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(54) **Building wall with improved insulation properties and fixing assembly for use in the building wall**

(57) The present invention provides a wall (1) comprising a first panel (3) and a second panel (4) defining the surfaces of the wall (1) and extending in planes substantially parallel to each other and a sheet of sound and/or thermal insulating material (5) located between the panels (3, 4);

at least one elongate fixing element (2) formed of metal positioned between the first and second panels (3, 4), and having;

first and second side surfaces (8, 9) arranged in a plane substantially parallel to the planes of the first and second panels (3, 4);

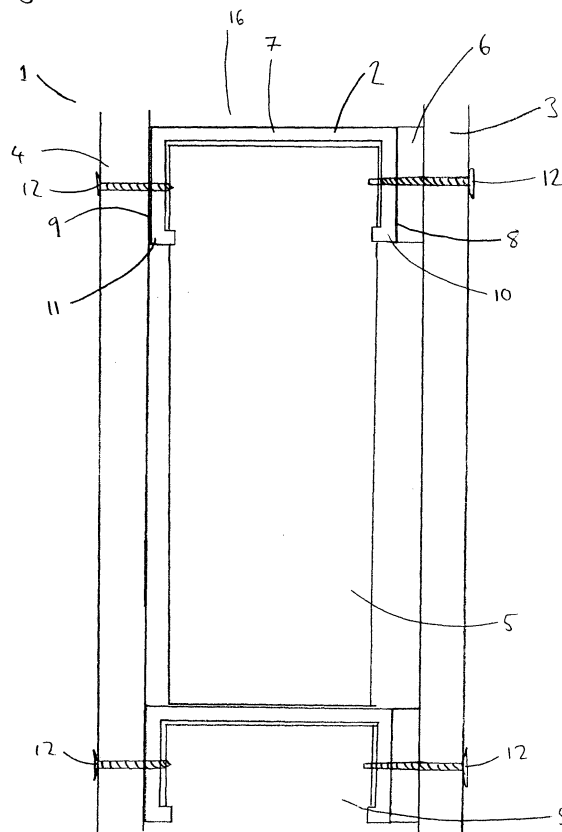
wherein the first panel (3) is attached to the first side surface (8);

the second panel (4) is attached to the second side surface (9); and

wherein a mat (6) comprising from 20 to 95 weight % aerogel is positioned between the first panel (3) and the first side surface (8) of the fixing element (2), the mat having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa.

A method of reducing thermal and sound transfer and an elongate fixing assembly for use in a building wall are also provided.

Figure 1



Description

[0001] The present invention relates to insulation in building walls and, especially in partition walls. Such walls generally comprise panels, which define the outer surfaces of the wall, held together by fixing elements, often in the form of C-profiles, U-profiles, I-profiles or H-profiles. Between the panels, mineral fibre panels are positioned as thermal and, predominantly, sound insulation. Whilst these insulation elements provide good insulation for the majority of the area of the wall, the fixing elements provide a thermal and/or sound bridge from one side of the wall to the other, which is detrimental to the overall insulation properties. This is particularly a problem, because the fixing elements are often formed of metal. Although metal fixing elements provide a strong structure for the wall, they are also relatively thermally and acoustically conductive.

[0002] A number of attempts have been made to reduce thermal and acoustic bridging in walls. One such system is described in GB339304. This document describes a wall wherein a highly insulating sheet made of cork, peat or the like may be placed over a support to prevent the cold striking through and the risk of moisture condensing on the inside of the wall. The insulating sheet is placed over the top of a metal sheet that forms the inner side of the wall and is covered with plaster of paris, porous concrete or the like. However, since the insulating sheet does not separate the metal sheet from the support, the thermal bridge is only partially blocked.

[0003] DE 10147831 describes a partition wall with U-profiles holding together two gypsum plaster boards. A U-profile is a fixing element with a back-plate and two side plates extending perpendicularly from either end of the back plate and in the same direction as each other. There is a gap between the U-profile and one gypsum plasterboard. Insulation material is placed both between the U-profiles and in the part between the outside surfaces of the U-profiles and the gypsum plasterboards. The insulation material is preferably a mineral fibre batt and the mineral fibre between the plasterboard and the U-profile may have a higher density. Due to the nature of the insulation a special screw is required to provide a significant and fixed gap between the gypsum plasterboard and the U-profile while still holding them fixed relative to each other. This arrangement results in a weaker structure than the standard arrangement with the U-profile screwed tightly against the gypsum plasterboard due to the increased bending stress on the screw.

