



(11) **EP 1 736 609 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
20.04.2011 Bulletin 2011/16

(51) Int Cl.:
E04C 2/296^(2006.01) E04C 2/20^(2006.01)
E04B 1/12^(2006.01) E04C 2/52^(2006.01)

(21) Application number: **05728583.5**

(86) International application number:
PCT/ES2005/000136

(22) Date of filing: **16.03.2005**

(87) International publication number:
WO 2005/090702 (29.09.2005 Gazette 2005/39)

(54) **SYSTEM FOR CONSTRUCTION WITH PRE-FABRICATED PANELS, AND PRE-FABRICATED PANEL**

SYSTEM ZUM BAU MIT VORGEFERTIGTEN PLATTEN UND VORGEFERTIGTE PLATTE

SYSTEME DE CONSTRUCTION A PARTIR DE PANNEAUX PREFABRIQUES ET PANNEAU PREFABRIQUE

(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 MC NL PL PT RO SE SI SK TR

(72) Inventors:
• **ASUMENDI GARCIA, Jose Antonio**
E-48930 Getxo (Vizcaya) (ES)
• **ONECA GONZALEZ, Jose**
E-48930 Getxo (Vizcaya) (ES)

(30) Priority: **18.03.2004 ES 200400682**
01.02.2005 ES 200500182

(74) Representative: **Pons Ariño, Angel et al**
Glorieta Ruben Dario 4
28010 Madrid (ES)

(43) Date of publication of application:
27.12.2006 Bulletin 2006/52

(73) Proprietors:
• **ASUMENDI GARCIA, Jose Antonio**
E-48930 Getxo (Vizcaya) (ES)
• **ONECA GONZALEZ, Jose**
E-48930 Getxo (Vizcaya) (ES)

(56) References cited:
EP-A- 0 246 856 WO-A1-98/50646
DE-A- 3 116 444 ES-A1- 2 126 523
ES-U- 1 019 342 FR-A1- 2 800 108
GB-A- 2 000 725 GB-A- 2 205 597
US-A- 3 301 732

EP 1 736 609 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a system for the construction of buildings which allows building any type of wall, partition, façade, false ceiling, floor, floor framing or carrying out formwork, without the need for any masonry work, based on sandwich-type modules formed by pre-fabricated panels which are lighter and easy to handle, assembled by means of gluing on-site and have sufficient resistance characteristics such that they do not require auxiliary reinforcement or supporting structures.

[0002] The basic element of the system is also object of the invention, i.e. a pre-fabricated panel consisting of an expanded polystyrene core on which a resin is applied, which resin forms the resistant outer layer thereof, further acting as the front face given that it has an appearance similar to the one obtained by means of a traditional one coat and can furthermore be painted or receive any type of outer finishes.

[0003] The construction elements obtained with the panels object of the invention further maintain all the characteristics of expanded polystyrene in terms of thermal insulation and have improved characteristics in terms of acoustic insulation and fire resistance.

[0004] The panels have a lower cost and their assembly is carried out quickly and easily by simply assembling and gluing the panels to one another such that the complete assembly can be carried out by non-specialized personnel, considerably reducing the end cost of the construction.

BACKGROUND OF THE INVENTION

[0005] The use of polystyrene panels is currently widely extended, fixing or placing the panels on the resistant wall for the purpose of forming thermal insulation although these panels cannot be used directly as partitioning elements because of their weakness.

[0006] Sometimes it is possible to use expanded polystyrene panels assembled or supported in generally metallic structures conferring the required resistant to the wall. This is the case for example in US patent 5,765,330 relating to a pre-fabricated wall panel comprising a wooden frame or framework, consisting of vertical stud members between which there are defined rectangular cavities filled with polyurethane, expanded polystyrene boardstock being applied on the entire rear surface, being fixed to the framework by means of wooden strips and nails.

[0007] European patent EP 0 612 894 also describes a panel intended to form separating partitions and consists of expanded polystyrene sheets on the entire height of the panel which are finished at the lower and upper parts with support profiles or elements, also incorporating a series of longitudinal profiles between the polystyrene

sheets.

[0008] European patent EP 006 756 relates to a construction panel structure incorporating rigid polystyrene sheets provided with a continuous side projection inserted in rigid tubular profiles in which the adjacent plate is also inserted, forming a frame next to an upper and lower profile for the panel used to construct buildings at a low cost and in a simple and easy manner.

[0009] In the described cases the strength of the panel is usually determined by the metallic structure, the incorporation of a reinforcement element therefore always being required.

[0010] Patent application PCT WO98/44213 describes a self-bracing panel for ceilings made of an insulating material incorporating metallic reinforcement profiles embedded in the panel which provide the required rigidity to the panel but which in any case are insufficient for allowing the construction of partitions or waits with these panels.

[0011] All these panels also have the drawback that the strength thereof is localized in areas where the reinforcement structure is arranged such that the central areas of the panels have very little strength.

[0012] Furthermore, once the wait is formed an outer coating must be applied on-site which will determine the finish and appearance of the partition.

[0013] Finally, US patent 4,019,297 relates to a construction panel intended to be part of the structure of a building formed by a structure comprising a frame formed by horizontal and vertical cross-members joined by means of nails between which polystyrene strips are arranged, the panel being reinforced on its entire surface by means of metal or plastic mesh and a rear cement coating reinforcing the assembly.

[0014] DE-A-311 444 describes a composite module used as a heat-insulating cladding of walls, ceilings and floors. This module is composed of individual panels which are adhesively bonded together. Each module comprises three pre-fabricated panels consisting of a central panel which is offset at the upper and rear part with respect to two parallel outer panels forming a tongue and groove on its sides. Two of said panels are of foam plastic and the other is an outer rigid panel made of wood.

DESCRIPTION OF THE INVENTION

[0015] The system for construction object of the invention is based on the use of pre-fabricated panels consisting of an expanded polystyrene core on which a resin is applied, such resin forming a resistant layer allowing its use as a construction element without needing to use reinforcement structures or frameworks. These panels can form partitions, load-bearing walls, false ceilings, etc., replacing the traditional masonry walls and partitions, maintaining the strength characteristics with lower weight and a very low cost.

[0016] Of course these panels are compatible with and can be assembled on metallic structures, frames or

frameworks of any type, or they can be combined with traditional concrete pillars and beams.

[0017] These panels further maintain the thermal insulation properties of the expanded polystyrene forming the core.

[0018] The resin is applied on one or both faces of the core, incorporating the corresponding catalyst and fillers such as silica sand, corundum, crushed glass, silicon carbide, foundry slag, fiberglass, carbon fiber or other fillers which allow reducing the amount of resin to be applied, reducing costs. The use of sands further allows obtaining a finish of the panel similar to that of a façade obtained by one coat. Sand also provides considerable fire resistance to the panel and good acoustic insulation characteristics.

