(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 266 343 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
25.10.2023 Bulletin 2023/43

(21) Application number: **20965940.8**

(22) Date of filing: **17.12.2020**

(51) International Patent Classification (IPC):
H01H 73/36 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
H01H 73/36

(86) International application number:
PCT/JP2020/047083

(87) International publication number:
WO 2022/130552 (23.06.2022 Gazette 2022/25)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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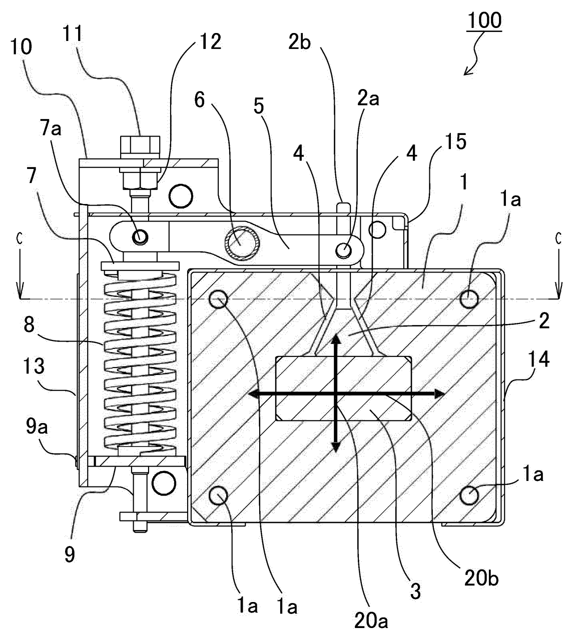
(54) **OVERCURRENT TRIP DEVICE, AND CIRCUIT BREAKER USING SAME**

(57) To obtain an overcurrent trip device which can realize a reduction in the size of the device and a circuit breaker using the same. An overcurrent trip device (100) includes a conductor (3) connected to a main circuit of a circuit breaker (200); a stationary core (1) which is formed so as to enclose the conductor (3) and one portion of which is opened; and a moving core (2) which is disposed in the opened position of the stationary core (1) with a magnetic gap (4) interposed between the moving core and the stationary core (1), is disposed so as to be movable by an electromagnetic force of when an overcurrent flows through the conductor (3), wherein the stationary core (1) is disposed in abutment with the conductor (3), and the moving core (2) is in contact with the conductor (3) when no overcurrent flows through the conductor (3) before in operation.

FIG.3



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Description

Technical Field

[0001] The present application relates to the field of an overcurrent trip device and a circuit breaker using the same.

Background Art

[0002] An overcurrent trip device is a device which, being assembled in a circuit breaker, detects an overcurrent generated when an electrical circuit including the circuit breaker causes a short circuit accident or the like, and sets in motion the opening/closing mechanism of the circuit breaker in the closed state, thus bringing the circuit breaker into the open state. The circuit breaker shifts into the open state and, at the same time, carries out interruption of an overcurrent flowing through a main circuit. The overcurrent trip device includes, for example, an electromagnet with which to detect the overcurrent flowing through the main circuit, an output shaft with which to transfer a drive force outputted from the electromagnet to the opening/closing mechanism of the circuit breaker, a return spring with which to stabilize an operating current value (the current value of when an opening operation is started) of the overcurrent trip device, and a scale device with which to change the spring load by operating the amount of deflection of the return spring and thereby adjust the operating current value.

[0003] The operation of the overcurrent trip device is such that when an overcurrent flows through a conductor passing through the center of the electromagnet, the attraction occurring in a moving core of the electromagnet exceeds the load of the return spring, whereby the moving core is attracted upward and, at the same time, an operation rod connected to the moving core moves upward, and a holding latch which transfers a closing load to a main circuit contact of the circuit breaker is separated from the main circuit contact, thereby starting up the opening/closing mechanism which urges the circuit breaker into an opening operation (for example, refer to PTL 1). This operation causes the circuit breaker to shift to the open state.

Citation List

Patent Literature

[0004] PTL 1: EP2431992A1

Summary of Invention

Technical Problem

[0005] According to the previously described PTL 1, a gap which does not contribute to the operation of the overcurrent trip device or a stopper which determines the position before movement of the moving core is provided between the conductor and the electromagnet, and also, a rod which transfers the load of the return spring to the moving core passes through the conductor, so that in order to obtain a necessary current-carrying capacity to compensate for the reduction in volume of the conductor, there is a need to increase the external dimensions of the conductor, and for these reasons, there is a problem in that the overcurrent trip device grows in external dimensions.

[0006] The present application has been made to solve the above problem, and an object of the present application is to obtain an overcurrent trip device which realizes a reduction in the size of the device and a circuit breaker using the same.

Solution to Problem

[0007] An overcurrent trip device disclosed in the present application is characterized by including a conductor connected to a main circuit of a circuit breaker; a stationary core which is formed so as to enclose the conductor and one portion of which is opened; and a moving core which, being disposed in the opened position of the stationary core with a magnetic gap interposed between the moving core and the stationary core, is disposed so as to be movable by an electromagnetic force of when an overcurrent flows through the conductor, wherein the stationary core is disposed in abutment with the conductor, and the moving core is in contact with the conductor when no overcurrent flows through the conductor before in operation.

[0008] Also, a circuit breaker disclosed in the present application includes an arc-extinguishing chamber in which an arc-extinguishing space is formed; a stationary side main contact disposed on the lower side of the arc-extinguishing chamber; a moving side main contact disposed so as to be able to contact with and separate from the stationary side main contact; and an overcurrent trip device which detects an overcurrent flowing between the stationary side main contact and the moving side main contact and drives the moving side main contact in a trip direction, wherein the previously mentioned overcurrent trip device uses the above-mentioned overcurrent trip device.

Advantageous Effects of Invention

[0009] According to the overcurrent trip device disclosed in the present application and to the circuit breaker using the same, it is possible to obtain the overcurrent trip device which can realize a reduction in the size of the device and the circuit breaker using the same.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a perspective view of an overcurrent trip device according to a first embodiment.

[Fig. 2] Fig. 2 is a plan view of the overcurrent trip device according to the first embodiment.

[Fig. 3] Fig. 3 is a sectional front view taken along the line A-A of the overcurrent trip device shown in Fig. 2.

[Fig. 4] Fig. 4 is a sectional side view taken along the line B-B of the overcurrent trip device shown in Fig. 2.

[Fig. 5] Fig. 5 is a sectional plan view taken along the line C-C of the overcurrent trip device shown in Fig. 3.

[Fig. 6] Fig. 6 is a plan view of a conductor of the overcurrent trip device according to the first embodiment.

[Fig. 7] Fig. 7 is an illustrated parts breakdown showing a moving core and guide plates of the overcurrent trip device according to the first embodiment.

[Fig. 8] Fig. 8 is an illustrated parts breakdown showing a modification example of the moving core and guide plates of the overcurrent trip device according to the first embodiment.

[Fig. 9] Fig. 9 is a sectional front view showing the state after a trip operation of the overcurrent trip device according to the first embodiment.

[Fig. 10] Fig. 10 is a sectional front view of an overcurrent trip device according to a second embodiment.

[Fig. 11] Fig. 11 is a sectional side view showing the outline configuration of a circuit breaker according to a third embodiment.

Description of Embodiments

[0011] Hereinafter, a description will be given, based on the drawings, of an overcurrent trip device 100 according to a first embodiment.

[0012] In the individual drawings, identical signs indicate identical or equivalent components.

First Embodiment

[0013] Fig. 1 is a perspective view of the overcurrent trip device 100 according to the first embodiment, and Fig. 2 is a plan view of the overcurrent trip device 100 according to the first embodiment. Also, Fig. 3 is a sectional front view taken along the line A-A of the overcurrent trip device 100 shown in Fig. 2, showing the state before a trip operation of the overcurrent trip device 100. Fig. 4 is a sectional side view taken along the line B-B of the overcurrent trip device shown in Fig. 2, and Fig. 5 is a sectional plan view taken along the line C-C of the overcurrent trip device shown in Fig. 3. Also, Fig. 6 is a plan view of a conductor 3 of the overcurrent trip device according to the first embodiment, and Fig. 7 is an illustrated parts breakdown showing a moving core 2 and guide plates 16 of the overcurrent trip device 100 according to the first embodiment.

[0014] The overcurrent trip device 100 according to the first embodiment is a device which is assembled in a circuit breaker 200 to be described later, wherein when an overcurrent flows through a main circuit (not shown) of the circuit breaker 200, the moving core 2 of the overcurrent trip device 100 moves, causing a latch drive portion 2b provided integral with the moving core 2 to set in motion the opening/closing mechanism of the circuit breaker 200 in the closed state.

[0015] Hereinafter, a description will be given, referring to Figs. 1 to 7, of the configuration of the overcurrent trip device 100.

[0016] The overcurrent trip device 100 has the conductor 3 which is connected to the main circuit (not shown) of the circuit breaker 200, a stationary core 1 which is formed so as to enclose the conductor 3 along a magnetic field generated around the conductor 3 by energizing the conductor 3 and one portion of which is opened so as to cut the magnetic field diagonally, and the moving core 2 which, being disposed in the opened position of the stationary core 1 with a magnetic gap 4 interposed between the moving core and the stationary core 1, is disposed so as to be movable in a direction in which the magnetic gap 4 decreases with an electromagnetic force of when an overcurrent flows through the conductor 3, that is, in the direction opposite the conductor 3 (in the upward direction in Fig. 3) so that the magnetic gap 4 decreases.

[0017] The conductor 3 is made of, for example, copper, and the stationary core 1 and the moving core 2 are made of, for example, a ferromagnet.

