(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 847 661 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.10.2007 Bulletin 2007/43

(51) Int Cl.:
E04C 2/36 *(2006.01)*

(21) Application number: **07251690.9**

(22) Date of filing: **23.04.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **21.04.2006 GB 0607908**
11.05.2006 GB 0609342

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(54) **Impact Resistance Panel**

(57) The present invention relates to panels and their use in the building and construction industry. The panels comprise apertures of a variety of sizes which allows the panel to be vapour-permeable and also allows water to drain away.

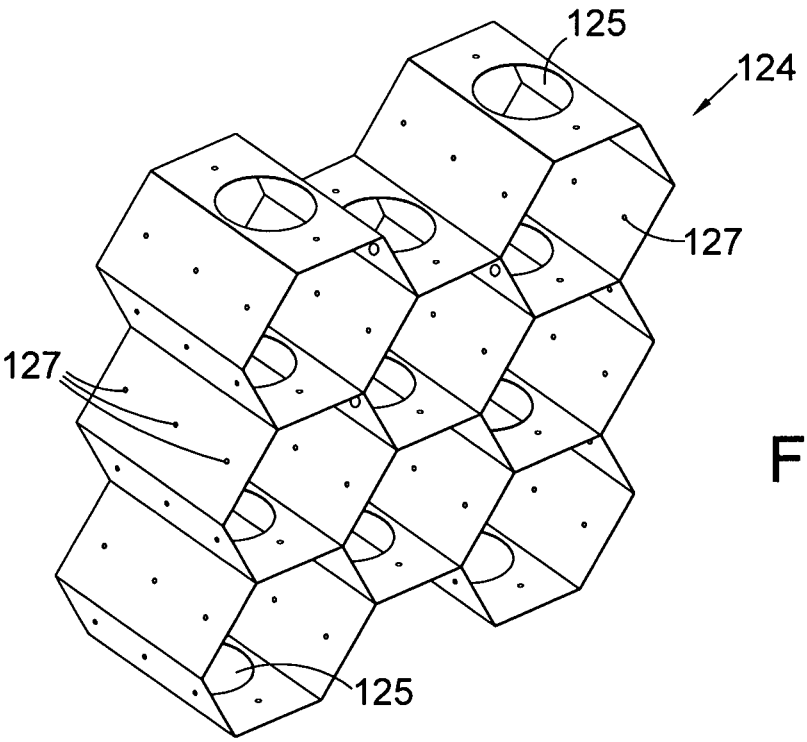


Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to panels and their use in the building and construction industry. The panels comprise apertures of a variety of sizes which allows the panel to be vapour-permeable and also allows water to drain away.

BACKGROUND OF THE INVENTION

[0002] Conventionally, the walls (i.e. shells) of the majority of residential property such as houses and flats, industrial property such as warehouses and factories, retail property such as shop units and shopping centres, and indeed any other type of building structure, have been constructed from bricks and/or building blocks such as breeze blocks. The bricks and/or building blocks are adhered to one another using cement. Constructing buildings in this manner is a time consuming process which significantly contributes to the cost of a building. A skilled tradesman is also required in the construction of a brick wall.

[0003] A brick wall also tends to have imperfections such as slight curvatures and distortions which leads to, for example, difficulties when applying an outer finish such as a render.

[0004] Furthermore, on the completion of a brick wall, the wall goes through a 'drying-out' process whereupon there may be some shrinkage in the wall which may lead to cracking and a loss of structural integrity.

[0005] The building of a brick wall may also be affected by bad weather such as frost and heavy rain. Additionally, brick walls may also be susceptible to dampness as bricks and cement have a tendency to retain moisture.

[0006] Building brick walls has the further disadvantage that brick walls are relatively heavy and require deep foundations to support the weight of a formed building. If deep foundations are required, this significantly adds to the cost of a building.

[0007] It has therefore been found to be advantageous to use panels in the construction of buildings. Although many panels exist in the art which may be used in building and construction, existing panels have many disadvantages.

[0008] It has been found that prior art panels are susceptible to damage such as accidental or deliberate kicking. Damaged panels are both difficult and expensive to repair. This is therefore a significant disadvantage with existing prior art panels.

[0009] Moreover, many panels known in the art have the technical disadvantage of becoming damp due to their inability to allow vapour to travel through the panel and/or allow water to drain away easily. Panels on becoming damp may rapidly deteriorate and lose their structural integrity and strength. Panels once damp may also transfer this dampness to other structural elements of buildings such as brickwork and steel beams which may significantly decrease the lifespan of a building. The dampness formed in buildings may also form a breeding source for bacteria which may potentially lead to a building becoming inhabitable.

[0010] A further significant disadvantage of existing panels is that they have restricted fire protection, noise reduction and are difficult to fit and provide inefficient thermal insulation.

[0011] It is an object of at least one aspect of the present invention to obviate or mitigate at least one or more of the aforementioned problems.

[0012] It is an object of the present invention to provide a panel suitable for use in the construction industry which facilitates vapour passing through the panel and also facilitates the draining of water.

[0013] It is a further object of at least one aspect of the present invention to provide panels suitable for use in the building and construction industry which provide improved fire protection, noise reduction, are simple and easy to fit, and provide improved thermal efficiency.

SUMMARY OF THE INVENTION

[0014] According to a first aspect of the present invention there is provided a vapour-permeable structural panel comprising:

a cellular panel member;
said cellular panel member comprising a first set of apertures and a second set of apertures;

wherein the first set of apertures facilitate vapour passage through the panel and the second set of apertures facilitate water passing through the panel.

[0015] The panel according to the present invention has the dual function of allowing both vapour formed in the panel and water trapped in the panel to dissipate away. The panel therefore prevents water vapour and moisture being retained in the panel which will adversely affect the structural integrity and the lifetime of the panel. Moisture remaining in the panel may also have an adverse affect on other structural units in a building.

[0016] The panels according to the present invention may therefore prevent vapour or water being retained in the frameworks of buildings. This has the advantage of maintaining the structural strength of a building and also increasing the lifespan of the building.

[0017] The cellular panel member may comprise a structural network with a plurality of interconnecting cell walls or edges. The interconnecting cell walls or edges may be welded or adhered together with, for example, a resin, glue or adhesive film. Typically, the interconnecting cell walls may have a thickness of between 0.01mm to 3mm.

[0018] The cellular panel member may be of any open network-type structure such as a honeycomb structure. The cellular panel member may therefore have a plurality

of openings which allows a lightweight and strong structure to be provided. For example, the openings may be hexagonal. The openings may be of any suitable shape and may for example be selected from any 3 to 10 sided structure.

[0019] The shape of the openings in the cellular panel member may be selected from any of the following: circular; elliptical; triangular; any type of tetragon such as a square, rectangle, parallelogram or rhombus; pentagonal; hexagonal (for example, in the form of a honeycomb); heptagonal; octagonal; nonagonal; decagonal or any other type of polygon.

[0020] The openings in the cellular panel member may have a cross-sectional size of about 0.5 - 5 cm^2. Preferably, the openings may have a cross-sectional size of about 1 cm^2. Typically, the openings in the open network-type structure may form a substantially regular pattern and may be substantially all of the same shape.

[0021] The first set of apertures may be located on a surface of the open-network type structure. The first set of apertures facilitate the passage of vapour through and away from the panel. The first set of apertures may be relatively small. There may be a plurality of apertures which may be of any appropriate size such as about 0.05 - 2 mm and preferably about 1mm in diameter. The first set of apertures may from a regular pattern throughout the open-network structure. The apertures forming the first set of apertures may be spaced apart by about 5 - 20 mm.

[0022] Typically, the apertures in the first set of apertures may be provided on substantially all surfaces of the open-network structure to allow the vapour to pass through and away from the panel. In the event that vapour is trapped in the panel, the trapped vapour may condense and thereby form water in the panel.

[0023] The first set of apertures may therefore form a series of perforations which have the specific function of allowing vapour to pass substantially freely away from the panel.

[0024] The second set of apertures may be located throughout the open-network type structure. The second set of apertures facilitate the passing of water through and away from the panel. The apertures in the second set of apertures may have a significantly larger cross-sectional diameter than the apertures in the first set of apertures and may be of any suitable shape such as circular. The apertures in the second set of apertures may have a cross-sectional diameter of about 5 - 20 mm and are specifically provided to allow any water that forms in the panel to drain away. Water may form via condensation such as from temperature changes from daytime to nighttime. Alternatively, there may be a leak in the structure of a building with the result that water may from in the panel. In the event that water remains in the panel, the panel may deteriorate over time and lose its structural strength. Moreover, the retained water may also come into contact with other structural features such as steel beams which may result in the weakening of a building.

[0025] The apertures forming the second set of apertures may be interspersed between a pattern of apertures forming the first set of apertures.

