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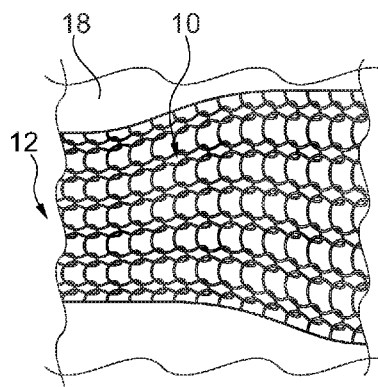


Fig. 3

(57) Abstract: Firestop device within a ventilated cavity, air gap or opening (12) in or between building parts (18), comprising a flame quenching gap element (10), said quenching gap element (10) is at least one malleable and non-combustible mesh made of a number of strands or threads (10a) which are braided, knitted or otherwise interconnected to each other in a two- or three dimensional fashion, wherein the strands or threads (10a) of the malleable mesh can slide freely against each other without any fixed or rigid connection in order to fill irregularities of the ventilated cavity, air gap or opening (12), and wherein a distance between parallel strands or threads (10a) is less than a fixed distance to maintain a quenching gap effect.

Firestop device.**Field of the invention**

5 The present invention relates to a firestop device within a ventilated cavity, air gap or opening, comprising a flame quenching element.

Background of the invention

10 Unprotected ventilation openings in buildings are critical when exposed to fire. Fires that spread underneath the facade cladding represent a major challenge for the fire brigade; both since it is difficult to identify where it actually is burning, and also since it often is difficult to access the fire. Both statistics and real fire situations point at increased safety benefits by preventing fire from spreading through gaps and cavities in the construction.

15 Today this problem is solved by using different types of ventilating fire barriers. These are characterized by allowing air to vent cavities and prevent fire from penetrating after they are sealed. Some prevent flames from propagating into the cavities for a brief period. Commonly, strips of intumescent are used to protect ventilated or ventilating cavities. When exposed to fire the intumescent substance is
20 activated by the heat and expands to fill the gap completely, hence preventing flames and hot gases to enter the cavity. The weakness with this solution is that flames can enter the cavity in the early stage of a fire, in seconds or minutes before the intumescent has completely sealed the gap. Fire barriers such as perforated metal sheets or metal sheet labyrinths, stop embers and flames in early stages.
25 However, these solutions will not be efficient for longer fire durations.

The applicant has previously invented ventilating solutions that blocks flames instantly and prevent fire spread throughout the entire fire rating period, all based on a fully reactive and ablative vent design, i.e. it contains no moving parts, no detector
30 activating system and no cabling.

The known vents are described in the inventor's earlier patents WO2004/004837 and WO2010/140893, and comprise a fire resistant mesh and intumescent.

35 Other fire barriers are known from GB2107183A, US2279791, US5811713, WO9422536A1, US2013/0255893A1 and GB1500913.

The quenching effect is well known in the art of chemical explosion suppression in pipes. The openings of a quenching net must be designed to block flaming by particular mixtures of combustible gas. The opening distances are referred to as quenching diameter or quenching gap and are listed in millimetres for each type of gas or gas mixtures.

During initial flame exposure, a gap between the ventilating fire barrier and the surrounding surfaces must not be more than the quenching gap size, as flames will bypass such openings, and thereby circumvent the barrier to the unexposed side.

Such gaps must be protected, for instance by battens or mastic, and this complicates correct mounting of the vents or the expected effect may not be achieved. This is particularly challenging in a gap or opening where the surrounding surfaces are irregular or change in size.

All known vents offer a limited ability to provide instant fire block and to fully fill irregularities in gaps and cavities, both during normal use in open state, and during the initial phase of a fire or in sealed state of the vent. The gaps may arise or enlarge during fire or by unfavourable handling and mounting of the vents. This particularly is a problem in voids and cavities behind the facade cladding.

A major problem is deflections or delaminations of facade elements by impact of fire which cause them to deflect away from air gaps and increase them. Most cavity fire barriers can not cope with large expansion, and sudden flame or fire are known to bypass them and having caused large damage; either because gap extends beyond the reach of the fire barrier or because the intumescent of the barrier do not expand quick enough to seal the gap extension caused by deflection.

Some type of firestop devices or cavity fire barriers tends to trap condensed water or rain droplets for extended time against surfaces of air gaps which eventually damage construction. The purpose of ventilated cavities is to keep the construction dry.

Objects of the present invention

The object of the invention is to provide a firestop device, which solves the above problems related to the known ventilating fire barriers.

The firestop device according to the invention can take form of an air transfer and water draining firestop device.

Further, it is an object that the firestop device according to the invention shall be easy and quick to install correctly.

It is also an object that the firestop device according to the invention is malleable to fill irregularities of a ventilated cavity or air gap in a building construction, during installation and normal use in addition to during fire.

Summary of the invention

Said objects are achieved with a firestop device according to the characterizing part of the independent patent claim. Further advantageous features are stated in the dependent claims.

The invention provides a firestop device within a ventilated cavity, air gap or opening in or between building parts, comprising a flame quenching gap element, said quenching gap element is at least one malleable and non-combustible mesh made of a number of strands or threads which are braided, knitted or otherwise interconnected to each other in a two- or three dimensional fashion, wherein the strands or threads of the malleable mesh can slide freely against each other without any fixed or rigid connection in order to fill irregularities of the ventilated cavity, air gap or opening and wherein a distance between parallel strands or threads is less than a fixed distance to maintain a quenching gap effect.

The strands or threads of the mesh can be stretched and compressed to fill a void between the building parts.

In a wide ventilated cavity, air gap or opening, the distance between transverse parallel strands can be less than the fixed distance, while the distance between longitudinally parallel strands can be increased.

In a narrow ventilated cavity, air gap or opening, the distance between longitudinally parallel strands can be less than the fixed distance, while the distance between transverse parallel strands can be increased.

The firestop device can comprise an intumescent substance, which upon exposure to heat expands and seals the ventilated cavity or air gap.

The malleable mesh of the firestop device can be reshapeable as the strands or threads of the mesh can move in any directions away from the original produced form by compression or tensile strain.

- 5 A grid size of the malleable mesh, being the size of openings between the strands or threads, is preferable less or equal to a quenching gap of a specific combustible gas or gas mixture.

- 10 The malleable mesh can be made out of knitted steel with low friction surface threads which slide against each other when under stress, such as tempered high-carbon steel giving a spring steel effect.

- 15 The malleable mesh can be manufactured or rolled into a tube structure, which is compressible to be formed in an oval structure, and expandable to fill voids of irregular surfaces.

An intumescent substance can be placed within or at least partially within the tube structure.

- 20 A core of intumescent substance can be placed within the tube structure.

A core of intumescent substance can be placed or embedded in or on a periphery of the tube structure.

- 25 The malleable mesh can be arched shaped, and a core of said intumescent substance can be placed or embedded within the arched shaped structure.

The core of intumescent substance can be spherical or rectangular.

- 30 The intumescent substance can be made of a reactive and endothermic substance.

The intumescent substance can be made of graphite or sodium silicates.

- 35 The quenching gap element can be made of memory metal, which when under exposure to heat expands to increase contact area with ventilating opening surfaces of the ventilated cavity, air gap or opening.

The malleable form of the quenching gap element can be adapted to reset itself to original form when not under stress.

5 The firestop device can be a water or liquid draining firestop device, in that a lower part of the malleable mesh, when placed between surfaces in the ventilated cavity, air gap or opening, is a water or liquid drip-off part of the malleable mesh.

10 The malleable mesh of the quenching gap element can be manufactured or rolled into a circular or oval tube form, and comprises an internal, helical support spring, which in a non-stretched condition has a larger external diameter than an internal diameter of the tube. The spring can be arranged to expand or keep the malleable mesh expanded.

15 The malleable mesh of the quenching gap element can be manufactured or rolled into a circular or oval tube form, and compressed at its middle to obtain four layers of quenching gap mesh, and comprise intermediary intumescent substance, which is held in place by sacrificial rivets.

20 Upon exposure to heat, the intumescent will expand at the least until it covers the gap in the exposed area or, in the case of 3D embodiment, until a longitudinal cross section of the surrounding mesh tube is filled. When the intumescent expands to fill the gap, air is prevented to transfer the vent and hence both heat and flames are prevented from transferring through the cavity.