[0019] The resin can be selected from the group formed by polyisobutadienes, polyesters, cycloaliphatic polyamides, epoxies, phenol resins and polyurethanes.

[0020] The panel can be used alone or it can be combined with other panels which it is adhered to by means of the resin itself, which is not only used as reinforcement means but also as an adhesive means until forming a sandwich-type module formed by two, three or more panels. The resin is also used for gluing the panels to the ground.

[0021] The preferred sandwich-type module consists of three panels arranged such that the central panel is offset with respect to the two other panels on two of the contiguous side faces, projecting with respect to the others on the opposite side faces. The module thus configured is obtained in the plant ready for transport to the site where it will be coupled to other modules by simply tongue and groove coupling and gluing with the resin itself, greatly simplifying the partition or wall assembly tasks which can be carried out by non-specialized personnel.

[0022] This assembly system completely eliminates the need for on-site masonry work, considerably reducing the end cost of the construction.

[0023] The pre-fabricated panels are easily obtained because the polystyrene layer is cut according to the required measurements, the resin layers are applied and they are assembled with other panels to form the described module, its measurements therefore adapting to the specific measurements of the wall or ceiling. Standard measurements have been provided in any case for the assembly of most of the wall, partition or ceiling, thus reducing manufacturing costs of the modules.

[0024] The panels are lighter and can be easily handled, therefore they are assembled by a single person without any specialization whatsoever being necessary for carrying out this task and allowing the complete assembly of a construction in a very short time given that the different modules, which are pre-cut to the necessary measurements in the plant, simply have to be assembled and glued, arranging them according to the corresponding assembly plan.

[0025] The module may incorporate an intermediate

panel made of wood, fiberboard, perforated sheet metal, gypsum board or another type of materials to obtain greater strength and to allow hanging any type of accessories.

5 **[0026]** The outer panel can be made of wood so as to obtain this type of finish as the front face of the obtained partition or wall.

[0027] The panels may also incorporate grooves or housings on their rear face or in the intermediate panel for the passage of electrical ducts, plumbing and the like, which allows quickly and easily carrying out these installations.

10 **[0028]** The panel can also be used for the construction of false ceilings by simply gluing on the lower part of the small metallic beams supporting the arches forming the ceiling or roof of the building, the traditional laborious systems for supporting the laminas conventionally forming false ceilings being eliminated. The strength of the panel allows hanging ceiling lamps or other elements from the panel.

15 **[0029]** Either the individual panels or the panel module can also be used as formwork panels for obtaining beams, columns or the like on which the concrete is adhered once it is set, therefore forming the visible surface of these elements. On the other hand, the panels can easily be disassembled for their later use, previously applying the corresponding demolding or release agent on the face in contact with the concrete.

20 **[0030]** The panels can have any construction finish by means of the application of paint, the projection of elements or the application of any type of coating desired, for example natural stone, front face, granite, marble, etc., these finishes being carried out on-site once the wall or partition is built by means of applying the coating material directly on the resistant layer.

25 **[0031]** The panels can also have imitation finishes, simulating stone, bricks, etc., these finishes being carried out in the panels in the plant, drawing them on the polystyrene core prior to applying the resin.

30 **[0032]** Due to the insulating characteristics of polystyrene, the panel or panel module installed in the building will have optimal thermal insulation, as well as improved fire resistance characteristics based on the characteristics of the resin applied and good acoustic insulation provided by the fillers used.

35 **[0033]** In summary, the system for construction object of the invention has the following advantages:

- 40 - The basic panel as well as the sandwich modules which can be formed are lighter and can therefore be easily handled and transported.
- It provides optimal thermal insulation based on the polystyrene core incorporated.
- 45 - It provides good acoustic insulation characteristics based on the incorporation of sand in the resistant layer.
- They have improved fire resistance characteristics based on an incorporation of sand in the resistant

- layer, as well as those provided by the resin itself.
- It allows fast and easy assembly and mounting with few personnel who furthermore do not have to have any special qualification.
- It eliminates on-site masonry work, plaster and finish work in partitions and walls.
- It allows the incorporation of ducts of any type without needing to carry out on-site chases.
- It can be used for the construction of any type of walls, partitions, ceilings, flooring, floor structure, cut-off walls, formwork, balustrades and any type of decorative elements.
- The cost of the panel is very low as is the end cost of the construction.

DESCRIPTION OF THE DRAWINGS

[0034] To complement the description being made and for the object of aiding to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached to said description as an integral part thereof in which the following has been represented with an illustrative and non-limiting character:

Figure 1 shows a sectional view of a sandwich module formed by a single pre-fabricated panel as a basic element of the system object of the invention consisting of a core and respective resistant layers located on the larger faces of the core.

Figure 2 shows a perspective view of the assembly of the sandwich modules formed by a single panel, one of them showing an imitation stone finish.

Figure 3 shows a perspective view of a sandwich module formed by a panel in which the arrangement of electrical fittings and the incorporation of grooves for the passage of ducts are observed.

Figure 4 shows a sectional view of a sandwich module on which a coating material has been applied on one of its resistant faces.

Figure 5 shows a sectional view in which a sandwich module formed by three panels using the resin layers themselves as adhesive is observed.

Figure 6 shows a perspective view of a sandwich module formed by three panels in which a central panel is observed which is offset with respect to end panels defining tongue and grooving.

Figure 7 shows a perspective view in which the assembly of sandwich modules formed by three panels is observed.

Figure 8 shows a perspective view representing two walls forming a corner, made with sandwich modules consisting of three panels.

Figure 9 shows a perspective view of a sandwich module formed by three panels in which the arrangement of electrical fittings on the front face of one of the panels and the incorporation of grooves on its rear face for the passage of ducts are observed.

Figure 10 shows a perspective view of a formwork formed by sandwich modules.

Figure 11 shows a sectional view of a formwork formed by sandwich modules.

Figure 12 shows a sectional view of a false ceiling consisting of sandwich modules formed by a panel.

PREFERRED EMBODIMENT OF THE INVENTION

[0035] The system for construction object of the invention allows producing partitions, load-bearing walls, façades, false ceilings, floors, floor framing and other construction elements without the use of any framework, reinforcement or support, the assembly furthermore being carried out easily and simply with pre-fabricated sandwich modules (4) comprising one or several panels (3) which are co-laterally joined by gluing, this system completely eliminating the normally required masonry work.

[0036] As can be seen in Figure 1, the basic element of the system is a panel (3) comprising an expanded polystyrene core to which a resin is applied on at least one of its faces, which resin forms a resistant layer (2) providing the panel (3) with the mechanical properties required for its use as a construction element for an establishment or building, such as a partition, wall, forging, false ceiling or others, without the need to use complementary reinforcement structures or frames, while at the same time having thermal insulation characteristics provided by the polystyrene core (1).

