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US 4937125 A

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(54) Abstract Title: **Insulated timber frame building panel**

(57) The insulated timber framed building panel comprises interior 9 and exterior 10 sheathing board layers between which a first layer of heat insulating material 11 is interposed, with a breathable membrane layer 12 being provided on the exterior side of the exterior sheathing board layer and a second layer of heat insulating material 13 provided on the exterior side of the breathable membrane layer. A layer of cladding 14 is preferably secured via timber battens at a predetermined distance from the second layer of insulation to define a heat gap 15 between the insulation and the cladding. A heat reflective membrane 16 is preferably secured via timber battens 17 on an interior side of the interior sheathing layer and a second interior sheathing board 18 may be provided inwards of the heat reflective membrane. Adjacent edges of the interior and exterior sheathing boards preferably overlie the first layer of heat insulating material to form channels and projections at opposite sides of the panel to facilitate connection to adjacent panels or other structures. Also claimed is a method for fabricating an insulated timber framed building panel, a corner joint arrangement and a method of constructing said joint arrangement and an insulated timber framed building structure and a method of constructing said insulated timber framed building structure.

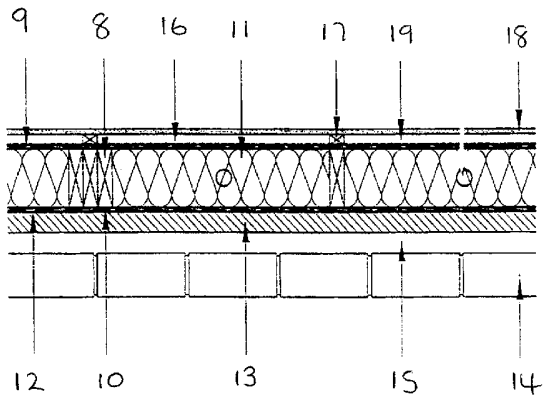

Figure 2

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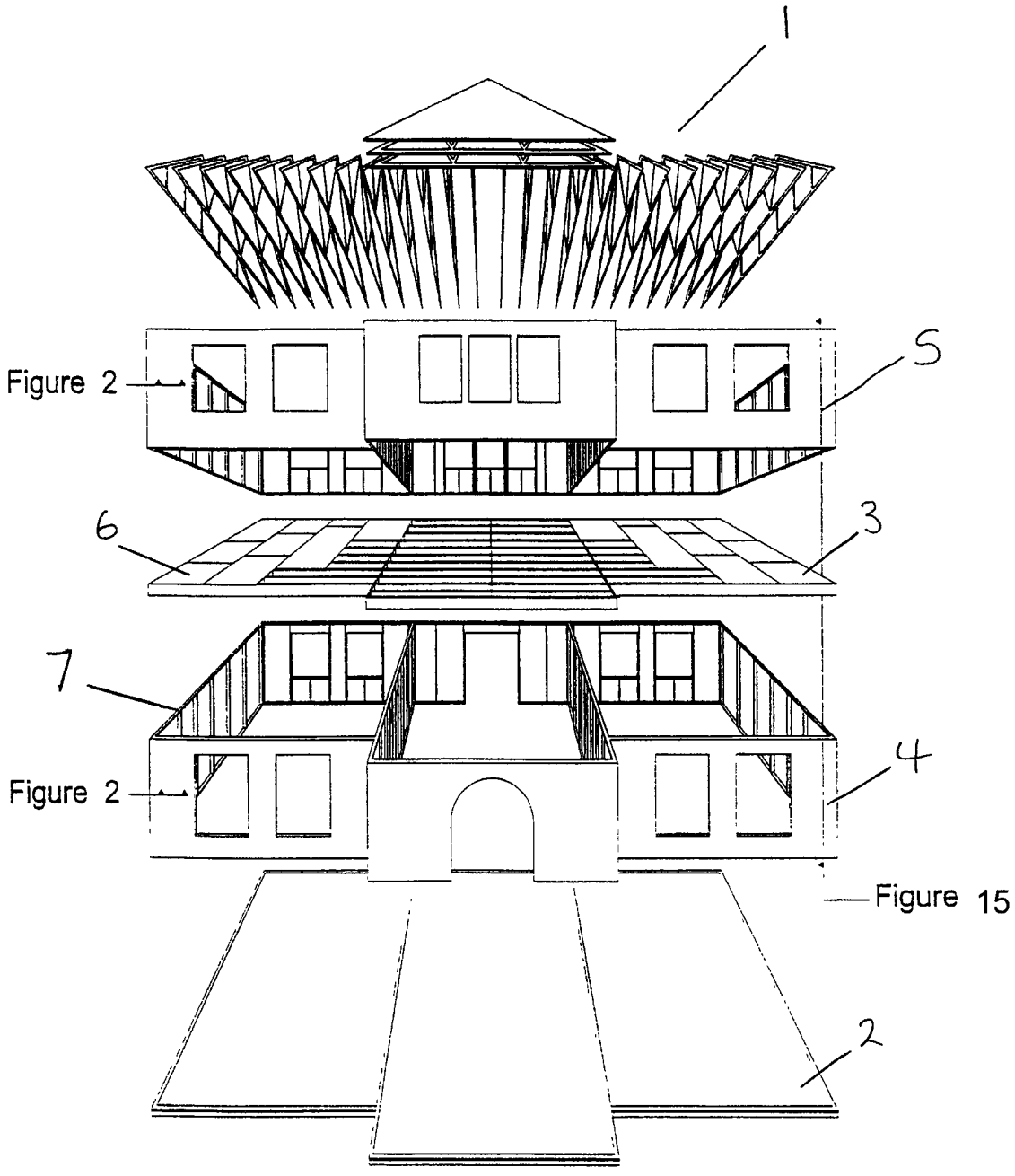


