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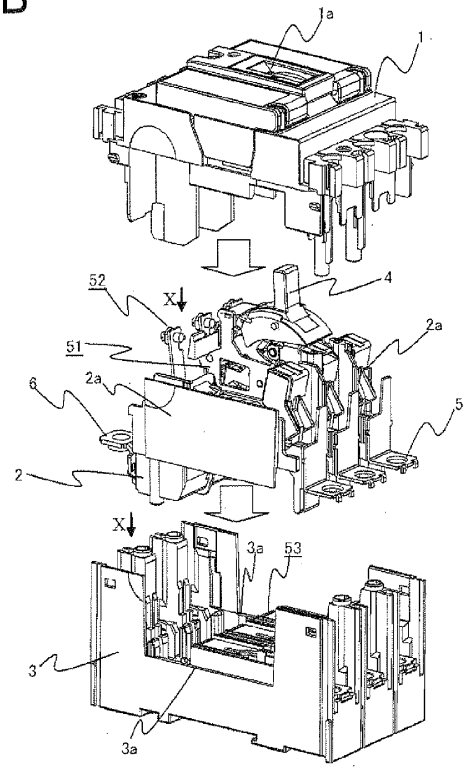
(54) Circuit breaker

(57) A circuit breaker that includes an overcurrent release device, adapted for automatic assembly, with a thermal electromagnetic trip unit is provided which prevents a metallic melt produced by a short circuit interruption from adhering to an opening and closing mechanism or the overcurrent release device. The circuit breaker comprises a middle housing (2), a lower housing and an upper housing; the middle housing (2) accommodates an opening and closing mechanism (51), and an overcurrent release device (52) that detects an overcurrent, to cause the opening and closing mechanism (51) to move pivotally; the lower housing (3) accommodates a circuit interrupting mechanism including an arc extinguisher that interrupts an arc generated between a movable contact arm (13) provided to a crossbar (12) that moves pivotally in an interlocking relation with the opening and closing mechanism (51) and a stationary contact arm (9) that repeats making contact with and moving apart from the movable contact arm (13); and the upper housing covers the middle housing (2), the lower housing and components accommodated within the middle housing (2); wherein the circuit interrupting mechanism (51) is covered by the middle housing (2), and the overcurrent release device (52) is accommodated in the middle housing (2) by press-fitting the release device (52).

FIG.1B



EP 2 339 605 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to circuit breakers such as molded-case circuit breakers and earth-leakage circuit breakers, and more particularly, to a component configuration in which an overcurrent release device or the like is disposed so as to be adapted for automatic assembly.

BACKGROUND OF THE INVENTION

[0002] A circuit breaker not only has a function to open/close an electrical path by moving an operating handle provided in the circuit breaker—i.e., a switching function-but also plays an important role in interrupting the electrical path in order to prevent burning of an electrical wire or a load device due to overcurrent. In terms of detection of the overcurrent, the circuit breaker is broadly classified into three types: thermal, electromagnetic and electronic circuit breakers, as is known in the art. Of these types, the electronic circuit breaker is used to arithmetically process a signal—derived from a current transformer equipped within a circuit breaker—using a CPU also equipped therewithin. Thus, a rated current of the electronic detection circuit breaker can easily be varied by externally applying a set-up signal to the CPU. This effectively works, particularly in providing protection coordination with a load device, e.g., an electric motor requiring a starting current, as is also known in the art. Typically, a so-called unitized overcurrent release device is used for this case, which thus provides an advantage in relatively easily achieving automatic assembly of the associated circuit breaker (refer to, for instance, Japanese Unexamined Patent Application No. H09-270225 (page 3, line 26 in the right column to page 4, line 4 in the left column; and FIGS. 3 and 8), which is hereinafter called Patent document 1).

[0003] On the other hand, the price of the electronic breaker inevitably increases because of the necessity of providing electronic circuit components including the foregoing current transformer and CPU. Thus, there is a great difference in price between the electronic breaker and a thermal trip circuit breaker or a thermal electromagnetic circuit breaker, particularly for breakers each having a smaller AF (more specifically, 63 AF, 125 AF, etc., where AF stands for ampere frame rating, representing the maximum current-carrying capacity of a circuit breaker). This is one of the reasons that thermal electromagnetic circuit breakers are widely used. In consideration of bending of a bimetal due to heat or movement of a movable core due to electromagnetic force, it is preferable that the overcurrent release device in this case be firmly fixed to an electrical path, i.e., a housing that constitutes the circuit breaker (refer to, for instance, Japanese Unexamined Patent Application No. 2006-236798 (page 4, line 18 to line 24, and FIGS. 1 and 2), which is hereinafter called Patent document 2).

[0004] Although "detection of overcurrent," described thus far, refers to the detection of a relatively small amount of current—which, of course, is a large amount of current in comparison with a rated current—needless to say, the overcurrent includes a large amount of current such as a short circuit current, and this overcurrent interruption, i.e., short circuit interruption is also performed by means of the circuit breaker. In terms of the short circuit interruption, with increased power capacity requirement, various manufacturers in the art obviously compete to develop circuit breakers with a larger current interruption capability. In particular, because circuit breakers for use in home application and the like are small in outer dimension, how to reduce the short circuit current, i.e., how to enhance current limiting performance is an important issue in order to improve a current interruption capability. An exemplary way to enhance this current limiting includes increasing the speed of contact opening movement by directly transmitting to a movable contact arm the movement of a movable core due to electromagnetic force that is created during a time when the short circuit current is carried through an electrical path. Further, a circuit breaker using "an arc commutation-based circuit interruption technology" in which an arc created between a movable contact and a stationary contact is rapidly guided to the arc extinguisher, is well known in the art (refer to, for instance, Japanese Unexamined Utility Model Application Publication No. S56-135649 (page 12 line 19 to page 14 line 24, and FIGS. 5 through 7), which is hereinafter called Patent document 3).

