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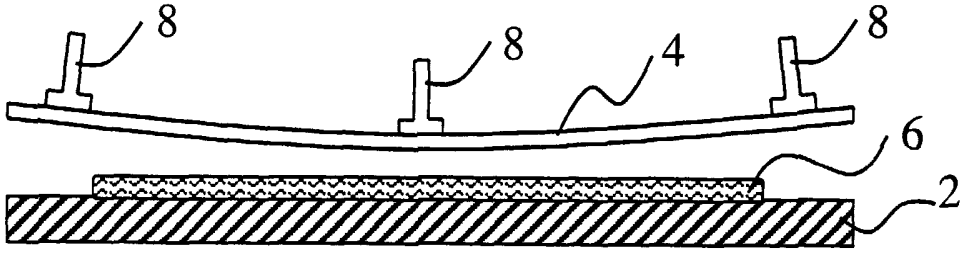
(54) Title: METHOD OF MANUFACTURING A COMPOSITE STONE-GLASS PANEL, AND PANEL OBTAINED BY SUCH METHOD



(57) Abstract: A method of manufacturing a composite panel (1, 1') including a slab of stony material (2) and a glass sheet (4) comprises providing a slab of stony material (2) while covering at least a central area thereof with a layer of thermosetting resin (6) in fluid condition, and bringing a forcedly convex glass sheet (4) close to the slab of stony material (2), while gradually zeroing the convexity of the glass sheet, whereby the sheet and the slab are made to adhere and, at the same time, the resin is uniformly distributed.

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METHOD OF MANUFACTURING A COMPOSITE STONE-GLASS PANEL, AND PANEL OBTAINED BY SUCH METHOD

The present invention relates to a method of manufacturing a composite stone-glass panel and to a panel obtained by such method.

More particularly, the invention concerns a method allowing coupling a single-layer or multi-layer glass sheet with a slab of natural stone, such as marble, granite or travertine.

Composite stone-glass panels are mainly employed to form external facings, thanks to their high resistance to atmospheric agents, or in general to manufacture highly resistant ornamental facings.

Document EP 0 122 357 discloses a method of producing a known composite panel. According to the teachings of said document, a slab of natural stone is coupled with a glass sheet through the interposition of a sheet of thermoplastic material. The sheet of thermoplastic material adheres to the walls of the sheet and the slab thanks to a gluing process including applying a certain pressure to the panel while simultaneously heating same to such a temperature that the thermoplastic material melts.

Panels manufactured by such a method have sometimes some drawbacks: actually, it may happen that, due to the poor adhesion of the sheet of thermoplastic material to the stone slab, the glass sheet becomes detached from the stone, even only in part, thereby causing potential danger situations and/or altering the panel aesthetic appearance.

It is an object of the invention to provide a method of producing a particularly safe and resistant panel having high quality and reduced cost.

It is another object to provide a method of producing a composite panel, which method allows firmly securing the glass

sheet to the stone slab and, at the same time, reclaiming the latter from cracks, grooves or defects, if any, even of important size.

The above and other objects are achieved by a method of producing a composite panel in accordance with the present invention, as claimed in the appended claims.

The method of the invention can advantageously be used for producing panels comprising a stone slab, e. g. of marble, granite or travertine, and a glass sheet of any kind, for instance a single-layer or multi-layer, colourless or coloured sheet.

The above and other objects of the invention will become more apparent from the description of a preferred embodiment, with reference to the accompanying drawings, in which:

- Figs. 1 to 6 are side views of six different steps of a method of producing a composite panel in accordance with the present invention;
- Fig. 7 is a diagrammatic partial cross-sectional view, in enlarged scale, of a first embodiment of a composite panel produced in accordance with the present invention; and
- Fig. 8 is a diagrammatic partial cross-sectional view, in enlarged scale, of a second embodiment of a composite panel produced in accordance with the present invention.

Referring to Fig. 1, a slab of stony material 2, for instance marble, granite, travertine or another natural stone, is horizontally arranged for preparing a composite panel.

In case the upper surface of slab 2 is not "rough" enough, in order to ensure a good grip of resin 6 that will be subsequently spread over the slab, slab 2 is submitted to a working process including either a step of mechanical abrasion ("pre-sizing") or, in the alternative, a step of chemical attack. Both workings are known in the field of stone processing.

