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(54) Automatic thermo-magnetic switch for domestic and similar applications

(57) An automatic thermo-magnetic switch for domestic and similar applications able to "carry" for equal volume a nominal current greater by at least 50% than the higher nominal current "carried" by conventional automatic thermo-magnetic switches.

The element for thermal protection (TE) against overloads comprises an indirectly heated bimetallic strip (L), while the heat which is developed inside the switch when this switch is traversed by current is at least partially dispelled by the means (G1,G2) for extinguishing the electric arc which is created upon opening the switch.

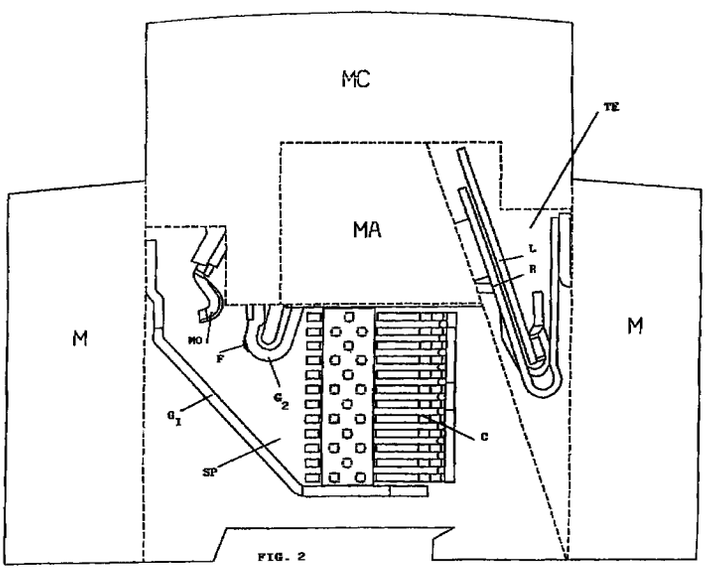

FIG. 2

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Description

The invention relates to an automatic thermo-magnetic switch for domestic and similar applications, which is able to "carry" for equal volume a nominal current greater by at least 50% than the higher nominal current "carried" by conventional automatic thermo-magnetic switches for domestic and similar applications.

Automatic thermo-magnetic switches for domestic and similar applications and their operation will not be described in detail here since these are well-known apparatus widely available on the market: it is merely recalled that such switches comprise:

- a pair of terminals to which the conductors, which make up the electrical circuit into which the switch is inserted, are connected;
- mechanical means manually actuatable by the user for closing and opening the switch, i.e. for bringing the moving contact towards and away from the fixed contact;
- thermal means for opening the switch, by actuating the mechanical means, in response to a current overload;
- magnetic means for opening the switch, by actuating the mechanical means, in response to a short-circuit; and
- means comprising the so-called "arc runners" or "arc chutes" which are able to extinguish the electric arc which is struck between the fixed and moving contacts of the switch upon opening this switch.

The thermal means have a relatively long response time and anyway much longer than that of the magnetic means, which have to respond almost instantaneously to a short-circuit so as to protect the user from overvoltages and/or from the thermal and electrodynamic effects associated with the overcurrents due to the short-circuit.

Furthermore, automatic thermo-magnetic switches for domestic and similar applications are normally of modular type so that they can be mounted in packages with standardized dimensions: these have a preset depth, substantially corresponding to the internal dimension of the aforesaid packages and their width must be an integer multiple of a preset value or modulus m (m = 17.5 mm).

Automatic thermo-magnetic switches for domestic and similar applications having a width of 1 modulus and which are able to "carry" a nominal current of not greater than 63 amperes are known and available on the market; thus the subject of the present invention is an automatic thermo-magnetic switch for domestic and similar applications having a width of 1 modulus and able to "carry" a nominal current of the order of 100 amperes, i.e. a nominal current greater by at least 50% than the higher nominal current "carried" for equal volume by conventional automatic thermo-magnetic switches for domestic and similar applications.

