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(54) CIRCUIT BREAKER FOR WIRING

SCHUTZSCHALTER FÜR VERDRAHTUNG

DISJONCTEUR DESTINÉ À UN CÂBLAGE

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(56) References cited:
WO-A1-03/054898
DE-C- 448 516
KR-A- 20040 074 429
KR-A- 20060 101 035
KR-A- 20070 093 498
US-A- 4 691 182
US-B1- 6 788 174

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Description

[Technical Field]

[0001] This application relates to a circuit breaker and more particularly to a circuit breaker that may connect or disconnect electrical path by a manual operation or an electrical operation and may block a current when an abnormal current such as overload current and short circuit current is generated thereby the circuit breaker may change instantaneous characteristic through simple operation, may enlarge temporary adjustment range and increase product reliability. A circuit breaker according to the preamble of claim 1 is known from WO 03/054898 A1.

[Background Art]

[0002] Korean Patent Publication No. 10-2009-0099891 discloses a molded case circuit breaker with an instantaneous trip device that is provided to rapidly and reliably perform an instantaneous trip by installing a main circuit unit on a lower compartment and a mechanical instantaneous trip device and a switch on an upper compartment. The molded case circuit breaker with the instantaneous trip device comprises a main circuit unit be positioned on a lower compartment of a molded case circuit breaker and including a fixed contact and a movable contact. A switch is positioned on an upper compartment of the molded case circuit breaker and has an open driving position to open a circuit and a closed driving position to form a closed circuit. A mechanical instantaneous trip triggers the switch to operate at the open driving position by an electromagnetic absorption force due to an abnormal current on a circuit. An insulation partition is installed between the upper compartment and the lower compartment.

[0003] Korean Utility Model Registration No.20-1999-0031458 discloses a technology that implements a structure of a trip device operating a switchgear when a fault current is detected to cause the switchgear to be properly operated although a trip current is detected in an any phase of a RST phase. The technology includes a trip case where a detection unit detecting an overload current and a short circuit current is embedded in each phase, a trip bar being installed inner side of upper part of the trip case to be rotatable in a certain angle and being interlocked by an operation of the detection unit of the overload current and the short circuit current to resist a spring restitution force and turning toward the power side to be integrally connected across each phase, a trip cover being equipped with the trip case and forming a shutter rotation supporting unit on an outside of the trip cover, a shutter being rotatably installed on the shutter rotation supporting and including a nail hitting unit hitting a nail in a trip operation, a handle contact being in contact with a handle for opening and closing on a reset and a locking unit being locked on a upper side of a shutter control unit of the trip bar on a reset and being locked in the shutter control unit of trip bar on reset and turn on and deviating the shutter control unit on a manual trip or an automatic trip and an elastic member being contracted until the locking unit of the shutter is released from the trip bar and the shutter control unit when the trip bar is rotated to give a strong rotational moment to the shutter by a restitution force according to releasing the locking unit of the shutter.

[0004] Korean Patent Publication No. 10-2008-0008920 relates to a trip device of an earth leakage circuit breaker and more particularly to secure safety of the earth leakage circuit breaker by having a button protruded in trip of the earth leakage circuit breaker to allow a user to recognize cut-off of power. The technology comprises a trip device of the earth leakage circuit breaker being equipped in a case and includes two bimetals of which one ends are connected to a power connection terminal and a driving trip bar with upper and lower insertion grooves to insert the other ends of the bimetals. A zero-phase current transformer is installed between the two bimetals. An operating trip bar is placed at the other side of the driving trip bar, mounted to an axis of a case, and rotated around the axis by vertical movement of the driving trip bar. A leakage current trip unit is mounted on an upper part of the overcurrent trip unit and has a printed circuit board with a trip circuit which pulls an upper end of the operating trip bar to rotate the operating trip bar around the axis at a predetermined angle. A contact bus is mounted on the other side of the operating trip bar. One end of a pressing plate is mounted on a stopping protrusion of the operating trip bar, and the other end thereof is mounted on a pushing plate of the contact bus to press the operating trip bar and the contact bus. The pressing plate releases pressing by being separated from the stopping protrusion during rotation of the operating trip bar. A handle is connected to the pressing plate to press the pressing plate.

