provided with an inclined guide surface 21, and the inclined guide surface 21 is configured to abut against the rotating rod 1 that is reset in the first direction T1. Under the guidance of the inclined guide surface 21, the rotating rod 1 that is reset in the first direction T1 can push the limiting block 2 away from the rotating rod 1. After the rotating rod 1 passes over the inclined guide surface 21, an elastic force of the elastic reset member 4 returns the limiting block 2 to a position of locking the rotating rod 1, and the whole tripping actuator 100 again returns to a state of accumulating potential and locking.

[0028] The elastic member 3 and the elastic reset member 4 are compression springs in this embodiment, and may also be tension springs in other embodiments, but mounting positions need to be changed accordingly to achieve the same effect as in this embodiment. Certainly, the elastic member 3 and the elastic reset member

4 may also be replaced with other elastic member structures such as elastic sheets and torsion springs.

Embodiment II

[0029] Referring to FIG. 4, this embodiment provides a switching appliance, including a tripping mechanism and a tripping actuator. This embodiment is substantially similar to Embodiment I. In Embodiment I, the rotating rod 1 includes two rotating arms extending in different directions and towards two sides of a rotation center of the rotating rod, and the elastic member 3 and the limiting block 2 act on the two rotating arms respectively. In Embodiment II, an elastic member 3B and a limiting block 2B simultaneously act on one of rotating arms of a rotating rod 1B, and mounting positions are adaptively changed.

[0030] In addition, an elastic reset member 4B of the limiting block 2B in this embodiment is a clockwork. A driver 6 adopts an attraction type electromagnetic driving mechanism and includes a fixed iron core, a coil and a yoke. The limiting block 2B is fixedly connected with an armature 9 to cooperate with the driver 6. When the coil is energized, the iron core attracts the armature 9 and the limiting block 2B to cause them to rotate, so as to release the rotating rod 1B.

[0031] With the structure of this embodiment, the overall configuration of the tripping actuator is more compact, which helps to reduce the volume of the tripping actuator.

Embodiment III

[0032] Referring to FIG. 5, this embodiment provides a switching appliance, including a tripping mechanism and a tripping actuator. This embodiment is substantially similar to Embodiment I, except that, in any one of the above embodiments, a plane where the elastic lever mechanism moves and a plane where the limiting block moves are parallel or coincide with each other, so that a width of the tripping actuator with this structure occupies a small space (a width direction is an inward direction of any paper in FIGS. 2-4), but in this embodiment, a limiting block 2C moves along a width direction of the tripping actuator, and a plane where the limiting block 2C moves intersects with a plane where an elastic lever mechanism moves, so that although a width of the tripping actuator occupies a large volume, a height of the tripping actuator can occupy a reduced space.

[0033] Moreover, the present disclosure also provides a tripping actuator with optimized structure, and a switching appliance having the tripping actuator.

[0034] The present disclosure is implemented by the following technical solutions.

[0035] The present disclosure provides a switching appliance, including a tripping mechanism and a tripping actuator configured to trigger the tripping mechanism. The tripping actuator includes a rotating rod and an elastic member acting on the rotating rod. The rotating rod can swing in a first direction to enable the elastic member to store energy, and can swing in a second direction opposite to the first direction upon receiving energy release of the elastic member. The tripping actuator further includes a limiting block and an electromagnetic driving mechanism. The limiting block is rotatably arranged, and a gravity center of the limiting block substantially coincides with an axis of rotation of the limiting block. The electromagnetic driving mechanism is configured to drive the limiting block to enter or exit a locking position. The limiting block in the locking position can abut against the rotating rod to limit the rotating rod from swinging in the second direction, and keep the elastic member in an energy-storage state; or the limiting block exits the locking position and releases the rotating rod. The tripping actuator further includes a push rod, and the push rod is slidably arranged on a path that the rotating rod swings in the second direction and is configured to eject out of the tripping actuator by receiving a swinging push of the rotating rod in the second direction.

[0036] In an embodiment, the limiting block is made of a magnetically conductive material.

[0037] In an embodiment, the limiting block is fixedly connected with a magnetically conductive portion configured to cooperate with the electromagnetic driving mechanism.

[0038] In an embodiment, the electromagnetic driving mechanism includes an iron core, a coil and a yoke. The iron core is fixedly arranged; the coil is wound on the iron core; and the yoke exhibits an "L-shaped" structure. One end of the yoke is close to one end of the iron core, while another end of the yoke is flush with and spaced apart from another end of the iron core. Another end of the yoke and another end of the iron core face the limiting block. A pin of the coil is led out of the tripping actuator.

[0039] In an embodiment, the electromagnetic driving mechanism further includes an elastic reset member, and the elastic reset member acts on the limiting block and is configured to reset the limiting block into the locking position after the limiting block exits the locking position.

[0040] In an embodiment, the switching appliance is a low-voltage switching appliance.

[0041] The present disclosure has the following beneficial effects.

[0042] According to the present disclosure, by locking and releasing the rotating rod by the limiting block, a small motion stroke of the limiting block can trigger a large motion stroke of the rotating rod, and the limiting block can immediately trigger the rotating rod only by moving a short distance, to rapidly eject the push rod out. Consequently, even if the current flowing through the electromagnetic driving mechanism is small and the electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the rotating rod.

