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(54) Improvements in or relating to a door.

(57) An element (10) for use as a door frame or part thereof comprises an intumescent strip (20) enclosed in a cured plastics material (11). The element (10) also comprises an element (22) of solid construction. In use, when the intumescent strip (20) is actuated to a temperature between 120°C and 300°C due to heat from a fire, it expands to a volume of at least six times its non-turgid state thereby sealing the element (10) to the fire door (30) and preventing the spread of fire to the other side of the door (30).

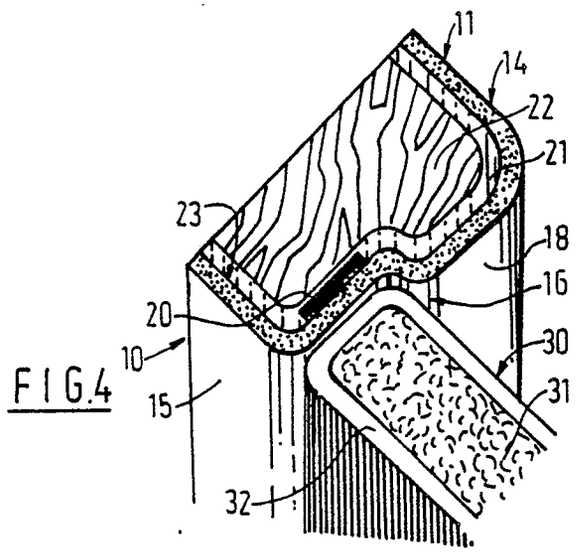

FIG.4

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IMPROVEMENTS IN OR RELATING TO A DOOR

This invention relates to improvements in or relating to a door. In particular, it relates to a construction of door frame for use with a fire door.

Fire doors and associated door frames are well known. The use of an intumescent strip on a door frame is known. The strip, made from a material which when heated to a temperature of say 180° C, expands to occupy a volume considerably greater than its volume at lower temperatures. The strip, when expanded, provides a seal between the door frame and the closed door and consequently prevents or serves to prevent the spread of noxious gases, heat and flames from one side of the door to the other.

Heretofore, a difficulty with the use of an intumescent strip was the necessity to mount the strip on the exposed surface of the door jamb or the frame. Consequently, frequent inspection of the strip was required as the exposed strip is subject to damage by people and objects passing through the frame and by vandalism. Indeed, damage to the strip is most frequent in locations where the presence of the strip is of particular importance. Such areas include laboratories, abbatoirs and aseptic rooms. In the case of aseptic rooms, the presence of the strip poses problems relating to hygiene insofar as the crevices at the interface between the strip and the frame can be a harbouring ground for dirt and bacteria. Cleaning of the door frame using high pressure water jets is not possible as the force of the water can damage the strip.

It is an object of the present to overcome these problems.

The invention, therefore, provides an element which comprises a cured plastics material enclosing an intumescent strip.

Preferably, the intumescent strip comprises a high performance high reactivity fire seal element comprising activated charcoal and having a thickness of about 2mm.

Preferably, the intumescent strip may be actuated at a temperature of at least 80°C. Preferably, the temperature is between 120°C and 300°C; most preferably 250°C to 300°C.

Preferably, the intumescent strip is capable of expanding to a volume of at least six times and up to fifty times its non-turgid state at a pressure of between 0.7MPa and 1.5MPa.

Preferably, the cured plastics material comprises a laminate of glass fibre re-inforced plastics material.

Preferably, the plastics material comprises a first layer of an unsatured polyester containing a thixotropic agent, a colour pigment and a hardener together with a glass fibre mat; and a second layer of fibre resistant polyester pigmented resiin containing an accelerator and a hardener.

Preferably, the intumescent strip is located substantially medially between said first layer and said second layer.

Preferably, a member of solid construction is laminated to one face of the material.

Preferably, the member of solid construction is laminated to said second layer.

Preferably, the element has the shape and configuration of a door frame or part thereof.

The invention, also, provides a method of making an element for use in the construction of a door frame which method comprises providing a cured glass fibre reinforced plastics material; the plastics material having, in use, a first face and a second face; laying a strip of intumescent material on the second face or part of the second face; covering the second face including the intumescent strip with uncured plastics material together with a mat of fibre material; and allowing the uncured plastics material to cure.