[0004] EP0849420 describes a cassette wall with Z-profiles in which, the insulation panels extend beyond the flanges of the metal cassettes, separating the flanges from outer cladding. In this way, the thermal bridge is substantially reduced. This document does not address thermal or acoustic bridging in partition walls and the system described has a number of disadvantages. Problems arise when fixing the cladding to the cassette, because of the distance between these two elements and the com-

pressibility of the mineral fibre panel. This distance results firstly in the screws being subjected to bending stress. Secondly, since the mineral fibre panel is compressible, there is a problem that it may be more compressed in the region of the screw. This might create an uneven outer surface and compromise the structural soundness of the cladding. The solution suggested in EP0849420 is to provide a firm outer layer in order to spread the pressure of the screw.

[0005] One problem with providing this firm outer layer is that it further increases the distance that the screw must span between the cladding and the cassette. This may put more stress upon the screw itself, whilst also increasing the space that the building envelope occupies. Furthermore, the firm layer may further increase cost and might not contribute significantly to the insulation.

[0006] EP1179645 describes another attempt to diminish the thermal bridging in a cassette 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 system relates specifically to cassette walls rather than partition walls and the solution described has some disadvantages. One disadvantage is that here too the screws are subjected to bending stress. Another disadvantage is the need to use special spacer elements.

[0007] EP801190 describes an insulated metal wall construction. The wall is a cassette wall and comprises a material strip manufactured from insulating material and dimensioned to absorb pressure forces. This document provides no information with regard to what material should be used for the material strip in order to provide the insulating and pressure absorbing properties. It also relates specifically to cassette walls rather than partition walls.

[0008] 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. Since the insulation covers the flanges and due to the nature of the insulation, it is necessary when using such a profiled element to somehow provide a fixed gap between the panel and the element.

[0009] An object of the present invention, therefore, is to provide a building wall, preferably a partition wall, which reduces the transmission of sound and/or heat through the wall and in particular through the fixing element that fixes the panels forming the surfaces of the

wall together.

[0010] A further object is to achieve such a reduction without the need for any special form of fixing means to fix the panels to the fixing element and to provide a building wall which has a good structural strength.

[0011] These objects are achieved with the building wall as defined in claim 1. The wall a first panel (3) and a second panel (4) defining the surfaces of the wall

(1) and extending in planes substantially parallel to each other and a sheet of sound and/or thermal insulating material (5) located between the panels (3, 4);

at least one elongate fixing element (2) formed of metal positioned between the first and second panels (3, 4), and having;
first and second side surfaces (8, 9) arranged in a plane substantially parallel to the planes of the first and second panels (3, 4);

wherein the first panel (3) is attached to the first side surface (8);

the second panel (4) is attached to the second side surface (9); and

wherein a mat (6) comprising from 20 to 95 weight % aerogel is positioned between the first panel (3) and the first side surface (8) of the fixing element (2), the mat having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa.

[0012] The present invention also provides a method for reducing thermal or sound transfer through a wall comprising in any suitable order the steps of:

providing a first panel and a second panel, and at least one sheet of sound and/or thermal insulation; providing in the plane of the wall at least one elongate fixing element formed of metal and having first and second side surfaces substantially parallel to each other;

providing a mat comprising from 20 to 95 wt % aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum stress, having a compressive strength of at least 20 kPa;

positioning the mat on the first side surface of the fixing element;

positioning the first panel substantially parallel to the first side surface of the fixing element to form a first surface of the wall and fixing the first panel to the first side surface of the fixing element such that the mat is between the first panel and the first side surface of the fixing element;

positioning the at least one sheet of insulation in the plane of the wall adjacent to the at least one fixing element;

positioning the second panel substantially parallel to the second side surface of the fixing element to form a second surface of the wall and fixing the second panel to the second side surface of the fixing element such that the at least one fixing element and at least one sheet of insulation are between the first panel and the second panel.

[0013] The present inventors have found a solution to these problems 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. In many cases, they are also highly fire resistant. 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.

[0014] 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.

[0015] "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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] The solution of the present invention uses, more particularly, products including aerogel insulation in the form of a mat. There are numerous disclosures in the prior art of methods of producing mats comprising aero-

gel. One type of mat particularly useful in the present invention is an aerogel matrix composite (AMC) mat. These mats 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 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.

[0021] 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.

[0022] 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 granules of aerogel to form a cohesive composite material.

[0023] 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.

[0024] WO 98/32709 describes a material comprising an aerogel layer with binder and at least one further layer.

[0025] Further aerogel-based materials are outlined in US 2007/0004306.

[0026] 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 applying Spacetherm to structural elements including steel frames. Partition walls using metal fixing elements are not discussed so problems relating to the fixing of panels to the fixing elements and the compressibility of the mats are not addressed.

