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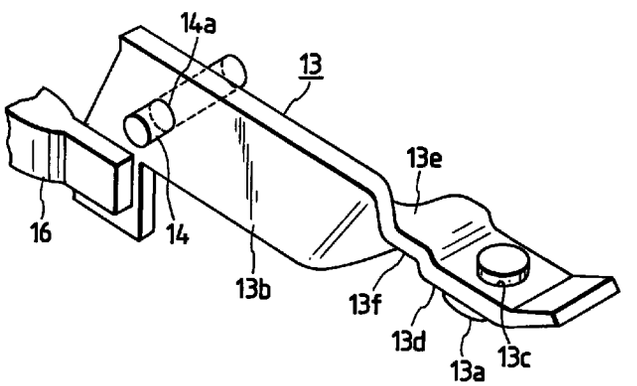
(54) Circuit breaker

(57) The invention concerns a circuit breaker in which its movable member (13) made up of a movable conductor (13b) such as a thin metal plate is sufficiently high in mechanical strength, and a movable contact (13a) welded to the movable conductor (13b) is positively secured to the latter, showing high welding strength, and which is low in manufacturing cost. The movable member (13) is designed as follows: One end portion of the movable conductor (13b) made of the metal plate is formed into a plate-shaped portion (13e) having a predetermined width, and the movable contact (13a) is provided on the plate-shaped portion (13e). The movable conductor (13b) is twisted 90° at the middle so that its remaining portion is perpendicular to the bottom of the casing.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

a) Field of the Invention

This invention relates to a molded-case circuit breaker, and more particularly to an improvement of the movable member in the circuit breaker which is operated to open and close the circuit.

b) Description of the Related Art

FIGS. 8 through 10 shows a conventional circuit breaker disclosed by, for instance, Japanese Utility Patent Publication No. 32922/1993. FIG. 8 is a side view of the circuit breaker which is tripped, and FIG. 9 is a side view of the latter which is in "on" state (the circuit being closed). In those figures, reference numeral 1 designates a casing of synthetic resin comprising a cover 1a and a base 1b; 2, a stationary member provided on the bottom of the base 1b, the stationary member 2 having a stationary contact 2a; 3, a frame secured to the base 1b of the casing 1 with screws 4; 5, an operating handle which is swingable about a protrusion 3a formed on the frame 3; 6, a cradle rotatably mounted on the operating handle 5; 7, an upper link pin; and 8, a link mechanism comprising an upper link 8a and a lower link 8b which are coupled to each other through a coupling pin 9. Further in FIGS. 8 and 9, reference numeral 10 designates a pulling spring which urges the coupling pin 9 towards the operating handle 5 to lock the upper link 8a to the upper link pin 7; 11, a cross bar which is rotatably provided with respect to the base 1b, the cross bar being coupled to the lower link 8b through a lower link pin 12; and 13, a movable member having a movable contact 13a, the movable member 13 being rotatably mounted on a movable member shaft 14 embedded in the cross bar 11.

In FIG. 9, reference numeral 15 denotes a stationary conductor secured to the base 1b; 16, a flexible conductor connected between the stationary conductor 15 and the movable member 13; 17, an instantaneous tripping electromagnetic device mounted on the base 1b, having a movable iron core 17a; 18, a timed tripping bimetal device; 18a, an adjusting screw for adjusting the tripping operation; 19, a trip bar which is engaged with the movable iron core 17a and the adjusting screw 18a; 20, a hook which is engaged with the trip bar 19; and 21, a latch adapted to engage with the hook 20, with the cradle 6 being engaged with the latch 21. Further in FIG. 9, reference numeral 22 designates a stopper pin on the frame 3; 23, a link stopper adapted to abut against the stopper pin 22, the link stopper 23 having an abutment portion 23a with which the upper link 8a is elastically brought into contact when tripped; and 24, a conventional de-ionization arc extinguish chamber.

For the above-described circuit breaker, a variety of movable members may be employed. FIG. 10 shows an example of the movable member which is made up of a flat-plate-shaped movable conductor 13b, and a movable contact 13a blazed to one surface of the conductor 13b which corresponds to the thickness of the latter 13b. FIG. 11 shows a movable member 13 disclosed by Japanese Utility Patent Application (OPI) No. 41348/1990 (the term "OPI" as used herein means an "unexamined application"), which is coupled to the base 1b. The movable member 13 is also made up of a flat-plate-shaped movable conductor 13b, and a movable contact 13a which is blazed to one surface of the movable conductor 13b which corresponds to the width of the latter 13b. FIG. 12 shows another example of the flat-plate-shaped movable member, which is formed as follows: One end portion of a flat-plate-shaped arm 13b is bent L-shaped to form a flat ear, and a movable contact 13a is blazed to the flat ear thus formed. The arm 13b has a hole 14a into which the movable member shaft is inserted. FIG. 13 is a plan view outlining the arrangement of a plurality of the movable members 13 shown in FIG. 12 which are built in a multi-pole circuit breaker. The centers of the movable contacts 13a and those of the stationary contacts 2a are shifted as much as L from the positions on the common movable member shaft 14 where the movable members 13 are supported by the latter 14.

The operations of the circuit breaker thus organized, such as the on-off operation with the operating handle 5 and the tripping operation by the electromagnetic device 7 or the bimetal device 18 when large current flows in the circuit, are as disclosed by the aforementioned Japanese Utility Patent Publication No. 32922/1993.

