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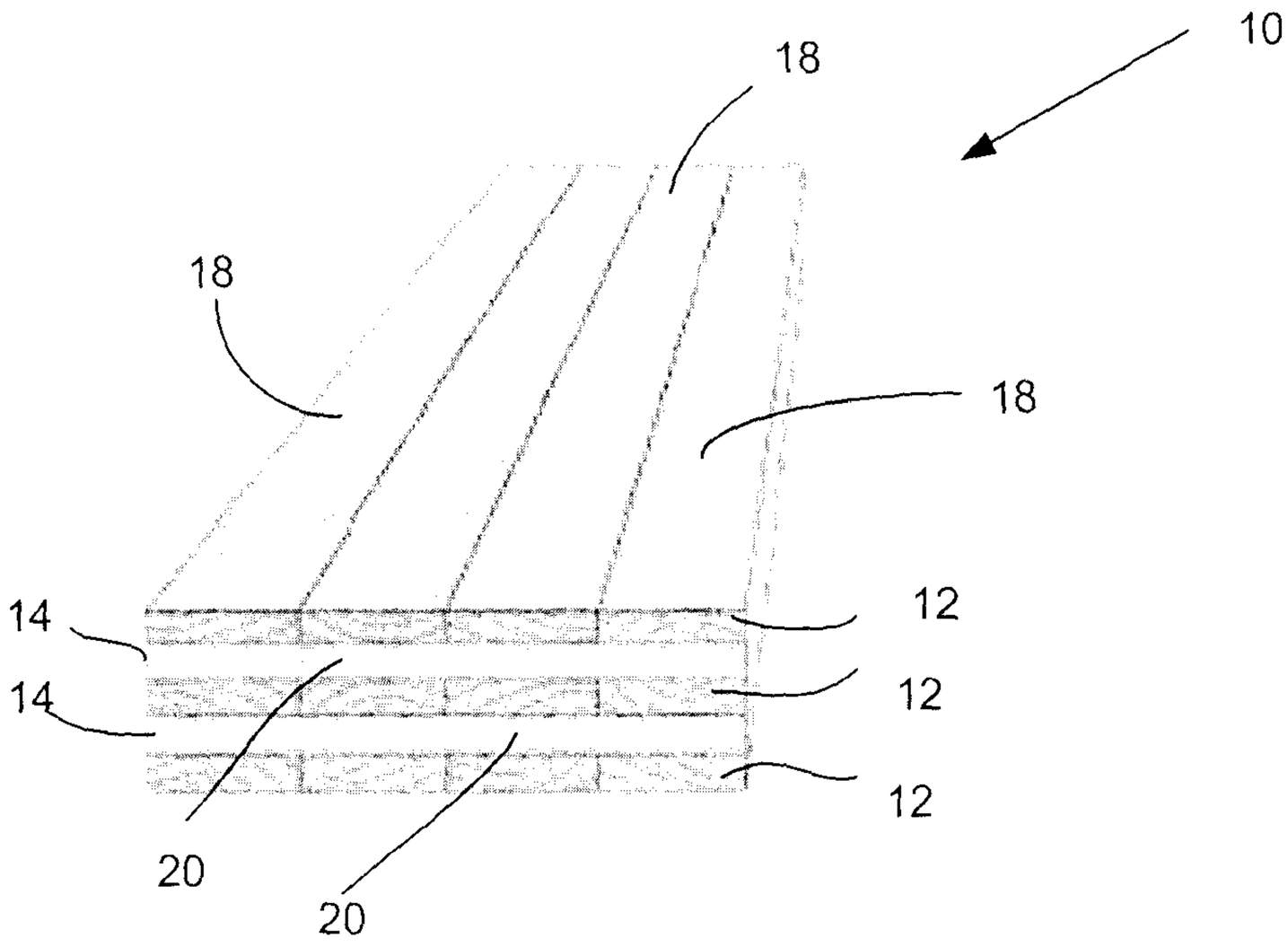

Fig. 1

(57) Abrégé/Abstract:
The present document describes a cross-laminated timber panel comprising at least a first and a third timber layers each oriented in different directions including at least one timber; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer and a mildew-resistant layer, a fire-resistance layer.

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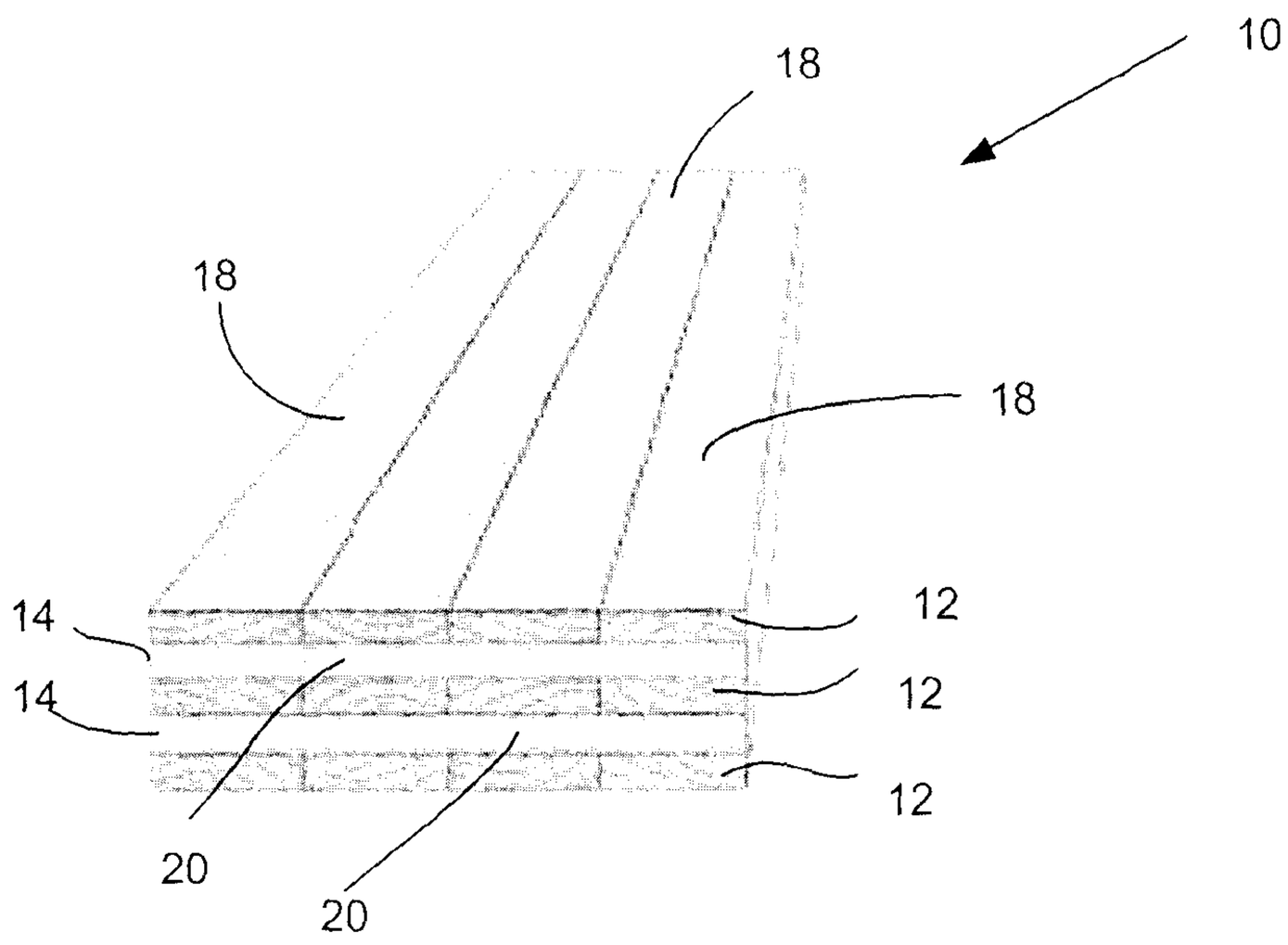

Fig. 1

(57) Abstract: The present document describes a cross-laminated timber panel comprising at least a first and a third timber layers each oriented in different directions including at least one timber; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer and a mildew-resistant layer, a fire-resistance layer.

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CROSS-LAMINATED TIMBER PANEL

BACKGROUND

(a) Field

[0001] The subject matter disclosed generally relates to cross-laminated timber panels. More specifically, the subject matter disclosed relates to an optimized cross-laminated timber panel.

(b) Related Prior Art

[0002] Cross-laminated timber is widely used in residential and light engineering structures in situations where large beam depths are required, such as long span openings in houses.

[0003] Large section timber is becoming more expensive and more difficult to obtain, and manufacturers have found it necessary to laminate smaller sections of lumber together to make the larger section sizes more readily available.

[0004] Laminating a number of smaller sections of timber together to make a larger member decreases the possibility of inherent weaknesses due to natural wood defects and also decreases the disparity in the strength of structural timber members because laminating effectively averages the varying properties of the timber used. However, when joining shorter sections of timber together to make a single lamination, the joints themselves become a point of inherent weakness.

[0005] Cross-laminated timber (CLT) panel construction is the next level in quality and speed of construction. Cross-laminated timber is a building system component that will transform construction methods and materials in North America. Wall, floor and roof elements manufactured in a climate-controlled facility and transported to building sites for rapid assembly can dramatically increase quality control in the building process.

[0006] The use of CLT, along with products and related technologies in insulation and building systems, can easily achieve the goals of energy

conservation standards set by the "Low Energy", "Passive House", "Energy 0" goals that will become mandatory in a very near future in Europe (2015) and most likely in North America.

[0007] There is clearly a need for a resistant cross-laminated timber panel having at least one layer including an insulation layer, a structural layer, a fire-resistance layer, a layer for receiving pipes and wires, a mildew-resistant layer or/and an insect-resistant layer.

[0008] There is therefore a need for improvements in the field of laminated timber, CLT, and related technologies for building systems.

SUMMARY

[0009] According to an embodiment, there is provided a cross-laminated timber panel comprising: at least a first and a third timber layers each at least partially oriented in different directions including at least one timber; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer and a mildew-resistant layer, a fire-resistant layer.

[0010] According to another embodiment, there is provided a cross-laminated timber panel with an opening comprising: at least a first and a third timber layers each at least partially oriented in different directions including at least one timber, said first and third timber layers comprising an opening; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer, a fire-resistance layer and a mildew-resistant layer, said second layer comprising an opening.

[0011] According to another embodiment, there is provided a cross-laminated timber panel comprising: at least a first and a third timber layers

oriented one direction including at least one timber; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer, a fire-resistance layer and a mildew-resistant layer.

[0012] According to another embodiment, there is provided a cross-laminated timber panel with an opening comprising: at least a first and a third timber layers oriented in one direction including at least one timber, said first and third timber layers comprising an opening; at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer, a fire-resistance layer and a mildew-resistant layer, said second layer comprising an opening.

[0013] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the second layer is a second timber layer at least partially oriented in the same direction as said first or third layers, said second layer including at least one timber.

[0014] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the second layer is a second timber layer oriented in a different direction from said first or third layers, said second layer including at least one timber.

