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(54) Construction panel

(57) The present invention relates to a panel made of plastic material to be used in the preparation of construction elements, especially slabs and ceilings.

Particularly, the present invention relates to a construction panel (1) made of plastic material, characterized in that it has a plurality of blind cavities (5) at a base surface (4), and having a walking surface (2), on the side opposite to said base surface (4), and closed side walls (3).

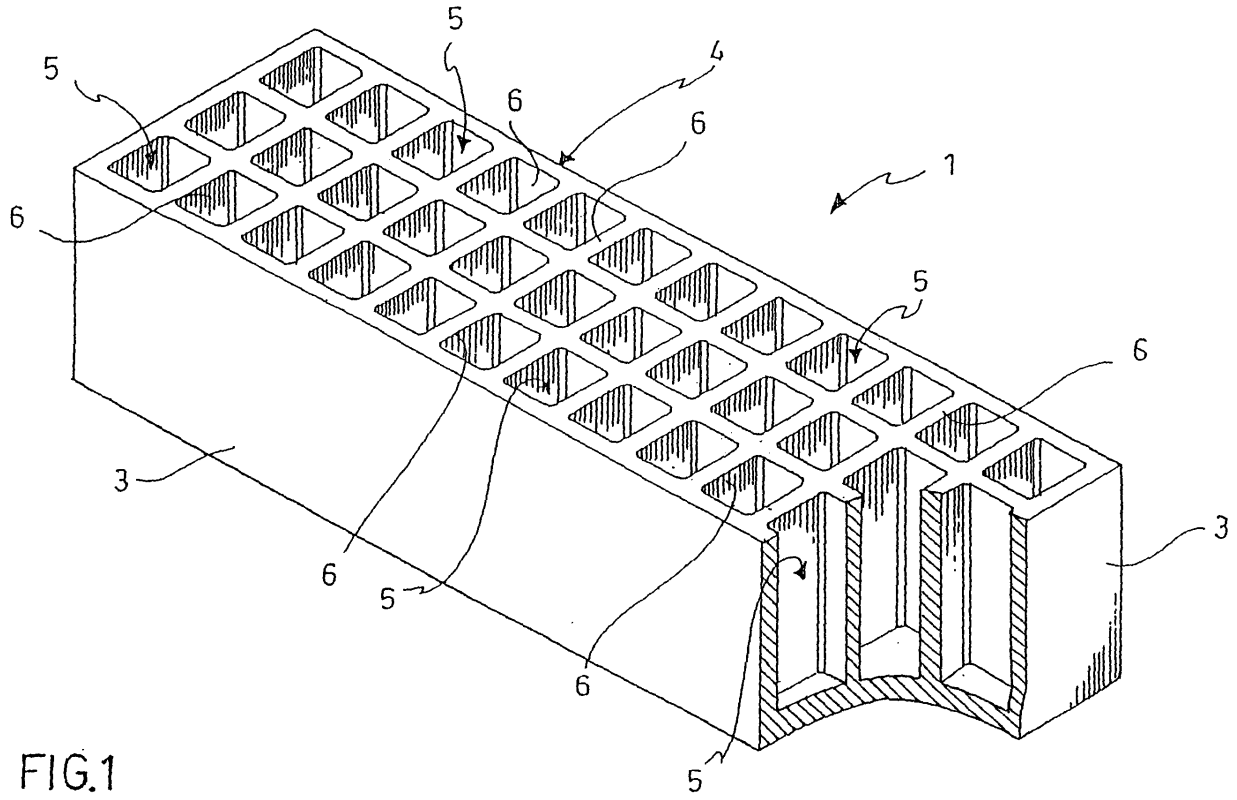

FIG.1

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Description

[0001] The present invention relates to a panel made of plastic material to be used in the preparation of construction elements, especially slabs and ceilings.

[0002] It is known to use a panel made of plastic material drowned in a concrete substrate to prepare prefabricated elements for slabs or ceilings. The carrying capacity of the element is thus ensured by the concrete matrix, whereas the inner core made of plastics has a lightening function, which is very important especially for prefabricated elements. Indeed, the slab may be made during work performance, or it may be prefabricated and then transported to the building site. It will be appreciated that especially in this latter case a lightweight element is essential.

[0003] Typically, such plastic panels consist of expanded polystyrene sheets, this material ensuring good strength and considerable lightweightness even with high thicknesses. Yet, the use of such material has some drawbacks. Indeed, during the preparation of a construction element, especially at a building site, normally the operator has to walk on the panel. Thus, it is very likely for the panel to have its rims broken in the area near the edges or borders. As a result, polystyrene powder is dispersed in the product.

