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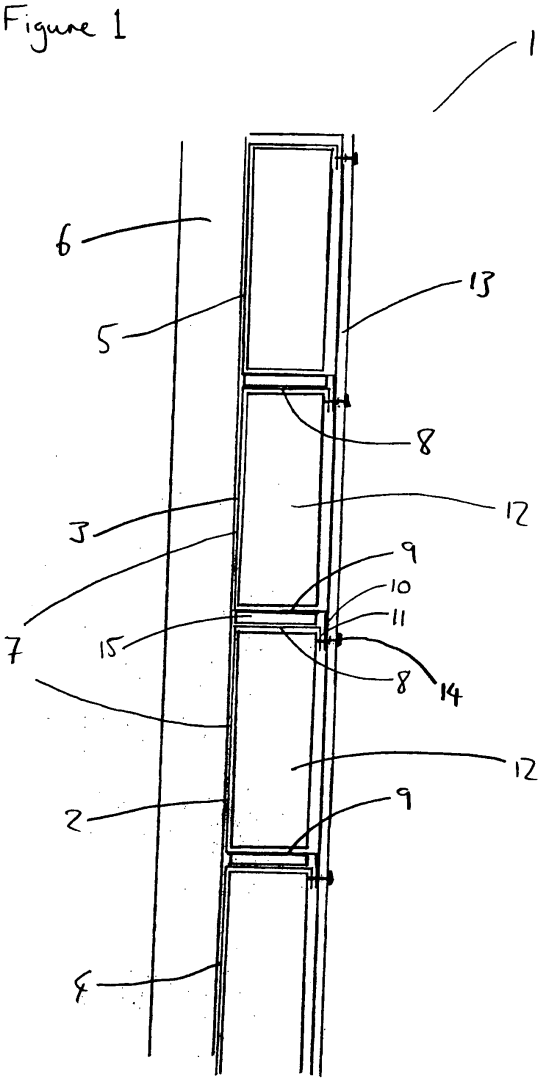
(54) System for a building envelope with improved insulation properties and cassette for use in the building

(57) The invention provides a system for a building envelope as defined in claim 1, which comprises;
a substructure generally arranged in the plane of the building envelope;
at least a first cassette and a second cassette, each having a major plate extending in substantially the same general plane as each other substantially parallel to and extending across the width of and attached to the substructure, top and bottom plates extending substantially perpendicularly from substantially the top and bottom respectively of the major plate away from the substructure, and downwardly directed flanges extending from substantially the distal ends of the top and bottom plates, the second cassette positioned adjacent to the first cassette such that the top plate of the first cassette faces the bottom plate of the second cassette and such that the flange of the bottom plate of the second cassette overlaps the flange of the top plate of the first cassette;
man-made vitreous fibre batts positioned between the top and bottom plates of the first cassette and between the top and bottom plates of the second cassette; and
outer cladding comprising sheeting elements, at least one sheeting element being fixed to the overlapping flanges of the first and second cassettes;
wherein a mat comprising from 20 to 95 wt % aerogel is positioned between the bottom plate of the second cassette and the top plate of the first cassette.

The invention also provides a method of making a building envelope, a cassette assembly for use in a building envelope and a use of a mat comprising from 20 to 95 wt % aerogel for improving the air tightness of a building envelope.

Figure 1



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Description

[0001] The present invention relates to systems for a building envelope, such as walls or roofs, and in particular to those which are constructed using cassettes, which are usually metal and most usually steel cassettes. The cassettes are fixed onto a substructure and insulation material is positioned in the cassettes. Cladding is then fixed to the outside of the cassettes. Such constructions are particularly common in industrial buildings.

[0002] Typically, the steel cassettes are formed of a major plate, which is typically vertical and horizontal plates extending in the same direction from the upper and lower ends of the major plate. These horizontal plates connect at their opposite ends to downwardly directed flanges. The wall may, therefore, be constructed using a number of these cassettes positioned one on top of the other such that the lower horizontal plate of an upper cassette faces the upper horizontal plate of a lower cassette. The downwardly directed flanges of the cassettes overlap each other.

[0003] It is usual to place insulation material between the upper and lower horizontal plates of each cassette. The insulation material can be held in place by the overlapping flanges and is usually in the form of a man-made vitreous fibre batt. This type of insulation material is particularly suitable for this application due to its good insulation properties, fire resistance and ease of installation.

[0004] Once the insulation material has been installed, the cladding is then fixed to the cassettes. The cladding is typically metal cladding and is often fixed to the cassettes with screws that pass through the cladding and both overlapping flanges.

[0005] Whilst the insulation provided by these constructions is generally reasonable, there are some drawbacks. In particular, the extensive contact between the cassettes provides a thermal and acoustic bridge between the cassettes in the plane of the building envelope. This is particularly problematic, because the cassettes are usually made of steel, which is used for its strength, cost and ease of manufacture, but has the disadvantage of being relatively thermally and acoustically conductive.

[0006] This can lead to heat from one part of the building being spread around the building envelope and, therefore, being more easily lost to the outside. The spread of heat through the building envelope may also be undesirable where heat-emitting equipment is in one part of the building whereas another part of the building is required to be kept cool.

[0007] Furthermore, the transfer of sound from one cassette to another has clear disadvantages in that it may facilitate the transfer of sound from one part of the building, which may be used, for example, as a workshop and another part of the building, which may contain office space.

[0008] Previous attempts to reduce thermal and acoustic bridging in this type of wall have generally been directed to decreasing the bridges provided by the horizontal plates of the cassettes from one side of the wall to the other rather than decreasing the transmission of heat and sound within the plane of the wall. In particular, EP0849420 describes a cassette wall, wherein, the insulation panels not only fill the space between upper and lower horizontal plates, but also cover the flanges thereby separating them from the cladding. In this way, the thermal bridge is substantially reduced. This document, however, is not concerned with decreasing the transmission of heat and sound from one cassette to another.

[0009] EP1179645 describes another attempt to diminish the thermal bridging in this type of wall. Again, insulation material is disposed between the cladding and the flanges of the cassettes. In order to prevent the insulation in this space from being compressed, spacer elements are provided to give a fixed space between cassette and cladding in which the insulation material can sit. The spacer elements may be in the form of a screw, having two separated threads with different diameters. Again, this solution relates to bridging from one side of the wall to the other rather than bridging within the plane of the building envelope.

[0010] EP801190 describes an insulated metal wall construction. The wall is a cassette wall and comprises insulation material that extends outwards beyond the cassette to fill the space all the way up to the outer metal plates and a material strip manufactured from insulating material and dimensioned to absorb pressure forces. This document is also not concerned with decreasing bridging within the plane of the building envelope.

[0011] WO2004/001154 describes a profiled element for a building wall, especially a cassette wall, with a heat or sound insulation member arranged in the profiled element. The insulation member is preferably made from mineral fibres and consists of at least two interconnecting insulation elements, the first of which fills the profiled element and the second of which is located on a large surface of the first. The insulation member can cover flanges of the profiled element, thereby reducing the number of cold bridges. This document is, therefore, also only concerned with reducing thermal and acoustic bridging from one side of the wall to the other.