Figure 1

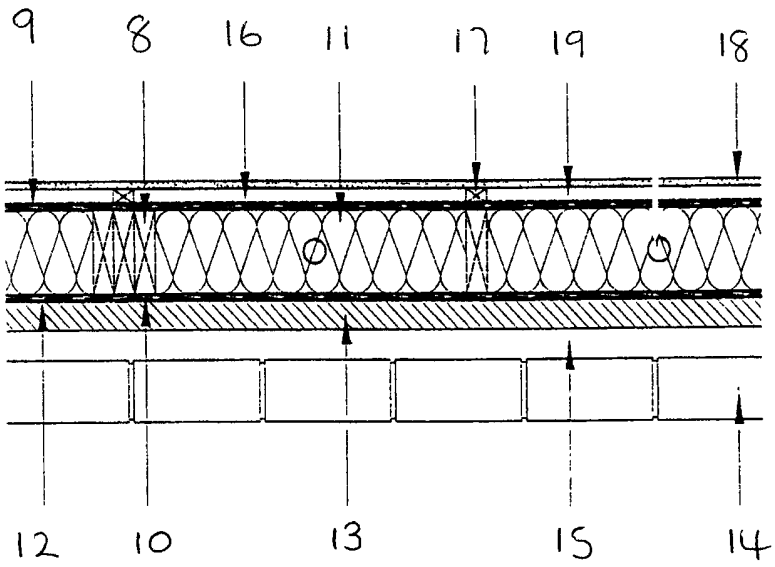


Figure 2

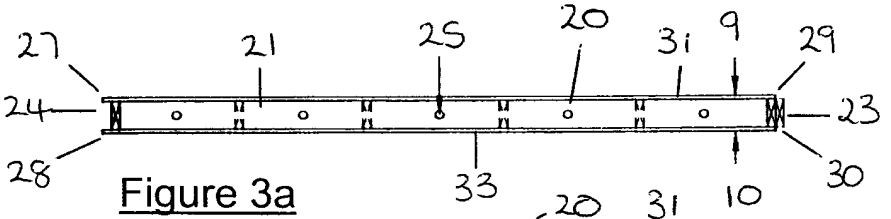


Figure 3a

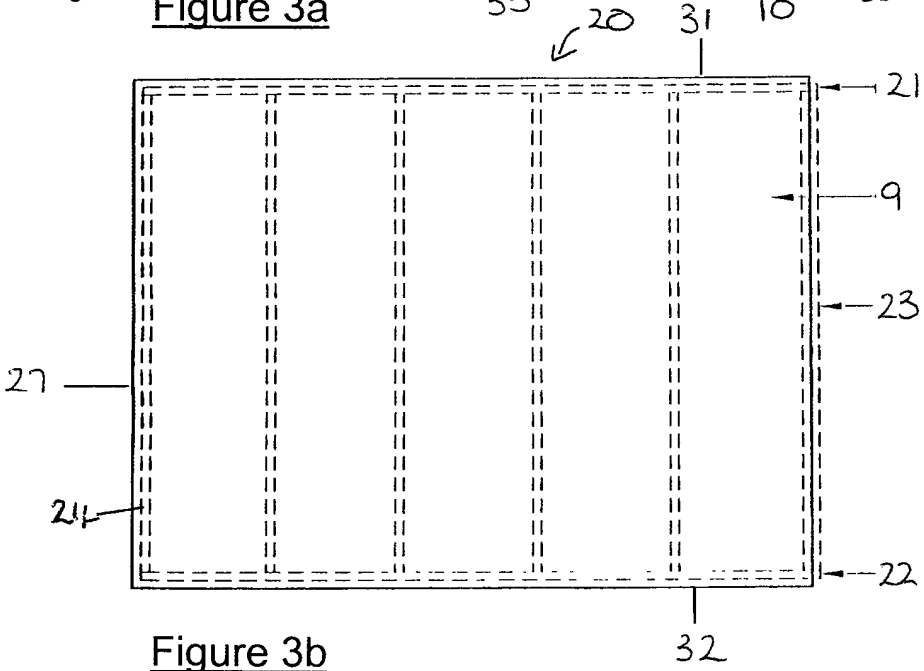


Figure 3b

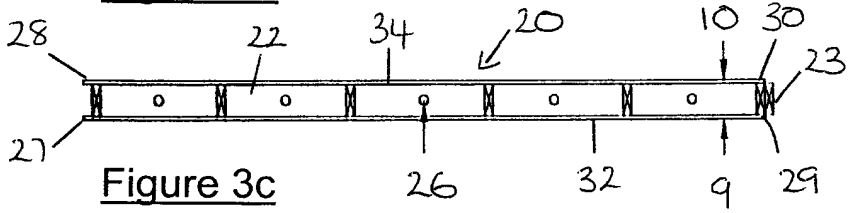


Figure 3c

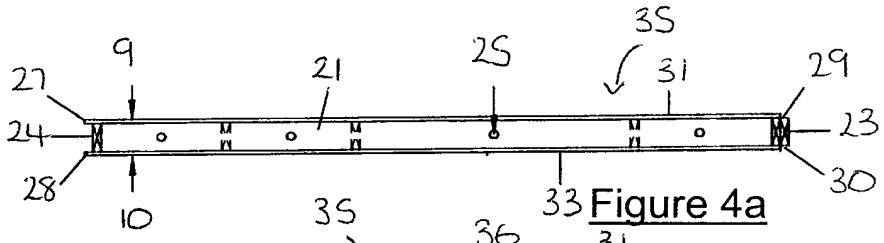


Figure 4a

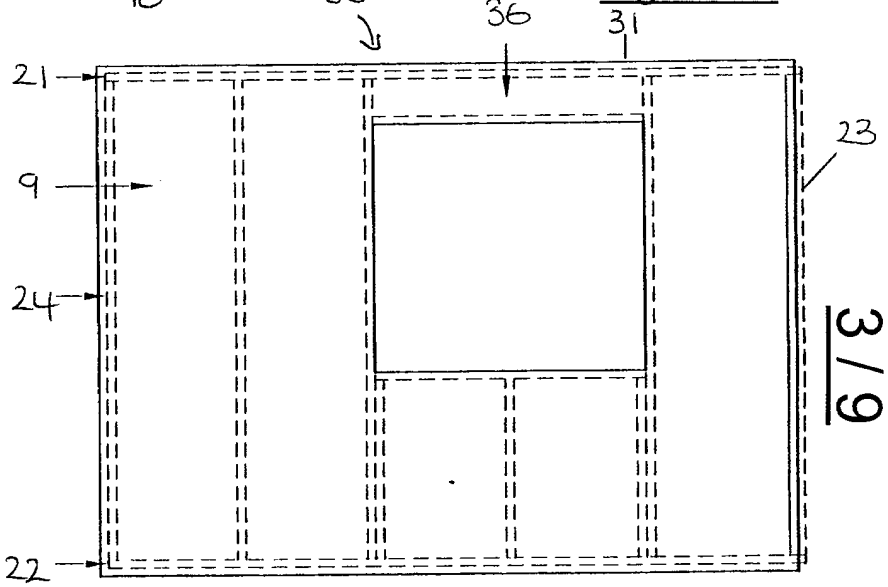


Figure 4b

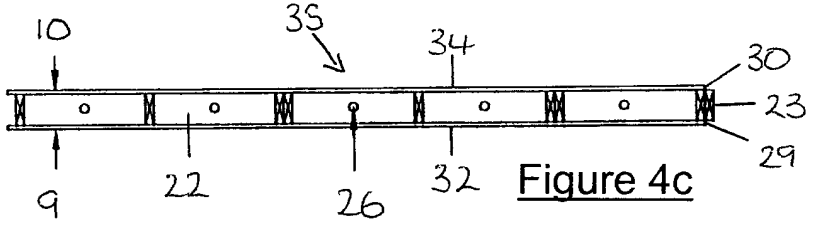
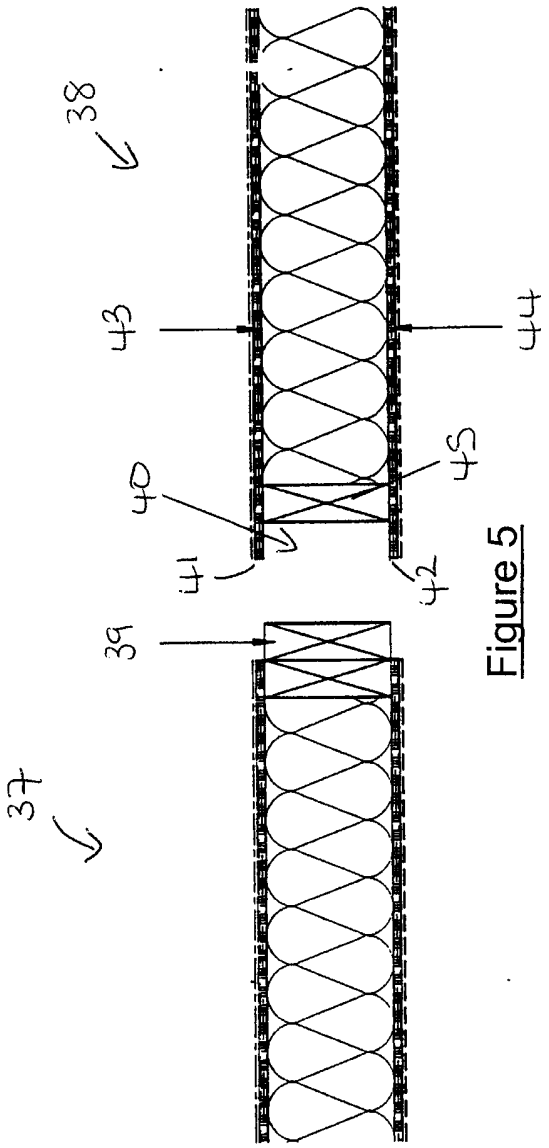


Figure 4c



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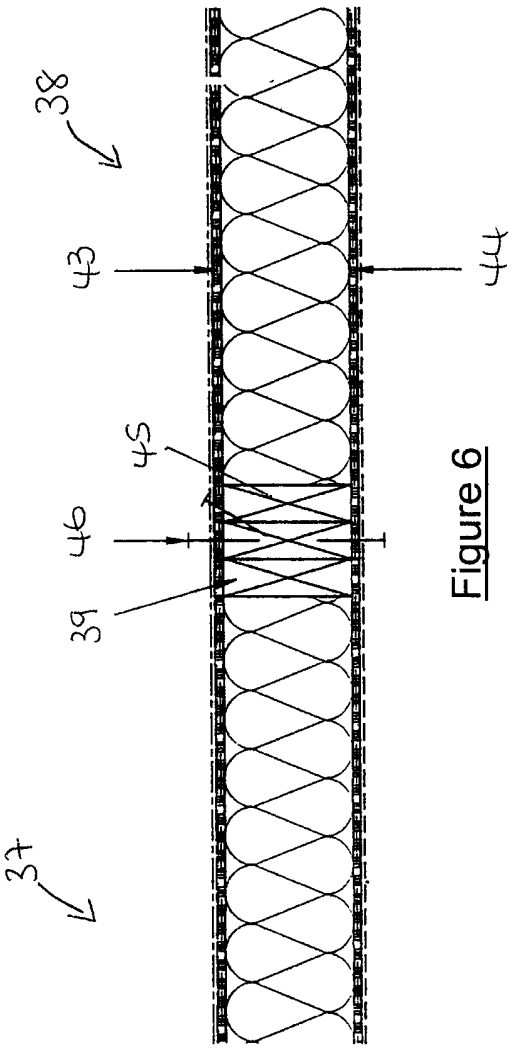