[0037] The resin is preferably applied in combination with a catalyst and fillers are optionally added, such as for example silica sand, corundum, crushed glass, silicon carbide, foundry slag, fiberglass and carbon fiber.

[0038] The resistant layer (2) formed by the resin and its corresponding fillers will have a thickness comprised between 1 and 10 mm, preferably between 1 and 4 mm.

[0039] The use of sand as a filler further provides good fire resistance and acoustic insulation characteristics as well as a finish similar to that of a façade obtained by one coat, therefore it can be used directly as an outer or inner front face of a wall or partition.

[0040] Traditional coatings such as layers of paint or projection of coating powders can further be applied on the resin itself.

[0041] In order to obtain better mechanical characteristics, the sandwich module (4) can be formed by two, three or more panels (3), the union between the panels (3) being carried out by means of the resistant resin layer (2) itself which acts as an adhesive. Figure 5 shows a sandwich module (4) consisting of three panels (3, 3', 3'') to form a resistant module that can be directly applied to obtain walls and partitions.

[0042] In a preferred embodiment shown in Figure 6, the sandwich module (4) is formed by three panels (3, 3', 3'') consisting of a central panel (3) that is offset at the upper and rear part with respect to two outer panels (3', 3'') defining on their sides a tongue and groove structure so as to facilitate their assembly with another sandwich

module (4) of the same structure arranged at the top, bottom or sides.

[0043] These sandwich modules (4) are obtained in the plant in a very simple manner, given that it is sufficient to cut them to the corresponding size and join them together with the resin itself, obtaining a module (4) that can be easily handled in terms of its weight and dimensions.

[0044] Once the modules are received on-site, they are assembled by simple assembly and gluing by means of the resin itself by a single operator in an easy and simple manner furthermore without requiring any specific specialization for the assembly. The fixing of the corresponding modules to the floor is also carried out by simple gluing through the resin itself. The entire walls of the building can thus be built without needing to use any reinforcement supports, frameworks or structures.

[0045] Figure 7 shows an assembly by means of the assembly and gluing of sandwich modules (4), the panels of each row of the wall being arranged in a staggered formation with respect to those of the row immediately above it, thus achieving a wall with greater strength.

[0046] The sandwich modules (4) will obviously be carried out in standard measurements which can be used to form most of the ceilings, walls or façades, special modules being made for the finishes, corners or special elements.

[0047] In any case based on the architect's design, all the different necessary sandwich modules (4) are easily manufactured in the plant and are assembled on-site simply following the instructions of the corresponding assembly plan.

[0048] Figure 8 shows two walls at an angle in which it can be observed how the sandwich modules (4) which are going to form the corner are bevel cut, this operation being carried out in the plant to simplify the assembly of the panel assembly.

[0049] The resistant layer (2) furthermore has a finish similar to the one coat normally used in construction by means of which after the assembly of the modules, the wall or partition is finished without needing to carry out finishes on-site although it is possible to apply, directly on the resin layer a coating layer, as shown in Figure 4, which can be a layer of paint, a layer of projection of powder, natural stone, granite or marble.

[0050] As can be observed in Figures 2 and 6, the panels (3) can also incorporate imitation finishes (6) carried out in the plant directly on the core (1) before applying the resin layer (2), being able to simulate stone or brick finishes or the like.

[0051] The sandwich modules (4) can incorporate any type of electrical fittings, plumbing, electric heating ducts, etc., the sandwich module (4) incorporating to that end housings (7) allowing the passage of ducts (8) which eliminates the need for carrying out the typical chases in the partitions for the passage of the grooves. A module of this type has been clearly represented in Figure 3.

[0052] The sandwich modules (4) can also be joined

to form a closed contour which can be used for the formwork of concrete columns, beams or walls, the sandwich module (4) being able to be eliminated after the setting of the concrete given that they have a very low cost or can be reused for a later formwork for the purpose of which a release agent or demolding agent will be applied on its face in contact with the concrete. Figures 10 and 11 show an arrangement of this type.

[0053] Likewise, and as shown in Figure 12, the sandwich modules (4) can be glued on the upper part of the small metallic beams (9) supporting the arches (10) forming the ceiling or roof of the building forming the corresponding false ceiling, thus eliminating the traditional laborious systems for supporting the false ceiling plates. The sandwich modules (4) further have a sufficient mechanical strength for allowing, for example, hanging ceiling lamps directly from the panels (3).

[0054] In the event that the sandwich modules (4) are applied as a façade coating, it is simply enough to place them on the façade by means of dowels and washers. In this application it is possible to use modules the core (1) of which is coated on only one of its faces or on both faces, this second possibility being the most suitable given that it will allow adding mortar so as to level the façade prior to placing the module on it. The existing façade can thus be repaired without having to drill or eliminate deteriorated parts, also providing good thermal insulation and a guarantee against moisture which, in its absence, would affect the façade.

Claims

1. A system for construction with pre-fabricated panels, comprising sandwich modules (4) co-laterally assembled to one another by gluing without using reinforcement structures or frameworks, wherein each sandwich module (4) comprises three pre-fabricated panels consisting of a central panel (3') which is offset at the upper and rear part with respect to two parallel outer panels (3") forming a tongue and groove on its sides allowing its assembly with another sandwich module (4) of the same structure arranged at the top, bottom or sides, **characterized in that** each pre-fabricated panel comprises: a core (1) of material selected from expanded polystyrene and polyurethane, and at least one resistant layer (2) located on at least one of the larger faces of the core having a thickness defined between 1 and 10 mm, and is formed by resin and optionally fillers, wherein the resin is selected from:

polyisobutadienes, polyesters, cycloaliphatic polyamides, epoxies, phenol resins and polyurethanes,

and wherein the fillers are selected from: silica sand, corundum, crushed glass, silicon carbide, foundry slag, fiberglass and carbon fiber.

