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(54) OPERATION MECHANISM FOR MINIATURE CIRCUIT BREAKER

(57) An operating mechanism of a miniature circuit breaker comprises a handle, a driving connecting rod, a stationary contact and a moving contact, and further comprises a tension spring and a trip lever, one end of the driving connecting rod is hinged with the handle, the other end of the driving connecting rod is matched with the moving contact, one end of the tension spring is fixed on a housing, and the other end of the tension spring is connected to the moving contact; the moving contact is driven by the tension spring and the driving connecting rod together to provide a contact pressure and an overstretching elastic force required for ensuring the reliability of electrical contact for closing the moving contact and the stationary contact, and the tension spring provides an energy storage elastic force required for resetting the mechanism for breaking the moving contact from the stationary contact; and the trip lever is arranged on the moving contact, and is used to control the locking and unlocking cooperation between the driving connecting rod and the moving contact, when a failure automatically occurs, the trip lever separates the driving connecting rod from the moving contact to automatically release the operation mechanism. The mechanism can effectively simplify the structure, reduce the manufacturing cost, improve the production efficiency, and optimize the mechanical performance.

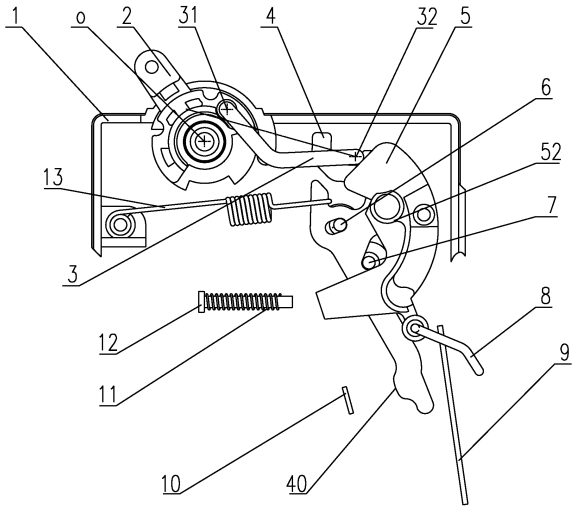

Fig. 1

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Description

Technical Field

[0001] The present invention relates to an operating mechanism of a miniature circuit breaker, and more particularly, to an operating mechanism applied to a low-voltage plastic housing modulized miniature circuit breaker, which belongs to the field of low-voltage electrical appliance.

Background Art

[0002] As is well known, the operating mechanism of a miniature circuit breaker is used to drive a moving contact and a stationary contact to break/close, and through the breaking/closing, the closing, opening, and tripping of the circuit breaker are controlled. A four-bar linkage is a most typical and most commonly used mechanism of the existing operating mechanism of a miniature circuit breaker, and comprises a handle connected to a driving connecting rod, thereby forming a toggle; a moving contact supporting device has a rotating plate rotatably installed on a pivot; and a mechanical linkage (usually also referred to as locking) that can be disconnected by the action of a trip bar, and a bimetallic strip is connected to the trip bar through a rotational connecting rod with one-way driving. The mechanical linkage above is cooperatively formed by a stopper of the trip bar and a latch (usually also referred to as a lever) rotatably installed on a spindle of the plate, the connecting rod is directly connected to the latch, and the assembly forms a gearing-down stage to reduce a tripping force of the operating mechanism. A feature of this type of mechanism is that the moving contact and the contact supporting are two independent components, and in order to obtain the necessary overstretching function, it is also necessary to arrange an overstretching mechanism between the moving contact and the contact supporting. For this purpose, two methods are generally used in the connection between the moving contact and the rotating plate supported by the contact, one of the methods is to bond by glue or weld together, with the defects of complex and unreliable firmness, the other method is to fix the moving contact on the contact supporting by a button spring instead of fixing on a rotating shaft of the operating mechanism, with the defect of leading to the lengthening of a rotating arm of the contact, and the speed of the mechanism action is slowed down, which is not favorable for the product breaking performance. Moreover, the contact supporting in the four-bar linkage is generally fixed by a spring and a rotating plate, and the contact supporting and the rotating plate can be rotated in a small range to ensure the contact pressure and the overstretching of the product. It can be seen that the common problem of existing mode that the moving contact is welded or fixed by the spring on the contact supporting is a large number of parts, a complicated driving chain structure, and complicated assembly and debugging, and the assembly efficiency is further reduced, thereby affecting the miniaturization and low cost of the circuit breaker. In addition, the structure of the mechanical linkage in existing operating mechanism of a miniature circuit breaker is established on the driving chain between the latch and the trip bar, and sharp-fanged meshing is usually used (which usually also referred to as a snap, etc.). The deficiency of the structure of the sharp-fanged meshing lies in that the sharp teeth is easy to be worn, thereby affecting the reliability and service life of the product.

[0003] With the ever-increasing miniaturized and multi-functional use requirements, the demand for improving new technologies to the operating mechanism of a miniature circuit breaker is increasingly urgent, the orientations of technological improvement can be summarized as miniaturization, low cost, and performance optimization including reliability and service life, and the common technical cores related to these orientations are to simplify the structure and reduce the parts, while being able to overcome the constraint of weak environment that affects the performance.

Summary of the Invention

[0004] The problem above of the prior art to be solved by the present invention aims to provide an operating mechanism of a miniature circuit breaker, the reliability of the operating mechanism of the circuit breaker, the convenience of assembly debugging and the production efficiency can further be improved, while the structure is simplified and the quantity of the parts is reduced.

[0005] In order to achieve the above object, the present invention adopts the following technical solutions:

An operating mechanism of a miniature circuit breaker comprises a handle 2 pivotally installed on a housing 1, a driving connecting rod 3, a stationary contact 10 and a moving contact 4 arranged in the housing 1, and further comprises a tension spring 13 and a trip lever 5, one end of the driving connecting rod 3 is hinged to the handle 2, the other end of the driving connecting rod 3 is matched with the moving contact 4, one end of the tension spring 13 is fixed on the housing 1, and the other end of the tension spring 13 is connected to the moving contact 4;the moving contact 4 is driven by the tension spring 13 and the driving connecting rod 3 together to provide a contact pressure and an overstretching elastic force required for ensuring the reliability of electrical contact for closing the moving contact 4 and the stationary contact 10, and the tension spring 13 provides an energy storage elastic force required for resetting the mechanism for breaking the moving contact 4 from the stationary contact 10; and the trip lever 5 is arranged on the moving contact 4, and is used to control the locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4, when a failure automatically occurs, the trip lever 5 separates the driving connecting rod 3 from the moving contact 4 to automatically release the

operation mechanism.

[0006] Preferably, the housing 1 is internally provided with a mechanism rotation shaft 6 and a limit shaft 7, the moving contact 4 is pivotally installed on the mechanism rotation shaft 6 in the housing 1, the moving contact 4 is fixed on the mechanism rotation shaft 6 and the limit shaft 7 of the housing 1 by the tension spring 13.