[0015] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the timber layer is made of Lamboard™.

[0016] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the second layer comprises at least one of polyvinyl chloride, plastic material, foam, Styrofoam™, metal,

metallic material, composite material, fibreglass, wood material, polymeric material and a combination thereof.

[0017] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the first timber layer further comprises more than two timbers oriented in a first direction.

[0018] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the second timber layer further comprises more than two timbers oriented in a second direction.

[0019] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the first timber layer is perpendicular to the second timber layer.

[0020] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein at least one of the first or third layers is made of Lamboard^{TM} wood.

[0021] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein said second layer is made of Lamboard^{TM} wood.

[0022] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein said glue is a reactive adhesive.

[0023] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the reactive adhesive comprises an insect repellent or an agent toxic to insects.

[0024] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the reactive adhesive comprises boric acid.

[0025] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the insulation layer comprises at least one of a humidity layer, a sound barrier, a floor insulator, an insulation membrane, a temperature-control membrane, a thermal insulation and a vibration barrier.

[0026] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the structural layer comprises at least one of an earthquake-resistant layer, a fire-resistant membrane and a structural beam layer.

[0027] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the hollow-core or partially hollow-core layer comprises at least one of a layer for receiving pipes and wires and a layer for receiving sand, and a layer for receiving an insulation material.

[0028] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein the layers are fully oriented in different directions.

[0029] According to another embodiment, there is provided the cross-laminated timber panel as described above, wherein at least parts of two layers are forming a beam-like structure.

[0030] According to another embodiment, there is provided the cross-laminated timber panel as described above,

[0031] According to another embodiment, there is provided a Lamboard™ laminated timber panel comprising timbers aligned in one direction and fixed side by side with glue.

[0032] According to another embodiment, there is provided the Lamboard™ laminated timber panel as described above, wherein the glue used

is less than about 1% of the final volume of the Lamboard™ laminated timber panel.

[0033] The following terms are defined below.

[0034] The term "second layer" is intended to mean any layer laminated with glue between two timber layers and selected from the group consisting of an insulation layer, a structural layer, a hollow-core or partially hollow-core layer, an insect-resistant layer, a fire-resistance layer and a mildew-resistant layer.

[0035] The term "timber layer " is intended to mean at least two, but most specifically a plurality of timbers fixed together with glue and generally oriented in the same direction.

[0036] The term "reactive adhesive" is intended to mean an adhesive which provides the formation of strong bonds involving a chemical reaction and capable of bearing a required load. For example, the reactive adhesive can react chemically with the humidity or moisture present in the timber or sprayed on the timber to form a strong chemical bond.

[0037] The term “beam-like structure” is intended to mean a portion of a cross-laminated timber panel having at least a portion of adjacent layers in a same direction, providing a structural beam. A cross-and parallel-laminated timber panel (or CPLT) includes at least one “beam-like structure”.

[0038] Features and advantages of the subject matter hereof will become more apparent in light of the following detailed description of selected embodiments, as illustrated in the accompanying figures. As will be realised, the subject matter disclosed and claimed is capable of modifications in various respects, all without departing from the scope of the claims. Accordingly, the drawings and the description are to be regarded as illustrative in nature and not as restrictive and the full scope of the subject matter is set forth in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] Further features and advantages of the present disclosure will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0040] Fig. 1 is a perspective view of a cross-laminated timber panel according to one embodiment;

[0041] Fig. 2 is a perspective view of a cross-laminated timber panel according to another embodiment;

[0042] Fig. 3 is a perspective view of a second layer connected between cross-laminated timber panels according to another embodiment;

[0043] Fig. 4 is a perspective view of a cross-laminated timber structure according to another embodiment;

[0044] Fig. 5A is a schematic view of a monolithic hollow layer according to another embodiment;

[0045] Fig. 5B is a schematic view of laminated hollow layers according to another embodiment;

[0046] Fig. 5C is a schematic view of laminated hollow layers according to another embodiment;

[0047] Fig. 5D is a schematic view of laminated hollow layers according to another embodiment;

[0048] Fig. 5E is a perspective view of a cross-laminated timber panel according to another embodiment;

[0049] Fig. 5F is a perspective view of a cross-laminated timber panel according to another embodiment;

[0050] Fig. 5G is a perspective view of a cross-laminated timber panel according to another embodiment;

[0051] Fig. 5H is a perspective view of a cross-laminated timber panel according to another embodiment;

[0052] Fig. 5I is a perspective view of a cross-laminated timber panel according to another embodiment;

[0053] Fig. 5J is a perspective view of a cross-laminated timber panel according to another embodiment;

[0054] Fig. 6 is a schematic view of cross-laminated panel according to another embodiment;

[0055] Fig. 7 is a schematic view of cross-laminated panel according to another embodiment;

[0056] Fig. 8 is a schematic view of cross-laminated panel according to another embodiment;

[0057] Fig. 9 is a schematic view of cross-laminated panel according to another embodiment;

[0058] Fig. 10 is a schematic view of cross-laminated panel according to another embodiment;

[0059] Fig. 11 is a schematic view of cross-laminated panel according to another embodiment;

[0060] Fig. 12 is a schematic view of cross-laminated panel according to another embodiment;

[0061] Fig. 13 is a schematic view of cross-laminated panel according to another embodiment;

[0062] Fig. 14 is a schematic view of cross-laminated panel according to another embodiment;

[0063] Fig. 15 is a schematic view of cross-laminated panel according to another embodiment;

[0064] Fig. 16 is a schematic view of cross-laminated panel according to another embodiment; and

[0065] Fig. 17 is a schematic view of cross-laminated panel according to another embodiment.

[0066] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0067] In embodiments there are disclosed an optimized cross-laminated timber panel and cross-laminated timber panel.

[0068] Referring now to the drawings, and more particularly to Fig. 1, there is shown a cross-laminated timber panel 10 for insulating or optimizing building structures which includes timber layers oriented in a first direction 12 and timber layers oriented in a second direction 14. More specifically, the embodiment of Fig. 1 includes three timber layers oriented in a first direction 12 and two timber layers oriented in a second direction 14. It is to be noted that the timber layers oriented in a second direction 14 are interspaced between the timber layers oriented in a first direction 12 for providing a cross-laminated timber panel 10.

[0069] It is to be noted that the timber layer oriented in a first direction 12 includes timbers oriented in a first direction 18 and that the timber layer oriented in a second direction 14 includes timbers oriented in a second direction 20. Also, the timbers oriented in a first direction 18 are parallel to each other. On the other hand, the timbers oriented in a second direction 20 are parallel to each other. Note is to be made that a timber layer oriented in a first direction 12 is usually perpendicular to a timber layer oriented in a second direction 14, so that the timbers oriented in a first direction 18 are perpendicular to the timbers oriented in

a second direction 20 for providing an optimized insulation or an optimized cross-laminated timber panel 10.

[0070] Moreover, the cross-laminated timber panel 10 of Fig. 1 includes an adhesive material (not shown) for providing strong bonds and for involving a chemical reaction between the timber layers oriented in a first direction 12 and the timber layers oriented in a second direction 12. It thus provides a cross-laminated timber panel 10 capable of 100% air-tightness. Solid wood, in its definition, provides air-tightness. In the manufacturing of a 5-layer panel, the cross-laminated timber panel provides the 100% air-tightness ensuring that all spaces between timbers are well sealed. This may also be achieved with a 3-layer panel. In the manufacturing of a CLT, the cross-lamination and the glue provide the 100% air-tightness ensuring that all spaces between timbers are well sealed.

[0071] Now referring to Fig. 2, there is shown another embodiment of a cross-laminated timber panel 10 for insulating or optimizing building structures which includes timber layers oriented in a first direction 12 and timber layers oriented in a second direction 14. More specifically, the embodiment of Fig. 2 includes two timber layers oriented in a first direction 12 and only one timber layer oriented in a second direction 14. It is to be noted that the timber layer oriented in a second direction 14 is interspaced between the timber layers oriented in a first direction 12 for providing a cross-laminated timber panel 10. It is to be noted that by using Lamboard™ wood product in the cross-laminated timber panel 10 assembly, several improvements can be achieved. For example, the higher strength of high-grade Lamboard™ may, under certain conditions, allow the use of fewer timber layers 12 and 14, where the five-layer cross-laminated timber panel 10 of Fig. 1 would normally be used, making the panels thinner and lighter. The production cost will be reduced by using less material and having to assemble fewer timber layers 12 and 14 in the final cross-laminated timber panel 10.

[0072] Moreover, the cross-laminated timber panel 10 of Fig. 3 includes a second layer 22 sandwiched between a timber layer 12 or 14 and another timber layer 12 or 14. The second layer 22 may be, without limitations, a polyvinyl chloride, a plastic material, foam, a Styrofoam™, a metal, a metallic material, a composite material, fibreglass, a wood material, a Lamboard™ type of wood or polymeric material, or a combination thereof. Now referring to Fig. 4, there is shown a laminated timber structure 24 which may be used as pre-fabricated structural wall, roof and floor panels. The laminated timber structure 24 may include one or a plurality of cross-laminated timber panels 10 and one opening 26 or a plurality of openings 26. Openings 26 may be included only in the cross-laminated panels 10, or also in the second layer 22. Openings 26 may be, without limitations, a door, a window, an aeration trap, an electric opening and the like.

[0073] The production process is simple and the cross-laminated panel 10 is usually produced with an uneven number of timber layers 12 and 14, usually, 3, 5 or more. However, there is no scientific reason to exclude even numbers of timber layers 12 and 14, which, in certain situations, may even be advantageous.

[0074] It is to be noted that the second layer 22 may be, without limitations, a beam, an earthquake-resistant element, floor insulation, an insulation membrane, a humidity membrane, a temperature-control membrane, a fire-resistance membrane, a sound barrier, a thermal insulation or a vibration barrier.

[0075] Also, in the choice of adhesive material, one component may be boric acid. This adhesive material is classed as a reactive adhesive. The reactive adhesive may be an insect repellent and may include boric acid, borax, aspartame, nicotine and/or copper sulphate. It can also, as an insect repellent, be used chalk powder, lime, quicklime or calcium carbonate added to the glue to prevent insects from penetrating further into the walls. The curing of these products is the formation of a strong bond capable of bearing the required loads

and involves a chemical reaction. A modern adhesive must have a long shelf life but must cure in a very short time when used. Reactive adhesives meet this standard because during or just before application, a second component is mixed in to initiate the chemical reaction. This is the case with this adhesive as well, but it need not be a concern for the user, because the second component is moisture, and moisture is normally present in adequate quantity in the atmosphere and particularly in wood. The adhesive can be applied directly from the container and the curing reaction begins as soon as it comes into contact with moisture.

[0076] The proper selection of glue is an important component of the optimized cross-laminated timber panel 10. The adhesive material (not shown) resists temperature and humidity variations and does not release noxious vapours during its aging process. It is also easily adaptable to the production technique of the cross-laminated timber panel 10.

[0077] During production, the glued timber layers 12 and 14 may be either left under a proper amount of pressure to cure or may be nailed or stapled or held with screws to set without requiring a press. However, a specific pressure or torque of these attachment systems is required so as not to create irregularities in the overall cross-laminated timber panel 10.

