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(54) **Electrical cartridge fuselinks and a method of manufacturing same.**

(57) An electrical cartridge fuselink of the type wherein a fusible member (5) is mounted within an insulating barrel (1), which at both of its ends is provided with a conductive end cap (7) which is electrically connected to the associated end of the fusible member (5). According to the subject invention said fusible member (5) is held in a central position between two centering members (2) which are secured to the associated ends of said barrel (1). By an appropriate design of these centering members (2) a reliable and reproducable, electrical and mechanical connecting can be established between the respective end of said fusible member (5) and its associated end cap (7) through the intermediary of the associated centering member (2) and solder (6, 8) which is also effective in providing an effective mechanical connection between the end caps (7) and their associated barrel ends.

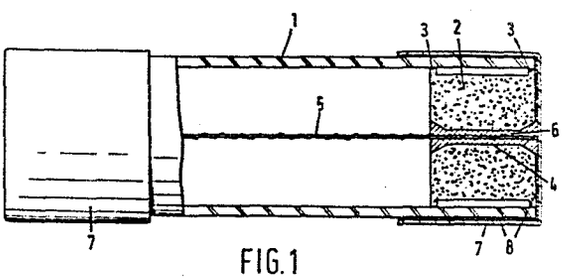

FIG.1

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Electrical cartridge fuselinks and a method of manufacturing same.

This invention relates to electrical cartridge fuselinks and a method for producing same. More in particular this invention relates to cartridge fuselinks intended to rupture at low current values, ranging e.g. from 20 mA - 10 A.

In general such cartridge fuselinks comprise a tubular casing or barrel, a fusible element disposed therein, and two end caps closing said casing or barrel at both of its ends.

In a well known type of fuselink, the respective end portions of the fusible member or fusible element, are electrically connected to their respective end caps by means of solder.

US patent 1,922,642 describes a fuselink of the above-identified type, wherein the fuse element comprises a metal coating disposed on and supported by an extremely thin fibre. The end cap members are rigidly secured at either end of a tubular casing by means of a lump of solder. Wires or supporting wires are rigidly secured in the solder and extend into said casing in such a manner that their inner end portions are spaced apart from each other. Through said lumps of solder said wires which form part of the fusible element, and also a small filament connecting these wires at their inner end, are electrically connected to said end caps.
The manner in which these various elements are assembled, however, is rather complicated and time consuming. Therefore this prior art fuse construction is unsuitable for automated manufacture and assembly processes. Moreover, the tubular casing is required to have an integral inwardly extending projection at either end which means a further complication as to structure and manufacturing process.

US patent 3,845,439 relates to a method of manufacturing electric cartridge fuselinks, and more in particular fuselinks intended to rupture at current values of 20mA to 10 A. In these prior art fuselinks, a fusible wire of silver of extremely small diameter is wound around a substantially straight core of fibre material. By using the rigidifying effect of a coating of thermosetting material on the fibre material, microwire can be wound on extremely thin cores so that well defined fuselinks for low current values are obtained. In fuselinks manufactured in accordance with this prior art method, the conductive connections between the fusible wire and the metal end caps which are cemented at either end of the tubular casing, is provided by means of a solder alloy. The fuse element is positioned within the tubular casing by means of eyelets. This prior art structure is unsuitable for manufacturing processes by which the various parts are automatically and reliably assembled.

A similarly structured fuselink is known from Dutch patent application 79,00862. This prior art has the same deficiencies as outlined above.

European patent application 00 30 157 describes a method of manufacturing cartridge fuselinks which facilitates the use of mass production techniques, while enabling the production of relatively inexpensive fuselinks of an improved construction. More in particular this prior art is directed to fuselinks intended to rupture at low current values, and to a manufacturing method which is especially suitable for mass production of such fuselinks. To facilitate the manufacturing of such fuselinks having small diameter fuse wires and to improve their operational reliability, this prior art proposes to dispose a fusible wire along a strip of insulating material, adhering metallic layers to the fusible wire and strip at spaced zones along the strip so as to

attach the fusible wire to the strip, and separating the fusible wire and strip at the spaced attachment zones so as to produce fuse elements having fusible wires attached at opposite ends to insulating supports by metallic layers. To assemble a fuselink according to this prior art, one metal end cap having a slug of solder adhered to its inside circular surface is firstly fastened over one end of the barrel and then the fuse element produced in the above described manner, and which is of substantially the same length as the barrel, is inserted into the barrel and its end adjacent to the cap is soldered thereto by the application of heat and a light pressure. Thereafter the second end cap having a slug of solder adhered to its inside bottom surface is fastened in position over the opposite end of the barrel with the application of heat and pressure so as to solder the adjacent end of the fuse element to this second end cap.

