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PATENT SPECIFICATION

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(19)

(54) FIRE SCREENING PANELS

(71) We, BFG GLASSGROUP, a Groupement d'Interet Economique established under the laws of France (French Ordinance dated 23rd September 1967) of Rue Caumartin 43, Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a light-transmitting fire screening panel comprising at least one sheet of glass and at least one layer of intumescent material.

It is an object of this invention to provide new formulations of such an intumescent layer which will afford various advantages which will be referred to later in the specification.

According to the present invention, there is provided, as broadly defined, a light-transmitting fire-screening panel comprising at least one layer of intumescent material sandwiched between two or more sheets of glass, characterised in that there is at least one said layer which contains a hydrated alkali metal silicate as intumescent material and one or more adjuvants selected to as to affect the intumescence of such material in such a way that on the outbreak of fire heat transfer across the panel is reduced or delayed, such adjuvant(s) being chosen from polyhydric alcohols having six or less hydroxyl groups (for example glycerine, ethylene glycol sorbitol and monosaccharides such as glucose).

Such adjuvants have the general advantage of imparting improved fire resistance to the panel.

When fire breaks out on one side of such a panel, a graph of the temperature of the other side against time will show an initial rise followed by a period when the temperature of that other side remains substantially constant (at about 100°C) while intumescence of the layer proceeds. When intumescence is complete there is a second rise in temperature. It is clearly desirable to postpone the rise to a given temperature level for as long as possible, and it has been found that all the adjuvants cited have the effect of modifying such a graph in a favourable way.

A said adjuvant may be effective to delay the rise in temperature of that face of the panel which is remote from a fire which breaks out near the panel in one or more of the following ways.

A) by prolonging the said second period during which the temperature remains substantially constant at intumescence proceeds;

B) by reducing the gradient of the time/temperature curve after intumescence has been completed;

C) by introducing a further period during which the layer undergoes modification at a constant temperature; and

D) by lowering the temperature at which intumescence is initiated.

The actual way in which said adjuvant will modify the properties of a layer on the outbreak of fire cannot always be stated precisely, but it is presently believed that adjuvants which act to prolong the constant temperature period during which intumescence takes place may be selected from: glycerine and sorbitol.

In order to reduce the gradient of the time/temperature curve after intumescence has been completed, it is believed suitable to select a said adjuvant from monosaccharides which increase the viscosity of the tumid layer.

In order to introduce a further period during which the layer undergoes modification at a constant temperature, it is believed suitable to select a said adjuvant from:glycerine and ethylene glycol.

It will be noted that glycerine acts on the layer in two ways.

It will be appreciated that not all these adjuvants are of equal value, and that the advantages obtained will depend on the proportions in which the various adjuvants are used. In particular, the selection of an appropriate proportion is preferred so as to preserve the transparency of the panel and to avoid colouration of the layer.

In general, although the optimum proportion will vary according to the adjuvant used, it is preferred that a said adjuvant should be present in a proportion of less than 20%, and usually less than 10%. In many cases adjuvants are used in proportions of less than 5%. These proportions and other proportions per cent given in this specification are proportions by weight of the adjuvant compared with the total weight of the layer in a finished panel.

Glycerine is a particularly important adjuvant for use in an intumescent layer of a panel according to the invention. Excellent results are achieved when up to 10% glycerine is used, and for optimum results at least 4% is used.

It has been found that the addition of glycerine to the intumescent layer has the effect of prolonging the time during which the temperature of the face of the panel remote from a fire remains substantially constant at about 100°C, and furthermore that a second constant temperature period is exhibited where the then tumid layer undergoes further modification.

Glycerine used in these proportions has one further very important advantage. Intumescent layers are commonly formed by pouring a solution of the intumescent material into a mould or onto a supporting sheet and drying it. During production there is a risk that the intumescent layer will crack it it is dried too quickly, and this would of course impair the transparency of the finished panel; it has been found that the addition of glycerine inhibits such crack formation and thus it enables relatively thick intumescent layers to be formed without a prohibitively long drying time. Clearly the drying of relatively thin layers can also be speeded up. Ethylene glycol also imparts the advantage of more speedy drying.

Sorbitol is also an important adjuvant and its use gives advantages in the foam structure of the tumid layer after the outbreak of fire, and it has the effect of prolonging the period during which the temperature of the panel face remote from a fire remains substantially constant. Sorbitol is preferably used in amounts from 2 to 4% of the layer. Satisfactory results have been achieved using up to 20%.

Of the other adjuvants recited, particular mention is made of ethylene glycol, since experiments have indicated that the use of this material can retard heat transmission in an effective way.

