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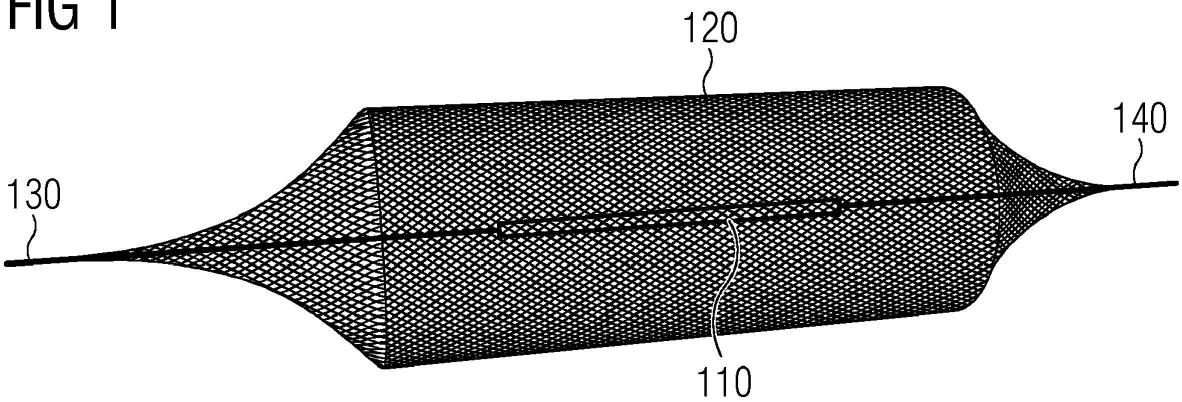
(54) ELECTRICAL ARRANGEMENT FOR USE IN A HIGH PRESSURE ENVIRONMENT

(57) An electrical arrangement (100) is described, in particular an electrical fuse, for use in a high pressure environment, comprising an electrical element (110) and an enclosure (120) which is fully surrounding the electrical element (110), thereby defining a volume in which the electrical element (110) is arranged, wherein the enclosure (120) is configured for being permeable for a liquid and for being impermeable for solid particles. Furthermore, an electronic device (200) is described which comprises the electrical arrangement (100). In addition, a method of manufacturing the electrical arrangement (100) is described.

FIG 1



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Description

Field of invention

[0001] The present invention relates to the field of electrical arrangements, in particular to the field of electrical fuses, which are operated at elevated pressures, for example subsea electrical arrangements. Furthermore, the present invention relates to an electronic device and to a method of manufacturing an electrical arrangement.

Art Background

[0002] For offshore facilities, for example platforms for oil and gas production, as well as for other applications such as offshore wind turbines, electrical facilities are installed subsea, for example at the ocean floor. Such electrical facilities may be compressors, pumps, switchgears, transformers or any combination of electronic devices which are electrically connected to a subsea power grid for being supplied with electric power. The electrical facilities may be installed at depths of 3000 m or more, where a pressure of 300 bar can prevail.

[0003] For operating electrical devices at a high pressure, for example on the ocean floor, dielectric liquids are used for the purpose of electrical insulation and improved cooling properties. Such subsea devices may comprise an enclosure which is filled with the dielectric liquid. To save weight and size the pressure inside the enclosure of the device may be the same as the pressure in the environment outside of the device giving a slimmer canister construction compared to having atmospheric pressure inside and environment pressure outside. The electrical insulation properties of the dielectric liquid are to a high degree depending on the cleanliness of the dielectric liquid. When a power fault occurs in any electrical element of the device, for example in an electrical circuit or sub-circuit of the device, the concerned electrical element may experience an overcurrent which leads to overheating of the respective electrical element. When the electrical element is overheated, undesired contaminants such as solid particles may be generated which changes the electrical properties of the dielectric oil. Depending on the type of used dielectric liquid, substances like carbon may be generated when the dielectric liquid reaches a critical temperature, which substances significantly impede the electrical insulation properties of the dielectric liquid. As a result, short circuits and errors can damage further parts of the device.

[0004] In the case that an error occurs in a part of the electronic device, for example an undesired overcurrent, it is important to protect the rest of the electronic device from damage. Such damage may occur on the one hand due to the overcurrent itself, i.e. the resulting high temperature, and on the other hand due to the particles which are generated when the erroneous sub-part of the electronic device is melting or when a fuse is melting which is assigned to the erroneous sub-part.

