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(54) **FIRE EXTINGUISHING NOZZLE AND FIRE EXTINGUISHER**

(57) A first aspect of the present invention concerns a fire extinguishing nozzle comprising a mixing, a ventilation and a foaming chamber, wherein said ventilation chamber comprises a first hollow cylindrical body comprising at least three air inlet holes, said foaming chamber comprises a second hollow cylindrical body having an axial length (L) and an inner diameter (d), and said ventilation chamber and/or said foaming chamber comprise a mesh, wherein the ratio of the axial length over the inner diameter (L:d) is comprised between 4:5 and 9:5 for extinguishing class A fires, or between 6:1 and 10:1 for extinguishing class B fires.

A second and third aspect respectively relate to a fire extinguisher comprising a fire extinguishing composition and a fire extinguishing nozzle, and to the use of a nozzle or fire extinguisher for extinguishing class A or class B fires.

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to fire extinguishing equipment. More in particular the invention concerns fire extinguishing nozzles.

BACKGROUND

[0002] Fire extinguishing compositions generally contain mixtures of surfactants that act as foaming agents, together with solvents and other additives that provide the desired mechanical and chemical properties to the foam. There is a general desire to improve the foaming characteristics of known fire extinguishing compositions, in order to obtain a fire extinguishing process that is faster, more efficient, and in particular, specifically tailored towards a certain fire class.

[0003] One way of improving the foaming characteristics of fire extinguishing compositions, is by altering the composition itself. For this purpose, fluorinated surfactants have long been used to improve foaming properties, however they have recently come under scrutiny in the light of environmental safety.

[0004] Another way of improving foaming characteristics lies in altering the discharging equipment, i.e. the fire extinguisher that is used. E.g. EP 3 337 576 describes a fire extinguisher comprising a nozzle with a number of perforated plates for influencing foaming characteristics of a fire extinguishing composition. The effect of these 'hardware alterations' on foam formation is however rather small, resulting in a limited performance, especially for extinguishing class A and B fires. Furthermore, FR 2 303 605 and US 4 830 790 both relate to fire extinguishing nozzles. The nozzles therein described however do not show beneficial effects regarding foam formation with the purpose of extinguishing class A and B fires.

[0005] A further important aspect of fire extinguishing foams, especially if foams are to be used where live electrical equipment is present, relates to dielectric testing. At present, this still remains a problem in the art.

[0006] Accordingly, there remains a need in the art for a fire extinguisher which drastically improves foaming characteristics of fire extinguishing compositions, and which can improve performance for extinguishing either class A or class B fires, independently of the fire extinguishing composition used.

[0007] The present invention aims to resolve at least some of the problems and disadvantages mentioned above.

SUMMARY OF THE INVENTION

[0008] The present invention and embodiments thereof serve to provide a fire extinguishing nozzle suitable for extinguishing class A or class B fires according to claim 1.

[0009] The fire extinguishing nozzle according to the present invention has the advantage of improving the foaming characteristics of a fire extinguishing composition. It is submitted that, by using the nozzle according to the present invention, the foaming characteristics of a fire extinguishing composition are altered as such, that the fire extinguishing composition can be optimally used to extinguish class A or class B fires in a fast and efficient way.

[0010] Preferred embodiments of the fire extinguishing nozzle are shown in any of the claims 2 to 11.

[0011] In a second aspect, the present invention relates to a fire extinguisher according to claim 12. Dependent claim 13 discloses a preferred embodiment of said fire extinguisher.

[0012] A last aspect of the present invention concerns the use of a fire extinguishing nozzle or a fire extinguisher as herein described for extinguishing class A or class B fires, according to claim 14. Dependent claim 15 discloses a preferred embodiment of said use.

FIGURES

[0013]

Figure 1 shows a perspective view of an embodiment of a fire extinguishing nozzle according to the present invention, which nozzle comprises a single, indivisible body.

Figure 2 shows a perspective view of an embodiment of a fire extinguishing nozzle according to the present invention, which nozzle comprises a single, indivisible body.

Figure 3a shows a perspective view of an embodiment of an assembled fire extinguishing nozzle according to the present invention, which nozzle comprises three separate and/or detachable parts.

Figure 3b shows a perspective view of an embodiment of a disassembled fire extinguishing nozzle according to the present invention, which nozzle comprises three separate and/or detachable parts.

Figure 4a shows a perspective view of an embodiment of an assembled fire extinguishing nozzle according to the present invention, which nozzle comprises three separate and/or detachable parts.

Figure 4b shows a perspective view of an embodiment of a disassembled fire extinguishing nozzle according to the present invention, which nozzle comprises three separate and/or detachable parts.

Figure 5 shows a perspective view of an embodiment of a ventilation chamber according to the present invention.

Figure 6 shows a perspective view of an embodiment of a ventilation chamber and a foaming chamber according to the present invention, which ventilation and foaming chamber form a single, indivisible body.

Figure 7 shows a perspective view and a cross-sectional inlet view of an embodiment of a mixing chamber according to the present invention.

Figure 8 shows a sectional representation according to a central, axial axis of an embodiment of a ventilation chamber according to the present invention.

Figure 9 shows a perspective view of an embodiment of a foaming chamber according to the present invention.

Figure 10 shows a cross-sectional view of an embodiment of a foaming chamber according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present invention relates to a fire extinguishing nozzle suitable for extinguishing class A or class B fires. Although the nozzle according to the present invention can be used for extinguishing fires of all fire classes, the advantages as herein discussed are substantially focused on fire classes A and B.

[0015] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0016] As used herein, the following terms have the following meanings:
"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

[0017] "About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, even more preferably +/-1% or less, and still more preferably +/-0.1% or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed invention. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

[0018] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

[0019] In a first aspect, the present invention relates to a fire extinguishing nozzle suitable for extinguishing class A or class B fires. The fire extinguishing nozzle herein described comprises a mixing chamber, a ventilation chamber and a foaming chamber. The mixing chamber is configured to introduce a fire retardant composition inside the nozzle. The ventilation chamber is coupled to said mixing chamber, and comprises a first hollow cylindrical body comprising at least three air inlet holes. Said air inlet holes are arranged on the circumference of, and are directed into the first hollow cylindrical body, wherein said ventilation chamber is configured to introduce ambient air into the nozzle and subsequently to mix said ambient air with the fire retardant composition. The foaming chamber of the nozzle comprises a second hollow cylindrical body having an axial length (L) and an inner diameter (d), and is coupled to the ventilation chamber. Herein, the foaming chamber is configured to provide in the formation of a fire extinguishing foam. Furthermore, the ventilation chamber and/or foaming chamber comprise a mesh, wherein said mesh is oriented in the radial plane of the inner cross-section of the ventilation chamber and/or foaming chamber. The fire extinguishing nozzle as herein described is characterized by the ratio of the axial length over the inner diameter (L:d) of the foaming chamber. Said ratio is comprised between 4:5 and 9:5 for extinguishing class A fires, or is comprised between 6:1 and 10:1 for extinguishing class B fires.

