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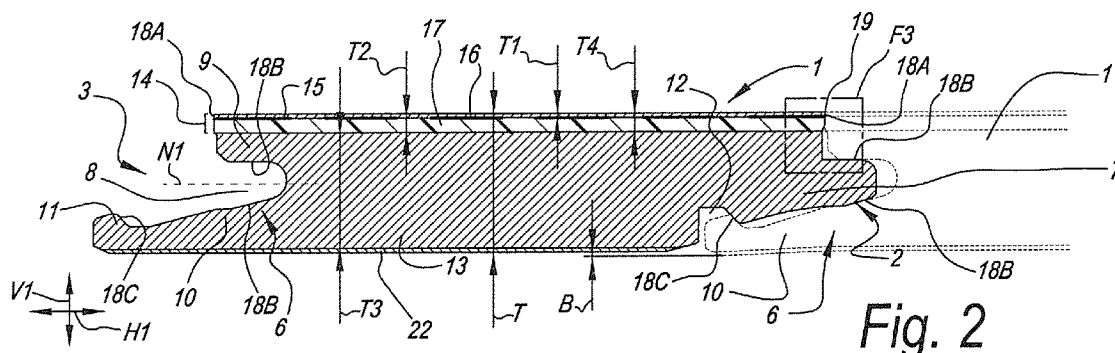
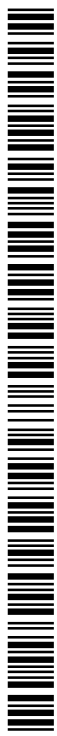


Fig. 2

(57) Abstract: Floor panel with a substrate (13) and a provided thereon top layer (14), wherein said top layer (14) comprises a printed decor (15), provided between a foamed PVC sublayer (17) and a transparent wear layer (16), characterized in that said wear layer (16) is free from PVC, is not foamed, and has a thickness T1 which is less than the thickness T2 of said foamed PVC sublayer (17).



Floor panel.

This invention relates to floor panels.

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More particularly, the invention relates to floor panels with a substrate and a provided thereon top layer with a printed decor. Such floor panels are widely known as such, for example, from WO 97/47834. The floor panels disclosed there relate to, amongst others, floor panels with a substrate which substantially consists of a HDF
10 board with a laminate layer which is directly pressed thereon and which comprises one or more paper sheets impregnated with melamine resin, amongst which preferably also a paper sheet with a print in, for example, a wood or stone motif, namely a so-called decor paper.

15

It is known that the melamine surface of such laminate panel leads to the occurrence of ticking sounds when in use. From the state of the art, a plurality of solutions to this problem is known. From WO 03/016655, it is known to provide a sound-damping layer, such as a cork layer, underneath the melamine layer. From WO 2010/088769, amongst others, it is known to provide the melamine layers with a coating of a flexible
20 monomer. WO 2009/101217 and WO 2010/070474 represent examples of laminate panels wherein the panels, instead of melamine resin, substantially are composed of polyvinyl chloride (PVC). In the case of WO 2010/070474, this relates to panels with a printed decor which can be formed on the substrate and is finished with a transparent PVC layer.

25

In the panels wherein the top layer thereof is completely composed of PVC, a loss of scratch resistance is noted in comparison to the traditional melamine surface. Moreover, the PVC layer must be made considerably thicker than a melamine layer in order to obtain a comparable wear resistance. The nature and thickness of the
30 PVC layer leads to a plastic-like appearance of the floor panel, certainly in the cases where an imitation of a product, such as wood, stone or ceramics, is aspired. The relief which can be obtained in a PVC layer is blurred, which reduces the truthfulness of the obtained imitation. The aforementioned WO 2010/070474 attempts to remedy this by providing the surface with embossments obtained by a combination of
35 chemical and mechanical techniques.

The present invention primarily aims at offering an alternative floor panel, wherein a solution is offered to one or more of the problems with the panels of the state of the art.

- 5 To this aim, the invention relates to a floor panel with a substrate and a provided thereon top layer, wherein said top layer comprises a printed decor, provided between a foamed sublayer, preferably of PVC or another thermoplastic material, and a transparent wear layer, with the characteristic that said wear layer is free from PVC, is not foamed, and has a thickness which is less than the thickness of said
10 foamed PVC sublayer. The invention offers a compromise between sound absorption and truthful imitation. As already mentioned, this latter is of particular importance when imitating wood, stone or ceramics.

- It is evident that said wear layer preferably is made harder or more wear-resistant
15 than the foamed sublayer. To this aim, the wear layer can be realized in various possible manners.

- According to a first possibility, for the wear layer use can be made of a thermoplastic material with a higher glass transition temperature than the material of the sublayer,
20 for example, with a higher glass transition temperature than that of PVC, or with a glass transition temperature of more than 80, or even of 90°C or more. So, for example, a wear layer of polystyrene (PS), polypropylene (PP), preferably isotactic polypropylene, polymethylmethacrylate (PMMA), polycarbonate (PC), or a polyamide (PA) can be opted for.

- 25 According to a second possibility, for the wear layer use can be made of a material with a different hardening mechanism than PVC. PVC hardens by cooling off, and for the wear layer, according to the present possibility a material is chosen which hardens according to a different mechanism than cooling off. Herein, this may relate
30 to a thermally hardening material, such as a melamine-based resin, a UV-hardening lacquer layer, an electron beam-hardening lacquer layer, an excimer-hardening lacquer layer, a drying lacquer layer or the like. Preferred is a lacquer layer that can be hardened by means of radiation, such as an UV-hardening lacquer layer, preferably an acrylic-based lacquer layer, a urethane-based lacquer layer, a
35 polyester-based lacquer layer or an epoxy-based lacquer layer. By using a radiation-hardening lacquer layer, the sublayer, during hardening of the lacquer layer, is minimally or not at all affected during hardening of the lacquer layer.

According to a third possibility, for the wear layer use can be made of a material enclosing hard particles. This then preferably relates to hard particles, such as aluminum oxide or silicon oxide, which preferably have an average particle size
5 between 20 and 200 micrometers. Preferably, a content of such particles of 2 to 20 grams per square meter is applied. It is noted that this third possibility preferably is combined with one of the above measures. For example, a radiation-hardening lacquer layer can be applied which encloses the above-mentioned hard particles.