In the conventional circuit breaker as described above, the movable member 13 which, as shown in FIG. 10, is formed by blazing the movable contact 13a to the surface of the flat-plate-shaped movable conductor 13b which corresponds to the thickness of the latter 13b, suffers from the following difficulties: The flat-plate-shaped movable conductor 13b is reduced in mechanical strength by blazing heat. On the other hand, depending on the thickness of the movable conductor 13b, the blazing area of the movable contact 13a is small, so that the movable contact welded to the movable conductor is not sufficiently secured thereto. In addition, for the same reason, the heat generated in the movable contact 13a by current is not readily conducted to the movable conductor 13a, so that the movable contact 13a is liable to become high in temperature. On the other hand, the blazing work is liable to be fluctuated in welding pressure, in welding current, in welding time, and therefore the resultant weld is not stable in mechanical strength. Hence, the blazing work takes time and labor, which increases the manufacturing cost.

The movable member made up of the flat-plate-shaped movable conductor 13b as shown in FIG. 11 is advantageous as follows: Since the movable conductor 13b is relatively large in width, the movable contact 13a can be blazed to the conductor 13b with ease, or it may be joined to the latter 13b by caulking. In addition, the elasticity of the movable conductor 13b enhances the operation of the latter 13b and that of a link mechanism

(not shown). However, the movable member suffers from the following difficulty: Since the slit 1d is large in correspondence to the large width of the movable conductor 13b, arc gas produced at the contact when the circuit is opened is liable to flow through the slit 1d to the tripping device (17 and 18 in FIG. 9).

On the other hand, the movable member shown in FIG. 12, which comprises; the flat-plate-shaped movable conductor 13b whose one end portion is bent L-shaped to form the flat ear; and movable contact 13a blazed to the flat ear thus formed, is also disadvantageous in the following points: The movable contact 13a is liable to be shifted as shown in FIG. 13. In other words, the centers of the movable contacts 13a are shifted as much as L to the left from the central lines of the flat-plate-shaped conductors 13b, respectively, which are supported on the movable member shaft 14. Accordingly, the center of each of the movable contacts 13a is shifted by L to the left from the center of the casing 1. This shift makes the positional relationship between the stationary contact 2a and the movable contact 13a liable to change, and increases the external dimensions of the circuit breaker depending on its structure.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to eliminate the above-described difficulties accompanying a conventional circuit breaker. More specifically, a first object of the invention is to provide a circuit breaker in which its movable member made up of a movable conductor such as a thin metal plate is sufficiently high in mechanical strength, and the movable contact welded to the movable conductor is positively secured to the latter, showing high weld strength, and which is low in manufacturing cost when compared with the conventional one. A second object of the invention is to provide a circuit breaker in which arc gas produced at the contact when the circuit is opened scarcely flows to the tripping device (17 and 18 in FIG. 9).

The foregoing object of the invention has been achieved by the provision of a circuit breaker which, according to the invention, comprises:

a stationary member having a stationary contact on one end portion thereof, the stationary member being provided on the side of the bottom of a synthetic resin casing;

a movable member including first and second plate-shaped portions which are formed by twisting the middle portion of a metal plate so that the plate-shaped portions form 90° with each other,

the first plate-shaped portion having a movable contact at the end which is confronted with said stationary contact; and

cross bar which supports the end of the second plate-shaped portion and is coupled to a switching mechanism, and which is adapted to operate the movable member so that the movable contact is moved into and out of engagement with the stationary contact.

In the circuit breaker, the movable member may be so modified that it is formed by forging a metal material to include first and second plate-shaped portions which form 90° with each other, and a movable contact is provided on the first plate-shaped portion at the end in such a manner that it is confronted with the stationary contact.

Furthermore, in the circuit breaker, a portion of the movable conductor which is next to the first plate-shaped portion on which the movable contact is formed may be curved inwardly with respect to the first plate-shaped portion, thus providing a step.

Moreover, in the circuit breaker, the movable member may be so modified that it includes: an L-shaped plate material having a protrusion at one end which is bent 90°; and a movable contact provided on the protrusion thus bent in such a manner that the movable contact is confronted with the stationary contact, and the center of the movable contact is on the central line of the movable member.

In addition, in the circuit breaker, the synthetic resin casing may have a partition wall having a slit which is engaged with the portion of the movable conductor 13b which is made perpendicular to the bottom of the casing and is located between the movable contact of the movable member and the cross bar, the slit being made as small in width as permitting the movement of the movable member therein.

In the circuit breaker designed as described above, one end portion of the movable conductor made of a metal plate is formed into a first plate-shaped portion having a predetermined width on which the movable contact is provided, and the movable conductor is twisted 90° at the middle so that the remaining portion is perpendicular to the bottom of the casing. The movable member thus formed is sufficiently high in mechanism strength, and the movable contact welded to the movable conductor is positively secured to the latter.

In the circuit breaker, the movable member is so modified that it is formed by forging a metal material and includes the first and second plate-shaped portions which form 90° with each other. The movable member thus formed is also sufficiently high in mechanical strength, and the movable contact welded to the movable conductor is positively secured to the latter.

Furthermore, in the circuit breaker, as was described above the portion of the movable conductor which is next to the first plate-shaped portion, on which the movable contact is provided, is curved inwardly with respect to the first plate-shaped portion to form the step. The step thus formed protects the movable conductor from arc gas produced at the contact.

Moreover, in the circuit breaker, the movable member is so modified that it includes: the L-shaped plate material having the protrusion at one end which is bent 90°; and the movable contact provided on the protrusion thus bent in such a manner that the movable contact is confronted with the stationary contact, and the center of the movable contact is on the central line of the movable member. Hence, the movable member is simple in

design and high in mechanical strength, and the movable contact welded to the movable conductor is positively secured to the latter.

