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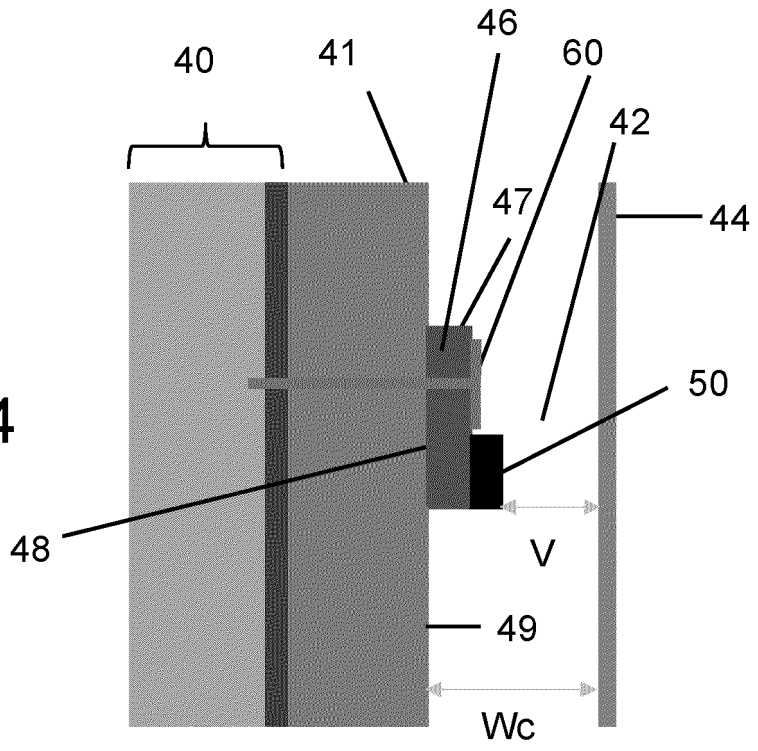
(54) **BUILDING FIRE PROTECTION**

(57) An open state fire propagation barrier in a ventilated facade structure comprises a fire barrier panel and an intumescent material supported by the fire barrier panel, the intumescent material being arranged to expand when subjected to fire conditions so as to cause the fire propagation barrier to block ventilation of the ventilated cavity. The open-state fire propagation barrier is secured in place by one or more fire barrier fixings, each fire barrier fixing having a portion which engages with the open-state fire propagation barrier, a portion which passes through the thermal insulation layer and a portion which engages with a load bearing wall.

FIG 4



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Description

[0001] This invention relates to a fire propagation barrier system for a wall structure of a building and to associated fire barriers. It relates particularly to a fire propagation barrier system for a ventilated cavity facade.

[0002] In particular, the present invention relates to the type of wall structure of a building which comprises, from the inside to the outside of the building, a load bearing wall, a continuous layer of thermal insulation, a ventilated air cavity and an external cladding. Such structures are arranged so that the external cladding provides weather protection to the structure, so that in summer cooling is facilitated by warm air in the ventilated cavity being replaced by cooler air thanks to natural convention and so that in winter sufficient air circulation occurs to facilitate moisture removal.

[0003] In order to provide enhanced fire performance, particularly for example where such structures are used for external wall constructions over 18m in height, it is recommended to install cavity fire propagation barriers at the junctions between the external cladding and the fire-resisting barriers of the building construction (e.g. the compartment floors, the compartment walls or other walls or door assemblies that form a fire-resisting barrier of the building).

[0004] One aim of the present invention is to provide an improved fire propagation barrier system for a building, particularly as part of a ventilated façade system.

[0005] In accordance with one of its aspects, the present invention provides a wall structure for a building in accordance with claim 1. Other aspects are defined in other independent claims. The dependent claims define preferred or alternative features.

[0006] The present invention is useful, for example, in the type of structure illustrated in Fig 1 and Fig 2 which comprises:

i) in order from the interior to the exterior of the building: a load bearing wall 10; a plurality of thermal insulation panels secured to the a load bearing wall 10 which together make up a continuous thermal insulation layer 11 secured to and covering the load bearing wall, a ventilated cavity 12 and an external cladding 14;
ii) window openings 15;
iii) load bearing floors 16; and
iv) fire propagation barriers 17 provided across the ventilated cavity 12. In this example, the fire propagation barriers 17 include:

- open state horizonal compartmenting fire propagation barriers 17' which run horizontally within the ventilated cavity 12 at a level corresponding to the height of each load bearing floor 16; and
- closed-state vertical compartmenting fire propagation barriers 17" which run vertically within the ventilated cavity 12.

The combination of the horizontal 17' and vertical 17" compartmenting fire propagation barriers separates the ventilated cavity 12 into discrete cavity compartments 18 with fire propagation between discrete cavity compartments 18 being prevented or restrained in the case of fire by the fire propagation barriers 17.

For each vertically arranged column of air cavity compartments, a lower ventilation opening (not shown) is provided towards the base of the lowest air cavity compartments in the column and an upper ventilation opening (not shown) is provided towards the top of the highest air cavity compartments in the column vertical column. These ventilation openings allow flow of air between the cavity compartments and the outside atmosphere.

Fire propagation barriers are also provided in the ventilated air cavities around the window openings 15, around door openings (not shown) and around other openings in the load bearing wall 10.

The provision of fire propagation barriers in this way restrains the propagation of fire and temperature increase from fire i) from one air cavity compartment to another and ii) from each air cavity compartment to an opening (e.g. a window or door opening) in the load bearing wall 10.

The open-state horizonal compartmenting propagation barriers 17' allow, in ordinary use, for air to circulate vertically between adjacent cavity compartments 18; this provides the ventilated cavity. When subjected to fire conditions the open-state fire propagation barriers close so as to prevent or at least restrict vertical propagation of fire and fire gasses.

The closed-state vertical compartmenting propagation barriers 17" prevent or restrict passage of gasses and fire both in ordinary conditions and in fire conditions.