[0027] The present inventors have found that by providing, between the first side surface of the fixing element and the first panel, a mat comprising 20 to 95 weight %

aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa, it is possible to provide improved insulation in a wall with good structural strength and without the need to use special screws or spacers to create a fixed space between the fixing element and the first panel. Since the mat is capable of resisting a relatively high pressure, the mat used in the present invention effectively provides its own gap between the first side surface and the first panel. Therefore, it is possible to use a regular screw, which passes through the first panel, the mat and the first side surface of the fixing element because the mat comprising 20 to 95 wt % aerogel retains its depth more effectively than the mineral fibre batts which are traditionally used as insulation in such walls.

[0028] According to the present invention, the compressive stress at 10% compression or, where appropriate, the compressive strength is tested according to European Standard EN 826:1996. Preferably, the mat has a compressive stress at 10% compression of at least 40 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 40 kPa. More preferably, the mat has a compressive stress at 10% compression of at least 60 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of at least 60 kPa.

[0029] 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 120 kPa, more usually no more than 100 kPa or, if 10% compression is not reached before the maximum compressive stress, has a compressive strength of no more than 120 kPa, more usually no more than 100 kPa.

[0030] Furthermore, since aerogel provides effective insulation, it is possible to use a thin mat relative to the amount of mineral wool that would have to be used, thereby decreasing the distance that the screws must span and as a result decreasing the stress on the screws. Preferably, the mat has a thickness of no more than 40mm, more preferably no more than 20mm and most preferably no more than 10mm.

[0031] 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.

[0032] The stated weight % of aerogel denotes the content of aerogel in its "pure" form, e.g. without the inclusion of any content of binder, fibre or filler, if available in the mat. The stated weight % does, however, include substances like hydrophobizing agents and IR opacity substances for the aerogel material.

[0033] 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.

[0034] Whilst the mat can be any mat that comprises 20 to 95% aerogel and has the required resistance to compression, it is conveniently an aerogel matrix composite (AMC) mat, comprising a matrix of fibres impregnated with an 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.

[0035] 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 resorcinolformaldehyde condensates.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] Other types of mat comprising 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 the form of particles which may optionally be held in the mat with a binder. The mat comprising aerogel particles may also optionally comprise fibres.

[0041] In such a mat, the fibres are preferably polymer fibres, mineral fibres, ceramic fibres, glass fibres or mixtures thereof. Most preferably they are mineral fibres.

[0042] Examples of mats comprising aerogel in the form of a particulate suitable for use in the present invention are described in US 6485805, US 6479416 and WO2006/065904.

[0043] It is also possible for the mat to be single block or sheet comprising from 20 to 95 weight % aerogel or a plurality of aerogel blocks or sheets combined to form the mat.

[0044] Whilst all aerogel materials are within the scope of the invention, 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.

[0045] 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.

[0046] The present invention is most useful in a partition wall that separates two interior rooms within a building. In such applications, it is important to provide good sound and thermal insulation, but also to provide a wall that has good strength, and is relatively thin, whilst also being economical to produce.

[0047] The wall of the present invention comprises two panels that define the surfaces of the wall. These panels may be any suitable panel, for example, gypsum plasterboards or chipboards. It is even possible for one of the panels to be in the form of a brick wall panel. However, it is preferred that the panels are gypsum plasterboards or gypsum fibreboards.

[0048] According to the present invention, a sheet of sound and/or thermal insulating material is located between panels. The sheet may be formed of any sound and/or thermal insulating material known in the art. However, due to its flexibility, and fire-resistant properties, it

is preferred that the sheet of insulating material is a man-made vitreous fibre batt. It is also possible, however, to incorporate aerogel into the sheet of insulating material.

[0049] Usually, the man-made vitreous fibre batt has a density of between 10 and 150 kg/m³, preferably between 20 and 100 kg/m³ and more preferably between 30 and 70 kg/m³.

[0050] Also positioned between the first and second panels is at least one elongate fixing element. Normally, the fixing element extends at least in part inboard of the edges of the first and second panels and extends beyond the edge of the sheet of insulation material. The fixing element usually has a spacer between the first side surface and the second side surface. The spacer serves to separate the two panels and provides space for the sheet of sound and/or thermal insulating material. The spacer usually extends in a plane substantially perpendicular to the first and second panels. In the building wall and method of the invention, the spacer may be of any suitable form. However, it is preferable that the spacer is in the form of a back-plate.