The subject of the present invention is an automatic thermo-magnetic switch for domestic and similar applications comprising: a pair of terminals to which the conductors, making up the electrical circuit into which the said switch is inserted, are connected; mechanical means able to close and to open the switch, said mechanical means being manually actuatable by the user; thermal means able to open said switch, by actuating said mechanical means in response to a current overload; magnetic means able to open said switch, by actuating said mechanical means in response to a short-circuit; and means able to extinguish the electric arc which is struck between the contacts of said switch upon opening the said switch which is able to "carry", for equal volume, a nominal current of around 100 amperes and anyway of between 80 and 125 amperes.

In this switch, the thermal means consist of an indirectly heated bimetallic strip and the means of extinguishing the electric arc are able at least partially to dispel the heat which is developed inside the switch when the switch is closed.

The automatic thermo-magnetic switch of the present invention comprises:

- a pair of terminals (M) to which the conductors, making up the electrical circuit into which the said switch is inserted, are connected;
- mechanical means (MC) able to close and to open said switch, said mechanical means (MC) being manually actuatable by the user;
- thermal means (TE) able to open said switch, by actuating said mechanical means (MC) in response to a current overload;
- magnetic means (MA) able to open said switch, by actuating said mechanical means (MC) in response to a short-circuit; and
- means (SP) able to extinguish the electric arc which is struck between the contacts (F, MO) of said switch upon opening said switch. The automatic thermo-magnetic switch of the present invention is characterized in that said thermal means (TE) comprise an indirectly heated bimetallic strip and in that said means of extinguishing (SP) said electric arc are able at least partially to dispel the heat which is developed inside said switch when said switch is closed.

Further characteristics and advantages of the present invention will be better described with reference to a non-limiting embodiment illustrated in the appended Figures, wherein:

- Figure 1 shows a block diagram of an automatic thermo-magnetic switch for domestic and similar applications of conventional type, wherein the means for extinguishing the electric arc are schematically illustrated;

- Figure 2 shows a block diagram of an automatic thermo-magnetic switch for domestic and similar applications according to the present invention, wherein the thermal means and the means for extinguishing the electric arc according to the invention are schematically illustrated;
- Figure 3 shows a top view and a cross-section of a segment of a first arc chute of known type;
- Figure 4 shows a top view and a cross-section of a segment of a second arc chute of known type;
- Figure 5 shows a top view and a cross-section of a segment of a first arc chute according to the invention;
- Figure 6 shows a top view and a cross-section of a segment of a second arc chute according to the invention.

In the appended Figures, corresponding elements will be identified by the same alphanumeric references.

Figure 1 shows a block diagram of an automatic thermo-magnetic switch for domestic and similar applications of known type; Figure 1 depicts by means of functional blocks, which are not further described since they are known per se:

- the terminals M to which are connected conductors (not shown in the Figure) of the electrical circuit into which the switch is inserted;
- mechanical means MC manually actuatable by the user able to close and to open the switch by bringing the moving contact MO towardsand away from the fixed contact F;
- the thermal means TE able to open the switch, by actuating the mechanical means MC, in response to a current overload;
- the magnetic means MA, able to open the switch, by actuating the mechanical means MC, in response to a short-circuit;
  the means for extinguishing SP the electric arc which is struck between the fixed contact F and the moving contact MO upon opening the switch and which "jumps" onto the arc chutes G (G_1, G_2), along which it travels until it reaches the so-called "deionizing-chip vent" C (known per se), where it is quenched, are schematically illustrated.

In the switch of Figure 1, the arc chute G_2 constitutes the extension of the fixed contact F.

In the known switch of Figure 1, the shape of the arc chutes G (G_1, G_2) and the material, for example: iron, from which they are made are chosen exclusively on the basis of their task of making the "toes" of the electric arc travel with the greatest possible speed from the contacts (F, MO) to the vent C. A top view and a cross-section of two segments of arc chutes G of known type are illustrated in Figures 3 and 4.