[0007] Preferably, the moving contact 4 is rotatably installed on the mechanism rotation shaft 6 through a strip arc-shaped groove hole 41 thereon, the installation and cooperation between the arc-shaped groove hole 41 of the moving contact 4 and the mechanism rotation shaft 6 comprise having an overstretching gap h in a state that the moving contact 4 and the stationary contact 10 are closed.

[0008] Preferably, the moving contact 4 is provided with an arc-shaped groove hole 41, a driving groove 42, a pivot hole 43, a limit groove 44, a spring hook 45 and a moving contact point 40, and the arc-shaped groove hole 41 is installed and cooperated with the mechanism rotation shaft 6 on the housing 1;the limit groove 44 is in contact cooperation with the limit shaft 7 on the housing 1; and the driving groove 42 on the moving contact 4 is in driving cooperation with a driving end 32 of the driving connecting rod 3, and the pivot hole 43 on the moving contact 4 is installed and coupled with a pivot 52 on the trip lever 5.

[0009] Preferably, the moving contact 4 is provided with the arc-shaped groove hole 41 and the pivot hole 43, one end is provided with a concave driving groove 42, the other end is provided with the moving contact point 40, the spring hook 45 and the limit groove 44 are respectively located on two sides of the moving contact 4, the spring hook 45 is located between the arc-shaped groove hole 41 and the driving groove 42, the limit groove 44 is located between the arc-shaped groove hole 41 and the moving contact 4, the pivot hole 43 is located between the limit groove 44 and the arc-shaped groove hole 41, the arc-shaped groove hole 41 is located on a side of the moving contact 4 close to the spring hook 45, and the pivot hole 43 is located on a side of the moving contact 4 close the limit groove 44.

[0010] Preferably, one end of the moving contact 4 is provided with a driving groove 42 that is in driving cooperation with a driving end 32 of the driving connecting rod 3, the trip lever 5 is pivotally installed on the moving contact 4, the trip lever 5 is provided with a release driving part 53 and a locking surface 51 for realizing the locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4.

[0011] Preferably, the locking cooperation is that the locking surface 51 on the trip lever 5 abuts with the driving end 32 of the driving connecting rod 3, the driving end 32 is locked in the driving groove 42 on the moving contact 4, and the driving end 32 of the driving connecting rod 3 and the locking surface 51 of the trip lever 5 generate a locking force acting jointly on the driving groove 42; and the unlocking cooperation is that the locking surface 51 on the trip lever 5 is separated from the driving end 32 of the driving connecting rod 3, and the driving end 32 can slide in the driving groove 42 on the moving contact 4.

[0012] Preferably, the trip lever 5 is further provided with a reset device for driving the trip lever 5 to rotate around a pivot 52, the reset rotation of the trip lever 5 drives a locking surface 51 on the trip lever 5 to abut with a driving end 32 of the driving connecting rod 3, which locks the driving end 32 in the driving groove 42 on the moving contact 4, so as to lock the driving connecting rod 3 with the moving contact 4.

[0013] Preferably, a release driving part 53 on the trip lever 5 is driven by a trip device of the miniature circuit breaker to rotate around a pivot 52 and drive a locking surface 51 of the trip lever 5 to separate from a driving end 32 of the driving connecting rod 3, and the separation enables the driving end 32 to slide in a driving groove 42 on the moving contact 4, so as to unlock the driving connecting rod 3 and the moving contact 4.

[0014] Preferably, an extension line of a connecting line between two ends 31 and 32 of the driving connecting rod 3 is stabilized below a center of rotation O of the handle 2 in a state that the moving contact 4 and the stationary contact 10 are closed; an extension line of a connecting line between two ends 31 and 32 of the driving connecting rod 3 is stabilized above a center of rotation O of the handle 2 in a state that the moving contact 4 and the stationary contact 10 are broken; and the extension line between the two ends 31 and 32 of the driving connecting rod 3 is transferred from a position below the center of rotation O of the handle 2 to a position above the center of rotation O in a trip process.

[0015] Preferably, in the state that the moving contact 4 and the stationary contact 10 are closed, an acting force on the moving contact 4 comprises a pulling force of the tension spring 13, a contact pressure of the stationary contact 10 acting on the moving contact point 40 of the moving contact 4, and locking forces of the driving end 32 of the driving connecting rod 3 and the locking surface 51 of the trip lever 5 jointly acting on the driving groove 42 of the moving contact 4, and a resultant force of the contact pressure and the locking force is balanced with the pulling force of the tension spring 13; and in the state that the moving contact 4 and the stationary contact 10 are broken, an acting force on the moving contact 4 comprises a pulling force of the tension spring 13, a restraining force of the mechanism rotation shaft 6 on the housing 1 acting on the arc-shaped groove hole 41, and a contact force of the limit shaft 7 on the housing 1 acting on the limit groove 44 of the moving contact 4, and a resultant force of the contact force and the pulling force of the tension spring 13 is balanced with the restraining force of the mechanism rotation shaft 6 acting on the arc-shaped groove hole 41.

[0016] The operating mechanism of a miniature circuit breaker of the present invention adopts a three-bar linkage to realize a closing/breaking conversion structure,

which eliminates a welding or spring connection process between the moving contact and the contact supporting, reduces the quantity of parts, effectively simplifies the structure, and reduces manufacturing cost. Moreover, by adopting the three-bar linkage and optimal design solutions of a new force system structure, locking structure, overstretching structure, and the closing/breaking conversion structure, the operating mechanism can still provide the required overstretching function, and can also effectively simplify the structure, reduce the manufacturing cost, improve the production efficiency, and optimize the mechanism performance.

Brief Description of the Drawings

[0017] The advantages and features of the present invention are more clearly seen in the description of the embodiments shown in the accompanying drawings, wherein:

Fig. 1 is a schematic plan view of an integral structure of an operating mechanism of a miniature circuit breaker of the present invention when a moving contact 4 and a stationary contact 10 are in a stable breaking state.

Fig. 2 is a schematic plan view of the integral structure of the operating mechanism of a miniature circuit breaker of the present invention in a momentary state during operation of the moving contact 4 from the breaking state to the closing state.

Fig. 3 is a schematic plan view of the integral structure of the operating mechanism of a miniature circuit breaker of the present invention when the moving contact 4 and the stationary contact 10 are in a stable closing state.

Fig. 4 is a stereoscopic schematic diagram of the moving contact 4 in the operating mechanism shown in Fig. 1.

Detailed Description of the Preferred Embodiments

[0018] The detailed embodiments of the operating mechanism of a miniature circuit breaker of the present invention are further described hereinafter with reference to the embodiments shown in Figs. 1 to 4.

