

(19)



(11)

EP 4 088 949 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

16.11.2022 Bulletin 2022/46

(51) International Patent Classification (IPC):

B44C 1/24 (2006.01)**B44C 5/04** (2006.01)**E04F 15/02** (2006.01)(21) Application number: **21190114.5**

(52) Cooperative Patent Classification (CPC):

B44C 5/04; B44C 1/24; E04F 15/02033;**E04F 15/102; E04F 15/105; E04F 15/107**(22) Date of filing: **06.08.2021**

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN(30) Priority: **12.05.2021 US 202163187510 P****14.07.2021 US 202163221596 P**(71) Applicant: **Flooring Industries Limited, SARL****8070 Bertrange (LU)**

(72) Inventors:

- **MEERSSEMAN, Laurent**
7750 Mont de l'Enclus (BE)
- **NAEYAERT, Christophe**
8490 Jabbeke (BE)
- **DE RICK, Jan**
9500 Geraardsbergen (BE)
- **SCHACHT, Benny**
8908 Vlamertinge (BE)

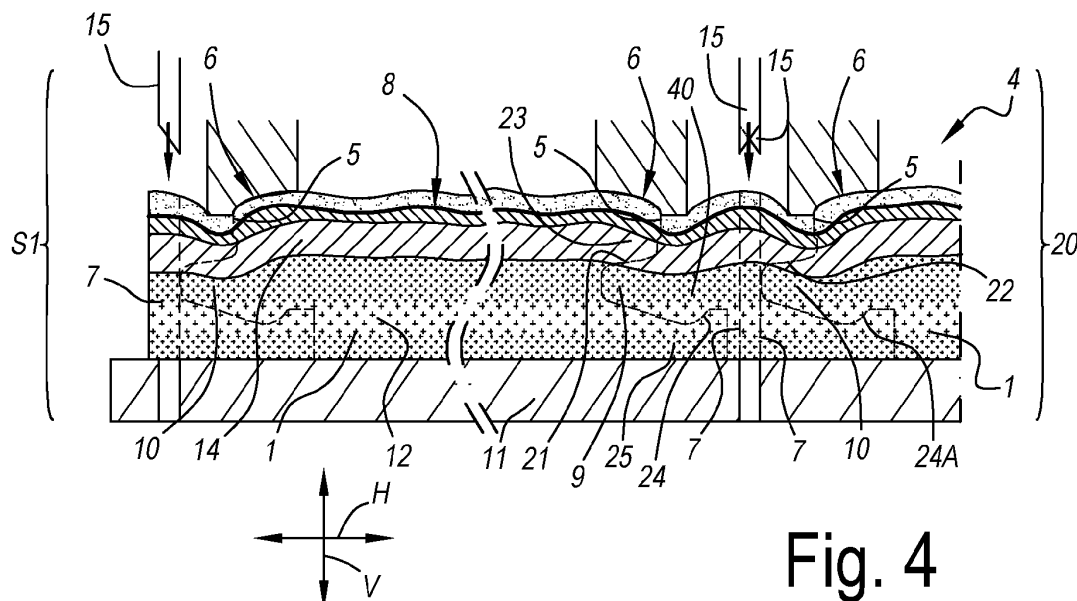
(74) Representative: **Vande Ginste, Kristof Omer**

Flooring Industries Limited, SARL
Patent department
Ooigemstraat 3
8710 Wielsbeke (BE)

(54) **METHODS FOR MANUFACTURING A DECORATIVE PANEL**

(57) Method for manufacturing a decorative panel, wherein said panel (1) comprises a substrate (2) and a decorative top layer (3), wherein said substrate (2) is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said substrate (2) and/or decorative top layer (3) is obtained from a larger

material (4) by means of a dividing operation (S1), characterized in that said panel (1) comprises at at least one and preferably at both upper edges (5) of a pair of opposite side edges a lower edge area (6), wherein said lower edge area (6) is obtained during said dividing operation (S1).

**Fig. 4****EP 4 088 949 A1**

Description

[0001] This invention relates to methods for manufacturing decorative panels, as well as to decorative panels obtainable through such methods. The invention is in the first place aiming at floor panels, but may be put to practice with wall panels, ceiling panels or furniture panels as well.

[0002] More particularly, the invention relates to floor panels of the type which is at least composed of a substrate and a decorative top layer forming a decorative surface, wherein said top layer comprises a motif. Above said motif a transparent or translucent synthetic material layer may be provided, which layer then forms part of said top layer.

[0003] In particular, the present invention relates to floor panels of the type which, at two or more opposite edges, comprises coupling means or coupling parts, with which two of such floor panels can be coupled at the respective edges, such that they are locked together in a horizontal direction perpendicular to the respective edge and in the plane of the floor panels, as well as in a vertical direction perpendicular to the plane of the floor panels. Such floor panels can be applied for composing a so-called floating floor covering, wherein the floor panels are interconnected at their edges, however, are lying freely on the underlying floor.

[0004] From WO 97/47834, EP 1 290 291 and WO 2006/066776, laminate floor panels are known for forming a floating floor covering. However, laminate floor panels show the disadvantage that they mostly are provided with a moisture-sensitive substrate, namely MDF or HDF (Medium Density Fiberboard or High Density Fiberboard), and that the top layer provided on said substrate, when the floor covering is in use, leads to the development of ticking noises. From EP 1 290 291, it is known to provide laminate floor panels with a bevelled edge portion that is formed by removing a material portion from the edge of the floor panel, to thereby expose a portion of the core material. From WO 2006/06676 it is known to form bevelled edge portions by compressing the core material, such that the top layer extends uninterruptedly from the global surface of the panel to and over the bevelled edge portion.

[0005] From EP 1 938 963, vinyl-based floor panels are known for forming such floating floor covering. Such vinyl-based floor panels mostly have a thickness of 3 to 5 millimeters and have a high material density. WO 2011/141,849 and WO 2014/117,887 disclose decorative panels having a foamed core. WO 2012/004701 discloses that vinyl-based floor panels may be provided with a bevelled edge portion as well, either by machining away a material portion and exposing a layer underlying the motif, or by deforming the surface of the panel such that the motif extends also over the bevelled edge portion.

[0006] The present invention relates to an alternative method of manufacturing a decorative panel, which in particular is intended as a floor panel for forming a floating

floor covering. According to various preferred embodiments of the invention, also a solution is offered for one or more problems with the floor panels and their method of manufacture of the state of the art.

[0007] To this aim, the invention is a method for manufacturing a decorative panel, wherein said panel comprises a substrate and a decorative top layer, wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said substrate and/or decorative top layer is obtained from a larger material by means of a dividing operation, with as a characteristic that said panel comprises at least one and preferably at both upper edges of a pair of opposite side edges a lower edge area, wherein said lower edge area is obtained prior to or during said dividing operation. Obtaining the lower edge area while the decorative panel material still forms part of a larger material allows for a more fluent production process. For example any bulging out or unwanted deformation of the larger material due to the forming of the lowered edge area can be concentrated in a part of the larger material which is destined to be removed in subsequent steps, for example in said dividing operation or afterwards. Further the method of the invention allows to position the dividing operation with respect to said upper edges having said lower edge area, e.g. such that opposite side edges have a lower edge area of predetermined size or shape. Further, in the cases where such larger material contains two or more decorative panels, lower edge areas at two or more upper edges of said two or more decorative panels can be formed in the same operation. In such case the lower edge areas can be made to resemble closely with limited effort.

[0008] Preferably, said dividing operation comprises performing a cutting operation releasing at least said substrate from said larger material at at least two opposite side edges.

[0009] Preferably, said cutting operation forms opposite cut edges for releasing said at least two opposite side edges, wherein said opposite cut edges are positioned at a mutually different distance from said upper edges of said panel. The different distances allow for formation of profiled edges horizontally extending differently beyond the respective upper edge, with a minimized material loss.

[0010] Preferably, said dividing operation comprises a cutting operation, more particularly a punching operation, namely an operation in which a stationary, i.e. non-rotating, cutting blade or knife is pressed down to, into and through the material to be cut.

[0011] The lower edge area can be formed using one or more of a variety of different methods, of which here below some important possibilities are described without desiring to be exhaustive.

[0012] According to a first possibility, said lower edge area is formed simultaneously with, i.e. during said dividing operation, or practically simultaneously with said dividing operation. In this manner, a very accurate posi-

tioning of the cut edge relative to the upper edge of the panel can be obtained. With the forming tools being engaged with the larger material at least during part of said dividing operation, the respective lowered edge area is considered to be formed simultaneously with or during the dividing operation, and the lowered edge area is considered to be obtained during said dividing operation. With the forming tools engaging with the larger material while the larger material is within the dividing apparatus and/or aligned with the operational position of the cutting tools, and disengaging prior to the engagement of the cutting tools with said larger material, the respective lowered edge area is considered to be formed, at least in part, prior to, but practically simultaneously with said dividing operation.

[0013] According to a practical embodiment, for example of said first possibility, said dividing operation comprises:

- providing said larger material in a dividing apparatus;
- indenting said larger material at the location of said upper edges in order to at least partially form said lower edge area;
- releasing said substrate and/or said decorative top layer from said larger material by means of a cutting operation with a cutting tool, for example by means of a knife that is forced in and through said larger material.

[0014] Preferably, said indenting is executed by means of a mold or mold portions that press down on said substrate and/or said decorative top layer. Said mold or mold portions may be engaged with said substrate and/or said decorative layer at the start of said cutting operation, and are preferably still engaged at the end of said cutting operation. With the mold or mold portions being engaged with the larger material at least during part of said cutting operation, the respective lowered edge area is formed, at least in part, simultaneously with or during the dividing operation. In this manner the material to be cut may be kept stationary, and an accurate positioning of the cut edge may be obtained. Preferably, said mold or mold portions are movable with respect to said cutting tool. Preferably, said mold or mold portions are substantially at standstill during the cutting operation, i.e. while the cutting tool is moved into and through said substrate and/or decorative layer.

[0015] According to a second possibility, said lower edge area is formed in line with, preferably prior to, said cutting operation releasing at least said substrate from said larger material at at least two opposite edges. The inline operation allows for an accurate positioning of the cutting operation with relation to the lower edge areas or the final upper edges of the decorative panels to be obtained.

[0016] In accordance with said second possibility, the formation of the lower edge area is preferably formed using a continuous forming or deforming operation. Pref-

erably said lower edge area is formed by means of one or more structured rollers and/or by means of one or more moving belts indenting said larger material. Such operation can fluently be arranged in-line with a continuous operation, for example with an extrusion and lamination operation for forming the larger material. The rollers and/or belts may form the lower edge area while the larger material is fed passed the respective equipment.

[0017] In accordance with said second possibility, said cutting operation is preferably performed by means of a plurality of, preferably rotating, cutting tools. The cutting tools may be saw blades or rotating knives. Preferably, said cutting tools are positioned to form opposite cut edges at predefined distances from said upper edges of said decorative panel.

[0018] The position of said cutting tools maybe controllable and/or controlled on the basis of an upstream portion of said larger material. The cutting tools may for example be controlled to attain said predefined distances between a cut edge and a respective upper edge. The upstream portion of said larger material may be recorded by means of optical or tactile sensors, such as by means of one or more camera's or feeling gauges. The upstream portion preferably comprises a portion within or at a fixed distance of an available lower edge area and/or upper edge to be obtained. The upstream portion may be detectable because of its relief, in the case of a lower edge area for example because it extends beneath the global surface of the larger material, or because of its decoration or marking.

[0019] As already mentioned above, preferably the method, in accordance with said first or second possibility, further comprises a step of providing a larger material comprising said substrate and/or decorative top layer by means of a continuous operation preferably including one or more extrusion operations, scattering operations, pressing operations and/or lamination operations.

[0020] Preferably, in accordance with said second possibility, said lowered edge area and said cutting operation is performed in line with said step of providing said larger material.

[0021] According to a special embodiment of said first or second possibility, said lowered edge area is formed by indenting material at an edge of a pre-machined portion of said larger material. By means of pre-machining a portion of material can be taken away at the location where the lower edge area is to be formed. In this manner less material must be displaced to form the lower edge area, and a more accurate result may be obtained with less power needed for the deformation. Preferably, said pre-machined portion is performed from the top of said larger material at least into said substrate. Preferably, said pre-machined portion comprises an undercut, i.e. a portion available vertically beneath a remaining top surface portion of said larger material.

[0022] According to said second possibility, said method may further comprise a step of providing a larger material comprising at least said substrate, wherein said

substrate is provided with lowered substrate areas at the location of said lower edge area, prior to application of said decorative top layer to said substrate. According to a variant, said method may further comprise a step of providing a larger material comprising at least said substrate, wherein a decorative top layer is applied to said substrate, wherein said decorative top layer or a portion thereof comprises a structure prior to application thereof to said substrate. Preferably, said structure of said top layer or the respective portion thereof includes said lowered edge area. Preferably, at least in case of said variant, said decorative top layer comprises a plurality of layers and comprises a motif. A layer underlying said motif may comprise thinned portions or openings basically corresponding to the structure of said lowered edge area. Such thinned portions or openings may limit the needed deformation and power to obtain the lowered edge area or areas. Preferably, at least two, and preferably all of said plurality of layers are laminated to each other, prior to their application to said substrate.

[0023] According to a third possibility, said method further comprises a step of providing a larger material comprising said substrate and/or decorative top layer by means of a continuous or discontinuous pressing operation wherein a plurality of prefabricated layers are adhered to each other. Preferably, said lower edge area is formed simultaneously with said pressing operation. Preferably said pressing operation is a discontinuous pressing operation, for example by means of a single daylight or multiple daylight press. Such press may comprise at least one pressing element associated to each larger material to be pressed, in the case of a single daylight press, at least a pressing element for coming into contact with the decorative top layer, and potentially a pressing element for coming into contact with the bottom of the larger material to be pressed. Such press element, especially the press elements coming into contact with the decorative top layer, may be structured, for example it may concern a structured press plate or a structured foil. The pressing operation may be a heated press operation, potentially followed by a cooling operation under pressure, preferably in the same or in a separate, but similar press.

[0024] According to the method of said third possibility, preferably at least one of said prefabricated layers may comprise thinned sections and/or removed sections, preferably at least at the location where said lower edge area is obtained or to be obtained. Such thinned portions or removed sections may limit the needed deformation and power to obtain the lowered edge area or areas. Preferably, said at least one of said prefabricated layers is a thermoplastic layers from which sections have been removed by means of a cutting operation, more particularly a punching operation. Preferably, said at least one of said prefabricated layers is a one-piece layer.

[0025] In general, independent from the fact whether one of the above possibilities are used, said larger material is preferably provided with a reference portion prior

to said dividing operation. Such reference portion may aid in positioning the larger material with respect to further operations. Preferably, said reference portion is used to align the larger material to the dividing operation or part thereof, more particularly to one or more cuts performed therein, or vice-versa, namely wherein said reference portion is used to align one or more cutting tools performing said cuts to the larger material, or both. For example, said aligning may be such that the lower edge area is parallel to one or more of the cuts performed in said dividing operation.

[0026] Said reference portion may comprises an indentation or excavation provided in the bottom of said larger material. According to a variant or in combination with the aforesaid, said reference portion may comprise an edge of said larger material. According to another variant, said reference portion comprises a visual or tactile marking available at the side of said larger material that comprises said lower edge area.

[0027] Preferably, said reference portion is provided at a predefined distance from an upper edge of said panel.

[0028] Preferably, said reference portion cooperates with a stop or guiding tool in said dividing operation. The reference portion may therefore be performed as an excavation for engagement with a portion of a stop or guiding tool, be it in said dividing operation or in another operation.

[0029] Preferably, in accordance with the invention, said decorative top layer continuous uninterruptedly from on the global upper surface of said panel to and over said lower edge area.

[0030] Preferably, said lower edge areas are formed as straight or curved chamfers. According to a variant the lower edge areas may be formed with an L- shape, i.e. with a horizontal, or substantially horizontal bottom adjoining the upper edge and an upwardly extending wall portion at the proximal side of the lower edge area.

[0031] Preferably, said lower edge areas are available at both edges of a pair of opposite upper edges, wherein said lower edge areas at opposite upper edges mutually extend to a same depth and/or over a same horizontal distance, as measured perpendicularly to said upper edge. In the case of lower edge areas formed as straight or curved chamfers, a so-called V-groove may be formed when two lower edge areas of similar panels are adjacent in a covering formed from such decorative panels.

[0032] For example in the case of L-shaped lower edge areas, they may be available at one or both edges of a pair of opposite upper edges. With an L-shaped lower edge area an imitation of a grout line, rubber or asphalt joint may be achieved.

[0033] Preferably, at least two substrates and/or top layers for respective panels are obtained or obtainable from said larger material. Preferably the larger material has a practically endless web-shape or a limited length slab-shape, wherein at least in one direction, for example the width direction of the web or slab, four or more rec-

tangular panels can be obtained, wherein the width of the panels is preferably oriented in the same direction as the width of the web or slab.

[0034] As is clear from the above, preferably said substrate at the location of said lower edge area is compressed or deformed.

[0035] In general, the substrate and/or decorative top layer of the decorative panel of the invention, preferably show one or a combination of two or more of the following properties:

- the substrate and/or the decorative layer comprise a foamed material layer, for example a closed cell foam of a thermoplastic material such as PVC. The availability of a foamed material layer is convenient for example in case the lower edge area is formed at least in part by means of compression or deformation. The cell walls may be collapsed to create said lower edge area or a portion thereof;
- the substrate and/or the decorative layer comprise one or more voids, at least at a position vertically underneath said lower edge area. Said voids may be formed by the cells of a foamed material layer and/or may be formed by means of removing material from an otherwise solid material layer and/or may be formed as open or closed chambers within a material layer of said substrate;
- the substrate and/or the decorative layer comprise material having a shore hardness A lower than 80, and preferably higher than 20. A material layer having a relatively low hardness may be more easily deformable in order to create at least a portion of said lower edge portion. Preferably said material is available in the panel at least at a position immediately below said decorative layer.

[0036] Said substrate may comprise at least one of an Magnesiumoxychloride or Magnesiumoxysulphate containing board or layer.

[0037] Alternatively, or in combination with the above, said substrate may comprise at least a thermoplastic material containing board or layer, preferably a filled synthetic composite comprising thermoplastic material and filler material, preferably mineral filler materials, such as sand, talcum, chalk or other forms of CaCO₃.

[0038] Preferably, said decorative top layer comprises a motif preferably formed by a printed pattern or a wood veneer. Said decorative top layer may comprise a carrier layer upon which said printed pattern is provided and a transparent wear layer applied on top of said printed pattern. Said carrier layer may be a thermoplastic foil, preferably a PVC foil, a paper layer or a wood veneer. Preferably, said wear layer is a thermoplastic foil.

