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(54) System, method and modular element for the construction of wooden buildings

(57) The invention relates to a system for the construction of wooden buildings, **characterized in that** it comprises: - a plurality of modular multilayer elements (1) provided with an inner layer (10) of insulating material enclosed between two layers of wood (11), each of these modular components (1) being provided with at least a connecting portion (12) complementarily shaped with respect to a corresponding portion (13) of another modular element to allow the matching of two or more of these elements (1) by coupling of their respective connecting portions (12, 13); - a plurality of supporting elements (2) connected to a fixed structure or base (3) and arranged spaced of a value substantially corresponding to the value of a dimension of these modular elements (1), so as to enable the stable positioning of the said modular elements (1) when these are coupled in correspondence of said connecting portions (12, 13).

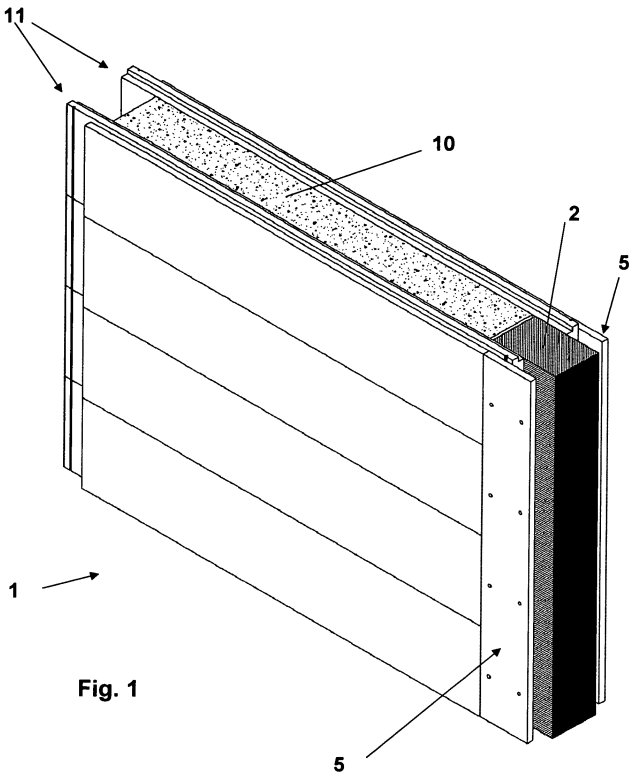

Fig. 1

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Description

[0001] The present invention concerns a system, a method and a modular element for the construction of wooden buildings.

[0002] Even if in this description will be used the word "wood", the invention also extends to the substitutes of wood, i.e. materials which are structurally and/or functionally similar.

[0003] Currently, timber constructions are usually carried out according to different building methods.

[0004] A first type of construction is the solid construction socalled "Blockhaus", which is achieved by means of logs horizontally stacked and provided with special joints that allow the assembly of the walls. Another type of construction uses prefabricated panels of wood and plasterboard. Another technique provides for the pre-manufacture of entire walls.

[0005] The current techniques of wood construction have drawbacks; some of these drawbacks will be listed hereafter.

[0006] The structures of "Blockhaus" type require a considerable amount of timber, skilled labour and, therefore, have considerable costs for transportation and labour.

[0007] With regard to prefabricated panels, these panels have an insufficient mechanical strength, especially for breaking through, and do not provide with adequate insulation. Finally, the entire pre-fabricated walls are considerably bulky, resulting in high costs for transportation and assembly, since considerably powerful means are necessary for their handling in the factory, during transport and during the final assembly.

[0008] The aim of this invention is to provide a system, a method and a modular element which can eliminate the drawbacks of the prior art and which, at the same time, provide a new design and producing methodology able to combine relatively low cost to a product having high mechanical and thermal insulation features, and which is very simply to be assembled. This result was reached in accordance with the invention by adopting the idea of a system, a method and a modular element having the features described in independent claims. Other features are described in the dependent claims.

[0009] Among the advantages of this invention there are:

- the achieved timber constructions have optimal mechanical properties, relating to the static structure, and relating to the resistance to seismic stress and in respect to the possibility of breaking through the walls;
- the timber construction according to the present invention provide a very high thermal insulation, thus obtaining a very high rating in the energy classification; for example, a construction built according to the invention offers, for the same thickness of the structure, an insulation coefficient of three times higher than the traditional type of construction;
- constructions made according to the invention do not need additional insulation treatments;
- the method of construction is relatively simple and, therefore, can be implemented in different geographical areas, even without having a highly specialized labour;
- constructions made in accordance with the present invention have a lifetime comparable to the timber construction of the traditional type (and also higher with the same maintenance), but are obtainable with relatively low time and cost;
- for producing timber construction in accordance with the present invention are not used harmful materials, thus obtaining a final product which is fully eco-compatible, and which also fits in with a non-invasive impact.

[0010] These and other advantages and features of the present invention will be more and better understood by means of the description that follows and with the help of the attached drawings, given as a practical exemplification of the invention, but not to be considered limitative, in which:

- Fig.1 is a schematic perspective view of a possible embodiment of a portion of wall made in accordance with the invention and including a vertical support element and four modular multilayer elements;
- Fig.2 is a schematic exploded perspective view of part of Fig.1, in which a portion of the support element and only one modular element are shown;
- Fig.3 is a schematic front view of a wall built in accordance with the invention;
- Figs. 4 and 5 are related, respectively, to a cross-section and an enlargement of a particular of the wall of Fig.3;
- Fig.6 is a schematic perspective view of a possible embodiment of a modular multi-layer element;
- Fig.7 is an enlarged particular of Fig.6;
- Figs. 8 and 9 are schematic perspective views relating, respectively, to a joint in correspondence of an angle between two exterior walls (Fig.8) and to an angular joint between an outer wall and inner wall (Fig. 9);
- Fig.10 is a plan view on a possible embodiment of modular multi-layer element, in which some possible accessories are schematically represented;
- Fig.11 is a schematic perspective view of a joint in correspondence of an angle between two walls, with a particular schematically shown in a different scale.