10 It is clear that the wear layer in the context of the present invention is seen as the entire layer between the printed decor and the surface of the panel. Further, it is clear that this wear layer preferably essentially or even entirely is composed as in the above possibilities. However, it is not excluded that the wear layer on the surface of the panel also comprises a superficial coating.

15 Preferably, the thickness of the wear layer is less than half of the thickness of the sublayer, or even less than 25% of the thickness of the sublayer. A good value for the thickness of the wear layer is situated between 0.1 and 0.5 millimeters, and still better between 0.15 and 0.3 millimeters. Such limited thickness, certainly in the case
20 of radiation-hardened lacquer layers comprising aluminum oxide particles, still offers a wear resistance sufficient for applications as a floor panel.

Preferably, said printed decor consists of a print formed directly on said sublayer, whether or not after a pre-treatment of the aforementioned sublayer, for example,
25 with uniformly colored layers. Herein, the print can be realized by depositing pigment-containing inks on said sublayer, for example, by means of a digital inkjet printer. Preferably, at least use is made of inks with the basic colors cyan, magenta, yellow and black (CMYK). However, it is not excluded that one or more so-called spot colors are applied. Herein, this relates to colors adapted to the decor to be
30 printed. In the case of wood motifs, then a reddish color is taken into consideration. Preferably, the print is formed by means of UV-hardening inks. As for hardening the inks, no or little heat is required, the sublayer will not be affected by the hardening of the inks.

35 As aforementioned, said wear layer preferably relates to a lacquer layer, such as an acrylic-based layer or a urethane-based layer. In general, preferably a lacquer layer

is applied which can be hardened by radiation or can be hardened by drying of a solvent.

Said wear layer preferably is hardened by means of UV radiation, electron radiation
5 and/or excimer radiation.

Said wear layer preferably comprises hard particles, such as aluminum oxide particles.

10 According to a particular embodiment, the aforementioned wear layer comprises a material sheet, such as a paper sheet. Such material sheet in a significant manner contributes to the impact resistance of the floor panel and reduces the risk that the mostly hard, but brittle, wear layer will break. The material sheet renders the wear layer more ductile, which is also interesting when post-treating the edges of the floor
15 panel. The ductility of the wear layer reduces the risk of chipping edges when milling the possible coupling means. Moreover, such material sheet forms a barrier against the displacement of possible anti-wear or hard particles in the still wet wear layer during production, such that these particles can be more effective in the obtained floor panel. Surprisingly, the inventors have found that when using a pure, unfilled
20 paper, such as an alpha-cellulose paper, the transparency of the top layer is hardly affected, even in the case that this concerns a top layer on the basis of radiation-hardening lacquers, such as with acrylic-based or urethane-based lacquer layers. On the contrary, the thickness of the wear layer can be restricted further while maintaining impact and wear resistance, such that the transparency, or, in other
25 words, the visibility of the printed decor through the wear layer, can be increased. The possible particles in the wear layer are immobilized to a great extent due to the presence of the material sheet, until their position, so to speak, finally is frozen when hardening the wear layer. According to the most preferred embodiment hereof, the wear layer comprises a material sheet which as such comprises embedded hard
30 particles. For example, this may relate to a so-called Mead overlay, for example, as described in US 5,820,937, wherein an alpha-cellulose paper, during the production thereof, is filled with aluminum oxide particles or other anti-wear particles. In such embodiment, the hard particles in particular are held at a fixed position in the thickness of the wear layer; moreover, no special measures have to be taken in
35 order to keep the hard particles in suspension in the lacquer layer or other material of the wear layer. This latter leads to a reduced risk of loss of transparency as an effect of possible suspension agents and to a smoother production process. Also

when processing the edges there is less risk of pulling off hard particles, as those are somewhat held together in the material sheet. It is clear that, in the case that hard particles are applied, either embedded in a material sheet or blended into the actual material of the wear layer, for example, in a radiation-hardening lacquer, or both, the preferred characteristics of the above-mentioned third possibility for the wear layer can be applied.

As aforementioned, said sublayer preferably consists of foamed PVC. Preferably, this relates to foamed PVC of the type applied in so-called cushion vinyl, and/or foamed PVC with a plasticizer content of 12 phr or more, for example, 20 phr or more. The foaming degree of the sublayer preferably is such that a density reduction in comparison with the not foamed material is obtained which is higher than 20 percent, and preferably even higher than 50 percent. Preferably, this substantially concerns foam of the closed cell type or of the substantially closed type or cell type.

Preferably, the aforementioned sublayer is foamed at least in a chemical manner. This is possible, for example, by adding azodicarbonamide as a foaming agent to the PVC composition. According to a variant, said sublayer can be foamed at least in a mechanical manner. In such case, this relates, for example, to adding expanding granular material to the PVC composition, such as, for example, polystyrene-based granules or those known under the trademark of Expancel ©.

There are different possibilities for providing said sublayer on the substrate.

According to a first possibility, said sublayer is adhered to said substrate by means of a glue layer. Such embodiment allows a smooth production of the foamed PVC sublayer, for example, on a continuous production line provided especially for this purpose. In order to allow such production, the foamed PVC sublayer preferably encloses a carrier, such as a glass fiber-based carrier, for example, a glass fleece (nonwoven) or glass fabric (woven). Such carrier gives a certain impact resistance to the final floor panel.

According to a second possibility, said sublayer is adhered directly to the substrate, without the intermediary of glue layers. According to this possibility, preferably a PVC plastisol is used, which, in liquid or paste form, is provided on the surface of the substrate and is foamed there. Preferably, the sublayer is cooled off by means

of a press element, for example, by means of one or more press rollers or press belts, such that the thickness thereof can be calibrated to a certain extent.

Independent of the manner in which the sublayer is adhered to the substrate, this
5 sublayer preferably comprises a glass fleece or glass fabric. As already mentioned, such glass fleece or glass fabric contributes to the impact resistance of the floor panel. According to a particular preferred embodiment, said glass fleece or glass fabric is situated on the upper surface of said sublayer, or at least is situated in the upper quarter of the thickness of said sublayer. Such embodiment particularly is of
10 importance when the wear layer and/or the printed decor to a certain extent is brittle, or at least is considerably more brittle than the PVC sublayer. In such case, there will be a risk of the lacquer layer breaking. The presence of a glass fiber-based layer or another reinforcing layer close to the wear layer can reduce this risk considerably. The inventor has found that, for example, with acrylic-based and/or radiation-
15 hardened lacquer layers this solution can be sufficient for floor applications.

