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(54) **CIRCUIT BREAKER**

(57) In a circuit breaker in which a breaking operation is performed when a trip bar 33 is driven by an overcurrent tripping device and a reset operation of the trip bar 33 is performed by a biasing force of a spring 35, wherein a point of action on which the biasing force of the spring acts on the trip bar is formed between a bearing point of

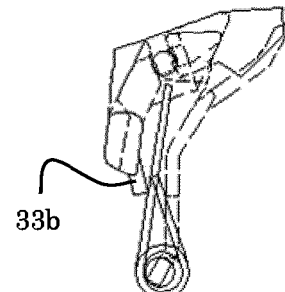
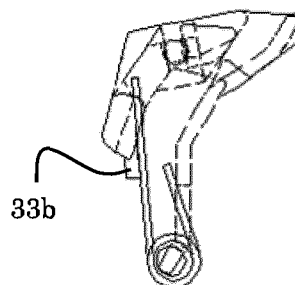
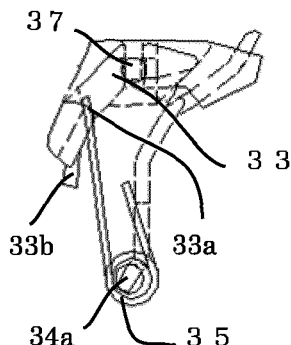
the spring and an end of the spring, and thereby within the full operating range of the trip bar, the operating load of the trip bar is not increased until the tripping completion position by the overcurrent tripping device, moreover, it is possible to obtain a large rotational moment on the trip bar after the tripping is completed.

FIG. 8

(a) ON state

(b) Tripping completion position

(c) Tripping state



Description

Technical Field

[0001] The present invention relates to a circuit breaker, particularly a relative structure of the trip bar and the spring biasing the trip bar.

Background Art

[0002] In a conventional circuit breaker, when overcurrent flows in the circuit, a tripping mechanism reliably performs the trip operation without hindering the tripping load of a tripping device, and when the circuit breaker in the trip state is reinserted, it is necessary to reliably perform the reset operation. Conventionally, as one example of its countermeasure, a trip bar is biased by one end of a spring (twist spring) biasing the trip bar, and a latch is biased to the other end of the spring biasing the trip bar.

Patent Literature

[0003] [Patent Literature 1] JP5304658B2

Disclosure of Invention

Technical Problem

[0004] In a conventional circuit breaker, when resetting the trip circuit breaker in a trip state, the trip bar is characterized in that the trip bar is restored from a trip position to a reset position only by the force of the spring biasing the trip bar. However, with the aforementioned structure of the trip bar and the spring biasing the trip bar, a substantially constant spring moment is obtained regardless of the operating position of the trip bar, and since the operating angle itself is also small, when shifting from the trip state to the reset state, a problem that it is difficult to obtain a large rotational moment for favoring the reset operation appeared.

[0005] The present invention was made in the light of the circumstances as described above, and it is an object of the present invention to provide a trip bar as well as a spring biasing the trip bar capable of increasing the trip bar restoring force at the reset time, without increasing the operation load of the trip bar which is necessary at the trip time.

Solution to Problem

[0006] A circuit breaker according to the present invention is a circuit breaker in which a trip bar is driven by an overcurrent tripping device to perform a breaking operation and the trip bar performs a reset operation by a biasing force of a spring biasing the trip bar, according to the action point where the biasing force of the spring biasing the trip bar acts on the trip bar formed between the end part of the spring biasing the trip bar, and between

the end part of the spring biasing the trip bar and the bearing part of the spring biasing the tip part, it is possible to obtain a large rotational moment in the trip bar at the tripping completion, without increasing the operating load of the trip bar until the tripping completion position by the overcurrent tripping device in the operating range of the trip bar.

Advantageous Effects of Invention

[0007] According to the present invention, during the operation of the trip bar, the rotational moment acting on the trip bar by the spring biasing the trip bar is obtained in two stages, and until the tripping completion by the overcurrent tripping device, the load at the trip bar during the tripping completion doesn't increase, it becomes possible to increase the returning force of the trip bar at the reset time after the tripping completion, and it is possible to prevent the reset impossibility of the circuit breaker mainly caused by the influence of melt or soot generated when a short circuit break of the circuit breaker occurs.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a view showing a first embodiment of the present invention and is an external perspective view showing an example of an external appearance in a state in which the cover of the circuit breaker is removed.

[Fig. 2] Fig. 2 is a view showing a first embodiment of the present invention and is a longitudinal sectional side view showing an example of the open circuit state (off state) of the circuit breaker.

[Fig. 3] Fig. 3 is a view showing a first embodiment of the present invention and is a side view of the main part of the circuit breaker showing an example of a closed circuit state (ON state) of the circuit breaker.

[Fig. 4] Fig. 4 is a view showing a first embodiment of the present invention and is a side view of the main part of the circuit breaker showing an example of an open circuit state (OFF state) of the circuit breaker.

[Fig. 5] Fig. 5 is a view showing a first embodiment of the present invention and is a side view of the main part of the circuit breaker showing an example of a trip state of the circuit breaker.

[Fig. 6] Fig. 6 is a view showing a first embodiment of the present invention and is a side view of the main part of the circuit breaker showing an example of a reset state of the circuit breaker.