In addition, in the circuit breaker, the synthetic resin casing has the partition wall with the slit which is engaged with the portion of the movable conductor which is made perpendicular to the bottom of the casing and is located between the movable contact of the movable member and the cross bar; and the slit is limited in width to the extent that the movable member is movable moved therein. The partition wall prevents arc gas produced at the contact from flowing to the tripping device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view, with parts cut away, showing a circuit breaker which is tripped, which constitutes a first embodiment of the invention.

FIG. 2 is a side view, with parts cut away, showing the circuit breaker which is in "on" state.

FIG. 3 is a perspective view of an example of a movable member in the circuit breaker according to the invention.

FIG. 4 is a perspective view of another example of the movable member in the circuit breaker.

FIG. 5 is a perspective view showing a movable member in a circuit breaker, which constitutes a second embodiment of the invention.

FIG. 6(A) is a front view showing a movable member in a circuit breaker, which constitutes a third embodiment of the invention, and FIG. 6(B) is a side view thereof.

FIG. 7 is a perspective view of a movable member and its relevant component in a circuit breaker, which constitutes a fourth embodiment of the invention.

FIG. 8 is a side view of a conventional circuit breaker which is tripped.

FIG. 9 is a side views of the conventional circuit breaker which is in "on" state.

FIGS. 10 through 12 are perspective views showing examples of a movable member in the conventional circuit breaker.

FIG. 13 is an explanatory diagram showing a plurality of the movable members shown in FIG. 12 which are applied to a multi-pole circuit breaker.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

FIGS. 1 and 2 show a circuit breaker with a part of its molded casing cut away, which constitutes a first embodiment of the invention. More specifically, FIG. 1 is a side view of the circuit breaker which is tripped, and FIG. 2 is a side view of the latter which is in "on" state (the circuit being closed). In the circuit breaker, the components except a base 1b and a movable member 13 are equal to those in the above-described conventional circuit breaker, and are therefore designated by the same reference numerals or characters in FIGS. 1 and 2. In addition, in the base 1b and the movable member 13, parts corresponding functionally to those in the conventional circuit breaker are designated by the same reference numerals or characters.

FIG. 3 shows an example of the movable member 13 in the first embodiment of the invention. In FIG. 3, reference character 13b designates a movable conductor fabricated from a conductive metal plate such as a copper plate or brass plate. The movable conductor 13b has a movable contact 13a on its one end portion. The one end portion of the movable conductor 13b is formed into a plate-shaped portion 13d larger in width than the diameter of the movable contact 13a. A movable contact mounting hole 13c is formed in the plate-shaped portion 13d, so that the movable contact 13a is fixedly secured to the plate-shaped portion 13d by caulking. The middle portion 13e of the movable conductor 13b is twisted through 90° so that the remaining portion of the movable conductor 13b is perpendicular to the bottom 1c of the base 1b. In FIG. 3, reference numeral 14 denotes a movable member shaft; and 14a, a rotary shaft hole into which the movable member shaft 14 is inserted. The movable member 13 thus formed is rotatably held through the movable member shaft 14 on the cross bar 11 (shown in FIG. 1).

The portion of the movable conductor 13b which is next to the plate-shaped portion 13d is curved inwardly with respect to the latter 13d, to form a step 13f. In the above-described embodiment, the movable contact 13a is fixedly secured to the movable conductor 13b; however, the invention is not limited thereto or thereby. For instance, as shown in FIG. 4, a round or square movable contact may be secured to it by blazing.

Second Embodiment

In the above-described first embodiment, the movable conductor 13b is made of a metal plate. However, as shown in FIG. 5, it may be formed by forging copper material or brass material. That is, in the second embodiment, the movable conductor 13b is formed by cold forging so that it comprises: a plate-shaped portion 13d at one end which has a predetermined width in correspondence to the size of the movable contact 13a; and the remaining portion which is also in the form of a plate which has a thickness smaller than the predetermined width of the plate-shaped portion 13d. The remaining portion is oriented at 90° with respect to the plate-shaped portion 13d so that it is perpendicular to the bottom of the base 1b. In FIG. 5, reference character 13f designates a step; and 14a, a rotary shaft hole. The movable member whose movable conductor 13b is formed by forging in the above-described manner has the same effects as the movable member made of a metal plate in the first embodiment.

Third Embodiment

In the above-described first embodiment, the middle portion of the movable conductor 13b is twisted through 90° so that one end portion of the movable conductor 13b is provided as the plate-shaped portion on which the movable contact 13a is formed, and the remaining portion is perpendicular to the bottom of the base 1b. Instead of the movable member in the first embodiment, a movable member formed as shown in FIG. 6 may be employed with the same effects. That is, in the third embodiment, the movable member 13 is formed by bending a plate material. FIGS. 6(A) and 6(B) are a plan view and a side view of the movable member 13, respectively. As shown in FIGS. 6(A) and 6(B), a movable conductor 13b for forming the movable member 13 is made of an L-shaped plate whose one end portion is formed into a plate-shaped portion 13d having a predetermined width, on which a movable contact 13a is formed. The plate-shaped portion 13d is bent through 90° so that the remaining portion is perpendicular to the bottom of the base 1b. And the middle portion of the movable conductor 13b is so bent that the center of the movable contact 13a is on the central line of the movable member 13.