[0039] In accordance with a special embodiment, said decorative top layer comprises from bottom to top at least a backing layer, a printed carrier layer and a transparent wear layer. Preferably said backing layer forms the majority of the thickness T of said decorative top layer, or

at least 45 percent thereof. Said decorative top layer is preferably assembled from said backing layer, printed carrier layer and wear layer by means of thermal lamination, i.e. preferably in the absence of separate glue layers in between said layers. Preferably said decorative top layer, or at least the bottom layer thereof, is connected to said substrate by means of thermal lamination as well, i.e. in the absence of a separate glue layer. However it is not excluded that said decorative top layer, or at least the bottom layer thereof, is glued to said substrate.

[0040] In the cases where said decorative layer comprises a backing layer, said backing layer is preferably a thermoplastic layer, preferably of soft PVC, namely PVC with more than 10 phr plasticizer, and/or of a thermoplastic foamed material, e.g. foamed PVC.

[0041] In general, with the exception of the first possibility mentioned above for forming said lower edge area, said lower edge area is preferably formed by means of one or more structured rollers and/or by means of one or more belts indenting said larger material.

[0042] As already mentioned above, preferably the methods of the invention comprise a step of providing a larger material comprising said substrate and/or decorative top layer by means of a continuous operation preferably including one or more extrusion operations, scattering operations, pressing operations and/or lamination operations. Preferably the step of providing a larger material at least comprises one or more extrusion operations and a lamination operation, or at least one or more scattering operations and a lamination operation. During the lamination operation multiple layers may be laminated, at once, subsequently or in any other sequence.

[0043] Preferably, the larger material comprises a printed pattern of adjacent rectangular and oblong panels or tiles. For example, a printed pattern applied to a carrier layer, such as a thermoplastic foil. Preferably said lower edge areas are at least available in between adjacent longitudinal edges of said panels or tiles. The longitudinal edges of said panels or tiles may be directed in the feed direction of said continuous operation. According to a variant, the longitudinal edges of said panels are directed transversely to said feed direction. In the latter case the possible stretching of the printed pattern can be controlled in an enhanced manner and the forming operation for said lower edge areas can be executed more accurately, as well as the dividing operation. In the cases where a printed thermoplastic foil is used, for example a printed PVC foil may be used. Such PVC foil may be of the soft type, or of the semi-rigid or rigid type. A rigid type PVC foil, i.e. a PVC foil comprising 0 to 5 phr of plasticized is preferred in order to minimize possible elongation of the PVC foil during processing, e.g. the lamination.

[0044] Preferably, the larger material is a flat web shaped substrate material, for example having a width W of 1 to 2.1 meter, preferably about 1.3 meter, and, preferably, a thickness T₂ of 2 to 7 mm, for example about 4 mm. The flat web shaped substrate material is preferably provided in continuous length, for example by

means of an extrusion operation.

[0045] The orientation of rectangular and oblong panels with their longitudinal edges transversely to the feeding direction in the lamination operation forms an inventive aspect of the present invention as well, independent from the fact whether or not lower edge areas are available or being formed. This independent aspect can be defined as a method for manufacturing a decorative panel, wherein said panel comprises a substrate and a decorative top layer, wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said substrate and decorative top layer is obtained from a larger material by means of a dividing operation, with as a characteristic that said method comprises a lamination operation for providing at least a part of said decorative top layer on said substrate, wherein said lamination operation is a continuous operation wherein the respective part of said decorative top layer is fed to the lamination operation in a feeding direction, and wherein said panel is rectangular and oblong with the longitudinal edges thereof being directed transversely to said feeding direction. Preferably said method further comprises an embossing operation and/or a forming operation for forming lower edge areas.

[0046] With the intention of better showing the characteristics according to the invention, in the following, as an example without limitative character, several embodiments are described, with reference to the accompanying drawings, wherein

- Figure 1 schematically illustrates some steps in a method in accordance with the invention;
- Figure 2 at a larger scale shows a cross-section in accordance with line II-II indicated on figure 1;
- Figure 3 at a larger scale shows a cross-section in accordance with line III-III indicated on figure 1;
- Figure 4 in a same view as figure 3 illustrates the method at a different point in time;
- Figure 5 schematically illustrates some steps in a further method in accordance with the invention;
- Figure 6 represents a top view in accordance with the arrow F6 represented in figure 5;
- Figure 7 at a larger scale illustrates a cross-section in accordance with the line VII-VII in figure 6;
- Figure 8 at the same scale illustrates a cross-section in accordance with the line VIII-VIII in figure 6 for a variant;
- Figure 9 shows the variant of Figure 8 with formed lower edge areas;
- Figures 10 to 14 in a same view as figure 8 represent variants;
- Figure 15 at a larger scale illustrates a cross-section in accordance with the line XV-XV shown in figure 5, for a variant;
- Figure 16 schematically illustrates some steps in a further method in accordance with the invention;
- Figures 17 at larger scale represents a cross-section in accordance with the line XVII-XVII indicated on

figure 16;

- Figure 18 and 19 at the same scale represent, for variants, a cross-section in accordance with the line XVIII-XVIII indicated on figure 16;
- Figure 20 shows a perspective view in accordance with the arrow F20 indicated on figure 19;
- Figure 21 schematically illustrates some steps in a further method in accordance with the invention;
- Figure 22 in a cross-section in accordance with the line XXII-XXII indicated on figure 5 represents a variant;
- Figures 23 and 24 in a perspective view illustrate some alternative dividing operations;
- Figures 25 represents at a larger scale the area indicated with F25 in figure 5;
- Figures 26 and 27 represent alternatives for the area indicated with F26 in figure 25;
- Figure 28 shows a cross-section in accordance with line XXVIII-XXVIII shown in figure 27;
- Figure 29 schematically illustrates some steps in a further method in accordance with the invention; and
- Figure 30 at larger scale show a cross-section in accordance with the line XXX-XXX in figure 29.

[0047] Figure 1 illustrates some steps in a method for manufacturing a decorative panel 1.

[0048] As shown in figure 2 to 4, said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said substrate is a thermoplastic material containing substrate, wherein said substrate and decorative top layer is obtained from a larger material 4 by means of a dividing operation S1, with as a characteristic that said panel 1 comprises at both upper edges 5 of a pair of opposite side edges a lower edge area 6, wherein said lower edge area 6 is obtained prior to or during said dividing operation S1.

[0049] Said dividing operation S1 comprises performing a cutting operation releasing at least said substrate 2 of said panel 1 from said larger material 4 at at least two opposite edges.

[0050] The cutting operation forms opposite cut edges 7 for releasing said at least two opposite edges, wherein said opposite cut edges 7 are positioned at a mutually different distance D1-D2 from said upper edges 5 of said panel 1. The distance D2 at the upper edge 5 where the panel will be provided with a groove 9 is larger than the distance D1 at the upper edge 5 where the panel will be provided with a tongue 10. The tongue 10 and groove 9 form part of coupling means with which two of such panels can be coupled at the respective edges, such that they are locked together in a horizontal direction H perpendicular to the respective edge and in the plane of the panels 1, as well as in a vertical direction V perpendicular to the plane of the panels.

[0051] The decorative top layer 3, preferably at least the printed pattern 8 thereof, continues uninterruptedly from on the global upper surface of said panel 1 to and over said lower edge area 6.

[0052] Said lower edge areas 6 at opposite upper edges 5 mutually extend to a same or substantially same depth and/or over a same or substantially a same horizontal distance, as measured perpendicularly to said upper edge 5. Said lower edge areas 6 are formed as chamfers, in this case somewhat bent chamfers.

[0053] In the example, at least two substrates and/or top layers for respective panels 1 are obtained from said larger material 4.

[0054] Said substrate 2 at the location of said lower edge area 6 is compressed or deformed. The bottom of the substrate 2 remains undeformed. In this case the bottom of the substrate 2 is supported by supporting means 11 to this aim.

[0055] Said substrate 2 and/or decorative top layer 3 show the following properties:

- the substrate 1 comprises a foamed central material layer 12, for example a closed cell foam of a thermoplastic material such as PVC; this central material layer 12 is adjacent to a more dense, and/or less foamed, material layer 13, a so-called crust layer, both at its bottom and top surface;
- the substrate 1 comprises one or more voids, at least at a position vertically underneath said lower edge area; in this case the voids are formed by the cells of the foam, but in according with a not represented variant the void may be structural, for example a chamber formed during extrusion of the substrate 2, for example similar as further illustrated in figure 11.
- the decorative layer 3 comprises material having a shore hardness A lower than 80, and preferably higher than 20. In this case this material is available at least in the backing layer 14. This leads to a more fluent compression in the lower edge areas 6.

[0056] As shown, said lower edge areas 6 are formed simultaneously with, or during said dividing operation S1, such in accordance with the first possibility for forming lower edge areas mentioned in the introduction.

[0057] Preferably, as shown here, said dividing operation S1 comprises:

- providing said larger material 4 in a dividing apparatus 20;
- indenting said larger material 4 at the location of said upper edges 5 in order to at least partially form said lower edge areas 6;
- releasing said substrate 2 and said decorative top layer 3 from said larger material 4 by means of a cutting operation with a cutting tool 15, for example by means of a knife that is forced in and through said larger material 4.

[0058] Said indenting is executed by means of a mold or mold portions 16 that press down on said substrate 2 and said decorative top layer 3. Said mold or mold portions 16 are engaged with said substrate 2 and said dec-

orative layer 3 at the start of said cutting operation, and are preferably still engaged at the end of said cutting operation. For this purpose said mold or mold portions 16 are movable with respect to said cutting tool 15.

[0059] Preferably said mold or mold portions 16 are substantially at standstill during the cutting operation, i.e. while the cutting tool 15 is moved into and through said substrate 2 and decorative layer 3.

[0060] As illustrated here said dividing operation comprises a cutting operation, more particularly a punching operation, namely an operation in which a stationary, i.e. non-rotating, cutting blade or knife is pressed down to, into and through the larger material 4 to be cut.

[0061] In the example of figures 1 to 4, said substrate 2 comprises at least a thermoplastic material containing board or layer, preferably a filled synthetic composite comprising thermoplastic material and filler material, preferably mineral filler materials, such as sand, talcum, chalk or other forms of CaCO₃. Said decorative top layer 3 comprises a motif formed by said printed pattern 8. According to an alternative a wood veneer may be used to form the motif. The printed pattern 8 is provided on a carrier layer 17 and a transparent wear layer 18 is applied on top of said printed pattern 8.

[0062] Preferably, the wear layer 18 comprises a relief 19 applied thereto or realized prior to said dividing operation S1. Said relief 19 preferably remains available in the lower edge areas 6, after the molding portions 16 are disengaged.

[0063] In the example, said decorative top layer 3 comprises from bottom to top at least a backing layer 14, a printed carrier layer 17 and a transparent wear layer 18, preferably said backing layer 14 forms the majority of the thickness T of said decorative top layer 3, or, as is the case here, at least 45 percent thereof. The substrate 2 is preferably a one piece substrate, i.e. without internal glue layers, and preferably forms the majority of the thickness T1 of the panel 1.

[0064] In the example, said backing layer 14 is a thermoplastic layer of soft PVC, namely PVC with more than 10 phr plasticizer, that also comprises filler materials.

[0065] One or more of the cutting tools 15 and/or molds or molding portions 16 may be heated, but are preferably not heated.

[0066] It is further remarked that, in the represented case of figures 1 to 4, the deformation of the substrate 2 and decorative layer 3, and the positioning of the coupling means in the decorative panel 1 is such that the contact surfaces 21-22 between the top of the tongue 10 and the bottom of the upper groove lip 23 is formed in the backing layer 14, while the horizontally locking surfaces 24-24A on the lower groove lip 25 and the bottom of the tongue 10 are formed in the substrate 2.

[0067] Figures 5 to 7 represent an embodiment in accordance with the second possibility mentioned in the introduction for forming lower edge areas 6. Herein the lower edge area 6 is formed in line with, in this case prior to said cutting operation S1 that releases at least said

substrate 2 from said larger material 4 at at least two opposite edges. The lower edge area 6 is formed using a continuous forming operation by means of a structured roller 26. The roller 26 comprises mold portions 16 at its circumference that press down or deform the larger material 4 to create said lower edge areas 6. The roller 26 forms the lower edge area 6 while the larger material 4 is fed passed it in the feeding direction F. The forming operation S2 is arranged in line with an extrusion operation S3 and a lamination operation S4 for forming the larger material 4.

[0068] The extrusion operation S3 comprises a feed 27 for feeding raw material for the substrate 2 to the extruder 28. The raw material is extruded through a so-called flat die or slot die 29 into a flat web shaped substrate material, for example having a width W of 1 to 2.1 meter, preferably about 1.3 meter, and a thickness T2 of 2 to 7 mm, preferably about 4 mm. In the lamination operation S4 one or more of a carrier layer 17 having a printed pattern 8, a transparent wear layer 18 and a backing layer 14 may be laminated to the web shaped substrate material to form the larger material 4.

[0069] In the example, an optional thickness calibration S5 by means of one or more rollers and/or calibration plates and/or heaters and/or coolers may be performed on the extruded material.

[0070] In the example, prior to said forming operation S2, a relief 19 is formed at least in said transparent wear layer 18 in an embossing operation S6. As illustrated here, the printed pattern 8 represents a wood pattern and the relief 19 comprises indentations representing wood pores and/or wood grain lines. The indentations may be performed in accordance with the printed pattern 8, to create a so-called embossing-in-register, and a true to nature look of the panels 1. It is of course not excluded that other printed patterns 8 are used, such as stone or fantasy patterns, wherein, in such case, also corresponding indentations can be applied, whether or not in register with the printed pattern 8.

[0071] As shown in figures 5 and 6 the relief 19 is formed by means of an embossing roller 30.

[0072] Prior to said embossing operation S6 and/or prior to said deforming operation S2 the larger material 4, in particular the decorative top layer 3 may be heated, for example by means of infrared or near-infrared radiators 31.

[0073] Whether or not in combination with such heating, the rollers 30 and/or 26 may be cooled, or at least not heated by any other means than the possibly still hot larger material 4 and/or decorative top layer 3.

[0074] It is however also possible that the roller 30 and/or 26 are heated by other means than the possibly still hot larger material 4 and/or decorative top layer 3, for example by means of thermic oil at a temperature above 40°C, or above 65°C. In such case, a prior heating of the larger material 4, or in particular the decorative top layer 3, may be unnecessary.

[0075] Especially in the case of using a heated roller

30 and/or a heated roller 26 it is preferred that the larger material 4 follows a bent path around the respective roller 30-26 for an arc length L corresponding to at least 10°. Such is illustrated here in case of the embossing roller 30, where the larger material 4 follows a bent path around the embossing roller for an arc length L corresponding to about 90°.

[0076] It is to be noted that at least the embossing roller 30 and/or the structured roller 26 that forms the lowered edge areas 6 is preferably paired with at least one counter roller 32-32'. Preferably, said at least one counter roller 32-32' has a rubber surface or mantle and/or has a surface or mantle with a shore hardness A lower than 80 at 23 degrees Celsius, and even better between 60 and 80 at 23 degrees Celsius.

[0077] The cutting operation S1 is performed by means of a plurality of rotating cutting tools 15. In this case the cutting tools 15 are comprised on a cutting roller 33. It is clear that the cutting operation S1 shown here released the substrate 2 from the larger material only at one pair of opposite edges. The cutting operation S1 is more particularly configured to form one or more cut edges 7 in the feeding direction F of the larger material 4.

[0078] The cutting tools 15 are positioned to form opposite cut edges 7 at fixed distances D1-D2 from the upper edges 5 of said decorative panel 1. The position of the cutting tools 15 may be controllable or controlled on the basis of an upstream portion of said larger material as illustrated by means of the arrows 34 and the sensor 35. The sensor may be a tactile and/or optical sensor.

[0079] A supporting means 11 is provided for the cutting tools 15 by means of the counter roller 36. The counter roller may be provided with indentations that match the position of the cutting tools 15.

[0080] As illustrated in figure 7 with the dashed line 37 the larger material 4 may be provided with reference portions 38, preferably prior to said dividing operation S1. In the example the reference portions 38 are formed as indentations in the bottom of said larger material 4. For the forming the counter roller 32' may be provided with protrusions 39 for indenting the bottom of the larger material 4, or a separate means may be provided for realizing excavations, e.g. indentations, in the bottom of the larger material 4.

[0081] The reference portions 38 are provided at a fixed distance D3 from an upper edge 5, and may be used in the cutting operation S1 to align one or more cutting tools 15 such that the lower edge area 6 is parallel, and preferably at predefined distance, to one or more of the cut edges 7.

[0082] As illustrated here, the reference portions 38 are provided in a part of the larger material 4 that is maintained in the finally obtained decorative panels 1. According to a variant, the reference portions 38 may be provided in the so-called technical zone 40, i.e. a part of the larger material 4 that is to be removed in subsequent operations, for example in a milling operation that forms the coupling means at the respective edges.

[0083] Figures 8 and 9 illustrate a variant wherein the lowered edge area 6 is formed by indenting material at an edge of a pre-machined portion 41 of said larger material 4. The pre-machined portion 41 is performed from the top of said larger material 4, through said decorative top layer 3, into said substrate 2. In the example, the pre-machined portion 41 comprises lateral undercuts 42 vertically beneath a remaining decorative top layer portion of said larger material 4.

[0084] As shown in figure 9 the walls 43 of the undercuts 42 are brought closer to each other in the forming operation S2, and are potentially brought into contact. The walls 43 may adhere to each other by thermal fusion or by means of a separate glue, such as tetrahydrofuran glue, or by means of additional, e.g. powdery, substrate material added to the pre-machined portions 41. The latter is an interesting embodiment, when the substrate material comprises a thermoplastic material, such as polyvinyl chloride (PVC), polyethylene (PE), polyethylene terephthalate (PET) or polypropylene (PP), since such material can fluently be brought to create adherence between the walls 43 by means of heating and subsequent cooling, be it forced cooling or cooling at thermic conditions.

[0085] Figure 10 and 11 illustrate variants where the substrate 2 comprises voids 44 at a position vertically underneath the to be formed lowered edge area 6 or in the technical zone 40. In the case of figure 10, said voids are formed by the cells of a foamed material portion 45 within the substrate 2. In the case of figure 11, said voids are formed by chambers 46 comprised in said substrate 2. Such chambers 46 may have a maximum size D4 being at least 20 percent of the undeformed thickness T2 of the substrate 2. Both in the case of figure 10, as in the case of figure 11, the substrate 2 is otherwise formed as one or more solid material layers, in this case as a single solid material layer.

[0086] Figure 12 illustrates another variant. In this case the substrate 2 comprises foamed material portions 45 at the location of the to be formed lower edge areas 6. More particularly, the foamed material portions 45 are in this case available at the surface of the substrate 2.