[0020] A "fire extinguisher" is an active fire protection device used to extinguish or control small or medium-sized fires, often in emergency situations. Typically, a fire extinguisher consists of a hand-held cylindrical pressure vessel containing a fire extinguishing composition which can be discharged in order to extinguish a fire. A fire extinguisher as described herein comprises a "fire extinguishing nozzle", also referred to as "nozzle", which is a device designed to control the direction or characteristics of a fluid flow. In light of the present invention, the fluid flow is a fire extinguishing composition.

[0021] Regarding the terminology "fire class", according to EN 2 there are six classes of fire. "Fire class A" relates to fires in combustible solids, mainly solids of organic nature such as coal, wood, paper, and fabrics. "Class B fires" relate to fires in flammable liquids, such as gasoline, petroleum, tars, oils, oil-based paints and solvents. "Class C fires" indicate fires in flammable gases, like hydrogen, propane, butane or methane. "Class D fires" are specifically directed towards combustible metals, especially alkali metals such as lithium, sodium and potassium, alkaline earth metals such as magnesium, and group 4 elements such as titanium and zirconium. "Class F fires" relate to fires in cooking oils and fats, e.g. kitchen fires.

[0022] The nozzle as herein described comprises a mixing chamber, a ventilation chamber and a foaming chamber, wherein the wordings "mixing", "ventilation" and "foaming" specifically indicate the function said chambers perform. As such, they respectively function to (pre)mix a fire extinguishing composition in the nozzle, to allow ventilation and/or aeration of the fire extinguishing composition, and to optimize the process of foaming, i.e. producing a fire extinguishing foam from the liquid fire extinguishing composition as provided to the mixing chamber.

[0023] The term "mesh" as herein described refers to a barrier made of connected strands of metal, fiber, or other flexible or ductile materials. A mesh can also be referred to as a "screen". Meshes are generally characterized by their "mesh size", particularly their "U.S. Mesh Size", which is defined as the number of openings in one square inch of a mesh. For example, a 36 mesh screen will have 36 openings per one square inch. Through the nature of this expression, the average diameter of the openings is however dependent on the thickness of the connected strands. In light of the present invention, the mesh size is preferably expressed as a micron-value indicating the average diameter of the openings of the mesh. For example, a mesh size of 1000 μm indicates a mesh wherein the average diameter of the openings is 1000 μm.

[0024] The term "axial length" represents the length of a cylindrical body along its rotational axis. Accordingly, the "inner diameter" is measured in the perpendicular plane to the rotational axis and extends along the inside of the hollow cylindrical body.

[0025] The fire extinguishing nozzle according to the present invention has the advantage of improving the foaming characteristics of a fire extinguishing composition for fire class A or fire class B situations. Relating to the fire extinguishing nozzle whereby the ratio L:d is comprised between 4:5 and 9:5, it is observed that the discharged fire extinguishing foam is of a less compact nature and is thinner than fire extinguishing foams which are discharged through nozzles as generally known in the art. This is particularly advantageous for class A fires, wherein the fire extinguishing foam needs to be applied on the surface of a burning material, which has to be covered as quickly and completely as possible. Generally, where denser foams exhibit slower spreading of the fire extinguishing foam over a burning object, the fire extinguishing nozzle according to the present invention allows faster spreading of a fire extinguishing foam, thus resulting in the highly efficient and highly fast extinguishing of class A fires. Relating to the fire extinguishing nozzle whereby the ratio L:d is comprised between 6:1 and 10:1, it is observed that the discharged fire extinguishing foam is more compact and thicker than fire extinguishing foams which are discharged through nozzles as generally known in the art. This is particularly advantageous for class B fires, as the fire extinguishing foam is intended to form a substantive layer on top of the burning liquid surface. The resulting compact and thick foam layer is able to better contain the flames in a certain area, and thus prevents the further spreading of the fire. Meanwhile, contact between the burning liquid and ambient air is efficiently reduced and/or eliminated, resulting in the liquid fire being more rapidly extinguished. As a result, it is submitted that the fire extinguishing nozzle as herein described provides in a more efficient and a faster extinguishing of class A or class B fires. The foaming characteristics of a fire extinguishing composition are altered as such, that the fire extinguishing composition can be optimally used to extinguish class A or class B fires in a more efficient and faster way.

[0026] According to a further or another embodiment, the foaming chamber comprises a foam separator element. A "foam separator element" as described herein has the meaning of any physical element suitable for at least temporary separating a fire fighting foam which is formed in the foaming chamber, into at least two streams. The nozzle as described herein thus allows for the formation of a fire extinguishing foam which largely improves the results of dielectric tests. This is a vast improvement in light of extinguishing fires in cases where live electrical equipment is present and allows for formation of a qualitative foam which passes dielectric tests.

[0027] In the context of the present invention, especially when the fire extinguishing nozzle as herein described is to be used where live electrical equipment is present, reference is made to the terminology "dielectric test". A "dielectric test" indicates a test that verifies the ability of a fire extinguisher to extinguish a fire on a live electrical apparatus without inflicting damage and/or causing danger to the operator of the fire extinguisher. During such dielectric test, the electrical conductivity of the liquid flow is measured, which preferably stays under a given limit. Limits and suitable measuring methods for dielectric tests are subject to national or regional regulation and/or standardization, e.g. EN 3-7:2007-10: "Portable fire extinguishers - Part 7: Characteristics, performance requirements and test methods". It is submitted that the fire extinguishing nozzle as herein described has the advantage of passing EN 3-7:2007-10 dielectric tests, and as a result can be safely used for extinguishing class A or class B fires where live electrical equipment is present.

[0028] By preference, the foam separator element (13) is oriented in the radial plane of the inner cross-section of the foaming chamber (4). As such, foam formation inside the foaming chamber is minimally hindered and/or interrupted while equally providing for good separation of the foam. The nozzle thus delivers formation of a high quality fire extinguishing foam which passes dielectric tests.

[0029] According to a further or another embodiment, the foam separator element is an elongated element which is oriented in, and extends along, the radial plane of the inner cross-section of the foaming chamber. The configuration wherein an elongated element is oriented in, and extends, along said radial plane is easy to implement, yet highly effective for improving dielectric testing results of fire extinguishing foams formed in the foaming chamber according to the present invention.

[0030] In some embodiments, the foam separator element is positioned to divide the hollow cylindrical body at least partly into two semi-cylindric parts, which allows for the efficient separation of the fire extinguishing foam formed inside the foaming chamber, thus delivering optimal dielectric test results. By preference, said two semicylindric parts have equal dimensions.

[0031] According to a further or another embodiment, the foam separator element is a rod-like element, which rod-like element is oriented in the radial plane of the inner cross-section of the foaming chamber, thereby dividing said radial plane into two semi-circular parts. "Rod-like elements" as described herein can be, though are not limited to, elements chosen from the group of rods, cylinders, pins, shafts, batons, or spikes. The rod-like element thus allows for optimal dielectric test results, yet by means of an easy implementable modification. By preference, said two semi-circular parts have equal dimensions.