2. System according to claim 1 wherein the sandwich module incorporates housings or grooves (7) for the passage of ducts (8) for installations, such as electrical ducts and plumbing. 5
3. System according to claim 1 wherein the sandwich module incorporates a coating layer (5) on the resistant layer (2) of a material selected from paint, projections of powder, natural stone, granite and marble. 10
4. System according to claim 1 wherein the core (1) shows on its faces in contact with the resistant layer (2) an imitation finish (6) simulating a stone or brick finish. 15
5. System according to claim 1 wherein the resistant layer (2) has a thickness defined between 1 and 4 mm. 20
6. System according to any of claims 1-5, **characterized in that** the sandwich modules (4) are assembled forming a formwork for concrete columns, beams or walls. 25
7. System according to any of claims 1-5, **characterized in that** the sandwich modules (4) are assembled forming a false ceiling which is adhered to small beams (9) supporting arches (10) forming the roof or false ceiling of the building. 30

Patentansprüche

1. Ein System für den Bau mit vorgefertigten Paneelen, welches Module (4) in Sandwich-Bauweise umfasst, die kollateral mittels Klebung ohne die Verwendung von Verstärkungsstrukturen oder Rahmen miteinander verbunden werden, wobei jedes Sandwich-Modul (4) drei vorgefertigte Paneele umfasst, die aus einem zentralen Paneel (3') bestehen, das an dem oberen und hinteren Teil gegenüber zwei parallelen äußeren Paneelen (3'') versetzt angeordnet ist, die an seinen Seiten eine Feder und Nut bilden, wodurch die Montage mit einem anderen Sandwich-Modul (4) mit derselben Struktur erlaubt wird, das an der oberen, unteren Seite oder den Seiten angeordnet ist, **dadurch gekennzeichnet, dass** jedes vorgefertigte Paneel Folgendes umfasst: 40

einen Kern (1) aus einem Material, das aus expandierfähigem Polystyrol und Polyurethan ausgewählt wurde, und mindestens eine widerstandsfähige Schicht (2), 45

die sich auf mindestens einer der größeren Seiten des Kerns befindet und eine Dicke zwischen 1 und 10 mm besitzt, und die aus Harz sowie optional Füllstoffen gebildet ist, wobei das Harz aus Folgendem ausgewählt wurde: Polyisobutadien, Polyester, cycloaliphatische Polyamide, Epoxyd, Phenolharz und Polyurethan, und wobei die Füllstoffe aus Folgendem ausgewählt wurden: Quarzsand, Korund, Glasgrieß, Siliziumkarbid, Gießereischlacke, Glasfaser und Kohlenstofffaser.

2. System nach Anspruch 1, wobei die Sandwich-Module Gehäuse bzw. Rillen (7) für die Passage von Kanälen (8) für Installationen einschließen, wie elektrische Kabelkanäle und Leitungen. 15
3. System nach Anspruch 1, wobei das Sandwich-Modul eine Beschichtungsschicht (5) auf der widerstandsfähigen Schicht (2) aus einem Material einschließt, das aus Farbe, Projektionen von Pulver, Naturstein, Granit und Marmor ausgewählt wurde. 20
4. System nach Anspruch 1, wobei der Kern (1) auf seinen Seiten, die in Kontakt mit der widerstandsfähigen Schicht (2) stehen, eine Imitationsoberfläche (6) aufweist, die eine Oberfläche aus Stein oder Ziegel simuliert. 25
5. System nach Anspruch 1, wobei die widerstandsfähige Schicht (2) eine Dicke besitzt, die zwischen 1 und 4 mm definiert ist. 30
6. System nach irgendeinem der Ansprüche 1-5, **dadurch gekennzeichnet, dass** die Sandwich-Module (4) montiert sind, um einen Rahmen für Betonsäulen, -träger oder -wände zu bilden. 35
7. System nach irgendeinem der Ansprüche 1-5, **dadurch gekennzeichnet, dass** die Sandwich-Module (4) montiert sind, um eine Zwischendecke zu bilden, die an kleinen Trägern (9) befestigt ist, welche Bögen (10) stützen, die das Dach oder die Zwischendecke des Gebäudes bilden. 40

Revendications

1. Un système de construction avec des panneaux préfabriqués, comprenant des modules sandwichs (4) assemblés collatéralement l'un à l'autre par collage sans utilisation de structures de renforcement ni de châssis, dans lequel chaque module sandwich (4) comprend trois panneaux préfabriqués consistant en un panneau central (3') qui est décalé dans la partie supérieure et arrière par rapport à deux panneaux parallèles externes (3'') formant une languette et une rainure sur ses côtés permettant son assem- 45

- blage avec un autre module sandwich (4) de la même structure disposé en haut, en bas ou sur les côtés, **caractérisé en ce que** chaque panneau préfabriqué comprend : un noyau (1) dans un matériau sélectionné parmi le polystyrène expansé et le polyuréthane, et au moins une couche robuste (2) située sur l'une au moins des faces les plus grandes ayant une épaisseur définie entre 1 et 10 mm et qui est formée avec de la résine et optionnellement des enduits, dans laquelle la résine est sélectionnée parmi des : polyisobutadiènes, polyesters, polyamides cycloaliphatiques, époxyes, résines phénoliques et polyuréthanes, et dans laquelle les enduits sont sélectionnés parmi : le sable siliceux, corindon, verre pilé, carbure de silicium, mâchefer de fonderie, la fibre de verre et la fibre de carbone. 5
2. Système selon la revendication 1 dans lequel le module sandwich comprend des logements ou des rainures (7) pour le passage de conduits (8) pour des installations, comme des conduits électriques ou de plomberie. 10
3. Système selon la revendication 1 dans lequel le module sandwich comprend une couche d'enduit (5) sur la couche robuste (2) dans un matériau sélectionné parmi : peinture, projections de poudre, pierre naturelle, granit et marbre. 15
4. Système selon la revendication 1 dans lequel le noyau (1) présente sur ses faces en contact avec la couche robuste (2) une finition (6) imitant une finition en pierre ou brique. 20
5. Système selon la revendication 1 dans lequel la couche robuste (2) a une épaisseur définie entre 1 et 4 mm. 25
6. Système selon l'une quelconque des revendications 1-5, **caractérisé en ce que** les modules sandwichs (4) sont assemblés en formant un coffrage pour des colonnes, poutres ou parois en béton. 30
7. Système selon l'une quelconque des revendications 1-5, **caractérisé en ce que** les modules sandwichs (4) sont assemblés en formant un faux-plafond qu'on fait adhérer à de petites poutres (9) soutenant des arcs (10) formant le toit ou le faux-plafond du bâtiment. 35

