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(54) **A FIRE-PROTECTION COAT**

(57) The present invention relates to fire-protection coat (1) comprising external fire resistant coating sheets (2) between which a layer of thermally-expandable intumescent heat-insulating material (3) is disposed, and which are fastened together with each other by means of first stable fastening means (M1) resistant to an expansion of the heat-insulating material (3) and high temperature, and second degradable fastening means (M2) undergoing a degradation under the influence of an expansion of the heat-insulating material (3) or high temperature. The coat (1) according to the present invention is characterized in that it additionally comprises a number of spacer sheets (4) arranged between said external fire-resistant coating sheets (2); the first stable fastening means (M1), preferably fire-resistant seams, fasten the spacer sheets (4) with the coating sheets (2) along first fastening lines (L1) in the state of an adherence of the spacer sheets (4) to the coating sheets (2) along these first fastening lines (L1); the second fastening means (M2) fasten the external fire-resistant coating sheets (2) with each other along second fastening lines (L2) in the state of an adherence of these coating sheets (2) to each other along these second fastening lines (L2), optionally indirectly by medium of another elements of said coat (1) located between these coating sheets (2) along these second fastening lines (L2); said thermally-expandable intumescent heat-insulating material (3) is disposed in channels (5) constituting cavities between the coating sheets (2) and the spacer sheets (4) defined by the lines of contact between the elements of the coat (1) along the second fastening lines (L2) of the second degradable fastening means (M2).

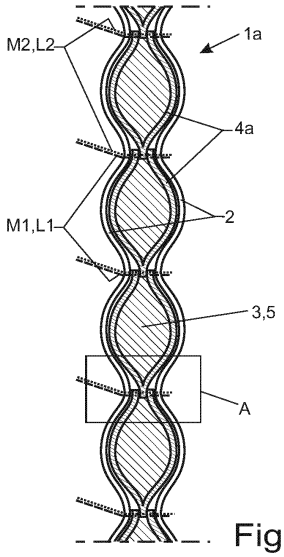

Fig. 1c

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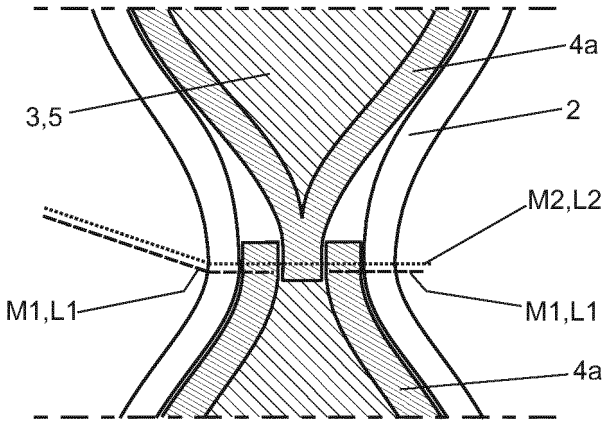


Fig. 1d
(the area A of Fig. 1c)

Description

[0001] The present invention relates to a fire-protection coat, in particular a fire-protection coat of a roll-up fire-protection curtain, comprising external fire-resistant coating sheets; wherein between the external fire-resistant coating sheets a layer of thermally-expandable intumescent heat-insulating material is disposed, and wherein the external fire-resistant coating sheets are fastened together with each other by means of first stable fastening means resistant to an expansion of the heat-insulating material and high temperature, and second degradable fastening means undergoing a degradation under the influence of an expansion of the heat-insulating material or high temperature.

Background of the Invention

[0002] Patent publication GB2387351 discloses an intumescent fire barrier comprising two external layers made of a fire-resistant material, wherein between the external layers there is disposed an internal layer made of an expandable material. The external layers may contain metal, glass fiber material or material comprising metal fibers. The internal layer may comprise graphite. The barrier comprises fastening means retaining a given shape of the barrier in normal conditions, wherein the fastening means may comprise polyethylene, polypropylene or other materials of a specified melting temperature. The barrier comprises also seams resistant to high temperature similarly designed for retaining a shape of the barrier, wherein these fastening means are not tensioned in normal conditions. In response to a specific temperature increase said fastening means melt or otherwise break thus enabling an expansion of the internal layer, wherein such an expansion results in tensioning seams resistant to high temperature restraining an expansion of the barrier above a predefined thickness. In such a barrier loose fragments of the seams resistant to high temperature may get tangled or undergo a non-uniform tensioning during an expansion of the internal layer, in a result of which the seams may be broken during an expansion of the internal layer what in turn shall result in an uncontrollable expansion of the barrier and a damage of the barrier. A local rupture of the seams may cause increases of tensions in other fragments of the seams, wherein such tension increases may induce also ruptures of these other fragments. As a result an initial local rupture of the seams may result in a complete destruction of the seams and thus a complete destruction of the barrier. The disclosed barrier is not suitable for employing it as a coat of a roll-up fire-protection curtain in consideration of a lack of possibility of rolling it up on a winding roller. Furthermore the internal fragments of the seams that are to be in an unstrained state may be subjected to an undesirable tensioning and/or tangling during filling the space between the external layers with an expendable material of the internal layer.

[0003] In such a barrier, in particular when used in a typical vertical orientation, it is not possible to employ a powdered material in the internal layer, as increasing amounts of a powdered material would be successively accumulated in the bottom part of the barrier in a result of an action of gravitational force, what in turn would cause that an insufficient amount of a heat-insulation material exists in the top part of the barrier of gradually worsening heat-insulating parameters.

[0004] An object of the present invention has been to provide a fire-protection coat provided with an expandable intumescent layer which shall feature excellent fire-protection and heat-insulation properties as well as functional reliability consisting inter alia in a reduction of a possibility of a damage in a result of an expansion of the expandable intumescent material. Furthermore such a coat should be easy to produce in a simple manner and preferably should be suitable to be employed in a roll-up fire-protection curtain

Summary of the Invention

[0005] According to the present invention there is provided a fire-protection coat of the kind mentioned in the outset which is characterized in that

- said coat additionally comprises a number of spacer sheets arranged, preferably substantially in parallel to each other, between said fire-resistant coating sheets;
- the first stable fastening means, preferably fire-resistant seams, fasten the spacer sheets with the coating sheets along first fastening lines in the state of an adherence of the spacer sheets to the coating sheets along these first fastening lines;
- the second fastening means fasten the external fire-resistant coating sheets with each other along second fastening lines in the state of an adherence of these coating sheets to each other along these second fastening lines, optionally indirectly by medium of another elements of said coat located between these coating sheets along these second fastening lines;
- said thermally-expandable intumescent heat-insulating material is disposed in channels constituting cavities between the coating sheets and the spacer sheets defined by the lines of contact between the elements of the coat along the second fastening lines of the second degradable fastening means.

[0006] The fire-protection coat according to the present invention may be in particular a coat of a roll-up fire-protection curtain housed on a winding roller.

[0007] The second degradation temperature of the second degradable fastening means is preferably lower than the first degradation temperature of the first fastening means and preferably ranges from 90 to 110% of the expansion temperature of the thermally-expandable in-

tumescent heat-insulating material, and preferably amounts to from 90 to 200 °C.

[0008] Said thermally-expandable intumescent heat-insulating material according to the present invention has preferably a form of a loose material, such as for example granular powdered material, or a form of a liquid gel form. Said expandable material of the coat according to the present invention increases its volume many fold after reaching an expansion temperature. Such a material may for example contain graphite that increases its volume for example from 20- to 30-fold after reaching an expansion temperature ranging from 140 to 180 °C.

[0009] The first degradation temperature of the first fastening means in the coat according to the present invention is preferably not lower than 1000 °C.