[0051] The fixing element also comprises first and second side surfaces, which are in a plane substantially parallel to the planes of the first and second panels and usually substantially perpendicular to the spacer, when the spacer is present. In general, the side surfaces may take any suitable form. In particular, the fixing element may be a simple block, wherein the central portion of the block is the spacer and the side surfaces are the surfaces of the block that face the first and second panels and are for affixing the side panels.

[0052] It is often preferred, however, especially where the spacer is in the form of back-plate, that the side surfaces are formed on side plates. Where the fixing element is in this form, with a spacer in the form of a back-plate and side surfaces formed on side plates, the fixing element may be in a number of forms. Two of the preferred forms are those of a C-profile or a U-profile, wherein the back-plate has two side-plates extending in the same direction, perpendicularly to and from each end of the back-plate. Other preferred forms are I-profiles and H-profiles wherein the ends of the back-plate are attached to substantially the centre of each side plate.

[0053] The fixing element may be made of any suitable metal, but it is usually made of steel.

[0054] According to the building wall and method of the present invention, the first panel is attached to the first side surface and the second panel is attached to the second side surface. The preferred manner of attachment will depend on the form and material of the respective panel and fixing element, and could be nails, rivets, staples or any other suitable means. However, in general the preferred method of fixing the side surfaces of the fixing element to each respective panel is with screws. Preferably, several mutually spaced screws are used.

[0055] Previously, where it has been desired to place insulation material between the fixing element and the board, it has sometimes been necessary to use a special

type of screw which provides a space between the fixing element and the panel for insulating material. Such screws generally have a diameter that is not uniform along the length of the shaft of the screw. In addition, the thread of the screw may not be substantially continuous along substantially the entire length of the shaft of the screw. These screws work by screwing into the fixing element where the diameter of the screw is small and into the panel where the diameter of the screw is large. However, the length of the screws and their non-uniform diameter may lead to a weaker structure than if a standard screw were used. Using these special screws may also increase the cost of the wall. Since the mat comprising aerogel of the present invention negates the need for such screws, as previously outlined, according to the present invention the panel is preferably attached to the fixing element with screws that have a substantially uniform diameter along substantially the entire length of the shaft of the screw. It is also preferred that the thread of the screw is substantially continuous along substantially the entire length of the shaft of the screw.

[0056] According to the wall and method of the invention, the mat comprising aerogel is positioned between the first side surface and the first panel. This positioning of the mat serves to decrease the transfer of heat and/or sound through the fixing element from one side of the wall to the other. Although the mat is only required to separate the first side surface from the first panel, it is also possible to further improve the insulation by providing a second mat comprising from 20 to 95 weight % aerogel positioned between the second side surface and the second panel, the mat having a compressive stress for 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa.

[0057] According to the wall and method of the invention, the aerogel mat may be fixed in position by any means. For example, the mat may be attached to the side surface of the fixing element with adhesive. Adhesive could also be used to fix the mat to a suitable point on the panel. Alternatively, it is possible for the mat to be held in place by the means that attach the panel to the side surface. As outlined above, screws are often used for this purpose and the screws may pass through the mat comprising aerogel, thereby fixing it in position relative to the fixing element and the panel.

[0058] Whilst it is possible according to the present invention for the mat comprising aerogel to extend across the entire area of the panel, this is not generally considered necessary due to the insulation material that is positioned in between the panels and between the fixing elements. Since the purpose of the mat is to prevent the transfer of heat and/or sound through the fixing element, it is generally the case that the mat does not extend across the entire area of the panel. It is preferred that the mat extends across no more than 30% of the respective panel and the mat often does not extend beyond the area

of the respective side surface of the fixing element.

[0059] Generally, more than one fixing element is required to hold the panels together. Therefore, it is preferred that the wall comprises at least one further fixing element parallel to and spaced from the first fixing element and outboard of the opposite edge of the sheet of insulation. Usually, the wall will comprise several fixing elements spaced from and parallel to each other with sheets of insulation between them. In such cases, it is preferred that each fixing element has a mat between its first side surface and the first panel.

[0060] Usually, the building wall will comprise a lattice of fixing elements.

[0061] According to the method of the invention, the steps may be carried out in any suitable order. One example of a suitable order is the order in which the steps are written in claim 11.

[0062] Alternatively, it is possible for the mat to be fixed to a suitable position on the first panel before the first panel is positioned and fixed to the first side surface of the fixing element. In this embodiment, the mat will be positioned on the first side surface of the fixing element at the same time as the first panel is positioned.

[0063] In another embodiment of the method, the second panel is positioned and fixed before the first panel is positioned and fixed. In this embodiment the sheet(s) of insulation are positioned before the first panel is positioned.

[0064] In all embodiments, the mat is positioned before, or at the same time as the first panel is positioned and fixed.

