Corrugated fire-retardant shutter

Gewellter feuerhemmender Verschluss

Volet ignifuge ondulé

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Description

Technical Field

[0001] The present invention relates to a cost effective and a relatively lightweight fire-retardant shutter for smoke redirection and damping applications in air ducts, buildings and building industry. In particular, the invention concerns a fire-retardant shutter comprising at least one layer of a corrugated fire-resistant material and an intumescent material, wherein the intumescent material is positioned at least partially inside the concave surfaces formed by the corrugations of the fire-resistant material.

Background for the invention

[0002] It is a well-known fact that in case of fire in a building, timing is everything. Fire spreads upwards in a matter of seconds and sideways in the matter of minutes. While spreading, it generates hazardous fumes that can render people disoriented or even unconscious. Therefore, a quick intervention to cut the advancing smoke off and delay the progression of fire is key in saving lives, especially in complex buildings like large offices or schools, wherein the nearest fire-exit can be corridors or even staircases away.

[0003] For these reasons, there is a constant need for the development of quickly reacting and relatively durable fire barriers, capable of buying as much time as possible and ensuring safest escape route possible for the affected fire victims.

[0004] Consequently, nowadays there exist numerous fire protection solutions with different advantages and drawbacks. For protection of air ducts or ventilation shafts there are two most common types of barriers. The first one provides a broad category of passive perforated intumescent plugs or grilles in which the intumescent component expands in response to heat or fire, fusing the grille into a solid block which, for a certain time, will hold the fire from spreading. Another category comprises fire-resistant fire and smoke dampers that can close quickly in response to heat. The purely intumescent barriers in general have better insulating properties but are much slower in closing and therefore tend to allow some smoke to pass. On the other hand, the closing dampers are more effective against smoke but, being largely made of metal, they transfer heat much faster which leads to quick elevation of temperatures on the other side of the damper. Hybrid solutions, that combine both the fire resistant material with the intumescent exist but are usually composed of multiple layers and hence are bulky, tending to limit air passage through air ducts, shafts, or even small windows or narrow corridors.

[0005] An example of one solution is provided in EP2520338, which discloses a curtain comprising two parallel flat layers of the fire-resistant material encasing powdery or doughy intumescent material. The design appears simple, however it suffers from major manufacturing complications to prevent the loose intumescent from falling out from between the two parallel sheets. To do so, the sheets are first joined by a plurality of bracing slats perpendicular to the surface of the fire resistant sheets, then the intumescent is packaged in discrete bags that are then, inserted between the shelves formed by the bracing slats.

[0006] Similarly, NL2010146 discloses a relatively thick double-walled and hollow-cored segmented rollable curtain with complex multichamber bags encasing intumescent powder. Consequently, the curtain not only appears dimensionally not suitable for smaller openings like air ducts, but also it is complicated to manufacture due to its numerous components.

[0007] Other prior art documents such as WO02053679 or US2013255893, disclose curtains of heavy knitted fire-resistant fabric, wherein the intumescent material particles are either glued onto the surface of the fabric or woven into it, respectively. Although these solutions could be sufficiently lightweight, they do not allow incorporation of intumescent layers sufficiently thick to achieve a longer lasting thermal barrier. Another document of the prior art, GB 2 411 199 A, describes a fire door comprising an intumescent material. In spite of the promising combination of the intumescent and fire-resistant elements, the above listed shutters are either complex to manufacture or provide insufficiently satisfying characteristics including the extent of intumescent char expansion and thus also the time they can withstand the fire.

[0008] In view of the above, it appears that there remains a need in the art for a low-cost, quickly-closing and durable fire-retardant shutter that can easily be fitted to air ducts, ventilation shafts as well as architectural openings such as doors, corridors or even windows. The present invention provides a solution to this and other problems.