25 Reshaping of the malleable firestop device may be done by hand in all directions to fill larger gaps in some parts, and smaller gaps in other parts. In this way, the vent in the form of the firestop device will fit into uneven ventilation gaps with crevices, cracks, indents or sloping surfaces wherein it should be installed. The vent area may be changed on site, and therefore one achieves optimal size to fully fill in linear gaps
30 at any point such that the above mentioned gaps between the vent and the surrounding surfaces are avoided. This is especially advantageous when the opening or cavity wherein the firestop device is to be fitted is long and the gap size irregular.

35 For a malleable quenching gap element shaped into a tube surrounding intumescent, an important feature is the encapsulation ability to be slightly pressed into a narrow gap to form a "flat oval". This means that when sealed a much thicker layer of

intumescent can provide a barrier of insulation against fire than previous designs with encapsulations that are circular after installation.

5 If the opening is longer than the length of the quenching gap element, the ends of devices with all treads or strands meet up against each other for instance by compressing or feeding into another, and thereby creating a splice without dedicated seals.

10 The firestop device shall be able to stretch and compress in order to fill the space between opposing surfaces of the gap wherein it shall be fitted. This avoids the need to cut lengths precisely prior to fitting. When the firestop device is rolled to a tube, the mesh will be compressed longitudinally to increase the volume and fill the void in the ventilated cavity or air gap.

15 The firestop device may be described as a ventilating dry linear seal which can be formed by hand using no tool or adhesives to fit into uneven ventilating gaps which incorporates crevices, cracks, indents, irregularities or sloping surfaces. At the same time by hand one may straighten out by hand any bends or indents of the device itself caused by former impact of handling. The device properties that allow forming
20 by hand on site resemble that of putty beads, mastic gun or clay by being 3D elastic, although it still transfers air and drains water without being sticky and without requiring tools.

25 A firestop device according to the present invention provides a reversible or provisional fire protection. It can be removed at any time, hardly leaving any marks. Further, as the quenching gap element comprises a mesh, it may also provide draining of water at the same time as it prevents rodents from penetrating into cavities.

30 Instead of trapping water against porous surfaces of cavity the firestop device preferably offer its lower point as a part of metal mesh between the surfaces which allows drip-off to ground and faster natural air drying.

35 The firestop device thus provides robust fire resistance by integrity, insulation, blocking of direct flame impingement and of embers. The firestop device provides said fire resistance in open state as well as sealed state.

Description of the diagrams

Embodiments of the present invention will now be described, by way of example only, with reference to the following diagrams wherein:

5 Figure 1 – 5 show a firestop device according to the invention, in ventilated cavities or air gaps of different configurations.

Figure 6 – 9 show different configurations of the firestop device according to the invention, in a ventilated cavity or air gap.

Figure 10 show the firestop device according to the invention in a long and irregular ventilated cavity or air gap.

10 Figure 11 – 19 show different configurations of firestop device according to the invention, in a ventilated cavity or air gap, and including intumescent substance.

Figure 20 shows the firestop device according to the invention in a tubular form.

15 Figure 21-26 show further embodiments of the firestop device according to the invention.

Figure 27 shows a spring included in the firestop device according to the invention.

Description of preferred embodiments of the invention

20 As shown in the drawings, a firestop device according to the invention comprises a quenching gap element 10 placed in a ventilated cavity, air gap or opening 12. Optionally, an intumescent substance 14 can be used together with the quenching gap element 10.

25 The ventilated cavity, air gap or opening 12 is an opening, void or channel in or between two or more parts 18 of a building construction. The building parts 18 can for instance be doors, ducts, floors, walls, foundation, eaves, etc., and in particular wall boards or panels, wherein an air passage occurs. The ventilated cavity, air gap or opening 12 may be very narrow. Hence, the ventilated cavity, air gap or opening
30 12 is not within a typical vent provided to insure normal ventilation into and out of the building construction. However, if suitable, the firestop device according to the invention can also be utilized in a typical vent.

35 The firestop device according to the invention, which may be an air transfer and water draining firestop device, offers a malleable form of non-combustible mesh and possible intumescent. The malleable form is preferably made of a number of strands or threads 10a, 10b which are braided, knitted or otherwise held into each other in a

two- or three dimensional fashion. The strand or threads 10a,10b of the mesh should not be welded or glued to each other, but they can form interlocking asymmetrical loops giving high resilience. Such malleable form can be alterable by hand. The form may thus be reshaped as the strands or threads 10a,10b of the mesh can move in all
5 directions away from the original produced form by compression or tensile strain at any point. The grid size of the mesh, being the size of the opening between threads 10a,10b or the openings between the firestop device and adjoining surfaces, must be less or equal to the maximum size of the quenching gap of the application as determined by the gas mixture. The distance **a** and **b**, as shown in figure 1, is thus
10 less than the quenching gap in mm of the gas or mix of gases for the specific flame blocking application.

In the drawings **c** denotes linear height of surface contact between the quenching gap element 10 and the inner surface of the ventilated cavity or air gap 12, which
15 serves as heat sink for absorbing and storing heat, and provide flame quenching and provide uniform thick intumescent in the fire spread direction.

Figure 20 shows the quenching gap element 10 in the form of a mesh in a tubular form.

20 An important feature with the invention is how the strands 10a,10b of the mesh are stretched and compressed when it fills a void between building parts 18. When the mesh is in the form of a tube and inserted between the building parts 18, the mesh is compressed longitudinally to increase the volume. The distance between parallel
25 strands 10a should for instance never be larger than a fixed distance, for instance 2mm, to maintain the quenching gap effect. The fixed distance is determined by the quenching gap of the specific combustible gas or gas mixture. In a wide passage the distance between transverse parallel strands 10a remains less than the fixed distance while the distance between longitudinally parallel strands 10b increases,
30 and in a narrow passage the distance between longitudinally parallel strands 10b remains less than the fixed distance while the distance between transverse parallel strands 10a increases.

Figure 1-9 show different embodiments suitable for ember and flame blocking,
35 normally short duration flame blocking.

Figure 1 shows the quenching gap element 10 placed in a linear even gap 12 between two building parts 18, with the mesh in a normal tube form, i.e. not stretched nor compressed or bent. The distance between transverse parallel strands 10a are less than the fixed distance and the distance between longitudinally parallel strands 10b are less than the fixed distance.

Figure 2 shows the quenching gap element 10 placed in a non-linear gap 12 between two building parts 18, in where the gap width linearly increases or decreases, and the openings of the mesh are compressed in the wide sections and stretched in the narrow sections.

Figure 3 shows the quenching gap element 10 placed in an uneven gap 12 between two building parts 18, in where the gap width randomly increases or decreases, and the openings of the mesh are compressed in the wide sections and stretched in the narrow sections.

Figure 4 shows similar the quenching gap element 10 placed in an uneven gap 12 between two building parts 18, in where the gap width randomly increases or decreases, and the openings of the mesh are compressed in the wide sections and stretched in the narrow sections. In the wide passage the distance between transverse parallel strands 10a remains less than the fixed distance while the distance between longitudinally parallel strands 10b is increased, and in the narrow passage the distance between longitudinally parallel strands 10b remains less than the fixed distance while the distance between transverse parallel strands 10a is increased.

Figure 5 shows the quenching gap element 10 placed in a somewhat linear gap 12 between two building parts 18, but where sharp edges occasionally leave voids larger than the quenching gap. Said voids may require to be filled with fire resistant mastic 16 or not depending on the edge. The mesh of the quenching gap element 10 may suitably be pushed into the voids.

Figure 6 shows a cross section of the quenching gap element 10 placed in an even gap 12 between two building parts 18 with good linear height, and with the mesh in a compressed oval form.

Figure 7 shows a cross section of the quenching gap element 10 placed in a gap 12 between two building parts 18 with irregular gap height, showing that the mesh has the flexibility of adapting to the gap 12.