Figure 2 shows a block diagram of an automatic thermo-magnetic switch for domestic and similar applications according to the invention, wherein the thermal means TE and the means for extinguishing SP the electric arc according to the invention are schematically illustrated, while functional blocks are used to represent the terminals M, the mechanical means MC and the magnetic means MA, substantially equivalent to the corresponding functional blocks of the switch of Figure 1.

A switch according to the invention is able to "carry" a nominal current of around 100 amperes and anyhow of between 80 and 125 amperes.

The thermal means TE consist of an indirectly heated bimetallic strip L: in Figure 2 the bimetallic strip L is illustrated; said bimetallic strip, in response to the overload current, actuates the mechanical means MC in a manner known per se and is indirectly heated by radiation from the resistive element R traversed by the current which passes through the switch.

In the switch of Figure 2 the arc chute G_1 is metallically connected in a manner known per se, but not illustrated in Figure 2, to one of the terminals M, while the arc chute G_2 constitutes the extension of the fixed contact F. The shape of the aforesaid arc chutes G (G_1, G_2) and the materials exhibiting good magnetic characteristics and high thermal capacity (for example: iron, copper and/or their alloys) from which they are made are therefore chosen in such a way that the arc chutes G (G_1, G_2) are able both to carry the "toes" of the electric arc, when present, from the contacts (F, MO) to the vent C, and to dispel the overtemperature of the current-conducting elements (mainly the fixed F and moving MO contacts and the terminal M linked to the arc chute G_1). The overtemperature for equal volume is decreased to around the same values as may be encountered in a switch of known type. Said overtemperature is generated by the heat which is developed, when the switch is closed and traversed by current, as a consequence of the contact resistances present between the terminal M to which the arc chute G_1 is linked and the conductor adjoining this terminal M, and between the contacts (F, MO) of the switch.

It is expedient that this heat, which is non-negligible in view of the relatively high nominal current and of the small dimension of the switch according to the invention, to be removed so as to be able to comply with the limits laid down by the product Standards for the particular parts (terminals, casing, etc.) and for the correct operation and reliability of the kit.

By comparing Figures 1 and 2 it may be observed that the arc chutes G of Figure 2 have a suitable thickness, approximately double the arc chutes G of Figure 1; further characteristics of arc chutes G made according to the invention will be described with reference to the two segments of arc chutes G illustrated in Figures 5 and 6.

Figures 1 and 2 are drawn in the same scale: by comparing these figures it may be observed that the functional blocks (M, MC, MA, TE, SP) which make up the two switches have the same layout and the same

dimensions. The two switches therefore have the same performance as regards response times to a short-circuit and to an overload, while the thermal means TE and the means of extinction SP made according to the invention enable the switch of Figure 2 to "carry" a nominal current of the order of 100 amperes.

The use of a indirectly heated bimetallic strip L to make the thermal means TE according to the invention is particularly advantageous since it does not entail the use of "braided wires" and/or of other flexible linking means which, if dimensioned so as to carry a nominal current of around 100 amperes, would be too rigid (for equal dimensions of the thermal means TE) to allow correct operation of the said thermal means TE and/or so bulky as to make it impossible (or, at least, extremely difficult) to place the thermal means TE in the narrow space available.

Figure 3 shows a top view and a cross-section view on the plane A-A of a segment of the first arc chute G of conventional type, having a rectangular cross-section.

Figure 4 shows a top view and a cross-section view through the plane B-B of a segment of a second arc chute G of conventional type, which exhibits a longitudinal ridge R on which one of the "toes" of the electric arc moves when the arc is carried from the zone of the contacts (MO, F) of the switch to the vent C.

Figure 5 shows a top view and a cross-section view through the plane C-C of a segment of a first arc chute G, made according to the invention, which exhibits a longitudinal central ridge R on which one of the "toes" of the electric arc moves and one or more series of apertures A made in each of the zones located at the sides of the longitudinal central ridge R (which are of no relevance to the "toes" of the electric arc) so as to increase the useful surface for dissipating the heat.

In the embodiment of Figure 5 the apertures A are of circular shape but, without departing from the scope of the invention, it is possible to make apertures A of square, rectangular, rhomboidal shape and/or of some other shape in the side zones of the arc chute G.