[0026] On at least one face of the panel, there may be at least at least one reinforcing layer. In preferred embodiments, there may be reinforcing layers on both front and rear faces of the panel.

[0027] The reinforcing layer may provide additional strength to the panel.

[0028] Preferably, the at least one reinforcing layer may be formed from fiberglass, a fiberglass composite material, a fiberglass mat or chopped fiberglass strands.

[0029] The at least one reinforcing layer may have a thickness of between 0.01 to 5mm. Typically, the at least one reinforcing layer may have a thickness of about 0.5mm.

[0030] Preferably, the at least one reinforcing layer may be in the form of a woven structure of interlacing fibers. The interlacing fibers of the woven structure may be substantially perpendicularly oriented forming a mesh-like structure.

[0031] Typically, the reinforcing layer may allow vapour to permeate through the structural panel.

[0032] Conveniently, the cellular panel member may be formed from any of the following: a metal; polymeric material; alloy; or wood pulp. Preferably, the cellular panel member may be formed from sheet aluminium alloy.

[0033] The vapour-permeable structural panel may have a thickness of between 5mm and 50mm. Typically, the vapour-permeable structural panel may have a thickness of about 10mm, 15mm or 20mm.

[0034] The panel may be of a substantially planar type structure and may be cut or formed to any suitable size.

[0035] Typically, the vapour-permeable structural panel may have a weight of about 1 to 3kg/m^2.

[0036] According to a second aspect of the present invention there is provided a method of forming a vapour-permeable structural panel comprising:

providing a cellular panel member; and
providing a first set of apertures and a second set of apertures on said cellular panel member;

wherein the first set of apertures facilitate vapour passing through the panel and the second set of apertures facilitate water passing through the panel.

[0037] Conveniently, the cellular panel member may be formed from sheet metal, polymeric material, alloy or wood pulp. Most preferably, the cellular panel member may be formed from sheet aluminium alloy.

[0038] The cellular panel member may be formed by initially forming the first and second apertures on a sheet of substantially flat material. The first and second apertures may be formed using any form of cutting process such as using a blade with a cutting edge or using a laser. Alternatively, the first and second apertures may be punched out of the substantially flat material. Adhesive material such as resin may then be applied in parallel

lines onto sheet material comprising the first and second apertures. The sheet material may then be cut and folded, or otherwise arranged, into layered sections so that the parallel lines of adhesive may be staggered from one layer to another. The folded cut sections may then be heated under pressure. The folded cut sections may then be pulled apart to form the cellular panel member. The stretching may be electronically or manually controlled.

[0039] Typically, at least one reinforcing layer may be adhered onto at least one face of the cellular panel member. Preferably, reinforcing layers may be adhered to both front and rear faces of the panel.

[0040] Preferably, the at least one reinforcing layer may formed from woven fiberglass, a fiberglass composite, a fiberglass mat or chopped fiberglass strands. The fibers of the fiberglass, fiberglass composite, fiberglass mat or chopped fiberglass strands may be bound to other fibers of the fiberglass, fiberglass composite, fiberglass mat or chopped fiberglass and to the cellular panel member, with a resin or other settable material. The resin may be a polyester resin, epoxy resin, phenolic resin, polyreutamic resin or combinations thereof.

[0041] The fibers of the fiberglass, fiberglass composite, fiberglass mat or chopped fiberglass strands may be woven thereby forming a layer of interlacing fibers. The interlacing fibers may be substantially perpendicularly oriented.

[0042] Typically, the at least one reinforcing layer may be applied to a surface of the cellular panel member with a heated roller. The heated rollers sets the resin in the reinforcing layer, binding the reinforcing layer to the cellular panel member. If required, further heating steps to fully set the resin may be used.

[0043] According to a third aspect of the present invention there is provided a wall section comprising:

a frame forming a support structure; and
at least one vapour-permeable structural panel comprising a cellular panel member, said cellular panel member comprising a first set of apertures and a second set of apertures, wherein the first set of apertures facilitate vapour passing through the panel and the second set of apertures facilitate water passing through the panel.

[0044] The panels according to the present invention may be adapted to provide improved fire protection, noise reduction and thermal efficiency.

[0045] The panels may be attached to any other parts of a wall section such as a steel beam in a building or brickwork/breeze blocks. Typically, the panel may be attached using any suitable type of mechanical fastening means such as nuts and bolts, screws, rivets or the like. Alternatively, any suitable form of adhesive means such as adhesive pads may be used.

[0046] The panel may also be attached to other parts of a wall section using a water tight seal. Any form of rubber seal or adhesive means forming a water tight seal may be used. For example, a pre-compressed neoprene and silicone seal and/or panel adhesive may be used.

[0047] The panel according to the present invention may be used in a variety of situations. For example, the panels may be used in a flue extract, in combination with a building expansion joint, in combination with a fire-break, in combination with a window, be located at an external corner of a building, in combination with eaves, in combination with a bell cast bead and any other suitable building construction.

[0048] The panel according to the present invention may be provided in combination with a variety of other materials such as fire protective material, noise reduction material and thermal layers. The fire protective material may be any fire retardant material such as rock wool and mineral wool which has the function of acting as a fire break in the event of a fire. Any suitable dense material may be used as noise reduction material. For example, dense rubber-like material such as PVP may be used. Thermal layers such as glass wool, cellular glass, expanded polystyrene, shredded fibers, or any combination thereof may also be used. This allows the fitted panels to provide efficient thermal insulation for buildings such as office blocks and houses.

[0049] On an outer surface of a wall section containing a vapour-permeable structural panel according to the present invention a variety of one or more different surfaces may be applied. The surfaces may include one or more of: a glass matting embedded in resin; traditional render; wet dash; acrylics; marble; terracotta; dry dash; tyrolean finishes; high build finishes; ceramics; timber and aluminium finished metal glass mirrors; stone; granite; and silicone based coatings.

[0050] On the outside of the wall section at the bottom there may be a unit which allows any collected water to drain away. The unit may be a standard pipe unit which collects any water draining from the panels and allows this water to drain away.

[0051] According to a fourth aspect of the present invention there is provided a building incorporating a vapour-permeable structural panel according to the first aspect.

[0052] The vapour-permeable structural panel may form any part of the building such as any part of the walls, ceiling or the floor.

[0053] According to a fifth aspect of the present invention there is provided an impact resistant panel comprising:

an insulation layer;
a cellular layer; and
a reinforcing layer.

[0054] The impact resistant panel is designed and adapted to resist damage from, for example, accidental or deliberate kicking from persons. The impact resistant panel may therefore be substantially robust and have a high mechanical strength. The impact resistant panel is

intended to be used as a construction panel for the building industry.

[0055] The impact resistant panel is unitary with the insulation layer, cellular layer and reinforcing layer and this allows construction on a building site to occur quickly and easily. As the impact resistant panel comes as a unitary panel, it also eliminates any wastage and errors or faults in the construction process.

[0056] Typically, the insulation layer may be formed from any suitable material. For example, the insulation layer may be formed from any one of or combination of the following: foam, cellular glass, shredded cellular fibres or expanded polystyrene. Preferably, the insulation material is of a substantially light material and provides strength to the impact resistant panel. The insulation layer may be of any suitable thickness such as between 1 to 20 cm or preferably about 5 to 10 cm. Typically, the insulation layer may be a continuous layer in the impact resistant panel.

[0057] The cellular layer may be any structural network with a plurality of interconnecting cell walls or edges. For example, the cellular layer may be in the form of a honeycomb section. Alternatively, any other suitable shape of mesh-like structure may be used such as comprising any of the following shape of apertures: circular; electrical, triangular; any type of tetragon such as a square; rectangle; parallelogram or rhombus; pentagonal; hexagonal; heptagonal; octagonal; nonagonal; decagonal; or any other type of polygon.

[0058] Preferably, the cellular layer may be formed from an aluminium mesh.

[0059] Typically, the cellular layer may have a thickness of about 0.1 to 20 mm.

[0060] The cellular layer may be formed from any suitable material such as any metal, polymeric material, alloy or plastics material.

[0061] Typically, the cellular layer may be attached to the insulating layer using any suitable means such as any form of chemical bonding and/or adhesive.

[0062] The reinforcing layer may be of any suitable woven structure of interlacing fibres. The interlacing fibres of the woven structure may be substantially perpendicularly oriented forming a mesh-like structure.

[0063] Typically, the reinforcing layer may be formed from fibreglass, a fibreglass composite material, a fibreglass mat or chopped fibreglass strands.

[0064] The function of the reinforcing layer is to provide strength to the impact resistant panel and to prevent the panel breaking and/or distorting on impact.

[0065] On top of the reinforcing layer there may be applied adhesive material such as resin.