[0065] In one embodiment, the wall is assembled by positioning the panels and the sheet(s) of insulation in the following order:

positioning the first panel substantially parallel to the first side surface of the fixing element to form a first surface of the wall and fixing the first panel to the first side surface of the fixing element such that the mat is between the first panel and the first side surface of the fixing element;

positioning the at least one sheet of insulation in the plane of the wall adjacent to the at least one fixing element;

positioning the second panel substantially parallel to the second side surface of the fixing element to form a second surface of the wall and fixing the second panel to the second side surface of the fixing element such that the at least one fixing element and at least one sheet of insulation are between the first panel and the second panel,

wherein the mat is positioned on the first side surface before or at the same time as the first panel is positioned.

[0066] In another embodiment, the wall is assembled by positioning the panels and the sheet(s) of insulation in the following order:

positioning the second panel substantially parallel to the second side surface of the fixing element to form a second surface of the wall and fixing the second panel to the second side surface of the fixing element;

positioning the at least one sheet of insulation in the plane of the wall adjacent to the at least one fixing element;

positioning the first panel substantially parallel to the first side surface of the fixing element to form a first surface of the wall and fixing the first panel to the first side surface of the fixing element such that the mat is between the first panel and the first side surface of the fixing element and such that the at least one fixing element and at least one sheet of insulation are between the first panel and the second panel;

wherein the mat is positioned on the first side surface before or at the same time as the first panel is positioned.

[0067] In some embodiments, the sheet(s) of insulation are positioned before either panel is positioned and fixed, although these embodiments are not preferred.

[0068] The present invention also provides an elongate fixing assembly for holding at least one pair of panels in fixed parallel relationship as opposite surfaces of a wall, comprising an elongate fixing element, the elongate fixing element being formed of metal and comprising:

a spacer, and

first and second side surfaces formed respectively on first and second side plates and facing away from the opposing side plate and extending from substantially respective long edges of the spacer such that the planes of the first and second side surfaces are substantially parallel to each other;

and the elongate fixing assembly further comprising a mat comprising from 20 to 95 weight % aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa, the mat being fixed to the first side surface of the fixing element.

[0069] This fixing element assembly may be used in place of a standard fixing element to obtain a wall 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 wall and does not require the use of any special means such as special screws or spacers to provide a fixed gap between the panel and the fixing element. The assembly also has all of the advantages outlined for the method and wall of the present invention.

[0070] Furthermore any relevant preferred or optional feature of the wall or method of the present invention is also preferred in relation to the fixing element assembly, in particular the materials used for the fixing element and

the mat. The assembly may also comprise a further mat comprising from 20 to 95 wt % aerogel and having a compressive stress for 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa, fixed to the second side surface of the fixing element.

[0071] The present invention may be better understood with reference to the following drawings.

Brief Description of the Drawings

[0072]

Figure 1 shows a cross-sectional view of a building wall according to the present invention, where the fixing element is in the form of a C-profile.

Figure 2 shows a cross-sectional view of a building wall according to the present invention, where the fixing element is an I-profile.

Figure 3 shows a fixing assembly according to the present invention in cross-section.

Detailed Description of the Drawings

[0073] Figure 1 shows a building wall (1) with C-profiles as the fixing elements (2). The fixing elements (2) are made of metal. Steel is particularly preferred. The fixing elements have a spacer (7) in the form of a back-plate and a first side surface (8) and a second side surface (9) on the outer surfaces of respectively a first side plate (10) and a second side plate (11). The fixing elements (2) are positioned between a first panel (3) and a second panel (4) and are spaced apart from each other. The fixing elements (2) extend inboard (16) of the first and second panels (3, 4). Insulation sheets (5), preferably man-made vitreous fibre batts are positioned between the panels (3, 4) and between the fixing elements (2).

[0074] A mat (6) comprising from 20 to 95 % aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa is positioned between the first side surface (8) of the fixing elements (2) and the first panel (3).

[0075] Screws (12) are used to attach the first panel to the fixing element.

[0076] Figure 2 shows an alternative embodiment of the wall of the present invention. This embodiment shows a fixing element (2) in the form of an I-profile extending inboard (16) of and perpendicular to first and second panels (3, 4). The fixing element (2) in this case has a spacer (7) in the form of a back-plate and first and second side surfaces (8, 9) formed respectively on first and second side plates (10, 11). This embodiment shows two mats (6) comprising aerogel positioned between the first side surface (8) and the first panel (3) and between the second side surface (9) and the second side panel (4). Also

shown are screws (12) that fix the panels (3, 4) to the side surfaces (8, 9) and insulation sheets (5) both above and below the fixing element (2).