[0012] An object of the present invention, therefore, is to provide a system for a building envelope, such as a wall or roof, which reduces the transmission of heat and/or sound through it and in particular from one cassette to another. The reduction of heat and/or sound transfer between the cassettes can also reduce the transfer of heat through the building envelope from one side to the other.

[0013] A further problem with prior art building envelopes is that often the contact point between the cassettes is not sufficiently air-tight. This could result in the building envelope not meeting the building regulations on air-tightness and could result in heat being lost from the building through convection. Therefore, a further object of the invention is to provide a building envelope with improved air-tightness.

[0014] These objects are achieved with the system for a building envelope such as a wall or a roof as defined in claim 1, which comprises;

a substructure generally arranged in the plane of the building envelope;
at least a first cassette and a second cassette, each having a major plate extending in substantially the same general plane substantially parallel to and extending across the width of and attached to the substructure, top and bottom plates extending substantially perpendicularly from substantially the top and bottom respectively of the major plate away from the substructure, and downwardly directed flanges extending from substantially the distal ends of the top and bottom plates, the second cassette positioned adjacent to the first cassette such that the top plate of the first cassette faces the bottom plate of the second cassette and such that the flange of the bottom plate of the second cassette overlaps the flange of the top plate of the first cassette;
man-made vitreous fibre batts positioned between the top and bottom plates of the first cassette and between the top and bottom plates of the second cassette; and
outer cladding comprising sheeting elements, at least one sheeting element being fixed to the overlapping flanges of the first and second cassettes;

wherein a mat comprising from 20 to 95 wt % aerogel is positioned between the bottom plate of the second cassette and the top plate of the first cassette.

[0015] The present invention also provides a method according to claim 10 comprising in any suitable order the steps of;

providing a substructure generally arranged in the plane of the building envelope;
providing at least first and second cassettes having a major plate with a first face and a second face, top and bottom plates extending substantially perpendicularly from substantially opposite ends of the first face of the major plate, and downwardly directed flanges extending from substantially the distal ends of the top and bottom plates;
providing a mat comprising from 20 to 95 wt % aerogel;
providing outer cladding comprising sheeting elements;
providing man-made vitreous fibre batts;
positioning the second cassette adjacent to the first cassette such that the major plates of the first and second cassettes extend across the width of and substantially parallel to the substructure in the same general plane with their second faces facing the substructure and their top and bottom plates extending substantially perpendicularly from substantially the top and bottom of the major plates away from the substructure with the top plate of the first cassette facing the bottom plate of the second cassette and the flange of the bottom plate of the second cassette overlapping the flange of the top plate of first cassette;
fixing the first and second cassettes to the substructure;
positioning man-made vitreous fibre batts to extend between the top and bottom plates of the first cassette and between the top and bottom plates of the second cassette; and
fixing the sheeting elements of the outer cladding to the overlapping flanges of the cassettes;

wherein the method further comprises positioning the mat between the top plate of the first cassette and the bottom plate of the second cassette prior to the positioning of the second cassette adjacent to the first cassette.

[0016] The present inventors have found a solution to the problem of thermal and acoustic bridging within the plane of the building envelope using dried gel products, commonly known as aerogels. These products are known to have excellent insulation properties, owing to their very high surface areas, high porosity and relatively large pore volume. They also generally have good fire resistant properties. They are manufactured by gelling a flowable sol-gel solution and then removing the liquid from the gel in a manner that does not destroy the pores of the gel.

[0017] Generally, gels are described as compositions, wherein a continuous liquid phase is enclosed by a continuous solid three-dimensional network of colloidal particles. An aerogel can be formed by removing the liquid from the gel and replacing it with air as the dispersion medium.

[0018] "Aerogel" when used in the broader sense means a gel with air as the dispersion medium. Within that broad description, however, exist three types of aerogel, which are classified according to the conditions under which they have been dried.

[0019] Where a wet gel is dried at above the critical point of the liquid, there is no capillary pressure and therefore relatively little shrinkage as the liquid is removed. The product of such a process is very highly porous and is known as an aerogel, the term being used in the narrow sense. On the other hand, if the gel is dried by evaporation under sub-critical conditions, the resulting product is a xerogel. In the production of a xerogel, the material usually retains a very high porosity and a large surface area in combination with a very small pore size.

[0020] In the wider sense of the word, aerogels also encompass dried gel products, which have been dried in a freeze-drying process. These products are generally called cryogels.

[0021] The term "aerogel" in its broader sense of "gel having air as the dispersion medium" encompasses each of aerogels in the narrower sense, xerogels and cryogels. As used herein, the term "aerogel" denotes aerogels in

the broader sense of a gel having air as the dispersion medium.

[0022] A number of different aerogel compositions are known in the art. These include both inorganic and organic aerogels. The inorganic aerogels are often based on metal oxides such as silica, carbides and alumina, whereas organic aerogels include carbon aerogel and polymeric aerogels, for instance polyamide aerogels.

[0023] The solution of the present invention uses products including aerogel insulation in the form of a mat. There are numerous disclosures in the prior art of methods of producing mats comprising aerogel. One type of mat particularly useful in the present invention is an aerogel matrix composite mat (AMC). These mats are commercially available from Aspen Aerogels, Inc. and are made by impregnating a matrix of re-enforcing fibres with a flowable sol-gel solution, gelling and then removing the liquid from the gel in a manner that does not destroy the pores of the aerogel. These aerogel matrix composites are mechanically strong, good insulators and require a shorter processing time than pure aerogels. They are, therefore, suitable for industrial use as insulating material and are commonly used for this purpose. For example US 2002/0094426 describes aerogel matrix composites and their use for insulation purposes.

[0024] Elsewhere in the prior art, aerogel mats have been formed in different ways. A number of documents, for example, describe the use of aerogels preformed as particles to produce insulation products. For example, US 6485805 describes an insulating composite comprising silica aerogel granules and having a thermally reflective layer, which is preferably a thin aluminium foil layer. The aerogel granules are preferably adhered to the thermally reflective layer with a binder.

[0025] It is also possible to incorporate aerogel particles into a composite material comprising fibres. US 6479416, for example, relates to a composite material comprising aerogel particles and thermoplastic fibres. The composite may also contain other types of fibres, but the thermoplastic fibres bind to each other and to the particles of aerogel to form a cohesive composite material.

[0026] WO2006/065904 describes a method for making an insulation blanket comprising adding a wetting agent to aerogel particles before combining them in water with fibres to form a slurry. The slurry is then dewatered, and the resulting web dried and calendared to form the blanket. The method may also include providing a layer on at least one side of the blanket to form a panel. This document further describes a product, wherein the blanket is placed between at least two glass layers. The resulting panel may be used as a window, wall, floor or the like.

