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EP 0 288 040 B1

Description

The present invention relates to a circuit breaker according to the preamble of claim 1, and in particular to an improvement of arc extinguish structure.

FIG.1A shows the structure nearby a contact and arc extinguish grids 10 of a prior art circuit breaker. A fixed contact 4 and an arc runner 5 are fixed on a fixed arm 3. The fixed arm 3 is fixed by a bolt 12 and a folded tip part 31 of the fixed arm 3 is also fixed by a bolt 12. A movable contact 2 is provided on a movable arm 1. In a closing state, the movable contact 2 and fixed contact 4 are contacted.

When an over-current flows in a circuit, the movable contact 2 is disconnected from the fixed contact 4 by a releasing device (not shown). At this time, an arc 9a occurs between the movable contact 2 and the fixed contact 4. When the movable arm 1 is moved in to a position x, the arc is moved into a position 9b. FIG.1B is a plan view for showing a relation between the arc 9 and the arc extinguish grid 10. The arc extinguish grid 10 is made of magnetic material and has a notch 10a for introducing the arc. Because the notch 10a is formed, lines of magnetic force are deflected as shown in FIG.1B. Therefore, the arc 9 is moved in a direction shown by an arrow A. Referring now to FIG.1A, the arc is moved from 9b to 9f through 9c, 9d and 9e. The moved arc 9 is stretched, divided and extinguished as described above.

This conventional circuit breaker, however, suffers the following problems.

When the arc is not smoothly moved and thus moves to a side end of notch 10a, i.e., to a position 99 as shown in FIG.1B, the arc 99 stays in this position by emission of thermoelectrons from the arc extinguish grid 10. Especially, such staying of the arc occurs in part S in FIG.1A. Therefore, the arc runs slowly, the extinguishment is delayed and thus breaking efficiency is deteriorated.

When a high voltage is broken or a large current shortcircuit arises, the arc sometimes runs over from the rear end of grids 10 and makes an arc shortcircuiting 9g, as shown in FIG.1A.

A circuit breaker which discloses all features of the preamble of claim 1 is known from **FR-A-2 348 559**. This known circuit breaker comprises an arc extinction means which is also formed by a grid of plates, this grid being disposed in the space above an arc-runner. Furthermore, this known circuit breaker also seems to comprise notches which are formed at the arc introducing end of each plate. The upper end of the uppermost plate of this known circuit breaker, in addition, is covered by an insulating layer and the lower end of the lowermost plate (which faces the arc-runner) also is covered

by an insulating layer. These insulating layers preferably are formed like an "U". In a special embodiment, both insulating layers are formed by a kind of band or binding so that the side faces of all plates are covered, too.

By the a.m. construction of that known circuit breaker, it is possible to partially solve the problem discussed with reference to the prior art circuit breaker shown in Figures 1A and 1B, namely the problem of extinguishing the arc as fast as possible in order to increase the breaking efficiency. A detailed analysis of the known circuit breaker has however shown that shortcircuits cannot be avoided under every breaking condition.

It is therefore the object of the present invention to improve a circuit breaker according to the preamble of claim 1 in such a way that the breaking efficiency can be improved.

According to the present invention this object is solved by the advantageous measures indicated in claim 1.

Hence, the circuit breaker of the present invention comprises an insulation film which is formed on both surfaces of each plate either at the area of said arc introducing end or at the area of the opposite end thereof. These advantageous measures improve the breaking efficiency and allow to avoid really any shortcircuit even at high voltages and large currents.

As has already been mentioned above, the present invention is directed to a circuit breaker in which the arc which is generated during the disconnection of the two contacts is extinguished by means of a grid which is positioned above an arc-runner and which, in addition, comprises a notch which is formed at that end of each plate at which the arc is introduced (i.e. the end which faces the two contacts). In contrast thereto, document **EP-A-33 479** discloses a circuit breaker of a somewhat different kind in which the arc extinction is performed by the combination of a so-called "arc motivating assembly" and an arc chute or dionising assembly. This arc motivating assembly consists of two columns which are flanking the contact pairs, wherein each column is composed of small plates of a magnetic material that are spaced from each other by insulating layers; furtheron, the top end of each column comprises a choke covered by an insulating layer. The arc chute consists of a number of double arc plates formed of a sheet of a magnetic and conductive material which is folded to a "U" in which a thin insulating layer is disposed between the arms of the "U". Due to the different construction of the arc extinction means the insulating layer of this known circuit breaker is a functional necessary construction element in order to make sure that the current follows the arms and the curved portions of the "U". Therefore, the purpose

of the provision of this insulating layer cannot be compared to the purpose of the insulating layer of the present invention.

The document **FR-A-1 364 473** discloses a circuit breaker wherein caulking protrusions are provided which are inserted into corresponding holes of side plates in order to connect the plates with the side wall. This document, however, does not disclose the provision of any insulating layers.

In the following, the present invention will be described in more detail with reference to the accompanying drawings, in which:

FIG.1A is a sectional view of a prior art circuit breaker;

FIG.1B is a plan view of the arc extinguish grid of the circuit breaker of FIG.1A;

FIG.2A is a side view of a circuit breaker of a first embodiment of the present invention;

FIG.2B is a plan view of the embodiment of FIG.2A;

FIG.2C is a sectional view of the embodiment of FIG.2A;

FIG.3A is a sectional view of a circuit breaker of another embodiment of the present invention.

FIG.3B is a plan view of the embodiment of FIG.3A;

FIG.4A is a side view of a circuit breaker of still another embodiment of the present invention;

FIG.4B is a plan view of the circuit breaker of FIG.4A;

FIG.5A is a side view of a circuit breaker of still another embodiment of the present invention; and

FIG.5B is a plan view thereof.

