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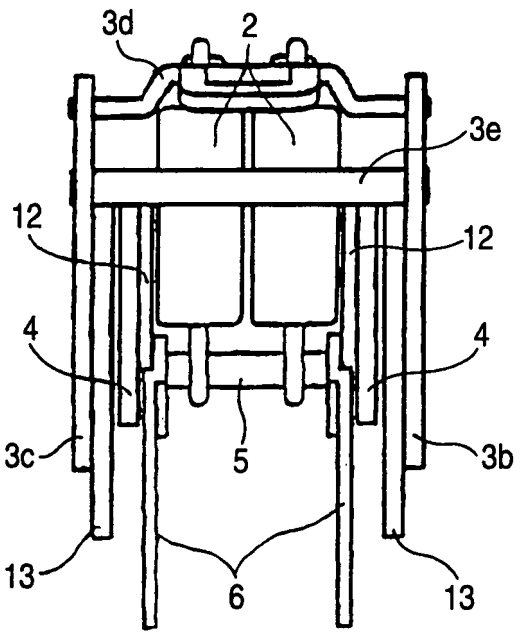
(54) Circuit breaker

(57) A circuit breaker includes inside a crossbar 7, a lower link 6, a lever 4 that rotates during tripping of the circuit breaker, an upper link 12 that configures a toggle link, and main springs 2, with the circuit breaker also including a handle arm 3 that cooperates with these. The handle arm 3 comprises a frame body whose cross section is substantially U-shaped and where one end of two side plates 3b and 3c are joined together by a structural body. At least one of the side plates 3b and 3c is a separate part fixedly attached to the structural body, and the side plates 3b and 3c are fixedly attached to the structural body at positions that do not line up in a straight line on the side plates.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a structure of a circuit breaker.

Description of the Related Art

[0002] In a switch mechanism portion of a conventional circuit breaker, a handle arm that drives main springs has a U shape that covers the main springs from the side in order to ensure right-left balance, and the handle arm has an integral structure of a U-shaped metal plate in order to ensure rigidity (e.g., see JP-A No. 2006-196242, FIG. 1).

[0003] Usually, a quick switch mechanism part of a circuit breaker is often a plate-shaped part whose rotational axis is parallel to the width direction of the circuit breaker, and those that are layered from the side have the best efficiency in terms of assembly, but because the handle arm that is often disposed on the outside has a U-shaped integral structure, layered assembly from the side has been impossible in conventional circuit breakers. Further, because the contact pressure of the contact point in circuit breakers differs per rated current, plural specifications whose loads differ are necessary for the main springs for driving, and plural width direction dimensions become necessary in correspondence to those plural specifications. When the handle arm has a U-shaped integral structure as has conventionally been the case, it has been necessary to manufacture plural handle arms whose width direction dimensions differ to match the width direction dimensions of circuit breakers. When handle arms with the same specification are shared in common in order to avoid this, there has been the problem that the outer shape dimension becomes larger in a circuit breaker whose rated current is small, the circuit breaker becomes difficult for the user to use, and the product cost becomes higher.

SUMMARY OF THE INVENTION

[0004] The present invention has been made in order to solve the aforementioned problem and provides a circuit breaker where assembly of the switch mechanism portion of the circuit breaker can be performed easily and which can easily accommodate various kinds of specifications.

[0005] A circuit breaker pertaining to this invention includes: a crossbar that holds a movable contact; a lower link that drives the crossbar; a lever that engages with a latch of an overcurrent trip device and rotates during tripping of the circuit breaker; an upper link that is supported on the lever and is joined together with the lower link via a spring pin to configure a toggle link together with the lower link; main springs whose driven sides are joined together with the spring pin; and a handle arm that joins together with driving sides of the main springs and is rotatably supported on a frame fixed to a casing of the circuit breaker. The handle arm comprises a frame body whose cross section is substantially U-shaped and where one end of each of two side plates are joined together by a structural body. At least one of the side plates is a separate part fixedly attached to the structural body. The side plate that is a separate part is fixedly attached to the structural body at three or more positions that do not line up in a straight line on this side plate.

[0006] In this circuit breaker, the structural body of the handle arm may comprise one top plate and at least one pin.

[0007] In this circuit breaker, the top plate may be formed integrally with one of the two side plates.

[0008] In this circuit breaker, the structural body of the handle arm may comprise one top plate whose cross section is substantially L-shaped, and the three or more places where the top plate and the side plate are fixedly attached to each other may be dispersed on both portions of the L shape.

[0009] In this circuit breaker, the structural body of the handle arm may comprise at least three pins that have the same shape.

[0010] The shapes of the two side plates of the handle arm excluding the handle arm of the circuit breaker where one of the side plates and the structural body are integrated may be the same.

[0011] In the circuit breaker pertaining to this invention, assembly of the switch mechanism portion of the circuit breaker is easy, and the circuit breaker contributes to reducing the types of parts and the number of parts with respect to the demand of various specifications because of the standardization of the parts of the circuit breaker.

[0012] The foregoing and other objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a side sectional view of a circuit breaker pertaining to this invention;

FIG. 2 is a side sectional view showing a switch mechanism portion of a circuit breaker pertaining to embodiment 1 of this invention;

FIG. 3 is a front view showing essential parts of FIG. 2;

FIG. 4 is a side sectional view showing the switch mechanism portion of the circuit breaker pertaining to embodiment 1 in an OFF state;

FIG. 5 is a side sectional view showing the switch mechanism portion of the circuit breaker pertaining

to embodiment 1 in an ON state;
FIG. 6A is a front view showing a handle arm of the circuit breaker pertaining to embodiment 1, FIG. 6B is a side view of the same handle arm, and FIG. 6C is a plan view of the same handle arm;
FIG. 7A is an exploded front view showing the handle arm of the circuit breaker pertaining to embodiment 1, FIG. 7B is an exploded side view of the same handle arm, and FIG. 7C is an exploded plan view of the same handle arm;
FIG. 8 is a diagram describing assembly of the switch mechanism portion using the handle arm of the circuit breaker pertaining to embodiment 1;
FIG. 9A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 2, FIG. 9B is a side view of the same handle arm, and FIG. 9C is a plan view of the same handle arm;
FIG. 10A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 3, FIG. 10B is a side view of the same handle arm, and FIG. 10C is a plan view of the same handle arm;
FIG. 11A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 4, FIG. 11B is a side view of the same handle arm, and FIG. 11C is a plan view of the same handle arm; and
FIGS. 12A to 12C are front views showing three types of handle arms whose specifications are different.