Subsequently, still in order to improve the resin grip, it is advisable that the slab is submitted to a thermal treatment capable

of eliminating, to the greatest possible extent, the humidity present in the slab. Such a treatment is performed for instance by keeping slab 2 at a temperature of 50°C for a period of 4 hours.

A layer of thermosetting resin 6 in fluid condition is then spread on slab 2, by using a manual system or, preferably, an automatic one. Generally, it will be sufficient to cover a central area of slab 2 with resin 6, as shown in Fig. 2, since the subsequent working steps will result in a uniform distribution of the resin over the whole slab.

It is important that thermosetting resin 6 used in this working step is highly fluid and, above all, that it is free from air bubbles. To this aim the resin, usually a two-component resin, is prepared by means of a mixing and de-aerating cycle performed under high vacuum conditions. Thermosetting resin 6 being used can be for instance an epoxy resin, a polyester resin of a phenolic resin.

Subsequently, as shown in Fig. 3, a glass sheet 4 is placed above slab 2 of stony material coated with resin 6, while forcing the surface of glass sheet 4 facing slab 2 of stony material to take a convex shape. Indeed, glass sheet 4 is taken by an automatic manipulator, equipped with suckers 8, and made slightly convex. Such convexity has been exaggerated in Fig. 3 to highlight the sheet deformation.

Fig. 4 shows that convex sheet 4 is brought close to slab 2 of stony material, whereby the central region of the convex surface of glass sheet 4 is brought in contact with resin 6.

The convexity of glass sheet 4 is then gradually decreased, until becoming null, as shown in Fig. 5, so that glass sheet 4 is made to adhere to slab 2 of stony material and at the same time resin 6 is uniformly distributed over the whole of the contact surface between the sheet and the slab. Resin 6, besides becoming perfectly distributed over the whole surface, fills stone defects, cracks, grooves or pores, if any, and perfectly adheres to the glass

sheet.

To further improve the resin grip on the glass sheet, it is moreover possible to treat beforehand glass sheet 4 by chemical attack, so as to roughen the sheet surface that will then contact the resin.

The composite panel thus formed is then submitted to compression, as shown in Fig. 6, and said compression is kept during the whole catalysation of thermosetting resin 6.

To exert such a compression, the composite panel may be placed into a conventional mechanical or hydraulic press 10, 12 or, possibly, inside a vacuum autoclave, so as to assist in the distribution of resin 6 between the sheet and the slab.

In the alternative, the compression step can take place by placing the composite panel into a sealed sack within which vacuum is created.

Fig. 7 is a cross-sectional view in enlarged scale of a first composite panel 1 manufactured by the above process. In such embodiment, slab 2 of stony material is thicker than glass sheet 4. Stone slab 2 can be for instance strengthened, according to known technologies, by a layer of glass reinforced plastics applied to the panel surface not exposed to view. In the latter case, the thickness of stone slab 2 can even be less than 10 mm.

Fig. 8 shows instead a second embodiment of a composite panel manufactured by the above process. Panel 1' shown here has been obtained by coupling a front glass sheet 4 and a very thin stone slab, for instance 2 to 5 mm thick, so as to allow light to pass and to make the panel translucent.

As to glass sheets 4, glasses of any kind can be indifferently used, for instance single-layer or multi-layer glasses, colourless glasses or, for aesthetic reasons, coloured glasses.

Patent claims

1. A method of manufacturing a composite panel (1, 1') including a slab of stony material (2) and a glass sheet (4) coupled to each other, the method comprising the steps of:

- providing a slab of stony material (2);
- covering at least a central area of the upper surface of said slab of stony material (2) with a layer of thermosetting resin (6) in fluid condition;
- providing a glass sheet (4) above said slab of stony material (2), while forcing the surface of said glass sheet (4) facing said slab of stony material (2) to take a convex shape;
- bringing said glass sheet (4) close to the slab of stony material (2), thereby bringing a central sheet area in contact with the resin (6) present on a corresponding central area of the slab of stony material (2);
- gradually decreasing the convexity of the glass sheet (4), until such convexity becomes null, whereby the glass sheet (4) is made to adhere to the slab of stony material (2) and said resin (6) is uniformly distributed between the slab (2) and the sheet (4);
- uniformly compressing said slab of stony material (2) against said glass sheet (4) during catalysation of the thermosetting resin (6).