[0004] In addition to being friable, panels made of expanded polystyrene have no high compression strength, and thus some subsidence may occur when walking thereon. To solve these drawbacks a high quality, high density polystyrene should be used, whose high costs, however, are incompatible with this kind of use. By the term "high density expanded polystyrene" is meant an expanded polystyrene having a density exceeding 15 kg/m^3.

[0005] In fact, this type of polystyrene increases the specific weight of the panel and consequently the cost per m^3. Whereby, construction panels are required to have a specific weight not exceeding 13 kg/m^3, which cannot be normally obtained when the panels are made of high density expanded polystyrene.

[0006] A further drawback is that such panel may absorb huge amounts of water, this making it less suitable for making floors/ceilings, thus substantially restricting their application to ground floorings.

[0007] A further problem connected to the use of prior art panels made of expanded material is safety in case of fire. In this event, in fact, the high temperature caused by the flames melts the expanded material enclosed in the slab with consequent release of gas, which, by easily reaching high-pressures in such conditions, may cause the slab to break and facilitate the propagation of fire.

[0008] For this and other reasons, the need is still felt for a panel made of lightweight material that overcomes the aforementioned drawbacks.

[0009] These problems are addressed by the present invention and are solved by a panel made of plastic material for construction elements such as set forth in the annexed claims.

[0010] Further characteristics and advantages of the panel for construction elements being the object of the present invention will be better understood from the description of some exemplary embodiments provided below by way of non-limiting illustration, with reference to the following figures:

Fig. 1 shows a perspective view of the panel according to the invention;
Fig. 2 shows a perspective view of a second embodiment of the panel according to the invention;
Fig. 3 shows a perspective view of a detail of the panel according to the invention;
Fig. 4 is a partial top perspective view of the panel of the invention according to a further embodiment;
Fig. 5 is a planar view from below of a second embodiment of the panel according to the invention;
Fig. 6 is a side sectional view of a cavity of the panel from Fig. 5;
Fig. 7 is a cut-away perspective view of the cavity from Fig. 6;
Fig. 8 shows a sectional side view of a further embodiment of the panel of the invention;
Fig. 9 is a cut-away perspective view of the cavity of the inventive panel according to a further embodiment.

[0011] With reference to the figures, the panel according to the invention is generally indicated by the reference number 1.

[0012] The panel 1 is substantially of parallelepiped shape with a rectangular (as depicted in the drawings) or square base. Typical sizes may be, for example: width between 200 and 600 mm; length between 200 and 3000 mm; thickness between 100 and 240 mm. It should be understood, however, that this size may change in a wide range of possibilities according to the type of use as required.

[0013] The panel 1 comprises a walking surface 2 and four closed side surfaces 3, whereas the surface 4 has a plurality of blind cavities 5. The number of cavities 5 may vary depending on the needs. Preferably, the number of cavities 5 will be such that the volume of the empty space ranges between 30% and 70% of the total volume of the panel 1, such that an apparent density (weight/full volume + empty volume) is obtained less than 13 kg/m^3, preferably less than 10 kg/m^3.

[0014] The cavities 5 may extend over a great part of the thickness of panel 1 or only over a small part thereof. Preferably, the cavities 5 will have depths comprised between 10% and 95% of the total thickness of panel 1, more preferably between 80% and 95%.

[0015] The balance between the empty volume and full volume will also depend on the type of material used. For example, with high density expanded polystyrene, the empty volume ratio will have to be increased such that the apparent density of the panel is hold below the

threshold as defined above. It should be noted that the use of high density polystyrene (with a density exceeding 15 kg/m^3, preferably exceeding 18 kg/m^3, more preferably exceeding 20 kg/m^3) should be considered as preferred, as this material gives the panel a greater strength.

[0016] Thereby, a first object of the present invention is a construction panel made of high-density expanded polystyrene, said panel having an apparent density lower than 13 kg/m^2, preferably lower than 10 kg/m^3.

[0017] As mentioned above, the walking surface 2 must have a good compression strength. To this end, the partition walls 6 provided between the cavities 5 will also serve as reinforcing ribs. Preferably, such partition walls will have thicknesses ranging between 5 and 80 mm.

[0018] The cavity 5 may be of different shapes. There may be cavities 5 having openings that are square (Figure 1), rectangular (Figure 2), round, elliptical, star-shaped, polygonal in general (pentagonal, hexagonal, etc.), and the like. The inner cavity may also, though not necessarily, be provided with a more or less marked tapering, such that the cavity section will narrow inwards. The inner walls of the cavity may possibly have vertical or horizontal grooves.