[0043] In the present disclosure, the gravity center of the limiting block substantially coincides with the axis of

rotation of the limiting block, so that when the tripping actuator is subjected to external mechanical impact in any direction, the limiting block does not rotate and is basically in a balanced state. Hence, compared with the related art, the tripping actuator in a non-working position has stronger resistance to impact. The mechanical trigger structure is adopted in the present disclosure and has strong resistance to vibration and impact.

Embodiment IV

[0044] Referring to FIG. 1, as a preferred embodiment of the present disclosure, a switching appliance is provided; more specifically, a low-voltage circuit breaker is provided, including a tripping mechanism 200 and a tripping actuator 100 for triggering the tripping mechanism 200.

[0045] Referring to FIG. 6, the tripping actuator 100 includes an outer housing 8, a rotating rod 1, and an elastic member 3. The outer housing 8 serves as a support body, and the rotating rod 1 is rotatably arranged within the outer housing 8. The rotating rod 1 can swing around its fulcrum in a first direction T1 or a second direction T2, the first direction T1 (e.g., a clockwise direction) being opposite to the second direction T2 (e.g., a counterclockwise direction). One end of the elastic member 3 acts on the rotating rod 1, and another end of the elastic member 3 is fixed at a certain point within the outer housing 8.

[0046] In this embodiment, the elastic member 3 is a tension spring; when the rotating rod 1 swings in the first direction T1, the elastic member 3 can be stretched to store energy; conversely, when releasing energy, the elastic member 3 can pull the rotating rod 1 to swing in the second direction T2.

[0047] Referring to FIG. 6, the tripping actuator 100 further includes a limiting block 2 and an electromagnetic driving mechanism. The limiting block 2 is rotatably disposed within the outer housing 8. The electromagnetic driving mechanism includes an iron core 51, a coil 52, and a yoke 53. The iron core 51 is fixedly arranged; the coil 52 is wound on the iron core 51; and the yoke 53 exhibits an "L-shaped" structure. One end of the yoke 53 is close to one end of the iron core 51, while another end of the yoke 53 is flush with and spaced apart from another end of the iron core 51. Another end of the yoke 53 and another end of the iron core 51 face the limiting block 2. In this embodiment, the limiting block 2 is made of a magnetically conductive material, and a pin of the coil 52 is led out of the tripping actuator 100.

[0048] The electromagnetic driving mechanism further includes an elastic reset member 4, and one end of the elastic reset member 4 acts on the limiting block 2 while the other end of the elastic reset member 4 is fixed within the outer housing 8. When the coil 52 is energized, the electromagnetic driving mechanism generates an electromagnetic driving force to drive the limiting block 2 to swing, and the elastic reset member 4 is configured to reset the limiting block 2.

[0049] As shown in FIG. 6, the limiting block 2 has a locking position when swinging back and forth. The limiting block 2 in the locking position can abut against one end of the rotating rod 1 to limit the rotating rod 1 from swinging in the second direction T2 and keep the elastic member 3 in the energy-storage state. When the limiting block 2 exits the locking position, the rotating rod 1 can be released, as shown in FIG. 7.

[0050] The tripping actuator 100 further includes a push rod 7 slidably connected to the outer housing 8 and disposed on a path that the rotating rod 1 swings in the second direction T2. When the limiting block 2 exits the locking position to release the rotating rod 1, the rotating rod 1 pushes the push rod 7 to allow it to quickly eject out of the tripping actuator 100, thereby triggering the tripping mechanism 200.

[0051] According to the present disclosure, by locking and releasing the rotating rod 1 by the limiting block 2, a small motion stroke of the limiting block 2 can trigger a large motion stroke of the rotating rod 1, and the limiting block 2 can immediately trigger the rotating rod 1 only by moving a short distance, to rapidly eject the push rod 7 out. Consequently, even if the current flowing through the electromagnetic driving mechanism is small and the electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the rotating rod 1.

[0052] Meanwhile, the mechanical trigger structure is adopted in this embodiment and has strong resistance to vibration and impact. In this embodiment, a gravity center of the limiting block 2 substantially coincides with an axis S of rotation of the limiting block 2 (by "substantially coincide" it means that the gravity center of the limiting block 2 is allowed slightly deviate from but basically coincides with the axis S of rotation of the limiting block 2), so that when the tripping actuator 100 is subjected to external mechanical impact in any direction, the limiting block 2 does not rotate and is basically in a balanced state. Hence, compared with the related art, the tripping actuator 100 in this embodiment has stronger resistance to impact when in a non-working position.

[0053] In this embodiment, the limiting block 2 is made of a magnetically conductive material, and in other embodiments, a magnetically conductive portion may be fixedly connected to the limiting block 2, to cooperate with the electromagnetic driving mechanism.

[0054] In this embodiment, the rotating rod 1, the limiting block 2, and the electromagnetic driving mechanism form a "transverse, vertical and transverse" layout structure, which is beneficial to reducing the volume of the tripping actuator 100.

[0055] Moreover, the present disclosure also provides a tripping actuator with optimized structure, and a switching appliance having the tripping actuator.

[0056] The present disclosure is implemented by the following technical solutions.

[0057] The present disclosure provides a switching appliance, including a tripping mechanism and a tripping actuator for triggering the tripping mechanism. The tripping actuator includes an elastic push rod mechanism and a limiting block. In a sliding displacement stroke, the elastic push rod mechanism includes a first stroke of accumulating elastic potential energy and a second stroke of releasing elastic potential energy. The limiting block can approach or go away from the elastic push rod mechanism. The limiting block approaches the elastic push rod mechanism to lap the elastic push rod mechanism and keep it in a state of accumulating elastic potential energy; and the limiting block goes away from the elastic push rod mechanism to release the elastic push rod mechanism and make it eject out of the tripping actuator, so that the tripping mechanism is triggered.