[0018] The guide plates 16 for causing the moving core 2 to slide thereon and thereby regulating the range of movement of the moving core are provided one on each of a front and a back surface of the stationary core 1 in an extension direction 20a of the conductor 3. The guide plates 16 are provided to guide the up/down movement of the moving core 2. As shown in Fig. 7, opposed coaxial holes 18a and 18b are provided one in each of the guide plates 16 on the respective outer sides of the stationary core 1, and a rotating shaft 6 is provided so as to fit in the opposed holes 18a and 18b which are the portions related thereto.

[0019] A lever 5, which moves rotationally around the rotating shaft 6, one end portion of which is connected to the latch drive portion 2b of the moving core 2 via a moving core pin 2a, and the other end of which is connected to a spring seat 7 via a spring seat pin 7a, is provided between the guide plates 16.

[0020] The spring seat 7 is provided so as to come into close contact with a spring 8. The spring seat 7 has the function of serving as the seat of the spring 8 and applying the load force of the spring 8 to the lever 5. The load force of the spring 8 is the stress applied by a load, such as the load of the spring 8, which causes deflection. The load force applied to the lever 5 is converted to the direction of rotation around the rotating shaft 6 and applied to the moving core 2 in the direction in which the magnetic gap 4 increases. A lever cover 15 including an opening through which the latch drive portion 2b of the moving core 2 passes is provided above the lever 5 and fixed to a spring guide 10. In the first embodiment, a compression spring is used as the spring 8, but the spring 8 not being limited specifically to a compression spring, another spring, such as a torsional spring, may be used.

[0021] Also, in the overcurrent trip device 100, a stationary core cover 14 is provided so as to cover the outer periphery of the stationary core 1. The guide plates 16, the lever 5, the lever cover 15, and the stationary core cover 14 are made of a material, such as austenitic stainless, brass, or aluminum, which is not a ferromagnet.

[0022] Also, as shown in Fig. 2, the spring guide 10 is fixed to the guide plates 16, via tubes 17, by spring guide rivets 10a. When the spring guide 10 is in close contact with the guide plates 16, the tubes 17 may be omitted.

[0023] As shown in Fig. 3, the stationary core 1 is disposed in tight abutment with the conductor 3. That is, the conductor 3 is provided fitted in the stationary core 1, and the position of the stationary core 1 in a perpendicular direction 20b to the extension direction 20a of the conductor 3 is determined by the conductor 3. Also, the structure is such that the moving core 2 receives the load force of the spring 8 in the direction in which the magnetic gap 4 increases, and this is supported by the conductor 3, thus fixing the moving core 2. In the same structure, the role of a component which determines the position of the stationary core 1 is played by the conductor 3. Also, the role of a component which defines the dimensions of the magnetic gap 4 of the moving core 2 is played by the conductor 3, and no other component is provided separately. The moving core 2 is supported by the conductor 3.

[0024] Consequently, an electromagnet configured of the conductor 3, stationary core 1, and moving core 2 of the overcurrent trip device 100 has no space that does not contribute to an electromagnetic force, so that the electromagnet can obtain a greater electromagnetic force compared with in the structure which includes a gap between a conductor and a stationary core and a component with which to fix a moving core as in a heretofore known electromagnet. That is, in order to obtain an arbitrary electromagnetic force, a reduction in dimensional outline size and in weight is carried out by the structure of the overcurrent trip device 100.

[0025] The overcurrent trip device 100 includes outside the stationary core 1 a stage 9 and a spring adjusting bolt 11 in addition to the spring 8. The stage 9 being in contact with the spring 8, a threaded portion provided on the spring adjusting bolt 11 mates in a threaded hole provided passing through the center of the stage 9. A side surface 9b of the stage 9 is opposite the wall surface of the spring guide 10 inside the spring guide 10 shown in Fig. 4, thus suppressing the rotation of the stage 9 around the axis of the threaded hole. By causing the spring adjusting bolt 11 to rotate, the stage 9 moves in an axial direction of the threaded hole along the wall surface of the spring guide 10.

[0026] The movement of the stage 9 allows expansion/contraction of the spring 8, thus changing the load force of the spring 8. The moving core 2 is urged by the spring 8 in the direction in which the magnetic gap 4 between the moving core and the stationary core 1 increases, and the movement of the stage 9 changes the strength of urging the moving core 2. The strength of urging the moving core 2 determines the operating current value of the overcurrent trip device 100, and it is possible, by making this adjustable, to set a plurality of current scale values. The initial load of the spring 8 is set to be equal to the electromagnetic drive force at the operating current value of the overcurrent trip device 100. Furthermore, after setting the operating current value, a nut 12 is fixed to the spring guide 10 using the threaded portion of the spring adjusting bolt 11, and thereby the spring adjusting bolt 11 is provided so as not to rotate, while the position of the stage 9 is fixed, and thereby the spring 8 is provided so as to be constant in spring load.

[0027] The spring guide 10 is provided surrounding the spring 8 and the side surface 9b of the stage 9. The spring guide 10 suppresses deflection of the spring 8 other than the direction of movement of the stage 9 and suppresses rotation of the stage 9. The spring guide 10 includes on the outer side thereof a scale 13. The scale 13 is thus provided and a protuberant scale indication portion 9a is provided on the stage 9, and thereby the position of the stage 9 is quantitatively grasped from the positional relationship between the protuberant scale indication portion 9a and the scale 13.

[0028] By quantitatively grasping the position of the stage 9, the correlation between the position of the stage 9 and a current scale value can be recorded in advance, and thus it is possible to make a change to the current scale values based on the recorded current scale value without bringing the overcurrent trip device 100 into operation by causing a current to flow through the conductor 3.

[0029] As shown in Fig. 4, a hole 7b is provided in the center of the spring seat 7, providing the structure in which a cylindrical portion (a non-threaded, smooth-surfaced portion) of the spring adjusting bolt 11 is fitted in the hole 7b, and the hole 7b and the cylindrical portion of the spring adjusting bolt 11 slide when carrying out a trip operation. Also, the upper and lower ends of the spring adjusting bolt 11 fit in the spring guide 10. Owing to the same structure, the movement of the spring seat 7 when carrying out the trip operation is restricted to the axial direction by the spring adjusting bolt 11, so that the movement in the direction of rotation centering on the spring seat pin 7a of the spring seat 7 is suppressed before and after the operation. That is, a change in the load force of the spring 8 which transfers to the moving core 2 can be prevented before and after the operation of the overcurrent trip device 100, and it is possible to suppress variation in the operating current value.

[0030] The operating current value of a heretofore known overcurrent trip device is set to an arbitrary value before the overcurrent trip device is assembled in an electrical circuit, but when the operating current value changes after the device is assembled in the electrical circuit, there is concern that breakage of the electrical circuit occurs due to false opening wherein a trip operation is carried out in the state in which an overcurrent is less than a set current value or due to the fact that a circuit breaker is not opened even though the overcurrent exceeds the set current value and that current interruption is not performed against the overcurrent. The overcurrent trip device is configured of an electromagnet, and the operating current value is configured of a magnetic flux generated from a main circuit, a magnetic gap of the electromagnet, and a spring load applied by a return spring. Consequently, in order to set the operating current value to be stable, there is a need to establish a structure such that the magnetic gap and the spring load do not change before or after the impact of opening/closing the circuit breaker or the operation of the overcurrent trip device. According to the heretofore known overcurrent trip device, however, there is a problem in that the consideration of suppressing a change in the operating current value has not been undertaken and thus variation occurs in the operating current value.

[0031] According to the overcurrent trip device 100 of the first embodiment, as shown in Fig. 4, the hole 7b is provided in the center of the spring seat 7 which is the seat of the spring 8, and the smooth-surfaced cylindrical portion of the spring adjusting bolt 11 with which to adjust the load of the spring 8 is fitted in the hole 7b, wherein the hole 7b and the cylindrical portion of the spring adjusting bolt 11 slide when carrying out a trip operation, and thereby the position of the spring seat 7 before and after the trip operation is set to the axial direction by the cylindrical portion of the spring adjusting bolt 11. Therefore, a change in the load force of the spring 8 which transfers to the moving core 2 can be prevented before and after the operation of the overcurrent trip device 100, and it is possible to suppress variation in the operating current value and as a result possible to stabilize the operating current value.

[0032] As shown in Fig. 5, the stationary core 1 is configured of a laminated core and includes laminated magnetic steel plates 1b. The stationary core 1 is desirably configured of a laminated core for the purpose of suppressing an eddy current, but, not being limited to being of a laminated configuration, may be configured of a block of ferromagnet, such as an iron metal. Four stationary core bolts 1a each pass through the laminated magnetic steel plates 1b, the guide plates 16, a conductor front portion 3a, and the stationary core cover 14 in the direction of lamination, fixing these components together. The number of the stationary core bolts 1a is not limited to this number as long as it is the number which can fix the above-described components.

[0033] As shown in Fig. 6, the conductor 3 of the overcurrent trip device 100, being provided in the structure formed of the conductor 3 provided in the position passing through the stationary core 1 and of the conductor front portion 3a provided on the front in the lamination direction of the stationary core 1, is connected to a conductor of the circuit breaker 200 or of the electrical circuit through conductor connection holes 3b. The number of the conductor connection holes 3b is provided changed in accord with the shape of a conductor to be connected. The conductor 3 and the conductor front portion 3a may be provided in the form of separate components, as shown in Fig. 6, and the two components may be provided in combination. As shown in Fig. 5, the conductor 3 is fixed to the stationary core 1 by the stationary core bolts 1a, thereby configuring the conductor 3 and the stationary core 1 as an integral unit.

[0034] As shown in Fig. 7, a protruding portion 2c is provided on each of both surfaces of the moving core 2 which come into contact with the respective guide plates 16, and a groove portion 16a is provided in a portion, of the guide plate 16 corresponding to the protruding portion 2c, which comes into contact with the protruding portion 2c. The protruding portion 2c and the groove portion 16a are provided so as to fit each other, and thereby the range of movement of the moving core 2 when in trip operation is restricted to the longitudinal direction of the protruding portion 2c and of the groove portion 16a.