DETAILED DESCRIPTION OF THE INVENTION

Embodiment 1

[0014] FIG. 1 to FIG. 8 show the entirety and part of the structure of a circuit breaker pertaining to embodiment 1 of this invention. FIG. 1 is a sectional view of the entire circuit breaker in a tripped state. FIG. 2 is a side sectional view of a switch mechanism portion of the circuit breaker in the tripped state. FIG. 3 is a front view of essential parts of the switch mechanism portion in the tripped state (with main springs being shown schematically). FIG. 4 is a side view of the switch mechanism portion in an OFF state. FIG. 5 is a side sectional view of the switch mechanism portion in an ON state. FIG. 6A is a front view showing a handle arm, FIG. 6B is a side view of the same handle arm, and FIG. 6C is a plan view of the same handle arm. FIG. 7A is an exploded front view of the handle arm, FIG. 7B is an exploded side view of the same handle arm, and FIG. 7C is an exploded plan view of the same handle arm. FIG. 8 is a diagram describing layered assembly of the switch mechanism portion using the handle arm.

[0015] First, the entire structure of the circuit breaker will be described in regard to FIG. 1. The circuit breaker pertaining to this invention includes a casing 20 in which are housed the following: a movable contact 8 that includes a movable contact point 9 on one end; a fixed contact 10 that is brought into and out of contact with the movable contact point 9; a crossbar 7 that holds the movable contact 8; a lower link 6 that drives the crossbar 7; a lever 4 that is engaged with a latch 11 of an overcurrent trip device and rotates during tripping of the circuit breaker; an upper link 12 that is supported on the lever 4 and links to the lower link 6 via a spring pin 5 to configure a toggle link together with the lower link 6; main springs 2 whose driven sides are joined to the spring pin 5; a substantially U-shaped handle arm 3 that is joined to driving sides 2a of the main springs 2 and is rotatably supported on a frame fixed to the casing 20 of the circuit breaker; and a handle 1.

[0016] Next, the switch mechanism portion of this circuit breaker will be described in detail by FIG. 2 to FIG. 5. The switch mechanism comprises the handle 1 that projects from the casing 20, the handle arm 3 that is joined to the handle 1, a rotating shaft 3a of the handle arm 3, the main springs 2, the lever 4, the spring pin 5, the upper link 12, the lower link 6, the crossbar 7, and the latch 11. In the state shown in FIG. 4, when the handle 1 is operated, the driving sides 2a of the main springs 2 move around the rotating shaft 3a of the handle arm 3. Due to this movement, the load direction of the main springs 2 is changed and the spring pin 5 is caused to move rightward, whereby the lower link 6 moves, the crossbar 7 rotates, and the movable contact point 9 on the movable contact 8 contacts the fixed contact 10, so that the circuit breaker is in the state shown in FIG. 5. Similarly, in FIG. 5, when the handle 1 is operated, the driving sides 2a of the main springs 2 move around the rotating shaft 3a of the handle arm 3. Due to this movement, the load direction of the main springs 2 is changed and the spring pin 5 is caused to move leftward, whereby the lower link 6 moves, the crossbar 7 rotates, and the movable contact point 9 on the movable contact 8 opens and separates from the fixed contact 10, so that the circuit breaker is in the state shown in FIG. 4.

[0017] Further, in this FIG. 5, when an overcurrent or the like is sensed and an unillustrated overcurrent trip device is actuated, the latch 11 moves and disengages from the lever 4. Because the lever 4 is always energized in the clockwise direction by the main springs 2, rotation begins around a lever rotating shaft 4b. Because of this rotation, the driving sides 2a of the main springs 2 relatively move with respect to the spring pin 5, and eventually an upward force begins to work on the spring pin 5 and the lower link 6 moves, whereby the crossbar 7 lifts up and the movable contact point 9 on the movable contact 8 opens and separates from the fixed contact 10, so that the circuit breaker is in the state shown in FIG. 2. It will be noted that the relationships between the parts disposed inside the handle arm 3 are as shown in FIG. 3.

[0018] The handle arm 3 of the circuit breaker pertaining to this invention is shown in FIGS. 6A, 6B and 6C and in exploded view in FIGS. 7A, 7B and 7C. Turning now to FIGS. 6A to 6C and FIGS. 7A to 7C, the handle arm 3 is formed in a substantial U-shape by two side plates 3b and 3c comprising metal plates and by a structural

body that joins together one end (in the drawings, the upper portion) of each of these side plates 3b and 3c. In the present embodiment 1, the structural body comprises a top plate 3d comprising one metal plate and a later-described pin 3e. A tongue piece 3d1 for attachment to the handle 1 is disposed on the front and rear ends of the top plate 3d. Further, retainer portions 3d2 that retain the main springs 2 are disposed in the center portion of the top plate 3d. Additionally, projections 3d3 for joining the top plate 3d to the side plates 3b and 3c are disposed in two places each on each side (four places in total) of the top plate 3d. In this example, the projections 3d3 are disposed in two places each on each side of the top plate 3d, but in terms of the relationship of assembly rigidity, the projections 3d3 may also be disposed in three places each or four places each on each side as long as they are disposed in two places each or more. Because the top plate 3d is one plate, it is manufactured by press working or punch working.