[Fig. 7] Fig. 7 is a side view showing an example of a first embodiment of the present invention and is a side view showing an example of the main part of the present invention, and is a side view showing the trip bar, the latch, spring biasing the trip bar and the

lever in an enlarged state in the reset state.

[Fig. 8] Fig. 8 is a view showing an example of the first embodiment of the present invention and is a side view showing an example of the main part of the present invention, wherein (a) shows a state of the main part in an ON state (closed state) of the circuit breaker, (b) shows a state of the main part at a tripping completion position of the circuit breaker, (c) shows the state of the main part in the trip state of the circuit breaker.

[Fig. 9] Fig. 9 is a side view showing an example of the second embodiment of the present invention, and is showing an example of the main part of the present invention, wherein (a) shows a state of the main part in an ON state (closed state) of the circuit breaker, (b) shows the state of the main part at the tripping completion position of the circuit breaker, and (c) shows the state of the main part in the trip state of the circuit breaker.

[Fig. 10] Fig. 10 is a side view showing an example of the third embodiment of the present invention, and is a side view showing an example of the main part of the present invention, wherein (a) shows a state of the main part in an ON state (closed state) of the circuit breaker, (b) shows the state of the main part at the tripping completion position of the circuit breaker, and (c) shows the state of the main part in the trip state of the circuit breaker.

[Fig. 11] Fig. 11 is a side view showing an example of the main part of a conventional circuit breaker, wherein (a) shows the state of the main part in the ON state (closed state) of the circuit breaker, (b) shows the state of the main part at the tripping completion position of the circuit breaker, (c) shows the state of the main part in the trip state of the circuit breaker.

Description of Embodiments

First Embodiment

[0009] Hereinafter, an opening and closing mechanism of a circuit breaker will be described regarding a first embodiment of the present invention with reference to the drawings.

[0010] Fig. 1 is an external perspective view of a circuit breaker with the cover removed according to a first embodiment of the present invention, Fig. 2 is a cross-sectional view showing the OFF state in Fig. 1, Fig. 3 to Fig. 4 are side elevational views of the main part showing the opening and closing mechanism of the circuit breaker, Fig. 3 shows a closed circuit (ON) state, Fig. 4 shows an open circuit (OFF) state, Fig. 5 shows a trip state, and Fig. 6 shows a reset state.

[0011] As shown in Fig. 1 and Fig. 2, the circuit breaker 101 is configured using a casing 10 including a base 11 and a cover 12 formed of an insulating material. On the base 11, the number of the circuit breaker unit 20 of the

pole is arranged at intervals, and an opening/closing mechanism part 40 having a well-known toggle link mechanism is disposed on the upper part of the circuit breaker unit 20.

[0012] The cover 12 covers the circuit breaker unit 20 of each pole on the base 11 and the opening and closing mechanism part 40, and an operating handle 41 of the opening and closing mechanism part 40 protrudes from a handle window hole 12a of the cover 12.

[0013] Each circuit breaker units 20 of each pole is constructed in the same way, and a cross bar 32 is common to each circuit breaker unit 20 of each pole and arranged on the base 11 so as to be orthogonal to each circuit breaker unit 20 of each pole. The cross bar 32 is rotated about its axis by the opening and closing mechanism section 40, and movable contact arms 23 of each circuit breaker unit 20 of each pole are attached thereto respectively. When the cross bar 32 rotates about its axial center, each movable contact arm 23 of each circuit breaker unit 20 of each pole is simultaneously rotated, and due to the rotation of the movable contact arm 23, a movable contact 22 is contacted to or separated from a stationary contact 21. The opening and closing mechanism section 40 is made up of a well-known toggle link mechanism, and is provided with a well-known trip bar 33 which is driven by a tripping device 30.

[0014] Each circuit breaker unit 20 of each pole owns a power supply side terminal 24 provided on the base 11 and a stationary contact arm 27 having the stationary contact 21 disposed at a position extended from the power supply side terminal 24, the movable contact 22 which contacts and separates from the stationary contact 21, the movable contact arm 23 having the movable contact 22 at one end which is freely rotatably held by the cross bar 32, an overcurrent tripping device 30 connected to the movable contact arm 23 via a movable contact holder 26, a load side terminal 25 disposed at a position extended from the tripping device 30 and an arc extinguishing device 50 in which a plurality of grid plates surrounding the contacts 21 and 22 and the stationary contact 27 are stacked.

[0015] The stationary contact 21 and the movable contact 22 constitute an opening/closing contact for opening and closing the electric path. When the movable contact 22 contacts the stationary contact 21, the electric circuit between the terminals 24 and 25 is turned on, further, when the movable contact 22 is separated from the stationary contact 21, the electric circuit between the terminals 24 and 25 is turned off. At this time, the arc generated between the movable contact 22 and the stationary contact 21 is extinguished by the arc-extinguishing device 50.

[0016] In Fig. 3, a cross bar 32 made of a synthetic resin material is rotatably supported by a base 11 made of a synthetic resin material or a fixed frame 43 mounted on the base 11. The movable contact arm 23 having a movable contact 22 at one end is pivotally supported inside the cross bar 32 so as to rotate in conjunction with

the rotation of the cross bar 32. The stationary contact 27 having the stationary contact 21 for contacting and separating from the movable contact 22 are mounted on the base 11.