The glass fibre reinforced plastics material may be manufactured by providing, in a suitably shaped mould, a first layer of gel coat material, allowing the layer to set until tacky; applying a second layer of liquid plastics material to the first layer; placing a mat of fibre material on the second layer and allowing the plastics material on the second layer to be absorbed by the mat; covering the mould with a suitable cover; subjecting the mould to a moulding pressure to form the desired glass fibre reinforced plastics material; and removing the plastics material from the mould. The gel coat material of the first layer preferably comprises an unsaturated polyester containing a thixotropic agent, a colour pigment and a hardener. The hardener may be, for example, methylethylketone peroxide and/or cobalt naphtenate. The plastics material of the second layer preferably comprises a fire resistant polyester pigmented resin containing an accelerator and a hardener such as benzoyl peroxide.

The intumescent strip comprises a high performance high reactivity fire seal based on activated graphite having a thickness of about 2mm. The strip can develop a pressure of between 0.7MPa and 1.5MPa when expanding from its non-turgid state. The strip is capable of expanding to a volume between six times and fifty times its non-turgid volume and maY be activated at a temperature of at least 80°C. Preferably, the temperature is between 120°C and 300°C most preferably between 250°C and 300°C. In its non-turgid state, the strip is unaffected by water, steam or atmospheric

carbon dioxide.

The mat of fibre material covering the intumescent strip should preferably comprise a fire resistant resin which resin may be cured by an accelerator and hardener such as benzoyl peroxide. Preferably, the method of making the element comprises the step of placing an element of solid construction on the uncured plastics material.

The element of solid construction preferably comprises timber. Alternatively, the element may comprise a metal.

The invention also relates to an element whenever made by the method according to the invention.

The invention will be understood in greater detail from the following description of a preferred embodiment thereof given by way of example only and with reference to the accompanying drawings:-

Figures 1-4 are perspective views of the production of a door frame element according to the invention with Figure 4 showing a closed door relative to the elements; and

Figures 5-8 are perspective views of the elements of Figures 1-4 of the drawings in use during a fire.

Referring now to the drawings, there is shown an element 10 in the form of a seamless door frame comprising a cured glass fibre reinforced material 11 having, in use, an exposed face 12 and a concealed face 13.

The material 11 may be manufactured by providing in a suitably shaped mould, a first layer of liquid plastics material; allowing the layer to set until tacky; applying a second layer of liquid plastics material to the first layer; placing a mat of fibre material on the second layer and allowing the plastics material on the second layer to be absorbed by the mat; covering the mould with a suitable cover; subjecting the mould to a moulding pressure to form the desired glass fibre reinforced plastics material; and removing the plastics material from the mould.

The plastics material of the first layer preferably comprises an unsaturated polyester containing a thixotropic agent, a colour pigment and a hardener.

The hardener may be, for example, methylethylketone peroxide and/or cobalt naphtenate.

The plastics material of the second layer preferably comprises a fire resistant polyester pigmented resin containing an accelerator and a hardener such as benzoyl peroxide. It is preferable that several mats of material be placed on the second layer. The mats are preferably made from glass fibre.

Following manufacture, the plastics material 11 is allowed to set and cure. The shape of the material 11 is that of a door frame having exposed side walls 14, 15 and an S-shaped door jamb 16. The S-shaped door jamb 16 is divided into two sections viz a first section 17 and a section 18. However, it will be appreciated that, in the case of a swing door, the door jamb 16 would have a plane face (not shown).

The position of a door 19, when closed, relative to the door jamb section 17 is shown in Figure 4 of the drawings.

Accordingly, on the concealed face 13 of the door jamb section 17 is placed an intumescent strip 20.

The intumescent strip comprises a high performance high reactivity fire seal based on activated graphite having a thickness of about 2mm. The strip can develop a pressure of between 0.7MPa and 1.5MPa when expanding from its non-turgid state. The strip is capable of expanding to a volume of between six times and fifty times its non-turgid volume and may be activated at a temperature of at least 80°C. Preferably, the temperature is between 120°C and 300°C, most preferably between 250°C and 300°C. In its non-turgid state, the strip is unaffected by water, steam or atmospheric carbon dioxide.