[0019] The two side plates 3b and 3c that are joined together with the top plate 3d comprise substantially rectangular metal plates, and concave portions 3b1 and 3c1 that are supported on the shaft 3a are respectively disposed in the lower portions of the side plates 3b and 3c. Two projection-use holes 3b3 and 3c3 into which the projections 3d3 of the top plate 3d fit are respectively disposed in the upper portions of the side plates 3b and 3c. Further, pin-use holes 3b4 and 3c4 into which the distal ends of the pin 3e are inserted are respectively disposed in the vicinities of projecting portions of rear portions of the side plates 3b and 3c. The pin 3e configures part of the structural body and comprises a metal rod that joins together the side plates 3b and 3c and simultaneously preserves the distance between the side plates 3b and 3c. The projections 3d3 disposed in two places each on each side of the top plate 3d are inserted into the projection-use holes 3b3 and 3c3 in the two side plates 3b and 3c, and the distal ends of the pin 3e are inserted into the pin-use holes 3b4 and 3c4, whereby the side plates 3b and 3c are fixedly attached to the top plate 3d and the pin 3e at these portions. The number of places where each of the side plates 3b and 3c is fixedly attached to the structural body (sometimes called "fixedly attached places") is three: the two places of the projections 3d3 on each side of the top plate 3d and the one place of the pin 3e (six places in total on both sides of the handle arm 3). The number of fixedly attached places is three or more, and the positions where the fixedly attached places are disposed are, from the standpoint of ensuring the rigidity of the handle arm 3, positions that do not line up in a straight line on the side plates.

[0020] These parts which configure the handle arm 3 are shown in the front view of FIG. 7A, the side view of FIG. 7B, and the plan view of FIG. 7C. A method of fixedly attaching the places where the side places 3b and 3c, the top plate 3d and the pin 3e are joined together -- that is, the fixedly attached places -- when assembling the configural parts of the handle arm 3 shown in FIGS. 7A to 7C will now be described. The projections 3d3 of the top plate 3d and the end portions of the pin 3e are inserted into the projection-use holes 3b3 and 3c3 and the pin-use holes 3b4 and 3c4 disposed in the side plates 3b and 3c, and thereafter fixed attachment is performed by caulking to crush in a caulking machine the portions sticking out from the side plates 3b and 3c. Easy and strong fixed attachment is performed by a fixed attachment method resulting from caulking, but the fixed attachment method is not limited to this and may also be a method that welds or adheres the projections 3d3 of the top plate 3d and the end portions of the pin 3e to the side plates 3b and 3c.

[0021] Next, the process of assembling the handle arm 3 and the parts disposed therein when assembling the circuit breaker will be described. FIG. 3 is a diagram showing a state where the inside parts are attached to the handle arm 3, and FIG. 8 is a diagram showing part attachment and the process of assembling the handle arm 3 itself. The assembly process shown in FIG. 8 is called layered assembly where the parts are sequentially superposed and assembled from one side. First, one side of each of the top plate 3d and the pin 3e is combined with the one side plate 3c. Next, one side frame 13 is placed on the side plate 3c while performing alignment. Next, a sub-unit comprising a combination of the spring pin 5, the lower link 6, the upper link 12, the lever 4 and the main springs 2 is superposed and axial alignment of the lever 4 is performed. Next, a frame 13 is placed thereon and frame caulking is performed. As for the frame caulking, plural pins are disposed between the frames 13 and the frames are caulked and fixed together at the shafts of the pins. Finally, the other side plate 3b is fixedly attached to the top plate 3d and the pin 3e, and the top plate 3d and the pin 3e are caulked to complete the handle arm 3. FIG. 3 shows the assembly-completed handle arm 3 with the parts disposed therein.

[0022] In the handle arm 3 configured in this manner, so-called layered assembly, where the inside parts are assembled as a sub-unit and this sub-unit is attached by insertion from a side direction, is possible, and the efficiency with which the circuit breaker may be assembled can be raised. Further, after assembly of the inside parts, each of the side plates 3b and 3c is fixedly attached at three points comprising the two points of the top plate 3d and the width direction positioning pin 3c, so a handle arm whose rigidity is high and which does not deform even when the large load of the main springs 2 acts on the center portion of the top plate 3d can be obtained.

[0023] It will be noted that, by using flat plates having no concavo-convexities for the side plates 3b and 3c, either side plate can be used on both the right and left sides. Further, as shown in FIGS. 12A, 12B and 12C, handle arms corresponding to various widths can be configured simply by changing, in accordance with the specification of the circuit breaker, the width of the top plate and the length of the positioning pin that are the structural body. For this reason, the types of parts and the number

of parts of the handle arm can be reduced.

Embodiment 2

[0024] FIG. 9A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 2 of this invention, FIG. 9B is a side view of the same handle arm, and FIG. 9C is a plan view of the same handle arm. Description of portions shared in common with those of embodiment 1 will be omitted. In this embodiment 2, the structural body that joins together the two side plates 3b and 3c is configured by one top plate 3g. This top plate 3g is configured by one metal plate that is bent in a substantial L shape when seen from the side. Projections 3g1 (two on each side, a total of four on both sides) are disposed on the sides of a horizontal portion that is one portion of the L shape, and projections 3g2 (one on each side, a total of two on both sides) are disposed on the other portion bent in the L shape. That is, the projections in the places where the top plate 3g and the side plates 3b and 3c are fixedly attached together are disposed so as to be dispersed on each portion of the L shape. Projection-use holes 3b3 and 3c3 that correspond to the three projections 3g1 and 3g2 on each side of the top plate 3g are respectively disposed in the two side plates 3b and 3c to which the top plate 3b attaches. Additionally, the projections 3g1 and 3g2 of the top plate 3g are fitted into the corresponding projection-use holes 3b3 and 3c3 in the side plates 3b and 3c, whereby the top plate 3g and the side plates 3b and 3c are integrally assembled. The projections 3g1 and 3g2 are caulked, whereby a substantially U-shaped handle arm is formed. Calling the portions where the projections 3g1 and 3g2 and the projection-use holes 3b3 and 3c3 fit together joined places or fixedly attached places, the top plate 3g and the side plates 3b and 3c are joined together at three fixedly attached places on each side. The number of fixedly attached places is not limited to three on each side; it suffices as long as the number is three on each side. Similar to embodiment 1, the number of fixedly attached places is three or more, and the fixedly attached places are disposed in positions that do not line up in a straight line on the side plates.