[0005] In the circuit breaker in Patent document 3, a so-called partition (on the drawing of FIG. 3) between an arc extinguisher and an operating mechanism corresponds to only an arc runner located above the arc extinguisher, and its hermeticity (airtightness) is not so good. Thus, it is recognized as a problem that a metallic melt produced by the short circuit interruption is adhered to the opening and closing mechanism and the like, and that a reduction in insulation occurs resulting from an arc gas entering the mechanism and the like. On the other hand, because a short circuit sensor and a bimetal device are provided on a supporting frame that forms the operating mechanism, the uniform characteristic can be obtained; however, this configuration is not intended for automatic assembly, which can obviously have a detrimental effect on the cost reduction of circuit breakers. Further, difficulties are expected in dealing with the adjustment error or misfabrication.

[0006] In consideration of only the hermeticity (airtightness) during a short circuit interruption, a circuit breaker in Patent document 2 provides one solution to such problems. However, in this situation, because it is required that a middle cover serve as a shield between the overcurrent release device and the arc extinguisher, the overcurrent release device necessarily needs to be screw-secured to a lower case, thus also causing difficulties in the automatic assembly. Even so, relying on an electronic

overcurrent release device only for the automatic assembly does not provide a practical solution or approach, as previously mentioned.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to overcome the above problems, and an object thereof is to provide a circuit breaker that includes an overcurrent release device, adapted for automatic assembly, with a thermal electromagnetic trip unit, the circuit breaker preventing a metallic melt produced by a short circuit interruption from adhering to an opening and closing mechanism or the overcurrent release device.

[0008] A circuit breaker according to the present invention comprises a middle housing that accommodates an opening and closing mechanism having an operating handle, disposed between opposing frame plates, and an overcurrent release device that detects an overcurrent, to cause the opening and closing mechanism to move pivotally; a lower housing that accommodates a circuit interrupting mechanism including an arc extinguisher that interrupts an arc generated between a movable contact arm provided to a crossbar that moves pivotally in an interlocking relation with the opening and closing mechanism and a stationary contact arm that repeats making contact with and moving apart from the movable contact arm; and an upper housing that covers the middle housing, the lower housing and components accommodated within the middle housing; wherein the circuit interrupting mechanism is covered by the middle housing, and the overcurrent release device is accommodated in the middle housing by press-fitting the release device.

[0009] As described above, according to the present invention, a circuit breaker with a high current interruption capacity can be provided which achieves low productive cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an outline perspective view of a circuit breaker and an exploded perspective view of housings according to Embodiment 1 of the present invention;

FIG. 2 is an exploded perspective view illustrating a middle housing, including accommodated components, of the circuit breaker in FIG. 1;

FIG. 3 is an exploded perspective view illustrating an overcurrent release device in FIG. 1;

FIG. 4 is a set of a plan view illustrating the middle housing, a partial enlarged view of the plan view and a cross-sectional view taken along arrows shown in the partial enlarged view;

FIG. 5 is a set of a plan view illustrating a lower housing shown in FIG. 1, a partial enlarged view of the plan view and a cross-sectional view taken along arrows shown in the partial enlarged view;

FIG. 6 is a set of a cross-sectional view with the lower housing being fitted to the middle housing, in FIG. 1 and a partial enlarged view of the cross-sectional view; and

FIG. 7 is a set of a perspective view illustrating a circuit interrupting mechanism in FIG. 1 and an exploded perspective view showing arc-related parts constituting the circuit interrupting mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

[0011] FIG. 1 shows perspective views with a circuit breaker being tripped open according to Embodiment 1 of the present invention; FIG. 1A shows a housing outline, and FIG. 1B depicts exploded views of an upper housing, a middle housing and a lower housing, from the housing assembly as shown in FIG. 1A. Next, FIG. 2 is an exploded perspective view illustrating parts/components accommodated in the middle housing; FIG. 3 is an exploded perspective view illustrating an overcurrent release device and a yoke for one single pole derived from those shown in FIG. 2. Furthermore, FIGS. 4 and 5 show the middle housing and the lower housing, respectively. FIGS. 4A and 5A show plan views corresponding to views as viewed in the direction of arrow *X* in FIG. 1B. FIGS. 4B and 5B show cross-sectional views. FIG. 6 shows cross-sectional views (which correspond to those of FIGS. 4B and 5B) with the lower housing being fitted to the middle housing. FIG. 7 is a perspective view illustrating parts/components accommodated in the lower housing.

[0012] Referring to FIG. 1, an insulated housing for a three-pole circuit breaker 101 is constituted with an upper housing 1, a middle housing 2 and a lower housing 3. Of these housings, the middle housing 2 accommodates an opening and closing mechanism 51 including an operating handle 4 and overcurrent release devices 52 for respective poles (a total of three poles in this case); the lower housing 3 accommodates arc extinguishers 53 also for respective poles. Note that only one pole structure will basically be described hereinafter because the structure of the three-pole circuit breaker is the same for each pole. In the middle housing 2 among theses housings, side plates 2a of the middle housing 2 are fitted into recesses 3a of side portions (not numbered) of the lower housing 3 in order to prevent damages due to a rise of an inner pressure resulted from an arc produced during the current interruption. Consequently, the side plates 2a form a part of the insulated housing. Because the operating handle 4 protrudes through an aperture 1a for a handle in the upper housing 1, it can be moved in the ON direction (clockwise direction on the drawing of FIG. 1) or in the OFF direction (counter-clockwise direction on the drawing of FIG.1), as is known in the art; the arrangement of the arc extinguishers 53 shows that numerals 5

and 6 denote a power source terminal and a load terminal, respectively, as is also known in the art.