[0035] That is, it is possible to suppress the positional change of the moving core 2 before and after the impact of opening/closing the circuit breaker 200 or the operation of the overcurrent trip device 100, and thus possible to suppress variation in the operating current value.

[0036] Fig. 8 is an illustrated parts breakdown showing a modification example of the moving core and guide plates of the overcurrent trip device according to the first embodiment. In the first embodiment, the structure is shown in which the protruding portions 2c are provided on the moving core 2 and the groove portions 16a are provided one in each of the guide plates 16, as shown in Fig. 7, but as shown in Fig. 8, groove portions 2d may be provided in the moving core 2 and protruding portions 16b may be provided one on each of the guide plates 16.

[0037] Next, a description will be given of a trip operation of the overcurrent trip device 100. Fig. 9 is a sectional front view showing the state after a trip operation of the overcurrent trip device 100 according to the first embodiment, and is a sectional front view taken along the line A-A of Fig. 2. As shown in Fig. 9, a holding latch 51 is linked to the opening/closing mechanism (not shown) included in the circuit breaker 200 and, with one side in contact with the latch drive portion 2b of the moving core 2, is fixed so as to be pivotable. Before a trip operation wherein no fault current flows through the conductor 3, the load force is applied to the moving core 2 from the spring 8 and, as shown in Fig. 3, the moving core 2 is disposed in an initial position (a position before in operation) in which the moving core 2 is opposite the stationary core 1 so as to have the magnetic gap 4.

[0038] When a fault current flows through the conductor 3 and an electromagnetic drive force acting on the moving core 2 is greater than the load force of the spring 8, the moving core 2 moves from the initial position (position before in operation) to a trip position in which the magnetic gap 4 is reduced to zero, as shown in Fig. 9. In Fig. 9, the arrows shown in the stationary core 1 and moving core 2 show a magnetic circuit Φ, and a fault current I is shown in the conductor 3. By the moving core 2 moving, the latch drive portion 2b causes the holding latch 51 to pivot, and thereby latching is released. The opening/closing mechanism of the circuit breaker 200 linked to the holding latch 51 comes in motion, bringing the circuit breaker 200 into the open state.

[0039] As above, according to the overcurrent trip device 100 of the first embodiment, it includes the conductor 3 connected to the main circuit of the circuit breaker 200, the stationary core 1 which is formed so as to enclose the conductor 3 and one portion of which is opened, and the moving core 2 which, being disposed in the opened position of the stationary core 1 between the moving core and the stationary core 1 via the magnetic gap 4, is disposed so as to be movable by an electromagnetic force of when an overcurrent flows through the conductor 3, wherein the stationary core 1 is disposed in abutment with the conductor 3, and the moving core 2 is in contact with the conductor 3 when no overcurrent flows through the conductor 3 before in operation.

[0040] Also, according to the overcurrent trip device 100 of the first embodiment, it has the spring 8 with which to apply a return load to the moving core 2 and the lever 5, one end portion of which is linked to the moving core 2 and the other end portion of which is provided outside the stationary core 1. Also, according to the overcurrent trip device 100 of the first embodiment, the spring 8 and the lever 5 are supported on the outer side of the stationary core 1 by the guide plates 16, and the spring 8, the lever 5, and the guide plates 16 are provided integral with the conductor 3 together with the stationary core 1.

[0041] Consequently, according to the overcurrent trip device 100 of the first embodiment, it is possible to realize a reduction in the size of the overcurrent trip device 100.

Second Embodiment

[0042] Fig. 10 is a sectional front view of an overcurrent trip device according to a second embodiment. In Fig. 10, components identified by identical signs to those used to describe the overcurrent trip device 100 in the first embodiment indicate identical or corresponding components, and the description thereof is omitted. In Fig. 10, the region shown in section shows the section of the spring adjusting bolt 11 which passes through the center of the axis thereof. An overcurrent trip device 100 according to the second embodiment is such that the moving core 2 provided in the overcurrent trip device 100 shown in the first embodiment is different in position and that a connection portion 2e is provided between the latch drive portion 2b and the moving core 2.

[0043] The direction in which the latch drive portion 2b causes the opening/closing mechanism to move is shown by the arrow in Fig. 10. The moving core 2 is provided on the opposite side of the latch drive portion 2b across the conductor 3, so that the connection portion 2e is provided on the way from the moving core 2 to the latch drive portion 2b. Also, the direction of movement is the direction toward the conductor 3, so that the latch drive portion 2b is provided in a hook shape, and the rotating shaft 6 of the lever 5 is provided on the outer side of the moving core pin 2a and a spring seat pin (not shown). The overcurrent trip device 100 according to the second embodiment is such that the stationary core 1 is disposed in tight abutment with the conductor 3 in the same way as in the first embodiment. That is, the conductor 3 is provided fitted in the stationary core 1, and the structure is such that the moving core 2 receives the load force of the spring 8 in the direction in which the magnetic gap 4 increases, and that this is supported by the conductor 3, thus fixing the moving core 2, so that the overcurrent trip device 100 is reduced in dimensional outline size and in weight.

[0044] As above, according to the overcurrent trip device 100 of the second embodiment, the position of the moving core 2 is provided on the opposite side of the latch drive portion 2b across the conductor 3, and the direction of causing the opening/closing mechanism to move is different from in the first embodiment, so that it is possible, even when the direction of movement of the opening/closing mechanism is different, to install the overcurrent trip device 100.

Third Embodiment

[0045] Fig. 11 is a sectional side view showing the outline configuration of a circuit breaker 200 according to a third embodiment. Hereinafter, a description will be given, referring to the drawing, of the circuit breaker 200 according to the third embodiment. As shown in Fig. 11, the overcurrent trip device 100 shown in the first or second embodiment is assembled in the circuit breaker 200, and the overcurrent trip device 100 sets in motion the opening/closing mechanism of the circuit breaker 200 in the closed state. Fig. 11 shows the circuit breaker 200 inserted in a fixing frame 70.

[0046] In the circuit breaker 200, an upper conductor 53 and a lower conductor 54 are disposed below an arc-extinguishing chamber 52 in which an arc-extinguishing space is formed when a current flows.

[0047] A stationary side main contact 55 is connected to the upper conductor 53. The other lower conductor 54 is connected to a moving conductor 57 via a flexible conductor 56, and a moving side main contact 58 is provided in a position, opposite the stationary side main contact 55, of an end portion of the moving conductor 57. The moving conductor 57 pivots around a rotating shaft 59, wherein opening is carried out by an opening spring 60, and closing is carried out by an actuator 61. The configuration is such that the stationary side main contact 55 and the moving side main contact 58 come into contact with each other, and thereby a current flows between the upper conductor 53 and the lower conductor 54 via the moving conductor 57 and the flexible conductor 56.

[0048] The overcurrent trip device 100 is disposed in the middle of the lower conductor 54. The lower conductor 54 is connected to the conductor 3 of the overcurrent trip device 100, and a main circuit current flows therethrough. Also, the overcurrent trip device 100 is engaged with a latch 64 by a latch drive link 63. Herein, the latch drive link 63 shown by the broken line in Fig. 11 corresponds to a portion through which to transfer the movement of the lever 5 of the previously described overcurrent trip device 100 to the holding latch 51, meaning that the latch 64 is driven based on this operation.

[0049] Next, a description will be given of the operation when the fault current I flows. When the fault current I flows, the overcurrent trip device 100 disposed on the lower conductor 54 operates upon detecting an overcurrent, this operation is transferred to the latch 64 by the latch drive link 63, the latch 64 pivots clockwise around a latch shaft 65, releasing the engagement with the moving conductor 57, and the moving conductor 57 pivots clockwise around the rotating shaft 59, thereby carrying out an opening operation.

[0050] The stationary side main contact 55 and the moving side main contact 58 are housed inside the arc-extinguishing chamber 52. A stationary side arcing contact 66 and a moving side arcing contact 67 are disposed above the stationary side main contact 55 and the moving side contact 58, and an arc is generated at a breaking time.

[0051] The configuration is such that in the opening operation, the stationary side arcing contact 66 and the moving side arcing contact 67 separate from one another retardedly after separation between the stationary side main contact 55 and the moving side main contact 58, and thereby an arc is prevented from being generated between the stationary side main contact 55 and the moving side main contact 58, thus protecting the main contact portions by preventing them from eroding away. Also, a stationary side arcing horn 68 and a moving side arcing horn 69 are disposed above the the stationary side arcing contact 66 and the moving side arcing contact 67 in order to commutate and lead the generated arc to the upper portion of the arc-extinguishing chamber 52.

[0052] The structure of the circuit breaker 200 described in Fig. 11 shows one example, and the structure of the circuit breaker 200 is not limited to the configuration of Fig. 11. Any structure other than that of the circuit breaker 200 shown in Fig. 11 may be used as long as the structure is of a configuration such that a current flowing through the main circuit of the circuit breaker 200 is detected by the overcurrent trip device 100, and that the engagement between the moving conductor 57 and the latch 64 is released by the operation of the overcurrent trip device 100, thus opening the circuit breaker 200.

[0053] As above, the circuit breaker 200 according to the third embodiment includes the arc-extinguishing chamber 52 in which the arc-distinguishing space is formed, the stationary side main contact 55 disposed on the lower side of the arc-distinguishing chamber 52, the moving side main contact 58 disposed so as to be able to contact with and separate from the stationary side main contact 55, and the overcurrent trip device 100 which detects an overcurrent flowing between the stationary side main contact 55 and the moving side main contact 58 and drives the moving side main contact 58 in a trip direction, wherein the overcurrent trip device 100 is the overcurrent trip device described in the first or second embodiment.

