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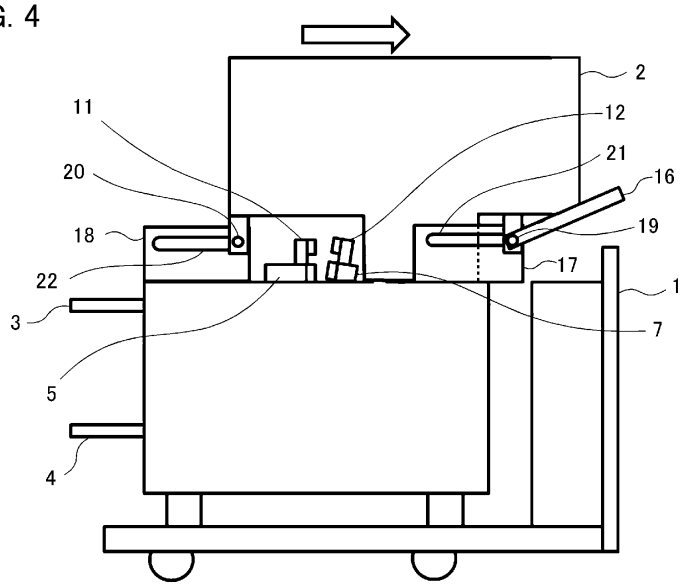
(54) DIRECT CURRENT CIRCUIT BREAKER

(57) In an arc-extinguishing chamber shifting mechanism of a DC breaker, it is required that contact portions can be easily and safely maintained and inspected in a short time.

Arc-extinguishing chamber shifting mechanism 17, by which the arc-extinguishing chamber 2 can be shifted between two positions which are composed of an operation position, which is arranged at an upper portion of the contact 5 at a fixed side and the contact 7 at a movable side, and an inspection position at which the arc-extinguishing chamber 2 is shifted in a horizontal direction from the operation position, and an upper portion of the contact 5 at a fixed side and the contact 7 at a movable side is set as an open state, is provided.

FIG. 4



EP 3 561 841 A1

Description

Technical Field

[0001] The present invention relates to a DC breaker, and particularly relates to an arc-extinguishing chamber shifting mechanism which is suitable for a DC high-speed breaker.

Background Art

[0002] As a protection breaker which is used for an electric railroad substation, there is a DC high-speed breaker which is indicated, for example, in Patent Document 1. A main contact, by which a main circuit electric current is passed, and an arc contact, by which the main contact is protected, are provided at contact portions of a DC high-speed breaker of this kind. The arc contact is opened and separated at a timing, which is later than a timing of the main contact, when an electric current is interrupted, whereby an arc is certainly generated at the arc contact, and it is prevented that the main contact is melted and broken by an arc, and it is prevented that an energization capability is lowered when the main contact is melted and broken.

[0003] Therefore, damage is caused by the arc at the arc contact, so that maintenance and an inspection of the arc contact are required after an electric current is interrupted at many times or after a large electric current is interrupted, and there is a required case in which the arc contact is replaced. When the arc contact is maintained and inspected, it is required that an arc-extinguishing chamber, which covers a circumference of the contact portions, is detached from a main body of a DC breaker, or it is required that the arc-extinguishing chamber is shifted to a position at which the arc contact can be replaced.

[0004] Moreover, an arc, which is caused when an electric current is interrupted, is set at a very high temperature, so that a surrounding structure is melted and broken, and a metal powder or soot of carbide is caused. When the metal powder or the carbide adheres to a main contact, a contact resistance at an adhering portion is increased, and there is a possibility in which an accident of an energization fault is caused, so that, in order to prevent the energization fault, when a maintenance and an inspection is performed, it is required that a main circuit portion is exposed, and a condition of a main contact portion is confirmed, and when a maintenance is required, an operation, by which the adhering portion is removed, is required.

[0005] In a conventional art, for example, in a DC breaker which is indicated in Patent Document 2, in order to expose a contact portion when the DC breaker is inspected, an attaching clamp, by which a hinge bar is attached to an arc-extinguishing portion, is provided, and a U-shaped clamp is attached to a frame of the DC breaker so as to be linked to the hinge bar, whereby the U-shaped clamp and the hinge bar are formed as a hinge mechanism by which the arc-extinguishing portion is formed as a single swinging arc-extinguishing portion in a state where the hinge bar is used as a center of a rotation, so that the DC breaker is configured in such a way that the contact portion is exposed when the DC breaker is inspected.

Conventional Art Document

Patent Document

[0006]

Patent Document 1: Japanese Utility Model Publication No. H06-60944
Patent Document 2: Japanese Laid-Open Patent Publication No. H07-153350

SUMMARY OF THE INVENTION

Problems to be solved by the Invention

[0007] As described above, in order to maintain and inspect a contact portion, it is required that the contact portion is exposed, so that there are two kinds of methods by which an arc-extinguishing chamber is detached from a main body of a DC breaker, or the arc-extinguishing chamber is shifted. Because the arc-extinguishing chamber is formed as a heavy object, it is dangerous that the arc-extinguishing chamber is lifted and detached by one person, so that, in order to detach the arc-extinguishing chamber from the main body of the DC breaker, it is required that a special hanging tool is prepared and a hanging device, such as a crane, is prepared, therefore, there have been problems in that a workability is worsened, and a maintenance and an inspection for the DC breaker depend on an environment of a facility. Moreover, it is required that a fastening component, by which the arc-extinguishing chamber and the main body of the DC breaker are fastened, is detached, so that there has been a problem in that many times are expended for a working operation.

[0008] In a method by which an arc-extinguishing chamber is shifted, there is a hinge mechanism for which a rotational movement is used as a conventional art. The hinge mechanism has an advantage in which the hinge mechanism can be configured by using a simple configuration, and the hinge mechanism has an advantage in which an operation force is reduced in accordance with a moment ratio and the arc-extinguishing chamber can be shifted by using a relatively lower operation force when the arc-extinguishing chamber is rotated (shifted), and a few time is required in order to expose a contact. On the other hand, there has been a problem in which if a hand is separated from the arc-extinguishing chamber before the arc-extinguishing chamber is sifted to a static position in accordance with, for example, a factor in which a hand is slid when the arc-extinguishing chamber is rotated and

operated, the arc-extinguishing chamber is vigorously dropped off with a rotational movement, and the arc-extinguishing chamber is broken by an impact which is caused when the arc-extinguishing chamber is dropped off. Moreover, if a person is stayed in a dropping off area of the arc-extinguishing chamber, there is a possibility in which the arc-extinguishing chamber is touched to a body, such as a hand or a head, and a bodily injury is caused, so that it has been required that the arc-extinguishing chamber is very carefully shifted.

[0009] The present invention has been made to solve the above-described problems, and an object of the invention is to be able to realize that a contact portion is easily and safely maintained and inspected in a short time at arc-extinguishing chamber shifting mechanisms of a DC breaker.

Means for solving problems

[0010] In a DC breaker of the present invention, arc-extinguishing chamber shifting mechanisms, by which the arc-extinguishing chamber can be shifted between two positions which are composed of an operation position, which is arranged at an upper portion of the contact at a fixed side and the contact at a movable side, and an inspection position at which the arc-extinguishing chamber is shifted in a horizontal direction from the operation position, and an upper portion of the contact at a fixed side and the contact at a movable side is set as an open state, are provided.

Effects of the Invention

[0011] According to the present invention, arc-extinguishing chamber shifting mechanisms, by which an arc-extinguishing chamber can be shifted from an operation position to an inspection position at which an upper portion of a contact at a fixed side and a contact at a movable side is set as an open state, whereby a DC breaker, in which contact portions can be easily maintained and inspected in a short time, can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a side view which indicates an overall configuration, in a closed contact state, for explaining a configuration of a DC high-speed breaker which is formed as a DC breaker according to Embodiment 1 of the present invention;
Fig. 2 is a side view which indicates a state in which a contact, of the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention, is opening and separating;
Fig. 3 is a side view which indicates a state before an arc-extinguishing chamber, of the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention, is shifted;
Fig. 4 is a side view which indicates a state after the arc-extinguishing chamber, of the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention, is shifted;
Fig. 5 is a side view which indicates the arc-extinguishing chamber and portions of shifting mechanisms in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 6 is a side view which indicates a main portion of the arc-extinguishing chamber in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 7 is an oblique perspective view for explaining a configuration of the arc-extinguishing chamber and the shifting mechanisms in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 8 is a disassembled oblique perspective view for explaining an attachment configuration of the arc-extinguishing chamber and the shifting mechanisms in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 9 is a disassembled oblique perspective view for explaining a configuration of the shifting mechanism at a front side of the DC breaker in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 10 is a disassembled oblique perspective view for explaining a configuration of the shifting mechanism at a rear side of the DC breaker in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 1 of the present invention;
Fig. 11 is a cross-sectional view for explaining a configuration of a shifting mechanism a DC high-speed breaker which is formed as a DC breaker according to Embodiment 2 of the present invention, in a state where the shifting mechanism is viewed from a front of the DC breaker;
Fig. 12 is a side view for explaining an operation of a shifting mechanism, at a front side of a DC breaker, in a DC high-speed breaker which is formed as the DC breaker according to Embodiment 3 of the present invention;
Fig. 13 is a side view for explaining an operation of the shifting mechanism, at the front side of the DC breaker, in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 3 of the present invention;
Fig. 14 is a side view for explaining an operation of the shifting mechanism, at the front side of the DC breaker, in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 3 of the present invention;
Fig. 15 is a cross-sectional view for explaining the other form of a shifting mechanism in a DC high-

speed breaker which is formed as a DC breaker according to Embodiment 4 of the present invention;
Fig. 16 is a cross-sectional view for explaining the other form of a shifting mechanism in a DC high-speed breaker which is formed as a DC breaker according to Embodiment 5 of the present invention;
Fig. 17 is a view for explaining a configuration of a fixing clamp of a shifting mechanism in a DC high-speed breaker which is formed as a DC breaker according to Embodiment 6 of the present invention; and
Fig. 18 is a view for explaining a configuration of the fixing clamp of the shifting mechanism in the DC high-speed breaker which is formed as the DC breaker according to Embodiment 6 of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0013] Hereinafter, embodiments of the present invention will be described in reference to the drawings. In addition, reference symbols, which are the same as those in each of the drawings, refer to the same or equivalent parts.