[0005] As described above, the circuit breaker automatically blocks a circuit when an abnormal current (e.g., overload current and short circuit current) occurs in an electric circuit to protect the circuit and includes a terminal unit connecting a power side and a load side, a main circuit formed with a fixable contact and a movable contact in the circuit breaker, a switch unit connecting or disconnecting the main circuit and a trip unit automatically actuating the switch unit when the abnormal current occurs to block the main circuit. Herein, the trip unit detects the abnormal current in the circuit breaker independently of a manual operation when the abnormal current occurs thereby the trip unit automatically shorts a circuit.

[0006] A trip detects current amount therein to block the main circuit within current amount exceeding predetermined percent of a rated current and a proper time when an instantaneous current flows, that is, when a current exceeds the predetermined percent of a rated current. Such function is referred to as a instantaneous trip function. However, a general trip device has a disadvan-

tage of not variously and constantly adjusting the predetermined percent of a rated current and such problem may cause trip function reliability.

[Technical Problem]

[0007] This application proposes to provide a circuit breaker capable of adjusting an instantaneous current as a predetermined percent of a rated current through a simple operation of an instant dial and the instantaneous current being a main circuit blocking current when an abnormal current occurs in a circuit breaker.

[0008] This application proposes to provide a circuit breaker capable of adjusting a moment arm length between an instant spring and an armature through a plurality of local depressions, each corresponding to instantaneous value of an instant dial and adjusting an instantaneous current where a trip occurs as a wide percent range of a rated current.

[0009] This application proposes to provide a circuit breaker capable of detecting an abnormal current when an abnormal current occurs in a circuit breaker to automatically actuate a switch and to block a main circuit for main circuit protection.

[Technical Solution]

[0010] In some embodiments, a circuit breaker includes a fixable contact unit, a movable contact unit opposing the fixable contact unit, a switch unit actuating the movable contact unit and a trip unit blocking a main circuit through the switch unit when an abnormal current occurs,

[0011] and the trip unit includes an instant dial and an instant spring, the instant dial including a magnet, an armature opposing the magnet, a temporary adjustment unit, an instant bar actuating the temporary adjustment unit and a cam being in contact with the instant bar and the instant spring connecting one side of the temporary adjustment unit and one side of the armature,

[0012] and the cam may include a plurality of local depressions, each corresponding to an instantaneous value and adjusts a moment arm length between the instant spring and the armature through the plurality of the local depressions.

[0013] In one embodiment, the instant bar may further include a shaft for a rotation with an arm being in contact with the cam and the instant bar. The instant bar may determine a contact surface of the cam being in contact with the arm through the instant dial to adjust a rotation angle of the temporary adjustment unit. The instant spring may be expanded or contracted according to the rotation angle of the temporary adjustment unit. The moment arm length may be defined as a vertical length between the instant spring and the armature.

[0014] In one embodiment, the magnet may be electrically connected with the main circuit to generate an electromagnetic force when the abnormal current occurs. The armature may be rotated by the electromagnetic force to be electrically connected with the magnet.

[Technical Effects]

[0015] The circuit breaker and related technologies may adjust an instantaneous current as a predetermined percent of a rated current through a simple operation of an instant dial and the instantaneous current being a main circuit blocking current when an abnormal current occurs in a circuit breaker.

[0016] The circuit breaker and related technologies may adjust a moment arm length between an instant spring and an armature through a plurality of local depressions, each corresponding to instantaneous value of an instant dial and adjusting an instantaneous current where a trip occurs as a wide percent range of a rated current.

[0017] The circuit breaker and related technologies may detect an abnormal current when an abnormal current occurs in a circuit breaker to automatically actuate a switch and to block a main circuit for main circuit protection.

[Description of Drawings]

[0018]

FIG. 1 is a cross sectional diagram illustrating a circuit breaker according to an example embodiment of the described technology.

FIG. 2 is a cross sectional diagram illustrating a trip unit of a circuit breaker in FIG. 1 where the trip unit is not adjusted through an instant dial.

FIG. 3 is a cross sectional diagram illustrating a trip unit of a circuit breaker in FIG. 1 where the trip unit is adjusted through an instant dial.

FIG. 4 is a diagram illustrating an instant dial in FIG. 2 through FIG. 3.

[Mode for Invention]

[0019] The embodiments and the configurations depicted in the drawings are illustrative purposes only and do not represent all technical scopes of the invention, so it should be understood that various equivalents and modifications may exist at the time of filing this application. Although a preferred embodiment of the disclosure has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

[0020] Terms and words used in the specification and the claims shall be interpreted as to be relevant to the technical scope of the invention based on the fact that the inventor may property define the concept of the terms to explain the invention in best ways.