[0017] One end 46a of a lower link 46 is connected by a crossbar pin 36 to the cross bar 32, the other end 46b of the lower link 46 is connected to one end 45a of an upper link 45 by a link pin 47. The other end 45b of the upper link 45 is connected to a lever 44 engaged with a latch 34. An opening/closing spring 48 is stretched between the link pin 47 and a handle arm 42 that interlocks with the handle 41 formed of a synthetic resin material. Further, the lower link 46, the upper link 45, and the link pin 47 constitute a toggle link mechanism, and when the handle 41 is operated in the right direction as shown on the document, when the action line of an opening and closing spring 48 exceeds the dead point of the toggle link mechanism, the toggle link mechanism is rapidly expanded, and it is possible to maintain the closed circuit state of the circuit breaker 101.

[0018] From this state, when the handle 41 is operated in the leftward direction as shown on Fig. 3 of the document, the action line of the opening and closing spring 48 again exceeds the dead point of the toggle link mechanism, and the toggle link mechanism is bent, that is, the lower link 46 pulls up the cross bar pin 36, the cross bar 32 pivots counterclockwise as shown in Fig. 3, as the movable contact arm 23 is lifted, thereby as shown in Fig. 4, the movable contact 22 and the stationary contact 21 are separated, and the circuit breaker 101 shifts to open the circuit.

[0019] Next, the tripping operation of the circuit breaker 101 will be described with reference to Fig. 5. When an overcurrent flows through the circuit breaker in the closed state, the tripping device 30 (see Fig. 2) operates, as shown on the document, the lower end of the trip bar 33 freely rotated to the fixed frame 43 via the trip bar pin 37 is pressed, and the trip bar 33 is rotated counterclockwise as shown on Fig. 5 of the document. The trip bar 33 rotates around the trip bar pin 37 as a fulcrum, when the engagement between the trip bar 33 and the engagement part 34b of the latch 34 pivotally supported by the fixed frame 43 as being freely rotatable at a fulcrum 34a is disengaged, as shown on the document, the latch 34 is rotated in the counterclockwise direction as around the fulcrum 34a.

[0020] When the latch 34 rotates, the junction between the latch 34 and the lever 44 pivotally supported by the fixed frame 43 as being freely rotatable at a fulcrum 34a is disengaged from the engagement part 34c, as shown on the document, the lever 44 rotates around the fulcrum 44a in the clockwise direction by the force of the opening and closing spring 48 as a fulcrum. At the same time, the upper link 45 pivotally supported by the lever 44 pulls up the cross bar 32 via the lower link 46, the movable contact 22 and the stationary contact 21 are separated and the tripping operation is completed.

[0021] Next, the reset operation of the circuit breaker

101 will be described with reference to Fig. 6. In the circuit breaker in the trip state (state of Fig. 5), when the handle 41 is rotated in the leftward direction as shown on the document, the handle arm 42 rotates the lever 44. The lever 44 rotates, when the engagement position at the engagement part 34c (see Fig. 4) of the lever 44 and the latch 34 is exceeded, due to the rotational moment of the torsion spring shaped spring 35 biasing the trip bar 33 attached to the rotary shaft 34a of the latch 34 (The center of this rotational moment is the fulcrum 34a of the latch 34, the point of action is 33a, 33b, 33c), the latch 34 and the trip bar 33 are in an engaged state by the engaging part 34b (see Fig. 4). According to this engagement, the lever 44 is held in a reset state (being a state in which the lever 44 and the latch 34 are engaged as indicated by 34c in Fig. 4) and the reset operation is completed. The state in which the reset operation is completed is enlarged and illustrated in Fig. 7. The point of action on which the biasing force of the spring 35 biasing the trip bar 33 acts on the trip bar 33, is formed between one end of the spring 35 biasing the trip bar 33 and a bearing point, that is the fulcrum 34a which is the rotation center of the trip bar spring 35.

[0022] An example of the main part of the present invention will be described below in detail with reference to the example of Fig. 8. Fig. 8 is a side view showing an example of a main part of the present invention, (a) is a view showing the state of the main part in the ON state (closed state) of the circuit breaker, (b) is a view showing the state of the main part at the tripping completion position of the circuit breaker, (c) is a view showing the state of the main part in the trip state of the circuit breaker.

[0023] In the closed state of the circuit breaker (see Fig. 8 (a)), the trip bar 33 comes in contact on one end of the spring 35 biasing the trip bar 33 at the first engagement part 33a.