[0054] Consequently, according to the circuit breaker 200 of the third embodiment, the overcurrent trip device 100 shown in the first or second embodiment is assembled therein, so that it is possible to reduce the space of the circuit breaker 200 in which to install the overcurrent trip device 100, and as a result possible to reduce the size of the circuit breaker 200.

[0055] Although the present application is described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects, and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations, to one or more of the embodiments.

[0056] It is therefore understood that numerous modifications which have not been exemplified can be devised without departing from the scope of the present application. For example, at least one of the constituent components may be modified, added, or eliminated. At least one of the constituent components mentioned in at least one of the preferred embodiments may be selected and combined with the constituent components mentioned in another preferred embodiment.

Reference Signs List

[0057] 1 stationary core, 1a stationary core bolt, 1b magnetic steel plate, 2 moving core, 2a moving core pin, 2b latch drive portion, 2c protruding portion, 2d groove portion, 2e connection portion, 3 conductor, 3a conductor front portion, 3b conductor connection hole, 4 magnetic gap, 5 lever, 6 rotating shaft, 7 spring seat, 7a spring seat pin, 7b hole, 8 spring, 9 stage, 9a scale indication portion, 9b side surface, 10 spring guide, 10a spring guide rivet, 11 spring adjusting bolt, 12 nut, 13 scale, 14 stationary core cover, 15 lever cover, 16 guide plate, 16a groove portion, 16b protruding portion, 17 tube, 18a, 18b opposed holes, 20a extension direction, 20b perpendicular direction, 51 holding latch, 52 arc-distinguishing chamber, 53 upper conductor, 54 lower conductor, 55 stationary side main contact, 56 flexible conductor, 57 moving conductor, 58 moving side main contact, 59 rotating shaft, 60 opening spring, 61 actuator, 63 latch drive link, 64 latch, 65 latch shaft, 66 stationary side arcing contact, 67 moving side arcing contact, 68 stationary side arcing horn, 69 moving side arcing horn, 70 fixing frame, 100 overcurrent trip device, 200 circuit breaker, I fault current, Φ magnetic circuit

Claims

1. An overcurrent trip device, **characterized by** comprising:

    a conductor connected to a main circuit of a circuit breaker;
    a stationary core which is formed so as to enclose the conductor and one portion of which is opened; and
    a moving core which, being disposed in the opened position of the stationary core with a magnetic gap interposed between the moving core and the stationary core, is disposed so as to be movable by an electromagnetic force of when an overcurrent flows through the conductor, wherein
    the stationary core is disposed in abutment with the conductor, and the moving core is in contact with the conductor when no overcurrent flows through the conductor before in operation.

2. The overcurrent trip device according to claim 1, **characterized in that**
    the moving core is caused to move in the direction opposite the conductor so that the magnetic gap decreases when an overcurrent flows through the conductor.

3. The overcurrent trip device according to claim 1 or 2, **characterized in that**
    guide plates which guide up/down movement of the moving core are provided one on each of a front and a back surface of the stationary core in the direction in which the conductor extends.

4. The overcurrent trip device according to claim 3, **characterized in that**

    the moving core has protruding portions, one on each of a front and a back surface of the moving core in the direction in which the conductor extends, that
    the guide plates each have a groove portion opposite the corresponding protruding portion, and that
    the protruding portions of the moving core are provided so as to fit in the respective groove portions of the guide plates.

5. The overcurrent trip device according to any one of claims 1 to 4, **characterized by** comprising:

    a spring with which to apply a return load to the moving core; and
    a lever, one end portion of which is linked to the moving core, and the other end portion of which is linked to the spring provided outside the stationary core.

6. The overcurrent trip device according to claim 3 or 4, **characterized by** comprising:

    a spring with which to apply a return load to the moving core; and
    a lever, one end portion of which is linked to the moving core, and the other end portion of which is linked to the spring provided outside the stationary core, wherein
    the spring and the lever are supported outside the stationary core by the guide plates, and wherein
    the spring, the lever, and the guide plates are provided integral with the conductor together with the stationary core.

7. The overcurrent trip device according to claim 5 or 6, **characterized in that**

    a rotating shaft is disposed in the lever, and
    the lever pivots around the axis of the rotating shaft, transferring the load force of the spring to the moving core.

8. The overcurrent trip device according to any one of claims 5 to 7, **characterized in that**

    a hole is provided in the center of a spring seat which is the seat of the spring, that
    a smooth-surfaced cylindrical portion of a spring adjusting bolt with which to adjust the load of the spring is fitted in the hole, and that
    the hole and the cylindrical portion of the spring adjusting bolt slide when carrying out a trip operation, and thereby the position of the spring seat before and after the trip operation is set to an axial direction by the cylindrical portion of the spring adjusting bolt.

9. A circuit breaker, **characterized by** comprising:

    an arc-extinguishing chamber in which an arc-extinguishing space is formed;
    a stationary side main contact disposed on the lower side of the arc-extinguishing chamber;
    a moving side main contact disposed so as to be able to contact with and separate from the stationary side main contact; and
    an overcurrent trip device which detects an over-

current flowing between the stationary side main contact and the moving side main contact and drives the moving side main contact in a trip direction, wherein
the overcurrent trip device is the overcurrent trip device according to any one of claims 1 to 8.