[0025] By configuring the handle arm in this manner, there is the same action as in embodiment 1, and additionally the structural body that joins together the side plates suffices with one top plate, so the width direction positioning pin can be dispensed with, parts can be omitted, and the equipment for fixing can be simplified. Further, by using side plates having no concavo-convexities, either side plate can be used on both the right and left sides, and it is possible to further reduce the types of parts. Further, because one of the three fixedly attached places is separated from the top surface (horizontal surface), the effect that the positions in the width direction, or in other words the degree of parallelism between the side plates 3b and 3c, are easy to determine is obtained. Moreover, similar to embodiment 1, handle arms corresponding to various widths can be configured simply by changing, in accordance with the specification of the circuit breaker, the width dimension of the top plate.

Embodiment 3

[0026] FIG. 10A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 3 of this invention, FIG. 10B is a side view of the same handle arm, and FIG. 10C is a plan view of the same handle arm. In this embodiment 3, three pins 3e having the same shape are used as the structural body that joins together the two side plates 3b and 3c. That is, the sites corresponding to the top plate and the pin of the handle arm in embodiment 1 are configured by three pins having the same shape, whereby the same action as in embodiment 1 is preserved and the types of parts can be further reduced.

[0027] To describe in detail excluding points shared in common with embodiment 1, three pin-use holes 3b4 and 3c4 are respectively disposed in the upper portion of each of the two side plates 3b and 3c. Additionally, the side plates 3b and 3c are joined together by three pins 3e that have the same shape and each of whose two distal ends fits together with the pin-use holes 3b4 and 3c4. After the side plates 3b and 3c and the pins 3e have been combined, they are fixedly attached to each other by caulking the distal ends of the pins 3e that project from the side plates 3b and 3c. Similar to embodiment 1, the number of places where the pins 3e and the pin-use holes 3b4 and 3c4 are joined (i.e., fixedly attached) together is three or more, and the fixedly attached places are disposed in positions that do not line up in a straight line on the side plates.

[0028] Thus, a substantially U-shaped handle arm whose rigidity is high can be configured, the rigidity of both of the side plates is ensured by the three pins, and the positions of the side plates in the width direction are determined and maintained. The main springs 2 are locked to the central pin of the three pins 3e. Because the pins 3e have the same shape, the same action as in embodiment 1 is preserved, and the types of parts can be further reduced. It will be noted that contact portions 3f for lever resetting that are bent inward are disposed as needed on the rear portions of the side plates 3b and 3c.

Embodiment 4

[0029] FIG. 11A is a front view showing a handle arm of a circuit breaker pertaining to embodiment 4 of this invention, FIG. 11B is a side view of the same handle arm, and FIG. 11C is a plan view of the same handle arm. In this embodiment 4, a top plate 3cc and a pin 3e are used for the structural body that joins together the two side plates 3b and 3c, but the top plate 3cc extends over the top portion of the one side plate 3c and is bent in an L shape. Two projections 3cc1 are disposed on the

distal end of the top plate 3cc comprising the extension portion that is bent in an L shape, and projection-use holes 3b3 corresponding to these projections 3cc1 are disposed in the other side plate 3b. The side plate 3b is fixedly attached to the top plate 3cc at these places and fixed by caulking. Moreover, similar to embodiment 1, the pin 3e configuring part of the structural body joins together the side plates 3b and 3c. The method of joining together the side plates 3b and 3c and the pin 3e is the same as in embodiment 1, so detailed description thereof will be omitted here. Similar the first embodiment, the number of fixedly attached places is three or more, and the fixedly attached places are dispersed so as to be disposed in the direction of a line interconnecting the power side and the load side of the circuit breaker. It will be noted that contact portions 3f for lever resetting that are bent inward are disposed as needed on the rear portions of the side plates 3b and 3c.

[0030] By configuring the handle arm in this manner, the same action as in embodiment 1 is preserved, the number of parts can be reduced, and time and effort for assembling the circuit breaker can be saved because the top plate and one of the side plates are integrated. Further, the rigidity of the handle arm can be further raised because there are fewer fixedly attached places.

[0031] Various modifications and alterations of this invention will be apparent to those skilled in the art without departing from the scope and spirit of this invention, and it should be understood that this is not limited to the illustrative embodiments set forth herein.

Claims

1. A circuit breaker comprising:

a crossbar (7) that holds a movable contact (8);
a lower link (6) that drives the crossbar;
a lever (4) that engages with a latch (11) of an overcurrent trip device and rotates during tripping of the circuit breaker;
an upper link (12) that is supported on the lever and is joined together with the lower link via a spring pin (5) to configure a toggle link together with the lower link;
main springs (2) whose driven sides are joined together with the spring pin; and
a handle arm (3) that joins together with driving sides of the main springs and is rotatably supported on a frame (13) fixed to a casing (20) of the circuit breaker,
wherein
the handle arm comprises a frame body whose cross section is substantially U-shaped and where one end of each of two side plates (3b, 3c) are joined together by a structural body,
at least one of the side plates is a separate part fixedly attached to the structural body, and
the side plate that is a separate part is fixedly attached to the structural body at three or more positions that do not line up in a straight line on this side plate.

