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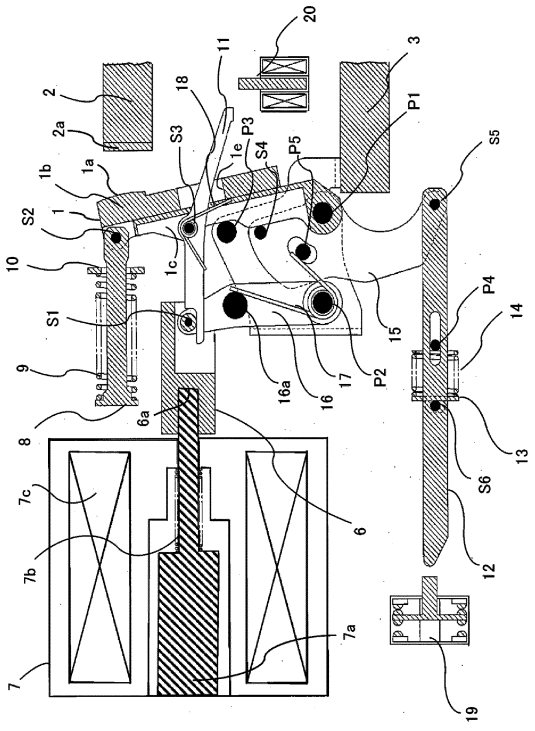
(54) **CIRCUIT BREAKER**

(57) The traveling contact connected to and separated from the fixed contact, the rod-shaped latch (11) that is rotatably pivotally supported in the barycentric region between one end having a latch engaging part (11a) and the other end driven by tripping, the insulating rod (6) having a latch pin (S1) at one end that engages with the latch engaging part, the input actuator (7) that drives the other end of the insulating rod, and the spring (9) for opening that drives the traveling contact in the opening direction are provided, when the other end of the latch is pulled off and driven while the traveling contact is closed to the fixed contact, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling contact is driven in the opening direction by the opening spring, with the traveling contacts open, the latch pin is driven in the input direction via the insulating rod by the input actuator, the latch is driven in the input direction via the latch engaging part, and the traveling contact is driven in the opening direction with the fixed contact, it is not easily affected by vibration, and it is possible to stabilize the closing operation and the closing holding.

FIG. 2



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Description

Technical Field

[0001] The present application relates to a circuit breaker having a fixed contact as well as a traveling contact connected to and separated from the fixed contact.

Background Art

[0002] Circuit breakers, especially DC circuit breakers, are required to cut off the circuit short-circuit current for a short time, and the operation mechanism needs to open the main contact in a short time. Therefore, a switch operation mechanism as in Patent Document 1 has been proposed.
[Patent Literature 1] JP 2015-162402 A

Disclosure of Invention

Technical Problem

[0003] The circuit breaker may be affected by impact vibration during switch operation, and vibration due to installation conditions when holding the closing. In a circuit breaker that maintains a closing state by a latch mechanism, there is a problem that the latch oscillates due to the vibration, the latch engaging part is disengaged, and an unnecessary opening is reached.

[0004] The present application discloses a technique made in view of the above circumstances, and it is an object of the present invention to obtain a structure not easily affected by vibration and being able to stabilize the closing operation and the closing holding.

Solution to Problem

[0005] The circuit breaker disclosed in this application is equipped with a fixed contact, a traveling contact connected to and separated from the fixed contact, a rod-shaped latch that is rotatably pivotally supported in the barycentric region between one end having a latch engaging part and the other end driven by tripping, an insulating rod having a latch pin at one end that engages with the latch engaging part, an input actuator that drives the other end of the insulating rod, and a spring for opening that drives the traveling contact in the opening direction,

[0006] When the other end of the latch is pulled off and driven while the traveling contact is closed to the fixed contact, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling contact is driven in the opening direction by the opening spring.

[0007] When the latch pin is driven in the input direction by the input actuator via the insulating rod in a state where the traveling contact is open, the latch is driven in the input direction via the latch engaging part, and the traveling contact is driven in the opening direction with the fixed contact.

Advantageous Effects of Invention

[0008] According to the circuit breaker disclosed in the present application, it is not easily affected by the vibration of the circuit breaker, it is possible to stabilize the closing operation and the closing holding.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a diagram showing the first embodiment of the present application, and is an external side view for explaining mainly a structure of a circuit breaker of an operation mechanism.
[Fig. 2] Fig. 2 is a diagram showing the first embodiment of the present application, is a schematic side sectional view of a circuit breaker in an opening state, and is a diagram for explaining mainly a structure of an operation mechanism of the circuit breaker.
[Fig. 3] Fig. 3 is a diagram showing the first embodiment of the present application, is a schematic side sectional view of a circuit breaker in a closing state, and is a diagram for explaining the structure of an operation mechanism of the circuit breaker.
[Fig. 4] Fig. 4 is a diagram showing the first embodiment of the present application, is a schematic side sectional view showing a circuit breaker opening state and an input actuator excited state by releasing a latch by a tripping device, and is a figure for demonstrating mainly the structure of the operation mechanism of a circuit breaker.
[Fig. 5] Fig. 5 is a diagram showing the first embodiment of the present application, is a perspective view showing an input driving rod and an insulating rod connecting hole of an input actuator, and is a diagram for explaining mainly a structure of a circuit breaker of an operating mechanism.
[Fig. 6A] Fig. 6A is a diagram showing the first embodiment of the present application, is a perspective view showing a connection between a traveling terminal and an opening spring unit as an exploded view of components.
[Fig. 6B] Fig. 6B is a diagram showing the first embodiment of the present application, is a perspective view showing the connection between the traveling terminal and the opening spring unit, and is a diagram showing the relationship between the width of the traveling contact and the traveling terminal link after combination.
[Fig. 7A] Fig. 7 is a diagram showing the first embodiment of the present application, is a diagram for explaining a structure of an operation mechanism of a circuit breaker, is a perspective view showing an insulating rod and a latch engaging part, and is a

figure showing the steady state where the upper surface and the side surface of a latch engaging part are covered with an insulating rod.

[Fig. 7B] Fig. 7A is a diagram showing the first embodiment of the present application, is a diagram for explaining a structure of an operation mechanism of a circuit breaker, is a perspective view showing an insulating rod and a latch engaging part, and is a figure showing the pulled out state of the latch engaging part from the insulating rod in order to show the positional relationship between the latch engaging part and the insulating rod.

[Fig. 8] Fig. 8 is a diagram showing the second embodiment of the present application, is a diagram for explaining another structure of the operation mechanism of the circuit breaker, and is a schematic side sectional view of the circuit breaker in an opening state.

[Fig. 9A] Fig. 9A is a diagram showing the third embodiment of the present application, is a diagram for explaining still another structure of the operation mechanism of the circuit breaker, and is a schematic side sectional view of the circuit breaker in an opening state.

[Fig. 9B] Fig. 9B is a diagram showing the third embodiment of the present application, is a diagram for explaining still another structure of the operation mechanism of the circuit breaker, and is a schematic side sectional view of the circuit breaker in a closing state.

[Fig. 9C] Fig. 9C is a diagram showing the third embodiment of the present application, is a diagram for explaining still another structure of the operation mechanism of the circuit breaker, and is a side sectional schematic diagram of the circuit breaker opening state and the input actuator excitation state by releasing the latch by the tripping device.

Description of Embodiments

[0010] Hereinafter, each embodiment of the present application will be described with reference to the drawings as an example of application to a DC circuit breaker.

[0011] In the drawings, the same reference numerals indicate the same or corresponding parts.

First Embodiment

[0012] Figs. 1 to 7B explain the structure of the operation mechanism of the circuit breaker in the first embodiment of the present application, Fig. 1 shows the structure of the operation mechanism of the circuit breaker, Fig. 2 shows the opening state of the circuit breaker, which is mainly the operation mechanism, Fig. 3 shows the closing state of mainly the circuit breaker of the operating mechanism, Fig. 4 shows the excitation state of the input actuator in the opening state due to the release of the latch engaging part of the operation mechanism of the circuit breaker, Fig. 5 shows the connection between the input driving rod and the insulation rod of the circuit breaker, which is mainly the operation mechanism, Figs. 6A and 6B show the connection between the traveling terminal of the operation mechanism and the opening spring unit of the circuit breaker, Figs. 7A and 7B show mainly the insulating rod and latch engaging part of the operating mechanism of the circuit breaker.

[0013] As shown in Fig. 1, the circuit breaker has a traveling terminal 1, a first fixed terminal 2, and a second fixed terminal 3 provided below the first fixed terminal 2. The second fixed terminal 3 is connected to the traveling terminal 1 via a flexible shunt 4.

[0014] Various driving mechanisms including a closing drive mechanism are attached to a mechanical frame 5 fixed in the circuit breaker. The closing driving mechanism is connected to an insulating rod 6, and the insulating rod 6 is moved (to be exact, pivoted) in the left-right direction of Fig. 1 by an input actuator 7.

[0015] A part of an opening driving mechanism having a spring rod 8 for opening, a spring 9 for opening, and a spring guide 10 for opening is connected to the traveling terminal 1. The opening driving mechanism is composed of a spring rod 8, a spring 9, a spring guide 10, and the traveling terminal 1.

[0016] The traveling terminal 1 is provided with a traveling contact 1a at one end thereof, and the other end is connected to the mechanical frame 5. Further, a rod-shaped latch 11 as shown in the figure is rotatably attached to the traveling terminal 1 with a traveling connecting pin S3 as a support.

[0017] An engaging part 11a is provided at one end of the latch 11, and the latch engaging part 11a engages with the latch pin S1 provided on the insulating rod 6. The tripping part is provided at the other end of the latch 11, and the tripping part of the latch 11 is pushed by a latch tripping mechanism, rotating the latch 11. In this embodiment, the engagement between the latch engaging part 11a and the latch pin S1 is shown, and for example, any other material such as an edge part of a component other than the pin may be used as long as the latch can be engaged and disengaged. Further, the engaging part may be provided on the insulating rod and the pin may be provided on the latch.

[0018] In this way, by providing an engaging part on one side of the latch 11 and a tripping part on the other side via the rotation axis of the latch 11, the latch 11 is provided with an engaging part and a tripping part on the other side, the center of gravity of the latch is not biased to one side, and it is less susceptible to vibration, and the operation in closing can be stabilized. Further, when the installation location is affected by vibration, the influence of vibration can be reduced even when the closing is held. The rotation axis of the latch 11 is preferably provided near the center of gravity of the latch 11, and more preferably provided in accordance with the center of gravity. In other words, the rotation center of the latch 11 is located in the center of gravity region of the rod-

shaped latch 11, further, by providing an engaging part at one end of the latch 11 and a tripping part at the other end, the latch 11 is provided, the center of gravity of the latch is not significantly biased to one of the rod-shaped latches 11, it is less likely to be affected by vibration, and stable engagement between the latch 11 and the latch pin S1 can be ensured.