Figure 6 shows a top view and a cross-section view through the plane D-D of a segment of a second arc chute G, made according to the invention, which exhibits a "C" cross-section so as to increase the heat-dispersing surface and a longitudinal ridge R located at the centre of the arc chute G.

In the embodiment of Figure 6 the side zones of the arc chute G do not have apertures A but, without departing from the scope of the invention, it is possible to make apertures A of circular, square, rectangular, rhomboidal shape and/or of some other shape in the side zones of the arc chute G.

Without departing from the scope of the invention it is also possible for the arc chutes G to be given shapes and/or dimensions which differ from those illustrated by way of non-limiting examples in Figures 5 and 6.

The present invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concepts. The materials employed, so long as they are compatible with the specific use, as well as the contingent shapes and dimensions, may be any according to requirements.

Claims

1. Automatic thermo-magnetic switch for domestic and similar applications, comprising:

   - a pair of terminals (M) to which the conductors, making up the electrical circuit into which the said switch is inserted, are connected;
   - mechanical means (MC) able to close and to open said switch, said mechanical means (MC) being manually actuatable by the user;
   - thermal means (TE) able to open said switch, by actuating said mechanical means (MC) in response to a current overload;
   - magnetic means (MA) able to open said switch, by actuating said mechanical means (MC) in response to a short-circuit; and
   - means (SP) able to extinguish the electric arc which is struck between the contacts (F, MO) of said switch upon opening said switch;

   characterized in that said thermal means (TE) comprise an indirectly heated bimetallic strip and in that said means of extinguishing (SP) said electric arc are able at least partially to dispel the heat which is developed inside said switch when said switch is closed.

2. Switch according to Claim 1, characterized in that it is able to carry a nominal current of between 85 and 125 amperes.

3. Switch according to Claim 2, characterized in that it is able to carry a nominal current of around 100 amperes.

4. Switch according to Claim 1 characterized in that said means of extinguishing (SP) the said electric arc comprise a pair of arc chutes (G_1, G_2), said arc chutes (G_1, G_2) being made with materials exhibiting good magnetic characteristics and high thermal capacity.

5. Switch according to Claim 4, characterized in that said arc chutes (G_1, G_2) have a longitudinal central ridge (R) and at least one series of apertures (A) made in the zones of said arc chute (G_1, G_2) which are located at the sides of said longitudinal central ridge (R).

6. Switch according to Claim 4, characterized in that said arc chutes (G_1, G_2) have a "C" cross-section and a longitudinal central ridge (R).

7. Switch according to Claim 6, characterized in that it has at least one series of apertures (A) made in the zones of said arc chute (G_1, G_2) which are located at the sides of said longitudinal central ridge (R).

8. Switch according to Claim 5 or 7, characterized in that said apertures (A) are of circular, square, rectangular and/or rhomboidal shape.