[0087] Figure 13 illustrates another variant. In this case, the substrate 2 comprises excavations 47 at the location of the to be formed lower edge areas 6. The excavations 47 comprises powder material 48. The powder material 48 may conform to the shape of the lower edge areas 6 during the forming operation S2, for example by melting or otherwise flowing to conform to the mold portions 16. Preferably, said powder material 48 subsequently solidifies to maintain said shape. As an alternative to the powder material a material may be used that shows liquid or paste like behavior upon forming the lower edge areas. Preferably the filling material, be it a powder material 48 or another material, is of thermoplastic nature. Preferably for the filling material the same or similar material as the substrate 2 is used. In the case of a PVC containing substrate, PVC containing powder may be

used, but any other thermoplastic containing powder material may serve the purpose.

[0088] Figure 14 illustrates another variant wherein the substrate 2 comprises zones 49 of different material composition at the location where the lower edge areas 6 are to be formed. In this case the zones 49 extend from the bottom to the top of the respective material layer. In this case, the substrate 2 is formed as a single material layer, and the zones 49 extend from the bottom to the top of the substrate 2. Preferably, the material of the zones 49 shows one or a combination of two or more of the following properties:

- the property that the material of the zones 49 is foamed;
- the property that the material of the zones 49 is foamed to a higher extent than the material of the substrate 2 or the respective material layer outside said zones 49. Potentially the material of the substrate 2 or the respective material layer outside said zones 49 is unfoamed;
- the property that the material of the zones 49 has a lower density than the material of the substrate 2 or the respective material layer outside of said zones 49. Preferably, the average density of said zone 49 is at least 100 kg/m³ lower than the average density of the material of the substrate 2 or the respective material layer outside of said zones 49;
- the property that the material of the zones 49 comprises filler, however in a weight ratio filler/thermoplastic material that is smaller than in case of the material of the substrate 2 or the respective material layer outside of said zones 49. Preferably, the weight ratio filler/thermoplastic material in said zones is below 0.8, while the weight ratio filler/thermoplastic material in the substrate 2 or the respective material layer outside of said zones is at least 1;
- the property that the material of the zones 49 comprises a plasticizer, however in a ratio as expressed by phr (parts per hundred of the resin) which is higher than in case of the material of the respective material layer or the substrate 2 outside of the zones 49. Preferably, the plasticizer content in said zones 49 is at least 5 phr higher than the plasticizer content, if any, in the substrate 2 or respective material layer outside said zones 49;
- the property that the material of the zones 49 and the material of the substrate or the respective material layer outside of the zones 49 both comprise thermoplastic material, preferably the same thermoplastic material, preferably a material chosen from the list consisting of PVC, PP, PE and PET;
- the property that the material of the zones 49 has a shore hardness A value lower than 80, and preferably lower than 20;
- the property that the material of the zones 49 has a shore hardness A which is at least 10 lower than the material of said substrate 2 or the respective material

layer outside of said zones 49;

- the property that the zones 49 and the remainder of the material of the respective material layer or substrate 2 have been obtained through coextrusion.

[0089] Figure 15 illustrates a variant where the substrate 2, prior to the lamination step S4 has been preformed at least partially in accordance with the lower edge areas 6 to be formed.

[0090] Such preforming may be obtained by using a suitable die instead of said slot die 29, or by suitably machining the extruded web shaped substrate material.

[0091] Although the figures 8 to 15 have been described in relation to the method illustrated by means of figures 5 to 7, it is clear that pre-machined portions 41, voids, foamed material portions 45, chambers 46, zones 49, preformed substrates 2, or the use of powder material 48 may be advantageous in combination with any of the methods of the present invention, for example with the method illustrated in figures 1 to 4, or with the method further illustrated in figures 16 to 20, or as illustrated in figures 29 to 30.

[0092] It is further remark that a substrate 2 or substrate material layer that comprises coextruded zones 49 of different composition may find broader application than solely for realizing lower edge areas 6. Such zones 49 may for example be practiced to create an increased flexibility or mechanical strength at the edges for the benefit of the quality of the coupling means to be machined therein and/or to create an increased water repellency or water resistance at these edges while keeping the material costs manageable. Therefor the present invention in accordance with a first special independent aspect also is a method for manufacturing decorative panels 1, said panels 1 at least comprising a substrate 2 and a decorative surface, wherein said method at least comprises the step of forming a material layer of said substrate 2 by means of extrusion, with as a characteristic that said material layer comprises zones 49 of a material composition that is different from the material composition of said material layer outside of said zones 49. Preferably a larger material 4 comprising said material layer is obtained from which by means of a dividing operation S1 at least the substrate 2 of said decorative panel 1 or a material layer thereof can be obtained. It is clear that the decorative surface can be formed in many ways, for example with at least a printed pattern 8, whether or not provided on a carrier layer 17, and/or a transparent wear layer 18 and/or a backing layer 14. It is further clear that said zones 49 are preferably located at one or more edges of said decorative panel 1. Preferably said zones 49 show the properties as listed above in connection to figure 14. It is further clear that the example substrates 2 of figures 10 to 12 and 14 may be obtained through the method of the present special independent aspect. Preferably at least the lower groove lip 25 and/or that portion of the tongue 10 that extends horizontally beyond the pertaining upper edge 5 is entirely realized in such a zone

49. Preferably the zones 49 extend in a direction perpendicular to the upper edges at least over a distance that corresponds to the distance between the upper edges 5 of two to be formed panels 1 that are adjacent in the larger material 4. Preferably at least one, and preferably two edges of a pair of opposite edges of a decorative panel are entirely formed in the material of said zone 49. Preferably similar zones 49 are available at the other pair of opposite edges, in the case of a square or rectangular and oblong decorative panel 1.

[0093] It is further noted that the present invention, in an independent manner, also relates to a decorative panel 1 or a larger material suitable for dividing in decorative panels 1, wherein said panel 1 at least comprises a substrate 2 and a decorative surface, wherein said substrate 2 comprises at least one material layer, with as a characteristic that said material layer comprises zones 49 of a material composition that is different from the material composition of said material layer outside of said zones 49. The material composition of the zones 49, their size and position may further show the characteristics as described in connection to said first special independent aspect here above, without the substrate 2 necessarily comprising a material layer that has been obtained by means of extrusion. Preferably said zones 49 show the properties as listed above in connection to figure 14.

[0094] Figure 16 illustrates a method in accordance with the present invention. The illustrated method is a further example of said second possibility mentioned in the introduction. Herein the lower edge areas 6 are formed prior to said cutting operation S1. In particular the printed carrier layer 17, the transparent wear layer 18 and/or the backing layer 14 are laminated to form a decorative top layer 3 in a lamination operation S4A prior to laminating the obtained decorative top layer 3 to said substrate 2 in a subsequent lamination operation S4B. In said lamination operation S4A a decorative top layer 3, as shown in figure 17 is obtained, namely comprising lower edge areas 6 at the surface thereof having the transparent wear layer 18, while the opposite surface is maintained substantially flat or flat to allow for fluent lamination in said lamination operation S4A. In the example of figure 16, this is obtained through a forming operation S2 by means of a structured roller 26 indenting said decorative top layer 3 prior to said lamination operation S4B.

[0095] Figure 18 illustrates a variant where a pre-structured backing layer 14 is used. In such case the availability of the structured roller 26 may still be of interest to obtain a good lamination quality onto said pre-structured backing layer 14. The pre-structured backing layer 14 comprises thinned sections 50 at least at the location where said lower edge areas are to be obtained.

[0096] Figure 19 and 20 show a further variant where a backing layer 14 is used that comprises removed sections 51 corresponding to the lower edge areas 6 to be formed. Such embodiment is of interest to enable the formation of said lower edge areas 6 at lower power or deformation. Figure 20 clearly illustrate that, despite the

removed sections 50, the backing layer 14 remains a one-piece layer.

[0097] Regarding the variants of figures 18 to 20 it is noted that these backing layers 14 with thinned sections 50 and/or removed sections 51 may be provided in a prefabricated manner from a roll, or be provided with said thinned sections 50 and/or removed sections 51 prior to and in line with said lamination operation S4A, for example immediately prior or practically immediately prior to the lamination operation S4A, or in between the unrolling and the lamination operation S4A.

[0098] Figure 21 illustrates a method in accordance with the third possibility for forming a lowered edge area 6 mentioned in the introduction. A larger material 4 comprising a substrate 2 and a decorative top layer 3 is formed by means of a pressing operation S4' wherein a plurality of prefabricated layers 17-18-14 are adhered to each other. In this case the printed carrier layer 17, the transparent wear layer 18 and the backing layer 14 are adhered to the substrate 2 by means of said pressing operation S4'. Lower edge areas 6 are formed simultaneously with said pressing operation S4' by means of a structured press element 52 coming into contact with said decorative top layer 3 to be formed. In the example, the backing layer 14 comprises removed sections 51, similar or identical to that described in connection to figures 19 and 20.

[0099] As illustrated by the dashed line 53 a bottom press plate 54 may be shaped to provide reference portions 38 in the bottom of the larger material 4. Such reference portions may be similar to those illustrated in connection to figure 7.

[0100] It is clear that the pressing operation S4', as illustrated in figure 21, makes use of a single daylight press. Of course, as a not represented alternative, a multiple daylight press may be used, wherein then several stacks composed of at least a substrate 2 and one or more layers 14-17-18 of a decorative top layer 3, are positioned on top of each other with one or more intermediate pressing elements 52, and pressed at once.

[0101] Figure 22 illustrates that the transparent wear layer 18 may be provided with thinned sections 50 corresponding in position to the lower edge areas 6 to be formed. Such transparent wear layer 18 may be used in combination with any of the methods described in the preceding and following figures and/or in the introduction and claims. It is clear that such transparent wear layer 18 with thinned sections 50 will at least partially accommodate a lower edge area 6 with minimized deformation. The thinned sections 50 may provide for a lower abrasion resistance at the surface of the lower edge areas 6. However, the inventors deem this of no interest, as the lowered edge areas 6 are usually so small that they cannot be walked upon, and are hence less subject to wear and abrasion.

[0102] Figure 23 illustrates that a reference portion 38 may be used to align the larger material 4 with a dividing operation S1 or dividing apparatus 20. In the example of

figure 20, a single reference portion 38 is used for the alignment. Herein a guiding tool 38A engages with said reference portion 38. As is the case here, such reference portion 38 is preferably available in the middle 20% of the width of the larger material 4. In so doing a possible misalignment is limited, and is expected to be largest with the outer decorative panels 1 to be divided out. It is possible however that, in accordance with a preferred embodiment, the position of the cutting tools 15 is controllable or controlled on the basis of a material portion of said larger material 4, in order to minimize potential misalignment in the width direction.

[0103] Figure 24 illustrates an alternative wherein multiple reference portions 38 are used subsequently to divide out one decorative panel at a time and/or to perform one cut at a time. In so doing the larger material may be re-aligned multiple times using a suitable reference portion 38, preferably the reference portion 38 closest to the cut to be made. In the view of figure 24 after having performed a cut, the divided out decorative panel 1 can be removed, the larger material 4 shifted towards the viewer in the direction of the arrow 55 and realigned using the reference portion 38A. Afterwards a subsequent cut to divide out the next decorative panel 1 is performed.

[0104] Figure 25 shows an enlargement of the set-up for the embossing roller 30, the structured roller 26 and counter roller 32' from figure 5. According to a not-represented variant, the embossing roller and the structured roller may swap positions, i.e. a method wherein the forming operation S2 is performed prior to and in line with the embossing operation S6.

[0105] Figure 26 shows an alternative set-up for the forming operation S2 per se. Herein the structured roller 26 is paired with a plurality of counter rollers 32A-32B-32C, and optionally with a belt 56 provided on said counter rollers 32A-32B-32C. Herein the larger material 4 follows a bent path around the roller 26 for an arc length L corresponding to at least 100°, in this case even 180°.

[0106] Preferably, the pressure exerted on the larger material 4 at the location of the counter rollers 32A-32B-32C increases in the feed direction F. The contact at counter roller 32A is hence preferably at lower contact pressure than the contact at counter roller 32B which is in its turn preferably at lower contact pressure than the contact at counter roller 32C. According to a variant, or in combination therewith, the gap 57A-57B-57C between the counter rollers 32A-32B-32C and embossing roller 26 diminishes in the feed direction F. Thus the gap 57A at the location of counter roller 32A is preferably larger than the gap 57B at counter roller 32B which is in its turn preferably larger than the gap 57C at counter roller 32C. The pressure exerted on the larger material 4 and/or the gaps 57A-57C-57B may be adjustable by changing the position of the respective counter rollers 32A-32B-32C as shown by means of the arrows in figure 26.

[0107] Preferably, at least one of said plurality of counter rollers 32A-32B-32C has a rubber surface. Preferably the first counter roller 32A in feed direction F has a rubber

surface. In the case a belt 56 is used, this preferably concerns a steel belt, which may be heated or not.

[0108] Preferably the structured roller 26 of the embodiment of figure 26 is a heated roller, for example heated by means of thermic oil or another fluid at a temperature above 40°C, or above 65°C. Other manners of heating the roller 26 are of course not excluded, and it is also possible that the larger material 4 is heated prior to entering the gap between the first counter roller 32A and the structured roller 26. In such case the structured roller 26 may be cooled, or at least not heated by any other means than the possibly still hot larger material 4 and/or decorative top layer 3.

[0109] The inventors have found that pairing a structured roller 26 and/or an embossing roller 30 with a plurality, i.e. at least, two counter rollers 32A-32B leads to a better reproduction or copying of the relief of the embossing roller 30 and/or structured roller 26 into the decorative top layer 3, in particular into at least the transparent wear layer 18. The increase of the contact pressure in feeding direction F and/or the decrease of the gap 56 in feeding direction F is beneficial in moving the material of the decorative top layer 3, such as at least the material of the transparent wear layer 18, and potentially the material of the substrate 2, in the case of deep structures requiring a deformation of the substrate 2. An enhanced flow of the material of the decorative top layer 3 and/or the substrate 2 leads to a better conformity of the obtained relief to the structure on the embossing roller 30 and/or the structured roller 26 that forms the lower edge areas 6.

[0110] The findings explained above make clear that the present invention, in accordance with a second special independent aspect also is a method for manufacturing a decorative panel, or a larger material suitable to be divided into a plurality of decorative panels, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said method comprises an embossing operation S2-S6 wherein at least the decorative top layer 3 is provided with indentations, with as a characteristic that said embossing operation is performed by means of a roller 26-30 having protrusions for forming said indentations and wherein said roller 26-30 is paired with at least two counter rollers 32A-32B-32C, preferably at least three counter rollers 32A-32B-32C.

[0111] Preferably, in accordance with said second special independent aspect, the method further shows one or more of the following characteristics:

- said embossing operation S2-S6 is performed on said larger material 4, wherein the larger material preferably follows a bent path around the roller 26-30 for an arc length L corresponding to at least 100°, and preferably at least 150°;
- said embossing operation S2-S6 is performed on said larger material 4 and in that the pressure exerted on the larger material 4 at the location of said at least two counter rollers 32A-32B-32C increases in the

feed direction F of said larger material 4;

- said embossing operation S2-S6 is performed on said larger material 4 and in that the gap 57 between said at least two counter rollers 32A-32B-32C and the roller 26-30 having said protrusions diminishes in the feed direction F of said larger material 4;
- said roller 26-30 comprising said protrusions is a heated roller, for example heated by means of thermic oil or another fluid at a temperature above 40°C, or above 65°C;
- said roller 30 comprises protrusions suitable for forming indentations in the shape of a wood pore or wood grain and/or said roller 30 is applied as an embossing roller in any of the methods described in the introduction and/or in the drawings;
- said roller 26 comprises protrusions being mold portions 16 for forming lower edge areas 6 and/or said roller 26 is applied as a structured roller 26 for forming lower edge areas 6 in any of the methods described in the introduction and/or in the drawings.

[0112] It is clear that one or more of the counter rollers 32A-32B-32C may be provided with protrusions 39 for indenting the bottom of the larger material 4, similar to the protrusions 39 illustrated by means of figure 7. In this way reference portions 38 may be formed at a fixed distance D3 from an upper edge 5, for example for positioning the larger material 4 in the cutting operation S1.

[0113] Figures 27 and 28 show an alternative for the structured roller 26 used in said forming operation S2. Herein the mold portions 16 are comprised on belts 58 which are pressed down on the decorative top layer 3 and/or the substrate 2 by means of a roller 26A. The roller 26A is paired with a counter roller 32 at the bottom of the substrate 2. The position of the belts 58 may be controlled or controllable in the transverse direction as indicated with the arrows 59, for example based on a tactile and/or optical section of an upstream portion of said decorative top layer 3.

[0114] Figure 29 shows a further method for forming lowered edge areas 6, such in accordance with the second possibility therefor as mentioned in the introduction. Herein the lowered edge areas 6 are formed prior to the cutting operation S1.

[0115] As shown in Figure 29, the substrate 2 is provided in a continuous manner, for example as is the case here with an extrusion operation S3. An additional foamable layer 60, for example a PVC comprising a foaming agent, such as azodicarbonamide, is applied on top of the extruded substrate layer 2A. The foamable layer 60 is then provided with a foaming inhibitor by means of a printing operation, in this case by means of the roller 61. The foaming inhibitor is applied in a pattern corresponding to areas where less foaming is desired, such as at least in positions corresponding to lower edge areas 6 to be formed.

[0116] Downstream from said roller 61, in the feeding direction F, a heat treatment, for example by means of

an oven 62 is used to initiate the foaming. In the represented case the foaming takes place after the lamination step S4, and before the not represented dividing operation S1. Alternatively, the heat treatment may be executed with an oven 62A prior to said lamination operation S4. As a further alternative, the heat treatment may be executed after or simultaneously with said dividing operation S1.

[0117] Figure 30 illustrates a cross-section of the larger material 4 obtained through the method of figure 29. The substrate 2, which included the extruded substrate layer 2A and the foam layer 60 is shaped in accordance with the lower edge areas 6, at least in part due to the differential foaming caused by means of the foaming inhibitor.

[0118] It is clear that according to variants, embodiments described in connection with figures showing an extrusion operation S3 may be alternatively put to practice by means of other continuous operations such as by means of one or more scattering and/or calendaring operations.