2. A method as claimed in claim 1, wherein said step of providing a slab of stony material (2) includes a working process capable of roughening the slab surface to be coupled with said glass sheet (4).

3. A method as claimed in claim 2, wherein the surface of said slab of stony material (2) is roughened by a process of mechanical pre-sizing.

4. A method as claimed in claim 2, wherein the surface of said slab of stony material (2) is roughened by chemical attack.

5. A method as claimed in claim 1, wherein, before covering at least a central area of the upper surface of said slab of stony material (2) with a layer of thermosetting resin (6), said slab of stony material (2) is submitted to a heating step.

6. A method as claimed in claim 1, wherein said glass sheet (4) is previously processed by chemical attack to roughen the sheet surface to be coupled with said slab of stony material (2).

7. A method as claimed in claim 1, wherein said step of compressing said slab of stony material (2) against said glass sheet (4) is performed by placing said composite panel (1, 1') into a press.

8. A method as claimed in claim 1, wherein said step of compressing said slab of stony material (2) against said glass sheet (4) is performed inside an autoclave within which vacuum is created.

9. A method as claimed in claim 1, wherein said step of compressing said slab of stony material (2) against said glass sheet (4) is performed by placing said composite panel (1, 1') into a sealed sack within which vacuum is created.

10. A method as claimed in claim 1, wherein said thermosetting resin (6) is an epoxy resin.

11. A method as claimed in claim 1, wherein said thermosetting resin (6) is a polyester resin.

12. A method as claimed in claim 1, wherein said thermosetting resin (6) is a phenolic resin.

13. A method as claimed in any preceding claim, wherein said slab of stony material (2) has a thickness in the range 2 to 5 mm, so as to allow light to pass and to make said composite panel (1, 1') translucent.

14. A composite panel (1, 1') of the type including a slab of stony material (2) coupled to a glass sheet (4), characterised in that said glass sheet (4) adheres to said slab of stony material (2) thanks to the interposition of a layer of thermosetting resin (6).