[0077] Figure 3 depicts a fixing element assembly (13) according to the present invention. The piece (13) comprises a fixing element, e.g. a U-profile (2) and a mat (6). The fixing element (2) has a spacer (7) in the form of a back-plate and a first side-plate (10) and a second side plate (11) attached to opposite end edges (14, 15) of the back-plate. Each side plate (10, 11) has a respective side surface (8,9) facing away from the opposite side-plate (10, 11). The mat (6) is fixed to the first side surface (8).

[0078] As will be appreciated by the skilled person the wall could be included in any kind of construction, e.g. on a ship or an oil rig, and is not restricted to a building.

Claims

1. A wall (1) comprising a first panel (3) and a second panel (4) defining the surfaces of the wall (1) and extending in planes substantially parallel to each other and a sheet of sound and/or thermal insulating material (5) located between the panels (3, 4);

at least one elongate fixing element (2) formed of metal positioned between the first and second panels (3, 4), and having;

first and second side surfaces (8, 9) arranged in a plane substantially parallel to the planes of the first and second panels (3, 4);

wherein the first panel (3) is attached to the first side surface (8);

the second panel (4) is attached to the second side surface (9); and

wherein a mat (6) comprising from 20 to 95 weight % aerogel is positioned between the first panel (3) and the first side surface (8) of the fixing element (2), the mat having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa.

2. A wall according to claim 1 in which the aerogel is in the form of a particulate.

3. The wall of claim 1 wherein the mat comprises a matrix of fibres impregnated with aerogel.

4. A wall according to claim 3, wherein the fibre matrix comprises polymer fibres, mineral fibres, ceramic fibres, glass fibres or mixtures thereof, preferably in the form of a wool.

5. A wall according to any preceding claim, wherein the first and second panels are gypsum plaster boards

or gypsum fibre boards.

6. The wall of any preceding claim, wherein a second mat comprising an aerogel is positioned between the second side surface of the fixing element and the second panel. 5
7. The wall of any preceding claim, wherein the first mat and, where applicable, the second mat extends across no more than 30% of the area of the respective panel. 10
8. The wall of any preceding claim, wherein the first mat and, where applicable, the second mat does not extend substantially beyond the edges of the first side surface and, where applicable, the second side surface of the fixing element. 15
9. The wall of any preceding claim further comprising at least one further fixing element parallel to and spaced from the first fixing element and outboard of the opposite edge of the sheet of insulation. 20
10. The wall of any preceding claim wherein the first panel is fixed to the first side surface of the fixing element by several mutually spaced screws which pass through the first panel and the mat into the first side surface, the screws preferably having shafts with a substantially uniform diameter along substantially their entire length. 25
30
11. A method for reducing thermal or sound transfer through a wall comprising in any suitable order the steps of: 35
 - providing a first panel and a second panel, and at least one sheet of sound and/or thermal insulation;
 - providing in the plane of the wall at least one elongate fixing element formed of metal and having first and second side surfaces substantially parallel to each other; 40
 - providing a mat comprising from 20 to 95 wt % aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum stress, having a compressive strength of at least 20 kPa; 45
 - positioning the mat on the first side surface of the fixing element; 50
 - positioning the first panel substantially parallel to the first side surface of the fixing element to form a first surface of the wall and fixing the first panel to the first side surface of the fixing element such that the mat is between the first panel and the first side surface of the fixing element; 55
 - positioning the at least one sheet of insulation in the plane of the wall adjacent to the at least

one fixing element;
positioning the second panel substantially parallel to the second side surface of the fixing element to form a second surface of the wall and fixing the second panel to the second side surface of the fixing element such that the at least one fixing element and at least one sheet of insulation are between the first panel and the second panel.

12. A method according to claim 11 further comprising independently any of the additional features of claims 2 to 10.

13. An elongate fixing assembly for holding at least one pair of panels in fixed parallel relationship as opposite surfaces of a wall, comprising an elongate fixing element, the elongate fixing element being formed of metal and comprising:
 - a spacer, and
 - first and second side surfaces formed respectively on first and second side plates and facing away from the opposing side plate and extending from substantially respective long edges of the spacer such that the planes of the first and second side surfaces are substantially parallel to each other;
 - and the elongate fixing assembly further comprising a mat comprising from 20 to 95 weight % aerogel and having a compressive stress at 10% compression of at least 20 kPa or, if 10% compression is not reached before the maximum compressive stress, having a compressive strength of at least 20 kPa, the mat being fixed to the first side surface of the fixing element.