[0010] In preferred embodiments of the coat according to the present invention at least one second fastening line runs between two adjacent first fastening lines on the coating sheet or the first fastening lines coincide with the second fastening lines.

[0011] The second fastening means preferably additionally fasten the spacer sheet in its internal area between the first fastening lines thereof with the coating sheets along the second fastening line shifted relative to the first fastening lines of this spacer sheet, preferably along the second fastening line running along the first fastening line of the adjacent spacer sheet.

The spacer sheet preferably is additionally fastened to said coating sheets by means of the second fastening means in the internal area of the spacer sheet and in the areas of the coating sheets shifted relative to the areas of fastening this spacer sheet by means of the first fastening means; preferably along the fastening lines of the first fastening means of the adjacent spacer sheet in a result of which in an inactive state channels defined by two-layer walls are formed in the coat, wherein each of such walls comprises an external layer of the coating material and an internal layer of a material of the spacer sheet.

[0012] The coat according to the present invention preferably comprises additionally an internal supporting layer, preferably a supporting sheet, and third stable fastening means resistant to an expansion of the heat-insulating material and high temperature, preferably fire-resistant seams, which fasten the spacer sheets with this supporting layer along third fastening lines in the state of an adherence of the spacer sheets to this supporting layer along these third fastening lines.

[0013] The third fastening line of a given spacer sheet runs preferably along the first fastening line of the adjacent spacer sheet and/or the second fastening line. The third fastening line of a given spacer sheet may preferably run along the third fastening line of the corresponding spacer sheet located at the other side of the supporting layer.

[0014] In such variants the coat has obviously increased fire resistance, and said channels for expandable material, preferably powdered expandable material, are partitioned longitudinally in two parts by means of the internal supporting layer.

[0015] The coats according to the present invention may preferably comprise additionally fourth fastening means which fasten the external fire-resistant coating sheets with each other along fourth fastening lines which are intersectional relative to the second fastening lines of the second degradable fastening means and thus intersect transversely with the channels filled with thermally-expandable heat-insulation material, in the state of an adherence of these coating sheets to each other along these fourth fastening lines, optionally indirectly by medium of another elements of said coat located between the coating sheets along these fourth fastening lines. Said fourth fastening means may be stable fastening means resistant to an expansion of the heat-insulating material and high temperature or may be degradable fastening means undergoing a degradation under the influence of high temperature or an expansion of the heat-insulating material. Said fourth fastening means forming fastening lines running transversely relative to the spacer sheets partition channels filled with an expandable material into sections separated from each other. In this manner stability and uniformity of a powdered expandable material distribution become even more improved.

[0016] Additionally according to the present invention it is preferable if particular component elements of the coat according to the present invention, and in particular the coating sheet, the spacer sheet and/or the supporting sheet, comprise an additional layer of an aluminium foil layer and/or thermally-expandable material layer (preferably a coating composition containing graphite), and/or an insulation material layer (preferably a fiber mat), and/or a moistening cooling agent, and/or thermally-expanding agent (preferably based on water-glass), and/or crystal water. Furthermore it may be preferable to connect component layers of multi-layer coat elements with each other by means of gluing, sewing together, welding, riveting or laminating.

[0017] The coat according to the present invention may be preferably provided with a ballast arrangement comprising two longitudinal ballast sections arranged opposite relative to each other on the external surfaces of the coating sheets along the terminal edges of the coating sheets at a certain distance from these edges, wherein each edge area of the coating sheet projected beyond the ballast sections is fastened to the ballast section directly adjoining thereto with forming free-moving folded longitudinal sealing fold.

[0018] According to the present invention it is further preferably if a thermally-expandable intumescent material stripe is fastened along each lateral longitudinal edge to each coating sheet on the surface opposite relative to the second coating sheet at a certain distance along this edge of the coating sheet, wherein lateral longitudinal edge area of each coating sheet is folded onto this thermally-expandable intumescent material stripe and a fold formed in this manner is stitched down to the thermally-

expandable intumescent material stripe at a certain distance from the coating sheet edge with forming a free-moving longitudinal catch lip.

[0019] In a result of exposing the coat according to the present invention to high temperature amounting at least to an expansion temperature of the expandable heat-insulation material an expansion of this material occurs in said channels, which acting on the walls of the channels induces a generation of a disruptive force acting on the second fastening means that undergo a destruction under the influence thereof. Alternatively or concurrently with the above mentioned disrupture process a degradation of the second fastening means occurs also under the influence of a high temperature exceeding the second degradation temperature.

[0020] A degradation of the second fastening means and a further expansion of the heat-insulating material cause an increase of the width of the channels in a result of moving the coat coating sheets away from each other and thus providing a larger volume available for the expanding expandable material. The coat according to the present invention comprises no element which could disturb or restrain an expansion of the heat-insulating material and in a result could cause a disrupture of the coating sheets of the coat.

[0021] The proposed construction provides a small thickness of the coat in an inactive state and a possibility of bending the coat to a large extent along the second fastening lines of the second degradable fastening means. These features are very advantageous from the point of view of a capability of rolling the coat up, in particular a capability of rolling the coat up on a storage winding roller of a fire-protection curtain. Furthermore the construction proposed according to the present invention ensures a permanent stable and uniform distribution of an expandable material over the surface of the coat what is of an exceptional importance in a case of using a powdered expandable material. Uniformness of an expandable material distribution in the coat according to the present invention is preserved even after repeated rolling up and rolling off the coat on and from a storage winding roller of a roll-up fire-protection curtain. The coat according to the present invention features in addition a small bend radius enabling a simple and relatively "tight" rolling it up on a winding roller, and therefore it occupies small amount of space on a winding roller. A production of such a coat comprises a realization of relatively simple and cheap technological operations, such as sewing together, so that a production of such a coat is cheap and the coat is reliable. According to the present invention it is also very advantageous that said coat may be manufactured in such a manner that it is not affected by a linear shortening in the direction transversal relative to the route of the channels filled with the expandable heat-insulating material during an expansion of this material, but on the contrary it may even be a subject of a certain elongation. Thanks to that with using such a coat for closing an opening in an architectural construction, in a case of a fire an increase of the closure tightness may be achieved with forming an improved separation of the remaining space from the fire area.

Brief description of drawings

[0022] The invention shall be described and explained below in reference to its preferred embodiments and in connection with the attached drawings wherein:

Figs. 1a-1e show schematically the first embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Figs. 2a-2e show schematically the second embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Figs. 3a-3b show schematically the third embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Fig. 4 shows schematically the fourth embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Fig. 5 shows schematically the fifth embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Fig. 6 shows schematically the sixth embodiment of the fire-protection coat according to the present invention in a cross-sectional view;
Fig. 7 shows an embodiment of a ballast rail arrangement of the bottom end of the coat of Fig. 1; and
Fig. 8 shows an exemplary construction of the longitudinal edge area of the coat of Fig. 1.

[0023] Numerical references of elements performing the same functions remain the same in all figures of the drawing, wherein suffixes (a-f) were added, where appropriate, to additionally distinct elements having the same functionality but different construction.

[0024] A fire-protection coat 1a shown in Figs. 1a-1e comprises external fire-resistant coating sheets 2, an internal layer of thermally-expandable intumescent heat-insulating material 3 and a number of spacer sheets 4a. The coating sheets 2 are made of a fire-resistant fabric material (such as for example glass and/or aramid and/or ceramic fabric). Such a fabric may be additionally coated with synthetics and/or composite materials and/or aluminium laminated materials and/or graphite, and furthermore it may be reinforced using stainless steel wire or inconel wire. The spacer sheets 4 are made of the same material as the material of the coating sheets 2. The spacer sheets 4 may be alternatively formed of a net made of the above mentioned materials.