[0027] WO 98/32709 describes a material comprising an aerogel layer with binder and at least one further layer.

[0028] Further aerogel-based materials are outlined in US 2007/0004306.

[0029] Aerogel mats are advertised for use in building applications by A. Proctor Group Ltd under the brand Spacetherm. These mats are AMC mats. A "Spacetherm-CBS Overview" on the Spacetherm website suggests using the mats to diminish cold bridging. Cassette walls, however, are not mentioned and there is no discussion of thermal or acoustic bridging within the plane of a building envelope.

[0030] The present inventors have found that by providing a mat comprising from 20 to 95 weight % aerogel between the top plate of the first cassette and the bottom plate of the second cassette, it is possible to provide improved thermal and sound insulation in a building envelope especially in the plane of the building envelope itself.

[0031] The use of this mat can also improve the air-tightness of the building envelope. As described herein, air-tightness is measured according to European Standard EN 13829. The mat can be used to improve the air-tightness of a building envelope of the type described in claim 1 relative to a building envelope where the top plate of the first cassette is in direct contact with the bottom plate of the second cassette. This improvement is defined in relation to a building envelope where all other things are equal.

[0032] Furthermore, since aerogel provides effective insulation, it is possible to use a relatively thin mat so that the distance between the cassettes is minimised. This results in improved air-tightness in comparison with a building envelope using another type of insulation mat (e.g. mineral fibre) in the same position. Preferably, the mat has a thickness of no more than 40mm, more preferably no more than 20mm and most preferably no more than 10mm.

[0033] The aerogel content of the mat must be between 20 and 95 weight % to provide the required properties, but is preferably at least 30, and more preferably at least 40 weight % aerogel. The mat preferably comprises no more than 90, more preferably no more than 80 and most preferably no more than 70 wt % aerogel.

[0034] The aerogel content of the mats used in the present invention will result in good insulation properties. Preferably the mat has a thermal conductivity (λ_D-value; based on measurements in accordance with European Standard EN 12667 at a reference mean temperature of 10 °C) of less than 30, more preferably less than 22 and most preferably less than 17 mW/m*K. Usually, the mats will have a thermal conductivity (λ_D-value) of no less than 5, more usually no less than 9 and most often no less than 12 mW/m*K.

[0035] Whilst the mat can be any mat that comprises 20 to 95 wt % aerogel, it is conveniently an aerogel matrix composite (AMC) mat, comprising a matrix of fibres impregnated with aerogel. Mats of this type are commercially available from Aspen Aerogels, Inc. and are made by impregnating a matrix of reinforcing fibres with a flowable sol-gel solution, gelling and then removing the liquid from the gel in a manner that does not destroy the pores of the gel. These aerogel matrix composites are mechanically strong and good insulators. They are, therefore,

suitable for industrial use as insulating material and are commonly used for this purpose. For example US 2002/0094426 describes aerogel matrix composites and their use for insulation purposes. Further mats of this type are described in, for example, US Patent Publication No. 20020094426; US Patent No. 5,789,075; US Patent No. 5,306,555; US Patent No. 6,770,584; US Patent No. 6,479,416; US Patent No. 6,083,619; and US Patent No. 6,080,475.

[0036] The aerogel matrix composite is typically formed by impregnating a fibre matrix with a flowable sol-gel solution. Usually this is a silica-containing sol-gel solution, but suitable aerogels may also be based on alumina or other metal oxides suitable for the sol-gel technique. Aerogel matrix composites may also be made from organic precursors (e.g. as in US 5973015 and 6087407). In particular, US5086085 describes aerogels based on melamine formaldehyde condensates and US 4873218 describes aerogels based on resorcinol-formaldehyde condensates.

[0037] The sol-gel solution is then gelled to form a fibre-gel composite. Finally, the fibre-gel composite is dried to form the aerogel matrix composite. More detailed descriptions of suitable methods can be found in US Patent Publication No. 20020094426; US Patent No. 5,789,075; US Patent No. 5,306,555; US Patent No. 6,770,584; US Patent No. 6,479,416; US Patent No. 6,083,619; and US Patent No. 6,080,475.

[0038] Where the fibre-gel composite is dried under supercritical conditions, very little shrinkage occurs and an aerogel (in the narrow sense) matrix composite arises. Sub-critical drying results in a xerogel matrix composite and freeze-drying results in a cryogel matrix composite. Each of these can be broadly described as aerogel matrix composites.

[0039] The very high porosity that results from supercritical drying conditions provides aerogel matrix composites with excellent insulation properties. Therefore, the mat used in the present invention is preferably an aerogel matrix composite, that has been formed by drying under supercritical conditions.

[0040] The fibres that form the matrix of an AMC may be of any suitable material, but preferably the fibre matrix comprises polymer fibres, mineral fibres, ceramic fibres, glass fibres or mixtures thereof. Due to the strength they impart to the mat as well as their fire-resistant properties, the fibres are more preferably mineral fibres, ceramic fibres, glass fibres or mixtures thereof. Preferably the fibres are in the form of a wool.

[0041] Other types of mat comprising from 20 to 95 weight % aerogel may also be used in the present invention as have been described as background art. According to the present invention the mat may comprise aerogel in particulate form which may optionally be held together in the mat with a binder. The mat comprising aerogel particles may also optionally comprise fibres.

[0042] In such a mat, the fibres are preferably polymer fibres, mineral fibres, ceramic fibre, glass fibres or mixtures thereof. Most preferably they are mineral fibres.

[0043] Examples of mats comprising aerogel in particulate form suitable for use in the present invention are described in US 6485805, US 6479416 and W02006/065904.

[0044] It is also possible for the mat to be a single block or sheet or a plurality of blocks or sheets comprising from 20 to 95 wt % aerogel combined to form the mat.

[0045] Whilst all aerogel materials are within the scope of the invention, preferably the aerogel formed of an inorganic material. The most favourable insulation properties are obtained with silica-based composites. Therefore, preferably the mat comprises a metal or silicon oxide aerogel, more preferably a silicon oxide aerogel.

[0046] It is also generally the case that aerogels that have been dried under supercritical conditions have superior insulation properties in relation to other aerogels. Therefore the mat used in the present invention preferably comprises aerogel that has been formed by drying under supercritical conditions.

[0047] The mat preferably has at least a certain resistance to compression. This allows the mat to sit between the cassettes without being damaged by the pressure of the cassettes on either side and ensures that no special means are required to space the cassettes. According to the present invention, the resistance to compression is measured according to the European Standard test EN 826:1996, which measures the compressive stress required for 10% compression, or where the maximum compressive stress occurs before 10% compression, measures the compressive strength (i.e. the maximum compressive stress).

[0048] Preferably, the mat has a compressive stress at 10% compression of at least 5 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 5 kPa. More preferably, the mat has a compressive stress at 10% compression of at least 10 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 10 kPa. Most preferably, the mat has a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 20 kPa.