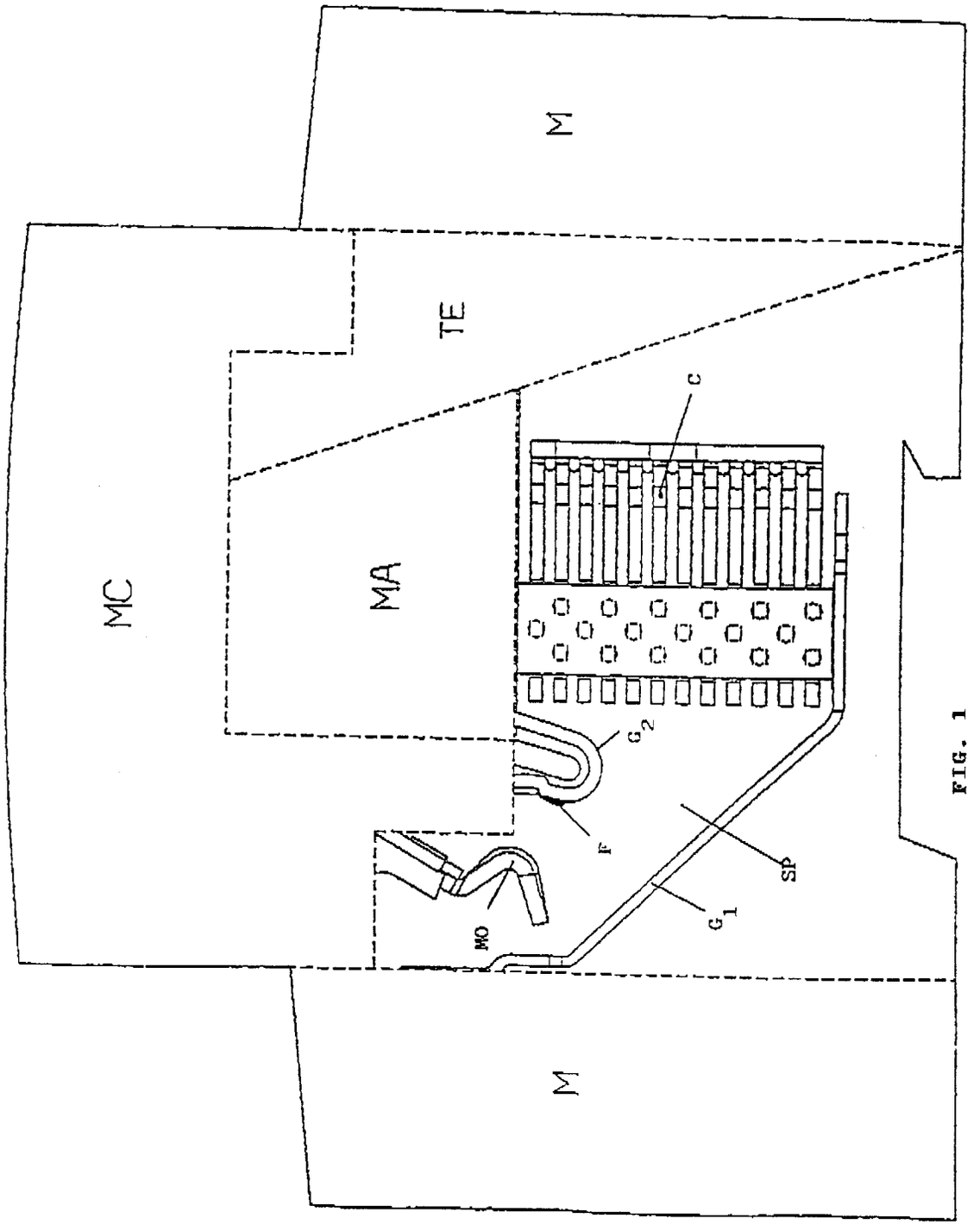

FIG. 1

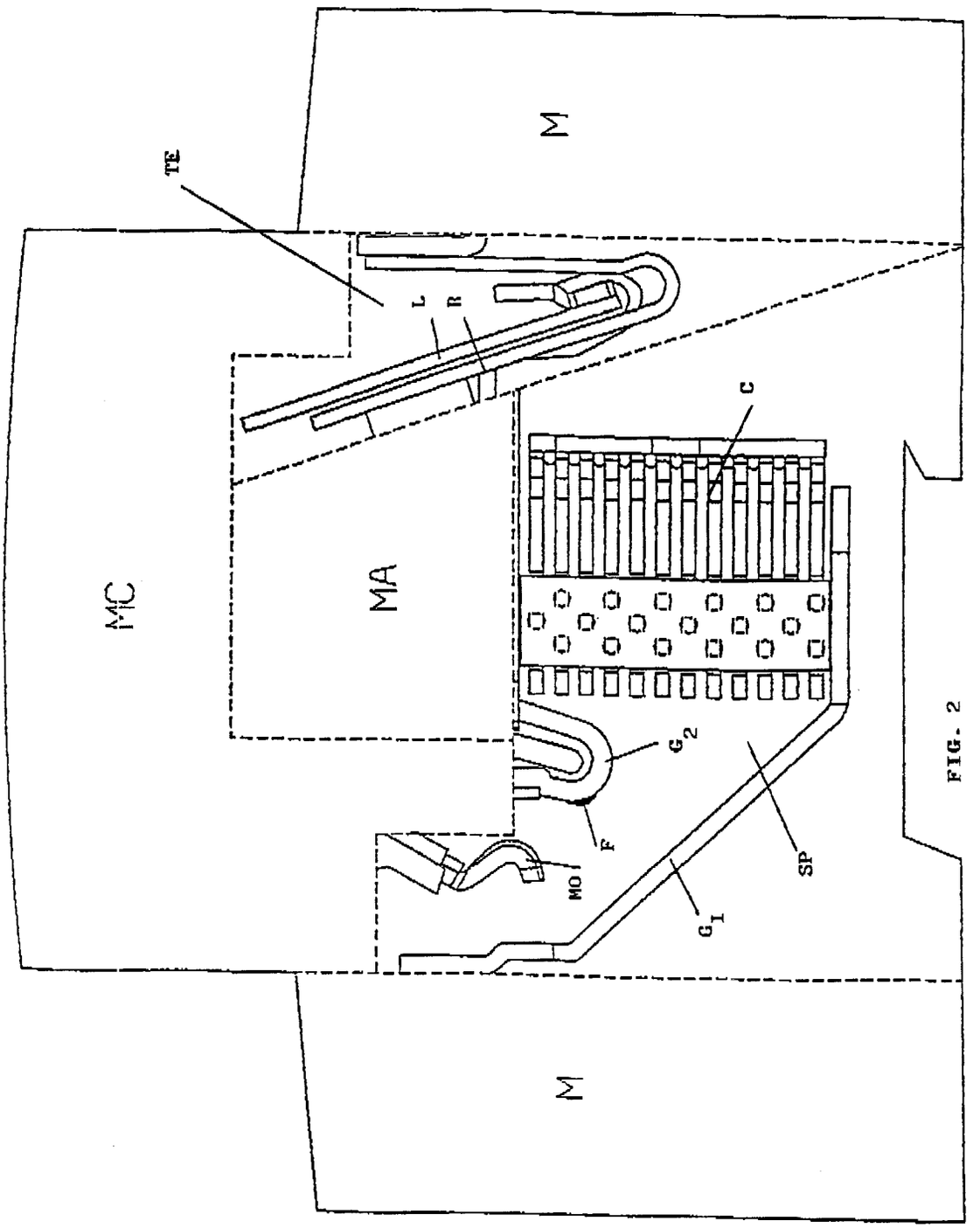

FIG. 2