[0058] In an embodiment, the tripping actuator further includes a housing; the elastic push rod mechanism includes a push rod and an elastic member; the push rod is slidably connected to the housing; one end of the elastic member acts on the push rod, while another end thereof is fixedly disposed.

[0059] In an embodiment, a part of the push rod slidably connected to the housing is a straight rod portion; and a part of the push rod connected to the elastic member is an inner end of the straight rod portion located within the housing. Alternatively, the inner end of the straight rod portion located within the housing is bent and connected with a curved rod portion, and the curved rod portion serves as a part of the push rod connected to the elastic member.

[0060] In an embodiment, the elastic member is a tension spring, a compression spring, a torsion spring, or a clockwork.

[0061] In an embodiment, the elastic push rod mechanism is provided with a lapping portion to lap with the limiting block. The limiting block is provided with an inclined guide surface, and the inclined guide surface is configured to abut against the lapping portion of the elastic push rod mechanism that is reset to a potential-storage state, so that the lapping portion can pass over the inclined guide surface.

[0062] In an embodiment, a driver is further provided to drive the limiting block to achieve a motion stroke thereof.

[0063] In an embodiment, the driver is a linear movement driving device or a rotation driving device.

[0064] In an embodiment, an elastic reset member is further provided, and the elastic reset member acts on the limiting block and is configured to reset the limiting block towards the elastic push rod mechanism after the limiting block goes away the elastic push rod mechanism.

[0065] In an embodiment, the elastic reset member is a tension spring, a compression spring, a torsion spring, or a clockwork.

[0066] In an embodiment, the switching appliance is a low-voltage switching appliance.

[0067] The present disclosure has the following beneficial effects.

[0068] According to the present disclosure, by locking and releasing the elastic push rod mechanism by the limiting block, a small motion stroke of the limiting block can trigger a large motion stroke of the push rod, and the limiting block can immediately trigger rapid ejection of the push rod only by moving a short distance. Consequently, even if the current flowing through the coil of the electromagnetic driving mechanism that drives the limiting block is small and the electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the elastic push rod mechanism.

[0069] In another aspect, the elastic push rod mechanism in this embodiment is used as a push rod for triggering the tripping mechanism, which can reduce the number of parts and make the structure of the tripping actuator more compact. The mechanical trigger structure is adopted in the present disclosure and has strong resistance to vibration and impact.

Embodiment V

[0070] Referring to FIG. 1, as a preferred embodiment of the present disclosure, a switching appliance is provided; more specifically, a circuit breaker is provided, including a tripping mechanism 200 and a tripping actuator 100 for triggering the tripping mechanism 200.

[0071] As shown in FIG. 8 and FIG. 9, the tripping actuator 100 includes a housing and an elastic push rod mechanism disposed within the housing, and the elastic push rod mechanism specifically includes a push rod 10 and an elastic member 30.

[0072] In this embodiment, the housing of the tripping actuator 100 serves as a support body, the push rod 10 is slidably connected to the housing, and the push rod 10 can slide in a first direction T3 and a second direction T4, the first direction T3 and the second direction T4 being opposite to each other.

[0073] The elastic member 30 is a compression spring in this embodiment; and one end of the elastic member 30 acts on the push rod 10, while another end of the elastic member 30 is fixed at a certain point within the housing. When the push rod 10 slides in the first direction T3, the elastic member 30 is compressed to store energy; conversely, the elastic member 30 can release energy to push the push rod 10 to slide in the second direction T4.

[0074] A sliding stroke of the push rod 10 along the first direction T3 is defined as a first stroke of the elastic push rod mechanism, and the first stroke enables the elastic push rod mechanism to enter a state of accumulating elastic potential energy. A sliding stroke of the push rod 10 along the second direction T4 is defined as a second stroke of the elastic push rod mechanism, and the second stroke is a sliding stroke performed by the elastic push rod mechanism after releasing the elastic potential energy.

[0075] As shown in FIG. 10, the tripping actuator 100 further includes a limiting block 20. In this embodiment,

the limiting block 20 is disposed within the housing, and a driver is drivingly connected to the limiting block 20. In this embodiment, the driver may be a push-pull electromagnet 50, and an iron core of the push-pull electromagnet 50 is fixedly connected to the limiting block 20, so that the limiting block 20 can be driven to move reciprocally when the iron core moves reciprocally under the action of an electromagnetic force generated by a coil. A movement path of the limiting block 20 is configured to be close to or away from the push rod 10.

[0076] As shown in FIG. 8, the push rod 10 is fixedly provided with a lapping portion 110, and when approaching the push rod 10, the limiting block 20 can lap and limit the lapping portion 110 and keep the elastic push rod mechanism in the state of accumulating elastic potential energy.

[0077] As shown in FIG. 9, when going away from the push rod 10, the limiting block 20 can release the elastic push rod mechanism, so that the push rod 10 quickly slides in the direction T4 to be ejected out of the housing, thereby triggering the tripping mechanism 200.