[0005] EP 2 492 947 A1 discloses a subsea electrical fuse for use in a pressurized environment. The fuse is made of a section of a conductor trace on a printed circuit board (PCB). The PCB can be a multilayer PCB, wherein the section of the conductive trace, which is constituting the electrical fuse, is arranged between two layers of the PCB. Therefore, when the fuse is melting, the resulting particles are trapped inside the PCB between the two layers and thus cannot lead to damage of other components.

[0006] WO 2015/022 171 discloses a subsea fuse which is adapted to be operated in a pressurized environment. The subsea fuse comprises a fuse element which is arranged between a first lid and a second lid. The fuse element is surrounded by a flexible hollow elongated element forming a chamber around the fuse element. The flexible material of the hollow elongated element allows for a pressure equilibration between an interior of the chamber and an exterior. Furthermore, the hollow elongated element retains particles which are generated when the fuse element is melting.

[0007] EP 3 016 128 A1 discloses a subsea fuse assembly for being operated in a pressurized environment. The subsea fuse assembly comprises a fuse element which is arranged in an enclosure defining an accommodation chamber for the fuse element. Portions of the enclosure are made of a flexible material in order to transmit the pressure outside the chamber to the interior of the chamber and vice versa. When the fuse element is melting, the generated gases and debris are held back in the chamber. As a result of the gas formation, the flexible portions of the enclosure lead to an expansion of the enclosure.

[0008] There may be a need for providing an electrical arrangement for securing electrical components in the case of power faults, which electrical arrangement has a simplified architecture.

Summary of the Invention

[0009] This need may be met by the subject-matters according to the independent claims. Advantageous embodiments of the present invention are described by the dependent claims.

[0010] According to a first aspect of the invention an electrical arrangement is provided, in particular an electrical fuse, for use in a high pressure environment, wherein the electrical arrangement comprises an electrical element, for example a fuse element, and an enclosure which is fully surrounding the electrical element, thereby defining a volume in which the electrical element is arranged. The enclosure is configured for being permeable for a liquid and for being impermeable for solid particles.

[0011] The electrical arrangement according to the first aspect of the invention is based on the idea that by providing an enclosure which is fully surrounding the electrical element and which is permeable for liquids while being impermeable for solid particles, the solid particles are retained within the enclosed volume and therefore are prevented from contaminating a main dielectric liquid volume outside the enclosure. By means of the permeability of the enclosure for liquids, the pressure level inside the enclosure remains equal to the pressure level outside of the enclosure. Therefore, the architecture of the enclosure can be kept simple, since it is not necessary that the enclosure comprises flexible portions which expand for pressure equilibration between the interior and the exterior of the enclosure. Such an expansion would lead to an undesired increase of the volume of the entire enclosure. Furthermore, when the pressures inside and outside of the enclosure are equal, there is no need for contacting the electrical element inside the enclosure by means of sealed penetrators which are complicated to design and manufacture. By providing a semi-permeable enclosure, i.e. an enclosure which is permeable for liquids and impermeable for solid particles of a given size, the desired pressure equilibration and the filtering of the solid particles can be achieved, while the volume of the enclosure can be kept constant.

[0012] According to a further aspect of the invention an electronic device for use in a high pressure environment is provided, wherein the electronic device comprises an enclosure which preferably is pressure-compensated., i.e. the pressure inside the enclosure is equal to the pressure outside of the device. The electronic device further comprises at least one electrical arrangement according to the above described aspect of the invention, which is arranged in the enclosure. In addition, the electronic device comprises an electronic component which is supplied with electric power through the electrical arrangement. Furthermore, the electronic device comprises the dielectric liquid which is contained in the enclosure, for electrically insulating the electrical arrangement.

[0013] The electronic device may be a subsea blowout preventer, a transformer, a switchgear, a variable speed drive, a controller or any further device or a combination thereof which is supplied with electric power, e.g. by a subsea power grid or by power from platforms or from shore. The above-mentioned devices constitute only an exemplary selection of devices, wherein the present invention is not limited thereto. As apparent, the electrical arrangement according to the first aspect of the invention can be utilized in any arbitrary electronic device.