Embodiment 1

[0014] Fig. 1 is a side view, at a time when an electric current is passed, for explaining a configuration of a DC high-speed breaker which is formed as a DC breaker according to Embodiment 1 of the present invention, and Fig. 2 is a side view, at a time when an electric current is interrupted, for explaining a configuration of an arc-extinguishing chamber of the DC high-speed breaker.

[0015] Firstly, a configuration of the DC high-speed breaker will be explained in reference to Fig. 1.

[0016] A DC high-speed breaker 1 (in the following descriptions, the DC high-speed breaker 1 is referred to as a breaker) includes an upper portion conductor 3 which is arranged at a lower portion of an arc-extinguishing chamber 2, a lower portion conductor 4 which is arranged at a lower side of the upper portion conductor 3, a main contact 5 at a fixed side, which is connected to the upper portion conductor 3, and a main contact 7 at a movable side, which is mounted at an end portion of a movable element 6 which is connected to the lower portion conductor 4 via a flexible conductor 32, in a state where the movable element 6 can be relatively moved.

[0017] The main contact 7 at a movable side is rotated and driven in a direction of the main contact 5 at a fixed side by an operation mechanism 31, in a state where a rotary shaft 10 is used as a fulcrum, whereby the main contact 7 is contacted to the main contact 5 at a fixed side, and an energized circuit is set as a connection state.

[0018] In the connection state, an electric current is passed through a passage of the upper portion conductor 3, the main contact 5 at a fixed side, the main contact 7 at a movable side, the movable element 6, and the lower portion conductor 4.

[0019] When an electric current is interrupted, if a fault electric current is flowed, an overcurrent detector 8, which is arranged at the lower portion conductor 4, detects an overcurrent, and the overcurrent detector 8 is operated, and a latch 9, by which the movable element 6 is maintained when an electric current is passed, is released, whereby the movable element 6 is rotated in a state where the rotary shaft 10 is centered, and an opening-pole operation is performed. The main contact 5 at a fixed side and the main contact 7 at a movable side are installed in an inner portion of the arc-extinguishing chamber 2, and arc contacts, at which an arc is generated when an electric current is interrupted, are arranged at an upper portion of a main contact portion, and the arc contacts are composed of an arc contact 11 at a fixed side and an arc contact 12 at a movable side.

[0020] When the opening-pole operation is performed, the arc contact11 and the arc contact 12 are opened and separated at a late time after the main contacts are opened and separated, whereby an arc Ar is generated as indicated in Fig. 2, and the arc contact11 and the arc contact 12 prevent that an arc is generated at the main contacts and the main contacts are melted and broken, and the arc contact11 and the arc contact 12 protect the main contact from an arc. Arcing horns, by which a generated arc is transferred and flowed so as to be guided to an upper portion of the arc-extinguishing chamber 2, are arranged at upper portions of the arc contact11 and the arc contact 12, and the arcing horns are composed of an arcing horn 13 at a fixed side and an arcing horn 14 at a movable side. Grids 15 having a magnetic characteristic, which are composed of magnetic objects having a thin plate shape, by which an arc voltage is enhanced and a limited electric current is interrupted in accordance with a dropped-off voltage of an electrode and an extension of an arc length, are arranged at an upper side of the arc-extinguishing chamber 2, and an arc is guided to an aggregate of the grids 15, whereby the arc is interrupted.

[0021] Fig. 3 is a schematic side view for explaining an operation of arc-extinguishing chamber slide shifting mechanisms which are used as arc-extinguishing chamber shifting mechanisms in the DC breaker according to the present invention, and Fig. 3 indicates a state before the arc-extinguishing chamber 2 is slid and sifted. Moreover, Fig. 4 is a schematic side view for explaining an operation of the arc-extinguishing chamber slide shifting mechanisms according to the present invention, and Fig. 4 indicates a state after the arc-extinguishing chamber 2 is slid and sifted. In Fig. 3 and Fig. 4, a right side of each of Fig. 3 and Fig. 4 is a front side of the DC breaker, a left side of each of Fig. 3 and Fig. 4 is a rear side of the DC breaker. Moreover, an arrow in Fig. 4 represents a shift direction of the arc-extinguishing chamber 2.

[0022] Fig. 5 is a side view which indicates the arc-extinguishing chamber 2 and portions of the arc-extinguishing chamber slide shifting mechanisms in the DC

breaker according to Embodiment 1. Moreover, Fig. 6 is a side view which indicates a main portion of the arc-extinguishing chamber 2 in the DC breaker according to Embodiment 1.

[0023] Fig. 7 is an oblique perspective view for explaining the arc-extinguishing chamber slide shifting mechanisms and the arc-extinguishing chamber 2 in the DC breaker according to the present invention, and Fig. 8 is a disassembled oblique perspective view for explaining an attachment configuration of the arc-extinguishing chamber 2 and the arc-extinguishing chamber slide shifting mechanisms, and Fig. 9 is a disassembled oblique perspective view for explaining a configuration of the arc-extinguishing chamber slide shifting mechanism at a front side of the DC breaker, and Fig. 10 is a disassembled oblique perspective view for explaining a configuration of the arc-extinguishing chamber slide shifting mechanism at a rear side of the DC breaker.

[0024] Hereinafter, a configuration and an operation of the arc-extinguishing chamber slide shifting mechanisms.

[0025] An arc-extinguishing chamber slide shifting mechanism 17, for which special handles 16 for a shift operation are provided, is attached, to the arc-extinguishing chamber 2, at a front side of the DC breaker for the arc-extinguishing chamber 2, and an arc-extinguishing chamber slide shifting mechanism 18 is attached, to the arc-extinguishing chamber 2, at a rear side of the DC breaker. When the DC breaker is operated, contact portions are covered, by the arc-extinguishing chamber 2, as indicated in a state in Fig. 3, and the DC breaker has a configuration in which the contact portions are not exposed. On the other hand, when the contact portions are maintained and inspected, in the DC breaker according to Embodiment 1, if the special handles 16 for a shift operation are pulled, as indicated in Fig. 4, toward a front side of the DC breaker, wheels 19 and 20, which respectively have a round bar shape, of the arc-extinguishing chamber slide shifting mechanisms at the both sides are shifted on rails 21 and 22, which respectively have a long hole shape, while the wheels 19 and 20 are guided in a horizontal direction, and the arc-extinguishing chamber 2, which is attached to the arc-extinguishing chamber slide shifting mechanisms, is concurrently slid and shifted, whereby the contact portions are exposed, and the contact portions can be maintained and inspected.

[0026] Fig. 7 is an oblique perspective view for explaining a configuration after the arc-extinguishing chamber 2, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18 are assembled, and Fig. 8 is a disassembled oblique perspective view for explaining an attachment configuration of the arc-extinguishing chamber 2, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18. The arc-extinguishing chamber 2, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18 are respectively configured as a unit, and the arc-extinguishing chamber 2, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18 are linked by fastening components, such as bolts or screws, from components in a state which is indicated in Fig. 8, whereby the arc-extinguishing chamber 2, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18 are assembled as indicated in Fig. 7.

[0027] Fig. 9 is a disassembled oblique perspective view for explaining a configuration of the arc-extinguishing chamber slide shifting mechanism 17 at a front side of the DC breaker. In the arc-extinguishing chamber slide shifting mechanism 17, an arc-extinguishing chamber attaching clamp 23, which is linked to the arc-extinguishing chamber 2, and a fixing clamp 24, at which the rail 21 having a long hole shape is provided, are linked by using the wheel 19 which is composed of a pin. Moreover, the special handles 16 for a shift operation engage a grip 25 and joints 26, and the joints 26 are linked in a state where the wheel 19 is used as a rotational shaft. Moreover, in order to prevent an error shift operation when the DC breaker is operated, a lock pin 27 for fixing is provided at the joints 26, and notches 28 are provided at the fixing clamp 24 in such a way that the notches 28 are engaged to the lock pin 27.

[0028] Fig. 10 is a disassembled oblique perspective view for explaining a configuration of the arc-extinguishing chamber slide shifting mechanism 18 at a rear side of the DC breaker.

[0029] In the arc-extinguishing chamber slide shifting mechanism 18, an arc-extinguishing chamber attaching clamp 29, which is linked to the arc-extinguishing chamber 2, and a fixing clamp 30, at which the rail 22 having a long hole shape is provided, are linked by using the wheel 20 which is composed of a pin.

[0030] As described above, in the DC breaker according to Embodiment 1 of the present invention, the rails 21 and 22, which respectively have a long hole shape, and the arc-extinguishing chamber slide shifting mechanisms 17 and 18, which are composed of the wheels 19 and 20, which are shifted on the rail 21 and the rail 22, are attached to the arc-extinguishing chamber 2, whereby a device, such as a tool or a crane, is not required, and the arc-extinguishing chamber 2 can be easily shifted in a short time, and the DC breaker can be maintained and inspected in a state where the contact portions are exposed.

[0031] A DC breaker, according to Embodiment 1, includes a contact 5 at a fixed side; a contact 7 at a movable side, which is driven by an operation mechanism 31 and is separated from the contact 5 at a fixed side; and an arc-extinguishing chamber 2 which is arranged at an upper portion of the contact 5 at a fixed side and the contact 7 at a movable side; wherein arc-extinguishing chamber shifting mechanisms 17 and 18, by which the arc-extinguishing chamber 2 can be shifted between two positions which are composed of an operation position, which is arranged at an upper portion of the contact 5 at a fixed side and the contact 7 at a movable side, and an inspection position at which the arc-extinguishing chamber 2 is shifted in a horizontal direction from the operation posi-

tion, and an upper portion of the contact 5 at a fixed side and the contact 7 at a movable side is set as an open state, are provided.

[0032] Moreover, the arc-extinguishing chamber shifting mechanisms 17 and 18, in the DC breaker, according to Embodiment 1, include the wheels 19 and 20 which are provided at both sides of the arc-extinguishing chamber 2, and rails 21 and 22, which are provided at both sides of a main body of the DC breaker which includes the operation mechanism 31, for guiding shift operations of the rails 21 and 22.