Summary of the invention

[0009] The present invention is defined in the appended independent claims. Preferred embodiments are defined in the dependent claims. In particular, the present invention concerns a fire-retardant shutter or for applications in air ducts, shafts, and architectural openings, the shutter comprising:

- a layer made of a fire-resistant material that is corrugated i.e. comprising furrows forming a concave surface and ridges forming a convex surface in an alternate and parallel pattern,
- an intumescent material (2) positioned at least partially inside the concave surface of at least one furrow (1a), and
- at least one additional layer (3) coupled to the first layer of the fire-resistant material (1), such as to form a closed space encasing the intumescent material (2).
In a preferred embodiment, the shutter of the present invention particularly advantageous for manufacturing of relatively light-weight and small fire-barriers or smoke evacuators that could be discretely mounted e.g. in a form of a curtain or a roller-blind in air ducts, shafts, building corridors and like, and then swiftly extended or unrolled in case of a fire or smoke. The increased stiffness along the direction of corrugations minimizes occurrence of deformations that could impede or slow down the unrolling or opening of the shutter, and furthermore ensures even covering of the opening and thus forming a better barrier. On the other hand, the presence of corrugations provides natural casing for various forms of intumescent materials that, once the shutter is exposed to heat, undergo phase transition and swell de- 5 creasing temperature of the material, and leaves the matrix. The remaining substance is called char and be- 10 comes expanded ("foams") as the eliminated water un- 15 comes expanded ("foams") as the eliminated water un- 20 comes expanded ("foams") as the eliminated water un- 25 comes expanded ("foams") as the eliminated water un- 30 comes expanded ("foams") as the eliminated water un- 35 comes expanded ("foams") as the eliminated water un- 40 comes expanded ("foams") as the eliminated water un- 45 comes expanded ("foams") as the eliminated water un- 50 comes expanded ("foams") as the eliminated water un-

Another important component of the shutter of the present invention is the intumescent material. As stated before, an intumescent is a substance which swells as a result of heat exposure, thus increasing in volume and decreasing in density. Most known materials expand in response to heat but the intumescents do so via a chemical reaction, usually elimination of a water mole- 5

In an alternative embodiment of the present invention, the shutter of the present invention is sufficiently flexible to roll around at least a portion of a rotating drum. The fire retardant shutter of the invention further comprises at least one additional layer that is coupled to its first layer of the fire re- 10

Thus, in a preferred embodiment of the present shutter, the fire-resistant material of the first corrugated layer is selected from a group comprising inox, aluminium, fabric of aramid, calcium silicate, or a mix thereof. 15

Similarly, in an alternative embodiment, whether or not combined with the previous one, the fire-resist- 20

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like Favuseal, Palusol, or Kerafix etc. Because the division of intumescent materials is not clear-cut and many commercial compositions are known, it can be assumed for the purposes of the present invention that a suitable intumescent shall be understood as any material or material mixture expanding in response to heat and capable of reaching a volumetric expansion ratio of at least 2, preferably 4, or most preferably 8 or higher, wherein said ratio is defined as the ratio of the final volume of the material expanded under standard fire conditions, as given in ISO 834 (1975), to its initial volume under STP (expanding ratio \( ER = \text{final volume}/\text{initial volume} \)).

Therefore, in a preferred embodiment in accordance with other embodiments, the intumescent material is a material reaching a volumetric expansion ratio of at least 2, preferably 4, or most preferably 8 or higher under standard fire conditions.

The shutter of the present invention can further advantageously be coupled to an elongated mandrel in such way the alternate furrows ridges are parallel to the elongated surface of the mandrel as to allow retracting or extending of the shutter by winding or unwinding around said mandrel, thus forming a roller blind. In an embodiment of said embodiment, the roller blind may further comprise means for mounting it in a special housing or directly in an air duct or an architectural opening.

In a further embodiment of said embodiment, the roller blind may further comprise means for mounting it in a special housing or directly in an air duct or an architectural opening. In a further aspect, the present invention also provides a fire-retardant shutter assembly for closing an area defined by a first direction, X1, and a second direction, X2, said assembly comprising:

(a) a shutter according to any of the claims 1-8 said shutter further defined as comprising

- a leading edge extending along the second direction, X2, and parallel to the first direction, X1, in one direction to close the area and in the opposite direction to open said area, and
- two lateral edges separated by the leading edge;

(b) a housing for accommodating said shutter and capable of being installed in the area defined by directions X1 and X2, said housing comprising

- at least one shutter-adjacent profile, that is a profile parallel to the first direction, X1, and the profile closest to the shutter’s leading edge when the shutter is in a non-extended position, and
- at least two side profiles that are connected and perpendicular to the shutter-adjacent profile and parallel to the second direction, X2; and

(c) means for extending the shutter leading edge along the second direction, X2, as to close said area.