[0014] Depending on the application, the electronic component may be a switch, a transistor, a capacitor or any other electronic component of the electronic device, which shall be protected from damage in the case of a power fault.

[0015] The electronic device according to the further aspect of the invention is based on the idea that by supplying the electronic component with electric power through the electrical arrangement according to the first aspect of the invention, an electronic device is provided in which a damage is spatially restricted to the electrical arrangement. For example, the electrical arrangement may be a fuse which melts due to overcurrent. In that case, the enclosure of the electrical arrangement filters the particles of the molten fuse and thus prevents the dielectric liquid from being contaminated by the particles. In maintenance of the faulty electronic device, it is not necessary to replace the entire amount of dielectric liquid contained in the enclosure. Due to the permeability for liquids, the enclosure of the electrical arrangement does not experience a change in volume, even when the volume of the dielectric liquid increases due to an increase of the temperature during melting of the electrical element. Providing an enclosure with a constant volume may provide the advantage that the space requirement of the electrical arrangement is low and the entire electronic device can be designed compact.

[0016] According to a further aspect of the invention a method of manufacturing an electrical arrangement is provided, in particular an electrical fuse for use in a high pressure environment. The method comprises providing an electrical element which is arranged between two sections of a conductor, and attaching an enclosure to the two sections of the conductor, such that the enclosure is fully surrounding the electrical element, thereby defining a volume in which the electrical element is arranged, wherein the enclosure is configured for being permeable for a liquid and for being impermeable for solid particles.

[0017] According to an embodiment of the invention the enclosure is further configured for being permeable for gases. In other words, the enclosure is fluid-permeable. In the context of the present application, the term "fluid-permeable" denotes that liquid molecules and gas molecules are capable of passing the enclosure, whereas solid particles are "filtered", "retained" or "trapped" by the enclosure, i.e. they are not able to leave the interior of the enclosure.

[0018] Providing a fluid-permeable enclosure may provide the advantage that gas molecules which are produced inside the enclosure when the electrical element is melting can leave the enclosure and therefore do not cause an increase of the enclosure volume. Hence, as mentioned above, the space requirement of the electrical arrangement is low and the entire electronic device can be designed compact.

[0019] According to a further embodiment of the invention the electrical element is a fuse element.

[0020] Fuse elements are used in order to protect parts of electronic devices, such as sub-circuits or electronic components from overload and short circuits. For this purpose, fuses comprise at least one electrically conductive section which is configured for melting or vaporizing when the fuse I^2t value is reached or exceeded due to overcurrent in the electrically conductive section. By selecting a suitable material and a suitable cross-section of the conductive section, the threshold I^2t value for melting can be easily adjusted. Using a fuse element as electrical element is highly advantageous since the fuse element is configured for melting before other components or sub-circuits are melting or damaged. Therefore, it is possible to confine the particle contamination to the interior of the enclosure. Contamination of the dielectric liquid outside the enclosure is limited to a minimum and may not have to be replaced after a potential short circuit. Although it is advantageously to use a fuse element as electrical element, the invention is not limited to fuse elements. As becomes apparent to those skilled in the art, it is also possible to arrange other elements, circuits, conductors and/or components within the enclosure, which could be subjected to melting due to power faults or which could release particles due to aging. Furthermore, it is possible to provide a plurality of enclosures in which respectively one or more components, fuse elements, subcircuits and/or conductors of the same or different types are accommodated. Such embodiments benefit from the inventive concept and thus are within the scope of protection.

[0021] According to a further embodiment of the invention the electrical element is configured for melting and/or for vaporizing under formation of the solid particles when a threshold temperature is exceeded, wherein in particular the threshold temperature is lower than what is required for the dielectric oil to decompose. For example, if transformer oil is used as dielectric liquid, the electrical element may be configured for melting and/or vaporizing at a threshold temperature below 260°C.

[0022] In particular, the electrical element may be a low-temperature fuse element, i.e. a fuse element which is e.g. made of a low temperature metal configured for melting at relatively low temperatures compared to medium or high temperature fuse elements. A low-temperature fuse element may provide the advantage that it is reliably melting and/or vaporizing before a temperature is reached which can lead to a decomposition of the dielectric liquid or can lead to damage of further components.

[0023] In the context of the present application, the term "low temperature metal" denotes a metal which has a melting and/or vaporizing threshold temperature below 260.

