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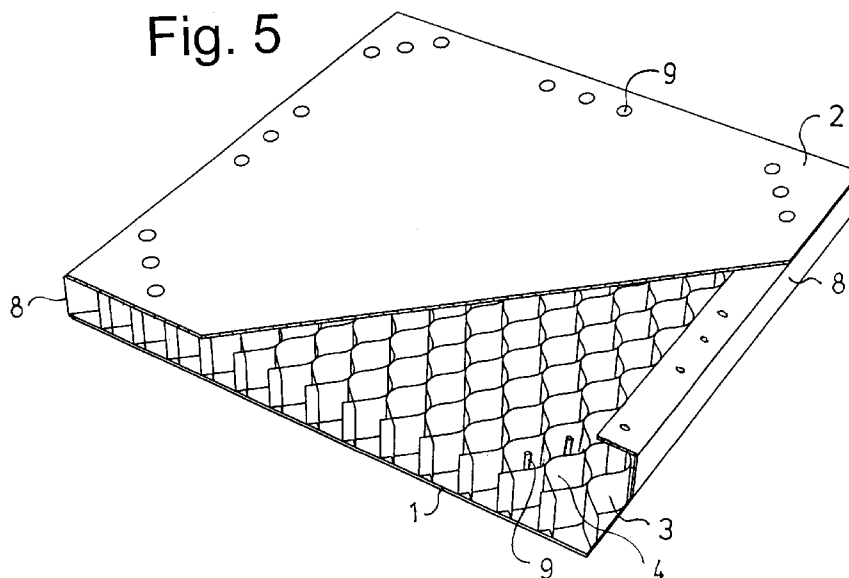
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(54) Title: PANEL WITH CELLULAR STRUCTURE

Fig. 5



(57) Abstract: At least one plastic cellular foil (3) with empty or filled chambers (4) is fixed between parallel layers (1, 2) while the parallel layers (1, 2) are closing openings of chambers (4) on both sides. Also the parallel layers (1, 2) are preferably from flexible plastic foil, and preferable filling is created by loose particles (5) of heat insulating material with size up to 6,5 cm, for instance foam glass and/or waste glass cullet and/or glass powder and/or polystyrene. Walls of chambers (4) and possibly of parallel layers (1, 2) can be perforated and the panel can be provided with circumferential reinforcing walls (8).

PANEL WITH CELLULAR STRUCTURE

Technical Field

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The invention relates to the panel with built-in cellular structure, which is suitable in particular for construction of insulation layers in building industry. The panel can be used in particular for base, floors and facing of buildings.

10 Background Art

Various types of construction panels and insulation panels are currently available on the market. Predominantly classic construction elements such as bricks, blocks and wood are still used for the very buildings. Construction panels that are used for construction are usually from materials based on cement, such as concrete, cellular concrete etc. It is usually necessary or suitable to face buildings from these materials or their parts with insulating panels or the panels from insulating materials are eventually built-in directly into floor, base, terrace, etc. Insulating panels are thus used as an interlayer or as a surface facing. Broad choice of hitherto insulating panels is available on the market, but generally each type of these panels shows significant disadvantages.

Usually only various foils from plastics are used for waterproofing. These foils have simple structure of a sheet of material, usually supplied in rolls. Advantage of a foil is that it is flexible and provides also certain degree of sound and heat insulation, but the level of sound and heat insulation reached is very poor.

For instance boards from polystyrene or rock wool are used for sound and heat insulations. Advantage of polystyrene boards is their low mass and no water absorption capacity, but their significant disadvantage is their low mechanical resistance. They are fragile and they can fracture on impact, stress, or when a heavier object is leaning against these boards. Polystyrene particles can pour out of possible crannies, for instance when used under wood lining. Another and fundamental disadvantage of polystyrene is its complete inflexibility so that it is problematic to use it for lining of uneven or dissected surfaces. Polystyrene panels

are very often used for insulation layers, however effectiveness of sound and heat insulation is relatively limited.

Other well known and frequently used means for heat and sound insulation are panels from rock wool. They have advantage of low weight and, depending on density, also of the possibility of bending, but their significant disadvantage is their water absorption capacity, softness, and very low mechanical resistance. Filamentous structure of these panels allows intrusion of pests and also liability to damage.