- 5 Figure 8 shows the quenching gap element 10 placed in an even gap 12 between two building parts 18, with the mesh in a sheet form fixed to make a quenching element of four layers with good heat sink performance. The mesh of the quenching gap element 10 thus displays an S or arched form.
- 10 Figure 9 shows the quenching gap element 10 placed in an even gap 12 between two building parts 18, and comprises a circular or oval mesh incorporating a smaller second circular mesh within, to achieve four layers of quenching and heat sink performance spaced by air between them in the flow direction.
- 15 Figure 10 shows the quenching gap element 10 placed in an extremely rugged gap 12, for instance between mortar surfaces 18 in a building construction. The mesh can be compressed or stretched to fill most of the gap 12, and in addition a fire resistant linear seal 16, such as by mastic gun, can be applied to fill irregularities larger than the quenching gap. An intumescent substance 14 can be used together
20 with the quenching gap element 10, as explained in connection with the other embodiments.

Figure 11-15 show different embodiment suitable for ember, flame, and sustained fire blocking, between building parts 18, and also with an intumescent substance 14.

- 25 The intumescent substance 14 can be of any form, but preferably of a rectangular or spherical shape, and is a reactive and endothermic substance with heat sink performance.

Figure 11 shows the quenching gap element 10, with the mesh in an oval sheet
30 form, embedded into an intumescent substance 14, i.e. reactive element, which is fixed to the surface of the ventilating gap 12. As the reactive and endothermic substance expands and removes heat the firestop device prevent embers, flames and sustained fire exposure to penetrate for an extended time.

- 35 Figure 12 shows a similar solution as in figure 11, but with the reactive element, i.e. intumescent substance 14, resting at the bottom of a circular firestop device of the invention, and heat sink areas c on both sides of the ventilation gap 12.

Figure 13 shows use of three circular quenching gap elements 10, as shown in figure 11, compressed to fill a gap 12 with good linear height, and that gives extended time fire resistance in wide gap applications. The mesh is embedded into the reactive elements 14.

5

Figure 14 shows a sheet form of the invention, with the quenching gap element 10 in an arched or U-form, and with a circular reactive element 14.

10

Figure 15 shows a combination with any of several existing devices marketed for sustained fire resistance and the invention. The firestop device according to the invention can be added to make existing products ember and direct flame resistant. Figure 16-17 show different embodiment suitable for ember, flame, sustained fire, and radiation blocking, and also with an intumescent substance 14.

15

Figure 16 shows a combination of different embodiments, in where three quenching gap elements 10 are used. One or more of the quenching gap elements 10 can have or be embedded in the intumescent substance 14. The firestop device according to the invention may thus provide sufficient flame quenching and attenuation of heat radiation to prevent ignition on the unexposed side prior to the device being sealed by expanding reactive substance.

20

Figure 17 shows a circular or oval quenching gap element 10 with intumescent substance 14 in upright position within the mesh and with overlapping radiation shields 20 below the quenching gap element 10 in order to provide radiation blocking without blocking air transfer.

25

Figure 11-19 all show different embodiments in an even gap 12 between building parts 18, but may be used in similar gaps as shown in figures 1-10.

30

Figure 18 shows bundled circular forms of the firestop device according to the invention, which gives a good heat sink cross section area. Figure 19 shows a similar embodiment for wide gaps 12.

35

Figure 21 shows an intumescent strip 14 held in place by two quenching gap elements 10 in the form of knitted mesh tubes inside one quenching gap element 10 in the form of a main mesh tube in order to provide four layers of quenching gap in a series to block direct flame attack.

Figure 22 shows an intumescent strip 14 held in place in ideal vertical position by one deformed quenching gap element 10 in the form of a knitted mesh tube inside a main quenching gap element 10 in the form of a mesh tube which also provides four layers of quenching gap in a series to block direct flame attack.

5

Figure 23 shows a quenching gap element 10 in the form of a mesh tube with an expansion pocket 24. The pocket 24 will extend the firestop device to extra width in case of severe deflection of bordering elements.

10 Figure 24 shows a quenching gap element 10 in the form of a mesh tube containing intumescent in the form of a three-dimensional ventilating quenching gap element 10 with a spiral wired three-dimensional net 30 placed inside, and which is dipped in intumescent before drying. This spiral wired "3D" net 30 can be manufactured as large sheets. The sheets can be cut to strips, squares, strings, rectangular forms,
15 and be coated with intumescent material.

Figure 25 shows a quenching gap element 10 in the form of a mesh tube compressed at its middle line to obtain four layers of quenching gap mesh to block flame attack. When the quenching period is over and intumescent have expanded,
20 the plastic melts to allow the main quenching gap mesh 10 to expand fully into one oval tube that contacts surrounding elements by a large area. The malleable mesh of the quenching gap element 10 can when manufactured or rolled into a circular or oval tube form be compressed to form an hour glass figure, as seen in figure 25 and viewed in cross section. The narrow parts of the hour glass figure comprises
25 intumescent substance 14, which is held in place by sacrificial rivets 26, for instance hollow rivets made of plastic. The intumescent substance 14 can for instance be divided into two parts held together with the sacrificial hollow rivets 26, and which will give a two-step expansion.

30 The tube of mesh may also, as seen in figure 26, be compressed to form a B like shape and similarly be equipped with intumescent substance 14 and sacrificial rivets. The embodiment is similar to the one shown in figure 25, except that the center line is fixed to surrounding elements, e.g. wall.

35 The mesh can be of 3D shape (e.g. tube) or of 2D shapes such as rectangular, circular or triangular sheets. A quenching mesh alone without intumescent will protect against ember and short duration flame attacks. The malleable mesh in

combination with intumescent substance is embodiments for ember, flame attack and sustained fire exposure.

5 The malleable mesh of the invention is made out of knitted steel with low friction surface threads which slide against each other when under stress. For knitting pattern and machinery one may apply such as designed for decorative products or for sieve products.

10 Such meshes to be used in the firestop device according to the invention should be a mesh type with a suitable thread size and mesh gap diameter of for instance 2 mm (for quenching gap). Furthermore, rolled into a tube form prove especially useful when pushed into gap where it is compressed to an oval form. Tubes of 20 mm, 40 mm and 45 mm are tested in fire. There seems to be no limit in tube size small or
15 diameter, and mesh size. The thread material should provide at least a minimum of spring steel effect, achieved by it being for instance tempered high-carbon steel.

The invention does not require any specific intumescent substance. Designs that require large expansion may require 5-15 times expansion of normal state, while
20 even 2 times expansion may be sufficient in other designs. Typical intumescent substances are basically endothermic materials containing water or forming water by chemical process once heated. The water subsequently transforms to steam upon heat exposure, such as sodium silicate or graphite used for providing high pressure expansion which compacts the resulting char.

25 The mass of intumescent is designed to fill up the expansion volume and add sufficient pressure for good seal and even to compensate for delamination and deflection movements of cavity surfaces that may increase the gap or void cross section during impact of fire.

30 To avoid trapping of liquid against porous surfaces of the cavity, the firestop device can use its lower part 22 of the metal mesh between the surfaces to allow for drip-off of liquid, such as water, to ground and faster natural air drying. The lower part of the malleable mesh, when placed between the surfaces in the ventilated cavity or air gap
35 12, will thus be a drip-off part of the malleable mesh.

In a further embodiment of the invention, the malleable mesh of the quenching gap element 10 is rolled into a circular or oval tube form, and comprises an internal, helical support spring 28, as shown in figure 27, which in a non-stretched condition has a larger external diameter than an internal diameter of the tube. The spring 28, which can be a steel spring, is arranged to expand and keep the malleable mesh expanded. Each winding of the spring 28 can for instance have a distance 0,5 to 1 times the diameter of the mesh tube. The steel spring, with thicker or stronger treads than those of the mesh, will when placed inside the tube expanded to support the tube inherent form-keeping or memory metal effect. The spring is stretched to feed it inside the tube. When relaxed it retracts until it puts force against the tube wall and supports the mesh.

When for instance used in a ventilated cavity, air gap or opening 12 as shown in any of figures 1-5 and 10, the spring will contribute to the expansion and support of the malleable mesh, and to the fire protection abilities of the present invention.