Fourth Embodiment

In a fourth embodiment of the invention, the casing 1 has a partition wall with a slit. The slit is engaged with the portion of the movable conductor 13b which is made perpendicular to the bottom of the base 1b and is located between the movable contact 13a of the movable member 13 and the cross bar 11. This structure eliminates the adverse effect of the arc gas produced at the contact. The partition wall is as indicated at 1e in FIG. 7. The partition wall 1e has the slit 1d which is made as small in width as permitting the movement of the movable member 13 (in the directions of the arrow A) in the slit. The partition wall 1e prevents the arc gas g produced at the contact from flowing to the tripping device (17 and 18 in FIG. 9).

The circuit breaker, which is designed as described above, has the following effects or merits:

In the circuit breaker constituting the first embodiment, one end portion of the movable conductor made is formed into the first plate-shaped portion having the predetermined width on which the movable contact is provided, and the movable conductor is twisted 90° at the middle so that the other end portion is perpendicular to the bottom of the casing. This structure increases the mechanical strength of the supporting portion of the movable member during switching, and enhances the welding of the movable contact. Thus, the movable contact welded to the movable conductor is positively secured to the latter, and the movable member can be pivotally supported with ease.

In the second embodiment, the movable member is formed by forging a metal material to include the first and second plate-shaped portions which form 90° with each other. The movable member thus formed is also sufficiently high in mechanical strength, and the movable contact welded to the movable conductor is positively secured to the latter.

Furthermore, in the circuit breaker, the movable conductor has the portion which is next to the first plate-shaped portion on which the movable contact is provided, and is curved inwardly with respect to the first plate-shaped portion to form the step. The step thus formed protects the movable conductor from the arc gas produced at the contact.

In the third embodiment, the movable member is made up of the L-shaped plate material having the protrusion at one end which is bent 90°. The movable member thus formed is simple in design, and high in mechanical strength, and the movable contact welded to the movable conductor is positively secured to the latter.

In the fourth embodiment, the synthetic resin casing has the partition wall with the slit which is engaged with the portion of the movable conductor which is made perpendicular to the bottom of the casing and is located between the movable contact of the movable member and the cross bar, and the slit is limited in width to the extent that the movable member is movable therein. The partition wall prevents the arc gas produced at the contact from flowing to the tripping device.

Claims

1. A circuit breaker comprising:

   a stationary member having a stationary contact on one end portion thereof, said stationary member being provided on the side of the bottom of a synthetic resin casing;

   a movable member including first and second plate-shaped portions which are formed by twisting the middle portion of a metal plate so that said plate-shaped portions form 90° with each other, said first plate-shaped portion having a movable contact at the end in such a manner that said movable contact is confronted with said stationary contact; and

   cross bar which supports the end of said second plate-shaped portion and is coupled to a switching mechanism, and which is adapted to operate said movable member so that said movable contact is moved into and out of engagement with said stationary contact.

2. A circuit breaker comprising:

   a stationary member having a stationary contact on one end portion thereof, said stationary member being provided on the side of the bottom of a synthetic resin casing;

   a movable member including first and second plate-shaped portions which are formed by forging a metal material in such a manner that said first and second plate-shaped portions form 90° with each other, said first plate-shaped portion having a movable contact at the end in such a manner that said

movable contact is confronted with said stationary contact; and

cross bar which supports the end of said second plate-shaped portion and is coupled to a switching mechanism, and which is adapted to operate said movable member so that said movable contact is moved into and out of engagement with said stationary contact.

3. A circuit breaker as claimed in claim 1 or 2, wherein:

said movable member has a portion which is next to said first plate-shaped portion on which said movable contact is formed, and is curved inwardly with respect to said first plate-shaped portion, thus providing a step.

4. A circuit breaker comprising:

a stationary member having a stationary contact on one end portion thereof, said stationary member being provided on the side of the bottom of a synthetic resin casing;

a movable member including an L-shaped plate material having a protrusion at one end which is bent 90°; and a movable contact provided on said protrusion thus bent in such a manner that said movable contact is confronted with said stationary contact and the center of said movable contact is on the central line of said movable member; and

cross bar which supports the other end of said movable member and is coupled to a switching mechanism, and which is adapted to operate said movable member so that said movable contact is moved into and out of engagement with said stationary contact.

5. A circuit breaker as claimed in any one of the preceding claims, wherein:

said synthetic resin casing has a partition wall having a slit which is engaged with the portion of the movable member which is made perpendicular to the bottom of said casing and is located between said movable contact of said movable member and said cross bar, said slit being made as small in width as permitting the movement of said movable member therein.

6. A movable member adapted to be installed in a circuit breaker to open and close a circuit in cooperation with a stationary member having a stationary contact, said movable member comprising:

a first plate-shaped portion on which a movable contact is provided; and

a second plate-shaped portion oriented at 90° with respect to said first plate-shaped portion, said second plate-shaped portion defining a center line, and wherein:

said first and second plate-shaped portions are integrally connected to each other so that a center of said movable contact is substantially located on said center line.

7. The movable member according to claim 6, wherein said movable member is formed by twisting the middle portion of a metal plate, which portion is located between said first and second plate-shaped portions.

8. The movable member according to claim 6, wherein said movable member is formed by forging a metal material.

9. The movable member according to claim 6, wherein said second plate-shaped portion includes a first section defining said center line, a second section parallel to said first section and displaced from said center line, and a third section integrally connecting said first section to said second section, wherein said first plate-shaped portion is integrally connected to said second section.