None of the materials mentioned above has such strength to be used for loaded surface. Also none of them has simultaneously all required properties, i.e. waterproofing capability, heat and sound insulation capability, strength and a load-weight and tensile resistance.

At present, so called cellular foil is known in building industry. Its arrangement is described for instance in US pat. 5,449,543 and WO 97/16604. It is created as a system of strips of plastic foil that are interconnected so that a structure of hollow chambers/cells is created between their walls. Cavities of these chambers are open in vertical direction. The cellular foil is flexible to great extent. It is delivered in a folded state for manipulation and distribution, where the cellular walls are pressed together, and it is unfolded on a plane at the place of use, by which a honeycomb-like structure with open chambers is created. Hence, when the cellular foil is in folded state for distribution and storage, its chambers are flat, two-dimensional, and in the unfolded state for its use, its chambers are three-dimensional with through openings. This cellular foil is designed to be laid on surfaces of erosion attacked outdoor terrains, such as river banks or slopes along roads, or also backfilling of mining groves, where it is placed to prevent slacking of loosened rock from the walls and unwanted pulverization and fragmentation of surface elements. It is also used for consolidation of bed of constructions such as roads or railways, where it is loosely unfolded on earth base after baring and clearing away of arable soil, or over drainage blanket from gravel and/or sand. Here, the cellular foil is then overfilled with gravel and grouted with concrete and, as the case may be, coated with paving asphalt. Sometimes, it is filled directly with concrete. Various types of cellular foil are available already, in different types and versions, some of them having cell walls equipped with perforation to allow water

permeation and to eliminate unwanted pressures in the building. For all hitherto known applications, the cellular foil is overfilled with loose materials, while its chambers are filled and covered with setting or non-solidifying loose matter. When used on constructions, heavy machinery is commonly used on this cellular foil, when it is laid on the place of use and it's overfilling with gravel follows using excavators and subsequently travels by road compaction roller.

Document CZ U 9885 describes insulation panel consisting of parallel layers, for instance boards from insulation material, which are interconnected by means of grating. The parallel layers are at least two and the grating between the layers creates a spacer by means of which a system of hollow chambers is created in the panel. Air, gas, or vacuum is in these chambers. The grating is made of metal, plastic, or paper. This panel is strong, inflexible, and water-resistant. It has some, but insufficient, insulation properties.

Disclosure of the Invention:

The above-mentioned disadvantages are eliminated to a considerable extent by the invention. The invention proposes new panel for use in building industry, with internal cellular structure. The new panel is a body containing at least two parallel layers from impermeable water resistant material, from which at least one parallel layer creates the face wall of the panel and at least one layer creates the reverse wall of the panel. The essence of the new invention is that at least one flexible cellular foil from plastic is fixed between the parallel layers. A building cellular foil is used, i.e. structure created as a system from strips of material spliced together so that these strips spliced together create through chambers with layout similar to a bee comb. The cellular foil is fixed in the panel according to the invention in its unfolded state, i.e. in the state in which chambers of this cellular foil are three-dimensional, while parallel layers are attached to the cellular foil from both sides so that they cover openings of chambers. Accordingly, one of these parallel layers is situated on the side of inputs to the cellular foil chambers and the other layer on the side of outputs from chambers.

The parallel layers as well as cellular foil consist preferably from material based on plastics. This allows easy connection of these materials, gives tensile strength

as well as compression strength and also elasticity, preventing tensile as well as pressure cracking, and providing the panel with mechanic resistance.

The parallel layers are preferably from flexible material. Due to this, possibility of panel bend as needed is reached. Cellular foil from plastic is also flexible, therefore panels in this configuration are able to accommodate their shape to the surface line. This allows using these panels also for uneven surfaces, tiling of corners, projections etc., which is significant advantage that other mechanically resistant building materials usually do not have.

Covering wall can be created on at least one circumferential side of the panel.

Due to this, reinforcement and shape applanation is reached.

The covering wall can be preferably on all circumferential sides of the panel. Circumferential frame of the panel is created in this way. Creation of covering wall or walls from flexible material is advantageous because creation of flexible circumferential frame is reached in this way. Circumferential frame can be created for instance using elongation and fold of material of the face and/or reverse wall of the panel, or as a set-in frame, but also as a sewn in or ironed band of material, etc.