[0024] According to a further embodiment of the invention the electrical element is made of a metal and/or an alloy with low melting temperature such as rose's metal.

[0025] By providing an electrical element made of a low temperature metal, it can be ensured that the electrical element is reliably melting before a temperature is reached at which the dielectric liquid decomposes or other components are damaged due to overcurrent.

[0026] It is also possible to provide an electrical element made of any other electrically conductive material, for example solder tin. Basically, any fusible alloy can be used. When selecting a suitable material, it should be considered that the intended melting temperature of the electrical element should be below the decomposition temperature of the dielectric liquid, as explained below in more detail.

[0027] According to a further embodiment of the invention, the electrical arrangement is configured for retaining the solid particles inside the volume which is defined by the enclosure.

[0028] As mentioned above, the volume defined by the enclosure may remain constant over time, i.e. before, during and after melting of the electrical element. As explained above, this can be achieved by providing an enclosure which is permeable for liquids and which is preferably in addition permeable for gases. In other words, only solid particles are selectively filtered by the enclosure.

[0029] According to a further embodiment of the invention the enclosure is a mesh, a sleeve or perforated cylinder comprising a plurality of openings, wherein a size of the openings is selected such that the liquid can pass the openings, whereas the solid particles are retained inside the volume by means of the enclosure.

[0030] Providing a mesh as an enclosure, which has openings or pores with a defined size enables to reliably filter the solid particles while the mesh can be manufactured cheaply and simply. The mesh can be manufactured from one material or from multiple materials. For example, the mesh can be manufactured from any kind of fibers. Since there is no pressure difference between the interior of the mesh and the exterior of the mesh, it is not necessary to provide a thick-walled enclosure. The mesh may have any desired shape, for example a cylindrical shape, a spherical shape, an oval shape or any combination thereof. It is possible to spatially adapt the shape of the mesh to the structural conditions inside the electronic device.

[0031] According to a further embodiment of the invention the size of the openings in the mesh or perforated cylinder is in a range between 100 microns and 2000 microns but may have other sizes depending on the application.

[0032] Providing a mesh with openings having a size in the above mentioned range has turned out as being especially advantageous with respect to the filtering properties while still allowing a sufficient permeability for liquids and gases, respectively.

[0033] According to a further embodiment of the invention the enclosure is made of an electrically insulating material.

[0034] By using an electrically insulating material for the enclosure, it is avoided that the enclosure can act as a bypass which conducts current, e.g. when the electrical element is molten. Furthermore, an enclosure which is made of an electrically insulating material can come into contact with adjacent conductors in the electronic device, for example circuits, without causing a short circuit. Since there is no pressure difference between the interior and exterior of the enclosure, it is not necessary to provide an enclosure which has a thick wall or a certain bending strength. This enables a high degree of freedom with respect to the material selection. The enclosure may be rigid e.g. a perforated cylinder. Although it is not necessary, it is however possible that the enclosure is flexible or comprises flexible portions.

[0035] According to a further embodiment, the dielectric liquid is a dielectric oil.

[0036] For example, the dielectric oil may be a transformer oil. The term "transformer oil" denotes an oil composition which is based on synthetic ester. It has a minimum dielectric strength of 24 MV/m and a decomposition threshold temperature of substantially 260°C. Alternatively, a silicone oil can be used as dielectric liquid. Silicone oils are highly temperature stable and possess a decomposition threshold temperature of substantially 180°C. It is apparent to a skilled person that any dielectric liquid having desired properties can be used alternatively or in addition.

[0037] According to a further embodiment of the invention the electrical element, e.g. the electrical fuse, is configured for melting and/or vaporizing at a threshold temperature which is lower than a decomposition threshold temperature of the dielectric liquid.

[0038] The electrical insulation properties of the dielectric liquid depend on the cleanliness of the dielectric liquid. The presence of particles in the dielectric liquid can significantly impede the insulation properties and can therefore lead to arcing and damage in the electronic device. When the dielectric liquid is excessively heated, it decomposes under formation of undesired substances, for example carbon which is conductive. The resulting suspension of dielectric liquid and carbon particles has a certain electrically conductivity and thus cannot provide a sufficient electrical insulation anymore. In order to avoid the generation of undesired substances, the melting threshold temperature of the electrical element should be adjusted to be below the decomposition threshold temperature of the dielectric liquid. For example, if transformer oil is used as dielectric liquid, which has a decomposition threshold temperature of typically 260°C, the melting threshold temperature of the electrical element should be adjusted to be below the oil decomposition temperature threshold. By a convenient selection of material and cross-section of the electrical element under consideration of the used dielectric liquid, an excessive heating and decomposing of the dielectric liquid can be reliably prevented.