[0024] From this state, the circuit breaker comes in contact with the first engaging part 33a, similarly to the above, until the tripping completion position on the process of performing the tripping operation (see Fig. 8 (b)), then, the rotational moment of the trip bar 33 by the spring 35 biasing the trip bar 33 during this time is almost constant, the load at the time of tripping the trip bar 33 is not abruptly increased until the tripping by the tripping device is completed. Thereafter, when the tripping position is reached (see Fig. 8 (c)) after the tripping is complete, the trip bar 33 and the spring 35 biasing the trip bar 33 are brought in contact with each other, at a protrusion 33b separately provided from the first engagement part 33a and provided on the trip bar. Therefore, the trip bar 33 and the spring 35 biasing the trip bar 33 come in contact with the base side of the spring 35 biasing the trip bar 33, the rotational moment due to the spring 35 biasing the trip bar 33 abruptly increases. In other words, in the reset operation in which the trip bar 33 performs a movement (counterclockwise rotation as shown on the document) opposite to the tripping operation (clockwise rotation as shown on the document), the restoring force of

the trip bar 33 increases at the time of resetting, and it is possible to prevent an impossible reset mainly due to the influence of melt and soot generated at the time of the short-circuit interruption. According to the soot during an interruption adhering to the rotating shaft 37 part of the trip bar 33, the friction against the rotation of the trip bar 33 at the rotary shaft 37 part increases, since the rotation of the trip bar 33 is hindered, the resetting can be impossible when the spring force of the spring 35 biasing the trip bar 33 is small, but according to the first embodiment of the present invention, it is possible to prevent impossible reset as described above.

[0025] For example, in the conventional circuit breaker shown in Fig. 11, as shown in the figure, the operating angle of the trip bar 33 is small, since the trip bar 33 and the spring biasing the trip bar 35 always comes in contact with the trip bar 33 at the end of the spring 35 biasing the trip bar 33 at one engagement part 33a, it is difficult to obtain a large rotational moment, the reset can become impossible, but according to the first embodiment of the present invention, it is possible to prevent the impossible reset as described above.

[0026] Further, the center of the rotational moment acting on the trip bar 33 by the spring 35 biasing the trip bar 33 (the fulcrum 34a of the latch 34) remains unchanged, when the contact position (action point) between the trip bar 33 and the spring 35 biasing the trip bar 33 changes (from 33a in the drawing shows into 33b (in the case of first embodiment) or into 33c (in the case of the second and third embodiments being described later)), the rotational moment of the trip bar 33 increases.

Second Embodiment

[0027] The second embodiment of the present invention will be described below based on the embodiment of Fig. 9. In order to obtain a rotational moment in two stages, one end of the spring 35 biasing the trip bar 33 on the trip bar 33 side is bent from the bent part 35a. As a result, the same effect as in the first embodiment can be obtained, until the tripping by the tripping device is completed, as the trip bar 33 comes in contact with the first engagement part 33a of the spring 35 biasing the trip bar 33 and the trip bar 33, the load at the time of tripping is not increased, further, after the tripping is completed, the contact position is changed to the second engagement part 33c of the trip bar 33 so that the restoring force of the trip bar 33 upon resetting can be increased, it is possible to prevent impossible reset due mainly to the influence of melt and soot generated at the time of the short-circuit interruption.

Third Embodiment

[0028] The third embodiment of the present invention will be described below based on the embodiment of Fig. 10. The protrusion 33b of the trip bar 33 shown in the first embodiment and the spring 35 biasing the trip bar

33 formed by bending one end on the side of the trip bar 33 shown in the second embodiment from the bent part 35a are used in combination. This makes it possible to obtain even greater effects.

[0029] According to the above description and each of the aforementioned drawings, the first embodiment has the following technical features.

[0030] Technical feature 1: In a circuit breaker having a trip bar pivotally supported pivotally on the fixed frame, a latch and a lever, a tripping mechanism part that performs a reset operation by the engagement of the three above parts and the urging force of the trip bar spring provided on the latch rotation shaft in the tripping operation by the tripping device, wherein an opening and closing mechanism of the circuit breaker includes a handle arm rotatably pivoted to a fixed frame and operated by a handle, a toggle link mechanism having an upper link and a lower link, and an opening and closing spring stretched between the connection part connecting the upper link with the lower link and the handle arm, a crossbar which is connected to the lower link by a crossbar pin and rotates by the operation of the toggle link mechanism, a movable contact arm having a movable contact at one end and being pivotally supported at the other end so as to be rotatable and a stationary contact arm having a stationary contact to come into contact with and separate from the movable contact, the trip bar has a projection projecting toward the center of rotation of the spring biasing the trip bar and engaging with the spring biasing the trip bar from the tripping completion position to the tripping position.

[0031] Technical feature 2: In a circuit breaker having a trip bar pivotally supported pivotally on the fixed frame, a latch and a lever, a tripping mechanism part that performs a reset operation by the engagement of the three above parts and the urging force of the trip bar spring provided on the latch rotation shaft in the tripping operation by the tripping device, wherein an opening and closing mechanism of the circuit breaker includes a handle arm rotatably pivoted to a fixed frame and operated by a handle, a toggle link mechanism having an upper link and a lower link and an opening and closing spring stretched between the connection part connecting the upper link with the lower link and the handle arm, a crossbar which is connected to the lower link by a crossbar pin and rotates by the operation of the toggle link mechanism, a movable contact arm having a movable contact at one end and being pivotally supported at the other end so as to be rotatable, and a stationary contact arm having a stationary contact to come into contact with and separate from the movable contact, by bending one end of the spring biasing the trip bar of the tripping mechanism part, a rotational moment is obtained in two stages as described above.

[0032] Note that, in each drawing, the same symbols denote the same or equivalent portions.

[0033] Note that the present invention may be modified or omitted from each embodiment as appropriate within

the scope of the invention.