The cellular foil chambers can be empty in the panel according to the invention. In this case, cavities of these chambers are filled only with air and are creating here insulating air cavities. Some chambers can be used for reinforcing or fixing elements and in such case, chambers in predominant number will preferably remain empty without filling. Panels created in this way have advantage in that they have low weight, they are flexible, and their shape is easily accommodated to the base. In this case, parallel layers can be loosely laid over chambers or can be fixed to the edges of chambers so that they are firmly closing openings of these chambers on both opposite sides of the cellular foil.

Alternatively, with the advantage of higher insulating capabilities regarding sound and heat insulation, the chambers of the cellular foil in the panel can be filled with suitable insulating material. Preferably the contained material is loose, but in such case it is necessary that the parallel layers are fixed to the edges of chambers so that they are firmly closing openings of these chambers on both opposite sides of the cellular foil.

Filling of chambers can be homogeneous or heterogeneous, of the size ranging from dust particles up to larger particles, for instance also according to the height of the cellular foil used. It can be for instance from 2 cm to 30 cm high, and also a cellular foil with larger or smaller chamber diameter can be selected, especially depending on the intended panel size and purpose. The loose filling of chambers is preferably created by particles predominantly in the size range from dust particles up to the diameter of 6.5 cm.

The filling of chambers is preferably created at least partially by particles of loose material with heat insulating properties, for instance particles based on glass and/or polystyrene.

Besides the new construction of panels, also a new type of filling is invented for the new panel according to the invention. The filling of chambers is preferably created at least partially by particles based on foam glass and/or waste glass cullet and/or glass powder. This filling is environment friendly and it has many advantages. Panel with this filling does not absorb water, it is permeable to air, and it has relatively low weight. It has excellent heat and sound insulation properties. It can be easily disposed of without environmental burden. It also allows reutilisation of wastes based on glass. This filling is easily stored and it is suitable for use from the health point of view. It also allows easy production of panels because when using this filling, it is possible to fix parallel layers to the cellular foil simply by cementing or ironing using heat.

The invention expects production of new panels especially in the waterproofing form, i.e. without openings. However, in the case when air permeability is preferred, it is advantageous that the walls of chambers of the cellular foil, and as the case may be also at least one parallel layer, are perforated. Ventilation holes then allow for high degree of steam permeability and ventilation.

The invented panel is utilisable in building industry both for laying as well as for lining and facing. It can be used for instance for insulation of floor constructions, as roof insulation, and/or as interior or exterior lining of buildings and other constructions. It can have a surfacing allowing its use without further lining, or it can serve as a layer that will be furnished with another, for instance solid lining. It can serve as humidity insulation, heat insulation, and sound insulation. It allows use also for uneven surfaces. The panel can be produced in a flexible form that

can be turned and modelled. It is therefore possible to use it even for complicated floor structures and undulating walls and for sharp angle bends. These panels can be custom made with various dimensions and height. During manufacture, waste secondary raw materials such as construction and waste glass etc. can be reutilised. The panel is not pulverizing, cracking, warping after contact with water, and compared to other panels, for instance concrete or plasterboard, it has low weight. Production of the invented panel is relatively undemanding regarding materials, manipulation, staff as well as qualification, and the panel thus allows availability for producer as well as consumer with low purchase costs. Cellular foil of suitable selectable height, preferably from 2 cm to 30 cm, can be used in the panel, with smaller or larger chambers considering the required panel elasticity, chamber filling used, spatial and other conditions at the place of panel application etc. In the case when steam permeability and air permeability is required, it is possible to use perforated cellular foil in the panel and increase the required degree of air permeability by means of using a system of ventilating holes in one or both parallel layers.

Review of figures on drawings

The invention is illustrated using drawings, where Fig. 1 shows perspective view of example of the panel with loose filling according to the invention, partial section, Fig. 2 shows detail of the panel with fused on connection of parallel layers to chambers of the cellular foil, Fig. 3 shows detail of the panel with cemented connection of parallel layers to chambers of the cellular foil, Fig. 4 shows example of the panel with venting openings in the walls of the cellular foil and in parallel layers, and Fig. 5 shows perspective view of example of the panel with hollow chambers and elastic frame.

Examples of embodiment of the invention

Example 1

Descriptive example of optimal embodiment of the invention is panel with cellular structure according to the Fig. 1 and 2.

