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(54) **Flat wall panel at least substantially made of cellulose material**

(57) A flat wall panel at least substantially made of cellulose material, a special feature being the fact that the wall panel is at least substantially made of layers (2) of paper/cardboard, each layer at least substantially being made up of a corrugated sublayer and a flat sublayer provided on one side thereof, which layers of paper/cardboard are interconnected via an adhesive applied

to the corrugations of the corrugated sublayers, wherein the wall panel is impregnated, in particular with a resinous material, and wherein at least one strengthening layer (3) having a greater elasticity modulus than the layers (2) of paper/cardboard is provided, which strengthening layer (3) is connected to a layer (2) of paper/cardboard on one side of the wall panel via an adhesive.

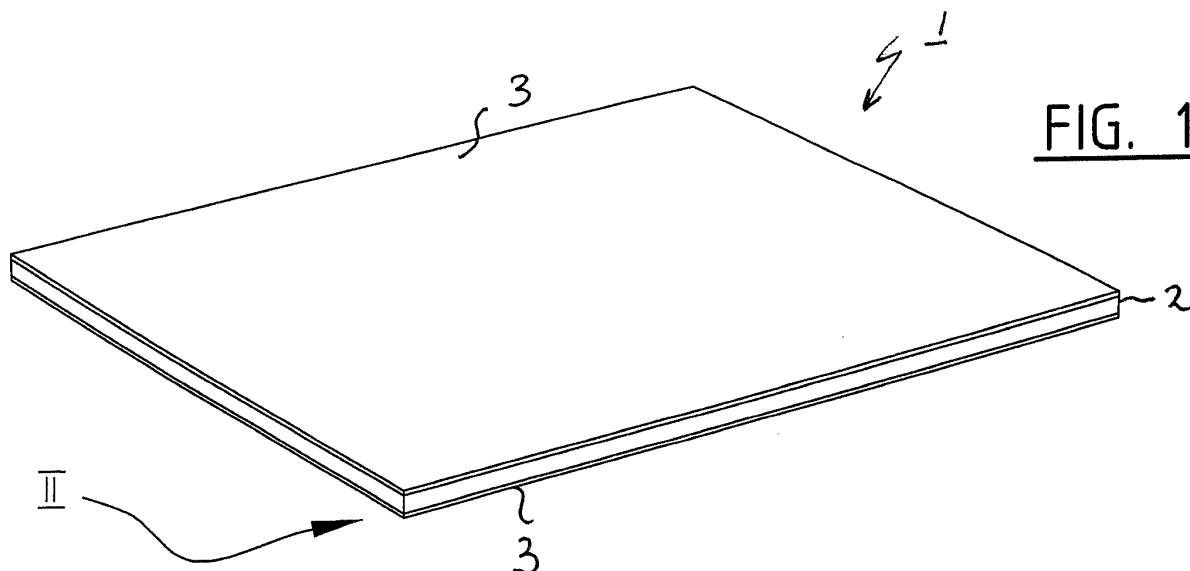


FIG. 1

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Description

[0001] The invention relates to a flat wall panel at least substantially made of cellulose material. The invention also relates to a method for manufacturing said wall panel.

[0002] Such a wall panel is known from German patent No. 2 026 768 (Universal Papertech corp.). Said patent describes a building that is built up of a great many different construction elements, such as a concrete floor, roof and side wall panels made of an intermediate layer of corrugated cardboard sandwiched between two flat outer layers, as well as cramps and corner elements. In practice, the constructional strength of the roof and side wall panels appears to be insufficient to give the building sufficient strength.

[0003] The object of the invention is to improve the wall panel that is known from the aforesaid German patent publication, in the sense that a wall panel having an optimum constructional stiffness is provided for use as a construction element of a building, as a wall panel in, for example, a separation wall, etc. It is noted that the term wall panel is understood to include an element for use in a wall, a floor, a ceiling, a roof, etc.

[0004] According to the invention, a wall panel of the kind referred to in the introduction is characterized in that the wall panel is at least substantially made of layers of paper/cardboard, each layer at least substantially being made up of a corrugated sublayer and a flat sublayer provided on one side thereof, which layers of paper/cardboard are interconnected via an adhesive applied to the corrugations of the corrugated sublayers, wherein the wall panel is impregnated, in particular with a resinous material, and wherein at least one strengthening layer having a greater elasticity modulus than the layers of paper/cardboard is provided, which strengthening layer is connected to a layer of paper/cardboard on one side of the wall panel via an adhesive.