[0019] Further, the circuit breaker has an auxiliary switch driving mechanism. The auxiliary switch drive mechanism is composed of a driving rod 12 for auxiliary switch, a spring guide 13 for driving auxiliary switch, and a link 15 for driving an auxiliary switch, the link 15 is attached to the mechanical frame 5.

[0020] The operation mechanism of the circuit breaker consists of a closing driving mechanism, an opening driving mechanism, a latch mechanism connecting them, and an auxiliary switch drive mechanism, the detailed structure of each mechanism will be sequentially described below with reference to Figs. 1 to 4 together with the input actuator that urges the opening direction.

[0021] First, the input actuator will be described.

[0022] As shown in Fig. 2, the input actuator 7 is equipped with a driving rod 7a for input, a return spring 7b for returning the driving rod 7a, and an input coil 7c. At the time of closing, the driving rod 7a moves horizontally to the right in Fig. 2 and the return spring 7b is stored by the excitation of the input coil 7c. At the time of opening, the return spring 7b is released by the demagnetization of the input coil 7c, and the driving rod 7a horizontally moves to the left in Fig. 2 and is in the reset state.

[0023] Next, the closing driving mechanism will be described.

[0024] The closing driving mechanism is composed by an insulation rod 6, the latch pin S1 provided on the insulating rod 6, one end is rotatably attached to the latch pin S1, a link 16 for closing driving, the other end of which is pivotally supported with a fixing pin P2 as the center of rotation, a spring receiving pin 16a provided on the link 16, a return spring 17 for returning the closing driving link 16 to return the closing driving link 16, and the fixing pin P2 fixed to the mechanical frame 5, these members are mounted on the mechanical frame 5 as follows.

[0025] One end of the closing driving link 16 is rotatably supported by the mechanical frame 5 by the fixing pin P2, an insulating rod 6 is supported by the latch pin S1 on the link 16. Further, the link return spring 17 composed of the twist spring for the closing driving link return uses the fixing pin P2 as the support shaft, one of the arms is arranged so as to hang on a fixing pin P5, and the other arm is hung on the spring receiving pin 16a provided on the link 16, the closing driving link 16 is always urged counterclockwise.

[0026] Further, as shown in Fig. 5, the other end of the insulating rod 6 connected to the closing driving link 16 is as shown in Fig, it is connected to the driving rod 7a via a connecting hole 6b formed in the insulating rod 6. Returning to Fig. 2, the tip of the driving rod 7a pushes the pushing surface 6a of the insulating rod formed on the insulating rod 6, the latch pin S1 connected to the insulating rod 6 moves in an arc with the fixing pin P2 as the axis of rotation.

[0027] Next, the opening driving mechanism and the latch mechanism will be described.

[0028] The opening driving mechanism is composed of a traveling terminal 1 composed of a traveling contactor 1b on which a traveling contact 1a is formed and an opening driving link 1c, a shunt 4, a fixing pin P1 and an opening spring unit.

[0029] Here, a traveling contact 1a that is in contact with and separated from the fixed contact 2a is formed at one end of the traveling contactor 1b.

[0030] The opening spring unit includes a spring rod 8 for opening, a spring 9 for opening, a spring guide 10 for opening, a traveling connecting pin S2 for opening, and a retaining pin S7.

[0031] The spring guide 10 is fixed in the circuit breaker.

[0032] Further, the latch mechanism is composed of a latch 11, the traveling connecting pin S3, and a latch return spring 18, these members are mounted on the mechanical frame 5 as follows.

[0033] At the other end of the traveling terminal 1 where one end is rotatably supported by the mechanical frame 5 by the fixing pin P1, a spring rod 8 for opening constituting the opening spring unit is pivotally supported by the traveling connecting pin S2 for opening.

[0034] As shown in Fig. 6A, the traveling connecting pin S2 is prevented from being pulled out, this is done by inserting the retaining pin S7 into a pin hole 22 of the blind hole provided in the opening driving link 1c, and attaching the traveling contactor 1b so as to cover it.

[0035] As shown in Fig. 6B, when viewed from the fixed contact 2a, the traveling contactor 1b and the opening driving link 1c are formed to have the same width, the diameter of the spring rod 8 for opening is also configured to be the same as the width of the traveling terminal 1. Further, the opening spring rod 8 is supported by the opening spring guide 10 so as to be freely movable in the vertical direction to some extent.

[0036] To secure the space for arranging arc behavior control parts when cutting off the circuit short-circuit current, it is preferable to configure the vicinity of the traveling contact in the operation mechanism in a small space, in the circuit breaker of this embodiment, the traveling connecting pin S2 for opening for axially supporting the spring rod 8 to the traveling terminal 1 is provided with a structure inserted into the stopper pin through hole 1d formed in the traveling terminal 1 in the direction orthogonal to the opening/closing movement direction of the contact, the traveling connecting pin S2 is configured so as not to protrude from the stopper pin through hole 1d of the traveling terminal 1 in the orthogonal direction, that is, in the width direction of the traveling terminal 1. Therefore, the vicinity of the traveling contact in the operation mechanism can be configured in a space-saving manner.

[0037] One end and the inner diameter of the spring 9 are supported by the spring rod 8, and the other end of the spring 9 is regulated by the spring guide 10. As described above, the spring 9 is provided so as to be expandable and contractible according to the operation of the spring rod 8 due to the arc movement of the traveling terminal 1. The traveling terminal 1 is always urged counterclockwise by this opening spring force, and the opening position is regulated by a stopper pin P3.

[0038] The latch mechanism includes the latch 11, the latch return spring 18, and the traveling connecting pin S3, and these members are mounted on the traveling terminal 1 as follows.

[0039] The latch 11 is rotatably supported by the traveling connecting pin S3 in a state of penetrating the latch through hole 1e of the traveling terminal 1. The latch 11 is composed of the latch engaging part 11a at one end and a latch pushing part 11b at the other end of the rotation shaft, as shown in Figs. 7A and 7B, the latch engaging part 11a is engaged with the latch pin S1 with the insulating rod 6 covering the upper surface and the side surface with a cover.

[0040] Further, the latch return spring 18 of the twist spring is arranged so that one arm is hooked on the traveling terminal 1 and the other arm is hooked on the latch 11 with the traveling connecting pin S3 as a support shaft, the latch 11 is always urged clockwise.

[0041] If metal-based scattered matter generated when the current is cut off accumulates on the latch engagement part, engagement failure may occur, in the circuit breaker of this embodiment, the latch engaging part (the part that engages with the latch pin S1) is not located directly below the arc generation location (contact/detachment position), since it is provided at a position away from the position directly below, it is possible to suppress poor engagement. Further, since the upper surface or the side surface of the latch engaging part is covered with a cover or the like, the possibility of poor engagement can be further reduced.

[0042] The traveling connecting pin S3 moves in an arc with the fixed pin P1 that pivotally supports the traveling terminal 1 as a rotation axis. This arc radius r1 (corresponding to the distance between the fixed pin P1 and the traveling connecting pin S3) is equivalent to the arc traveling radius r2 (corresponding to the distance between the fixed pin P2 and the latch pin S1) of the latch pin S1 constituting the closing driving mechanism.).

[0043] A parallel crank mechanism is formed by a link 16 of a closing driving mechanism connected via a latch pin S1 and the traveling connecting pin S3, a link 1c of an opening driving mechanism, and a latch 11 of a latch mechanism. The relationship between r1 and r2 may be r1 = r2 or r1≈r2.

[0044] Next, the auxiliary switch driving mechanism will be described.

[0045] The auxiliary switch driving mechanism includes Link 15 for driving the auxiliary switch, the rod 12 for driving the auxiliary switch, the spring guide 13 for driving the auxiliary switch, a spring 14 for driving the auxiliary switch, a traveling connecting pin S4, a traveling connecting pin S5, a traveling connecting pin S6, a fixing pin P4, these members are mounted on the mechanical frame 5 as follows

[0046] The mechanical frame 5 is provided with a fixing pin P1 that pivotally supports the traveling terminal 1. The link 15 is rotatably provided on the fixing pin P1. The driving rod 12 is pivotally supported by the traveling connecting pin S5 formed on the link 15.

[0047] Further, the driving rod 12 is supported by the fixing pin P4 provided in an elongated hole formed in the drive rod 12, and moves in the horizontal direction in conjunction with the operation of the link 15. Further, the spring guide 13 is connected to the driving rod 12 by the traveling connecting pin S6. That is, the spring guide 13 is connected to the traveling connecting pin S6 formed on the driving rod 12. With the driving rod 12 as the inner diameter support shaft, the spring 14 is flexibly provided according to the horizontal movement of the driving rod 12 in a state where one end is restricted by the fixing pin P4 and the other end is restricted by the spring guide 13.

[0048] The driving rod 12 is always urged to the left by the spring 14, and the link 15 is always urged clockwise with the fixing pin P1 as the axis of rotation via the traveling connecting pin S5. In the opening state, the traveling connecting pin S4 provided on the link 15 comes into contact with the traveling terminal 1, so that clockwise rotation is restricted.

[0049] The opening/closing operation by the excitation and demagnetization of the input actuator 7 will be described with reference to Figs. 2 and 3.

[0050] The load of the main configuration spring is in the relationship of the opening spring 9> the spring for driving auxiliary switch 14, and the spring load of each return spring is smaller than these spring loads.

[0051] Fig. 2 shows the input coil 7c in the demagnetized state and the operating mechanism in the opening state, and the closing operation will be described first from this state.

[0052] When the input coil 7c is excited, the driving rod 7a moves horizontally to the right in Fig. 2, and the return spring 7b for returning the driving rod is stored. At this time, the driving rod 7a pushes the pushing surface 6a of the insulating rod 6, and the insulating rod 6 moves to the right. Along with the movement of the insulating rod 6, the link 16 connected to the latch pin S1 moves in a clockwise arc with the fixing pin P2 as the center of rotation while accumulating the return spring 17. During the traveling process, the latch pin S1 engages with the latch engaging part 11a of the latch 11 and urges the latch 11 to the right.

[0053] At this time, the traveling connecting pin S3 that pivotally supports the latch 11 has the fixing pin P1 as the center of rotation, by moving in an arc clockwise with the traveling terminal 1, the traveling contact 1a formed on the traveling contactor 1b constituting the traveling terminal 1 comes into contact with the fixed contact 2a

of the first fixed terminal 2.

[0054] Further, the spring 9 for opening is stored by the spring rod 8 that follows the traveling of the traveling terminal 1, the traveling terminal 1 is urged counterclockwise, but the closing state shown in Fig. 3 is maintained while the input actuator 7 is excited. In such a closed state, an electric path is formed from the first fixed terminal 2 to the second fixed terminal 3 via the traveling contactor 1b and the shunt 4 of a copper-based material that carries electricity.