Holding the plastics material 11 in a suitable mould, an uncured plastics material and a mat of fibre material is placed over the strip 20 and the concealed face 13 to form a glass fibre reinforced plastics material 21. The material 21 is of similar construction to the material 11 described above. While still in a tacky state, an element 22 of solid construction is placed on the material 21 and the material 21 is allowed to cure. The element 22 may be made from a suitable material such as timber or metal. In the present example, timber is used.

In Figure 4 of the drawings, the two plastics materials 11 and 21 are shown as distinct entities separated by a line 23. In practice, the materials 11 and 21 will, after curing and setting of the material 21, appear as an homogenous single layer 24 as shown in Figures 5-7 of the drawings with the intumescent strip 20 embedded therein.

It will be appreciated further than an entire U-shaped door frame is constructed from initially providing a U-shaped material 11 from a first casting step and then, having placed the intumescent strip 20 along the entire first section 17, the second plastics material and the element 22 are provided from a second casting step. It will further be appreciated that the free ends of the U-shaped door frame when in situ will not be exposed revealing the structure thereof.

In mounting the door frame 10 to an opening, the element 22 is firmly attached to the walls of the opening. There should be no direct connection by

way of fasteners or screws between the layer 24 and the walls of the opening. The element 22 is firmly connected to the opening. This may be achieved by drilling suitably sized holes (not shown) through the layer 24 so that screws may be inserted and passed fully therethrough to enable firm fixing of the element 22 to the walls of the opening. The holes should be of a size sufficient for the head of the screw to pass through so that the layer 24 is not directly connected to the walls of the opening.

The door frame 10 is constructed from three elements viz two uprights and a lintel. Mitre joints should be present between the uprights and the lintel. A gap of about 4mm should be present at each mitre joint which gaps are filled with a non-combustable material. The uprights should not be mortared into the floor of the opening. If it is imperative that if some mortaring is required then only the element 22 of the uprights should be mortared into the screed at the opening. In that event, the element 22 would project an appropriate distance beyond the layer 24 to permit mortaring. Essentially, therefore, the laminate comprising the plastics material 11, the intumescent strip 20 and the plastics material 21 will be capable of movement, under certain conditions, relative to the element 22.

The door 30, which is of seamless construction, preferably comprises a mineral core 31 and a fibre reinforced plastics material coating 32 enclosing the core 31. Such doors are of well known construction and can be obtained from Wen-Plast Limited, North Quay, Wicklow, Ireland.

In use, the door frame 10 and the door 30 may be used in a conventional manner. The door 30 should have associated therewith a mechanism for ensuring that either the door is automatically returned to the closed condition immediately following use or the door is closed in response to a fire alarm signal being actuated.

In the event of a fire, the temperature of the door frame 10 (and the door 30) will rise. When the temperature of the intumescent strip reaches between 250°C and 300°C it will, for the type of strip 20 referred to herein, rapidly begin to expand to about six times and up to fifty times its volume at a pressure of about 1.42MPa or about 0.709MPa depending on the type of strip selected.

In expanding, the strip 20 will expand in the direction of the arrows 40, 50 (Figure 5 of the drawings). However, because the material 22 is of such solid construction, the effect of expansion of the strip 20 will be primarily in the direction of the arrow 40. This is achieved by the action of the intumescent strip 20 against the material 22. The force of expansion will be sufficient to distort the plastics material 11 outwardly against the door frame 30. The force of expansion will also cause the layer 24 to become delaminated from the material 22. This delamination takes place first in the area of the intumescent strip 20 opening a gap 25 (see Figure 6 of the drawings).

Delamination rapidly continues until the layer 24 is completely separated from the material 22 (see Figure 7 of the drawings). At this stage of the fire, the intumescent strip 20 will have liquified to a viscous mass 29 which percolates into the gap 25 (Figure 8 of the drawings).

It is important, therefore, that there is no direct fixture means such as fasteners or screws between the layer 24 and the walls of the opening. The heat of the fire will enable fusing of the layer 24 to the material of the door 30 in the area 26 thereby providing an effective seal between the door 30 and the frame 10. It has been found that a door frame 10 used in conjunction with a door 30 of the type referred to will withstand a fire of considerable force for a period long enough for evacuation of people on the safe side of the door/frame construction. The period has been found to be in excess of 2 hours 30 minutes.

