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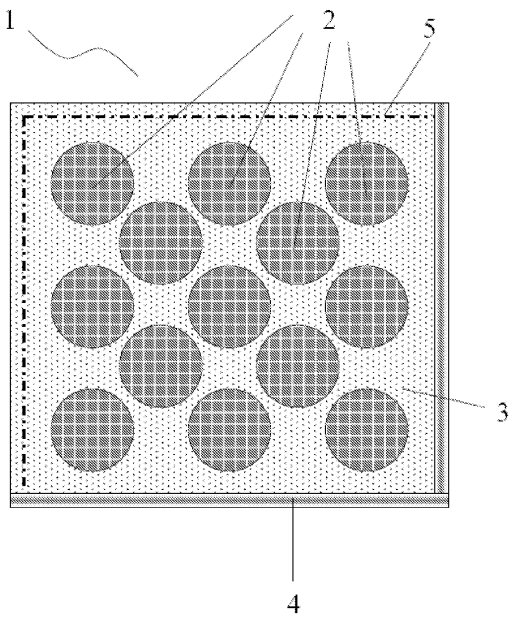
## (54) Preformed thermo-acoustic insulation panel

(57) The present invention relates to a preformed panel (1) for heat and sound insulation of buildings and structures, such as walls, ceilings and/or floors, comprising a layer (3) of non-woven fabric, preferably comprising polyester fibres, provided with a plurality of cells (2). The preformed panel (1) according to the present invention preferably comprises, on at least one of the surfaces of the layer (3) of non-woven fabric, preferably on both of them, a rigid covering layer (6) which covers and seals the cells (2) of the preformed panel (1).

Fig. 1

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## Description

### Field of the invention

**[0001]** The present invention relates to a preformed panel for heat and sound insulation of buildings and structures, such as walls, ceilings and/or floors.

### Background art

**[0002]** At present, among the commercially available materials there exist insulation materials which have both heat-insulating and sound-insulating properties, although not always to the same degree; often a material will provide better heat insulation than sound insulation, or vice versa.

**[0003]** Different materials of mineral, vegetable, animal and synthetic origin are used for heat and sound insulation.

**[0004]** Materials of mineral origin are, for example, rock wool, glass wool, expanded clay and pumice.

**[0005]** Materials of natural, vegetable or animal origin are, for example, various types of wood, cellulose, hemp, coconut, jute, reed, cork and lambswool.

**[0006]** Finally, materials of synthetic origin are, for example, expanded polyurethane foam, expanded or extruded polystyrene, and synthetic fibres, such as polyester fibres, polypropylene fibres, polyamide or polyactide fibres and acrylic fibres, modacrylic and aramid (para-aramid and meta-aramid) fibres.

**[0007]** The abovementioned materials are present commercially in the form of rigid and semi-rigid panels or in the form of loose material, in bead or fibre form, or in the form of matting. For example, it is possible to find in commerce semi-rigid panels or matting of rock wool or glass wool, rigid panels of cork, polystyrene, cork shavings, polyester fibres or polyamide fibres, and matting made of polyester or other synthetic materials.

**[0008]** The installation of the abovementioned products, which is typically performed externally, internally or in the cavities of civil and industrial buildings, requires several manual processing and finishing operations in order to obtain the finished assembly. The greater the number of operations performed, the greater is the possibility of reducing the insulation effect.

**[0009]** Panels made of natural insulants, such as wool, wood or cork, ensure both good heat and good sound insulation and do not contain harmful substances, as, instead, is the case with insulants made of mineral fibres. They are, however, prone to deterioration with time and have a fairly high cost.

**[0010]** Mineral insulating materials such as glass wool and rock wool, although they are fairly inexpensive and have good heat and sound insulating properties due to their fine-hair macroscopic structure which dampens noise and ensures heat insulation by trapping of large amounts of air, have the drawback that they are irritants when they make contact with the skin and require a moisture-proof barrier in order to prevent degradation which reduces the heat-insulating properties.