[0055] In the closing process, the link 15 for driving the auxiliary switch pivotally supported by the fixed pin P1 moves in a clockwise arc with the fixed pin P1 as the center of rotation. At this time, the driving rod 12 connected via the traveling connecting pin S5 is driven by the spring force of the spring 14 for driving the auxiliary switch moves to the left until the end of the slotted hole provided in the link 15 for driving the auxiliary switch comes into contact with the fixing pin P5, an auxiliary switch 19 is operated at the tip part.

[0056] In the closing state of Fig. 3, a gap 21 is provided between the traveling connecting pin S4 and the traveling terminal 1 so that the traveling connecting pin S4 does not come into contact with the traveling terminal 1.

[0057] In other words, in the process of operating the traveling terminal 1 to closing, the traveling connecting pin S4 of the link 15 is regulated by the traveling terminal 1, and the traveling amount of the link 15 is regulated, in the completed state of the operation of the traveling terminal 1 to the closing, a gap 21 is generated between the traveling connecting pin S4 and the traveling terminal 1, and the regulation is released.

[0058] Next, the opening operation by demagnetizing the input coil 7c will be described.

[0059] When the input coil 7c is demagnetized from the closing state shown in Fig. 3, the return spring 7b is released and the driving rod 7a moves to the left in Fig. 3. At this time, since the force with which the driving rod 7a pushes the pushing surface 6a of the insulating rod 6 disappears, the return spring 17 is released, the closing driving link 16 having the insulating rod 6 and the latch pin S1 moves in an arc counterclockwise with the fixing pin P2 as the axis of rotation.

[0060] As a result, the force pushing the latch engaging part 11a of the latch pin S1 disappears, and the opening spring 9 is released, the traveling terminal 1 having the latch 11 moves in an arc counterclockwise with the fixing pin P1 as the axis of rotation.

[0061] In the process of opening, the traveling terminal 1 and the traveling connecting pin S4 come into contact with each other, and the link 15 having the traveling connecting pin S4 moves in an arc counterclockwise with the fixing pin P1 as the axis of rotation due to the release force of the spring 9. At this time, the driving rod 12 horizontally moves to the right in Fig. 3 via the traveling connecting pin S5 to reset the auxiliary switch 19 and store the spring 14. The traveling terminal 1 stops when it comes into contact with the stopper pin P3, and maintains the opening state of Fig. 2 by the initial load of the opening spring 9.

[0062] Next, the opening operation by disengaging the latch engagement in the tripping device from the closing state will be described with reference to Figs. 3 and 4.

[0063] Fig. 4 shows the traveling terminal 1 in the opening state and the input coil 7c in the excited state due to the release of the latch engagement in the tripping device.

[0064] In the closing state of Fig. 3, a tripping device 20 that has detected the circuit short-circuit current operates upward and pushes the latch pushing part 11b to rotate the latch 11 counterclockwise.

[0065] When the latch 11 rotates, the engagement between the latch engaging part 11a and the latch pin S1 is released, and the traveling terminal 1 shifts to the opening state while the input coil 7c is maintained in the excited state.

[0066] In the process of opening of the traveling terminal 1 or after opening, the input actuator 7 shifts to the reset state and the link 16 for closing also shifts to the reset state by releasing the excitation of the input coil 7c.

[0067] The latch 11 is returned counterclockwise by the latch return spring 18, and is in the opening state shown in Fig. 2.

[0068] The operation description of the auxiliary switch driving mechanism in the main opening operation is the same as the opening operation by demagnetization of the input coil 7c, and is omitted because it has already been explained.

[0069] As described above, according to the operation mechanism of the circuit breaker of the first embodiment, one end is a latch engaging part and the other end is a pushing part for disengaging the latch rotation shaft, by arranging the position of the center of gravity of the latch near the center of rotation of the latch, it is less susceptible to vibration during circuit breaker operation and vibration in the installed state, it is possible to stabilize the closing operation and the closing holding.

[0070] In addition, by keeping the latch engagement part away from the bottom of the contact part and covering it, it is possible to avoid the adhesion of metal-based scattered matter when the current is cut off, it is possible to stabilize the closing operation and the closing holding, and to stabilize the latch release force at the time of opening.

[0071] Further, by forming the closing driving mechanism, the opening driving mechanism and the latch mechanism by the parallel crank mechanism, it is possible to suppress the amount of slippage of the latch engaging surface with respect to the latch pin in the closing process, engagement failure due to slippage of the latch engaging surface can be suppressed, and the closing operation and closing holding can be stabilized.

[0072] In addition, in order to efficiently use the spring energy of the opening spring in the opening driving mechanism, by arranging the opening spring near the main contact part away from the center of rotation of the traveling terminal, it is possible to reduce the load on the

opening spring, and further by separating the traveling terminal configuration into a copper-based material that is responsible for energization and an iron-based material that is responsible for rigidity, the wall thickness of the components can be reduced, and the opening time can be shortened by reducing the size and weight.

[0073] Further, by keeping the space within the main contact width without using a retaining ring for the connecting part of the opening spring unit, it is possible to secure a space for arranging the arc behavior control component at the time of current interruption.

[0074] Further, the traveling terminal and the auxiliary switch driving link are separated in the process of closing, and a gap is provided between both parts when closing, high-speed opening operation is possible without hindering the movement of the traveling terminal in the initial process of opening in the short-circuit current cutoff.

[0075] In addition, by connecting the input actuator and the insulating rod of the closing driving mechanism only in the opening direction, it is possible to reduce the transmission of the release energy of the contact pressure released from the input actuator at the time of opening to the closing driving mechanism and the opening driving mechanism, the components can be made thinner and smaller.

Second Embodiment

[0076] The second embodiment of the present invention will be described below with reference to Fig. 8. In the second embodiment of the present application, the description of the same or corresponding part as that of the first embodiment will be omitted, and the parts different from the first embodiment will be mainly described below.

[0077] In the first embodiment, special part to drive the auxiliary switch were needed, as the link 15 for driving the auxiliary switch to turn on / off the auxiliary switch 19, the drive rod 12 for driving the auxiliary switch, the auxiliary switch drive spring 14, but in the second embodiment, the auxiliary switch 19 is driven by the opening spring rod 8.

[0078] With such a configuration, the above-mentioned parts required in the first embodiment become unnecessary, and the number of parts can be reduced.

Third Embodiment

[0079] In the first and second embodiments described above, the circuit breaker having a structure in which the traveling terminal rotates has been described, but the opening/closing mechanism is not limited to this structure, for example, it may be a circuit breaker having a structure in which the traveling terminal moves linearly in the horizontal direction.

[0080] Further, in the third embodiment of the present application, the description of the same or corresponding part as that of the first and second embodiments will be omitted, and the parts different from the first and second embodiments will be mainly described below.

[0081] Figs. 9A, 9B and 9C are diagrams showing the circuit breaker of the third embodiment.

[0082] Fig 9A shows the circuit breaker opening state, Fig. 9B shows the closing state, and Fig. 9C shows the circuit breaker opening state and the input actuator excitation state by releasing the latch by the tripping device.

[0083] In Figs. 9A, 9B and 9C, the traveling terminal has a traveling contactor 1b, the traveling contact 1a and an opening driving link 1c, the traveling contactor 1b is connected to the second fixed terminal 3 via the shunt 4.

[0084] In the opening state shown in Fig. 9A, the engaging part of the latch 11 is located in a state where a slight gap is provided with respect to the latch pin S1 provided on the insulating rod 6.

[0085] At the time of transition from the opening state shown in Fig. 9A to the closing state shown in Fig. 9B, the insulating rod 6 is horizontally moved to the right by the excitation of the input actuator 7. In the process of this horizontal traveling, the latch pin S1 provided on the insulating rod 6 engages with the latch 11 pivotally supported by the pin S3 on the traveling contactor 1b, the insulating rod 6 and the traveling contactor 1b move horizontally to the right. At the same time, the spring rod 8 connected to the opening driving link 1c by the pin S2 also moves in the same direction, the spring rod 8 stores the spring 9 for opening.

[0086] By moving the traveling contactor 1b in the horizontal direction in this way, the traveling contact 1a comes into contact with the fixed contact 2a of the first fixed terminal 2, resulting in the closing state as shown in Fig. 9B.

[0087] Further, the auxiliary switch 19 is driven by the movement of the spring rod 8.

[0088] The spring guide 10 is fixed in the circuit breaker.

[0089] On the other hand, the spring 9 is released by the demagnetization of the input actuator 7, and the traveling contactor 1b moves horizontally to the left in Fig. 9B, the opening driving link 1c comes into contact with the stopper pin P3, resulting in the opening state as shown in Fig. 9A.

[0090] Further, in the case that the latch 11 and the latch pin S1 are disengaged from each other to opening, the tripping device 20 is driven, by pushing the latch and rotating the latch counterclockwise, the latch engagement is released, the spring 9 is released, and while the input actuator 7 keeps the excited state, the traveling contactor 1b and the fixed contact 2a are separated from each other, resulting in the opening state as shown in Fig. 9C.

[0091] After the opening state of Fig. 9C or in the opening process, the input actuator 7 is demagnetized, resulting in the opening state as shown in Fig. 9B.

[0092] With such a configuration, the link 16 for closing driving, the fixing pin P2 for supporting the link 16, the fixing pin 1 for supporting the traveling terminal 1, which

are required in the first embodiment, are no longer required, the number of parts can be reduced, the space required for arc drive can be reduced, and the mechanism can be configured in a small space.

[0093] In other words, the description of each of the above-described embodiments has the following features.

Technical Feature 1: The fixed contact, the traveling contact connected to and separated from the fixed contact, the rod-shaped latch that is rotatably pivotally supported in the barycentric region between one end having a latch engaging part and the other end driven by tripping, the insulating rod having a latch pin at one end that engages with the latch engaging part, the input actuator that drives the other end of the insulating rod, and the spring for opening that drives the traveling contact in the opening direction are provided, when the other end of the latch is pulled off and driven while the traveling contact is closed to the fixed contact, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling contact is driven in the input direction by the opening spring, with the traveling contacts open, the latch pin is driven in the opening direction via the insulating rod by the input actuator, the latch is driven in the input direction via the latch engaging part, and the traveling contact is driven in the opening direction with the fixed contact.

Technical Feature 2: The Technical feature 1 is characterized in that the traveling contact opens and closes with the fixed contact while moving in an arc.

Technical Feature 3: The feature 1 is characterized in that the traveling contact opens and closes with the fixed contact while moving linearly.

[0094] Technical Feature 4: The fixed contact, the traveling contact which is connected to and separated from the fixed contact, the traveling terminal in which one end is pivotally attached to the fixed part and the other end having the traveling contact is driven by the driving force in the opening direction, the latch in which the part between one end having the latch engaging part and the other end driven by tripping is pivotally attached between one end of the traveling terminal and the other end of the traveling terminal, and the closing driving link of which one end is pivotally attached to the fixed part has a latch pin engaged with the latch engaging part at the other end thereof are provided, when the other end of the latch is pulled off and driven while the traveling terminal is closed, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling terminal is pivotally moved so as to be opened by the driving force in the opening direction, when the latch pin is driven by a driving force in the input direction while the traveling terminal is open, as the latch pivots via the latch pin and the latch engaging part of the latch, the traveling terminal is pivotally operated to closing.