[0021] The terms "first" and "second" can be used to

refer to various components, but the components may not be limited to the above terms. The terms will be used to discriminate one component from the other component. For instance, the first component may be referred to the second component and vice versa without departing from the right of the disclosure.

[0022] When a component is referred to as being "connected to" or "linked to" another component, the component may be directly connected to or linked to another component or an intervening component may be present therebetween. In contrast, if a component is referred to as being "directly connected to" or "directly linked to" another component, an intervening component may not be present therebetween.

[0023] The terms used in the specification are for the purpose of explaining specific embodiments and have no intention to limit the disclosure. Unless the context indicates otherwise, the singular expression may include the plural expression. In the following description, the term "include" or "has" will be used to refer to the feature, the number, the step, the operation, the component, the part or the combination thereof without excluding the presence or addition of one or more features, the numbers, the steps, the operations, the components, the parts or the combinations thereof.

[0024] Unless defined otherwise, the terms including technical and scientific terms used in this specification may have the meaning that can be commonly apprehended by those skilled in the art. The terms, such as the terms defined in the commonly-used dictionary, must be interpreted based on the context of the related technology and must not be interpreted ideally or excessively.

[0025] FIG. 1 is a cross sectional diagram illustrating a circuit breaker according to an example embodiment of the described technology.

[0026] Referring to FIG. 1, a circuit breaker 100 includes a fixable contact unit 110, a movable contact unit 120, a switch unit 130 and a trip unit 140.

[0027] The fixable contact unit 110 is fixedly installed inner of the circuit breaker 100 to form a fixed contact. In one embodiment, the fixable contact unit 110 may be formed by bending the fixed contact into U shape.

[0028] At this point, the U shape bending may wind a current flow direction of the fixable contact unit 110 and the movable contact unit 120 when an abnormal current (i.e., overload current, instantaneous current and short circuit current) occurs to increase an electric repulsion between the fixable contact unit 110 and the movable contact unit 120.

[0029] The movable contact unit 120 may oppose the fixable contact unit 110 and may be rotated through the switch unit 130 to be connected or disconnected with the fixable contact unit 110. In one embodiment, the movable contact unit 120 may be moved through a manual operation of the switch unit 130 or may be automatically moved through the trip unit 140.

[0030] The switch unit 130 may be connected with the movable contact unit 120 and may rotate the movable contact unit 120 to be connected or disconnected with the fixable contact unit 110. In one embodiment, the switch unit 130 may be manually actuated to connect or block a main circuit and may be automatically actuated through the trip unit 140 to connect or block the main circuit.

[0031] The trip unit 140 may detect the abnormal current when the abnormal current occurs and may automatically actuate the switch unit 130 to block the main circuit. In one embodiment, the trip unit 140 includes a magnet 141, an armature 142, a temporary adjustment unit 143, an instant bar 144, an instant dial 145 and an instant spring 146.

[0032] In another embodiment, the trip unit 140 may further include a hitter and a bimetal. The armature 142 may be actuated when the abnormal current more than or equal to about 10 times of the rated current in the main circuit flows to actuate the trip unit 140. The bimetal may be actuated when the abnormal current more than or equal to about 1.3 through 8 times of the rated current in the main circuit flows to actuate the trip unit 140.

[0033] FIG. 2 is a cross sectional diagram illustrating the trip unit 140 of the circuit breaker 100 in FIG. 1 not adjusted through the instant dial 145 and FIG. 3 is a cross sectional diagram illustrating the trip unit 140 of the circuit breaker 100 in FIG. 1 adjusted through the instant dial 145.

[0034] Referring to FIG. 2 through FIG. 3, the trip unit 140 includes the instant dial 145 including the magnet 141, the armature 142 opposing the magnet 141, the temporary adjustment unit 143, the instant bar 144 actuating the temporary adjustment unit 143 and a cam 145a being in contact with the instant bar 144 and the instant spring 146 connecting one side of the armature 142 with one side of the temporary adjustment unit 143. In one embodiment, the trip unit 140 may further include a shutter 147 actuating the switch unit 130 and a cross bar 148 limiting a movement of the shutter 147.

[0035] The magnet 141 may be electrically connected to the main circuit and may generate an electromagnetic force when the abnormal current occurs in the main circuit. In one embodiment, the magnet 141 may generate the electromagnetic force sufficient to pull the armature 142 when the abnormal current more than or equal to about 10 times of the rated current in the main circuit flows. An electromagnetic force strength capable of pulling the armature 142 may be adjusted through the instant dial 145.