10. The movable member according to claim 9, wherein said movable member is formed from a L-shaped metal plate.

FIG. 1

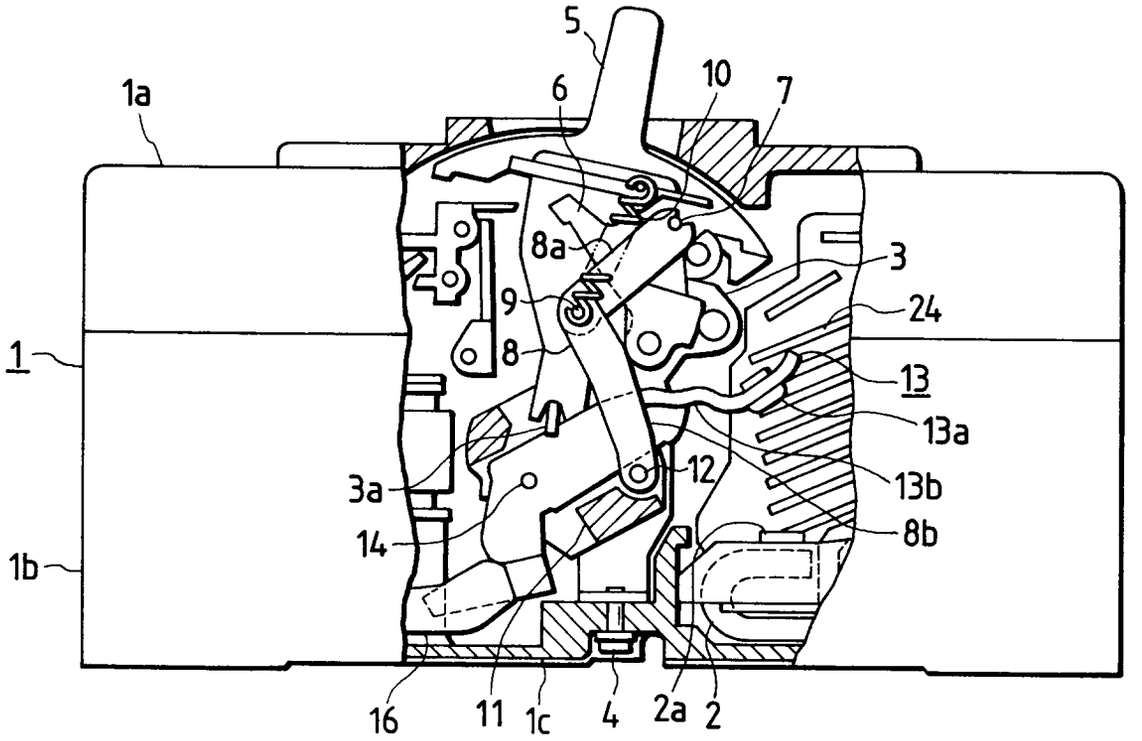
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FIG. 2

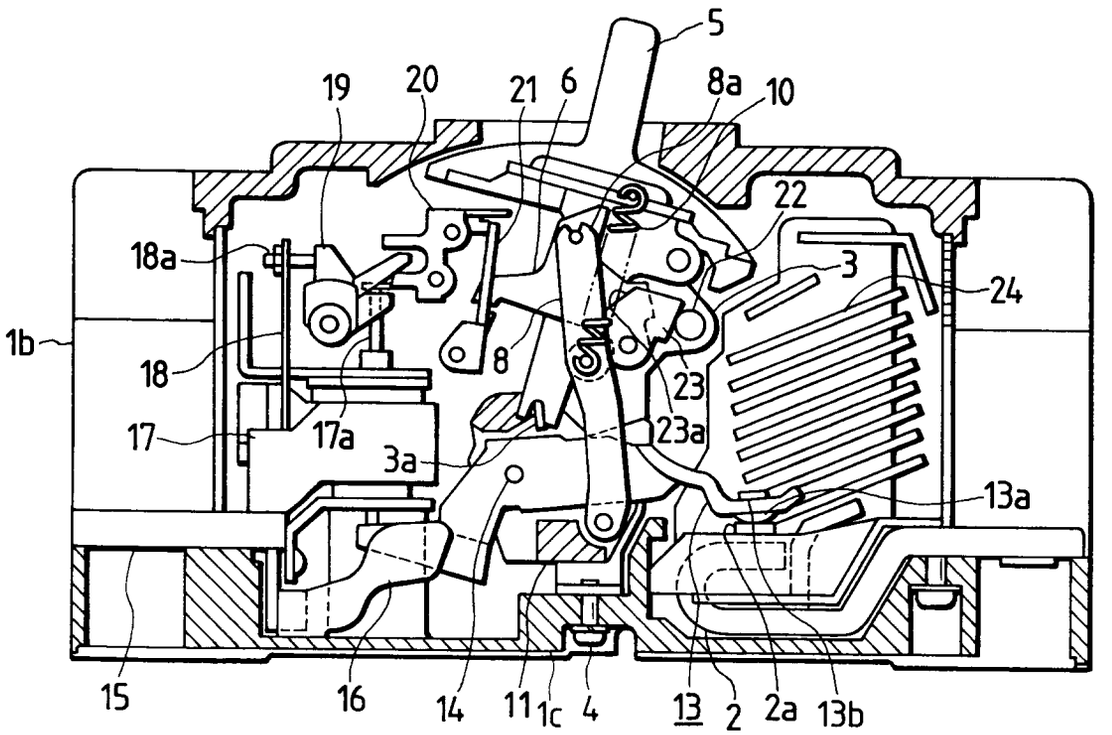
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FIG. 3