[0025] The spacer sheets 4a are arranged in parallel to each other between the coating sheets 2 thus defining channels 5 in which there is disposed a powdered heat-insulating material 3 comprising for example graphite. The spacer sheets 4a have form of longitudinal material stripes folded in half in a result of pressing or ironing them

along the longitudinal axis. In an alternative embodiment one spacer sheets may be composed of two sheets connected with each other along the internal edges by means of seams made of a stable fastening means that are analogical with the first stable fastening means. The sheets 4a are fastened to the coating sheets 2 along the edges by means of the first stable fastening means M1 and along the pressing or ironing area by means of the second degradable fastening means M2.

[0026] The first stable fastening means M1 are fire-resistant seams resistant to an expansion of the heat-insulating material 3 and high temperature. The first fastening means M1 fasten along first fastening lines L1 the spacer sheets 4a with the coating sheets 2 in the state of an adherence of these sheets to each other along these fastening lines L1. The fastening lines L1 of a given sheet 4a are parallel relative to each other and coincides with each other in a final coat 1a.

[0027] The second degradable fastening means M2 are seams made of threads resistant to atmospheric conditions but having a melting temperature or a burnout temperature being as low as possible, wherein durability of the threads is selected in such a manner that they experience a disrupture under the action of a force induced by an expansion of the heat-insulating material 3 disposed in the channels 5 and/or in a result of melting or burn-out thereof. Exemplary second degradable fastening means M2 are seams formed of polyethylene or polyester threads.

[0028] The second fastening means M2 fasten the external fire-resistant coating sheets 2 with each other along the second fastening lines L2 in the state of an adherence of these coating sheets 2 to each other along these fastening line L2 indirectly by medium of the edge areas of the spacer sheets 4a sewn on to the sheets 2 by means of the first fastening means M1 and by medium of the folding areas of the spacer sheets 4a.

[0029] An area of a pressing or ironing 41 of a given spacer sheet 4a is located between the edge areas of the adjacent spacer sheet 4a. Thanks to that the second fastening means M2 additionally fasten the spacer sheet 4a with the coating sheets 2 in the internal area of the sheet 4a, between its first fastening lines L1, along the second fastening line L2 shifted relative to the first fastening lines L1 of this spacer sheet 4a. In this embodiment, the second fastening line L2 of a given sheet 4a coincides with the first fastening lines L1 of the adjacent spacer sheet 4a.

[0030] In a result of fastening the coating sheets 2 by means of the spacer sheets 4a and the fastening means M1, M2, a number of channels 5 parallel to each other is formed in the coat 1a constituting spaces between the coating sheets 2 and the spacer sheets 4a defined by the contact lines of the elements of the coat 1a along the second fastening lines L2 of the second fastening means M2 and filled with powdered heat-insulating material 3.

[0031] Figures Figs. 1a-1c illustrate consecutive stages of manufacturing the coat 1a. In the first stage (Fig. 1a) the spacer sheets 4a are sewn in between the coating sheets 2 along the first fastening lines L1 by means of the first fastening means M1. In the second stage (Fig. 1b) the coating sheets 2 are sewn together with each other in the state of an adherence by means of the second fastening means M2 along the second fastening lines L2. In the final stage (Fig. 1c) the channels 5 are filled with a heat-insulating material 3, and subsequently the channels 5 are obviously closed at both ends for example by means of appropriate seams.

[0032] In Fig. 1d there is clearly visible that the first fastening means M1 are not extended through the whole thickness of the coat 1a and connect only the coating sheet 2 along the fastening line L1 with the edge area of the spacer sheet 4a adjoining directly thereto. Whereas the second fastening means M2 extend over the whole thickness of the coat 1a and connect all elements of the coat 1a with each other along the second fastening line L2 and in an inactive state of the coat 1a without an expansion of the heat-insulating material they define boundaries of the channels 5 filled with the heat-insulating material 3.

[0033] Fig. 1e presents the coat 1a in an active state after an expansion of the heat-insulation material 3 that occurred in a result of an influence of high temperature of a fire. An expansion of the heat-insulating material 3 caused a disrupture of the second fastening means M2 enabling a further expansion of the material 3 resulting in an increase of the cross-sections of the channels 5, stretching the spacer sheets 4a (which are folded in an inactive state of the coat) and moving the coating sheets 2 away from each other to a distance equal to the width of the spacer sheets 4a.

[0034] Figures Figs. 2a-2e present the second embodiment of the fire-protection coat 1b according to the present invention provided with a supporting layer 6 in a form of a supporting sheet made of a fire-resistant fabric (such as for example glass and/or aramid and/or ceramic fabric). Such a fabric may be additionally coated with synthetics and/or composite materials and/or aluminium laminates and/or graphite, and furthermore it may be reinforced using stainless steel wire or inconel wire. The supporting sheet 6 may be alternatively formed of a net made of the above mentioned materials. The supporting sheet 6 is located between the coating sheets 2 and forms a continuous partition dividing the space between the coating sheets 2. It is thus not possible to fasten one spacer sheet to the both coating sheets 2. Therefore the coat 1b comprises two groups of the spacer sheets 4b arranged on the opposite sides of the supporting sheet 6. Each of the spacer sheets 4b has a form of a stripe fastened along the external edge area to the coating sheet 2 by means of the first stable fastening means M1 along the first fastening line L1, and fastened along the internal edge area to the supporting sheet 6 by means of the third stable fastening means M3 along the third fastening line L3 in the state of an adherence of this spacer sheet 4b to the supporting sheet 6.

[0035] Both the first fastening means M1 and the third fastening means M3 are stable fastening means resistant to an expansion of the heat-insulating material 3 and high temperature and have form of fire-resistant seams of the first degradation temperature Td1 amounting to 1000 °C. Furthermore the means M1 and M3 are resistant to a force induced by an expansion of the heat-insulating material 3 in an active state of the coat 1b visualized in Fig. 2e.

[0036] The spacer sheets 4b are arranged symmetrically on both sides of the supporting sheets 6, and the first fastening lines L1 of the first fastening means M1 of a given pair of the opposite spacer sheets 4b coincide with each other and with the third fastening lines L3 (that coincide with each other) of the third fastening means M3 of the adjacent pair of the opposite spacer sheets 4b.

[0037] The coating sheets 2 of the coat 1a are, in a manner analogical to the coat 1a from Figs. 1a-1e, connected with each other by means of the second degradable fastening means M2.

The second fastening means M2 connect the external fire-resistant coating sheets 2 with each other along the second fastening lines L2 in the state of an adherence of these coating sheets 2 to each other along these fastening lines L2 indirectly by medium of the edge areas of the spacer sheets 4b sewn on to the sheets 2 by means of the first fastening means M1 and by medium of the edge areas of the spacer sheets 4b sewn on to the supporting sheet 6 by means of the third fastening means M3. Thus all fastening lines L1, L2, L3 coincide with each other.

[0038] The second degradation temperature Td2 of the second fastening means M2 is lower than the first degradation temperature Td1 of the first fastening means and ranges from 90 to 110% of the expansion temperature Tp of the expandable heat-insulating material 3. The second degradation temperature Td2 preferably amounts to from 90 to 200 °C. Thanks to such a selection of the degradation temperature Td2 a loosening of the constraints formed by the fastening means M2 takes place concurrently with the beginning of an expansion of the heat-insulating material 3 and thus providing a possibility of moving the coating sheets 3 away from each other is ensured induced by the expansion of the material 3 until a maximal thickness of the coat 1b visualized in Fig. 2e is obtained.