For the substrate, preferably use is made of a substrate substantially consisting of a MDF or HDF board material.

20 Preferably, the floor panel of the invention further is characterized in that, at least at two opposite edges, it is provided with mechanical coupling parts and that these coupling parts, in a coupled condition of two of such floor panels, provide for a tensioning effect of the aforementioned sublayers against each other at the location of the respective edges. By such embodiment, a certain waterproofness of the edges
25 can be obtained. This is of importance, for example, in the cases in which for the substrate use is made of a porous and/or wood-based substrate, for example, in the case that MDF or HDF is applied.

According to a particular embodiment, said substrate, on at least two opposite
30 edges, is provided with a covering, which prevents or restricts the penetration of moisture into the substrate, wherein said covering is made overlapping with the edge of said sublayer. According to this embodiment, in other words, a moisture-repellent covering on the edge of the floor panel is provided, wherein this covering extends from on the substrate to at least over the border with said sublayer. Preferably, the
35 covering extends farther, namely to at least over the border with the printed decor and/or with the wear layer.

Preferably, the wear layer is provided with a structure or relief formed by embossments on the surface thereof. Preferably, this structure contributes to the imitation of the pattern depicted in the printed decor, and/or the structure forms a delimitation of the printed decor, for example, on at least an edge thereof. So, for example, in the case of a wood imitation use can be made of embossments in the form of wood pores and/or nerves. According to another example, use can be made of a delimitation of the decor in the form of chamfers or other bevels. In the case of a stone decor, use can be made of a structure imitating the presence of cement joints.

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Preferably, the wear layer is provided with structural parts which continue up into said sublayer, or wherein, in other words, the printed decor is structured, too. Such embodiment is of particular interest when realizing structural parts, such as bevels, because in this manner, they still can be realized deep, regardless of the limited thickness of the wear layer. The obtained relief in the printed decor itself here also contributes to the truthful imitation of the panel. According to a particular example hereof, even the possible reinforcement layer, for example, the glass fleece or glass fabric, can follow the contour of the respective structural parts.

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It is noted that the also above-mentioned particular embodiment, wherein the wear layer comprises a material sheet, forms an example of a second independent aspect of the present invention. The second aspect aims at an improved impact resistance, ductility, transparency and/or wear resistance of products comprising a lacquer layer. To this aim, the present invention relates to a decorative panel or profile, wherein this panel or profile comprises at least a substrate, a decor and a wear layer provided on the decor, with the characteristic that the aforementioned wear layer substantially consists of lacquer, a material sheet and possible hard particles, wherein said lacquer relates to a radiation-hardening lacquer or a lacquer which dries by evaporation of a solvent. Preferably, the wear layer consists of 70 g/m² to 160 g/m².

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Preferably, the aforementioned material sheet is a paper sheet, preferably an alpha-cellulose paper. Preferably, the paper sheet has a weight of 25 g/m² to 65 g/m².

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According to the most preferred embodiment, said material sheet is a paper sheet, preferably an alpha-cellulose paper sheet, which comprises embedded hard, for example, mineral, particles, such as aluminum oxide particles or corundum.

Preferably, the respective paper sheet comprises 2 to 20 grams per square meter of such particles, and preferably with an average particle size between 20 and 200 micrometers. Preferably, the paper sheet has a weight, including embedded particles, of 25 g/m² to 65 g/m². This may relate, for example, to a paper sheet in accordance with the US 5,820,937 already mentioned above.

Preferably, said lacquer is an acrylic-based radiation-hardening lacquer.

It is clear that a decorative panel having the characteristics of the present second aspect of the invention may also show the characteristics of the first aspect or the preferred embodiments thereof.

According to the variant of the second aspect, the invention relates to a decorative profile. This may relate, for example, to the type of profile which is applied for finishing a floor covering, such as a transition profile, end profile, skirting board or the like. This variant provides for a smooth production of profiles matching decorative panels, for example, in particular match decorative panels which comprise a print formed on the substrate and are finished with a transparent lacquer layer. Contrary to DPL laminate panels, for example, for such panels printed paper with a motif matching the print of the decorative panel is not commonly available. As this decorative sheet or paper sheet would be available, the thick lacquer layer complicates encasing a profiled substrate. According to the present variant of the second aspect, the invention may lead to a decorative profile of floor quality which can be produced in a simpler manner and in this way creates a greater freedom for the design of such profiles.

According to a third independent aspect, the invention also relates to a method for manufacturing a decorative panel or profile, for example, with the characteristics of the second aspect. To this aim, the invention relates to a method comprising at least the following steps:

- the step of providing a carrier;
- the step of providing a layer of transparent lacquer, in liquid condition, on said carrier;
- the step of providing a material sheet in said lacquer; preferably, the material sheet is a paper sheet, for example, a paper sheet with embedded hard particles;

- the step of hardening said lacquer, preferably by means of radiation, and/or by drying.

Preferably, said carrier is a plate-shaped or profiled substrate. This may relate, for example, to an MDF- or HDF-based substrate. Other possibilities, such as plywood, particle board, mineral-based or synthetic material-based substrates, are not excluded. It is clear that a plate-shaped substrate preferably is applied for realizing a decorative panel, and that a profiled substrate preferably is applied for realizing a decorative profile. In the case that the method of the third aspect of the invention is applied for manufacturing decorative panels having the characteristics of at least the first aspect, the aforementioned carrier is made as a plate-shaped substrate on which a foamed layer, preferably of PVC, is provided. Of course, other composed substrates, either layered or otherwise, are not excluded.

According to a variant, the aforementioned carrier is a paper or a foil, and the method preferably further also comprises the step of providing said carrier on a plate-shaped or profiled substrate. Such providing preferably is performed by gluing the respective carrier onto the substrate, for example, by means of a so-called encasing process, for example, of the type such as known from US 3,296,056 or US 4,198,455. The method of the third aspect allows making the transparent lacquer layer thinner while still obtaining a wear resistance required, for example, for the application in floors. The restricted thickness of the lacquer layer provides for a smooth application of the carrier on the substrate. The obtained wear-resistance of the decorative panel or profile preferably reaches the wear class AC2 or higher, even up to AC5 and higher, as expressed according to EN 13329-Annex E.