Referring to the enclosed drawings, a system for the construction of wooden buildings comprises a plurality of modular multilayer elements (1) and a plurality of supporting elements (2) connected to a fixed structure or base (3), as described hereafter.

[0011] The support elements (2) can be made, prefer-

ably, using wood and the like. Alternatively, other materials, provided with appropriate mechanical properties, can be used; for example, the support elements can be in metal materials.

[0012] The modular multilayer elements (1) are provided with an inner layer (10) of insulating material enclosed between two layers of wood (11).

[0013] In particular, the the inner layer of insulating material can be formed of cork or an agglomeration of cork, or wood-wool, etc.. The inner layer (10) can have a thickness between 8cm and 30cm, preferably between 10cm and 22cm, and, in particular it can be about 16cm in an embodiment which is particularly advantageous.

[0014] The outer layer (11) can have a thickness between 2cm and 10cm, preferably between 4cm and 8cm, and, in particular it can be about 6-6,5cm in an embodiment which has been particularly advantageous during the tests.

[0015] Other sizes will vary depending on construction reasons.

[0016] Each of the modular elements (1) has at least a connecting portion (12) complementary shaped in respect to a corresponding portion (13) of another modular element for allowing the combination of two or more of those elements (1) by means of the coupling of the respective connecting portions (12, 13).

[0017] With reference to the drawings (particularly Figs.6 and 7), each modular element (1) has two upper connecting portions (12) which are arranged externally, in correspondence of the outer layers of wood (11), and which develop for the entire length of the element (1); the modular element (1) is provided with similar connecting portions (13), disposed in the lower part.

[0018] Each of the upper portions (12) has a rectangular profile, which defines a kind of square protruding molding (120).

[0019] Fig.7 shows a particular representing the value of an 88° angle which is an advantageous embodiment of the profile (120).

[0020] In the lower part, the modular element (1) has a pair of connecting portions (13) whose concavities reproduce substantially the convexities of the higher portions (12). In particular, the profile of the concave bottom portion is a rectangular profile with 90° angles. Thanks to the 88° angle of the higher profile (12) is possible to insert said profile in the cavity of the concave profile (13) although the size is the same. Thanks to a strengthening in the coupling of the modules (1) a remarkably stable fit is obtained.

[0021] A sealing gasket is inserted (4) inside the cavity (13) for improving the mating.

[0022] The support elements (2) may be differently sized. Of course, with reference to examples, it is preferable that the size of the section corresponding to the thickness, indicated with (S) in Fig.2, is a value corresponding to the corresponding value of the inner layer (10). In particular, depending on the dimensional changes due to design calculations, it is very convenient to keep constant the value of this measure (thickness) and to increase the other measure (width) of the support element. In other words, if the walls are formed by modular elements (1) having an inner layer (10) of 16cm thickness, the corresponding elements (2) may have, according to the static calculations, sections which measure, for example, of 16cmx16cm, 16cmx24cm or 16cmx32cm. Support elements (2) are bound to a fixed structure or base (3) (for example a bed/foundation or a plinth) and are arranged spaced at value substantially corresponding to the value of a dimension (length) of the modular elements (1) so as to permit the stable positioning of these elements (1) coupled in correspondence of said connecting portions (12, 13).

[0023] In particular, a method in accordance with the present invention provides to fix to the structure or fixed base (3) a plurality of supporting elements (2) to form pairs of supports (2) spaced of a preset value.

[0024] A stack of modular multi-layer elements (1) matched (i.e., superimposed) is inserted between each pair of supporting elements (2).

[0025] The stack of modular elements (1) is delimited (at the bottom) by a base element or shelf (19), fixed to the fixed structure (3) by means of screws and plugs (33), and (at the top) by a head or top element (18) (see, in particular, Fig.4). The shelf and the head element can advantageously be in wood. The elements (19, 18) are provided with coupling portions which are complementary shaped in respect to the corresponding portions (12, 13) of modular elements adjacent to them. In other words, the base element (19) will be provided with a "male" portion to be connected with the portion (13) of the modular element (1) placed at the bottom of the stack; correspondly, the top element (18) will have a "female" portion for receiving the upper portion (12) of the modular element (1) placed at the top of the stack.

[0026] The outer layers (11) of the modular element (1) are longer (horizontal direction) of the inner layer (10) to cover at least a part of the corresponding faces of the adjacent support (2). The portions of the faces of the elements (2) which are not covered by the outer layers can be covered by covering elements (5), which can fixed by means of screws.

[0027] In the example shown, the support elements (2) are placed on the base element (19) and are bound to it by means of L-shaped brackets (29) crossed by screws. In an alternative embodiment, not shown, the supporting elements (2) can be placed in corresponding cavities of the base element (19).

[0028] In the drawings, the connection between the different modular elements (1) is represented by means of the connecting portions (12, 13); this solution is not limitative since are possible other type of connection. Similarly, the fixing between the support elements (2) and the modular elements (1) can be achieved in other ways. Possible alternatives may include swallow-tailed connections, bolts, screws, wooden plugs, etc.. As shown schematically in Fig.10, the multi-layer modular

element (1) may be provided with structural reinforcement elements (70) arranged transversely to its longitudinal development. This feature greatly increases the resistance of the system to stress. In the example, the reinforcement elements (70) are formed by vertical studs, made of wood.