[0013] FIG. 2 shows a yoke 7 that serves as a chief part of the invention and is a part constituting the overcurrent release device 52. Components other than this device—i.e., the opening and closing mechanism 51, the overcurrent release device 52 without the yoke 7, and the arc extinguisher 53 (refer to FIG. 1B)—are also known in the art. Namely, a stationary contact arm 9 has a stationary contact 8 on its outer side and is fixed to a yoke 7; a movable contact arm 13 is connected to a power source terminal 5 via a flexible copper strand 10 and has a movable contact 11 on its end portion, the movable contact arm 13 being provided to a crossbar 12 that moves pivotally in an interlocking relation with the opening and closing mechanism 51. The stationary contact arm 9 repeats making contact with and moving apart from the movable contact arm 13. The arc extinguisher 53 interrupts an arc generated—due to the contact arms particularly moving apart from each other—between the stationary contact 8 and the movable contact 13.

[0014] The opening and closing mechanism 51 is unitized with a handle arm 15 that is pivotably supported by means of a frame 14 formed by a pair of opposing frame plates 14A and 14B, the operating handle 4 fixed to the handle arm 15, a trip bar 16 and a latch 17 that are also pivotably supported by the frame 14 and pivotally moved by the movement of the overcurrent release device 52 as will be described later, and a crossbar 12 that is interlocked with a toggle link mechanism (not numbered) actuated by a pivotal movement of the latch 17 and that is similarly pivotably supported by the frame 14 and moved pivotally. The frame plate 14A (14B) includes feet 14A1 (a foot corresponding to the plate 14B is not shown nor numbered) and 14A2 (a foot corresponding to the plate 14B is shown but not numbered) in its front and rear portions, i.e., located toward its power source and the load, respectively. By inserting these feet 14A1 and 14A2 in insert holes 2b (refer to FIG. 4A) provided in the middle housing 2, the opening and closing mechanism 51 is fixed in place within the insulated housing. Here, because details of the toggle link mechanism—i.e., a manual operation (from on to off or vice versa) of the circuit breaker 101, a trip operation thereof, or a reset operation thereof after tripping —do not relate to the essence of the invention, further detailed descriptions of such operations are not provided herein.

[0015] As shown in FIG. 3, in terms of the electric current path, the overcurrent release device 52 is configured with the stationary contact arm 9 having the stationary contact 8 on its one side, a coil 18 electrically connected (hereinafter simply called "connected") to the stationary contact arm 9, a relay terminal 19 connected to the coil 18, a bimetal 20 connected to the relay terminal 19, a flexible copper strand 21 (also refer to FIG. 2) connected to a given place for obtaining a desired amount of bend of the bimetal 20 due to heat generated from the bimetal 20, and a load terminal 6 connected to the flexible copper strand 21. Further, in order to make the best use of electromagnetic force in the coil 18, the overcurrent release device 52 is configured with a stationary core 22 fixed to the stationary contact arm 9 together with the yoke 7, an insulted pipe 23 that covers the stationary core 22 and is located within an inner cylindrical space of the coil 18, and a movable core 24 that is located within the inner cylindrical space of the insulted pipe 23 and moves against the biasing force of a biasing spring, not shown. Namely, the overcurrent release device 52 is a thermal electromagnetic one in which the relay terminal 19, the bimetal 20 and flexible copper strand 21 constitute a thermal element, while the yoke 7, the coil 18, the stationary core 22, the insulated pipe 23, the biasing spring and the movable core 24 constitute an electromagnetic element.

[0016] As previously described, the operation of the overcurrent release device 52 is known in the art; that is, when an overload current flows through a circuit breaker for a predetermined period of time or more, the bimetal 20 bends in the right direction on the drawing, so that an adjustment screw 20a causes the trip bar 16 to move pivotally. This pivotal movement causes the latch 17 abutting the trip bar 16 to move pivotally, which in turn causes the opening and closing mechanism 51 to trip, thereby causing the movable contact arm 13 to move apart from the stationary contact arm 9. On the other hand, when a short circuit current flows through the circuit breaker, a large amount of magnetic force is generated in the coil 18, and the movable core 24 moves in the right direction against the biasing force of the spring, thereby causing the latch 17 to directly move pivotally and in turn the opening and closing mechanism 51 to trip in a like manner. Here, the overcurrent release device 52 is accommodated in the insulated housing by fitting the load terminal 6 in the lower housing 3, and the yoke 7 and the relay terminal 19 in the middle housing 2. The essence of the present invention lies in the way of fitting the yoke 7 in the middle housing 2; thus, it will be described below in detail.

[0017] The foregoing relay terminal 19 and load terminal 6 plus the power source terminal 5 act as relay points in the electric current path. In that sense, they need only to be inserted in an insert hole 2c (for the relay terminal 19), an insert recess 3b (for the load terminal 6), and an insert recess 3c (for the power source terminal 5), which are shown in FIGS. 4 and 5, and particularly, both the terminals 5 and 6 do not need to be so firmly fixed. On the other hand, when taking into consideration that the yoke 7 includes a movable component corresponding to the movable core 24 and that there exists the bimetal 20 that is mechanically coupled to the yoke 7 (via the stationary contact arm 9, the coil 18 and the relay terminal 19), the yoke 7 needs to be firmly fixed by insertion because movement of the movable core 24 and bending of the bimetal 20 influence the current characteristic of the circuit breaker 101.