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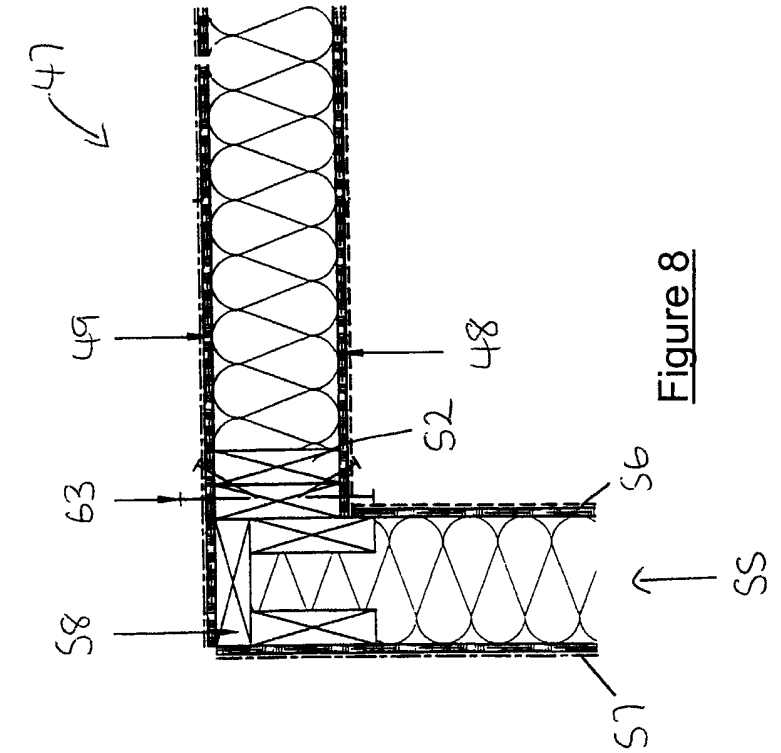