It will be appreciated that following the fire, the door/door frame construction would have to be replaced.

With the intumescent strip material embedded in the door frame, it is not necessry to perform routine inspection of the strip as it will not be subject to damage. Furthermore, in aseptic locations, high pressure water hoses may be used without fear of damage to the strip.

It will be appreciated that in Figures 5-8 of the drawings, the degree of expansion of the intumescent strip 20 is not shown to scale and the drawings are merely illustrative for explanatory purposes the stages of the effects of a fire on a door construction.

It will also be appreciated that the construction may be applied to constructions other than doors as for example, windows, port holes etc.

The invention is not limited by or to the specific embodiment described which can undergo considerable variation without departing from the scope of the invention.

Claims

1. An element which comprises a cured plastics material enclosing an intumescent strip.

2. An element as claimed in claim 1 wherein the intumescent strip comprises a high performance high reactivity fire seal element comprising activated graphite; has a thickness of about 2mm; may be actuated at a temperature of at least 80°C

and is capable of expanding to a volume of at least six times its non-turgid state at a pressure of between 0.7MPa and 1.5MPa.

3. An element as claimed in claim 2 wherein the actuation temperature is between 120°C and 300°C.

4. An element as claimed in any of claims 1-3 wherein the cured plastics material comprises a laminate of glass fibre reinforced plastics material having a first layer of an unsaturated polyester containing a thixotropic agent, a colour pigment and a hardener together with a glass fibre mat; and a second layer of a fire resistant polyester pigmented resin containing an accelerator and a hardener.

5. An element as claimed in claim 4 wherein the intumescent strip is located substantially medially between said first layer and said second layer.

6. An element as claimed in any of claims 1-5 which further comprises a member of solid construction laminated to one face of the material which member may be a timber or a metal.

7. A method of making an element which method comprises providing a cured glass fibre reinforced plastics material; the cured plastics material having a first face and an opposing second face; laying a strip of intumescent material on the second face or part of the second face; covering the second face including the intumescent strip with uncured plastics material together with a mat of fibre material; and allowing the uncured plastics material to cure.

8. A method as claimed in claim 7 wherein the glass fibre reinforced plastics material is maufactured by providing, in a suitably shaped mould, a first layer of gel coat material; allowing the layer to set until tacky; applying a second layer of liquid plastics material to the first layer; placing a mat of fibre material on the second layer and allowing the plastics material of the second layer to be absorbed by the mat; covering the mould with a suitable cover; subjecting the mould to a moulding pressure to form the desired glass fibre reinforced plastics material; and removing the plastics material from the mould wherein the gel coat material of the first layer comprises an unsaturated polyester containing a thixotropic agent, a colour pigment and a hardener; and the plastics material of the second layer comprises a fire resistant polyester pigmented resin containing an accelerator and a hardener.

9. A method as claimed in claim 8 wherein the most of fibre material comprises a fire resistant resin.

10. A method as claimed in any of claims 7-9 wherein the instumescent strip comprises a high performance high reactivity fire seal element comprising activated graphite; has a thickness of about 2mm; may be actuated at a temperature of at least 80°C; and is capable of expanding to a volume of at least six times its non-turgid state at a pressure of between 0.7MPa and 1.5MPa.

11. A method as claimed in claim 11 wherein the actuation temperature is between 120°C and 300°C.

12. A method as claimed in any of claims 7-11 which further comprises the step of placing a member of solid construction on the uncured plastics material and wherein the member comprises a timber or a metal.

13. A method as claimed in any of claims 7-12 wherein the element has a shape suitable for acting as part of a door frame.