[0019] In the embodiment as shown in Figs. 1 to 3, the operating mechanism of a miniature circuit breaker of the present invention comprises a housing 1, a stationary contact 10 (the stationary contact is schematically illustrated in the drawing), a handle 2 pivotally installed on the housing 1, and a driving connecting rod 3 hinged with the handle 2. The operating mechanism of the present invention further comprises a tension spring 13, a moving contact 4 jointly driven by the driving connecting rod 3 and the tension spring 13, and a trip lever 5 for controlling the locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4. One end of the driving connecting rod 3 is hinged with the handle 2, and a driving end 32 at the other end is matched with the moving contact 4;One end of the tension spring 13 is fixed on the housing 1, the other end is connected to the moving contact 4, so that the moving contact 4 is driven by the tension spring 13 and the driving connecting rod 3 together to provide a contact pressure and an overstretching elastic force required for ensuring the reliability of electrical contact for closing the moving contact 4 and the stationary contact 10, and the tension spring 13 provides an energy storage elastic force required for resetting the mechanism for breaking the moving contact 4 from the stationary contact 10; and the trip lever 5 is arranged on the moving contact 4, and is used to control the locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4, and when a failure automatically occurs, the trip lever 5 separates the driving connecting rod 3 from the moving contact 4 to automatically release the operation mechanism, which has nothing to do with the operation of the handle 2.

[0020] As the embodiment shown in Figs. 1 to 3, the housing 1 of the circuit breaker is provided with three shafts respectively installed in the housing 1, which respectively are a shaft for fixing one end of the tension spring 13, a mechanism rotation shaft 6 and a limit shaft 7, the moving contact 4 is pivotally installed on the mechanism rotation shaft 6 in the housing 1, the moving contact 4 is fixed on the mechanism rotation shaft 6 and the limit shaft 7 of the housing 1 by the tension spring 13, the extension spring 13 and the limit shaft 7 are respectively located on two sides of the moving contact 4, and the limit shaft 7 defines a rotation range of the moving contact 4.

[0021] As shown in Fig. 4, the moving contact 4 is provided with an arc-shaped groove hole 41, a driving groove 42, a pivot hole 43, a limit groove 44, a spring hook 45 and a moving contact point 40, and the arc-shaped groove hole 41 is installed and cooperated with the mechanism rotation shaft 6 on the housing 1 ;the limit groove 44 is in contact cooperation with the limit shaft 7 on the housing 1; and the driving groove 42 on the moving contact 4 is in driving cooperation with a driving end 32 of the driving connecting rod 3, and the pivot hole 43 on the moving contact 4 is installed and coupled with a pivot 52 on the trip lever 5. One end of the tension spring 13 is coupled with the housing 1, the other end of the tension spring 13 is coupled with a spring hook 45 on the moving contact 4, so that the moving contact 4 is fixed on the rotating shaft 6 and the limit shaft 7 of the housing 1 by the tension spring 13, and the tension spring 13 provides the contact pressure required by the moving and stationary contacts to reach the reliability of electrical contact. The driving connecting rod 3 can slide in the concave driving groove 42 of the moving contact 4 and push the moving contact 4 to rotate, the moving contact can rotate around the mechanism rotation shaft 6 to reach a contact position of the moving and stationary contacts, and when the operating mechanism is buckled again, a change occurs from a force bearing point of the moving contact 4,

so that the moving contact 4 is separated from the mechanism rotation shaft 6. As a specific preferred embodiment of the present invention shown in Fig. 4, the moving contact 4 is provided with the arc-shaped groove hole 41 and the pivot hole 43, one end is provided with a concave driving groove 42, the other end is provided with the moving contact point 40, the spring hook 45 and the limit groove 44 are respectively located on two sides of the moving contact 4, the spring hook 45 is located between the arc-shaped groove hole 41 and the driving groove 42, the limit groove 44 is located between the arc-shaped groove hole 41 and the moving contact 4, the pivot hole 43 is located between the limit groove 44 and the arc-shaped groove hole 41, the arc-shaped groove hole 41 is located on a side of the moving contact 4 close to the spring hook 45, and the pivot hole 43 is located on a side of the moving contact 4 close the limit groove 44.

[0022] Thus it can be seen that, an advantageous feature of the operating mechanism of a miniature circuit breaker of the present invention is that three structural solutions different from the prior art are comprised simultaneously: the first solution adopts a three-bar linkage consisting of the driving connecting rod 3, the moving contact 4 and the trip lever 5, omitting a traditional latch lever; the second solution adopts a structure of the moving contact 4, omitting a traditional rotating plate supported by the contact and the overstretching mechanism or a communication mechanism arranged between the contact supporting and the moving contact; the third solution adopts a spring structure that can provide the energy storage elastic force, the contact pressure and the overstretching elastic force at the same time, i.e., the tension spring 13 that can still ensure complete functions of elastic force energy storage, elastic contact and elastic overstretching, omitting the traditional overstretching spring. The essence of the present invention not only changes an integral structure solution of the operating mechanism and a working principle, but also changes the specific structural solution of the operating mechanism, such as a force system structure, a locking structure, an overstretching structure, a closing/breaking conversion structure, etc. of the mechanism. Obviously, the design has the characteristics of simple structure and few parts, which can effectively reduce the manufacturing cost and increase the production efficiency. At the same time, the performance of the mechanism can be optimized.

[0023] The force system structure of the present invention mainly relates to a force system balance structure of an elastic force driving structure and a core member. The elastic force driving structure can have various specific implementation modes, and a preferred mode adopted by the present invention is that: the tension spring 13 not only provides the energy storage elastic force for breaking of the moving contact 4 and the stationary contact 10, but also provides the contact pressure and the overstretching elastic force for closing the moving contact 4 and the stationary contact 10. In the existing four-bar linkage, the elastic force driving structure shall use a energy storage spring and an overstretching spring, each of the two springs has the own function, wherein the energy storage spring provides the energy storage elastic force for breaking the moving contact and the stationary contact (i.e., the elastic force energy storage), and the overstretching spring provides the contact pressure (i.e., the elastic contact) and the overstretching elastic force (i.e., elastic overstretching) for closing the moving contact and the stationary contact, and one function is missed when one spring is missed. The present invention adopts a tension spring 13 to realize three elastic force driving functions of the elastic force energy storage, the elastic contact and the elastic overstretching. The force system balance structure of the present invention can have a variety of specific implementation modes, and a preferred mode adopted by the present invention comprises the following two situations. The first situation is that: in the state that the moving contact 4 and the stationary contact 10 are closed (as shown in Fig. 3), an acting force on the moving contact 4 comprises a pulling force of a spring hook 45 of the tension spring 13 acting on the moving contact 4, a contact pressure of the stationary contact 10 acting on a moving contact point 40, and locking forces of the driving end 32 of the driving connecting rod 3 and the locking surface 51 of the trip lever 5 jointly acting on the driving groove 42 of the moving contact 4 (i.e., the driving between the driving end 32 of the driving connecting rod 3 and the driving groove 42 on the moving contact 4 is in a state of transferring force, a mutually affected driving force shall exist between the driving end 32 and the driving groove 42), and a resultant force of the contact pressure and the locking force is balanced with the pulling force of the tension spring 13. In the first situation shown in Fig. 3:the mechanism rotation shaft 6 on the housing 1 does not provide a restraining force to the arc-shaped groove hole 41 on the moving contact 4, and that is, the installation and cooperation between the mechanism rotation shaft 6 and the arc-shaped groove hole 41 are in a separated state; and the limit shaft 7 on the housing 1 does not provide a contact force to the limit groove 44 on the moving contact 4, and that is, the contact between the limit groove 44 and the limit shaft 7 on the housing 1 is in a separated state. The second situation is that: in the state that the moving contact 4 and the stationary contact 10 are broken (as shown in Fig. 1), an acting force on the moving contact 4 comprises a pulling force of the spring hook 45 of the tension spring 13 acting on the moving contact 4, a restraining force of the mechanism rotation shaft 6 on the housing 1 acting on the arc-shaped groove hole 41 on the moving contact 4, and a contact force of the limit shaft 7 on the housing 1 acting on the limit groove 44 of the moving contact 4, and a resultant force of the contact force and the pulling force of the tension spring 13 is balanced with the restraining force of the arc-shaped groove hole 41. In the second situation as shown in Fig. 1, the driving between the driving end 32 of the driving connecting rod 3 and the driving groove 42 on the moving contact 4 is