Figure 8

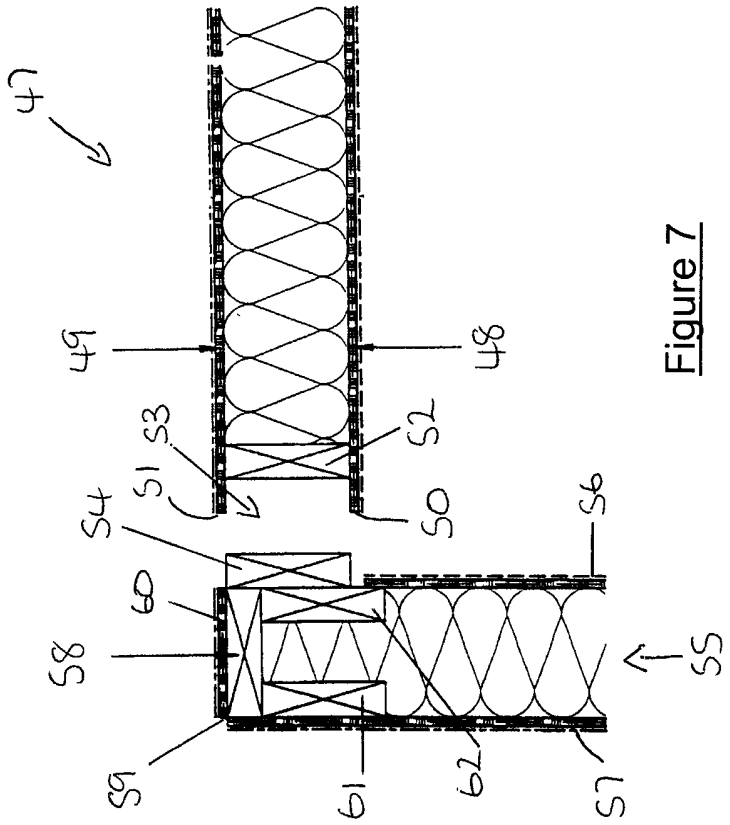

Figure 7

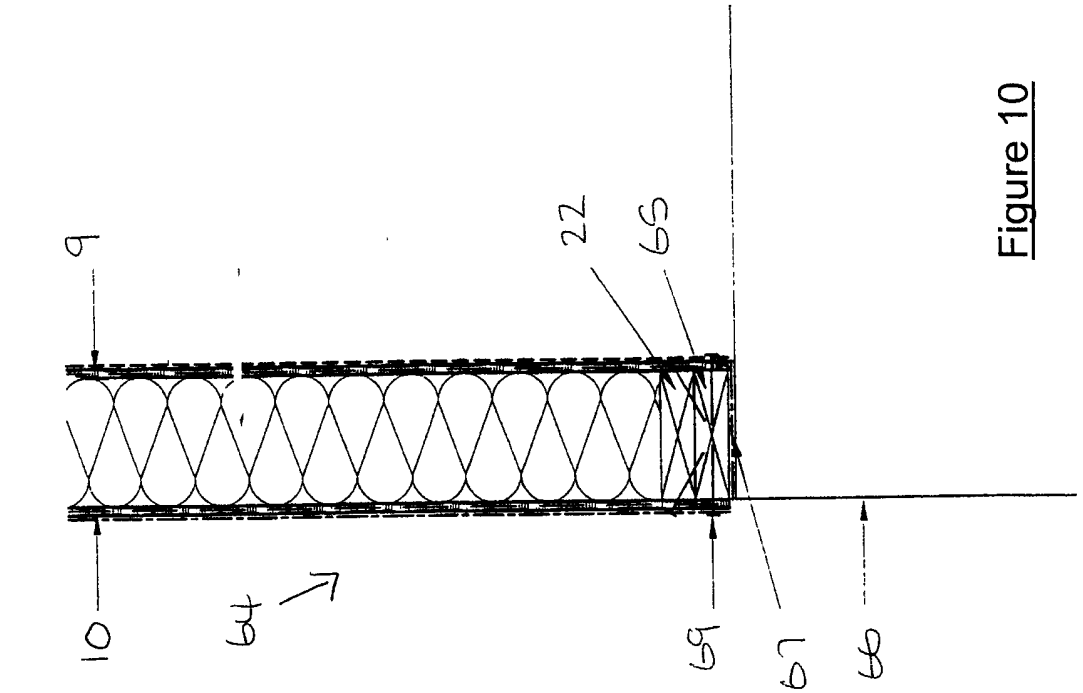

Figure 10

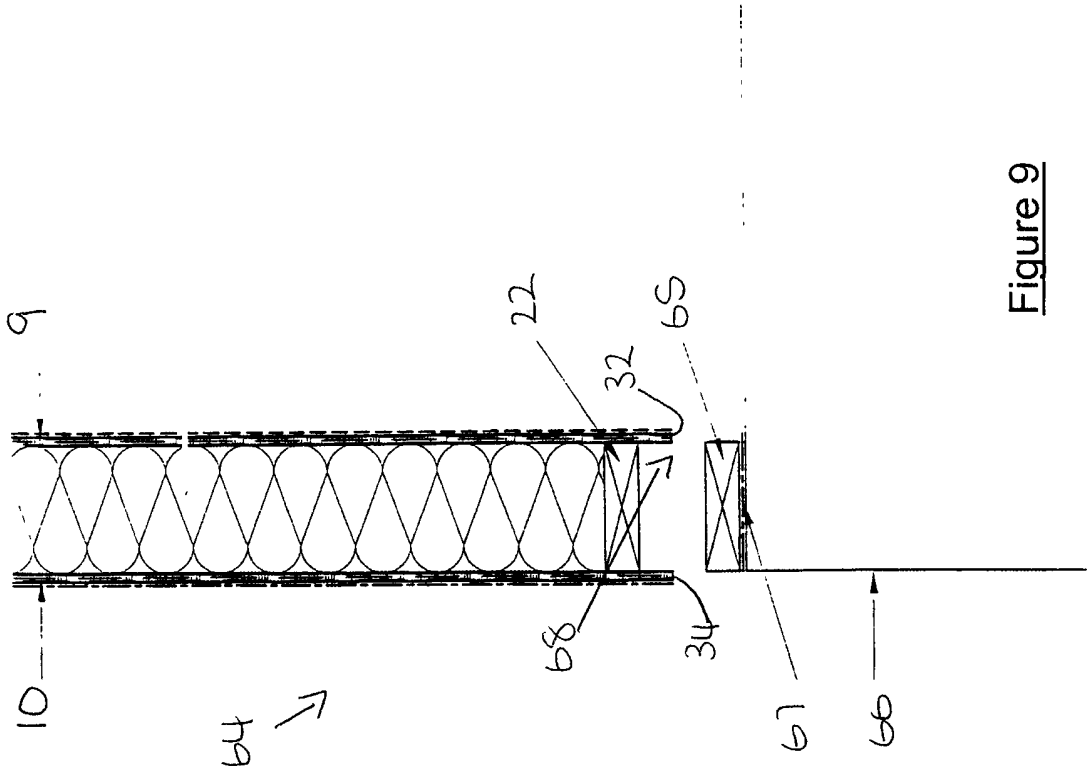

Figure 9

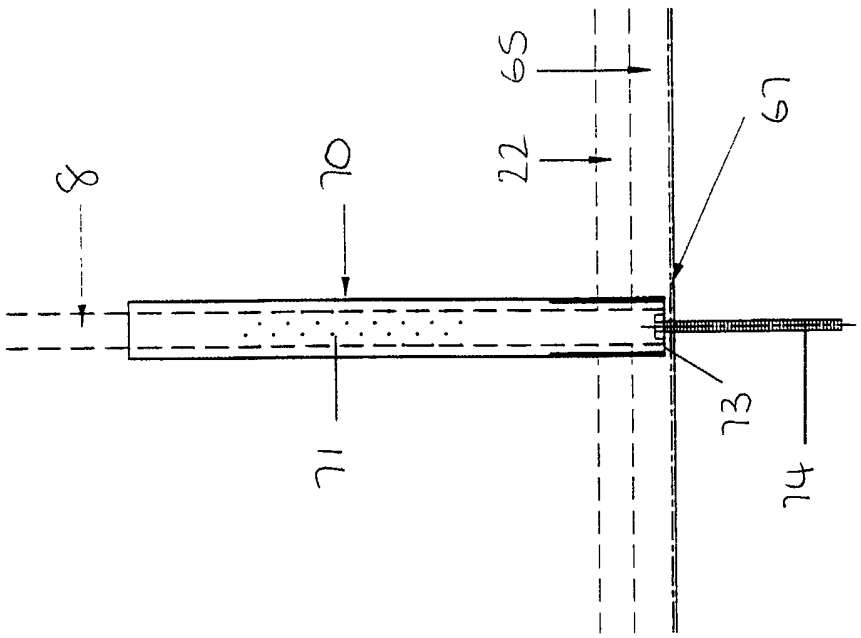

Figure 12

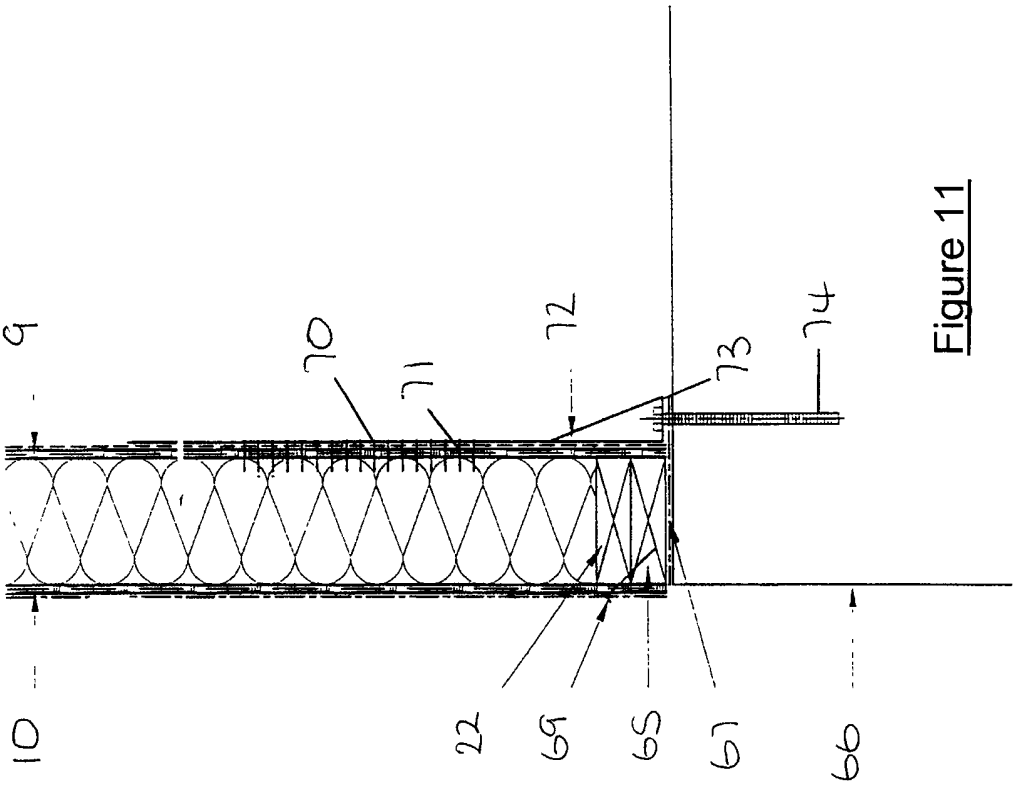

Figure 11

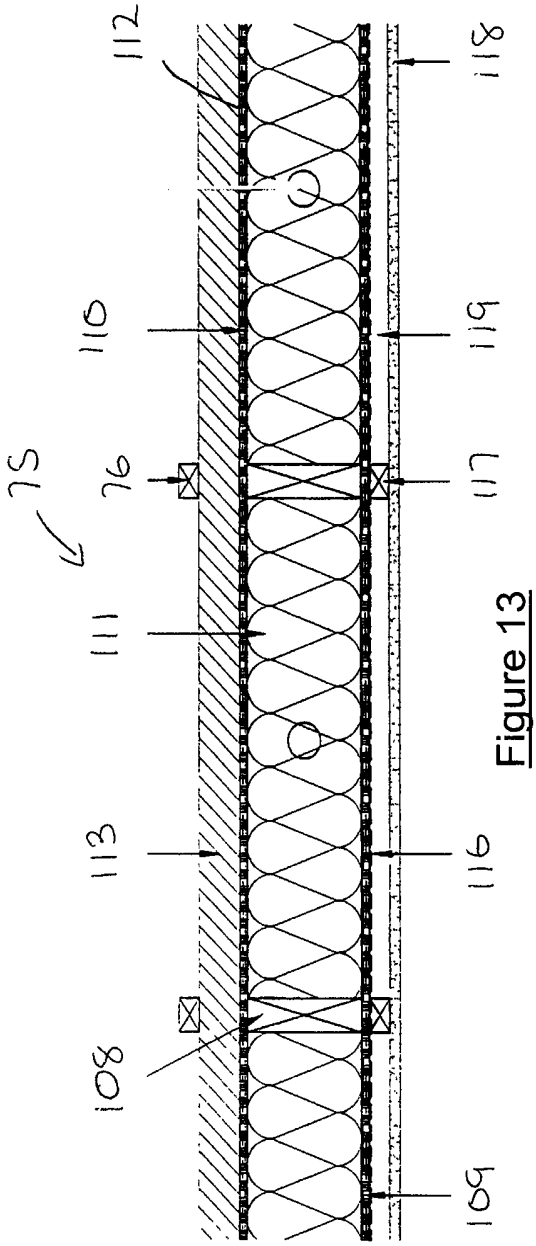

Figure 13

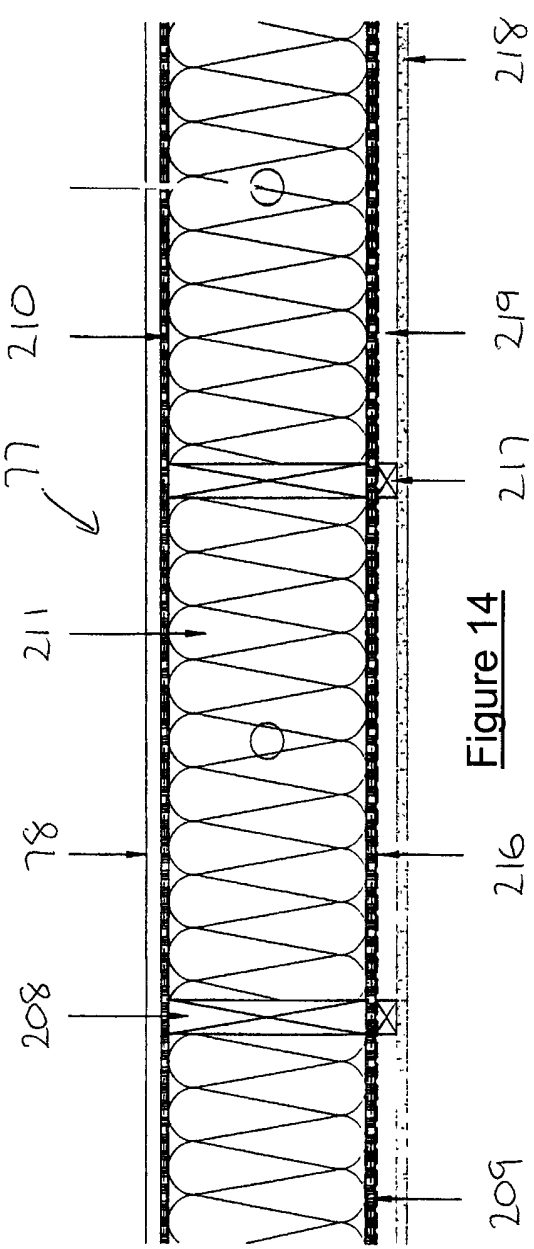

Figure 14

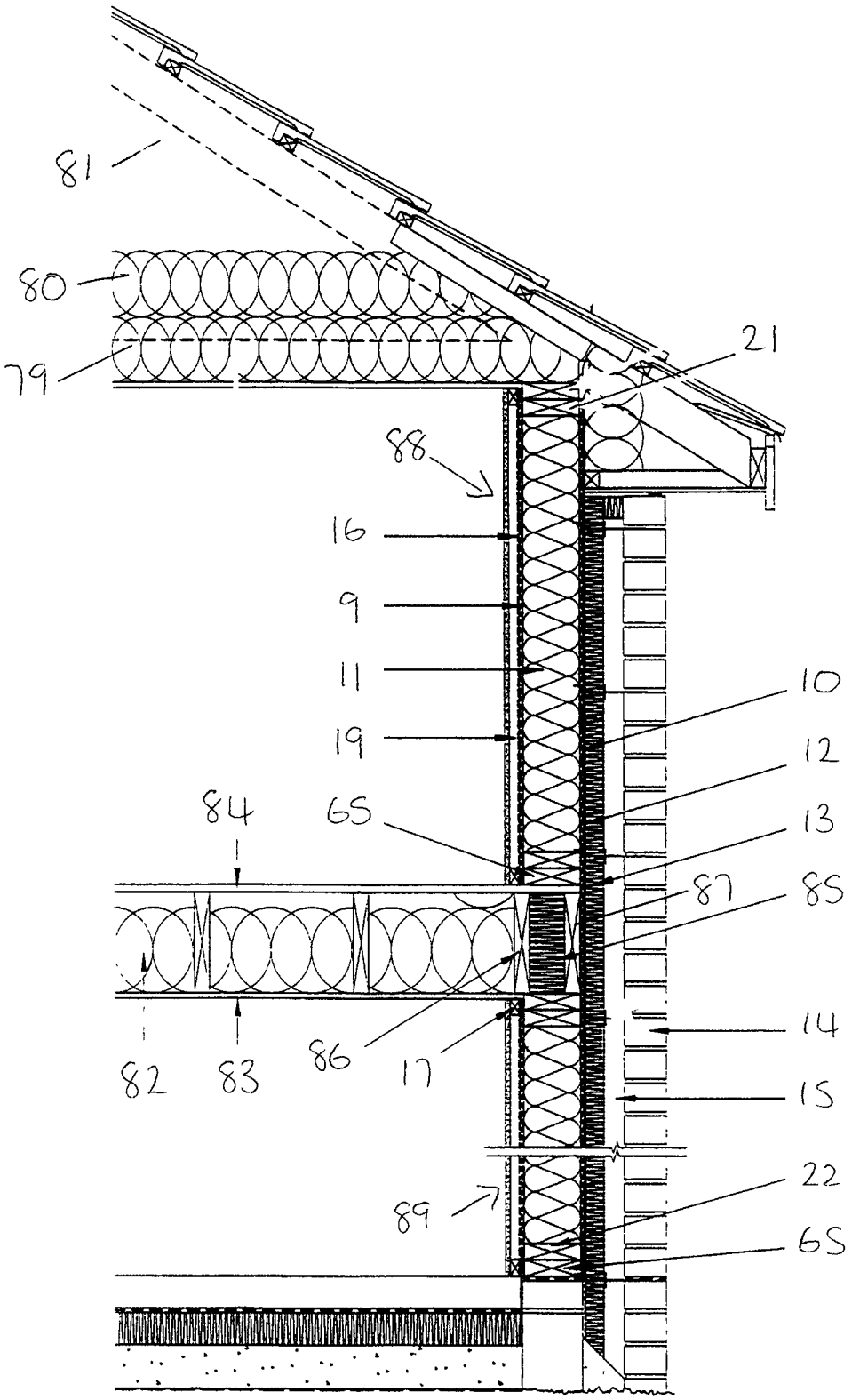

Figure 15

INSULATED TIMBER FRAMED BUILDING STRUCTURE AND COMPONENTS THEREOF

The present invention relates to an insulated timber framed building structure and components thereof, in particular an insulated timber framed building panel and a corner joint arrangement between a pair of insulated timber framed building panels.

Following the United Nations Convention for Climate Change held in Kyoto in December 1997 and subsequent annual summits, the conservation of energy has become a priority to all of the countries that entered the Kyoto protocol.

Many countries, including the United Kingdom, are improving energy conservation through revised building regulations. In the United Kingdom, the document 'Conservation of Fuel and Power' Part L1 from The Building Regulations 2000 (Revised 2002) imposes minimum heat loss targets for buildings in a series of phases. For example, the Regulations currently require an external wall to have a heat loss of no more than 0.35 W/m^2K but that will reduce to 0.25 W/m^2K in the final phase. Similar demands have been made to all aspects of new buildings in the United Kingdom. The increased demands placed on the constructions industry by The Building Regulations have lead to the need to develop new building systems which conform to or surpass the final phase targets.

Timber framed buildings have been well known for centuries and continue to be popular today, not least because they are typically cheaper and quicker to erect than similar masonry based buildings. Modular building systems have been developed which provide prefabricated building panels for the ceilings, floors and/or walls that can be assembled on-site relatively quickly and easily without requiring a highly skilled workforce. In view of the increasingly stringent energy conservation requirements placed on the manufacturers and suppliers of timber framed building components there is a need to develop an insulated timber framed building structure incorporating, for example, insulated timber framed building panels and

insulated corner joint arrangements, which possess the required level of insulation at a reasonable cost but which must also be relatively quick and cheap to assemble. None of the currently available solutions offer the required degree of insulation whilst also being affordable and quick and easy to assemble.

An object of the present invention is therefore to provide an improved building structure and components thereof which satisfy the above need.