[0039] According to a further embodiment of the method, attaching the enclosure to the conductor is performed by means of an adhesive and/or by means of a clamping mechanism.

[0040] Depending on the application-specifically selected material and shape of the enclosure, it can be attached by means of a clamping mechanism, e.g. a biased clamping ring, a screw-adjustable clamping ring, by clips, or by any other clamping means. It is also possible to attach the enclosure by means of an appropriate adhesive which is insoluble in the respective dielectric liquid. For some applications, it may be advantageously to attach the enclosure by means of plastic welding.

[0041] It has to be noted that embodiments of the invention have been described with reference to different subject matters. In particular, some embodiments have been described with reference to method type claims whereas other embodiments have been described with reference to apparatus type claims. However, a person skilled in the art will gather from the above and the following description that, unless other notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters, in particular between features of the method type claims and features of the apparatus type claims is considered as to be disclosed with this document.

[0042] The aspects defined above and further aspects of the present invention are apparent from the examples of embodiment to be described hereinafter and are explained with reference to the examples of embodiment. The invention will be described in more detail hereinafter with reference to examples of embodiment but to which the invention is not limited.

Brief Description of the Drawing

[0043]

Figure 1 shows an electrical arrangement according to an aspect of the invention.

Figure 2 shows an electronic device according to a further aspect of the invention.

Detailed Description

[0044] The illustration in the drawing is schematically. It is noted that in different figures, similar or identical elements or features are provided with the same reference signs or with reference signs, which are different from the corresponding reference signs only within the first digit. In order to avoid unnecessary repetitions elements or features which have already been elucidated with respect to a previously described embodiment are not elucidated again at a later position of the description.

[0045] Further, spatially relative terms, such as "front" and "back", "above" and "below", "left" and "right", et cetera are used to describe an element's relationship to another element(s) as illustrated in the figures. Thus, the spatially relative terms may apply to orientations in use which differ from the orientation depicted in the figures. Obviously all such spatially relative terms refer to the orientation shown in the figures only for ease of description and are not necessarily limiting as an apparatus according to an embodiment of the invention can assume orientations different than those illustrated in the figures when in use.

[0046] **Figure 1** shows an electrical arrangement 100 according to a first aspect of the invention. The electrical arrangement 100 is submerged in a dielectric liquid (not shown) for electrical insulation. The electrical arrangement 100 comprises an electrical element 110 and an enclosure 120 which is fully surrounding the electrical element 110. In the shown embodiment, the electrical element 110 is configured as a low-temperature fuse element, i.e. an electrically conductive element which is intended for melting and/or vaporizing when a predetermined threshold temperature, for example between 100°C and 200°C, is exceeded. The fuse element 110 is arranged between two sections 130, 140 of a conductor. When the fuse element 110 is molten, the current flow from one section 130 to the other section 140 of the conductor is interrupted, thereby protecting electrical components (not shown) which are arranged upstream and downstream with respect to the fuse element 110 from overcurrent and damage. When the fuse element 110 is melting, solid particles are generated. The enclosure 120 is configured as a mesh having openings of a defined size. The size of the openings is selected such that the enclosure 120 is impermeable for the generated solid particles. As a consequence, the solid particles are "trapped" in an interior of the enclosure 120, i.e. they cannot pollute a main volume of dielectric liquid outside the enclosure 120. Furthermore, the enclosure 120 is configured for being permeable for liquids. Thus, if the volume of the dielectric liquid changes, for example due to changes of the temperature, the liquid molecules can pass the openings of the enclosure 120. Hence, the pressure inside the enclosure 120 is equilibrated to the pressure outside of the enclosure 120. This allows for omitting complex penetrators which are conventionally used for overcoming pressure differences. Further, it is not required to form the enclosure 120 thick-walled for withstanding pressure differences. For example, a simple layer of fibers can be used as an enclosure 120. As becomes apparent, for the pressure equilibration between an interior and an exterior of the enclosure 120, it is not necessary to provide flexible portions which are intended to change a volume of the enclosure 120 for pressure equilibration. Also in the case that the fuse element 110 is melting under formation of gases and solid particles, the volume of the enclosure 120 can be kept constant. This is highly advantageous with respect to the space requirement of the electrical arrangement 100.