FIG.2A shows a preferred embodiment of a circuit breaker embodying the present invention. A fixed contact 4 and an arc runner 5 are fixed on a fixed arm 3. The fixed arm 3 is fixed by a bolt 12, and a folded tip part 31 of the fixed arm 3 is also fixed by a bolt 12. A movable contact 2 is provided on a movable arm 1. Plates 30 of an arc extinguish grid 30 are fixed to side plates 11 by caulking protrusions 50 provided at side part of the plates 30 after inserting the protrusions 50 into holes of the side plates 11. The plates 30 of the arc extinguish grid are made of magnetic material and their surfaces are aligned nearly perpendicular to an arc. An insulation film 32 covers a front part of both surfaces of each plate 30. Therefore, each plate 30 has an insulation part 32 and a metallic part 34. An arc-proof insulating paint, such as arc-proof epoxy coating paint (Limitrack: trademark of Ryoden Kasei), or liquid ceramic, is suitable for the insulation film 32. In this embodiment, the insulation film 32 is formed by dipping the arc plates 30 of the extinguish grid and the side plates 11 into a solution of the arc-proof insulating paint. The insulation film 32 covers the arc introducing part 30b of the

arc extinguish grid. In addition, when the caulked parts 50 are also covered with the arc-proof insulating paint, the caulked parts 50 are prevented from rusting.

There is often a trouble that powder is generated from the edge of each side plate 11 by vibration of the circuit breaker, this powder causing incomplete connection of contact. Such trouble is prevented by avoiding the generation of the powder by the arc-proof insulating paint.

Referring now to FIG.2A, operation of the circuit breaker is described hereafter. In a closing state, the movable contact 2 and the fixed contact 4 are contacting. When an over-current flows in a circuit, the movable contact 2 is disconnected from the fixed contact 4 by a known releasing device (not shown). At this time, an arc 9a is produced between the movable contact 2 and the fixed contact 4.

The arc extinguish grid is made of magnetic material such as iron and has a notch 30a for introducing the arc. Because the notch 30a is formed, lines of magnetic force are deflected (see FIG.1B). Therefore, the arc 9 is moved in the direction shown by an arrow A.

Even when the arc touches the insulation part 32 of the extinguish grid, thermoelectrons are not emitted from the arc extinguish grid since the arc-proof insulation film 32 is formed. Therefore, the arc does not stay, but is smoothly moved into the metallic part 34 of arc extinguish grid. When the arc 9 touches the metallic part 34 of the arc extinguish grid, the arc 9 is smoothly quenched.

In another embodiment, after dipping the arc extinguish grid into a solvent, an arc-proof insulating paint is formed to such a predetermined portion that the side plate 11 only is dipped wholly in the arc-proof insulating paint. In this embodiment, generation of powder from the edge of the side plate 11 due to vibration of the circuit breaker is prevented.

FIG.3A is a sectional view of a circuit breaker of another embodiment, and FIG.3B is a plan view thereof. In this embodiment, the insulation films 32 are formed in such a manner that the plates of the arc extinguish grid are covered by the insulation film 32 wider at the part near the arc-runner 5, but narrower at the portion far from the arc-runner 5.

Since those plates 30 of the arc extinguish grid which are nearer to the arc runner 5 have a higher liability of sticking by the arc than those farther therefrom (as has been described with reference to FIG.1A), the above-mentioned configuration of making the insulation film 32 wider near the arc-runners 5 than in other portions results in better prevention of the arc-staying at the arc extinguish grid.

FIG.4A is a sectional view of a circuit breaker of still another embodiment which is suitable for

high voltage and large current, and FIG.4B is a plan view thereof. In this embodiment, the insulation films 32 are formed at rear ends of the plates 30 of the arc extinguish grid.

In a closing state, the movable contact 2 is touching the fixed contact 4. When an over-current flows in a circuit, the movable contact 2 is disconnected from the fixed contact 4 by a known releasing device (not shown). At this time, an arc 9 arises between the movable contact 2 and the fixed contact 4.

The arc extinguish grid is made of magnetic material and has a notch 30a for introducing the arc. Because the notch 30a is formed, lines of magnetic force are deflected (see FIG.1B). Therefore, the arc 9 is moved in the direction shown by an arrow A. Finally, the arc 9 is moved into the rear ends of the arc extinguish grid. Because the rear ends of the plates of the grid are covered by the insulation film 32, shortcircuiting by an arc at the rear part as 9g in FIG.1A is prevented, and thus superior and stable breaking efficiency is obtainable.

FIG.5A and FIG.5B show still another modified embodiment, wherein the insulation film 32 covers a limited part behind the notch 30a of each plate 30 of the arc extinguish grid. In this embodiment, since a considerable metallic part 34 is exposed, arc contact time to the metallic part 34 of the arc extinguish grid is longer than that in the embodiment of FIG.4A. Therefore, the cooling and quenching of the arc is very efficient.

Claims

1. Circuit breaker, comprising

- [a] a fixed contact (4) provided on a fixed arm (3);
- [b] a movable contact (2) provided on an arm (1) which is movable by a releasing means so as to disconnect the two contacts (2, 4);
- [c] an arc-runner (5) the end of which is fixed to said fixed arm (3); and
- [d] an arc extinguishing grid positioned in the space above said arc-runner (5) and being formed by a plurality of plates (30) made of magnetic material, the surfaces of which are directed nearly perpendicular to an arc and which comprise a notch (30a) formed at the arc introducing end thereof which faces said two contacts (2, 4);

characterized in that

- [e] an insulation film (32) is formed on both surfaces of each plate (30) either at the area of said arc introducing end or at the area of the opposite end.

2. Circuit breaker according to claim 1, **characterized in that** said insulation film (32) is formed at said arc introducing end, wherein the size of the area of said insulation film (32) is the smaller the more the respective plate (30) is distant from said arc-runner (5).