[0029] In addition, the modular element (1) may be advantageously provided with internal channels (71) suitable to allow the passage of electrical supply networks and/or water supply pipes. With (72) is schematically shown a supply box, i.e. an access point to electrical or water circuit. The access points to the internal channel (71) can be provided on one or both sides of the wall in wood construction. This feature greatly improves the functionality of the plant design in this type of construction.

[0030] Regard to Fig.8, it is possible to note that two supporting elements (2) are arranged close together in correspondence of the angle between exterior walls and are coated on three sides with the outer layers of the modular elements. In particular, a first support element (2), placed on left and bottom in the example, is covered on its two opposite sides by the outer layers (11) of the modular (1) disposed on the left, while on its third side is covered by the extension of the outer layer of the other modular element (1) (disposed on the right). The second support element (2) is coated on two sides by the outer layers (11) of the modular element disposed on right, while its third side is against the external face of the outer layer (11) of the modular element placed on left, which covers the first support element (2).

[0031] In this embodiment the covering element (5) is not used.

[0032] In Fig. 9 is shown how to use a swallow-tailed connection (88) for fixing a dividing wall (80) to an exterior wall, indicated with (81).

[0033] In Fig.11, a support element (2'), differently shaped in respect to the previous examples, is disposed in correspondence of the angle formed by two walls. In fact, the support element (2') has two appendixes (22') which develop orthogonally and which have a thickness corresponding to the value of the thickness of inner layer (10) so as to be inserted inside the outer layers (11) of the two modular elements (1) which form the corner. Changes may be made to the form, dimensions, component part locations, and type of materials employed in the embodiment described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. System for the construction of wooden buildings, **characterized in that** it comprises:

   - a plurality of modular multilayer elements (1) provided with an inner layer (10) of insulating material enclosed between two layers of wood (11), each of these modular components (1) being provided with at least a connecting portion (12) complementarily shaped with respect to a corresponding portion (13) of another modular element to allow the matching of two or more of these elements (1) by coupling of their respective connecting portions (12, 13);
   - a plurality of supporting elements (2) connected to a fixed structure or base (3) and arranged spaced of a value substantially corresponding to the value of a dimension of these modular elements (1), so as to enable the stable positioning of the said modular elements (1) when these are coupled in correspondence of said connecting portions (12, 13).

2. Method for the construction of wooden buildings, **characterized in that** it comprises the following steps:

   - fixing, to a fixed structure or base (3), a plurality of supporting elements (2) to form pairs of supports (2) spaced of a preset value;
   - inserting, between a pair of supporting elements (2), a stack of modular multilayer elements (1) placed side by side or superimposed, said modular elements (1) being provided with an inner layer (10) of insulating material enclosed between two layers of wood (11), and connecting portions (12, 13) complementarily shaped in order to allow the formation of a stable stack;
   - applying covering elements (5) to any uncovered portion of said supporting elements (2).

3. System and method according claim 1 or 2, **characterised in that** between said connecting portions (12, 13) are disposed corresponding seal gaskets (4).

4. System and method according to claim 1 or 2, **characterized in that** said plurality or stack of modular elements (1) is delimitated by a base element (19) connected to the fixed structure (3) and by a head element (18), said elements (19, 18) being provided with coupling portions complementarily shaped in respect to the corresponding portions (12, 13) of the modular elements which are adjacent to them.

5. System and method according to claim 4, **characterized in that** said supporting elements (2) rest on said base element (19) or housed in a corresponding seat which is provided on said base element (19), and are fixed to the same base element by "L-shaped" brackets (29) crossed by screws.

6. System, method and modular multilayer element (1)

according to one or more of the previous claims **characterized in that** the inner layer has a thickness comprised between 10cm and 22cm and each of the two outer layers has a thickness comprised between 2cm and 10 cm.

7. System, method and modular multilayer element (1) according to one or more of the previous claims **characterized in that** the modular element (1) is provided with reinforcing structural elements (70) disposed transversely in respect to its longitudinal development and/or with inner channels (71) allowing the passage of electrical supply networks and/or water supply pipes.

8. System, method and modular multilayer element (1) in one or more of the previous claims **characterized in that** the outer layers (11) of the modular element (1) are longer than the inner layer (10) to cover, at least partially, the corresponding sides of the supporting element (2).

9. System, method and modular multilayer element (1) in one or more of the previous claims **characterized in that** the connecting portions (12, 13) are shaped according to one or more substantially rectangular profiles.

10. System, method and modular multilayer element (1) in one or more of the previous claims **characterized in that** the insulating material used for the inner layer (10) is cork.