Embodiment 2

[0033] Fig. 11 is a cross-sectional view which indicates a configuration of an arc-extinguishing chamber slide shifting mechanism in a DC breaker according to Embodiment 2 of the present invention, in a state where the arc-extinguishing chamber slide shifting mechanism is viewed from a front of the DC breaker. Configurations of the other portions in the DC breaker according to Embodiment 2 are identical to configurations of the other portions in the DC breaker according to Embodiment 1.

[0034] Fig. 11 is a cross-sectional view for explaining a configuration by which a shift operation is limited, in a direction except for a shift direction, by a guide in order to prevent that an arc-extinguishing chamber 2 is vibrated when the arc-extinguishing chamber 2 is shifted, or the arc-extinguishing chamber 2 is dropped off when an earthquake is caused. In order to prevent that the arc-extinguishing chamber 2 is dropped off, in arc-extinguishing chamber slide shifting mechanisms 17 and 18, a width of an arc-extinguishing chamber attaching clamp 23 is wider than a width of a fixing clamp 24, and the arc-extinguishing chamber 2 is engaged, whereby it is limited that the arc-extinguishing chamber 2 is shifted in a lateral direction which is indicated by an arrow Aa and an arrow Ab which are viewed from a front direction of the DC breaker. Moreover, the arc-extinguishing chamber attaching clamp 23 and the fixing clamp 24 are linked in such a way that a wheel 19 having a round bar shape is passed through each of holes of the arc-extinguishing chamber attaching clamp 23 and the fixing clamp 24, so that it is limited that the arc-extinguishing chamber 2 is shifted in an upper-lower direction which is indicated by an arrow Ba and by an arrow Bb. As described above, it is limited, in accordance with configurations of the arc-extinguishing chamber attaching clamp 23, the fixing clamp 24, and the wheel 19, that the arc-extinguishing chamber 2 is moved in a direction except for a slide shift direction of the arc-extinguishing chamber 2, so that it can be prevented that the arc-extinguishing chamber 2 is dropped off, and safety of the arc-extinguishing chamber 2 can be obtained.

[0035] In the arc-extinguishing chamber slide shifting mechanisms 17 and 18 in the DC breaker according to Embodiment 2, blocking components, which block that the wheels 19 and 20 are shifted in a direction except for a direction in which the arc-extinguishing chamber 2 is shifted, are provided at the wheels 19 and 20 and rails 21 and 22.

Embodiment 3

[0036] Fig. 12 through Fig. 14 are side views which indicate a configuration and operations of an arc-extinguishing chamber slide shifting mechanism in a DC breaker according to Embodiment 3 of the present invention. Fig. 12 indicates a state in which an arc-extinguishing chamber is locked when the DC breaker is operated, and Fig. 13 indicates a state in which a lock of the arc-extinguishing chamber is released when the DC breaker is maintained and inspected, and Fig. 14 indicates a state after the arc-extinguishing chamber is shifted when the DC breaker is maintained and inspected. Configurations of the other portions in the DC breaker according to Embodiment 3 are identical to configurations of the other portions in the DC breaker according to Embodiment 1.

[0037] Fig. 12 is a side view for explaining a configuration and an operation by which an arc-extinguishing chamber 2 is fixed and an error shift operation, which is not intended, is prevented when the DC breaker is operated, in a state where a lock pin 27 is provided at special handles 16 for a shift operation. At an arc-extinguishing chamber slide shifting mechanism 17 in a front direction of the DC breaker, the lock pin 27, which is used when the DC breaker is operated, is provided at the special handles 16 for a shift operation, and the lock pin 27 is engaged to notches 28 which are provided at a fixing clamp 24, whereby the lock pin 27 interferes with the notches 28 even if the arc-extinguishing chamber 2 tries to slide and shift, so that the arc-extinguishing chamber 2 cannot be shifted, and a shift operation of the arc-extinguishing chamber 2 is locked. In a case in which a lock is released in order to shift the arc-extinguishing chamber 2, the special handles 16 for a shift operation are elevated in a lock release direction (a counterclockwise direction) of an arrow C which is indicted in Fig. 13, and the special handles 16 for a shift operation are pulled in a slide shift direction of an arrow D which is indicted in Fig. 14, in a state where the special handles 16 for a shift operation are elevated, whereby the arc-extinguishing chamber 2 can be slid and shifted.

[0038] As described above, in the DC breaker according to Embodiment 3 of the present invention, an error shift operation, which is not intended, of the arc-extinguishing chamber 2 is prevented when the DC breaker is operated, and a tool is not used and a fastening component is not detached when the arc-extinguishing chamber 2 is slid and shifted, and the arc-extinguishing chamber 2 can be easily slid and shifted.

[0039] The arc-extinguishing chamber slide shifting mechanisms 17 and 18, in the DC breaker according to Embodiment 3, include the handles 16 for a shift operation, by which wheels 19 and 20 are operated in a shift direction of the arc-extinguishing chamber 2, and locking

means (components), which are provided at the handles 16 for a shift operation, by which shift operations to an open state, which are caused in accordance with shift operations of the wheels 19 and 20, are blocked or released.

Embodiment 4

[0040] Fig. 15 is a cross-sectional view which indicates a configuration of an arc-extinguishing chamber slide shifting mechanism in a DC breaker according to Embodiment 4 of the present invention, in a state where the arc-extinguishing chamber slide shifting mechanism is viewed from a front of the DC breaker. Configurations of the other portions in the DC breaker according to Embodiment 4 are identical to configurations of the other portions in the DC breaker according to Embodiment 1.

[0041] Fig. 15 is corresponding to the other form according to Embodiment 1, and although the wheel 19 is composed of one round bar in Embodiment 1, wheels 190 which are guided by rails, which respectively have a long hole shape and are provided at an arc-extinguishing chamber attaching clamp 230 and a fixing clamp 240, are composed of two round bars, in Embodiment 4, which are used as left-right different components. Because the DC breaker is configured as described above, a function, which is similar to a function according to Embodiment 1, can be obtained, and an amount of a processing for the round bars can be reduced, and moreover, because the wheels 190 have the same configuration, the number of manufacture is increased, so that a cost for configuring the arc-extinguishing chamber slide shifting mechanism can be reduced.

Embodiment 5

[0042] Fig. 16 is a cross-sectional view, in which an arc-extinguishing chamber slide shifting mechanism is viewed from a front of a DC breaker, which indicates a configuration of the arc-extinguishing chamber slide shifting mechanism in the DC breaker according to Embodiment 5 of the present invention. Configurations of the other portions in the DC breaker according to Embodiment 5 are identical to configurations of the other portions in the DC breaker according to Embodiment 1.

[0043] Fig. 16 is corresponding to the other form according to Embodiment 1, and although the arc-extinguishing chamber slide shifting mechanisms are composed of the wheels and the rails which respectively have a long hole shape, in order to slide and shift the arc-extinguishing chamber in the DC breaker according to Embodiment 1, an outer circumference portion 231a of an arc-extinguishing chamber attaching clamp 231 and an outer circumference portion 241a of a fixing clamp 241 respectively has a bent configuration as indicated by dot-and-dash line circles E, and the arc-extinguishing chamber attaching clamp 231 is slid on the fixing clamp 241, whereby a function, which is similar to a function according to Embodiment 1, can be obtained, and a processing for the wheels and the rails is not required, so that a cost for the wheels and the rails can be reduced.

Embodiment 6

[0044] Fig. 17 and Fig. 18 are views for explaining a configuration of a fixing clamp of an arc-extinguishing chamber slide shifting mechanism in a DC breaker according to Embodiment 6 of the present invention. Configurations of the other portions in the DC breaker according to Embodiment 6 are identical to configurations of the other portions in the DC breaker according to Embodiment 1.

[0045] In the DC breaker according to Embodiment 6, which is indicated in Fig. 17 and Fig. 18, a configuration of the fixing clamp, by which an error shift operation of an arc-extinguishing chamber 2, which is caused by a vibration, is suppressed in such a way that shapes of both ends of a long hole portion of a rail, which are static positions of an arc-extinguishing chamber 2, are lowered in a ground direction, will be explained. When a rail is horizontal with respect to a ground, in order to slide and shift the arc-extinguishing chamber 2, it is required that an operation force F_1 is greater than a friction force F_3 which is acted in accordance with a force F_2 in a vertical direction, which is acted to the wheels, and a coefficient of friction, which is set in accordance with a state between the wheels and the rails. However, a long hole, which is a rail 500 of a fixing clamp 400, is formed as a long hole 500 having a shape in which both end portions of the long hole 500 are lowered as indicated in Fig. 17 and Fig. 18, whereby, when the arc-extinguishing chamber 2 is stayed at static positions Sp, an operation force F_4, which is required for sliding and shifting the arc-extinguishing chamber 2, is set as a resultant force, in which the friction force F_3 and a force "$F_2 \times \sin\theta$", which is set in accordance with the force F_2 and an angle θ, are added. Therefore, it is required that the operation force F_4 is greater than the force F_2, and a lowered width Lw for both end portions is varied, whereby the operation force F_4 can be set.

[0046] As described above, in the DC breaker according to Embodiment 6 of the present invention, the operation force F_4 is set in a range in which an operator can operate the DC breaker, whereby an operational capability of the arc-extinguishing chamber 2 is not lost, and an involuntary error shift operation, which is caused in accordance with a vibration, of the arc-extinguishing chamber 2 is inhibited, and safety of the arc-extinguishing chamber 2 can be improved.

[0047] The rail 500 of the arc-extinguishing chamber slide shifting mechanism in the DC breaker according to Embodiment 6 is formed as the long hole which is extended in a shift direction of the arc-extinguishing chamber 2 so as to be formed at a fixed portion of the arc-extinguishing chamber slide shifting mechanism, and the both end portions of the long hole are bent toward a static

position side of the arc-extinguishing chamber 2.

[0048] In the scope of the present invention, it is possible that each of embodiments is freely combined, or each of embodiments is suitably modified or omitted.

Description of the Symbols

[0049] "1" is a DC high-speed breaker; "2," an arc-extinguishing chamber; "5," a main contact at a fixed side; "7," a main contact at a movable side; "16," special handles for a shift operation; "17 and 18," arc-extinguishing chamber slide shifting mechanisms; "19 and 20," wheels; "21 and 22," rails; "27," a lock pin; "28," notches.