The panel represents a flat body, face and back wall of which is created by parallel layers 1, 2 from water resistant impermeable material. It can be for instance flexible foil from polypropylene, high density polypropylene etc. When placing the panel on a horizontal base, one of these layers 1, 2 is located at the bottom and the other layer is on the top, as shown on Figs. 1 and 2. Cellular foil 3 is fixed between the parallel layers 1, 2. Building cellular foil 3 available on the market and nowadays commonly used for installation into terrain for instance in road construction or in amenity planting on slopes around roads and rivers. It consists of plastic strips interconnected so that a system of chambers 4 is created and the chambers are through in vertical direction. The chambers 4 of the cellular foil 3 in the panel are filled with loose material from particles 5 of various sizes. The layers 1, 2 are fixed to the edges of chambers 4 and they are firmly closing openings of these chambers 4 on both opposite sides of the cellular foil 3. In this optimal embodiment, filling of chambers 4 consists of particles 5 based on so called foam glass of a dust size up to the diameter of 6.5 cm.

The said materials are not requirement, however they can be preferably recommended. This panel is waterproofing and heat- as well as sound-insulating. It is water-resistant and highly tensile as well as compression resistant. Combination of to a certain extent elastic layers 1, 2 as well as cellular foil 3 allows flexibility of the panel, which can be used for laying as well as for lining.

During production of the panel, the loose material in chambers 4 can be compacted for instance by travels with a compaction roller. The panel can have dimensions and height as needed and depending on whether it will be used for laying, for instance to create floor insulation, or whether it will be used for lining.

The panel shown on Fig. 2 has parallel layers 1, 2 fixed to the edges of chambers 4 by fusing on. Advantageous are here seamless joints between walls of chambers 4 and layers 1, 2 and easy production.

Example 2

Other example of embodiment of the invention is panel with cellular structure according to the Fig. 3.

The panel is of similar embodiment as the previous one, but its parallel layers 1, 2 are fixed to the chambers 4 by cementing using glue 6. Glue 6 can be applied over the whole parallel layer 1, 2 as shown on the Figure, or the glue 6 can be applied only to the cellular foil 3 edges. Figure 3 also shows the option that for instance one of the parallel layers 1, 2, e.g. the face one, in this case the upper parallel layer 2, can be created by board from rigid or flexible material. This panel has high mechanic resistance of its surface.

Example 3

Another example of embodiment of the invention is panel with cellular structure according to the Fig. 4.

This panel is of similar embodiment as the panel according to the first example, with that difference that walls of chambers 4 of the cellular foil 3, and also both parallel layers 1, 2 are perforated, equipped with a system of ventilating holes 7.

Example 4

Another example of embodiment of the invention is panel with cellular structure according to the Fig. 5.

The panel has appearance of a flat body, face and back walls of which are created by parallel layers 1, 2 for instance from flexible plastic canvas cloth reinforced with fibres. When placing the panel on a horizontal base, one of these layers 1, 2 is located at the bottom and the other layer is on the top. Flexible plastic cellular foil 3 is fixed between the parallel layers 1, 2. The chambers 4 of the cellular foil 3 are free of filling and their cavities in the panel are having function of insulating air cavities. The layers 1, 2 are freely laid over the cellular foil 3 and are covering openings of their chambers 4 on both opposite sides of the cellular foil 3.

The panel contains flexible circumferential frame consisting of four circumferential covering walls 8. The panel is made from rectangle of insulating canvas cloth one part of which creates the lower parallel layer 1 at the bottom and the second part is folded at the top over the cellular foil 3, where it creates the

upper parallel layer 2. Circumferential covering walls 8 of the panel are created by folded edges of the canvas cloth. The whole is held together by means of pins 9 on the principle of rivets that are stabbed through the parallel layers 1, 2 and chambers 4 of the cellular foil 3. For the sake of vivid description, Fig. 5 shows the panel in partial section, after cutting off the front covering wall 8 and part of the upper parallel layer 2.

This panel is waterproofing and to a significant extent also heat- as well as sound-insulating. It is water-resistant, tensile resistant, and to a certain extent also compression resistant. Its main preference is a very low weight in connection with elasticity and good flexibility.

The example embodiments herein demonstrate the broad scope of the invention without limiting it in any way. Various combinations of features described above are also possible. For instance it is possible to furnish the panel additionally with suitable surface finishing such as glued-on wooden board, decorative foil with print etc. Then, the panel can be preferably used for instance also for exterior lining of buildings or surface lining of interiors, where the face side can be furnished for instance with printing imitating other material. Or directly one of or both parallel layers 1, 2 of the panel can be made from variously selected material.