40

45

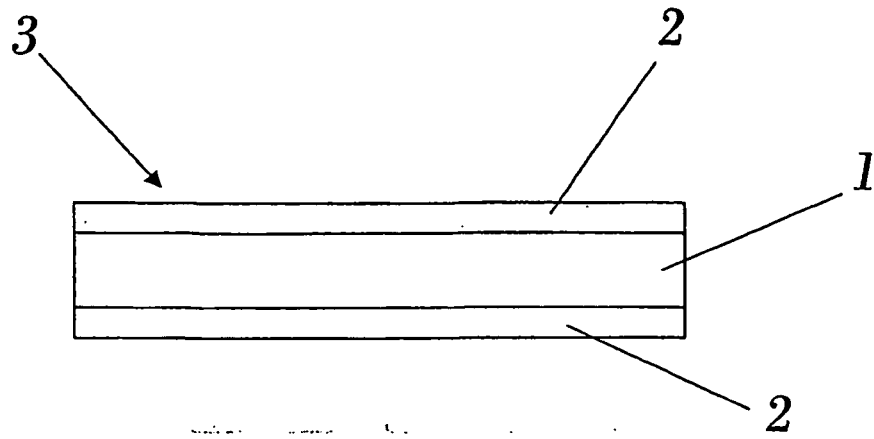


FIG. 1

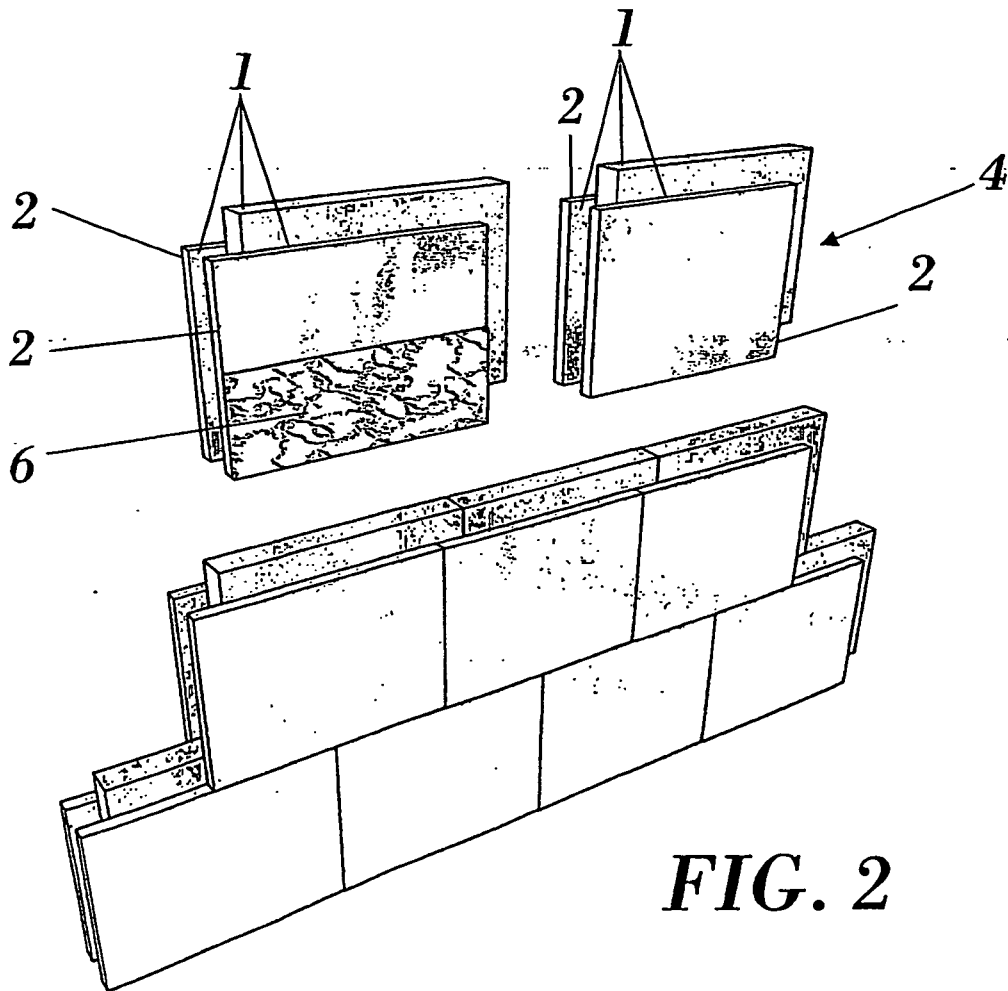
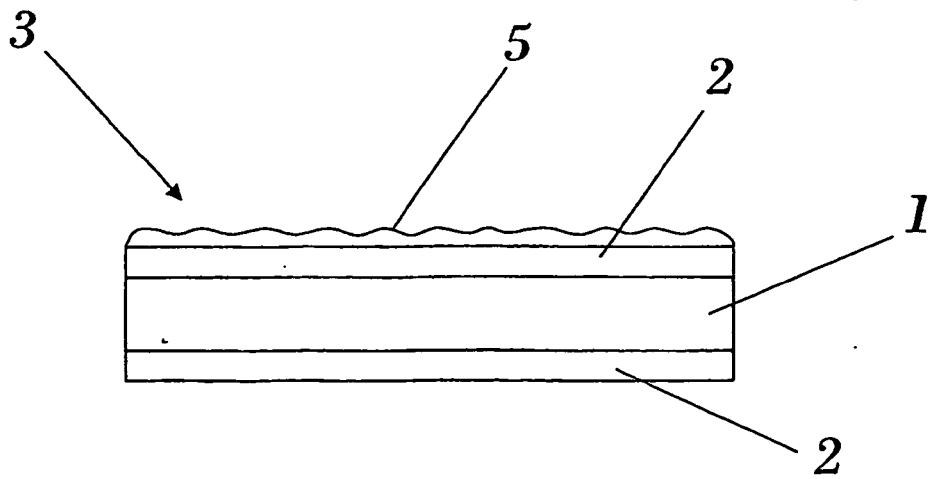
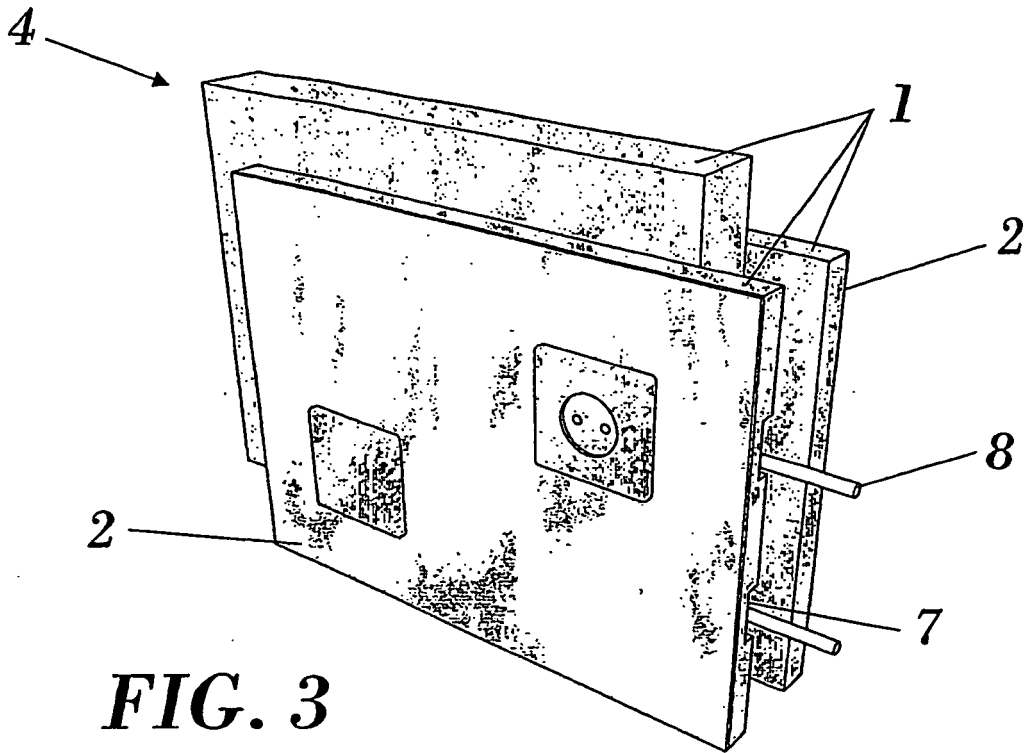