[0049] In general the compressive stress at 10% compression or, where applicable, the compressive strength is as high as possible. However, usually the mat has a compressive stress at 10% compression of no more than 100 kPa, more usually no more than 80 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of no more than 100 kPa, more usually no more than 80 kPa.

[0050] The building envelope of the present invention may be any outer wall of the building or the roof of the building. Where it is an outer wall, the building envelope may be substantially vertical or it might be slanted. Where the building envelope is a roof it may be substantially horizontal or it may be slanted. Where the building en-

velope is a roof, the top and bottom plates will, in fact be at the same level as each other. Most commonly, the building envelope is a substantially vertical wall.

[0051] The building envelope of the present invention comprises a substructure. The substructure is generally a supporting structure and is commonly a column and often a beam. Most often, it is a steel or aluminium column or beam. It may, however, be a solid wall in itself, for example a brick wall.

[0052] According to the system and method of present invention, a man-made vitreous fibre batt is located between the top and bottom plates of the first cassette and the top and bottom plates of the second cassette. The man-made vitreous fibre batt may made by any known method, but preferably it is made by pouring mineral melt onto a spinner and collecting the fibres together with a binder on a collecting belt to form a web. The web may then be cross-lapped and cured to produce the batt. It is also possible, to incorporate aerogel into the man-made vitreous fibre batt. The man-made vitreous fibre batt can comprise aerogel in the form of particles or it may have a sheet of aerogel-containing material on one of its surfaces.

[0053] Usually, the man-made vitreous fibre batt has a density of between 10 and 150 kg/m^3, preferably between 20 and 100 kg/m^3 and more preferably between 30 and 70 kg/m^3.

[0054] The cassettes used in the present invention have a major plate and top and bottom plates extending substantially perpendicularly from substantially the top and bottom ends of the major plate. Whilst the major plate is usually substantially vertical, meaning the top and bottom of the major plate extend substantially horizontally from the major plate, it is possible for the major plate to be slanted from the vertical and the top and bottom plates to be slanted from the horizontal. It is also within the scope of the building envelope and method of the present invention for the major plate to be rotated in the plane of the surface of the substructure so that the top and bottom plates are slanted with respect to the horizontal.

[0055] The major plate may be a solid plate, or it may be perforated. When it is perforated, e.g. a fleece of a non soundproof type might be positioned between the major plate of the cassette and a man-made vitreous fibre batt to avoid emissions of fibrous particles. In case perforated cassettes are used the insulation layer is usually built up of two man-made vitreous batts with a film arranged in between. This film may be made of any material suitable for improving the air-tightness of the building envelope and might e.g. be adhered to a major surface of one of the man-made fibrous batts.

[0056] The cassettes also comprise downwardly directed flanges extending from substantially the distal ends of the top and bottom plates. These flanges are usually parallel to the major plate. They are also usually substantially vertical. Whilst the flanges often extend from the very end of the top and bottom plates, it is only necessary for the flanges to be near enough to the ends to allow the cladding to be easily fixed to them and to allow sufficient space between the flanges and the major plate to accommodate the man-made vitreous fibre batt.

[0057] The cassettes may be made of any suitable material, but they are usually made of metal, preferably steel or aluminium.

[0058] According to the system and method of the invention, the mat comprising from 20 to 95 wt % aerogel is positioned between the top plate of the first cassette and the bottom plate of the second cassette. This positioning of the mat serves to decrease the transfer of heat and/or sound predominantly within the plane of the wall.

[0059] Although the mat is only required to separate the top plate of the first cassette from the bottom plate of the second cassette, the transfer of heat and sound in the plane of the building envelope may be further diminished by a further mat comprising from 20 to 95 wt % aerogel positioned directly above the bottom plate of the second cassette and/or directly below the top plate of the first cassette. Another mat comprising from 20 to 95 wt % aerogel may be positioned at the lower end of the downwardly directed flanges.

[0060] In some embodiments the thermal and/or acoustic bridging between the cassettes is further diminished by providing a mat comprising from 20 to 95 wt % aerogel positioned between the flange of the top plate of the first cassette and the flange of the bottom plate of the second cassette. The thermal bridge could also be further diminished by a further mat comprising aerogel positioned between the overlapping flanges and the major plate (i.e. on the face of the flange of the top plate of the first cassette that faces the major plate). In these embodiments, the bottom plate of the second cassette must be wider than the top plate of the first cassette by a distance sufficient to allow space for the mat to fit between the flanges.

[0061] It would also be desirable to diminish the transfer of heat and sound through the horizontal plates of each cassette from one side of the building envelope to the other. Therefore, in a preferred embodiment a further mat comprising aerogel is positioned between the flange of the bottom plate of the second cassette and the sheeting element of the outer cladding. In this embodiment it is also desirable for this mat to have a high compressive stress for 10% compression or if the maximum compressive stress is reached before 10% compression, a high compressive strength so that it is not damaged and no spacing means are required to separate the first and second cassettes. Therefore the mat comprising aerogel that is positioned between the flange of the bottom plate of the second cassette and the sheeting element preferably has a compressive stress for 10% compression of at least 20 kPa, more preferably of at least 40 kPa and most preferably at least 60 kPa or where the maximum compressive stress is reached before 10% compression, a compressive strength of at least 20 kPa, more preferably of at least 40 kPa and most preferably at least 60 kPa.

[0062] Each of these further mats comprising aerogel

may be incorporated in the method or system of the present invention either independently or in combination. They may also have any of the preferred or optional features of the mat comprising aerogel that is positioned between the top plate of the first cassette and the bottom plate of the second cassette.

[0063] According to the system and method of the present invention, the sheeting elements of the outer cladding are fixed to the overlapping flanges of the first and second cassettes. The preferred manner of attachment will depend on the form and material of the respective sheeting element and cassette flanges, and could be nails, rivets, staples or any other suitable means. However, in general the preferred method of fixing the sheeting element(s) to the cassettes is with screws. Preferably, several mutually spaced screws are used.

[0064] According to the wall and method of the invention, the mat comprising from 20 to 95 wt % aerogel positioned between the top plate of the first cassette and the bottom plate of the second cassette may be fixed in position by any means. For example, the mat may be attached to the top plate of the first cassette with adhesive. Adhesive could also be used to fix the mat to the bottom plate of the second cassette. Alternatively, the mats may be fixed in place by the pressure exerted by first and second cassettes on either side with no additional fixing means.

[0065] Any further mats comprising aerogel may also be fixed in position by any means, but preferably they are attached to the cassette with adhesive.

[0066] Preferably, the mat that is positioned between the top plate of the first cassette and the bottom plate of the second cassette extends along substantially the whole length of the cassettes. Usually this mat extends substantially the whole width of the top plate of the first cassette and the bottom plate of the second cassette from the plane of the major plates to the downwardly directed overlapping flanges. However, in some embodiments, the mat will not extend substantially the whole width of the top plate of the first cassette and the bottom plate of the second cassette. In the most preferred embodiment, the mat fills all of the space between the top plate of the first cassette and the bottom plate of the second cassette.