FIG.1

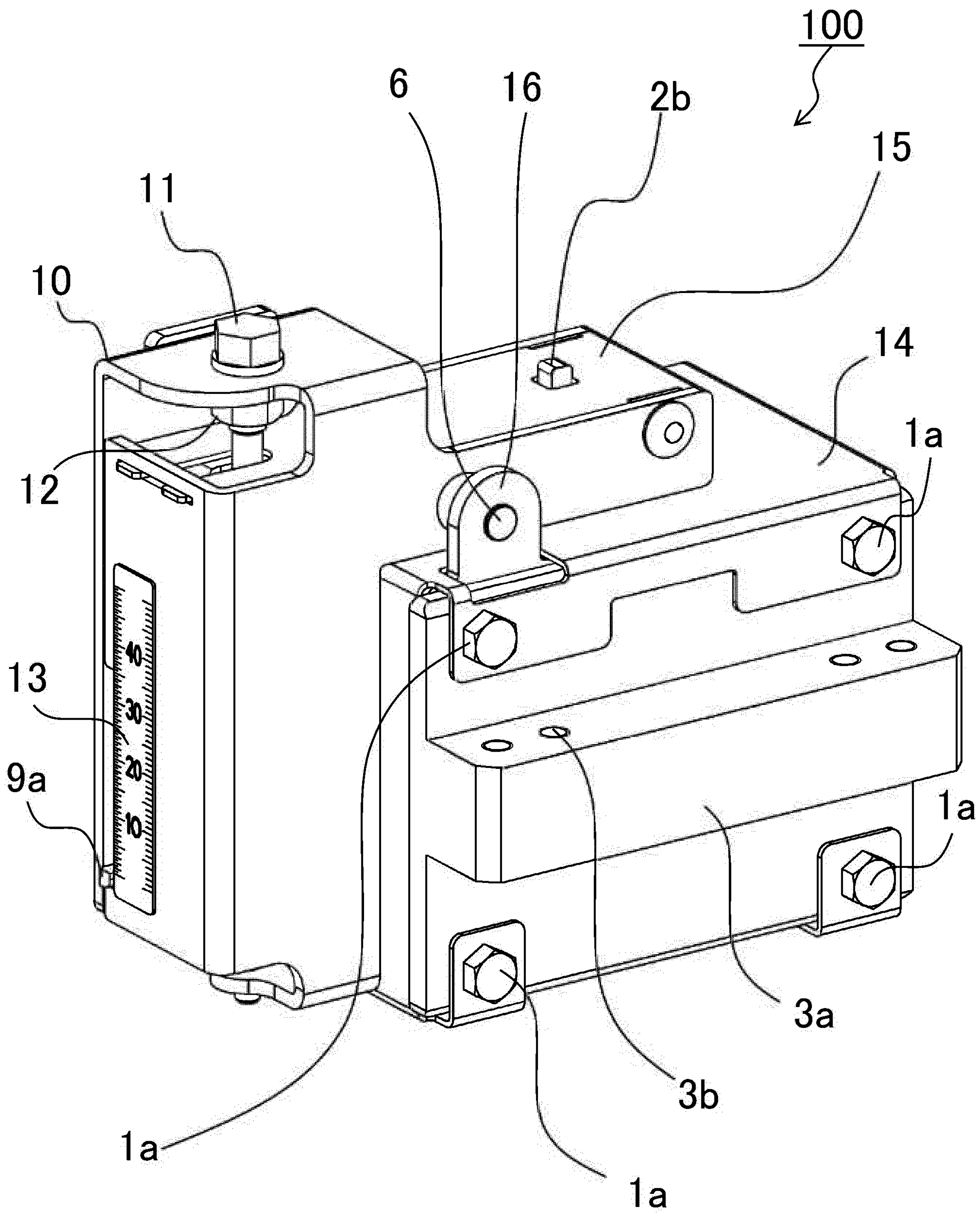


FIG.2

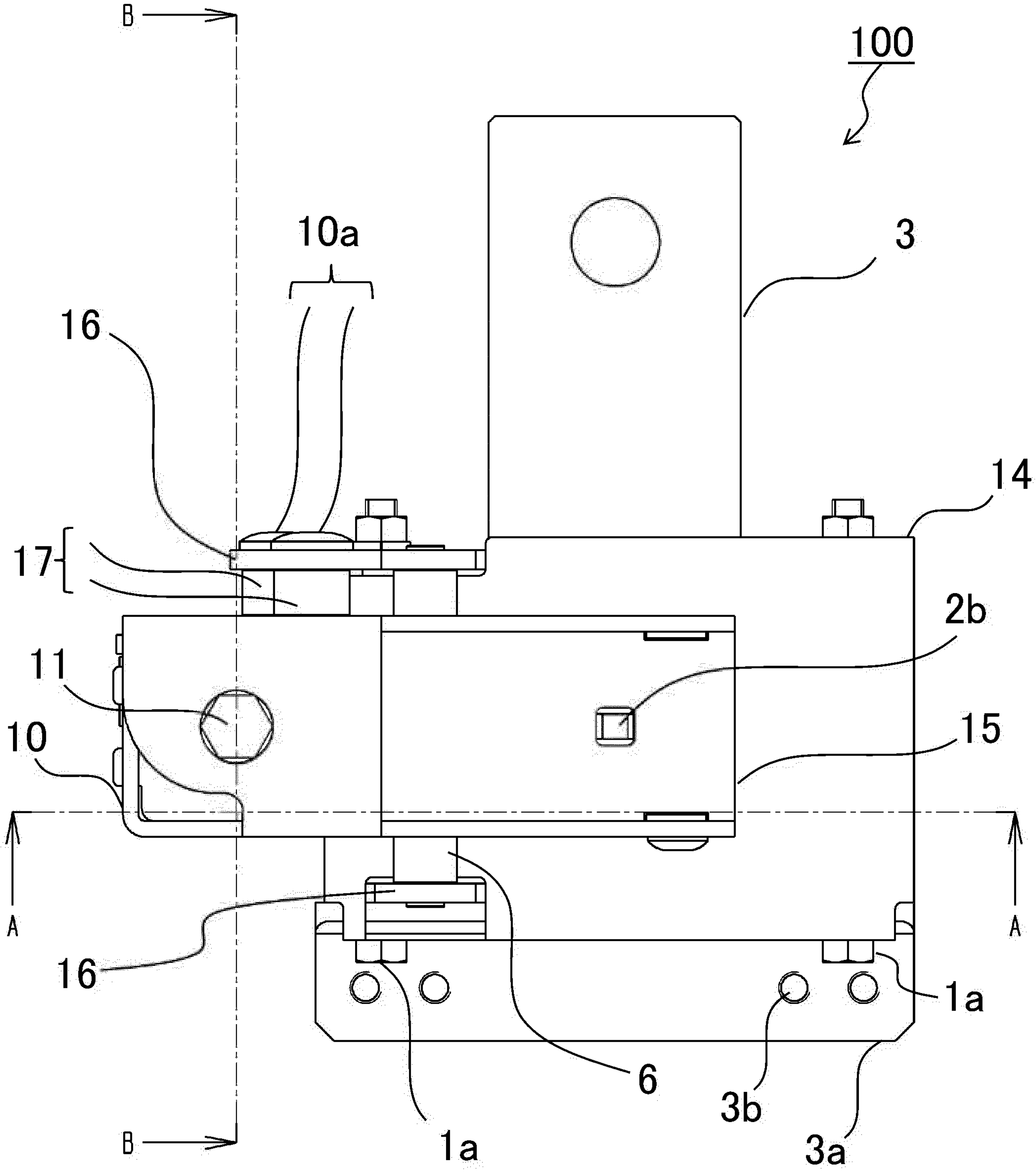


FIG.3

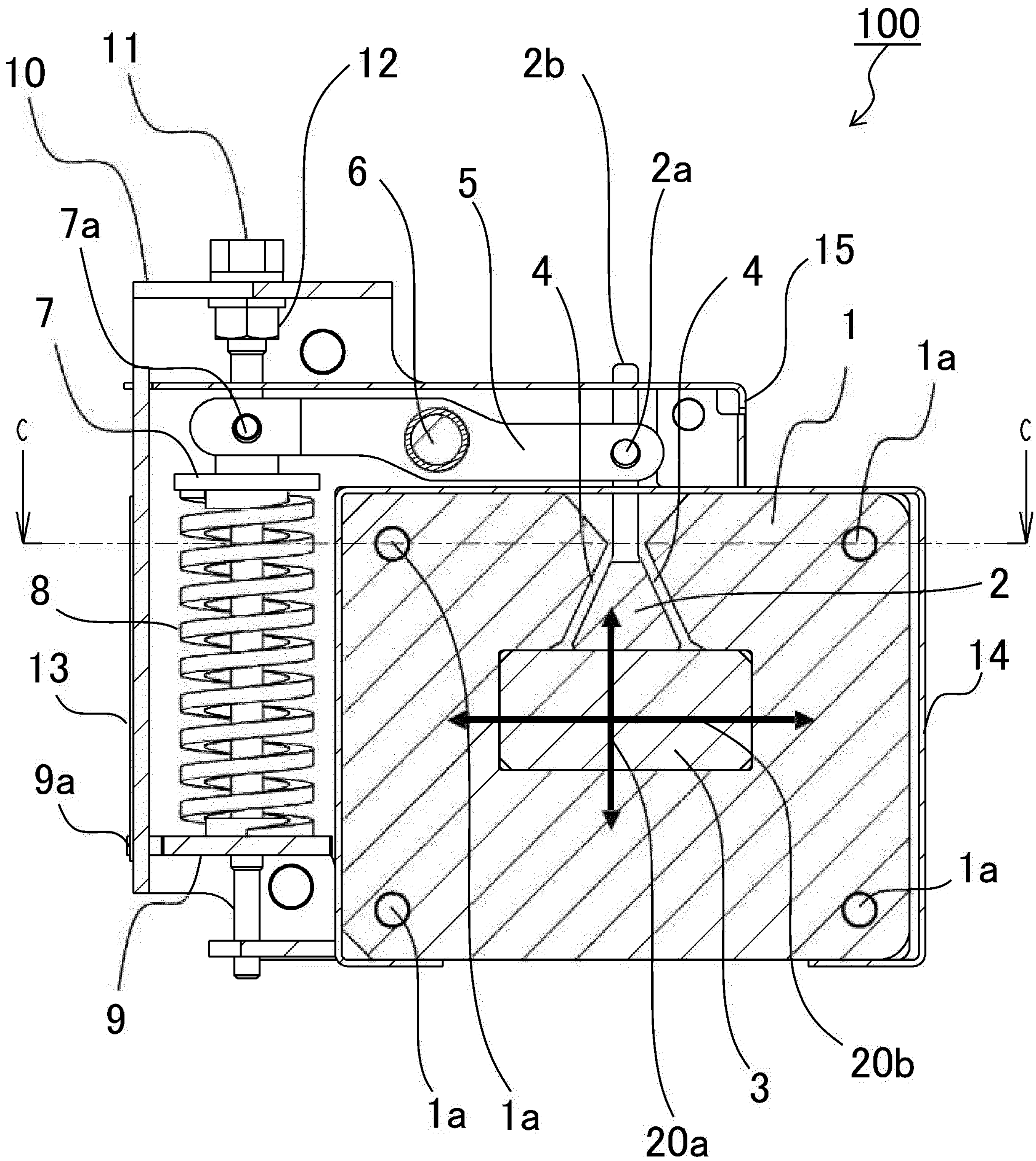


FIG.4

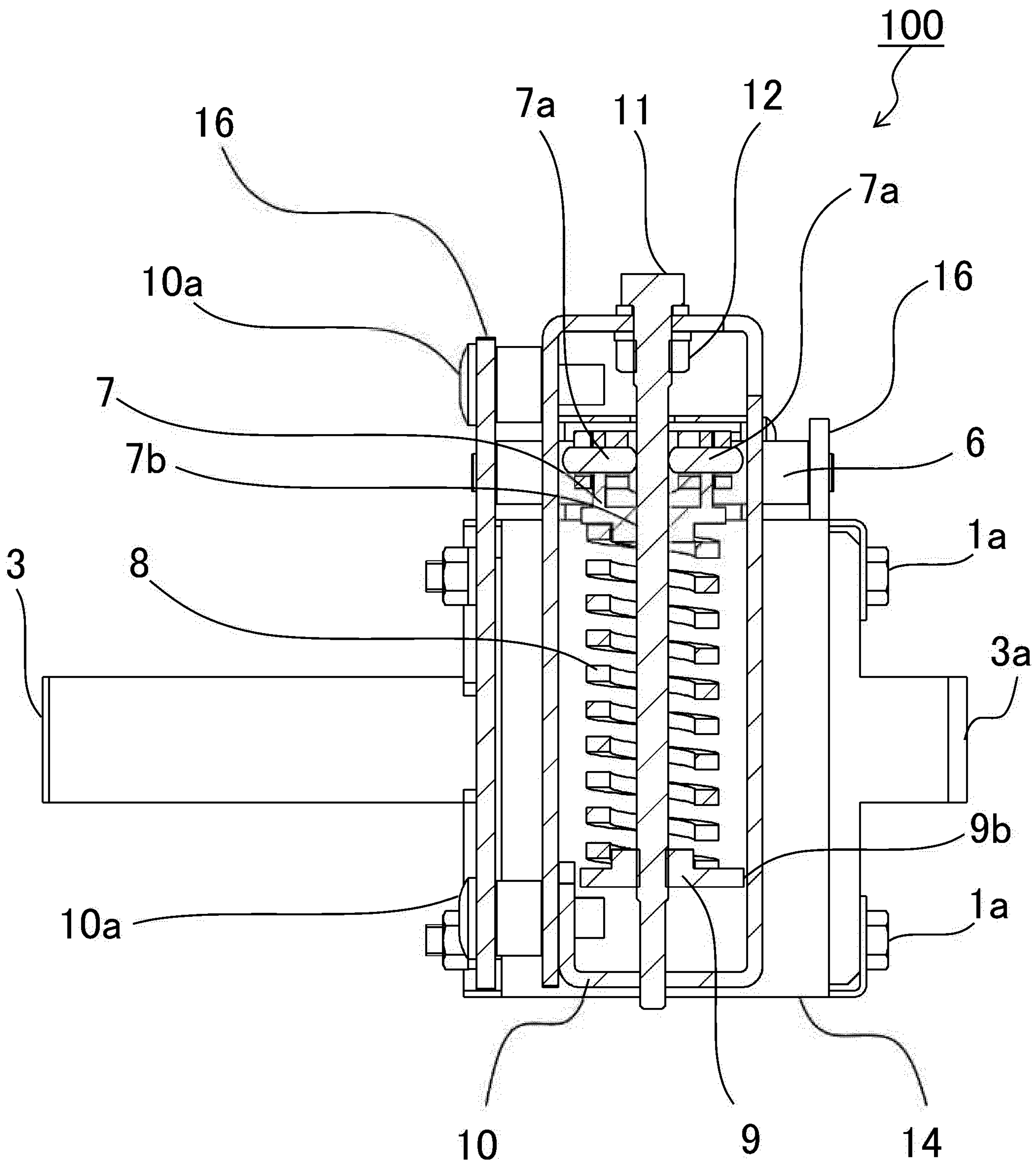


FIG.5

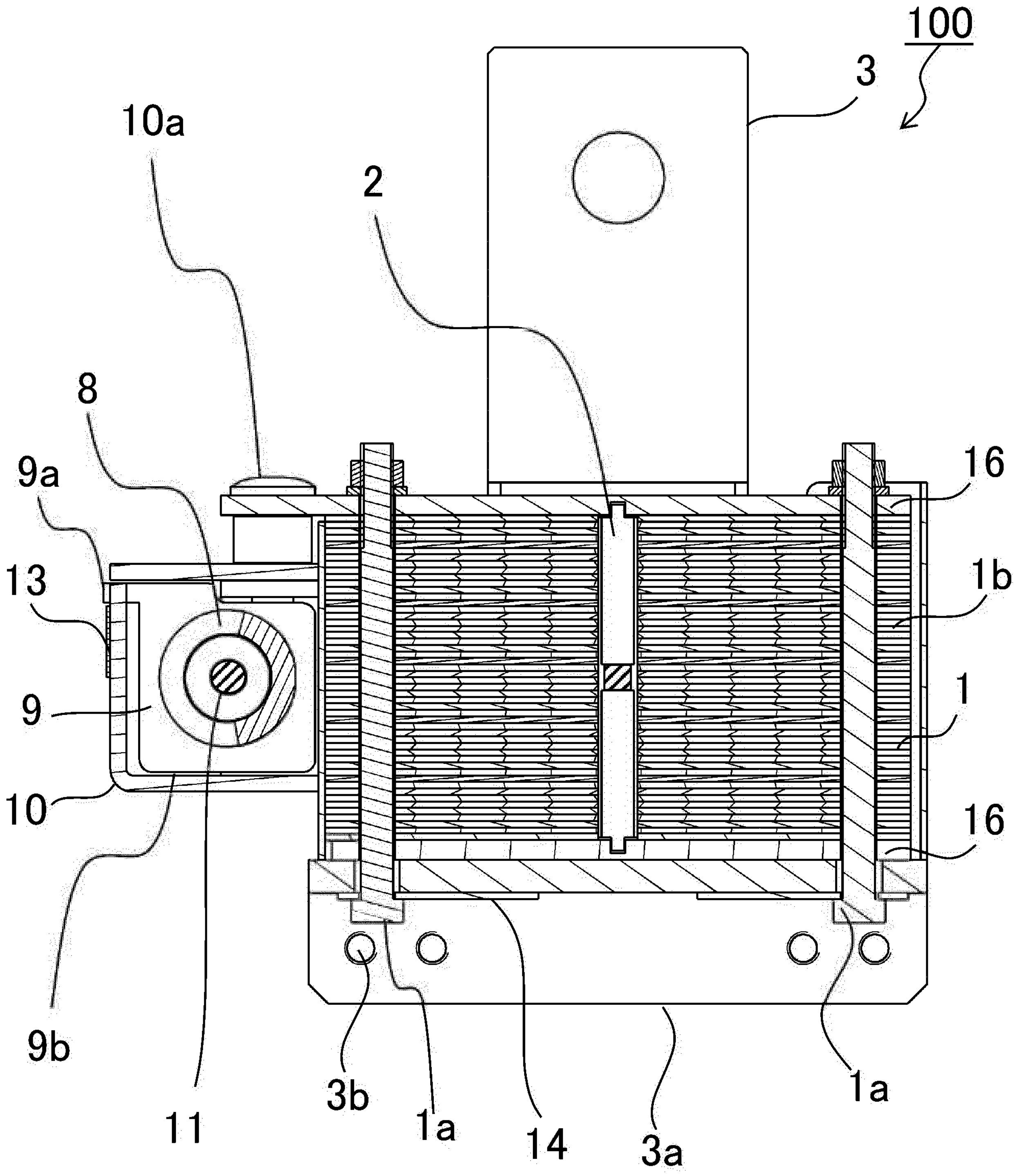


FIG.6

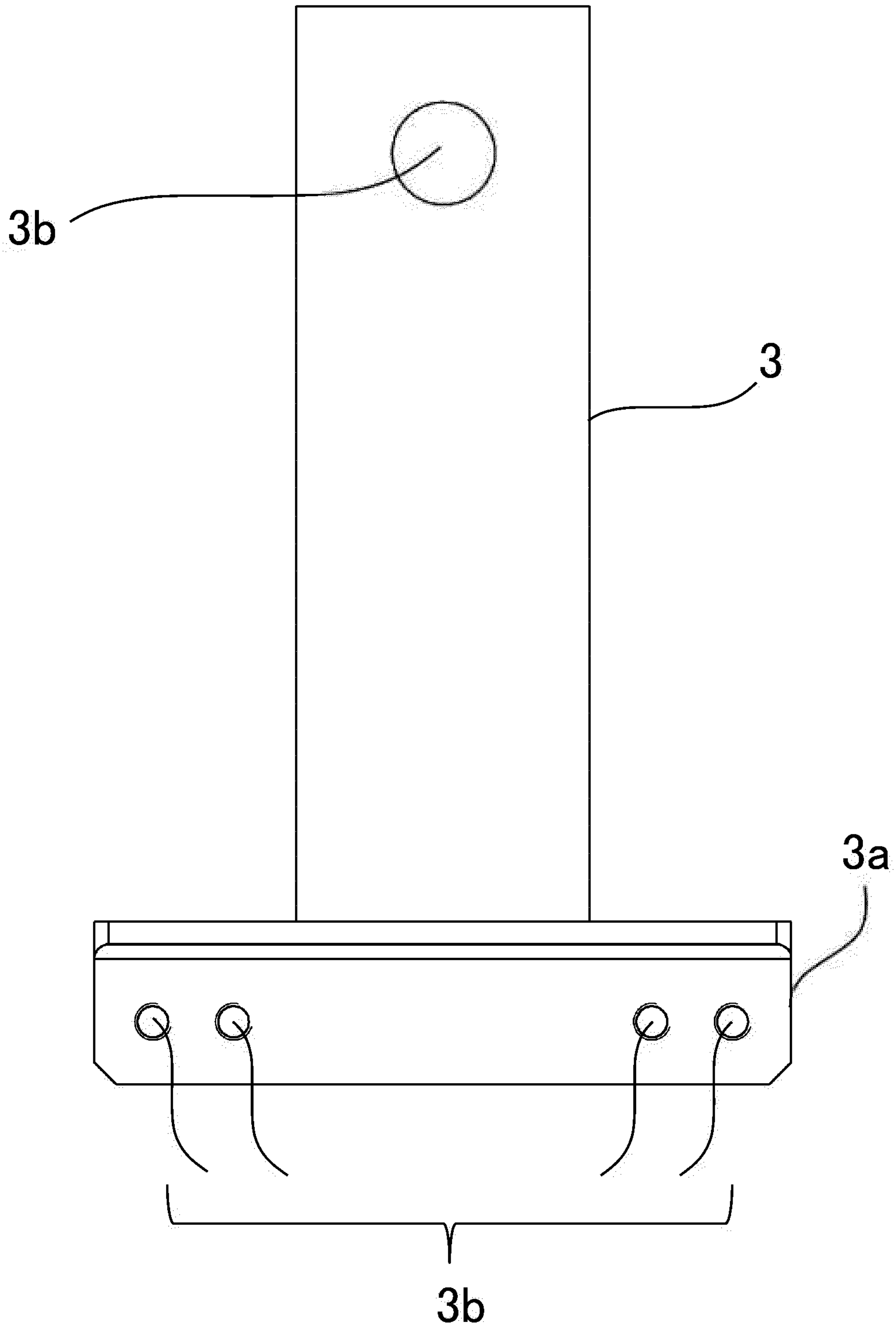


FIG.7

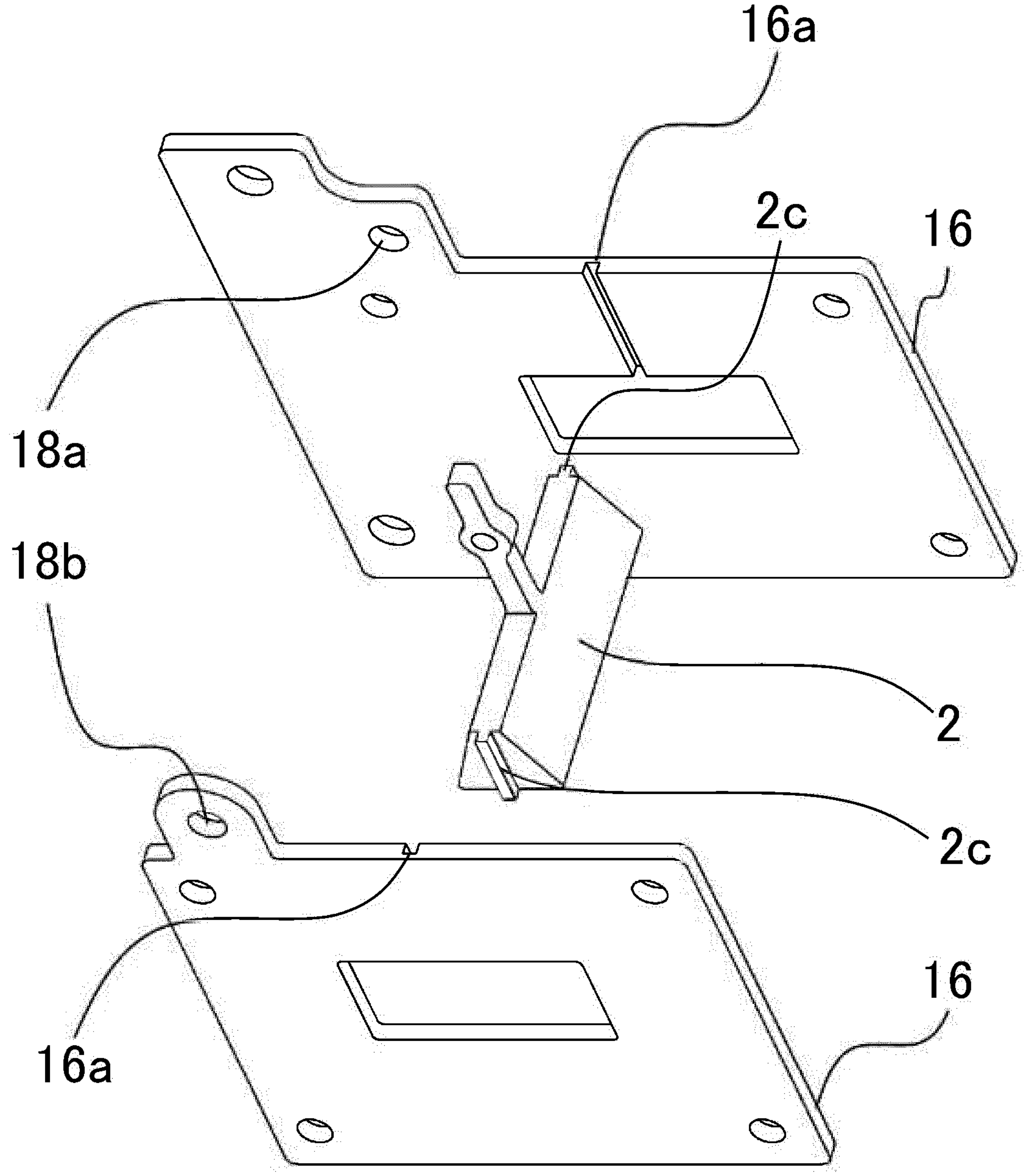


FIG.8

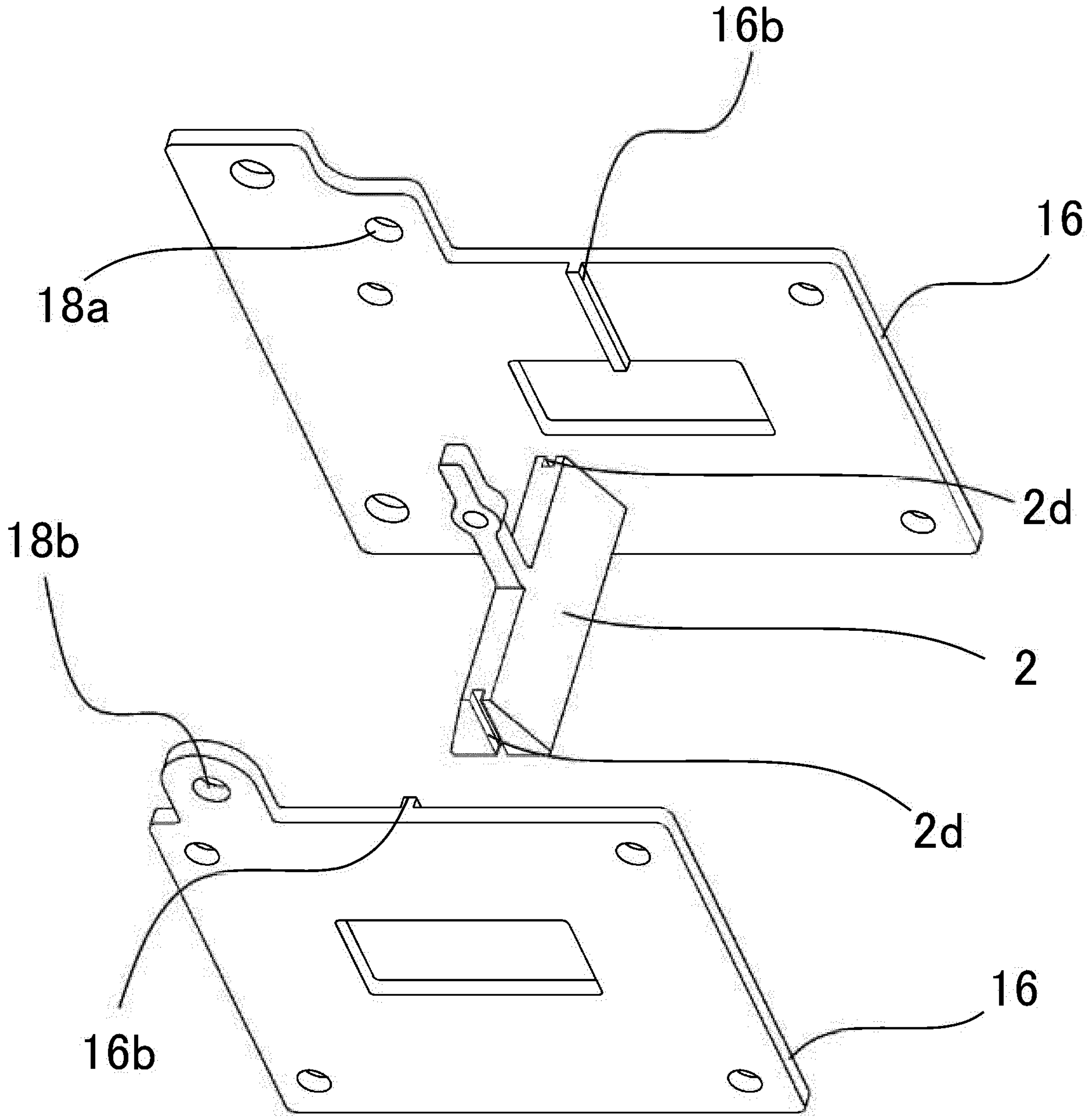


FIG.9

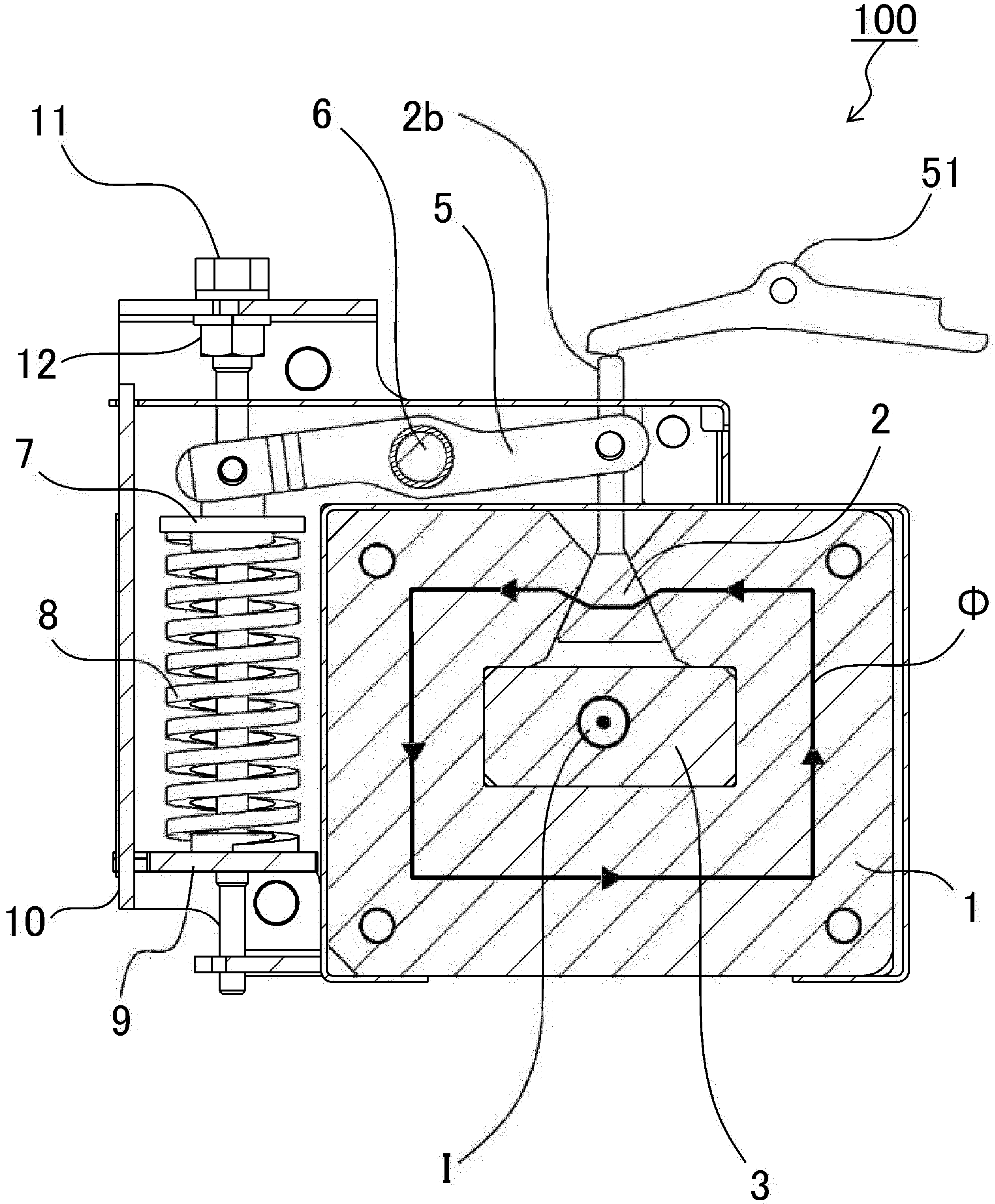


FIG.10

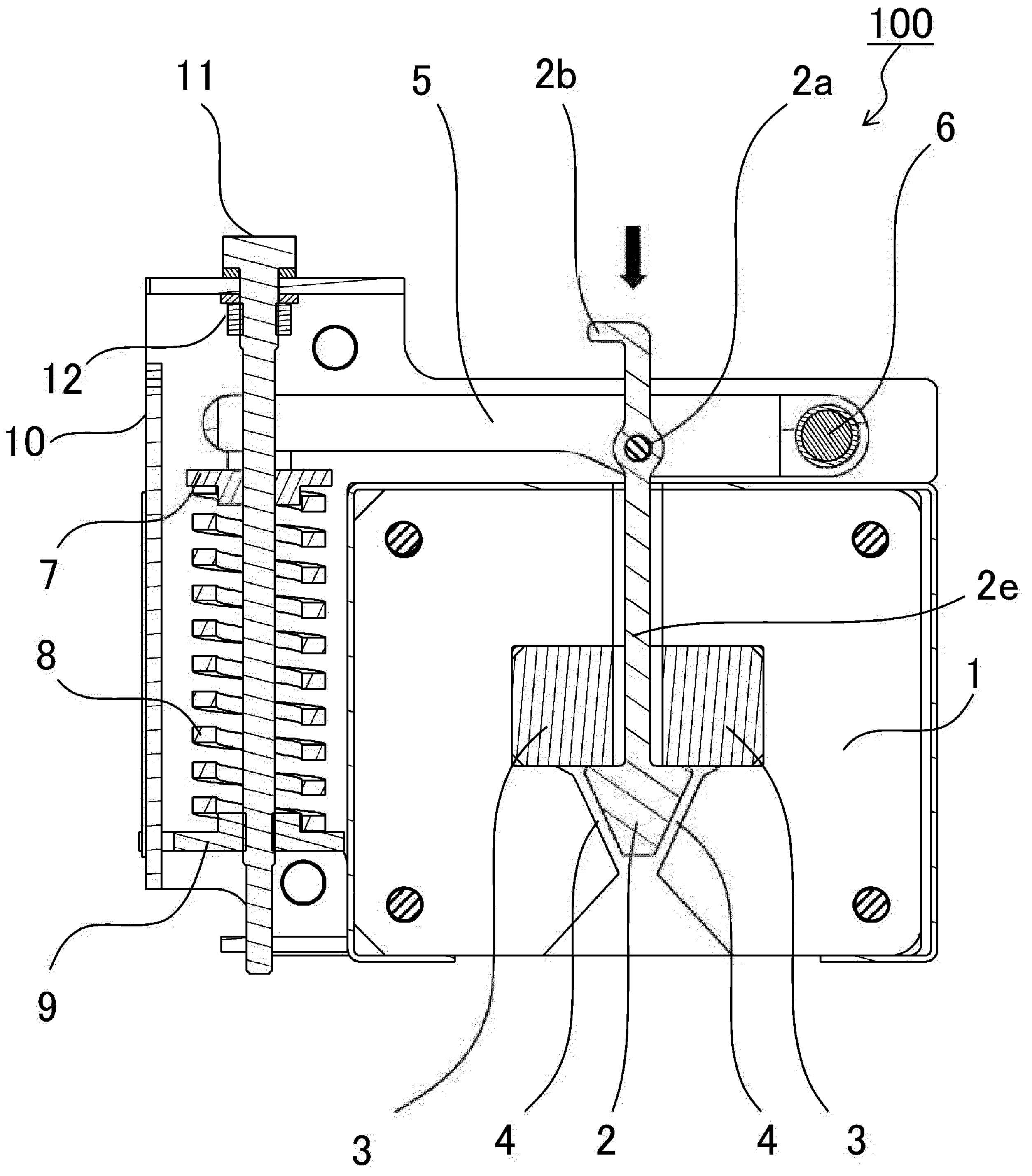