[0018] Thus, in the invention, two bent portions 7a are provided to the yoke 7, and also two second holes 2e to

which the bent portions 7a are fitted are formed in the middle housing 2. The dimensional relationship between the bent portions 7a and the second holes 2e will be described in more detail: an inner dimension B between partitions of the middle housing 2 at portions to which the yoke 7 is inserted is made slightly narrower than an outer dimension **A** including the bent portions 7a (so that **A** > **B**). On the other hand, an inner dimension ***C*** between partitions at a portion of each of the second holes 2e is made equal to the outer dimension ***A*** (i.e., ***A*** = ***C***) and further, an area of the inner dimension ***C*** is made aligned to a surface area ***D*** of each of the bent portions 7a. By thus doing so, when the yoke 7 is inserted, the partitions formed with a thermoplastic resin slightly extend outwardly from each other. When the outer dimension ***A*** between the bent portions 7a reaches the inner dimension ***C***, the partitions that have extended outwardly return to their original positions, thereby blocking free movements of the bent portions 7a. Namely, coupled with the fact that the overcurrent release device 52 is fixed to at least one pole, the overcurrent release device 52, once inserted, is hard to draw out from the housing; in other words, this means that the overcurrent release device 52 is firmly fixed to the given position, which in turn contributes to provide a uniform current characteristic.

[0019] In this way, the overcurrent release device 52 does not need to be screw-secured or otherwise fixed to the insulated housing. As is apparent from FIGS. 1A and 2, the circuit breaker 101 is formed by stacking up each of the components from the upper portion on the drawing, thus allowing the automatic assembly and thereby allowing reduction in fabrication costs. Here, in manufacturing the mold of the middle housing 2, the second holes 2e are made as through-holes; however, the type of the holes is not limited to this, but the holes may be non-through holes as long as the yoke 7 will not move freely.

[0020] When taking costs for fabrication of the mold into consideration, however, it is more preferable that through-holes be made. In the meantime, placed under a portion of the middle housing 2 to which the overcurrent release device 52 is fixed is an arc extinguisher 53, as shown also in FIG. 1B. On the other hand, the second holes 2e are not fully blocked by the bent portions 7a, albeit blocked to some extent thereby. Thus, arc gas having generated within the arc extinguisher 53 during the short circuit interruption is expected to reach the opening and closing mechanism 51 through the second holes 2e, which is not so favorable. To this end, in Embodiment 1, protrusions 3e are provided in portions—including the positions of the second holes 2e—of the lower housing 3 in the direction from the power source terminal to the load terminal (refer to FIG. 5B). As is apparent from FIG. 6, this causes the protrusions 3e to fully block the second holes 2e, thus allowing enhancement of, particularly, the interruption performance. And yet, the protrusions 3e are in advance provided in order to assure the insulation between the poles, particularly, the surface distance. Consequently, achieving the automatic assembly, uniform characteristic, and enhancement of the interruption performance, as described thus far, does not involve increased costs associated with additional components.

[0021] In terms of enhancement of the interruption performance, Embodiment 1 adopts the circuit breaker using the arc commutation-based circuit interruption technology, which is described in BACKGROUND OF THE INVENTION. The circuit breaker using the arc commutation-based circuit interruption technology is such that an arc generated during the short circuit interruption is guided to the arc extinguisher 53 by making use of an electromagnetic repulsive force, and is eventually interrupted by the arc extinguisher 53 while a current path established by the arc is being formed. More specifically, in the arc generated between both the stationary contact arm 9 and the movable contact arm 13, one located toward the contact arm 9 transfers to the yoke 7, and one located toward the contact arm 13, to an arc runner 25 (refer to FIG. 7). This arc transfer provides a current path from the power source terminal 5 to the arc runner 25 to grids 53a of the arc extinguisher 53 to the yoke 7 to the coil 18 to...to the load terminal 6. In this case, two different magnetic repulsive forces are generated, a first force of which is generated because, referring to FIG. 7, the direction (arrow ***E*** of a current flowing along the arc runner 25 is different from the direction (arrow ***F*** of a current of the grid 53a moving upwardly from the lower portion on the drawing of FIG. 7, and a second force of which is generated because the direction indicated by arrow ***F*** *is* different from the direction (arrow ***G***, refer to FIG. 3) of a current moving toward a yoke portion where the yoke 7 and the stationary contact arm 9 are fixed together. By the first and second forces, the arc is guided to the arc extinguisher 53. Then, the guided arc is interrupted, thus resulting in the rapid interruption of a large current flow due to a short circuit.

[0022] As is apparent from the foregoing description, the yoke 7 needs to be exposed to the stationary contact arm 9 and the grid 53a, which exposure is implemented by the measures below. That is, a first hole 2d is formed on the bottom of the middle housing 2 to which the overcurrent release device 52 is fixed, and firmly attaching of the overcurrent release device 52 causes the first hole 2d to be blocked by the yoke 7. In other words, the uppermost grid 53a in the arc extinguisher 53 faces the yoke 7 without anything therebetween. The first hole 2d has a narrower hole portion extended rightwardly (downwardly on the drawing of FIG. 4A). Both the contact arms 9 and 13 are inserted in the narrower portion that is provided as a path through which the movable contact arm 13 passes when it moves pivotally. Further, a reflector 26 serves as a pressure receiving portion that receives an increased arc gas pressure, to encourage opening movement of the movable contact arm 13, and a core 27 functions to enhance the electromagnetic repulsive force. Thus, a circuit interrupting mechanism according to the invention represents an apparatus assembly configured with, in addition to the reflector 26 and the core

27, the arc extinguisher 53 and the arc runner 25, for instance.