[0067] Whilst only two cassettes are necessary in the present invention, depending on the area that the building envelope is required to cover, further cassettes may be provided. Often the building envelope comprises a third cassette having the same features as the first and second cassettes. The third cassette is positioned adjacent to the second cassette such that the top plate of the second cassette faces the bottom plate of the third cassette and such that the flange of the bottom plate of the third cassette overlaps the flange of the top plate of the second cassette. Usually, the building envelope comprises at least four, preferably at least five cassettes positioned on top of one another.

[0068] The present invention also provides a cassette assembly for use in the construction of a building envelope comprising;

a cassette having a major plate having a first face and a second face, top and bottom plates extending substantially perpendicularly from substantially opposite ends of the first face of the major plate and flanges extending from substantially the distal ends of the top and bottom plates; and

a mat comprising from 20 to 95 wt % aerogel;

wherein the mat is fixed, preferably with adhesive, to the top surface of the top plate and/or to the bottom surface of the bottom plate and preferably to the face of the flange of the top plate that faces away from the major plate and/or the face of the flange of the bottom plate that faces towards the major plate.

[0069] This cassette assembly may be used in place of a standard cassette to obtain a building envelope according to the present invention. The assembly is easy to make and easy to install, because it does not require the aerogel mat to be positioned during construction of the building envelope. The assembly also has all of the advantages outlined for the method and building envelope of the present invention.

[0070] Furthermore any relevant preferred feature of the building envelope or method of the present invention is also preferred in relation to the cassette assembly, in particular the materials used for the cassette and the mat.

[0071] In particular, the cassette assembly of the present invention may comprise a further mat comprising from 20 to 95 wt % aerogel fixed to the top face of the bottom plate and/or to the bottom face of the top plate.

[0072] In a particularly preferred embodiment of the cassette assembly, a further mat comprising from 20 to 95 wt % aerogel is positioned on the face of the flange of the bottom plate that faces away from major plate. In another embodiment of the present invention further mats comprising aerogel may be fixed to the face of the flange of the top plate that faces towards the major plate.

[0073] Each of these further mats comprising from 20 to 95 wt % aerogel may be incorporated into the cassette assembly either independently or in combination.

[0074] The present invention may be better understood with reference to the following drawings.

Brief Description of the Drawings

[0075]

Figure 1 is a cross-sectional view of a building envelope according to the present invention.

Figure 2 shows a detailed cross-sectional view of part of the building envelope of the present invention.

Figure 3 shows cross-sectional view of a preferred embodiment of the building envelope of the present invention.

Figure 4 is a cross-sectional a cassette assembly

according to the present invention.

Figure 5 shows an alternative embodiment of the cassette assembly of the invention in cross-section.

Detailed Description of the Drawings

[0076] Referring to Figure 1, an embodiment of the system for a building envelope (1) has a first cassette (2) and a second cassette (3). Also shown are further cassettes (4, 5) above and below the first and second cassettes (2, 3). The cassettes are fixed to a substructure (6) in the form of a steel beam or column. Each cassette has a major plate (7), a top plate (8) and a bottom plate (9). At the distal ends (i.e. that which is furthest from the joint with the major plate) of each of the top plate and the bottom plates (8, 9) are downwardly directed flanges (10, 11). The building envelope also comprises man-made vitreous fibre batts (12), which are positioned between the top plate (8) and the bottom plate (9) of each of the cassettes (2, 3, 4, 5). Outer cladding (13) is attached to the flanges (10, 11) with fixing means (14) in this case in the form of a screw. A mat (15) comprising from 20 to 95 wt % aerogel is positioned between the top plate (8) of the first cassette (2) and the bottom plate (9) of the second cassette (3).

[0077] The part of the building envelope in the area of the top plate of the first cassette and the bottom plate of the second cassette and the overlapping flanges is shown more clearly in Figure 2. The flange (10) of the bottom plate (9) of the second cassette (3) overlaps flange (11) of the top plate of the first cassette. The fixing means (14) passes through the cladding (13) and the flanges (10, 11). The mat (15) is positioned between the top plate (8) of the first cassette (2) and the bottom plate (9) of the second cassette (3).

[0078] Figure 3 shows a preferred embodiment of the building envelope of the invention. In addition to the mat (15) between the top plate (8) of the first cassette (2) and the bottom plate (9) of the second cassette (3), a mat (18) is positioned between the flange (10) of the top plate (8) of the first cassette (2) and the flange (11) of the bottom plate (9) of the second cassette (3). These mats (15, 18) may be two separate mats or one continuous mat.

[0079] Figure 4 shows a side view of an embodiment of the cassette assembly (16) of the invention. The assembly comprises a cassette with a major plate (7), a top plate (8) and a bottom plate (9). Downwardly directed flanges (10, 11) extend from substantially the distal ends of the top and bottom plates. A mat (15) comprising from 20 to 95 wt % aerogel is adhered to the bottom surface (17) of the bottom plate (9).

[0080] Figure 5 shows an alternative embodiment of the cassette assembly (16) of the invention. The assembly comprises a cassette with a major plate (7), a top plate (8) and a bottom plate (9). Downwardly directed flanges (10, 11) extend from substantially the distal ends of the top and bottom plates. A mat (15) comprising from 20 to 95 wt % aerogel is adhered to the top surface (19) of the top plate (8).

Claims

1. A system (1) for a building envelope, such as a wall or roof, comprising:

   a substructure (6) generally arranged in the plane of the building envelope;
   at least a first cassette (2) and a second cassette (3), each having a major plate (7) extending in substantially the same general plane substantially parallel to and extending across the width of and attached to the substructure (6), top and bottom plates (8, 9) extending substantially perpendicularly from substantially the top and bottom respectively of the major plate (7) away from the substructure (6), and downwardly directed flanges (10, 11) extending from substantially the distal ends of the top and bottom plates (8, 9), the second cassette (3) positioned adjacent to the first cassette (2) such that the top plate (8) of the first cassette (2) faces the bottom plate (9) of the second cassette (3) and such that the flange (10) of the bottom plate of the second cassette overlaps the flange (11) of the top plate of the first cassette;
   man-made vitreous fibre batts (12) positioned between the top and bottom plates (8, 9) of the first cassette (2) and between the top and bottom plates (8, 9) of the second cassette (3); and
   outer cladding comprising sheeting elements (13), at least one sheeting element being fixed to the overlapping flanges (10, 11) of the first and second cassettes;

   wherein a mat (15) comprising from 20 to 95 wt % aerogel is positioned between the bottom plate (9) of the second cassette (3) and the top plate (8) of the first cassette (2).

2. The system of claim 1, wherein a mat comprising from 20 to 95 weight % aerogel is positioned between the flange of the bottom plate of the second cassette and the flange of the top plate of the first cassette.

3. A system according to claim 1 or claim 2, wherein the mat has a compressive stress at 10% compression of at least 5 kPa, preferably 10 kPa, more preferably 20 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 5 kPa, preferably 10 kPa, more preferably 20 kPa.