in a state that the force is not transferred, and although the locking surface of the trip lever 5 is in a locking state, the mutually affected driving force is not need (which does not exist actually) between the driving end 32 of the driving connecting rod 3 and the driving groove 42 on the moving contact 4. In the state that the moving contact 4 and the stationary contact 10 are closed, an acting force on the moving contact 4 comprises a pulling force of the tension spring 13 acting on the spring hook 45, a contact pressure of the stationary contact 10 acting on the moving contact point 40, and locking forces of the driving end 32 of the driving connecting rod 3 and the locking surface 51 of the trip lever 5 jointly acting on the driving groove 42, and a resultant force of the contact pressure and the locking force is balanced with the pulling force of the tension spring 13. in the state that the moving contact 4 and the stationary contact 10 are broken, an acting force on the moving contact 4 comprises a pulling force of the tension spring 13 acting on the spring hook 45, a restraining force of the mechanism rotation shaft 6 on the housing 1 acting on the arc-shaped groove hole 41, and a contact force of the limit shaft 7 on the housing 1 acting on the limit groove 44, and a resultant force of the contact force and the pulling force of the tension spring 13 is balanced with the restraining force of the arc-shaped groove hole 41. It shall be understood that, the force system balance structure is the key for guaranteeing the operation performance and the action performance of the mechanism to the operating mechanism of a miniature circuit breaker, the force system structure of the present invention is relatively simple and reasonable, and unnecessary power loss and interference between forces can be avoided, so as to guarantee the stability and reliability of force balance, and the rapid and sensitive action of the operating mechanism.

[0024] The locking structure can have various specific implementation modes, and a preferred mode adopted by the present invention is that: the trip lever 5 is provided with a locking surface 51, a pivot 52 and a release driving part 53, the locking surface 51 and the driving connecting rod 32 of the driving connecting rod 3 are locked and unlocked, and the pivot shaft 52 is installed and coupled with a pivot hole 43 on the moving contact 4. The locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4 comprises locking cooperation and unlocking cooperation, one end of the moving contact 4 is provided with a driving groove 42 that is in driving cooperation with a driving end 32 of the driving connecting rod 3, the trip lever 5 is pivotally installed on the moving contact 4, the trip lever 5 is provided with a release driving part 53 and a locking surface 51 for realizing the locking and unlocking cooperation between the driving connecting rod 3 and the moving contact 4. Wherein, the locking cooperation makes the locking surface 51 on the trip lever 5 abut with the driving end 32 of the driving connecting rod 3, and locks the driving end 32 of the driving connecting rod 3 in the driving groove 42 of the moving contact 4, and the driving end 32 of the driving connecting rod 3 and the locking face 51 of the trip lever 5 generate the locking forces acting on the driving groove 42 together; and the unlocking cooperation makes the locking surface 51 be separated from the driving end 32 of the driving connecting rod 3, and make the driving end 32 of the driving connecting rod 3 slide in the driving groove 42. Obviously, the advantage of the structure lies in that, the locking and unlocking cooperation is established between the locking surface 51 on the trip lever 5 and the driving end 32 of the driving connecting rod (rod-like structure), compared with the traditional sharp-fanged meshing, the cooperation has obvious advantage of wear resistance, can also provide larger locking force, and can effectively improve the reliability of the locking. As shown in Figs. 1 to 3, regarding to a specific preferred embodiment of the trip lever 5 of the present invention, the trip lever 5 comprises a locking arm and a driving arm connected, an end portion of the locking arm is provided with the locking surface 51, the driving arm is provided with the release driving part 53, a V-type groove is formed between the locking arm and the driving arm, the locking arm is provided with the pivot 52 rotatably matched with the moving contact 4, the trip lever 5 is installed on the pivot hole 43 of the moving contact 4 through the pivot 52, and the V-type groove of the trip lever 5 is correspondingly arranged with the limit shaft 7.

[0025] The specific locking structure matched with the locking and unlocking cooperation structures above can have a variety of specific implementation modes, and a preferred mode adopted by the present invention comprises the following two situations. The first situation is that: the trip lever 5 is also provided with a reset device (not shown in the drawing) for driving the release driving part 53 on the trip lever 5 to rotate around the pivot 52 thereof, the reset rotation of the trip lever 5 drives the locking surface 51 thereon to abut with the driving end 32 of the driving connecting rod 3, so as to lock the driving end 32 in the driving groove 42 of the moving contact 4, and that is, the locking surface 51 and the driving end 32 of the driving connecting rod 3 are in a locking cooperation state. A return spring (not shown in the drawing) can be used in the reset device, and two ends thereof are respectively coupled with the trip lever 5 and the moving contact 4. An elastic angle device (not shown in the drawing) arranged on the trip lever 5 can also be used, and a corner end of the elastic angle establishes a friction and/or limit communication with the moving contact 4 or the housing 1. The second situation is that: The trip device of the miniature circuit breaker drives the release driving part 53 on the trip lever 5 to rotate around the pivot 52 thereof, and the rotation drives the locking surface 51 thereon to separate from the driving end 32 of the driving connecting rod 3, so that the driving end 32 can slide in the driving groove 42, and that is, the locking surface 51 and the driving end 32 of the driving connecting rod 3 are in an unlocking cooperation state. Generally, the trip device of the miniature circuit breaker comprises

two kinds of releases, one of which is an electromagnetic release, when the electromagnetic releasing condition is reached in the circuit, a firing pin 12 sleeved with a mandril action spring 11 of the electromagnetic release pops up to strike the release driving part 53 on the trip lever 5, so as to drive the trip lever 5 to rotate around the pivot 52 thereof. The other is a heat release, when a heat releasing condition is reached in the circuit, the heat sensing device 9 (such as a bimetallic strip device) bends and a driving shaft 8 pulls the release driving part 53 on the trip lever 5, so as to drive the trip lever 5 to rotates around the pivot 52 thereof. It needs to be emphasized that: the unlocking cooperation only occurs when the trip device drives the trip lever 5, or only occurs during a tripping process of the miniature circuit breaker, and the unlocking cooperation cannot occur during the processes of normal closing and normal opening. In a normal closing state (as shown in Fig. 3) and a normal opening state (as shown in Fig. 1), in a normal closing operation process (as the operation shown in Fig. 1 to the process shown in Fig. 3), and in a process of normal opening operation process (as the operation shown in Fig. 3 to the process shown in Fig. 1), since the trip device does not drive the trip lever 5, the trip lever 5 is always in the locking operation state. Especially, due to the effect of the reset device, as long as the trip device removes the driving to the trip lever 5, the trip lever 5 can automatically reset to the locking cooperation state regardless of the position, thereby ensuring the reliability of normal closing and normal opening.