[0019] As illustrated in Fig. 3 and 4, the walking surface 2 is preferably provided with a plurality of knurlings 7 having an anti-slip function, in order to prevent any accidental falls during laying works, and serving as anti-slipping means between two panels during transportation. These knurlings may also form reinforcing ribs for the surface, such as to make the latter more resistant to walking. The shape and size may be freely changed according to the requirements. For example, they may be arranged either parallel to the long (Fig. 4) or short(Fig. 3) sides of the panel, or they may be arranged crossed such as to form an alveolar surface 2.

[0020] The panel 1 according to the invention may be made of different plastic materials, in particular expanded plastic materials, such as polystyrene, polyethylene and polypropylene, both virgin and recycled. As stated above, the high density expanded polystyrene is the preferred material due to its characteristics of insulation and resistance in proportion to its specific weight.

[0021] According to a preferred embodiment, the panel 1 at the surface 4 in which the cavities 5 are opened, has one or more cross (such as in the example from Fig. 2) and/or longitudinal slots 8. These slots 8 are blind and extend over a great part of the panel 1, such as to form as many prompts to breakage. Thereby, an operator will be able to break the panel 1 such as to trim it to the desired size, even without the use of tools.

[0022] In Fig. 5, 6 and 7 there is shown a particular embodiment of the invention. In this embodiment, on the bottom of the cavities 5 there are formed one or more alveoluses 9. The shape of these alveoluses 9, as well as that of the cavities 5, can be different, such as cubical, hemispheric, ellipsoidal, and the like. The function of the alveoluses 9, as well as the knurlings 7, is to reinforce the walking surface 2 without adding a substantial amount of apparent density to the panel. In fact, despite the alveoluses are empty (and this results in the panel being lighter), a system of ribs is thus created therein, which reinforces the structure.

[0023] Similarly, and with the same function of reinforcing the walking surface 2 without increasing the apparent density of the panel, in Fig. 8 there is illustrated a further embodiment, where the alveoluses 9 have such a size that a second series of alveoluses 10 is accommodated on the bottom thereof.

[0024] In a further embodiment, shown in Fig. 9, the surface 4 has one or more feet 11 that are intended to act as support feet for the panel when the latter is installed with the concave surface 4 oriented downwards. These feet 11 will be preferably in a number of one to four, more preferably only one foot 11 preferably arranged in the middle of the panel. When a plurality of feet 11 is provided, they will be more preferably arranged at the vertexes of the panel. The feet 11 may be, however, arranged in any point of the surface 4, both along the outer edge and along the edges of the partition walls 6, by being distributed such as to allow for a good resting stability.

[0025] The function of the feet 11 is as follows. As will be described in greater detail below, during installation, the panel is placed on a fresh concrete casting, in which a metal grid has been generally drowned. Thereby, the feet 11 will be totally submerged in the fresh concrete until it rests on the basement on which the casting has been carried out. Finally, the panel will be covered with a further concrete casting, such as to complete the slab. In the event of fire, the intense heat will quickly melt the feet 11 made of expanded material, as they are separated from the heat source by a thin layer of concrete (less than 2 mm) and an optional further layer of plaster. Accordingly, as the feet 11 rising to the surface are being melted, a plurality of vent holes is created for the gas generated from the melting panel, thereby the development of overpressure within the slab is avoided.

[0026] The first concrete casting normally has a thickness of 4 cm. The feet 11 will be thus preferred to have a height of 4 cm, such as to also serve as level indicators for the concrete layer. The feet 11, however, may also be higher or lower than 4 cm, according to the requirements, without however departing from the scope of the present invention.

[0027] The feet 11 shown in Fig. 9 have a rectangular/square section. They may have, however, any other shape and size, such as round, elliptical, triangular, spherical and generally polygonal.

[0028] Fig. 9 shows the feet 11 associated with the embodiment of the panel 1 of Fig. 5-8, in which the cavities 5 comprise the alveoluses 9. The feet 11 can certainly be as well associated with the embodiment of Fig. 1-4 without the alveoluses 9.

[0029] The panel 1 according to the invention may be made by using the known methods for obtaining plastic products. Particularly, the panel 1 made of expanded plastic material may be produced by injection moulding,

possibly in the presence of a chemical or physical expanding agent.

[0030] The use of panel 1 in the building industry may provide its implementation both at the building site and during the production of prefabricated components.

[0031] In both cases, a concrete layer must be formed before installing the panel 1, the panel 1 has to be laid with the walking surface 2 turned upwards, and covered by means of concrete casting (with possible interposition of an electrowelded metal grid), such that panel 1 is drowned therein.

[0032] To install the panel 1 according to the embodiment from Fig. 9, the panel will have to be laid on the fresh concrete by taking care that the feet 11 are dipped into the concrete until they touch the base surface on which the concrete casting has been carried out. Thereby, the feet 11 will surface flush with the lower surface of the slab, which will just require to be completed by means of the usual plaster suitable to hide the feet 11 to the sight. In the event of fire, the plaster will yield and the expanded material composing the panel 1 will be melted. Vent holes will thus remain in place of the feet 11, from which the gas generated by the melt material within the slab will be released.