As it will be appreciated by any skilled person, the means of extending said shutter shall comprise any of the different arrangements, manual or automated alike, known in the art that are capable of setting the shutter into motion as to close or open the defined area in response to a trigger. The trigger can be any an internal or external signal relayed from an initiating device either integrated in the assembly, or nearby, or more distant. Examples of initiating devices are also well known in the art and are not within the scope of the present invention, they include e.g. pull stations, break-glass stations, heat detectors, fusible links, smoke detectors, flame detectors, water-flow detectors, cameras etc.

In a further embodiment, the housing of the fire-retardant shutter assembly shall further comprise a guiding system, such as guide rails or guiding cables, for guiding at least one lateral edge of the shutter, preferably both lateral edges of the shutter.

In another embodiment of the present invention, any of the housing, or the guiding system, or the shutter can comprise at least one sealing strip for better sealing of the extended shutter against the housing.

In a preferred embodiment of the fire-retardant shutter assembly of the invention, the shutter is coupled to a mandrel and the means for extending said shutter is rotational motion of said mandrel in the housing, thus forming a roller blind assembly.

In a possible embodiment of the previous embodiment, particularly advantageous where access to the shutter is difficult in high not easily accessible openings such as the ones of air ducts, the mandrel can be positioned in the lowest profile of the housing and the shutter extends upwards on a guiding system.

For a fuller understanding of the nature of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawings in which:

Figure 1 shows vertical cross sections of three alternative examples of a shutter not according to the present invention, said examples differing with respect to the shape of corrugations;

Figure 2 shows vertical cross sections of two alternative embodiments of the shutter of the present invention comprising the additional layer;

Figure 3 shows an exploded view of one embodiment of the shutter;

Figure 4 shows frontal view of one embodiment of the shutter (left panel), vertical cross sections of one embodiment of the shutter material prior (I) and after volumetric expansion (I') (right panel), and a horizontal cross section of the same expanded embodiment (bottom left panel) along the zone of the shutter comprising coupling bridges (4);

Figure 5 shows vertical cross sections of an embodiment of the shutter rolled in two different ways around a cylindrical mandrel (II);

Figure 6 shows vertical cross sections of three alternative examples of a shutter not according to the present invention, said examples differing with respect to the shape of corrugations;
The present invention provides a corrugated structure, i.e. having a structure comprising furrows (1a) forming a concave surface and ridges (1b) forming a convex surface, said furrows and ridges extending along the first direction, X1, and alternating along the second direction, X2, and higher bendability in the direction parallel to the corrugations (or parallel to the direction in which the furrows and ridges that form the corrugations extend), X1, and a second direction, X2. With regard to the movement of shutter, it can be defined as having a leading edge and two side lateral edges separated by and perpendicular to the leading edge. As the shutter moves, the leading edge extends along the second direction, X2, and moves parallel to the first direction, X1, in one direction to close the area and in the opposite direction to open said area. The fire-retardant shutter of the present invention serves two major roles.

**Detailed description of the invention**

[0028] The present invention provides a corrugated fire-retardant shutter for closing an area defined by a first direction, X1, and a second direction, X2. Typically, the fire-retardant shutter serves to close and seal the area to be sealed, thereby providing an effective seal against the passage of fire and smoke. There exists a need for the intumescent will expand firmly against the periphery of the area to be sealed, thereby providing an effective seal against the passage of fire and smoke.

(a) a layer made of at least one sheet of a fire-resistant material (1) defined as a material non-degrading at 300°C for at least 30 minutes, having a corrugated structure, (b) an intumescent material (2), positioned at least partially inside the concave surface of at least one furrow (1a).

[0029] As used herein, the term "fire-retardant" should be understood as intended for delaying the spread of flame, smoke, and/or fumes.