In certain particularly preferred embodiments of the invention, glycerine is used as an adjuvant in admixture with a saccharide, for example saccharose. Preferably when a said adjuvant is used in admixture with another adjuvant or some further additive, the admixture is present in a proportion of less than 20%. Amounts below 10% or even below 5% can give very good results. When a saccharide, such as saccharose, is used as a further additive it is preferably present in a proportion of 1 to 4%.

It has been found that the production of a panel of given efficiency which includes a layer comprising an alkali metal silicate as intumescent material can be facilitated by including certain adjuvants in the intumescent layer.

A layer of hydrated alkali metal silicate is formed from a solution, for example by pouring the solution over one of the sheets which will form the panel, or by pouring the solution onto a mould for subsequent transfer and assembly into the panel. It will be appreciated that the drying of the solution layer is critical in the case of a transparent panel since a crust is apt to form on the layer, and the layer is apt to crack as it dries, and this will have a markedly deleterious effect on the transparency of the panel. In order to overcome this problem it has hitherto been common practice to ensure that the drying takes place very slowly. The present invention, by suitable choice of adjuvant enables such drying time to be reduced, and also enables relatively thick layers of intumescent material to be formed with satisfactory transparency and without prohibitively long drying periods.

Preferably, the or a said adjuvant is selected from: glycerine and ethylene glycol, and advantageously glycerine or ethylene glycol is used in admixture with a saccharide, for example saccharose.

A said adjuvant is preferably used in a non-colouring proportion.

Advantageously the various plies of the panel are bonded together to form a laminate.

The degree of fire-resistance afforded by a panel incorporating at least one layer of intumescent material will obviously depend, inter alia, on the total thickness of the intumescent material used. However increasing the thickness of the intumescent material will usually decrease the transparency of the panel and also, because the formation of relatively thick layers gives rise to difficulties in production, the cost of the panel will be increased. Accordingly it is preferred that the total thickness of intumescent material is at most 8 mm. Advantageously the or each said layer is between 0.1 mm and 8 mm thick and optimally the or each said layer is between 1 mm and 3 mm thick.

The alkali metal silicate used as intumescent material is preferably hydrated sodium silicate.

The present invention will now be further described by way of example and with reference to the accompanying diagrammatic drawings in which Figures 1 to 3 are diagrammatic cross-sectional views of three embodiments of fire screening panel.

In the drawings, a layer 1 containing hydrated alkali metal silicate is applied and bonded to a first glass sheet 2.

In Figure 1, a second glass sheet 3 is applied to the exposed face of the intumescent layer 1 and is held in position by a clamping frame 4. The clamping frame 4 comprises an L-shaped section 5 and a separate or separable lip 6 so that on the outbreak of fire, the two glass sheets 2, 3 can move apart to accommodate changes in the volume of the layer as it becomes tumid.

In Figure 2, a second glass sheet 3 is bonded to the exposed face of the intumescent layer using a layer of polyvinyl butyral 7.

In Figure 3, a layer of intumescent material 1 is bonded directly between two glass sheets 2, 3.

Example 1 (Figure 1)

In a specific practical example, a solution of hydrated sodium silicate in water which contained glycerine as adjuvant was applied to a glass sheet at a rate of 2.8 l/m^2 to form a solid layer. The weight ratio of SiO_2 to Na_2O was 3.3 to 1 and the density of the solution was between 37° and 40° Baume. The layer was dried by gentle heating. This took about 6 hours. The composition of the layer when set was:

$SiO+Na_2O$	62%
Glycerine	4%
H_2O	34%

In fact it is quite possible to dry a similar intumescent layer which does not contain glycerine in about the same time, but it is found that the surface of the layer containing glycerine is smoother and uncracked, thus contributing to the clearness of the panel prior to the outbreak of fire.

In variant of this Example the 4% glycerine was replaced by a mixture with saccharose to give 3% glycerine and 1% saccharose in the finished panel. Similar results were achieved.

In a variant of this Example, the glycerine was not added to the solution, but rather the aqueous solution of sodium silicate was applied to the glass sheet and partially dried. A coating of glycerine was then applied to the exposed face of the layer.

The glycerine was in fact applied by dipping the layer into a bath of glycerine, but it will be appreciated that it could equally well have been applied in some other manner for example spraying.

Similar results were achieved.

Example II (Figure 2)

A solution of hydrated sodium silicate containing glucose was applied to a glass sheet as described in Example I and dried. When set, the layer had the following composition:

SiO_2+Na_2O	64%
Glucose	2%
H_2O	34%

This layer was then assembled to the second glass sheet via an intervening layer of polyvinyl butyral, amd the assembly was subjected to heat and pressure to effect bonding, taking care that the heat applied was not sufficient to initiate intumescence.