According to the most preferred embodiment, the material sheet is untreated when being provided in said lacquer. Preferably, this relates to a material sheet, to wit a paper sheet, consisting exclusively of cellulose fibers in which possibly hard particles are embedded. The paper sheet preferably is free from whiteners, such as titanium dioxide, and other fillers, such as clay and/or calcium carbonate. In other words, the ash content of the material sheet preferably consists substantially or entirely of aluminum oxide, as this may be the case with so-called overlay paper or alpha-cellulose paper, for example, of the type known from US 5,820,937.

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According to an alternative, the respective material sheet, prior to being provided in the lacquer, also is provided with lacquer, for example, impregnated with lacquer.

Preferably, this herein relates to the same lacquer as provided on the carrier. Possibly, in such case the step of providing the lacquer on the carrier may be omitted.

- 5 Preferably, said carrier, prior to said step of providing the lacquer in liquid condition, is printed, preferably by means of a digital printing technique, for example, by means of UV-hardening or water-based inks. Solvent-based inks, latex inks or oil-based inks are not excluded. Preferably, the print is formed on the respective carrier, possibly with the intermediary of primer layers, such as preparatory layers. In the
- 10 case that the carrier relates to a plate-shaped or profiled substrate, this substrate preferably is at least prepared with one or more layers of a uniform color and/or with a paper sheet. In the case that the carrier comprises a paper or a foil, the carrier preferably is at least prepared with an inkjet receiver coating.
- 15 As already mentioned before, the aforementioned material sheet preferably is a paper sheet, and still better a paper sheet comprising embedded hard particles.

Preferably, the aforementioned material sheet, in said step of providing said material sheet in the lacquer, is pressed on against the respective carrier. The pressing on

20 may be performed, for example, by means of one or more rollers.

It is clear that preferred embodiments of the decorative panel or the decorative profile of the first and/or second aspect lead to respective preferred embodiments of the present third aspect of the invention and that the invention of the third aspect is

25 particularly suitable for manufacturing the panels and/or profiles of the first and/or the second aspect of the invention.

With the intention of better showing the characteristics of the invention, herein below, as an example without any limitative character, some preferred embodiments are

30 described, with reference to the accompanying drawings, wherein:

- Figure 1 in perspective represents a floor panel according to the invention;
Figure 2, at a larger scale, represents a cross-section according to the line II-II represented in figure 1;
- 35 Figure 3, at a still larger scale, represents a view on the area indicated by F3 in figure 2;

Figures 4 to 6, in a view similar to that of figure 3, represent variants, wherein figure 6 forms an example of the second aspect of the invention;

Figure 7, in a view similar to that of figure 3, represents another embodiment of the second aspect of the invention;

5 Figure 8 in perspective represents a decorative profile with the characteristics of the second aspect of the invention; and

Figure 9, in cross-section and at a larger scale, represents a view to the area indicated by F9 in figure 8.

10 Figures 1 and 2 represent an oblong floor panel 1 with a pair of long opposite edges 2-3 and a pair of short opposite edges 4-5. Herein, the short pair of edges 4-5 as well as the long pair of edges 2-3 is provided with coupling means or coupling parts 6, with which two of such floor panels 1 can be coupled at the respective edges 2-3-4-5, such that they are interlocked in a horizontal direction H1 perpendicular to the
15 respective edge 2-3-4-5 and in the plane of the floor panels 1, as well as in a vertical direction V1 perpendicular to the plane of the coupled floor panels 1. Preferably, the coupling parts 6 on the pair of long edges 2-3 are realized similar to the coupling parts 6 on the pair of short edges 4-5 and both preferably allow at least a coupling by means of a turning movement along the respective edges 2-3-4-5. However, it is
20 not excluded that the coupling parts 6 on the respective pairs of edges 2-3 and 4-5 are realized differently. So, for example, coupling parts 6 may be provided on the long edges 2-3, which coupling parts allow at least a coupling by means of such turning movement, whereas the coupling parts 6 on the short edges 4-5 allow at least a coupling by means of a translation movement, for example, by means of a
25 horizontal shifting movement of the respective edges 4-5 towards each other, or by means of a downward movement of the respective edges 4-5 towards each other.

Figure 2 clearly shows that these coupling parts 6 substantially can be realized as a tongue 7 and groove 8, wherein this groove 8 is bordered by an upper lip 9 and a
30 lower lip 10. Said tongue 7 and groove 8, in a manner known as such, result in the above-mentioned locking in vertical direction V1. For obtaining the locking in horizontal direction H1, said tongue 7 and groove 8 are provided with locking parts, which here substantially consist of a protrusion 11 in the proximity of the end of the lower lip 10 and a cooperating therewith recess 12 in the lower side of said tongue
35 7. At the right hand side of figure 2, it is also shown that the cooperation of two of such floor panels 1 in the example results in a bending out B of the lower lip 10.

Hereby, a so-called "pretension" is created, by which two of such floor panels 1 are actively pressed towards each other.

Figure 2 further clearly shows that the floor panel 1 of the example is of the type
5 having a substrate 13 and a top layer 14 provided thereon. Herein, the top layer 14 comprises at least a printed decor 15 and a transparent wear layer 16 situated there above.

The particularity of the present invention consists in that the floor panel 1, between
10 the aforementioned printed decor 15 and the aforementioned substrate 13, comprises a foamed sublayer 17, preferably of PVC or another thermoplastic material, and that said wear layer 16 is free from PVC and is not foamed. Herein, the thickness T1 of the wear layer 16 is less than the thickness T2 of the sublayer 17. In this case, this relates to a sublayer 17 which comprises foamed PVC. In this
15 case, the substrate 13 comprises a HDF board (High Density Fiberboard) having an average density of more than 750 kilograms per cubic meter. The materials of the top layer 14, sublayer 17 and substrate 13 are chosen such that the hardness and/or wear resistance of the wear layer 16 is higher than the corresponding features of the sublayer 17. In this case, the wear layer substantially consists of an UV-hardened
20 acrylic lacquer comprising aluminum oxide particles. Preferably, the wear layer 16 is at least ten percent and still better at least twenty percent harder than the sublayer 17, wherein the hardness is expressed on the Rockwell scale.

The substrate 13 here relates to an internal layer of the floor panel 1 itself, which as
25 such consists of a single layer and wherein the respective layer has a thickness T3 which is larger than half of the thickness T of the entire respective panel 1. Preferably, the thickness T3 of the substrate 13 is at least 70% of the thickness T of the entire floor panel 1.