[0032] According to some embodiments, the rod-like element has a diameter of between 1,0 and 3,0 mm. The rod-like element thus has optimal dimensions, thereby dividing the fire extinguishing foam in at least two streams, however not obstructing flow of the fire extinguishing foam. Hence, outstanding fire extinguishing results are obtained, meanwhile passing dielectric tests. By preference, the rod-like element has a diameter of between 1,1 and 2,9 mm, of between 1,2 and 2,8 mm, of between 1,3 and 2,7 mm, of between 1,4 and 2,6 mm, or of between 1,5 and 2,5 mm. More by preference, said rod-like element has a diameter of between 1,5 and 2,0 mm, even more by preference of between 1,6 and 2,0, even more by preference of between 1,7 and 1,9 mm.

[0033] According to a further or another embodiment, the foaming chamber comprises an outlet rim, wherein said foam separator element is positioned between 1,0 and 10,0 mm from the outlet rim. Within said ranges, foam formation characteristics and dielectric test results are further improved. By preference, said foam separator element is positioned between 2,5 and 7,5 mm, from the outlet rim, more by preference between 4,0 and 6,0 mm from the outlet rim, even more by preference between 4,5 and 5,5 mm from the outlet rim.

[0034] According to a further or another embodiment, said ratio of the axial length over the inner diameter (L:d) of the foaming chamber is comprised between 4:5 and 8:5 for extinguishing class A fires, or between 7:1 and 9:1 for extinguishing class B fires. Within the preferred ranges herein disclosed, a broad range of fire extinguishing compositions gives rise to the formation of two distinct fire extinguishing foams which have the optimal foaming characteristics for class A or class B fires respectively.

[0035] In some embodiments, said ratio of the axial length over the inner diameter (L:d) of the foaming chamber is comprised between 4:5 and 9:5, preferably between 4:5 and 8:5 for extinguishing class A fires.

[0036] In some embodiments, said ratio of the axial length over the inner diameter (L:d) of the foaming chamber is comprised between 6:1 and 10:1, preferably between 7:1 and 9:1 for extinguishing class B fires.

[0037] According to a further or another embodiment, said axial length (L) of the foaming chamber is comprised between 10,0 and 30,0 mm for extinguishing class A fires, or between 100,0 and 170,0 mm for extinguishing class B fires.

[0038] By preference, the axial length (L) of the foaming chamber is comprised between 11,0 and 29,0 mm for extinguishing class A fires, or between 110,0 and 160,0 mm class B fires. Said ranges of the axial length (L) of the foaming chamber have shown to be particularly effective in extinguishing class A or class B fires. Furthermore, regarding connectivity of the nozzle to default fire extinguishers and/or fire extinguisher tubes as available on the market, said ranges of the axial length (L) provide for optimal axial length over inner diameter (L:d) ratios compatible with most known extinguishers and/or extinguisher tubes. In some preferred embodiments, the axial length (L) of the foaming chamber for extinguishing class A fires is comprised between 12,0 and 28,0 mm, between 13,0 and 27,0 mm, between 14,0 and 26,0 mm, or between 15,0 and 25,0 mm. In some preferred embodiments, the axial length (L) of the foaming chamber for extinguishing class B fires is comprised between 110,0 and 150,0 mm, between 120,0 and 140,0 mm, between 121,0 and 139,0 mm, between 122,0 and 138,0 mm, between 123,0 and 137,0 mm, between 124,0 and 136,0 mm, or between 125,0 and 135,0 mm.

[0039] According to a further or another embodiment, said mesh has a mesh size of between 700 and 1200 μm. It is submitted that the mesh size impacts various foaming characteristics, such as the discharge time, the discharge flow, foam expansion, foam bubble size, foam discharge angle etc. The inventors have found that the mesh size range as herein described finds a delicate balance between all of the aforementioned foaming characteristics. In particular, smaller meshes give rise to a foam with a smaller bubble size, which is beneficial for the control of e.g. hydrocarbon fires. However, by using a smaller mesh size the amount of foam expansion is reduced, which is suboptimal regarding the extinguishing of class B fires. On the other hand, using a bigger mesh size increases the amount of foam expansion and improves the foam discharge angle, while the resulting bubble size is suboptimal regarding the extinguishing of class A fires. A mesh size of between 700 and 1200 μm exhibits all of the aforementioned advantages, and allows the nozzle as herein described to further optimize foam characteristics for class A or class B fires.

[0040] By preference, said mesh has a mesh size of between 800 and 1100 μm. More by preference, said mesh has a mesh size of between 900 and 1100 μm, even more by preference between 950 and 1050 μm, between 960 and 1040 μm, between 970 and 1030 μm, between 980 and 1020 μm, or between 990 and 1010 μm.

[0041] According to a further or another embodiment, the inner cross-section of the ventilation chamber comprises a cross-sectional constriction. The term "cross-sectional constriction" herein refers to any technical means of limiting the cross-sectional area through which a fire extinguishing composition can freely flow. As a result of said constriction, the liquid flow through the ventilation chamber exhibits higher velocity and increased turbulence, wherein mixing of the fire extinguishing composition and ambient air is improved. As a result of said better mixing, foam expansion and foam bubble size of the resulting foam are further optimized for class A or class B fires. By preference, said cross-sectional constriction is shaped as a venturi-like necking, which induces the venturi effect inside the first hollow cylindrical body of the ventilation chamber, thereby drawing air through the air inlet holes of the ventilation chamber. Better mixing of the fire extinguishing composition and ambient air is achieved, thereby further improving foam characteristics of the resulting fire extinguishing foam. In some embodiments, the cross-sectional constriction has a minimal inner diameter of between 6,0 and 14,0 mm, by preference between 7,0 and 13,0 mm, more by preference between 8,0 and 12,0 mm, even more by preference between 9,0 and 10,0 mm.

[0042] According to a further or another embodiment, the mixing chamber comprises at least two constricted inlet holes which allow for further enhancing velocity and turbulence of the liquid flow before entering the ventilation chamber. Said constricted inlet holes by preference have an opening diameter of between 0,5 and 2,0 mm, more by preference of between 0,6 and 1,5 mm, even more by preference of between 0,7 and 1,2 mm.

[0043] Further or other embodiments of the invention relate to a nozzle wherein the mixing chamber comprises an elongated outlet. The elongated outlet is configured as such that it efficiently guides a fire extinguishing composition inside and/or at least halfway through the ventilation chamber. Said configuration provides for optimal mixing of the fire extinguishing composition and ambient air, which is sucked in through the air inlet hole of the ventilation chamber, thereby further enhancing the foam characteristics for class A or class B fires. By preference, said elongated outlet extends at least partially past the air inlet holes. In some embodiments, said elongated outlet is shaped as a circular truncated cone, which enables even better mixing of the fire extinguishing composition and ambient air.

[0044] According to a further or another embodiment, the elongated outlet has an inner diameter of between 6,0 and 12,0 mm, by preference between 7,0 and 11,0 mm, more by preference between 7,0 and 11,0 mm, or between 8,0 and 10,0 mm.