4. A system according to any of claims 1 to 3, wherein the mat comprises a matrix of fibres impregnated with aerogel.

5. A system according to claim 4, wherein the matrix of fibres comprises polymer fibres, mineral fibres, ceramic fibres, glass fibres or mixtures thereof, preferably in the form of wool.

6. A system according to any of claims 1 to 3, wherein the mat comprises aerogel in the form of a particulate.

7. A system according to any preceding claim, wherein the cassettes are metal cassettes, preferably steel or aluminium cassettes.

8. A system according to any preceding claim, wherein the sheeting elements of the outer cladding are formed of metal.

9. A system according to any preceding claim, wherein the mat is fixed to one of the top plate of the first cassette or the bottom plate of the second plate and/or its respective flange with adhesive.

10. A method of making a system for a building envelope, such as a wall or roof, the method comprising in any suitable order the steps of;

providing a substructure generally arranged in the plane of the building envelope;
providing at least first and second cassettes having a major plate with a first face and a second face, top and bottom plates extending substantially perpendicularly from substantially opposite ends of the first face of the major plate, and downwardly directed flanges extending from substantially the distal ends of the top and bottom plates;
providing a mat comprising from 20 to 95 wt % aerogel;
providing outer cladding comprising sheeting elements;
providing man-made vitreous fibre batts;
positioning the second cassette adjacent to the first cassette such that the major plates of the first and second cassettes extend across the width of and substantially parallel to the substructure in the same general plane with their second faces facing the substructure and their top and bottom plates extending substantially perpendicularly from substantially the top and bottom of the major plates away from the substructure with the top plate of the first cassette facing the bottom plate of the second cassette and the flange of the bottom plate of the second cassette overlapping the flange of the top plate of first cassette;
fixing the first and second cassettes to the substructure;
positioning man-made vitreous fibre batts to extend between the top and bottom plates of the first cassette and between the top and bottom plates of the second cassette; and
fixing the sheeting elements of the outer cladding to the overlapping flanges of the cassettes;

wherein the method further comprises positioning the mat between the top plate of the first cassette and the bottom plate of the second cassette prior to the positioning of the second cassette adjacent to the first cassette.

11. A method according to claim 10 having independently any of the additional features according to claims 2 to 9.

12. A cassette assembly for use in the construction of a building envelope comprising;

a cassette having a major plate having a first face and a second face, top and bottom plates extending substantially perpendicularly from substantially opposite ends of the first face of the major plate and flanges extending from substantially the distal ends of the top and bottom plates; and
a mat comprising from 20 to 95 wt % aerogel;

wherein the mat is fixed, preferably with adhesive, to the top surface of the top plate and/or to the bottom surface of the bottom plate and preferably to the face of the flange of the top plate that faces away from the major plate and/or the face of the flange of the bottom plate that faces towards the major plate.

13. A cassette assembly according to claim 12, wherein the assembly has any of the additional features of claims 2 to 7.

14. Use of a mat comprising from 20 to 95 wt % aerogel for improving the air-tightness of a building envelope, the building envelope comprising;

a substructure generally arranged in the plane of the building envelope;
at least a first cassette and a second cassette, each having a major plate extending in substantially the same general plane as each other substantially parallel to and extending across the width of and attached to the substructure, top and bottom plates extending substantially perpendicularly from substantially the top and bottom respectively of the major plate away from the substructure, and downwardly directed flanges extending from substantially the distal ends of the top and bottom plates, the second cassette positioned adjacent to the first cassette such that the top plate of the first cassette faces

the bottom plate of the second cassette and such that the flange of the bottom plate of the second cassette overlaps the flange of the top plate of the first cassette;
man-made vitreous fibre batts positioned between the top and bottom plates of the first cassette and between the top and bottom plates of the second cassette; and
outer cladding comprising sheeting elements, at least one sheeting element being fixed to the overlapping flanges of the first and second cassettes; wherein the use comprises positioning the mat between the top plate of the first cassette and the bottom plate of the second cassette and the improvement is in relation to a building envelope where the top plate of the first cassette and the bottom plate of the second cassette are in direct contact.