[0039] Figures Figs. 2a-2d illustrate a process of manufacturing the coat 1b. In the first stage the spacer sheets 4b are connected with the coating sheets 2 and the supporting sheet 6 by means of the first stable fastening means M1 and the third stable fastening means M3. In the next stage the coating sheets 2 are connected directly with each other by means of the second degradable fastening means M2 along the second fastening lines L2 coinciding also with the first and third fastening lines L1, L3. In such a manner pairs of the opposite channels 5 are defined on both sides of the spacer sheet 6 between the spacer sheet and the opposite spacer sheets 4b, that in the final stage are filled with a thermally-expandable powdered heat-insulating material 3 undergoing an expansion at the expansion temperature Tp, and subsequently the channels are closed at both ends.

[0040] Figures Fig. 3a-3b present the third embodiment of a fire-protection coat 1c, in which the spacer sheets 4c are integrated in a form of a single continuous sheet which by means of first stable fastening means M1 is sewn on along the parallel first fastening lines L1 alternately at one side to one coating sheet 2 and next at the other side to the opposite coating sheet 2. Furthermore along all first fastening lines L1 the coating sheets are according to the present invention connected with each other by means of the second degradable fastening means M2 along the second fastening lines L2. In an inactive state of the coat 1c as presented in Fig. 3a the channels 5 defined between the spacer sheets 4c and coating sheets 2 are filled to the same extent allowing the continuous spacer sheet forming individual spacers 4a to adopt a form of a plate element centrally arranged in an unrolled coat. Whereas in an active state after an expansion of the heat-insulating material 3, in a result of an influence of high temperature and a degradation of the second fastening means M3, the central sheet, which is planar in an inactive state, undergoes bending along the first fastening lines L1 of the first fastening means M1 being still in operation between which there are tensioned the spacer sections 4c oriented slantwise in alternately changing directions.

[0041] In Fig. 4 the fourth embodiment of the coat 1d according to the present invention is presented. This coat comprises spacer sheets 4d provided with a pressing or ironing identical to the one of the spacer sheets 4a and fastened to the coating sheets 2 in a manner analogical to the fastening employed in the first embodiment of the coat 1a. Whereas the coat 1d differs from the coat 1a in that in an inactive state of the coat 1d the spacer sheet 4d (in particular its longitudinal folding area) is not inserted in between the edge areas of the adjacent spacer sheet 4d and the first and second fastening lines L1, L2 of the first and second means M1, M2 situated thereon. In the coat 1d individual spacer sheets 4d do not overlap each other and in the interspace between them additional channels 51 are defined in a result of using the additional second fastening means M2d running along the additional second fastening lines L2d intersecting the areas of spacer sheets 4d fold, wherein the additional channels 51 are also filled with an expandable heat-insulating material 3. In an active state the coat 1b adopts a configuration identical with the configuration of the coat 1a shown in Fig. 1e.

[0042] In Fig. 5 the fifth embodiment of the coat 1e according to the present invention is presented. This coat comprises the spacer sheets 4e provided with a pressing or ironing identical to the one of the spacer sheets 4a and fastened to the coating sheets 2 in a manner analogical to the fastening employed in the first embodiment of the coat 1a, wherein the coat 1e comprises additional

second degradable fastening means M2e connecting the coating sheets additionally along the additional second fastening lines L2e running between the adjacent first fastening lines L1 of the first stable fastening means M1. In comparison to the coat 1a, the coat 1e comprises a doubled numbered of the channels 5 for the expandable heat-insulating material 3. In such a configuration it is possible to obtain a smaller thickness of the coat in an inactive state, wherein a heat-insulating material having a greater expansion rate is to be used.

[0043] Fig. 6 presents the sixth embodiment of a coat 1f according to the present invention. The coat 1f has a structure corresponding to a half of the structure of the coat 1b in which the supporting sheet has been replaced with the coating sheet 2. Each spacer sheet 4f has a form of a stripe fastened along one edge area by means of the first stable fastening means M1 along the first fastening line L1 to one coating sheet 2, and fastened along the opposite edge area also by means of first stable fastening means M1 along the first fastening line L1 to the second coating sheet 2. The edge areas of the adjacent spacer sheets 4f overlap each other, wherein in each such an overlap area one spacer sheet 4f is connected by means of the fastening means M1 with one coating sheet 2, and the other spacer sheet 4f is connected by means of the separate fastening means M1 with the other coating sheet 2. In the overlapping areas of the spacer sheets there are also arranged the second degradable fastening means M2 running along the second fastening lines L2 coinciding with the first fastening lines L1. In the coat 1f an expandable heat-insulating material 3 fills all the channels 5 defined between one of the coating sheets 2 and spacer sheets 4f and limited in an inactive state of the coat 1a by means of the second degradable fastening means M2. Such a construction of the coat 1a is advantageous in a case of using an expandable material of a very high expansion rate, as after activation of the coat 1e in high temperature and a degradation of the fastening means M2, an additional channel 51 is made available which is empty in an inactive state of the coat 1a and is defined between the adjacent spacer sheet 4e and the opposite coating sheet 2. In the coat 1f the fourth fastening means M4 are additionally employed which connect the coating sheets 2 with each other along the fourth fastening lines L4 which intersect at right angle with the second fastening lines L2 of the second degradable fastening means M2 and intersect transversely with the channels 5 filled with thermally-expandable heat-insulation material 3 and thus divide the channels 5 into sections 52 separated from each other. The fourth fastening means M4 may be similarly as the first fastening means M1 resistant to high temperature or may undergo a degradation in a manner analogical to the manner of degradation of the second degradable fastening means M2. The fourth fastening means M4 may be in an analogical manner employed in any other arbitrary variants of the coat according to the present invention, and for example they may be obviously employed in the above described coats 1a-1e.

[0044] In the channels 5 the expandable heat-insulating material may be introduced in a free form, i.e. the material may be simply poured directly into these channels, or in a preliminarily wrapped form in longitudinal cylindrical bags (optionally partitioned into sections corresponding to the sections 52) that undergo a degradation under the influence of an increase of temperature or pressure, or the material may be overlaid over the internal surface of the channel 5.

[0045] Fig. 7 presents an exemplary ballast arrangement 7 of the bottom end of the coat 1a from of Fig. 1. The ballast arrangement 7 comprises two metal tubular ballast sections 71 arranged opposite to each other on the external surfaces of the coating sheets 2 along the end edges of the coating sheets 2 at a given distance from these edges. The coat 1a is clamped at a certain distance from the bottom edge between the ballast sections 71 pressed to each other by means of screws 72 and nuts 73. The ballast sections 71 have a rectangular cross-section the longer side of which are in contact with the coat 1a. Each transverse edge area 21 of the coating sheet 2 that is protruded beyond the ballast sections 71 is fastened to the ballast section 71 directly adjoining thereto by means of clamping thereof on the external surface of the ballast section 71 using angle clamping sections 74, with forming free-moving folded longitudinal sealing fold 22. The interior space of the sealing fold 22 may be additionally filled with an thermally-expandable material or with any other arbitrary suitable ballast material such as for example steel shot, cast iron shot or lead shot.

[0046] Furthermore alternatively instead of the ballast arrangement 7 of the bottom end of the coat or in addition to such a ballast arrangement, in order to obtain an improved ballast of the coat end, the bottommost channel 5 of any arbitrary variant of the coat 1 according to the present invention may be filled with any arbitrary suitable ballast material such as for example steel shot, cast iron shot or lead shot, instead of an expandable heat-insulating material.

[0047] In other advantageous embodiment of such a ballast arrangement which is not shown in the drawings, surfaces of the ballast sections not being in contact with the coat may be additionally preferably covered with a heat-insulating material, such as for example a heat-insulating layer located between the ballast section and the clamping section.