[0033] When panel 1 requires some trimming to adjust it to some specific shapes, even non-squared ones, its alveolar structure provided with partition walls 6 will prevent the cement, cast in an upper layer, from filling all gaps, which makes the whole building element heavier. It will be appreciated that the more cavities 5 are provided in panel 1, the more evident such an effect will be, since these cavities will define gaps having limited volumes.

[0034] The panel 1 may be used both for manufacturing slabs and floors and in walls, especially padding walls. The panel 1 according to the invention will be used as a lightening material on the so-called "platforms", or will serve as a structural element in place of hollow bricks. A further use will be as thermal and/or acoustical insulating material.

[0035] Compared to the state of the art, the panel 1 according to the invention has many advantages.

[0036] First of all, the panel 1 according to the invention is more lightweight than the solid panel of the prior art, and yet its strength is not reduced. Indeed, due to the particular structure in which the partition walls 6, knurlings 7 and/or ribs created by the provision of the alveoluses 9, 10 serve as the reinforcement ribs, the rigidity and compression strength are improved. By using high-density polystyrene, which is made possible by the alveolar structure allowing to hold the apparent density below 13 kg/m^3, the friability is also reduced. These properties are very important during both the implementation and the transportation of the panels 1.

[0037] Furthermore, as compared with known panels, the panels according to the invention also provide an improved thermal and acoustical insulation.

[0038] Finally, water absorption is also reduced, if compared to that of a solid panel made of polystyrene, usually very lightweight and friable, which allows the panel 1 according to the invention to be also used for floors, where the humidity retained by the panel would otherwise form humidity spots on the ceiling.

[0039] As discussed above, the embodiment in which the panel 1 is provided with a plurality of feet 11 has the special advantage of providing a much safer use of the inventive panel, particularly in the event of fire. The slab manufactured with this panel is, in fact, provided with vent ducts for releasing the gases developing therein during the fire, and is thus much more resistant. During the step of installing the product, the feet 11 also perform an important function of level indicators for the cement casting, thereby a smooth thickness is ensured to the concrete layer.

[0040] It will be appreciated that only some specific embodiments of the construction panel made of plastic material being the object of the present invention have been described herein, to which those skilled in the art will be able to make any and all modifications necessary for its adjustment to specific applications, without departing from the scope of protection of the present invention.

[0041] For example, the shape of the panel base may even not be four-sided, but rather polygonal, circular, elliptical, etc., such that it may suit special slab shapes. Alternatively, the panel according to the invention may not lie on a plane, but rather it may have a concave or convex section, for being used in circular or circle arc-shaped walls.

Claims

1. A construction panel (1) made of plastic material, **characterized by** having a plurality of blind cavities (5) at a base surface (4) and having a walking surface (2) on the side opposite said base surface (4), and closed side surfaces (3).

2. The construction panel (1) according to claim 1, **characterized in that** it is made of high density expanded polystyrene and has an apparent density (weight/full volume + empty volume) less than 13 kg/m^3.

3. The construction panel (1) according to claim 2, wherein the apparent density (weight/full volume + empty volume) is less than 10 kg/m^3.

4. The construction panel (1) according to any claim 1 to 3, said panel (1) having a parallelepiped shape.

5. The construction panel (1) according to any claim 1 to 4, said panel (1) having the following size: width between 200 and 600 mm; length between 200 and 3000 mm; thickness between 100 and 240 mm.

6. The construction panel (1) according to any claim 1

to 5, wherein the volume of the empty space is comprised between 30% and 70% on the total volume of the panel (1).

7. The construction panel (1) according to any claim 1 to 6, wherein said cavities (5) have a depth comprised between 10% and 95% on the total thickness of the panel (1).

8. The construction panel (1) according to claim 7, wherein said cavities (5) have depths comprised between 80% and 95% on the total thickness of the panel (1) .

9. The construction panel (1) according to any of claims 1 to 8, wherein the partition walls (6) provided between said cavities (5) have thicknesses ranging between 5 and 80 mm.

10. The construction panel (1) according to any claim 1 to 9, wherein said cavities (5) have openings whose shapes are square, rectangular, round, elliptical, star-shaped, polygonal in general, and may be tapered internally.

11. The construction panel (1) according to any claim 1 to 10, wherein said walking surface (2) and/or the bottom of said cavities (5) comprise a plurality of knurlings (7) and/or alveoluses (9).

12. The construction panel (1) according to claim 11, wherein said knurlings (7) are arranged parallel to the short side or the long side of panel (1) or they are arranged in a crossed manner.