[0007] The time during which fire propagation will be prevented or restrained by the fire propagation barriers, and by other parts of the system, will depend upon the configuration and materials used. As used herein, reference to fire propagation being prevented by the fire propagation barriers should be understood as referring to fire propagation being prevented or restrained for a certain time duration, notably for a duration of at least 15 minutes (and preferably for a duration of at least 30 minutes, at least 60 minutes, or at least 90 minutes) when tested according to appropriate test standards as required by local building regulations.

[0008] The present invention is particularly applicable for use with a ventilated cavity façade systems which comprise a plurality of discrete ventilated cavity compartments, notably at least three, four or five discrete ventilated cavity compartments arranged one above the other in a vertical direction, notably providing a column of ventilated cavity compartments.

[0009] Fig 3 illustrates a known arrangement for incorporating fire propagation barriers in a ventilated facade system. In this known arrangement, the system com-

prises: i) in order from the interior to the exterior of the building: a load bearing wall 30; a plurality of thermal insulation panels secured to the a load bearing wall 30 which together make up a thermal insulation layer 31 secured to and covering the load bearing wall, a ventilated cavity 32 and a cladding layer 34; and ii) fire propagation barriers 37 provided across the ventilated cavity 32. Each fire propagation barrier 37 is arranged in a respective recess 38 provided in the thermal insulation layer 31. In the case of an open-state fire propagation barrier, the fire propagation barrier extends from an external surface of the load bearing wall 30 part way across the cavity 34 towards an internal surface of the cladding 34 and is provided with an intumescent layer (not shown); when subjected to fire conditions the intumescent layer closes the gap between the fire propagation barrier and the cladding layer 34. In the case of a closed-state fire propagation barrier (not shown), the fire propagation barrier extends from an external surface of the load bearing wall 30 across the cavity 34 to an internal surface of the cladding 34. The embedding of each fire propagation barrier 37 in its respective recess 38 retains the fire propagation barrier 37 in placed during construction and use (for example when subjected to fire conditions); in addition, it provides a restrictive and tortuous path which restrains any passage of fire or heat around the perimeter of the fire propagation barrier at the layer of thermal insulation 31.

[0010] In accordance with one of its aspects, the present invention provides a ventilated façade structure of a building comprising

i) in order:

- a load bearing wall;
- a thermal insulation layer, notably of mineral wool insulation;
- an air filled cavity; and
- a cladding layer;

in which the thermal insulation layer is provided by a plurality of adjacent, contiguous thermal insulation panels each of which is secured to the load bearing wall, the thermal insulation panels together providing i) an interior facing major surface of the thermal insulation layer which faces the load bearing wall and ii) an exterior facing major surface of the thermal insulation layer which faces the air filled cavity, with the air filled cavity providing a ventilated cavity between the exterior facing major surface of the thermal insulation layer and the cladding layer; and
ii) an open-state fire propagation barrier, notably an open-state mineral wool fire propagation barrier, provided within the ventilated cavity, the open-state fire propagation barrier being configured to allow ventilation of the ventilated cavity under ordinary conditions of use and to block ventilation of the ventilated cavity under fire conditions;

wherein the open-state fire propagation barrier comprises:

a) a fire barrier panel, notably a mineral wool fire barrier panel, which has an interior facing fire barrier surface which lies against a portion of the exterior facing major surface of the thermal insulation layer, and in which the fire barrier panel extends from the interior facing fire barrier surface across a portion of the air filled cavity towards the cladding layer; and
b) an intumescent material supported by the fire barrier panel, the intumescent material being arranged to expand when subjected to fire conditions so as to cause the fire propagation barrier to block ventilation of the ventilated cavity;
and wherein the open-state fire propagation barrier is secured in place by one or more fire barrier fixings, each fire barrier fixing having a portion which engages with the fire propagation barrier, a portion which passes through the thermal insulation layer and a portion which engages with the load bearing wall.

The open-state fire barrier panel preferably comprises a securing portion at which it is secured to the layer of thermal insulation by the fire barrier fixing, and a carrying portion, spaced from the securing portion, preferably arranged below the securing portion, which carriers the intumescent material.

Arranging the carrying portion which carries the intumescent to be spaced from the securing portion at which the open-state fire barrier panel is secured to the layer of thermal insulation by the fire barrier fixing facilitates separation of the securing and intumescent functions; it thus facilitates securing of the open-state fire barrier panel to the layer of thermal insulation without constraint of the intumescent material. Arranging the carrying portion which carriers the intumescent material below the securing portion helps to avoid a pendulum effect upon expansion of the intumescent material.

[0011] The term "ventilated façade structure" as used herein means that the structure includes an air filled ventilated cavity which is provided with a ventilation opening towards its base and a ventilation opening towards its top so that air surrounding the structure is free to flow into the ventilated cavity, air within the cavity can flow vertically through the ventilated cavity and air from the cavity can flow out of the ventilated cavity by natural convection.

[0012] The load bearing wall is preferably provided by a frame, for example a metal frame or a wooden frame, particularly a frame covered with a substantially continuous sheathing layer facing the ventilated air cavity. For example, one type of appropriate load bearing wall comprises spaced, vertically arranged load bearing struts, for example wooden struts or metal struts, to which inner panels are attached at the side of the structure facing an interior of a building to form a continuous inner facing

surface and to which sheathing boards are attached at the side of the structure facing the air cavity to form a continuous outer facing surface, with the spaces defined between the inner and outer facing surfaces being provided with thermal insulation, notably mineral wool insulation. Alternatively, the load bearing wall may be provided by a reinforced concrete wall or a masonry wall comprising discrete masonry units with mortar joints between them.