[0026] The overstretching structure can have various specific implementation modes, and a preferred mode adopted by the present invention is shown in Fig. 3:the moving contact 4 is rotatably installed on the mechanism rotation shaft 6 through a strip arc-shaped groove hole 41 on the moving contact 4, in the state that the moving contact 4 and the stationary contact 10 are closed, an overstretching gap h is arranged between the arc-shaped groove hole 41 of the moving contact 4 and the mechanism rotation shaft 6 on the housing 1, and the overstretching gap is realized through the strip arc-shaped groove hole 41 instead of a circular arc-shaped groove hole 41. The overstretching gap is realized by the installation and cooperation structures of the arc-shaped groove hole 41 and the mechanism rotation shaft 6 on the housing 1, the installation and cooperation enable the arc-shaped groove hole 41 installed on the mechanism rotation shaft 6 to be in sliding cooperation with the mechanism rotation shaft 6, so that the overstretching gap h can be formed in the process that the moving contact 4 and the stationary contact 10 are operated to close (i.e., the breaking state shown in Fig. 1 is operated into the closing state shown in Fig. 3), and the overstretching of the moving contact well known is compensated by the overstretching gap h. The specific overstretching compensation principle is as follows: in the state of breaking shown in Fig. 1, the handle 2 is operated to rotate in a clockwise direction, the moving contact 5 is driven by the driving connecting rod 3 to rotate in a clockwise direction around the mechanism rotation shaft 6 and contact with the stationary contact 10, so as to reach a momentary state shown in Fig. 2, in the state and before the state, the moving contact 5 rotates with the mechanism rotation shaft 6 as a supporting point, and that is, the overstretching gap h between the arc-shaped groove hole 41 and the mechanism rotation shaft 6 on the housing 1 is 0. When the handle 2 continues to rotate, a rotational supporting point of the moving contact 5 leaves the mechanism rotation shaft 6 and is transferred to the stationary contact 10, at the moment, the moving contact 4 rotates with a contact point of the stationary contact 10 as a circle center, and the moving contact 4 is separated from the mechanism rotation shaft 6 on the housing 1 by the overstretching gap h, until normal closing operation is finished at a complete operating position shown in Fig. 3. Certainly, from the state of closing shown in Fig. 3, the handle 2 is operated in the opposite direction to be returned to the state of breaking shown in Fig. 1, the normal opening operation is completed, and the positions of a action part is a reverse change of the operation above.

[0027] The closing/breaking conversion structure can have various specific implementation modes, and a preferred mode adopted by the present invention is that: in the state that the moving contact 4 and the stationary contact 10 are closed, an extension line of a connecting line between two ends 31 and 32 of the driving connecting rod 3 is stabilized below a center of rotation O of the handle 2 (as shown in Fig. 3), thereby making the operating mechanism stabilize in the state of closing; in the state that the moving contact 4 and the stationary contact 10 are broken, the extension line is stabilized above the center of rotation O of the handle 2 (as shown in Fig. 3), so that the operating mechanism is stabilized in the state of opening; and in a trip process, the extension line is transferred from a position below the center of rotation O of the handle 2 to a position above the center of rotation O in a trip process. It is not difficult to imagine that, in the trip process, the extension line being transferred from the position below to the position above is caused by the unlocking action of the trip lever 5, and that is, when the trip lever 5 is driven by the trip device to rotate around the pivot 52, the locking surface 51 thereon is separated from the driving end 32 of the driving connecting rod 3 and can slide in the driving groove 42. The sliding enables the driving end 32 of the driving connecting rod 3 to move downwardly, and the movement causes the extension line to rotate in a clockwise direction around one end 31 of the driving connecting rod 3, which eventually causes the extension line to pass a point of inflection (the center of rotation 0 of the handle 2) from the position below, and once the extension line passes the point of inflection, the elastic force of the tension spring 13 drives the moving contact 4 to rotate in the breaking direction (counterclockwise direction), until the moving contact 4 is in the state of stable breaking shown in Fig. 1, and that is to complete the tripping action.

[0028] The content above is further detailed description to the present invention with reference to specific preferred embodiments, and it cannot be assumed that the specific implementation of the present invention is limited to these descriptions. For those skilled in the art to which the present invention belongs, several simple deductions or substitutions can be made without departing from the concept of the present invention, and shall all be considered as falling within the protection scope of the present invention.

Claims

1. An operating mechanism of a miniature circuit breaker, comprising a handle (2) pivotally installed on a housing (1), a driving connecting rod (3), a stationary contact (10) and a moving contact (4) arranged in the housing (1), wherein: the operating mechanism of a miniature circuit breaker further comprises a tension spring (13) and a trip lever (5), one end of the driving connecting rod (3) is hinged with the handle (2), the other end of the driving connecting rod (3) is matched with the moving contact (4), one end of the tension spring (13) is fixed on the housing (1), and the other end of the tension spring (13) is connected to the moving contact (4); the moving contact (4) is driven by the tension spring (13) and the driving connecting rod (3) together to provide a contact pressure and an overstretching elastic force required for ensuring the reliability of electrical contact for closing the moving contact (4) and the stationary contact (10), and the tension spring (13) provides an energy storage elastic force required for resetting the mechanism for breaking the moving contact (4) from the stationary contact (10); and the trip lever (5) is arranged on the moving contact (4), and is used to control the locking and unlocking cooperation between the driving connecting rod (3) and the moving contact (4), when a failure occurs, the trip lever (5) separates the driving connecting rod (3) from the moving contact (4) so that the operating mechanism automatically trips.

2. The operating mechanism of a miniature circuit breaker according to claim 1, wherein: the housing (1) is internally provided with a mechanism rotation shaft (6) and a limit shaft (7), the moving contact (4) is pivotally installed on the mechanism rotation shaft (6) in the housing (1), the moving contact (4) is fixed on the mechanism rotation shaft (6) and the limit shaft (7) of the housing (1) by the tension spring (13).