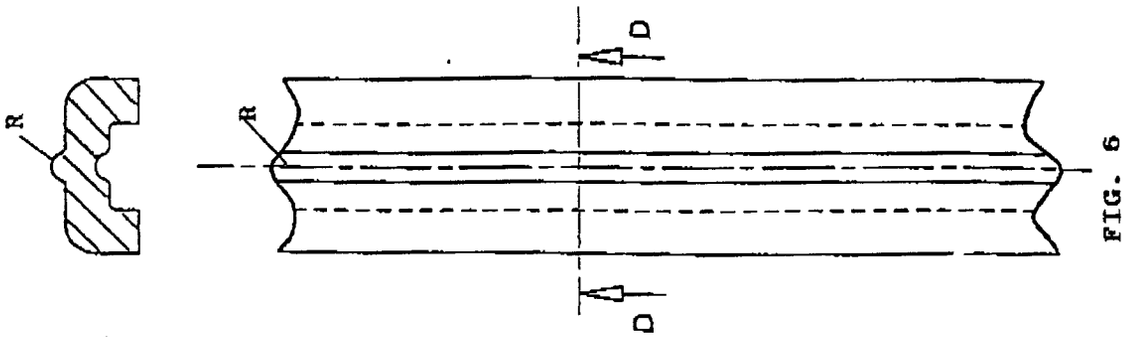

FIG. 6

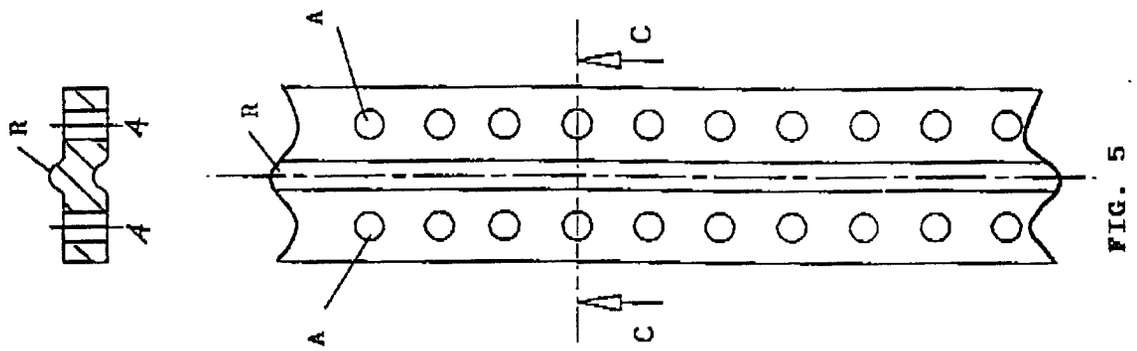

FIG. 5