[0066] On an outer surface of the impact resistant panel, there may be applied a variety of one or more different surfaces such as any of the following: a glass matting embedded in resin; traditional render; wet dash; acrylics; marble; terracotta; dry dash; tyrolean finishes; high build finishes; ceramics; timber and aluminium finished metal glass mirrors; stone; granite; and silicone based coatings.

[0067] Typically, the adhesive layer may be substantially continuous on the impact resistant panel.

[0068] According to a sixth aspect of the present invention there is provided a method of forming an impact resistant panel comprising:

providing an insulation layer;
providing a cellular layer and forming the cellular layer on top of the insulating layer; and
providing a reinforcing layer on top of the cellular layer.

[0069] According to a seventh aspect of the present invention there is provided a main support structure for a building, said main support structure adapted to allow movement while keeping a support framework substantially stationary.

[0070] Typically, by allowing the main support structure to allow movement while keeping the supporting framework substantially stationary, eliminates the need for movement joints in cladding attached to steel frames. This provides the significant advantages of enhanced aesthetics, improved weather-tightness and prolonged durability.

[0071] Attachment means may be provided which therefore allow the main support structure to have movement relative to the supporting framework. The attachment means may, for example, be any suitable fixing which allows a degree of movement of the main support structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0072] 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 a sectional side view of an uninsulated panel according to an embodiment of the present invention;
Figure 2 is a perspective view of a panel according to a further embodiment of the present invention;
Figure 3 is a sectional side view of a flue extract comprising a panel according to a further embodiment of the present invention;
Figure 4 is a sectional side view of a building expansion joint comprising a panel according to a further embodiment of the present invention;
Figure 5 is a sectional side view of a firebreak comprising a panel according to a further embodiment of the present invention;
Figure 6 is a sectional side view of a panel attached to insulation according to a further embodiment of the present invention;
Figure 7 is a sectional side view of an insulated window comprising a panel according to a further embodiment of the present invention;

Figure 8 is a sectional side view of an uninsulated window comprising a panel according to a further embodiment of the present invention;

Figure 9 is a sectional side view of an external corner comprising a panel according to a further embodiment of the present invention;

Figure 10 is a sectional side view of flush eaves comprising a panel according to a further embodiment of the present invention;

Figure 11 is a front view of a building comprising panels according to a further embodiment of the present invention;

Figure 12 is a sectional side view of an over sill comprising a panel according to a further embodiment of the present invention;

Figure 13 is a sectional side view of a trim bead comprising a panel according to a further embodiment of the present invention;

Figure 14 is a sectional side view of a bell cast bead comprising a panel according to a further embodiment of the present invention;

Figure 15 is a part-sectional view of an impact resistant panel according to a further embodiment of the present invention;

Figure 16 represents a sectional view of a main support structure according to a further embodiment of the present invention;

Figure 17 represents a sectional view of a main support structure according to a further embodiment of the present invention;

Figure 18 represents a sectional view of a main structure according to a further embodiment of the present invention; and

Figure 19 represents a sectional view of a main support structure according to a further embodiment of the present invention.

DETAILED DESCRIPTION

[0073] Figure 1 represents an uninsulated system, generally designated 100. The uninsulated system 100 comprises a substrate 110 in the form of a brick structure and a window frame 118. Attached to a lower surface of the substrate 110, using adhesive 112, and a mechanical fixing 116 such as a bolt, there is a panel 114 according to the present invention. The panel 114 is of any suitable honeycomb structure which allows vapour to permeate therethrough and any water to drain away. The panel 114 is described in more detail in Figure 2. On a side surface of the substrate 110, there is a pre-compressed neoprene and silicone seal 120, panel adhesive 122, a honeycomb board 124 and an external render finish 126.

[0074] Figure 2 is a perspective view of a cellular panel 124 used in the vapour-permeable panel 114 shown in Figure 1. As shown in Figure 2, the cellular panel 124 is in the form of an open honeycomb structure and comprises a series of large apertures 125 and small apertures 127. To facilitate the draining of water, the large apertures are located on upper and lower parts of the structure forming the open honeycomb structure. The large apertures 125 have a cross-sectional diameter of about 10 mm and the small apertures have a cross-sectional diameter of about 1 mm. The cellular panel 124 is breathable and allows free passage of vapour through the cellular panel 124. In the event of water entering the cellular panel 124, this may be drained away using the large apertures 125. Therefore, any accidental ingress of water may be drained through the large apertures 125. The size of the apertures may be adapted for different requirements in buildings. Although not shown in Figure 2, the cellular panel 124 forming the vapour-permeable panel 114 has a woven fiberglass reinforcing layer on the front and rear face of the panel 124. The woven fiberglass reinforcing layers provide additional strength to the cellular panel 124.

[0075] Figure 3 is a sectional side view of a further system 200 according to the present invention. The system 200 comprises a substrate 210 and a flue duct 211. Attached to the substrate 210, using adhesive 212 and a mechanical fixing 216 such as a bolt, there is a panel 214 according to the present invention. The panel 214 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. As shown in Figure 3, there is also a mineral wool firebreak 232 which provides fire protection in the event of a fire. On the outer surface there is a reinforcement mesh 230 embedded in adhesive and an outer render finish 240. As shown in Figure 3, there is also a pre-compressed neoprene and silicone seal 220 in abutment against the flue duct 211 which provides an effective water seal. The system 200 may be used to provide fire protection in a building.

[0076] Figure 4 represents a further system 300 according to the present invention. The system 300 comprises a substrate 310 of brick work. In the system 300, there is a movement bead 342 which functions as a building expansion joint. The system 300 also comprises a panel 314 according to the present invention attached to the substrate using adhesive 312. The panel 314 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also adhesive 322 and an outer render finish 340. The system 300 may therefore use panels according to the present invention in a building expansion joint.

[0077] Figure 5 represents a sectional view of a system 400 which provides a firebreak. As shown in Figure 5, there is a panel 414 attached using adhesive 412. The panel 414 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also panel adhesive 422 and render finish 440. As shown in Figure 5 there is a mineral wool firebreak 432. The system 400 may therefore be used to provide a firebreak.

[0078] Figure 6 represents a sectional side view of a further system 500 according to the present invention.

There is a substrate 510 with a panel 514 attached thereto using adhesive 512. The panel 514 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also panel adhesive 522 and an external render finish 540. In the system 500, there is also glass mesh joint reinforcement 550 embedded in a resin (e.g. Dunapox Ad23 Trade Mark) and hardener. The system 500 provides improved insulation in building structures.

[0079] Figure 7 represents a further system 600 wherein there is a substrate 610. There is a panel 614 attached to the substrate 610 using adhesive 612. The panel 614 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also panel adhesive 622 and an external render finish 640. A mechanical fixing bolt 616 is also used to provide further attachment of the panel 614. The system 600 is used in combination with a window frame 618 and a pre-compressed neoprene and silicone seal 620 provides an effective water seal.

[0080] Figure 8 is a sectional side view of an uninsulated window system 700. There is a substrate 710 with a panel 714 attached using adhesive 712. The panel 714 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also panel adhesive 722 and an external render finish 740. A mechanical fixing bolt 716 is also used for additional attachment means. On the lower surface of the panel 714, there is a honeycomb board 724 and a pre-compressed neoprene and silicone seal which provides an effective water seal.

[0081] Figure 9 is a sectional side view of a further system 800 according to the present invention. The system 800 comprises a substrate 810. Around the substrate 810, adhesive 812 is used to attach panels 814. The panels 814 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. A mechanical fixing bolt 816 is used for additional attachment means. On the outer surface there is an external render finish 840. Figure 9 also shows that the system 800 comprises a mesh corner 860 embedded in panel adhesive.

[0082] Figure 10 shows a further system 900 according to the present invention for use with flush eaves. Figure 10 shows that there is a gutter 970. Below the gutter 970, there is an eaves profile 972 and a pre-compressed neoprene and silicone seal 920. Below the pre-compressed neoprene and silicone seal 920, there is a panel 914 attached to a substrate 910. The panel 914 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. The panel 914 is attached using adhesive 912 and a mechanical fixing 916 such as a bolt. On the outer surface, there is panel adhesive 922 and an external render finish 940. In the event that rain water enters the panel, this may be drained away using the apertures as shown in Figure 2.

[0083] Figure 11 shows a front view of a system 1000 according to a further embodiment of the present invention. The system 1000 comprises a window 1012 and a base trim bead 1014. Figure 11 also shows that there is glass mesh 1010 providing an insulation board fixing pattern and a plurality of mechanical fixings. The system 1000 provides effective thermal insulation for a building.