[0095] Technical Feature 5: In the technical feature 4, the traveling terminal and the closing driving link extend in the same direction with a predetermined distance, the latch extends in a direction intersecting the extending direction of the traveling terminal and the closing driving link.

Technical Feature 6: In the technical feature 5, the traveling terminal, the closing driving link, and the latch are configured in a parallel crank mechanism.

Technical Feature 7: In any one of the technical features 4 to 6, the latch engaging part and the latch pin are arranged on the side of the traveling terminal opposite to the traveling contact, the latch pin is driven by a driving force in the input direction via the insulating rod, the side of the traveling contact of the latch engaging part and the latch pin is covered with a part of the insulating rod.

Technical Feature 8: In any one of the technical features 4 to 7, the traveling terminal is integrally composed of the traveling contact of the copper-based material responsible for energization and the opening driving link of the iron-based material responsible for rigidity.

[0096] Technical Feature 9: In any of the technical features 4 to 8, the opening spring rod that transmits the driving force in the opening direction to the traveling terminal and the traveling terminal are connected by the traveling connecting pin for opening.

Technical Feature 10: In any of the technical features 4 to 9, the fixing pin for pivotally attaching the one end of the traveling terminal to the fixing part is provided, and the auxiliary switch drive link is pivotally supported by the fixing pin, in the process of operating the traveling terminal to closing, the auxiliary switch driving link is driven by the spring force of the auxiliary switch driving spring to operate the auxiliary switch.

Technical Feature 11: In technical feature 10, in the process of operating the traveling terminal to closing, the traveling connecting pin of the auxiliary switch driving link is restricted to the traveling terminal, and the traveling amount of the auxiliary switch driving link is restricted, in the completed state of the operation of the traveling terminal to the closing, the gap is generated between the traveling connecting pin and the traveling terminal, and the regulation is released.

Technical Feature 12: In the technical feature 7, the driving force in the input direction is transmitted from the input driving rod of the input actuator to the insulating rod, the input driving rod and the insulating rod can operate independently when operating in the opening direction.

Technical Feature 13: In any of the technical features 4 to 8, the auxiliary switch is driven by the opening spring rod that transmits the driving force in the opening direction to the traveling terminal.

[0097] Although various exemplary embodiments and examples are described in this application, the various features, modes, and functions described in one or more embodiments are not limited to the application of a particular embodiment, but can be applied to embodiments alone or in various combinations.

[0098] Accordingly, countless variations not illustrated are envisioned within the scope of the art disclosed in

this application. For example, this shall include cases where at least one component is transformed, added or omitted, and even where at least one component is extracted and combined with components of other embodiments.

Reference Signs List

[0099]

1. Traveling terminal,
1a. Traveling contact,
1b. Traveling contactor,
1c. Opening driving link,
1d. Stopper pin through hole,
1e. Latch pin through hole,
2 First fixed terminal,
2a. Fixed contact,
3 Second fixed terminal,
4. Shunt,
5. Mechanical frame,
6. Insulated rod,
6a. Pushing surface of the insulated rod,
6a. Connection hole,
7. Input actuator,
7a. Driving rod for input,
7b. Return spring for return of the driving rod,
7c. Input coil,
8 Spring rod for opening,
9 Spring for opening,
10 Spring guide for opening,
11. Latch,
11a. Latch engaging part,
11b. Latch pushing part,
12. Driving rod for auxiliary switch,
13 Spring guide for driving auxiliary switch,
14. Spring for driving auxiliary switch,
15. Link for driving auxiliary switch,
16 closing driving link,
16a. Spring receiving pin,
17 Return spring for return of the link for driving opening,
18. Return spring latch,
19. Auxiliary switch,
20. Trip device,
21. Gap,
22. Pin hole,
P1. Fixed pin,
P2. Fixed pin,
P3. Stopper pin,
P4. Fixed pin,
P5. Fixed pin,
S1. Latch pin,
S2. Traveling connection pin for opening,
S3. Traveling connection pin,
S4. Traveling connection pin,
S5. Traveling connection pin,
S6. Traveling connection pin,
S7. Retaining pin

Claims

1. A circuit breaker comprising:

a fixed contact, a traveling contact connected to and separated from the fixed contact, a rod-shaped latch that is rotatably pivotally supported in the barycentric region between one end having a latch engaging part and the other end driven by tripping, an insulating rod having a latch pin at one end that engages with the latch engaging part, an input actuator that drives the other end of the insulating rod, and a spring for opening that drives the traveling contact in the opening direction, wherein;
when the other end of the latch is pulled off and driven while the traveling contact is closed to the fixed contact, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling contact is driven in the opening direction by the opening spring,
when the latch pin is driven in the input direction by the input actuator via the insulating rod in a state where the traveling contact is open, the latch is driven in the input direction via the latch engaging part, and the traveling contact is driven in the closing direction with the fixed contact.

2. A circuit breaker comprising:

a fixed contact, a traveling contact which is connected to and separated from the fixed contact, and
a traveling terminal in which one end is pivotally attached to a fixed part and the other end having the traveling contact is driven by a driving force in the opening direction, and comprising;
a latch in which a part between one end having a latch engaging part and the other end driven by tripping is pivotally attached between one end of the traveling terminal and the other end of the traveling terminal, and
a closing driving link of which one end is pivotally attached to the fixed part has a latch pin engaged with the latch engaging part at the other end thereof, wherein;
when the other end of the latch is pulled off and driven while the traveling terminal is closed, the engagement between the latch engaging part and the latch pin is disengaged, and the traveling terminal is pivotally moved so as to be opened by the driving force in the opening direction,
when the latch pin is driven by a driving force in the input direction while the traveling terminal is open, as the latch pivots via the latch pin and

the latch engaging part of the latch, the traveling terminal is pivotally operated to closing.

3. The circuit breaker according to claim 2, wherein;

the traveling terminal and the closing driving link extend in the same direction with a predetermined distance,
the latch extends in a direction intersecting the extending direction of the traveling terminal and the closing driving link.

4. The circuit breaker according to claim 3, wherein;
the traveling terminal, the closing driving link, and the latch are configured in a parallel crank mechanism.

5. The circuit breaker according to any one of claims 2 to 4, wherein;
the latch engaging part and the latch pin are arranged on the side of the traveling terminal opposite to the traveling contact, the latch pin is driven by a driving force in the input direction via an insulating rod, the side of the traveling contact of the latch engaging part and the latch pin is covered with a part of the insulating rod.

6. The circuit breaker according to any one of claims 2 to 5, wherein;
the traveling terminal is integrally composed of the traveling contact of a copper-based material responsible for energization and an opening driving link of the iron-based material responsible for rigidity.

7. The circuit breaker according to any one of claims 2 to 6, wherein;
the opening spring rod that transmits the driving force in the opening direction to the traveling terminal and the traveling terminal are connected by a traveling connection pin for opening.

8. The circuit breaker according to any one of claims 2 to 7, wherein;

a fixing pin for pivotally attaching the one end of the traveling terminal to the fixing part is provided, and an auxiliary switch driving link is pivotally supported by the fixing pin,
in the process of operating the traveling terminal to closing, the auxiliary switch driving link is driven by the spring force of the auxiliary switch driving spring to operate the auxiliary switch.

9. The circuit breaker according to claim 8, wherein;
in the process of operating the traveling terminal to closing, the traveling connecting pin of the auxiliary switch driving link is restricted to the traveling terminal, and the traveling amount of the auxiliary switch driving link is restricted, in the completed state of the operation of the traveling terminal to the closing, a gap is generated between the traveling connecting pin and the traveling terminal, and the restriction is released.

10. The circuit breaker according to claim 5, wherein;

the driving force in the input direction is transmitted from the input driving rod of the input actuator to the insulating rod,
the input driving rod and the insulating rod can operate independently when operating in the opening direction.

11. The circuit breaker according to any one of claims 2 to 6, wherein;
an auxiliary switch is driven by the opening spring rod that transmits the driving force in the opening direction to the traveling terminal.