3. The operating mechanism of a miniature circuit breaker according to claim 2, wherein: the moving contact (4) is rotatably installed on the mechanism rotation shaft (6) through a strip arc-shaped groove hole (41) thereon, the installation and cooperation between the arc-shaped groove hole (41) of the moving contact (4) and the mechanism rotation shaft (6) comprise having an overstretching gap h in a state that the moving contact (4) and the stationary contact (10) are closed.

4. The operating mechanism of a miniature circuit breaker according to claim 2, wherein: the moving contact (4) is provided with an arc-shaped groove hole (41), a driving groove (42), a pivot hole (43), a limit groove (44), a spring hook (45) and a moving contact point (40), and the arc-shaped groove hole (41) is installed and cooperated with the mechanism rotation shaft (6) on the housing (1);the limit groove (44) is in contact cooperation with the limit shaft (7) on the housing (1); and the driving groove (42) on the moving contact (4) is in driving cooperation with a driving end (32) of the driving connecting rod (3), and the pivot hole (43) on the moving contact (4) is installed and coupled with a pivot (52) on the trip lever (5).

5. The operating mechanism of a miniature circuit breaker according to claim 4, wherein: the moving contact (4) is provided with the arc-shaped groove hole (41) and the pivot hole (43), one end is provided with a concave driving groove (42), the other end is provided with the moving contact point (40), the spring hook (45) and the limit groove (44) are respectively located on two sides of the moving contact (4), the spring hook (45) is located between the arc-shaped groove hole (41) and the driving groove (42), the limit groove (44) is located between the arc-shaped groove hole (41) and the moving contact (4), the pivot hole (43) is located between the limit groove (44) and the arc-shaped groove hole (41), the arc-shaped groove hole (41) is located on a side of the moving contact (4) close to the spring hook (45), and the pivot hole (43) is located on a side of the moving contact (4) close the limit groove (44).

6. The operating mechanism of a miniature circuit breaker according to claim 1, wherein: one end of the moving contact (4) is provided with a driving groove (42) that is in driving cooperation with a driving end (32) of the driving connecting rod (3), the trip lever (5) is pivotally installed on the moving contact (4), the trip lever (5) is provided with a release driving part (53) and a locking surface (51) for realizing the locking and unlocking cooperation between the driving connecting rod (3) and the moving contact (4).

7. The operating mechanism of a miniature circuit breaker to claim 6, wherein: the locking cooperation is that the locking surface (51) on the trip lever (5) abuts with the driving end (32) of the driving connecting rod (3), the driving end (32) is locked in the driving groove (42) on the moving contact (4), and

the driving end (32) of the driving connecting rod (3) and the locking surface (51) of the trip lever (5) generate a locking force acting jointly on the driving groove (42); and the unlocking cooperation is that the locking surface (51) on the trip lever (5) is separated from the driving end (32) of the driving connecting rod (3), and the driving end (32) can slide in the driving groove (42) on the moving contact (4).

8. The operating mechanism of a miniature circuit breaker according to claim 1, wherein: the trip lever (5) is further provided with a reset device for driving the trip lever (5) to rotate around a pivot (52), the reset rotation of the trip lever (5) drives a locking surface (51) on the trip lever (5) to abut with a driving end (32) of the driving connecting rod (3), which locks the driving end (32) in the driving groove (42) on the moving contact (4), so as to lock the driving connecting rod (3) with the moving contact (4).

9. The operating mechanism of a miniature circuit breaker according to claim 1, wherein: a release driving part (53) on the trip lever (5) is driven by a trip device of the miniature circuit breaker to rotate around a pivot (52) and drive a locking surface (51) of the trip lever (5) to separate from a driving end (32) of the driving connecting rod (3), and the separation enables the driving end (32) to slide in a driving groove (42) on the moving contact (4), so as to unlock the driving connecting rod (3) and the moving contact (4).

10. The operating mechanism of a miniature circuit breaker according to claim 1, wherein: an extension line of a connecting line between two ends (31 and 32) of the driving connecting rod (3) is stabilized below a center of rotation O of the handle (2) in a state that the moving contact (4) and the stationary contact (10) are closed; an extension line of a connecting line between two ends (31 and 32) of the driving connecting rod (3) is stabilized above a center of rotation O of the handle (2) in a state that the moving contact (4) and the stationary contact (10) are broken; and the extension line between the two ends (31 and 32) of the driving connecting rod (3) is transferred from a position below the center of rotation O of the handle (2) to a position above the center of rotation O in a trip process.

11. The operating mechanism of a miniature circuit breaker according to claim 3, wherein: in the state that the moving contact (4) and the stationary contact (10) are closed, an acting force on the moving contact (4) comprises a pulling force of the tension spring (13), a contact pressure of the stationary contact (10) acting on the moving contact point (40) of the moving contact (4), and locking forces of the driving end (32) of the driving connecting rod (3) and the locking surface (51) of the trip lever (5) jointly acting on the driving groove (42) of the moving contact (4), and a resultant force of the contact pressure and the locking force is balanced with the pulling force of the tension spring (13); and in the state that the moving contact (4) and the stationary contact (10) are broken, an acting force on the moving contact (4) comprises a pulling force of the tension spring (13), a restraining force of the mechanism rotation shaft (6) on the housing (1) acting on the arc-shaped groove hole (41), and a contact force of the limit shaft (7) on the housing (1) acting on the limit groove (44) of the moving contact (4), and a resultant force of the contact force and the pulling force of the tension spring (13) is balanced with the restraining force of the mechanism rotation shaft (6) acting on the arc-shaped groove hole (41).