[0045] According to a further or another embodiment of the present invention, the mixing chamber, the ventilation chamber and the foaming chamber form a single, indivisible body. Herein, the nozzle as a whole determines its applicability for extinguishing of either class A or class B fires. A person using the nozzle does not need to perform any matching and/or assembling of separate parts and can directly couple the nozzle as such to a fire extinguisher, therefore saving valuable time in extinguishing a class A or class B fire in an emergency situation.

[0046] According to a further or another embodiment, the mixing chamber, the ventilation chamber and the foaming chamber comprise at least two separate and/or detachable parts of the nozzle. This allows for mixing and matching of separate and/or detachable parts, thus fine-tuning the nozzle for specific fires and/or emergency situations. By preference, the mixing chamber, the ventilation chamber and the foaming chamber comprise three separate and/or detachable parts of the nozzle.

[0047] In a second aspect, the present invention concerns a fire extinguisher comprising a fire extinguishing composition, said fire extinguisher is provided with a nozzle, wherein said nozzle is a nozzle according to any of the previous embodiments. The fire extinguisher as described herein, exhibits all of the advantages as already discussed, and optimizes the speed and efficiency wherein class A or class B fires can be extinguished.

[0048] By preference, said fire extinguishing composition is fluorine-free. Generally, non-fluorinated fire extinguishing compositions are preferred over fluorinated compositions, as fluorinated compositions have recently come under scrutiny in the light of environmental safety. However, fire extinguishing compositions generally contain fluorinated compounds, e.g. as surfactants, that act as foaming agents in order to provide the desired mechanical and chemical properties to the foam. This is especially the case in the light of class A or class B fires. The fire extinguisher as herein described now provides for the formation of a comparable or even better quality foam, using a fluorine-free fire extinguishing composition.

[0049] A third aspect relates to use of the fire extinguishing nozzle or fire extinguisher as described herein for extinguishing class A or class B fires, exhibiting all of the advantages as already discussed. In particular relating to class A fires, it is observed that the discharged fire extinguishing foam is of a less compact nature and is thinner than fire extinguishing foams which are discharged with fire extinguishing nozzles or fire extinguishers as generally known in the art. This is particularly advantageous as the fire extinguishing foam needs to be applied on the surface of a burning material, which has to be covered as quickly and completely as possible. In particular relating to class B fires, it is observed that the discharged fire extinguishing foam is more compact and thicker than fire extinguishing foams which are discharged with fire extinguishing nozzles or fire extinguishers as generally known in the art. This is particularly advantageous as the fire extinguishing foam is intended to form a substantive layer on top of the burning liquid surface. The resulting compact and thick foam layer is able to better contain the flames in a certain area, and thus prevents the further spreading of the fire. Meanwhile, contact between the burning liquid and ambient air is efficiently reduced and/or eliminated, resulting in the liquid fire being more rapidly extinguished.

[0050] It is submitted that the present use provides in a more efficient and a faster extinguishing of class A or class B fires. The foaming characteristics of a fire extinguishing composition are altered as such, that the fire extinguishing composition can be optimally used to extinguish class A or class B fires in a more efficient and faster way.

[0051] Notwithstanding present use of the nozzle as herein described vastly improves foam characteristics of all fire extinguishing compositions, a preferred use relates to said fire extinguishing compositions being fluorine-free. While fire extinguishing compositions generally contain fluorinated compounds in order to provide the desired mechanical and chemical properties to the foam, use of the fire extinguishing nozzle or the fire extinguisher as herein described now provides for the formation of a comparable or even better quality foam, using a fluorine-free fire extinguishing composition.

DESCRIPTION OF FIGURES

[0052] The following description of the figures of specific embodiments of the invention is merely exemplary in nature and is not intended to limit the present teachings, their application or uses. Throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

[0053] **Fig.** 1 shows a perspective view of an embodiment of a fire extinguishing nozzle 1 according to the present invention, which nozzle **1** comprises a single, indivisible body. The nozzle **1** is especially useful for extinguishing class A fires and is to be understood having an inlet **a** and an outlet **b.** Herein, the inlet **a** is to be coupled to a fire extinguisher and the outlet **b** concerns the passage through which the fire extinguishing composition is discharged. The nozzle **1** comprises a mixing chamber **2,** a ventilation chamber **3** and a foaming chamber **4.** Notwithstanding the mixing chamber **2,** the ventilation chamber **3** and the foaming chamber **4** are formed as a single, indivisible body, the ratio of the axial length over the inner diameter (**L:d**) of the foaming chamber **4** is unambiguously determined between 4:5 and 9:5. The ventilation chamber **3** comprises four air inlet holes **6,** allowing for contact between ambient air and the fire extinguishing composition passing through the nozzle **1.** For ease of coupling and/or decoupling the nozzle **1** to a fire extinguisher or fire extinguisher hose, an outer thread **12** is provided at the inlet **a.** By using the nozzle **1** as herein described, the discharged fire extinguishing foam is of a less compact nature and is thinner than fire extinguishing foams which are discharged through nozzles as generally known in the art. This is particularly advantageous for class A fires, wherein the fire extinguishing foam needs to be applied on the surface of a burning material, which has to be covered as quickly and completely as possible.

[0054] **Fig. 2** shows a perspective view of an embodiment of a fire extinguishing nozzle **1** according to the present invention, which nozzle **1** comprises a single, indivisible body. The nozzle **1** is especially useful for extinguishing class B fires and is to be understood having an inlet **a** and an outlet **b.** Herein, the inlet **a** is to be coupled to a fire extinguisher and the outlet **b** concerns the passage through which the fire extinguishing composition is discharged. The nozzle **1** comprises a mixing chamber **2,** a ventilation chamber **3** and a foaming chamber **4.** Notwithstanding the mixing chamber **2,** the ventilation chamber **3** and the foaming chamber **4** are formed as a single, indivisible body, the ratio of the axial length over the inner diameter (**L:d**) of the foaming chamber **4** is unambiguously determined between 6:1 and 10:1. The ventilation chamber **3** comprises four air inlet holes **6,** allowing for contact between ambient air and the fire extinguishing composition passing through the nozzle **1.** For ease of coupling and/or decoupling the nozzle **1** to a fire extinguisher or fire extinguisher hose, an outer thread **12** is provided at the inlet **a.** By using the nozzle **1** as herein described, the discharged fire extinguishing foam is more compact and thicker than fire extinguishing foams which are discharged through nozzles as generally known in the art. This is particularly advantageous for class B fires, as the fire extinguishing foam is intended to form a substantive layer on top of the burning liquid surface. The resulting compact and thick foam layer is able to better contain the flames in a certain area, and thus prevents the further spreading of the fire. Meanwhile, contact between the burning liquid and ambient air is efficiently reduced and/or eliminated, resulting in liquid fires being more rapidly extinguished.