The panel filling can be created from materials other than the abovementioned particles 5, e.g. sand, ceramic rubble, and other.

C L A I M S

1. Panel with cellular structure in the form of portable body containing at least two parallel layers (1,2) from impermeable water resistant material, between which
5 a filling is located, while at least one of these parallel layers (1,2) creates a face wall of the panel and at least one of them creates a back wall of the panel, **characterized by that** the filling between the parallel layers (1,2) is created by at least one flexible plastic cellular foil (3) from strips of spliced together material with chambers (4), which is fixed between the parallel layers (1,2), with chambers (4) in
10 unfolded state, while the parallel layers (1,2) are covering openings of the chambers (4) on opposite sides of the cellular foil (3).

2. Panel with cellular structure according to claim 1 **characterized by that** also the parallel layers (1, 2) consist of material based on plastics.

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3. Panel with cellular structure according to claims 1 and 2 **characterized by that** the cellular foil as well as the parallel layers (1, 2) are flexible.

4. Panel with cellular structure according to claims 1 to 3 **characterized by that**
20 **that** a covering wall (8) is created on at least one circumferential side of the panel.

5. Panel with cellular structure according to claim 4 **characterized by that** it is on its circumference fitted with covering walls (8) creating circumferential frame around the unfolded cellular foil (3), preferably from flexible material based on
25 plastics.

6. Panel with cellular structure according to claims 1 to 5 **characterized by that** the chambers (4) of the cellular foil (3) are at least in predominant number empty and they are creating insulating air cavities in the panel.

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7. Panel with cellular structure according to claims 1 and 5 **characterized by that** the chambers (4) of the cellular foil (3) are filled preferably with loose material while the parallel layers (1,2) are fixed to the edges of chambers (4) and they are

firmly closing openings of these chambers (4) on both opposite sides of the cellular foil (3).

8. Panel with cellular structure according to claim 7 **characterized by that** the
5 filling of chambers (4) is created predominantly by particles (5) of a dust size up to the diameter of 6.5 cm.

9. Panel with cellular structure according to claims 7 and 8 **characterized by that** the filling of chambers (4) is created by particles (5) of heat insulating material
10 based on for instance glass and/or polystyrene.

10. Panel with cellular structure according to claim 9 **characterized by that** the filling of chambers (4) is created at least partially by particles (5) based on foam glass and/or waste glass cullet and/or glass powder.

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11. Panel with cellular structure according to claims 1 to 10 **characterized by that** the walls of the chambers (4) of the cellular foil (3) and as the case may be also at least one parallel layer (1,2) are perforated, equipped with a system of ventilating holes (7).

