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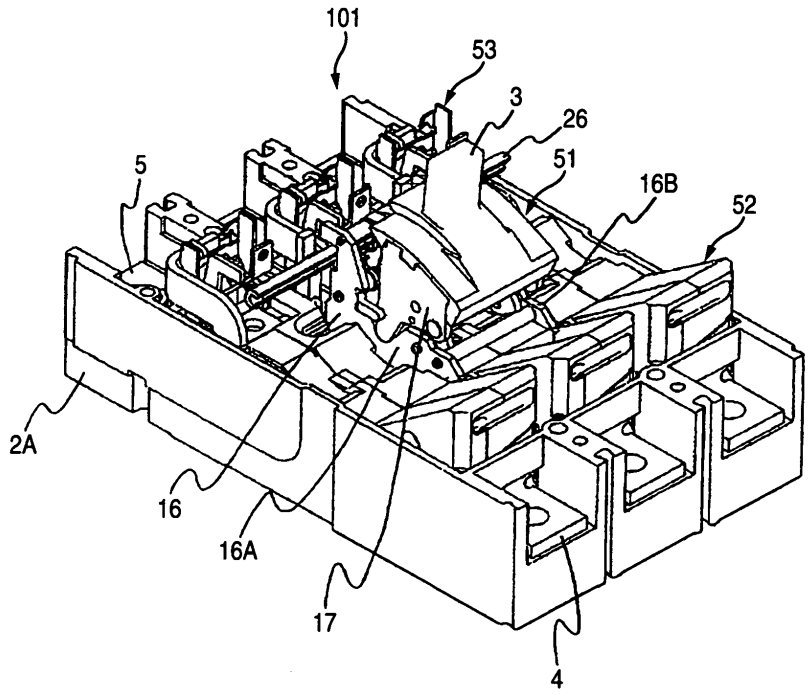
(54) Circuit breaker

(57) A circuit breaker is provided. The circuit breaker includes housing, a frame that is fixed to the housing, and a make and break mechanism. The housing is configured to comprise a double-break unit case having two pairs of the moving contact point and the stationary contact point or a member that is different from the double -break unit case. The frame has a first fixing portion for fixing the make and break mechanism to the double-break unit case and a second fixing portion for fixing the make and break mechanism to the housing in which the member is provided

FIG. 1



EP 2 107 588 A2

Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese Patent Application No. 2008-090586, which was filed on March 31, 2008, the disclosure of which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to a circuit breaker such as a molded case circuit breaker or an earth leakage breaker, and more particularly to standardization of components of a make and break mechanism and unified design on the appearance.

BACKGROUND

[0003] A circuit breaker has not only a function of opening or closing the electric path, namely, a switch function, by operating an operation handle provided for this circuit breaker, but also takes a great role of shutting off the electric path to prevent beforehand burning of an electric wire or a load device due to a flow of over-current. This breaking of the electric path is defined in the range from 1kA to 200kA as a "rated breaking current" in the JIS (Japanese Industrial Standards) C8370, for example, and it is well known that each manufacturer have been filling out the product variations so that the circuit breaker having an adequate rated breaking current can be appropriately selected in accordance with the conditions of the electric path, namely, the distance from a transformer and the thickness of electric wire.

[0004] By the way, at the time of cutout, an arc occurs between so-called one pair of contact points, including the moving contact point and the stationary contact point, but to extinguish this arc rapidly, it is preferable that an arc voltage for maintaining the arc itself is increased. Hence, if one pair of contact points (a so-called single-pole double-break) are provided in two sets, for example, the arc voltage is doubled, and particularly suitable for high breaking capacity products. A specific example of this single-pole double-break is a circuit breaker in which the power and load side contacts plates are arranged in point symmetry with respect to a revolution center of a revolving contacts plate that has tow moving contact points at both ends, and each of the power and load side contacts plates have a stationary contact point paired with one of the moving contact points (e.g., refer to patent document 1).