13. The construction panel (1) according to claim 11, wherein said alveoluses (9) comprise, in turn, a second series of alveoluses (10) on the bottom thereof.

14. The construction panel (1) according to any claim 1 to 13, wherein at the base surface (4) in which said cavities (5) are opened, said panel (1) has one or more transversal and/or longitudinal blind slots (8), such that they form as many prompts for breakage.

15. The construction panel (1) according to any of the claims 1 to 14, wherein said base surface (4) comprises one or more feet (11).

16. The construction panel (1) according to claim 15, wherein said feet (11) are in a number of one to four, and are arranged at the four vertexes of the panel (1).

17. The construction panel (1) according to claim 15 or 16, comprising only one foot (11) that is preferably arranged in the middle of the panel (1).

18. The construction panel (1) according to any claim 15 to 17, wherein said one or more feet (11) have an height of about 4 cm.

19. The construction panel (1) according to any claim 1 to 18, wherein said panel (1) is made of expanded plastic material.

20. A method for making the construction panel (1) according to claim 19, said panel (1) being obtained by injection moulding, possibly in the presence of a chemical or physical expanding agent.

21. A construction element made of concrete suitable for making slabs, floors or walls, **characterized in that** it comprises a construction panel (1) according to any claim 1 to 19, which is drowned in said concrete.

22. The construction element made of concrete according to claim 21, said element being prefabricated.

23. A method for manufacturing the construction element made of concrete according to claim 21 or 22, wherein said method comprises the following steps:

- formation of a concrete layer,
- laying of the panel (1) with the walking surface (2) turned upwards,
- optional interposition of an electrowelded metal grid, and
- covering by means of concrete casting, such that said panel (1) is drowned in said cement.

24. The manufacturing method according to claim 23, wherein during said step of laying the panel (1) with the walking surface (2) turned upwards, the feet (11) of said panel (1) are dipped in the fresh concrete until they reach the surface on which the concrete has been cast and rise on the surface thereof.