2. The circuit breaker of claim 1, wherein the structural body of the handle arm comprises one top plate (3d) and at least one pin (3e).

3. The circuit breaker of claim 2, wherein the top plate is formed integrally with one of the two side plates.

4. The circuit breaker of claim 1, wherein the structural body of the handle arm comprises one top plate (3g) whose cross section is substantially L-shaped, and the three or more places where the top plate and the side plate are fixedly attached to each other are dispersed on both portions of the L shape.

5. The circuit breaker of claim 1, wherein the structural body of the handle arm comprises at least three pins (3e) that have the same shape.

6. The circuit breaker of any one of claims 1, 2, 4 and 5, wherein the shapes of the two side plates (3b, 3c) of the handle arm are the same.

FIG. 1

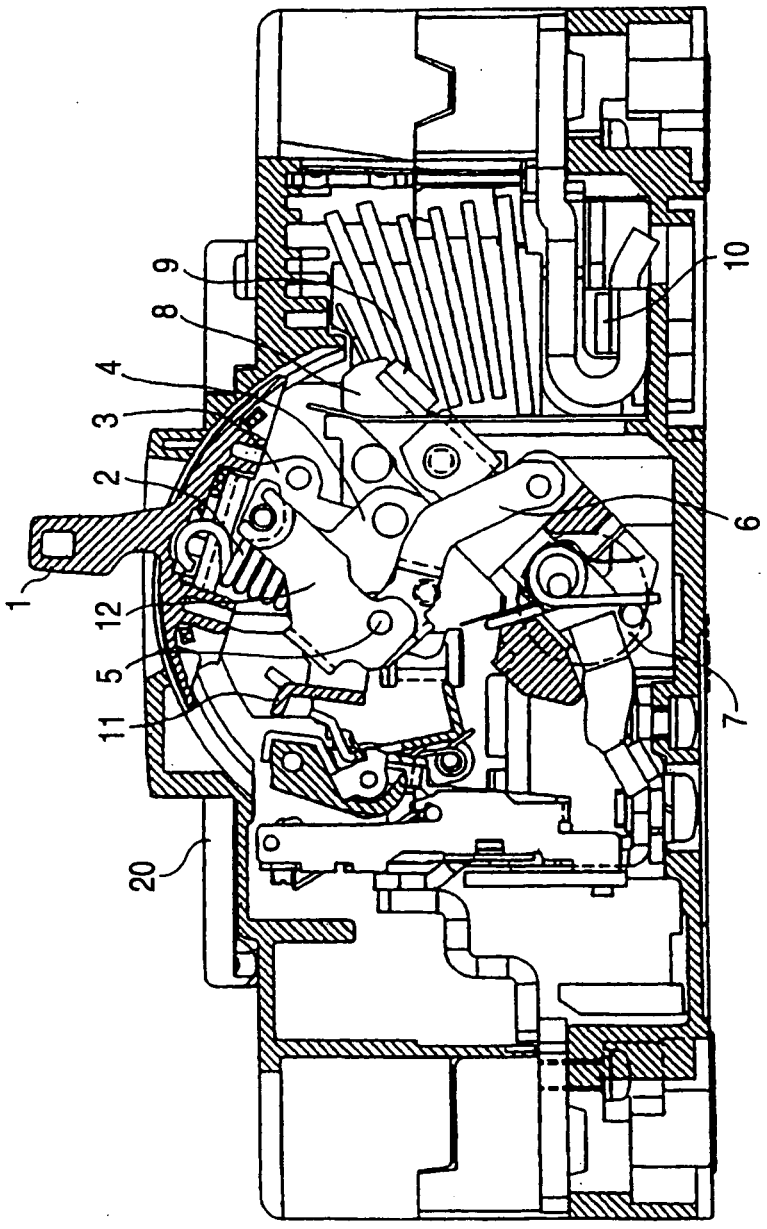


FIG. 2

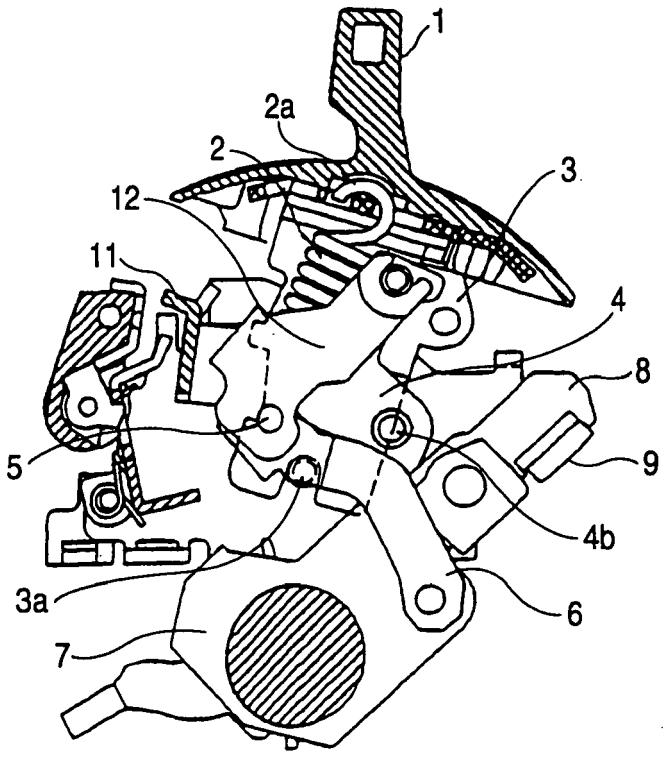


FIG. 3

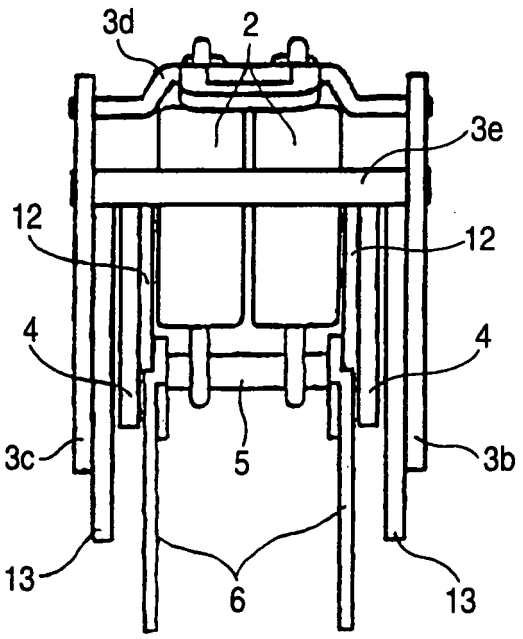


FIG. 4

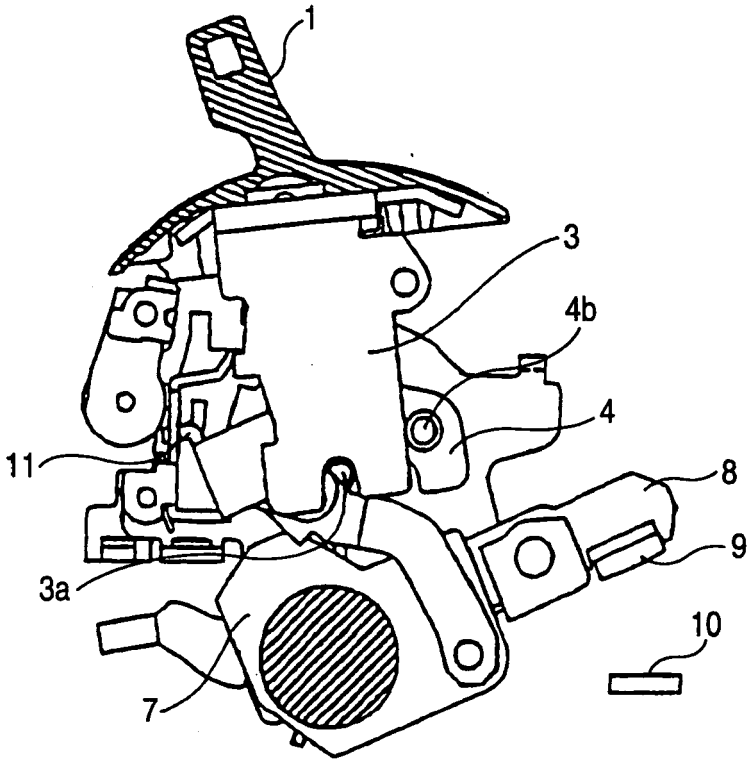


FIG. 5

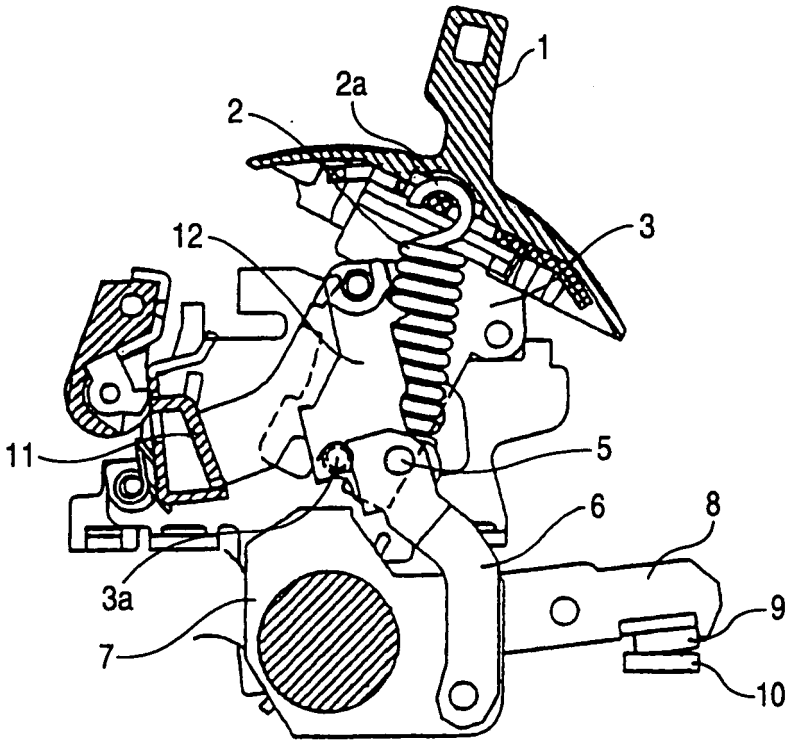


FIG. 6C