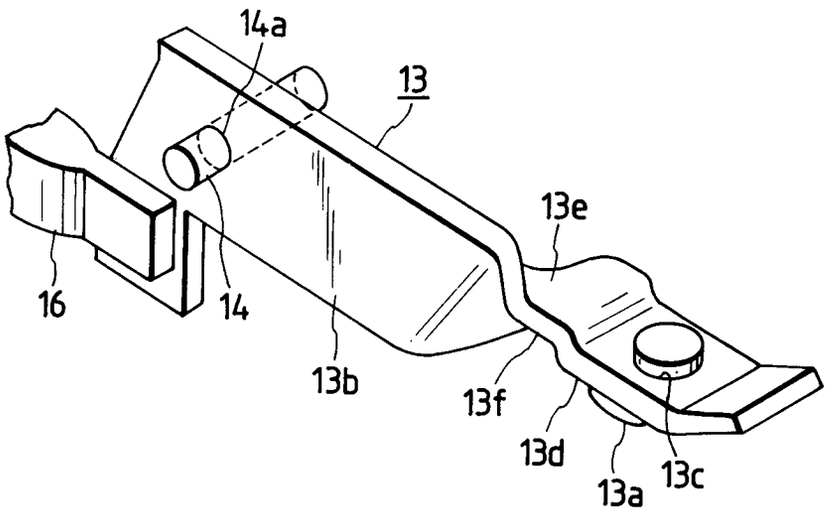

FIG. 4

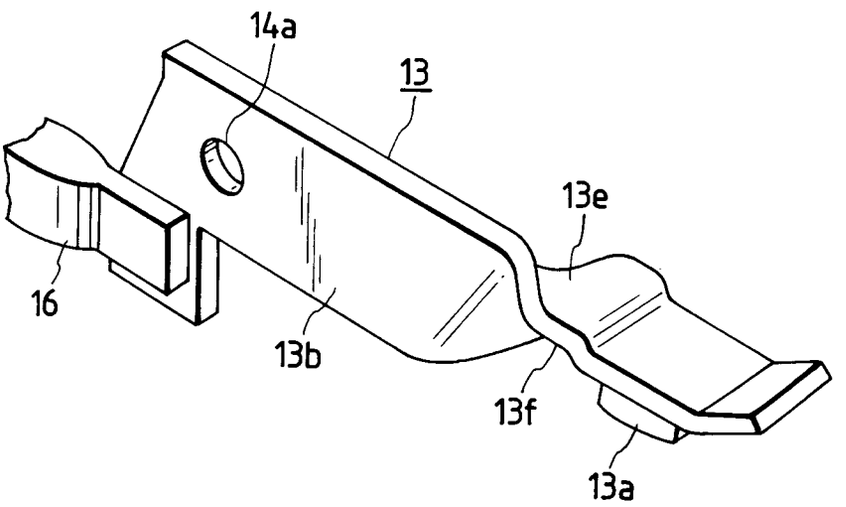

FIG. 5

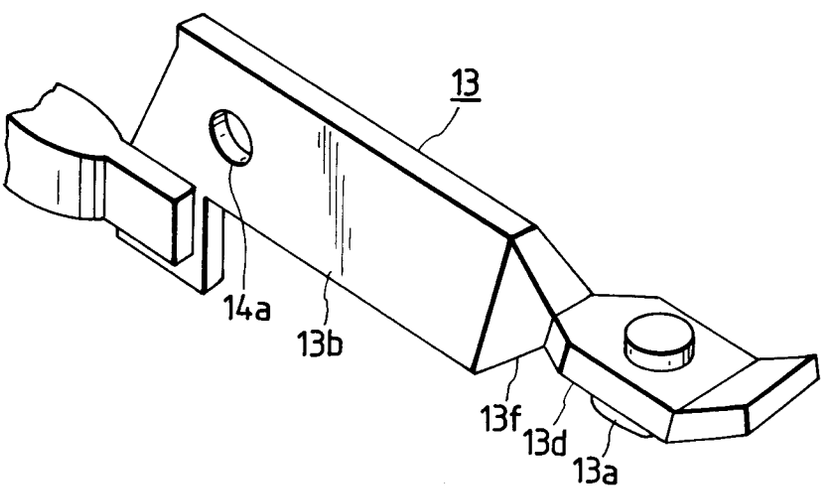

FIG. 6(A)

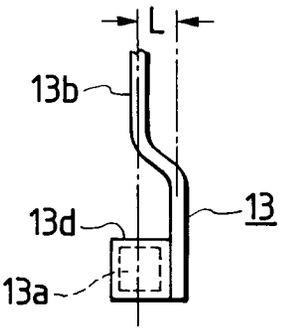

FIG. 6(B)