With the above prior art the end caps are cemented on either end of the barrel. Thereby in addition to the soldering step for establishing the desired electrical connections, an additional step is required for fastening these end caps in their position on the associated barrel ends. Moreover this prior art structure does not ensure reliable and reproducable electrical connections between the fusible wire and the end caps. Also the necessity of attaching the opposite ends of a fusible wire to an insulating support severely restricts the range of design parameters determining the current ratings and current-time characteristics of this known fuselink structure.

Now it is an object of the subject invention to provide a cartridge fuselink of the type comprising a fusible wire or other fusible member, an insulating barrel having said wire or said member disposed therein, and end caps or terminals mounted on either end of said barrel and each electrically connected to an associated end portion of

said wire or said member, of an improved structure by which the deficiencies of the prior art as discussed above, are effectively overcome.

More in particular it is an object of this invention to provide a cartridge fuselink which due to its structure can be readily manufactured and assembled by a fully automated process and with a large flexibility as to desired characteristics, i.e. range of rated currents and/or time-current characteristics, while meeting the close tolerances required by current practice.

It is a further object of this invention to provide a fuselink structure by which reliable and reproducable electrical connections between the respective end portions of the fusible element and the associated end caps are ensured and maintained under operational conditions, also when automated assembly processes are employed for the manufacture.

A cartridge fuselink of the above-identified type is according to the subject invention characterized thereby that adjacent each of the ends of said barrel there is rigidly secured in an elongated centering member defining a central channel longitudinally extending within said barrel for receiving an associated end portion of said fusible wire or other fusible member therein; the annular space defined between the inner wall of said channel and the respective end portion of said fusible wire or other fusible member received therein being filled with solder; a thin layer of solder integral with said solder extends between the outer surface of said centering member and outer barrel surface portions on one hand and the inside of the respective end cap on the other.

A method of manufacturing electric cartridge fuselinks of the kind described above is according to a further aspect of the subject invention characterized by the steps of press fitting said centering members into the open ends of said insulating barrel; disposing said end caps over the associated ends of said barrel, each end cap having an amount of solder adhered to its inside bottom surface; heating said end caps to melt the solder; pressing the respective end cap towards said barrel when said solder is in its liquid phase; and allowing the fuselink thus assembled to cool in order to solidify said solder.

It is observed that centering means for maintaining a fusible member centrally disposed within a tubular casing of an electric cartridge fuselink are generally known.

For instance US patent 2,300,142 describes a fusible protective device wherein a cylindrical body of insulating material at both of its open ends is closed by discs having slotted diametrical openings therethrough. Such discs are maintained in position on the ends of the fuse body by metal end caps, while the slotted openings in said discs are arranged removably to receive the respective end portions of a fusible member, which end portions are inserted through said openings and bent over on the outside of the discs so that the ends of this fuse member are securely clamped between the discs and the end walls of the caps.

British patent 1,167,583 describes a structure for a cartridge fuselink comprising a cartridge tube of insulating material which at both of its ends is closed by end caps which are press fitted

onto the tube. Each end cap has a central, raised frusto-conical portion on the inside of its end wall while a washer is held between each end cap and the adjacent end of the cartridge tube. Each of these washers has a socket portion which fits over and is of similar shape to the raised portion of the associated end cap. A fusible element centrally extending within said cartridge tube, passes through a hole in the center of said socket portion of the respective washer and is gripped between the conical socket of the respective washer and said central, raised portion of the associated end cap. When an end cap is pressed onto the cartridge tube, the cap and washer are squeezed into intimate contact.