FIG. 2



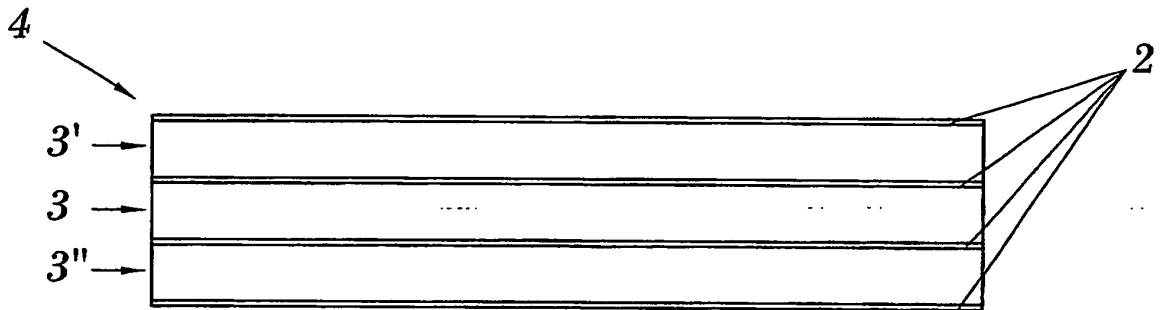


FIG. 5

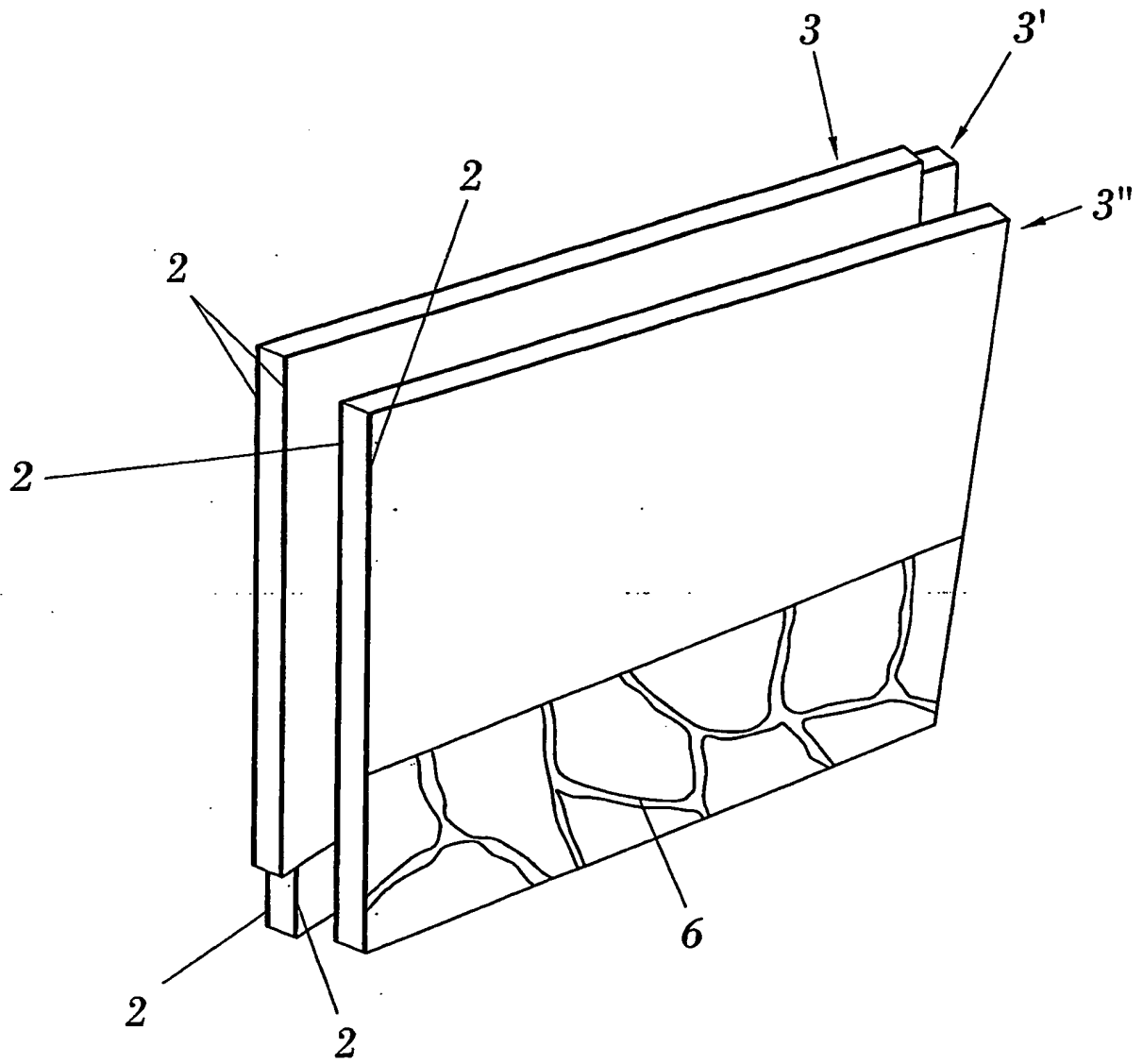