[0119] The decorative panels 1 and large materials 4 obtained through any of the methods of the invention show in themselves technical features that have inventive merit, even when they would be obtained through another method. It is therefore clear that the present invention further, in accordance with a third special independent aspect, relates to decorative panels 1 or larger materials 4 suitable for dividing in plurality of such decorative panels 1, which not necessarily are obtained through one of the afore disclosed methods, with as a characteristic that said decorative panel 1 or larger material 4 comprises a substrate 2 and a decorative top layer 3, wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said panel 1 comprises at least one and preferably at both upper edges 5 of a pair of opposite side edges a lower edge area 6, wherein said decorative panel 1 or larger material 4 shows one or more of the following properties:

- the decorative panel or larger material comprises at least one reference portion 38, preferably formed as an excavation or indentation at the bottom thereof. Said reference portion 38 preferably being positioned closer to one of said upper edges 5 than to the other. Such reference portion 38 or decorative panel 1 or larger material 4 may further show the features described in connection to figure 7, 21, 23 or 24, or the features thereof described in the introduction without necessarily being manufactured according to the methods disclosed in these figures or introduction. In particular the positioning with respect to the upper edges 5 may be similar or identical;
- the larger material 4 comprises at least one reference portion 38 positioned within a material portion to be removed during said dividing or in the so-called technical zone 40;
- the substrate 2 comprises voids 44, chambers 46

and/or foamed material portions 45 at a location vertically beneath said lower edge area 6. Such voids 44, chambers 46 and/or foamed material portions 45 may further show the features described in connection to figures 10, 11 and/or 12, and/or the features disclosed in this respect in the introduction. In particular the positioning of such voids 44, chambers 46 and/or foamed material portions 45 with respect to the upper edges 5 or lower edge areas 6 may be similar or identical without the decorative panels 1 or larger material 4 necessarily being manufactured according to the methods disclosed there;

- the substrate 2 the properties of the above paragraph, wherein said voids 44, chambers 46 and/or foamed material portions 45 are crushed and/or deformed at a location vertically beneath said lower edge area 6;
- the substrate 2 or a material layer within said substrate 2 comprises zones 49 of different material composition as compared to said substrate 2 or material layer outside of said zones 49. Preferably such zone 49 further shows one or more of the properties described in connection with figure 14 and/or the first special independent aspect of the invention.
- the substrate 2 comprises thinned sections 50, for example as further described in connection to figure 15;
- the decorative top layer 3 comprises a printed carrier layer 17 and/or a transparent wear layer 18 and/or a backing layer 14. Preferably at least one of said layers comprises thinned sections 50 and/or removed sections 51, as for example further described in connection to any of figures 18 to 20 and 22;
- the decorative top layer 3 continues uninterruptedly from the global upper surface of the decorative panel onto and over said lower edge area 6;
- the substrate 2 locally comprises glue or thermoplastic material below or immediately below said lower edge area. Such embodiment may for example be obtainable through the methods described in connection to figures 9 or 13.

[0120] It is clear that decorative panels 1 or larger materials 4 with any of the above technical features have the advantage that they may be manufactured with fewer needed power and/or with increased accuracy and/or forming a more realistic imitation of chamfered products or other products with a lower edge area 6.

[0121] It is repeated in connection to the drawings and/or any of the above mentioned independent aspects, that said substrate 2 may comprise at least a thermoplastic material containing board or layer, preferably a filled synthetic composite comprising thermoplastic material and filler material, preferably mineral filler materials, such as sand, talcum, chalk or other forms of CaCO₃.

[0122] Preferably, said decorative top layer 3 comprises a motif preferably formed by a printed pattern 8. Said decorative top layer may comprise a carrier layer 17 upon

which said printed pattern 8 is provided and a transparent wear layer 18 applied on top of said printed pattern 8. Said carrier layer may be a thermoplastic foil, preferably a PVC foil, a paper layer or a wood veneer. Preferably, said wear layer 18 is a thermoplastic foil, preferably a PVC foil.

[0123] In accordance with some embodiments, said decorative top layer comprises a backing layer 14, wherein said backing layer preferably forms the majority of the thickness T of said decorative top layer 3, or at least 45 percent thereof. Said decorative top layer 3 may be assembled from said backing layer, printed carrier layer and wear layer by means of thermal lamination, i.e. preferably in the absence of separate glue layers in between said layers. Preferably said decorative top layer 3, or at least the bottom layer thereof, is connected to said substrate 2 by means of thermal lamination as well, i.e. in the absence of a separate glue layer. However it is not excluded that said decorative top layer 3, or at least the bottom layer thereof, is glued to said substrate 2.

[0124] Further it is remarked that using a counter roller 32-32' with a soft and/or rubber surface paired up with an embossing roller 30 or structured roller 26 for forming lowered edge areas leads to a better reproduction of the embossing roller's or structured roller's relief into the decorative top layer 3 and/or the substrate 2. This is especially the case where hot embossing is practiced, namely in the cases where the embossing roller 30 and/or the structured roller 26 is heated. It is hence clear that the present invention, in accordance with a fourth special independent aspect is a method for manufacturing a decorative panel, or a larger material suitable to be divided into a plurality of decorative panels 1, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said method comprises an embossing operation S2-S6 wherein at least the decorative top layer 3 is provided with indentations, with as a characteristic in that said embossing operation S2-S6 is performed by means of a roller 26-30 having protrusions for forming said indentations and wherein said roller 26-30 is paired with at least one counter roller 32-32'-32A-32B-32C, said at least one counter roller having a rubber surface and/or having a surface with a shore hardness A lower than 80 at 23 degrees Celsius, and even better between 60 and 80 at 23 degrees Celsius. Preferably the method of the fourth special independent aspect is further characterized in that said roller 26-30 having said protrusions is a heated roller for example heated by means of thermic oil or another fluid at a temperature above 40°C, or above 65°C. Further the method of the fourth special independent aspect may show one or a combination of two or more of the following features:

- said roller 30 comprises protrusions suitable for forming indentations in the shape of a wood pore or wood grain;
- said roller 26 comprises protrusions being mold portions 16 for forming lower edge areas 6;

- said embossing operation S2-S6 is performed on said larger material 4 and in that the larger material 4 follows a bent path around the roller 26 for an arc length L corresponding to at least 100°, and preferably at least 150°;
- said method further shows the characteristics of the second special independent aspect and/or the preferred embodiments thereof;
- said roller having said protrusions is applied as an embossing roller 30 or a structured roller 26 in any of the methods described in the introduction or in the drawings.

[0125] From the above it is clear that the invention disclosed herein may be defined by means of one or more of the below numbered paragraphs, of which preferred embodiments have been described in more detail above.

1.- Method for manufacturing a decorative panel, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said substrate 2 and/or decorative top layer 3 is obtained from a larger material 4 by means of a dividing operation S1, characterized in that said panel 1 comprises at least one and preferably at both upper edges 5 of a pair of opposite side edges a lower edge area 6, wherein said lower edge area 6 is obtained prior to or during said dividing operation S1.

2.- Method according to numbered paragraph 1, characterized in that said dividing operation S1 comprises performing a cutting operation releasing at least said substrate 2 from said larger material 4 at at least two opposite edges.

3.- Method according to numbered paragraph 2, characterized in that said cutting operation forms opposite cut edges 7 for releasing said at least two opposite edges, wherein said opposite cut edges are positioned at a mutually different distance D1-D2 from said upper edges 5 of said panel.

4.- Method according to any of the preceding numbered paragraphs, characterized in that said lower edge area 6 is formed simultaneously with, practically simultaneously with, or during said dividing operation S1.

5.- Method according to any of the preceding numbered paragraphs, characterized in that said dividing operation S1 comprises:

- providing said larger material 4 in a dividing apparatus;
- indenting said larger material 4 at the location of said upper edges 5 in order to at least partially

- form said lower edge area 6;
- releasing said substrate 2 and/or said decorative top layer 3 from said larger material 4 by means of a cutting operation with a cutting tool 15, for example by means of a knife that is forced in and through said larger material. 5
- 6.- Method according to numbered paragraph 5, characterized in that said indenting is executed by means of a mold or mold portions 16 that press down on said substrate 2 and/or said decorative top layer 3. 10
- 7.- Method according to numbered paragraph 6, characterized in that said mold or mold portions 16 are engaged with said substrate 2 and/or said decorative layer 3 at the start of said cutting operation, and are preferably still engaged at the end of said cutting operation. 15
- 8.- Method according to numbered paragraph 6 or 7, characterized in that said mold or mold portions 6 are movable with respect to said cutting tool. 20
- 9.- Method according to any of numbered paragraphs 6 to 8, characterized in that said mold or mold portions 6 are substantially at standstill during the cutting operation, i.e. while the cutting tool 15 is moved into and through said substrate 2 and/or decorative layer 3. 25
- 10.- Method according to any of the preceding numbered paragraphs, characterized in that said dividing operation S1 comprises a cutting operation, more particularly a punching operation, namely an operation in which a stationary, i.e. non-rotating, cutting blade or knife is pressed down to, into and through the material to be cut. 30
- 11.- Method according to any of numbered paragraphs 2 to 3, characterized in that said lower edge area 6 is formed in line with, preferably prior to, said cutting or dividing operation S1 releasing at least said substrate 2 from said larger material 4 at at least two opposite edges. 35
- 12.- Method according to numbered paragraph 11, characterized in that said lower edge area 6 is formed by means of one or more structured rollers and/or by means of one or more belts indenting said larger material 4. 40
- 13.- Method according to numbered paragraph 11 or 12, characterized in that said cutting or dividing operation S1 is formed by means of a plurality of, preferably rotating, cutting tools 15. 45
- 14.- Method according to numbered paragraph 13, characterized in that said cutting tools are positioned

to form opposite cut edges 7 at predefined distances D1-D2 from said upper edges 5 of said panel 1.

15.- Method according to numbered paragraph 14, characterized in that the position of said cutting tools 15 is controlled on the basis of an upstream portion of said larger material 4.

16.- Method according to any of numbered paragraphs 11 to 15, characterized in that said method further comprises a step of providing a larger material 4 comprising said substrate 2 and/or decorative top layer 3 by means of a continuous operation preferably including one or more extrusion operations S3, scattering operations, pressing operations and/or lamination operations S4.

17.- Method according to numbered paragraph 16, characterized in that said lowered edge area 6 and said cutting or dividing operation S1 is performed in line with said step of providing said larger material 4.

18.- Method according to any of the preceding numbered paragraphs, characterized in that said lowered edge area 6 is formed by indenting material at an edge of a pre-machined portion 41 of said larger material 4.

19.- Method according to numbered paragraph 18, characterized in that said pre-machined portion 41 is performed from the top of said larger material 4 at least into said substrate 2.

20.- Method according to numbered paragraph 18 or 19, characterized in that said pre-machined portion 41 comprises an undercut 42.

21.- Method according to any of numbered paragraphs 11 to 17, characterized in that said method further comprises a step of providing a larger material 4 comprising at least said substrate 2, wherein said substrate 2 is provided with lowered substrate areas at the location of said lower edge areas 6, prior to application of said decorative top layer 3 to said substrate 2.

22.- Method according to any of numbered paragraphs 11 to 17, characterized in that said method further comprises a step of providing a larger material 4 comprising at least said substrate 2, wherein a decorative top layer 3 is applied to said substrate 2, wherein said decorative top layer 3 or a portion thereof comprises a structure prior to application thereof to said substrate 2.

23.- Method according to numbered paragraph 22, characterized in that said structure of said decorative top layer 3 or the respective portion thereof 3 in-

cludes said lowered edge area 6.

24.- Method according to numbered paragraph 22 or 23, characterized in that said decorative top layer 3 comprises a plurality of layers 14-17-18 and comprises a motif. 5

25.- Method according to numbered paragraph 24, characterized in that a layer 14 underlying said motif comprises thinned portions 50, removed portions 51 or openings basically corresponding to the position or structure of said lowered edge area 6. 10

26.- Method according to numbered paragraph 24 or 25, characterized in that at least two, and preferably all of said plurality of layers 14-17-18 are laminated to each other, prior to their application to said substrate 2. 15

27.- Method according to any of numbered paragraphs 1 to 3, characterized in that said method further comprises a step of providing a larger material 4 comprising said substrate 2 and/or decorative top layer 3 by means of a pressing operation wherein a plurality of prefabricated layers 14-17-18 are adhered to each other. 20 25

28.- Method according to numbered paragraph 27, characterized in that said lower edge area 6 is formed simultaneously with said pressing operation. 30

29.- Method according to numbered paragraph 27 or 28, characterized in that at least one of said prefabricated layers comprises thinned sections 50 and/or removed sections 51, preferably at least at the location where said lower edge area 6 is obtained. 35

30.- Method according to numbered paragraph 29, characterized in that said at least one of said prefabricated layers 14-17-18 is a thermoplastic layer from which sections has been removed by means of a cutting operation, more particularly a punching operation. 40 45

31.- Method according to numbered paragraph 30, characterized in that said at least one of said prefabricated layers is a one-piece layer.

32.- Method according to any of the preceding numbered paragraphs, characterized in that said larger material 4 is provided with a reference portion 38 prior to said dividing operation S1. 50

33.- Method according to numbered paragraph 32, characterized in that said reference portion is used to align the larger material 4 to the dividing operation S1 or part thereof, more particularly to one or more 55

cuts performed therein, or vice-versa, namely wherein said reference portion 38 is used to align one or more cutting tools 15 performing said cuts to the larger material 4, or both.

34.- Method according to numbered paragraph 33, characterized in that said aligning is such that the lower edge area 6 is parallel to one or more of the cuts performed in said dividing operation S1.

35.- Method according to any of numbered paragraphs 32 to 34, characterized in that said reference portion 38 comprises an indentation or excavation provided in the bottom of said larger material 4.

36.- Method according to any of numbered paragraphs 32 to 35, characterized in that said reference portion 38 comprises an edge of said larger material 4.

37.- Method according to any of numbered paragraphs 32 to 36, characterized in that said reference portion 38 comprises a visual or tactile marking available at the side of said larger material 4 that comprises said lower edge area 6.

38.- Method according to any of numbered paragraphs 32 to 37, characterized in that said reference portion 38 is provided at a predefined distance D3 from an upper edge 5 of said panel 1.

39.- Method according to any of numbered paragraphs 32 to 38, characterized in that said reference portion 38 cooperates with a stop or guiding tool 38A in said dividing operation S1.

40.- Method according to any of the preceding numbered paragraphs, characterized in that said decorative top layer 3 continuous uninterruptedly from on the global upper surface of said panel 1 to and over said lower edge area 6.

41.- Method according to any of the preceding numbered paragraphs, characterized in that said lower edge areas 6 at opposite upper edges mutually extend to a same depth and/or over a same horizontal distance, as measured perpendicularly to said upper edge 5.

42.- Method according to any of the preceding numbered paragraphs, characterized in that said lower edge areas 6 are formed as chamfers.

43.- Method according to any of the preceding numbered paragraphs, characterized in that at least two substrates 2 and/or top layers 3 for respective panels 1 are obtained or obtainable from said larger material 4.

44.- Method according to any of the preceding numbered paragraphs, characterized in that said substrate 2 at the location of said lower edge area 6 is compressed or deformed.

45.- Method according to any of the preceding numbered paragraphs, characterized in that said substrate 2 and/or decorative top layer 3 show one or a combination of two or more of the following properties:

- the substrate 2 and/or the decorative layer 3 comprise a foamed material layer, for example a closed cell foam of a thermoplastic material such as PVC;
- the substrate 2 and/or the decorative layer 3 comprise one or more voids, at least at a position vertically underneath said lower edge area;
- the substrate 2 and/or the decorative layer 3 comprise material having a shore hardness A lower than 80, and preferably higher than 20.

46.- Method according to any of the preceding numbered paragraphs, characterized in that said substrate 2 comprises at least one of an Magnesiumoxychloride or Magnesiumoxysulphate containing board or layer.

47.- Method according to any of the preceding numbered paragraphs, characterized in that said substrate 2 comprises at least a thermoplastic material containing board or layer, preferably a filled synthetic composite comprising thermoplastic material and filler material, preferably mineral filler materials, such as sand, talcum, chalk or other forms of CaCO_3 .

48.- Method according to any of the preceding numbered paragraphs, characterized in that said decorative top layer 3 comprises a motif preferably formed by a printed pattern 8 or a wood veneer.

49.- Method according to numbered paragraph 48, characterized in that said decorative top layer 3 comprises a carrier layer 17 upon which said printed pattern 8 is provided and a transparent wear layer 18 applied on top of said printed pattern 8.

50.- Method according to numbered paragraph 49, characterized in that said carrier layer 17 and/or said transparent wear layer 18 is a thermoplastic foil, preferably a PVC foil.

51.- Method according to numbered paragraph 50, characterized in that said decorative top layer 3 comprises from bottom to top at least a backing layer 14, a printed carrier layer 17 and a transparent wear layer 18, preferably said backing layer 14 forms the majority of the thickness T of said decorative top layer

3, or at least 45 percent thereof.

52.- Method according to numbered paragraph 51, characterized in that said backing layer 14 is a thermoplastic layer, preferably of soft PVC, namely PVC with more than 10 phr plasticizer, and/or of a thermoplastic foamed material.

53.- Method according to any of numbered paragraphs 1 to 3 or 18 to 26 or 32 to 52, characterized in that said lower edge area 6 is formed by means of one or more structured rollers 26 and/or by means of one or more belts 58 indenting said larger material 4.

54.- Method for manufacturing a decorative panel whether or not according to any of numbered paragraphs 1 to 26, possibly in combination with any of numbered paragraphs 32 to 52, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said substrate 2 is a mineral containing substrate and/or a thermoplastic material containing substrate 2, wherein said substrate 2 and decorative top layer 3 is obtained from a larger material 4 by means of a dividing operation S1, characterized in that said method comprises a lamination operation S4 for providing at least a part of said decorative top layer 3, preferably a part having a printed pattern 8 on said substrate 2, wherein said lamination operation S4 is a continuous operation wherein the respective part of said decorative top layer 3 is fed to the lamination operation S4 in a feeding direction F, and wherein said panel 1 is rectangular and oblong with the longitudinal edges thereof being directed transversely to said feeding direction 1.

55.- Method for manufacturing a decorative panels, wherein said panels 1 at least comprise a substrate 2 and a decorative surface, wherein said method at least comprises the step of forming a material layer of said substrate 2 by means of extrusion, characterized in that said material layer comprises one or more zones 49 of a material composition that is different from the material composition of said material layer outside of said zones 49.

56.- Method according to numbered paragraph 55, characterized in that a larger material 4 comprising said extruded material layer is obtained from which by means of a dividing operation S1 at least the substrate 2 of said decorative panel 1 or at least a material layer thereof is obtained.

57.- Method according to numbered paragraph 55 or 56, characterized in that said decorative surface comprises at least a printed pattern 8, whether or not provided on a carrier layer 17, and/or a transparent wear layer 18 and/or a backing layer 14.

58.- Method according to any of numbered paragraphs 55 to 57, characterized in that said zones 49 are located at one or more edges of said decorative panel 1.