[0013] The thermal insulation layer secured to the load bearing wall preferably comprises or consists of mineral wool insulation. The mineral wool insulation is preferably water repellent, for example thanks to inclusion of water repellent additives in the mineral wool insulation and/or provision of a water repellent facing arranged towards the air cavity; this helps to prevent water penetration and helps water run off during installation and use. Stone wool insulation is particularly suitable as it provides a desirable combination of thermal insulation and resistance to fire conditions. Preferably, the thermal insulation layer is provided by a plurality of adjacent pieces or slabs of insulation, notably slabs of mineral wool insulation. The slabs or pieces of thermal insulation may be secured to the load bearing wall by fixings, for example screw or pins, or by being held in a frame which is secured to the load bearing wall. The mineral wool insulation is preferably arranged with its major surfaces arranged in a vertical plane and the majority of its fibres orientated parallel to its major surfaces; this provides advantageous thermal insulation properties for the wall structure. Mineral wool insulation, particularly stone wool insulation, which has a density which is: $\geq$ 30 kg/m^3, preferably $\geq$ 40 kg/m^3; and/or <_ 70 kg/m^3, preferably $\leq$ 60 kg/m^3, notably in the range $\geq$ 40 kg/m^3 and $\leq$ 60 kg/m^3, is preferred as this provides an advantageous combination of thermal insulation, fire resistance and mechanical properties.

[0014] The thermal insulation layer is intended to insulate the exterior surface of the load bearing wall; consequently, it preferably overlays at least 90% and preferably at least 95% of the external surface of the load bearing wall (not including window openings and door opening in the load bearing wall).

[0015] As used herein:

- the terminology "external" and "outer" is used to refer to an element at or facing the outside of the building; and
- the terminology "internal" and "inner" is used to refer to an element at or facing the inside of the building.

[0016] The ventilated cavity preferably has a ventilated cavity width which is: $\geq$ 40mm preferably $\geq$ 45 mm; it may be $\leq$ 150 and is preferably $\geq$ 40mm and $\leq$ 150. The ventilated cavity width may be selected to be: $\geq$ 40mm and $\leq$ 60 mm; or $\geq$ 90 mm and $\leq$ 110 mm. This contributes to the desired performance of the wall structure. As used herein, the term "ventilated cavity width" means the average distance across the ventilated air cavity between the surface of the cladding layer facing the air cavity and the exterior facing major surface of the thermal insulation layer when measured perpendicularly from said surface of the cladding layer.

[0017] The cladding layer preferably comprises a plurality of adjacent, individual cladding panels each of which is secured to the load bearing wall, preferably via a frame secured to the load bearing wall. The cladding panels are preferably large format in their major plane (having a surface area $\geq$ 0.5 m^2, preferably $\geq$ 0.6 m^2) and relatively shallow in depth (having a depth preferably $\leq$ 40mm); they may be monolithic or perforated and the joints between them may be 'open' or 'closed'.

[0018] Each fire propagation barrier is preferably elongate in form having a length L (intended to lie in a plane parallel to the plane of the cladding layer), a width W (intended to lie in the direction of the width of the ventilated cavity) and a height H (in a direction perpendicular to its length and width). The width of the open-state fire propagation barrier is selected so that, under ordinary conditions of use, a ventilation gap of between 15mm and 35 mm is provided between the open-state fire propagation barrier and the cladding layer; this allows the desired air circulation in the ventilated cavity. When the open-state fire propagation barrier is subjected to fire conditions, expansion of the intumescent material reduces, and preferably closes, the ventilation gap; the ventilation gap may be reduced to less than 5mm, preferably to less than 1mm and more preferably to 0 mm. The width of each closed-state fire propagation barrier is selected to fill the width of the ventilated cavity so that no ventilation gap is provided between the closed-state fire propagation barrier and the cladding layer.

[0019] The height H of the fire propagation barrier provides a dimension of the fire propagation barrier which lies against the exterior facing major surface of the thermal insulation layer and contributes to restraining fire propagation; it should thus be selected to provide a desired duration during which the fire propagation barrier will prevent or restrain fire propagation. Particularly where a fire resistance of 30 minutes is desired, a mineral wool fire propagation barrier, notably having a density $\geq$ 120 kg/m^3 and $\leq$ 200 kg/m^3, having a height H of about 100mm has been shown to be effective. Thus, particularly where a fire resistance of 30 minutes is desired , the fire propagation barrier may have a height H which is $\geq$ 80 mm and preferably $\leq$ 150 mm, more preferably $\leq$ 120 mm. Particularly where a fire resistance of 90 minutes is desired, a mineral wool fire propagation barrier, notably having a density $\geq$ 120 kg/m^3 and $\leq$ 200 kg/m^3, having a height H of about 200 mm has been shown to be effective. Thus, particularly where a fire resistance of 90 minutes is desired, the fire propagation barrier may have a height H which is $\geq$ 180 mm and preferably $\leq$ 250 mm, more preferably $\leq$ 220 mm. In addition, the aforementioned heights H of the fire propagation barrier provide a footprint of a contact area of the fire propagation barrier

against the exterior facing major surface of the thermal insulation layer which is suitable for distributing compression forces of the fire propagation barrier against the exterior facing major surface of the thermal insulation layer upon expansion of the intumescent material; this helps to maintain contact during fire conditions whilst avoiding undesired or uncontrolled deformation of the thermal insulation layer upon expansion of the intumescent material. Such deformation of the thermal insulation layer would be likely to impair the reliability and/or fire performance of the system.

[0020] Each fire propagation barrier is preferably provided in sections having lengths which are ≥ 0.8 m, preferably ≥ 1 m and/or ≤ 2m, preferably ≤ 1.5 m, notably lengths which are ≥ 1.1 m and ≤ 1.3 m; such lengths facilitate handling and assembly. Each fire propagation barrier is preferably formed from adjacent individual fire barrier sections whose ends cooperate, for example by abutment, to provide an extended length of the fire propagation barrier, notably in a horizontal direction. Abutment between individual fire propagation barrier sections may be provided by simple abutment of respective planar end surfaces of each fire propagation barrier section. Alternatively, particularly with a view to reducing risk of fire propagation through such abutments, multi-surface abutments may be provided, for example a stepped abutment, a shiplap abutment or a mortise and tenon abutment.

[0021] Each fire propagation barrier preferably comprises and more preferably consists essentially of mineral wool insulation (for example at least 80% of the weight of the fire propagation barrier being mineral wool insulation). The mineral wool insulation is preferably water repellent, for example thanks to inclusion of water repellent additives; this helps to prevent the fire propagation barrier retaining water in a way which could be detrimental to the desired functioning of the wall structure. Stone wool insulation is particularly suitable as it provides a desirable combination of thermal insulation properties and resistance to fire conditions.