[0036] The armature 142 may be rotated by the electromagnetic force being generated in the magnet 141 to be electrically connected with the magnet 141 and may rotate the cross bar 148. In one embodiment, the armature 142 rotated by the electromagnetic force may return to a position before rotation by an elasticity of the instant spring 146 after the abnormal current is removed.

[0037] The temporary adjustment unit 143 opposes the armature 142 and one side of the temporary adjustment unit 143 is connected with one side of the armature 142

by the instant spring 146. In one embodiment, another side of the temporary adjustment unit 143 may be in contact with the instant bar 144 and the temporary adjustment unit 143 may be rotated by a rotation of the instant bar 144.

[0038] The instant bar 144 may acutate the temporary adjustment unit 143 and may further include an arm 144a contacting the cam 145a and a shaft for a rotation of the instant bar 144. In one embodiment, the instant bar 144a may determine a contact surface of the cam 145a being in contact with the arm 144a through the instant dial 145 to adjust a rotation angle of the temporary adjustment unit 143. The instant bar 144 may be rotated to clockwise direction through the instant dial 145 and may rotate the temporary adjustment unit 143 to counterclockwise direction.

[0039] The instant dial 145 includes the cam 145a being in contact with the arm 144a of the instant bar 144 and the cam 145a includes a plurality of local depressions145b, each corresponding to an instantaneous value.

[0040] FIG. 4 is an enlarged diagram illustrating an instant dial in FIG. 2 through FIG. 3.

[0041] In FIG. 2, FIG. 3 and FIG. 5, the instant dial 145 includes the cam 145a where a radius of the cam is gradually increased along a circumference thereof and the circumference forms the plurality of the local depressions 145b, each corresponding to the instantaneous value. In one embodiment, the cam 145a may contact the instant bar 144 to adjust a rotation of the instant bar 144 and the temporary adjustment unit 143.

[0042] The instant spring 146 is expanded or contracted by the instant bar 144 and the temporary adjustment unit 143 being rotated through the instant dial 145.

[0043] A vertical length between the instant spring 146 and the armature 142 is defined as a moment arm length and the moment arm length is adjusted through a contact between the instant bar 144 and the plurality of the local depressions 145b of the instant dial 145. In one embodiment, the instant dial 145 may determine a current level actuating the trip unit 140 through adjustment of the moment arm length when the abnormal current occurs in the main circuit.

[0044] According as the arm 144a of the instant bar 144 is in contact with the cam 145a of the instant dial 145 at from a relatively smaller radius of the local depression to a relatively larger radius of the local depression, a clockwise rotation of the instant bar 144 increases thereby a counterclockwise rotation of the temporary adjustment unit 143 gradually increases and the moment arm length increases. The current level actuating the trip unit 140 is increased according to an increase of the moment arm length.

[0045] When a current exceeding an instantaneous value set through the instant dial 145 in abnormal current flows, the trip unit 140 rotates the armature 142 by the electromagnetic force being generated in the magnet 141.

[0046] The armature 142 is rotated to counterclockwise direction by the electromagnetic force generated in the magnet 141 and rotates the cross bar 148. The cross bar 148 is rotated to release bondage of the shutter 147 and rotates the shutter 147. The shutter 147 actuates the switch unit 130 through the rotation of the shutter 147.

Claims

1. A circuit breaker (100) comprising:

   a fixable contact unit (110), a movable contact unit (120) opposing the fixable contact unit, a switch unit (130) actuating the movable contact unit and a trip unit (140) blocking a main circuit through the switch unit when an abnormal current occurs,

   wherein the trip unit includes an instant dial (145) and an instant spring (146), the instant dial including a magnet (141), an armature (142) opposing the magnet, a temporary adjustment unit (143), an instant bar (144) actuating the temporary adjustment unit and a cam (145a) being in contact with the instant bar and the instant spring connecting one side of the temporary adjustment unit and one side of the armature, **characterised in that** the cam includes a plurality of local depressions (145b), each corresponding to an instantaneous value and adjusts a moment arm length between the instant spring and the armature through the plurality of the local depressions.

2. The circuit breaker of claim 1, wherein a radius of the cam (145a) is gradually increased along a circumference thereof and the circumference forms the plurality of the local depressions (145b).

3. The circuit breaker of claim 1, wherein the instant bar (145) further includes a shaft for a rotation with an arm being in contact with the cam and the instant bar.

4. The circuit breaker of claim 3, wherein the instant bar (144) determines a contact surface of the cam being in contact with the arm through the instant dial to adjust a rotation angle of the temporary adjustment unit.