[0078] Also, by using high-grade Lamboard™ wood in the two vertical external timber layers 12 or 14, “hollow-core” panels may be produced for interior partitions significantly reducing construction costs or “hybrid insulated” panels for outside walls, permitting substantial reductions in wall thickness.

[0079] Adding semi-rigid wood insulation and large floor planks into one assembly may dramatically reduce vibrations and impact sound transmission in 100%-wood floor assemblies, reducing the need for cement or gypsum-based or anhydride toppings and rubber isolation membranes in residential flooring assemblies.

[0080] Cross-laminated timber has traditionally been an assembly of timber layers 12, 14 glued together, and subsequently grooved on the surface for the passage of wires and pipes. However, in the construction process, any one of the timber layers 12 or 14 of this wood panel can be machined using a router or a CNC (Computer Numerical Control) machine tool to allow the passage of wires and pipes within the thickness of the assembled panel without substantially diminishing its overall structural resistance. The purpose is to create empty spaces inside the cross-laminated timber panel 10 for the passage of wires and pipes as well as to reduce the quantity of wood used in the panel. These empty spaces can be filled with different insulators to create a noise barrier. It is important to use insulation which will maintain its long-term dimensional integrity (compared with unstable insulation which will compact in time, leaving an air gap and losing its effectiveness), and which will control temperature, humidity, vibration and the like. Foam, such as Styrofoam™, can be introduced in these cavities and glued following the normal CLT manner. The hollow core is thus completely filled with foam. This cross-laminated timber panel 10 is highly resistant, very solid and provides an improved thermal insulation, reduced vibration and a good sound barrier with superior characteristics.

[0081] Cross-laminated timber panels 10 can be reinforced in several ways. Besides the Lamboard™, a layer of fibreglass, carbon fibre, Kevlar, synthetic fibres may be glued between the two external timber layers 12 or 14 for a significant strength gain without the need for a thicker cross-laminated timber panel 10.

[0082] Moreover, between two of these timber layers 12 or 14, a membrane (such as PVC or any plastic) may be added to protect against humidity and temperature variations as the second layer 22. Fire-resistance layers can also be added as the second layer 22.

[0083] Cross-laminated timber panels 10 are made to be easily assembled but also easily dismantled, so demolition (deconstruction at decommissioning) of building generates less waste, requires less energy and creates less pollution.

[0084] Cross-laminated timber panels 10 are usually made of 3 or 5 laminated timber layers 12 or 14 of wood of the same thickness. A hybrid cross-laminated timber layer 10 with the incorporation of one or more layer(s) 22 of Lamboard™ or other material increases resistance which diminishes the need to use a thicker cross-laminated timber panel 10 for more resistance. Cross-laminated timber panels 10 may be produced with different types of wood, different numbers of layers (2, 3, 4, 5, or more) and different thicknesses of wood, depending on the specific requirements of each and every component of the overall construction assembly thus permitting significant cost and weight reductions. The external layers 12 or 14 of a cross-laminated timber panel 10 are the most important in flexure as for a floor since they greatly influence the resistance of the complete assembly. Using the cross-laminated timber panel 10, thinner slabs of wood may be used.

[0085] The Lamboard™ is manufactured using a modified Relam product. Local defects in black spruce lumber resulting in low structural grading are removed, and the resulting high-grade wood is recycled as edge-glued finger-jointed panels of desired width and length. The glue used in the joints represent less than 1% of the final volume (much less than the common 15 to 20% of comparable engineered wood products), so the Lamboard™ product is said to be of 99% recycled material.

[0086] Moreover, beam-like structure may be integrated in the fabrication of cross-laminated timber panels 10 as the second layer 22 or as a plurality of layers. The second layer 22 may be, without limitations, wood (in larger shape and grain oriented perpendicular to the rest of the structure and horizontal to the weight to be supported by the structure), metal, Lamboard™ or plastic, to work as a support beam for other elements. This improved cross-laminated timber

panel 10 is lighter and provides earthquake resistance, eliminates beams and supports different types of structures over openings of the construction. This type of assembly will create "Cross- and Parallel-Laminated Timber panels (CPLT) "(Fig 5B).

[0087] Also, fig. 5A is a schematic view of a monolithic hollow layer 28 according to another embodiment. Fig. 5B is a schematic view of laminated hollow layers 30 according to another embodiment. Fig. 5C is a schematic view of laminated hollow layers 32 according to another embodiment; and fig. 5D is a schematic view of laminated hollow layers 34 according to another embodiment. It is to be noted that in the hollow core layers 28, 30, 32 or 34, insulation layers may be made by introducing sand for example, or any insulation material. Moreover, Figs. 5E to 5J present a perspective view of a cross-laminated timber panel according to other embodiments 36, 38, 40, 42, 44 and 46.

[0088] Also, Figs. 6 to 17 show different embodiments of a cross-laminated timber panel.

[0089] Another of the key features of CLT panels resides in the capacity of treating each layer in a specific manner and then assembling these into different forms of final products.

[0090] Among the key advantages related to fabricating and using laminated timber and CLT in construction are:

[0091] • Lower carbon footprint through carbon sequestration in the wood panel;

[0092] • Lower energy consumption and pollution levels during manufacture compared to steel and concrete;

[0093] • Lower construction cost of structure, by shortening on-site erection time;

[0094] • Appreciable time saving in the overall construction process;

[0095] • Excellent thermal insulation platform by its air-tightness;

[0096] • Very good sound insulation qualities;

[0097] • Energy saving in operation because of its thermal inertia;

[0098] • Minimal waste and noise during construction process;

[0099] • Excellent wind and seismic resistance;

[00100] • Good fire resistance;

[00101] • Possible "no eco cost" deconstruction and total recuperation; and

[00102] • Possibility of using lumber that would otherwise be unsuitable in standard construction materials (low grade, beetle-killed, specific species, etc...).

[00103] While preferred embodiments have been described above and illustrated in the accompanying drawings, it will be evident to those skilled in the art that modifications may be made without departing from this disclosure. Such modifications are considered as possible variants comprised in the scope of the disclosure.

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CLAIMS:

1. A cross-laminated timber panel comprising:

at least a first and a third timber layers each at least partially oriented in different directions including at least one timber;

at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of a structural layer, a hollow core or partially hollow-core layer, a mildew-resistant layer, and a fire-resistance layer.

2. A cross-laminated timber panel with an opening comprising:

at least a first and a third timber layers each at least partially oriented in different directions including at least one timber, said first and third timber layers comprising an opening;

at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of a structural layer, a hollow-core or partially hollow-core layer, a fire-resistance layer and a mildew-resistant layer, said second layer comprising an opening.

3. A cross-laminated timber panel comprising:

at least a first and a third timber layers oriented in one direction including at least one timber;

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at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of a structural layer, a hollow-core or partially hollow-core layer, a fire-resistance layer and a mildew-resistant layer.

4. A cross-laminated timber panel with an opening comprising:

at least a first and a third timber layers oriented in one direction including at least one timber, said first and third timber layers comprising an opening;

at least one second layer laminated with glue between said first and third timber layers comprising at least one layer selected from the group consisting of a structural layer, a hollow-core or partially hollow-core layer, a fire-resistance layer and a mildew-resistant layer, said second layer comprising an opening.

5. The panel of any one of claims 1 to 4, further comprising at least a second layer selected from the group consisting of an insulation layer, and an insect-resistant layer.

6. The panel of claim1, wherein the timber layer is made of Lamboard™.

7. The panel of any one of claims 1 to 4, wherein the second layer comprises at least one of polyvinyl chloride, plastic material, foam, a polystyrene foam, metal, metallic material, composite material, fibreglass, wood material, polymeric material and a combination thereof.

8. The panel of any one of claims 1 to 4, wherein the first timber layer further comprises more than two side-glued timbers oriented in a first direction.

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9. The panel of claim 1, wherein the second timber layer further comprises more than two side-glued timbers oriented in a second direction.

10. The panel of claim 1, wherein the first timber layer is perpendicular to the second timber layer.

11. The panel of any one of claims 1 to 4, wherein at least one of the first or third layers is made of Lamboard™ wood.

12. The panel of claim 1, wherein said second layer is made of Lamboard™ wood.

13. The panel of anyone of claims 1 to 4, wherein said glue is a reactive adhesive.

14. The panel of claim 13, wherein the reactive adhesive comprises an insect repellent or an agent toxic to insects.

15. The panel of claim 13, wherein the reactive adhesive comprises boric acid.

16. The panel of any one of claims 1 to 4, wherein the insulation layer comprises at least one of a humidity layer, a sound barrier, a floor insulator, an insulation membrane, a temperature-control membrane, a thermal isolation and a vibration barrier.

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17. The panel of any one of claims 1 to 4, wherein the structural layer comprises at least one of an earthquake-resistance layer, a fire-resistance layer and a structural beam layer.

18. The panel of any one of claims 1 to 4, wherein the hollow-core or partially hollow-core layer comprises at least one of a layer for receiving pipes and wires and a layer for receiving sand, a layer for receiving an insulation material.

19. The panel of any one of claim 1 or 2, wherein the layers are fully oriented in different directions.

20. The panel of any one of claims 1 to 5, wherein at least parts of two layers are forming a beam-like structure.

21. The panel of any one of claims 1 to 5, wherein all the layers are forming a beam-like structure.

22. A Lamboard™ laminated timber panel comprising:
timbers aligned in one direction and fixed side by side with glue.

23. The Lamboard™ of claim 22, wherein the glue used is less than about 1% of the final volume of the Lamboard™ laminated timber panel.