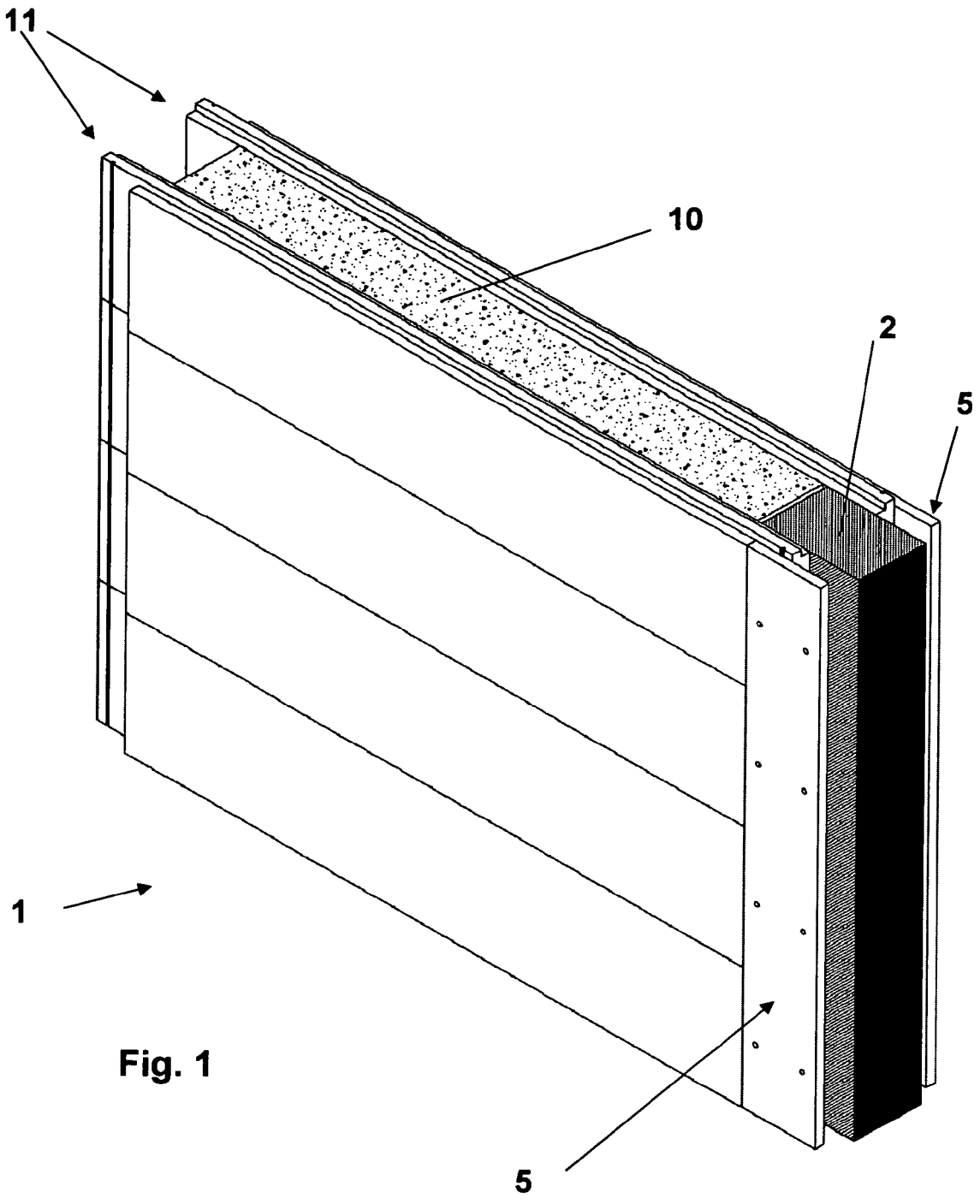


Fig. 1

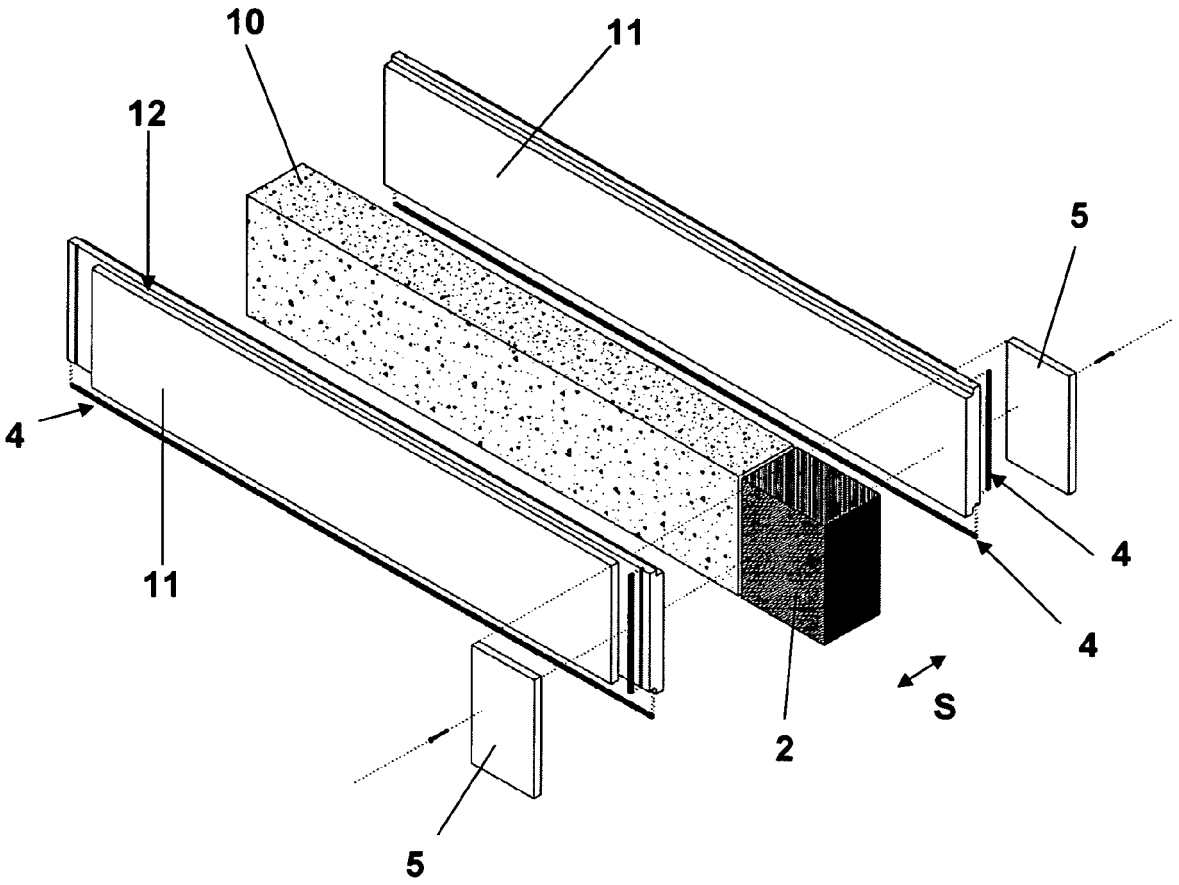


Fig. 2