[0084] Figure 12 is a sectional side view of a system 1100 according to a further embodiment of the present invention. The system 1100 comprises a new over sill 1192 placed over an existing sill 1190. There is also shown continuous beads 1194 onto which the new over sill 1192 is disposed on. Silicone mastic 1196 is also used for attachment. Below the new over sill 1192, there is a pre-compressed neoprene and silicone seal 1120 providing an effective water seal. Disposed on substrate 1110, there is a panel 1114 attached using adhesive 1112. The panel 1114 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also a mechanical fixing bolt 1116, panel adhesive 1122 and external render finish 1140.

[0085] Figure 13 is a sectional side view of a further system 1200 according to the present invention. There is a substrate 1210 with a panel 1214a attached using adhesive 1222. There is also a mechanical fixing 1216 such as a bolt providing further attachment means. There is also panel adhesive 1222 and an external render finish 1240. A bell cast bead 1217 is located below the panel 1214a. Below the bell cast bead 1217, there is a further panel 1214b, attached using adhesive 1212 and an external render finish 1240. The panels 1214a, 1214b comprise a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces.

[0086] Figure 14 represents a generic bell cast bead and is a sectional side view of a further system 1300 according to the present invention. There is a substrate 1310 with a panel 1314 attached using adhesive 1322. The panel 1314 comprises a honeycomb structure as shown in Figure 2 with woven glass fiber reinforcing layers on the front and rear faces. There is also a mechanical fixing bolt 1316 and a bell cast bead 1317. On the outer surface there is panel adhesive 1322 and an external render finish 1340.

[0087] All of the systems described above use panels according to the present invention which allow vapour formed in the panel and water trapped in the panel to dissipate away. The panels comprise apertures of different size which allows vapour and water in the panel to be removed. The panel therefore prevents water vapour and moisture being retained in the panel which will adversely affect the structural integrity and the lifetime of the panel. Moisture remaining in the panel may also have an adverse affect on other structural units in a building.

[0088] Referring to Figure 15, there is a representation of an impact resistant panel, generally designated 1400. The impact resistant panel 1400 comprises an insulation

layer 1410, an aluminium mesh layer 1412, a woven reinforcing layer 1414 and an outer adhesive layer 1416.

[0089] The impact resistant panel 1400 is formed using any appropriate manufacturing means and is specifically designed to have high impact resistance.

[0090] The insulation layer has a thickness of about 7 cm with the other layers being much thinner. The reinforcing layer 1412 of aluminium mesh provides substantial strength to the impact resistant panel 1400 and prevents damage from high impact.

[0091] Figures 16 to 19 represent schematic representations of main supporting structures which are designed to allow movement while keeping light steel frames stationary in position. The advantage of this is that this eliminates the need for movement joints in the cladding attached to the light steel frames, thereby providing the significant benefits of enhanced aesthetics, improved weather-tightness and prolonged durability.

[0092] In particular, Figure 16 is a representation which allows a top structure deflecting downwards while a bottom structure remains in position. As shown in Figure 16, the structure, generally designated 1500, comprises a main supporting structure 1512, a vertical stud 1516 on a frame 1514, a fixing 1518, a compressible neoprene washer/strip 1520 and a temporary packer 1522. As shown in Figure 16, the screw head of the fixing is hard against a channel 1515. The compressible neoprene washer/strip 1520 is not pre-compressed during installation.

[0093] The structure 1500 in Figure 2 therefore allows the main supporting structure 1512 to have movement whereas the vertical stud 1516 and frame 1514 remain fixed in place.

[0094] Figure 17 represents a further structure generally designated 1600 which comprises a main supporting structure 1612, a frame 1614, a vertical stud 1616, a fixing in the form of a screw 1618, a compressible neoprene washer/strip 1620 and a permanent packer 1622. The structure 1600 in Figure 17 allows the main supporting structure 1612 to have movement whereas the frame 1614 and vertical stud 1616 are fixed. The compressible neoprene washer/strip 1620 is not pre-compressed during installation.

[0095] As shown in Figure 17, the screw head of the stud 1618 is above a channel 1615 by a distance substantially equal to the maximum deflection under imposed load and finishes plus compressed thickness of the neoprene washer/strip 320.

[0096] In Figure 16, the bottom structure deflects downwards while the top structure remains in position. This allows the top structure to deflect without affecting the light steel frame. The frame is maintained in position by hanging from a top structure. Additionally, as shown in Figure 17, a screw head of the screw 1618 is hard against the channel 1615.

[0097] Figure 18 represents a further structure 1700 comprising a main support structure 1712, a frame 1714, a vertical stud 1716, an L-shaped bracket 1750, bolts 1760 and 1762, a washer 1764, a spring washer 1768, a nut 1772 and tightly-packed insulation 1770.

[0098] As shown in Figure 18, the bolt 1760 is fixed into a slotted hole in the bracket 1750. The bolt 1760 is located at the bottom of the slot.

[0099] Figure 19 represents a further structure 1800. The structure 1800 comprises a main supporting structure 1812, an L-shaped bracket 1850, bolts 1860 and 1862, a washer 1864 that allows sliding of the bracket 1850, a spring washer 1868 and a nut 1872.

[0100] As shown in Figure 19, the bolt 1860 is fixed into a slotted hole in the bracket 1850. The bolt 1850 is located at the bottom of the slot.

[0101] The structures 1700,1800 shown in Figures 18 and 19 allow both top and bottom structures to deflect. No affect is formed on the light steel framing as both top and bottom parts of the structure allow movement. Deflection is greatest at a point along the structure and there are usually points of zero deflection. The frame is thus maintained in position by the diaphragm strength of the attached cladding and internal boards.

[0102] Whilst specific embodiments of the invention have been described above, it will be appreciated that departures from the described embodiments may still fall within the scope of the invention. For example, any suitable size and shape of panels and other constructional elements may be used. Additionally, any suitable type of honeycomb panel structure may be used in the different embodiments of the present invention.

Claims

1. A vapour-permeable structural panel comprising:

a cellular panel member;
said cellular panel member comprising a first set of apertures and a second set of apertures;

wherein the first set of apertures facilitate vapour passage through the panel and the second set of apertures facilitate water passing through the panel.

2. A vapour-permeable structural panel according to claim 1, wherein the cellular panel member comprises a structural network with a plurality of interconnecting cell walls or edges which are welded or adhered together.

3. A vapour-permeable structural panel according to any of claims 1 or 2, wherein the cellular panel member is of an open network-type structure such as a honeycomb structure

4. A vapour-permeable structural panel according to any preceding claim, wherein the shape of the apertures in the cellular panel member is selected from any of the following: circular; elliptical; triangular; any

type of tetragon such as a square, rectangle, parallelogram or rhombus; pentagonal; hexagonal (for example, in the form of a honeycomb); heptagonal; octagonal; nonagonal; decagonal or any other type of polygon.

5. A vapour-permeable structural panel according to claim 3, wherein the openings in the open network-type structure form a substantially regular pattern and are substantially all of the same shape.

6. A vapour-permeable structural panel according to any preceding claim, wherein the first set of apertures are located on a surface of an open-network type structure and are about 0.05 - 2 mm in diameter.

7. A vapour-permeable structural panel according to any preceding claim, wherein the first set of apertures form a series of perforations which have the specific function of allowing vapour to pass substantially freely away from the panel.

8. A vapour-permeable structural panel according to any preceding claim, wherein the the second set of apertures are located throughout the open-network type structure and facilitate the passing of water through and away from the panel and have a cross-sectional diameter of about 5 - 20 the panel may deteriorate over time and lose its structural strength.

9. A vapour-permeable structural panel according to any preceding claim, wherein on at least one face of the panel, there is at least one reinforcing layer which provides additional strength to the panel.

10. A vapour-permeable structural panel according to any claim 9, wherein the reinforcing layer allows vapour to permeate through the structural panel.

11. A method of forming a vapour-permeable structural panel comprising:

providing a cellular panel member; and
providing a first set of apertures and a second set of apertures on said cellular panel member;

wherein the first set of apertures facilitate vapour passing through the panel and the second set of apertures facilitate water passing through the panel.

12. A method of forming a vapour-permeable structural panel according to claim 11, wherein the cellular panel member is formed from sheet metal , polymeric material, alloy (aluminium alloy) or wood pulp.

13. A method of forming a vapour-permeable structural panel according to any of claims 11 or 12, wherein the cellular panel member is formed by initially forming the first and second apertures on a sheet of substantially flat material with the sheet material then being cut and folded, into layered sections so that the parallel lines of adhesive may be staggered from one layer to another, the folded cut sections are then be heated under pressure wherein the folded cut sections are then be pulled apart to form the cellular panel member.

14. A method of forming a vapour-permeable structural panel according to any of claims 11 to 13, wherein at least one reinforcing layer is adhered onto at least one face of the cellular panel member.