3. Circuit breaker according to claim 1 or 2, **characterized in that** all plates (30) of said grid are fixed to a pair of side plates (11) by means of caulking protrusions (50) which are inserted into corresponding holes of said side plates (11), wherein said caulking protrusions (50) are also covered by said insulation film.

4. Circuit breaker according to one of claims 1 to 3, **characterized in that** said insulation film (32) is formed by a dip-coat layer.

Patentansprüche

1. Schutzschalter mit

[a] einem festangebrachten Kontakt (4), welcher auf einem festangebrachten Arm (3) vorgesehen ist;

[b] einem beweglichen Kontakt (2), welcher auf einem Arm (1) vorgesehen ist, welcher durch eine Freigabeeinrichtung beweglich ist, um die zwei Kontakte (2, 4) abzutrennen;

[c] einer Lichtbogen-Führungsschiene (5), deren Ende an dem festangebrachten Arm (3) befestigt ist; und

[d] einem Lichtbogen-Löschgitter, welches in dem Raum oberhalb der Lichtbogen-Führungsschiene (5) angeordnet ist und durch eine Mehrzahl von Platten (30) gebildet ist, welche aus magnetischem Material gefertigt sind, deren Oberflächen nahezu senkrecht auf einen Lichtbogen gerichtet sind, und welche eine Kerbe (30a) aufweisen, die an dem Lichtbogen einführenden Ende davon gebildet ist, welches den zwei Kontakten (2, 4) gegenübersteht;

dadurch gekennzeichnet, daß

[e] eine Isolationsschicht (32) auf beiden Oberflächen jeder Platte (30) entweder an dem Gebiet des Lichtbogen einführenden Endes oder an dem Gebiet des entgegengesetzten Endes gebildet ist.

2. Schutzschalter nach Anspruch 1, dadurch gekennzeichnet, daß die Isolationsschicht (32) an dem Lichtbogen einführenden Ende gebildet ist, wobei die Größe des Gebiets der Isolationsschicht (32) kleiner ist, je weiter die jeweilige Platte (30) von der Lichtbogen-Führungsschiene (5) entfernt ist.

3. Schutzschalter nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß alle Platten (30) des Gitters an einem Paar von Seitenplatten (11) mittels vorstehenden Versetzungsteilen (50) befestigt sind, welche in entsprechende Löcher der Seitenplatten (11) eingesetzt sind, wobei die hervorstehenden Versetzungsteile (50) ebenso durch die Isolationsschicht bedeckt sind. 5
4. Schutzschalter nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Isolationsschicht (32) durch eine Tauchüberzugsschicht gebildet ist. 10
4. Disjoncteur selon l'une des revendications 1 à 3, caractérisé en ce que ledit film d'isolation (32) est formé par une couche de revêtement trempée. 15

Revendications

1. Disjoncteur, comprenant
- [a] un contact fixe (4) prévu sur un bras fixe (3); 20
 - [b] un contact mobile (2) prévu sur un bras (1) qui est déplaçable par un moyen de relâchement de façon à déconnecter les deux contacts (2, 4);
 - [c] un passage d'arc (5) dont l'extrémité est fixée audit bras fixe (3); et 25
 - [d] une grille d'extinction d'arc positionnée dans l'espace au-dessus dudit passage d'arc (5) et formée par une pluralité de plaques (30) réalisées en matériau magnétique dont les surfaces sont dirigées presque perpendiculairement à un arc et qui comprennent une encoche (30a) formée à son extrémité d'introduction d'arc qui est orientée vers lesdits deux contacts (2, 4); 30
 - caractérisé en ce que 35
 - [e] un film d'isolation (32) est formé sur les deux surfaces de chaque plaque (30), soit à la zone de ladite extrémité d'introduction d'arc, soit à la zone de l'extrémité opposée. 40
2. Disjoncteur selon la revendication 1, caractérisé en ce que ledit film d'isolation (32) est formé à ladite extrémité d'introduction d'arc, dans lequel la dimension de la zone dudit film d'isolation (32) est d'autant plus petite que la plaque respective (30) est éloignée dudit passage d'arc (5). 45
3. Disjoncteur selon la revendication 1 ou 2, caractérisé en ce que toutes les plaques (30) de ladite grille sont fixées à une paire de plaques latérales (11) au moyen de saillies étanches (50) qui sont insérées dans des trous correspondants desdites plaques latérales (11), dans lequel lesdites saillies étanches (50) sont également couvertes par ledit film d'isolation. 50
- 55

FIG. 1A (Prior Art)