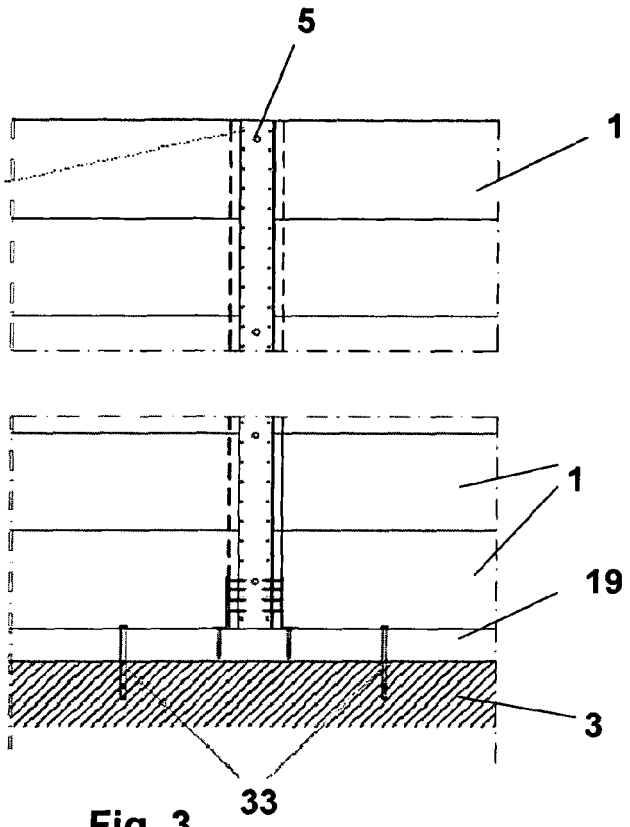


Fig. 3

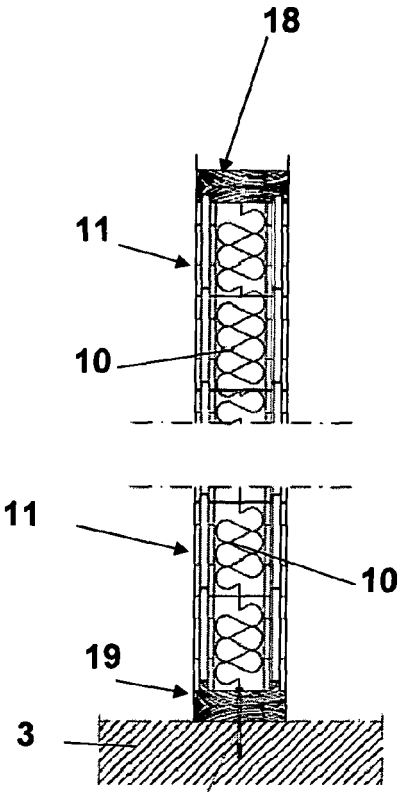
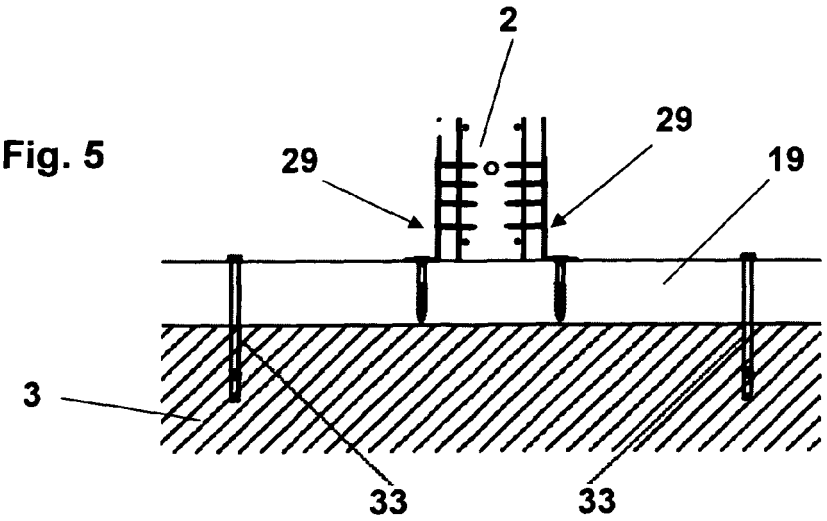