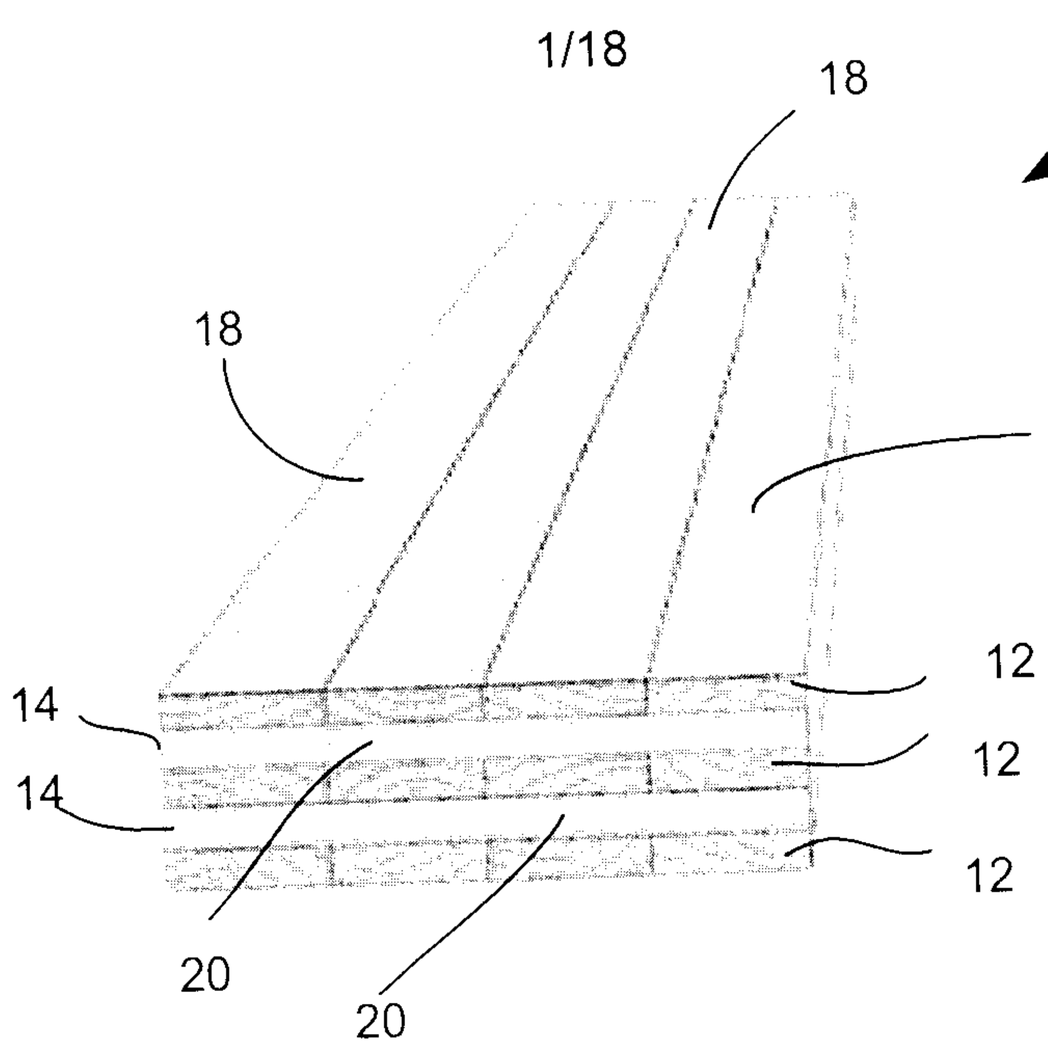


Fig. 1

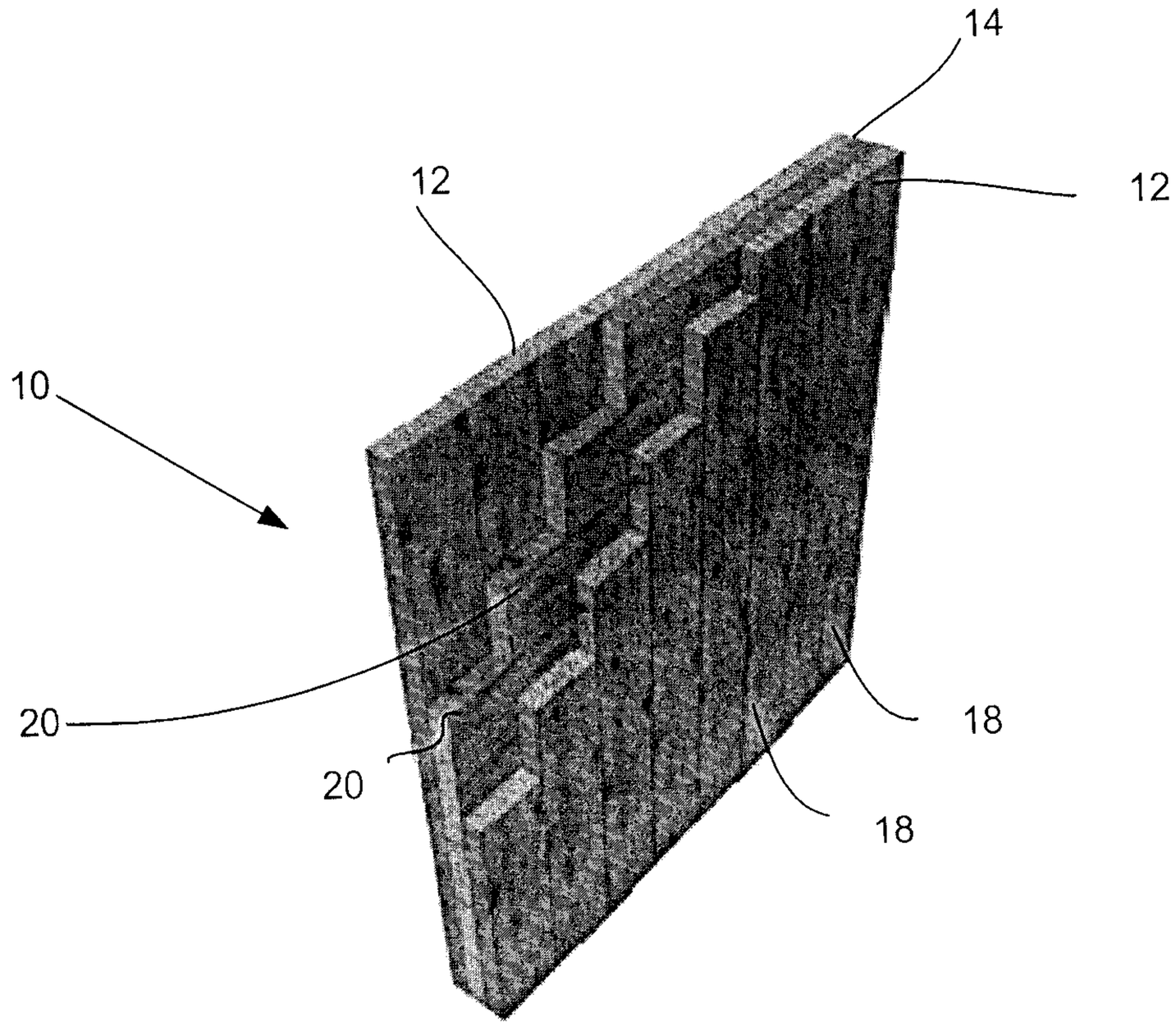


Fig. 2

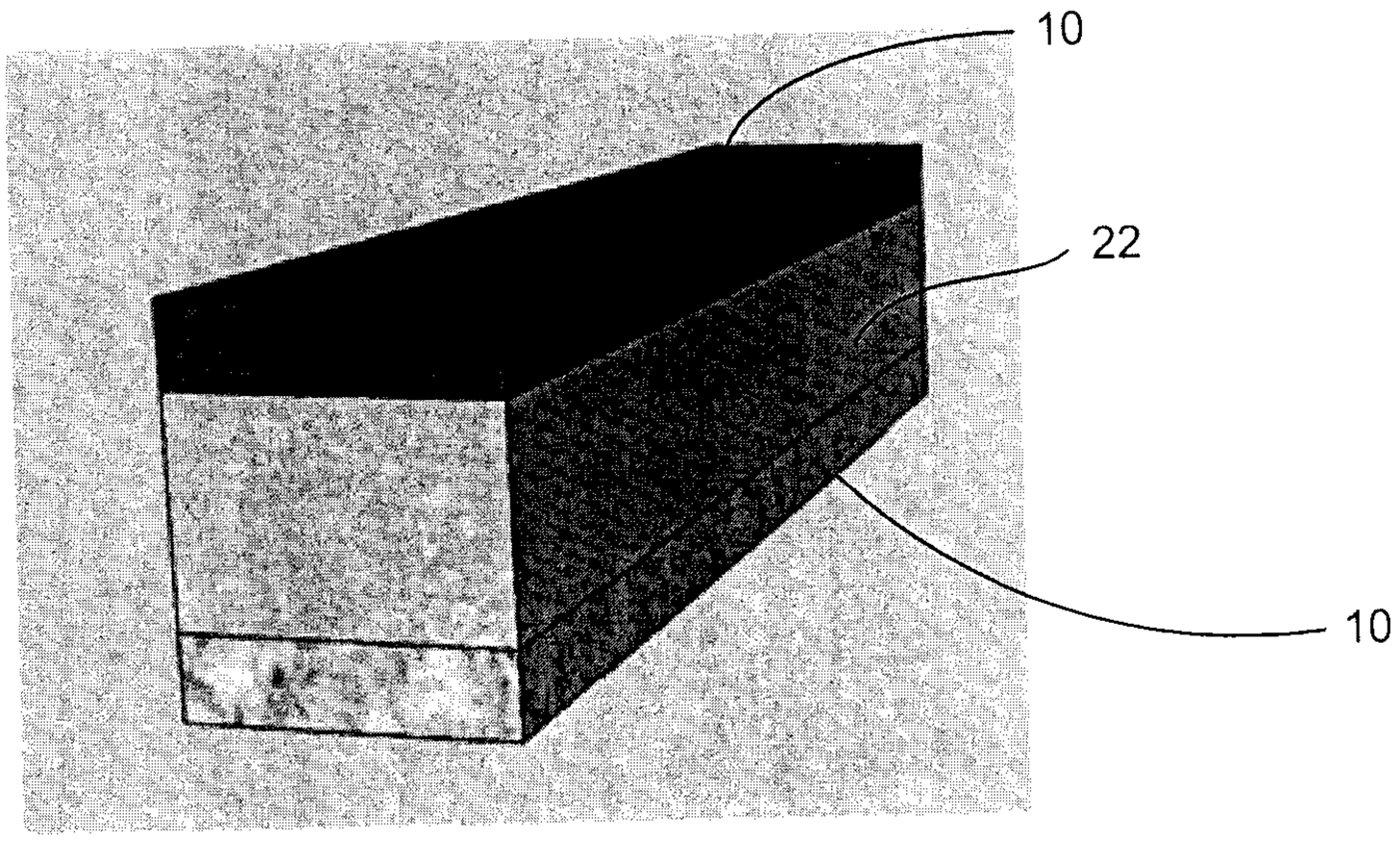


Fig. 3

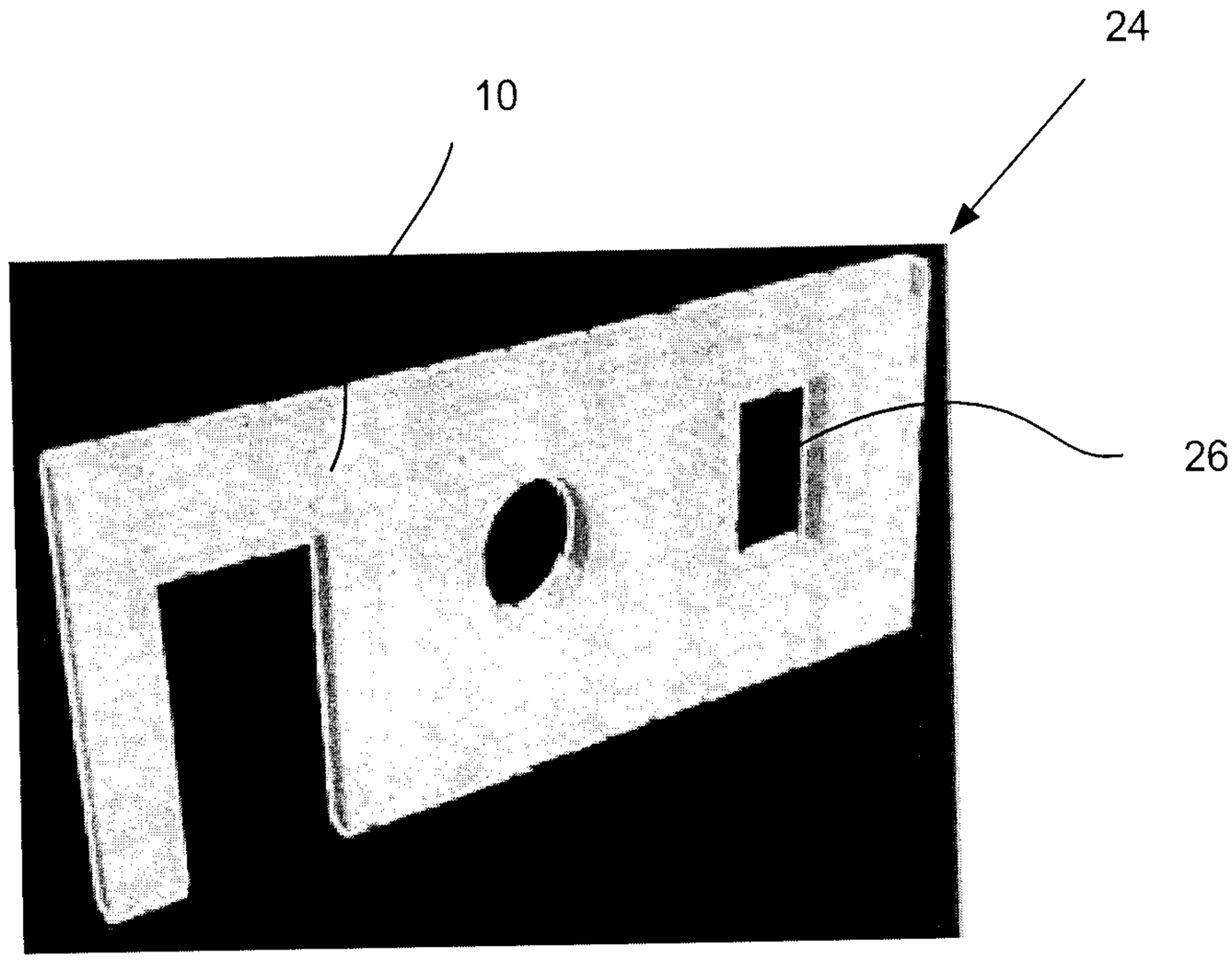


Fig. 4