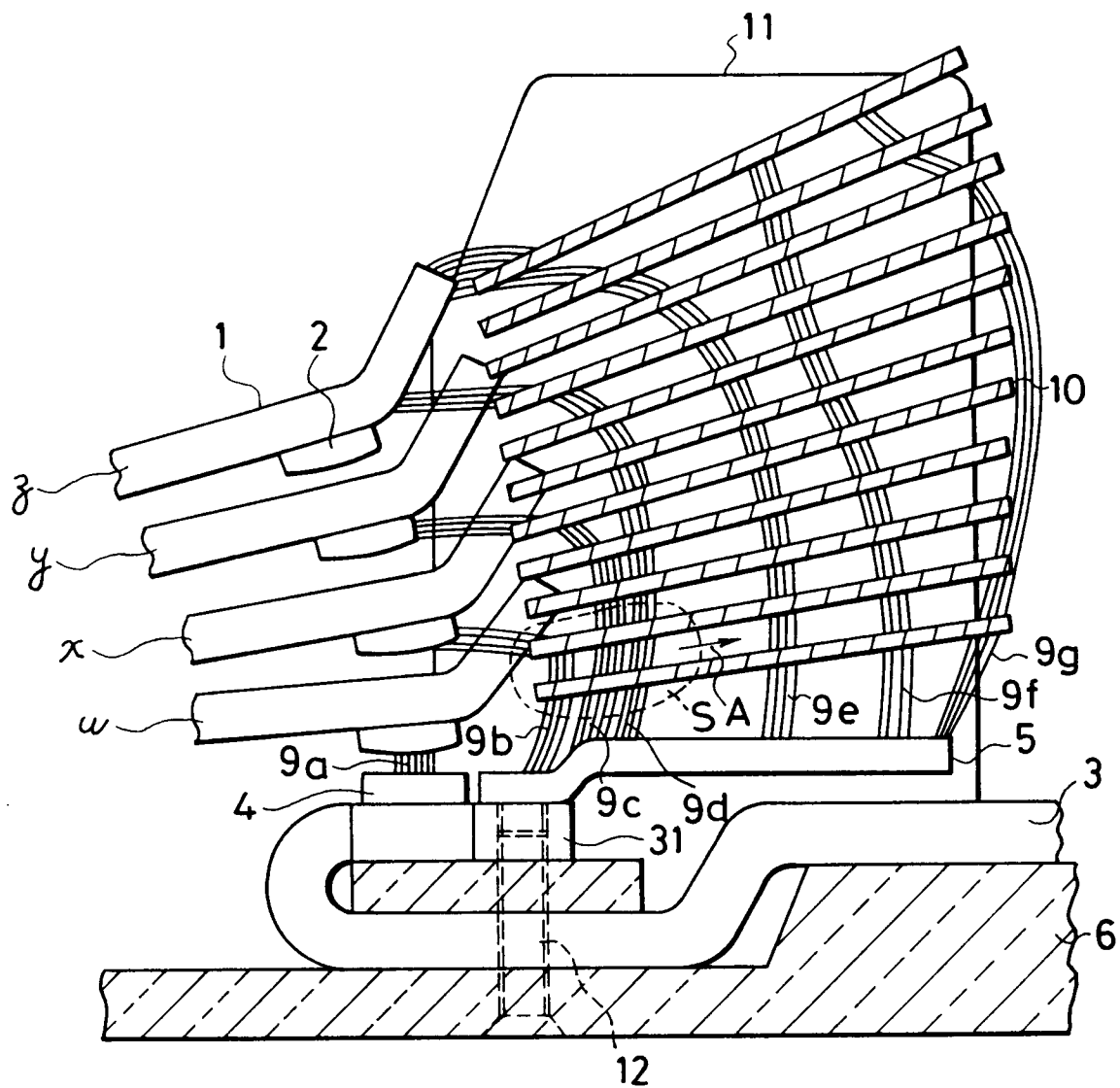
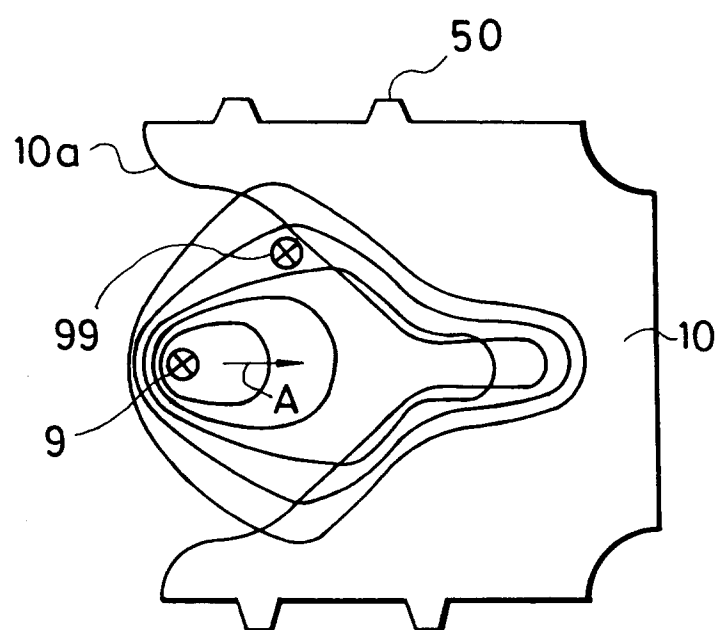


FIG. 1B (Prior Art)