[0023] An alternative measure for the above-described "encouraging of the opening movement" will herein be described. Referring back to FIG. 3, if a hollow portion 22a is provided to the stationary core 22 and in turn includes a rod 28 that is caused to abut or be close to the movable core 24, then the movement of the movable core 24, as has been described in BACKGROUND OF THE INVENTION, causes the rod 28 to strike the movable contact arm 13, thus allowing the movable contact arm 13 to rapidly move apart from the stationary contact arm 9 without waiting for the movement of the opening and closing mechanism 51. In addition to this measure, as described previously, since the circuit breaker using the arc commutation-based circuit interruption technology according to Embodiment 1 includes the coil 18 in the current path formed by arcing, electromagnetic force in the coil 18 causes the movable core 24 and then the rod 28 to remain moving in a direction that causes the movable contact arm 13 to open; thus, the pivotal movement (so-called backswing movement) of the movable contact arm 13 in a contact direction can be blocked, thereby maintaining high arc voltage, that is, achieving a rapid arc transfer. Here, installed between the yoke 7 and the coil 18 is a barrier 29 that serves to generate proper electromagnetic force, without any current (arc current) bypassing the coil 18, during maintaining the arc discharge, as well as detecting the current.

[0024] In this way, according to the invention, the circuit breaker 101 can satisfy essential or fundamental performance for a circuit breaker such as maintaining a uniform operating characteristic and enhancing the performance of interruption, and can also achieve automatic assembly. This can significantly contribute to improve profitability associated with small-size circuit breakers that are particularly very cost competitive. While the present invention has been shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various modifications and the like could be made thereto without departing from the spirit and scope of the invention.

Claims

1. A circuit breaker comprising:

a middle housing(2) that accommodates
an opening and closing mechanism(51) having an operating handle(4), disposed between opposing frame plates, and
an overcurrent release device(52) that detects an overcurrent, to cause the opening and closing mechanism to pivotally move;
a lower housing(3) that accommodates a circuit interrupting mechanism including
an arc extinguisher(53) that interrupts an arc generated between a movable contact arm(13) provided to a crossbar that pivotally moves in an interlocking relation with the opening and closing mechanism and a stationary contact arm (9) that repeats making contact with and moving apart from the movable contact arm; and
an upper housing(1) that covers the middle housing, the lower housing, and components accommodated within the middle housing wherein the circuit interrupting mechanism is covered by the middle housing, and the overcurrent release device is accommodated in the middle housing by press-fitting the release device.

2. The circuit breaker as recited in claim 1,
wherein a first hole(2d) is made so as to face the circuit interrupting mechanism, in a face of the middle housing orthogonal to a direction in which the middle housing is fitted into the lower housing, and
wherein the first hole(2d) is blocked by a component constituting the overcurrent release device(52).

3. The circuit breaker as recited in claim 1 or claim2,
wherein a second hole(2e) for preventing the overcurrent release device(52) from moving freely in a reverse direction to that of the movement of press-fitting is made in the middle housing(2) in order to press-fit the overcurrent release device in the middle housing, and
wherein when the middle housing(2) is fitted into the lower housing(3), the second hole(2e) is blocked by a protrusion(3e) provided on the lower housing.