[Patent document 1] JP-A-10-223115 (45th line in right column of page 2 to first line in left column of page 3, Fig. 1)

SUMMARY

[0005] As shown in Fig. 1 of the patent document 1, a constitutional feature of this single-pole double-break (hereinafter referred to as a rote active type) is that the power side moving contact point (number 3) needs to be parted in the opening direction from the bottom surface of the housing because of the exhaust to the load side (right side, on the paper) at the time of breaking. On the other hand, in the circuit breaker, it is generally required to exert a greater force in the contact point contacting direction than the contact point opening direction to assure the contact reliability between contact points. Herein, the arrangement of the main spring at the greatest space efficiency is in the direction of Fig. 1 (i.e., vertical direction), and the toggle link is composed of the upper link and the lower link (in the almost straight line when in the ON as shown, or substantially L-character when in the OFF, not shown). According to this arrangement, when the make and break mechanism drives the lower link, a lifting force (in the so-called clockwise or OFF direction) from the bottom surface is relatively small, but a greater pushing force (in the so-called counterclockwise or ON direction) can be generated in the direction toward the bottom face.

[0006] However, in the light of the exhaust to the load side and the contact point contacting pressure, this arrangement and constitution have the advantage that the higher reliability can be achieved as the products. On the other hand, the point at which the movable contacts plate (hereinafter referred to as a rotor) is driven by the lower link is located on the power side (left side, on the paper) of the revolution axis of this rotor, whereby the make and break mechanism comprising the lower link is naturally closer to the power side of the circuit breaker, and the operation handle is similarly arranged on the power side.

[0007] If all the circuit breakers are of the rote active type, the "closer to the power side" has almost no problem. However, the rated breaking capacity is diverse, each manufacturer must produce the breaker at the manufacturing cost according to the rated breaking capacity, namely, as the circuit breaker has the lower rated breaking capacity, the manufacturing cost must be cheaper. Though it is unnecessary that all the circuit breakers are single-pole double-break, a wide assortment of so-called single-pole single-breaks having excellent cost performance are provided in the current situation.

[0008] However, this single-pole single-break is also required to improve the breaking performance. As the policy, for example, the opening distance between contact points is secured by making the movable contact as long as possible. Therefore, the crossbar for holding the movable contact has to be closer to the load side, and accordingly the make and break mechanism comprising the operation handle is arranged almost in the center of the circuit breaker.

[0009] As a result, though the single-pole double-break and the single-pole single-break can share the so-called make and break mechanism leading from the operation handle to the lower link, there is complexity that two kinds of accessory units for the operation handle are

provided, and further there was a problem that the user-friendliness was worse due to a difference in the appearance design caused by different positions of the operation handle. Also, if the specific make and break mechanism is provided in accordance with the position of the operation handle, the component standardization is worse, and the cost competitiveness is inevitably lost.

[0010] This invention has been achieved to solve the above-mentioned problems, and it is an object of the invention to provide a circuit breaker of single-pole double-break and single-pole single-break in which the components of a make and breakmechanismare standardized and the position of an operation handle is unified.

[0011] According to an illustrative aspect of the present invention, there is provided a circuit breaker comprising a housing; a frame that is fixed to the housing; a movable contact member that has a moving contact point on at least one end; a stationary contact member that has a stationary contact point contacting with or separating from the moving contact point; a holding member for holding the movable contact member; and a make and break mechanism that comprises: a lower link for driving the holding member; a lever that is engaged with a latch of an over-current tripping device, the lever revolving at the time of tripping the circuit breaker; an upper link that is supported on the lever, the upper link coupled with the lower link via a spring pin, the upper link making up a toggle link together with the lower link; a main spring that is coupled with the spring pin on a driven side of the main spring; and a handle arm that has a substantially U-character shape, the handle arm coupled with the main spring on a driving side of the main spring, the handle arm rotatably supported on the frame; wherein the housing is configured to comprise a double-break unit case having two pairs of the moving contact point and the stationary contact point or a member that is different from the double-break unit case, and wherein the frame has a first fixing portion for fixing the make and break mechanism to the double-break unit case and a second fixing portion for fixing the make and break mechanism to the housing in which the member is provided.