[0055] **Fig. 3a** shows a perspective view of an embodiment of an assembled fire extinguishing nozzle **1** according to the present invention, which nozzle **1** comprises three separate and/or detachable parts, i.e. a mixing chamber **2,** a ventilation chamber **3** and a foaming chamber **4.** The nozzle **1** is especially useful for extinguishing class A fires and is to be understood having an inlet **a** and an outlet **b.** **Fig. 3b** shows a perspective view of the same embodiment of the fire extinguishing nozzle **1** in a disassembled state. The mixing chamber **2,** the ventilation chamber **3** and the foaming chamber **4** are herein recognizable as three separate entities. For ease of coupling and/or decoupling said parts, outer threads **12** are provided at the inlet **a** of the mixing chamber **2,** at the outlet of the mixing chamber **2,** and at the outlet of the ventilation chamber **3.** Compatible inner threads **11** are provided at the inlet of the ventilation chamber **2** and at the inlet of the foaming chamber **4.** The ratio of the axial length over the inner diameter (**L:d**) of the foaming chamber **4** is furthermore unambiguously determined between 4:5 and 9:5. The ventilation chamber **3** comprises four air inlet holes **6,** allowing for contact between ambient air and the fire extinguishing composition passing through the nozzle **1.** The ventilation chamber **3** further comprises a mesh **7,** which impacts various foaming characteristics, such as the discharge time, the discharge flow, foam expansion, foam bubble size, foam discharge angle etc. By using the nozzle **1** as herein described, the foaming characteristics of a fire extinguishing composition are altered as such, that the fire extinguishing composition can be optimally used to extinguish class A fires in a fast and efficient way.

[0056] **Fig. 4a** shows a perspective view of an embodiment of an assembled fire extinguishing nozzle **1** according to the present invention, which nozzle **1** comprises three separate and/or detachable parts, i.e. a mixing chamber **2,** a ventilation chamber **3** and a foaming chamber **4.** The nozzle **1** is especially useful for extinguishing class B fires and is to be understood having an inlet **a** and an outlet **b. Fig. 4b** shows a perspective view of the same embodiment of the fire extinguishing nozzle **1** in a disassembled state. The mixing chamber **2,** the ventilation chamber **3** and the foaming chamber **4** are herein recognizable as three separate entities. For ease of coupling and/or decoupling said parts, outer threads **12** are provided at the inlet **a** of the mixing chamber **2,** at the outlet of the mixing chamber **2,** and at the outlet of the ventilation chamber **3.** Compatible inner threads **11** are provided at the inlet of the ventilation chamber **2** and at the inlet of the foaming chamber **4.** The ratio of the axial length over the inner diameter (**L:d**) of the foaming chamber **4** is furthermore unambiguously determined between 6:1 and 10:5. The ventilation chamber **3** comprises four air inlet holes **6,** allowing for contact between ambient air and the fire extinguishing composition passing through the nozzle **1.** The ventilation chamber **3** further comprises a mesh **7,** which impacts various foaming characteristics, such as the discharge time, the discharge flow, foam expansion, foam bubble size, foam discharge angle etc. By using the nozzle **1** as herein described, the foaming characteristics of a fire extinguishing composition are altered as such, that the fire extinguishing composition can be optimally used to extinguish class B fires in a fast and efficient way.

[0057] **Fig. 5** shows a perspective view of an embodiment of a ventilation chamber **3** according to the present invention, comprising air inlet holes **6** and a mesh **7.** For ease of coupling and/or decoupling the ventilation chamber **3** to other parts of the nozzle, an outer thread **12** is provided.

[0058] **Fig. 6** shows a perspective view of an embodiment of a ventilation chamber **3** and a foaming chamber **4** according to the present invention, which ventilation **3** and foaming chamber **4** form a single, indivisible body. Notwithstanding the ventilation chamber **3** and the foaming chamber **4** are formed as a single, indivisible body, the ratio of the axial length over the inner diameter (**L:d**) of the foaming chamber **4** is unambiguously determined between 4:5 and 9:5. **Fig. 6** further serves to illustrate the first hollow cylindrical body **5** of the ventilation chamber **3,** which internally is provided with an inner thread **11,** to provide for easy coupling and/or decoupling to a mixing chamber, and comprises four air inlet holes **6.**

[0059] **Fig. 7** shows a perspective view and a cross-sectional inlet view of an embodiment of a mixing chamber **2** according to the present invention. The mixing chamber **2** comprises two constricted inlet holes **8,** which allow for enhancing the velocity and the turbulence of the liquid flow of a fire extinguishing composition before entering a ventilation chamber. Easy coupling of said mixing chamber **2** to an upstream fire extinguisher and a downstream ventilation chamber is provided for by the outer threads **12.** The mixing chamber further comprises an elongated outlet **9** which is configured as such that it efficiently guides a fire extinguishing composition inside and/or at least halfway through a ventilation chamber coupled thereto.

[0060] **Fig. 8** shows a sectional representation according to a central, axial axis of an embodiment of a ventilation chamber **3** according to the present invention. The ventilation chamber **3** comprises air inlet holes **6** and is provided with a mesh **7** and an outer thread **12,** for easy coupling to a foaming chamber. The first hollow cylindrical body **5,** in particular the inner cross-section of the ventilation chamber **3,** comprises a cross-sectional constriction **10,** which is shaped as a venturi-like necking. This induces the venturi effect inside the first hollow cylindrical body **5,** thereby drawing air through the air inlet holes **6** of the ventilation chamber **3.**

[0061] **Fig. 9** and **Fig. 10** respectively show a perspective view and a front view of a foaming chamber **4,** comprising a foam separator element **13** according to the present invention. The foam separator element **13** is shaped as a rod-like element, and at least temporary separates a fire fighting foam which is formed in the foaming chamber, into at least two streams. The foaming chamber **4** as described herein thus allows for the formation of a fire extinguishing foam which largely improves the results of dielectric tests. The foam separator element **13** is oriented in the radial plane of the inner cross-section of the foaming chamber **4,** thereby minimally hindering and/or interrupting foam formation while equally providing for good separation of the foam. The shown configuration wherein the foam separator element **14,** in particular the rod-like element, is oriented in and extends along said radial plane is easy to implement, yet highly effective for improving dielectric testing results of fire extinguishing foams. The foam separator element **14** is positioned to divide the hollow cylindrical body at least partly into two semi-cylindric parts **14, 14'** or alternatively to divide the radial plane into two semi-circular parts **15, 15',** which allows for the efficient separation of the fire extinguishing foam formed inside the foaming chamber **4.** The foaming chamber **4** comprises an outlet rim **16,** wherein said foam separator element **14** is positioned between 1,0 and 10,0 mm from the outlet rim **16.**

List of numbered elements:

[0062]

1	fire extinguishing nozzle
2	mixing chamber

3	ventilation chamber
4	foaming chamber
5	first hollow cylindrical body
6	air inlet hole
7	mesh
8	constricted inlet hole
9	elongated outlet
10	cross-sectional constriction
11	inner thread
12	outer thread
13	foam separator element
14,14'	semi-cylindric parts
15,15'	semi-circular parts
16	outlet rim of the foaming chamber
a	inlet
b	outlet
L	axial length
d	inner diameter

Claims

1. A fire extinguishing nozzle, the fire extinguishing nozzle (1) comprising a mixing chamber (2), a ventilation chamber (3) comprising at least three air inlet holes and a foaming chamber (4), wherein said ventilation chamber is coupled to said mixing chamber and said foaming chamber is coupled to said ventilation chamber and wherein:

    said ventilation chamber and/or said foaming chamber comprise a mesh (7),
    wherein said mesh is oriented in the radial plane of the inner cross-section of the ventilation chamber and/or foaming chamber, and
    said foaming chamber (4) comprises a foam separator element (13) suited to separate a foamed foam in the foaming chamber into at least two streams,
    wherein the foam separator element is oriented in the radial plane of the inner cross-section of the foaming chamber (4).