However, both of these structures have their peculiar shortcomings and failure risks and are not attractive for an economical automated mass fabrication process. This prior art therefore is unsuitable to meet the objects of the subject invention. A structure of an electric cartridge fuselink according to the subject invention has the important feature that the solder adheres to the inside of the end caps due to the heating and pressing operation. More in particular by capillary action the solder is driven into the annular space defined in the central channels of the centering members between the channel wall therein and the associated end portion of the fusible member, and is uniformly distributed as a thin layer between the inside of the end caps and the opposing surface portions of the tubular casing and the centering members. Thereby a well defined and extremely reliable electrical connection is established between the fusible element and the end caps, while additionally these end caps are rigidly secured on the respective ends of the tubular casing or barrel while providing a sealed connection

therewith. During the end cap heating step, the air within the barrel is also heated, whereby an internal pressure is built up which effectively contributes to the afore said capillary action.

In the embodiments of an electric cartridge fuselink of the subject invention, said centering members in an initializing step of the assembly process are press fitted into either open end of said barrel, so that they are firmly secured therein. There are various alternative embodiments of said centering members possible for providing press fitting engagement between the centering members and the inside wall portions of said barrel.

In a preferred embodiment of an electric cartridge fuselink of the subject invention each of said centering members is provided with one or more circumferential ridges circumferentially engaging the inside of said insulating barrel. In another embodiment of a fuselink of this invention said ridges are continuously extending around said centering members. In another embodiment of the subject invention said channel provided in said centering members, at one or both of its ends has a gradually increasing cross-section. In another embodiment of a cartridge fuselink of the subject invention each one of said centering members is slightly tapered, i.e. a cork shaped member which is closely fitting within the associated open end of said barrel. If desired, the portion of such centering members extending within said barrel is provided with longitudinal grooves. In another embodiment of a cartridge fuselink of the subject invention each of said centering members on its circumferential surface opposite the inside of said barrel is provided with one or more elastically deformable portions which are in press fitting engagement with the inside

of said barrel.

According to a further advantageous feature of the subject invention one or both of said centering members at its innermost end is provided with a tubular extension of a material allowing legend and/or markings, which can be viewed through the transparent barrel, to be registered thereon. Such tubular extension either is made integral with the respective centering member, or is a separate cylindrical section, e.g. made of plastic foil, which is attached to the associated inner end of the centering member.

Due to the manner in which electrical connections are established between the fusible wire or other fusible member and the solder and associated end caps, with a fuselink of the subject invention the length of said barrel is uniquely adaptable to the desired effective length of the fusible wire or other fusible member. Thereby the desired characteristics of the fuselink can be accurately controlled and adapted to required specifications.

With the subject invention fully automated manufacturing and assembling processes can be used for the production of electric cartridge fuselinks wherein preferably the fusible member comprises a rigidified fibre core of electrically non-conductive heat-insulating and heat-resistive material, and a winding of fusible wire, preferably micro-wire, wound thereon. Optionally the fusible member consists of one or more sections of straightened wire.

A structure of a fuselink of the subject invention is also extremely well suitable for an assembly process having a step whereby the barrel is filled with quenching powder, e.g. quartz sand, included therein. This filling step is executed as the next step following the

steps whereby the centering members are secured within the barrel, and the fusible member has been inserted therebetween. The quenching powder then is supplied to the interior of the barrel, either through the interspace between the inner channel wall and the end portion of the fusible member received therein, or through an additional bore through the centering member. After being filled with quenching powder said centering member is closed by any suitable means.

Important cost reductions are made possible by a fuse construction of the subject invention. More in particular following reductions are feasible with the application of the subject invention:

1) reduction in reject percentages;
2) reduction of the solder quantity;
3) reduction in manufacturing costs enabled by process automation; and
4) reduction of element material quantity, i.e. the length of the element, in particular when compared with fuselinks having the fusible member extending "diagonally" therein, with the ends of the element squeezed between caps and barrel.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a partly horizontal mid-sectional view of a first embodiment of an electric cartridge fuselink of the subject invention; and

Fig. 2 is a partly horizontal mid-sectional view of an alternative embodiment of an electric cartridge fuselink of the subject invention.