FIG. 1

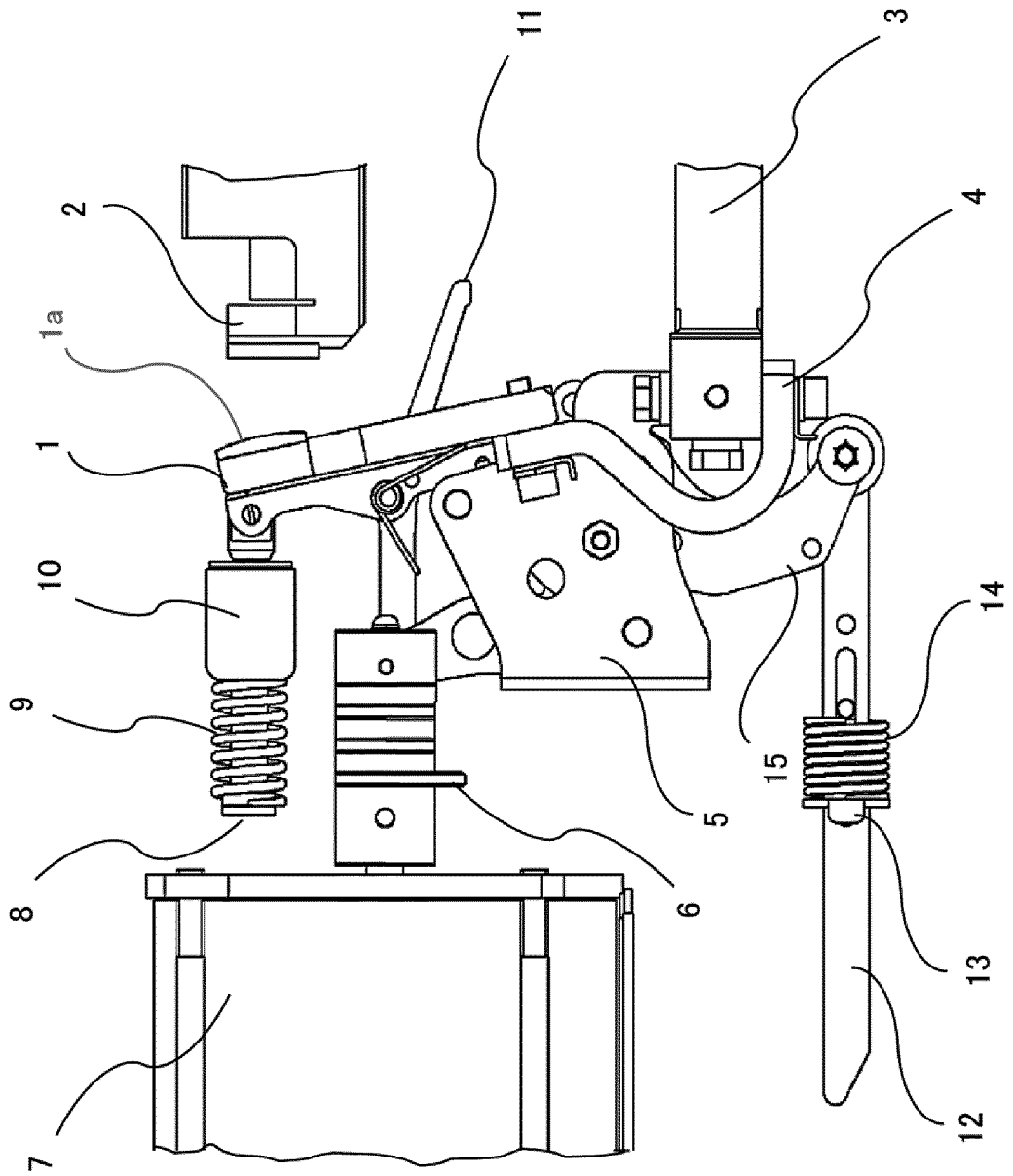
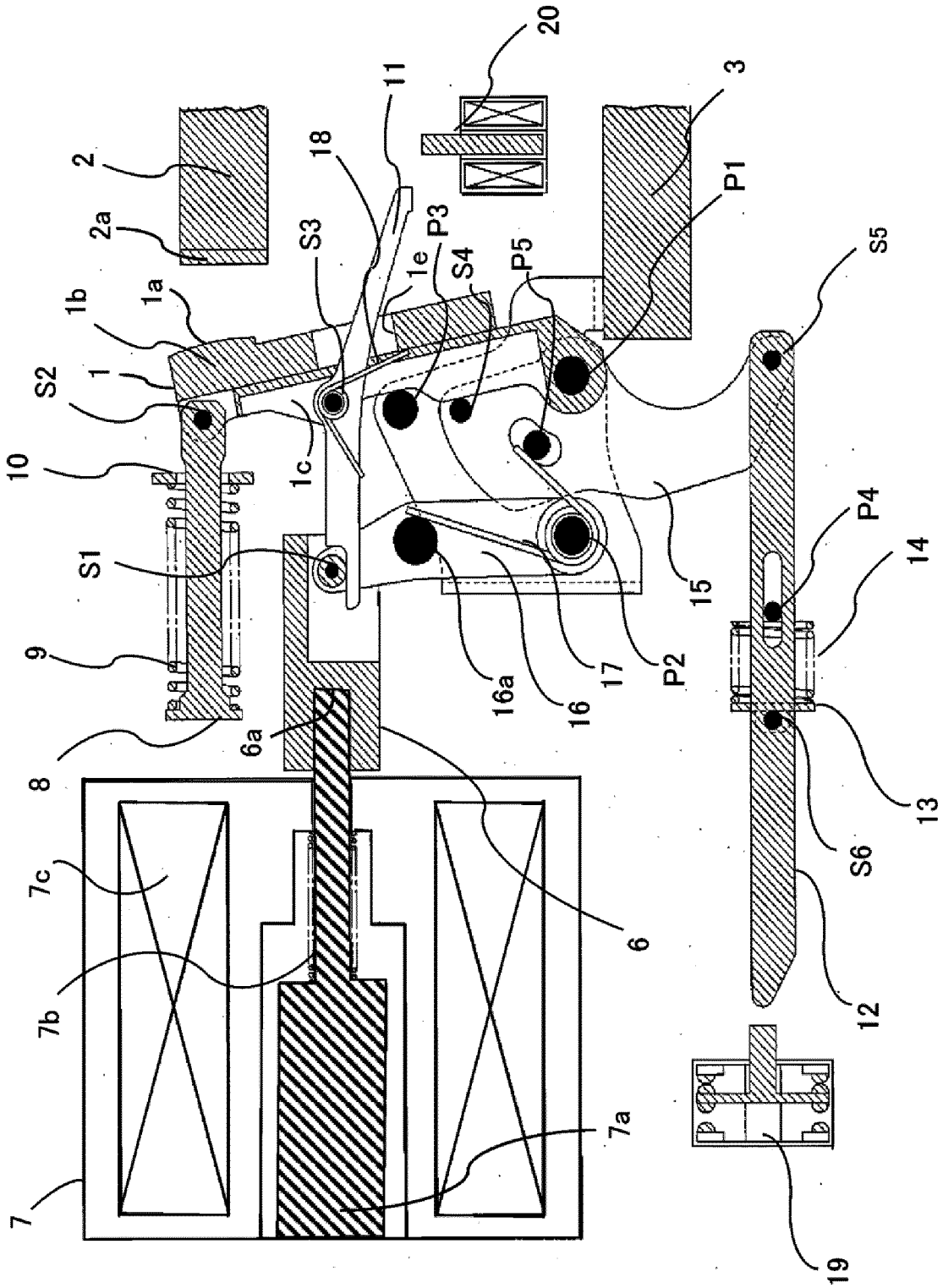


FIG. 2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2
18
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S3
P3
S5
1e
S4
P5
1b
1a
1
S2
1c
10
S1
15
P4
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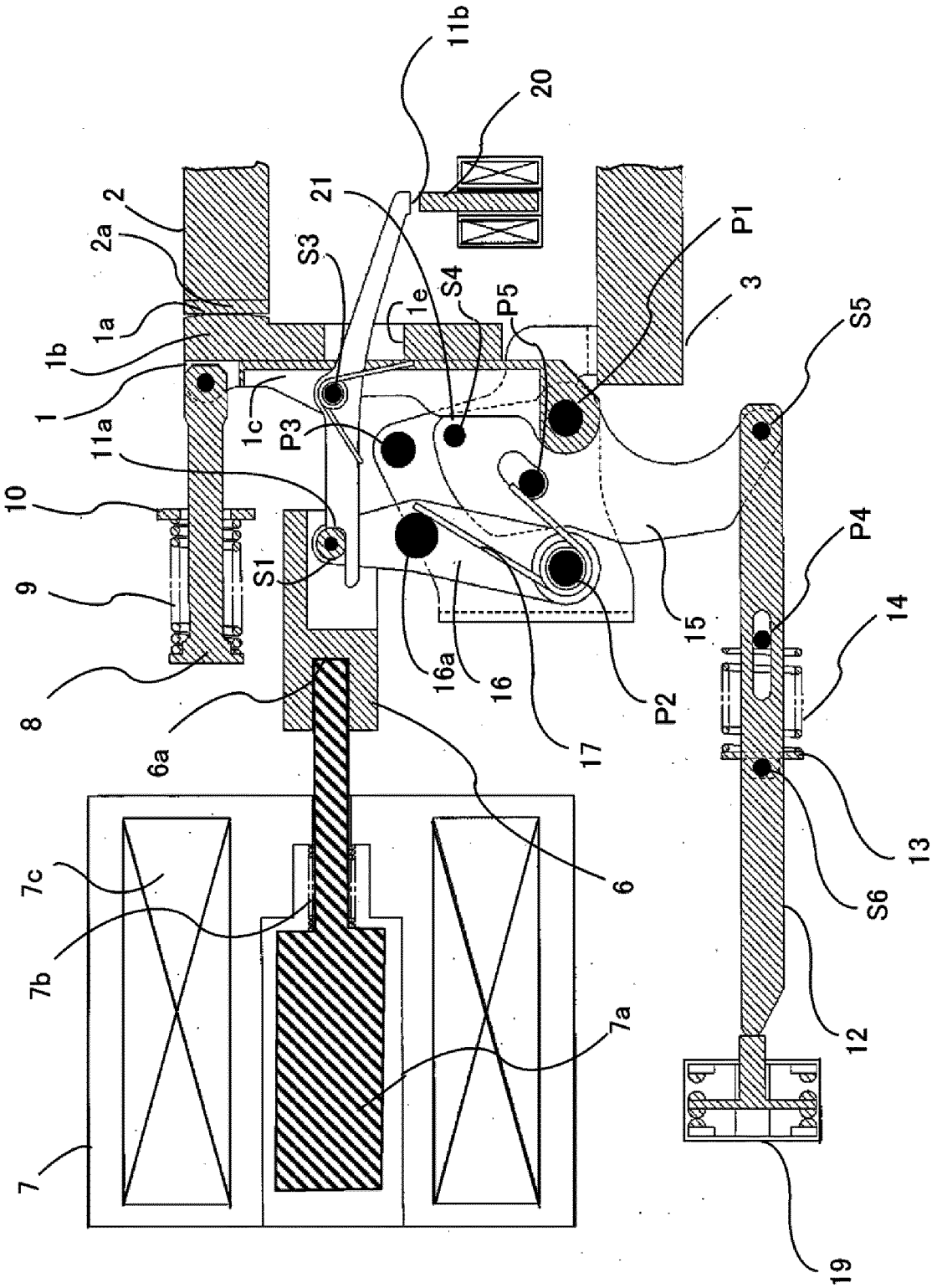
7
19

FIG. 3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1c
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S1
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S6
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FIG. 4

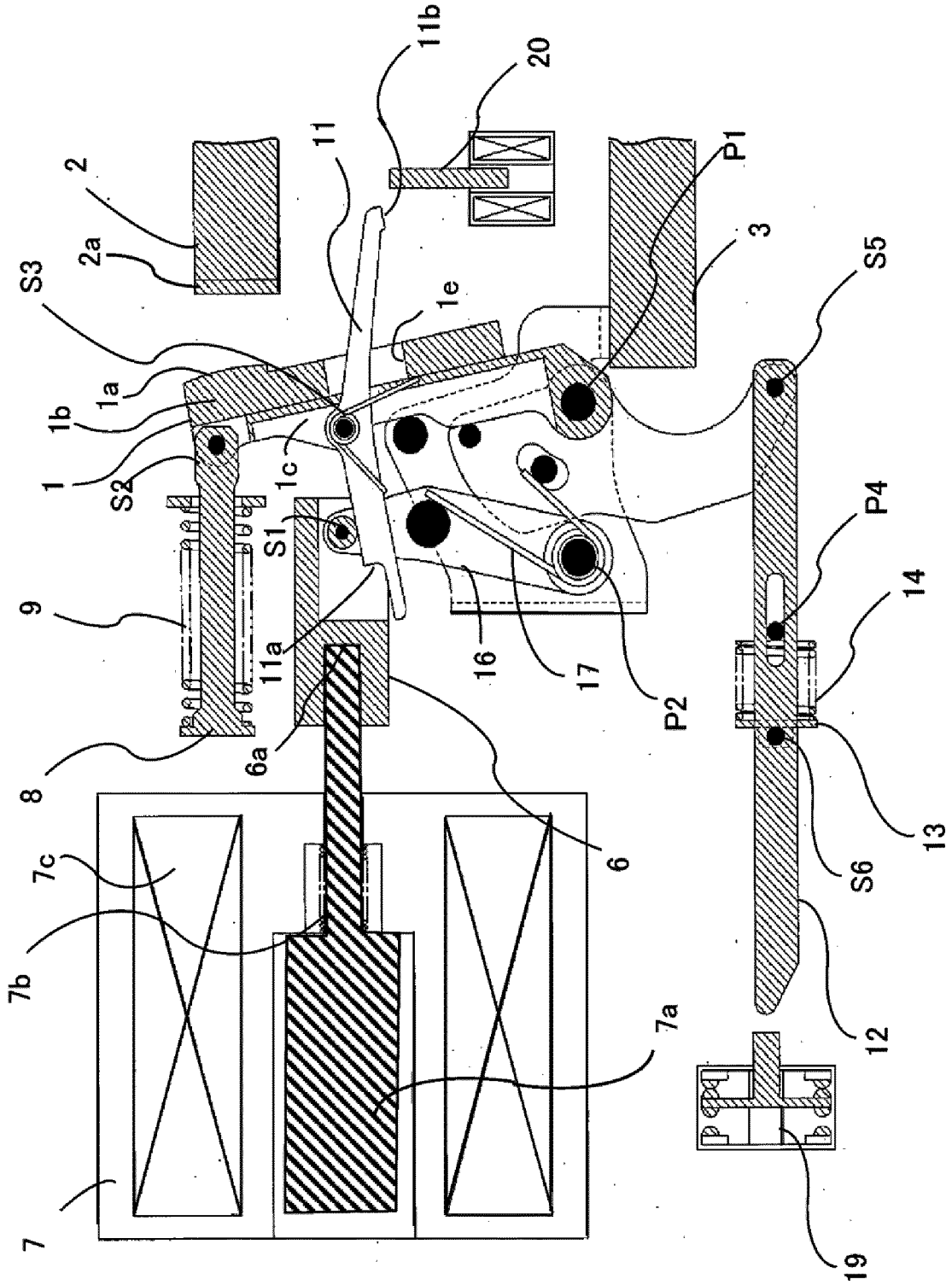
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FIG. 5