30 In the example, the contour of the coupling parts 6 is entirely realized in the substrate 13. By the contour, the surface is meant that comprises all contact surfaces 18 between two coupled floor panels 1, with the exception of the contact surface 18A on the upper edge 19 of the panels 1. Of course it is not excluded that, for example, the lower side of the upper groove lip 9 and/or the upper side of the tongue 7 coming
35 into contact therewith consists of the material of the sublayer 17. In such case, the remaining part of the contour of the coupling parts 6 preferably indeed is formed in the material of the substrate 13.

In the example, the sublayer 17 extends above the horizontal level N1 determined by a central line of the floor panel 1. In this case, it even extends above the horizontal level determined by a central line of the coupling parts 6, determined by the tongue-in-groove coupling 7-8, which central line in this case is running approximately even with the level N1. In the examples, the sublayer 17 is adhered directly onto the substrate 13, without the intermediary of glue layers.

Said pretension or bending B provides for a tensioning effect of the aforementioned sublayers 17 against each other at the location of the respective edges 19, namely in this case at the contact surfaces 18A.

Figure 3 clearly shows that above the tongue-in-groove coupling 7-8, however, underneath the surface of the floor panels 1, an air chamber 20 is provided. This air chamber 20 in this case consists of undercuts 21, which are provided on the tongue side as well as on the groove side of the panels 1. Of course, it is possible to obtain such air chamber 20 by applying such undercut 21 on one of both sides 2-3 only, preferably on the groove side; in this manner, the undercut 21 can also be of service when joining the tongue 7 and groove 8 together. Due to the presence of said air chamber 20, said tensioning effect can be concentrated on the contact surfaces 18A situated above this air chamber 20, such that the seam on the upper edge 19 can remain closed.

The sublayer 17 forms more than 45 percent of the overall thickness of the top layer 14. For the transparent or translucent wear layer 16, preferably a radiation-hardened lacquer layer with a thickness T1 of minimum 0.1 millimeter is applied. Preferably, the wear layer is not thicker than 0.6 millimeters. The inventors have found that a thickness T1 of 0.2 to 0.4 millimeters results in a good wear resistance.

The common thickness T4 of said top layer 14 preferably is between 1.5 and 3 millimeters, wherein a thickness T of 1.7 to 2.5 millimeters is desirable.

For the substrate 13, a board material can be used, for example, HDF or MDF, having a thickness T3 of 3 millimeters or more. Preferably, the thickness T3 of the substrate 13 is between 4.5 and 7 millimeters.

On the lower side of the substrate 13, in the case of the example of figure 2 also an optional backing layer 22 is applied. Such backing layer preferably consists of a material similar or equal to that of the wear layer 16 and/or the sublayer 17.

- 5 For the printed decor 15, use is made of UV-hardening pigment-containing inks which are deposited directly on the sublayer 17, for example, by means of a digital printing device, such as an inkjet printer. In this case, the print is realized without intermediate primer layers, and the inks thus are deposited directly on the foamed sublayer 17. Surprisingly, the inventor has found that a good printing quality can be
10 obtained regardless the presence of a foamed surface.

In figure 3 it is further represented in dash-dotted line that the sublayer 17 comprises a glass fleece or glass fabric 23. Herein, the glass fleece or glass fabric 23 is situated in the upper quarter 24 of said sublayer 17.

15

- Figure 4 represents a variant, wherein the substrate 13 is provided with a covering 25, which limits or prevents the penetration of moisture into the substrate 13. The respective covering 25 is made overlapping with the edge or border 26 of the sublayer 17. In this manner is prevented that the substrate portion immediately
20 underneath the sublayer 17 would be affected by moisture, and in this manner the risk is limited that effects, such as, for example, swelling of the substrate material as a result of moisture penetration, become visible on the surface of the floor panel.

- Figure 5 represents another variant, wherein the wear layer 16, at the surface 27
25 thereof, is provided with a structure or relief of embossments 28. Herein, the embossment 29 forms an example of an embossment for imitating wood pores. The embossments 30 form a bordering of the decor 15 in the form of chamfers at the edges 19 of the floor panel 1.

- 30 In this case, the embossments 30 form an example of structural parts which continue up into the sublayer 17, wherein the printed decor 15 is also structured at the location of these embossments 30. In this example, even the reinforcement layer 23 follows the contour of the embossments 30.

- 35 Figure 6 represents a variant of a floor panel 1 with the characteristics of the first aspect, which is obtained by means of a method with the characteristics of the third aspect. Herein, the decorative panel, or floor panel 1 in this case, comprises a wear

layer 16 which substantially consists of lacquer, a material sheet 31 and hard particles 32. In this case, the lacquer is a UV-hardened acrylic-based lacquer. Said material sheet 31 is an alpha-cellulose paper sheet in which said hard particles 32, in this case aluminum oxide particles, are embedded. The ash content of the
5 aforementioned material sheet 31 consists practically exclusively of said aluminum oxide particles. Said lacquer layer for the rest preferably is free from hard particles 32.

Figure 7 represents a decorative panel, in this case a floor panel 1, wherein the wear
10 layer 16 is made similarly as in the case of the embodiment of figure 6. In this case, the top layer 14 is free from a foamed layer. The printed decor 15 is a print formed directly on the substrate 13. To this aim, the substrate 13 is treated with a preparatory uniformly colored layer 33 which provides for a neutral printing base and improved adherence with the deposited inks or, in other words, the printed decor 15.

15 Figure 8 represents a decorative profile 34 with the characteristics of the second aspect of the invention and obtained according to the method of the third aspect of the invention. In this case, this relates to a multi-functional profile 34 which can be adapted in order to form, at user's choice, an expansion profile or T-profile, a transition profile or an end profile. Multifunctional profiles are known as such, for
20 example, from WO 2006/074824. The decorative profile 34 comprises a profiled substrate 13A, in this case composed of a T-shaped portion 35 and two nose portions 36 situated underneath the flanges 37 of the T-shaped portion 35. In this case, the profiled substrate 13A comprises an upper surface 38 and two outward-directed lateral surfaces 39, which adjoin to the upper surface 38. The upper surface
25 38 and the two lateral surfaces 39 are provided with a covering 40 with a printed decor.