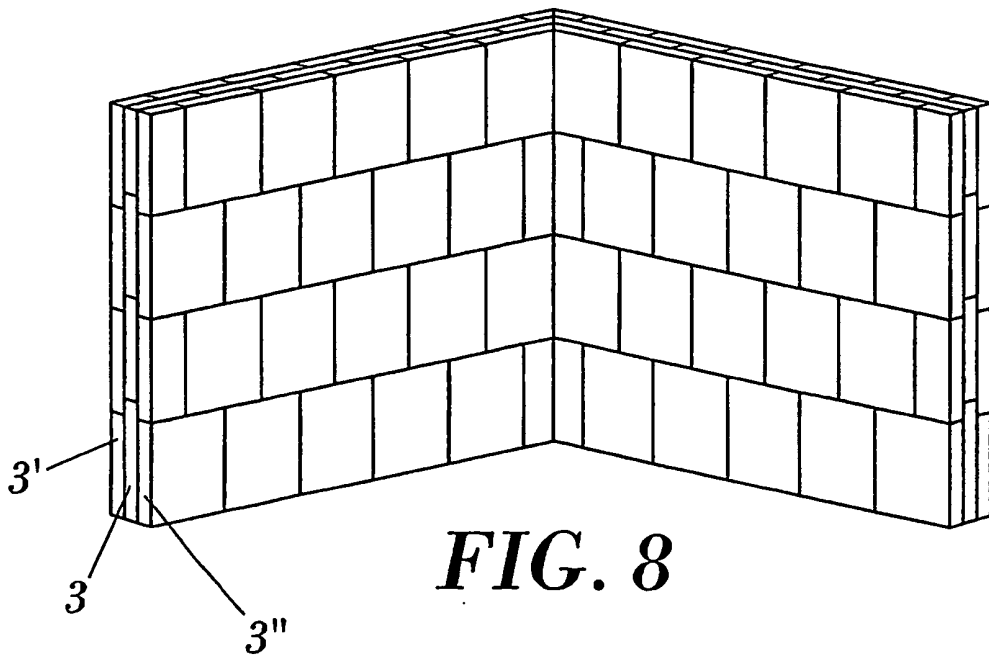
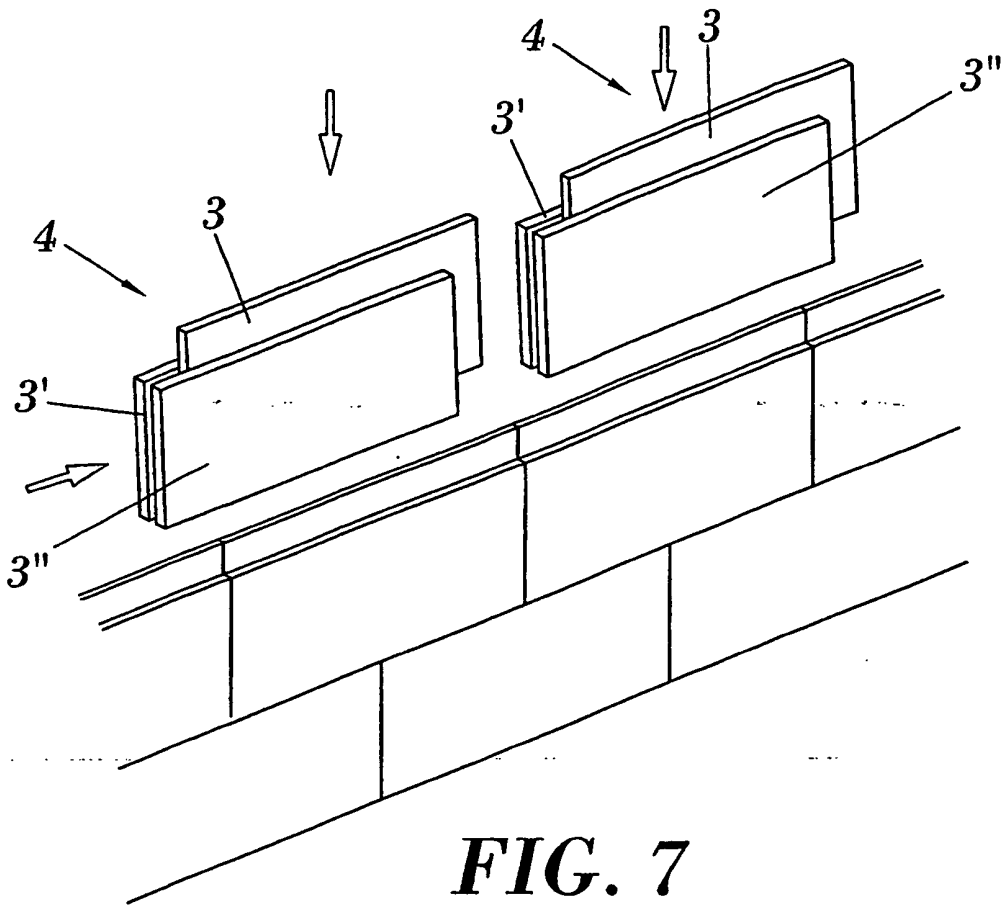