[0005] In other words, the whole of various adhered-together layers of paper/cardboard is connected on at least one flat (outer) side thereof to the less elastic strengthening layer. Experiments have shown that the present construction leads to an unexpectedly great constructional stiffness of the wall panel, so that it is possible to subject the wall panel to large forces without the dimensional stability being affected. The constructional stiffness is increased even further by using a strengthening layer having an elasticity modulus greater than or equal to 50 GPA, in particular greater than or equal to 100 GPA, more in particular greater than or equal to 150 GPA, more in particular greater than or equal to 200 GPA, more in particular greater than or equal to 300 GPA, more in particular greater than or equal to 400 GPA.

[0006] In a preferred embodiment of a wall panel according to the invention, the wall panel comprises two strengthening layers, which are connected to a layer of paper/cardboard on either side of the wall panel via an

adhesive. Thus a sandwich construction is obtained, in which the whole of various adhered-together layers of paper/cardboard is connected to a less elastic strengthening layer on both flat outer sides.

[0007] The result is an even greater constructional stiffness having a corresponding dimensional stability.

[0008] It is noted that impregnating the wall panel with, for example, a resinous material not only has the advantage of providing a greater constructional stiffness, but also of providing protection against external influences, such as moisture. As a result of said additional stiffness, fewer layers of corrugated paper/cardboard are in principle needed in order to give the flat panel the required stiffness. Said impregnation preferably takes place by means of vapour deposition, spraying or otherwise, said vapour deposition or spraying taking place in a direction parallel to the direction of the "cell structure" of the corrugated paper/cardboard that is used. Said impregnation may also be effected with mechanical means, wherein toothed and/or flat rollers are used for pressing the impregnating medium into the paper/cardboard.

[0009] In another preferred embodiment of a wall panel according to the invention, the strengthening layer comprises a fibre material. In particular, the fibre material consists of glass fibres, carbon fibres, mineral fibres and/or synthetic fibres. Said synthetic fibres may e.g. be fibres of the type known under the brand names "Kevlar" or "Twaron".

[0010] In another preferred embodiment of a plate-shaped material according to the invention, the strengthening layer comprises a layer of a plastic material. The plastic of said layer of plastic material is preferably selected from the group consisting of PVC-U, PP, PE, ABS, PVC-C and PVDF. It is noted that the above abbreviations relate to the following (plastic) materials.

PVC-U	Polyvinyl chloride (without plasticizer)
PP	Polypropylene
PE	Polyethylene
ABS	Acrylonitrile-Butadiene-Styrene
PVC-C	Polyvinyl chloride (post-chlorinated)
PVDF	Polyvinylidene fluoride

[0011] In another preferred embodiment of wall panel according to the invention, the strengthening layer comprises a layer of rubber. The rubber of said layer of rubber is preferably selected from the group consisting of EPDM or NBR. In another preferred variant, the strengthening layer is made of a metal, in particular stainless steel or wood.

[0012] In another preferred embodiment of a wall panel according to the invention, the wall panel is at least substantially made of an even number of layers of paper/cardboard. In combination with the strengthening layer, this provides a plate-shaped material which is hardly deformable, if at all. Preferably, the wall panel is mirror symmetrical with respect to a central longitudinal

plane of the wall panel so as to increase the dimension all stability thereof, so that "warping" is prevented at all times.

[0013] As already said before, the invention also relates to a method for manufacturing a wall panel according to the invention, wherein the wall panel is at least substantially made of layers of paper/cardboard, each layer at least substantially being made up of a corrugated sublayer and a flat sublayer provided on one side thereof, which layers of paper/cardboard are interconnected via an adhesive applied to the corrugations of the corrugated sublayers, wherein the wall panel is impregnated, in particular with a resinous material, and wherein at least one strengthening layer having a greater elasticity modulus than the layers of paper/cardboard is provided, which strengthening layer is connected to a layer of paper/cardboard on one side of the wall panel via an adhesive.

[0014] It is noted that the term paper is usually used for lighter types of paper; in the case of a heavier quality, the term cardboard is frequently used. Within the framework of the invention, the terms paper, cardboard and weight are not intended to be limitative as regards the type of material to be used.

[0015] The aforesaid resinous material with which the wall panel according to the invention is impregnated, is preferably an epoxy resin, a polyurethane resin, a polyester resin or a phenol resin. Fire-resistant and/or fire-retarding agents may be added thereto. Preferably, the resinous material with which the wall panel according to the invention is impregnated also functions as an adhesive for adhering two layers of paper/cardboard together, so that a separate adhesive, such as a glue, is not required. To that end, sets consisting of a corrugated sublayer and a flat sublayer provided on one side thereof, which sublayers are already impregnated with the resinous material, can be placed on top of each other so as to be adhered together (after the resinous material has dried).