**[0011]** Insulating materials of synthetic origin, such as polystyrene, although excellent from the point of view of heat insulation, have the defect that they have a low biodegradability as waste material. Expanded polyurethane is an excellent material, but involves risks when applied using the spraying technique, and has higher costs than other products of synthetic origin. Polyurethane is also used in embossed panels which are characterized by the presence of air chambers which help increase the heat insulation and sound insulation.

**[0012]** The patent application published under number US 2001/0012812 describes a panel which includes two layers comprising a plurality of cells with a frusto-pyramidal shape which are arranged facing and connected together and two covering layers which close and seal the cavities of the respective plurality of cells. The patent US 4,631,221 describes a panel which includes two external covering layers which enclose a shaped layer comprising a plurality of wells. The shaped layer is made of fabric, preferably knitted fabric, impregnated with a thermosetting resin.

**[0013]** The panels described according to the prior art do not satisfy the criteria of lightness, low cost and suitability for recycling which are required nowadays for preformed panels used for the heat and sound insulation of buildings.

### Disclosure of the invention

**[0014]** The present invention relates to a preformed panel for heat and sound insulation of buildings and structures, such as walls, ceilings and/or floors, comprising a layer of non-woven fabric, preferably comprising polyester fibres, provided with a plurality of cells.

**[0015]** The preformed panel according to the present invention preferably comprises, on at least one of the surfaces of the layer of non-woven fabric, preferably on both of them, a rigid covering layer which closes and seals the cells of the preformed panel.

**[0016]** The Applicant has surprisingly found that the preformed panel according to the present invention is able to overcome the drawbacks mentioned above in connection with the conventional panels used for heat and sound insulation.

**[0017]** In particular, the Applicant has found that, with use of the preformed panel according to the present invention, it is possible to reduce the thickness and weight of the panel, owing to the more efficient heat and sound insulation.

**[0018]** The Applicant has also found that, with use of the preformed panel according to the present invention, it is possible to improve and simplify installation owing to the greater lightness and rigidity of the panel itself.

**[0019]** The Applicant has found that, with use of the preformed panel according to the present invention, it is possible to reduce the overall cost of the heat and sound

insulation compared to conventional insulation systems since the cost of installation and finishing is reduced.

**[0020]** Finally, the Applicant has also found that the preformed panel according to the present invention offers advantages also from an environmental and ecological point of view, being preferably made of recycling material, in particular fibres of recycled polyester, and in turn being able to be easily recycled.

**Brief description of the drawings**

**[0021]**

Figure 1 shows a schematic top plan view of an embodiment of the preformed panel according to the present invention.

Figure 2 shows a schematic cross-sectional view of a first embodiment of the preformed panel according to the present invention applied to a wall.

Figure 3 shows a schematic cross-sectional view of a second embodiment of the preformed panel according to the present invention.

Figure 4 shows a schematic cross-sectional view of a third embodiment of the preformed panel according to the present invention.

**Detailed description of the invention**

**[0022]** Figure 1 shows a schematic top plan view of an embodiment of the preformed panel 1 according to the present invention.

**[0023]** The preformed panel 1 according to the present invention comprises a plurality of cells or cavities 2 - shown as having a circular shape in Figure 1 - which are formed in a layer of non-woven fabric material 3.

**[0024]** The preformed panel 1 may have a quadrangular shape, as shown in Figure 1, but may have other different shapes such as a triangular, rectangular, rhomboidal or other shape. Quadrangular and rectangular shapes are in any case the preferred shapes.

**[0025]** Advantageously the preformed panel 1 comprises a single layer of non-woven fabric material 3.

**[0026]** The dimensions of the panel 1 are not particularly characteristic and may be dependent upon the dimensions of the surface to be lined. The width of the panel 1 may range between 50 and 400 cm, and preferably between 100 and 300 cm. The length of the panel 1 may range between 50 and 400 cm, and preferably between 100 and 300 cm.