A first aspect of the present invention provides an insulated timber framed building panel comprising interior and exterior sheathing board layers with a first layer of heat insulating material interposed between said sheathing board layers, wherein a breathable membrane layer is provided on an exterior side of the exterior sheathing board layer and a second layer of heat insulating material is provided on an exterior side of said breathable membrane layer.

This aspect of the invention provides an insulated timber framed building panel which exhibits a level of heat insulation which is more than sufficient to meet the requirements of the UK Building Regulations. It will be evident to the skilled person that the design of the inventive panel makes it eminently suitable to be used as a wall, roof, ceiling or floor panel.

A further related aspect of the present invention provides a method for fabricating an insulated timber framed building panel comprised of providing spaced apart interior and exterior sheathing board layers with a cavity defined between said interior and exterior sheathing board layers, providing a first layer of heat insulating material in said cavity, providing a breathable membrane layer on an exterior side of the exterior sheathing board layer and providing a second layer of heat insulating material on an exterior side of said breathable membrane layer.

Preferably the first layer of insulating material is provided by injecting a liquid form of the insulating material into the cavity and allowing the liquid insulating material to solidify within the cavity.

Preferably a layer of cladding is provided a predetermined distance from an exterior side of said second layer of heat insulating material to define a first heat insulating air gap between the cladding layer and the second layer of heat insulating material.

It is preferred that said layer of cladding is fixed to at least one timber batten which is fixed to said second layer of heat insulating material, such that said first heat insulating air gap is defined between the cladding layer, the second layer of heat insulating material and the at least one timber batten.

In a preferred embodiment a heat reflecting membrane layer is provided on an interior side of the interior sheathing board layer. A further interior sheathing board layer may be provided a predetermined distance from an interior side of said heat reflecting membrane layer to define a second heat insulating air gap between the further interior sheathing board layer and the heat reflecting membrane layer. Said further interior sheathing board layer may be fixed to at least one timber batten which is fixed to said heat reflecting membrane layer, such that said second heat insulating air gap is defined between the further interior sheathing board layer, the heat reflecting membrane layer and the at least one timber batten.

Preferably adjacent edges of the interior and exterior sheathing board layers overlie said first layer of heat insulating material by a predetermined distance to define a channel between the sheathing board layers extending along a first edge of the panel, said channel being configured for mating receipt of a first projection.