Referring to Fig. 1 of the drawings, the electric cartridge fuselink shown therein comprises an insulating barrel 1 made from

transparent glass or other insulating material. In this embodiment illustrative for the principles of the subject invention said barrel is a cylindrical tube. Said tube is closed at both of its ends by centering members 2 which in this embodiment are press fitted into the tube. For these centering members preferably ceramic material, or sufficiently heat resisting plastic may be used. In the embodiment shown in Fig. 1 the centering members are bushes of a substantially cylindrical shape. Preferably each one of said centering members is provided with ridges 3 integral therewith and circumferentially extending around their surface opposite the inside of the tube. These ridges are in press fitting engagement with the inside of the tube thereby providing a rigid and strong mechanical connection between these members and the respective tube ends. Each one of said centering members 2 has a central bore defining a channel 4 longitudinally extending within the inside of said tube. These channels are adapted to receive an associated end portion of a fine fusible element or member 5. Preferably the fusible member comprises a rigidified fibre core of electrically non-conductive heat-insulating and heat-resistive material, and a winding of fusible wire, preferably micro-wire, wound thereon. Optionally the fusible member consists of one or more sections of straightened wire.

The annular space between the channel wall and the associated end portion of the fusible member is filled with solder 6. Optionally said channels at one or both of their ends have a gradually increasing cross section in order to facilitate the insertion of the fusible member and to improve the mechanical and electrical connection between the fusible member and the solder which thereby is also rigidly secured in the associated channel. At either end of the tube, metal end caps 7 are disposed thereon with a close fit.

A thin layer of solder 8 integral with the solder 6 inside the centering channel of the associated centering member extends between the outer surface thereof and outer surface portions of said tube at the one hand and the inside of the associated end cap at the other.

With this construction a reliable and reproducable electrical and mechanical connection is established between the fusible wire and the end cap members. Moreover due to said thin layer of solder the end cap members are rigidly and firmly secured to the associated ends of the tube, while providing a sealed connection therewith. Said centering members firmly hold the fusible member in a central position within the tube. Optionally each one of said centering members can be provided with two or more of said centering channels so that in one and the same fuselink two or more fusible members can be mounted in parallel relation.

It will be understood that the fusible member or fusible wire can have any desired cross-sectional shape with the shape of the centering channel adapted thereto. For instance a substantially circular cross-sectional shape, or a cross-sectional shape similar to that of a ribbon-shaped member can be employed.

It will be appreciated that various other modifications may be made to the details referred to herein without departing from the scope of the invention as defined in the appended claims. For example, whilst the invention is particularly suitable for miniature cartridge fuselinks for low current ratings, it may also be used for other fuselinks regardless of their size.

An alternative embodiment of a fuselink of the subject invention is shown in Fig. 2, wherein similar parts have been provided with the same reference numerals as in Fig. 1.

In the embodiment of Fig. 2 the centering members 2 are each shaped like a cork, i.e. slightly tapered with the innermost end having a slightly smaller surface area than that of the associated outermost end. This is not shown explicitly in the drawings, but it will be understood that in this manner the centering members are firmly secured, while substantially closing off the ends of the barrel. In an alternative embodiment of these centering members, longitudinal grooves 9 are provided in their circumferential surface opposite the inside of said barrel. In an alternative embodiment each one of said centering members along its outercircumenferential surface is provided with a resilient portion, such as a circumferential ridge 10. Fig. 3 shows an example of such a centering member in a longitudinal sectional view.

In a further alternative embodiment each one of said centering members is provided with an end flange 11, such as has been schematically shown in Fig. 4. By means of any suitable means 12, the end flange 10 is secured, e.g. cemented on the respective annular end surface of said barrel. With this embodiment it is not necessary to shape the main body of the centering member for press fitting engagement with the inside of said barrel. By way of illustration only, in the embodiment of Fig. 2, the fusible member is shown as a straightened single wire.

In a fuselink of the subject invention the operational characteristics of the fusible wire or fusible member are well defined due to the structure wherein such a wire or member is held between columns of solder having a well defined length and shape.

Also a fuselink structure of the present invention is extremely well suited for fully automated manufacuring and assembling processes.