[0012] As described above, the invention can provide a cheap circuit breaker that is user-friendly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Illustrative aspects of the invention will be described in detail with reference to the following figures wherein:

Fig. 1 is an external perspective view showing a single-pole double-break circuit breaker with a cover removed according to an embodiment 1 of the present invention;

Fig. 2 is a side cross-sectional view in a trip state in Fig. 1;

Fig. 3 is a cross-sectional view taken along the line A-A in Fig. 1;

Fig. 4 is a side cross-sectional view in the ON state in Fig. 1;

Fig. 5 is a side cross-sectional view in the OFF state in Fig. 1; and

Fig. 6 is an equivalent view of Fig. 2 showing a single-pole single-break circuit breaker according to the embodiment 1 of the invention.

DETAILED DESCRIPTION OF THE PREFERED EMBODIMENTS

Embodiment 1

[0014] Figs. 1 to 5 show a single-pole double-break circuit breaker according to an embodiment 1 of the present invention. More particularly, Fig. 1 is an external perspective view with a cover removed, Fig. 2 is a side cross-sectional view in a trip state, Fig. 4 is a side cross-sectional view in the ON state and Fig. 5 is a side cross-sectional view in the OFF state. Fig. 3 is a cross-sectional view taken along the line A-A in Fig. 2. Fig. 6 is an equivalent view of Fig. 2 showing a single-pole single-break circuit breaker according to the embodiment 1 of the invention.

[0015] In Fig. 1, an insulation housing of a single-pole double-break circuit breaker 101 for triple-pole comprises a cover 1 (see Fig. 2) and a base 2A. A make and break mechanism 51 having an operation handle 3, a double-break unit case 52 for the number of poles (in this case, triple-pole) and an over-current tripping device 53 are disposed on the base 2A. The operation handle 3 projects out of a handle window hole 1a (see Fig. 2) in the cover 1 to allow an operation in the ON or OFF direction, and a power side terminal 4 and a load side terminal 5 are in the positional relationship between the double-break unit case 52 and the over-current tripping device 53, as well known.

[0016] The double-break unit case 52 is well known, except for a rotor link as will be described later. That is, the double-break unit case has a power side stationary contact member 6 extended from the power side terminal 4 and having a power side stationary contact point 7 at one end, a load side stationary contact member 12 connected via the over-current tripping device 53 to the load side terminal 5 and having a load side stationary contact point 11 at one end, and a movable contact member 9 having the power side and load side moving contact points 8 and 10 contacting with or separating from the power side and load side stationary contacts 7 and 11 at both ends, and held by the rotor 13 of a resin molding, for example, and the arc-extinguishing devices 14 and 15 for extinguishing arc occurring by opening between the power side stationary contact point 7 and the power side moving contact point 8 and between the load side moving contact point 10 and the load side stationary contact point 11, as shown in Fig. 2. The rotor 13 has a contact pressure spring 32 (see Fig. 3) for producing a contact pressure between the contact points 7 and 8 and

between the contact points 10 and 11, and is connected by a connecting rod, not shown, to revolve the movable contact member 9 of each pole in accordance with the operation of the make and break mechanism 51. That is, the side cross-sectional view of Fig. 2 shows a middle pole in the connection with the make and break mechanism 51 that is the main part of the invention.

[0017] Next, the constitution of the make and break mechanism 51 will be described below. The make and break mechanism 51 is a so-called unit composed of a handle arm 17 like U-character shape axially supported for free rotation and an operation handle 3 fixed to the handle arm 17 on a frame 16 formed by a pair of opposed frame plates 16A and 16B, as shown in Fig. 1. Turning back to Fig. 2, the inside of the make and break mechanism 51 is engaged with a latch 18 of the over-current tripping device 53, and comprises a lever 19 axially supported on the frame 16 by a revolution shaft 19a, an upper link 20 axially supported by the lever 19, a lower link 21 coupled via a spring pin 22 with the upper link 20 to make up a toggle link, and a main spring 23 stretched to the spring pin 22 on the driven side 23a (see Fig. 3) and to the handle arm 17 on the drive side 23b (see Fig. 3). Herein, the first point of the invention is that the make and break mechanism 51 as the unit is usable in each of the circuit breaker 101 having the base 2A and the circuit breaker 102 having the base 2B.