Appropriately, said channel has a depth which is approximately equal to a height of said first projection. Said first projection may be connected to a further insulated

building panel or may be connected to a building structure other than a further insulating panel, such as the foundations of the building undergoing construction. For example, the first projection may be a horizontal timber fixed to the building foundations or a vertical supporting timber. If necessary, anchoring means may be provided which connects the panel to the building structure, e.g. the foundations. The anchoring means may take any convenient form but it is envisaged that the anchoring means comprises a plate connected to a facing surface of one of the sheathing board layers of the panel and a lateral flange, bracket or the like which extends away from the plate and is configured for receipt of a suitable fixing, such as a screw, nail or bolt, which can be driven through the flange/bracket into the building structure. It is preferred that the anchoring means is provided adjacent an edge of the panel which is closest to the edge which is to be connected to the building structure, for example, when the panel is to be connected to the foundations of a building under construction it is preferable to provide the anchoring means adjacent to the bottom edge of the panel, whereas when the panel is to be connected to an overhead beam or joist, it is more appropriate to provide the anchoring means adjacent the top edge of the panel.

Preferably a second projection is provided along a second edge of said panel, which may be opposite to the first edge. The second projection may then be used to connect the panel to an adjacent panel having a suitably configured channel.

The inventive panel may be constructed to define channels or projections extending along any of the edges of the panel. For example, the panel may define channels extending along upper, lower and one of its side edges and define a lateral projection extending along the remaining side edge. In this way, the panel can be fixed in place by mating receipt of horizontal timbers connected to the framework of the building under construction in the upper and lower channels of the panel followed by insertion of the lateral projection in a channel defined in a first neighbouring panel and then receipt of a further lateral projection defined by a

second neighbouring panel in the channel extending along the other side edge of the panel.

At least one of the first and second layers of heat insulating materials may be selected from the group consisting of a polymer foam, a glass fibre-based material, a mineral wool and a cellulose-based material. The first layer of heat insulating material is preferably expanded polymer foam. Furthermore, the second layer of heat insulating material is preferably extruded polymer foam. Conveniently, the polymer is selected from the group consisting of polyurethane, polyethylene and polystyrene.

In a preferred embodiment of the invention at least one of the sheathing board layers is manufactured from a material selected from the group consisting of gypsum-based oriented strand board and plywood.

The breathable membrane layer may be a woven or non-woven textile material. The breathable membrane layer may be selected from the group consisting of a compressed or non-compressed fleece material, a felt material and a paper material. More preferably the breathable membrane layer is selected from the group consisting of polyethylene, polypropylene, polyester, polyamide, polycarbonate and polyvinylchloride.

Conveniently, the layer of cladding is selected from the group consisting of brickwork, stonework, rendering, tiling, hanging timber and cement-based boarding.

Preferably the heat reflecting membrane layer comprises a metalised layer, which may be selected from the group consisting of a metalised foil, a metal laminate or a metal vaneer. In a preferred embodiment the heat reflecting membrane comprises aluminium, although any suitable metal can be used.

Another aspect of the present invention provides a corner joint arrangement between first and second insulated timber framed building panels, each of said panels comprising a first facing surface and a first edge surface, wherein the corner joint arrangement comprises a projection which projects outwardly from the first facing surface of the second panel received in a channel defined by the first panel, said channel extending along the first edge surface of the first panel.

A related aspect of the present invention provides a method for constructing a corner joint arrangement between first and second insulated timber framed building panels, each of said panels comprising a first facing surface and a first edge surface, wherein the method comprises inserting a projection which projects outwardly from the first facing surface of the second panel into a channel defined by the first panel, said channel extending along the first edge surface of the first panel.

Preferably at least one of the first and second panels comprises interior and exterior sheathing board layers with a first layer of heat insulating material interposed between said sheathing board layers.

It is preferred that adjacent edges of the interior and exterior sheathing board layers of the first panel overlie said first layer of heat insulating material of the first panel by a predetermined distance to define said channel between the sheathing board layers extending along the first edge surface of the first panel.

In a preferred embodiment when the projection is received in the channel the adjacent edges of the interior and exterior sheathing board layers of the first panel abut the first facing surface of the second panel.

Preferably said projection is provided near the edge surface of the second panel. Said edge surface of the second panel is preferably provided with a layer of heat

insulating material. It is preferred that said channel has a depth which is approximately equal to a height of said projection.

A plane of the first facing surface of the first panel is preferably substantially perpendicular to a plane of the first facing surface of the second panel. In this way, the first and second panels form a substantially right-angled corner joint arrangement.

At least one of the first and second panels is preferably an insulated timber framed building panel as hereinbefore described.

A still further aspect of the present invention provides an insulated timber framed building structure comprising first and second load bearing timber joists which are spaced apart to define a cavity between said first and second joists, wherein heat insulating material is provided in said cavity.

A related aspect of the present invention provides a method for constructing a timber framed building structure comprising providing a first load bearing timber joist, providing a second load bearing timber joist spaced apart from said first joist to define a cavity between said first and second joists, and providing heat insulating material in said cavity.

Appropriately, the heat insulating material is selected from the group consisting of a quilted material, a polymer foam, a glass fibre-based material, a mineral wool and a cellulose-based material.

It is preferred that the timber framed building structure comprises at least one insulated timber framed building panel in accordance with the insulated timber framed building panel as hereinbefore described. The timber framed building structure may comprise at least one corner joint arrangement between first and second insulated timber framed building panels as hereinbefore described.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is an exploded front view of a two storey insulated timber framed building in accordance with an aspect of the present invention;

Figure 2 is a plan section view through an insulated timber framed building panel in accordance with an aspect of the present invention;

Figures 3a-3c are top, side and bottom views of an insulated timber framed building panel in accordance with an aspect of the present invention;

Figures 4a-4c are top, side and bottom views of a further embodiment of an insulated timber framed building panel in accordance with an aspect of the present invention having a window aperture defined therein;

Figure 5 is a plan section view of a pair of insulated timber framed building panels in accordance with an aspect of the present invention in which one of the panels has a male part configured for receipt within a female part defined by the other panel;

Figure 6 is a plan section view of the panels of figure 5 after mating receipt of the male part of one panel within the female part of the other panel;

Figure 7 is a plan section view of a pair of insulated timber framed building panels in accordance with an aspect of the present invention in which one of the panels has a male part projecting outwardly from a facing surface of that panel for receipt within a female part defined by the other panel.

Figure 8 is a plan section view of the panels of figure 7 after mating receipt of the male part of one panel within the female part of the other panel to form a corner joint arrangement;

Figure 9 is a vertical section through an insulated timber framed wall panel in accordance with an aspect of the present invention having a female part defined at a lower end of the panel configured for mating receipt of a male part which is fixed to the foundations of a timber framed building structure;

Figure 10 is a plan section view of the panels of figure 9 after mating receipt of the male part of one panel within the female part of the other panel;

Figure 11 is a vertical section through an insulated timber framed panel fixed to the foundations of a building structure in the same way as shown in figure 10 but having additional anchoring means;

Figure 12 is a vertical section front view of the panel and additional anchoring means of figure 11;

Figure 13 is a plan section view of an insulated timber framed roof panel in accordance with an aspect of the present invention;

Figure 14 is a plan section view of an insulated timber framed floor panel which is not in accordance with the present invention but which shares many features with a panel in accordance with an aspect of the present invention; and

Figure 15 is vertical section through a two storey insulated timber framed building in accordance with an aspect of the present invention.

Figure 1 shows a two storey insulated timber framed building 1 in which the ground and first-floor flooring 2, 3 and the ground and first-floor exterior walls 4, 5

are formed from a plurality of insulated timber framed floor and wall panels 6, 7 respectively in accordance with an aspect of the present invention. A plurality of roof panels in accordance with an aspect of the present invention also form part of the building shown in figure 1 but these have been omitted for clarity.

Figure 2 provides a more detailed plan section view of the wall panel 7 of figure 1. The panel 7 has a timber framework comprising a series of spaced vertical timbers 8. Interior 9 and exterior 10 sheathing boards made from oriented stand board are fixed to opposite sides of the timbers 8 using metal fixing (not shown), which defines a series of cavities between the interior and exterior sheathing boards 9, 10 and timbers 8. Expandable polyurethane foam insulation 11 has been injected into the cavities such that, upon expansion, the foam insulation substantially fills the cavities.

The panel 7 further comprises a breather membrane 12 fixed to the exterior side of the exterior sheathing board 10 with stainless steel staples (not shown). A layer of extruded polyurethane foam insulation 13 is provided to the exterior side of the breather membrane 12 and is fixed to the vertical timbers 8 with metal fixings (not shown) via the breather membrane 12 and exterior sheathing board 10. A layer of external cladding 14 is fixed to the exterior of the panel 7 a predetermined distance from the layer of extruded polyurethane foam insulation 13 so as to define a heat insulating air gap 15.