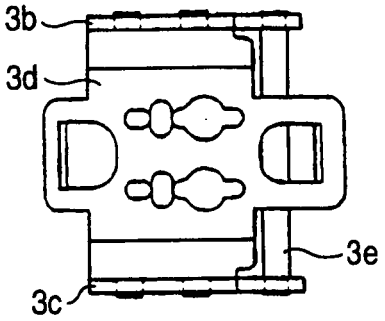


FIG. 6A

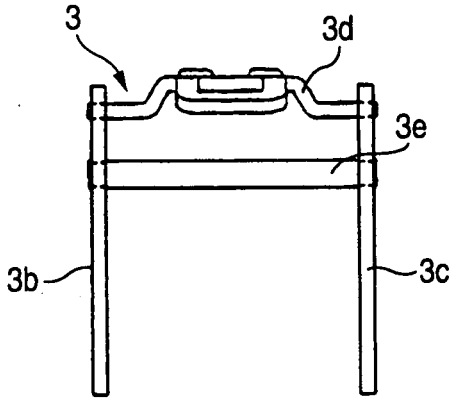


FIG. 6B

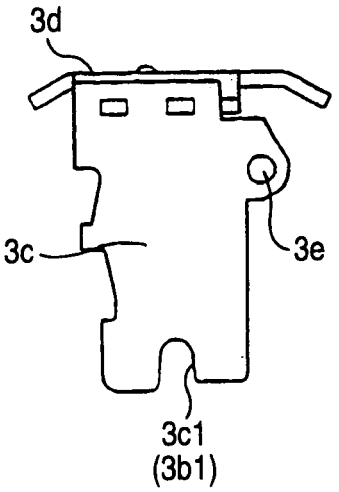


FIG. 7C

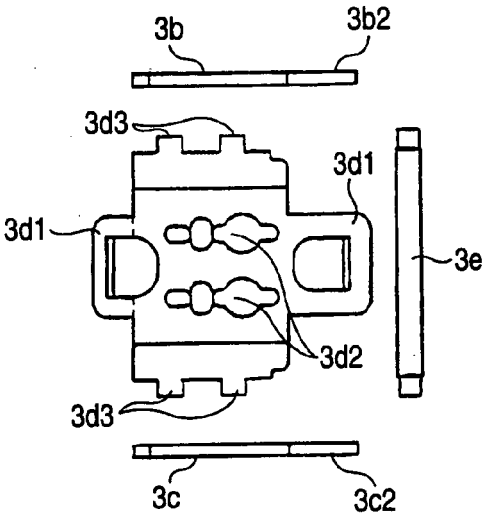


FIG. 7A

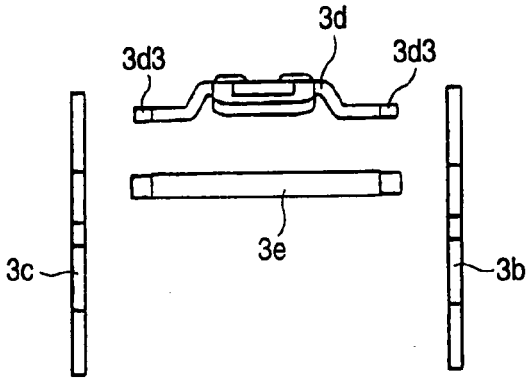


FIG. 7B

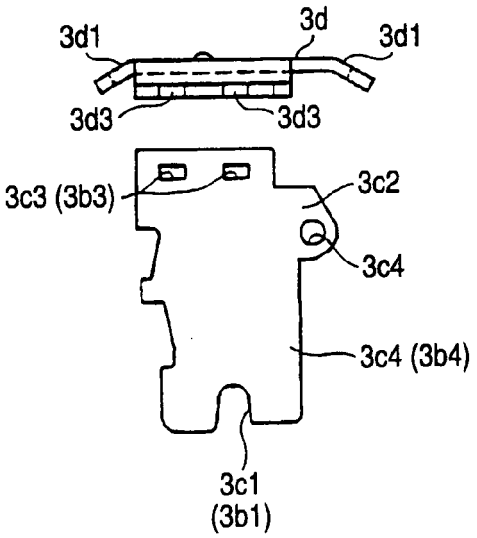


FIG. 8

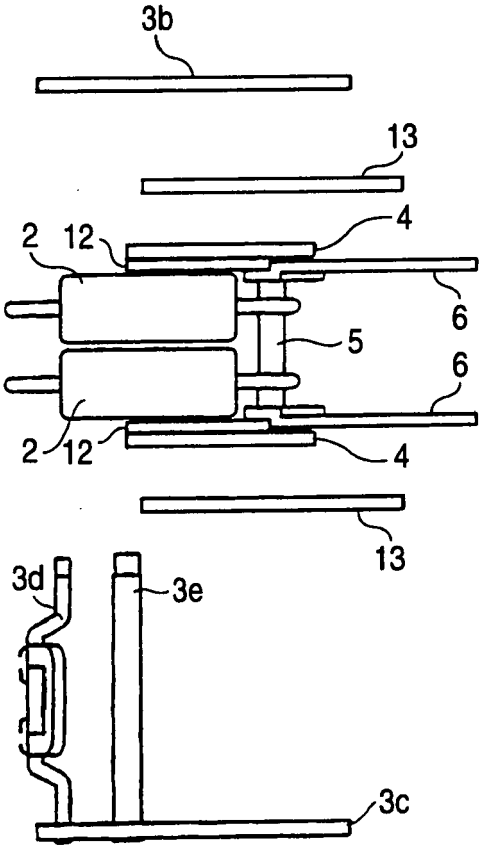


FIG. 9C

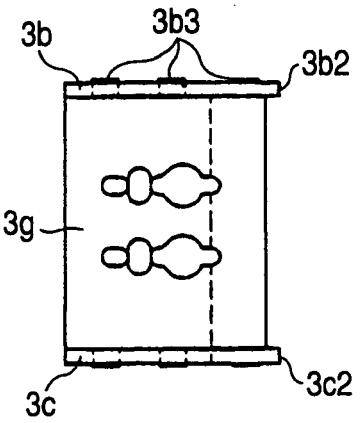


FIG. 9A

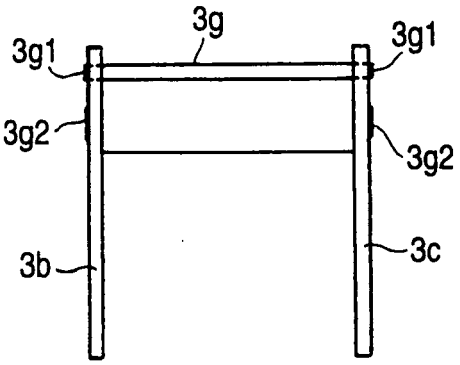


FIG. 9B

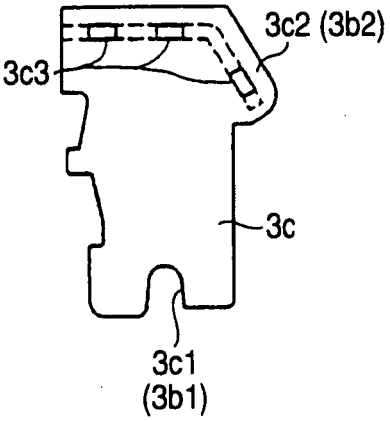


FIG. 10C

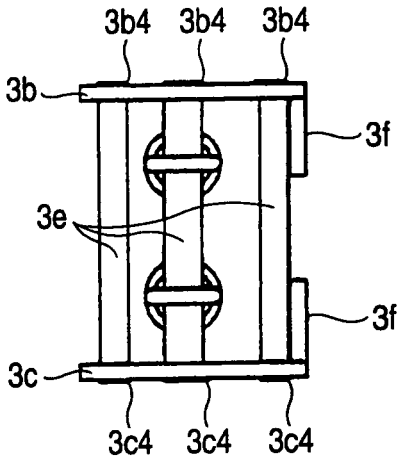


FIG. 10A