[0018] Referring to Figs. 2, 4 and 5, the connection between the make and break mechanism 51 and the double-break unit case 52 in the circuit breaker 101 and its operation will be described below. The make and break mechanism 51 is fixed with the double-break unit case 52 by the first stationary portions 16a1 and 16a2 provided on the frame plate 16A (16B), so that the lower link 21 projecting downward from the frame 16 on the paper is inserted into a revolution hole 52a provided in the double-break unit case 52 and coupled with one end 24a of the rotor link 24. This rotor link 24 has a shape like L-character, with the rotor pin 25 provided in the rotor 13 engaged in a long hole 24b at inflection point. That is, the motion of the lower link 21 is conveyed via the rotor link 24 to the rotor 13. The other end 24c of the rotor link 24, in other words, the power side (right side, on the paper) of the rotor revolution shaft 13a serves as the revolution shaft of the rotor link 24.

[0019] If the operation handle 3 is revolved clockwise on the paper in the OFF state of Fig. 5, the drive side 24b is moved around the revolution shaft 17a of the handle arm 17, as shown in Fig. 4. The load direction of the main spring 23 is changed by this movement to move the spring pin 22 as shown in Fig. 4, so that the lower link 21 is moved to push down the rotor link24. By this pushing down, the rotor 13 is revolved clockwise by the rotor pin 25 to make contact between the contact points 7 and 8 and the contact points 10 and 11, so that the operation handle transits to the so-called ON state, as shown in Fig. 4.

[0020] If the operation handle 3 is revolved counterclockwise this time on the paper in the ON state of Fig. 4, the lower link 21 is moved by moving the spring pin 22 to the left, so that the rotor link 24 is pulled up in the reverse direction as previously described. By this pulling up, the rotor 13 is revolved counterclockwise by the rotor pin 25, opening between the contact points 7 and 8 and between the contact points 10 and 11, so that the operation handle transits to the so-called OFF state, as shown in Fig. 5.

[0021] Also, if the over-current tripping device 53 is activated by sensing an over-current in the ON state of Fig. 4, the latch 18 is revolved by reaction of a trip bar 26 (see Fig. 1), releasing engagement between the latch 18 and the lever 19. Herein, the lever 19 is always urged clockwise on the paper by the main spring 23, and starts to revolve clockwise around the revolution shaft 19a, as well known. By this revolution, the drive side 23b is moved relatively to the spring pin 22, and finally an upper force begins to act on the spring pin 22, so that the lower link 21 is moved. Following the motion of the lower link 21, the operation handle transits from ON to OFF as previously described, and is put in a so-called trip state, as shown in Fig. 2.

[0022] In this manner, the motion of the lower link 21 is transmitted to the rotor link 24, and the rotor 13 is revolved by this rotor link 24, whereby there is the following feature. That is, conversely to patent document 1, a rotor drive end (corresponding to one end 24a of the rotor link 24) of the lower link 21 is on the load side (left side on the paper of Fig. 2) of the revolution shaft 13a of the rotor 13, and in addition, the point of application (corresponding to the position of the rotor pin 25) of the rotor link 13 is on the power side (right side on the paper) of the revolution shaft 13a. By this constitution, the point of application is closer to the supporting point (corresponding to the position of the other end 24c) than the point of force (corresponding to the position of one end 24a), which produces a greater driving force, more particularly, multiplied by L2/L1, where L1 and L2 are distances as shown in Fig. 4, than the rotor link 24 is not provided, whereby improving the contact reliability of contact points. And, by changing the position of the rotor pin 25, a subsidiary effect that the adjustment of the load required for contact between the contact points or the adjustment for opening distance between the contact points can be made relatively easily.

[0023] Subsequently, the second point of the invention will be describedbelow. The make and break mechanism 51 as described above can be also employed in a single-pole single-break circuit breaker 102 for triple poles, as shown in Fig. 6. At this time, the coupling between the make and break mechanism 51 and the double-break unit case 52 is contrived as previously described. That is, stating repeatedly, the rotor link 24 is interposed between the lower link 21 and the rotor 13, and the make and break mechanism 51 is disposed on the load side of the rotor 13, more particularly, in the almost center of the circuit breaker 101, as will be apparent from Fig. 2, where-

by it is possible to secure the sufficient opening distance between the contact points, even if the make and break mechanism is applied to the single-pole single-break circuit breaker 102 with the position of the make and break mechanism 51 unchanged, as shown in Fig. 6. Thus, the second point of the invention is that the frame plate 16A (16B) is provided with the second stationary portion 16b press-fitted into a concave portion, not shown, of the base 2B having a suitable shape for accommodating the components (stationary contact member 27, movable contact member 28, crossbar 29, movable member receptacle 30, arc-extinguishing device 31 and so on), fixing the make and break mechanism 51 on the base 2B, and coupling the lower link 21 with the crossbar 29, whereby the single-pole single-break circuit breaker 102 different from the single-pole double-break circuit breaker 101 can be formed. One series of operations of the single-pole single-break circuit breaker 102 are well known, and not described here in detail.