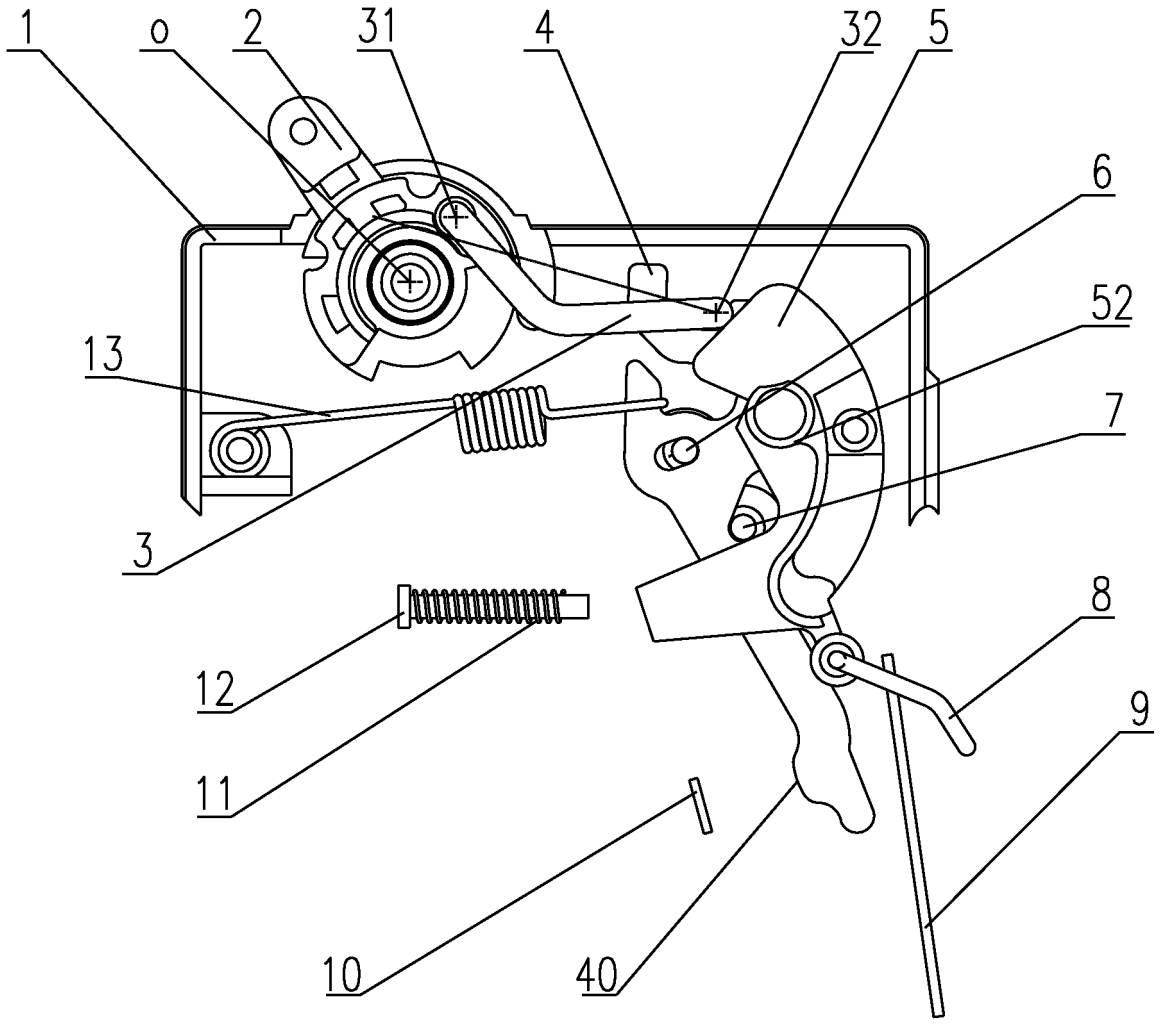

Fig. 1

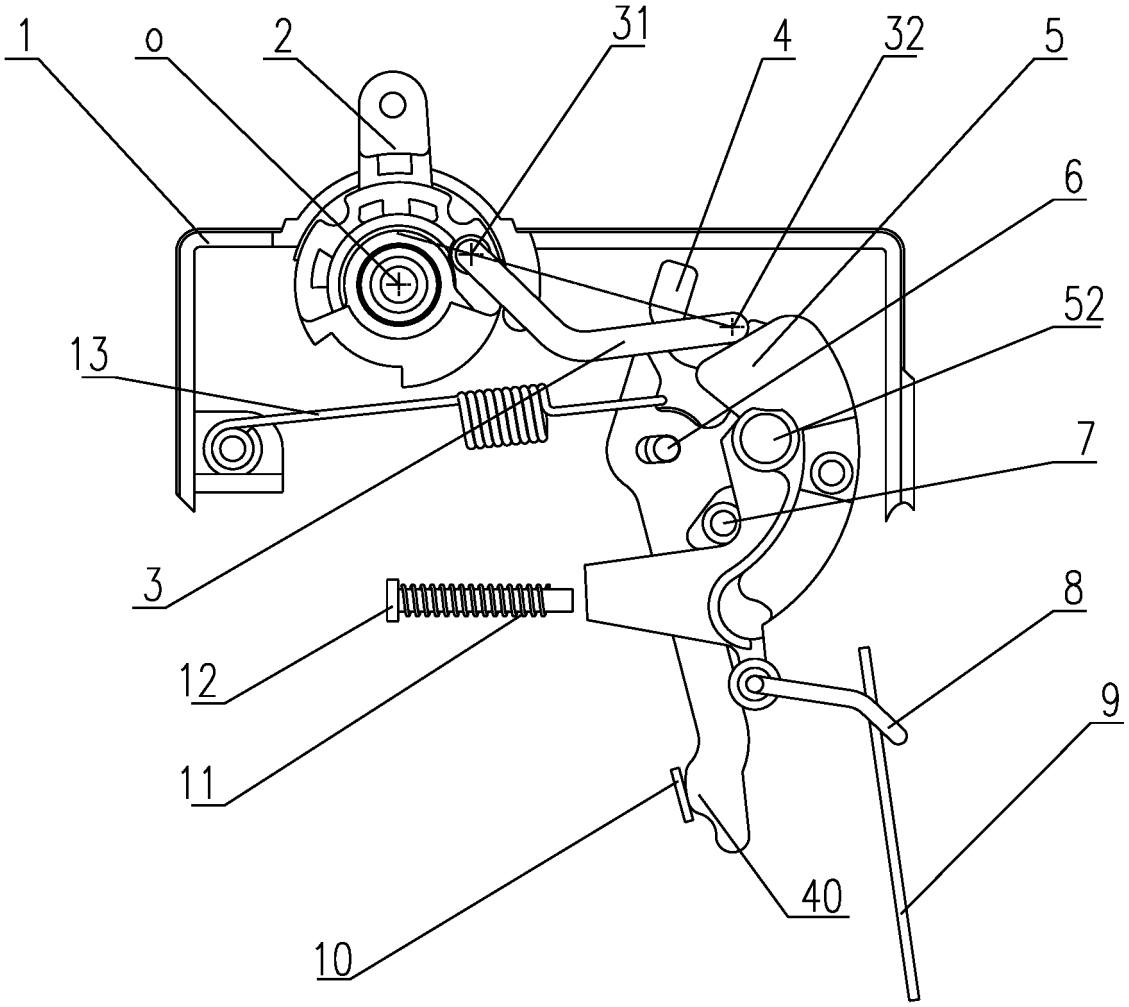

Fig. 2

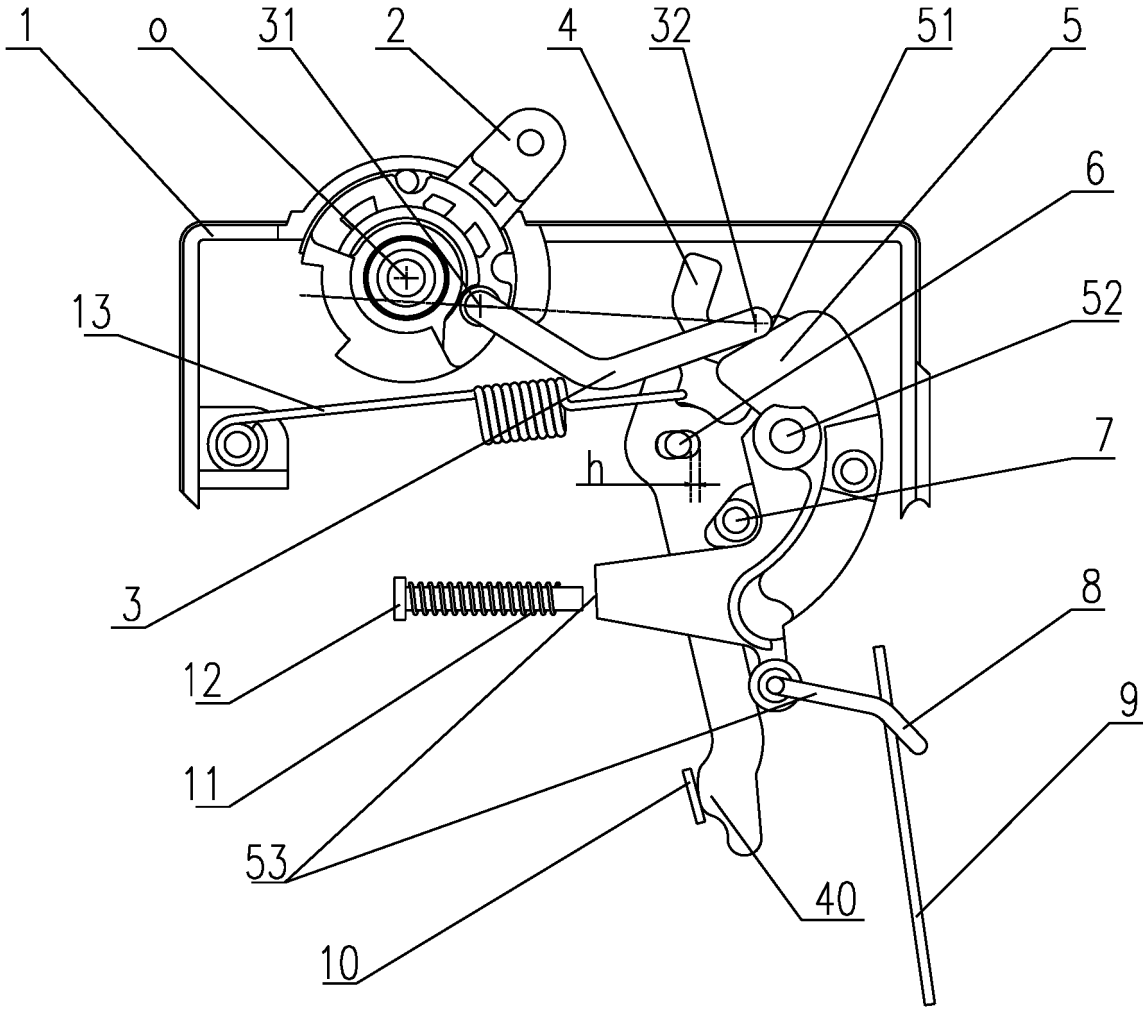

Fig. 3

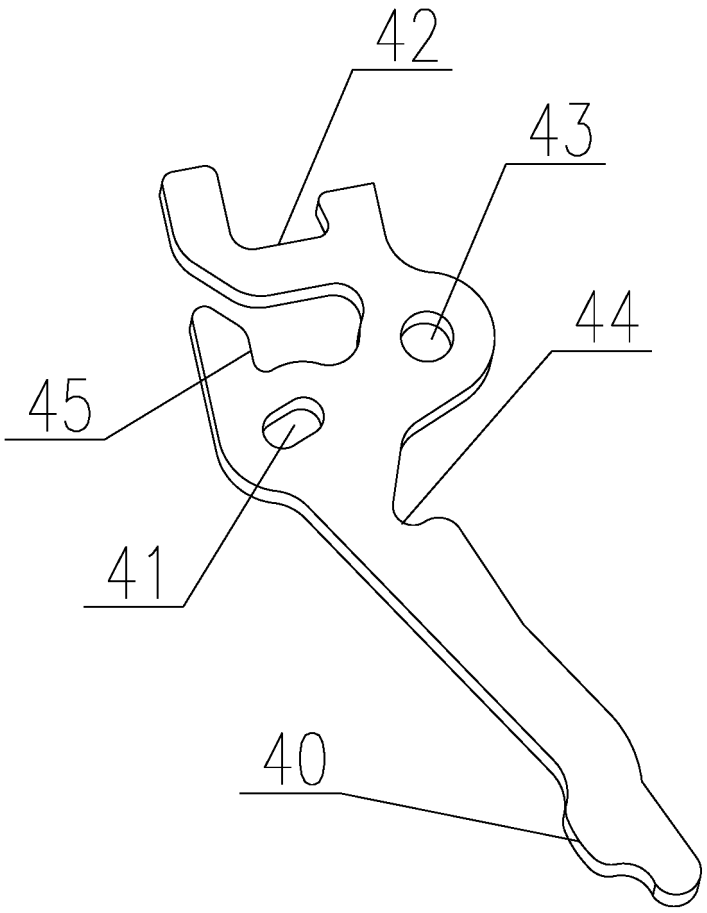

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/103018

A. CLASSIFICATION OF SUBJECT MATTER

H01H 71/10 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H

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

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

WPI, EPODOC, CNPAT, CNKI: operating mechanism, contact, pivot, extension spring, jump, BREAKER, OPERATE, MECHANISM, CONNECT, ROD, DRIVING, ROTATING SHAFT, HANDLE, SPRING, TRIP+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 205487987 U (ZHEJIANG CHINT ELECTRICS CO., LTD.), 17 August 2016 (17.08.2016), claims 1-7, 9-10, description, paragraphs [0004]-[0032], and figures 1-4	1-11
A	CN 203434106 U (YUEQING SHENGYU ELECTRIC CO., LTD.), 12 February 2014 (12.02.2014), description, paragraphs [0005]-[0011], and figures 1-3	1-11
A	CN 101677049 A (ZHENG, Chunkai), 24 March 2010 (24.03.2010), the whole document	1-11
A	CN 103346046 A (WENZHOU ROCKGRAND TRADE CO., LTD.), 09 October 2013 (09.10.2013), the whole document	1-11
A	JP H0636668 A (FUJI ELECTRIC CO., LTD.), 10 February 1994 (10.02.1994), the whole document	1-11
A	JP H06176678 A (FUJI ELECTRIC CO., LTD.), 24 June 1994 (24.06.1994), the whole document	1-11

☐ 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
11 January 2017 (11.01.2017)	**26 January 2017 (26.01.2017)**
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 **TANG, Hexiang** Telephone No.: (86-10), **01061648114**

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/103018

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 205487987 U	17 August 2016	None	
CN 203434106 U	12 February 2014	None	
CN 101677049 A	24 March 2010	CN 101677049 B	28 December 2011
CN 103346046 A	09 October 2013	None	
JP H0636668 A	10 February 1994	None	
JP H06176678 A	24 June 1994	None	

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