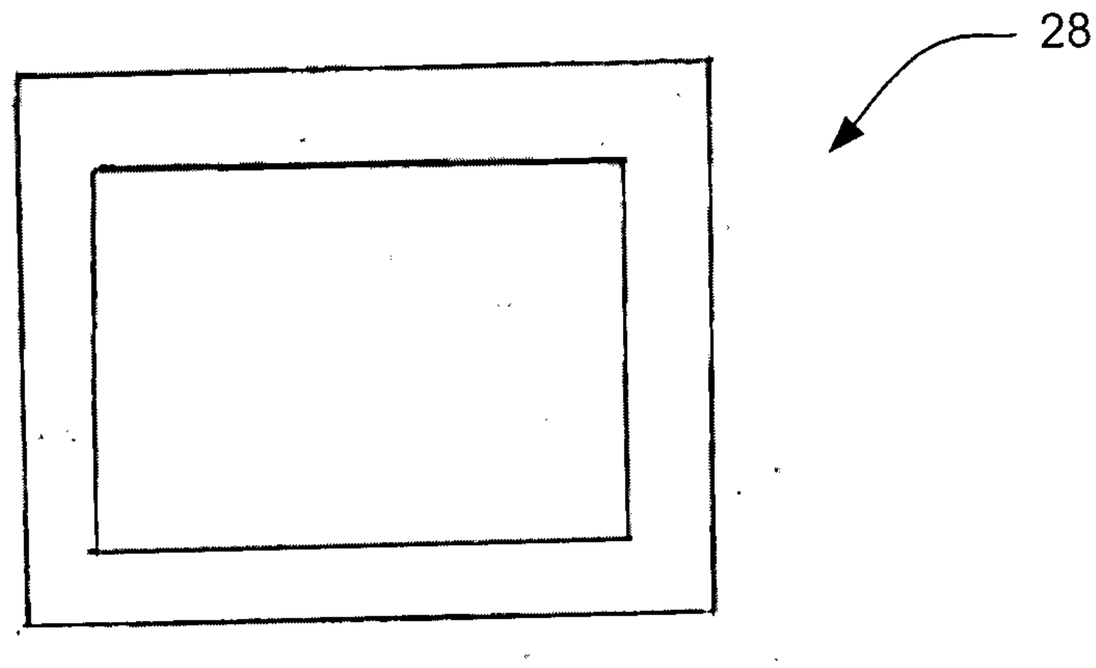


Fig. 5A

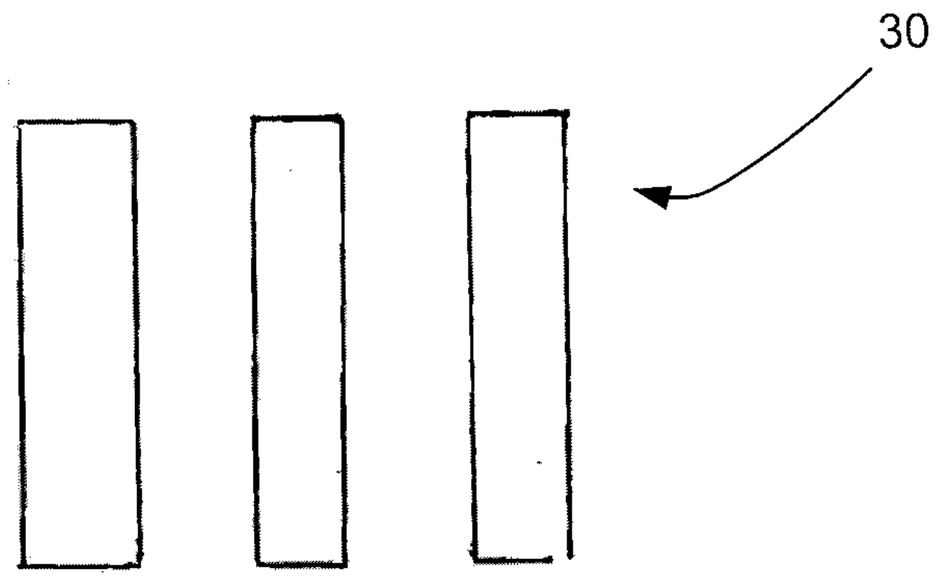


Fig. 5B

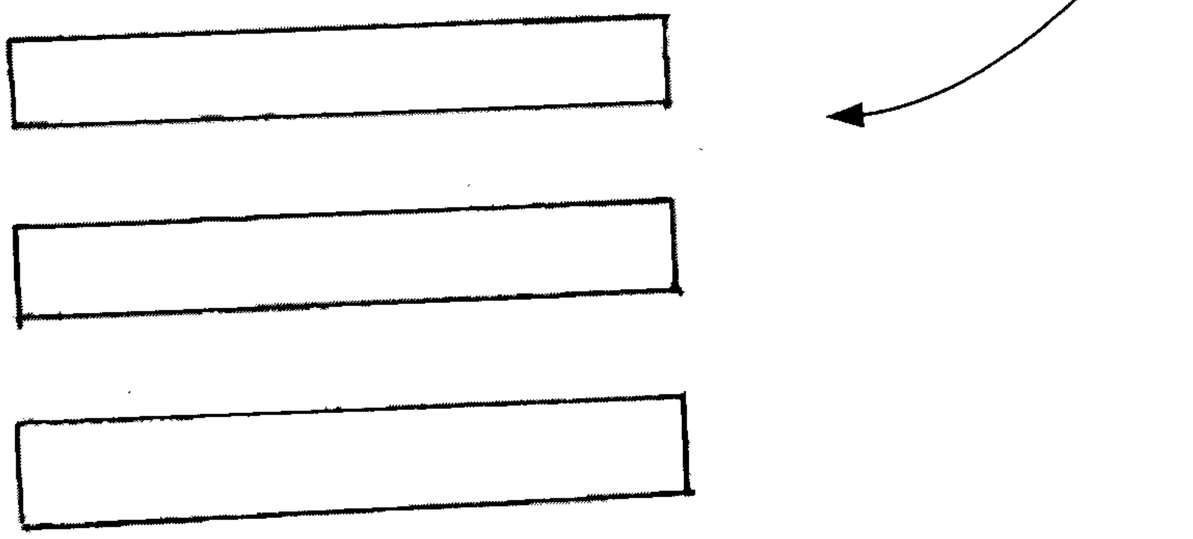


Fig. 5C

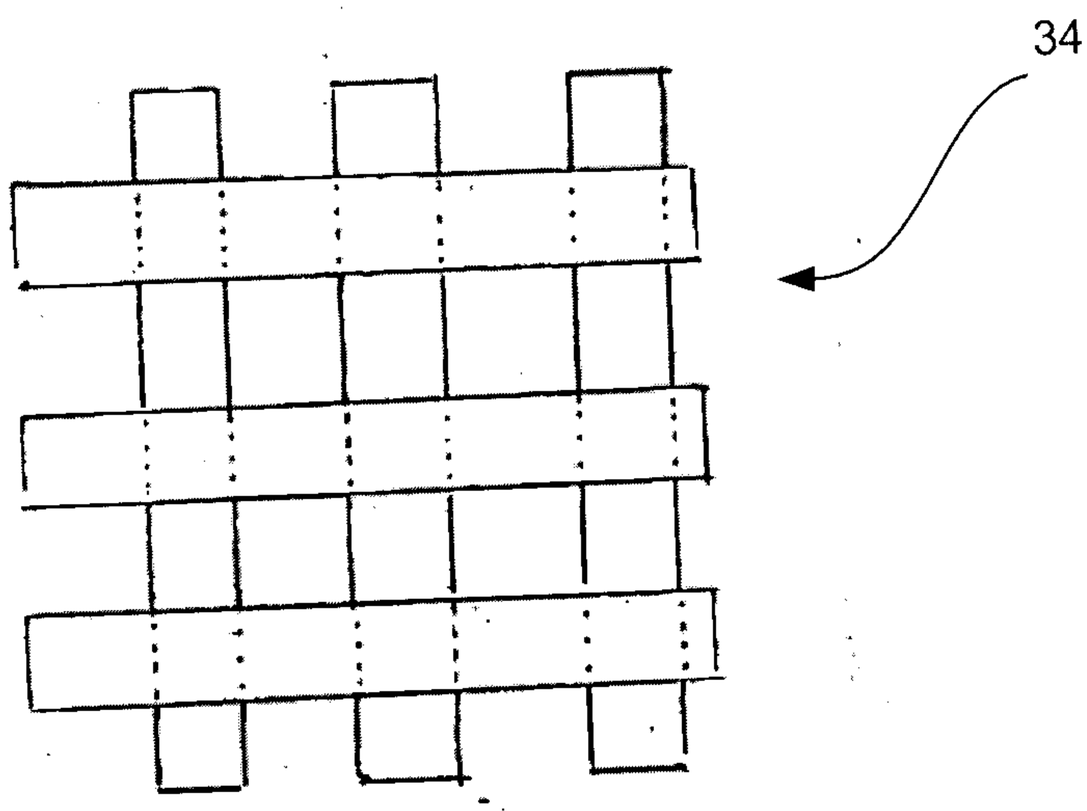