[0024] However, the aspect of the invention is that the make and break mechanism is shared between double-break and single-break, and the position of the make and break mechanism and the position of the operation handle for both circuit breakers 101 and 102 are unified by taking such policies that the stationary portions are provided commonly on the frame 16 as an outer hull, and the rotor link 24 is interposed in the double-break unit case. As a result, the component standardization is achieved, apparent incompatibility when both the circuit breakers 101 and 102 are arranged in parallel is resolved, and, for example, further a handle member and an electric operation unit for the operation handle 3 can be shared, whereby the circuit breaker that is user-friendly and has excellent cost performance can be provided to the user. Though the circuit breaker has been described above, the invention may be naturally applied to all the breakers of this type, and various variations may be made without departing from the scope of the invention.

Claims

1. A circuit breaker comprising:

a housing;
a frame that is fixed to the housing;
a movable contact member that has a moving contact point on at least one end;
a stationary contact member that has a stationary contact point contacting with or separating from the moving contact point;
a holding member for holding the movable contact member; and
a make and break mechanism that comprises:

a lower link for driving the holding member;
a lever that is engaged with a latch of an over-current tripping device, the lever revolving at the time of tripping the circuit breaker;
an upper link that is supported on the lever, the upper link coupled with the lower link via a spring pin, the upper link making up a toggle link together with the lower link;
a main spring that is coupled with the spring pin on a driven side of the main spring; and
a handle arm that has a substantially U-character shape, the handle arm coupled with the main spring on a driving side of the main spring, the handle arm rotatably supported on the frame;

wherein
the housing is configured to comprise a double-break unit case having two pairs of the moving contact point and the stationary contact point or a member that is different from the double -break unit case,
and wherein
the frame has a first fixing portion for fixing the make and break mechanism to the double-break unit case and a second fixing portion for fixing the make and break mechanism to the housing in which the member is provided.

2. The circuit breaker according to claim 1, further comprising,
a rotor link,
wherein the movable contact member, the stationary contact member and the holding member are accommodated within the double-break unit case,
and wherein
the holding member is a rotor, and the rotor is coupled with the lower link via the rotor link.

3. The circuit breaker according to claim 1 or 2,
wherein when the housing comprises the member therein, the holding member is a crossbar.