The mineral wool of the open state fire propagation barrier is preferably arranged to have the majority of its fibres orientated perpendicular to its width direction, with the density of the mineral wool providing a desired level of compression resistance in the width direction in fire conditions. This facilitates both manufacture and provides a reliable surface of the fire propagation barrier for the fire barrier fixings.

[0022] The mineral wool of each fire propagation barrier, particularly of a stone wool fire propagation barrier, may have a density which is: ≥ 120 kg/m^3, preferably ≥ 140 kg/m^3; and ≤ 200 kg/m^3, notably in the range ≥ 140 kg/m^3 and ≤ 180 kg/m^3; this provides an advantageous combination of fire resistance and mechanical properties, particularly when used in combination with the dimensions of the fire propagation barrier disclosed above.

[0023] At least one surface of the fire propagation barrier may be provided with a facing, for example a metal foil facing; this may be provided with marking and/or indications notably facilitating use and/or installation of the fire propagation barrier. The fire propagation barrier may be wrapped, for example shrink wrapped, with the wrapping contributing to maintaining the intumescent material and the fire barrier panel together during transport and/or installation. Preferably, the wrapping contributes to holding the intumescent material against the fire barrier during transport and/or installation. When the fire propagation barrier is wrapped in this way, the fire propagation barrier is preferably adapted to be installed with its wrapping in place, and for the wrapping nevertheless to allow desired expansion of the intumescent material when the fire propagation barrier is subjected to fire condition. For example, the wrapping may be provided by a plastics film, notably a plastics film which frees the intumescent material when the fire propagation barrier is subjected to fire condition, for example by being weakened, melted or burnt off. The wrapping is preferable provided as a continuous wrapping along the entire length of the fire propagation barrier.

[0024] In use, each fire propagation barrier is preferably secured within the ventilated cavity by a plurality of fire barrier fixings spaced along its length. The distance between each fire barrier fixing along the length of the fire propagation barrier may be ≥ 30 cm and/or ≤ 70 cm, preferably ≥ 30 cm and ≤ 50 cm; this provides a suitable number of fire barrier fixings to secure the fire propagation barrier in place whilst providing for simple installation. For example, where fire propagation barrier sections are provided in lengths of 1200 mm, each fire propagation barrier section may be secured in place with three fire barrier fixings, one fixing being arranged at the centre along its 1.2m length and each of the other two fixings being arranged at 200 mm from a respective end along the length. In this way, a fixing is positioned each 400mm along the length of adjacent fire propagation barrier sections.

The fire propagation barrier may be provided with a marking, visible during its installation, for example at its surface, to indicate recommended positions along its length for the positioning of the fire barrier fixing(s).

[0025] As used herein, the term "fire barrier fixing" means a structural member which restrains movement in at least one direction between the fire propagation barrier and the load bearing wall. Preferably the fire barrier fixings restrain movement between the fire propagation barrier and the load bearing wall in all directions; this prevents movement of the fire propagation barrier in the x, y and z axes relative to the load bearing wall and thus maintains the position of the fire propagation barrier relative to the load bearing wall during completion of the construction of the ventilated façade structure and, more importantly, if, during the lifetime of the ventilated façade structure, fire conditions occur in the air filled cavity.

[0026] Preferably, each fire barrier fixing consists of a screw fixing, the screw fixing preferably comprising a shaft having a head portion at one end and a threaded

tip portion at the other end, and in which

- the head portion engages with the fire barrier panel, preferably in cooperation with a washer;
- the shaft passes through the fire barrier panel and through the thermal insulating layer; and
- the tip portion engages with the load bearing wall.

The form of the threaded tip portion is selected as a function of the type of load bearing wall with which it will engage; notably, the threaded tip section is preferably provided with a thread selected from a thread configured to engage with a metal structure, a thread configured to engage with a wooden structure, a thread configured to engage with a concrete structure and a thread configured to engage with a masonry structure. The threaded tip section is preferably self-tapping.

During preferred installation, the threaded tip portion is intended to by inserted through the fire barrier panel and through the thermal insulation layer before engaging with the load bearing wall. Consequently, when the fire barrier panel and the thermal insulation layer are provided by mineral wool, the tip portion is preferable configured to facilitate its penetration into and through the mineral wool of the fire barrier panel and the thermal insulation layer. The tip section preferably penetrates into the load bearing wall by a distance which is ≥ 20 mm, preferably ≥ 30 mm and which may be ≤ 60 mm or ≤ 50 mm.

The shaft of the screw fixing is preferably a rod of circular cross section, notably having a diameter which ≥ 1.5 mm and ≤ 5 mm.

The head of the screw fixing engages with the fire barrier panel, preferably in cooperation with a washer, preferably a stainless steel washer, notably a washer having an external diameter which is ≥ 30 mm, preferably ≥ 50 mm. Providing a relatively large surface area of contact between the fire barrier fixing, for example an underside of a head of a screw fixing or of an associated washer, and an exterior facing surface of the fire barrier panel provides stability to the system when subjected to fire conditions. With this in mind, the surface area of contact between the fire barrier fixing and an exterior facing surface of the fire barrier panel may ≥ 4cm^2, preferably ≥ 5 cm^2, more preferably ≥ 10 cm^2 and even more preferably ≥ 15 cm^2; it is preferably ≤ 80 cm^2, more preferably ≤ 60 cm^2 to avoid encumberment.

The screw fixing is preferably steel, more preferably stainless steel.

Preferably, the screw fixing is a staple commercial product useable for a variety of applications (rather than a screw fixing that is specifically designed for this ventilated facade system); this allows the use of simple mass-produced screw fixings.

[0027] Each fire barrier panel has an interior facing fire barrier surface which lies against a portion of the exterior facing major surface of the thermal insulation layer. This greatly facilitates installation of the thermal insulation layer by avoiding the need to either i) cut recesses to receive a fire propagation barrier out of a thermal insulation layer which has been installed covering the entire area of the load bearing wall; or ii) install the thermal insulation layer in a way in which recesses are provided in the thermal insulation layer at positions at which it is anticipated that it will be desired to arrange fire propagation barriers.