[0030] Figure 1 schematically illustrates three examples of the material (I) forming the fire-retardant shutter showing different possible corrugation patterns in the fire-resistant material (1). Furrow (1a) and ridge (1b) sections are indicated. The presented shapes only serve illustrative purposes as many other corrugation types can be envisaged and obtained by methods known in the art, such as roll-forming, cold-rolling, various pressing or extrusion techniques, or processing in special corrugation machines, or other ways of sheet profiling or potentially even welding.

[0031] The unidirectional parallel corrugations of the shutter of the invention serve two major roles. Firstly, they confer the desirable physical properties as increased rigidity in the dimension perpendicular to the direction of the corrugations (or parallel to the direction in which the furrows and ridges that form the corrugations extend), X2, and higher bendability in the direction parallel to the corrugations (or perpendicular to the direction in which the furrows and ridges extend), X1, which together counteract bending of the shutter in any direction different than along the corrugations. And secondly, the concave surfaces inside the furrows provide natural support for accommodating the intumescent material (2).

[0032] Once the fire-resistant layer is profiled, it suffices to pour the intumescent powder or granules into the furrows and then secure the thus obtained product with an additional layer, or, in an example not according to the present invention, simply attach solid rods of the intumescent material into the concave surfaces by means of an adhesive. Such shutter can readily be positioned upright without further complicated manufacturing procedures for ensuring the intumescent does not dislocate.

[0033] As used herein, the term the term "intumescent material" is to be understood as a material swelling or expanding under conditions of exposure to fire or heat, typically by the expulsion of water vapour. In preferred embodiments of present invention, the intumescent material is capable of reaching a volumetric expansion ratio at least 2, preferably 4, or most preferably 8 or higher, wherein said ratio is defined as the ratio of the final volume of the material expanded under standard fire conditions, as given in ISO 834 (1975), to its initial volume under standard conditions for temperature and pressure (STP). The expansion ratio x is given by the formula:

\[
x = \frac{V_{\text{final}}}{V_{\text{initial}}}
\]

[0034] The degree to which the intumescent material expands is important during a fire event, as the expanding char will have to fill the space it is designed to occupy and must do so at a rapid rate. The higher the expansion ratio, the better the isolation properties and the probability the intumescent will expand firmly against the periphery of the area to be sealed, thereby providing an effective seal against the passage of fire and smoke. There exists many types of intumescent materials suitable to be used in the shutter of the present invention. Most types are graphite-based or based on various silica such as sodium-silicate, mica or vermiculite. Examples of commercial intumescents include various mixes including Rf-Exp-25, Palusol, Favuseal or Kerafix, some of which can attain expansion ratio of 50 or even higher. Further examples of intumescent compositions can be found in e.g. patent documents US5476891, US4273879, or WO2011060421.

[0035] In a preferred embodiment, the intumescent material (2) is positioned at least partially inside the concave surfaces of a plurality of furrows (1a) on at least one side of the corrugated fire-resistant material (1); but in certain embodiments, it can be positioned at least partially inside the concave surfaces of a plurality of furrows (1a) on both sides of the corrugated fire-resistant material (1) (cf. Figure 6, middle pane). In a particularly preferred embodiment, the intumescent material (2) is positioned at least partially inside the concave surfaces of a plurality of furrows (1a) on only one side of the corrugated fire-resistant material (1).

[0036] Commercial intumescent materials are usually...
supplied in powder, pellet, or pasty form, but may be processed to other form by extrusion, compression-moulding or injection-moulding. Because of high friability and looseness of the majority of the currently-available intumescent materials, in advantageous embodiments of the present invention, the corrugated shutter further comprises an additional layer of material (3) such as to form a closed space encasing the intumescent material (3). Two examples of such solution are illustrated in Figures 2. The additional layer (3) is preferably flat and preferably coupled to the corrugated or first layer (1) by e.g. an adhesive, welding with or without an adhesive, or by coupling bridges (4) such as rivets, nails, or screws. By application of the additional second layer (3) even the free-flowing intumescent materials (3) may be stored as distinguishable layers enclosed inside of the furrows formed in the corrugated fire-resistant sheet, as symbolically represented in Figure 3.