59.- Method according to any of numbered paragraphs 55 to 58, characterized in that said zones 49 show one or a combination of two or more of the following properties:

- the property that the material of the zones 49 is foamed;
- the property that the material of the zones 49 is foamed to a higher extent than the material of the substrate 2 or the respective material layer outside said zones 49, wherein said material outside of said zones 49 is preferably unfoamed;
- the property that the material of the zones 49 has a lower density than the material of the substrate 2 or the respective material layer outside of said zones 49;
- the property that the material of the zones 49 comprises filler, however in a weight ratio filler/thermoplastic material that is smaller than in case of the material of the substrate 2 or the respective material layer outside of said zones 49;
- the property that the material of the zones 49 comprises a plasticizer, however in a ratio as expressed by phr (parts per hundred of the resin) which is higher than in case of the material of the respective material layer or the substrate 2 outside of the zones 49;
- the property that the material of the zones 49 and the material of the substrate 2 or the respective material layer outside of the zones 49 both comprise thermoplastic material, preferably the same thermoplastic material, preferably a material chosen from the list consisting of PVC, PP, PE and PET;
- the property that the material of the zones 49 has a shore hardness A value lower than 80, and preferably lower than 20;
- the property that the material of the zones 49 has a shore hardness A which is at least 10 lower than the material of said substrate 2 or the respective material layer outside of said zones 49;
- the property that the zones 49 and the remainder of the material of the respective material layer or substrate 2 have been obtained through co-extrusion.

60.- Decorative panel or larger material suitable for dividing in a plurality of decorative panels 1, wherein said panel 1 at least comprises a substrate 2 and a decorative surface, wherein said substrate 2 comprises at least one material layer, characterized in that said material layer comprises zones 49 of a ma-

terial composition that is different from the material composition of said material layer outside of said zones 49.

61.- Decorative panel or larger material, characterized in that said decorative surface comprises at least a printed pattern 8, whether or not provided on a carrier layer 17, and/or a transparent wear layer 18 and/or a backing layer 14.

62.- Decorative panel or larger material according to any of numbered paragraphs 60 or 61, characterized in that said zones 49 are located at one or more edges of said decorative panel 1.

63.- Decorative panel or larger material according to any of numbered paragraphs 60 to 62, characterized in that said zones 49 show one or a combination of two or more of the following properties:

- the property that the material of the zones 49 is foamed;
- the property that the material of the zones 49 is foamed to a higher extent than the material of the substrate 2 or the respective material layer outside said zones 49, wherein said material outside of said zones 49 is preferably unfoamed;
- the property that the material of the zones 49 has a lower density than the material of the substrate 2 or the respective material layer outside of said zones 49;
- the property that the material of the zones 49 comprises filler, however in a weight ratio filler/thermoplastic material that is smaller than in case of the material of the substrate 2 or the respective material layer outside of said zones 49;
- the property that the material of the zones 49 comprises a plasticizer, however in a ratio as expressed by phr (parts per hundred of the resin) which is higher than in case of the material of the respective material layer or the substrate 2 outside of the zones 49;
- the property that the material of the zones 49 and the material of the substrate 2 or the respective material layer outside of the zones 49 both comprise thermoplastic material, preferably the same thermoplastic material, preferably a material chosen from the list consisting of PVC, PP, PE and PET;
- the property that the material of the zones 49 has a shore hardness A value lower than 80, and preferably lower than 20;
- the property that the material of the zones 49 has a shore hardness A which is at least 10 lower than the material of said substrate 2 or the respective material layer outside of said zones 49;
- the property that the zones 49 and the remainder

of the material of the respective material layer or substrate 2 have been obtained through co-extrusion, preferably through a method in accordance with any of numbered paragraphs 54 to 58.

64.- Decorative panel or larger material for dividing in a plurality of decorative panels, characterized in that said decorative panel 1 or larger material 4 comprises a substrate 2 and a decorative top layer 3, wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said panel 1 comprises at least one and preferably at both upper edges 5 of a pair of opposite side edges a lower edge area 6, wherein said decorative panel 1 or larger material 4 shows one or more of the following properties:

- the decorative panel or larger material comprises at least one reference portion 38, preferably formed as an excavation or indentation at the bottom thereof; said reference portion 38 preferably being positioned closer to one of said upper edges 5 than to the other;
- the larger material 4 comprises at least one reference portion 38 positioned within a material portion to be removed during said dividing;
- the substrate 2 comprises voids 44, chambers 46 and/or foamed material portions 45 at a location vertically beneath said lower edge area 6;
- the substrate 2 comprises crushed or deformed voids 44, chambers 46 and/or foamed material portions 45 at a location vertically beneath said lower edge area 6;
- the substrate 2 or a material layer within said substrate 2 comprises zones 49 of different material composition as compared to said substrate 2 or material layer outside of said zones 49;
- the substrate 2 comprises thinned sections 50;
- the decorative top layer 3 comprises a printed carrier layer 17 and/or a transparent wear layer 18 and/or a backing layer 14. Preferably at least one of said layers comprises thinned sections 50 and/or removed sections 51;
- the decorative top layer 3 continues uninterruptedly from the global upper surface of the decorative panel onto and over said lower edge area 6.

65.- Method for manufacturing a decorative panel, or a larger material suitable to be divided into a plurality of decorative panels 1, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said method comprises an embossing operation S2-S6 wherein at least the decorative top layer 3 is provided with indentations, characterized in that said embossing operation S2-S6 is performed by means of a roller 26-30 having protrusions for

forming said indentations and wherein said roller 26-30 is paired with at least two counter rollers 32A-32B-32C, preferably at least three counter rollers 32A-32B-32C.

66.- Method according to numbered paragraph 65, characterized in that said embossing operation S2-S6 is performed on said larger material 4 and in that the larger material 4 follows a bent path around the roller 26 for an arc length L corresponding to at least 100°, and preferably at least 150°.

67.- Method according to numbered paragraph 65 or 66, characterized in that said embossing operation S2-S6 is performed on said larger material 4 and in that the pressure exerted on the larger material 4 at the location said at least two counter rollers 32A-32B-32C increases in the feed direction F of said larger material 4.

68.- Method according to any of numbered paragraphs 65 to 67, characterized in that said embossing operation S2-S6 is performed on said larger material 4 and in that the gap 57 between said at least two counter rollers 32A-32B-32C and the roller 26-30 having said protrusions diminishes in the feed direction F of said larger material 4.

69.- Method according to any of numbered paragraphs 65 to 68, characterized in that said roller 26-30 comprising said protrusions is a heated roller, for example heated by means of thermic oil or another fluid at a temperature above 40°C, or above 65°C.

70.- Method according to any of numbered paragraphs 65 to 69, characterized in that said roller 30 comprises protrusions suitable for forming indentations in the shape of a wood pore or wood grain, and/or is applied as an embossing roller 30 in a method according to any of the methods in accordance with numbered paragraphs 53-59.

71.- Method according to any of numbered paragraphs 65 to 70, characterized in that said roller 26 comprises protrusions being mold portions 16 for forming lower edge areas 6 and/or is applied as a structured roller 26 in a method according to any of the methods in accordance with numbered paragraphs 53-59.

72.- Method for manufacturing a decorative panel, or a larger material suitable to be divided into a plurality of decorative panels 1, wherein said panel 1 comprises a substrate 2 and a decorative top layer 3, wherein said method comprises an embossing operation S2-S6 wherein at least the decorative top layer 3 is provided with indentations, characterized

in that said embossing operation S2-S6 is performed by means of a roller 26-30 having protrusions for forming said indentations and wherein said roller 26-30 is paired with at least one counter rollers 32A-32B-32C, said at least one counter roller having a rubber surface and/or having a surface with a shore hardness A lower than 80 at 23 degrees Celsius, and even better between 60 and 80 at 23 degrees Celsius.

73.-Method according to numbered paragraph 72, characterized in that said roller 26-30 having said protrusions is a heated roller for example heated by means of thermic oil or another fluid at a temperature above 40°C, or above 65°C.

74.- Method according to any of numbered paragraphs 72 or 73, characterized in that said roller 30 comprises protrusions suitable for forming indentations in the shape of a wood pore or wood grain.

75.- Method according to any of numbered paragraphs 72 to 74, characterized in that said roller 26 comprises protrusions being mold portions 16 for forming lower edge areas 6.

76.- Method according to any of numbered paragraphs 72 to 75, characterized in that said embossing operation S2-S6 is performed on said larger material 4 and in that the larger material 4 follows a bent path around the roller 26 for an arc length L corresponding to at least 100°, and preferably at least 150°.

77.- Method according to any of numbered paragraphs 72 to 76, characterized in that said method further shows the characteristics of numbered paragraph 65, whether or not in combination with the characteristics of numbered paragraph 67 and/or 68.

79.- Method according to any of numbered paragraphs 72 to 77, characterized in that said method further shows the characteristics of any of numbered paragraphs 53-59, wherein said roller having said protrusions is applied as an embossing roller 30 or a structured roller 26 in any of the methods in accordance with any of the numbered paragraphs 53-59.

[0126] The present invention is in no way limited to the above described embodiments, but such methods, decorative panels and larger materials may be realized according to several variants without leaving the scope of the invention.

Claims

1. Method for manufacturing a decorative panel, wherein said panel (1) comprises a substrate (2) and a decorative top layer (3), wherein said substrate is a mineral containing substrate and/or a thermoplastic material containing substrate, wherein said substrate (2) and/or decorative top layer (3) is obtained from a larger material (4) by means of a dividing operation (S1), wherein said dividing operation (S1) comprises performing a cutting operation releasing at least said substrate (2) from said larger material (4) at at least two opposite edges, **characterized in that** said panel (1) comprises at at least one and preferably at both upper edges (5) of a pair of opposite side edges a lower edge area (6), wherein said lower edge area (6) is obtained during said dividing operation (S1) or practically simultaneously with said dividing operation (S1), said dividing operation (S1) comprising:

- providing said larger material (4) in a dividing apparatus;
- indenting said larger material (4) at the location of said upper edges (5) in order to at least partially form said lower edge area (6);
- releasing said substrate (2) and/or said decorative top layer (3) from said larger material (4) by means of a knife that is forced in and through said larger material, wherein said cutting operation forms opposite cut edges (7) for said releasing at said at least two opposite edges, wherein said opposite cut edges (7) are positioned at a mutually different distance (D1-D2) from said upper edges (5) of said panel.

2. Method according to claim 1, **characterized in that** said indenting is executed by means of a mold or mold portions (16) that press down on said substrate (2) and/or said decorative top layer (3).

3. Method according to claim 2, **characterized in that** said mold or mold portions (16) are engaged with said substrate (2) and/or said decorative layer (3) at the start of said cutting operation, and are preferably still engaged at the end of said cutting operation.

4. Method according to claim 2 or 3, **characterized in that** said mold or mold portions (6) are movable with respect to said cutting tool.

5. Method according to any of claims 2 to 4, **characterized in that** said mold or mold portions (6) are substantially at standstill during the cutting operation, i.e. while the cutting tool (15) is moved into and through said substrate (2) and/or decorative layer (3).

6. Method according to any of the preceding claims, **characterized in that** said dividing operation (S1) comprises a cutting operation, more particularly a punching operation, namely an operation in which a stationary, i.e. non-rotating, cutting blade or knife is pressed down to, into and through the material to be cut. 5
7. Method according to any of the preceding claims, **characterized in that** said lowered edge area (6) is formed by indenting material at an edge of a pre-machined portion (41) of said larger material (4) 10
8. Method according to any of the preceding claims, **characterized in that** said larger material (4) is provided with a reference portion (38) prior to said dividing operation (SI). 15
9. Method according to claim 8, **characterized in that** said reference portion is used to align the larger material (4) to the dividing operation (S1) or part thereof, more particularly to one or more cuts performed therein, or vice-versa, namely wherein said reference portion (38) is used to align one or more cutting tools (15) performing said cuts to the larger material (4), or both. 20 25
10. Method according to any of the preceding claims, **characterized in that** said decorative top layer (3) continuous uninterruptedly from on the global upper surface of said panel (1) to and over said lower edge area (6). 30
11. Method according to any of the preceding claims, **characterized in that** said lower edge areas (6) at opposite upper edges mutually extend to a same depth and/or over a same horizontal distance, as measured perpendicularly to said upper edge (5). 35
12. Method according to any of the preceding claims, **characterized in that** at least two substrates (2) and/or top layers (3) for respective panels (1) are obtained or obtainable from said larger material (4). 40
13. Method according to any of the preceding claims, **characterized in that** said substrate (2) at the location of said lower edge area (6) is compressed or deformed. 45
14. Method according to any of the preceding claims, **characterized in that** said substrate (2) and/or decorative top layer (3) show one or a combination of two or more of the following properties: 50
- the substrate (2) and/or the decorative layer (3) comprise a foamed material layer, for example a closed cell foam of a thermoplastic material such as PVC; 55
- the substrate (2) and/or the decorative layer (3) comprise one or more voids, at least at a position vertically underneath said lower edge area;
 - the substrate (2) and/or the decorative layer (3) comprise material having a shore hardness A lower than 80, and preferably higher than 20.
15. Method according to any of the preceding claims, **characterized in that** said substrate (2) comprises at least a thermoplastic material containing board or layer, preferably a filled synthetic composite comprising thermoplastic material and filler material, preferably mineral filler materials, such as sand, talcum, chalk or other forms of CaCO₃, and **in that** said decorative top layer (3) comprises a motif preferably formed by a printed pattern (8) or a wood veneer.

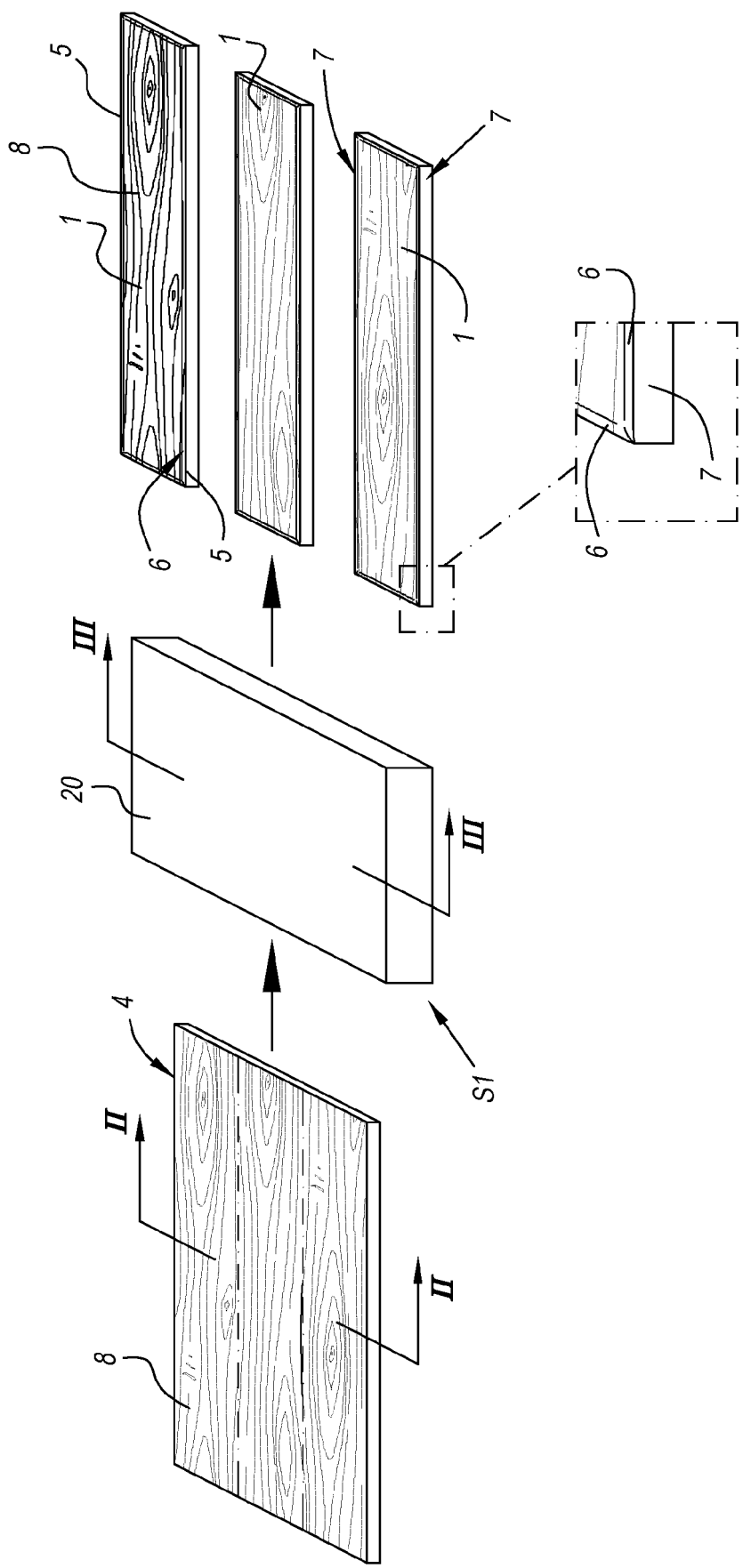
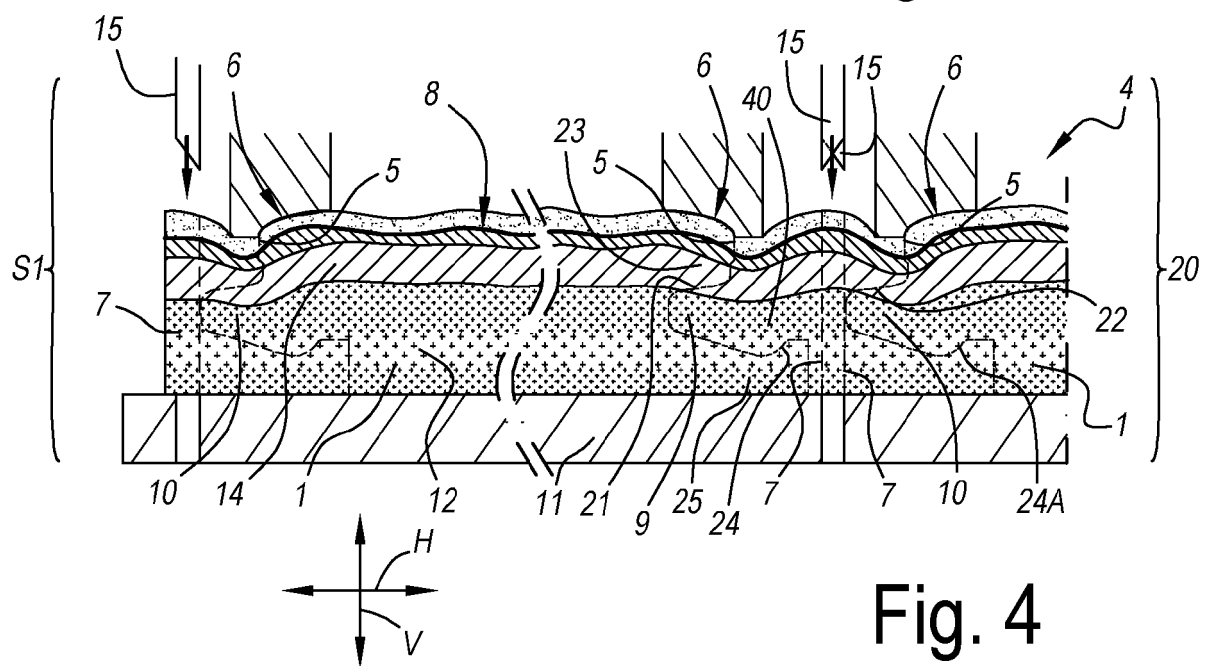
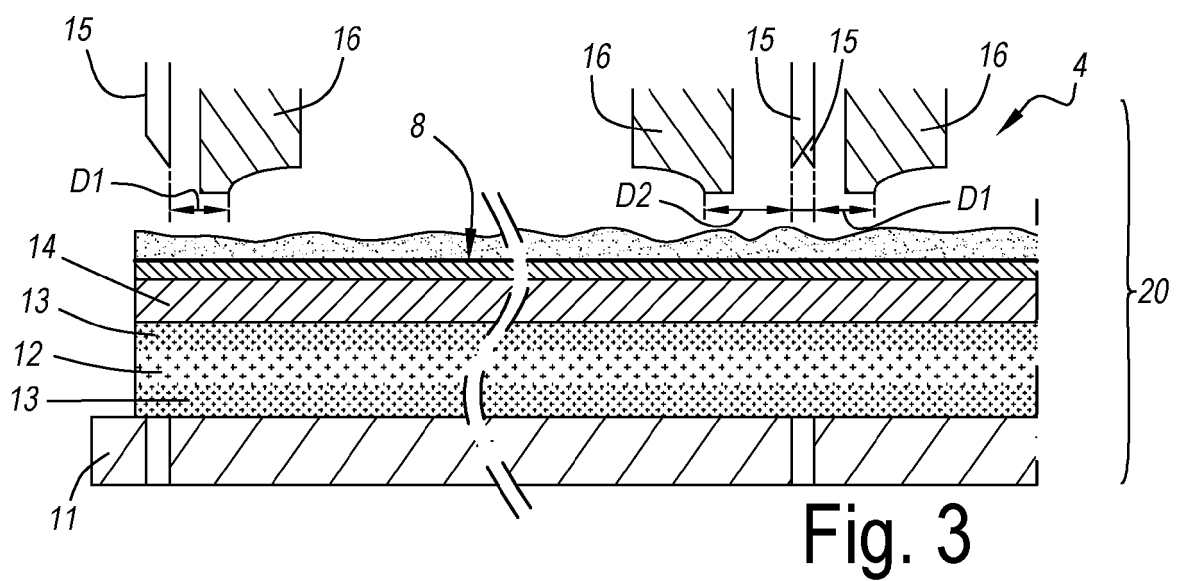
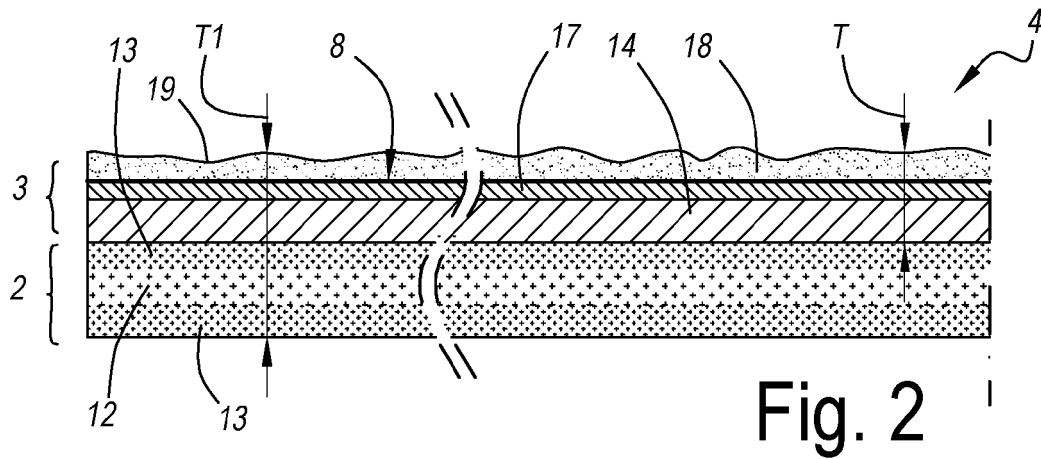