15. A composite panel as claimed in claim 14, wherein said thermosetting resin (6) is an epoxy resin.

16. A composite panel as claimed in claim 14, wherein said thermosetting resin (6) is a polyester resin.

17. A composite panel as claimed in claim 14, wherein said thermosetting resin (6) is a phenolic resin.

Fig. 1

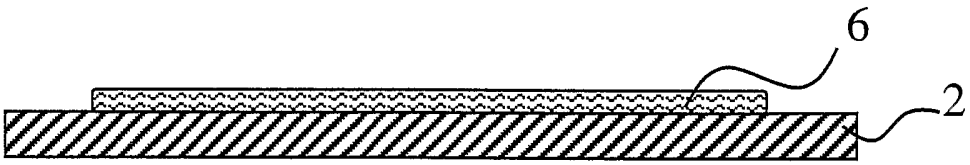

Fig. 2

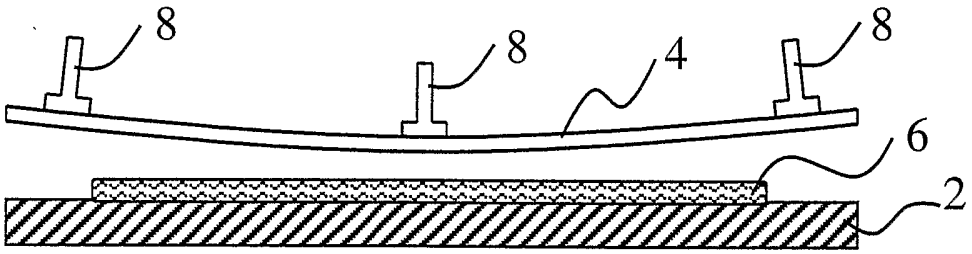

Fig. 3

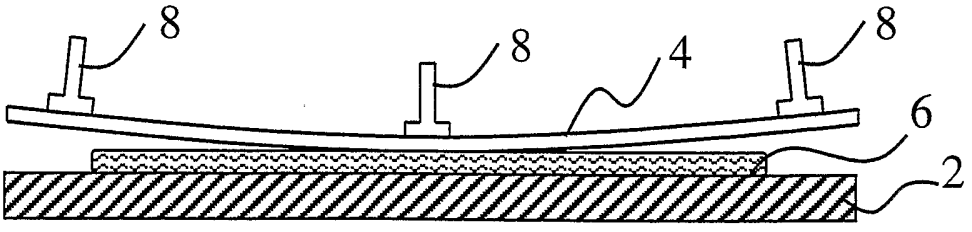

Fig. 4

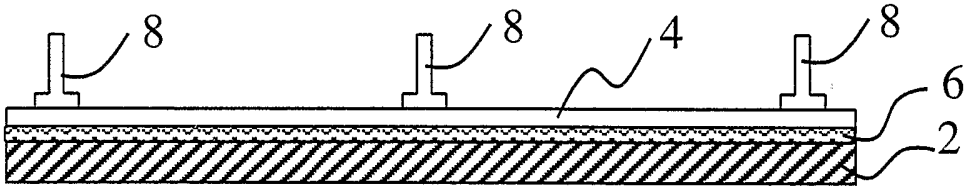

Fig. 5

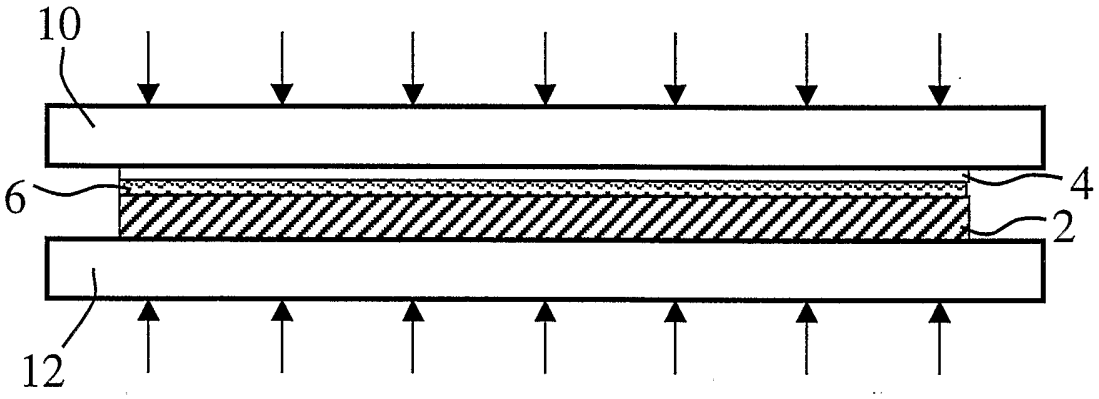

Fig. 6

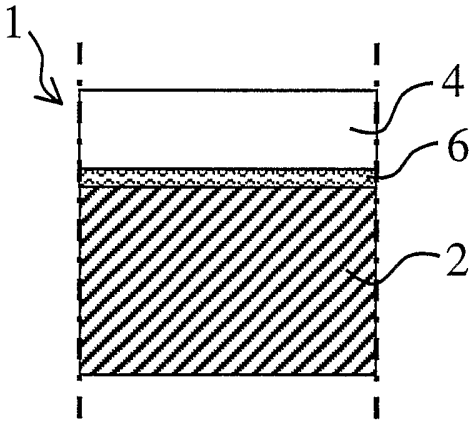

Fig. 7

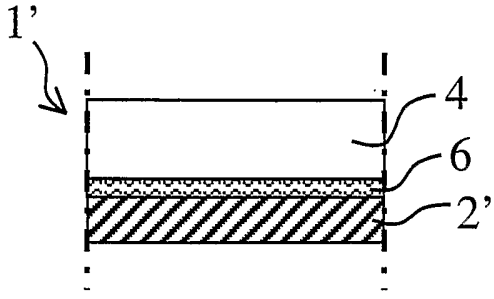

Fig. 8

INTERNATIONAL SEARCH REPORT

Inte ›lication No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B17/06 E04F13/14 B32B31/00 B32B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B E04F C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 4 724 023 A (MARRIOTT PETER H) 9 February 1988 (1988-02-09)	1
A	the whole document	7-9
X	DE 196 13 439 A (BLANKE BOHNE J PROF DR) 28 November 1996 (1996-11-28) column 1, line 62 -column 2, line 17 column 4, line 35 - line 57; figure 1	14,16
A	US 4 312 823 A (KRAAKMAN HILLEBRAND J J ET AL) 26 January 1982 (1982-01-26) column 5, line 1 -column 6, line 27	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 December 2002	17/12/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Van Belleghem, W

Form PCT/ISA/210 (second sheet) (July 1992)

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