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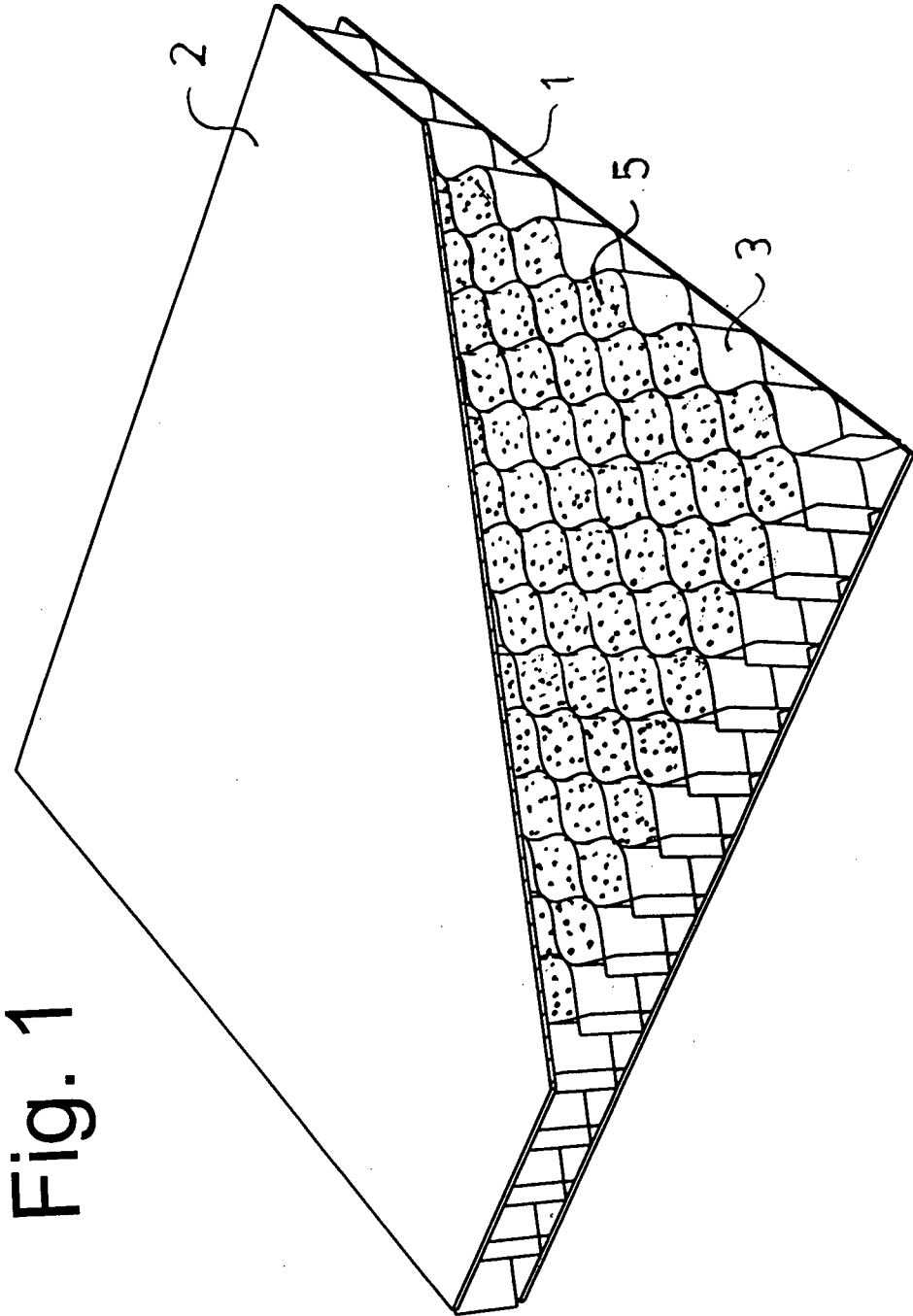
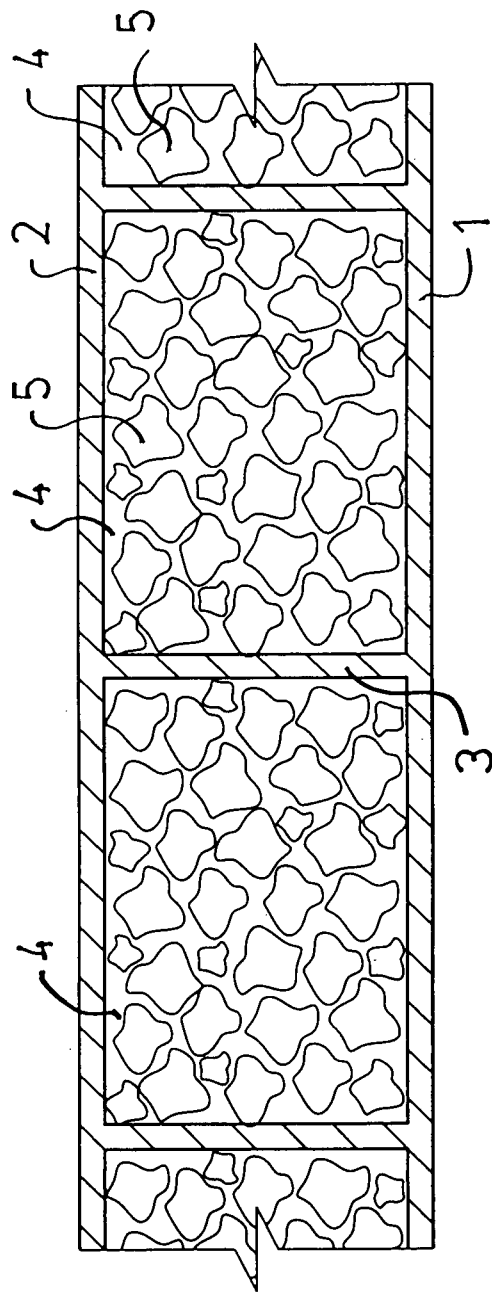