15. A method of forming a vapour-permeable structural panel according to claim 14, wherein the at least one reinforcing layer is formed from woven fiberglass, a fiberglass composite, a fiberglass mat or chopped fiberglass strands.

16. A method of forming a vapour-permeable structural panel according to any of claims 14 or 15, wherein the at least one reinforcing layer is applied to a surface of the cellular panel member with a heated roller and the heated rollers sets the resin in the reinforcing layer, binding the reinforcing layer to the cellular panel member.

17. A wall section comprising:

a frame forming a support structure; and
at least one vapour-permeable structural panel comprising a cellular panel member, said cellular panel member comprising a first set of apertures and a second set of apertures, wherein the first set of apertures facilitate vapour passing through the panel and the second set of apertures facilitate water passing through the panel.

18. A wall section according to claim 17, wherein the panels are attached to any other parts of a wall section such as a steel beam in a building or brickwork/ breeze blocks.

19. A wall section according to any of claims 17 or 18, wherein the panel is attached to other parts of a wall section using a water tight seal.

20. A wall section according to any of claims 17 to 19, wherein on an outer surface of a wall section surfaces include any one or more of the following are used: a glass matting embedded in resin; traditional render; wet dash; acrylics; marble; terracotta; dry dash; tyrolean finishes; high build finishes; ceramics; timber and aluminium finished metal glass mirrors; stone; granite; and silicone based coatings.

21. An impact resistant panel comprising:

an insulation layer;
a cellular layer; and
a reinforcing layer.

22. An impact resistant panel according to claim 21, wherein the impact resistant panel is unitary with the insulation layer, cellular layer and reinforcing layer.

23. An impact resistant panel according to any of claims 21 or 22, wherein the insulation layer is formed from any one of or combination of the following: foam, cellular glass, shredded cellular fibres or expanded polystyrene.

24. An impact resistant panel according to any of claims 21 to 23, wherein the cellular layer is of any structural network with a plurality of interconnecting cell walls or edges.

25. An impact resistant panel according to any of claims 21 to 24, wherein the cellular layer is formed from an aluminium mesh.

26. An impact resistant panel according to any of claims 21 to 25, wherein the cellular layer is formed from any metal, polymeric material, alloy or plastics material.

27. An impact resistant panel according to any of claims 21 to 26, wherein the cellular layer is attached to the insulating layer using chemical bonding and/or adhesive.

28. An impact resistant panel according to any of claims 21 to 27, wherein the reinforcing layer is a woven structure of interlacing fibres which are substantially perpendicularly oriented forming a mesh-like structure.

29. An impact resistant panel according to any of claims 21 to 28, wherein the reinforcing layer is formed from fibreglass, a fibreglass composite material, a fibreglass mat or chopped fibreglass strands.

30. An impact resistant panel according to any of claims 21 to 29, wherein on an outer surface of the impact resistant panel, there is applied a variety of one or more different surfaces such as any of the following: a glass matting embedded in resin; traditional render; wet dash; acrylics; marble; terracotta; dry dash; tyrolean finishes; high build finishes; ceramics; timber and aluminium finished metal glass mirrors; stone; granite; and silicone based coatings.

31. A method of forming an impact resistant panel comprising:

providing an insulation layer;
providing a cellular layer and forming the cellular layer on top of the insulating layer; and
providing a reinforcing layer on top of the cellular layer.

32. A main support structure for a building, said main support structure adapted to allow movement while keeping a support framework substantially stationary, wherein attachment means are provided which allow the main support structure to have movement relative to the supporting framework.