FIG. 1

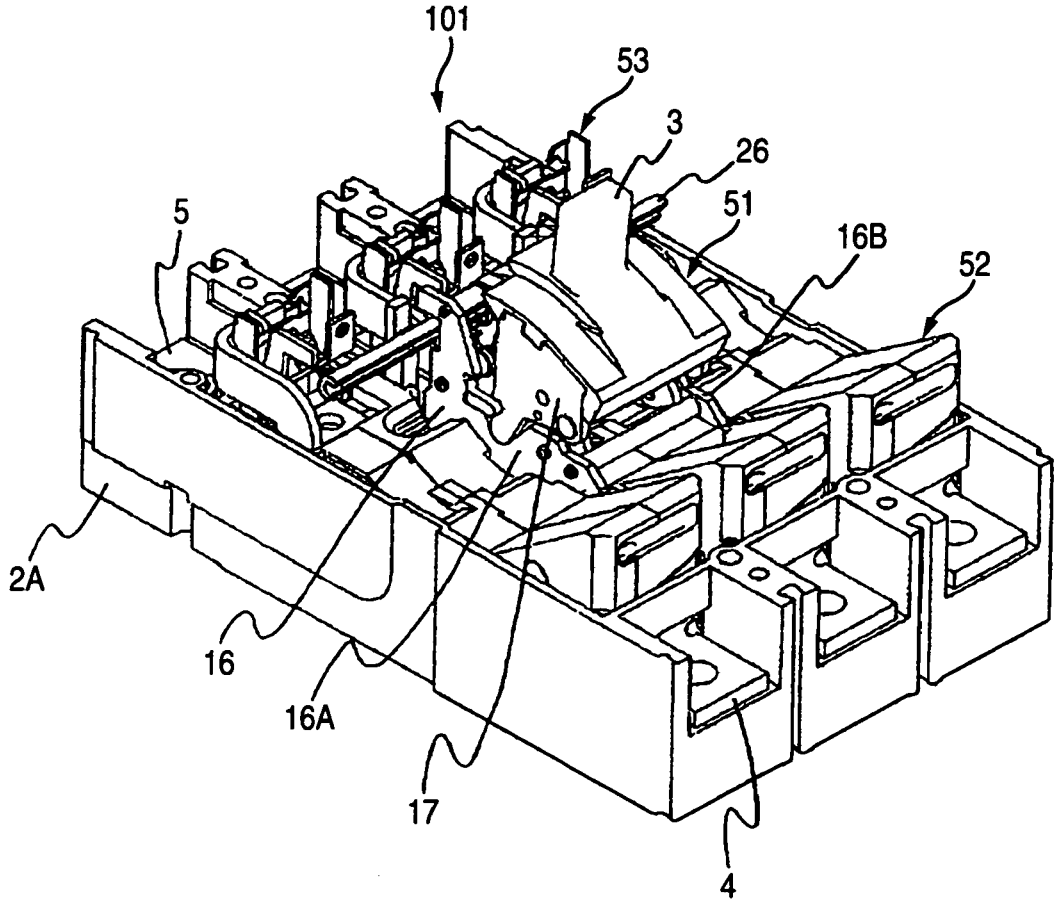
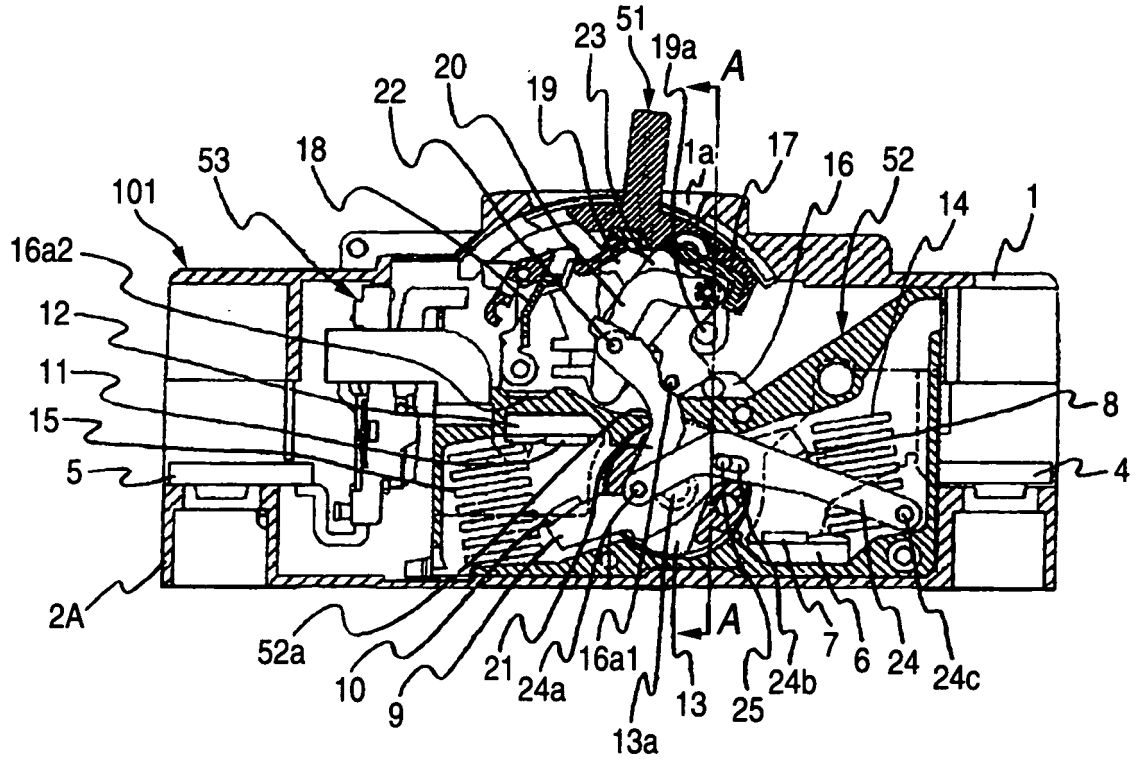