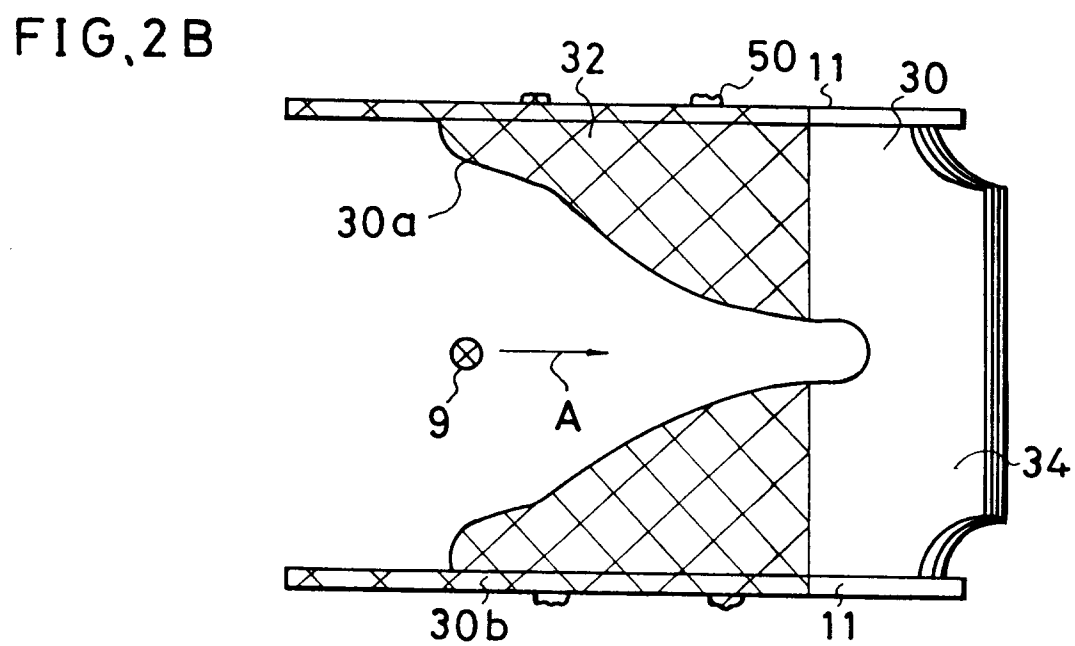
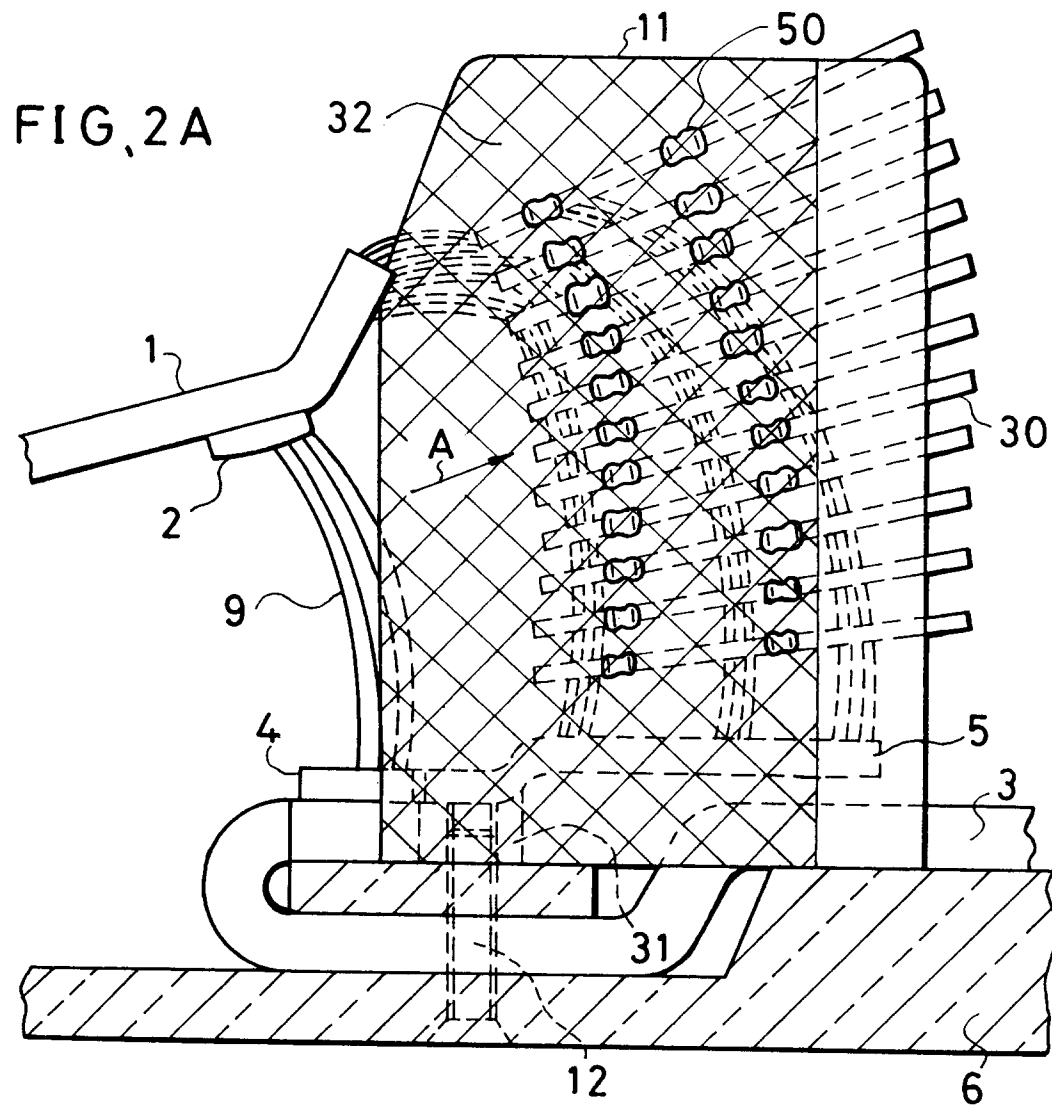