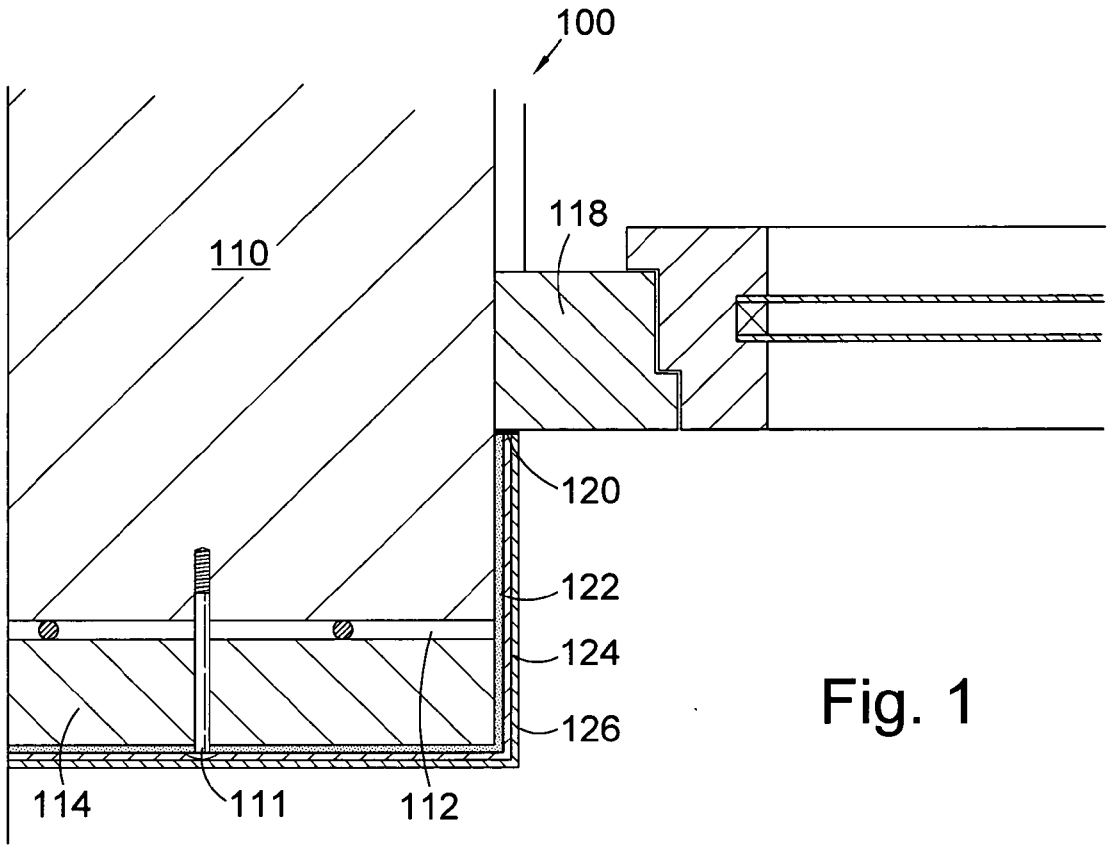


Fig. 1

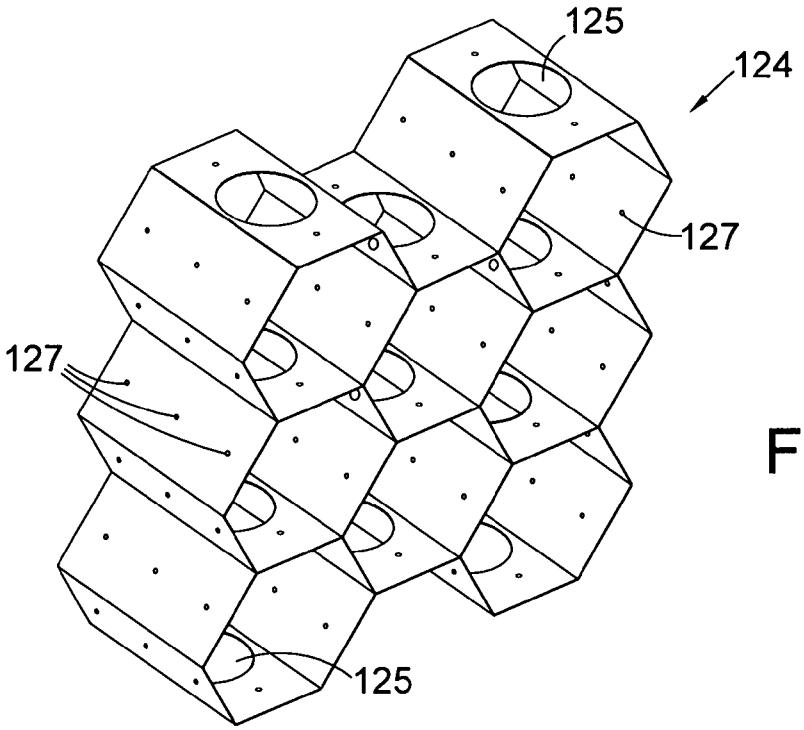


Fig. 2

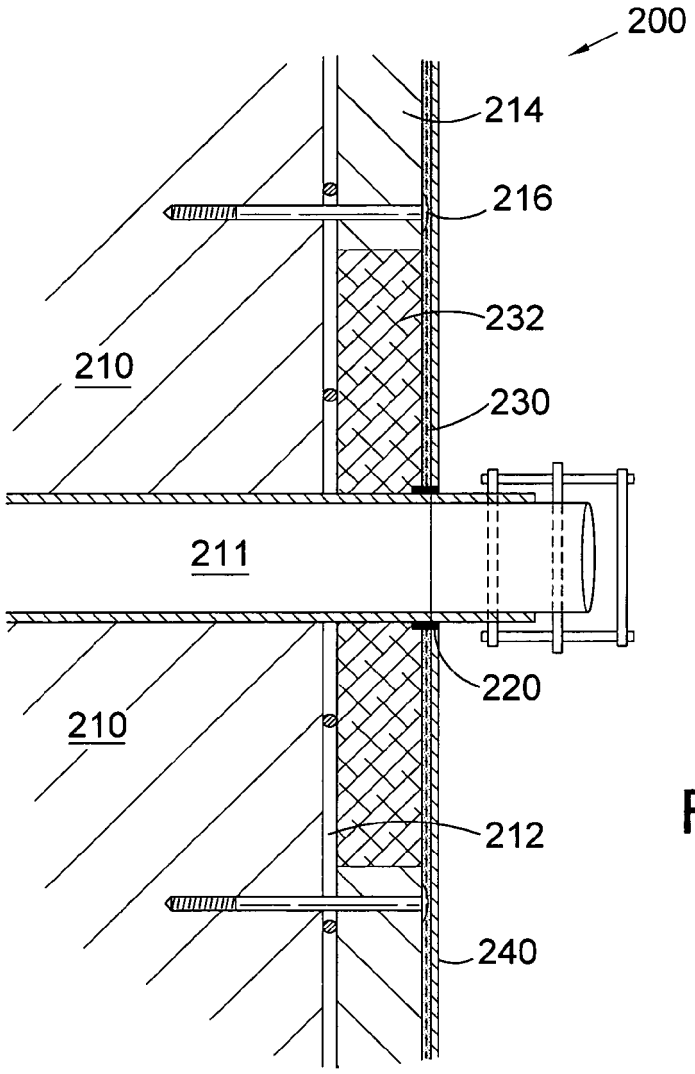

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Fig. 3

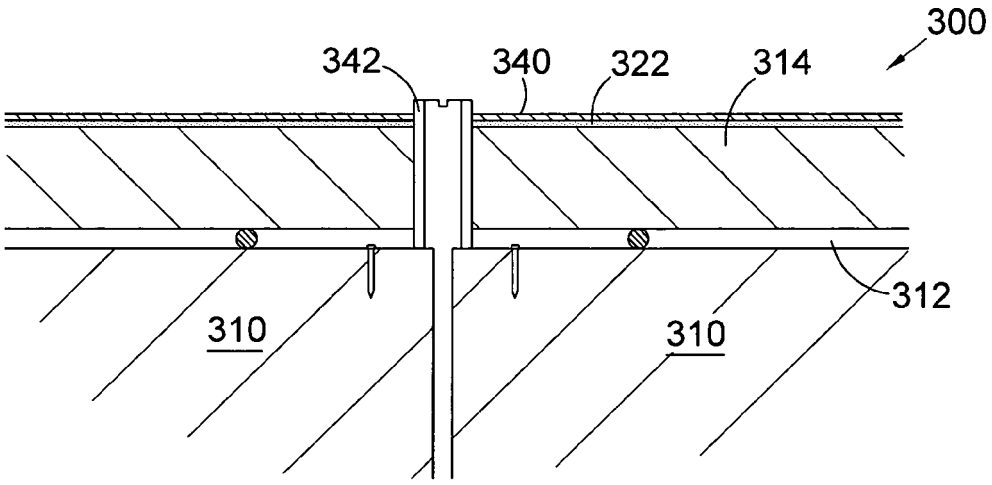

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Fig. 4

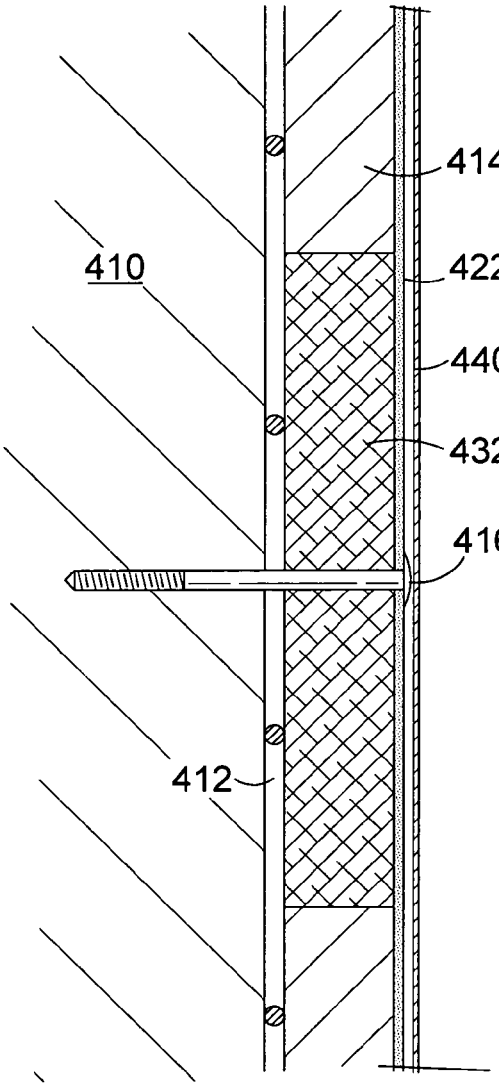


Fig. 5

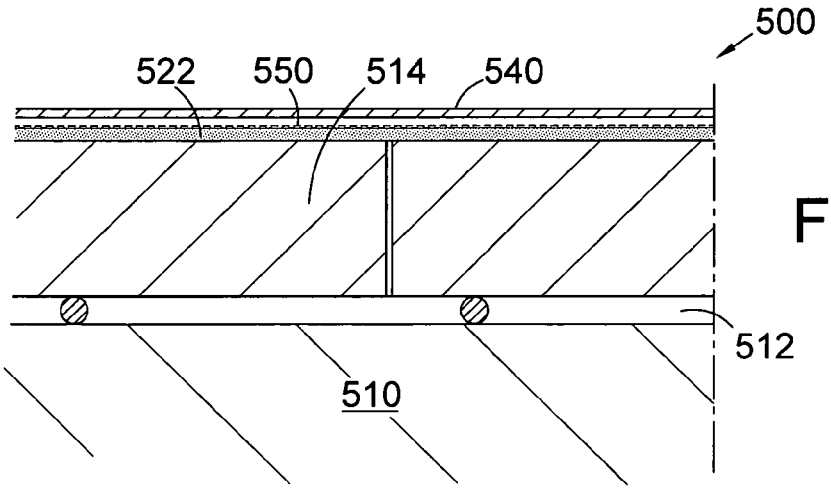


Fig. 6

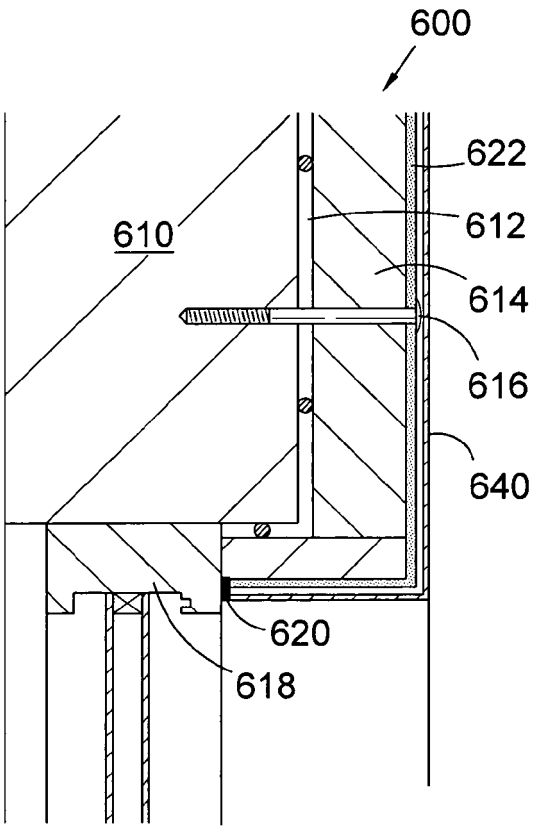

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Fig. 7

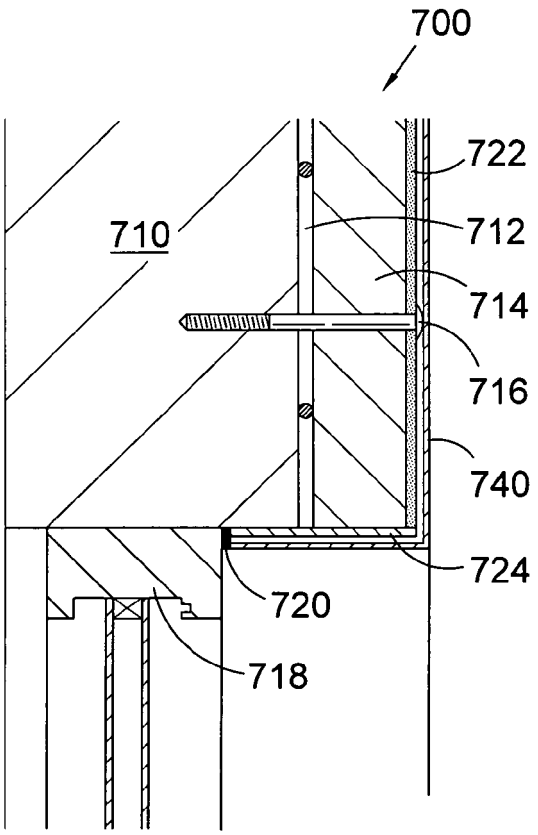