5. The circuit breaker of claim 4, wherein the instant spring (146) is expanded or contracted according to the rotation angle of the temporary adjustment unit.

6. The circuit breaker of claim 5, wherein the moment arm length is defined as a vertical length between the instant spring and the armature.

7. The circuit breaker of claim 1, wherein the magnet (141) is electrically connected with the main circuit to generate an electromagnetic force when the abnormal current occurs.

8. The circuit breaker of claim 6, wherein the armature (142) is rotated by the electromagnetic force to be electrically connected with the magnet.

Patentansprüche

1. Leistungstrennschalter (100), Folgendes umfassend:

   eine feststellbare Kontakteinheit (110), eine bewegliche Kontakteinheit (120) gegenüber der feststellbaren Kontakteinheit, eine Schaltereinheit (130), welche die bewegliche Kontakteinheit betätigt und eine Auslöseeinheit (140), die einen Hauptstromkreis durch die Schaltereinheit blockiert, wenn ein abnormaler Strom anliegt,
   wobei die Auslöseeinheit einen direktwirkenden Drehregler (145) und eine direktwirkende Feder (146) umfasst, wobei der direktwirkende Drehregler einen Magneten (141) umfasst, eine Armatur (142) gegenüber dem Magneten, eine temporäre Einstelleinheit (143), eine direktwirkende Leiste (144), welche die temporäre Einstelleinheit betätigt und einen Nocken (145a), der in Kontakt mit der direktwirkenden Leiste steht und die direktwirkende Feder eine Seite der temporären Einstelleinheit mit einer Seite der Armatur verbindet, **dadurch gekennzeichnet, dass**
   der Nocken eine Vielzahl von lokalen Vertiefungen (145b) umfasst, die jeweils einem momentanen Wert entsprechen und er durch die Vielzahl von lokalen Vertiefungen eine Hebelarmlänge zwischen der direktwirkenden Feder und der Armatur einstellt.

2. Leistungstrennschalter nach Anspruch 1, wobei ein Radius des Nockens (145a) graduell entlang eines Umfangs davon zunimmt, und der Umfang die Vielzahl von lokalen Vertiefungen (145b) bildet.

3. Leistungstrennschalter nach Anspruch 1, wobei die direktwirkende Leiste (145) darüber hinaus eine Welle für eine Rotation mit einem Arm umfasst, der in Kontakt mit dem Nocken und der direktwirkenden Leiste steht.

4. Leistungstrennschalter nach Anspruch 3, wobei die direktwirkende Leiste (144) eine Kontaktfläche des Nockens bestimmt, die durch den direktwirkenden Drehregler in Kontakt mit dem Arm steht, um einen Rotationswinkel der temporären Einstelleinheit einzustellen.

5. Leistungstrennschalter nach Anspruch 4, wobei die direktwirkende Feder (146) je nach Rotationswinkel der temporären Einstelleinheit gedehnt oder komprimiert ist.

6. Leistungstrennschalter nach Anspruch 5, wobei die Hebelarmlänge als eine vertikale Länge zwischen der direktwirkenden Feder und der Armatur definiert wird.

7. Leistungstrennschalter nach Anspruch 1, wobei der Magnet (141) elektrisch mit dem Hauptstromkreis verbunden ist, um eine elektromagnetische Kraft zu erzeugen, wenn der abnormale Strom anliegt.

8. Leistungstrennschalter nach Anspruch 6, wobei die Armatur (142) durch die elektromagnetische Kraft verdreht wird, um elektrisch mit dem Magneten verbunden zu werden.

Revendications

1. Disjoncteur (100), comprenant :

   une unité de contact fixe (110), une unité de contact mobile (120) opposée à l'unité de contact fixe, une unité de commutation (130) actionnant l'unité de contact mobile et un bloc déclencheur (140) bloquant un circuit principal par l'intermédiaire de l'unité de commutation lorsqu'un courant anormal se produit,
   dans lequel le bloc déclencheur comporte un cadran instantané (145) et un ressort instantané (146), le cadran instantané comportant un aimant (141), une armature (142) opposée à l'aimant, une unité de réglage temporaire (143), une barre instantanée (144) actionnant l'unité de réglage temporaire et une came (145a) étant en contact avec la barre instantanée et le ressort instantané reliant un côté de l'unité de réglage temporaire et un côté de l'armature,

   caractérisé en ce que

   la came comporte une pluralité de dépressions locales (145b), correspondant chacune à une valeur instantanée et règle une longueur de bras de moment entre le ressort instantané et l'armature par l'intermédiaire de la pluralité de dépressions locales.