**[0027]** The cells 2 in the panel 1 according to the present invention may have a variable shape and size and be variable in number. The essential requisite regarding the shape, size and number of the cells 2 is that of providing a plurality of cavities which are able to form a plurality of inset air chambers arranged between the wall to be insulated and the layer of non-woven fabric 3.

**[0028]** The cells 2 may have a spherical, cylindrical, cubic, pyramidal, quadrangular, tetrahedral, honeycomb, conical, truncated conical or other shape.

**[0029]** The cells 2 may have dimensions which are variable depending on the size of the panel 1. Generally, the cells 2 have dimensions, in terms of length, width and/or diameter, ranging between 10 mm and 500 mm, preferably between 20 mm and 300 mm, and even more preferably between 30 mm and 200 mm. Generally, the cells 2 have a depth of between 5 mm and 400 mm, preferably between 10 mm and 300 mm, and more preferably between 20 mm and 200 mm.

**[0030]** The number of cells 2 present in a panel 1 depends on the size of the cells and the panel 1 itself. Generally, the number and the dimensions of the cells 2 are such as to cover a surface, viewed from above as in Figure 1, greater than 50%, preferably greater than 70%, of the total surface, viewed from above as in Figure 1, of the panel 1.

**[0031]** Advantageously, the form and dimensions of the cells 2 are uniform in each panel 1, but it is possible to envisage panels comprising cells 2 of variable shape and size, i.e. with shapes and sizes different from each other, for example, large-size spherical shaped cells alternating with small-size cylindrical shaped cells.

**[0032]** The panel 1 according to the present invention preferably comprises cells of the same or similar shape, but may also comprise cells with two or more different shapes. For example, the panel 1 according to the present invention may also comprise spherical cells alternating with cylindrical and/or pyramidal cells, or conical cells alternating with truncated conical cells, and so on.

**[0033]** The panel 1 according to the present invention preferably comprises cells of the same or similar shape, but may also comprise cells with one or more different dimensions. For example, the panel 1 according to the present invention may also comprise cells having a different depth or different width and/or diameter. According to one embodiment, the panel 1 according to the present invention may also comprise cells which have both a different depth and different width and/or diameter.

**[0034]** Advantageously, the cells 2 of the preformed panel 1 according to the present invention may be partially or completely filled with (heat or sound) insulating material in the form of granules or shavings or fibres, so as to form a plurality of micro air-chambers which are interconnected inside the cells 2. This insulating material may be chosen from among common insulating materials such as cork, polyester and other synthetic fibres, rock wool, expanded clay, and so on.

**[0035]** The panel 1 shown in Figure 1 shows an embodiment of the panel according to the present invention comprising thirteen cylindrical shaped cells 2 which cover about 80% of the surface of the panel 1.

**[0036]** According to a preferred embodiment, the panel 1 has along its sides an alternation of projections 4 and grooves 5 with male/female mating, allowing modular assembly of a plurality of panels 1.

**[0037]** The panel 1 according to the present invention

is preferably made by thermoforming a layer 3 of non-woven fabric, preferably made of synthetic fibres, preferably polyester fibres, polypropylene fibres, polyamide fibres, polyactide fibres, acrylic fibres, modacryclic fibres and aramid fibres (para-aramid and meta-aramid fibres).

**[0038]** Advantageously the layer 3 of non-woven fabric is made of polyester fibres. The layer 3 of non-woven fabric is advantageously devoid of resins and/or synthetic impregnating agents.

**[0039]** The formation of the layer 3 of non-woven fabric typically uses fibres which are arranged in layers or intersecting and which are joined together mechanically (for example using needles), by means of adhesives or using thermal processes. According to a preferred embodiment, the layer 3 is formed by means of mechanical bonding of carded webs. Advantageously, the layer 3 of non-woven fabric is formed without the aid of any resin and/or synthetic impregnating agent. Advantageously the layer 3 of non-woven fabric consists substantially of synthetic fibres, preferably polyester fibres.