Claims

1. Firestop device within a ventilated cavity, air gap or opening (12) in or between building parts (18), comprising a flame quenching gap element (10), **characterized**
5 in that said quenching gap element (10) is at least one malleable and non-combustible mesh made of a number of strands or threads (10a,10b) which are braided, knitted or otherwise interconnected to each other in a two- or three dimensional fashion, wherein the strands or threads (10a,10b) of the malleable mesh can slide freely against each other without any fixed or rigid connection in order to fill
10 irregularities of the ventilated cavity, air gap or opening (12), and wherein a distance between parallel strands or threads (10a,10b) is less than a fixed distance to maintain a quenching gap effect.
2. Firestop device according to claim 1, **characterized** in that the strands or
15 threads (10a,10b) of the mesh are stretched and compressed to fill a void between the building parts (18).
3. Firestop device according to claim 2, **characterized** in that in a wide ventilated cavity, air gap or opening (12) the distance between transverse parallel strands (10a)
20 is less than the fixed distance, while the distance between longitudinally parallel strands (10b) is increased.
4. Firestop device according to claim 2, **characterized** in that in a narrow ventilated cavity, air gap or opening (12) the distance between longitudinally parallel
25 strands (10b) is less than the fixed distance, while the distance between transverse parallel strands (10a) is increased.
5. Firestop device according to claim 1, **characterized** by comprising an intumescent substance (14), which upon exposure to heat expands and seals the
30 ventilated cavity or air gap.
6. Firestop device according to claim 1, **characterized** in that the malleable mesh is reshapeable as the strands or threads (10a,10b) of the mesh can move in any
35 directions away from the original produced form by compression or tensile strain.
7. Firestop device according to claim 1, **characterized** in that a grid size of the malleable mesh, being the size of openings (a,b) between the strands or threads

(10a,10b), is less or equal to a quenching gap of a specific combustible gas or gas mixture.

8. Firestop device according to claim 1, **characterized** in that the malleable mesh is made out of knitted steel with low friction surface threads (10a,10b) which slide against each other when under stress, such as tempered high-carbon steel giving a spring steel effect.

9. Firestop device according to claim 1, **characterized** in that the malleable mesh is manufactured or rolled into a tube structure, which is compressible to be formed in an oval structure, and expandable to fill voids of irregular surfaces.

10. Firestop device according to claim 9, **characterized** in that an intumescent substance (14) is placed within or at least partially within the tube structure.

11. Firestop device according to claim 9, **characterized** in that a core of intumescent substance (14) is placed within the tube structure.

12. Firestop device according to claim 9, **characterized** in that a core of intumescent substance (14) is placed or embedded in or on a periphery of the tube structure.

13. Firestop device according to claim 1, **characterized** in that the malleable mesh is arched shaped, and a core of said intumescent substance (14) is placed or embedded within the arched shaped structure.

14. Firestop device according to claim 11, 12 or 13, **characterized** in that the core of intumescent substance (14) is spherical or rectangular.

15. Firestop device according to claim 5, **characterized** in that the intumescent substance (14) is made of a reactive and endothermic substance.

16. Firestop device according to claim 5, **characterized** in that the intumescent substance (14) is made of graphite or sodium silicates.

17. Firestop device according to claim 1, **characterized** in that the quenching gap element (10) is made of memory metal, which when under exposure to heat expands

to increase contact area with ventilating opening surfaces of the ventilated cavity, air gap or opening (12).

5 18. Firestop device according to claim 1, **characterized** in that the malleable form of the quenching gap element (10) is adapted to reset itself to original form when not under stress.

10 19. Firestop device according to claim 1, **characterized** in that the firestop device is a water or liquid draining firestop device, in that a lower part (22) of the malleable mesh, when placed between surfaces in the ventilated cavity, air gap or opening (12), is a water or liquid drip-off part of the malleable mesh.

15 20. Firestop device according to claim 1, **characterized** in that the malleable mesh of the quenching gap element (10) is manufactured or rolled into a circular or oval tube form, and comprises an internal, helical support spring (28), which in a non-stretched condition has a larger external diameter than an internal diameter of the tube.

20 21. Firestop device according to claim 20, **characterized** in that the spring (28) is arranged to expand or keep the malleable mesh expanded.

25 22. Firestop device according to claim 1, **characterized** in that the malleable mesh of the quenching gap element (10) is manufactured or rolled into a circular or oval tube form, and compressed at its middle to obtain four layers of quenching gap mesh, and comprises intermediary intumescent substance (14), which is held in place by sacrificial rivets (26).

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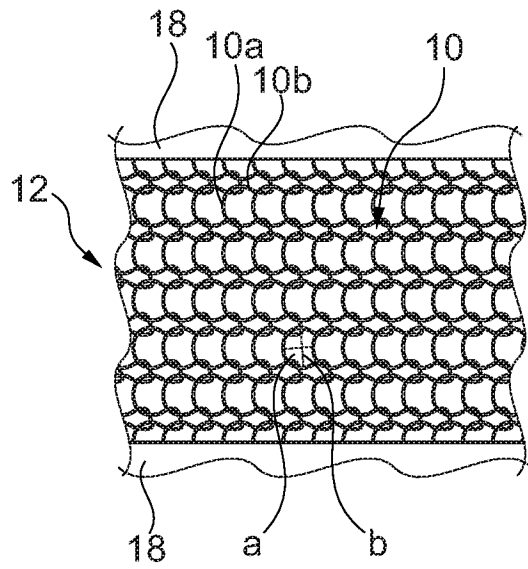