2. The fire extinguishing nozzle according to claim 1, **characterized in that**, the foam separator element (13) is an elongated element which is oriented in, and extends along, the radial plane of the inner cross-section of the foaming chamber (4).

3. The fire extinguishing nozzle according to claim 1 or 2, **characterized in that**, the foam separator element (13) is a rod-like element, which rod-like element is oriented in the radial plane of the inner cross-section of the foaming chamber, thereby dividing said radial plane into two semi-circular parts (15, 15').

4. The fire extinguishing nozzle according to claim 3, **characterized in that**, said two semi-circular parts (15 ,15') have equal dimensions.

5. The fire extinguishing nozzle according to any of the preceding claims 1-4, wherein said foaming chamber comprises an outlet rim (16), **characterized in that**, said foam separator element (13) is positioned between 1,0 and 10,0 mm from the outlet rim (16).

6. The fire extinguishing nozzle according to any of the preceding claims 1-5, **characterized in that** the mixing chamber, the ventilation chamber and the foaming chamber form a single, indivisible body.

7. The fire extinguishing nozzle according to any of the preceding claims 1-6, **characterized in that**, said mesh (7) has a mesh size of between 700 and 1200 μm, preferably between 800 and 1100 μm.

8. The fire extinguishing nozzle according to any of the preceding claims 1-7, **characterized in that**, the inner cross-section of the ventilation chamber (3) comprises a cross-sectional constriction (10).

9. The fire extinguishing nozzle according to claim 8, **characterized in that**, said cross-sectional constriction (10) is shaped as a venturi-like necking.

10. The fire extinguishing nozzle according to any of the preceding claims 1-9, **characterized in that**, the mixing chamber (2) comprises at least two constricted inlet holes (8).

11. The fire extinguishing nozzle according to any of the preceding claims 1-10, **characterized in that**, the mixing chamber (2) comprises an elongated outlet (9), wherein said elongated outlet (9) extends at least partially past the air inlet holes.

12. The fire extinguishing nozzle according to any of the preceding claims 1-11, **characterized in that**, the ventilation chamber (3) comprises four air inlet holes (6).

13. A fire extinguisher comprising a fire extinguishing composition, said fire extinguisher is provided with a nozzle according to any one of the claims 1-12.

14. The fire extinguisher according to claim 13, **characterized in that**, said fire extinguishing composition is fluorine-free.

15. Use of the fire extinguishing nozzle according to any one of the claims 1-12 or of the fire extinguisher according to claim 13 or 14 for extinguishing class A or class B fires.