[0078] In this embodiment, by locking and releasing the elastic push rod mechanism by the limiting block 20, a small motion stroke of the limiting block 20 can trigger a large motion stroke of the push rod 10, and the limiting block 20 can immediately trigger rapid ejection of the push rod 10 only by moving a short distance. Consequently, even if the current flowing through the coil of the push-pull electromagnet 50 is small and the electromagnetic force is weak, a tripping triggering action with fast speed, high sensitivity and large force can be realized by means of an elastic release process of the elastic push rod mechanism.

[0079] In another aspect, the elastic push rod mechanism in this embodiment is used as an push rod for triggering the tripping mechanism 200, which can reduce the number of parts and make the structure of the tripping actuator 100 more compact, compared with a solution of triggering the push rod by using a swinging member. Moreover, in this embodiment, the push rod 10 is of a straight rod structure, a part of the push rod 10 slidably connected to the housing is a straight rod portion, and the elastic member 30 is a compression spring acting on an end of the straight rod portion of the push rod 10 located within the housing, which helps to make the structure of the tripping actuator 100 compact. The mechanical trigger structure is adopted in the present disclosure and has strong resistance to vibration and impact.

[0080] The limiting block 20 is movable in this embodiment, and may also be rotatable in other embodiments, as long as the limiting block 20 can kinetically approach or go away from an elastic lever mechanism. Moreover, the driver in other embodiments may also adopt other rotation driving devices or movement driving devices, such as motors, cylinder and other forms of electromagnetic driving structures different from the push-pull electromagnet.

[0081] The lapping portion 110 is a raised structure on the push rod 10 in this embodiment, and in other embodiments, it may be replaced with a groove structure.

[0082] In this embodiment, the limiting block 20 abuts against the lapping portion 110 to realize ejection and locking of the push rod 10. In other embodiments, the limiting block 20 and the push rod 10 may adopt other coupling connection cooperation structures, as long as the limiting block 20 in a locking position can form a coupling effect with the push rod 10 to prevent a motion of the push rod 10 in the second direction T4. For example, in another embodiment, the limiting block 20 is fixedly provided with a magnetic attraction portion; the push rod 10 is fixedly provided with a magnetic attraction cooperating portion; and the magnetic attraction portion of the limiting block 20 in the locking position forms magnetic attraction cooperating fixation with the magnetic attraction cooperating portion of the push rod 10.

[0083] As the tripping mechanism 200 is reset after being tripped, the push rod 10 also moves to be reset. In this embodiment, an elastic reset member 40 is further provided; the limiting block 20 is movably connected to the outer housing; one end of the elastic reset member 40 acts on the limiting block 20, while another end acts on the outer housing. The elastic reset member 40 can store energy when the limiting block 20 goes away from the push rod 10 to assist in resetting the limiting block 20. Under the action of the elastic reset member 40, the limiting block 20 always has a tendency to approach the push rod 10. Consequently, in this embodiment, the limiting block 20 is provided with an inclined guide surface 210, and the inclined guide surface 210 is configured to abut against the lapping portion 110 of the push rod 10 that is reset in the first direction T3. Under the guidance of the inclined guide surface 210, the lapping portion 110 that is reset in the first direction T3 can push the limiting block 20 away from the push rod 10. After the lapping portion 110 passes over the inclined guide surface 210, an elastic force of the elastic reset member 40 returns the limiting block 20 to a position of locking the push rod 10, and the whole tripping actuator 100 again returns to a state of accumulating potential and locking.

[0084] The elastic member 30 and the elastic reset member 40 are compression springs in this embodiment, and may also be tension springs in other embodiments, but mounting positions need to be changed accordingly to achieve the same effect as in this embodiment. Certainly, the elastic member 30 and the elastic reset member 40 may also be replaced with other elastic member structures such as elastic sheets, torsion springs and clockworks.

Embodiment VI

[0085] As shown in FIG. 11, this embodiment provides a switching appliance, including a tripping mechanism and a tripping actuator. Embodiment VI is substantially similar to Embodiment V, and shows a housing 60 as a support body for understanding.

[0086] In this embodiment, a limiting block 20A is ro-

tatable, and a driver 50A adopts an attraction type electromagnetic driving mechanism and includes a fixed iron core, a coil and a yoke. The limiting block 20A is made of a magnetic material. When the coil is energized, the iron core attracts the limiting block 20A to make it rotate, thereby releasing the limiting block 20A. An elastic reset member 40A is a tension spring. In this embodiment, a push rod 10A is an approximately "L-shaped" curved rod, including a straight rod portion slidably connected to the housing 60 and a curved rod portion bent and connected to an inner end of the straight rod portion. An elastic member 30A is a tension spring acting on the curved rod portion.

[0087] Although the present disclosure is specifically shown and described in connection with preferred embodiments, it should be understood by the person skilled in the art that without departing from the spirit and scope of the present disclosure as defined in the appended claims, various changes can be made to the present disclosure in terms of forms and details, all of which fall into the protection scope of the present disclosure.

Claims

1. A switching appliance, comprising:

a tripping mechanism (200); and
a tripping actuator (100), configured to trigger the tripping mechanism (200), and comprising:

an elastic lever mechanism, comprising a first stroke of accumulating elastic potential energy and a second stroke of releasing the elastic potential energy, in a lever swinging stroke; and
a limiting block (2), configured to approach or go away from the elastic lever mechanism,

wherein the limiting block (2) laps the elastic lever mechanism by approaching the elastic lever mechanism and keeps the elastic lever mechanism in a state of accumulating the elastic potential energy; and the limiting block (2) releases the elastic lever mechanism by going away from the elastic lever mechanism,
the tripping actuator (100) further comprises a push rod (7) slidably arranged on a motion path of the second stroke of the elastic lever mechanism, and the push rod (7) is configured to be ejected out of the tripping actuator (100) by receiving push of the elastic lever mechanism and trigger the tripping mechanism (200).