**[0040]** The layer 3 of non-woven fabric is preferably shaped by means of thermoforming.

**[0041]** The thermoforming is performed under hot conditions by means of pressure or suction against specially provided moulds. When using the pressure technique, the layer of material is pressed against the mould owing to a high pressure exerted from the outside by the air, which facilitates also cooling thereof. When using the suction technique, the layer of material rests against the mould owing to the sucking action and reproduces all the patterns of the mould. According to a preferred embodiment, the layer 3 is formed by means of double-mould thermoforming. The layer of non-woven fabric material is first heated and arranged between two opposite cold moulds, one male and the other female, and then pressed between the two moulds by the mould machine, thus obtaining the desired form of the layer 3.

**[0042]** Figure 2 shows a schematic cross-sectional view of an embodiment of a preformed panel 1 according to the present invention applied to a wall 10 to be insulated.

**[0043]** The preformed panel 1 comprises a plurality of cells 2 with a quadrangular shape, preferably made by means of thermoforming of a layer 3 of non-woven fabric, being closed on one side and in contact with a rigid layer 6 and closed on the other side and in contact with the wall 10 to be insulated.

**[0044]** Figure 3 shows a variant of the preformed panel 1 according to Figure 2, comprising a second rigid layer 6' arranged on the opposite surface to the surface of the first rigid layer 6.

**[0045]** The preformed panel 1 according to the present invention preferably comprises, on at least one of the surfaces of the layer 3 of non-woven fabric, preferably on both of them, as shown in Figure 3, a rigid covering layer 6,6' which closes and seals the cells 2 of the panel 1.

**[0046]** The rigid covering layer 6,6' may be made of different materials, normally used in the heat and sound insulation industry, such as plasterboard, kenaf, wood, polystyrene and cork. The rigid layer 6,6' may be made as a fabric, non-woven fabric, and laminate, smooth or doped. For particular applications, in particular for use on surfaces which are exposed to light, the rigid layer 6,6' may also comprise the use of photovoltaic modules for energy generation, comprising one or more layers of photovoltaic material. The photovoltaic material comprises monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride (CdTe), microcrystalline cadmium sulphide (CdS), gallium arsenide (GaAs), copper indium diselenide (CIS), and copper indium gallium diselenide (CIGS).

**[0047]** The rigid layer 6,6' is applied to the panel 1 by means of known adhesion techniques, for example by means of adhesives, thermowelding, ultrasound, laser, microwave or by mean of mechanical fixing, for example by means of screws, rivets, nails, etc.

**[0048]** The rigid layer 6,6' may be preferably lined with a further finishing layer 7 or screed which can be painted or onto which wall coverings may be applied.

**[0049]** Advantageously, the preformed panel 1 according to the present invention may comprise a further layer, not shown in the figures, of fire retardant material intended to be prevent the spread of flames in the event of a fire. The fire retardant layer may be advantageously arranged between the rigid layer 6,6' and the finishing layer 7 or screed.

**[0050]** Even more preferably, the layer of non-woven fabric material may consist of a composition which is intrinsically fireproof, by using (originally) fireproof fibres.

**[0051]** Advantageously, as shown in Figure 4, the preformed panel 1 according to the present invention may comprise a further layer 8,8' of rubber material arranged between the layer 3 and the rigid layer 6,6'. Preferably, the layer 8,8' of rubber material is arranged on both sides of the layer 3. The material used comprises natural or synthetic rubber, such as polyisoprene, polybutadiene, polyisobutylene, poly(styrenebutadiene), and so on. By means of the layer 8,8' of rubber material it is possible to increase the heat and sound insulating power of the panel 1 according to the present invention.

**[0052]** Although the preformed panel 1 according to the present invention has been described with reference to one or more preferred embodiments of the invention, and in particular to Figures 1 to 4, the person skilled in the art will be able to introduce obvious modifications and variations which fall within the scope of the present invention which is defined by the claims below.

## Claims

1. A preformed panel (1) for heat and sound insulation of buildings comprising a layer (3) of nonwoven fabric made of synthetic fibres selected from the group consisting of polyester fibres, polypropylene fibres, polyamide fibres, polylactide fibres, acrylic fibres,

modacrylic fibres, and aramid (para-aramid and meta-aramid) fibres, said layer (3) comprising a plurality of cells (2).