FIG. 2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8
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24b
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24c

FIG. 3

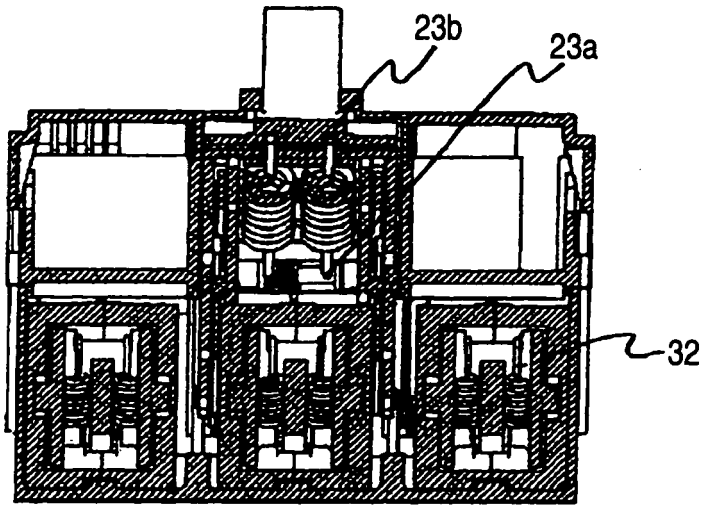


FIG. 4