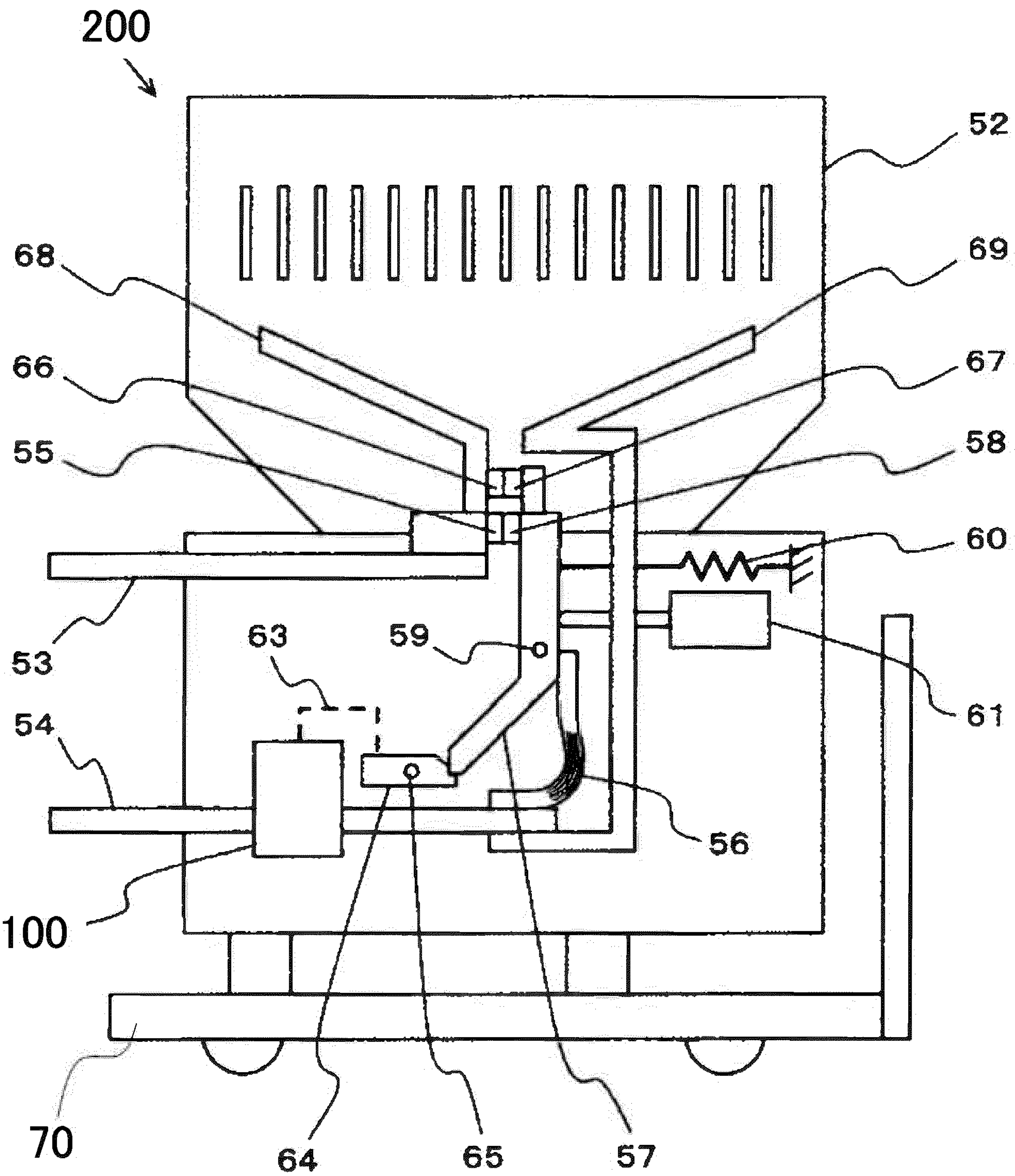


FIG.11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/047083

A. CLASSIFICATION OF SUBJECT MATTER
H01H 73/36(2006.01)i
FI: H01H73/36 Z
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)
H01H73/36

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 152760/1987 (Laid-open No. 060334/1989) (TERASAKI ELECTRIC CO., LTD.) 17 April 1989 (1989-04-17) specification, pp. 2-14, fig. 1-4	1, 9 2, 3, 4, 5, 6, 7, 8
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 011443/1990 (Laid-open No. 108236/1990) (MERLAN, Gellan) 28 August 1990 (1990-08-28) specification, pp. 2-23, fig. 1-5	1, 9
Y	JP 60-119705 A (MITSUBISHI MINING & CEMENT CO., LTD.) 27 June 1985 (1985-06-27) page 1, lower left column to page 3, upper right column, fig. 1-4	1, 9

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

* Special categories of cited documents:
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"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
12 February 2021 (12.02.2021)	22 February 2021 (22.02.2021)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application no.
PCT/JP2020/047083

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 1-060334 U1	17 Apr. 1989	(Family: none)	
JP 2-108236 U1	28 Aug. 1990	US 4443828 A columns 1-8, fig. 1-5 EP 0061364 A1	
JP 60-119705 A	27 Jun. 1985	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- EP 2431992 A1 **[0004]**