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Fig. 8

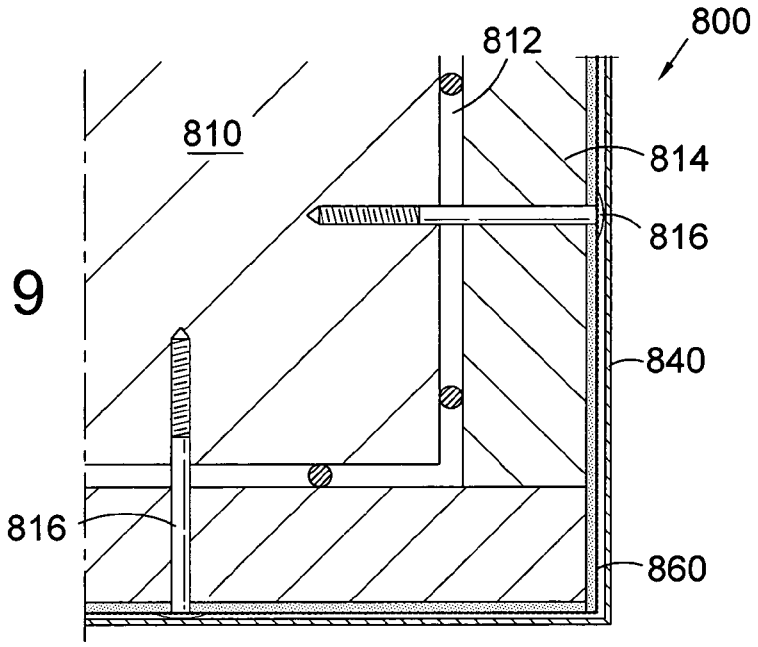

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Fig. 9

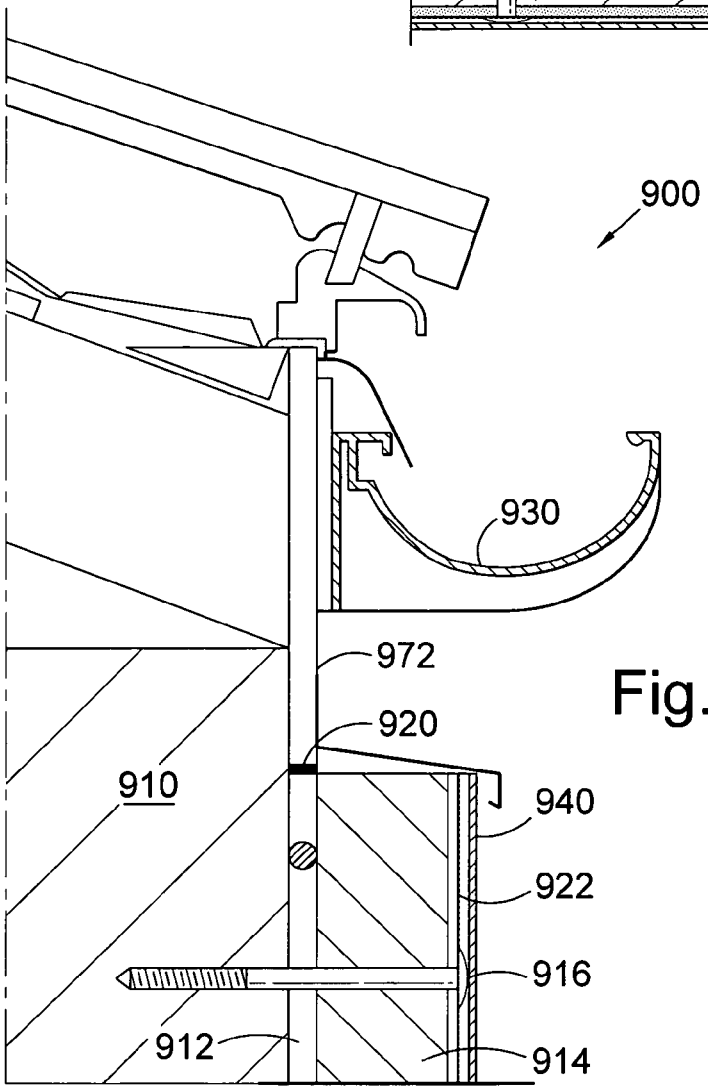

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Fig.10

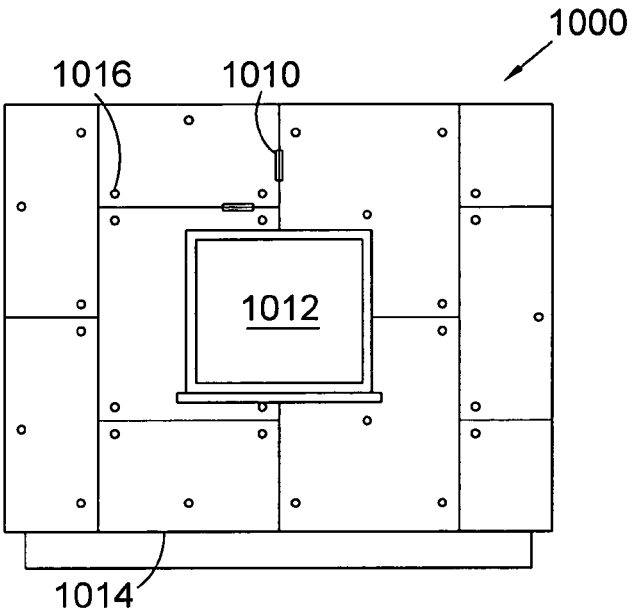

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Fig. 11

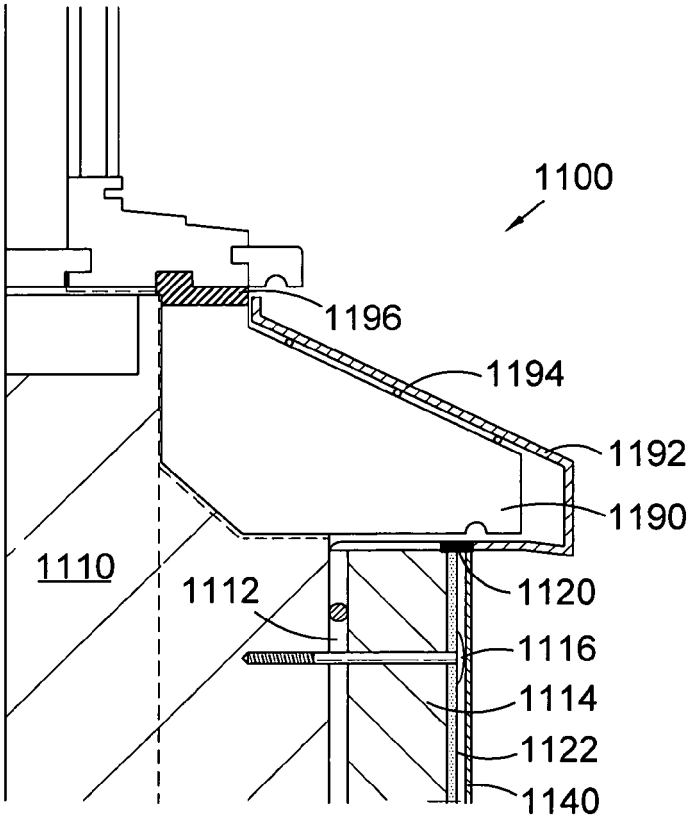

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Fig. 12

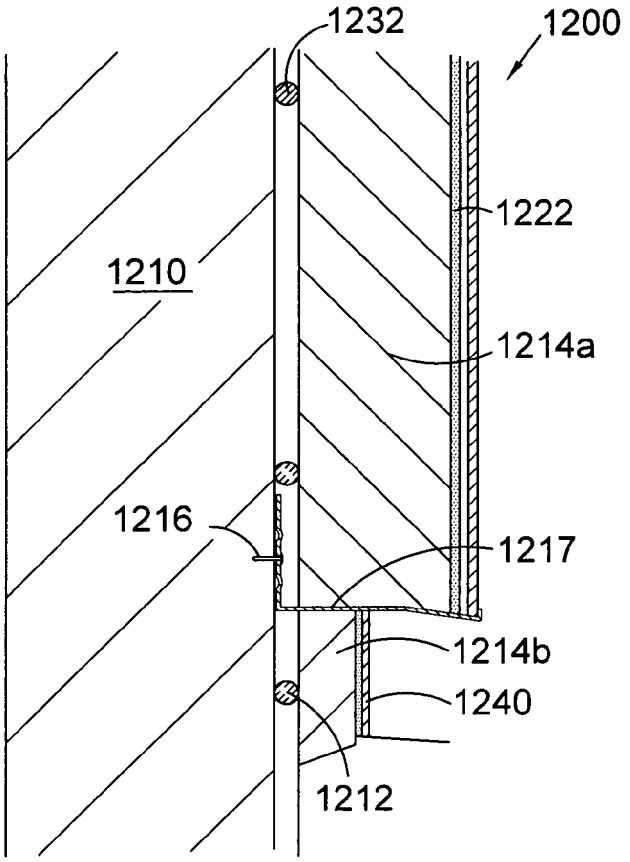

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Fig. 13