The exterior facing major surface of the thermal insulation layer is preferably a continuous planar surface, notably formed by abutment of the plurality of adjacent, contiguous thermal insulation panels. The continuous, planar surface need not, of course, be perfectly planar or perfectly continuous and the term "continuous, planar surface" as used herein indicates that this surface is sufficiently planar and sufficiently continuous to be substantially without gaps and recesses.

[0028] The intumescent material of the open-state fire propagation barrier expands when exposed to fire conditions, notably when exposed to heat. The intumescent material may comprise intercalated graphite, mono-ammonium phosphates, or sodium silicate. The intumescent material may be provided in the form of a strip of intumescent material, and notably in the form of a strip of intumescent material which is secured to the fire propagation barrier by a plurality of intumescent fixings, notably tacks, which pass through the intumescent material into the fire barrier panel.

[0029] An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Fig 1 is a schematic cross section of a ventilated façade system;
Fig 2 is a schematic cross section taken along line 2-2 of Fig 1;
Fig 3 is a schematic cross section of a known arrangement for incorporating fire propagation barriers in a ventilated facade structure;
Fig 4 is a schematic vertical cross section of a horizontally extending open-state fire propagation barrier;
Fig 5 is a plan view of a fire barrier fixing;
Fig 6 is a plan view of an alternative fire barrier fixing;
Fig 7 is a perspective view of a washer; and
Fig 8 is a schematic horizontal cross section of a vertically extending closed-state fire propagation barrier.

[0030] Fig 4 illustrates a portion of a ventilated façade structure of a building, for example of the type described in relation to Fig 1 and Fig 2, comprising:

i) in order from the interior to the exterior of the building: a load bearing wall 40; a plurality of thermal insulation panels secured to the a load bearing wall 40 which together make up a substantially continuous thermal insulation layer 41 secured to and covering the load bearing wall; a ventilated air cavity 42

and a cladding layer 44; and
ii) a mineral wool fire propagation barrier 47 provided across the air cavity 42.

[0031] The open-state fire propagation barrier 47 is secured in place by a plurality of fire barrier fixings 60 spaced along its length. Fig 4 illustrates the open-state fire propagation barrier 47 in its "open" configuration i.e. under ordinary conditions of use in which it extends across a portion (i.e. across part but not all of) the width Wc of the ventilated cavity (one preferred width Wc of the ventilated cavity preferably being 50mm, and an alternative preferred width Wc being 100mm) with a ventilation gap V (preferably 25 mm) being arranged between the fire propagation barrier 47 and the cladding 44.

[0032] The open state fire propagation barrier 47 comprises:

- an interior facing fire barrier surface 48 which lies against a portion of the exterior facing major surface of the thermal insulation layer 49; and
- an intumescent material 50 supported by the fire barrier panel, the intumescent material being arranged to expand when subjected to fire conditions so as to cause the fire propagation barrier to close the ventilation gap V and thus block ventilation of the ventilated cavity.

[0033] The fire barrier fixing is a screw fixing 60 and is illustrated in Fig 5. It comprises:

- a shaft 63 which passes through the fire propagation barrier 47 and through the thermal insulation layer 40;
- a head portion 62 at one end of the shaft which engages with the fire propagation barrier with the help of a washer 64 (illustrated in Fig 7); and
- a threaded tip portion 61 at the other end of the shaft which engages with the load bearing wall.

The screw fixing 60 of Fig 5 is intended for securing the fire propagation barrier into a concrete load bearing wall. Fig 6 illustrates an alternative, self-drilling screw fixing 60 intended for securing the fire propagation barrier into metal portions of a load bearing wall, for example into a metal frame of a load bearing wall.

[0034] The screw fixings 60 of Fig 5 and Fig 6 are standard, multi-purpose commercially available screw fixings; this facilitates supply and logistics. The same screw fixings are preferable used to secure the open-state and the closed-state fire propagation barriers.

[0035] Fig 8 shows a vertically extending closed-state fire propagation barrier 87 which comprises a mineral wool fire barrier panel 46 which has an interior facing fire barrier surface 48 which lies against a portion of the exterior facing major surface of the thermal insulation layer 49, and an exterior facing fire barrier surface 88 which lies against a portion of the cladding 44. The fire barrier panel 46 extends from the interior facing fire barrier surface 48 across the air-filled cavity 42 to the cladding layer 44 so as to block fluid circulation within the ventilated cavity under ordinary conditions of use and under fire conditions. The fire propagation barrier 87 is secured in place by fire barrier fixings 60, each fire barrier fixing 60 having a head portion 62 which engages with the closed-state fire propagation barrier via an intermediate washer, a shaft portion 63 which passes through the mineral wool fire barrier panel 46 and through the thermal insulation layer 41 and a tip portion 61 which engages with the load bearing wall 40. The head portion 62 of the fire barrier fixings 60, and its associated washer, is housed within a fixing recess 89 of the fire propagation barrier which is set back from the exterior facing fire barrier surface 88. In this way, contact between the closed-state fire propagation barrier 87 and the cladding is unhindered by the fire barrier fixing 60.