2. The switching appliance according to claim 1, wherein the elastic lever mechanism comprises a rotating rod (1) and an elastic member (3); and one end of the elastic member (3) acts on the rotating rod (1), while another end of the elastic member (3) is fixedly arranged.

3. The switching appliance according to claim 1, wherein the tripping actuator (100) further comprises a driver (6) configured to drive the limiting block (2) to approach or go away from the elastic lever mechanism.

4. The switching appliance according to claim 3, wherein the driver (6) is a linear movement driving device or a rotation driving device.

5. The switching appliance according to claim 1, wherein the tripping actuator (100) further comprises an elastic reset member (4), and the elastic reset member (4) acts on the limiting block (2) and is configured to reset the limiting block (2) towards the elastic lever mechanism after the limiting block (2) goes away from the elastic lever mechanism.

6. The switching appliance according to claim 5, wherein the limiting block (2) is provided with an inclined guide surface (21), and the inclined guide surface (21) is configured to abut against a rotating rod (1) of the elastic lever mechanism in the first stroke, to allow the rotating rod (1) to pass over the inclined guide surface (21).

7. The switching appliance according to claim 5, wherein the elastic reset member (4) is a tension spring, a compression spring, a torsion spring, or a clockwork.

8. The switching appliance according to claim 1, wherein a plane where the limiting block (2) moves is parallel to or coincides with a plane where the elastic lever mechanism moves.

9. The switching appliance according to claim 1, wherein a plane where the limiting block (2) moves intersects with a plane where the elastic lever mechanism moves.