Fig. 5D

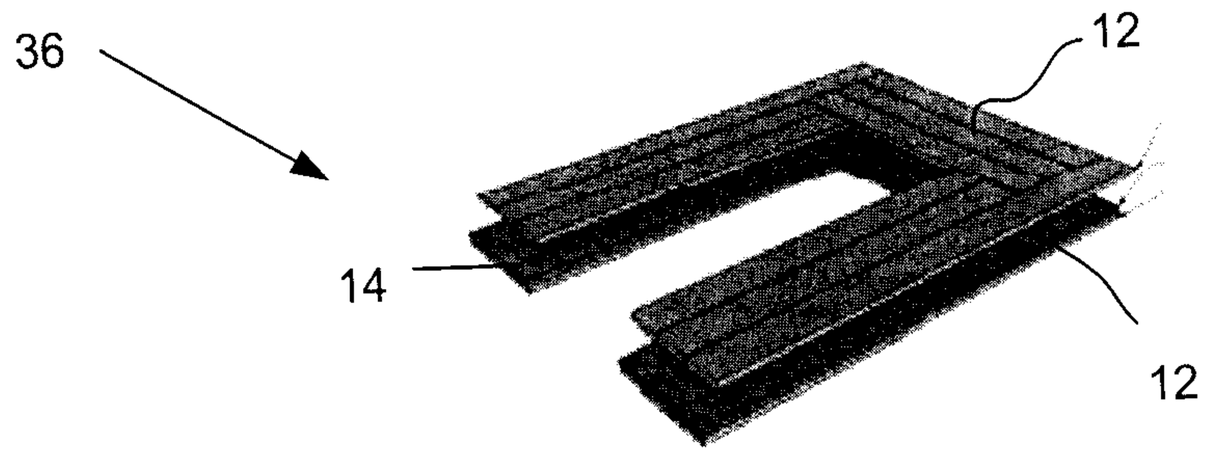
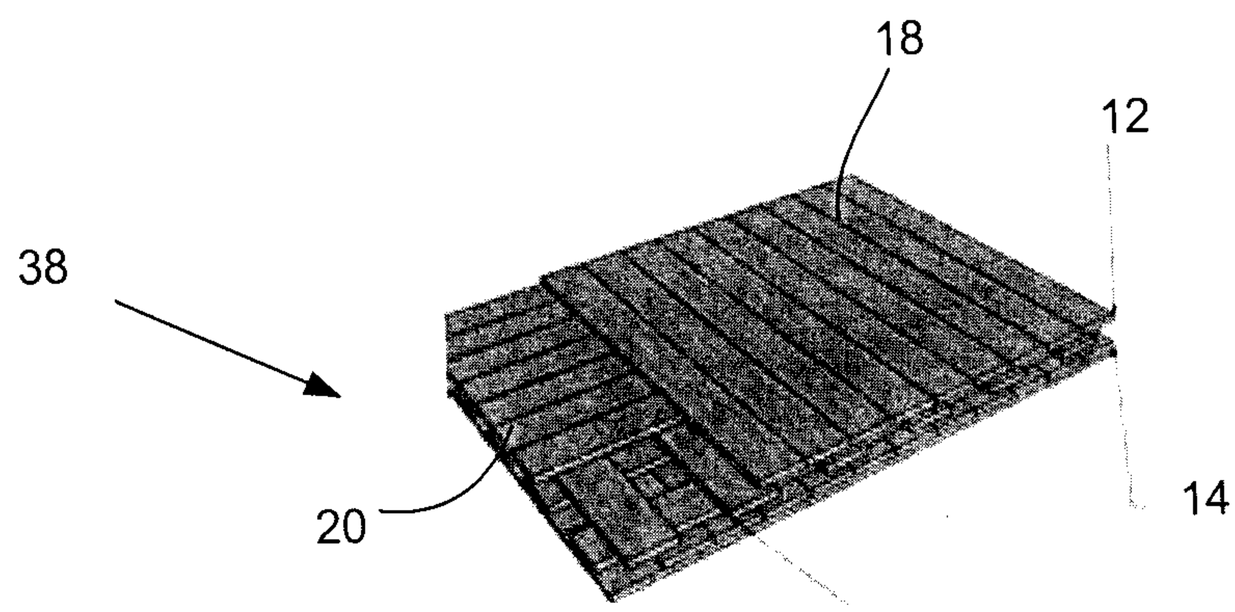


Fig. 5E



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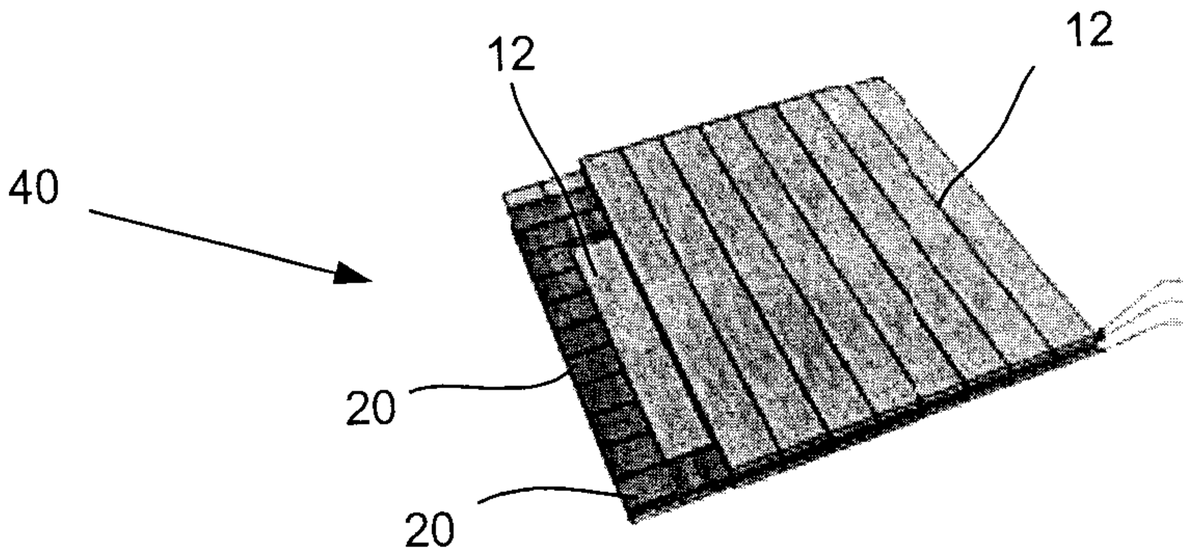