The insulated panel 7 further comprises a heat reflecting membrane 16 fixed to the interior side of the interior sheathing board 9. A series of timber battens 17 are fixed to vertical timbers 8 by the insertion of metal fixings (not shown) through the membrane 16 and sheathing board 9. An internal layer of Gypsum-based wall board 18 is fixed to the timber battens 17 so as to define a further heat insulating air gap 19, which may be used to house wiring and/or pipework (not shown) for electrical and/or plumbing services.

The construction of the insulated panel 7 as shown in figure 2 reduces heat losses to as low as 0.112 W/m^2, which is more than sufficient to meet the requirements set out in Part L1 of the 'Conservation of Fuel and Power' document from the UK Building Regulations 2000 (Revised 2002). The construction of the panel 7 is also sufficiently strong to provide a greater amount of load bearing capacity than many comparable building panels.

The panel 7 may be provided on site in a fully assembled state or a part-assembled state as appropriate. For example, as shown in figures 3a to 12, a part-assembled panel can be delivered on site consisting of just the interior and exterior sheathing boards 9, 10, inner layer of expanded polyurethane foam insulation 8, heat reflector membrane 16 and breather membrane 12. The part-assembled panel can then be connected to adjacent panels and/or other building structures (as described in relation to figures 9-12) and provided with the remaining layers (wallboard 18, extruded polyurethane foam 13 and cladding 15) to provide a fully assembled panel. The part-assembled panel can be connected to the adjacent panels or building structures before or after provision of one or more of the remaining insulated layers.

Referring now to Figures 3a-3c, a part assembled panel 20 is shown from top, side and bottom views respectively. As can be seen from figures 3a-3c, the top, bottom and side edges of each panel are enclosed with timbers 21-24 which completely enclose the layer of expanded polyurethane foam insulation 11. A series of apertures 25, 26 are defined in the top and bottom timbers 21, 22 respectively. The apertures 25 defined in the top timber 21 are designed to permit ingress of expandable polyurethane foam insulation in its liquid form to expand to fill the cavities defined between the sheathing boards 9, 10 and timbers 8. The apertures 26 are provided to allow air to be expelled from the cavities during ingress of the expandable polyurethane foam insulation 11. For reasons described in more detail in relation to figures 5 and 6, vertical timber 24 is offset from edges 27 and 28 of the interior and exterior sheathing boards 9, 10, and the vertical timber 23 actually

consists of a pair of vertical timbers corresponding to the width of vertical timbers 8 such that timber 23 extends outwardly from edges 29 and 30 of interior and exterior sheathing boards 9, 10. The top and bottom edges 31, 32 of the interior sheathing board and the top and bottom edges 33, 34 of the exterior sheathing board extend past the top and bottom timbers 21, 22 for reasons described in greater detail in relation to figures 9-12.

Figures 4a-4c show a further embodiment of a part-assembled panel 35 which corresponds to panel 20 of figures 3a-3c but which defines a window aperture 36.

Figures 5 and 6 show the edge detail of a pair of part-assembled panels 37, 38 (which correspond to panel 20 of figures 3a-3c) before and after connection to one another. Panel 37 has a pair of vertical timbers 39 which define a male part projecting from an edge of the panel 37 which is sized for mating receipt in a channel 40 defined between the overlying edges 41, 42 of interior and exterior sheathing boards 43, 44 (similar to edges 27 and 28 of panel 20 in figures 3a-3c) and vertical timber 45 (similar to vertical timber 24 of panel 20 in figure 3a-3c). Following insertion of male part 39 into channel 40, as shown in figure 6, a series of metal fixings 46 are inserted through the interior and exterior sheathing boards 43, 44 to secure panels 37 and 38 together. To complete assembly of the panels 37, 38, the outstanding layers of wallboard, foam, insulation and cladding are fixed in place.

Figures 7 and 8 illustrate the construction of a corner joint arrangement forming a further aspect of the present invention. In figure 7, a part-assembled panel 47 (corresponding to panel 20 of figures 3a-3c) has interior and exterior sheathing boards 48, 49. Overlying edges 50, 51 of boards 48, 49, together with vertical timber 52, define a channel 53 configured for receipt of timber 54 which is connected to a second panel 55 near an edge of the panel 55 and is arranged so as to project outwardly from the facing surface of the panel 55. Panel 55 comprises interior and exterior sheathing boards 56 and 57, and a vertical timber 58 (similar

to vertical timber 23 in figures 3a-3c) along an edge of the panel 55. Panel 55 differs from the basic construction of panel 20 of figures 3a-3c in that timber 58 is located flush with edge 59 of the exterior sheathing board 57. Vertical timber 58 is provided with a further section of sheathing board 60 together with layers of breather membrane and extruded polyurethane foam insulation (not shown) so as to insulate the edge of the panel. A further pair of vertical timbers 61, 62 are connected to vertical timber 58 and exterior and interior sheathing boards 57, 56 so as to form a framework to which vertical timber 54 is connected. Interior sheathing board 56 and the associated interior layers of insulation stop short of the timber 58 so as to provide a suitable clearance to accommodate the timber 54 which projects outwardly from the internal surface of the panel 55.

Figure 8 illustrates a corner joint arrangement formed between panels 47 and 55 by insertion of male part 54 into channel 53 followed by insertion of a series of metal fixings 63 through the layers of insulation and sheathing boards 48, 49 into male part 54. In this way a pair of panels in accordance with the present invention can be connected to form an insulated corner joint arrangement.

Figures 9 and 10 illustrate the connection of a part-assembled vertical panel 64 (corresponding to panel 20 of figures 3a-3c) to a horizontal timber 65 connected to foundations 66 of building 1 via damp proof course 67. The timber 65 acts as a male part which is configured for mating receipt within a channel 68 defined along the bottom edge surface of panel 64 between bottom edges 32, 34 of interior and exterior sheathing boards 9, 10 and horizontal bottom timber 22. Figure 10 illustrates the arrangement of figure 9 following receipt of timber 65 within channel 68 and the insertion of a series of metal fixings 69 through sheathing boards 9 and 10 into timber 65.

Figures 11 and 12 are side and front views of additional anchoring means which can be used to further reinforce the connection of panel 64 of figures 9 and 10 to the foundations 66. The additional anchorage means comprises a vertically

extending plate 70 which sits flush against the facing surface of interior panel 9 and is held in contact with the panel 64 by a series of metal fixings 71. A bracket 72 having a triangular cross section is connected to the bottom of plate 70 and has a laterally extending flange 73 which defines an aperture (not shown) for receipt of a bolt 74 to be driven through the aperture and into the foundations 66 of the building 1 via damp course 67.

Figure 13 illustrates a roof panel 75 in accordance with an aspect of the present invention in which components corresponding to those of panel 7 of figure 2 take the same reference numeral but increased by 100. The only significant difference between panel 75 and panel 7 is that a series of timber battens 76 are fixed to timber battens 108 by insertion of metal fixings (not shown) through extruded polyurethane foam layer 113 and breather membrane layer 112 to allow roof cladding (not shown) to be attached to the panel 75 to define a heat insulating air gap (not shown) between the roof cladding and the layer of extruded polyurethane foam 113.

While panels having the basic construction of panel 7 may be used as floor panels, as shown in figure 1, figure 14 illustrates an example of a floor panel 77 which shares many features with panels in accordance with the present invention but which does not fall within the scope of the present invention. The components of floor panel 77 shown in figure 14 corresponding to those of panel 7 in figure 2 take the same reference numerals but increased by 200. Panel 77 differs primarily from panel 7 in that no breather membrane or extruded polyurethane foam insulation is provided on the exterior sheathing board 210. These components are replaced with a layer of flooring 78 fixed directly to exterior sheathing board 210.

Figure 15 illustrates a section view through the insulated timber framed building 1 of figure 1. Components shown in figure 15 corresponding to components described in more detail in relation to figures 2 to 14 retain the same reference numerals for ease of reference. The building components shown in figure 15 not

previously described in relation to figures 1-14 are the use of multiple layers of quilt insulation 79, 80 provided in roof space 81, a layer of quilt insulation 82 provided in a space defined between ceiling panel 83 and floor panel 84 and the provision of a layer of quilt insulation 85 provided in a cavity defined between load bearing joists 86 and 87. The joists 86 and 87 extend horizontally and support ceiling panel 83 and floor panel 84 in addition to upper and lower wall panels 88 and 89 having the construction of panel 7 (shown in detail in figure 2). The provision of a layer of heat insulating material in the cavity defined between a pair of load bearing timber joists further enhances the overall heat insulation properties of the building 1 and forms a further aspect of the present invention.

The present invention provides a closed panel system which can be preassembled at the factory and simply erected on site, which ensures that the panel performs as desired rather than the performance being partly dependant upon skilled assembly on site. It is envisaged that the exceptional heat insulation properties of the inventive panel will significantly reduce heating costs which will provide both financial and environmental benefits.