15. The use according to claim 14, comprising any of the additional features of claims 2 to 9.

Figure 1

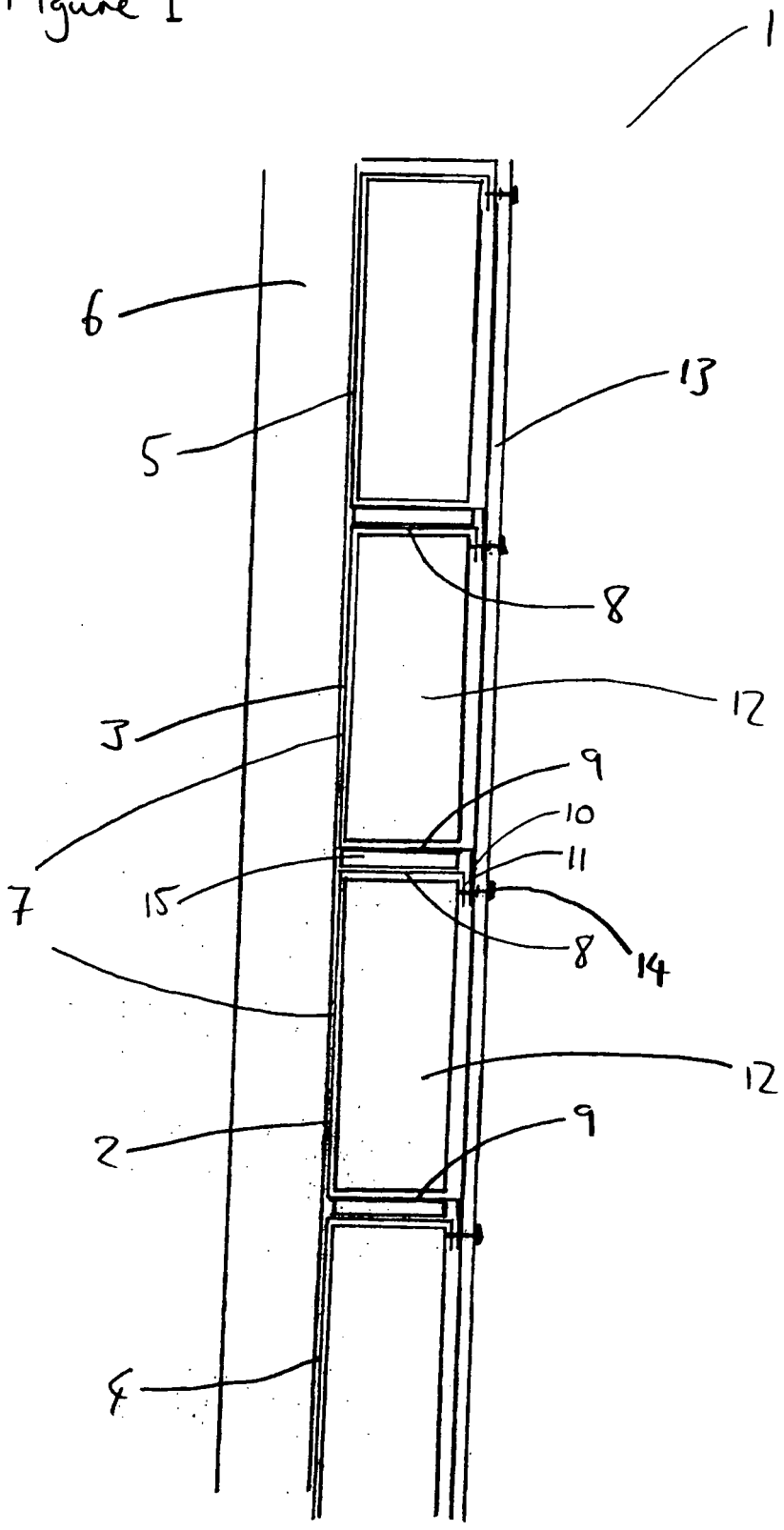


Figure 2

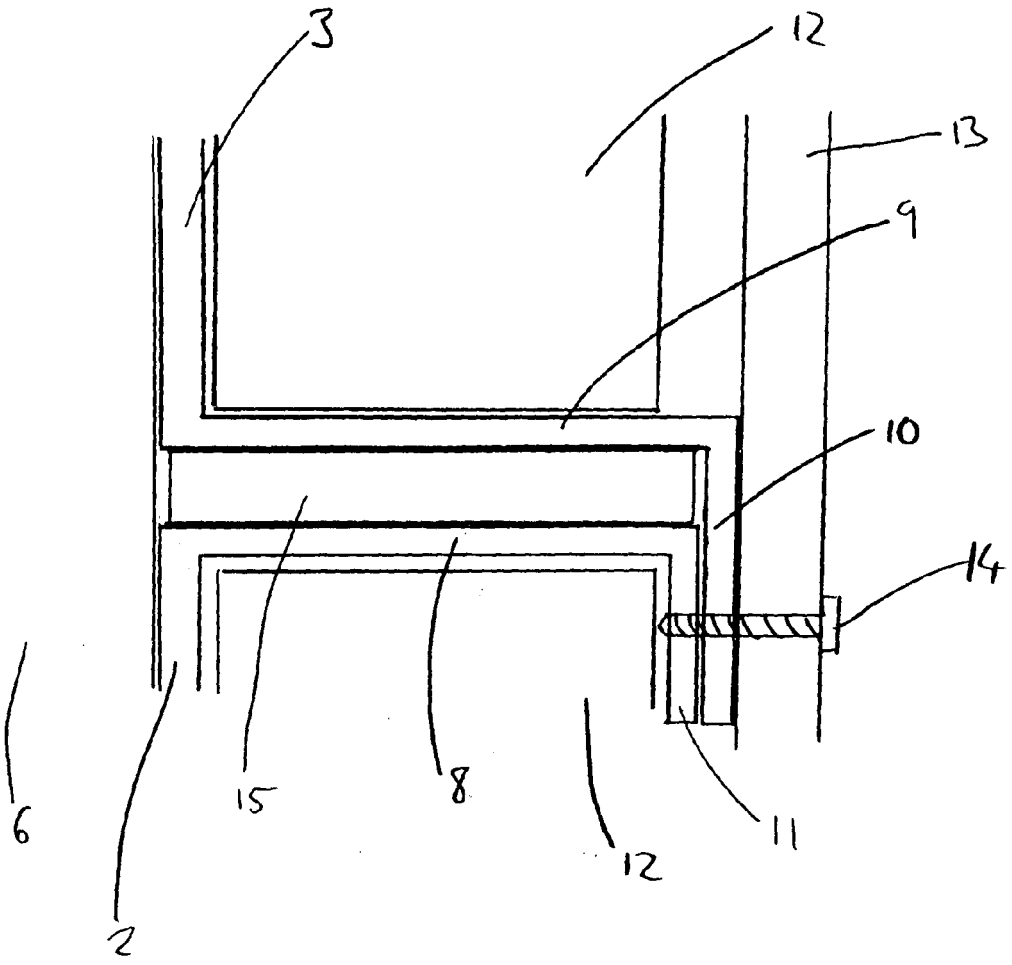


Figure 3

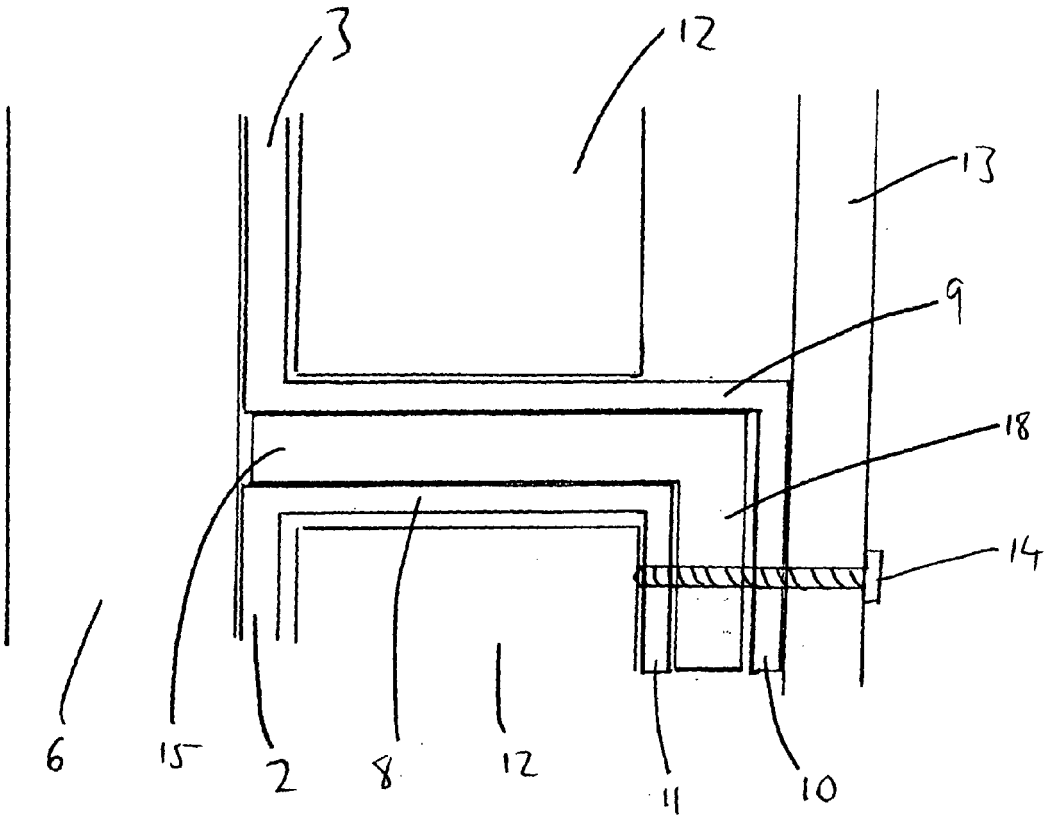


Figure 4

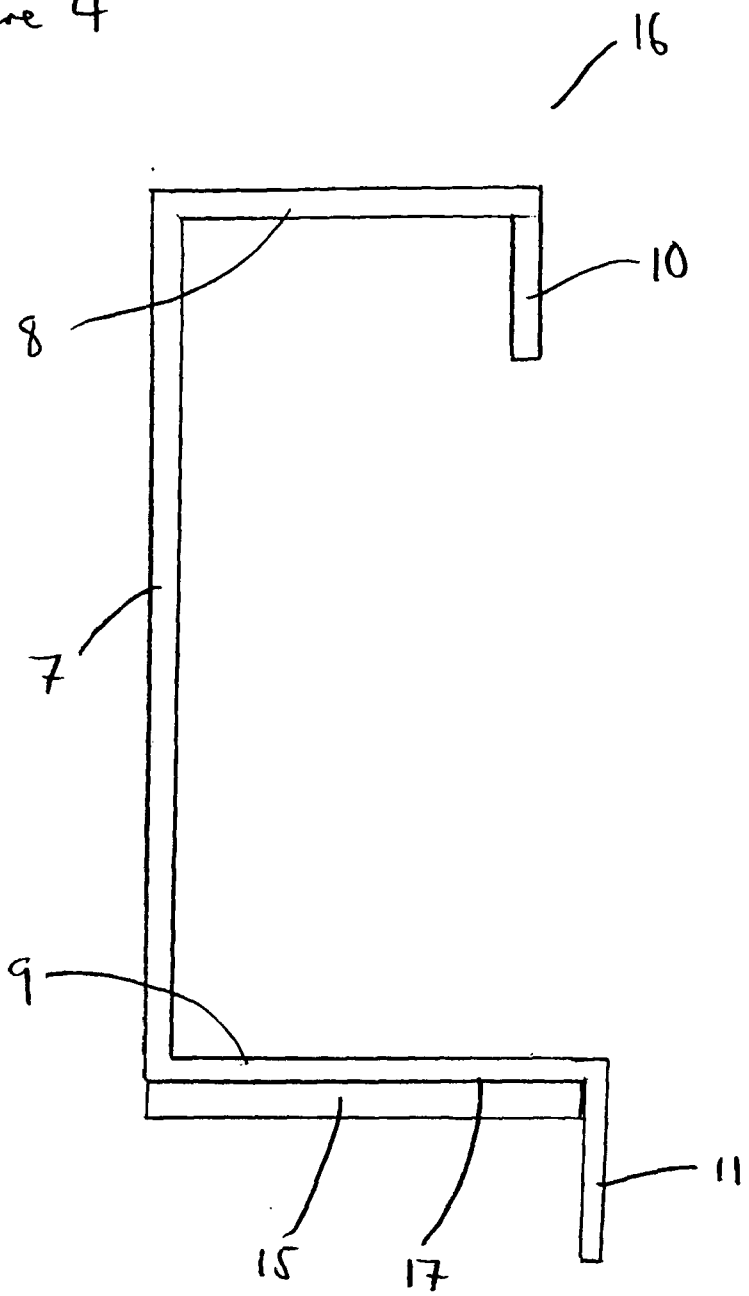