14. A door frame which comprises one or more elements as claimed in any of claims 1-6.

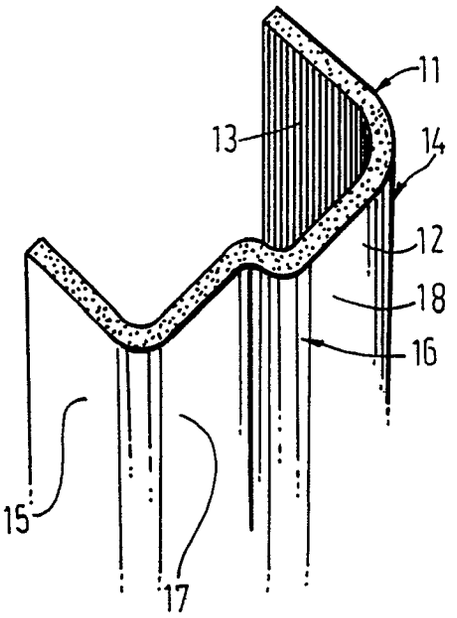

FIG.1

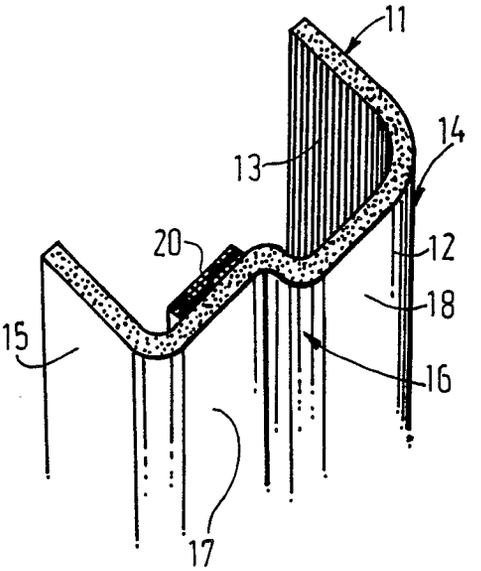

FIG.2

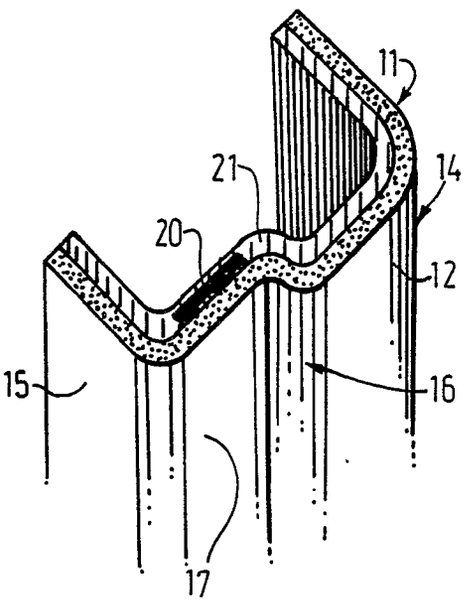

FIG.3