Reference Signs List

[0034]	5
11 Base	
12 Cover	
21 Stationary contact	
22 Movable contact	10
23 Movable contact arm	
27 Stationary contact arm	
32 Crossbar	
33 Trip bar	
33a First engaging part (action point)	15
33b Protrusion (action point)	
33c Second engaging part (action point)	
34 Latch	
34a Fulcrum of the latch 34 (Axis of rotation) (center of rotational moment) (bearing point of spring biasing the trip bar)	20
34b First engaging part (First engaging part between the trip bar 33 and the latch 34)	
34c Engaging part (Engaging part between the lever 44 and the latch 34)	25
35 Spring biasing a (the) trip bar	
36 Crossbar pin	
37 Trip bar pin (Fulcrum of the trip bar 33)	
41 Handle	
42 Handle arm	30
43 Fixed frame	
44 Lever	
44a Fulcrum of the lever 44	
45 Upper link	
45a One end of the upper link 45	35
45b Other end of the upper link 45	
46 Lower link	
46a One end of the lower link 46	
46b Other end of the lower link 46	
47 Link pin	40
48 Opening and closing spring	
101 Circuit breaker	

Claims 45

1. A circuit breaker in which a breaking operation is performed when a trip bar is driven by an overcurrent tripping device and a reset operation of the trip bar is performed by a biasing force of a spring, 50
wherein a point of action on which the biasing force of the spring acts on the trip bar is formed at an end of the spring and between a bearing point of the spring and the end of the spring. 55
2. A circuit breaker according to claim 1, wherein the trip bar has a protrusion and the point of action is formed on the protrusion.

3. A circuit breaker according to claim 1 or 2, wherein a bent part is provided on the spring, and the point of action is formed on the bent part.