Fig. 1

Fig. 2



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Fig. 3

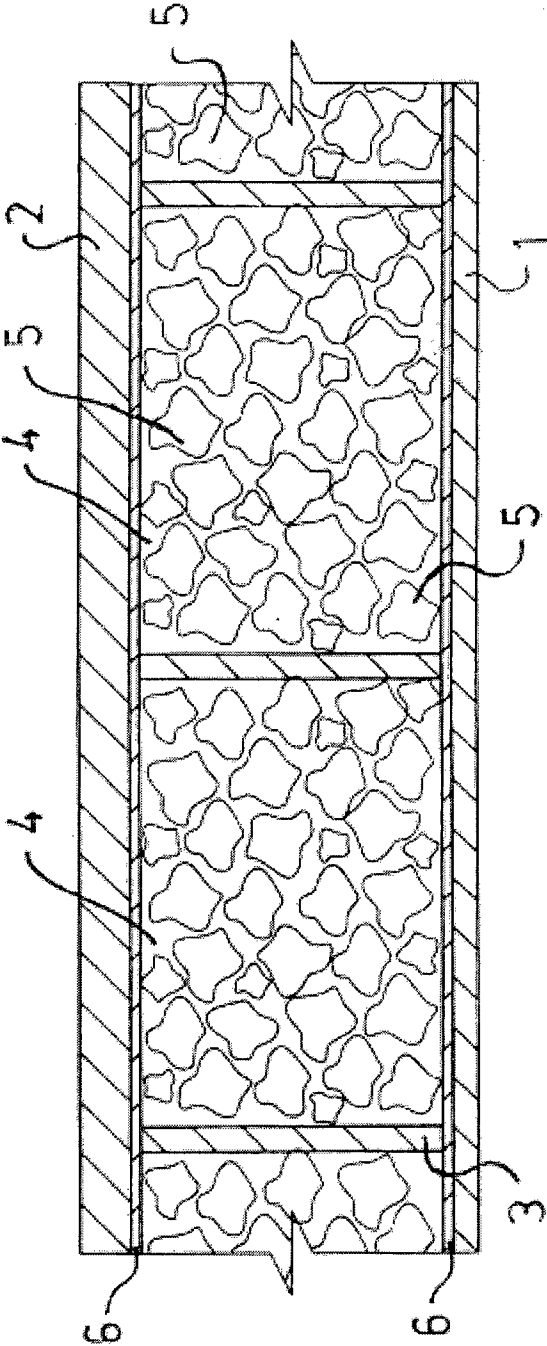
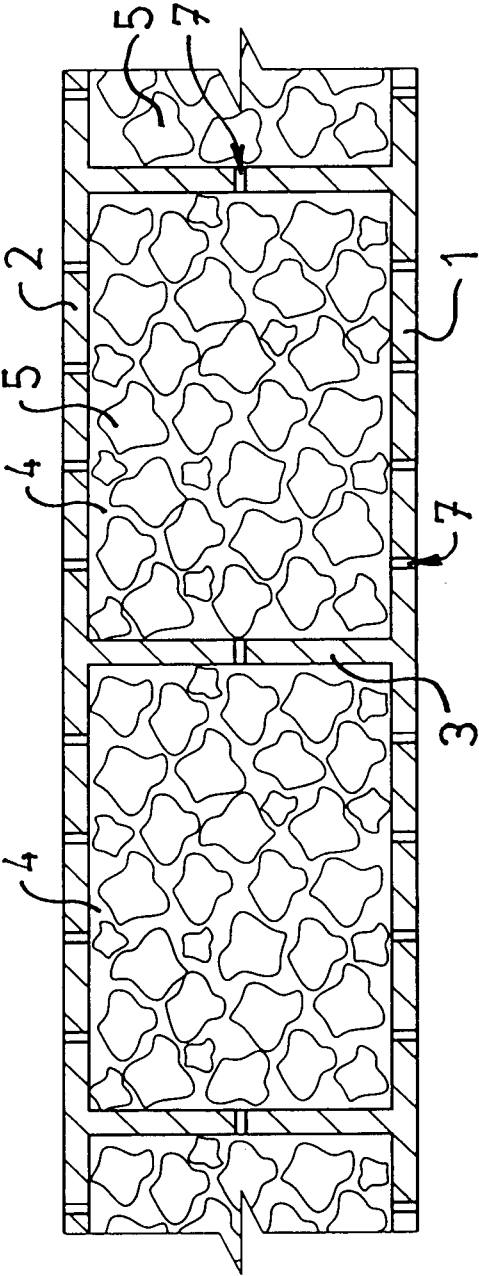