**2.** The preformed panel (1) according to claim 1, **characterized in that** said panel (1) comprises a rigid layer (6,6') on at least one of the surfaces of said layer (3).

**3.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said plurality of cells (2) comprise cells having a shape selected in the group consisting of spherical shape, cylindrical shape, cubical shape, pyramidal shape, quadrangular shape, tetrahedral shape, honeycomb shape, conical shape, truncated conical shape, and combinations thereof.

**4.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said plurality of cells (2) comprise cells having dimensions of between 10 mm and 500 mm.

**5.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said plurality of cells (2) comprise cells having depths of between 5 mm and 400 mm.

**6.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said plurality of cells (2) comprise cells having the same shape, dimension and depth as one another.

**7.** The preformed panel (1) according to any one of the preceding claims 1 to 5, **characterized in that** said plurality of cells (2) comprise cells having different shape, dimension and depth from one another.

**8.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said plurality of cells (2) covers a surface, viewed from above as in Fig. 1, greater than 50%, of the total surface, viewed from above as in Fig. 1, of said panel (1).

**9.** The preformed panel (1) according to claim 8, **characterized in that** said plurality of cells (2) covers a surface, viewed from above as in Fig. 1, greater than 70%, of the total surface, viewed from above as in Fig. 1, of said panel (1).

**10.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said panel (1) has along the sides thereof an alternation of projections (4) and grooves (5) with male/female mating.

**11.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said layer (3) of nonwoven fabric is produced by means of mechanical bonding of carded webs.

**12.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** said rigid layer (6,6') comprises a layer of photovoltaic material.

**13.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** it comprises a fire retardant layer.

**14.** The preformed panel (1) according to any one of the preceding claims, **characterized in that** it comprises a layer (8,8') of rubber material.

**15.** A building **characterized in that** it comprises at least a cladding produced with the preformed panel (1) according to any one of the preceding claims 1 to 14.