Fig. 1

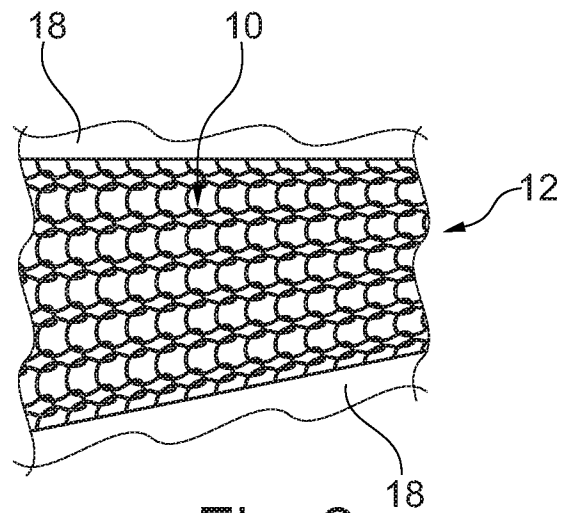


Fig. 2

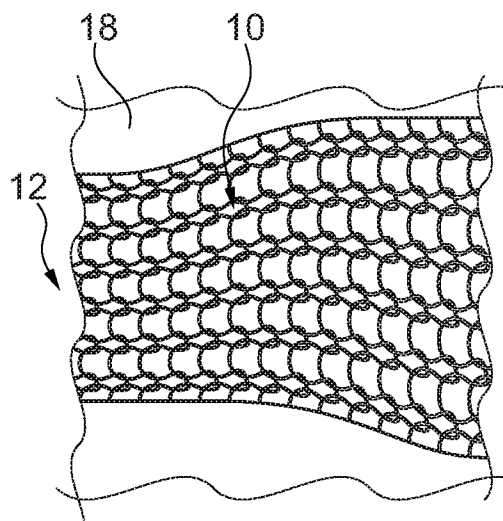


Fig. 3

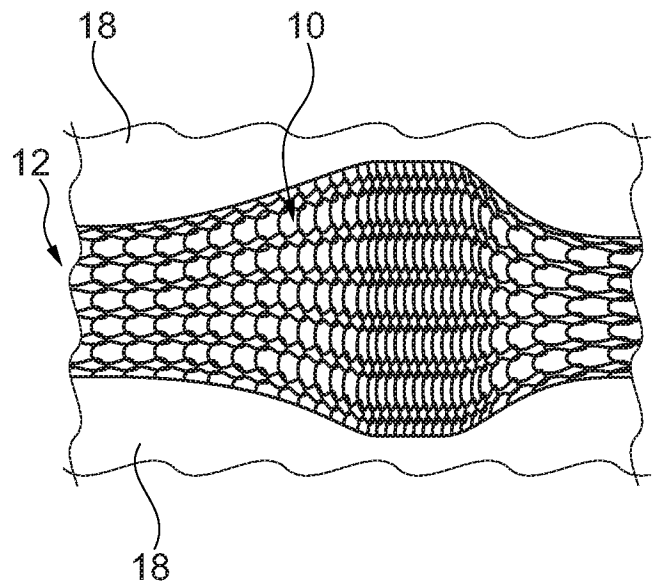


Fig. 4

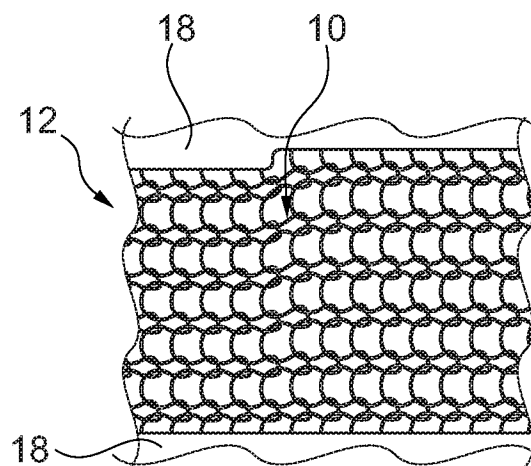


Fig. 5

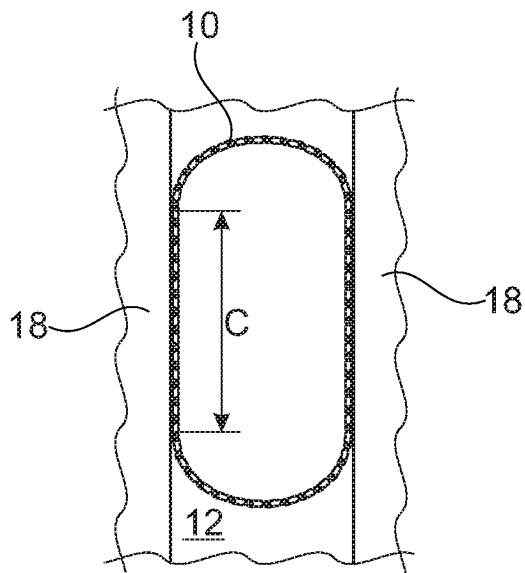


Fig. 6

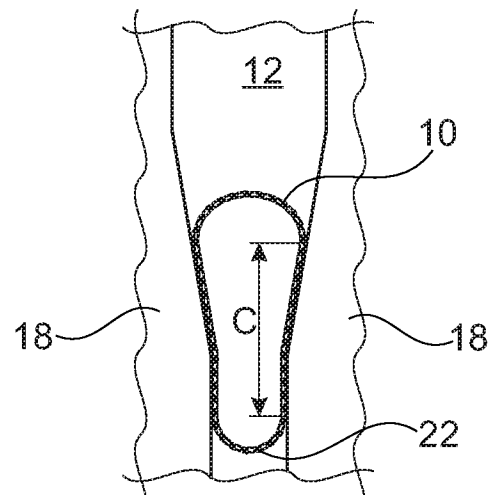


Fig. 7

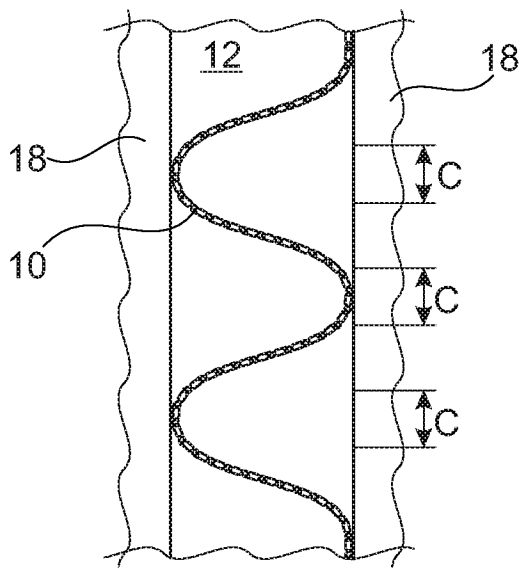


Fig. 8

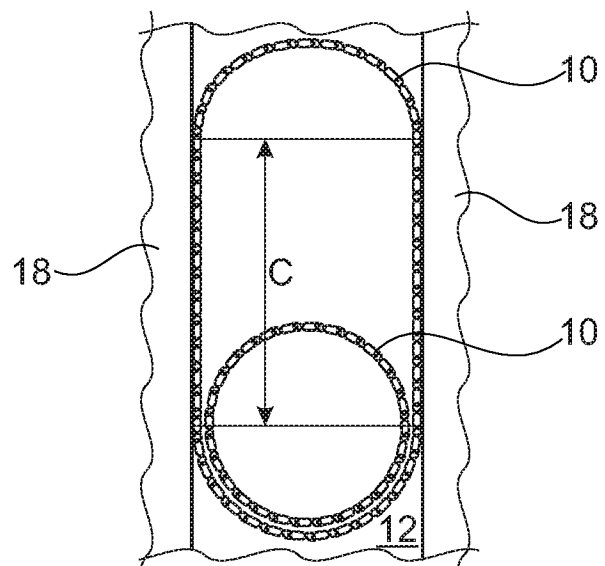


Fig. 9

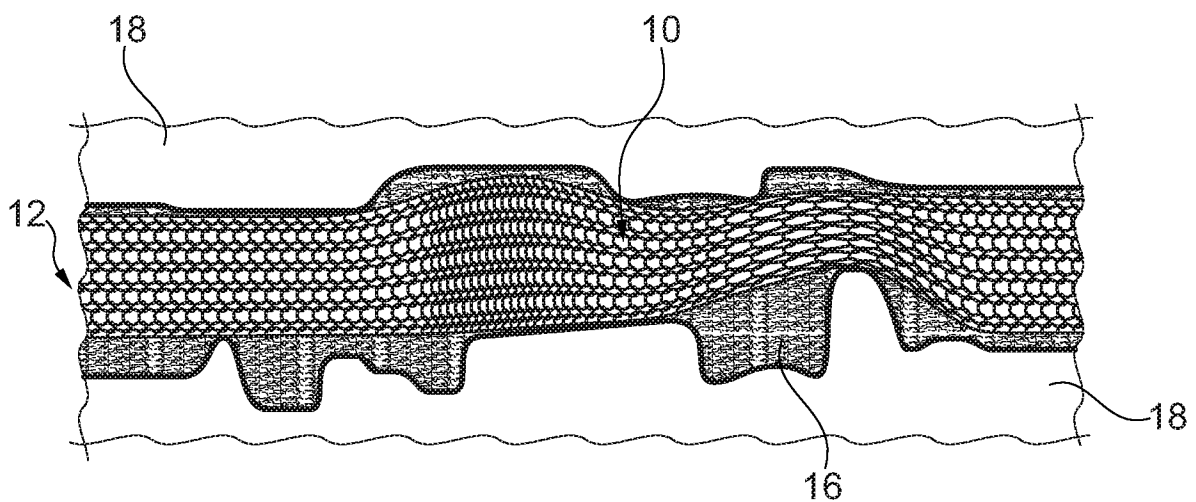