[0048] Fig. 8 presents an exemplary construction of a longitudinal edge of the coat 1a of Fig. 1. Along each lateral longitudinal edge of each coating sheet 2 on the surface opposite relative to the other coating sheet 2 a stripe 8 of a thermally-expandable intumescent material is sewn on at a certain distance along this edge of the coating sheet 2. A lateral longitudinal edge area 23 of each coating sheet 2 protruding beyond the area of sewing on the thermally-expandable intumescent material stripe 8, is folded onto this thermally-expandable intu-

mescent material stripe 8 and a fold formed in this manner is stitched down to the thermally-expandable intumescent material stripe 8 at a certain distance from the coating sheet 2 edge with forming a free-moving longitudinal catch lip 24. On the external side across each folded edge area 23 stiffening elements 25 are arranged apart from each other by certain distances and fastened by means of rivets 26. The presented construction serves for providing a possibility of guiding the longitudinal edge of the coat 1a in longitudinal guides 9 having form of open profile tubular sections having internal protrusions 91 defining a longitudinal guiding slot 92 in which the coat 1a is guided. The protrusions 91 define resisting edges with which the longitudinal catch lips 24 are caught together with the stiffening elements 25 of the coat 1a. An employment of the thermally-expandable intumescent material stripe 8 located in the guiding slot 92 of the guides 9 and the stiffening elements 25 ensures high fire and smoke tightness.

[0049] On the external surface of the frontal wall of the guide 9 profile which adjoins the guiding slot 92 at the side of a building structure partition (wall) on which the guide 9 is fastened, there may be optionally fastened an additional expandable intumescent seal 93 for example in a form of a material stripe of a thermally-expandable intumescent material.

[0050] The ballast rail arrangement and the construction of the longitudinal edge shown in the figures Figs. 7 and 8 may be employed in any arbitrary variants of the coat according to the present invention, in particular in the coats shown in the figures Figs. 1-6.

[0051] The roll-up fire-protection coat according to the present invention constitutes usually an element of a roll-up fire-protection curtain arrangement in which it is wound up on a winding roller arranged in a box with side console brackets. In such a case it is preferable if such an arrangement of a curtain with the coat according to the present invention comprises additionally a steel cord, preferably with a screw tensioner, or a steel section fastened between the console brackets. For a solution with a steel cord it is preferable to used at least two cords.

[0052] The figures are not necessarily to scale, and some features may be exaggerated or minimized, in order to provide better an invention illustration. Therefore the presented embodiments should not be regarded as limiting the scope of protection defined in the patent claims.

List of reference numerals

[0053]

1	fire-protection coat
2	coating sheet
21	bottom, transverse edge area
22	sealing fold
23	lateral longitudinal edge area
24	longitudinal catch lip
25	stiffening elements
26	rivets
3	heat-insulating material
4	spacer sheet
5	channel
51	additional channel
52	sections of the channel 5
6	supporting layer (supporting sheet)
7	ballast arrangement
71	ballast section
72	screw
73	nut
74	clamping section
8	thermally-expandable material stripe
9	longitudinal guide
91	internal protrusion
92	guiding slot
93	thermally-expandable seal
M1	first fastening means
L1	first fastening line
M2	second fastening means
L2	second fastening line
M21, M22	additional second fastening means
L21, L22	additional second fastening line
M3	third fastening means
L3	third fastening line
M4	fourth fastening means
L4	fourth fastening line

Claims

1. A fire-protection coat (1), in particular a fire-protection coat of a roll-up fire-protection curtain, comprising external fire-resistant coating sheets (2); wherein between the external fire-resistant coating sheets (2) a layer of thermally-expandable intumescent heat-insulating material (3) is disposed; and wherein the external fire-resistant coating sheets (2) are fastened together with each other by means of first stable fastening means (M1) resistant to an expansion of the heat-insulating material (3) and high temperature, and second degradable fastening means (M2) undergoing a degradation under the influence of an expansion of the heat-insulating material (3) or high temperature,

characterized in that

- said coat additionally comprises a number of spacer sheets (4) arranged between said external fire-resistant coating sheets (2);
- the first stable fastening means (M1), preferably fire-resistant seams, fasten the spacer sheets (4) with the coating sheets (2) along first fastening lines (L1) in the state of an adherence of the spacer sheets (4) to the coating sheets (2) along these first fastening lines (L1);
- the second fastening means (M2) fasten the

external fire-resistant coating sheets (2) with each other along second fastening lines (L2) in the state of an adherence of these coating sheets (2) to each other along these second fastening lines (L2), optionally indirectly by medium of another elements of said coat (1) located between these coating sheets (2) along these second fastening lines (L2);
- said thermally-expandable intumescent heat-insulating material (3) is disposed in channels (5) constituting cavities between the coating sheets (2) and the spacer sheets (4) defined by the lines of contact between the elements of the coat (1) along the second fastening lines (L2) of the second degradable fastening means (M2).

2. The fire-protection coat according to Claim 1, **characterized in that** the degradation temperature (Td2) of the second degradable fastening means (M2) is lower than the degradation temperature (Td1) of the first fastening means (M1) and ranges from 90 to 110 % of the expansion temperature (Tp) of the thermally-expandable intumescent heat-insulating material (3), and preferably amounts to from 90 to 200 °C.

3. The fire-protection coat according to Claim 1 or 2, **characterized in that** at least one second fastening line (L2) runs between two adjacent first fastening lines (L1) on the coating sheet (2) or the first fastening lines (L1) coincide with the second fastening lines (L2).

4. The fire-protection coat according to Claim 1 or 2 or 3, **characterized in that** the second fastening means (M2) additionally fasten the spacer sheet (4) in its internal area between the first fastening lines (L1) thereof with the coating sheets (2) along the second fastening line (L2) shifted relative to the first fastening lines (L1) of this spacer sheet (4), preferably along the second fastening line (L2) running along the first fastening line (L1) of the adjacent spacer sheet (4).

5. The fire-protection coat according to any one of Claims 1-4, **characterized in that** said coat comprises additionally an internal supporting layer (6), preferably a supporting sheet, and third stable fastening means (M3) resistant to an expansion of the heat-insulating material (3) and high temperature, preferably fire-resistant seams, which fasten the spacer sheets (4) with this supporting layer (6) along third fastening lines (L3) in the state of an adherence of the spacer sheets (4) to this supporting layer (6) along these third fastening lines (L3).

6. The fire-protection coat according to Claim 5, **characterized in that** the third fastening line (L3) of a given spacer sheet (4) runs preferably along the first fastening line (L1) of the adjacent spacer sheet (4) and/or the second fastening line (L2).

7. The fire-protection coat according to Claim 5, **characterized in that** the third fastening line (L3) of a given spacer sheet (4) runs preferably along the third fastening line (L3) of the corresponding spacer sheet (4) located at the other side of the supporting layer (6).

8. The fire-protection coat according to any one of Claims 1-7, **characterized in that** said coat comprises additionally fourth fastening means (M4) which fasten the external fire-resistant coating sheets (2) with each other along fourth fastening lines (L4) which are intersectional relative to the second fastening lines (L2) of the second degradable fastening means (M2), in the state of an adherence of these coating sheets (2) to each other along these fourth fastening lines (L4), optionally indirectly by medium of another elements of said coat (1) located between the coating sheets (2) along these fourth fastening lines (L4).

9. The fire-protection coat according to any one of Claims 1-8, **characterized in that** said coating sheet (2), said spacer sheet (4) and/or said supporting layer (6) comprises additionally an aluminium foil layer and/or thermally-expandable material layer (preferably a coating composition containing graphite), and/or an insulation material layer (preferably a fiber mat), and/or a moistening cooling agent, and/or thermally-expandable agent (preferably based on water-glass), and/or crystal water.