Fig. 4

Fig. 5



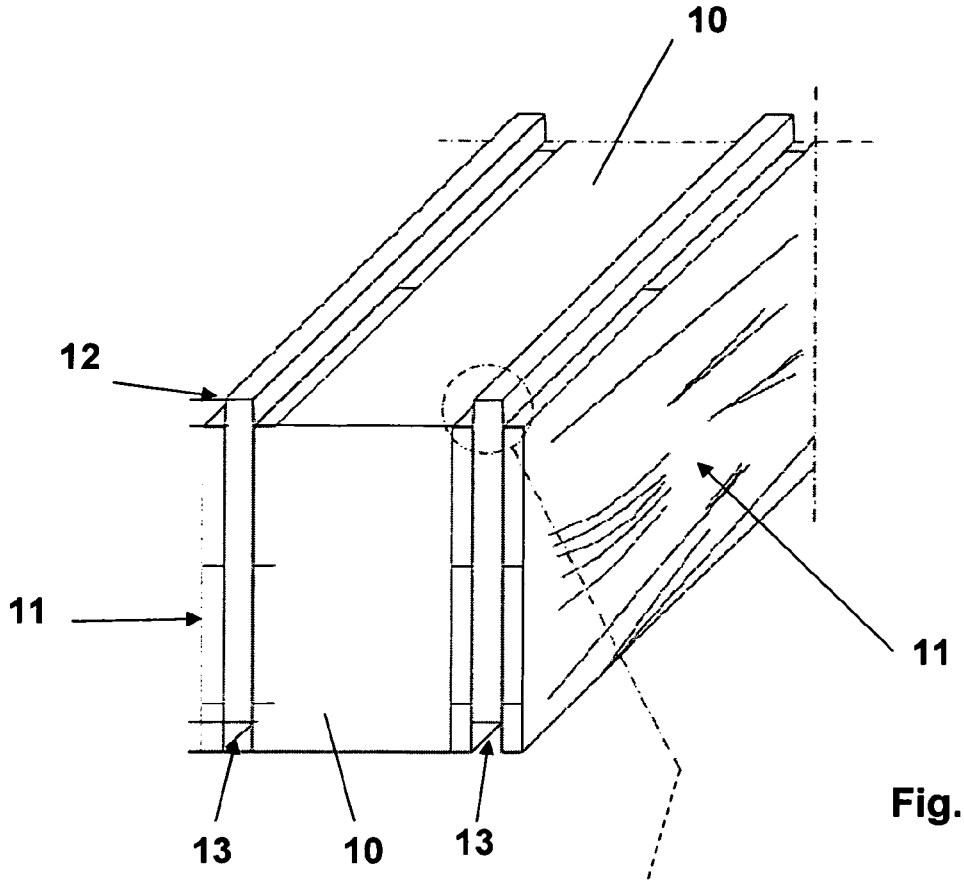


Fig. 6

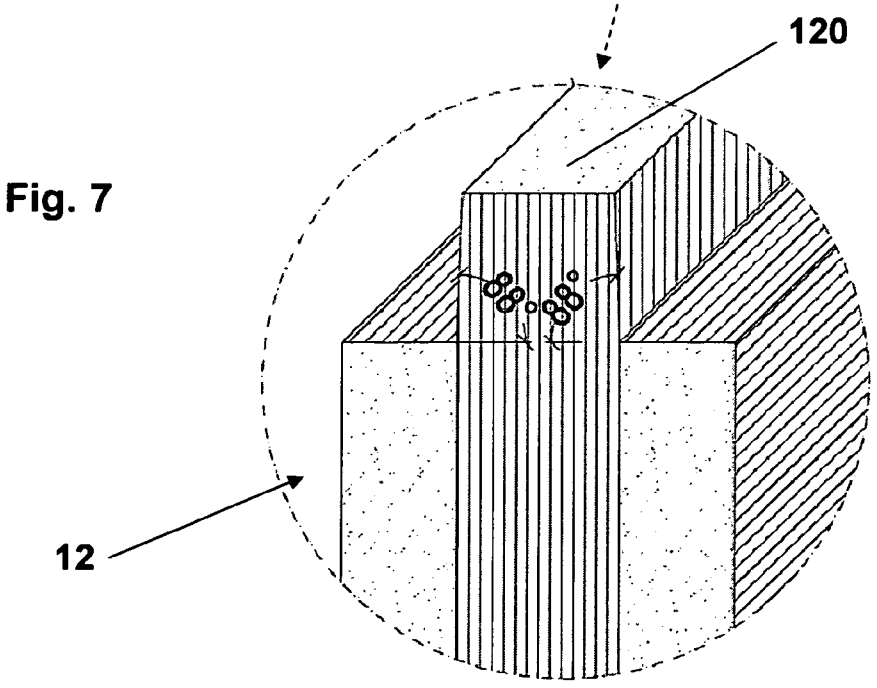


Fig. 7

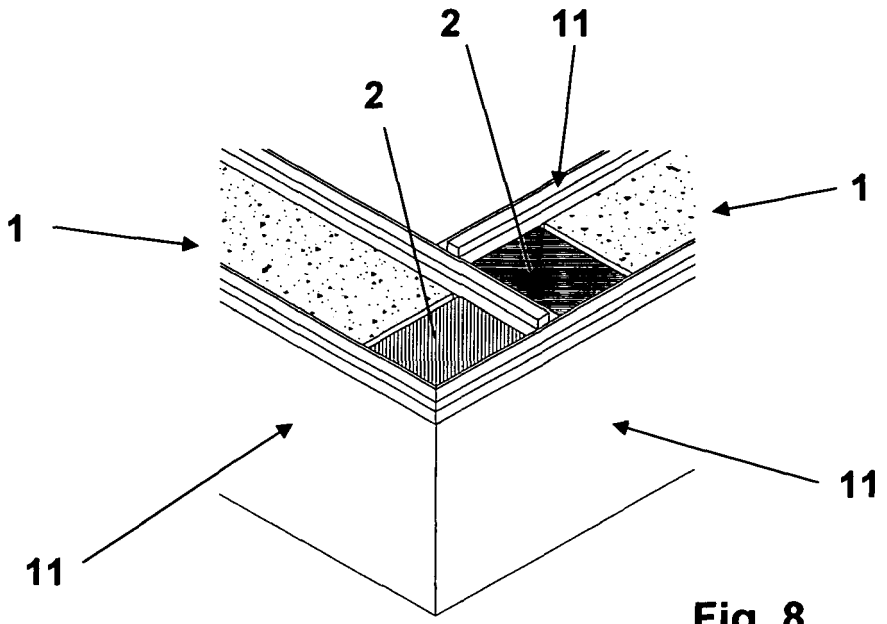


Fig. 8

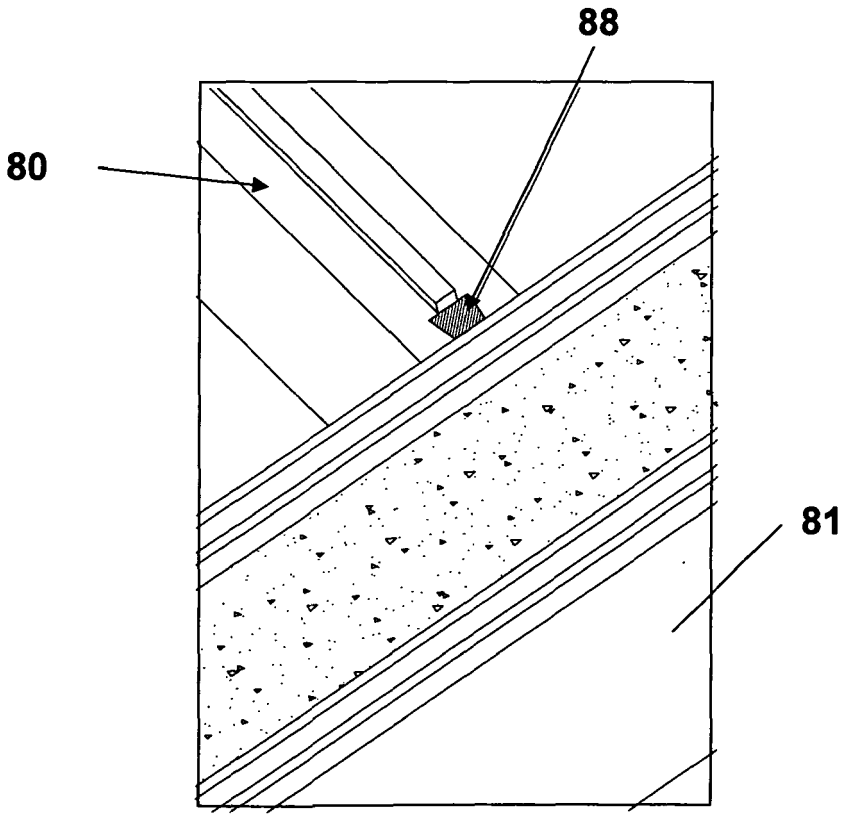