Figure 4 shows a preferred embodiment of the shutter according to the invention, wherein two (or more) corrugated fire-resistant sheets (1) overlap (1c). However, in alternative embodiments, two or more fire-resistant sheets (1) may be coupled to the continuous additional layer (3) without being directly connected to each other.

As further illustrated in Figure 4, the shutter of the present invention may advantageously be configured to allow increasing of the distance between the first (corrugated) layer (1) and the additional layer (3) upon expansion of the intumescent material (2') encased between them. Such effect can be achieved by means of extendible coupling bridges that either elongate or bend (4') as the additional layer (3) is pushed away from the first fire-resistant corrugated layer (1) by the expanding intumescent (2'). Examples of such extendible coupling bridges include but are not limited to springs or flexible metal slabs, provided as separate components or formed in one of the layers a scored portions.

As discussed before and with prejudice to materials used, parallel corrugations have the advantage of ensuring that the shutter of the present invention is bendable and rollable in only one direction, said direction, X2, being the direction perpendicular to the direction wherein the furrows and ridges of the corrugations are extending, X1. Figure 5 schematically illustrates two different modes of rolling or bending of the shutter material (I) around a rotating drum or mandrel (II).

In a preferred embodiment, the shutter of the present invention is provided in a form of a flexible roller blind, wherein the corrugated shutter material (I) is coupled to the elongated profile of a mandrel (II) in a way allowing to retract or extend the shutter material (I) by moving the shutter leading edge along the direction perpendicular to the longitudinal axis of the mandrel (II), X2, by means of rotational movement exerted by the mandrel (II).

Therefore, in preferred embodiments of present invention, the composite material (I) of the shutter is sufficiently flexible to roll around at least a portion of a rotatable mandrel (II).

Along these lines, examples of fire resistant materials suitable for either the first corrugated layer (1) or the additional layer include but are not limited to inox, aluminum, woven aramid, calcium silicate, mixes thereof, or various alloys thereof.

In one embodiment, the corrugated first layer (1) is preferably made of inox.

In another embodiment, noneexclusive with the previous embodiment, the additional layer (3) is also preferably made of inox. The additional layer (3) is selected from any flexible material or film, e.g. including woven or non-woven fabrics, hydroentangled materials, a spun-bond materials, or a meltblown materials, enameled cloths, meshes, a monofilament fabrics, aluminized glass cloths, perforated films, adhesive layers, a glue webs, or a glue films.

As will be obvious to one skilled in the art, a curtain of present invention may comprise a plurality of more additional layers, e.g. it can comprise two opposing layers of the corrugated fire-resistant material (1'), or additional layers directly coupled (3') or not directly coupled (3") to the corrugated layer of the fire-resistant material (1), as schematically illustrated in Figure 6.

Similarly, any of the layers, external layers in particular, may comprise additional coating or a top decorative layer facing ambient such as a paint layer or a wallpaper. Advantageously, such layers can be made of any of a fire retarded or fire resistant cellulosic material, melamine, veneer, high pressure laminates etc., and combinations thereof.

For the safety and ease of installation purposes, the present invention further provides a fire-retardant shutter assembly configured to be installed in and close an area defined by a first direction, X1, and a second direction, X2. The fire-retardant shutter assembly according to the invention comprises:

(a) a shutter according to any of the claims 1-8 said shutter defined as comprising

- a leading edge extending along the second direction, X2, and parallel to the first direction, X1, in one direction to close the area and in the opposite direction to open said area, and
- two lateral edges separated by the leading edge;

(b) a housing for accommodating said shutter and capable of being installed in the area defined by directions X1 and X2, said housing comprising

- at least one shutter-adjacent profile, that is a profile parallel to the first direction, X1, and the profile closest to the shutter's leading edge when the shutter is in a non-extended position, and
- at least two side profiles that are connected and perpendicular to the shutter-adjacent profile and parallel to the second direction, X2; and
assembly of springs to release the shutter. Enough to indicate the presence of a fire, allowing an intumescent material or a film.