FIG. 1

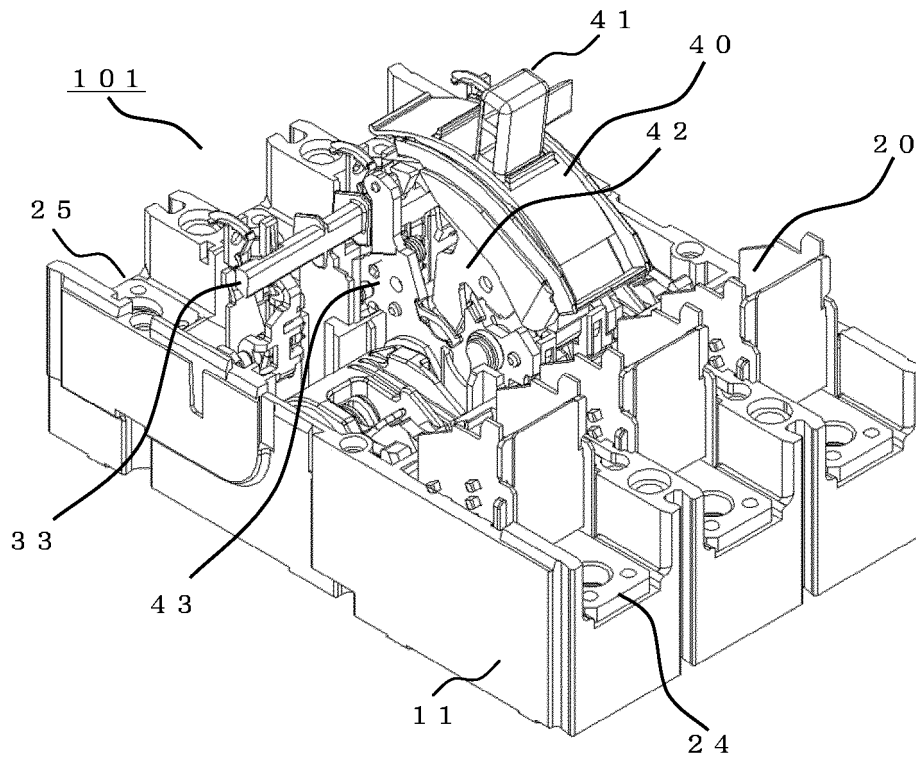


FIG. 2

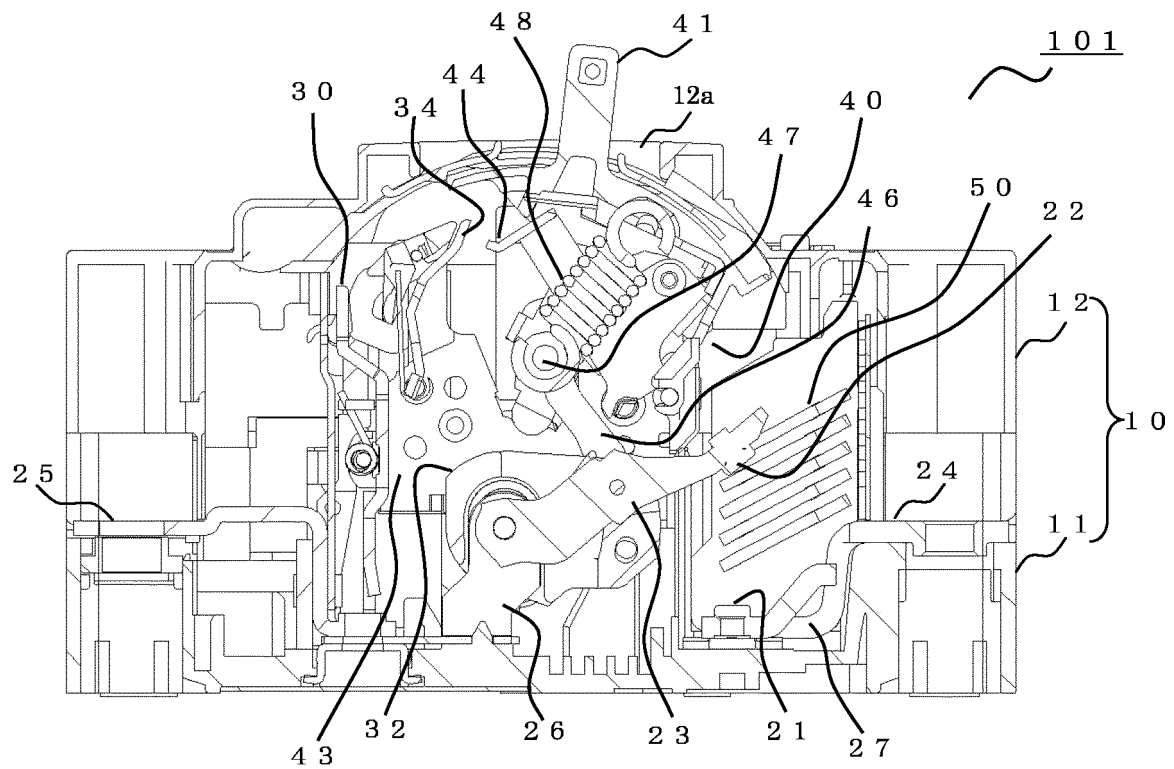


FIG. 3

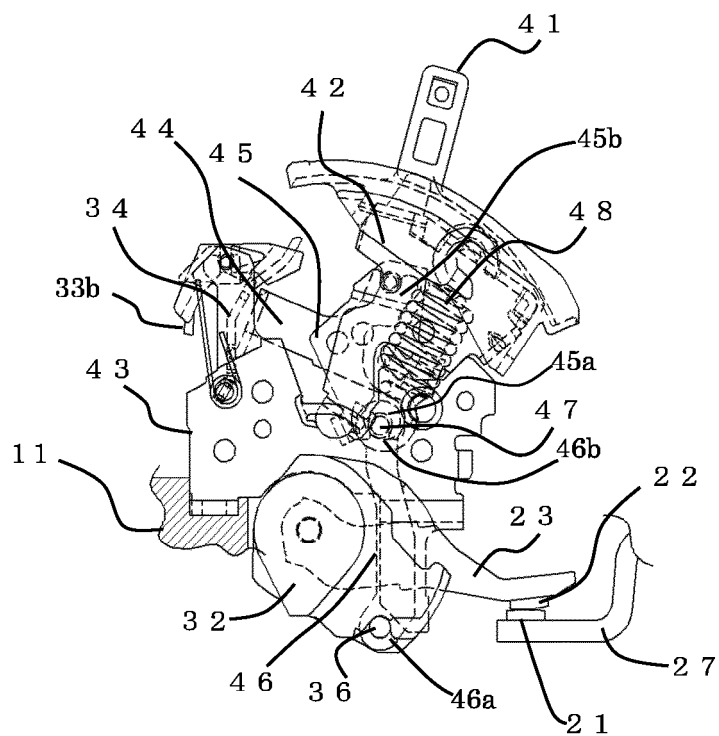


FIG. 4

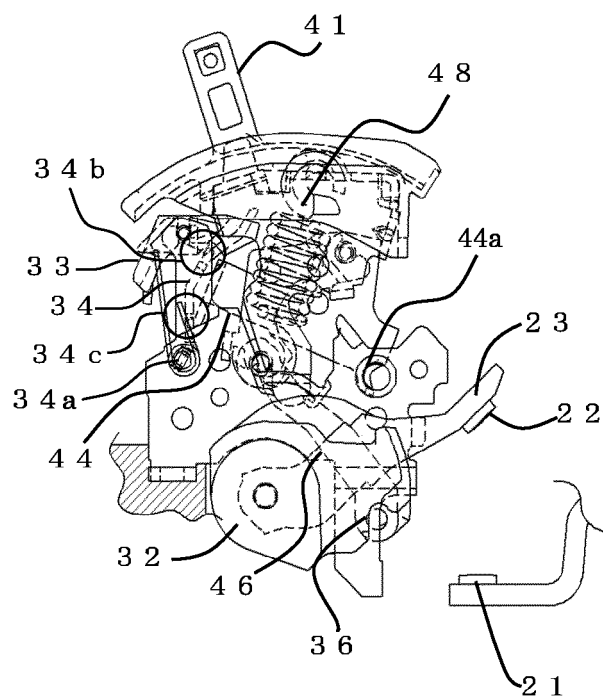


FIG. 5

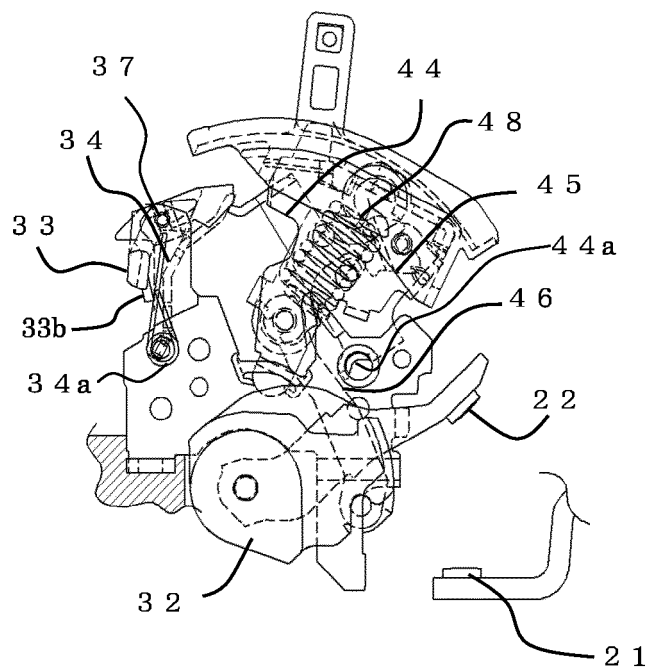


FIG. 6