Fig. 1



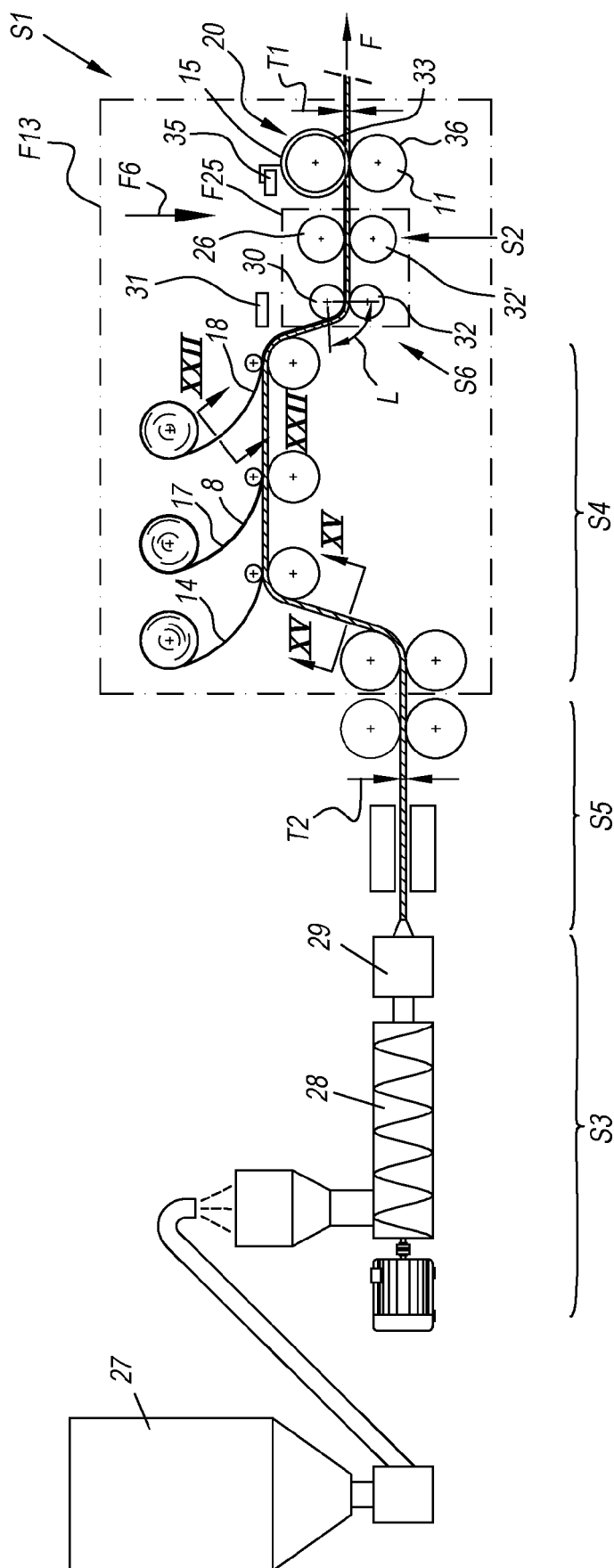


Fig. 5

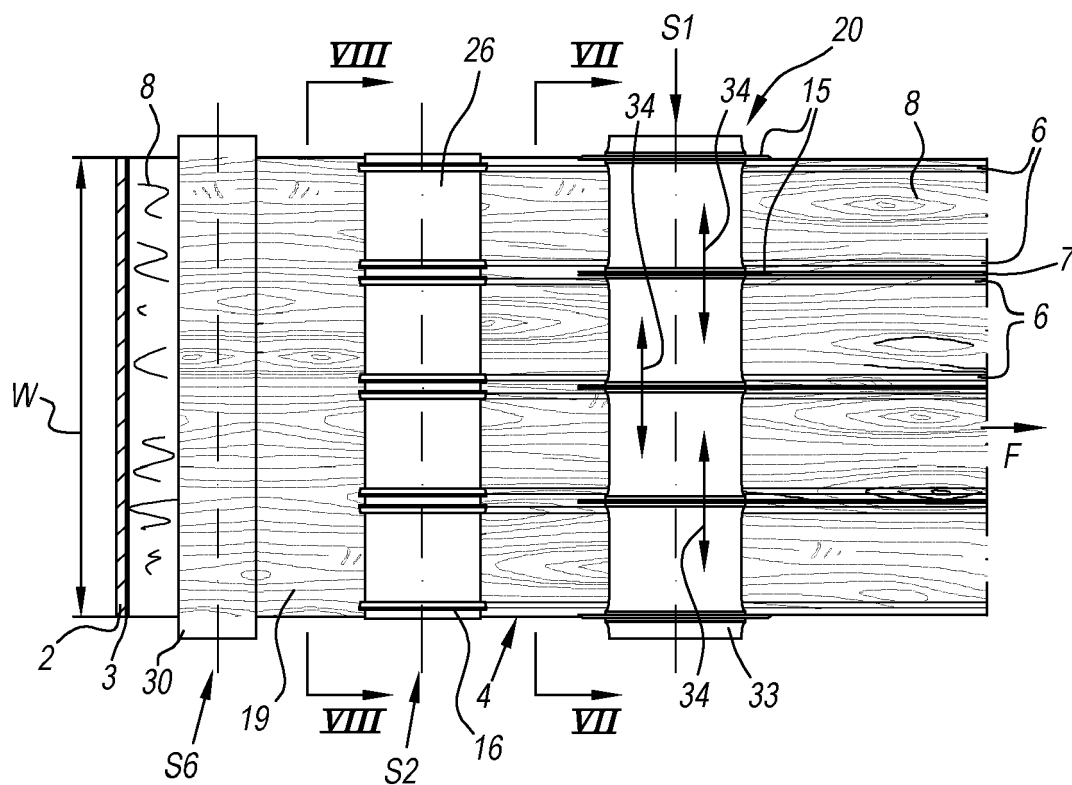


Fig. 6

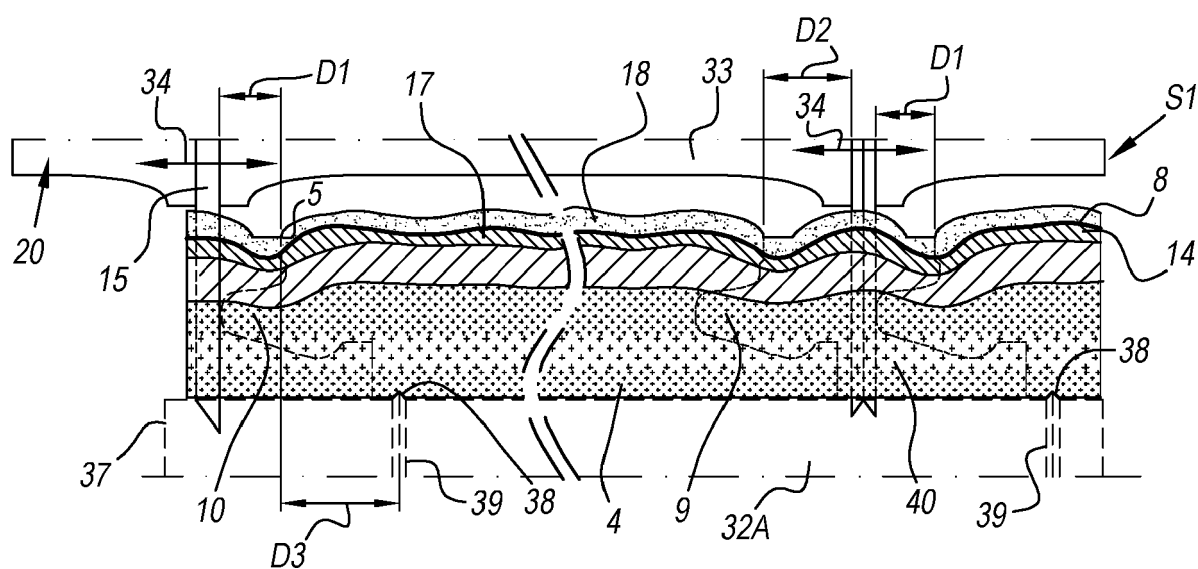


Fig. 7

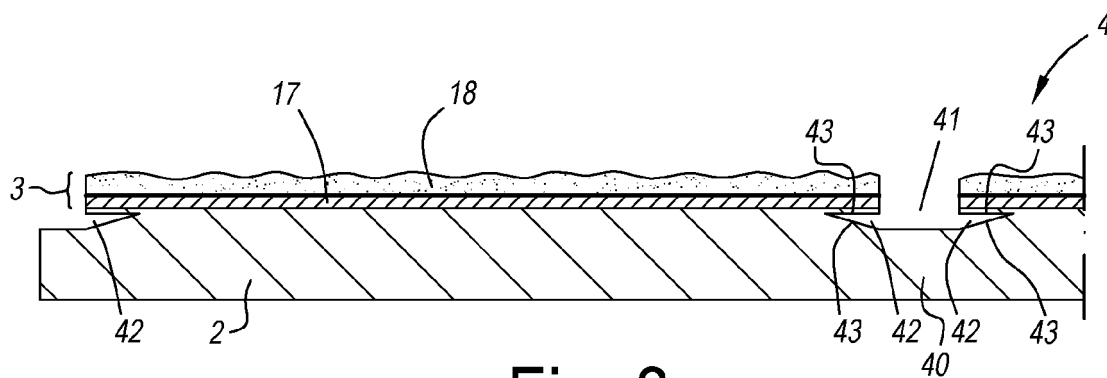


Fig. 8

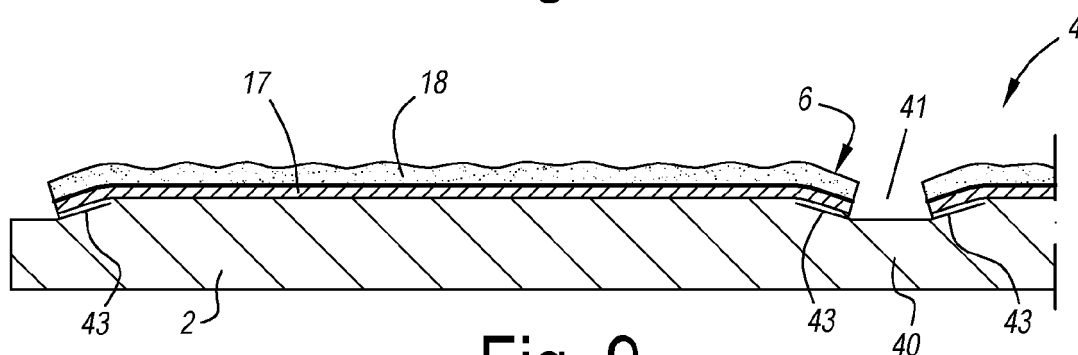


Fig. 9

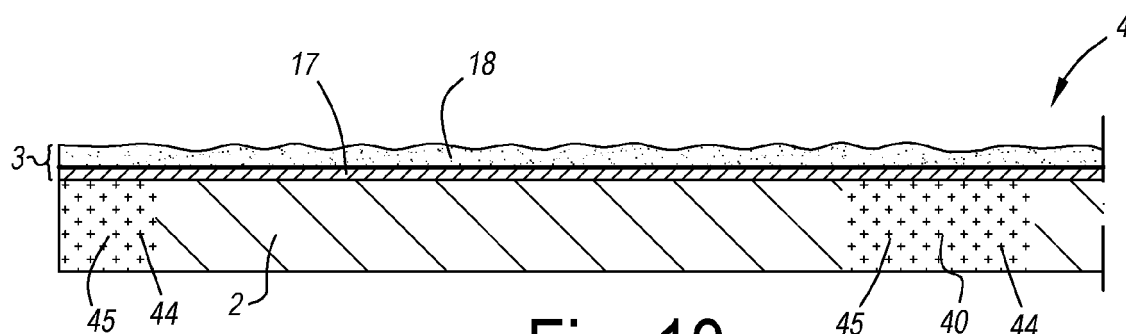


Fig. 10

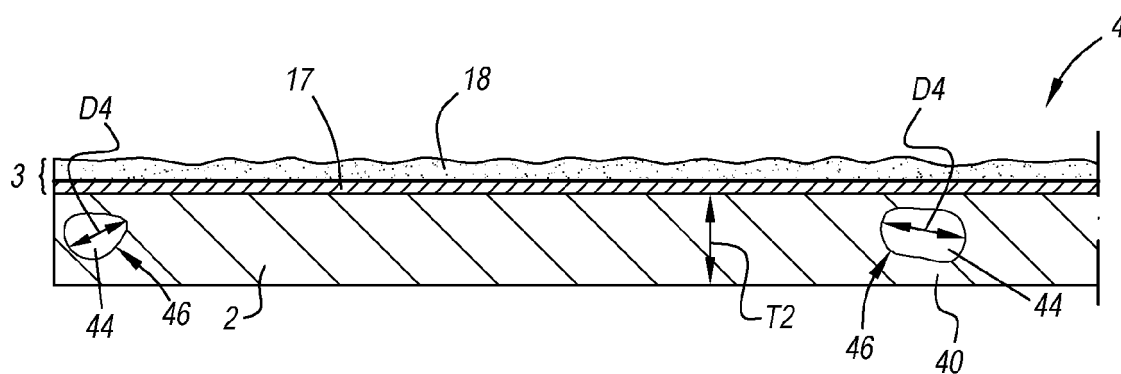


Fig. 11

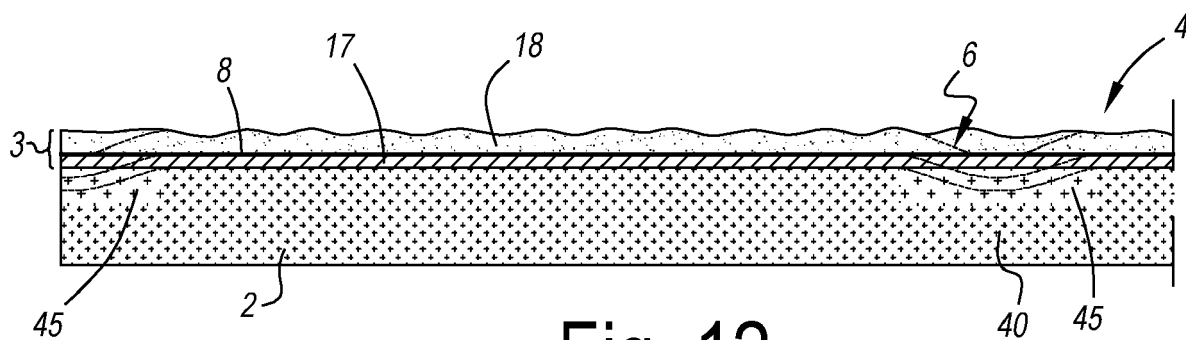


Fig. 12

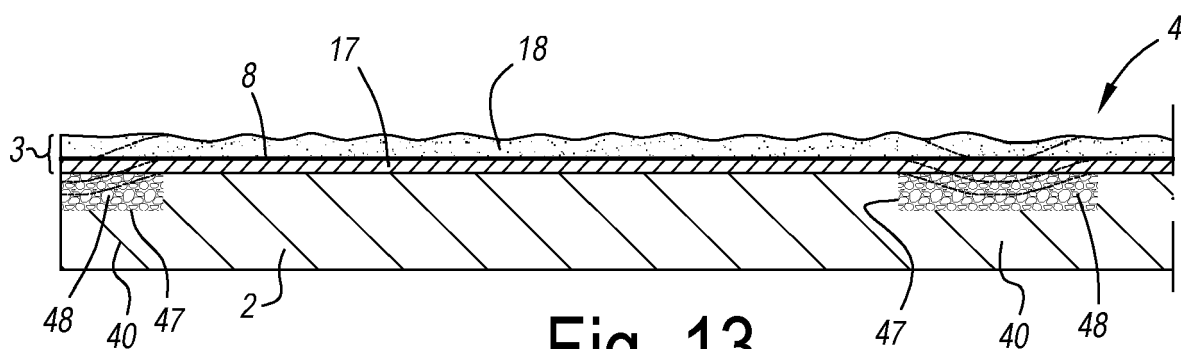


Fig. 13

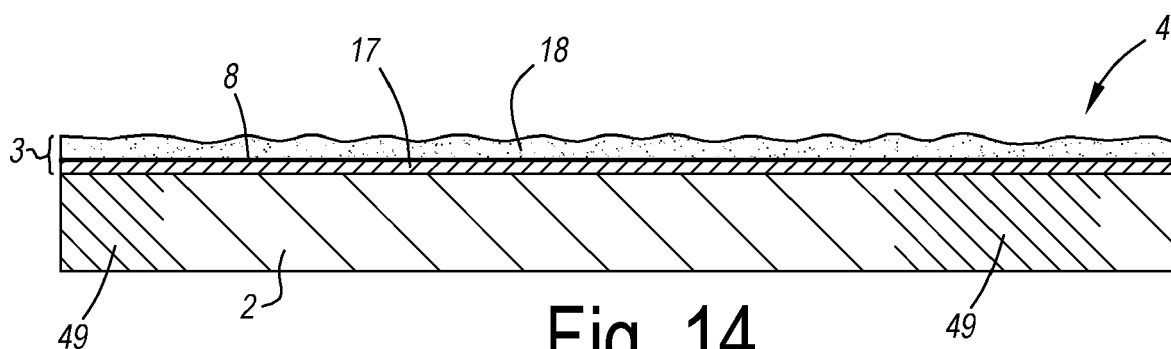


Fig. 14

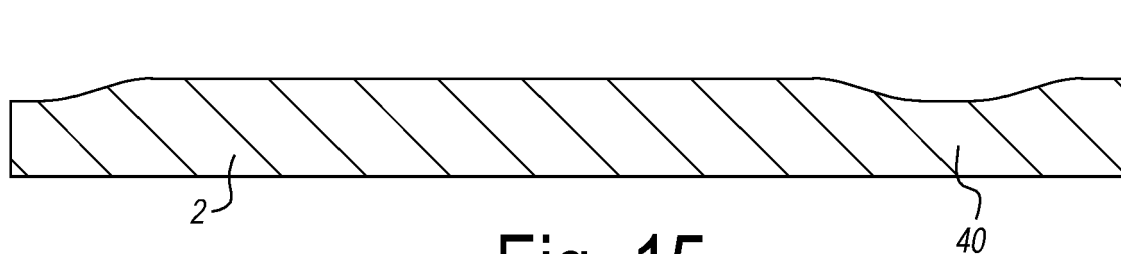


Fig. 15

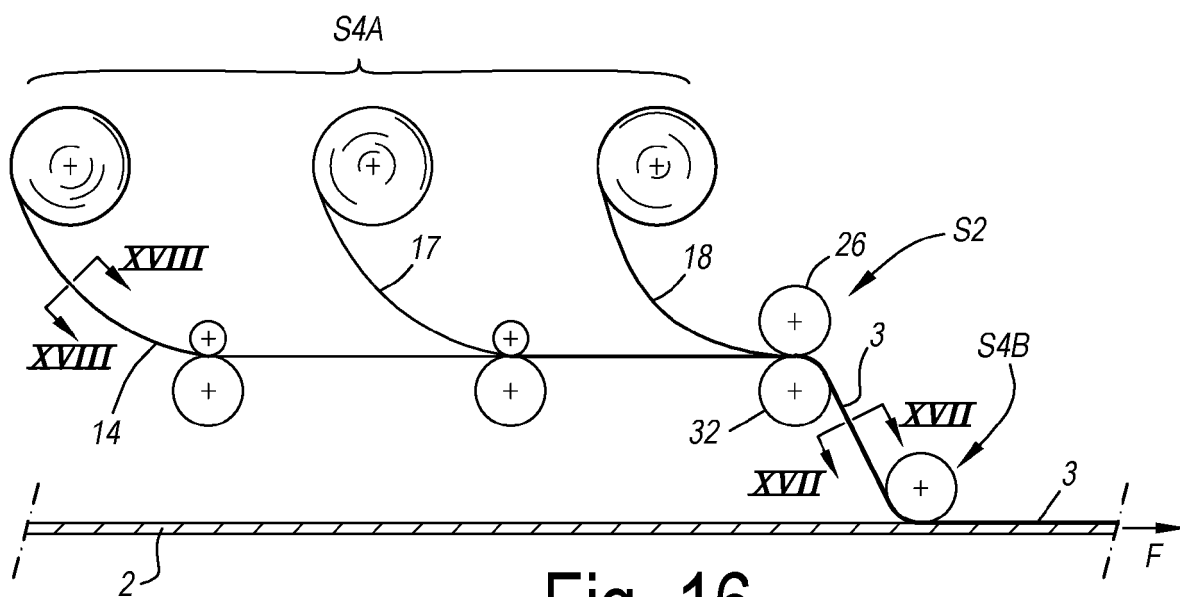


Fig. 16

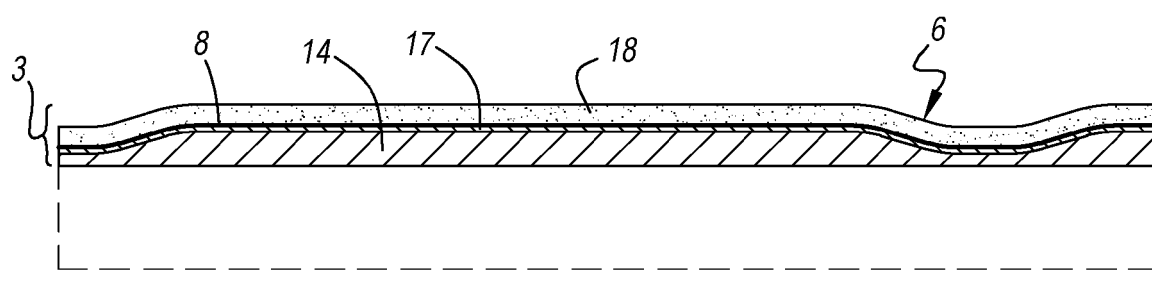


Fig. 17

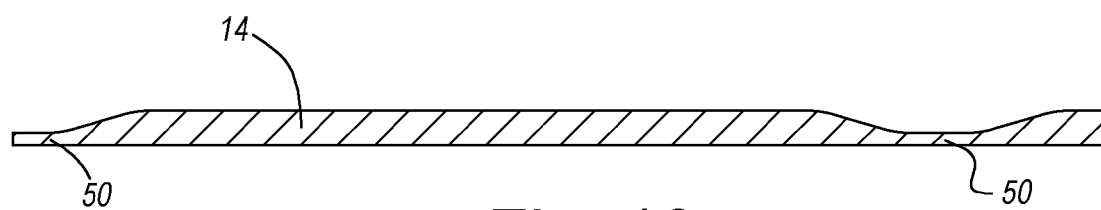


Fig. 18

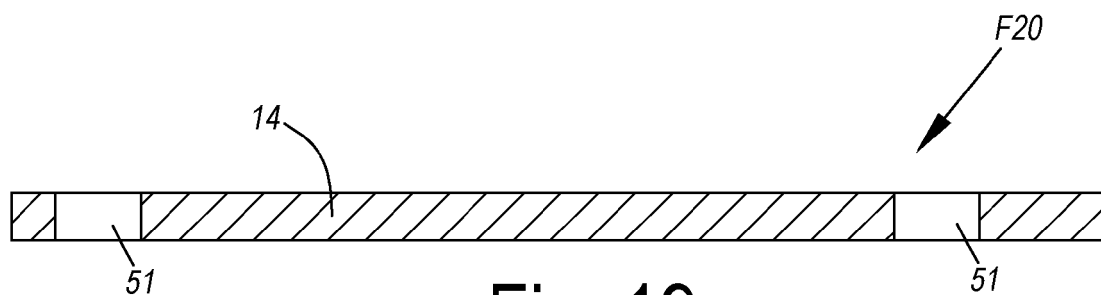


Fig. 19

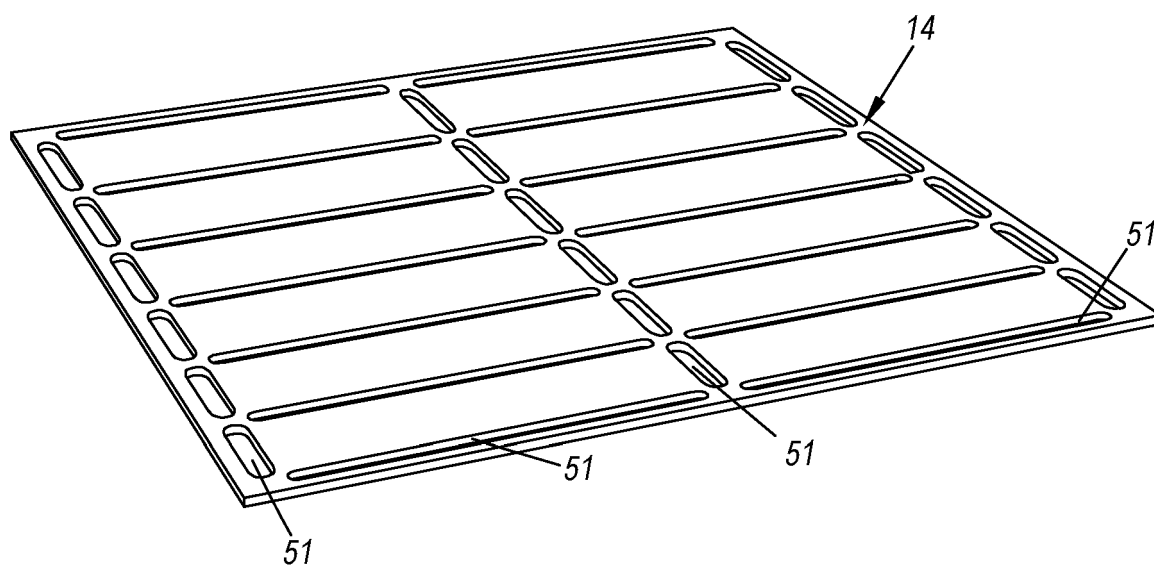


Fig. 20

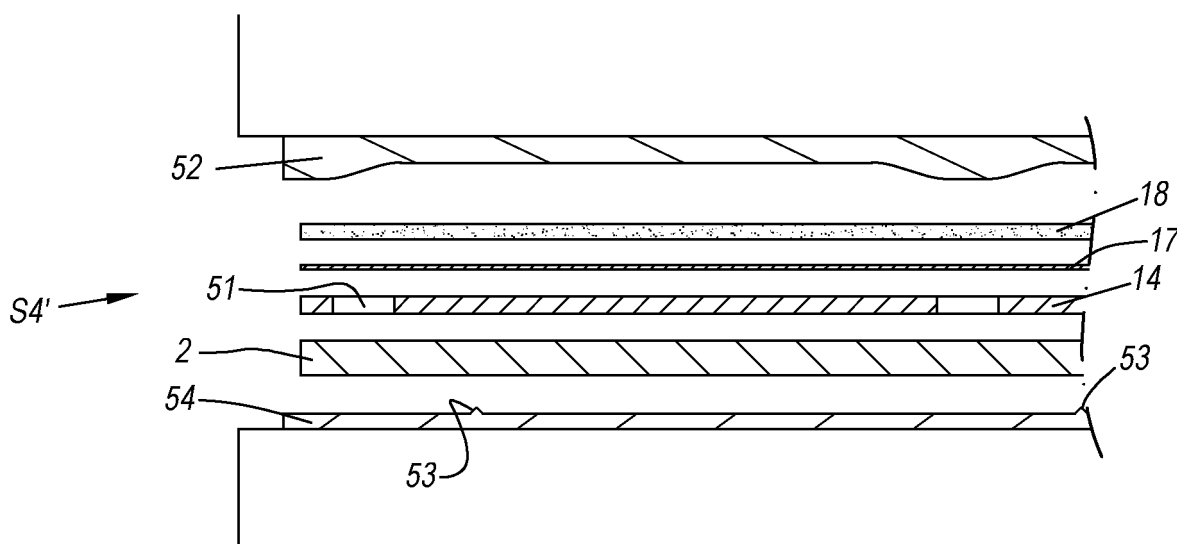


Fig. 21

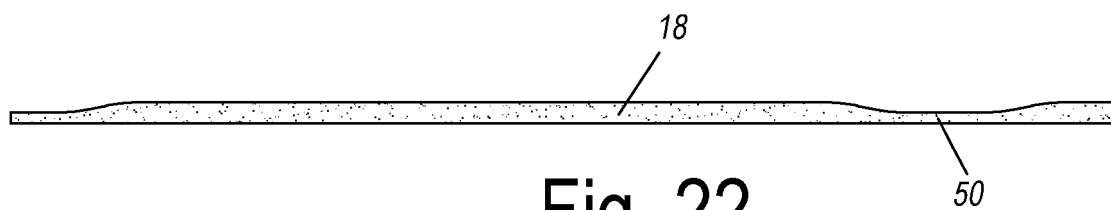


Fig. 22

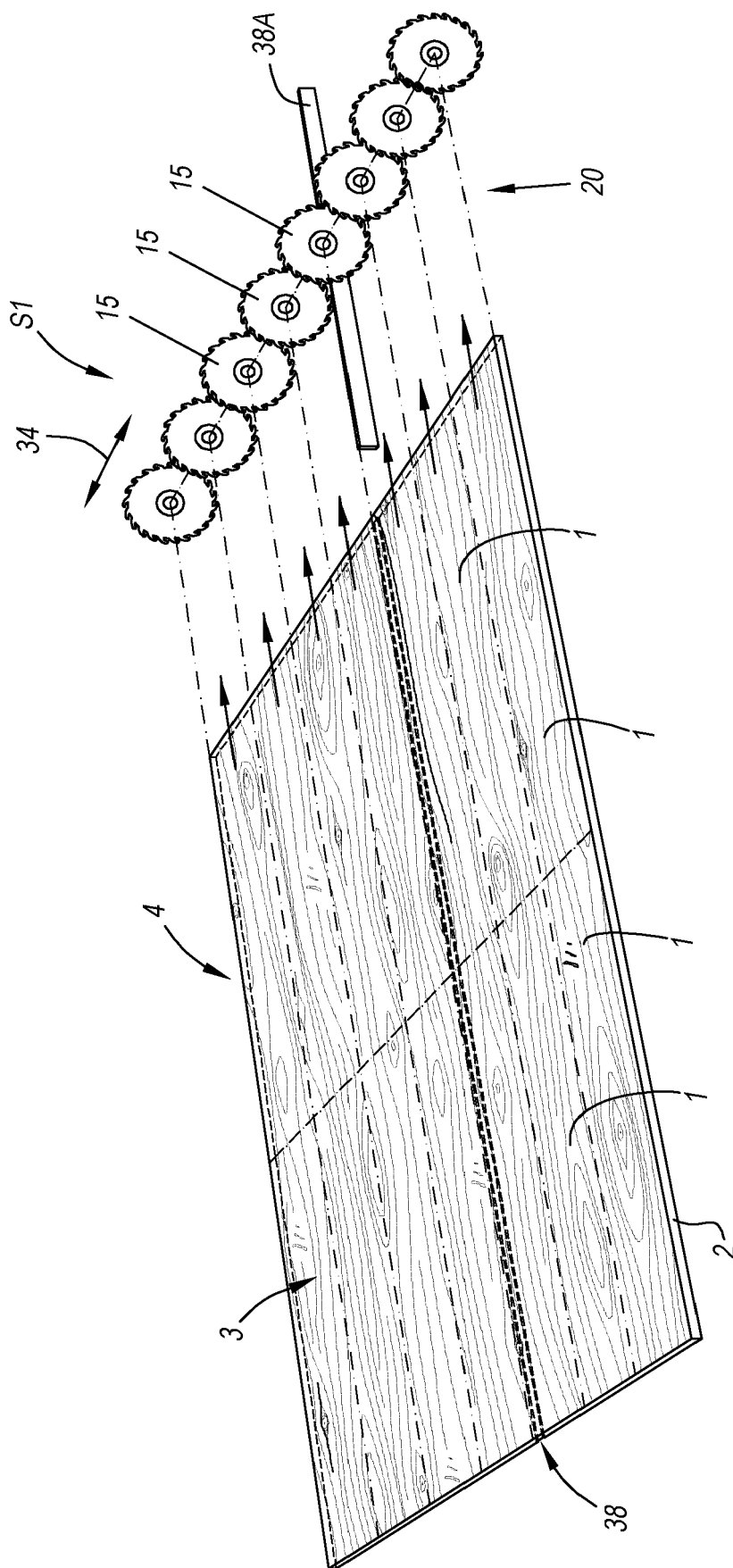


Fig. 23

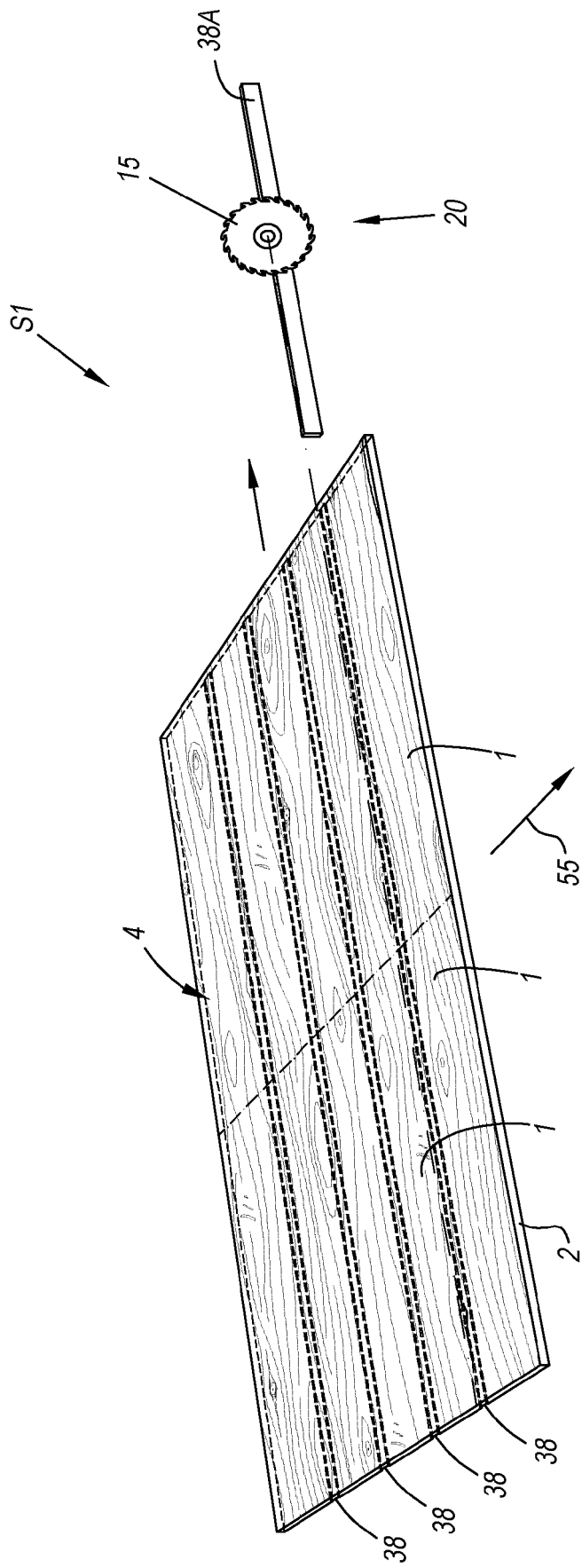


Fig. 24

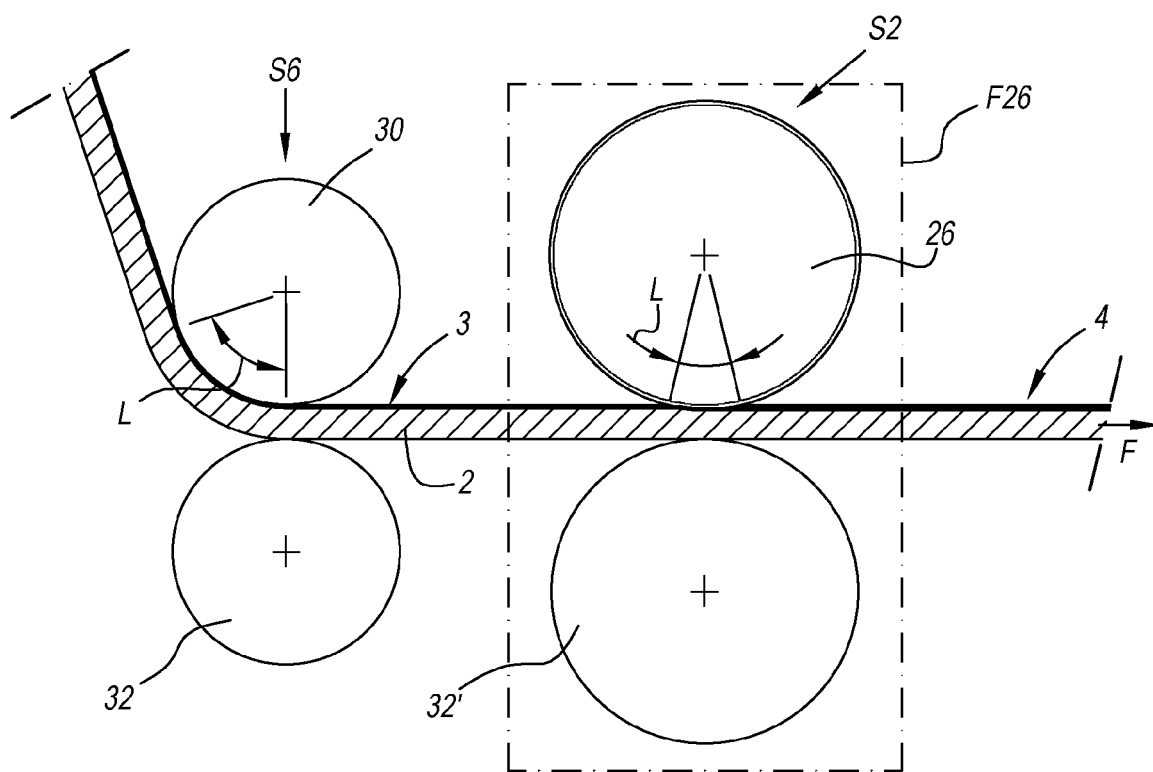