5 [0058] In advantageous embodiments, the fire-retardant shutter assembly of the invention is configured to stop fire progression through an opening smaller than or equal to 2 m², preferably 1.5 m², for at least 60 to 120 minutes.

Claims

1. A fire-retardant shutter comprising:

- a first layer made of a fire-resistant material (1) comprising furrows (1a) forming a concave surface and ridges (1b) forming a convex surface in an alternate and parallel pattern,
- an intumescent material (2) positioned at least partially inside the concave surface of at least one furrow (1a) and
- at least one additional layer (3) coupled to the first layer of the fire-resistant material (1), such as to form a closed space encasing the intumescent material (2), characterized in that said additional layer (3) is made of a flexible material or a film.

2. Fire retardant shutter according to claim 1, wherein the additional layer (3) is coupled to the first layer by means of coupling bridges (4).

3. Fire retardant shutter according to claim 2, wherein the coupling bridges (4) allow the distance between the first layer (1) and the additional layer (3) to be increased upon expansion of the intumescent material (2) encased between them.

4. Fire retardant shutter according to claims 1 to 3, wherein the additional layer (3) is made of a fire-resistant material.

5. Fire retardant shutter according to any of the preceding claims, wherein the fire-resistant material of the first layer (1) is selected from a group comprising Inox, aluminium, fabric of aramid, calcium silicate, or a mix thereof.

6. Fire retardant shutter according to any of the claims 1 to 5, wherein the fire-resistant material of the additional layer (3) is selected from a group comprising Inox, aluminium, fabric of aramid, calcium silicate, or a mix thereof.

7. Fire retardant shutter according to any of the preceding claims, wherein the intumescent material (2) is selected from a group comprising soft char mate-
rials or hard char materials or a mix thereof, and preferably is a hard char material comprising graphite, sodium silicate, or vermiculite.

8. Fire retardant shutter according to any of the preceding claims, further comprising at least one lateral sealing strip (III).

9. A fire-retardant shutter assembly for closing an area defined by a first direction, X1, and a second direction, X2, said assembly comprising

(a) a shutter according to any of the claims 1-8, said shutter defined as comprising

- a leading edge extending along the second direction, X2, and parallel to the first direction, X1, in one direction to close the area and in the opposite direction to open said area, and
- two lateral edges separated by the leading edge;

(b) a housing for accommodating said shutter and capable of being installed in the area defined by directions X1 and X2, said housing comprising

- at least one shutter-adjacent profile, that is a profile parallel to the first direction, X1, and the profile closest to the shutter’s leading edge when the shutter is in a non-extended position, and
- at least two side profiles that are connected and perpendicular to the shutter-adjacent profile and parallel to the second direction, X2; and

(c) means for extending the shutter leading edge along the second direction, X2.

10. A fire-retardant shutter assembly according to claim 9, wherein the housing comprises a guiding system for guiding at least one lateral edge, preferably both, of the shutter.

11. A fire-retardant shutter assembly according to claim 10, wherein the housing or the guiding system further comprises at least one lateral sealing strip (III).

12. A fire-retardant shutter assembly according to any of the claims 10-11, wherein the shutter is coupled to a mandrel (II) and wherein the means for extending said shutter is rotational motion.

13. A fire-retardant shutter assembly according to claim 12, wherein the mandrel (II) is positioned in the lowest profile of the housing and wherein the shutter extends upwards by means of the guiding system.

Patentansprüche

1. Flammenhemmender Rollladen, umfassend:

- eine erste Schicht, die aus feuerresistentem Material (1) hergestellt ist, umfassend Furchen (1a), die eine konkave Oberfläche bilden, und Rippen (1b), die eine konvexe Oberfläche in einem alternierenden und parallelen Muster bilden,
- ein Intumeszierendes Material (2), das mindestens teilweise innerhalb der konkaven Oberfläche von mindestens einer Furche (1a) positioniert ist,
- mindestens eine zusätzliche Schicht (3), die an die erste Schicht des feuerresistenten Materials (1) gekoppelt ist, um einen geschlossenen Raum zu bilden, der das intumeszente Material (2) einschließt,

dadurch gekennzeichnet, dass die zusätzliche Schicht (3) aus einem flexiblen Material oder einem Film hergestellt ist.