Fig. 5G

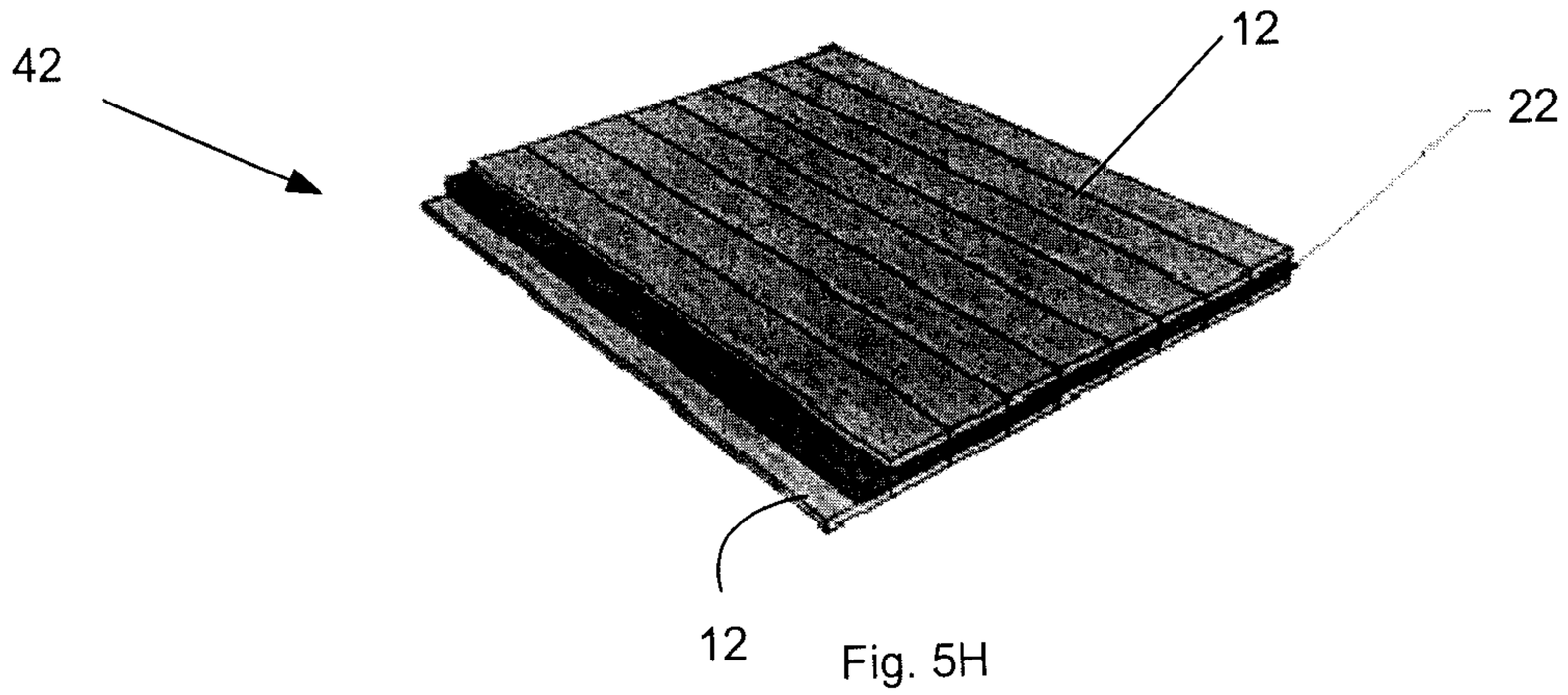

Fig. 5H

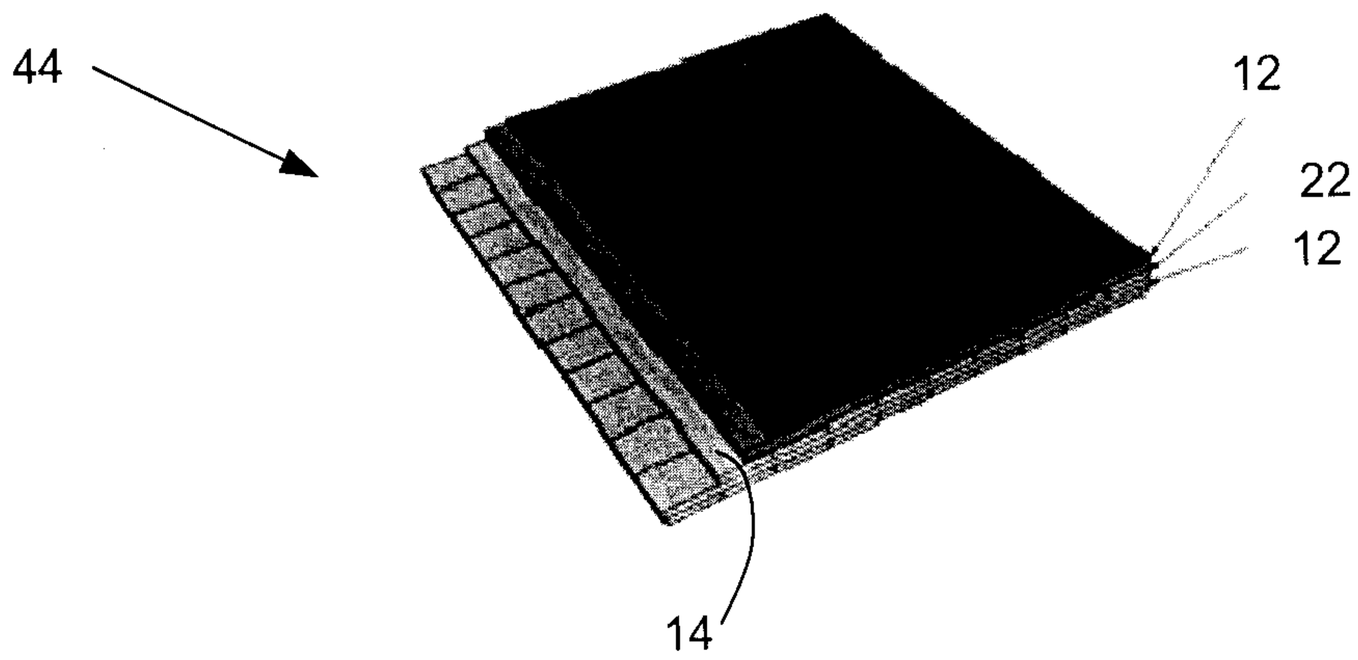

Fig. 5I

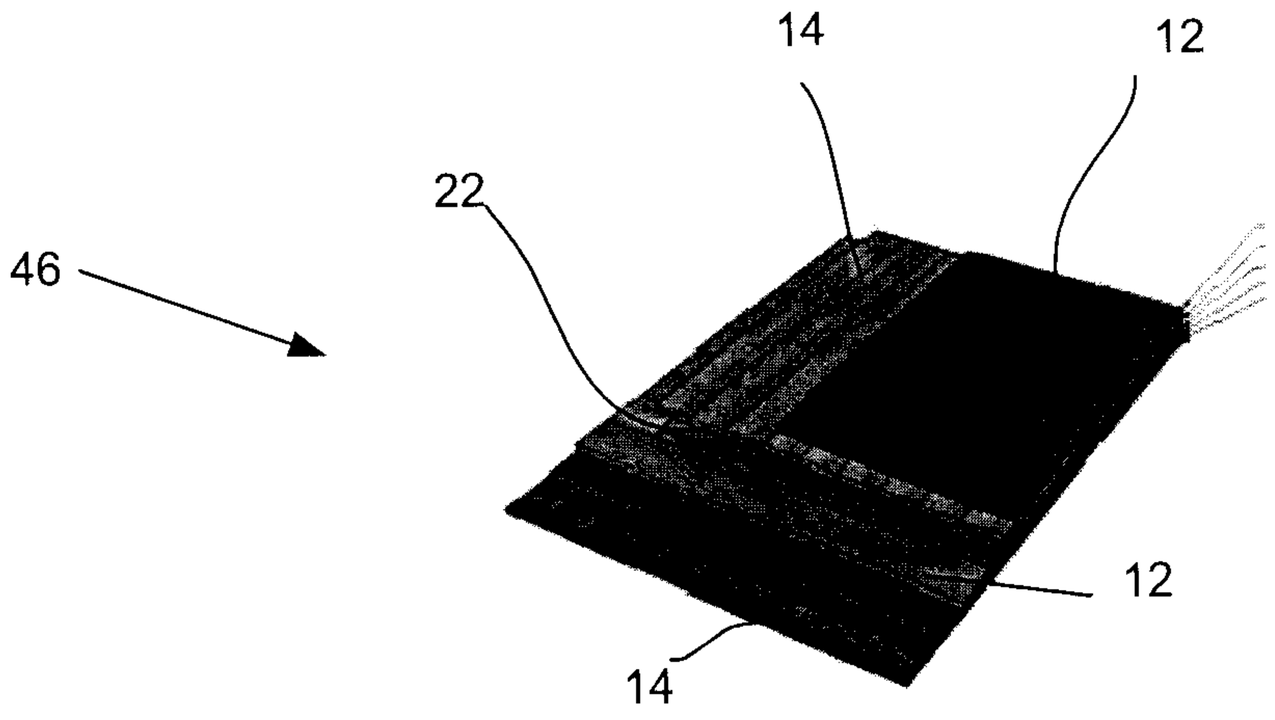

Fig. 5J

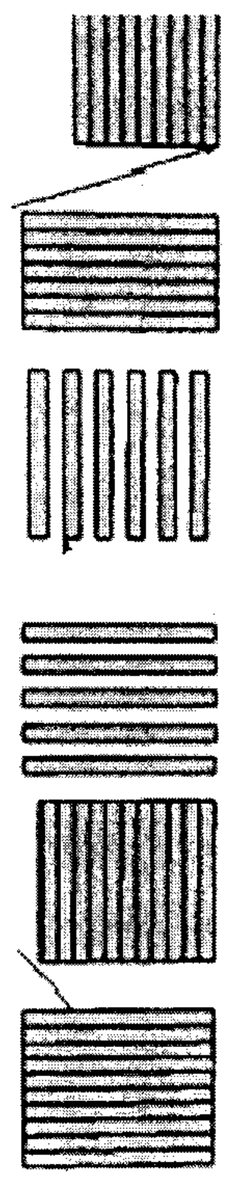

Fig. 6

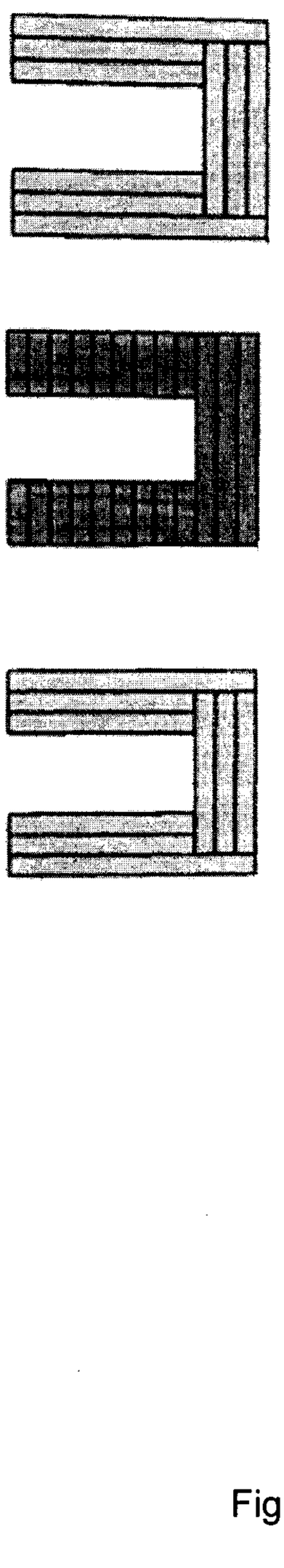

Fig. 7

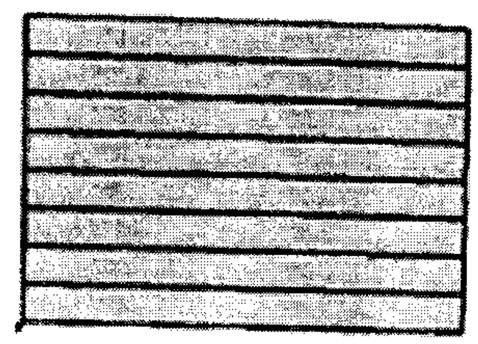

Fig. 8

Fig. 9

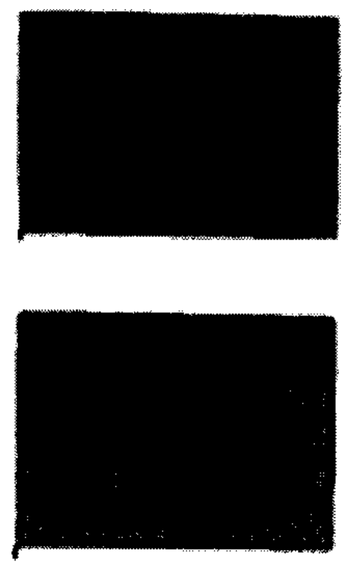

Fig. 10