FIG. 2C

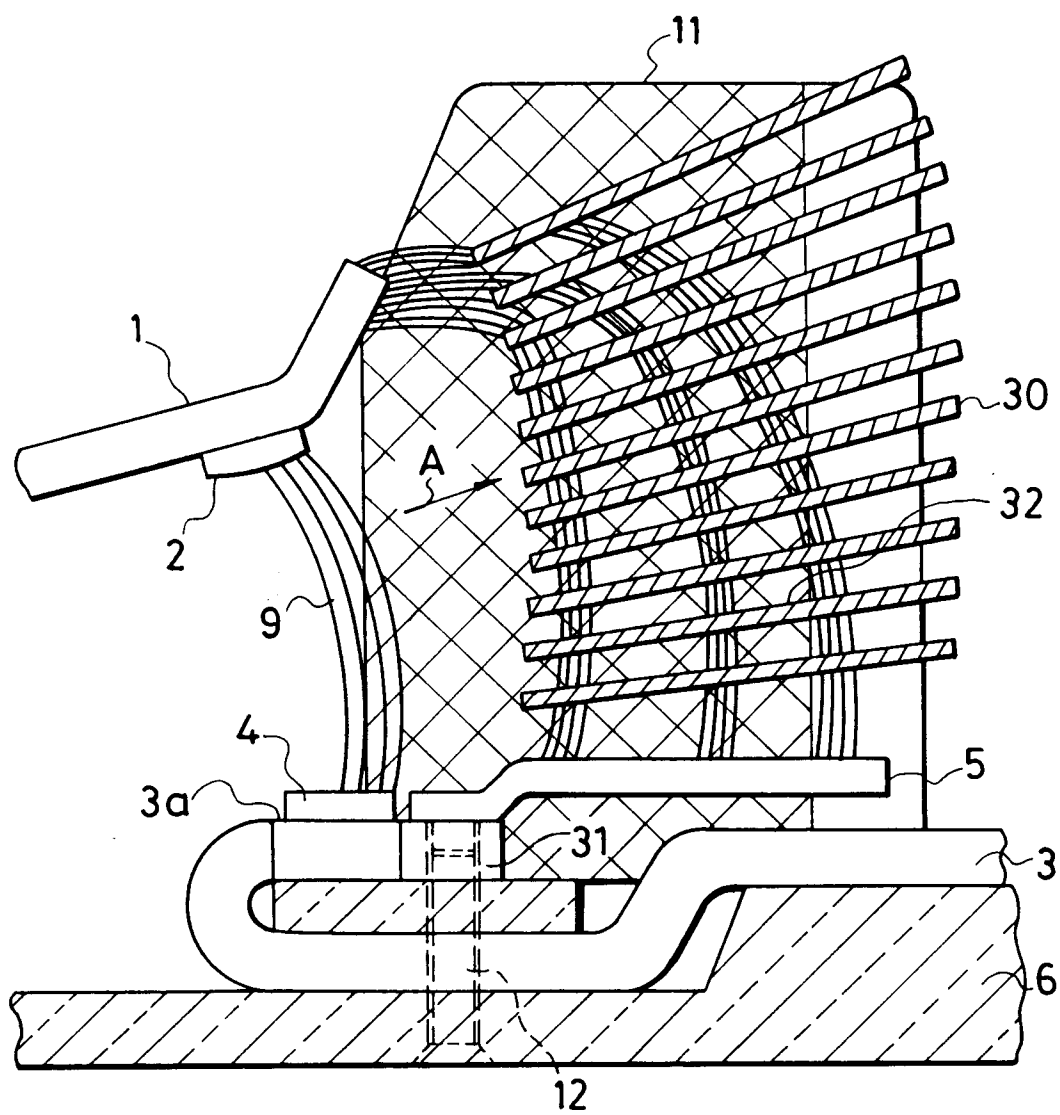


FIG. 3A

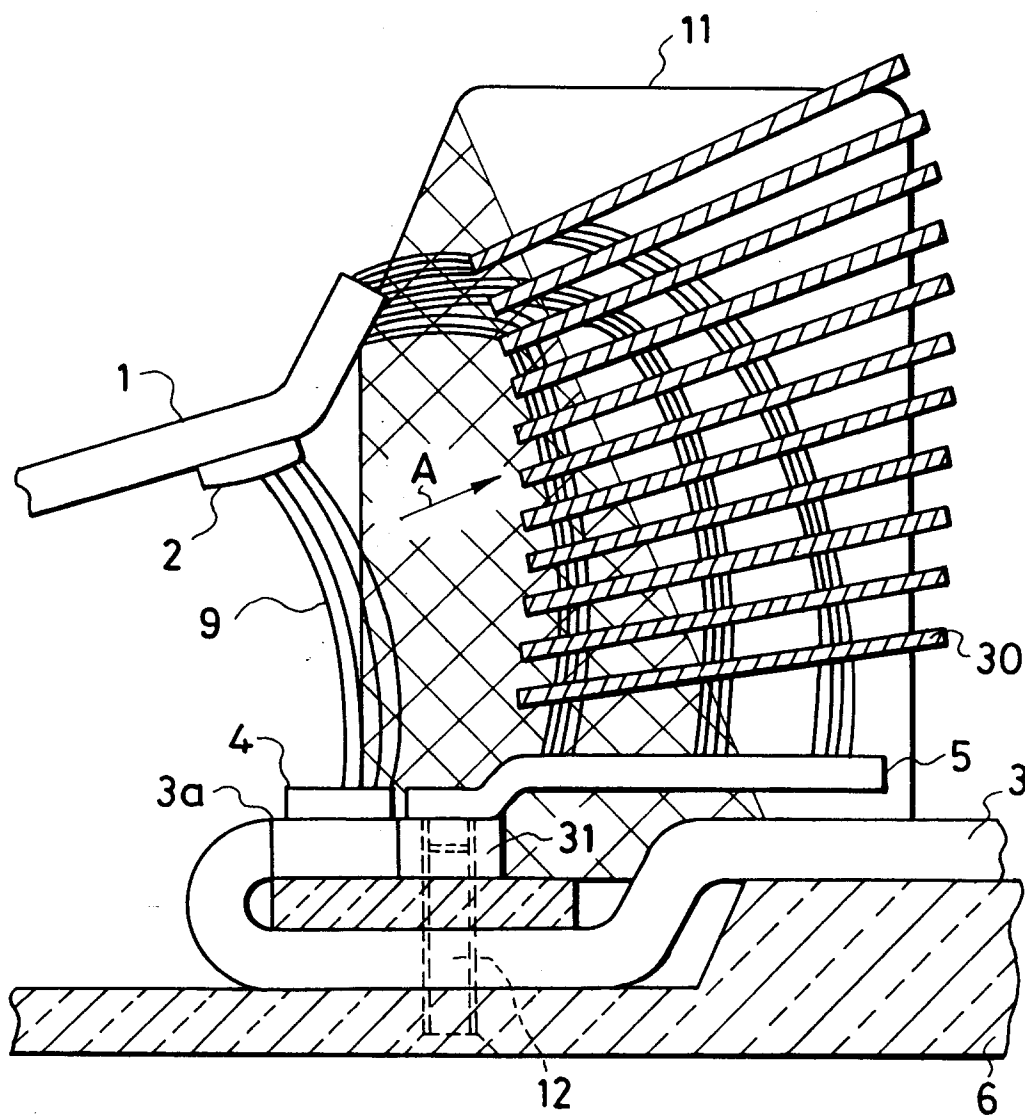