Claims

1. A DC breaker comprising:

a contact at a fixed side;
a contact at a movable side, which is driven by an operation mechanism and is separated from the contact at a fixed side; and
an arc-extinguishing chamber which is arranged at an upper portion of the contact at a fixed side and the contact at a movable side; wherein
arc-extinguishing chamber shifting mechanisms, by which the arc-extinguishing chamber can be shifted between two positions which are composed of an operation position, which is arranged at an upper portion of the contact at a fixed side and the contact at a movable side, and an inspection position at which the arc-extinguishing chamber is shifted in a horizontal direction from the operation position, and an upper portion of the contact at a fixed side and the contact at a movable side is set as an open state, are provided.

2. A DC breaker as recited in claim 1, wherein the arc-extinguishing chamber shifting mechanisms include wheels which are provided at the arc-extinguishing chamber, and rails, which are provided at a main body of the DC breaker which includes the operation mechanism, for guiding shift operations of the rails.

3. A DC breaker as recited in claim 2, wherein blocking components, which block that the wheels are shifted in a direction except for a direction in which the arc-extinguishing chamber is shifted, are provided at the wheels and the rails.

4. A DC breaker as recited in claim 2, wherein the arc-extinguishing chamber shifting mechanisms include handles for a shift operation, by which the wheels are operated in a shift direction of the arc-extinguishing chamber, and locking means, which are provided at the handles for a shift operation, by which shift operations to the open state, which are caused in accordance with shift operations of the wheels, are blocked or released.

5. A DC breaker as recited in claim 2, wherein the rails are formed as long holes which are extended in a shift direction of the arc-extinguishing chamber so as to be formed at fixed portions of the shifting mechanisms, and both end portions of the long holes are bent toward a static position side of the arc-extinguishing chamber.