[0016] The invention will now be explained in more detail with reference to figures illustrated in a drawing of a preferred variant of the invention, in which Fig. 1 is a schematic, perspective view of the present wall panel, Fig. 2 is a detail view of Fig. 1, and Fig. 3 is an exploded view of the wall panel of Fig. 1.

[0017] The figure shows a flat wall panel 1 according to the invention in the form of a "sandwich", in the sense that a core 2 built up of several layers of corrugated cardboard is connected on either side to a less elastic strengthening layer 3 of a thin material having an elasticity modulus of about 400 Gpa.

[0018] In this case, four layers of corrugated cardboard are provided, which are each built up of corrugated sublayer 4 and a flat sublayer 5 glued to one side thereof, using a glue applied to the corrugations 6 of the corrugated sublayer 4. The core 2 is impregnated with a resinous material. As already said before, the strengthening layers 3 are glued to both sides of the core

2.

[0019] The wall panel 1 is mirror symmetrical with respect to a central longitudinal plane 7 of the wall panel 1.

[0020] It is noted that the invention is not limited to the embodiment as shown in the figures, but that it also extends to other variants that fall within the scope of the appended claims. Thus it will be apparent to those skilled in the art that the wall panel may exhibit a (slight) curvature, whilst the wall panel may also comprise a curved longitudinal edge.

Claims

1. A flat wall panel at least substantially made of cellulose material, **characterized in that** the wall panel is at least substantially made of layers of paper/cardboard, each layer at least substantially being made up of a corrugated sublayer and a flat sublayer provided on one side thereof, which layers of paper/cardboard are interconnected via an adhesive applied to the corrugations of the corrugated sublayers, wherein the wall panel is impregnated, in particular with a resinous material, and wherein at least one strengthening layer having a greater elasticity modulus than the layers of paper/cardboard is provided, which strengthening layer is connected to a layer of paper/cardboard on one side of the wall panel via an adhesive.
2. A wall panel according to claim 1, wherein two strengthening layers are provided, which are connected to a layer of paper/cardboard on either side of the wall panel via an adhesive.
3. A wall panel according to claim 1 or 2, wherein the strengthening layer(s) comprise(s) a fibre material.
4. A wall panel according to claim 3, wherein the fibre material consists of glass fibres, carbon fibres, mineral fibres and/or synthetic fibres.
5. A wall panel according to any one of the preceding claims 1-4, wherein the strengthening layer(s) comprise(s) a layer of plastic material.
6. A wall panel according to any one of the preceding claims 1-5, wherein the strengthening layer(s) comprise(s) a layer of rubber.
7. A wall panel according to any one of the preceding claims 1-6, wherein the strengthening layer(s) is (are) made of a metal.
8. A wall panel according to any one of the preceding claims 1-7, wherein the strengthening layer(s) is (are) made of wood.

9. A wall panel according to any one of the preceding claims 1-8, wherein the wall panel is at least substantially made of an even number of layers of paper/cardboard.

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10. A wall panel according to claim 9, wherein the wall panel is mirror symmetrical with respect to a central longitudinal plane of the wall panel.

11. A method for manufacturing a flat wall panel according to any one of the preceding claims 1-10, **characterized in that** the wall panel is at least substantially made of layers of paper/cardboard, each layer at least substantially being made up of a corrugated sublayer and a flat sublayer provided on one side thereof, which layers of paper/cardboard are interconnected via an adhesive applied to the corrugations of the corrugated sublayers, wherein the wall panel is impregnated, in particular with a resinous material, and wherein at least one strengthening layer having a greater elasticity modulus than the layers of paper/cardboard is provided, which strengthening layer is connected to a layer of paper/cardboard on one side of the wall panel via an adhesive.