Fig. 10

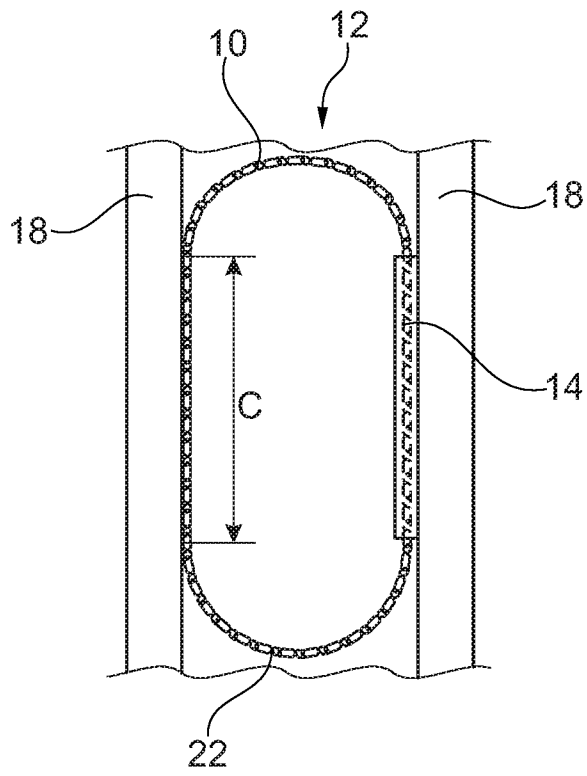


Fig. 11

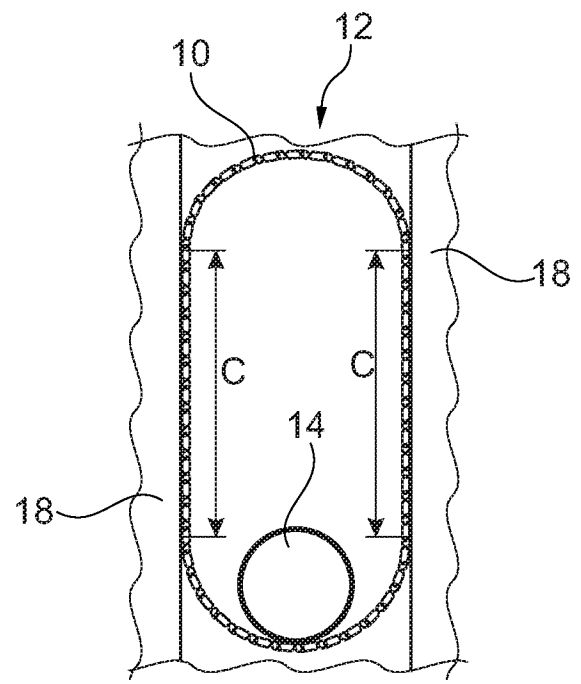


Fig. 12

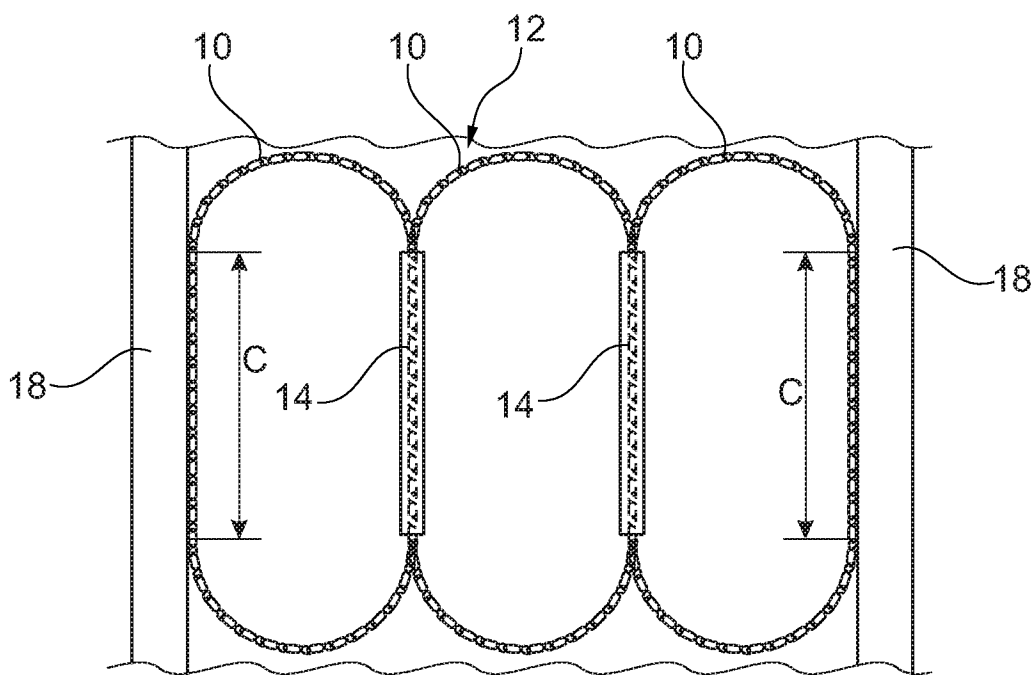


Fig. 13

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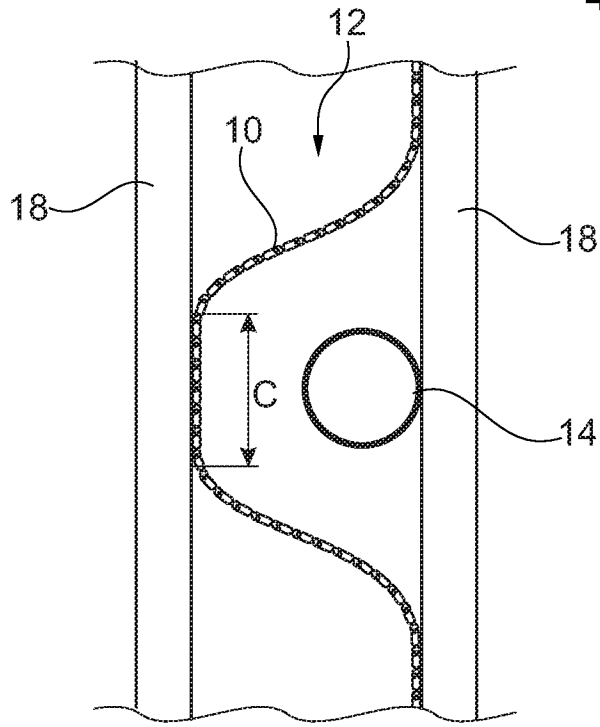


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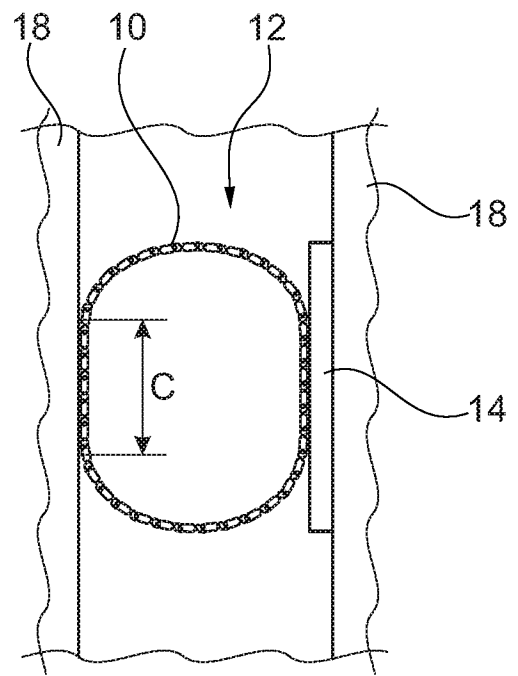


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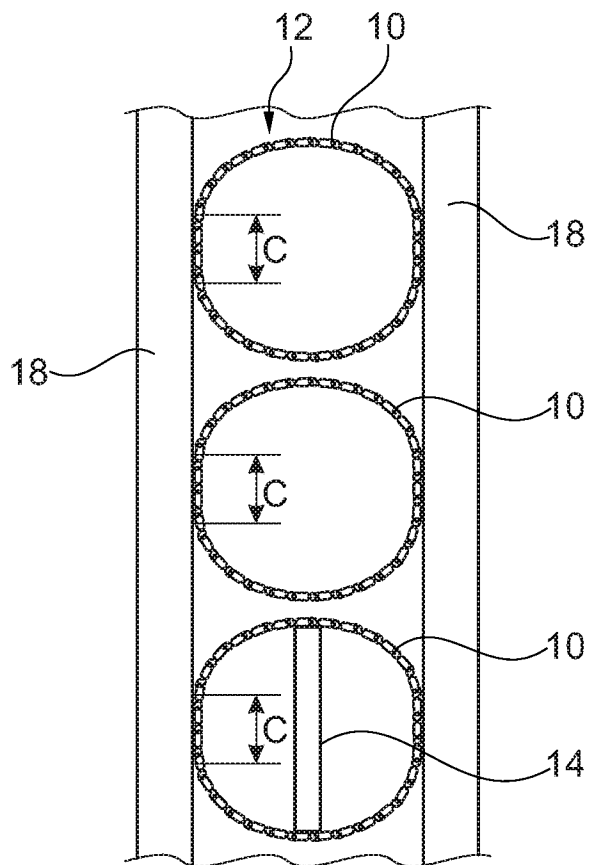