FIG. 1

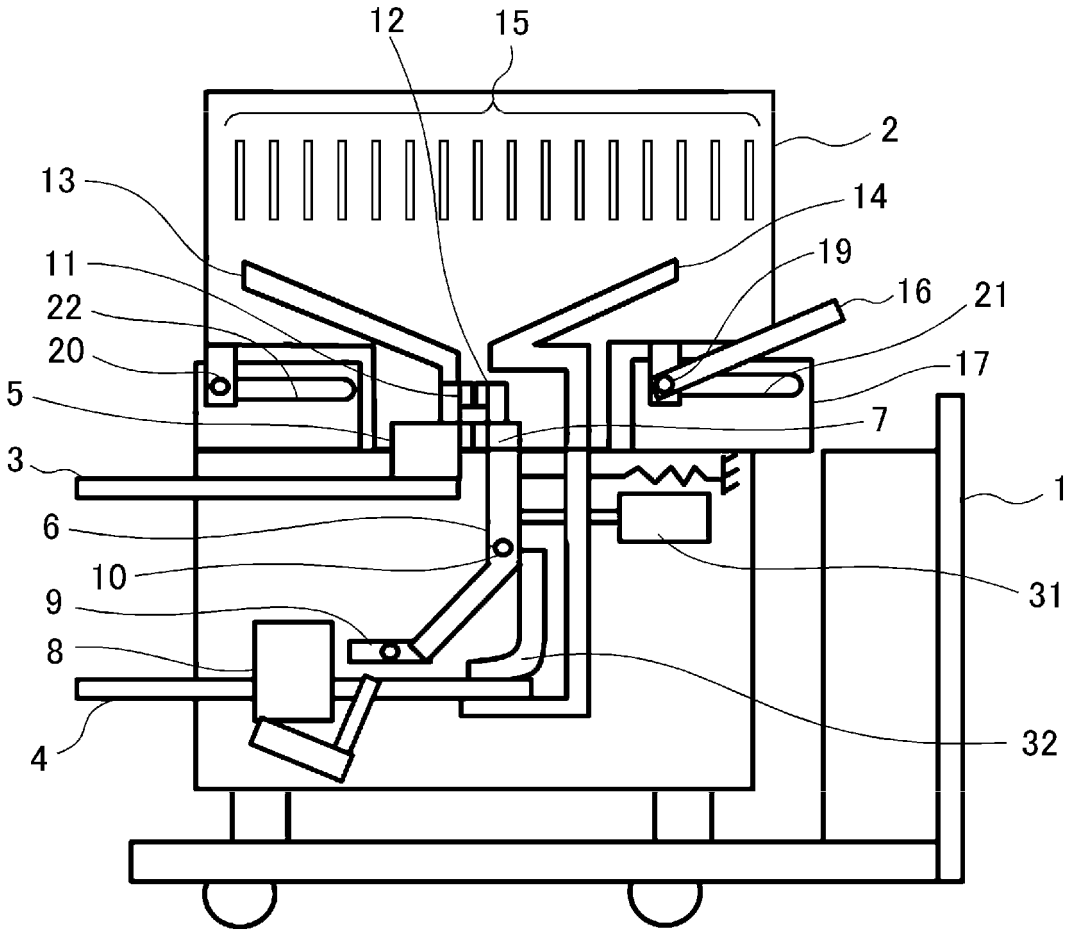


FIG. 2

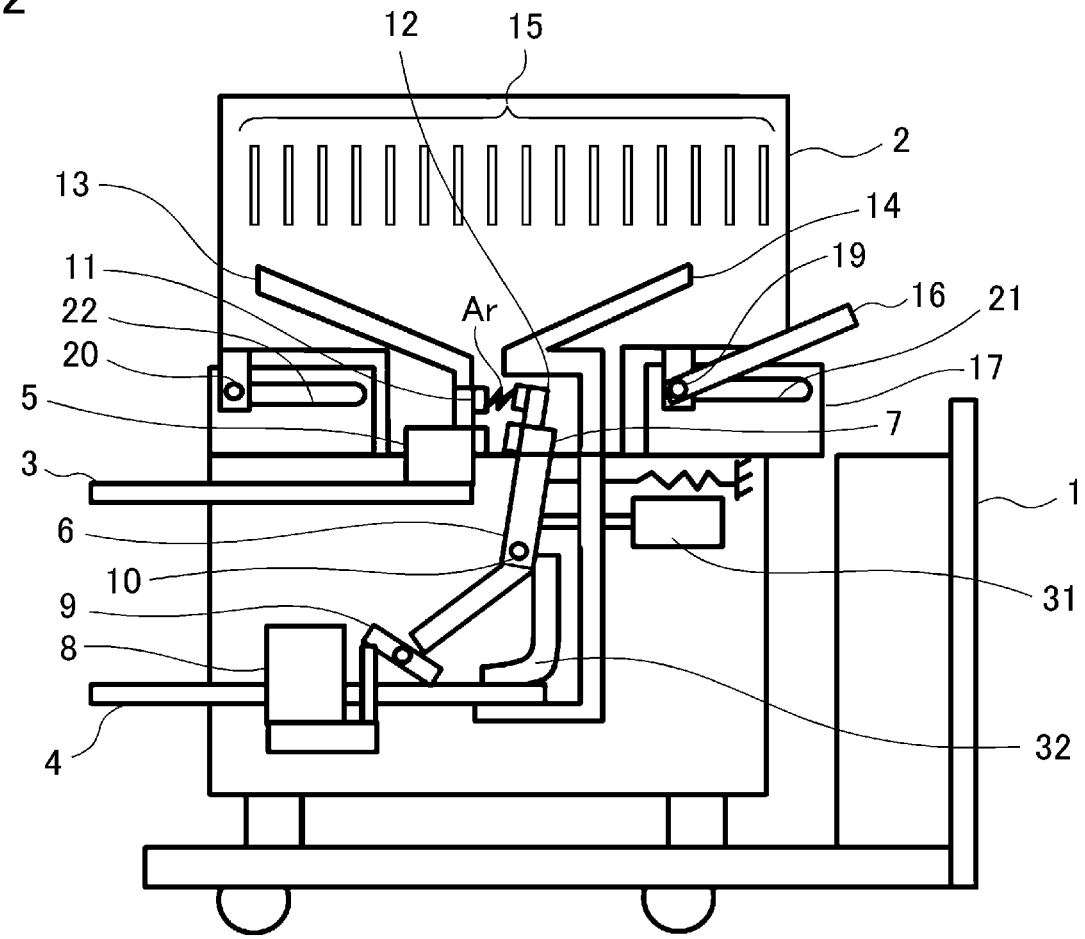


FIG. 3

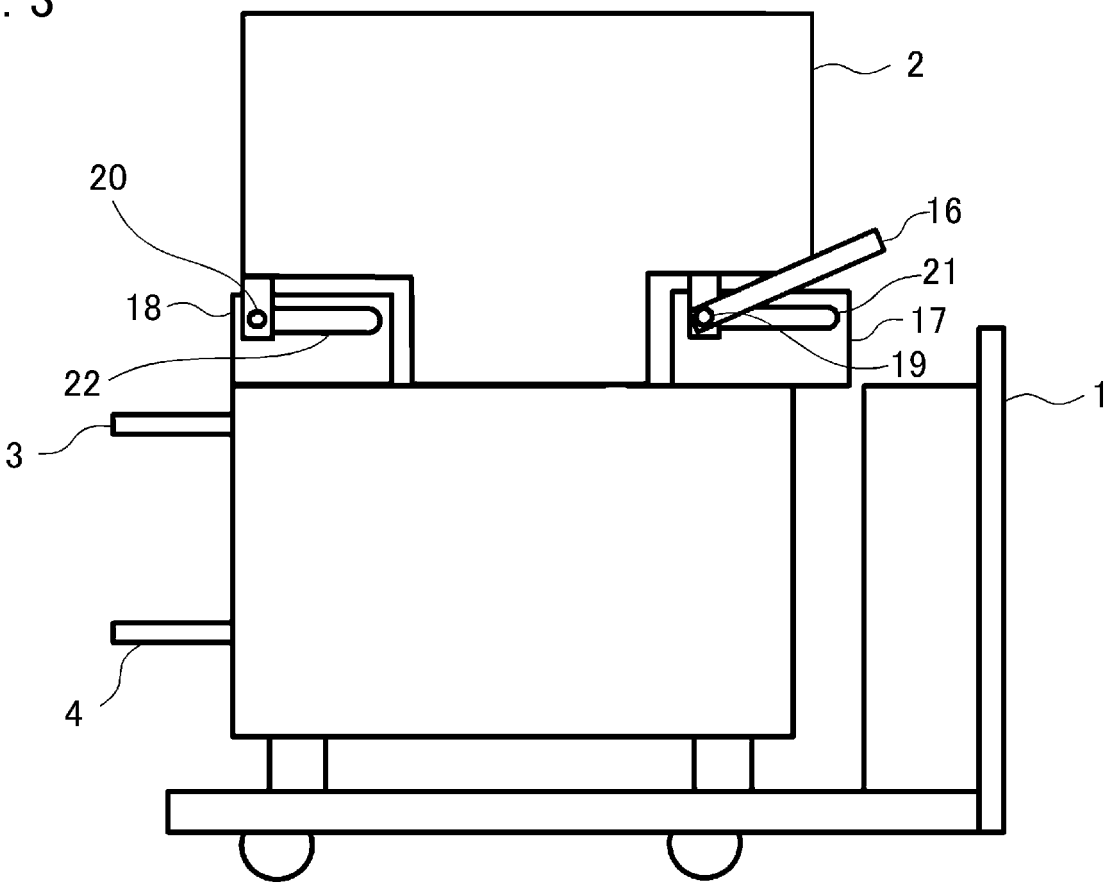


FIG. 4

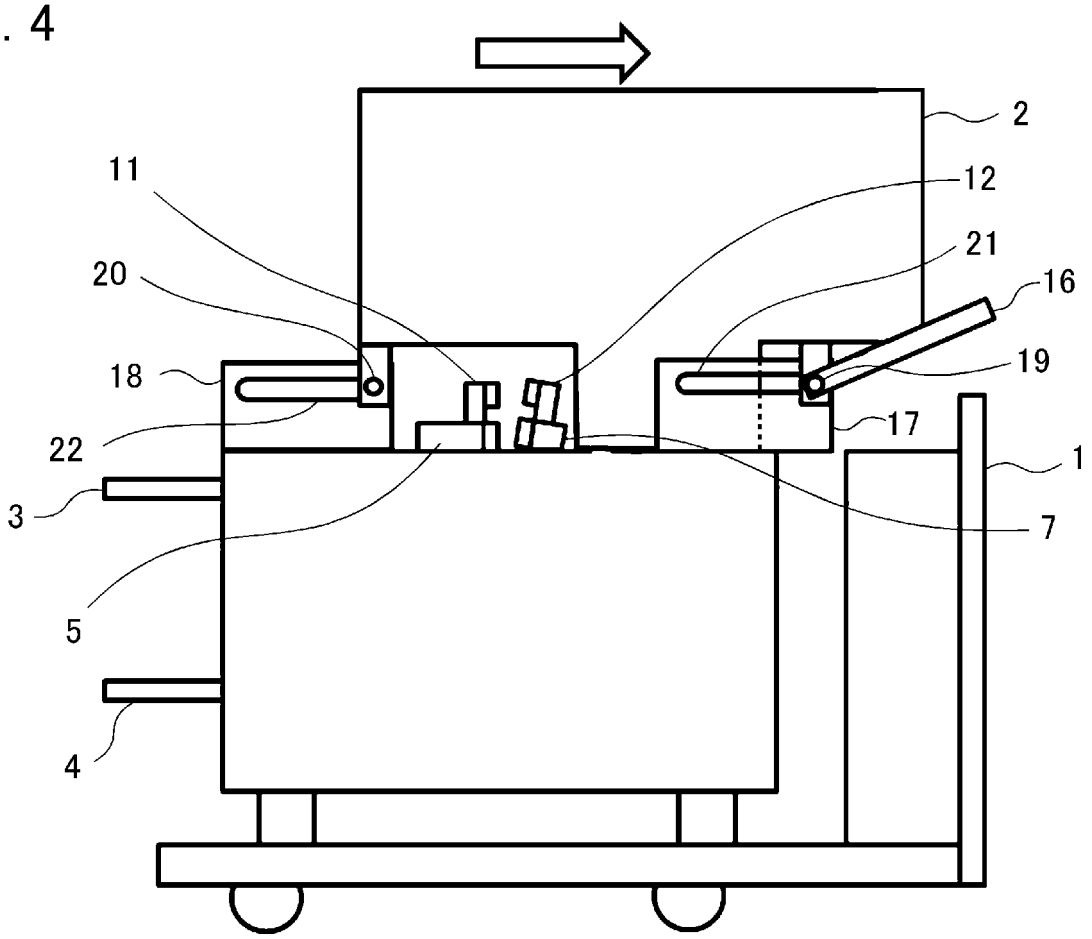


FIG. 5

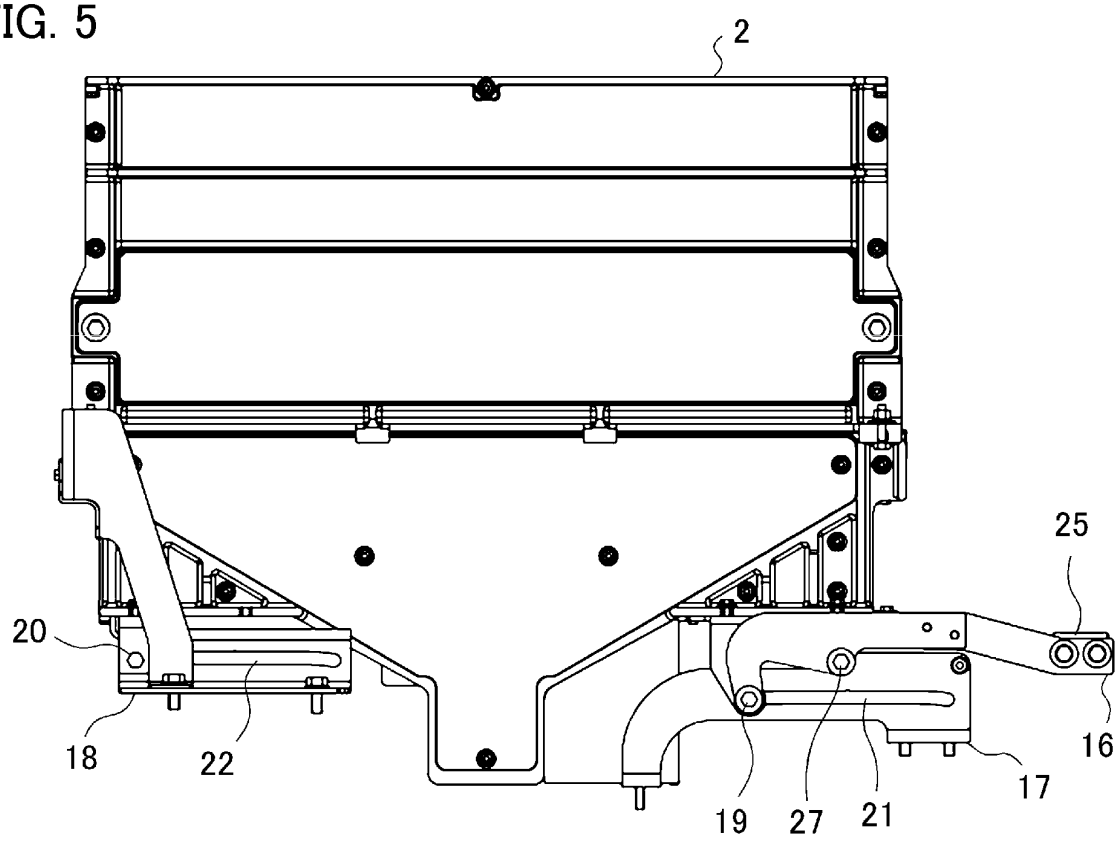


FIG. 6

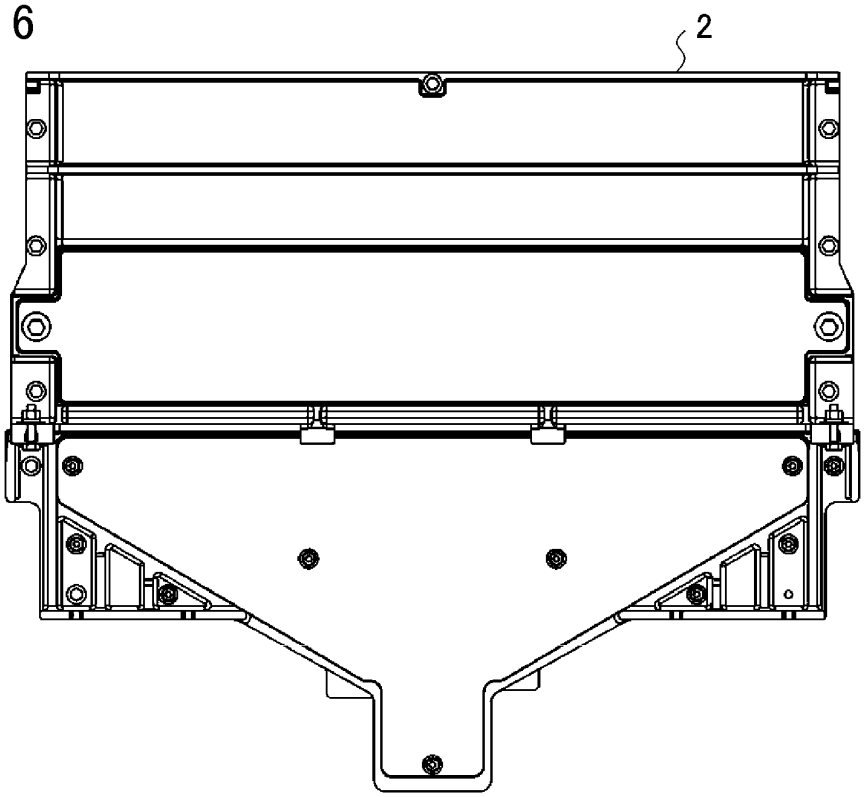


FIG. 7

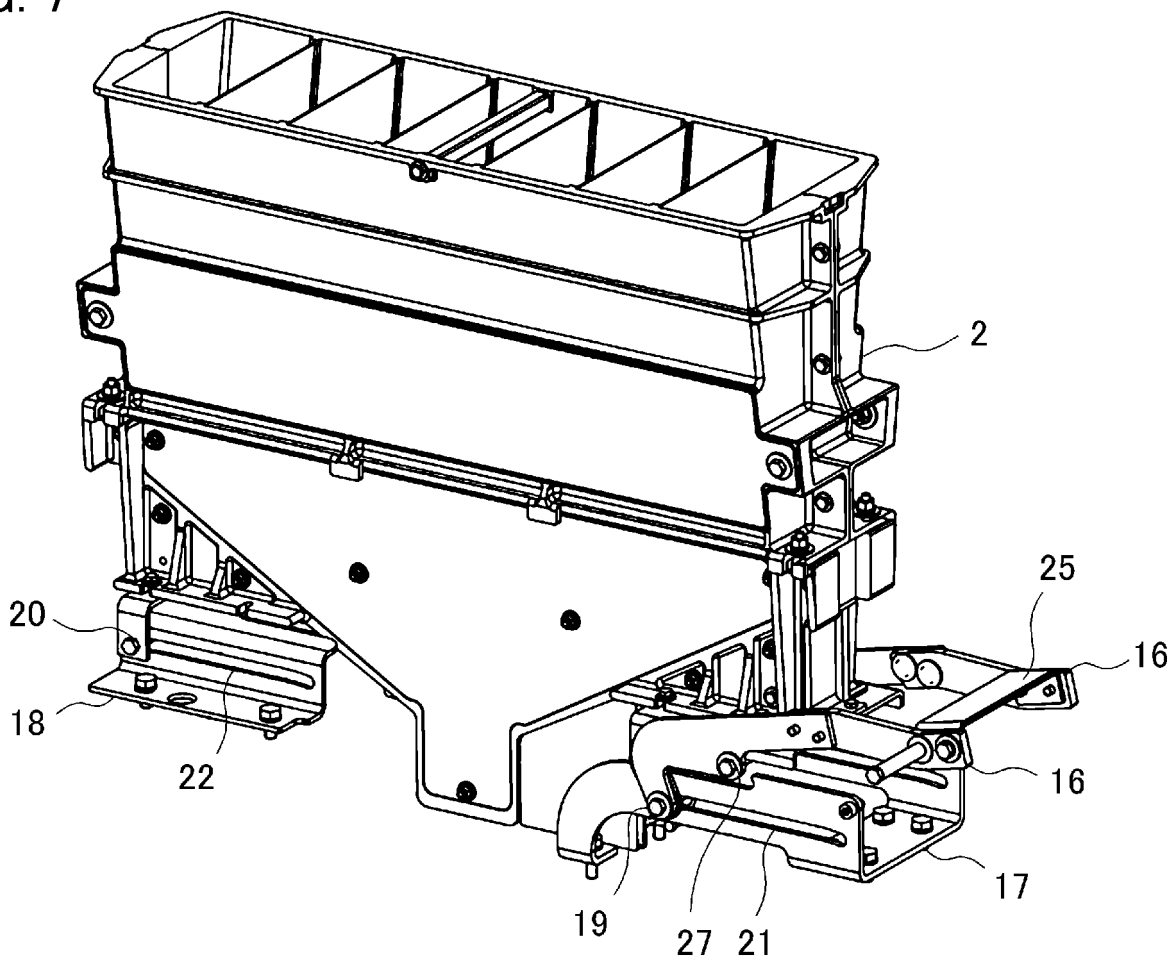


FIG. 8

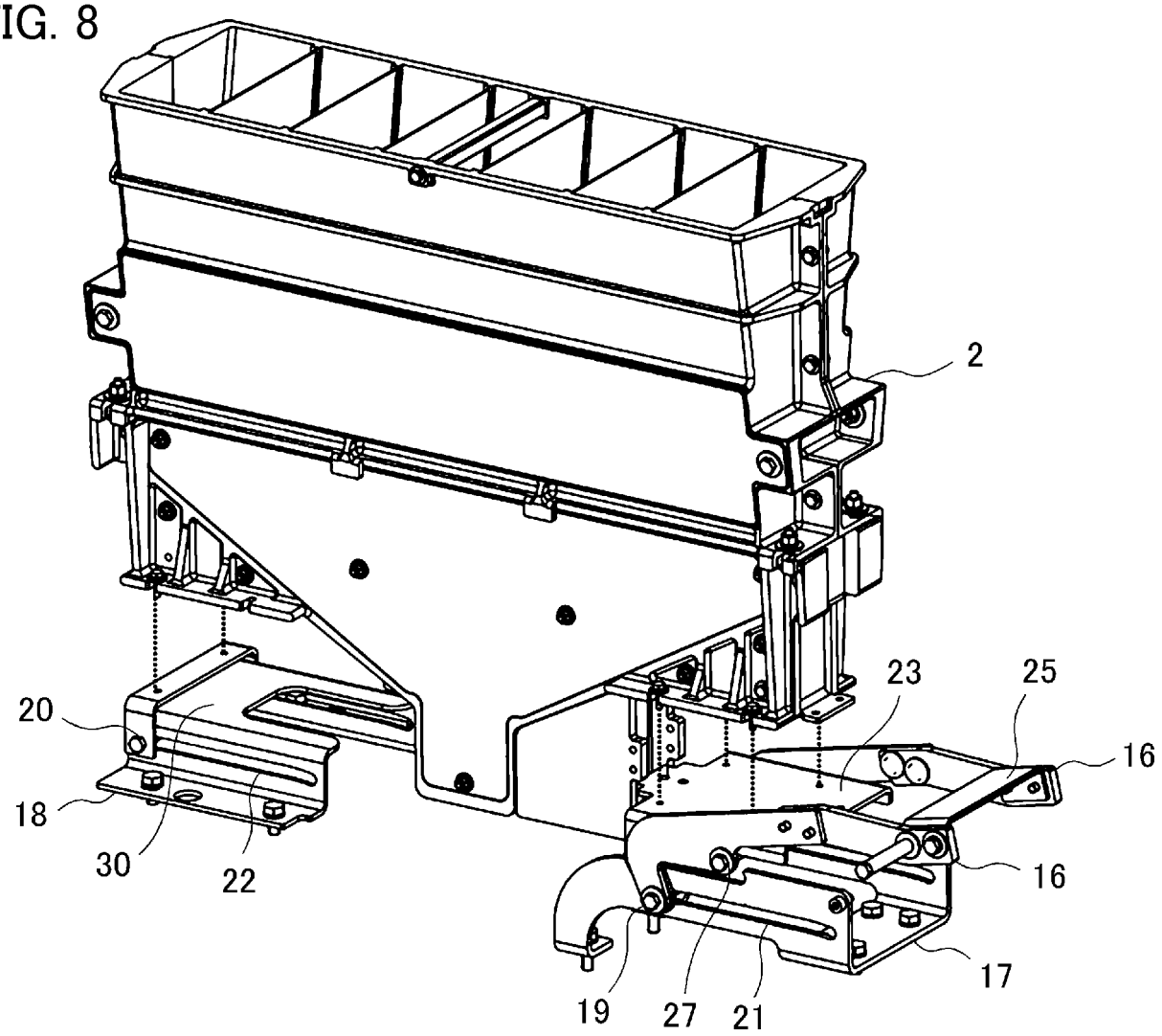


FIG. 9

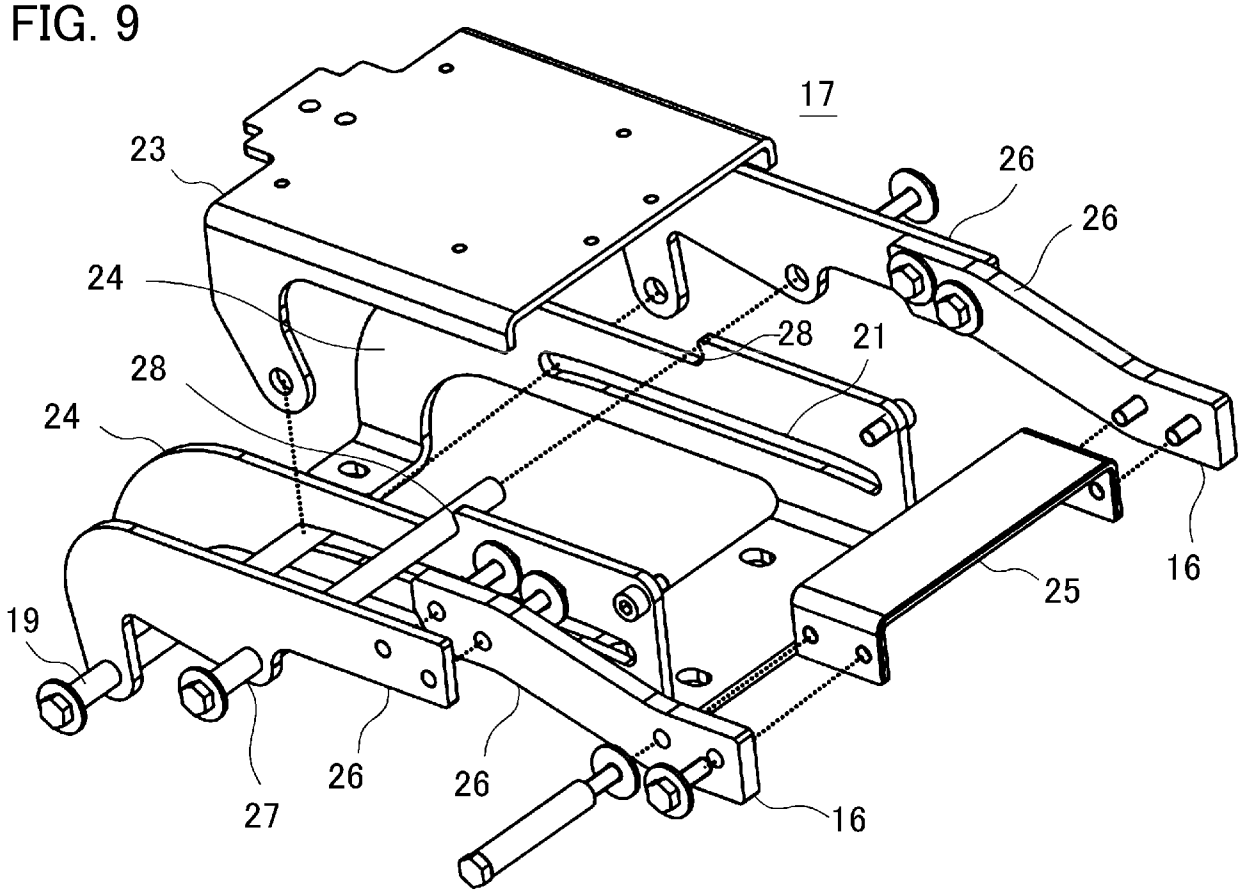


FIG. 10

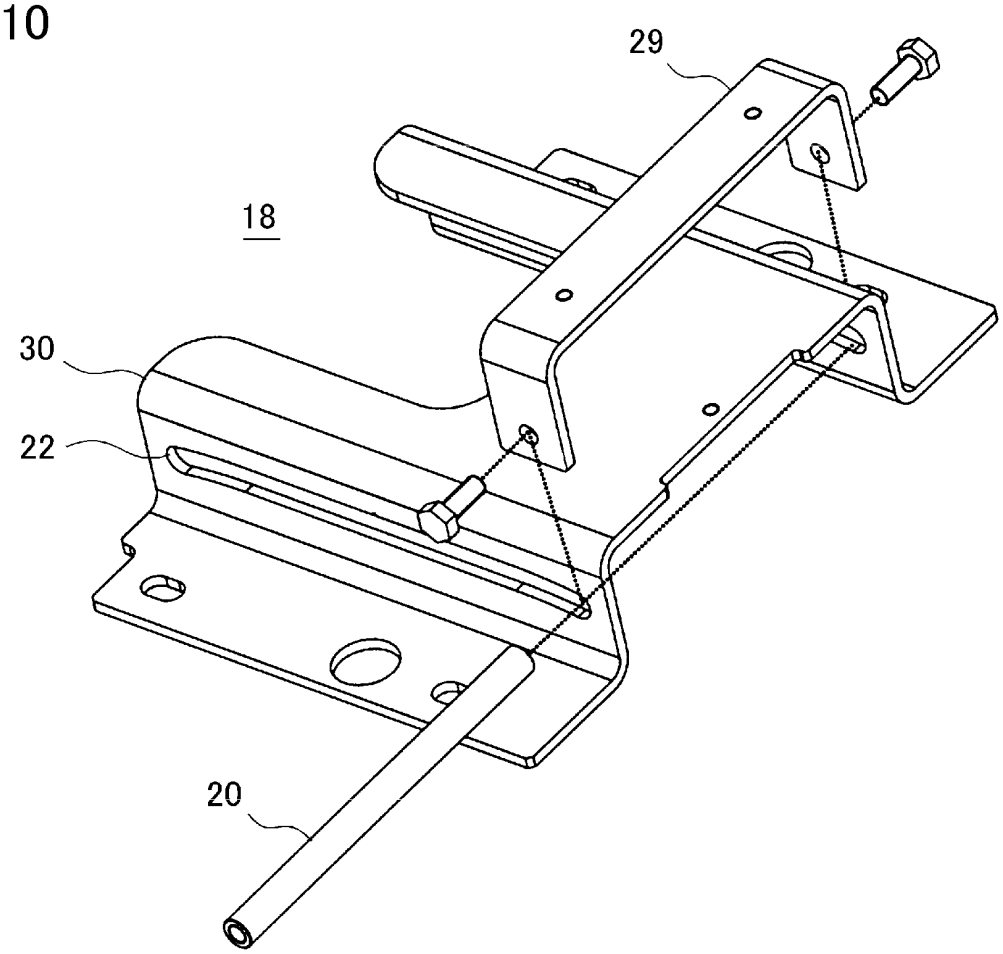


FIG. 11

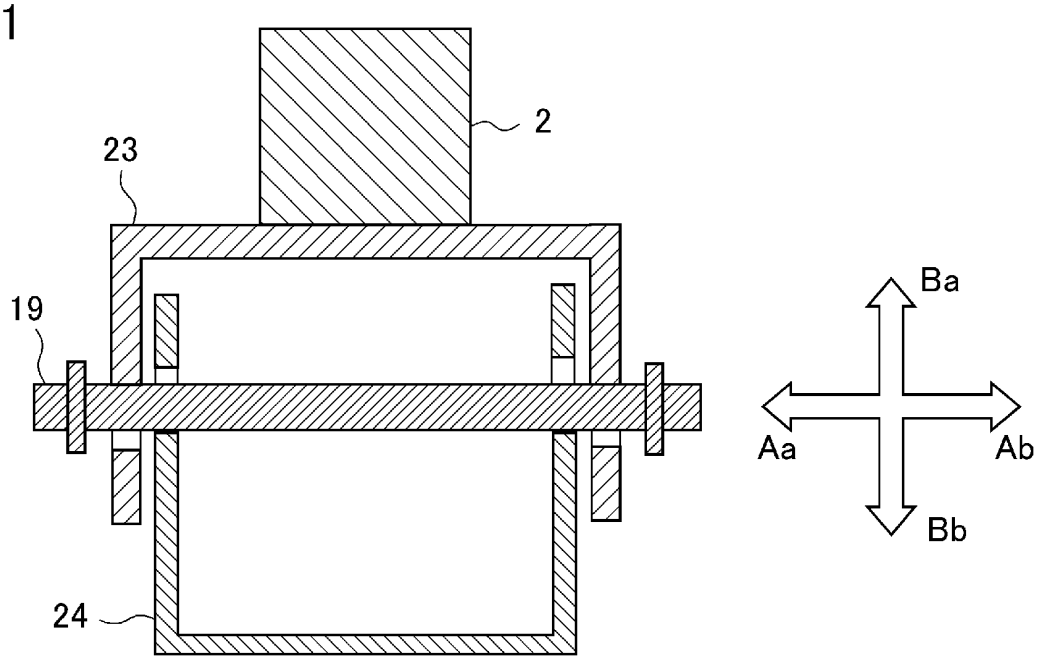


FIG. 12

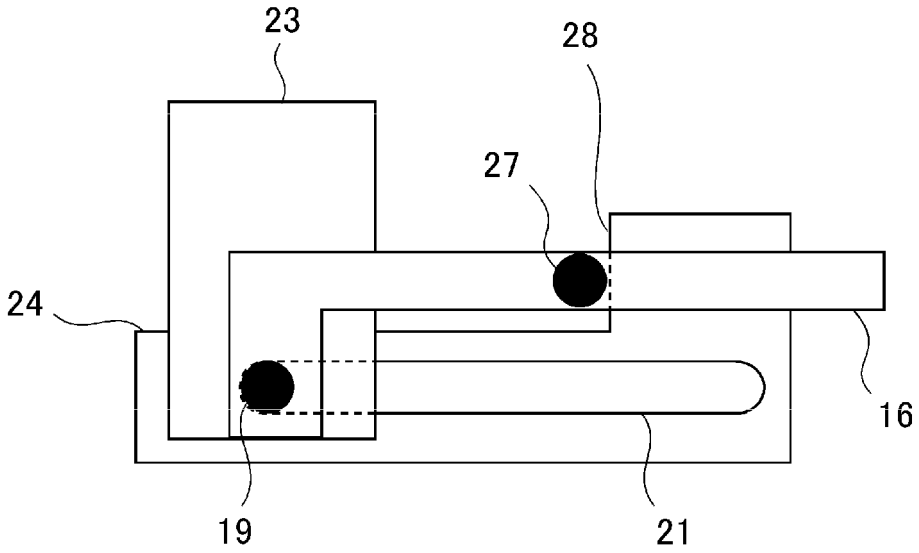


FIG. 13