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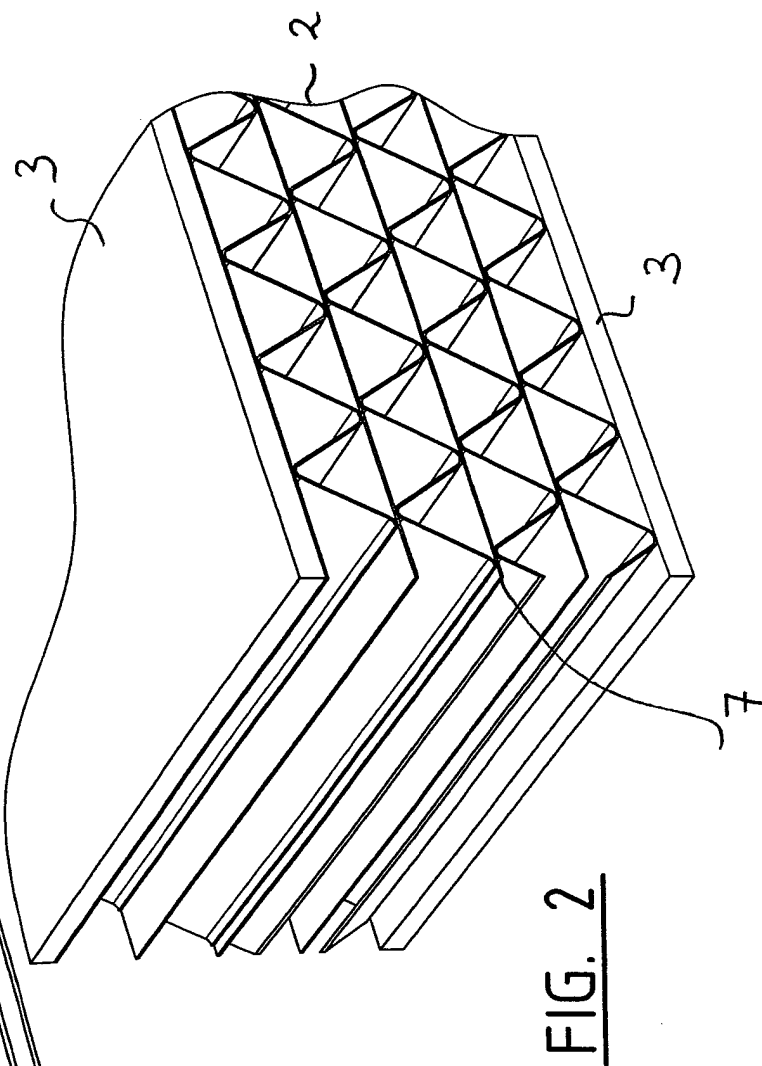
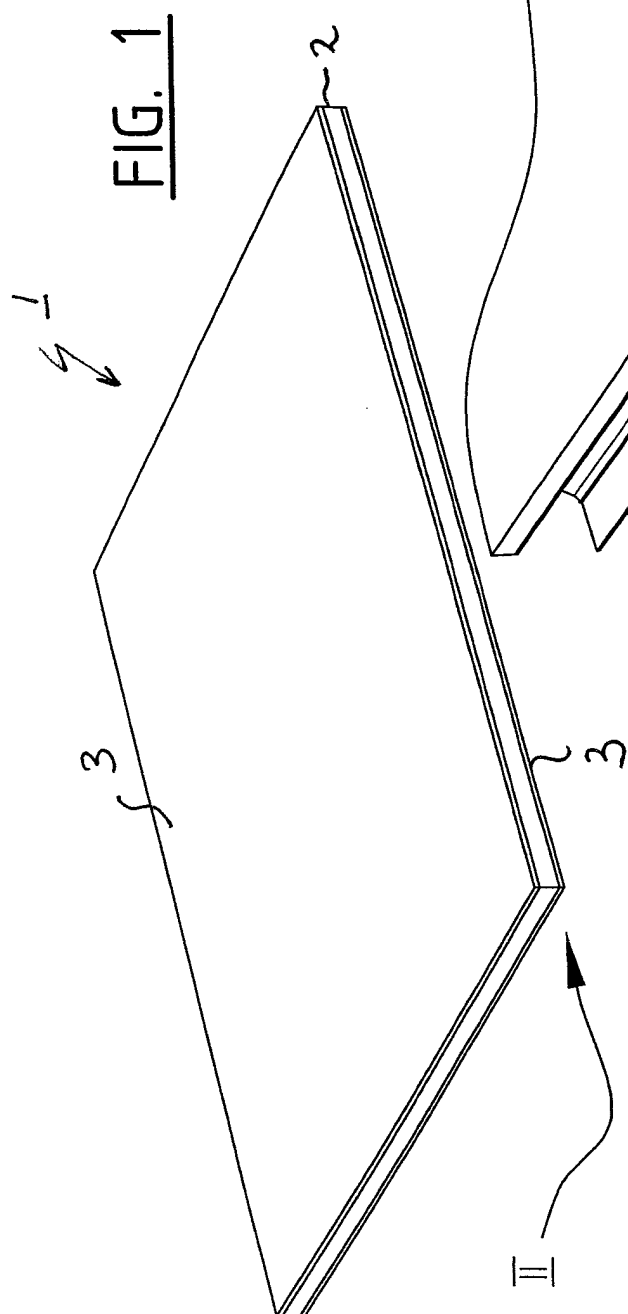
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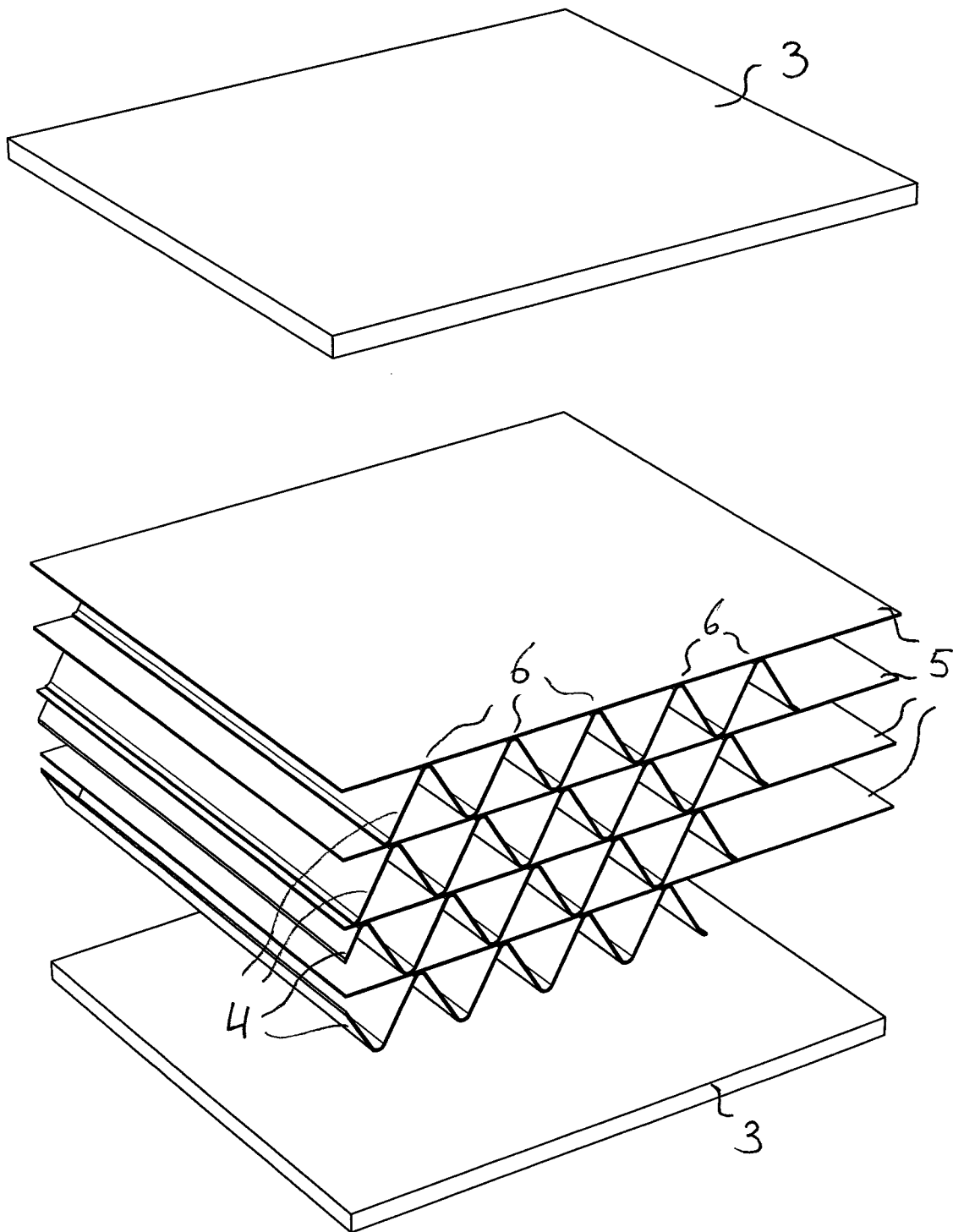


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 04 10 4942

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Place of search The Hague		Date of completion of the search 27 January 2005	Examiner Hendrickx, X
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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims			
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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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