Fig. 16

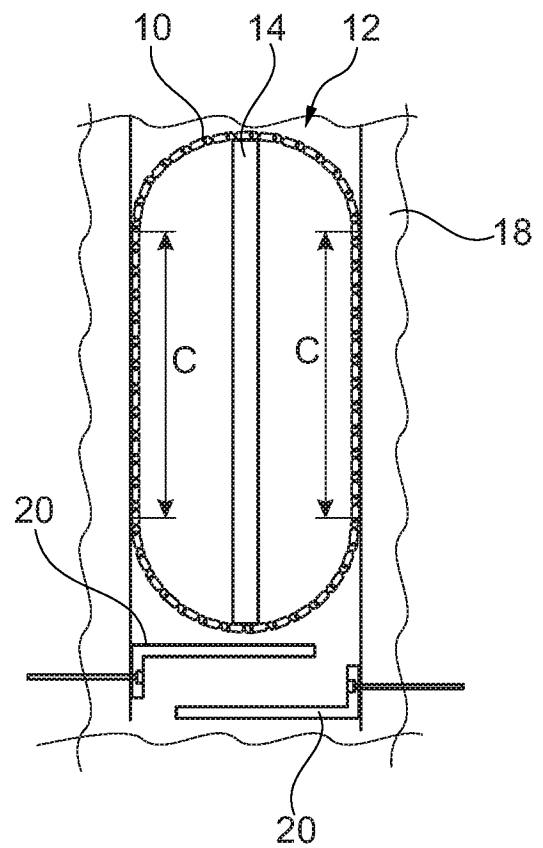


Fig. 17

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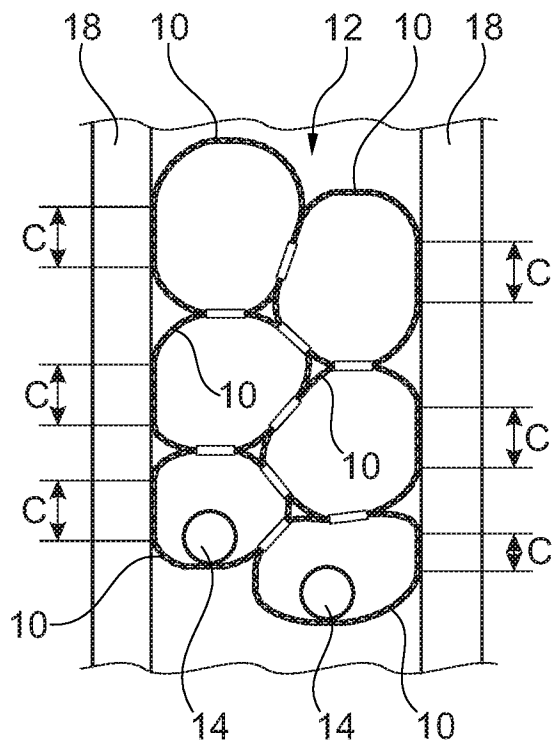