Figure 9 clearly shows that the covering 40 comprises a carrier 41 in the form of a
30 paper or foil. The carrier 41 is provided with a printed decor 15 and is finished with a wear layer 16. The wear layer 16 shows a similar composition as the wear layers of figures 6 and 7. The covering 49 is provided as a whole on the substrate 13A by means of a glue layer 42, for example, by means of a encasing process.

35 Referring to figures 6, 7 and 9, it is also noted that the composition of the transparent wear layer 16 is represented schematically only and that the cellulose fibers of the material sheet 31 in practice can be spread over a larger portion of the thickness T1

of the lacquer layer. In practice, the respective material sheet 31 can adjoin against the printed decor 15. Preferably, the wear layer 16 at its surface comprises a zone formed by a portion of lacquer which is free from cellulose fibers

- 5 The present invention is in no way restricted to the herein above-described embodiments, on the contrary may such floor panels, decorative panels, decorative profiles and methods for manufacturing them be realized without leaving the scope of the present invention.

Claims.

- 1.- Floor panel with a substrate (13) and a provided thereon top layer (14),
5 wherein said top layer (14) comprises a printed decor (15), provided between a
foamed PVC sublayer (17) and a transparent wear layer (16), characterized in that
said wear layer (16) is free from PVC, is not foamed, and has a thickness T1 which
is less than the thickness T2 of said foamed PVC sublayer (17).
- 10 2.- Floor panel according to claim 1, characterized in that said printed decor (15)
consists of a print formed directly on said sublayer (17).
- 3.- Floor panel according to claim 2, characterized in that the print is formed by
means of UV-hardening inks.
- 15 4.- Floor panel according to any of the preceding claims, characterized in that
said wear layer (16) concerns a lacquer layer.
- 5.- Floor panel according to any of the preceding claims, characterized in that
20 said wear layer (16) concerns an acrylic-based layer or a urethane-based layer.
- 6.- Floor panel according to any of the preceding claims, characterized in that
said wear layer (16) is hardened by means of UV radiation, electron radiation and/or
excimer radiation and/or is hardened by drying of a solvent.
- 25 7.- Floor panel according to any of the preceding claims, characterized in that
said wear layer (16) comprises hard particles, such as aluminum oxide particles.
- 8.- Floor panel according to any of the preceding claims, characterized in that
30 said sublayer (17) is adhered to said substrate (13) by means of a glue layer.
- 9.- Floor panel according to any of the claims 1 to 8, characterized in that said
sublayer (17) is adhered directly to the substrate (13), without the intermediary of
glue layers.
- 35 10.- Floor panel according to any of the preceding claims, characterized in that
said sublayer (17) comprises a glass fleece or glass fabric.

- 11.- Floor panel according to claim 10, characterized in that said glass fleece or glass fabric is situated on the upper surface of said sublayer (17), or at least is situated in the upper quarter (24) of the thickness T2 of said sublayer (17).
- 5 12.- Floor panel according to any of the preceding claims, characterized in that said sublayer (17) is foamed at least in a chemical manner.
13. Floor panel according to any of the preceding claims, characterized in that
10 said substrate (13) substantially consists of a MDF or HDF board material.
14. Floor panel according to any of the preceding claims, characterized in that the floor panel (1), on at least two opposite edges (2-3), is provided with mechanical coupling parts (6) and that these coupling parts, in a coupled condition of two of such
15 floor panels, provide a tensioning effect of said sublayers (17) against each other at the location of the respective edges (19).
15. Floor panel according to any of the preceding claims, characterized in that said substrate (13), at least on two opposite edges (2-3), is provided with a covering
20 (25), which prevents or limits the penetration of moisture into the substrate (13), wherein the respective covering (25) is made overlapping with the edge (26) of said sublayer (17).
- 16.- Floor panel according to any of the preceding claims, characterized in that
25 said wear layer (16) comprises a material sheet.
- 17.- Floor panel according to claim 17, characterized in that said material sheet is a paper sheet with embedded aluminum oxide particles.
- 30 18.- Decorative panel or profile, wherein this panel or profile comprises at least a substrate, a decor and a wear layer provided on the decor, characterized in that said wear layer substantially consists of lacquer, a material sheet and possible hard particles, wherein said lacquer relates to a radiation-hardening lacquer or a lacquer drying by evaporation of a solvent.
- 35 19.- Decorative panel or profile according to claim 18, characterized in that said material sheet is a paper sheet, preferably an alpha-cellulose paper.

20.- Decorative panel or profile according to claim 19, characterized in that the respective paper sheet comprises embedded hard particles.

5 21.- Decorative panel or profile according to any of the claims 18 to 20, characterized in that said lacquer is an acrylic-based radiation-hardening lacquer.

22.- Decorative panel according to any of the claims 18 to 21, characterized in that the decorative panel further also comprises the characteristics of one or more
10 of the claims 1 to 17.

23.- Method for manufacturing a decorative panel or profile with the characteristics of any of the claims 18 to 22, wherein the method comprises at least the following steps:

- 15
- the step of providing a carrier;
 - the step of providing a layer of transparent lacquer in liquid condition on said carrier;
 - the step of providing a material sheet in said lacquer;
 - the step of hardening said lacquer.

20

24.- Method according to claim 23, characterized in that said carrier is a plate-shaped or profiled substrate.