Fig. 9

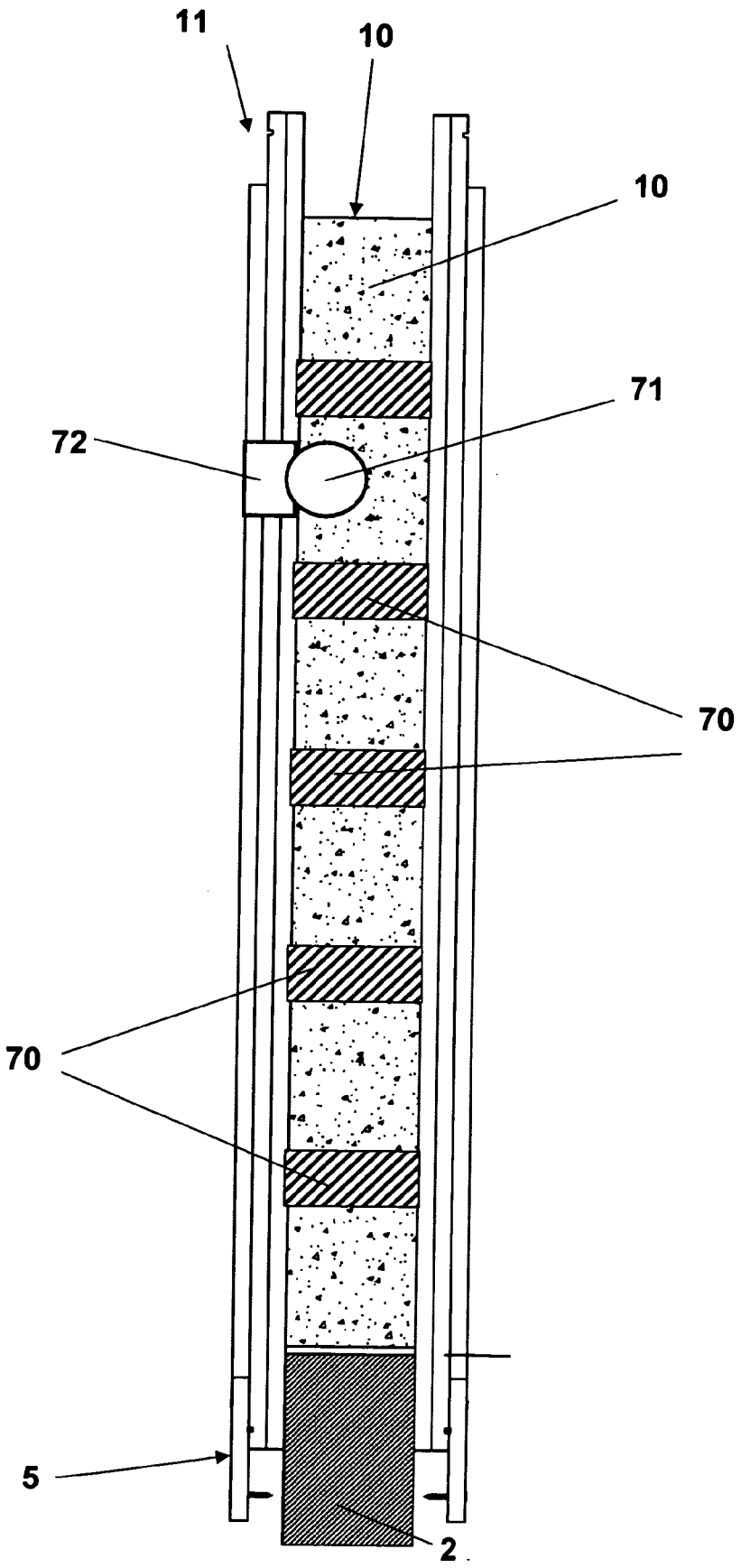


Fig. 10

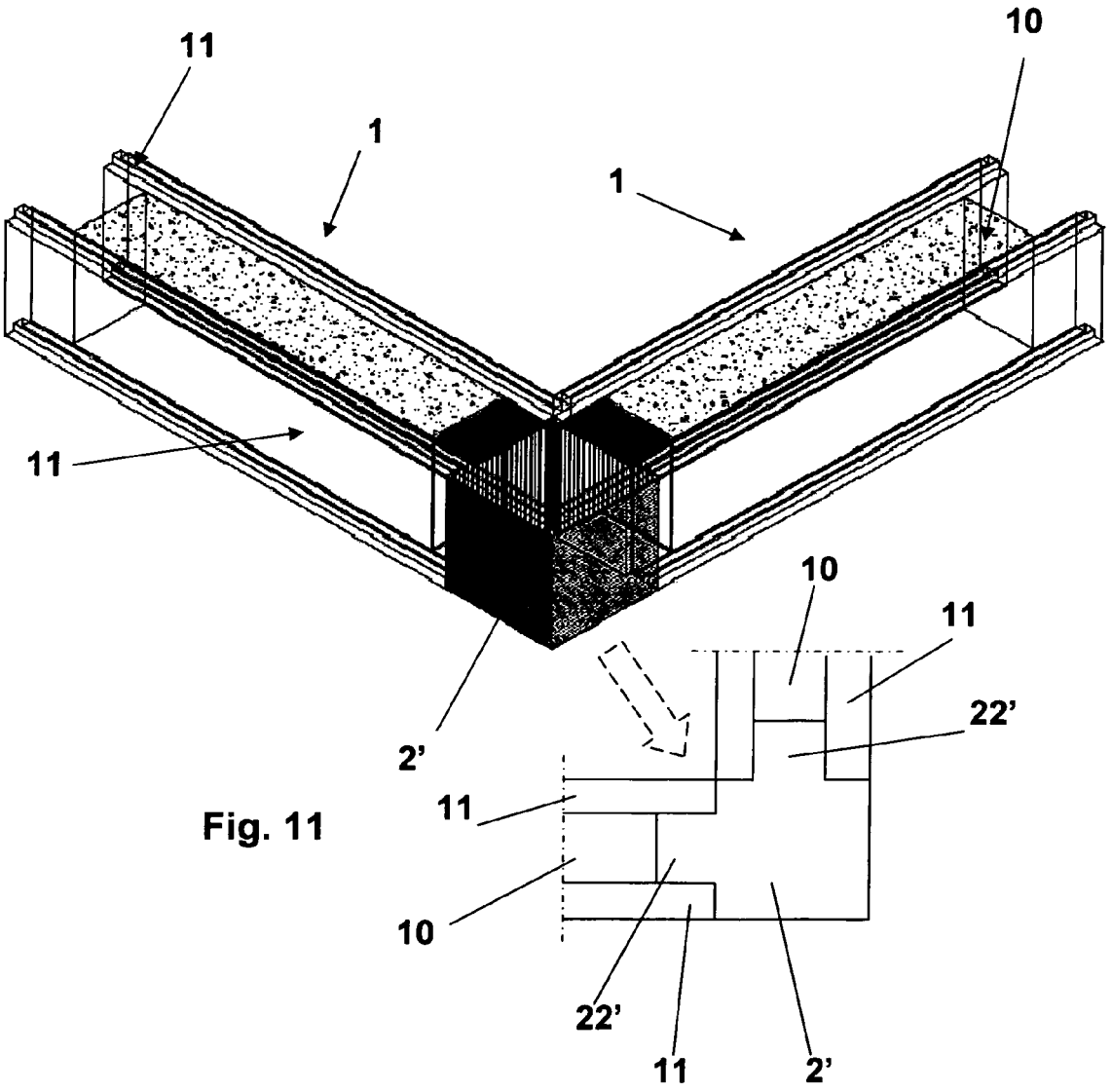


Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
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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	16 September 2009	Vratsanou, Violandi

CATEGORY OF CITED DOCUMENTS

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