10. The switching appliance according to claim 1, wherein the switching appliance is a low-voltage switching appliance.

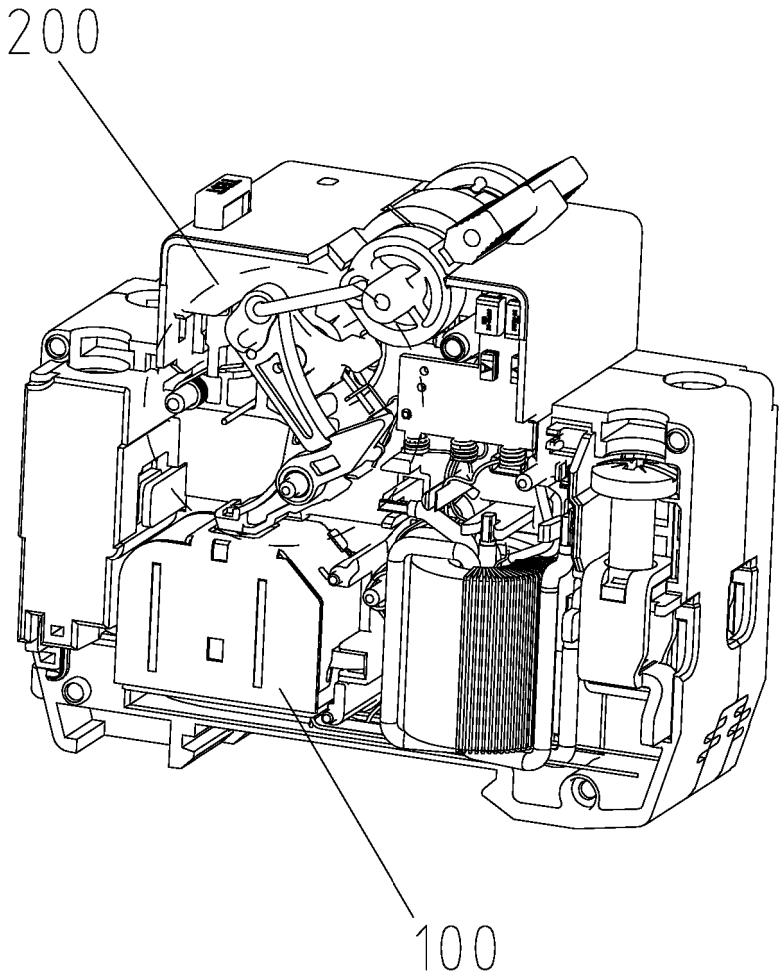

FIG. 1

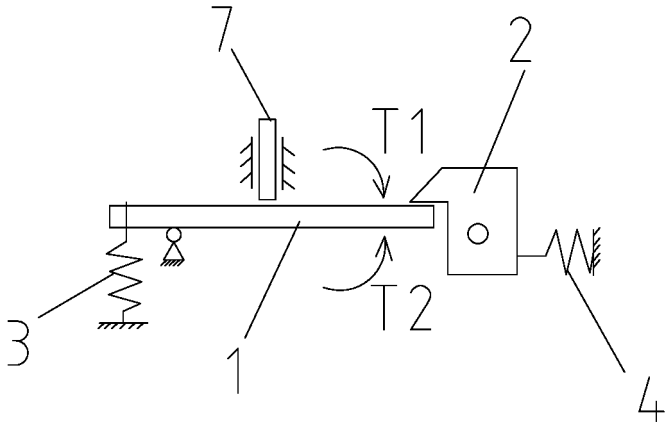

FIG. 2

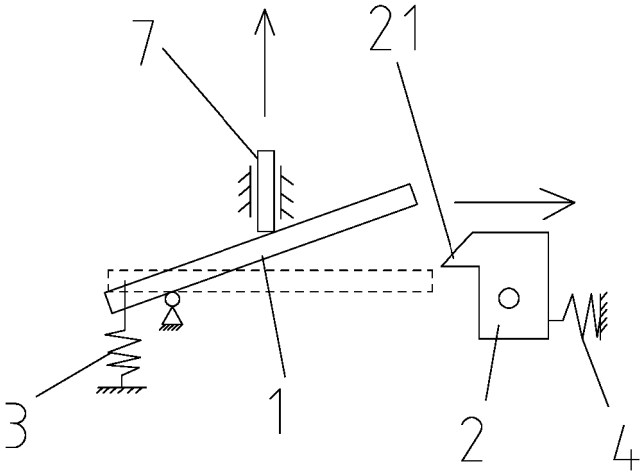

FIG. 3

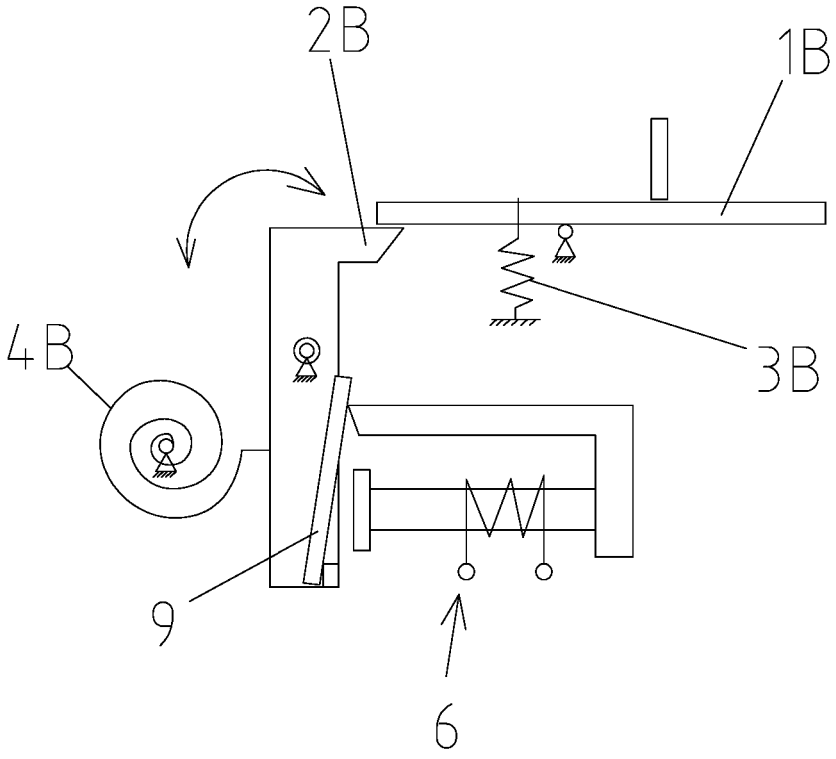

FIG. 4

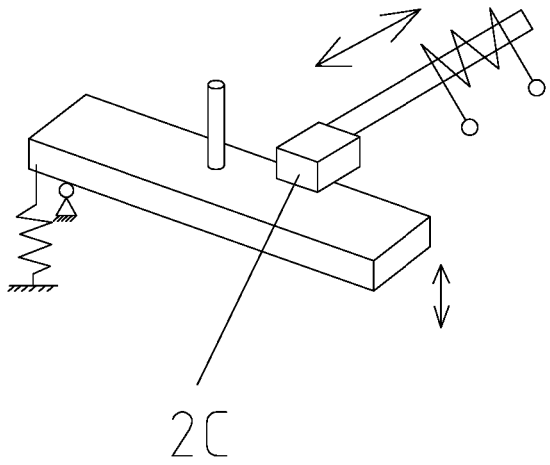

FIG. 5

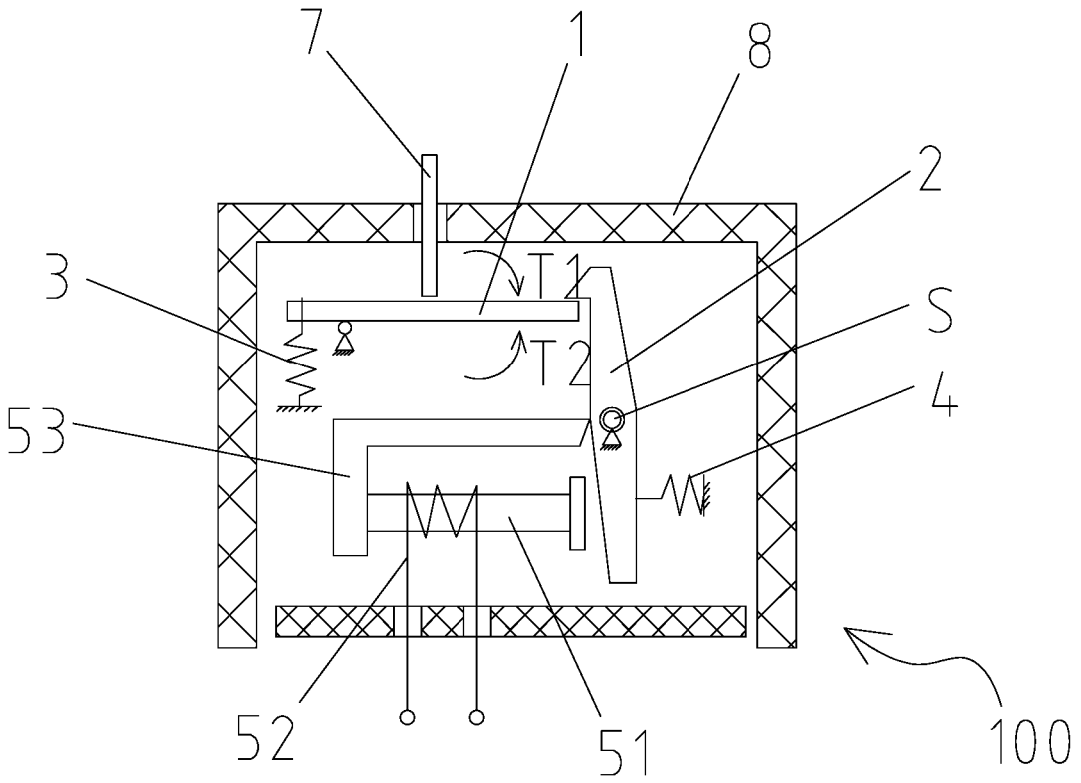