FIG. 6



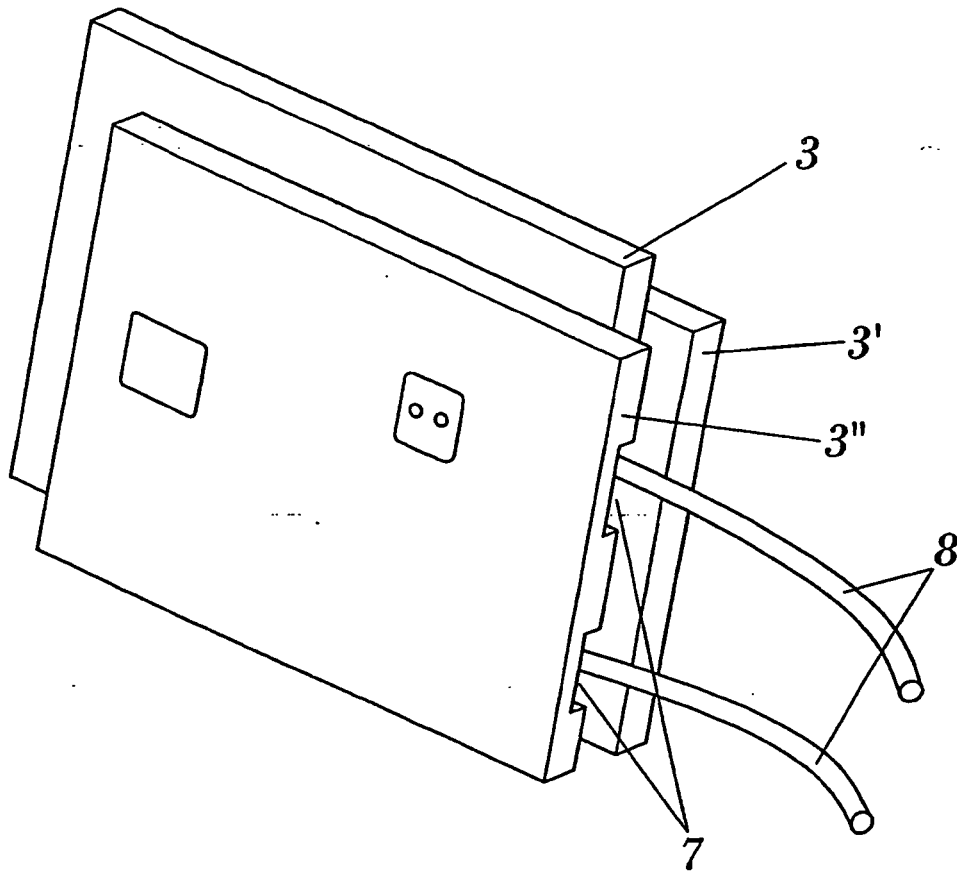


FIG. 9

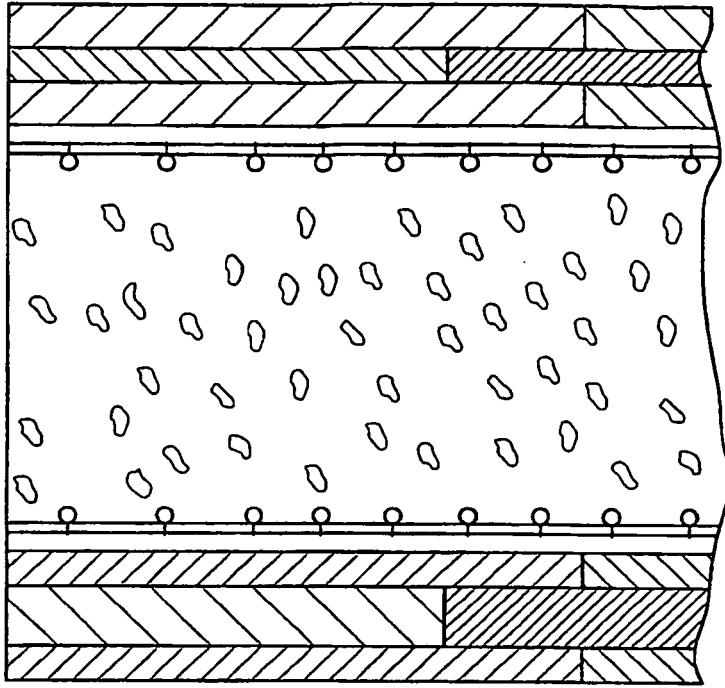


FIG. 11

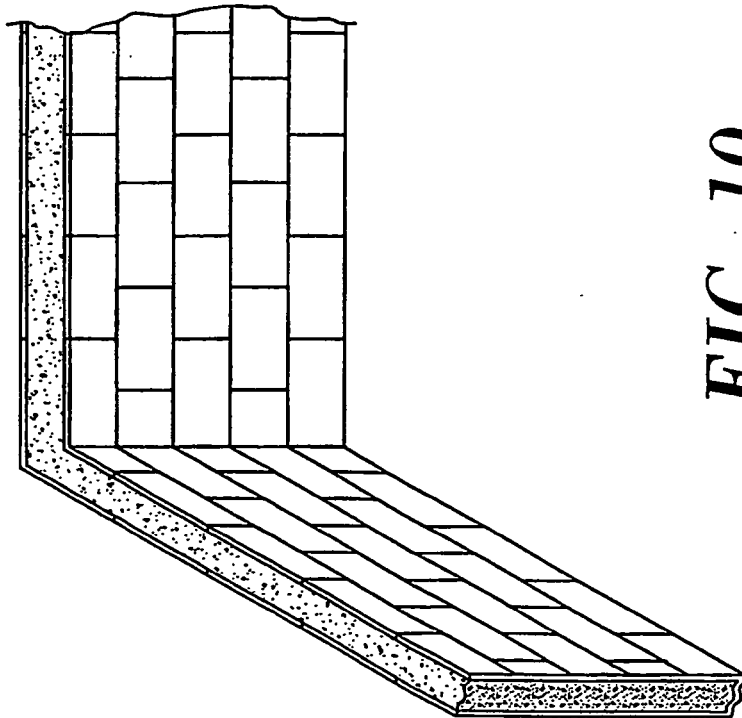


FIG. 10

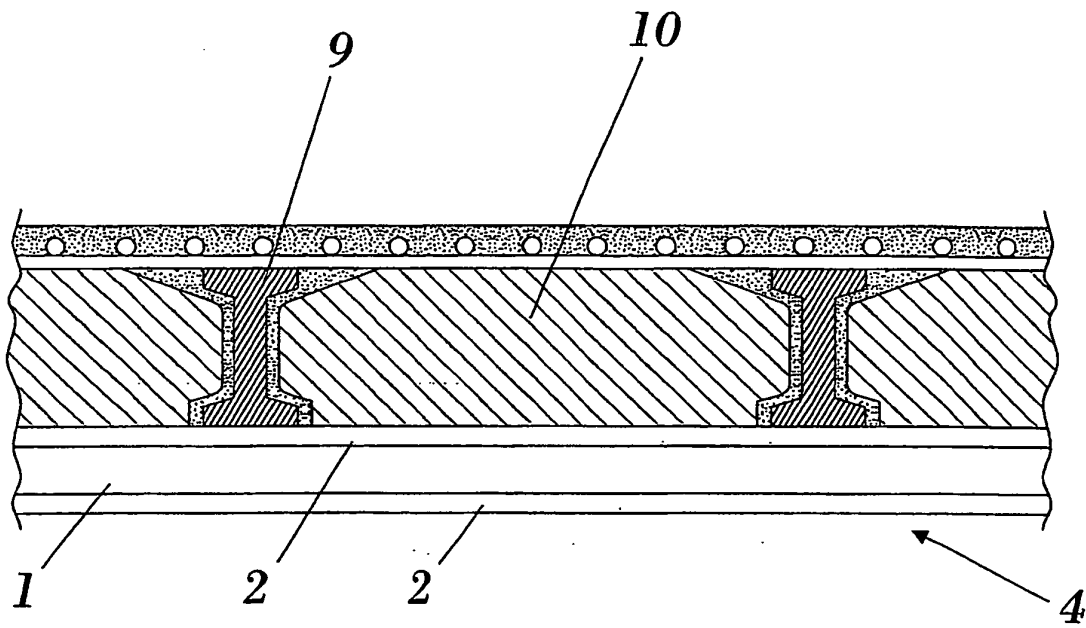


FIG. 12

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5765330 A [0006]
- EP 0612894 A [0007]
- EP 006756 A [0008]
- WO 9844213 A [0010]
- US 4019297 A [0013]
- DE 311444 A [0014]