2. Disjoncteur de la revendication 1, dans lequel un rayon de la came (145a) est progressivement augmenté le long d'une circonférence de celle-ci et la

circonférence forme la pluralité des dépressions locales (145b).

3. Disjoncteur de la revendication 1, dans lequel la barre d'instantanée (145) comporte en outre un arbre pour une rotation avec un bras étant en contact avec la came et la barre instantanée.

4. Disjoncteur de la revendication 3, dans lequel la barre instantanée (144) détermine une surface de contact de la came étant en contact avec le bras par l'intermédiaire du cadran instantané pour régler un angle de rotation de l'unité de réglage temporaire.

5. Disjoncteur de la revendication 4, dans lequel le ressort instantané (146) est détendu ou contracté en fonction de l'angle de rotation de l'unité de réglage temporaire.

6. Disjoncteur de la revendication 5, dans lequel la longueur de bras de moment est définie en tant que longueur verticale entre le ressort instantané et l'armature.

7. Disjoncteur de la revendication 1, dans lequel l'aimant (141) est relié électriquement au circuit principal pour générer une force électromagnétique lorsque le courant anormal se produit.

8. Disjoncteur de la revendication 6, dans lequel l'armature (142) est mise en rotation par la force électromagnétique pour être reliée électriquement à l'aimant.