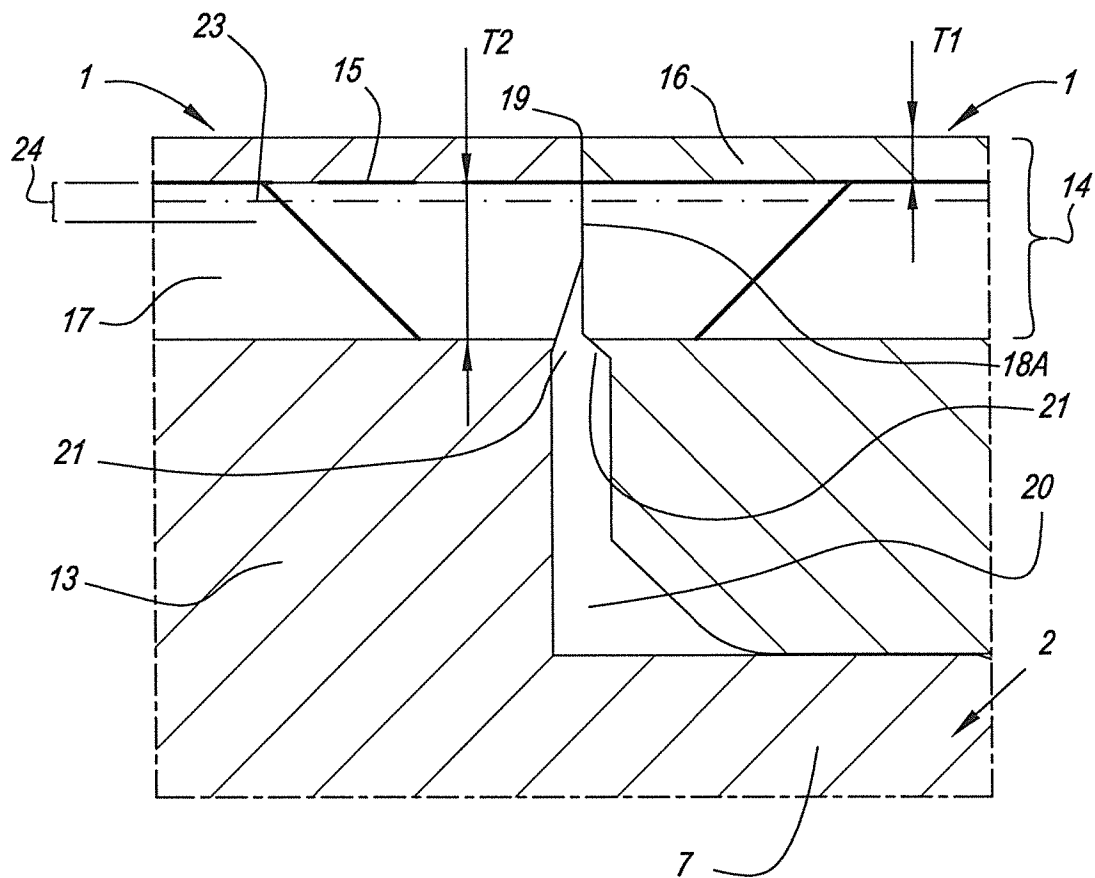
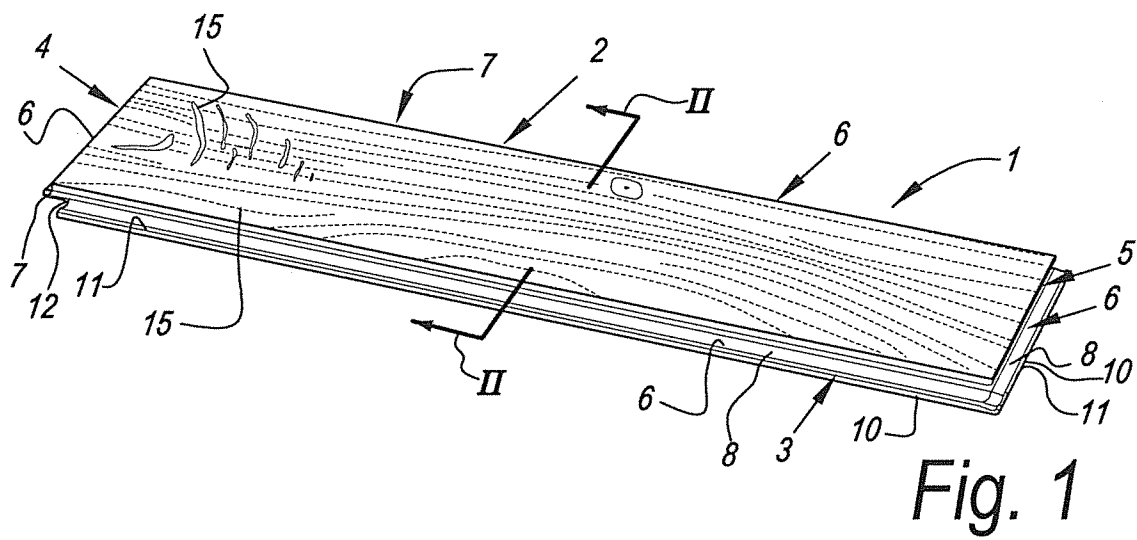
25.- Method according to claim 23, characterized in that said carrier is a paper or
25 a foil and that the method preferably further also comprises the step of providing said carrier on a plate-shaped or profiled substrate.