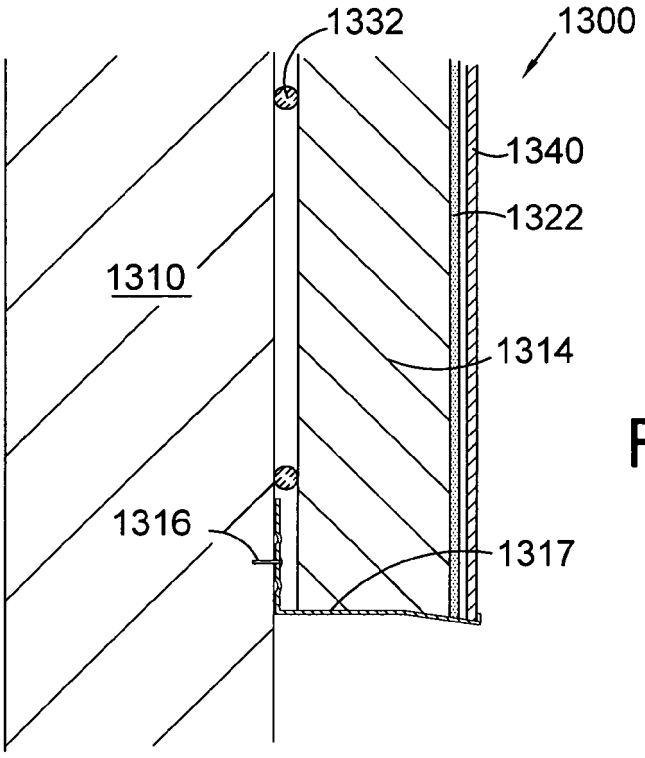

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Fig. 14

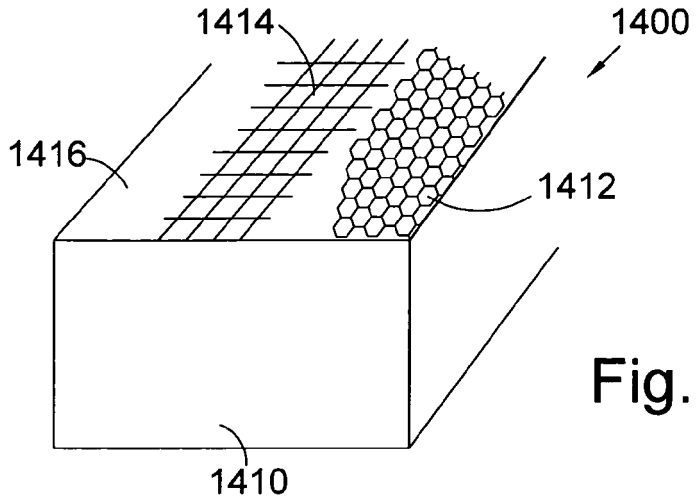


Fig. 15

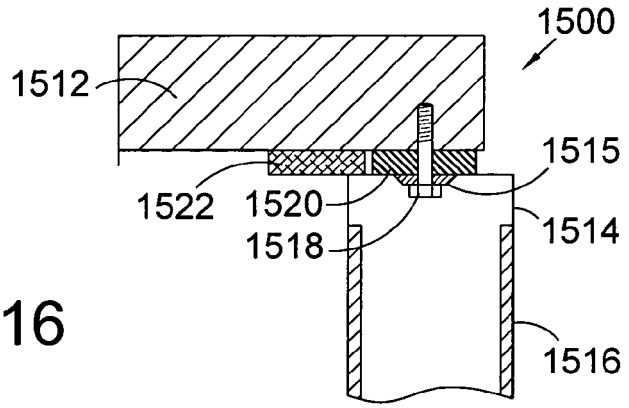


Fig. 16

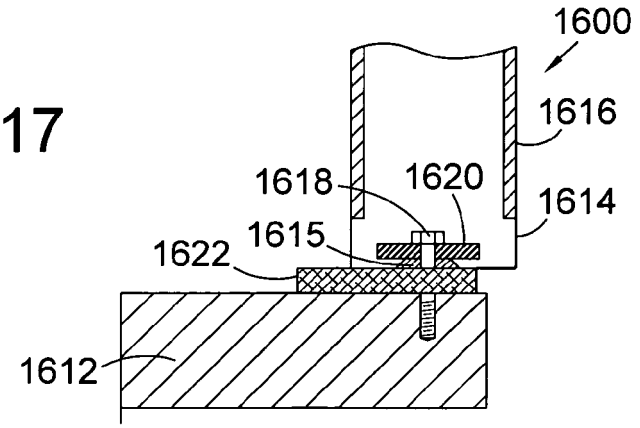


Fig. 17

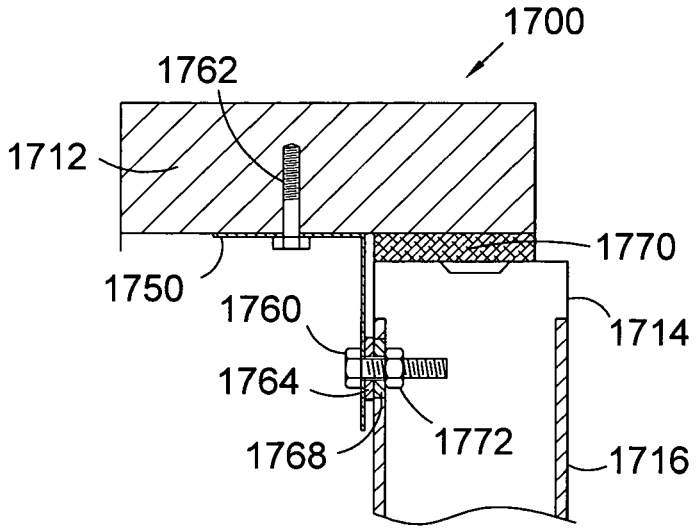

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Fig. 18

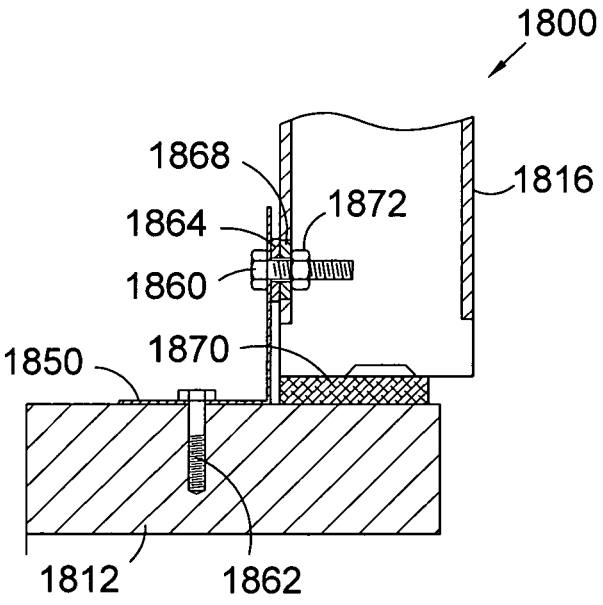

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1850
1812
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Fig. 19