It will be understood that numerous modifications can be made to the embodiments of the invention described above without departing from the underlying inventive concept and that these modifications are intended to be included within the scope of the invention. For example, the size and shape of the insulated timber framed panel may be adapted to suit any particular application. Moreover, the thicknesses of the various layers forming the insulated panel may be chosen to provide appropriate heat and/or acoustic insulating performance in different situations, for example, thicker layers of expanded polyurethane foam insulation may be used to improve heat insulation due to convection and/or conduction of heat, and a particular heat reflecting membrane may be chosen which exhibits a high level of heat reflection if it is desired to reduce heat transfer across the panel due to thermal radiation. As previously stated the insulated timber framed panel can be used as a wall panel, ceiling/roofing panel and/or a flooring panel. The performance of the

panel can be adapted to suit each of these different applications by appropriate selection of the properties of the various layers making up the panel.

CLAIMS

1. An insulated timber framed building panel comprising interior and exterior sheathing board layers with a first layer of heat insulating material interposed between said sheathing board layers, wherein a breathable membrane layer is provided on an exterior side of the exterior sheathing board layer and a second layer of heat insulating material is provided on an exterior side of said breathable membrane layer.

2. A panel according to claim 1, wherein a layer of cladding is provided a predetermined distance from an exterior side of said second layer of heat insulating material to define a first heat insulating air gap between the cladding layer and the second layer of heat insulating material.

3. A panel according to claim 2, wherein said layer of cladding is fixed to at least one timber batten which is fixed to said second layer of heat insulating material, such that said first heat insulating air gap is defined between the cladding layer, the second layer of heat insulating material and the at least one timber batten.

4. A panel according to claim 1, 2 or 3, wherein a heat reflecting membrane layer is provided on an interior side of the interior sheathing board layer.

5. A panel according to claim 4, wherein a further interior sheathing board layer is provided a predetermined distance from an interior side of said heat reflecting membrane layer to define a second heat insulating air gap between the further interior sheathing board layer and the heat reflecting membrane layer.

6. A panel according to claim 5, wherein said further interior sheathing board layer is fixed to at least one timber batten which is fixed to said heat reflecting membrane layer, such that said second heat insulating air gap is defined between

the further interior sheathing board layer, the heat reflecting membrane layer and the at least one timber batten.

7. A panel according to any preceding claim, wherein adjacent edges of the interior and exterior sheathing board layers overlie said first layer of heat insulating material by a predetermined distance to define a channel between the sheathing board layers extending along a first edge of the panel, said channel being configured for mating receipt of a first projection.

8. A panel according to claim 7, wherein said channel has a depth which is approximately equal to a height of said first projection.

9. A panel according to claim 7 or 8, wherein said first projection is connected to a further insulated building panel.

10. A panel according to claim 7 or 8, wherein said first projection is connected to a building structure other than a further insulating panel.

11. A panel according to any one of claims 7 to 10, wherein a second projection is provided along a second edge of said panel.

12. A panel according to claim 11, wherein the second edge is opposite to the first edge.

13. A panel according to any preceding claim, wherein at least one of the first and second layers of heat insulating materials is selected from the group consisting of a polymer foam, a glass fibre-based material, a mineral wool and a cellulose-based material.

14. A panel according to claim 13, wherein the first layer of heat insulating material is expanded polymer foam.

15. A panel according to claim 13 or 14, wherein the second layer of heat insulating material is an extruded polymer foam.

16. A panel according to claim 13, 14 or 15, wherein the polymer is selected from the group consisting of polyurethane, polyethylene and polystyrene.

17. A panel according to any preceding claim, wherein at least one of the sheathing board layers is manufactured from a material selected from the group consisting of gypsum-based oriented strand board and plywood.

18. A panel according to any preceding claim, wherein the breathable membrane layer is a woven or non-woven textile material.

19. A panel according to any preceding claim, wherein the breathable membrane layer is selected from the group consisting of a compressed or non-compressed fleece material and a felt material.

20. A panel according to any preceding claim, wherein the breathable membrane layer is selected from the group consisting of polyethylene, polypropylene, polyester, polyamide, polycarbonate and polyvinylchloride.

21. A panel according to claim 2 or 3, wherein the layer of cladding is selected from the group consisting of brickwork, stonework, rendering, tiling, hanging timber and cement-based boarding.

22. A panel according to claim 4, 5 or 6, wherein the heat reflecting membrane layer comprises a metalised layer.

23. A panel according to claim 22, wherein the heat reflecting membrane is selected from the group consisting of a metalised foil, a metal laminate or a metal vaneer.

24. A panel according to claim 22 or 23, wherein the heat reflecting membrane comprises aluminium.

25. A panel substantially as hereinbefore described with reference to the accompanying drawings.

26. A method for fabricating an insulated timber framed building panel comprised of providing spaced apart interior and exterior sheathing board layers with a cavity defined between said interior and exterior sheathing board layers, providing a first layer of heat insulating material in said cavity, providing a breathable membrane layer on an exterior side of the exterior sheathing board layer and providing a second layer of heat insulating material on an exterior side of said breathable membrane layer.

27. A method according to claim 26, wherein the first layer of insulating material is provided by injecting a liquid form of the insulating material into the cavity and allowing the liquid insulating material to solidify within the cavity.

28. A method according to claim 27, wherein the first layer of insulating material is expanded polymer foam.

29. A method according to claim 28, wherein the polymer is selected from the group consisting of polyurethane, polyethylene and polystyrene.

30. A method for fabricating an insulated timber formed building panel substantially as hereinbefore described with reference to the accompanying figures.

31. A corner joint arrangement between first and second insulated timber framed building panels, each of said panels comprising a first facing surface and a first edge surface, wherein the corner joint arrangement comprises a projection which projects outwardly from the first facing surface of the second panel received in a channel defined by the first panel, said channel extending along the first edge surface of the first panel.

32. A corner joint arrangement according to claim 31, wherein at least one of the first and second panels comprises interior and exterior sheathing board layers with a first layer of heat insulating material interposed between said sheathing board layers.

33. A corner joint arrangement according to claim 32, wherein adjacent edges of the interior and exterior sheathing board layers of the first panel overlie said first layer of heat insulating material of the first panel by a predetermined distance to define said channel between the sheathing board layers extending along the first edge surface of the first panel.

34. A corner joint arrangement according to claim 33, wherein the adjacent edges of the interior and exterior sheathing board layers of the first panel abut the first facing surface of the second panel.

35. A corner joint arrangement according to any one of claims 31 to 34, wherein said projection is provided near the edge surface of the second panel.

36. A corner joint arrangement according to any one of claims 31 to 35, wherein said edge surface of the second panel is provided with a layer of heat insulating material.

37. A corner joint arrangement according to any one of claims 31 to 36, wherein said channel has a depth which is approximately equal to a height of said projection.

38. A corner joint arrangement according to any one of claims 31 to 37, wherein a plane of the first facing surface of the first panel is preferably substantially perpendicular to a plane of the first facing surface of the second panel.

39. A corner joint arrangement according to any one of claims 31 to 38, wherein at least one of the first and second panels is an insulated timber framed building panel according to any one of claims 1 to 25.

40. A corner joint arrangement substantially as hereinbefore described with reference to figures 7 and 8 of the accompanying drawings.

41. A method for constructing a corner joint arrangement between first and second insulated timber framed building panels, each of said panels comprising a first facing surface and a first edge surface, wherein the method comprises inserting a projection which projects outwardly from the first facing surface of the second panel into a channel defined by the first panel, said channel extending along the first edge surface of the first panel.

42. A method for constructing a corner joint arrangement substantially as hereinbefore described with reference to figures 7 and 8 of the accompanying drawings.

43. An insulated timber framed building structure comprising first and second load bearing timber joists which are spaced apart to define a cavity between said first and second joists, wherein heat insulating material is provided in said cavity.

44. An insulated timber framed building structure according to claim 43, wherein said heat insulating material is selected from the group consisting of a quilted material, a polymer foam, a glass fibre-based material, a mineral wool and a cellulose-based material.

45. An insulated timber framed building structure substantially as hereinbefore described with reference to figure 15 of the accompanying drawings.

46. A method for constructing a timber framed building structure comprising providing a first load bearing timber joist, providing a second load bearing timber joist spaced apart from said first joist to define a cavity between said first and second joists, and providing heat insulating material in said cavity.

47. A method for constructing a timber framed building structure substantially as hereinbefore described with reference to figure 15 of the accompanying drawings.

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Claims searched: 1-30 **Date of search:** 25 October 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	EP1331316 A1 (BROWN ET AL) See whole document.
A	-	US4937125 A (SANMARTIN ET AL) See whole document.
A	-	DE20014795 U1 (NBS-NATURBAU-SCHWABEN GMBH) See whole document.

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The following online and other databases have been used in the preparation of this search report

WPI, EPODOC