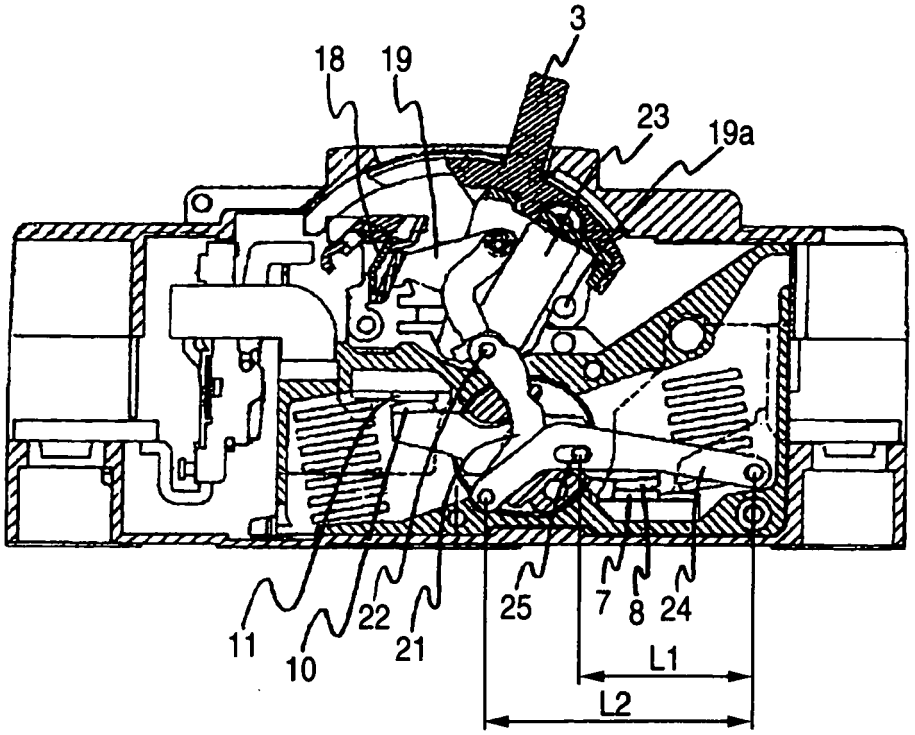


FIG. 5

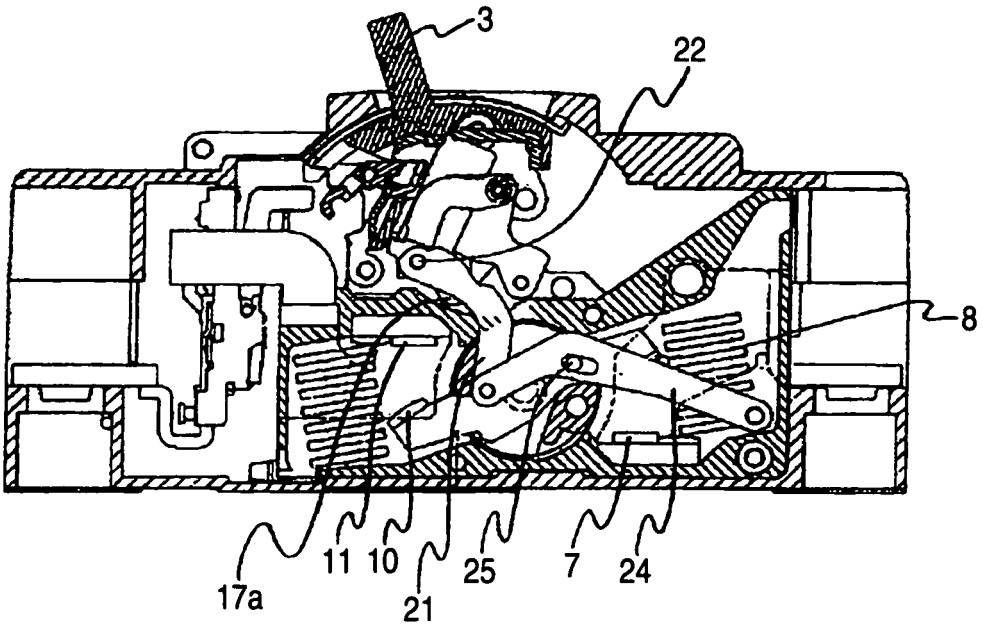
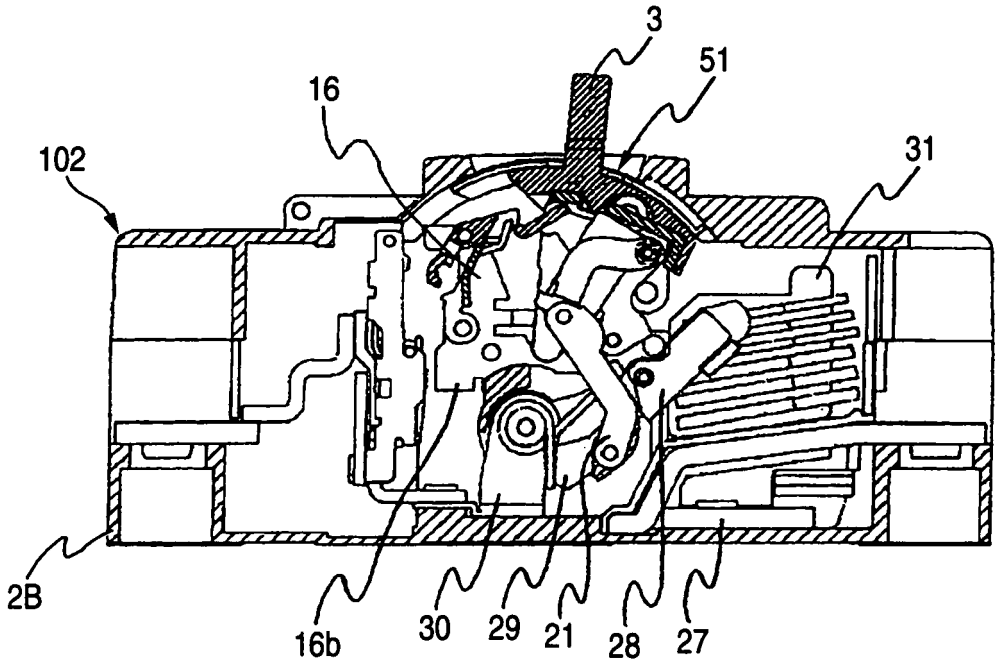


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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- JP 10223115 A **[0004]**