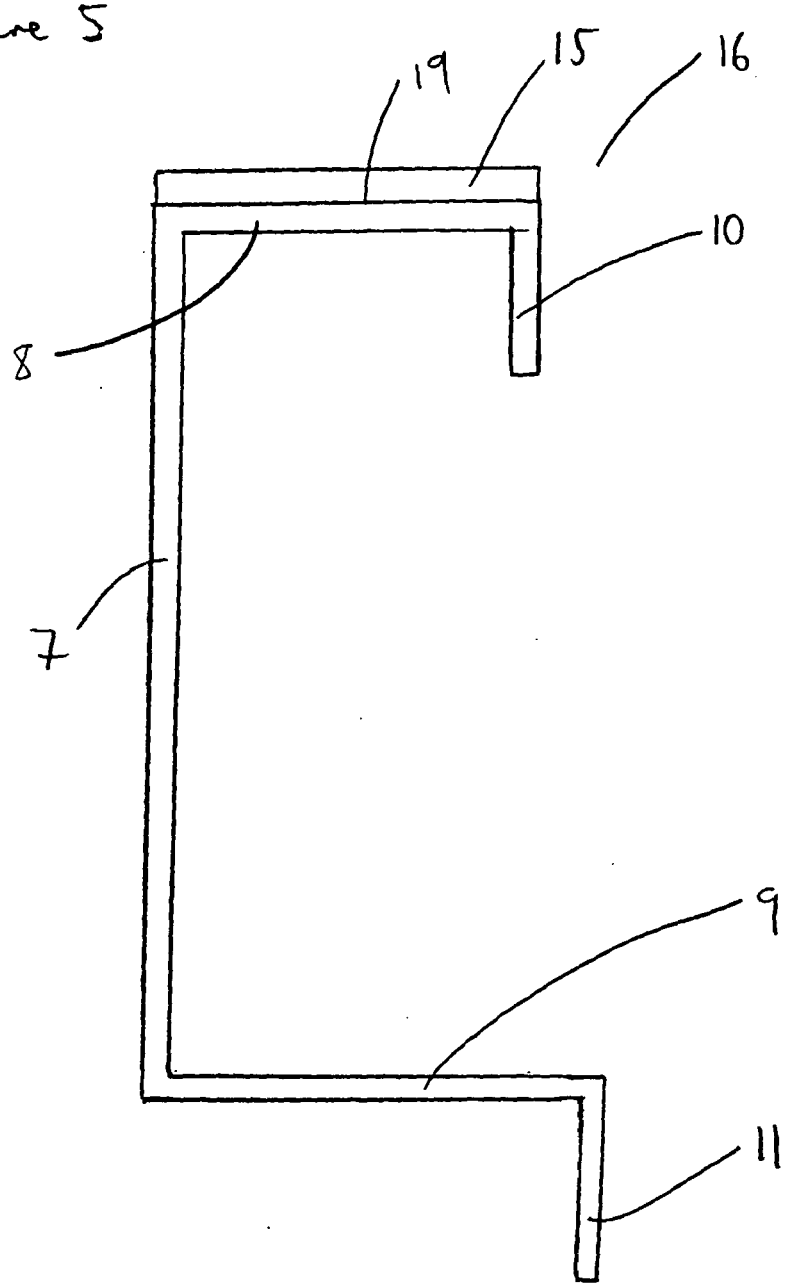


Figure 5



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EUROPEAN SEARCH REPORT

Application Number
EP 08 25 3398

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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