2. Flammenhemmender Rollladen nach Anspruch 1, wobei die zusätzliche Schicht (3) mit der ersten Schicht mit Hilfe von Kupplungsbrücken (4) gekoppelt ist.

3. Flammenhemmender Rollladen nach Anspruch 2, wobei die Kupplungsbrücken (4) ermöglichen, dass der Abstand zwischen der ersten Schicht (1) und der zusätzlichen Schicht (3) nach der Expansion des intumeszenten Materials (2), das zwischen ihnen eingeschlossen ist, erhöht wird.

4. Flammenhemmender Rollladen nach Anspruch 1 bis 3, wobei die zusätzliche Schicht (3) aus feuerresistentem Material hergestellt ist.

5. Flammenhemmender Rollladen nach einem der vorhergehenden Ansprüche, wobei das feuerresistente Material der ersten Schicht (1) ausgewählt ist aus der Gruppe, umfassend Edelstahl, Aluminium, Aramidfaser, Calciumsilikat oder eine Mischung davon.

6. Flammenhemmender Rollladen nach einem der vorhergehenden Ansprüche, wobei das feuerresistente Material der zusätzlichen Schicht (3) ausgewählt ist aus der Gruppe, umfassend Edelstahl, Aluminium, Aramidfaser, Calciumsilikat oder eine Mischung davon.

7. Flammenhemmender Rollladen nach einem der vorhergehenden Ansprüche, wobei das intumeszente Material (2) ausgewählt ist aus der Gruppe, umfas-
send weiche Kohlematerialien oder harte Kohlematerialien oder eine Mischung davon, und vorzugsweise ein hartes Kohlematerial, umfassend Graphit, Natriumsilikat oder Vermiculit.


9. Flammenhemmende Rollladeneinheit zum Verschließen eines Bereichs, der durch eine erste Richtung, X1, und eine zweite Richtung, X2, definiert ist, wobei die Einheit Folgendes umfasst:

   (a) einen Rollladen nach einem der Ansprüche 1 - 8, wobei der Rollladen als Folgendes umfassend definiert ist:
   - eine vordere Kante, die sich entlang der zweiten Richtung, X2, und parallel zur ersten Richtung, X1, in eine Richtung ausschiebt, um den Bereich zu schließen, und
   - zwei seitliche Kanten, die durch die vordere Kante getrennt sind;

   (b) ein Gehäuse zur Aufnahme des Rollladens und dazu in der Lage, in dem Bereich installiert zu werden, der durch die Richtungen X1 und X2 definiert ist, wobei das Gehäuse Folgendes umfasst:
   - mindestens ein dem Rollladen benachbarter Profil, d. h. ein Profil parallel zur ersten Richtung, X1, und das Profil am nächsten an der vorderen Kante des Rollladens, wenn sich der Rollladen in einer nicht ausgeschobenen Position befindet, und
   - mindestens zwei Seitenprofile, die mit dem dem Rollladen benachbarten Profil verbunden und dazu senkrecht und parallel zur zweiten Richtung, X2, sind; und

   (c) Mittel zum Ausschieben der vorderen Kante des Rollladens entlang der zweiten Richtung, X2.

10. Flammenhemmende Rollladeneinheit nach Anspruch 9, wobei das Gehäuse ein Führungssystem umfasst, um mindestens eine seitliche Kante, vorzugsweise beide, des Rollladens zu führen.

11. Flammenhemmende Rollladeneinheit nach Anspruch 10, wobei das Gehäuse oder das Führungssystem weiter mindestens einen seitlichen Dichtungstreifen (III) umfasst.


**Revendications**

1. Volet retardateur de feu comprenant:
   - une première couche faite d’un matériau résistant au feu (1) comprenant des cannelures (1a) formant une surface concave et des arêtes (1b) formant une surface convexe selon un schéma alterné et parallèle,
   - un matériau intumescent (2) positionné au moins partiellement à l’intérieur de la surface concave d’au moins une cannelleur (1a) et
   - au moins une couche supplémentaire (3) couplée à la première couche du matériau résistant au feu (1), de façon à former un espace clos enfermant le matériau intumescent (2),

   caractérisé en ce que ladite couche supplémentaire (3) est faite d’un matériau flexible ou d’un film.