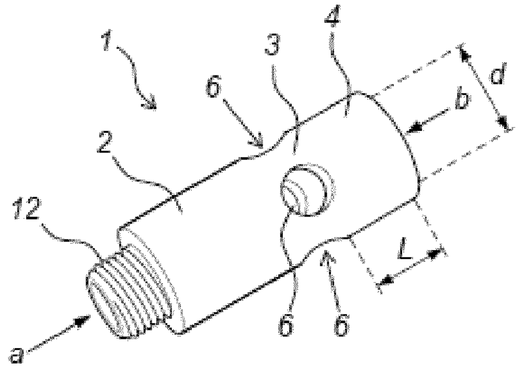

Fig. 1

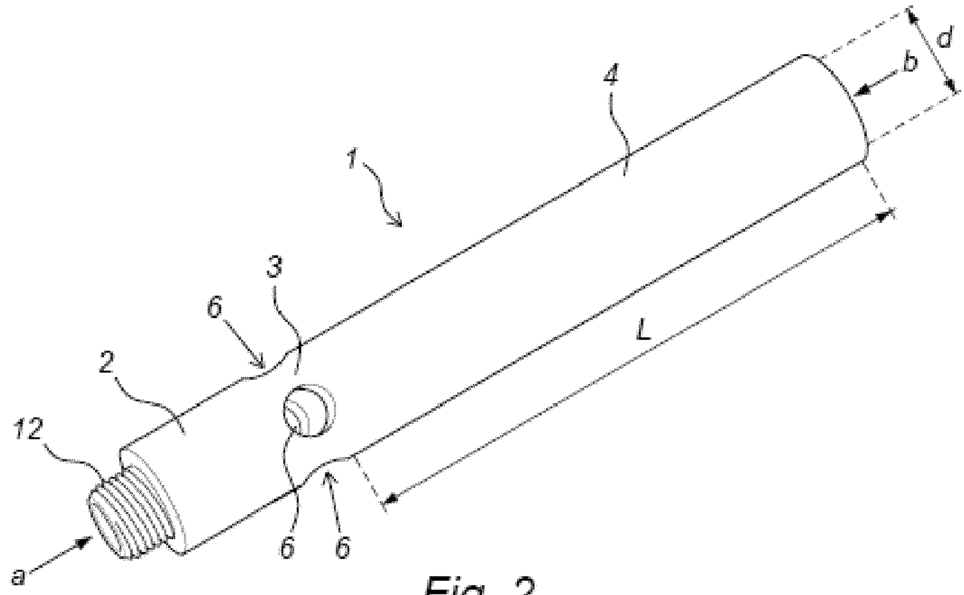

Fig. 2

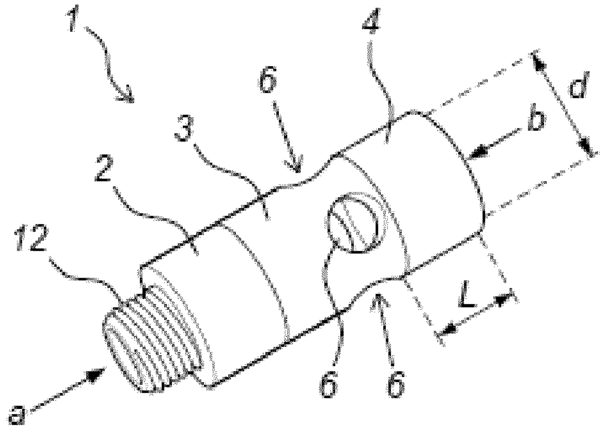

Fig. 3a

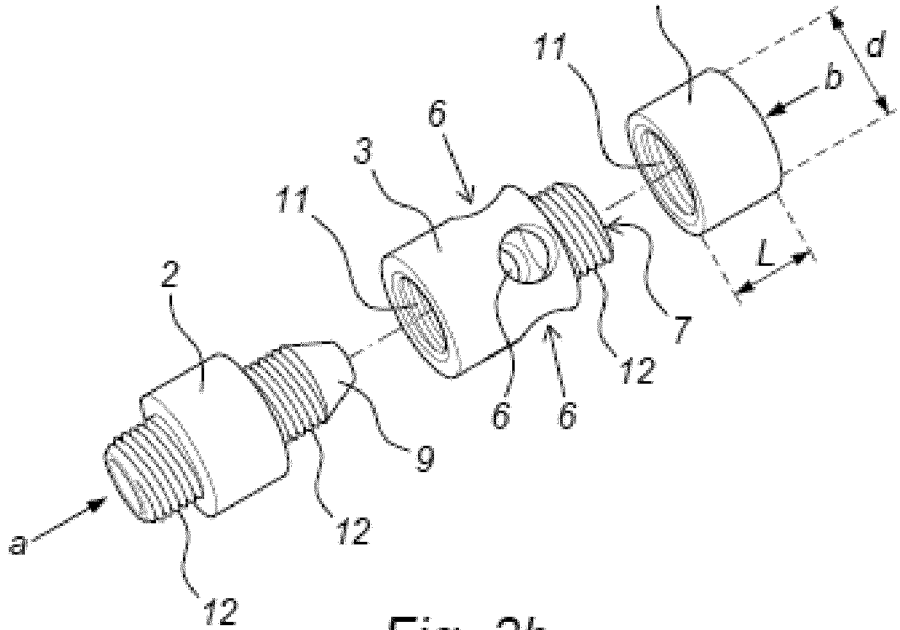

Fig. 3b

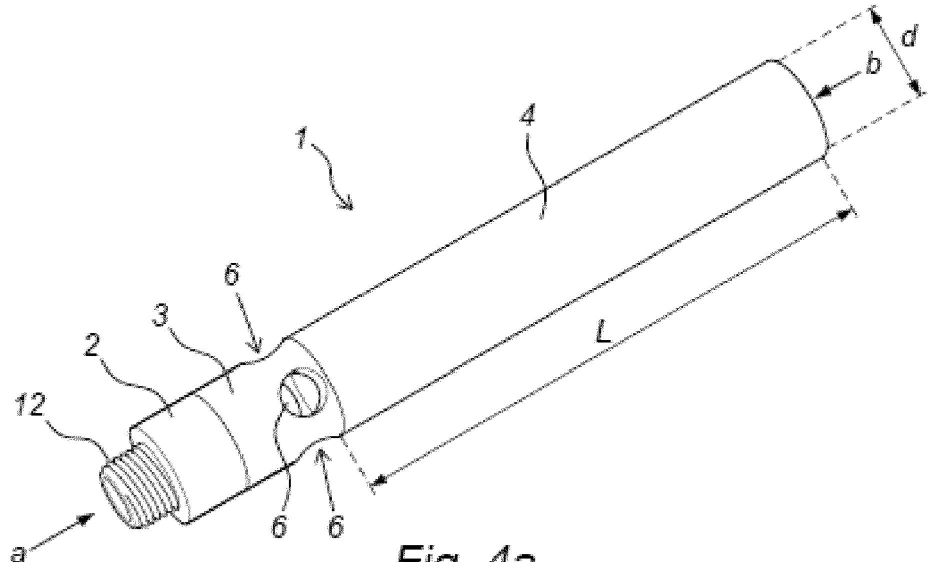

Fig. 4a

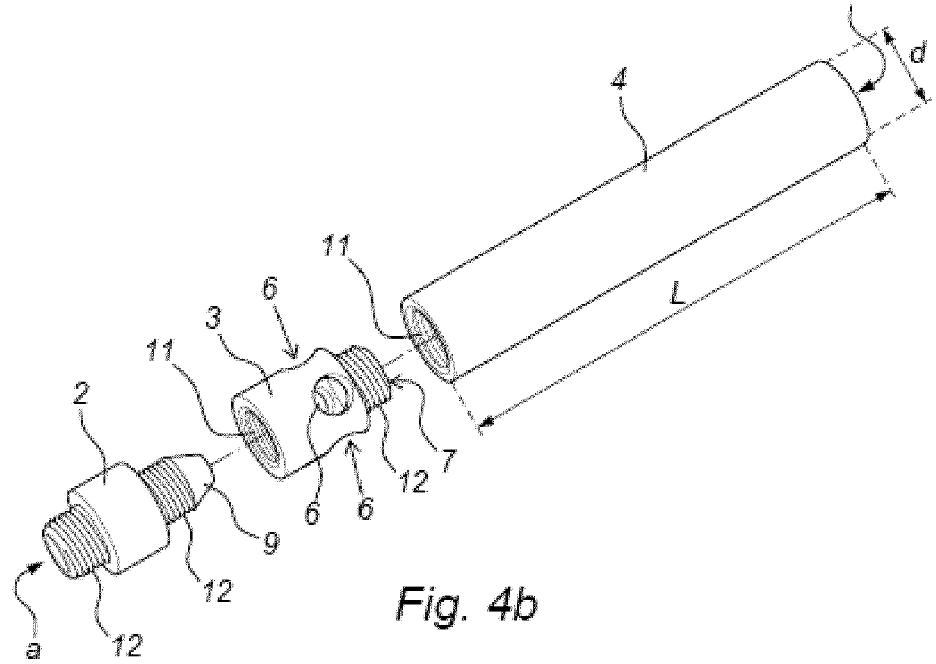

Fig. 4b

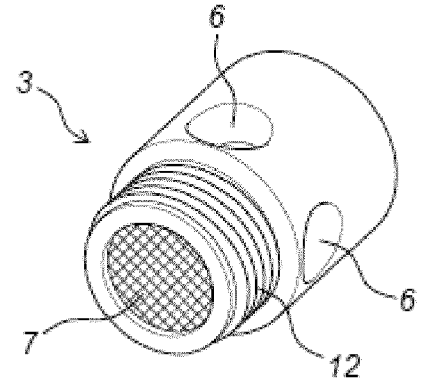

Fig. 5

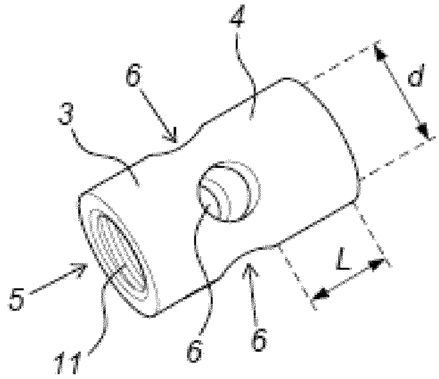

Fig. 6

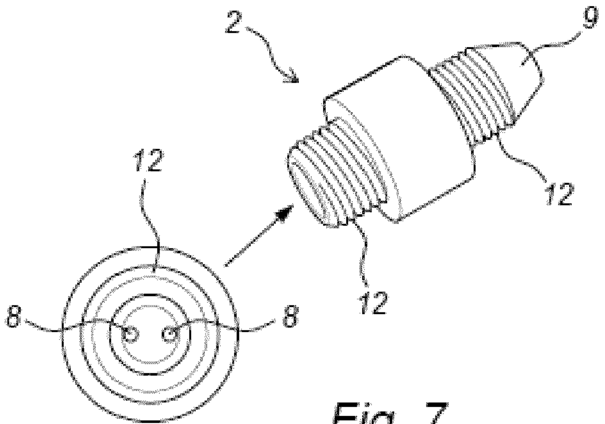

Fig. 7

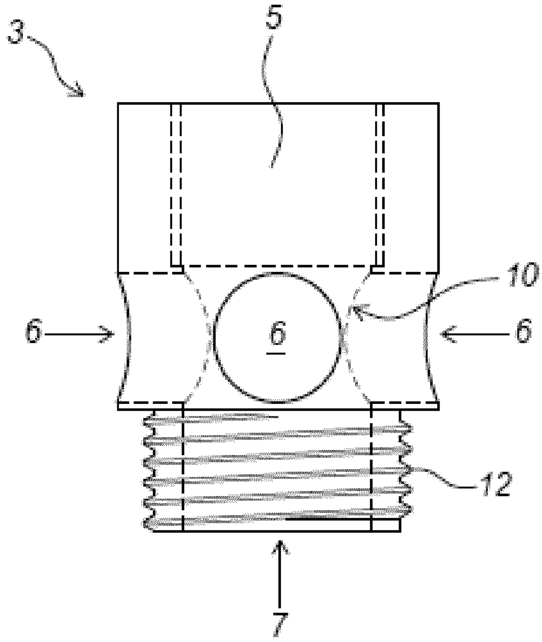

Fig. 8

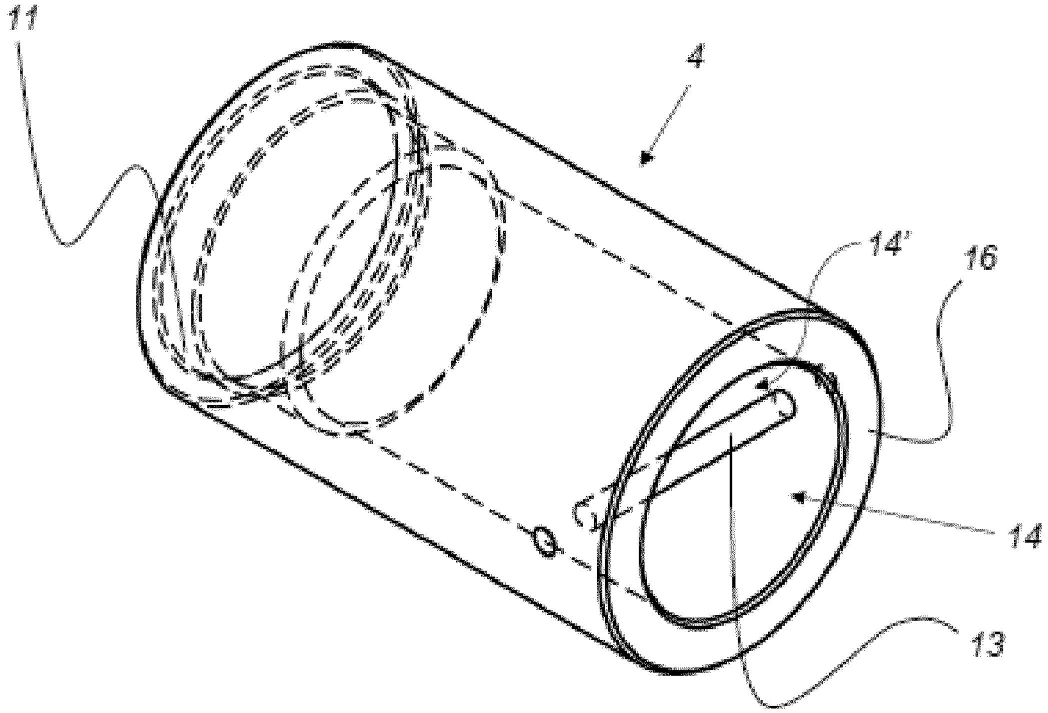

Fig. 9

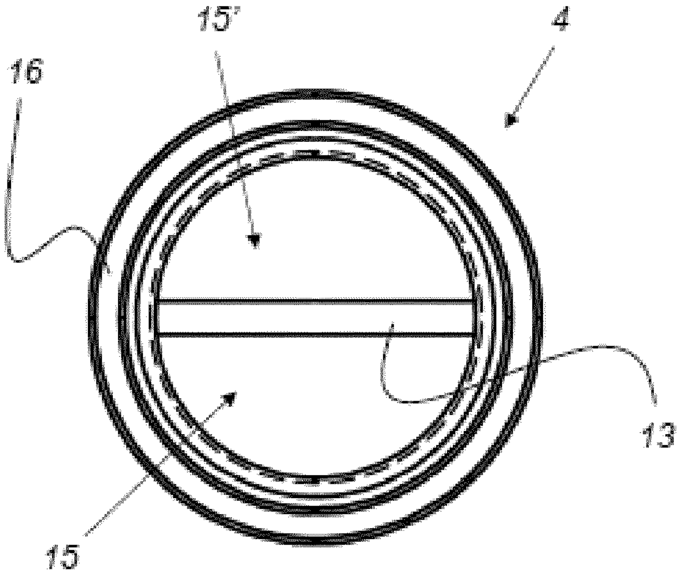

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 5878

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 2 303 605 A1 (ROTVAND GEORGES [FR]) 8 October 1976 (1976-10-08) * the whole document * * figures *	1-15	INV. A62C5/02 A62C31/12
A	US 4 830 790 A (STEVENSON DOUGLAS E [CA]) 16 May 1989 (1989-05-16) * example 1 * * figures 1,4 * * claims *	1-15	
A	GB 2 294 415 A (WARNSTAR LTD [GB]) 1 May 1996 (1996-05-01) * page 7, paragraph troisieme - paragraph quatrième * * figures * * claims * * page 5, paragraph deuxieme *	1-15	