In a variant of this Example, the intumescent layer was bonded directly to the second sheet. After this layer had set, it, and the second sheet, were wetted with more of the same solution and they were then assembled together and allowed to dry to complete bonding.

Example III (Figure 3)

Two sheets of glass each has an intumescent layer of hydrated sodium silicate containing glycerine applied to them as described in Example I, the layers each being 1.3 mm thick. The layers on the two sheets were then bonded together to form a panel (IIIA) 50 cm square. The sheets of glass were 3 mm thick.

Another panel (IIIB) in whose intumescent layers no adjuvant was present but which was otherwise identical was also made for comparison purposes.

The two panels were framed and tested in a wall of a furnace according to ISO R 834 and NBN 713.020. This test specifies that the temperature T (°C) within the furnace should increase after t minutes according to

$$\Delta T=345 \log_{10} (8t+1).$$

The maximum temperature of the outer faces of the panels were measured at various intervals after firing of the furnace, and the results are given in the following table (temperatures in °C to the nearest 5°C).

Time (minutes)	Panel IIIA	Panel IIIB
30	120	160
40	240	270
42	250	280

WHAT WE CLAIM IS:—

1. A light-transmitting fire-screening panel comprising at least one layer of intumescent material sandwiched between two or more sheets of glass, characterised in that there is at least one said layer which contains a hydrated alkali metal silicate as intumescent material and one or more adjuvants selected so as to affect the intumescence of such material in such a way that on the outbreak of fire heat transfer across the panel is reduced or delayed such adjuvant(s) being chosen from polyhydric alcohols having six or less hydroxyl groups (for example glycerine, ethylene glycol, sorbitol and monosaccharides such as glucose).

2. A panel according to claim 1, characterised in that a said adjuvant is present in a proportion of less than 20%, preferably less than 10%, by weight of the layer.

3. A panel according to claim 2, wherein glycerine is used as the or a said adjuvant, characterised in that such glycerine is present in a proportion of from 10% to 4% inclusive by weight of the layer.

4. A panel according to claim 2, wherein sorbitol is used as the or a said adjuvant, characterised in that such sorbitol is present in a proportion of between 2 and 4% by weight of the layer.

5. A panel according to claim 2, characterised in that a said adjuvant is used in admixture with one or more other of said adjuvants or some additive and such admixture is present in a proportion of less than 20% preferably less than 10%, by weight of the layer.

6. A panel according to any of claims 1 to 3, characterised in that glycerine is used as the or a said adjuvant in admixture with a saccharide, e.g. saccharose.

7. A panel according to claim 6, characterised in that such saccharide is present in a proportion of between 1 and 4% by weight of the layer.

8. A panel according to claim 1 or 2, characterised in that the or a said adjuvant is ethylene glycol.

9. A panel according to claim 8, characterised in that such adjuvant is used in admixture with a saccharide.

10. A panel according to any preceding claim, characterised in that said adjuvant is used in a non-colouring proportion.

11. A panel according to any preceding claim, characterised in that the various plies of the panel are bonded together to form a laminate.

12. A panel according to any preceding claim, characterised in that the alkali metal silicate used as intumescent material is hydrated sodium silicate.

13. A panel according to claim 1, and substantially as described in any of the Examples herein set forth.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1.

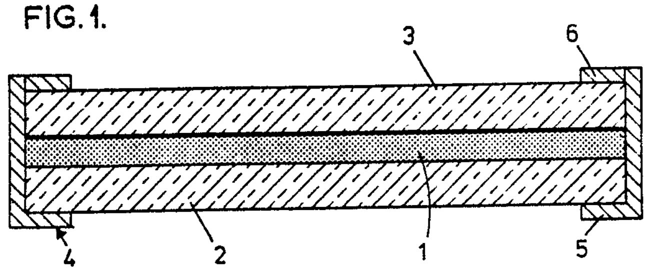

FIG. 2.

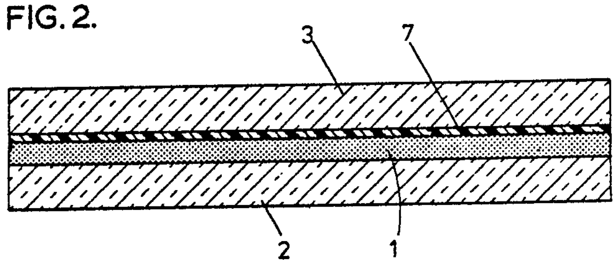

FIG. 3.