14. An elongate fixing assembly of claim 13, further comprising independently any of the additional features of claims 2 to 4 or claim 8.

Figure 1

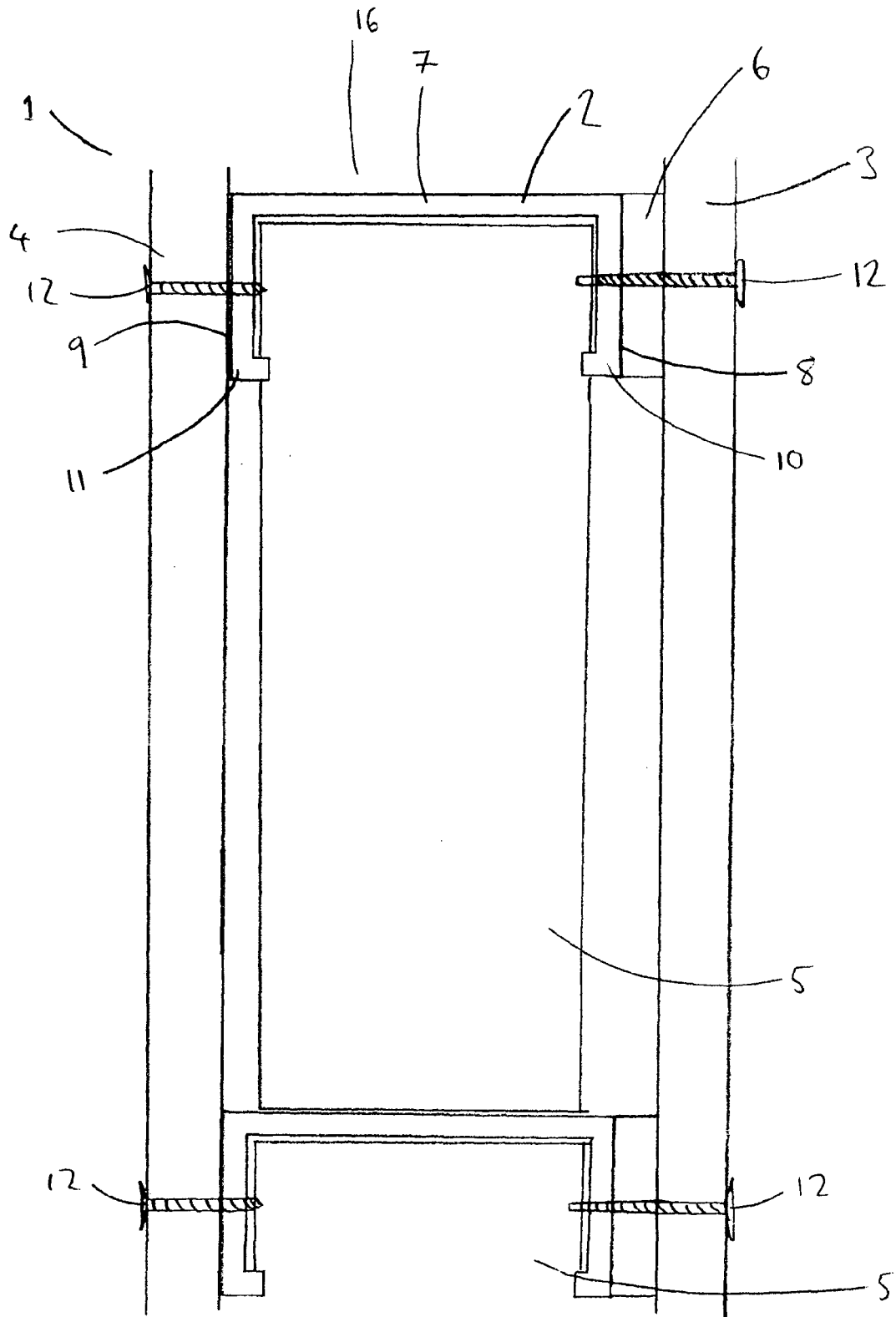


Figure 2

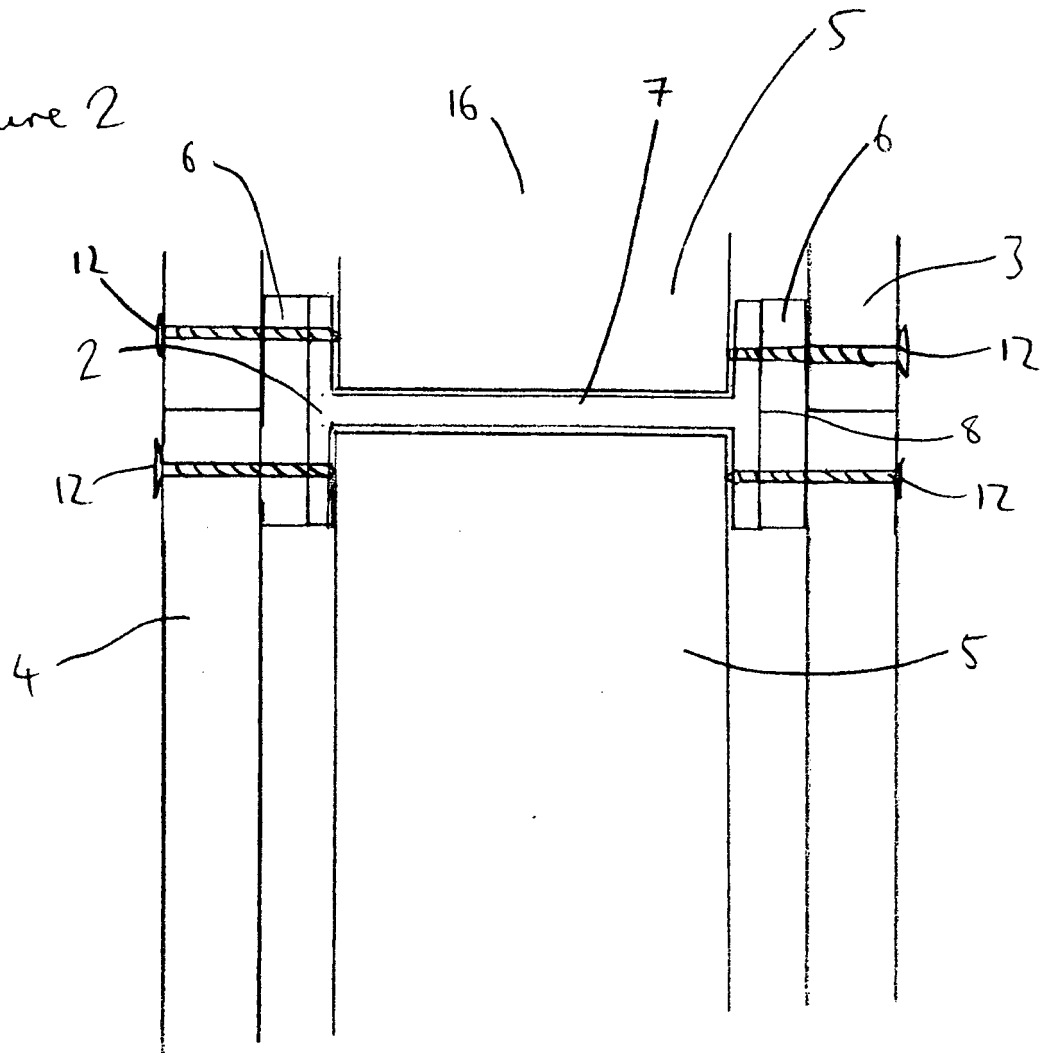