10. The fire-protection coat according to any one of Claims 1-9, **characterized in that** said coat comprises a ballast arrangement (7) comprising two longitudinal ballast sections (71) arranged opposite relative to each other on the external surfaces of the coating sheets (2) along the terminal edges of the coating sheets (2) at a certain distance from these edges, wherein each edge area (21) of the coating sheet (2) projected beyond the ballast sections (71) is fastened to the ballast section (71) directly adjoining thereto with forming free-moving folded longitudinal sealing fold (22).

11. The fire-protection coat according to any one of Claims 1-10, **characterized in that** a thermally-expandable intumescent material stripe (8) is fastened along each lateral longitudinal edge to each coating sheet (2) on the surface thereof opposite relative to the other coating sheet (2) at a certain distance along this edge of the coating sheet (2), wherein a lateral longitudinal edge area (23) of each coating sheet (2) is folded onto this thermally-expandable intumes-

cent material stripe (8) and a fold formed in this manner is stitched down to the thermally-expandable intumescent material stripe (8) at a certain distance from the coating sheet (2) edge with forming a free-moving longitudinal catch lip (24).

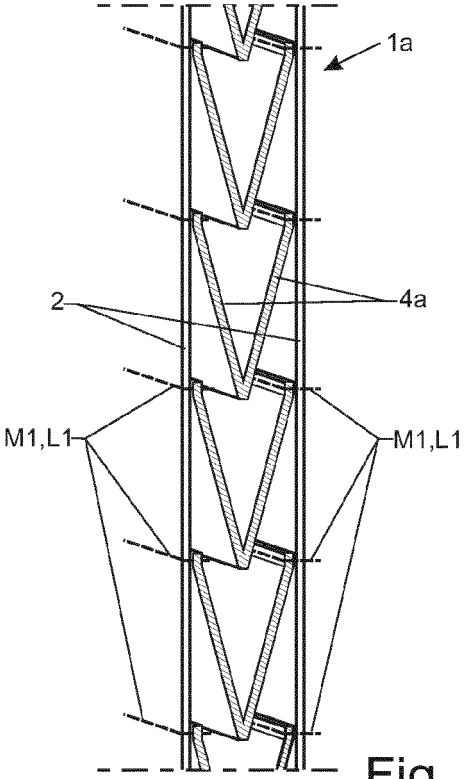


Fig. 1a

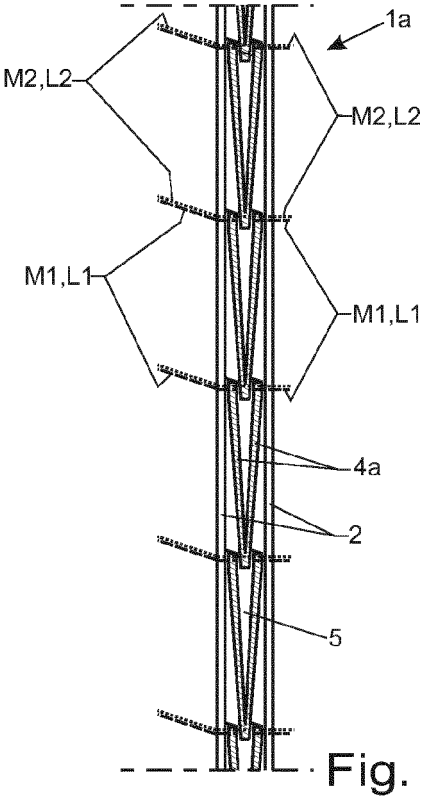


Fig. 1b

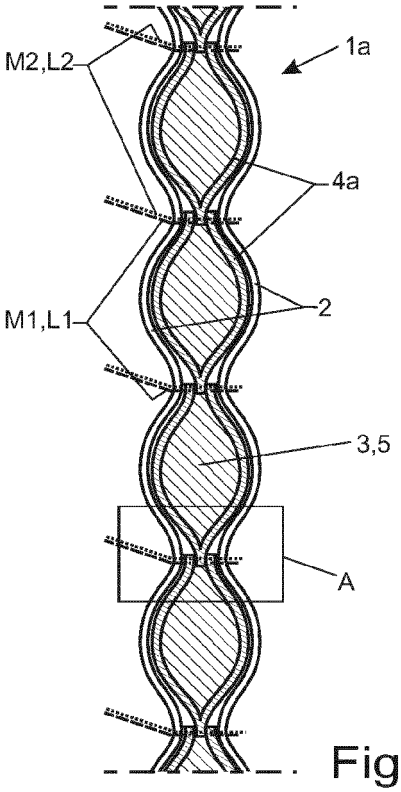


Fig. 1c

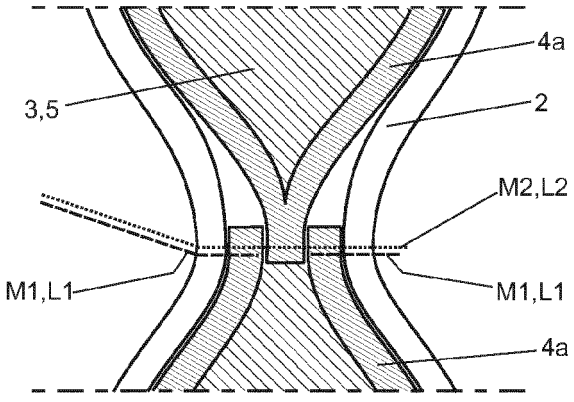


Fig. 1d
(the area A of Fig. 1c)