FIG.1A

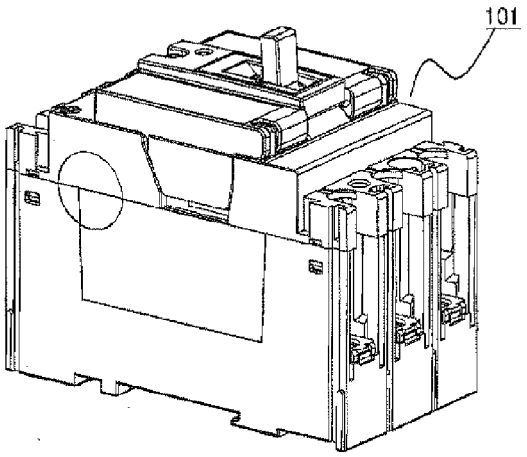


FIG.1B

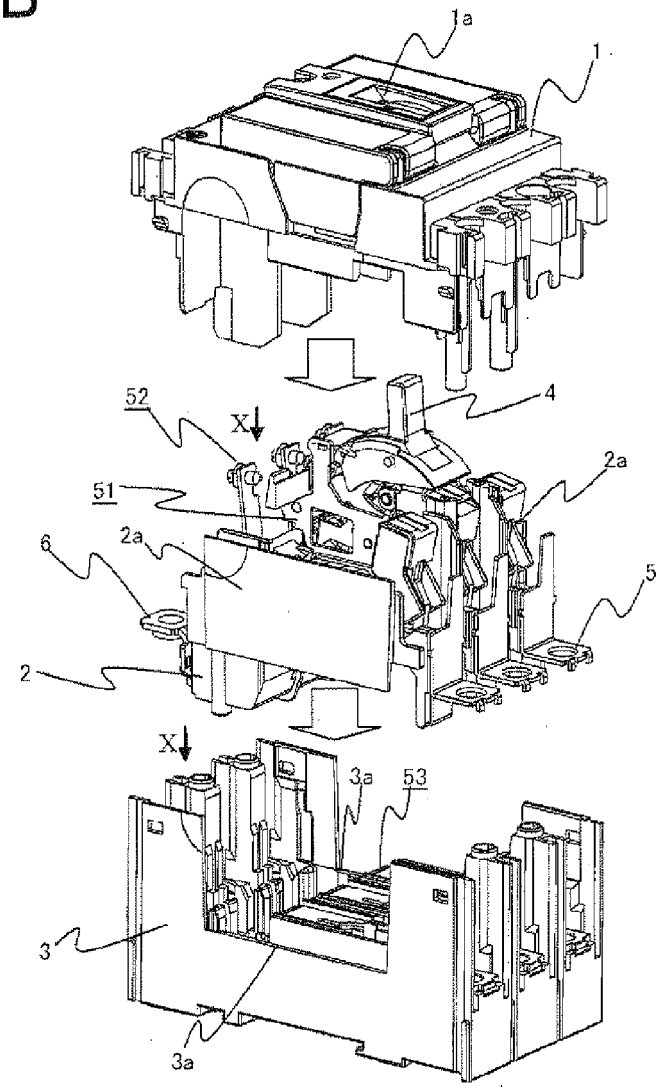


FIG.2

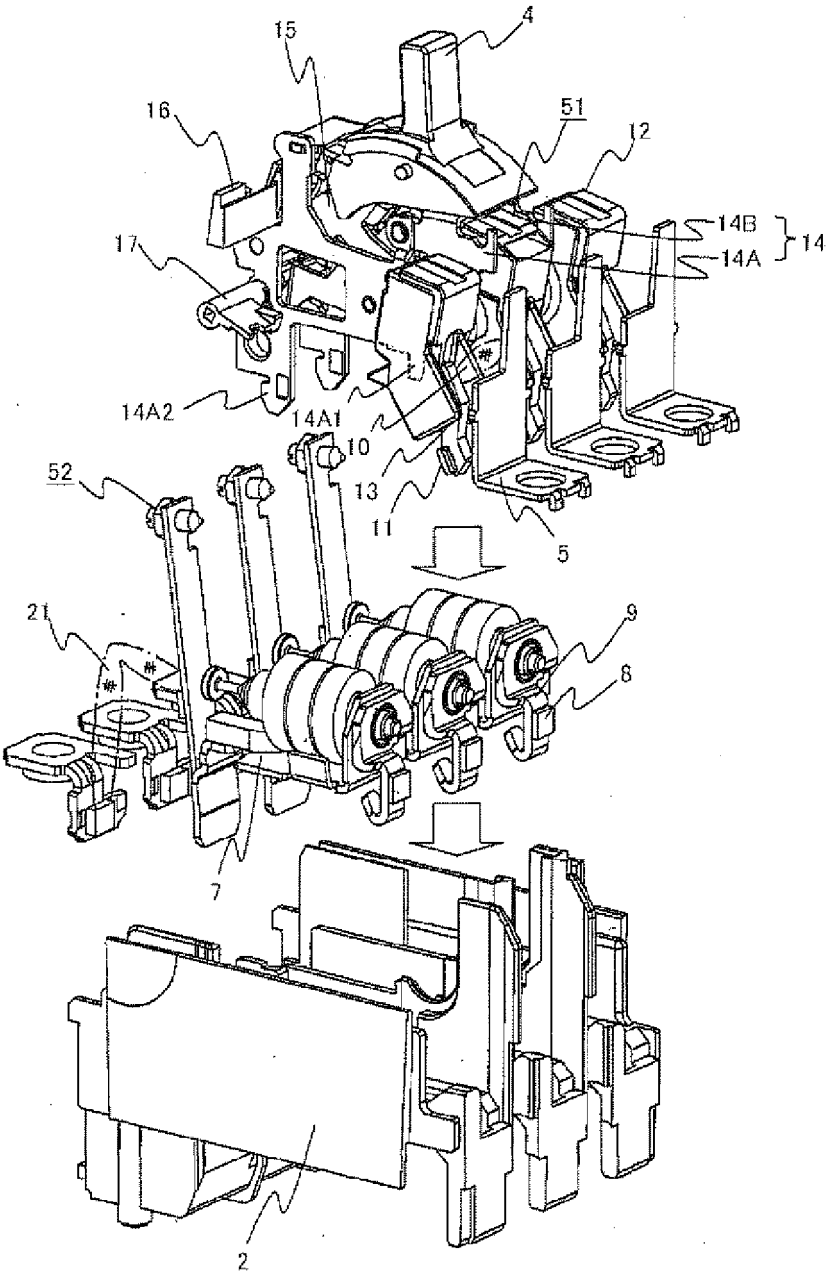


FIG.3

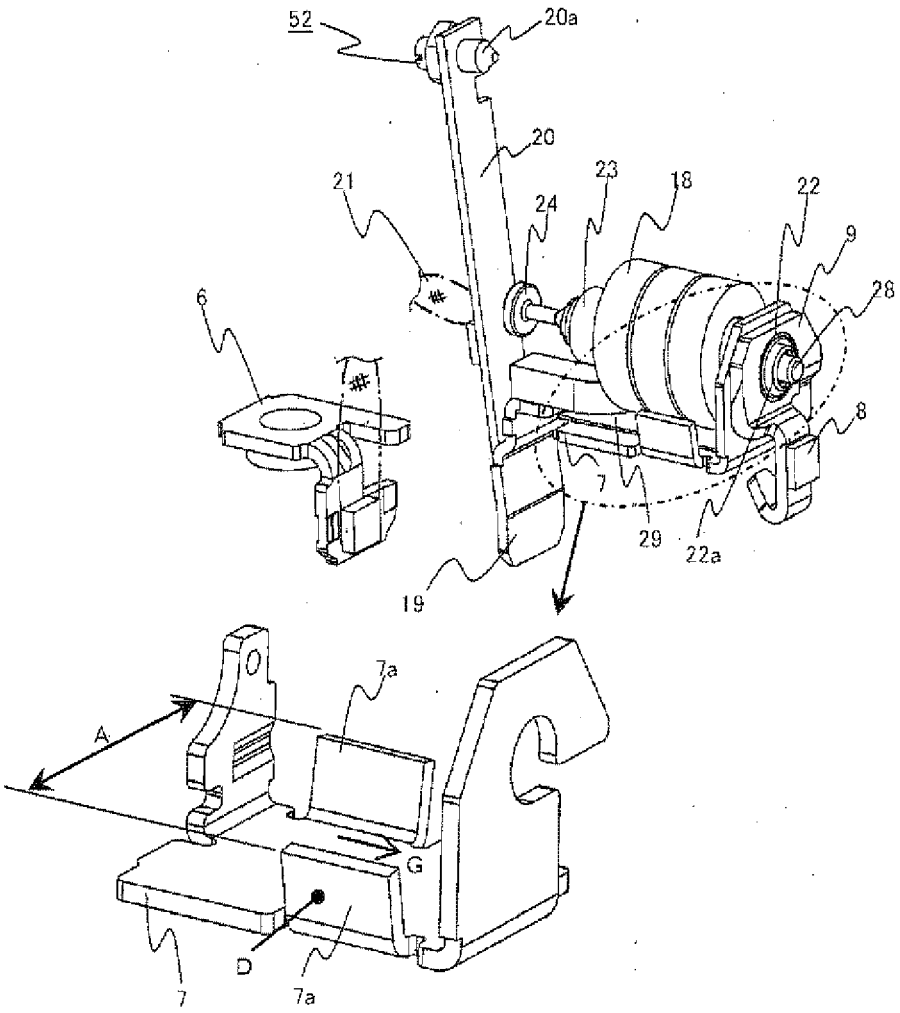


FIG.4A

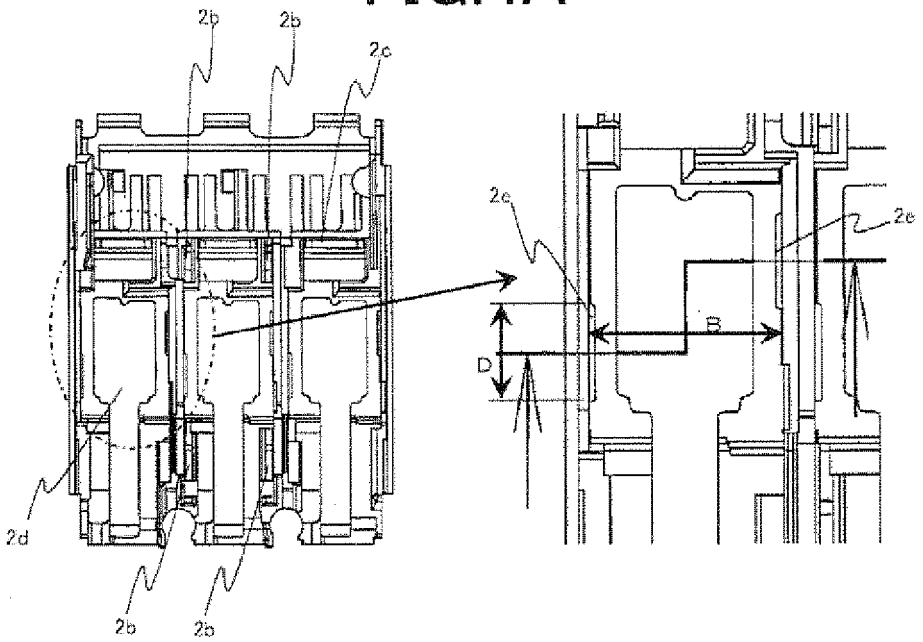


FIG.4B