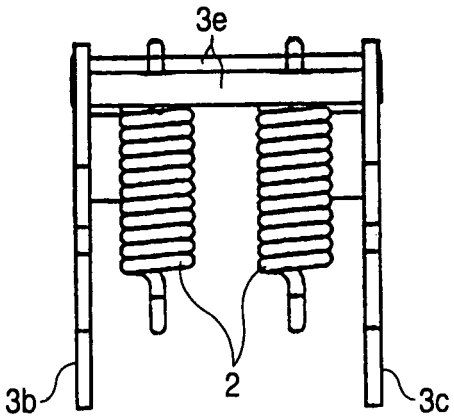


FIG. 10B

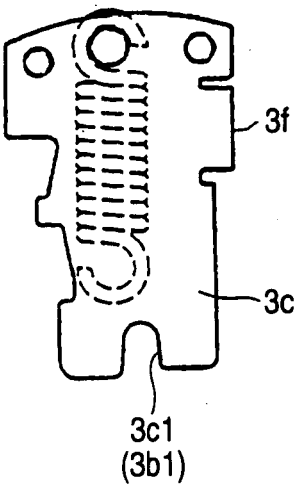


FIG. 11C

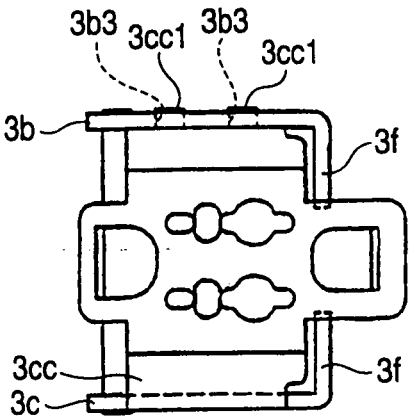


FIG. 11A

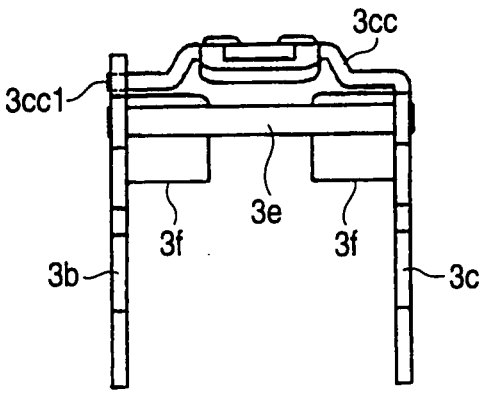


FIG. 11B

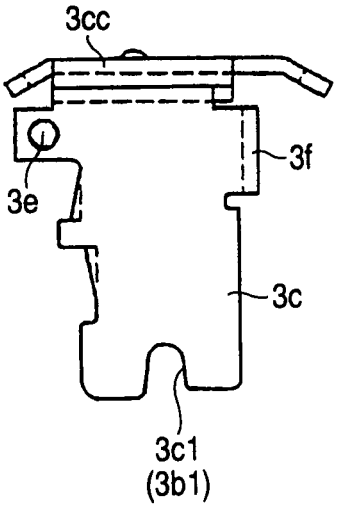


FIG. 12A

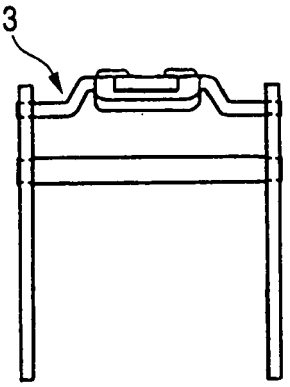


FIG. 12B

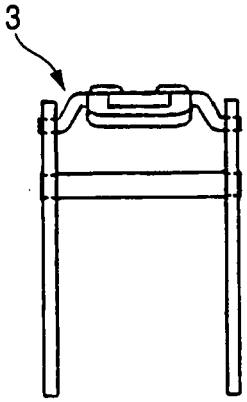
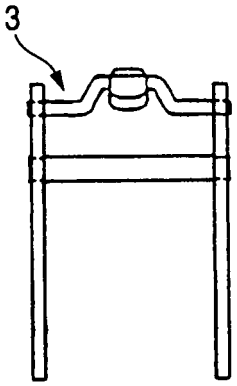


FIG. 12C



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Patent documents cited in the description

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