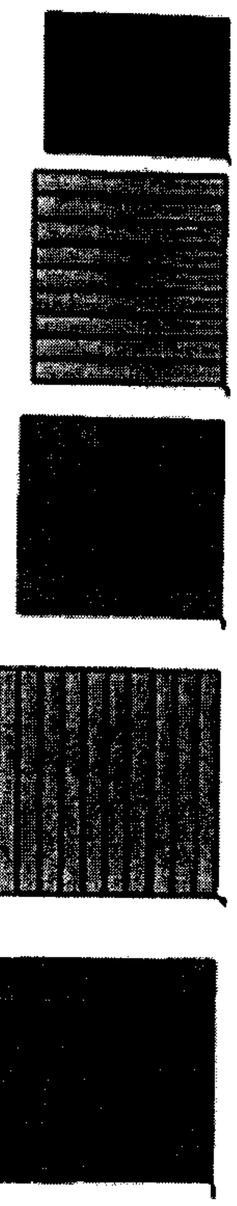

Fig. 11

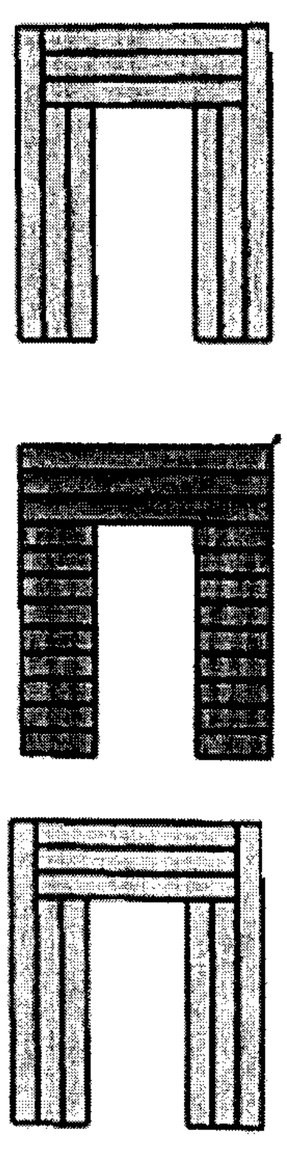

Fig. 12

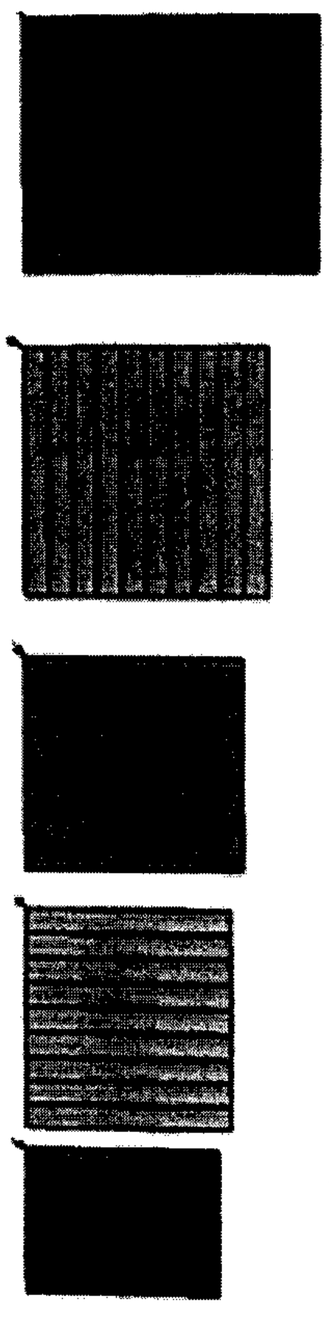

Fig. 13

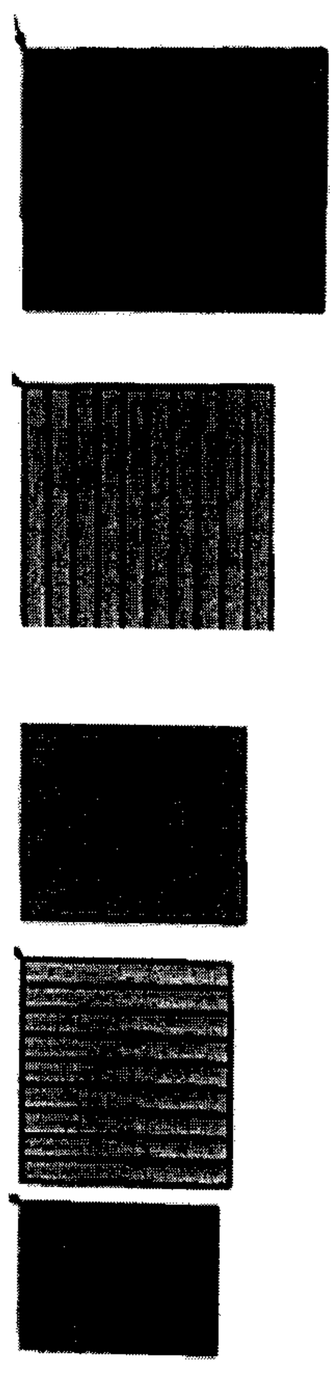

Fig. 14

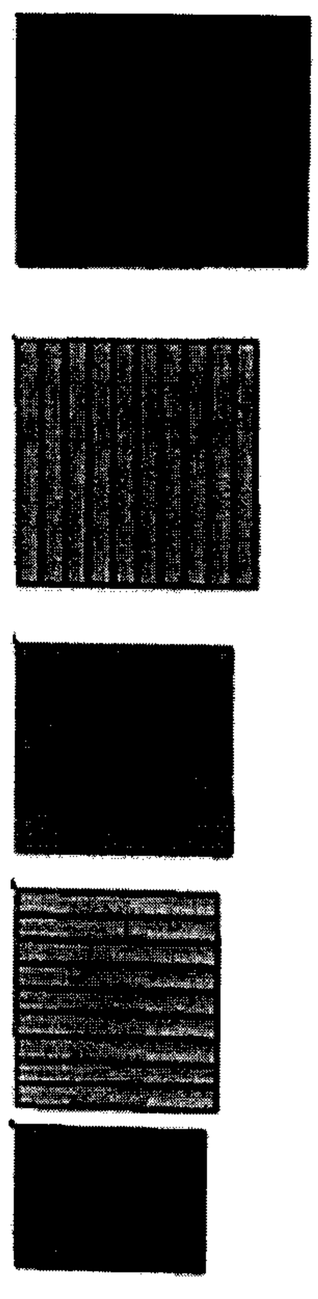

Fig. 15

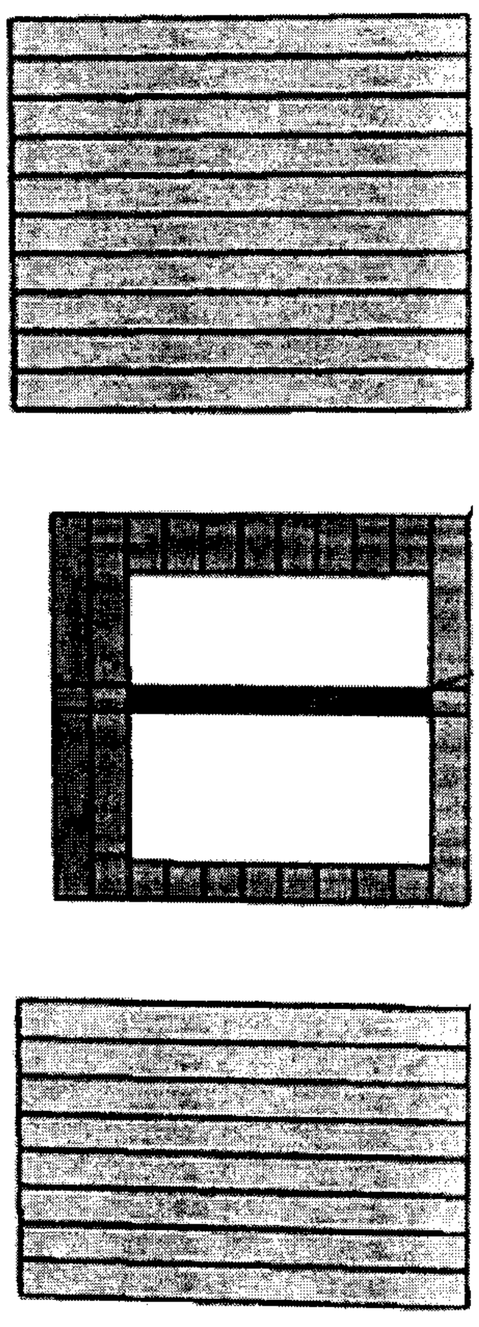

Fig. 16

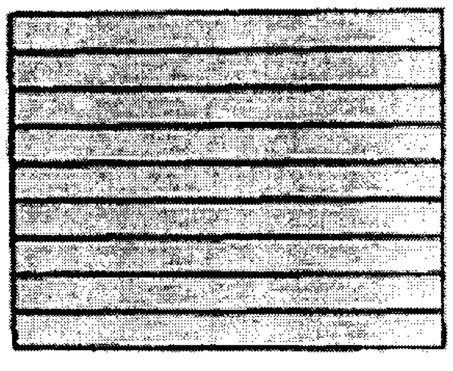

Fig. 17

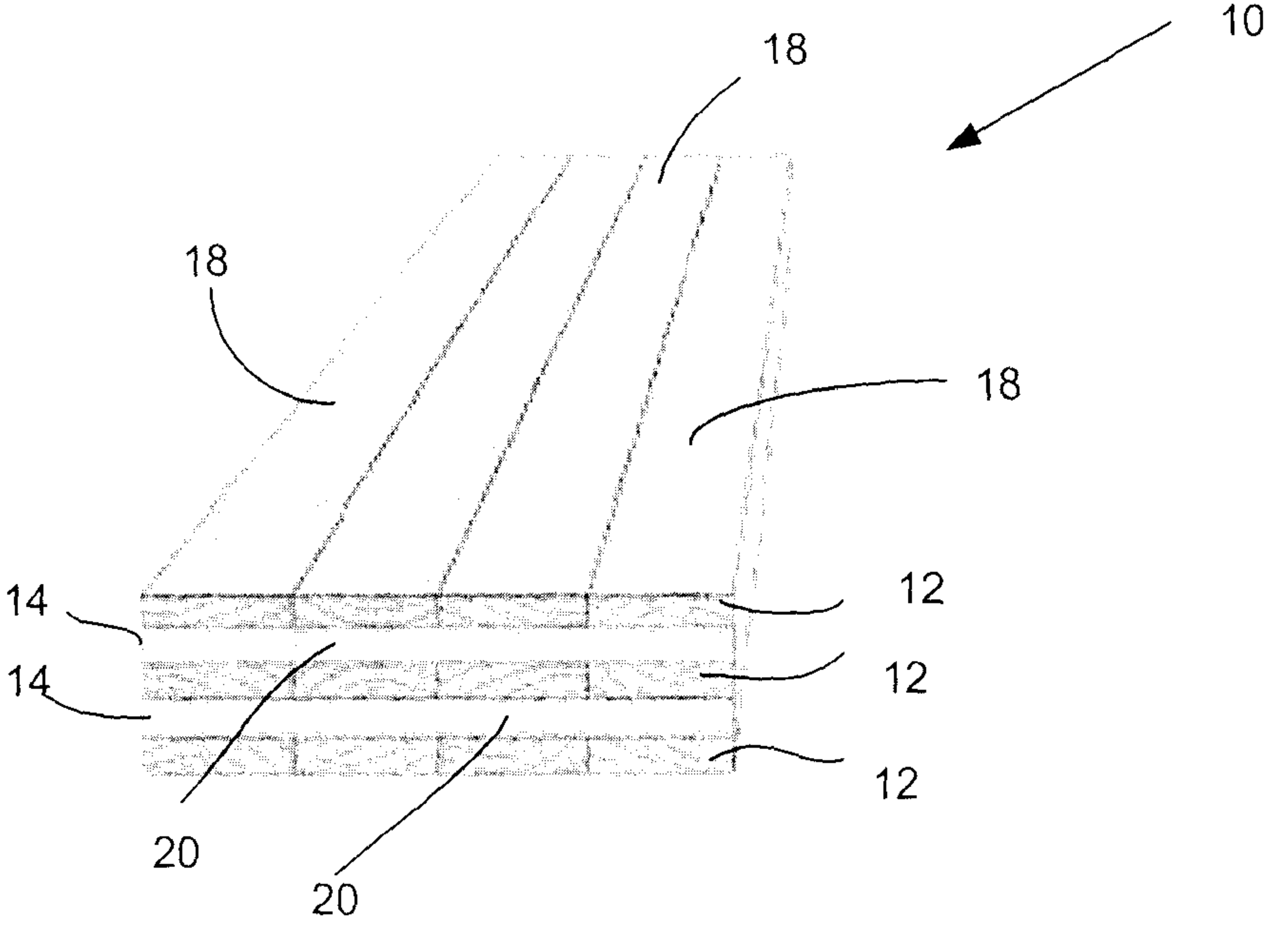

Fig. 1