To assemble a fuselink of the subject invention firstly both of the centering members are inserted into the respective open ends of the tube. In general the length and diameter of this tube have been selected in view of the desired characteristics of the fuselink and/or specified standards. For instance tubes having a length of 20 mm and a diameter of 5 mm are used. Once being secured in the tube by the afore mentioned press fitting engagement, a fusible member or wire is inserted into and guided by respectively the two channels of said two centering members. The length of the fusible member or fusible wire is made slightly less than the length of the tube. Thereafter both end caps each provided with a pellet of solder are positioned with a close fit on the associated ends of said tube. Thereafter the metal caps are heated so as to bring the solder into a liquid state. With the solder being in its liquid state the metal end caps are pressed in a direction towards the associated tube end. The heating and pressing steps for both end caps are executed simultaneously or sequentially. With a structure of the subject invention a capillary action occurs whereby the molten solder is formed into a thin layer while it is creeping up into the respective channels and the interspace between the inside of the metal end caps and the facing surface portions of the tube and the centering members. By controlling, the heating in particular the time interval thereof, the respective channels of the centering members can be accurately filled with solder. Thereby a well defined effective length of this fusible wire or fusible member can be obtained. Further a uniform layer of solder is obtained between the inside of the end cap and the tube and outer surface portion of the centering members. In this manner an

extremely good mechanical adherence between the caps and the glass tube is obtained together with a reliable electrical connection between the fusible wire or fusible member and the end caps. These aspects contribute in achieving an extremely high degree of reliability of fuselinks of the subject invention.

A structure of the subject invention further offers an improved flexibility of design. By varying the length and/or diameter of the fusible element or fusible wire, and/or the longitudinal length of the centering members the operational characteristics of the fuselink can be varied to a great extent while maintaining close tolerances.

The invention is also applicable for fuselink structures wherein other conventional caps are employed, such as for instance caps having a substantially conical end portion.

Whilst particular embodiments have been described, it will be understood that by those skilled in the art modifications can be made without departing from the scope of the invention as defined by the appended claims.

CLAIMS

1. An electrical cartridge fuselink comprising a fusible wire or other fusible member; an insulating barrel having said wire or member disposed therein; and end caps or terminals mounted on either end of said barrel and each electrically connected to an associated end portion of said wire or said member, characterized in that adjacent each one of the ends of said barrel there is rigidly secured thereto an elongated centering member having at least one centering channel longitudinally extending therethrough and within said barrel for receiving an associated end portion of said fusible wire or other fusible member therein; the annular space defined between the inner wall of said centering channel and the respective end portion of said fusible wire or other fusible member received therein being filled with solder; a thin layer of solder integral with said solder extending between the outer surface of said centering member and outer surface portions of said barrel at the one hand and the inner side of the associated end cap at the other.

2. An electrical cartridge fuselink according to claim 1, characterized in that said centering members are in press fitting engagement with the inner side of said barrel.

3. An electrical cartridge fuselink according to claim 1 or 2, characterized in that said centering members are each provided with one or more circumferential ridges which along their circumference are engaging the inside of said barrel.

4. An electrical cartridge fuselink according to claim 3, characterized in that said ridges are continuously extending around the associated centering member.

5. An electrical cartridge fuselink according to one of the foregoing claims, characterized in that two or more of said fusible wires or other fusible members are extending between and are connected with said centering members.

6. An electrical cartridge fuselink according to one of the foregoing claims, characterized in that said centering channel at one or both of its ends has a gradually increasing cross-section.

7. An electrical cartridge fuselink according to one of the foregoing claims 1, 2, 5 or 6, characterized in that each one of said centering members is cork-shaped and dimensioned for closing off said barrel at its opposite ends.

8. An electrical cartridge fuselink according to claim 7, characterized in that each one of said centering members in its surface opposite the inside of said barrel is provided with longitudinal grooves.

9. An electrical cartridge fuselink according to one of the foregoing claims, characterized in that said thin layer of solder material is extending continously and circumferentially around said barrel, while filling the circumferential interspace between said barrel and the inside of the associated end cap.

10. An electrical cartridge fuselink according to one of the foregoing claims 1 through 6, or 9, characterized in that each one of said centering members on its circumferential surface opposite the inside of said barrel is provided with one or more elastically deformable portions which are in press fitting engagement with the inside of said barrel.

11. An electrical cartridge fuselink according to claims 1 or 6, characterized in that each one of said centering members is

provided with an end flange, which is secured to the associated end surface portion of said barrel.