Fig. 18

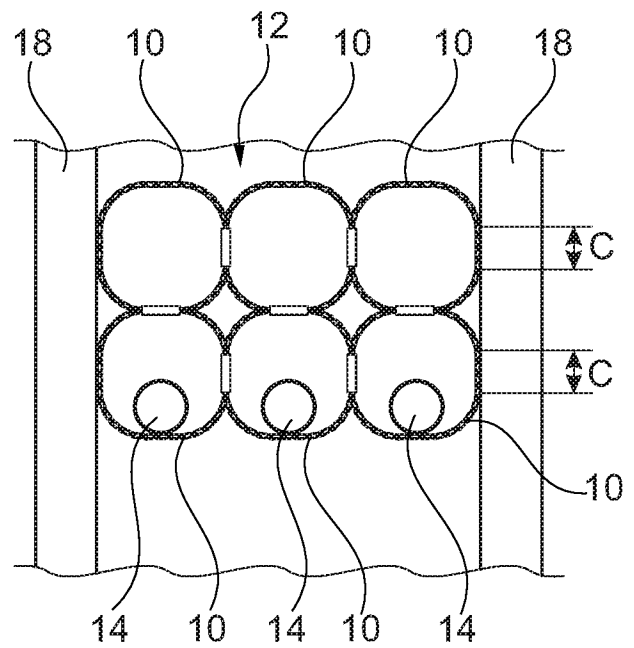


Fig. 19

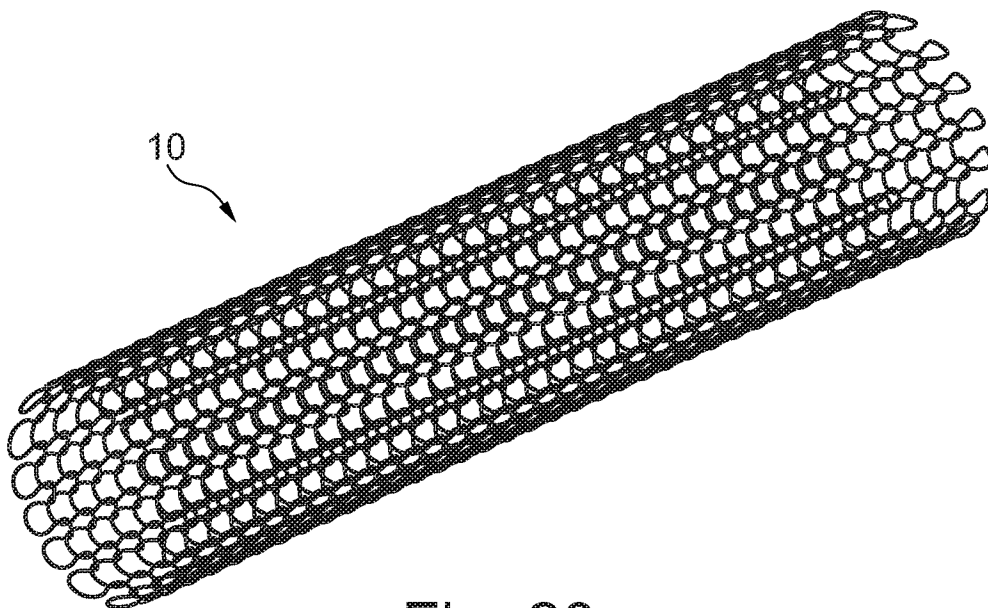


Fig. 20

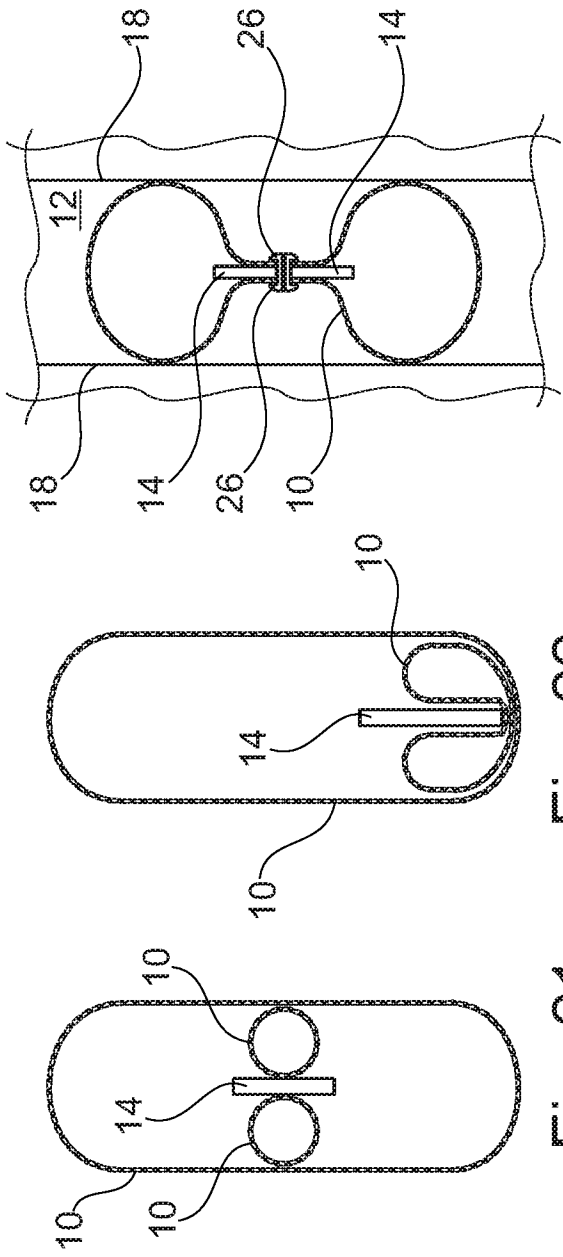


Fig. 21

Fig. 22

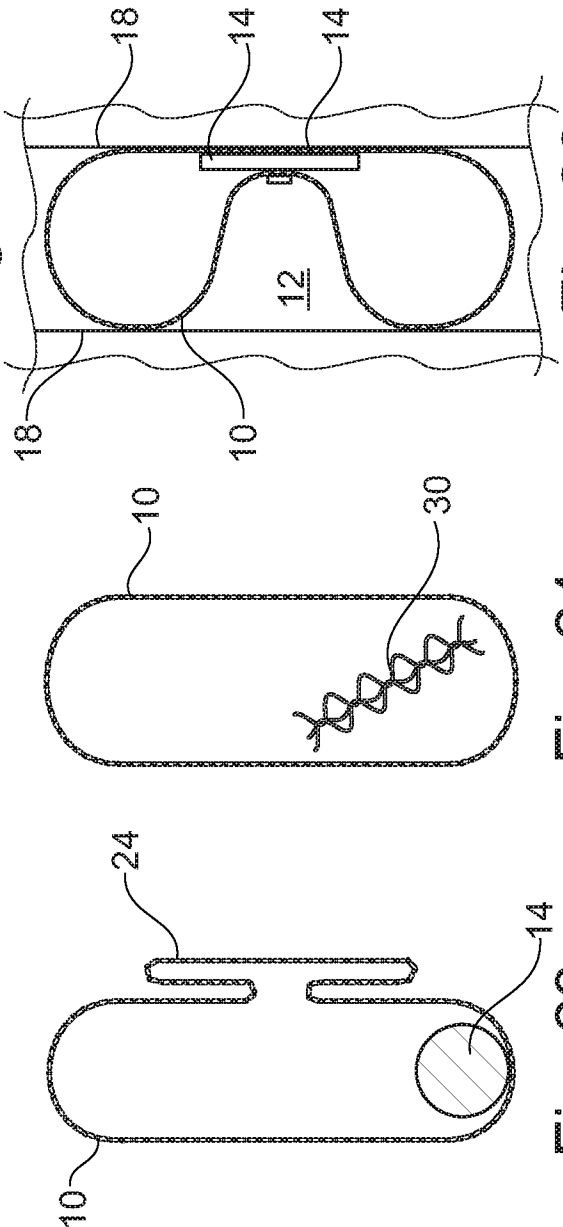


Fig. 23

Fig. 24

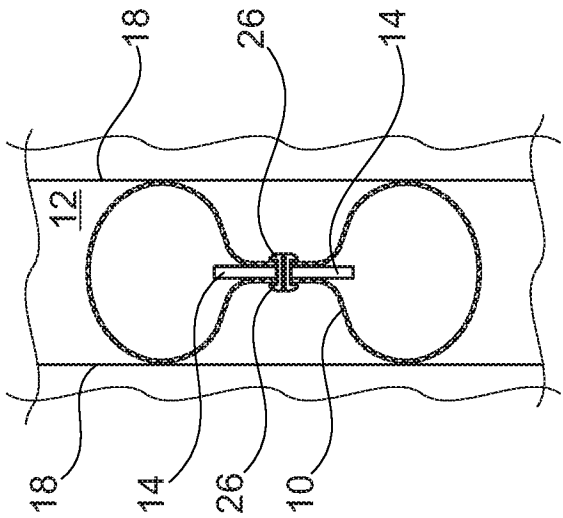


Fig. 25

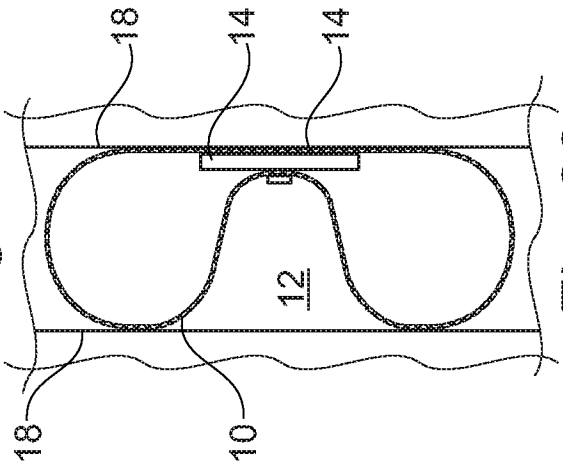


Fig. 26

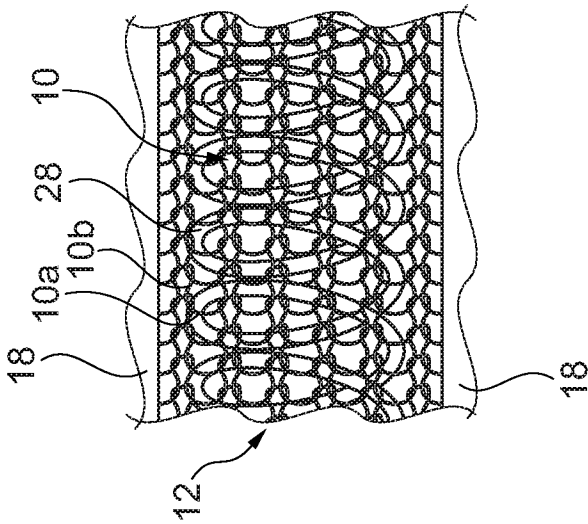


Fig. 27

INTERNATIONAL SEARCH REPORT

International application No
PCT/N02018/050080

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62C2/06 E04B1/94 F16L5/04 F16J15/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A62C E04B F16L F16J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/092251 A1 (MUNZENBERGER HERBERT [DE]) 18 April 2013 (2013-04-18) figures claims 1-3 paragraphs [0034], [0025] -----	1,6-8
X	FR 2 853 037 A1 (FED MOGUL SYSTEMS PROT GROUP [FR]) 1 October 2004 (2004-10-01) figure 1 -----	1,6,7,9
X	US 2013/097937 A1 (FLASHER GARY L [US]) 25 April 2013 (2013-04-25) figures ----- -/-	1,6-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

24 May 2018

Date of mailing of the international search report

30/05/2018

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Authorized officer

Andlauer, Dominique

INTERNATIONAL SEARCH REPORT

International application No

PCT/N02018/050080

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 156 533 A (CLOSE JAMES R [US] ET AL) 29 May 1979 (1979-05-29) figures abstract -----	1-7, 9-11, 13-22
X	GB 2 342 136 A (PREFORM TECHNOLOGIES LIMITED [GB]) 5 April 2000 (2000-04-05) figures abstract -----	1,5-7, 9-11
X	US 2013/255893 A1 (STOEBICH JOCHEN [DE] ET AL) 3 October 2013 (2013-10-03) cited in the application figures paragraphs [0061], [0062] -----	1,5,7,8
A	EP 3 106 556 A1 (BOEING CO [US]) 21 December 2016 (2016-12-21) figures paragraph [0003] -----	1,20,21
A	WO 2010/140893 A1 (SECURO AS [NO]; JENSEN GEIR [NO]) 9 December 2010 (2010-12-09) cited in the application figure 4 -----	1,5, 10-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/N02018/050080

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013092251 A1	18-04-2013	CA 2782930 A1	03-02-2013
		EP 2554886 A2	06-02-2013
		US 2013092251 A1	18-04-2013
FR 2853037 A1	01-10-2004	NONE	
US 2013097937 A1	25-04-2013	NONE	
US 4156533 A	29-05-1979	NONE	
GB 2342136 A	05-04-2000	NONE	
US 2013255893 A1	03-10-2013	CA 2801443 A1	10-07-2013
		US 9127501 B1	08-09-2015
		US 2013255893 A1	03-10-2013
		US 2016024785 A1	28-01-2016
EP 3106556 A1	21-12-2016	CA 2926393 A1	16-12-2016
		EP 3106556 A1	21-12-2016
		JP 2017053072 A	16-03-2017
		US 2016369436 A1	22-12-2016
WO 2010140893 A1	09-12-2010	AU 2010254688 A1	22-12-2011
		CA 2763726 A1	09-12-2010
		EP 2437856 A1	11-04-2012
		US 2009260303 A1	22-10-2009
		WO 2010140893 A1	09-12-2010