[0047] **Figure 2** shows an electronic device 200 according to a further aspect of the invention. The shown electronic device 200 may be located on the ocean floor and may be supplied with electrical power by means of a subsea power grid. The electronic device 200 comprises an enclosure 270 which is filled with dielectric liquid for electrical insulation. The electronic device may be pressure-compensated, i.e. the pressure inside the enclosure 270 is equalized to the surrounding water pressure. For this purpose, the electronic device 200 may comprise one or more pressure compensators (not shown). The electronic device 200 comprises a transformer 250 and at least one electronic component 260. The electronic component 260 may for example be a controller, a switch, a communication component or any other component. The electronic component 260 is supplied with electrical energy through the electrical arrangement 100. The electrical arrangement 100 in the shown embodiment is a fuse element. If a power fault occurs in the electronic component 260, the fuse element will melt at a predetermined threshold current. Consequently, the electronic component 260 is electrically separated from the transformer 250. As a result, a damage of the transformer 250 or of components downstream the electronic device 260 can be prevented. Furthermore, the electrical arrangement 100 protects the dielectric liquid from contaminants as explained above. Since the volume of the electrical arrangement 100 remains constant, the space requirement of the electrical arrangement 100 in the electronic device 200 is very low. As becomes apparent to those skilled in the art, the use of the enclosure 120 is not limited to fuse elements. Also any other electrical elements which could pollute the dielectric liquid with solid particles due to decomposing, melting or aging can be surrounded by the enclosure 120.

[0048] It should be noted that the term "comprising" does not exclude other elements or steps and the use of articles "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

[0049] The invention or the embodiments of the invention described in this document can be descriptively summarized as follows:

Claims

1. An electrical arrangement (100), in particular an electrical fuse, for use in a high pressure environment, comprising

    an electrical element (110),
    an enclosure (120) which is fully surrounding the electrical element (110), thereby defining a volume in which the electrical element (110) is arranged,

    wherein the enclosure (120) is configured for being permeable for a liquid and for being impermeable for solid particles.

2. The electrical arrangement (100) as set forth in the preceding claim,
   wherein the enclosure (120) is further configured for being permeable for gases.

3. The electrical arrangement (100) as set forth in any one of the preceding claims,
   wherein the electrical element (110) is a fuse element.

4. The electrical arrangement (100) as set forth in the preceding claim,
   wherein the electrical element (110) is configured for

melting and/or for vaporizing under formation of the solid particles when a threshold temperature is exceeded,
wherein the threshold temperature is below 260°C.

5. The electrical arrangement (100) as set forth in any one of the preceding claims,
wherein the electrical element (110) is made of a metal and/or an alloy.

6. The electrical arrangement (100) as set forth in any one of the preceding claims,
wherein the electrical arrangement (100) is configured for retaining the solid particles inside the volume which is defined by the enclosure (120).

7. The electrical arrangement (100) as set forth in the preceding claim,
wherein the enclosure (120) is a mesh comprising a plurality of openings,
wherein a size of the openings is selected such that the liquid can pass the openings, whereas the solid particles are retained inside the volume by means of the enclosure (120).

8. The electrical arrangement (100) as set forth in the preceding claim,
wherein the size of the openings is in a range between 100 micron and 2000 micron.

9. The electrical arrangement (100) as set forth in any one of the preceding claims,
wherein the enclosure (120) is made of an electrically insulating material.

10. An electronic device (200) for use in a high pressure environment, comprising

an enclosure (270), in particular a pressure-compensated enclosure (270),
at least one electrical arrangement (100) according to claim 1, which is arranged in the enclosure (270),
an electronic component (260) which is supplied with electric power through the electrical arrangement (100),
a dielectric liquid which is contained in the enclosure (270), for electrically insulating the electrical arrangement (100) .