25. Use of a construction panel (1) according to any claim 1 to 19 in the building industry.

26. Use according to claim 25, as a lightening material.

27. Use according to claim 25, as a structural element in place of hollow bricks.

28. Use according to claim 25, as a thermal and/or acoustical insulating material.

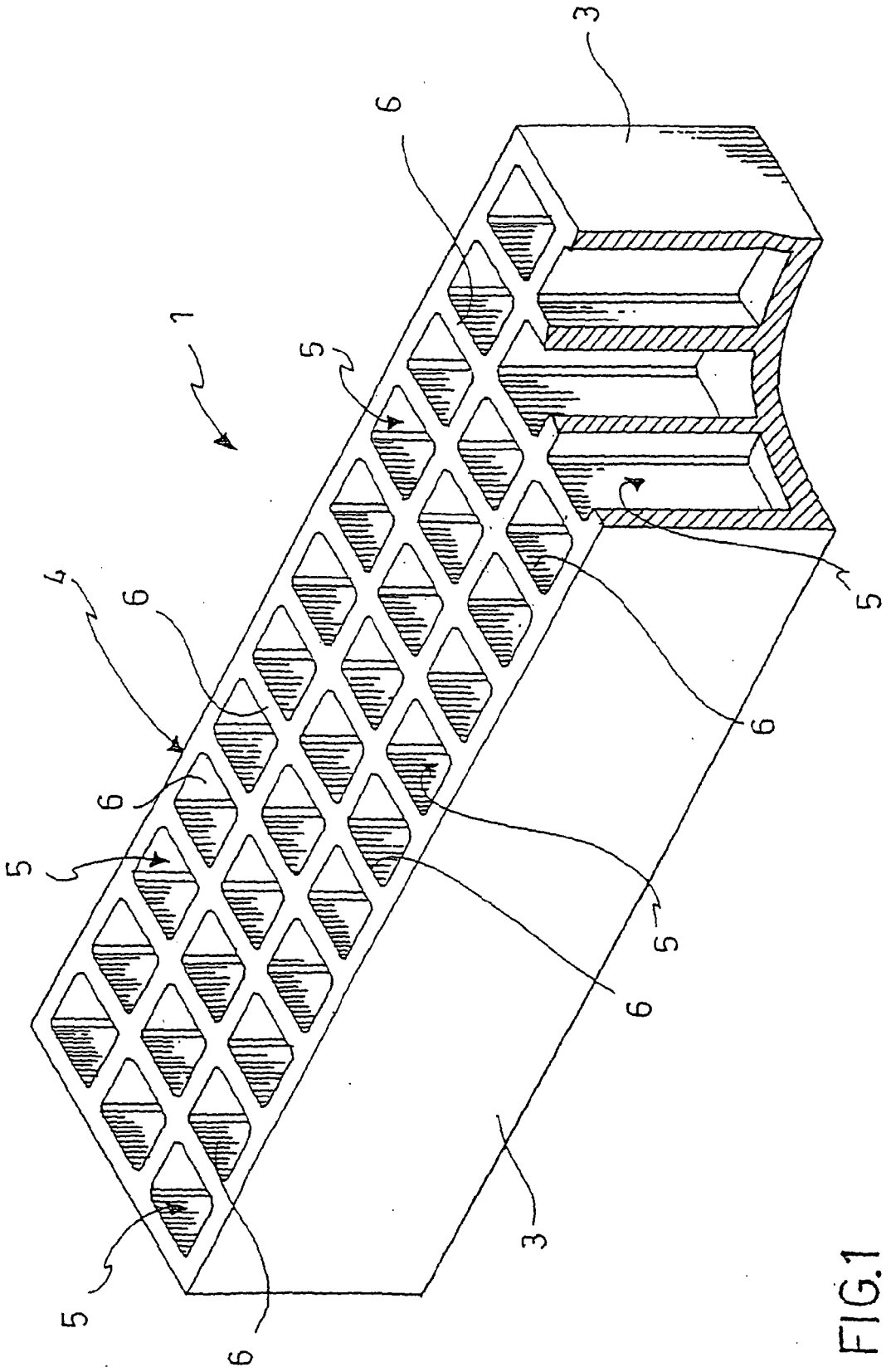

FIG.1

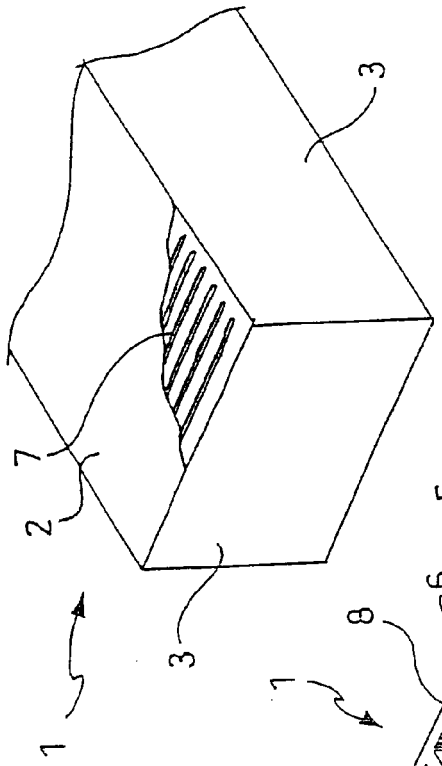

FIG.3

FIG.2

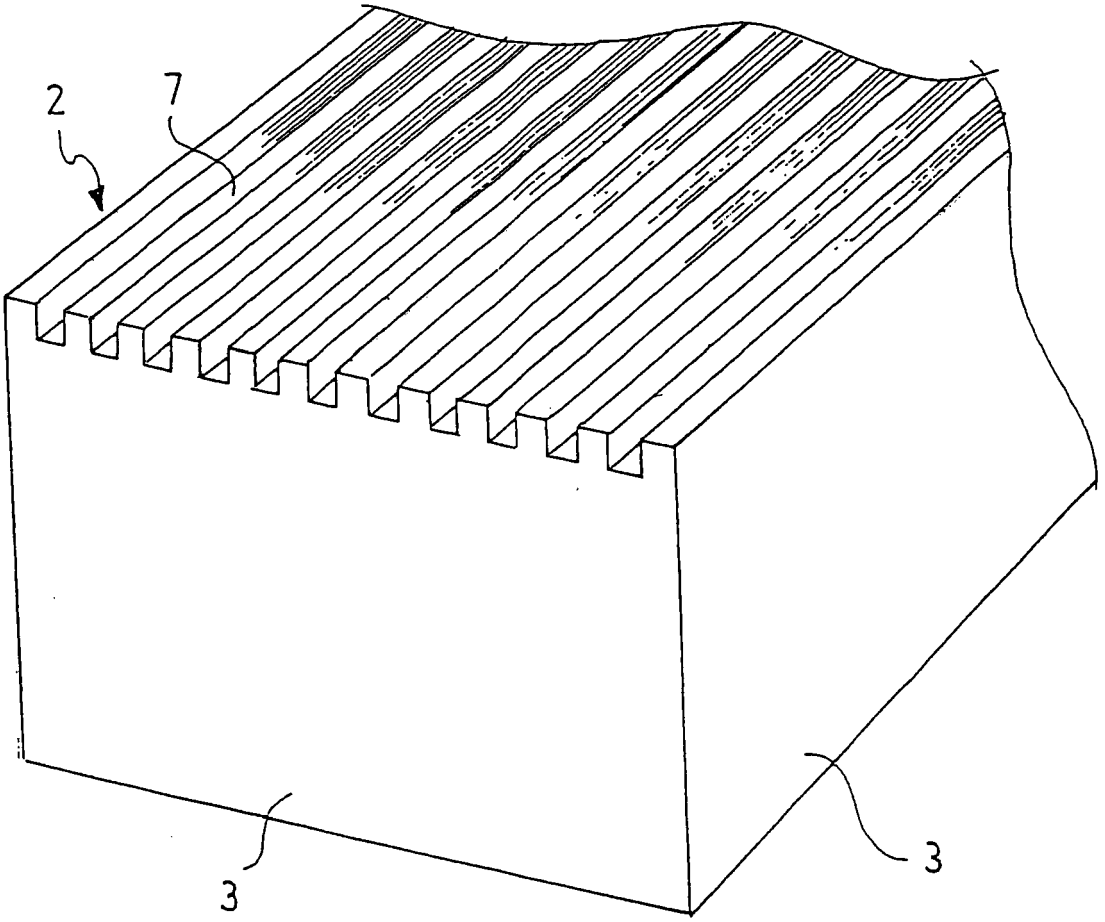

FIG. 4