List of reference numbers:

[0036]

10	load bearing wall
11	layer of thermal insulation
12	ventilated air cavity
14	cladding layer
15	window opening
16	load bearing floor
17	fire propagation barrier
18	air cavity compartment
30	load bearing wall
31	thermal insulation layer
32	ventilated cavity
34	cladding layer
37	fire propagation barrier
38	recess
40	load bearing wall
41	thermal insulation layer
42	ventilated air cavity
44	cladding layer
46	fire barrier panel;
47	open-state fire propagation barrier
48	interior facing fire barrier surface
49	exterior facing major surface of the thermal insulation layer
50	intumescent material
60	fire barrier fixing
61	threaded tip portion
62	head portion
63	shaft
64	washer
87	closed-state fire propagation barrier
88	exterior facing fire barrier surface
89	fixing recess
V	ventilation gap
Wc	cavity width

Claims

1. A ventilated façade structure of a building comprising

i) in order:

- a load bearing wall;
- a thermal insulation layer, notably of mineral wool insulation;
- an air filled cavity; and
- a cladding layer;

in which the thermal insulation layer is provided by a plurality of adjacent, contiguous thermal insulation panels each of which is secured to the load bearing wall, the thermal insulation panels together providing i) an interior facing major surface of the thermal insulation layer which faces the load bearing wall and ii) an exterior facing major surface of the thermal insulation layer which faces the air filled cavity, with the air filled cavity providing a ventilated cavity between the exterior facing major surface of the thermal insulation layer and the cladding layer; and

ii) an open-state fire propagation barrier, notably an open-state mineral wool fire propagation barrier, provided within the ventilated cavity, the open-state fire propagation barrier being configured to allow ventilation of the ventilated cavity under ordinary conditions of use and to block ventilation of the ventilated cavity under fire conditions;

wherein the open-state fire propagation barrier comprises:

a) a fire barrier panel, notably a mineral wool fire barrier panel, which has an interior facing fire barrier surface which lies against a portion of the exterior facing major surface of the thermal insulation layer, and in which the fire barrier panel extends from the interior facing fire barrier surface across a portion of the air filled cavity towards the cladding layer; and

b) an intumescent material supported by the fire barrier panel, the intumescent material being arranged to expand when subjected to fire conditions so as to cause the fire propagation barrier to block ventilation of the ventilated cavity; and

wherein the open-state fire propagation barrier is secured in place by one or more fire barrier fixings, each fire barrier fixing having a portion which engages with the open-state fire propagation barrier, a portion which passes through the thermal insulation layer and a portion which engages with the load bearing wall.

2. A ventilated façade structure in accordance with any preceding claim,
in which the open-state fire barrier panel comprises a securing portion at which it is secured to the layer of thermal insulation by the fire barrier fixing, and a carrying portion, spaced from the securing portion, preferably arranged below the securing portion, which carriers the intumescent material.

3. A ventilated façade structure in accordance with any preceding claim,
in which, under ordinary conditions of use, a ventilation gap of between 15mm and 35 mm is provided between the fire propagation barrier and the cladding layer and in which, when the fire propagation barrier is subjected to fire conditions, expansion of the intumescent material reduces the ventilation gap to less than 5mm, preferably to less than 1mm and more preferably to 0 mm.

4. A ventilated façade structure in accordance with any preceding claim,
in which the intumescent material is provided in the form of a strip of intumescent material, and notably in which the strip of intumescent material is secured to the fire propagation barrier by a plurality of intumescent fixings, notably tacks, which pass through the intumescent material into the fire barrier panel.

5. A ventilated façade structure in accordance with any preceding claim,

in which the ventilated façade structure further comprises a plurality of closed-state fire propagation barriers, notably closed-state mineral wool fire propagation barriers,
wherein each of the closed-state fire propagation barriers comprises a fire barrier panel, notably a mineral wool fire barrier panel, which has an interior facing fire barrier surface which lies against a portion of the exterior facing major surface of the thermal insulation layer, and an exterior facing fire barrier surface which lies against a portion of the cladding and in which the fire barrier panel extends from the interior facing fire barrier surface across the air filled cavity to the cladding layer so as to block fluid circulation within the ventilated cavity under ordinary conditions of use and under fire conditions;
and wherein each closed-state fire propagation barrier is secured in place by a fire barrier fixing, each fire barrier fixing having a portion which engages with the closed-state fire propagation barrier, a portion which passes through the thermal insulation layer and a portion which engages with the load bearing wall, and preferably in which each closed-state fire propagation bar-

rier comprises a fixing recess which is set back from the exterior facing fire barrier surface which lies against a portion of the cladding and in which the fire barrier fixing comprises a head which is arranged within the fixing recess.

6. A ventilated façade structure in accordance with claim 5, in which each closed-state fire propagation barrier is arranged vertically in the air filled cavity.

7. A ventilated façade structure in accordance with any preceding claim,

in which the open-state fire propagation barrier is arranged horizontally in the air filled cavity notably a ventilated façade structure in accordance with claim 5, in which

- each closed-state fire propagation barrier is arranged vertically in the air filled cavity,
- each open-state fire propagation barrier is arranged horizontally in the air filled cavity, and
- the closed-state and open-state fire propagation barriers together form discrete cavity compartments with fire propagation between the discrete cavity compartments being prevented or restrained by the fire propagation barriers .

8. A ventilated façade structure in accordance with any preceding claim,

in which the exterior facing major surface of the thermal insulation layer is a continuous planar surface
and in which each interior facing fire barrier surface lies against a portion of the continuous planar exterior facing major surface of the thermal insulation layer.

9. A ventilated façade structure in accordance with any preceding claim,

in which the fire barrier fixing consists of a screw fixing, the screw fixing comprising a shaft having a head portion at one end and a tip portion at the other end,
and in which

- the head portion engages with the fire barrier panel, preferably in cooperation with a washer
- the shaft passes through the fire barrier panel and through the thermal insulating layer, and
- the tip portion engages with the load bearing wall.

10. A ventilated façade structure in accordance with any preceding claim,
in which the layer of thermal insulation comprises mineral wool insulation, notably mineral wool insulation having a density in the range 30 kg/m^3 to 70 kg/m^3, preferably mineral wool insulation having a density in the range 40 kg/m^3 to 60 kg/m^3.

11. A ventilated façade structure in accordance with any preceding claim,
in which the fire barrier panel comprises mineral wool insulation, notably mineral wool insulation having a density in the range 120 kg/m^3 to 200 kg/m^3, preferably mineral wool insulation having a density in the range 140 kg/m^3 to 180 kg/m^3.

12. A ventilated façade structure in accordance with any preceding claim,
in which each fire protection barrier is provided by a plurality of adjoining fire protection barrier sections, notably in which each fire protection barrier section has a length within the range 0.8m to 1.4m long, preferably in which each fire barrier section is secured in place by between two and five fire barrier fixing, more preferably in which each fire protection barrier section has a length within the range 1.1 m to 1.3m long and is secured in place by three fire barrier fixings.