Fig. 1

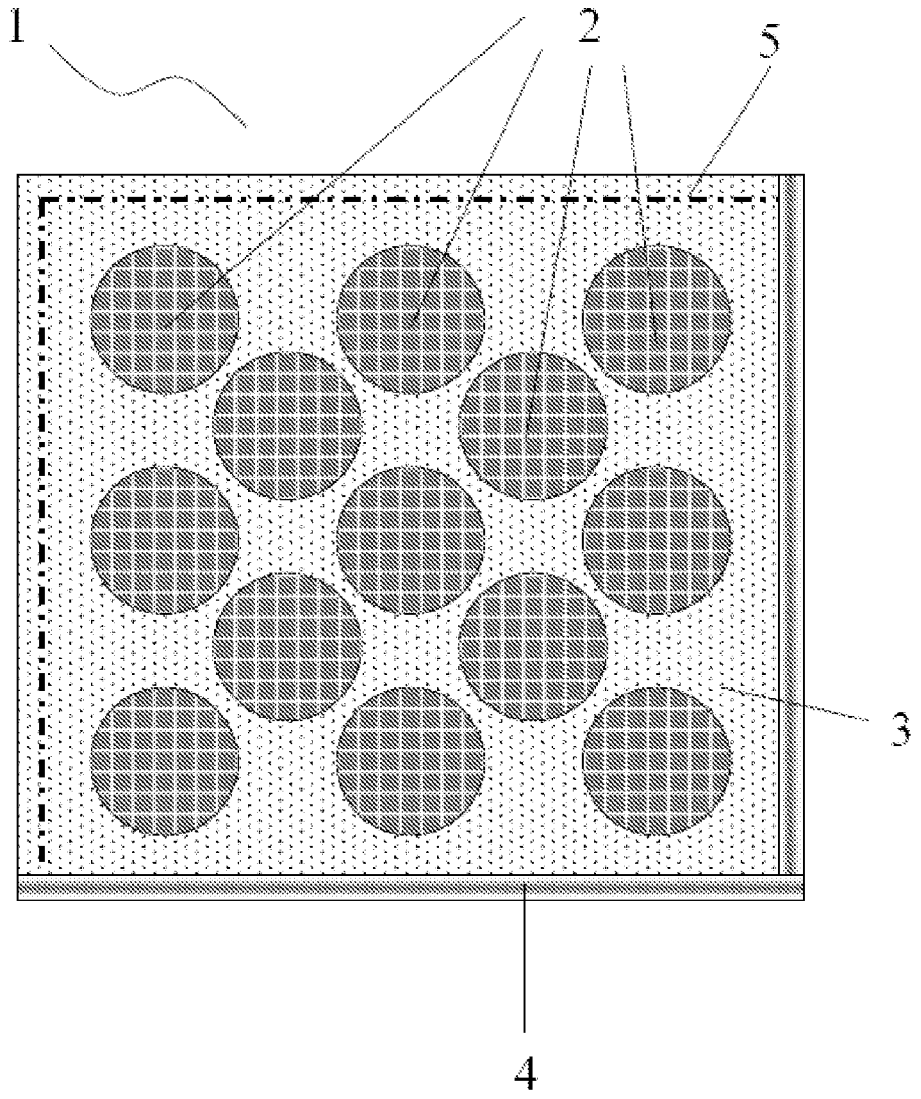


Fig. 2

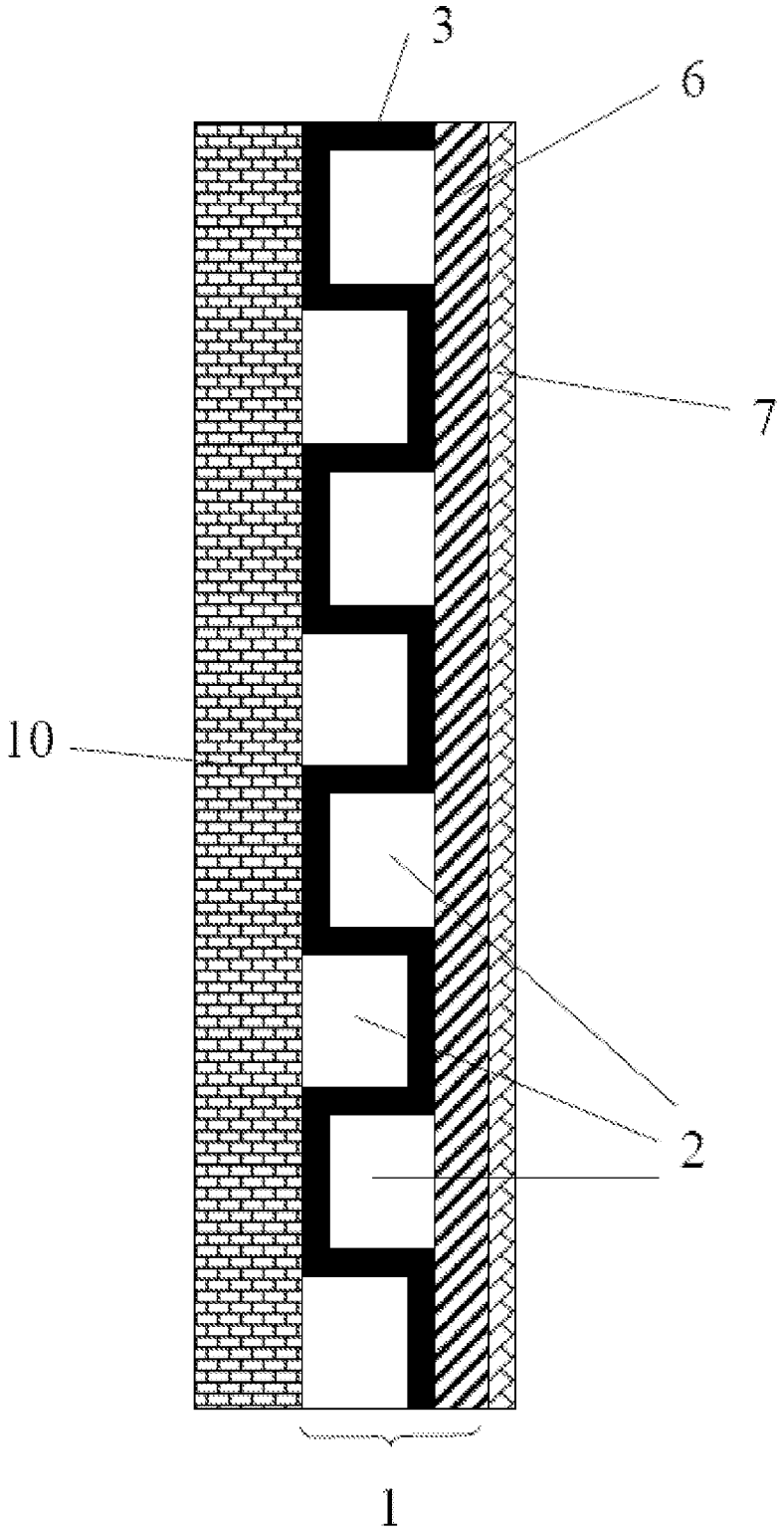


Fig. 3

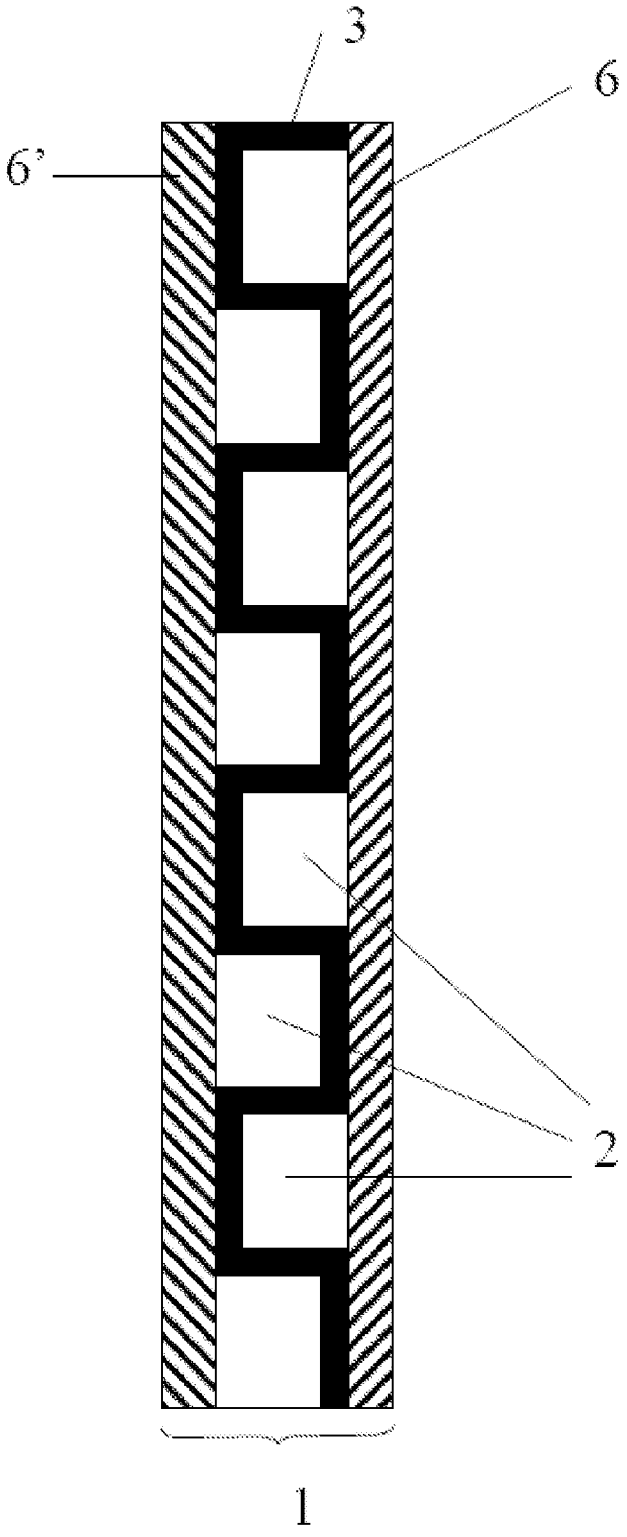