FIG. 6

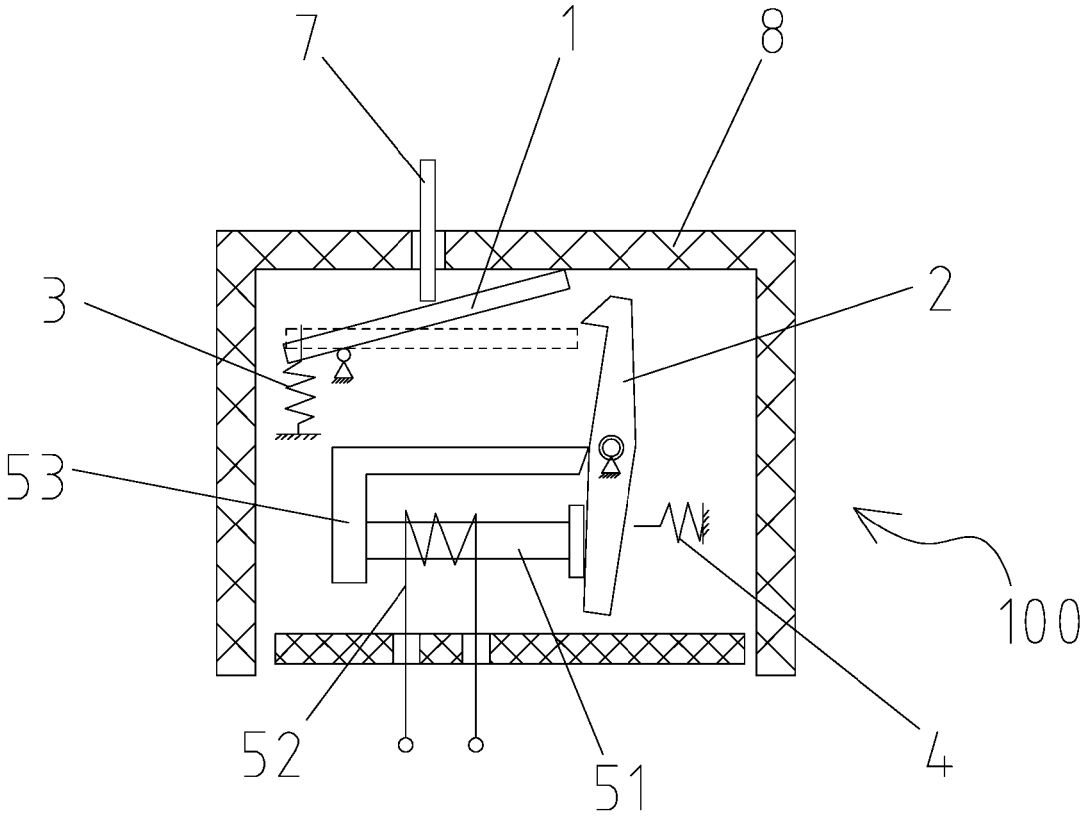

FIG. 7

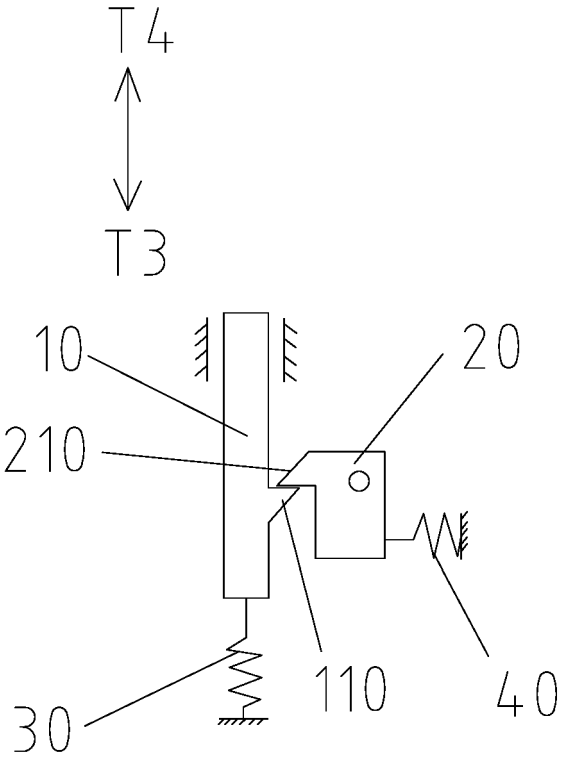

FIG. 8

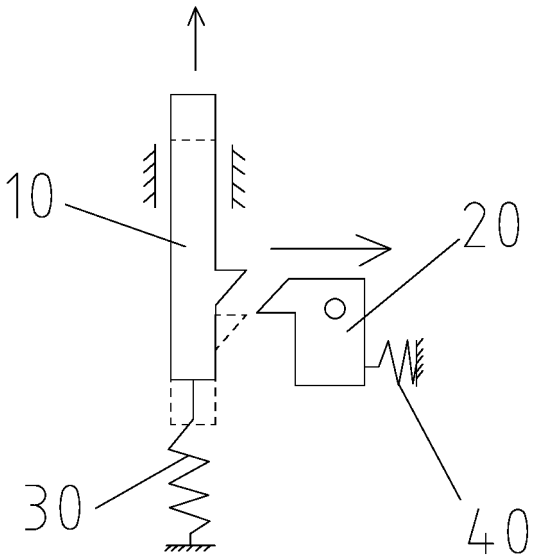

FIG. 9

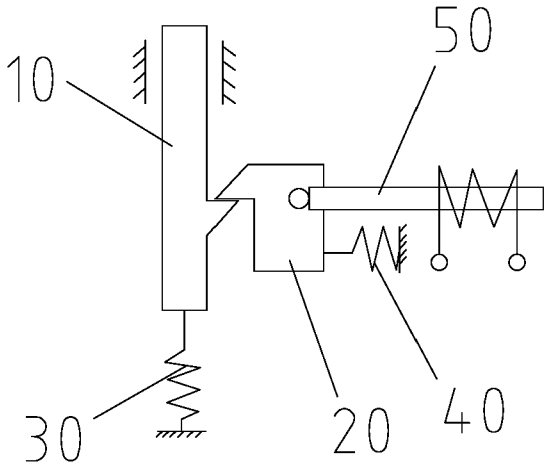

FIG. 10

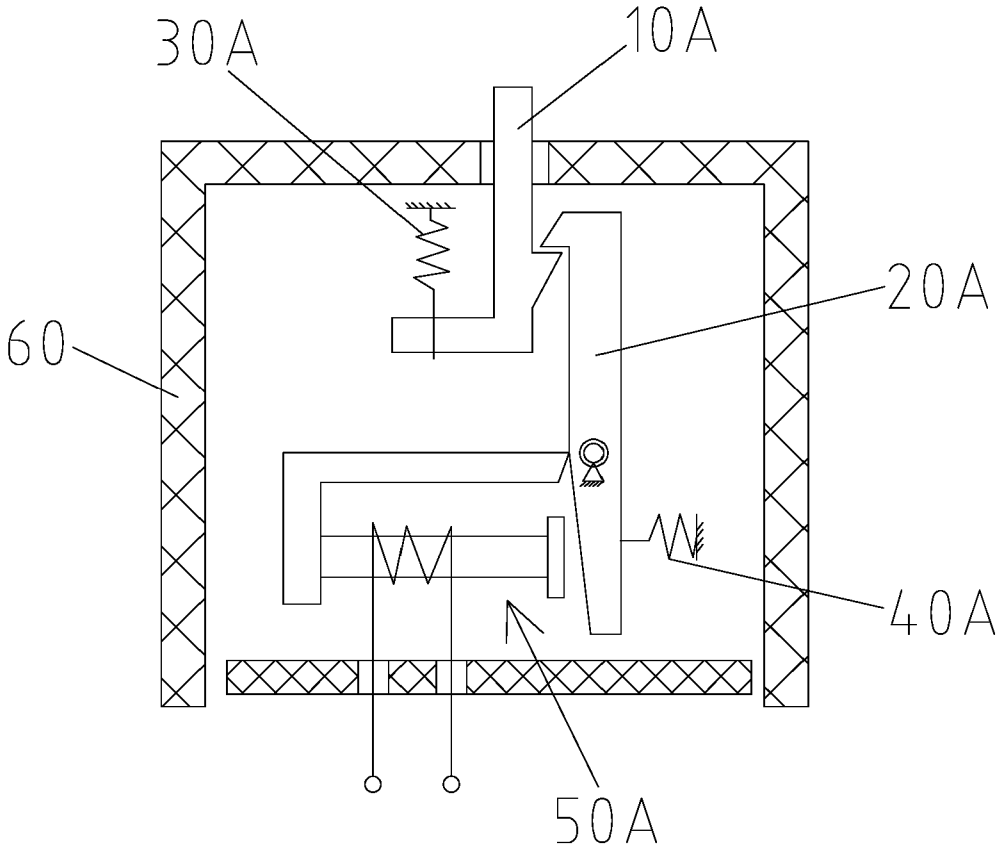

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 24 22 1463

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2023 104113 A1 (HAGER ELECTRO SAS [FR]) 7 September 2023 (2023-09-07) * paragraphs [0009] - [0050]; figures 1-12 *	1-10	INV. H01H71/24 H01H71/50 ADD. H01H83/22
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H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 May 2025	Arenz, Rainer

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22-05-2025

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