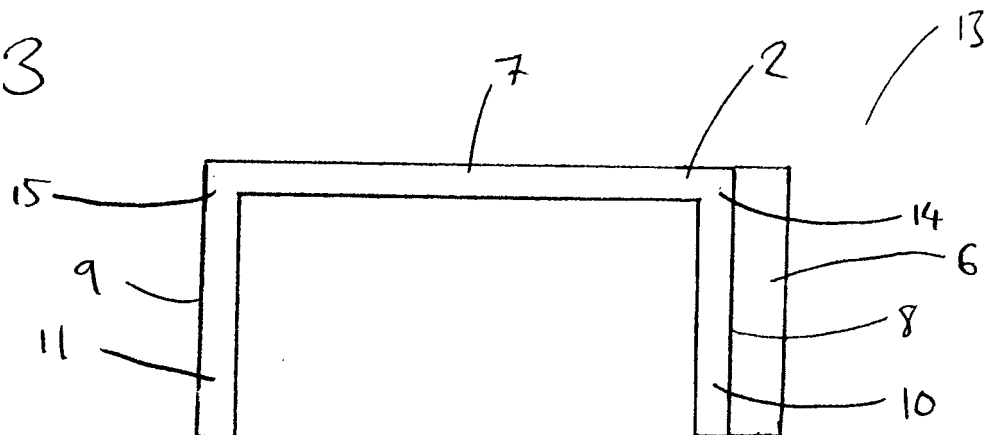


Figure 3





EUROPEAN SEARCH REPORT

Application Number
EP 08 25 3399

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EPO FORM 1503 03.82 (P04C01)

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