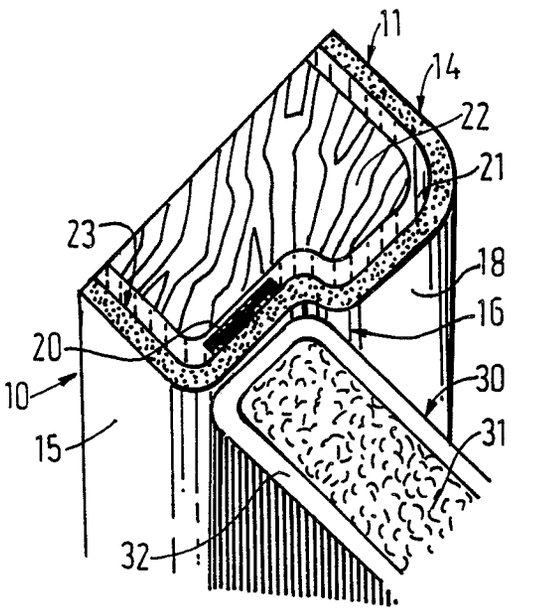

FIG.4

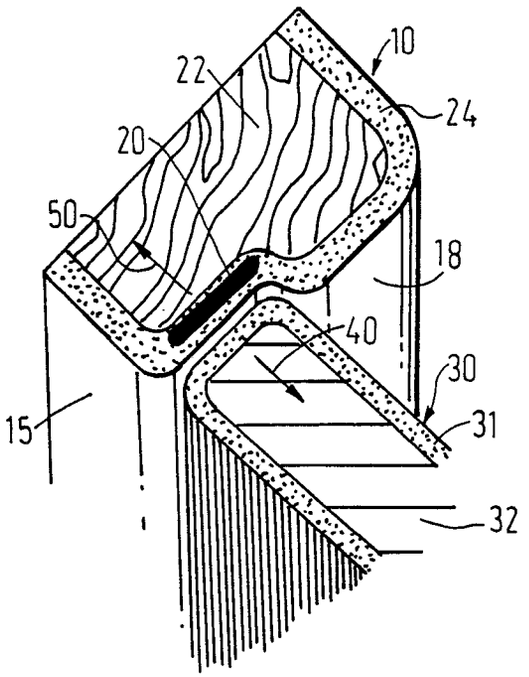

FIG.5

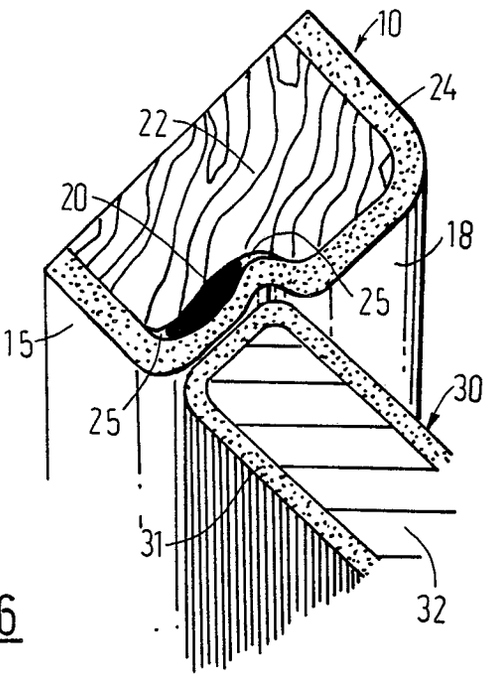

FIG.6

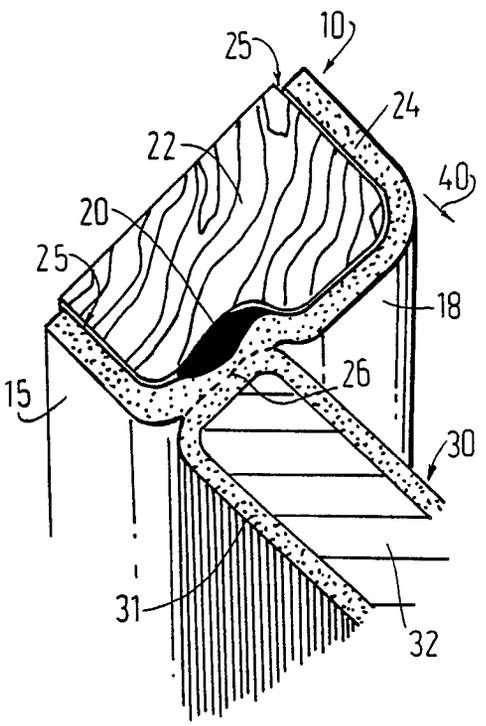

FIG.7

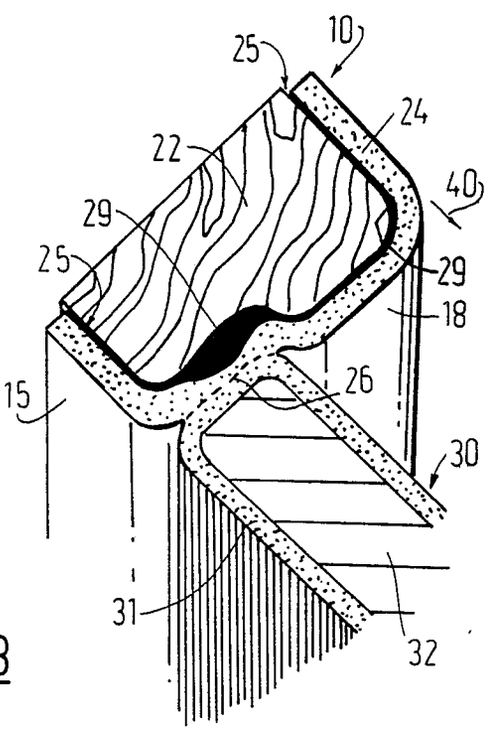

FIG.8