2. Volet retardateur de feu selon la revendication 1, dans lequel la couche supplémentaire (3) est couplée à la première couche au moyen de ponts de couplage (4).

3. Volet retardateur de feu selon la revendication 2, dans lequel les ponts de couplage (4) permettent d’augmenter la distance entre la première couche (1) et la couche supplémentaire (3) lors de la dilatation du matériau intumescent (2) enfermé entre elles.

4. Volet retardateur de feu selon les revendications 1 à 3, dans lequel la couche supplémentaire (3) est faite d’un matériau résistant au feu.

5. Volet retardateur de feu selon l’une quelconque des revendications précédentes, dans lequel le matériau résistant au feu de la première couche (1) est choisi dans un groupe comprenant l’inox, l’aluminium, une étoffe d’aramide, le silicate de calcium, ou un mélange de ceux-ci.

6. Volet retardateur de feu selon l’une quelconque des revendications 1 à 5, dans lequel le matériau résistant au feu de la couche supplémentaire (3) est choisi
dans un groupe comprenant l’inox, l’aluminium, une étoffe d’aramide, le silicate de calcium, ou un mélange de ceux-ci.

7. Volet retardateur de feu selon l’une quelconque des revendications précédentes, dans lequel le matériau intumescent (2) est choisi dans un groupe comprenant des matériaux de résidu carboné mou ou des matériaux de résidu carboné dur ou un mélange de ceux-ci, et est de préférence un matériau de résidu carboné dur comprenant du graphite, du silicate de sodium, ou de la vermiculite.

8. Volet retardateur de feu selon l’une quelconque des revendications précédentes, comprenant en outre au moins une bande d’étanchéité latérale (III).

9. Ensemble volet retardateur de feu pour clore une zone définie par une première direction, X1, et une seconde direction, X2, dit ensemble comprenant

(a) un volet selon l’une quelconque des revendications 1 à 8, dit volet étant défini comme comprenant

- un bord d’attaque s’étendant le long de la seconde direction, X2, et parallèle à la première direction, X1, dans une direction pour clore la zone et dans la direction opposée pour ouvrir ladite zone, et
- deux bords latéraux séparés par le bord d’attaque ;

(b) un boîtier pour loger dit volet et capable d’être installé dans la zone définie par les directions X1 et X2, dit boîtier comprenant

- au moins un profilé adjacent au volet, qui est un profilé parallèle à la première direction, X1, et le profilé le plus proche du bord d’attaque du volet lorsque le volet est dans une position non étendue, et
- au moins deux profilés de côté qui sont raccordés et perpendiculaires au profilé adjacent au volet et parallèles à la seconde direction, X2 ; et

(c) un moyen d’extension du bord d’attaque du volet le long de la seconde direction, X2.

10. Ensemble volet retardateur de feu selon la revendication 9, dans lequel le boîtier comprend un système de guidage pour guider au moins un bord latéral, de préférence les deux, du volet.

11. Ensemble volet retardateur de feu selon la revendication 10, dans lequel le boîtier ou le système de guidage comprend en outre au moins une bande d’étanchéité latérale (III).

12. Ensemble volet retardateur de feu selon l’une quelconque des revendications 10 et 11, dans lequel le volet est couplé à un mandrin (II) et dans lequel le moyen d’extension dudit volet est un mouvement de rotation.

13. Ensemble volet retardateur de feu selon la revendication 12, dans lequel le mandrin (II) est positionné dans le profilé le plus bas du boîtier et dans lequel le volet s’étend vers le haut au moyen du système de guidage.
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2520338 A [0005]
- NL 2010146 [0006]
- WO 02053679 A [0007]
- GB 2411199 A [0007]
- US 5476891 A [0034]
- US 4273879 A [0034]
- WO 2011060421 A [0034]