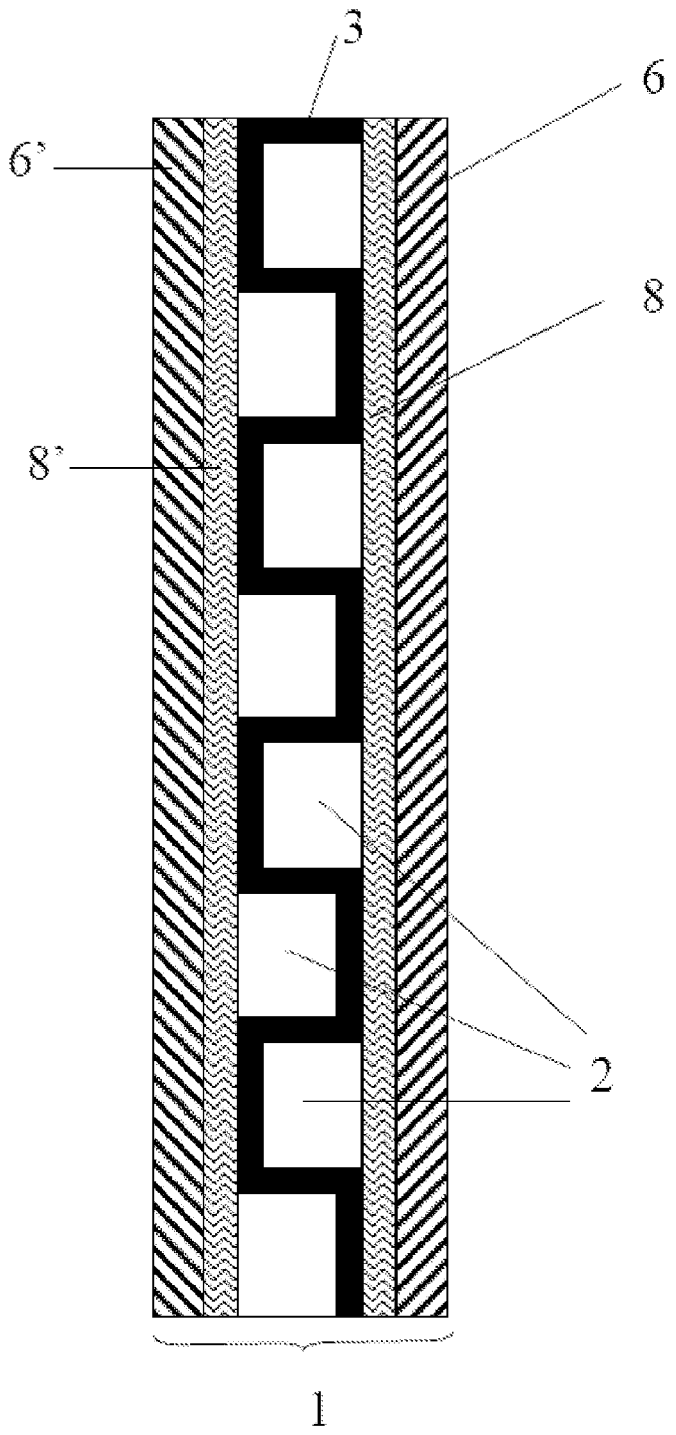


Fig. 4



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Application Number
EP 11 15 0762

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 7 March 2011 | Vratsanou, Violandi |

CATEGORY OF CITED DOCUMENTS

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