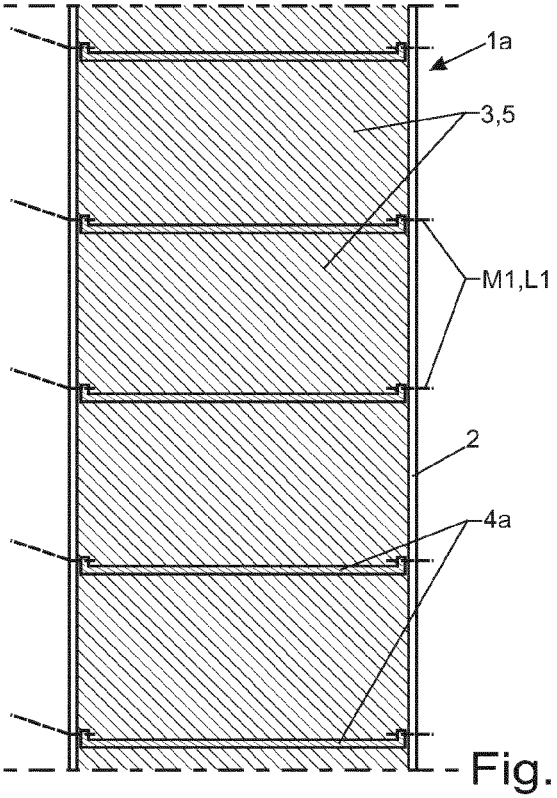


Fig. 1e

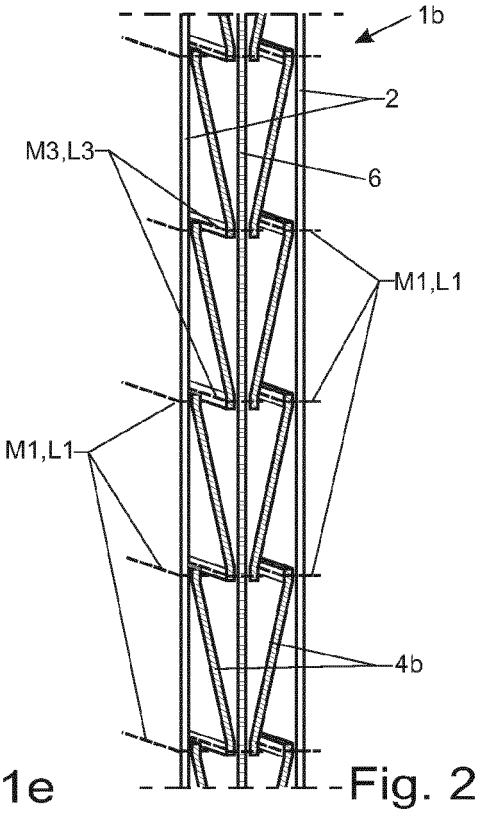


Fig. 2a

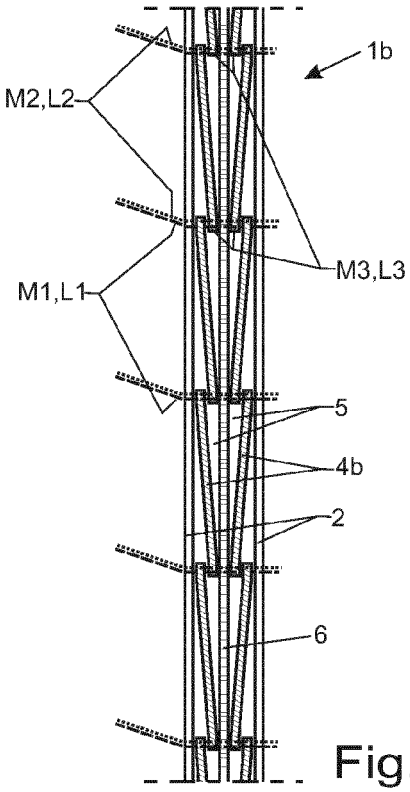


Fig. 2b

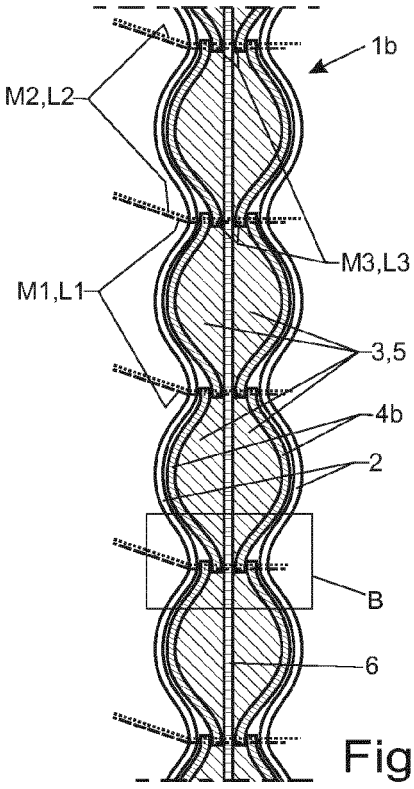


Fig. 2c

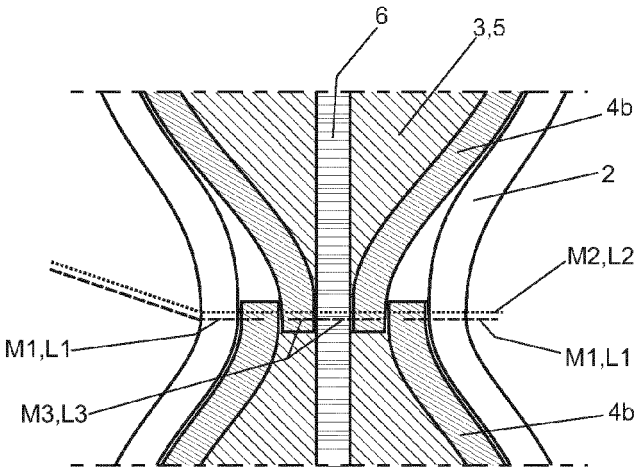


Fig. 2d
(the area B of Fig. 2c)