13. A ventilated façade structure in accordance with any preceding claim,
in which the fire propagation barrier has a height H which is ≥ 80 mm, notably a height H which is ≥ 180 mm.

14. A building provided with a ventilated façade structure in accordance with any of claims 1 to 13.

15. A method of constructing a ventilated façade structure of a building in accordance with any of claims 1 to 13, wherein the method comprises abutting each of the fire propagation barriers against a continuous planar exterior facing major surface the thermal insulation layer without providing a recess in the exterior facing major surface the thermal insulation layer for receiving the fire propagation barrier.

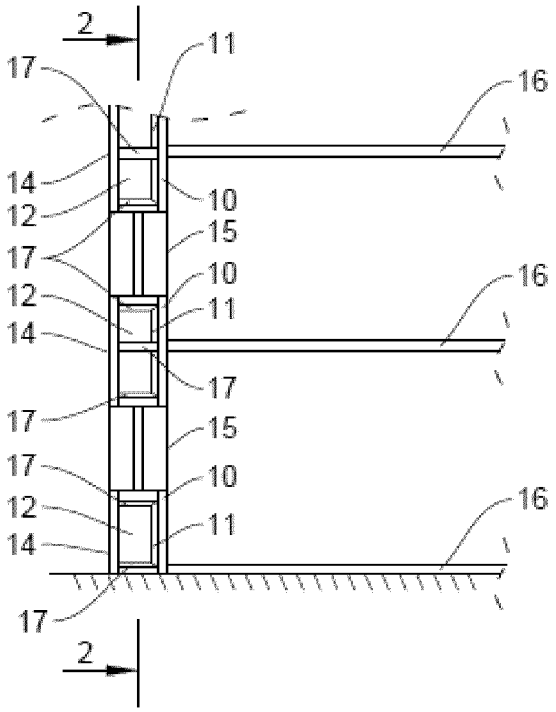
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FIG. 1

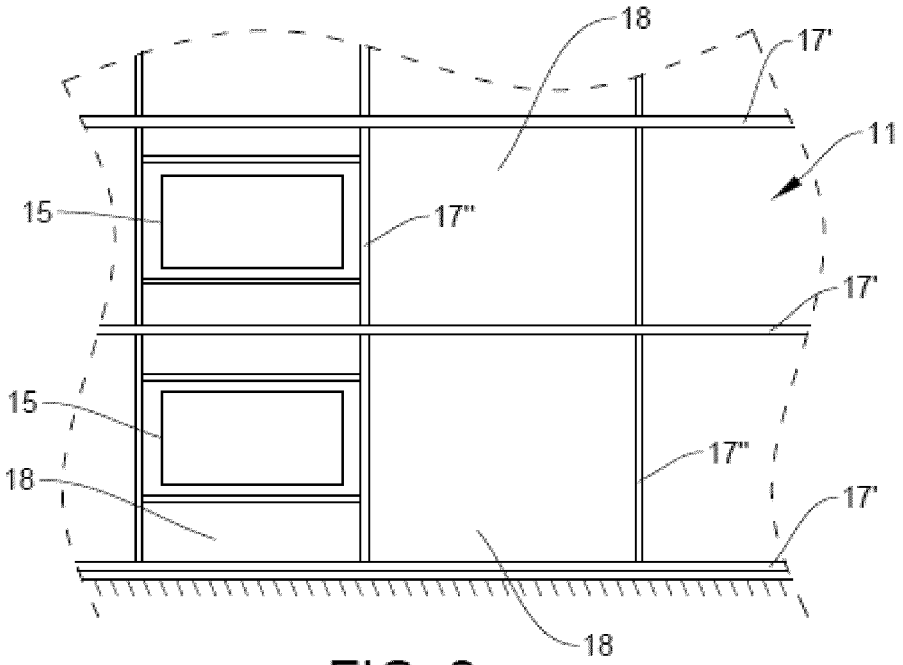
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FIG. 2