12. An electrical cartridge fuselink according to one of the foregoing claims, characterized in that said fusible member comprises a rigidified core of electrically non-conductive and heat resisting material and a winding of fusible wire wound thereon.

13. An electrical cartridge fuselink according to one of the foregoing claims 1-12, characterized in that said fusible wire or fusible member has a cross-sectional shape similar to that of a ribbon-shaped member.

14. An electrical cartridge fuselink according to one of the foregoing claims, wherein said barrel is of transparent material, characterized in that one or both of said centering members at its (their) innermost end(s) is (are) provided with a tubular extension of a material allowing legends and/or markings, which can be viewed through said barrel, to be registered thereon.

15. A method of manufacturing an electric cartridge fuselink according to one of the foregoing claims, characterized by the steps of disposing said centering members into the open ends of said insulating barrel; positioning said end caps over the associated ends of said barrel, each end cap having a pellet of solder inside; heating said end caps to melt the solder; pressing the respective end cap towards said barrel when said solder is in its liquid phase, while controlling the amount of heat; and allowing the fuselink thus assembled to cool in order to solidify said solder.

16. A method according to claim 15, characterized by the

steps that said end caps are heated simultaneously; and said end caps are pressed simultaneously and towards each other respectively.

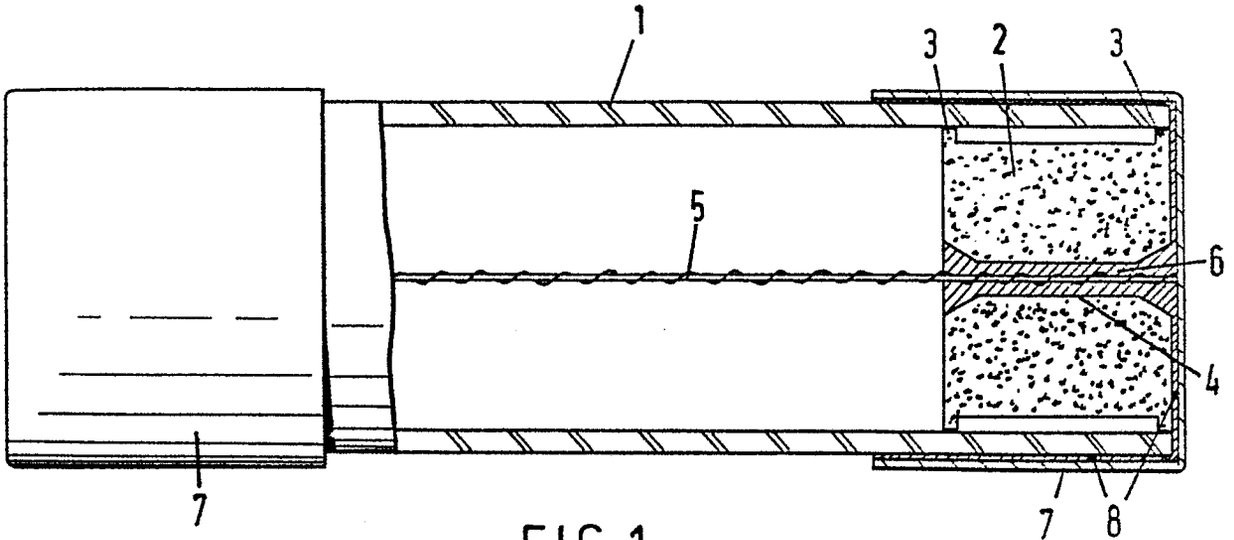

FIG.1

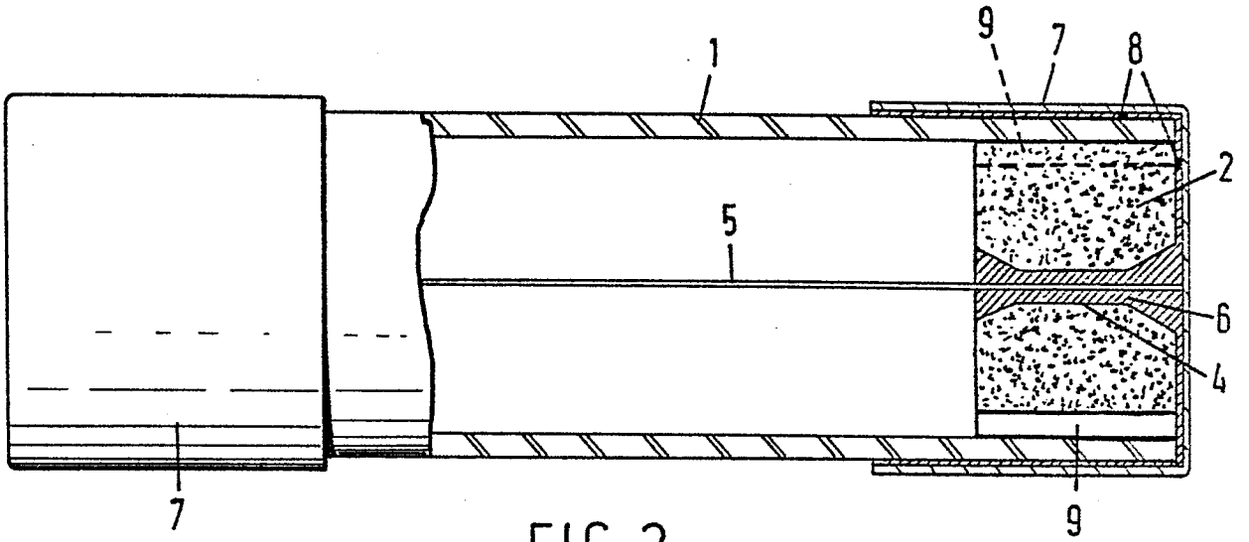