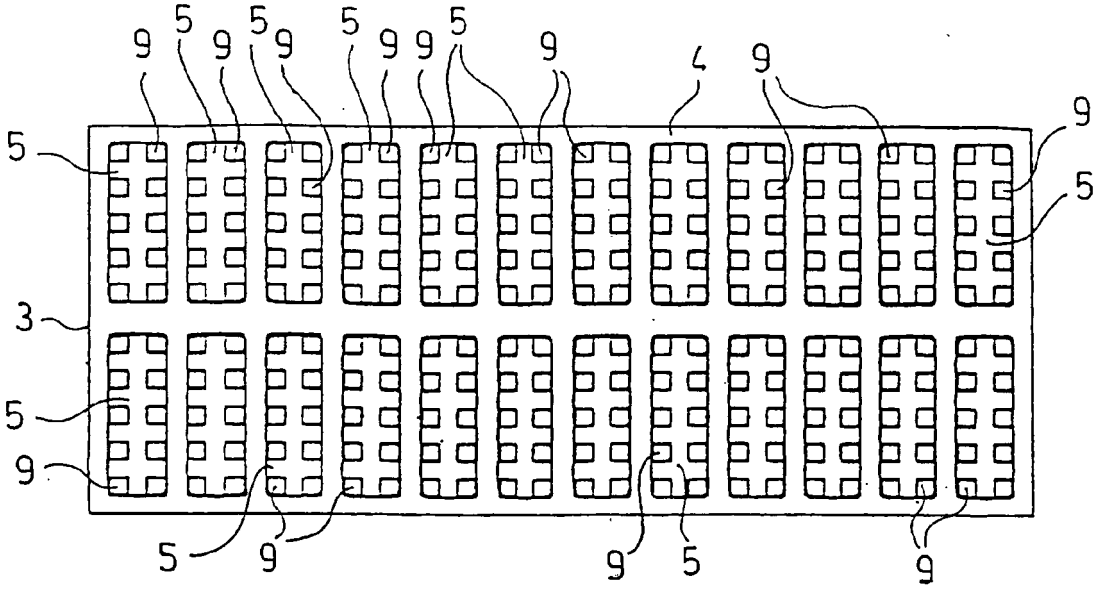

FIG. 5

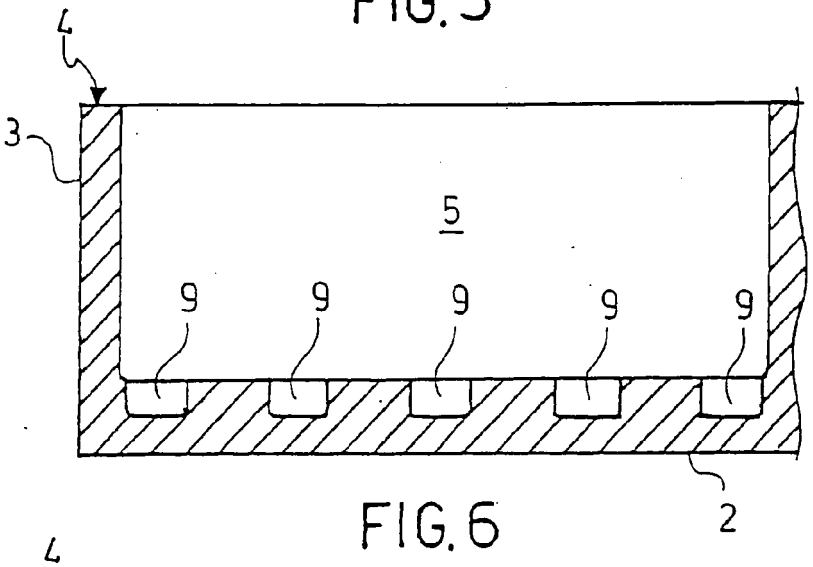

FIG. 6

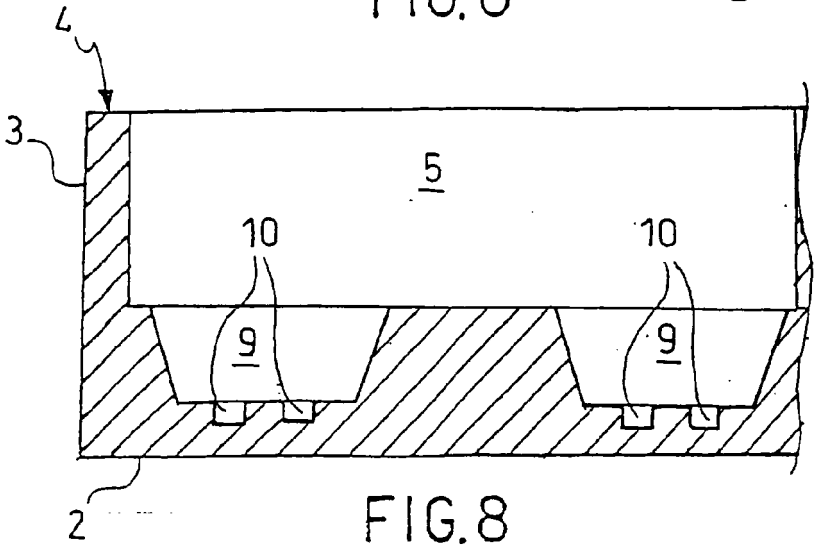

FIG. 8

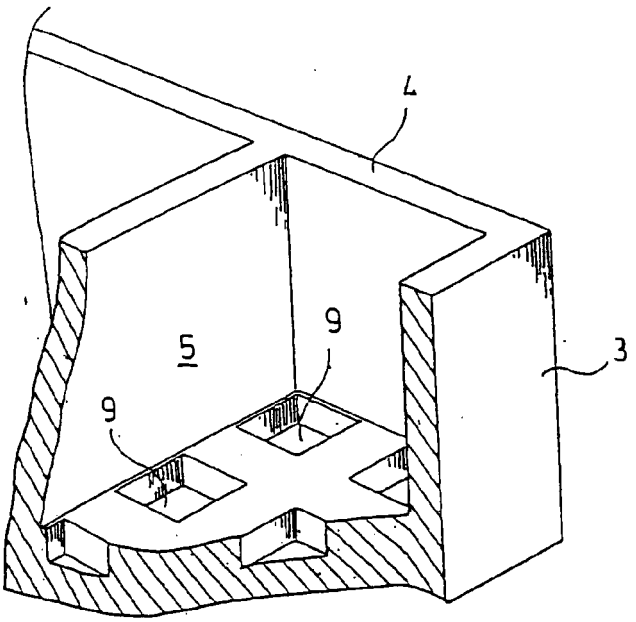

FIG. 7

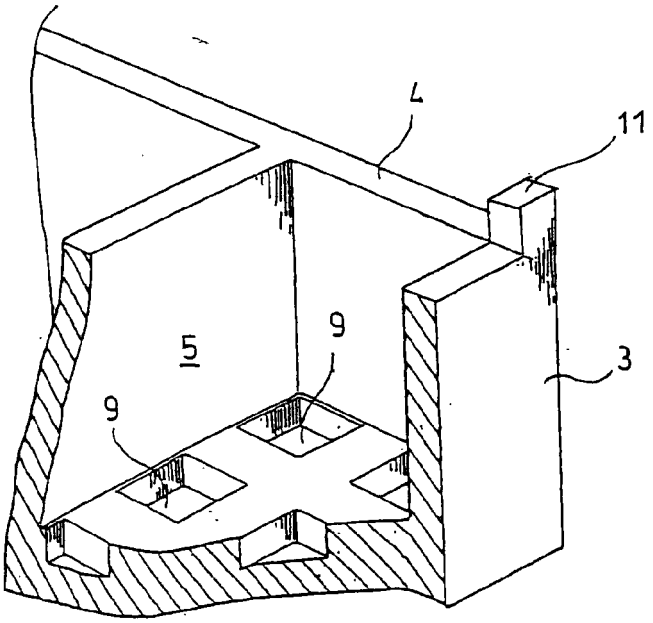

FIG. 9