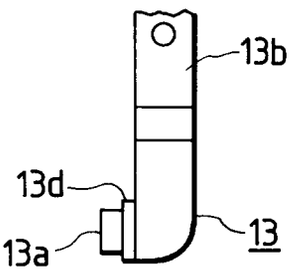

FIG. 7

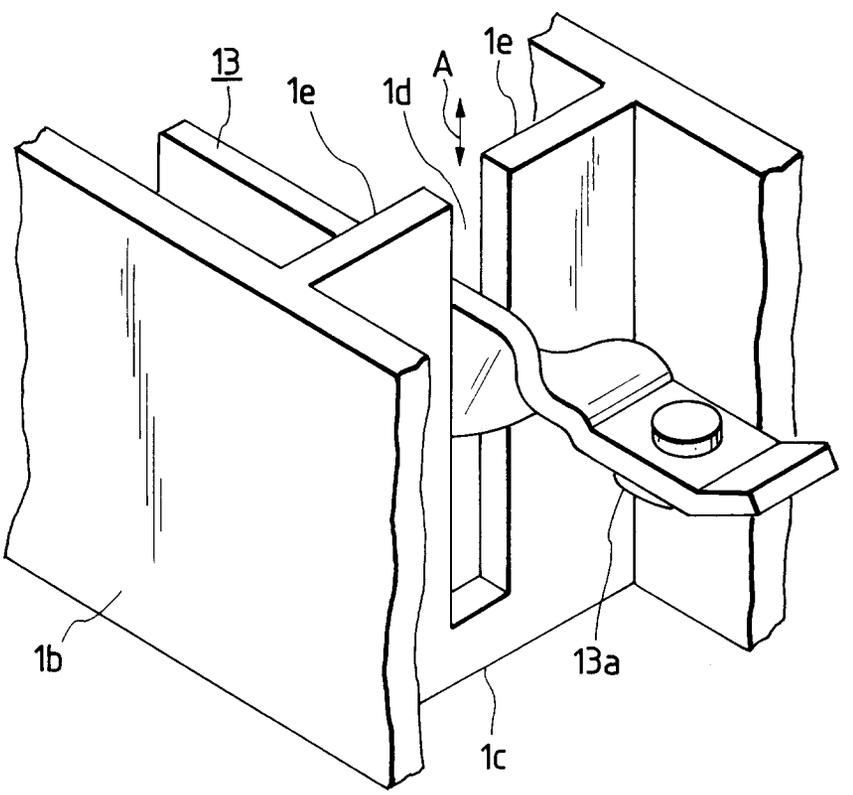

FIG. 8

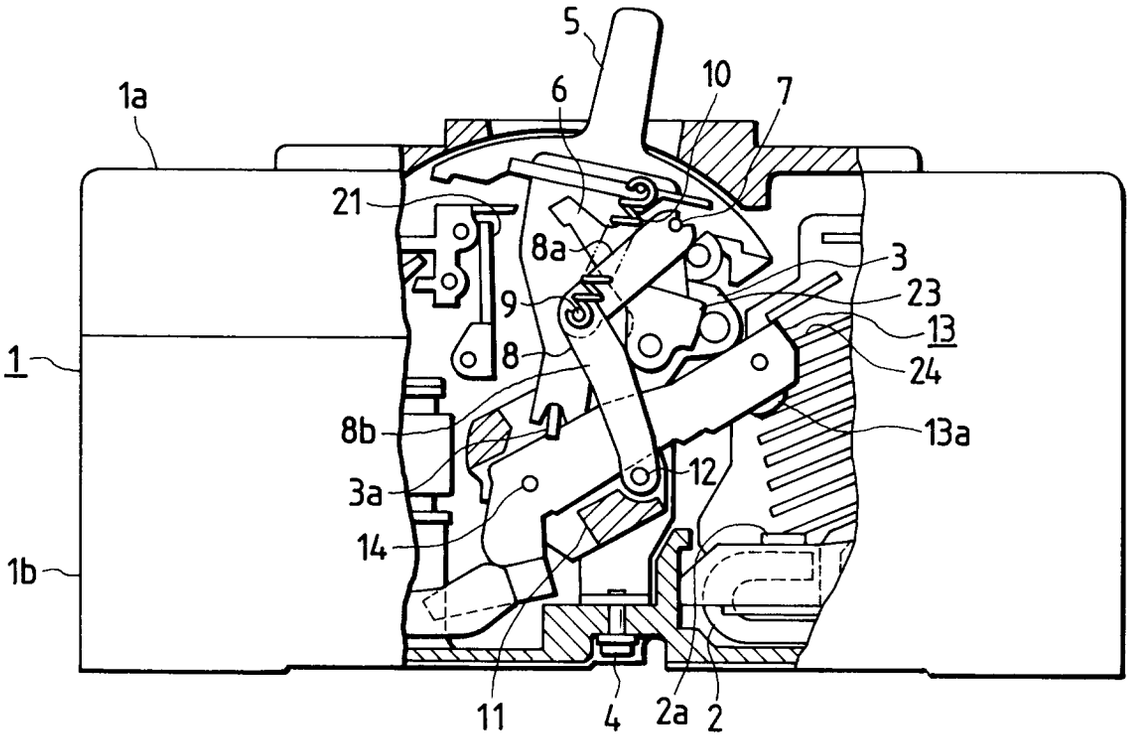
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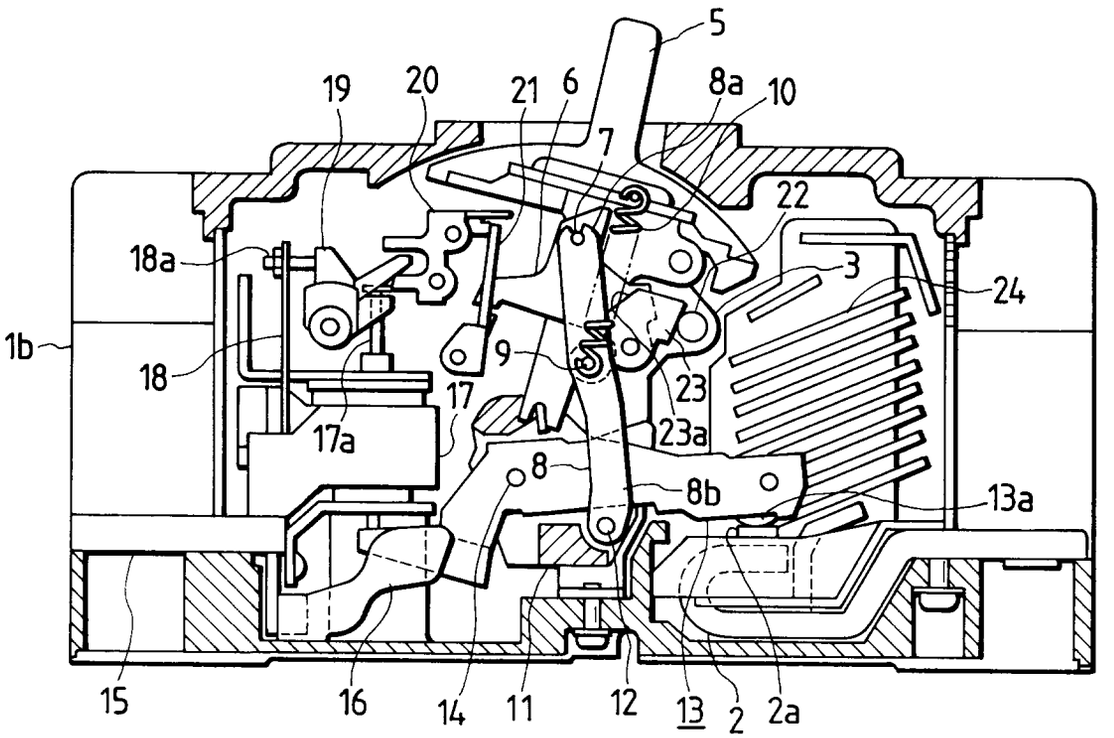
FIG. 9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2a