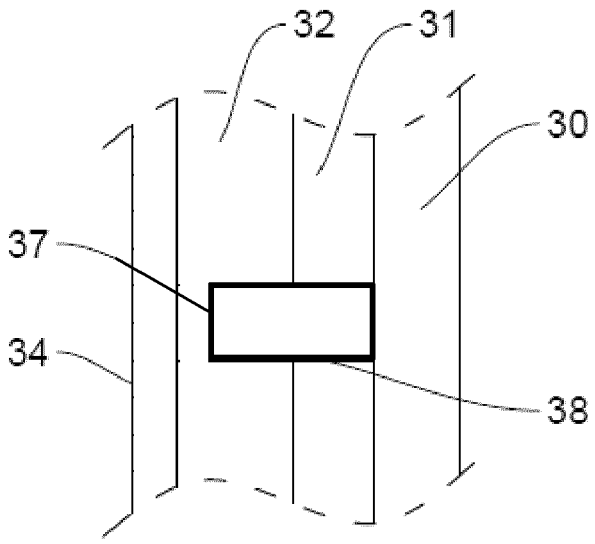


FIG. 3

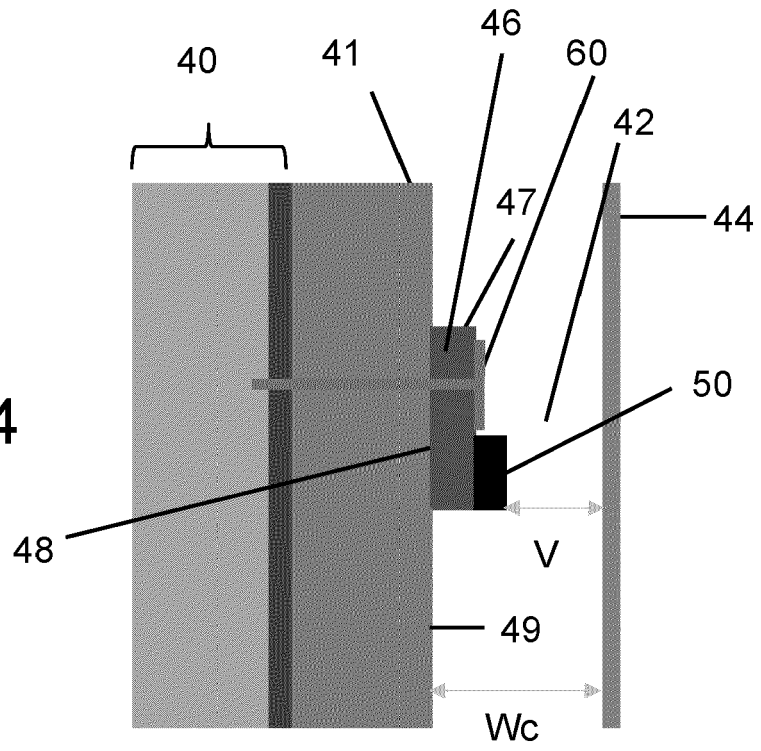


FIG 4

Fig 5

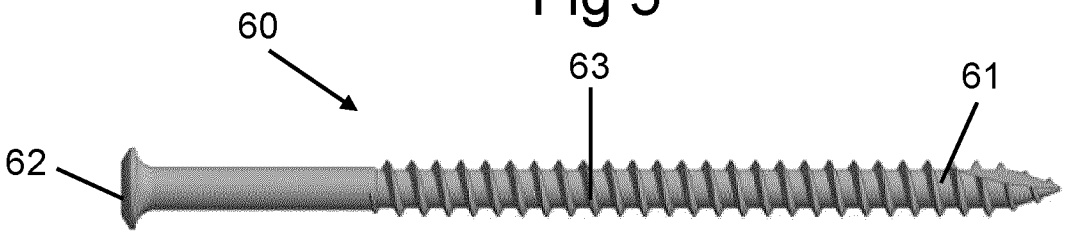


Fig 6

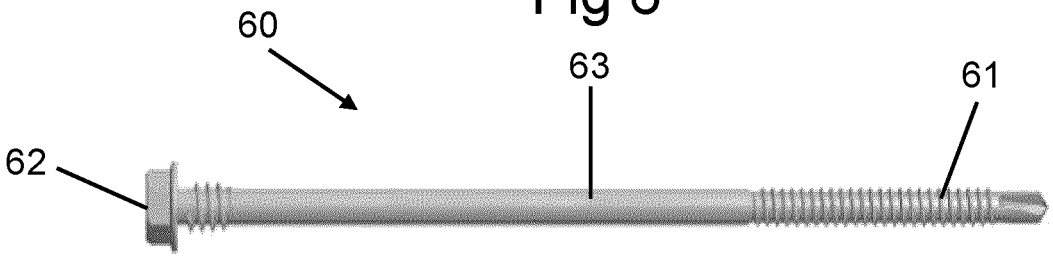


Fig 7

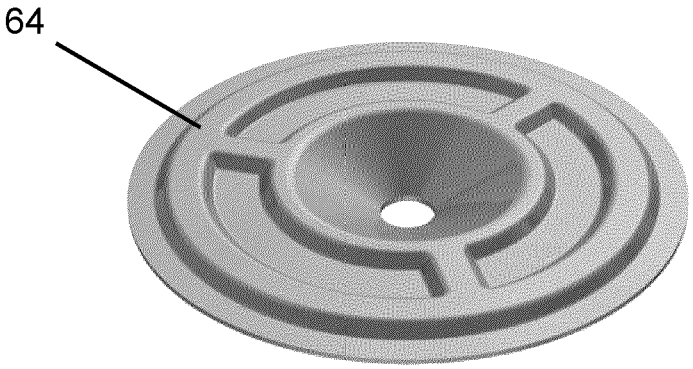
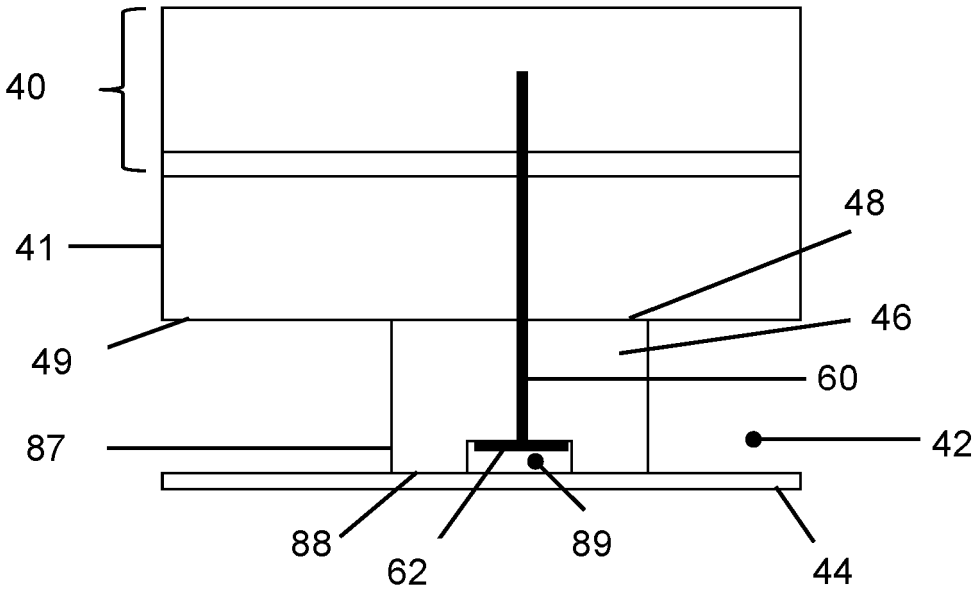


Fig 8



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EUROPEAN SEARCH REPORT

Application Number
EP 25 15 1346

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X	EP 2 426 284 A1 (LINZMEIER BAUELEMENTE GMBH [DE]) 7 March 2012 (2012-03-07) * paragraphs [0037], [0050] - [0052], [0062], [0066] - [0068]; figures 3A, 3B, 4 *	1-15	INV. E04B1/94 ADD. E04F13/00
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E04B
E04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 March 2025	Couprie, Brice

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17-03-2025

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