FIG. 3B

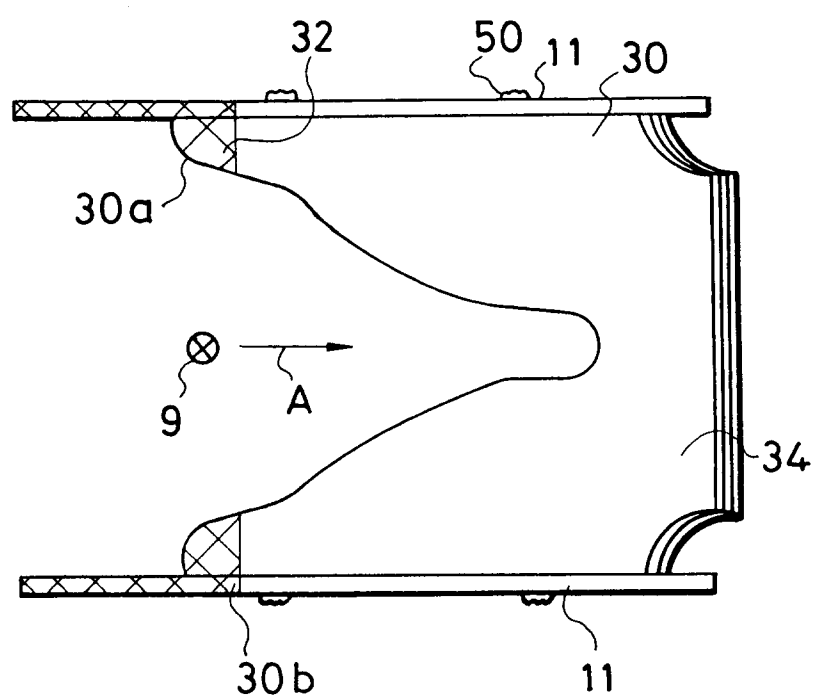


FIG. 4A

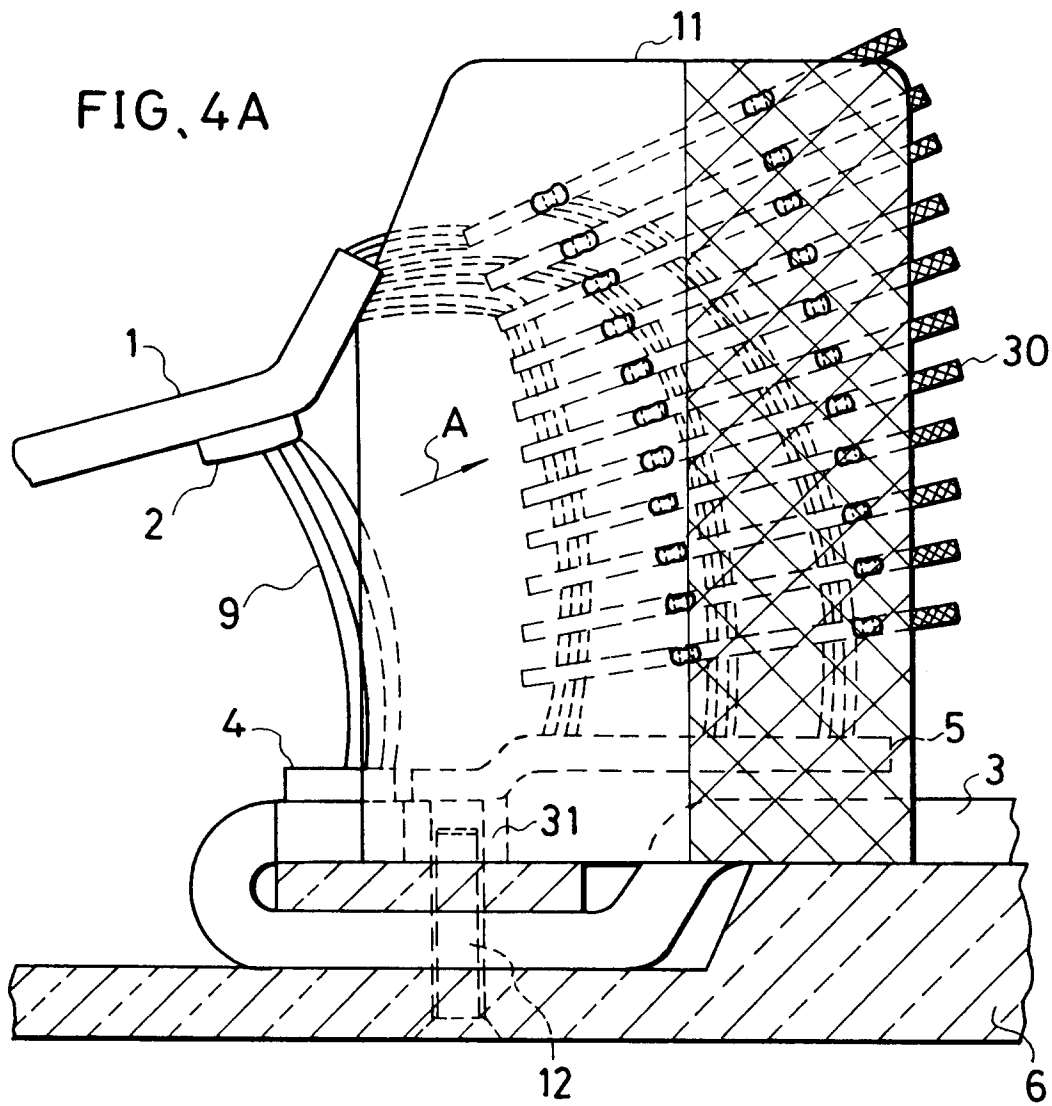


FIG. 4B