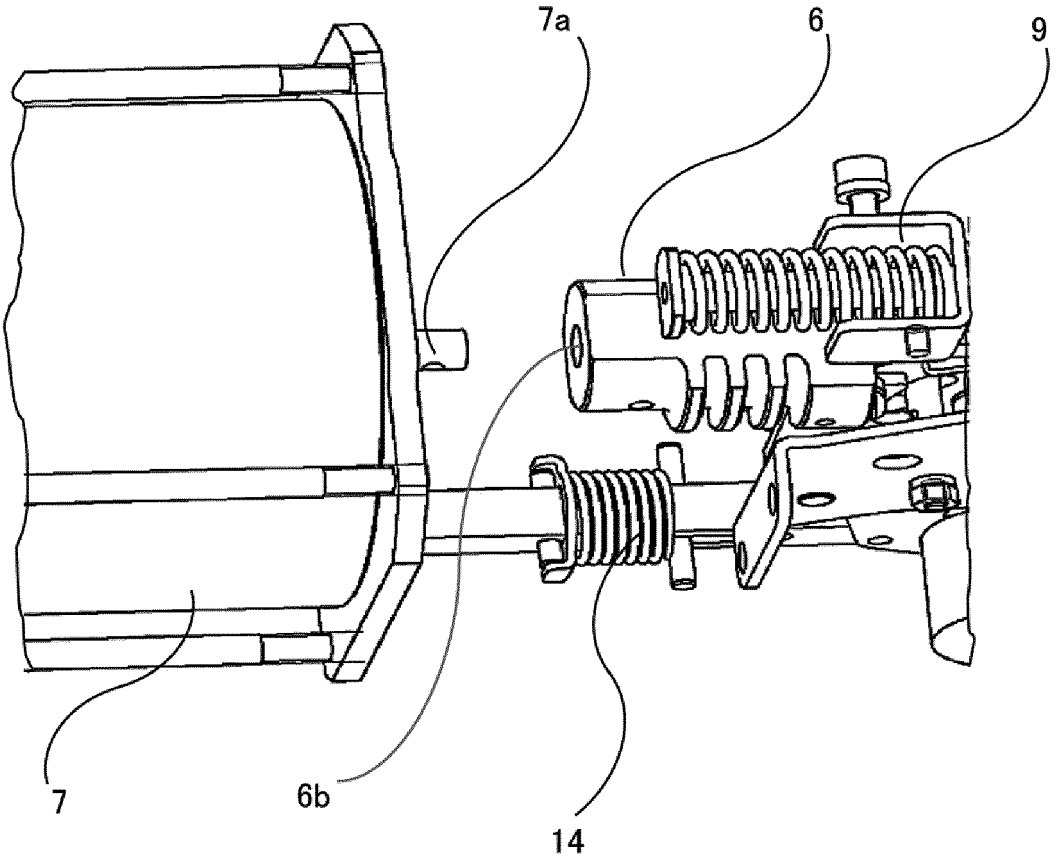


FIG. 6A

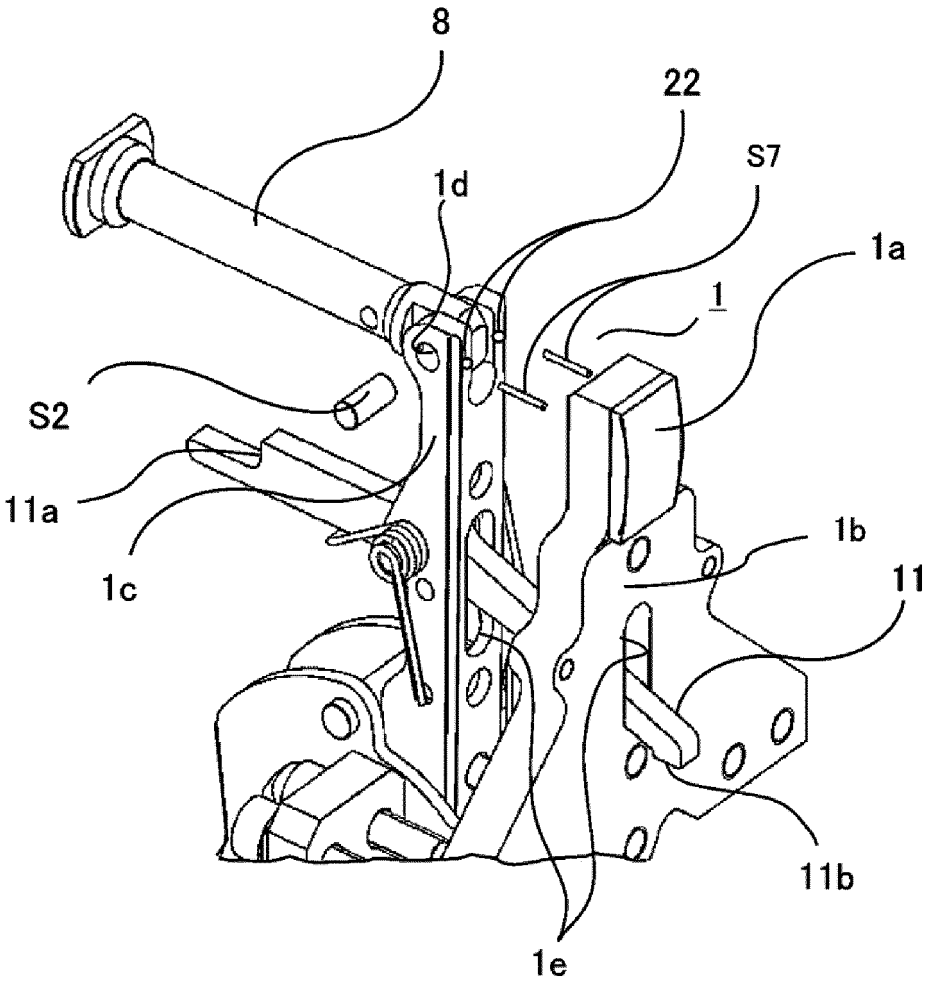


FIG. 6B

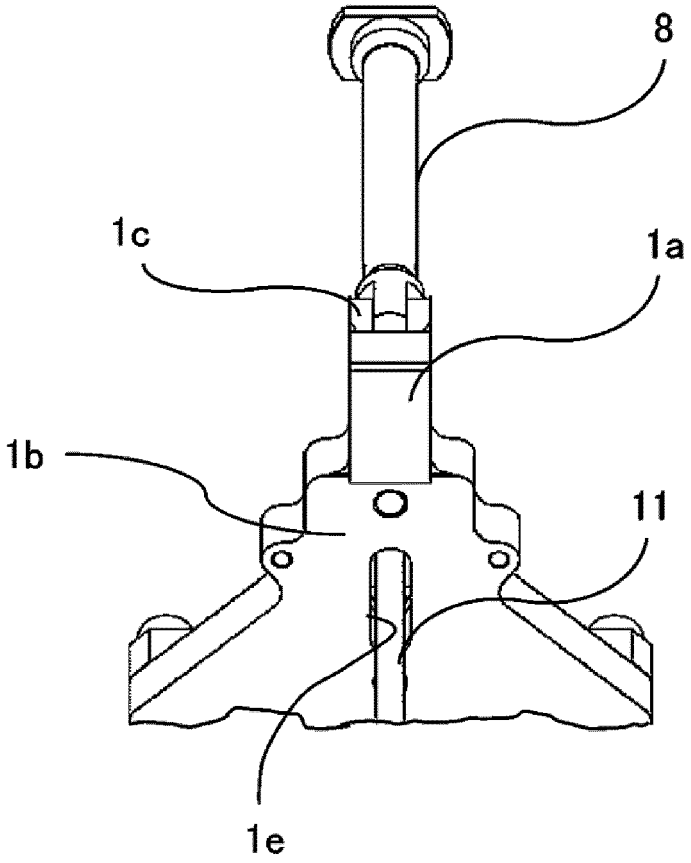


FIG. 7A

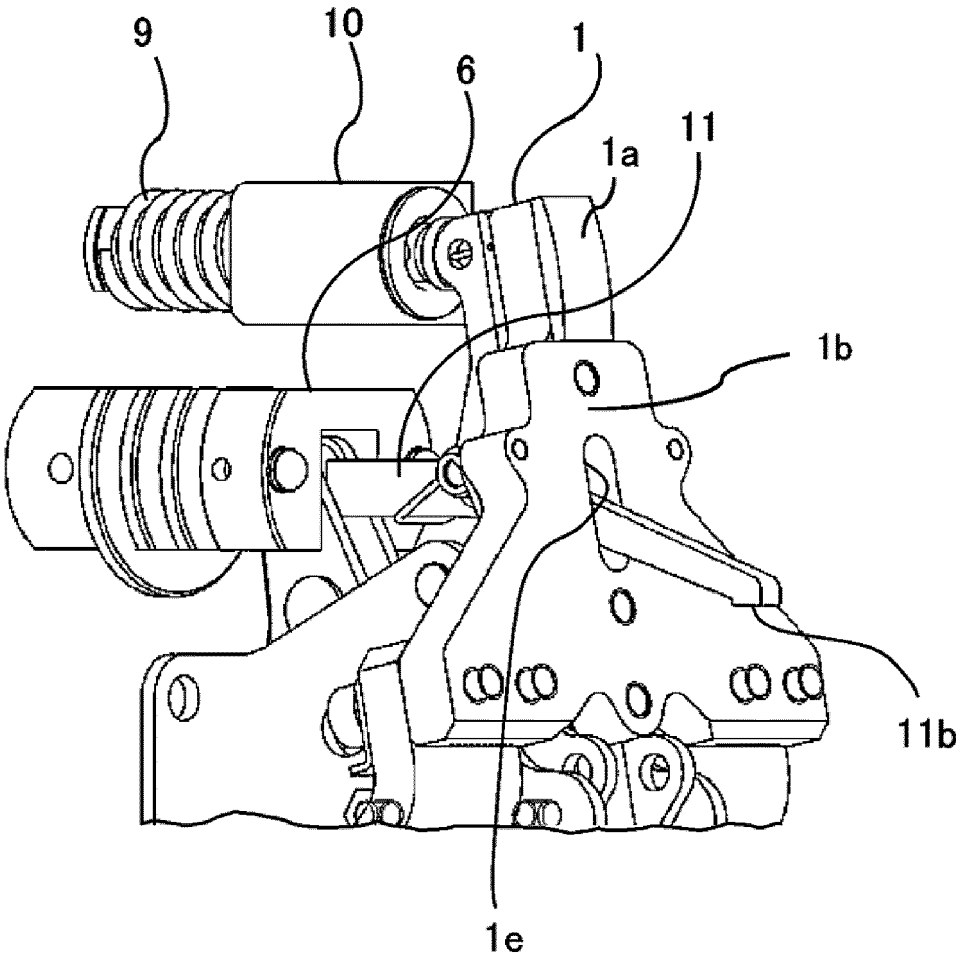


FIG. 7B

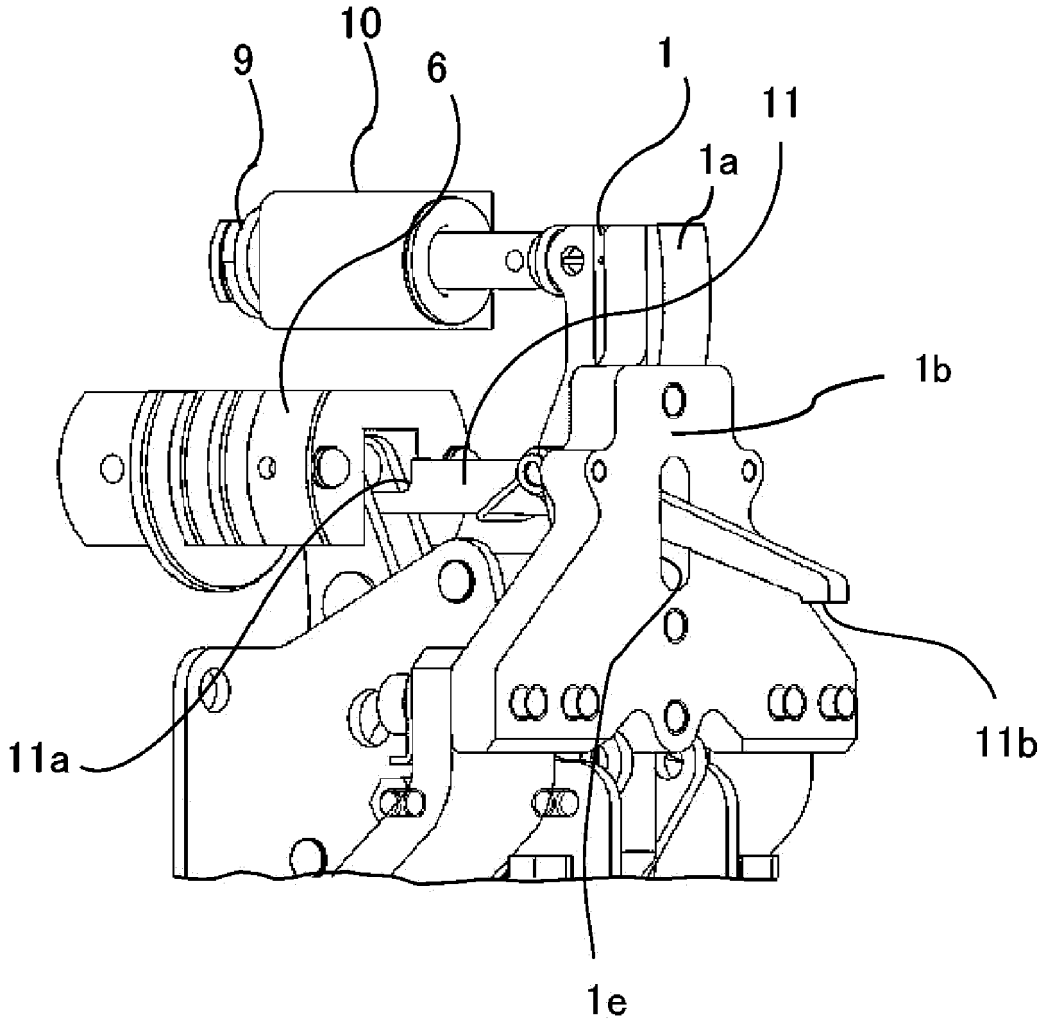


FIG. 8

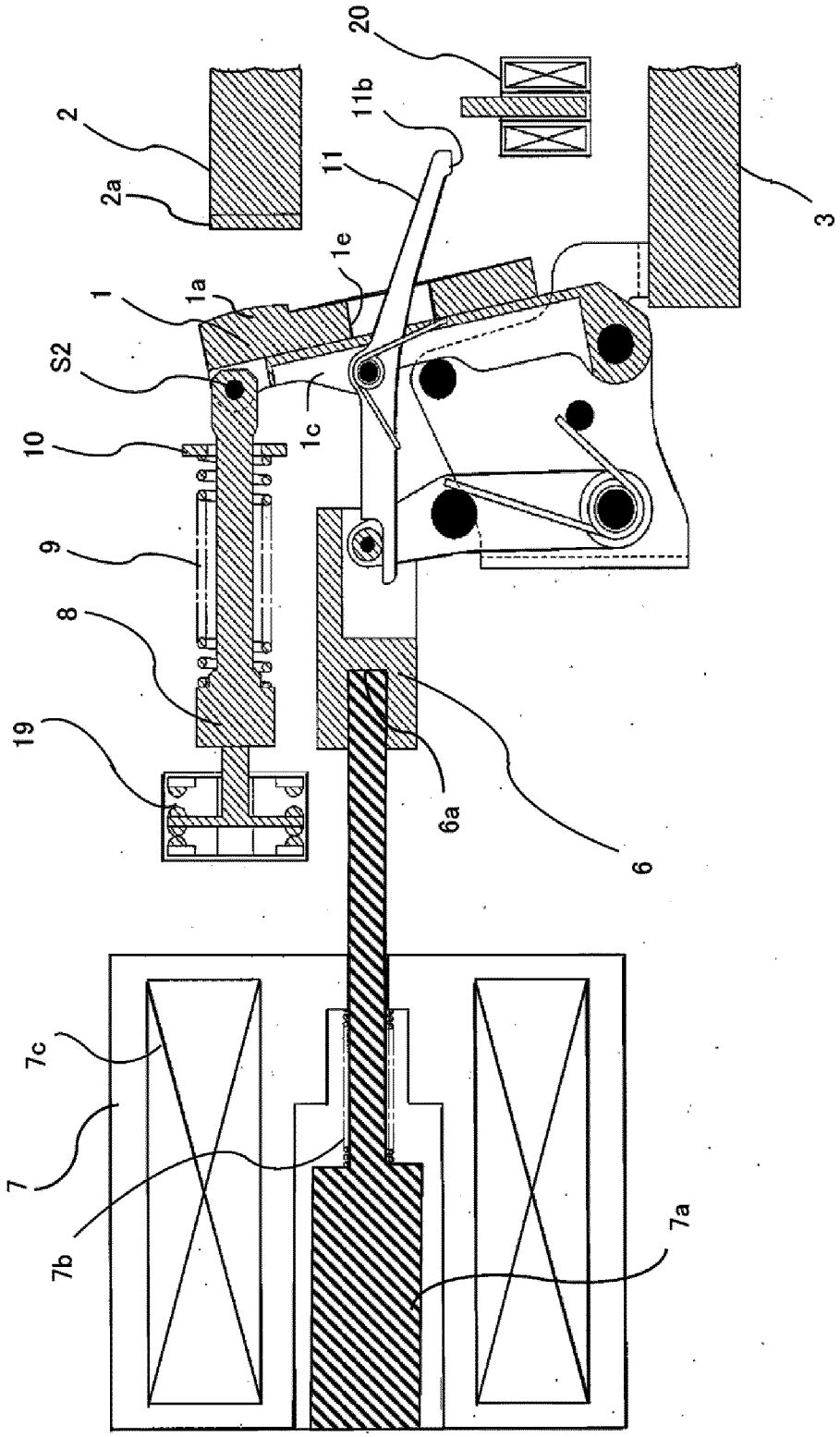


FIG. 9A

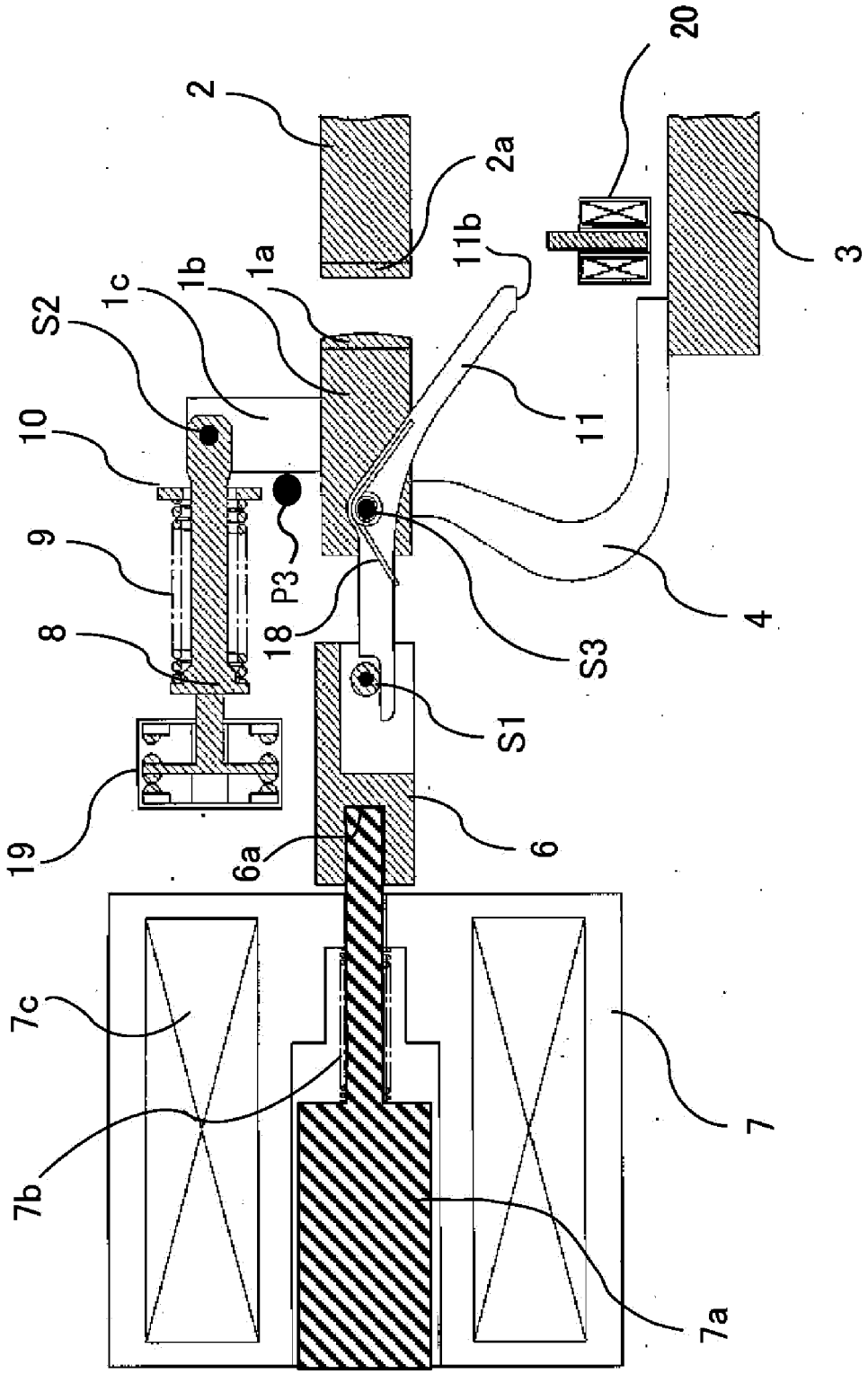


FIG. 9B

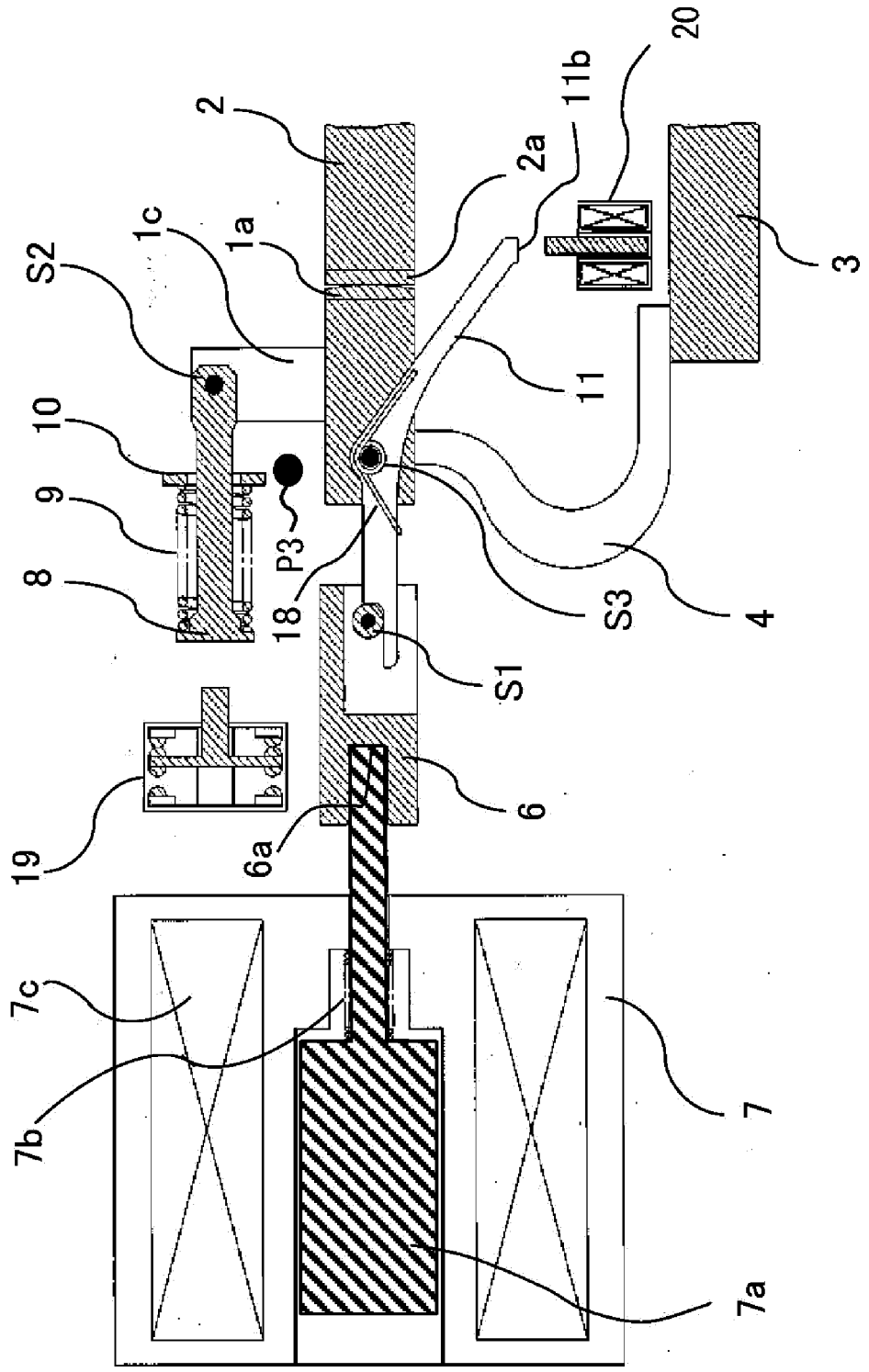
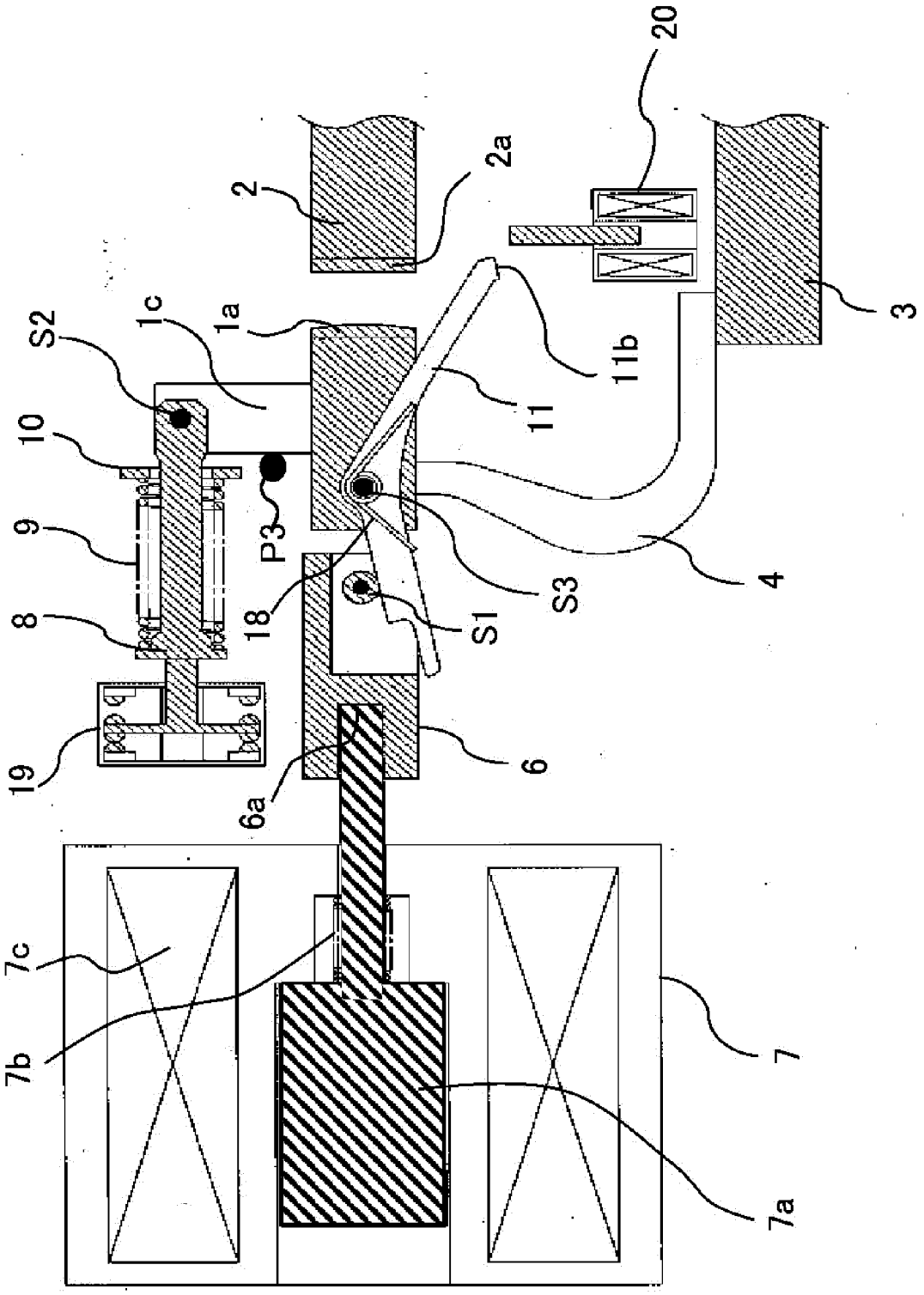


FIG. 9C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/005081

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. H01H33/42(2006.01)i
FI: H01H33/42K

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)
Int.Cl. H01H33/42

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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	JP 2015-162402 A (MITSUBISHI ELECTRIC CORPORATION) 07.09.2015 (2015-09-07), paragraphs [0001]-[0004], fig. 6	1 2-11
Y	JP 2000-067707 A (NISSIN ELECTRIC CO., LTD.) 03.03.2000 (2000-03-03), paragraphs [0001], [0010]-[0030], fig. 1	1
Y	WO 2017/122710 A1 (MITSUBISHI ELECTRIC CORPORATION) 20.07.2017 (2017-07-20), paragraphs [0011]-[0028], fig. 1	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"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
09.04.2020	21.04.2020

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/JP2020/005081

JP 2015-162402 A	07.09.2015	(Family: none)	
JP 2000-067707 A	03.03.2000	(Family: none)	
WO 2017/122710 A1	20.07.2017	CN 108475599 A KR 10-2018-0090862 A	

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2015162402 A **[0002]**