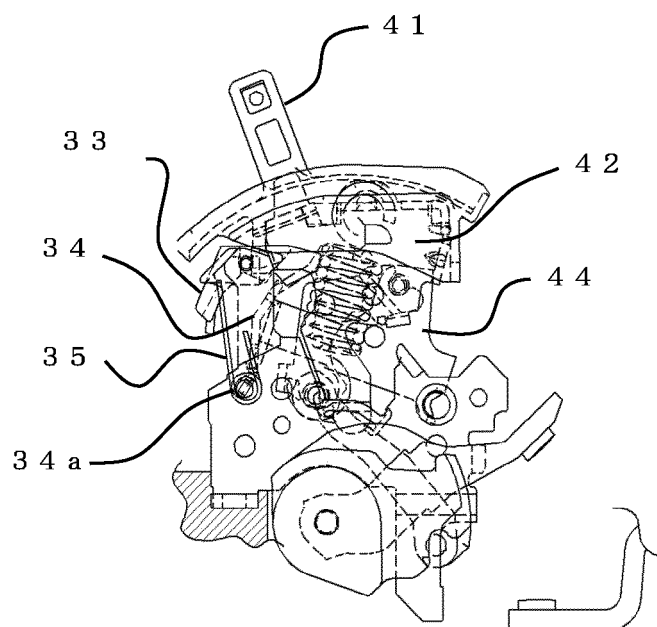


FIG. 7

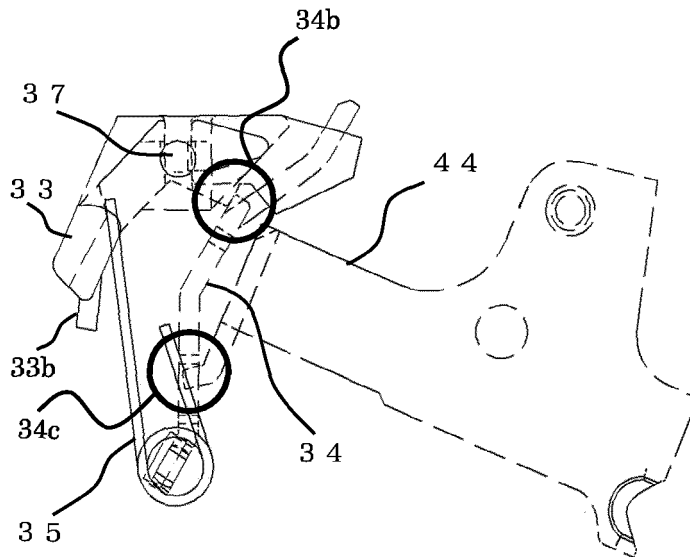


FIG. 8

(a) ON state

(b) Tripping completion position

(c) Tripping state

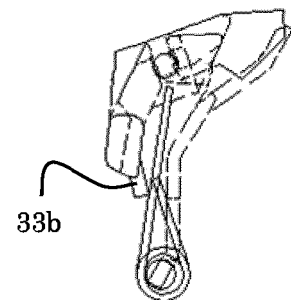
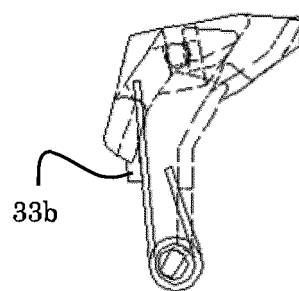
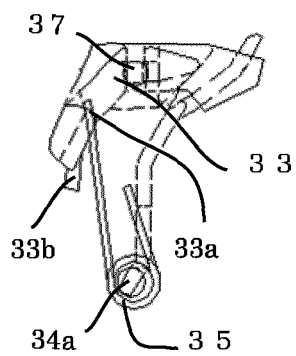