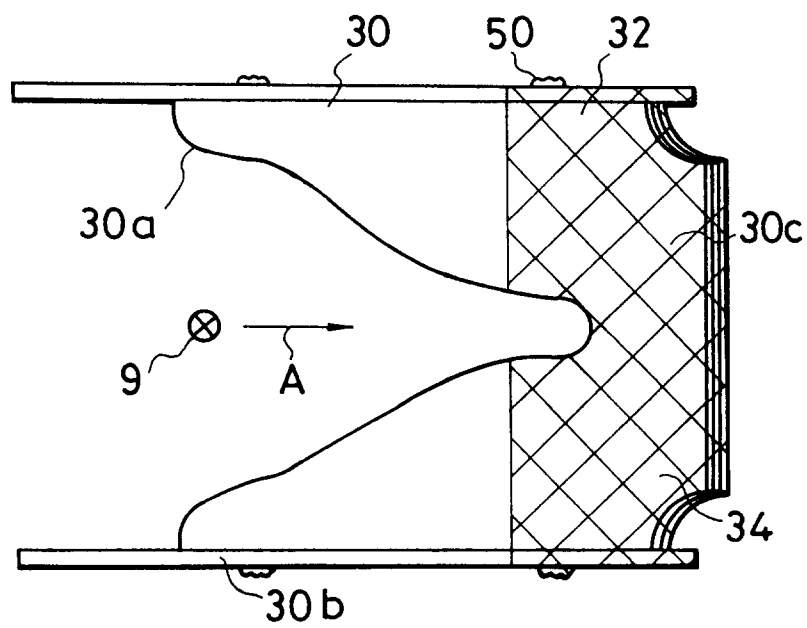


FIG. 5A

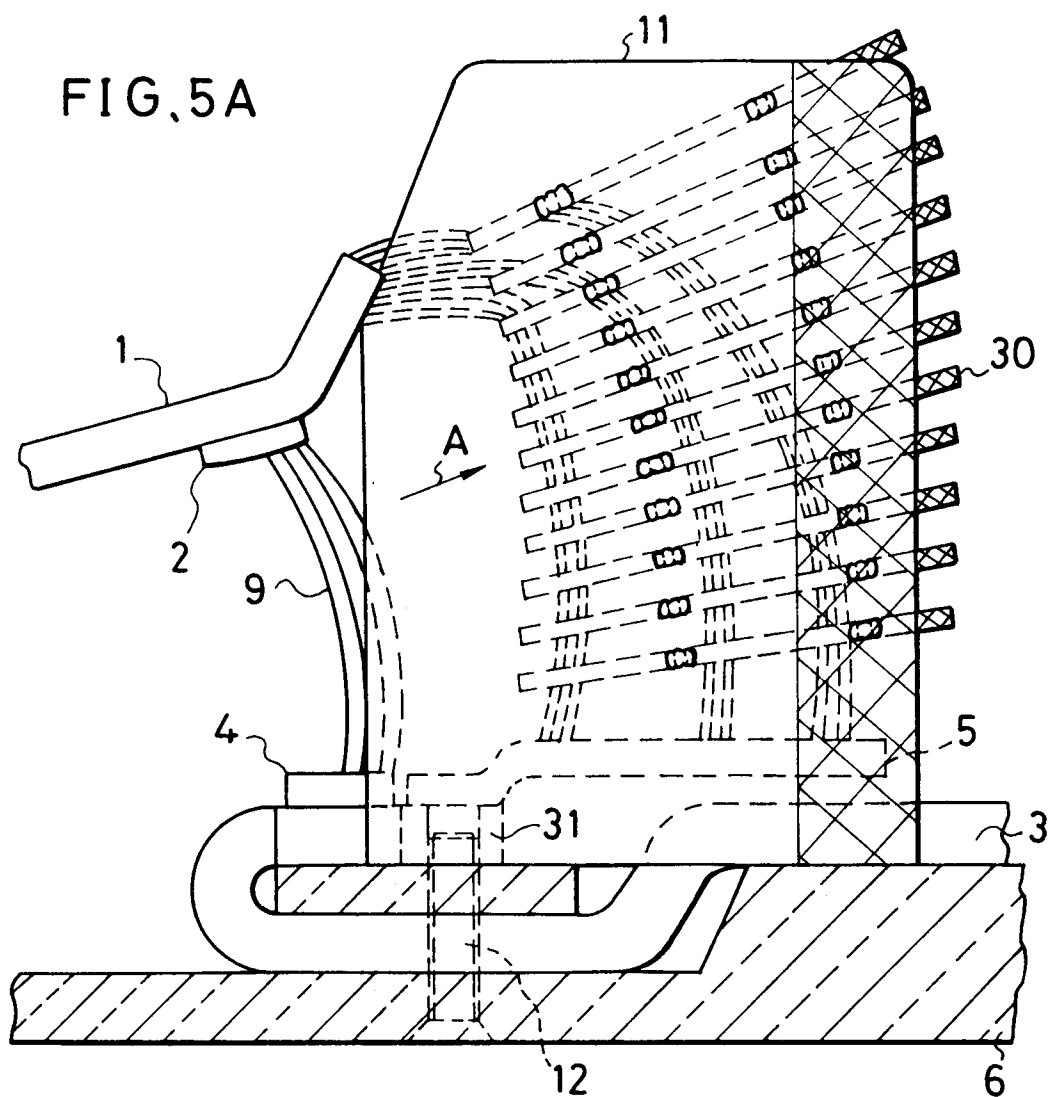


FIG. 5B