Fig. 25

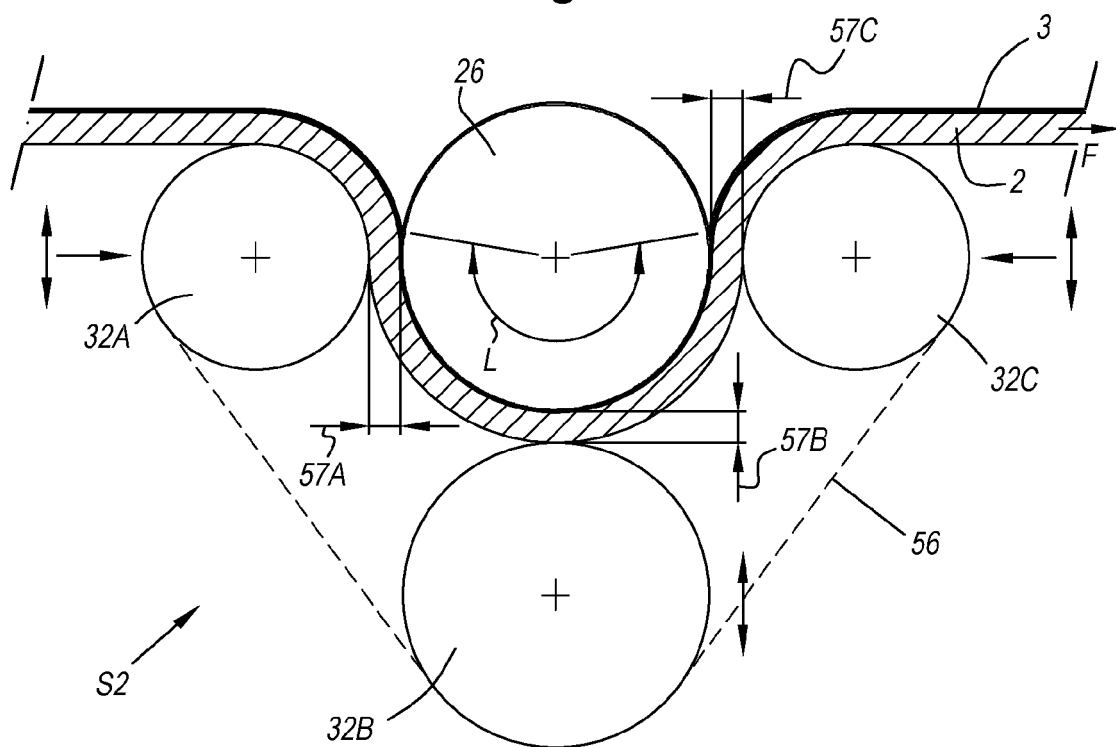


Fig. 26

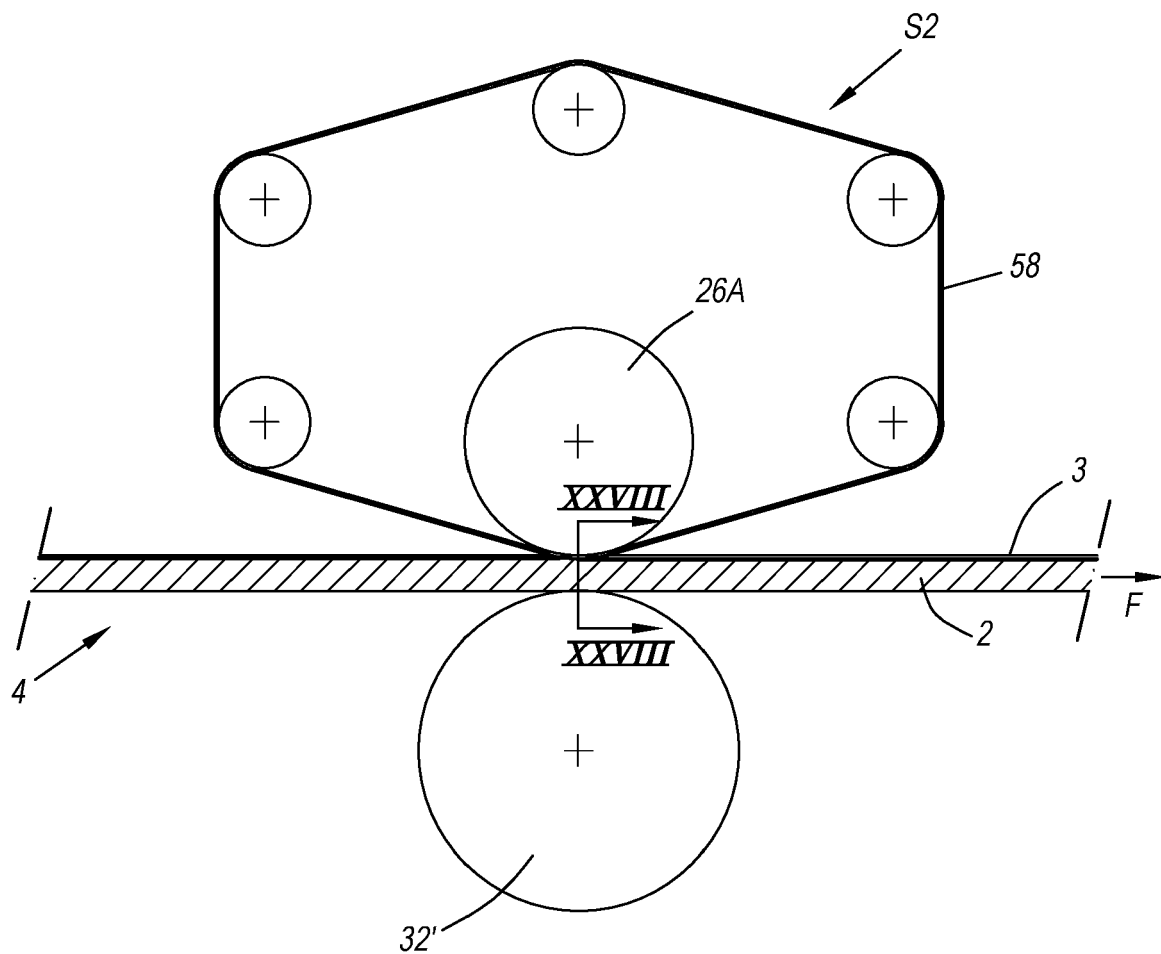


Fig. 27

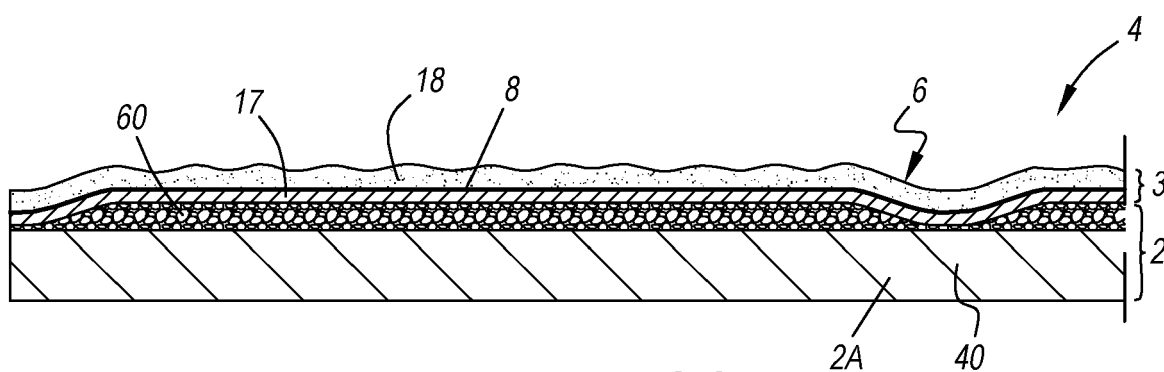


Fig. 30

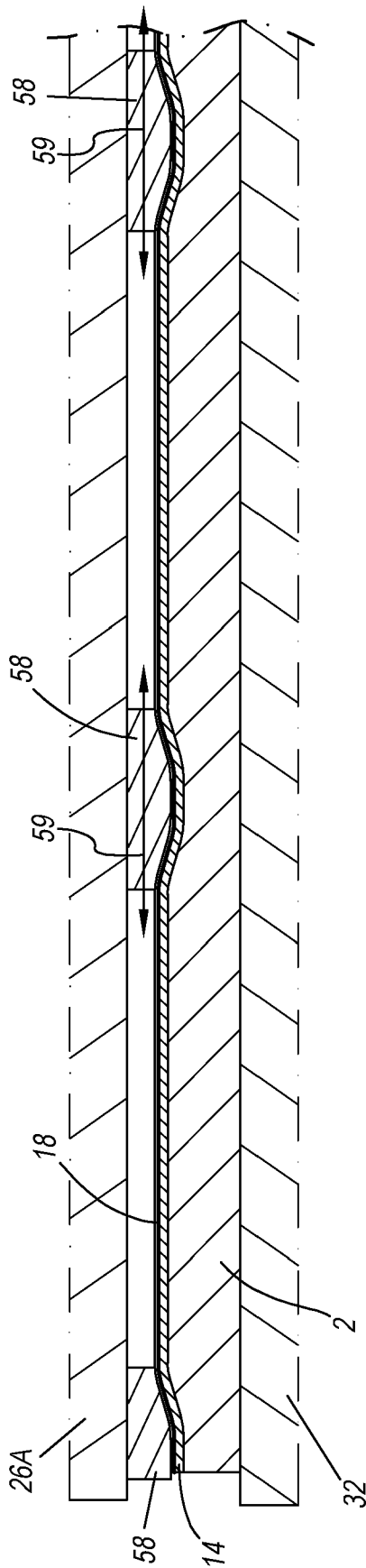


Fig. 28

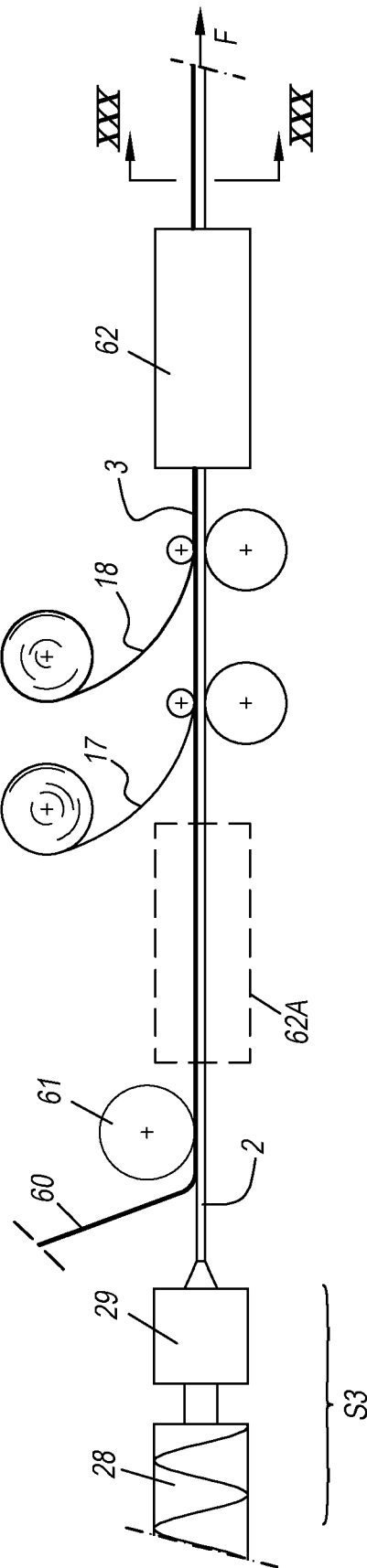


Fig. 29



EUROPEAN SEARCH REPORT

Application Number

EP 21 19 0114

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2011/041989 A1 (ANSPACH KEAN M [US] ET AL) 24 February 2011 (2011-02-24) * paragraph [0015] - paragraph [0038]; figures 1,4,6 *	1-6,8-15	INV. B44C1/24 B44C5/04 E04F15/02
X	EP 2 905 135 A2 (DAMMERS DIRK [DE]) 12 August 2015 (2015-08-12) * paragraphs [0004], [0012] - [0015], [0056] - [0064]; figures 1d'-1f', 4 *	1,2,7-15	
A	US 4 772 500 A (STROPPIANA FIORINDO [IT]) 20 September 1988 (1988-09-20) * the whole document *	1-15	
A	US 2012/240502 A1 (WILSON STEVEN [CA] ET AL) 27 September 2012 (2012-09-27) * the whole document *	1-15	
A,D	WO 2012/004701 A2 (FLOORING IND LTD SARL [LU]; MEERSSEMAN LAURENT [BE] ET AL.) 12 January 2012 (2012-01-12) * page 21, line 18 - line 26; figures 8,9 *	7,14	TECHNICAL FIELDS SEARCHED (IPC) B44C E04F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 February 2022	Examiner Björklund, Sofie
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			

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 21 19 0114

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

03-02-2022

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011041989 A1	24-02-2011	US 2011041989 A1	24-02-2011
		US 2014227491 A1	14-08-2014
EP 2905135 A2	12-08-2015	EP 2905135 A2	12-08-2015
		WO 2015117909 A1	13-08-2015
US 4772500 A	20-09-1988	AT 46381 T	15-09-1989
		CA 1279805 C	05-02-1991
		CH 665647 A5	31-05-1988
		EP 0203042 A1	26-11-1986
		IT 1183846 B	22-10-1987
		US 4772500 A	20-09-1988
US 2012240502 A1	27-09-2012	NONE	
WO 2012004701 A2	12-01-2012	CN 105178555 A	23-12-2015
		WO 2012004701 A2	12-01-2012

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- WO 9747834 A [0004]
- EP 1290291 A [0004]
- WO 2006066776 A [0004]
- WO 200606676 A [0004]
- EP 1938963 A [0005]
- WO 2011141849 A [0005]
- WO 2014117887 A [0005]
- WO 2012004701 A [0005]