FIG.2

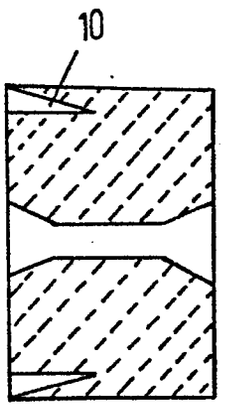

FIG.3

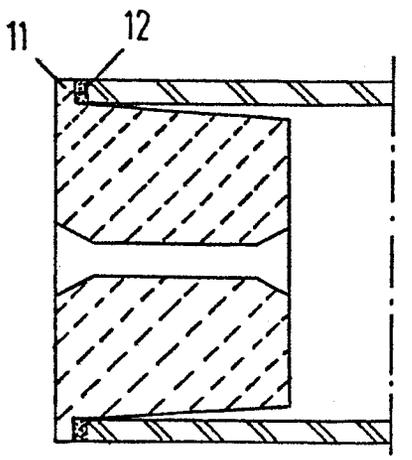

FIG.4

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EUROPEAN SEARCH REPORT

0094988
Application number

EP 82 20 0592

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. ³)
Y	US-A-3 885 303 (OLVIS) *Figure 3; column 2, lines 11-24; column 4, lines 42-50*	1,11, 12	H 01 H 85/16 H 01 H 69/02
Y	FR-A-1 276 123 (COMP. GEN. D'ELECTRICITE) *Page 1, column 1, line 22 - page 2, column 1, line 9; page 2, column 1, lines 14-51; column 2, lines 19-28,34-47*	1,5,11 ,13,15 ,16	
Y	DE-B-1 291 010 (SICHERUNGEN-BAU) *Column 1, lines 1-7; column 1, line 62 - column 2, line 4; column 2, lines 22-43,50-63*	1,6,11 ,14	
A	GB-A- 974 489 (LITTELFUSE) *Page 2, lines 119-125; page 3, lines 13-21,44-59*	1,2,15	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) H 01 H 85/00 H 01 H 69/00
A	US-A-3 304 394 (URANI) *Column 3, line 9 - column 4, line 41*	1,2,6	
A	US-A-1 638 534 (WESTERN ELECTRIC)	1,2,6-8	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04-02-1983	DESMET W.H.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

0094988
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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. ³)
A	DE-B-1 274 221 (ELEKTRO-UNION)	1,11, 15	
A	NL-C- 32 744 (VAN SWAAY) *Page 1, line 63 - page 2, line 7*	1-4,11	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

The present search report has been drawn up for all claims

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THE HAGUE	04-02-1983	DESMET W.H.G.

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D : document cited in the application
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