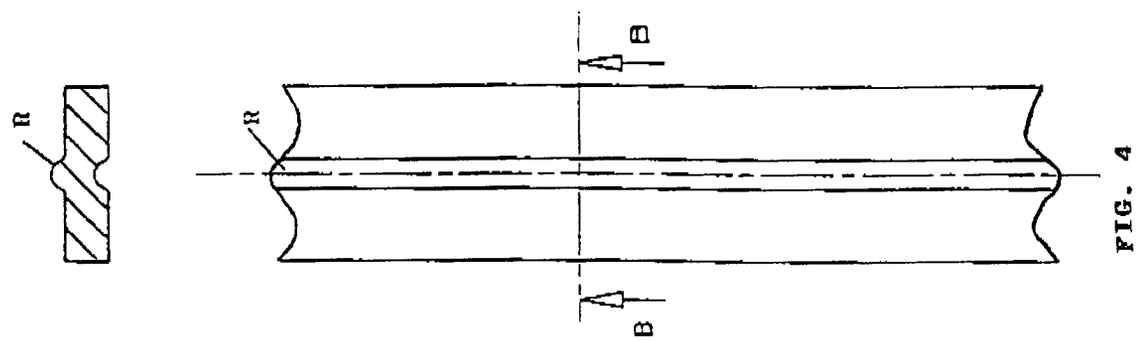

FIG. 4

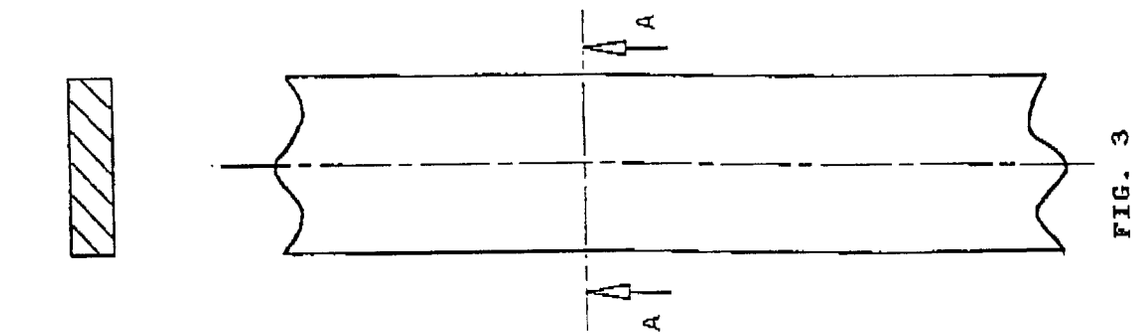

FIG. 3