Fig. 4



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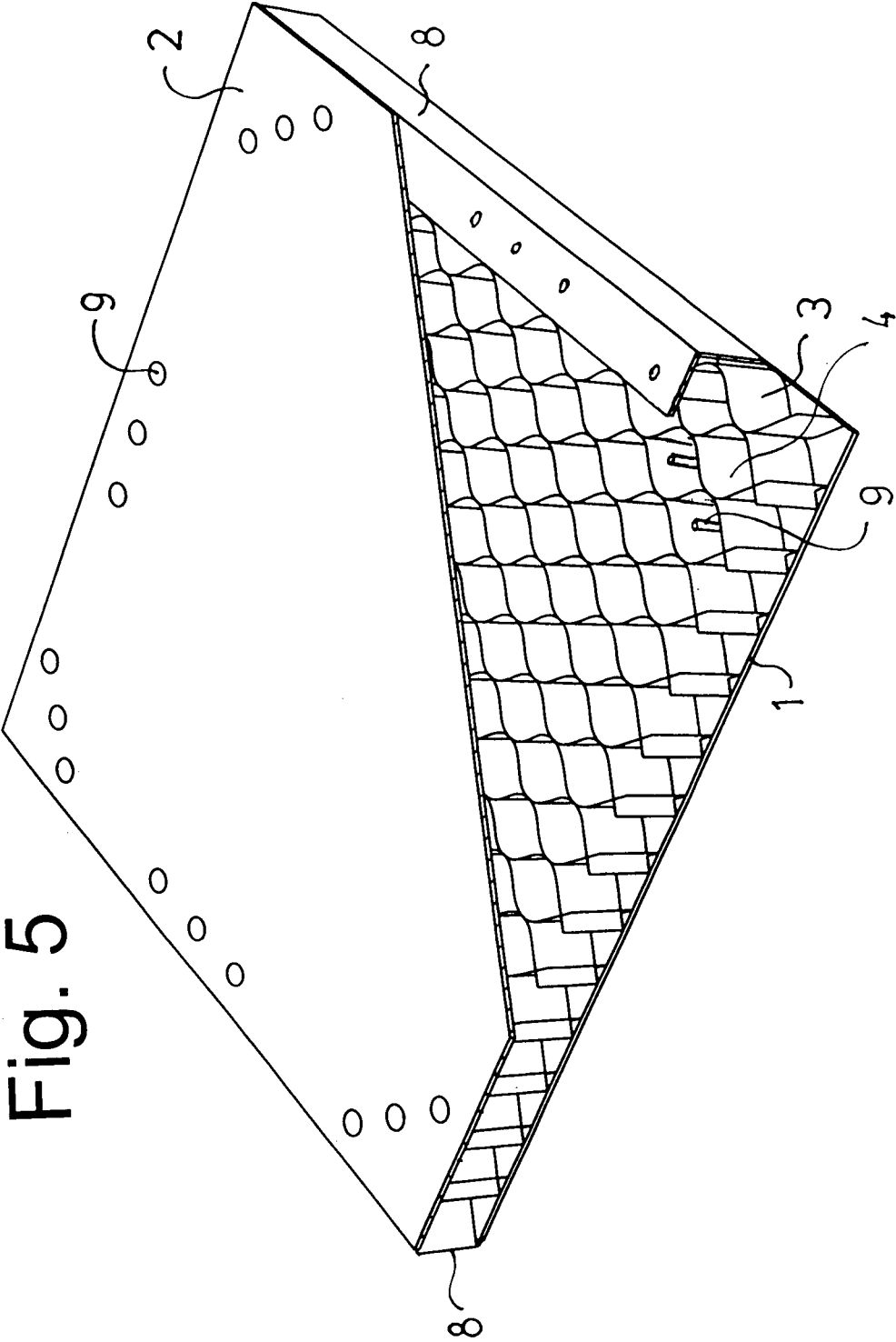


Fig. 5