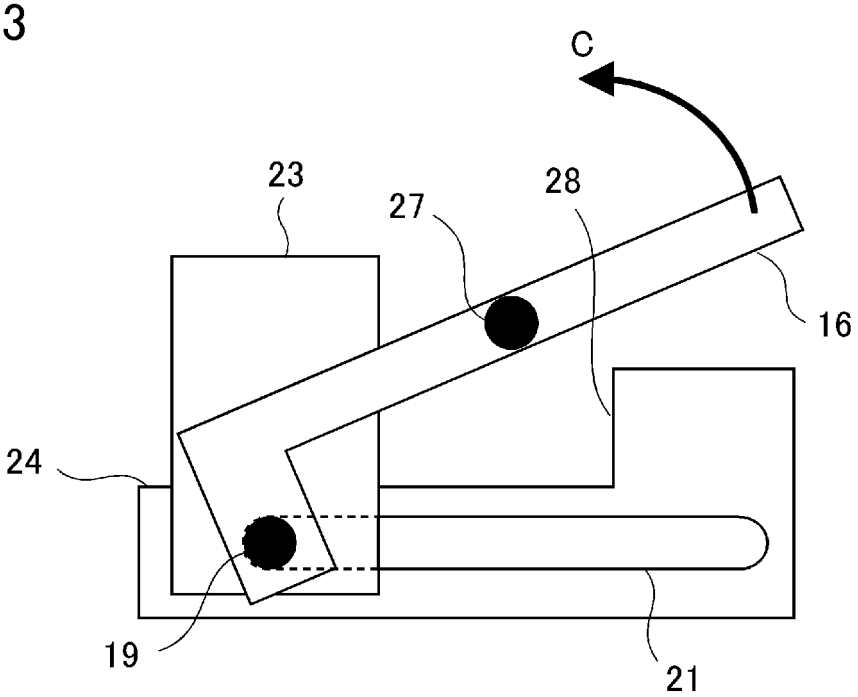


FIG. 14

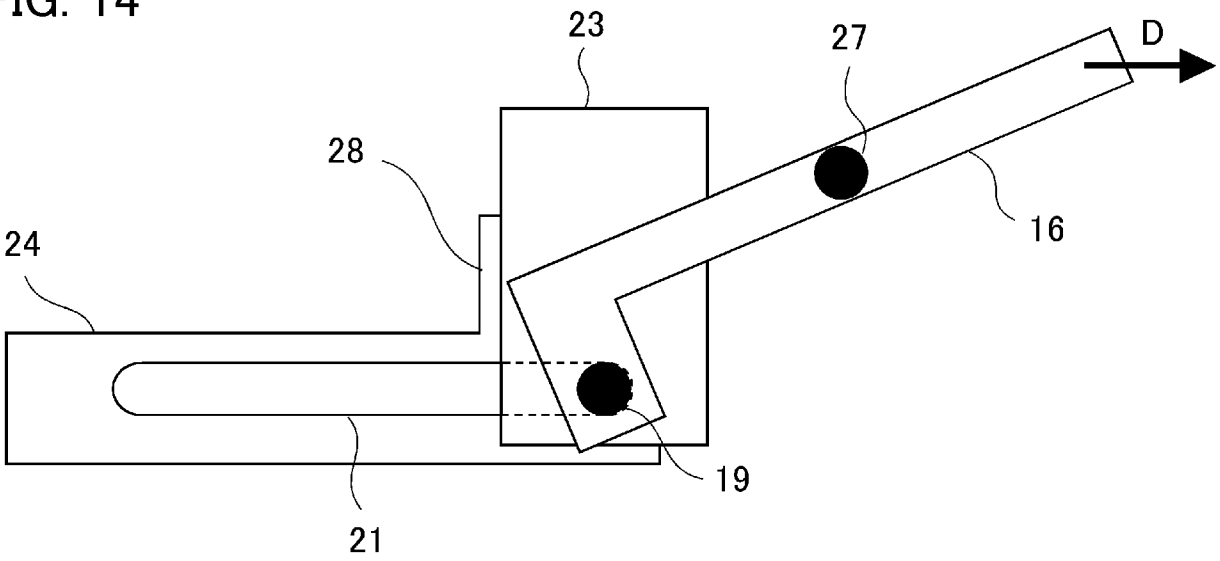


FIG. 15

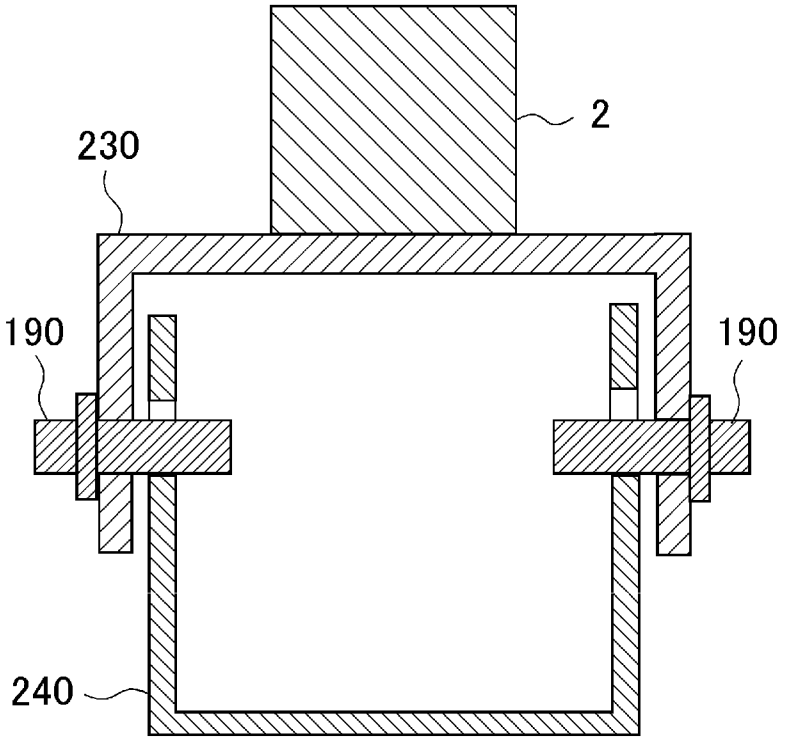


FIG. 16

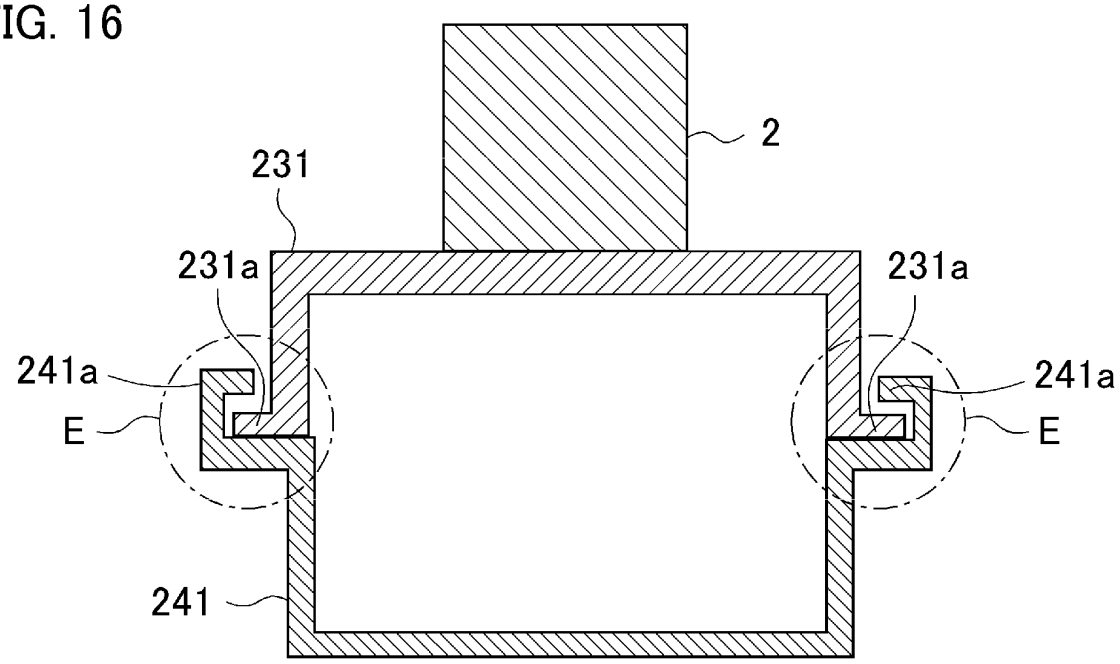


FIG. 17

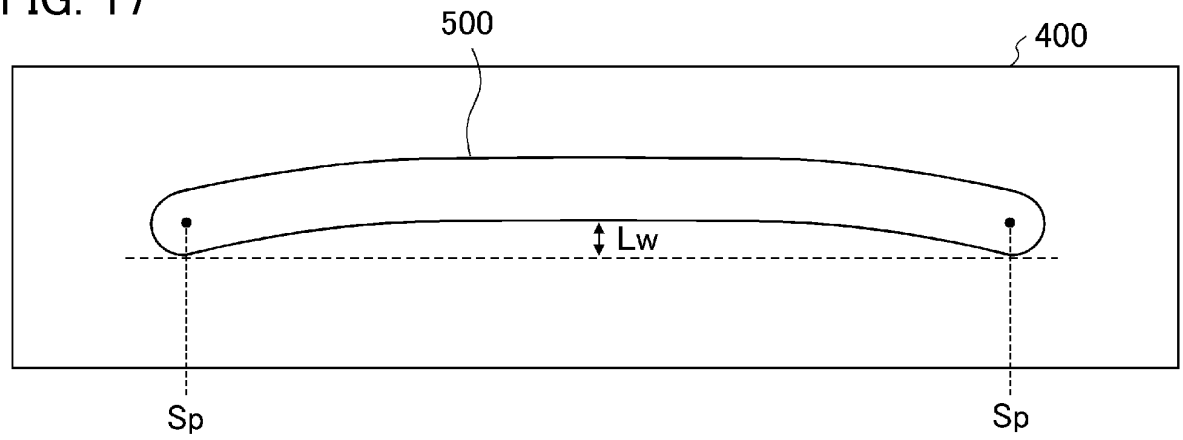
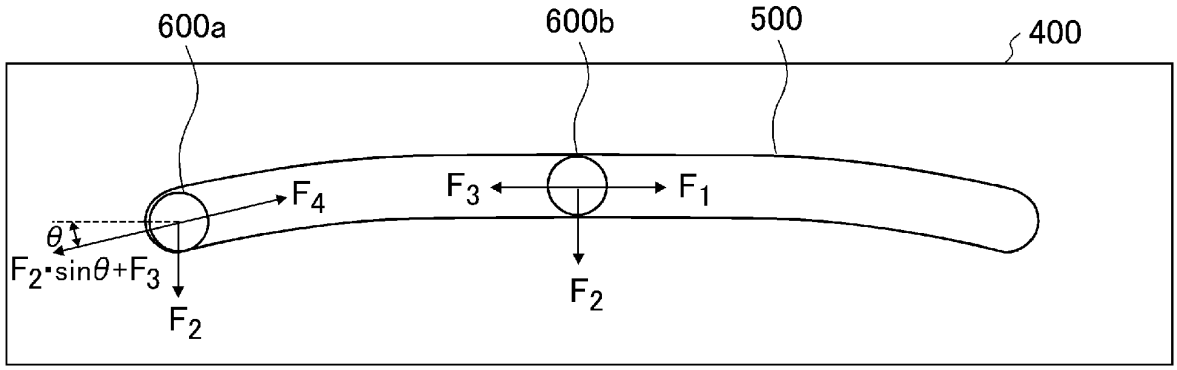


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/088642

A. CLASSIFICATION OF SUBJECT MATTER
H01H33/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01H33/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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	JP 7-153350 A (Fuji Electric Co., Ltd.), 16 June 1995 (16.06.1995), paragraphs [0002] to [0006]; fig. 7 to 8 (Family: none)	1-5
Y	JP 54-49001 A (Siemens AG.), 18 April 1979 (18.04.1979), page 2, lower left column, line 10 to page 6, upper left column, line 19; fig. 1 to 6 & US 4191433 A column 2, line 62 to column 5, line 30; fig. 1 to 6 & GB 1603273 A & DE 2737933 A1	1-5

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

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Date of the actual completion of the international search	Date of mailing of the international search report
08 March 2017 (08.03.17)	21 March 2017 (21.03.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/088642

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 6-334381 A (Toppan Printing Co., Ltd.), 02 December 1994 (02.12.1994), paragraphs [0004] to [0009]; fig. 1 to 4 (Family: none)	1-5
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 126293/1986(Laid-open No. 31845/1988) (Houkoku Kogyo Co., Ltd.), 01 March 1988 (01.03.1988), specification, page 4, line 10 to page 8, line 15; fig. 1 to 4 (Family: none)	4
Y	JP 64-81604 A (Toshiba Corp.), 27 March 1989 (27.03.1989), page 3, lower left column, lines 7 to 12; fig. 8 (Family: none)	5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H0660944 B **[0006]**
- JP H07153350 B **[0006]**