FIG. 9

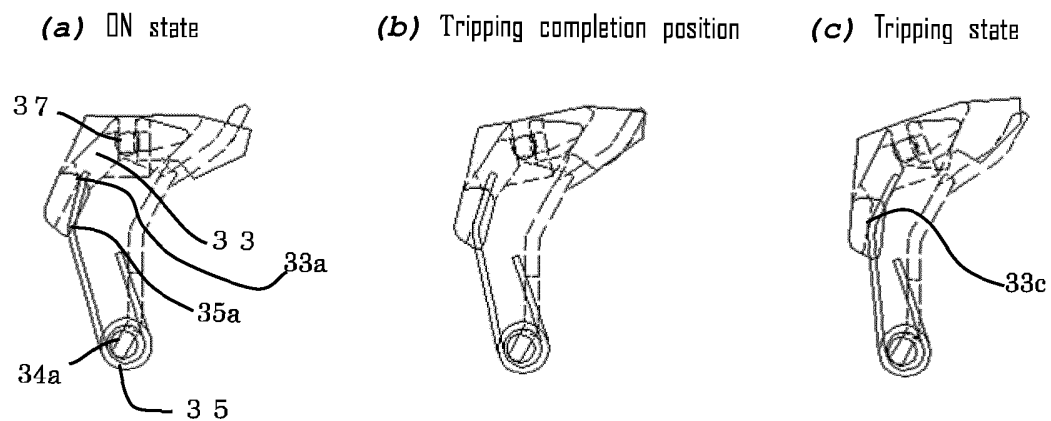


FIG. 10

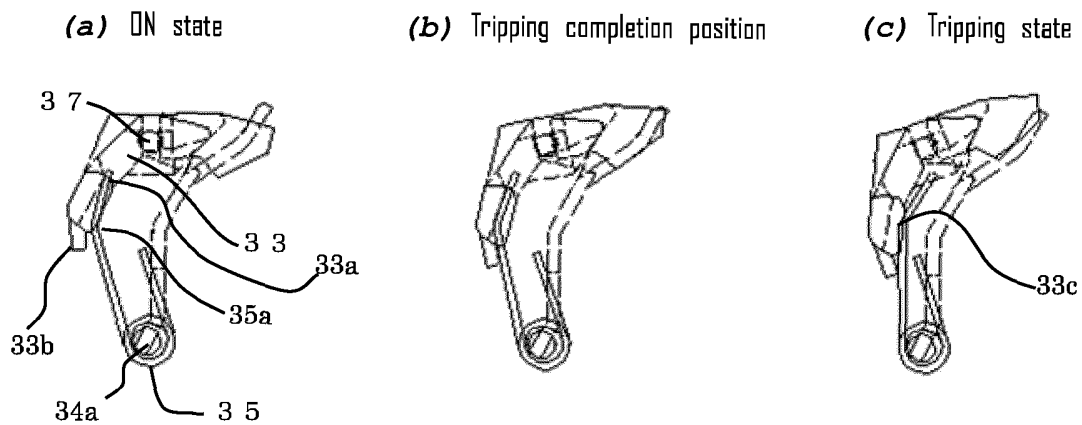
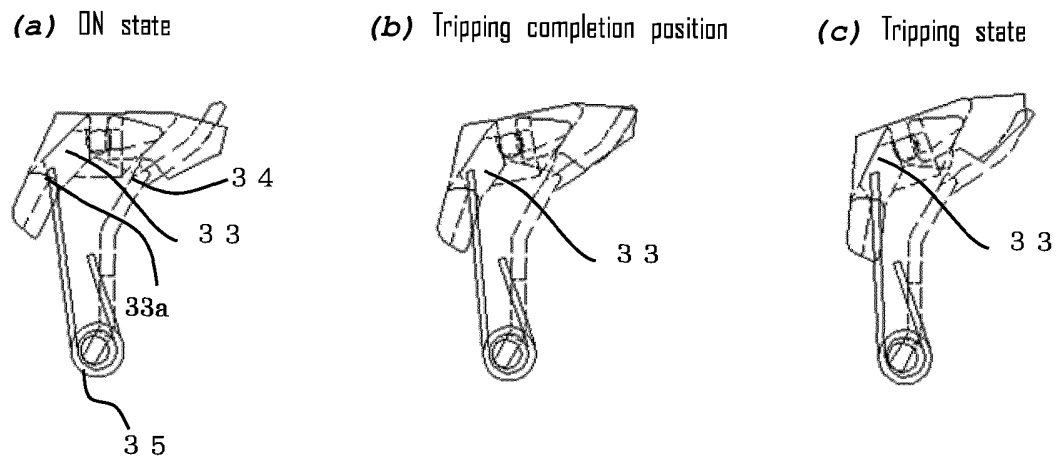


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/050470

A. CLASSIFICATION OF SUBJECT MATTER

H01H71/12(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)

H01H71/12

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-97833 A (Kawamura Electric Inc.), 24 April 2008 (24.04.2008), entire text; fig. 4 & CN 101154539 A & KR 10-2008-0029905 A	1-3
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 75097/1987 (Laid-open No. 182448/1988) (Mitsubishi Electric Corp.), 24 November 1988 (24.11.1988), entire text; fig. 2, 3 & EP 0292841 A2 & US 4888570 A	1-3

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 ☐ See patent family annex.

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Date of the actual completion of the international search
18 February 2015 (18.02.15)Date of mailing of the international search report
03 March 2015 (03.03.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/050470

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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