FIG. 10

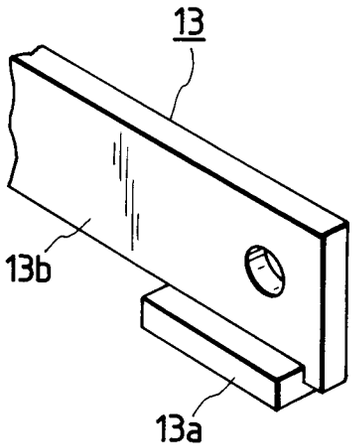


FIG. 11

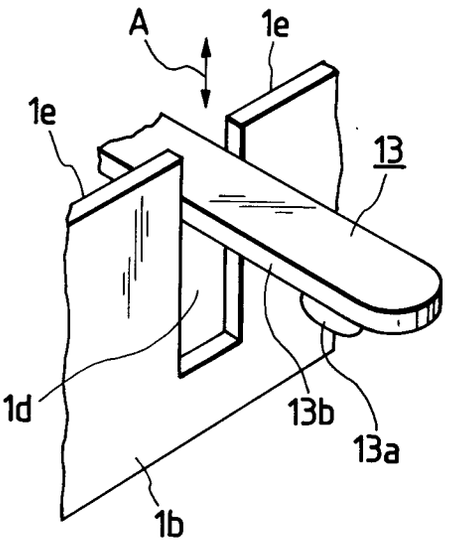


FIG. 12

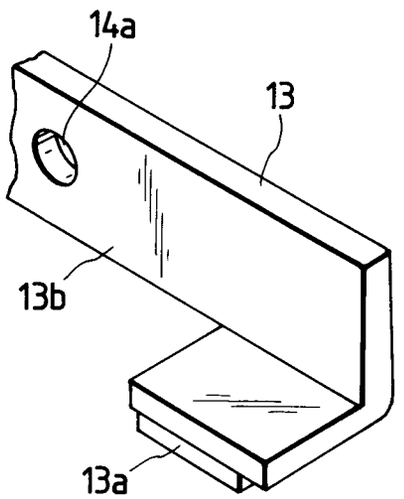
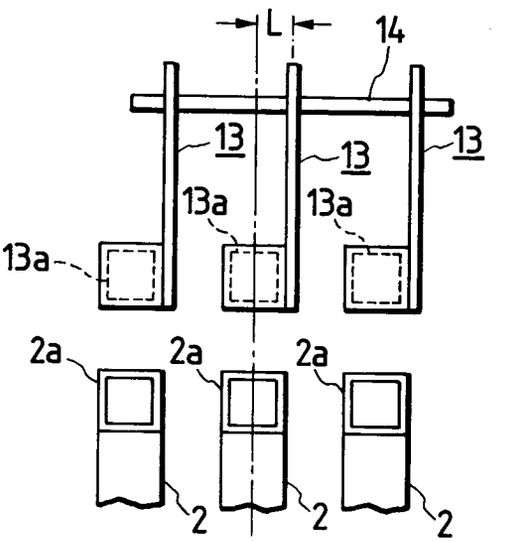


FIG. 13



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EUROPEAN SEARCH REPORT

Application Number
EP 94 11 9681

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-20 02 934 (GENERAL ELECTRIC COMPANY) * page 1, paragraph 1 - page 6, paragraph 1; claims 1,2; figures * ---	1	H01H73/04
A	WO-A-93 22784 (SQUARE D COMPANY) * page 3, line 3 - line 11 * * page 9, line 18 - page 10, line 17; figures 4-6 * ---	1-4,6	
A	US-A-3 464 040 (D. B. POWELL) * column 3, line 22 - line 57; figures 1-3 * ---	3,4,6,9, 10	
A	US-A-3 286 071 (F. L. GELZHEISER) * column 2, line 44 - column 3, line 40; figures 1,4 * ---	3,4,6,9, 10	
A	GB-A-207 363 (W. PRESTON) * page 2, line 43 - line 60; figure 3 * ---	1,7	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE-C-11 38 139 (LICENTIA PATENT-VERWALTUNGS-GMBH) * the whole document * -----	1,2,8	H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	18 December 1995	Ruppert, W

CATEGORY OF CITED DOCUMENTS

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