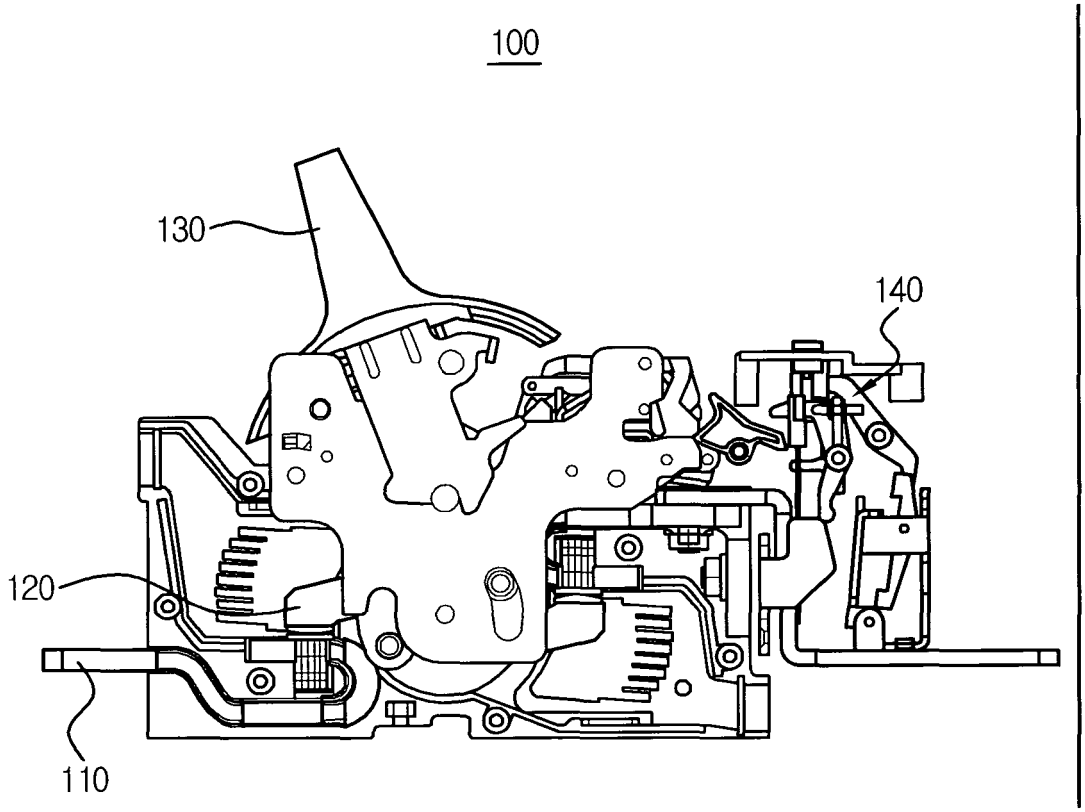

FIG. 1

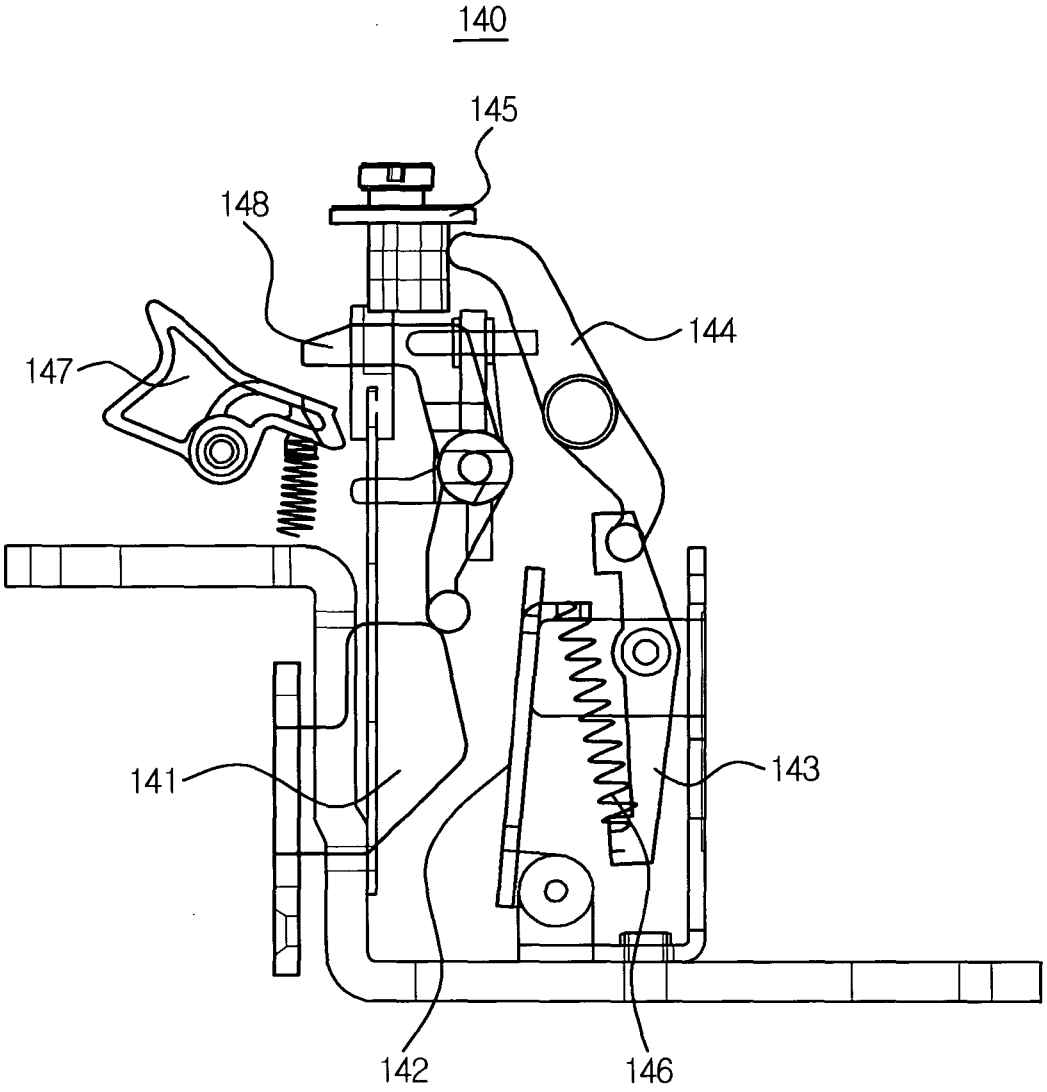

FIG. 2

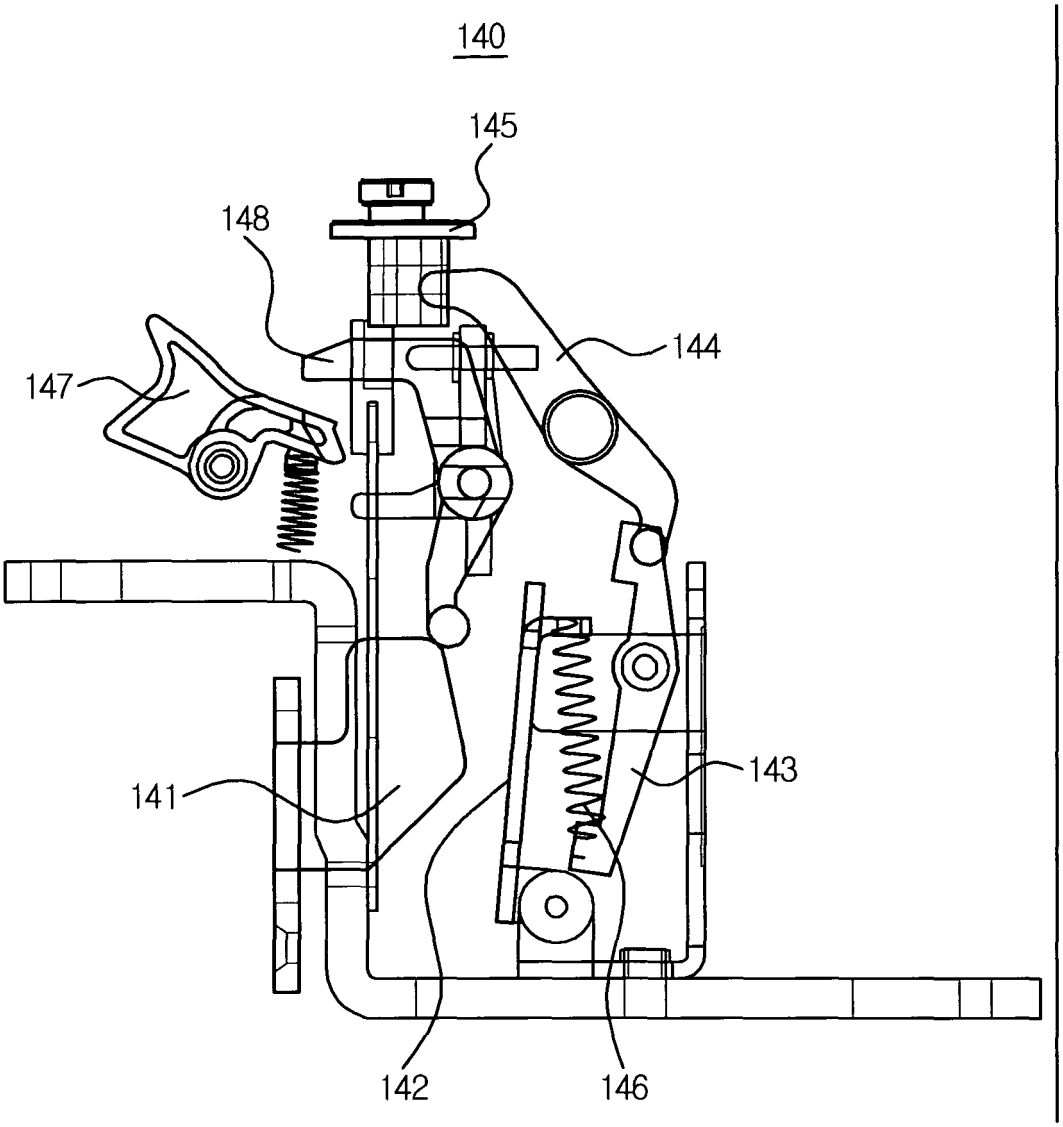

FIG. 3

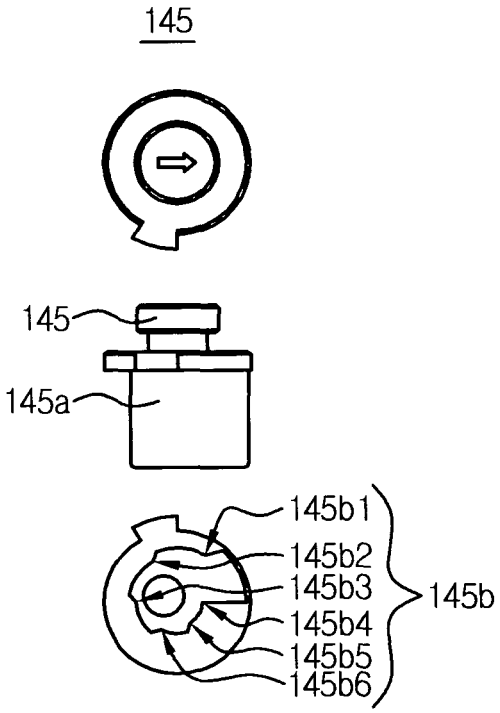

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 03054898 A1 **[0001]**
- KR 1020090099891 **[0002]**
- KR 2019990031458 **[0003]**
- KR 1020080008920 **[0004]**