A	WO 2017/012601 A1 (FEUERSCHUTZ JOCKEL GMBH & CO KG [DE]) 26 January 2017 (2017-01-26) * figures 2,3,4 * * page 9, line 10 - page 11, line 17 *	1-15	TECHNICAL FIELDS SEARCHED (IPC)
A	US 5 848 752 A (KOLACZ DAVID J [US] ET AL) 15 December 1998 (1998-12-15) * column 7, line 54 - line 67 * * figures *	1-15	A62C B01F B05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	13 April 2023	Cardin, Aurélie

CATEGORY OF CITED DOCUMENTS

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13-04-2023

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
FR 2303605	A1	08-10-1976	FR	2303605	A1	08-10-1976
			GB	1461044	A	13-01-1977
US 4830790	A	16-05-1989	NONE			
GB 2294415	A	01-05-1996	GB	2294415	A	01-05-1996
			US	5857627	A	12-01-1999
WO 2017012601	A1	26-01-2017	DE	112016003293	A5	26-04-2018
			EP	3337576	A1	27-06-2018
			WO	2017012601	A1	26-01-2017
US 5848752	A	15-12-1998	NONE			

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Patent documents cited in the description

- EP 3337576 A **[0004]**
- FR 2303605 **[0004]**
- US 4830790 A **[0004]**