11. The electronic device (200) as set forth in the preceding claim,
wherein the dielectric liquid is a dielectric oil.

12. The electronic device (200) as set forth in any one of the preceding claims 10 or 11,
wherein the electrical element (110) of the electrical arrangement (100) is configured for melting and/or vaporizing at a threshold temperature which is lower than a decomposition threshold temperature of the dielectric liquid.

13. A method of manufacturing an electrical arrangement (100), in particular an electrical fuse, for use in a high pressure environment, the method comprising

providing an electrical element (110) which is arranged between two sections (130, 140) of a conductor,
attaching an enclosure (120) to the two sections (130, 140) of the conductor, such that the enclosure (120) is fully surrounding the electrical element (110), thereby defining a volume in which the electrical element (110) is arranged, wherein the enclosure (120) is configured for being permeable for a liquid and for being impermeable for solid particles.

14. The method as set forth in the preceding claim, wherein

attaching the enclosure (120) to the conductor is performed by means of an adhesive and/or by means of a clamping mechanism.

FIG 1

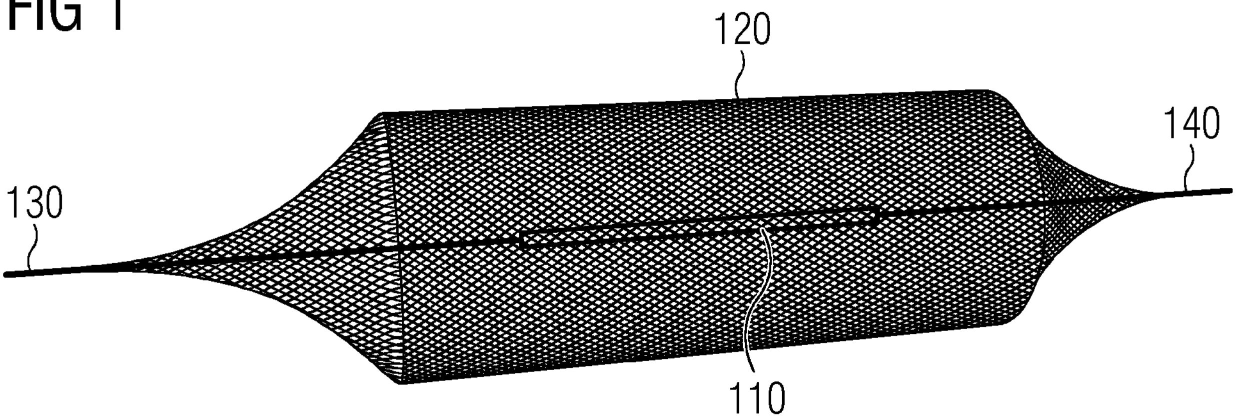
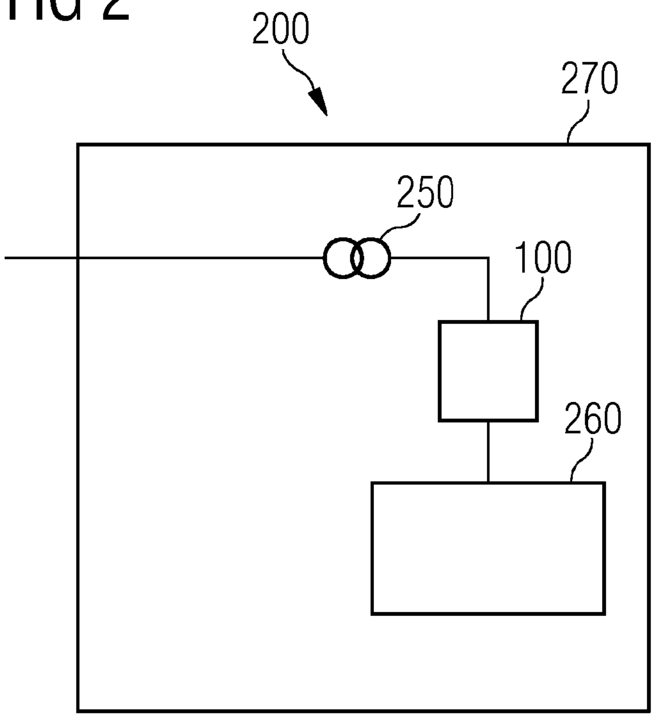


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 4526

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	6 March 2017	Simonini, Stefano

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 19 4526

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-03-2017

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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