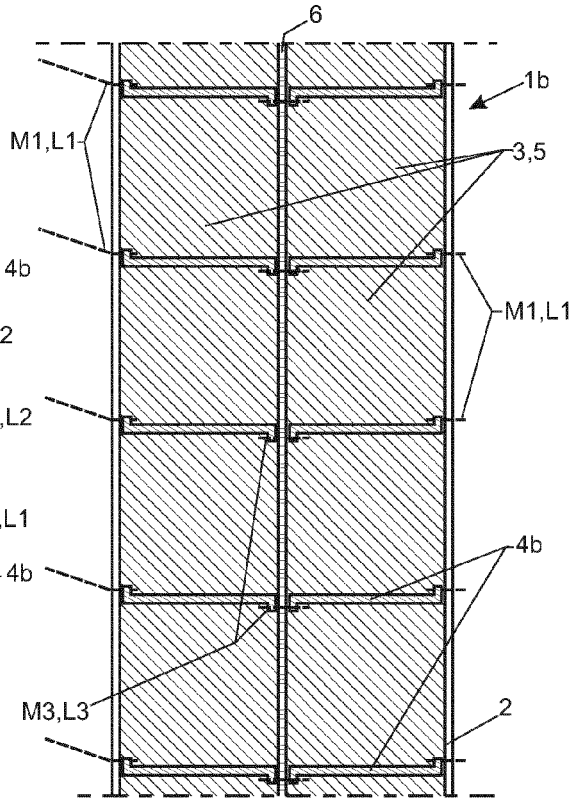


Fig. 2e

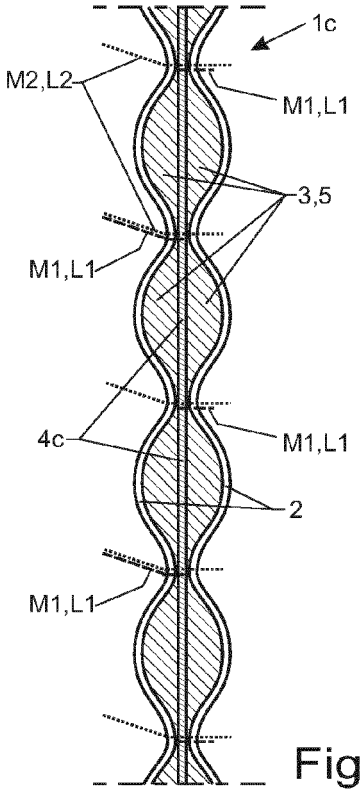


Fig. 3a

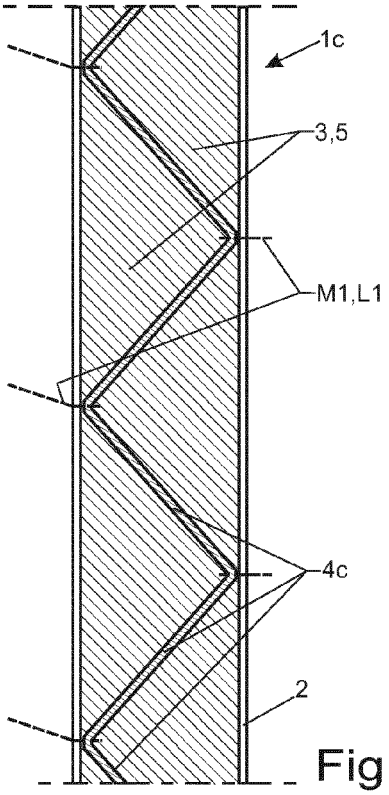


Fig. 3b

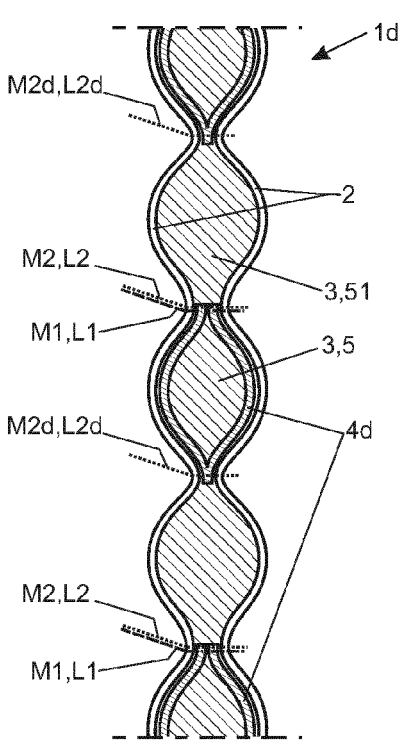


Fig. 4

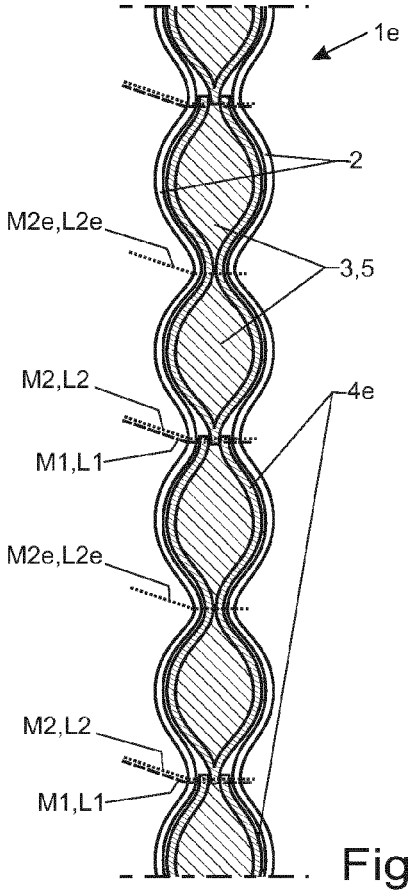


Fig. 5

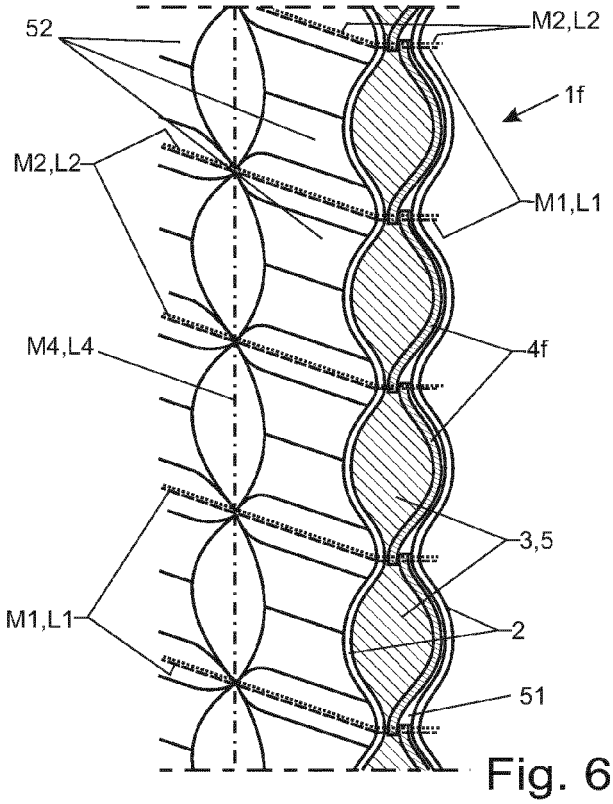
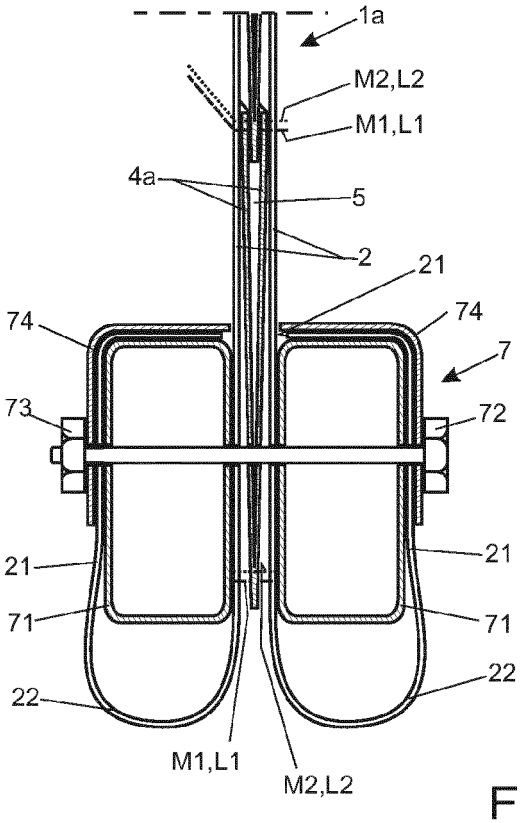


Fig. 6


1a
M2,L2
M1,L1
4a
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22
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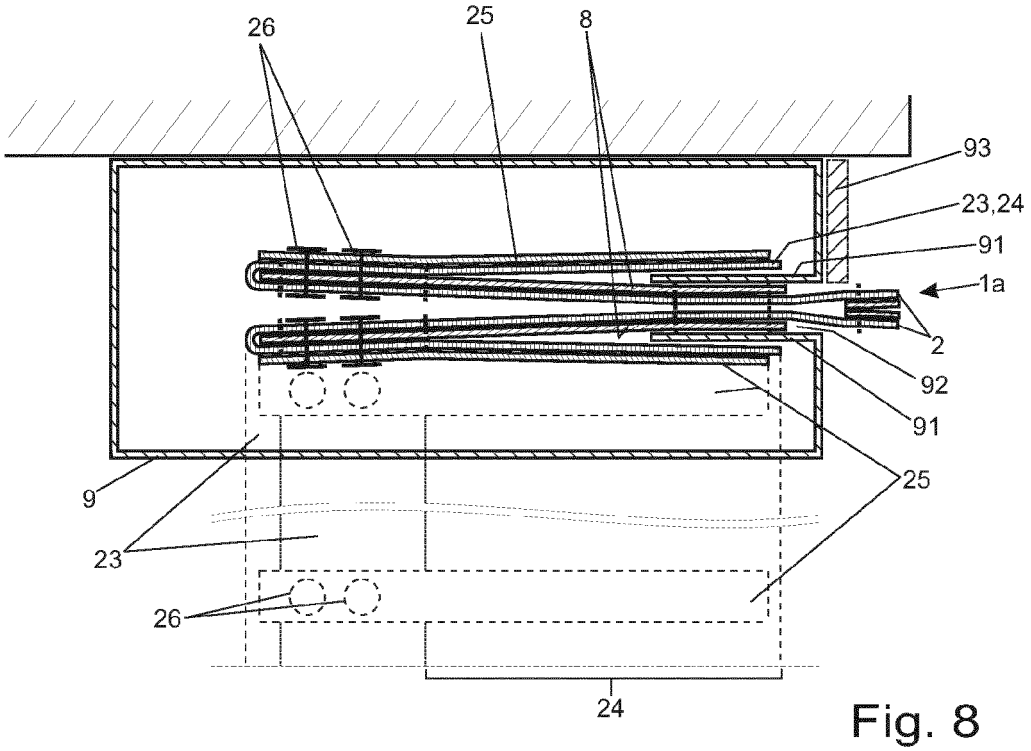
M1,L1
M2,L2

Fig. 7


26
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23,24
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1a
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26
24

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 3413

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	EP 3 225 283 A1 (FIMARC ZENON MALKOWSKI [PL]) 4 October 2017 (2017-10-04) * figures 16,26-28 * * paragraph [0007] - paragraph [0010] *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

A62C
E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 August 2019	Nehrdich, Martin

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23-08-2019

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EP 3225283 A1	04-10-2017	NONE	

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

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