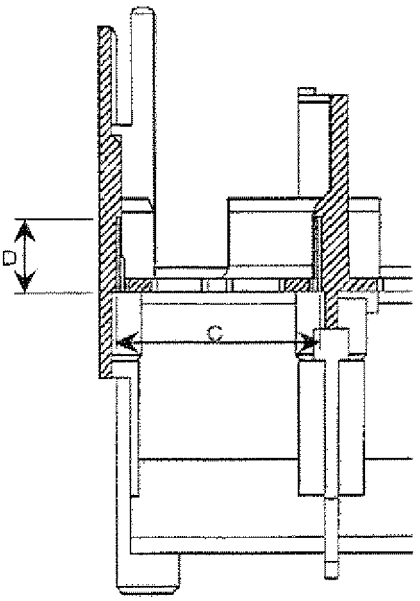


FIG.5A

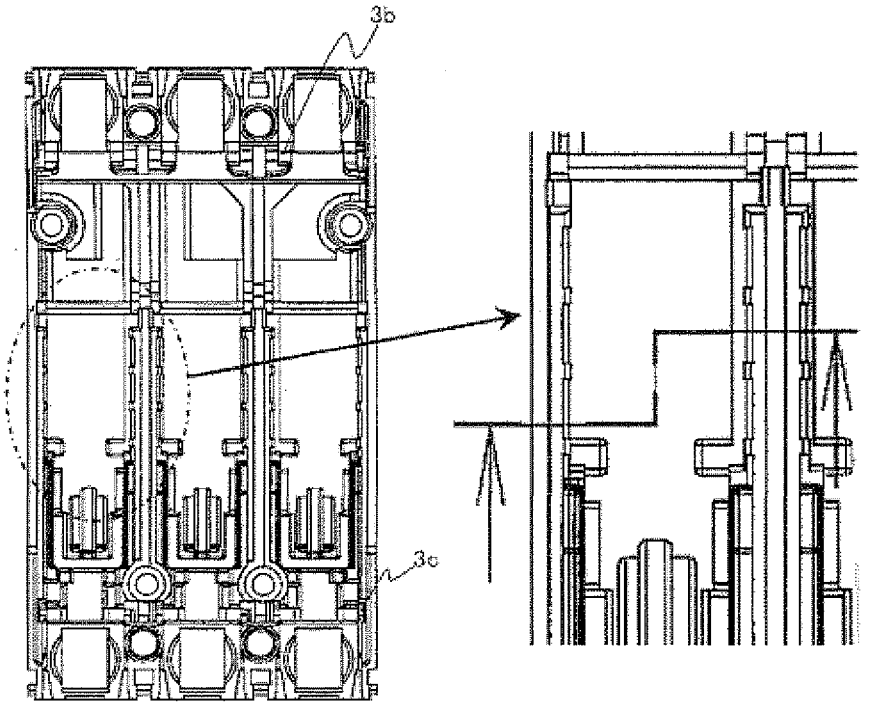


FIG.5B

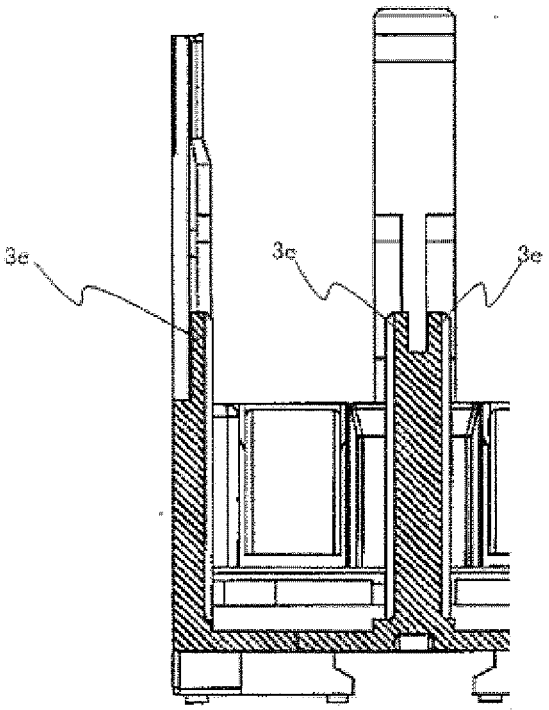


FIG.6

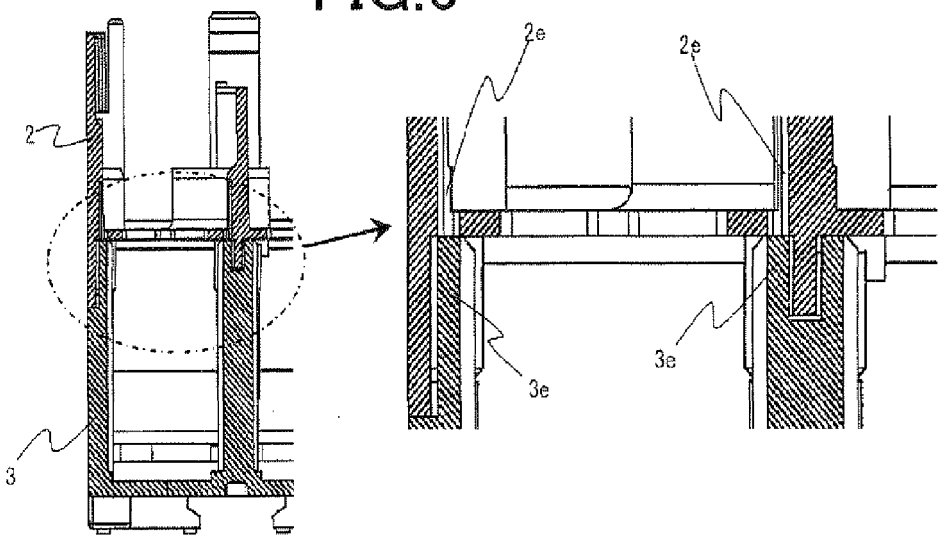
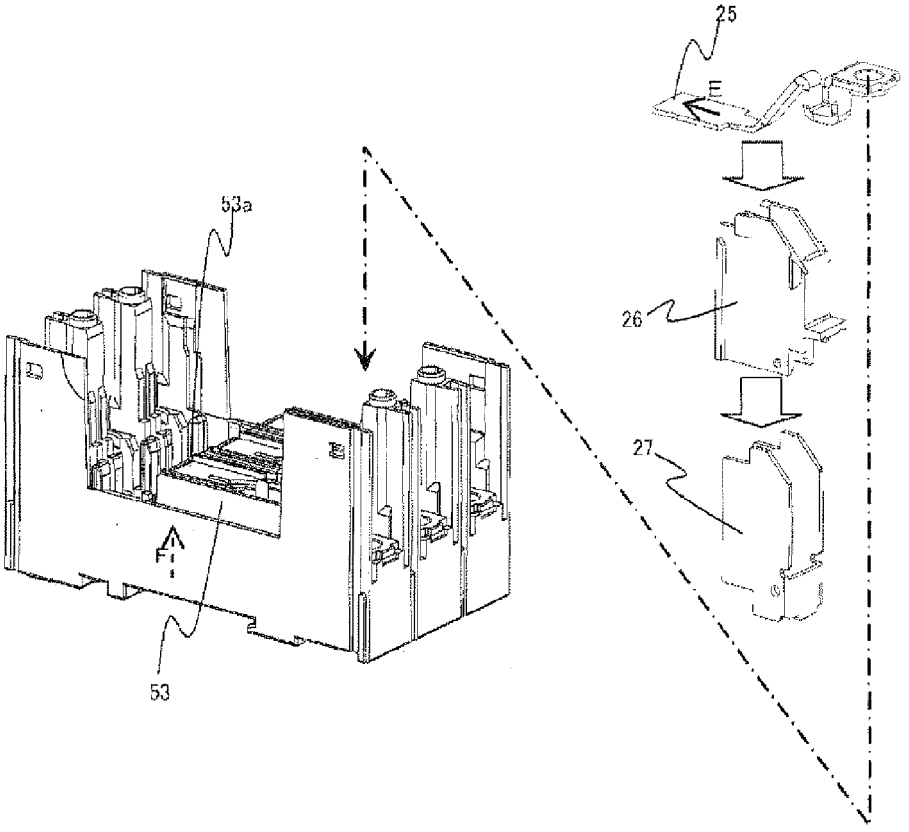


FIG.7



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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 8874

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 March 2011	Dobbs, Harvey

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28-03-2011

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