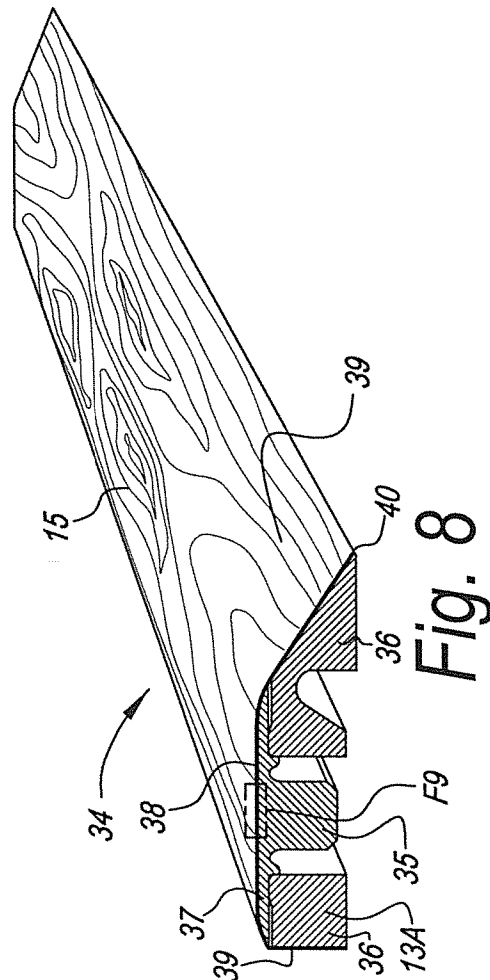
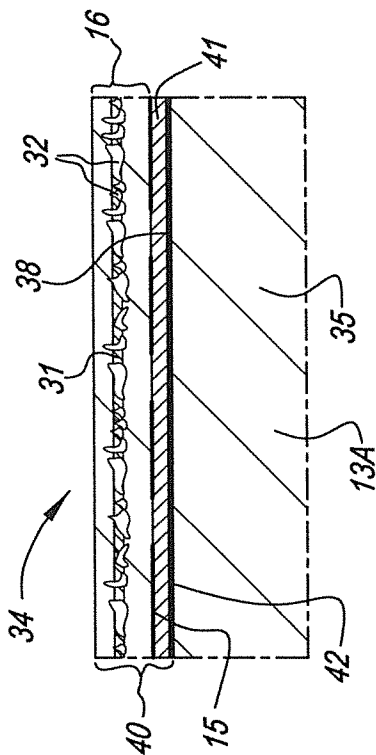
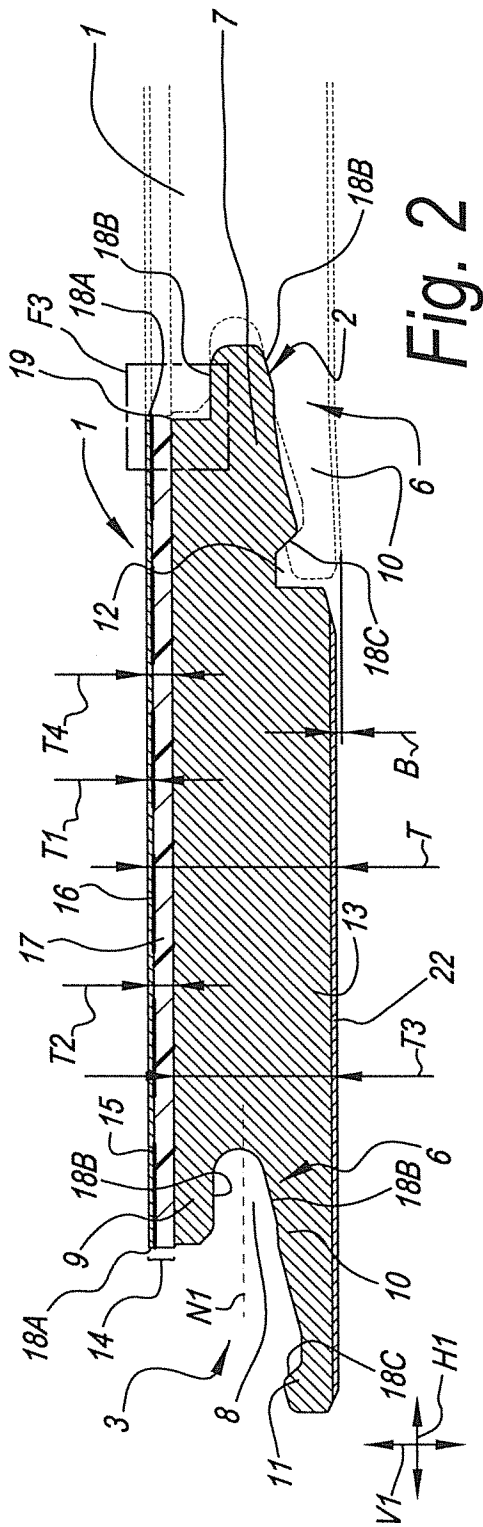
26.- Method according to any of the claims 23 to 25, characterized in that said carrier is printed prior to said step of providing the lacquer in liquid condition, preferably by means of a digital printing technique, preferably by means of UV-
30 hardening or water-based inks.

27.- Method according to any of the claims 23 to 26, characterized in that said material sheet is a paper sheet, preferably a paper sheet comprising embedded hard
35 particles.

28.- Method according to any of the claims 23 to 27, characterized in that in said step of providing said material sheet in the lacquer, the material sheet is pressed on against the carrier.

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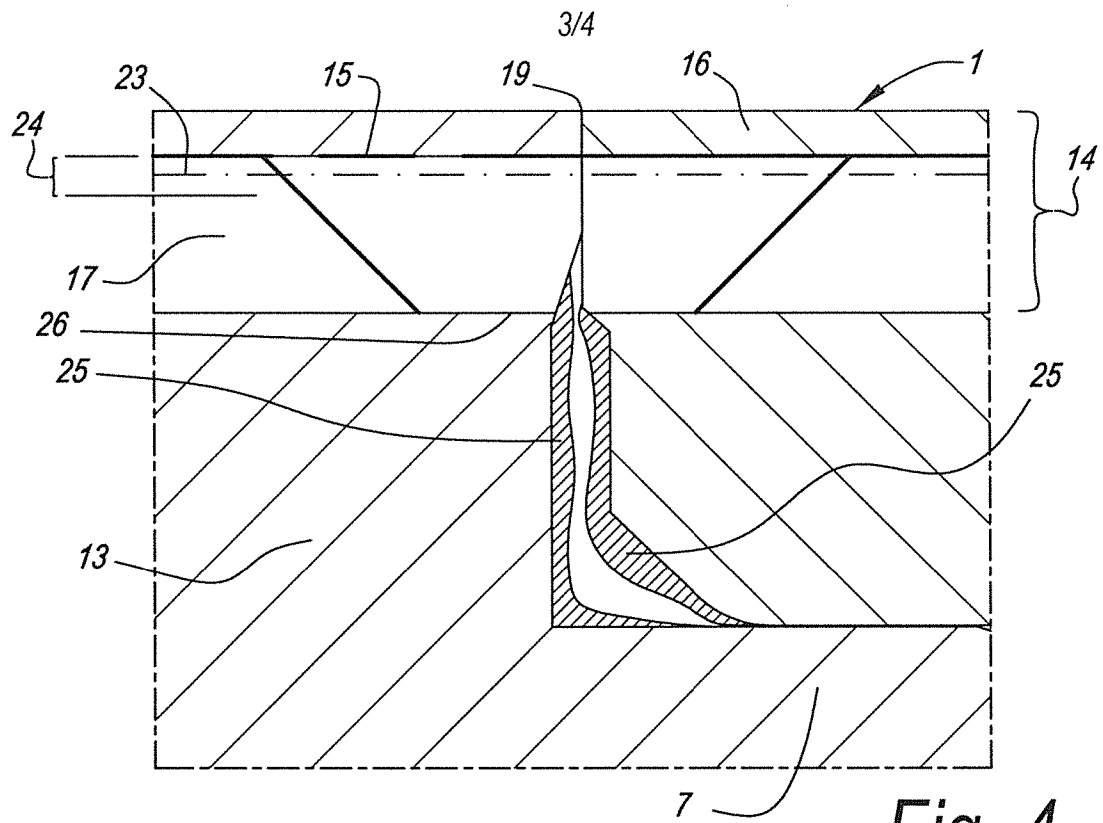


Fig. 4

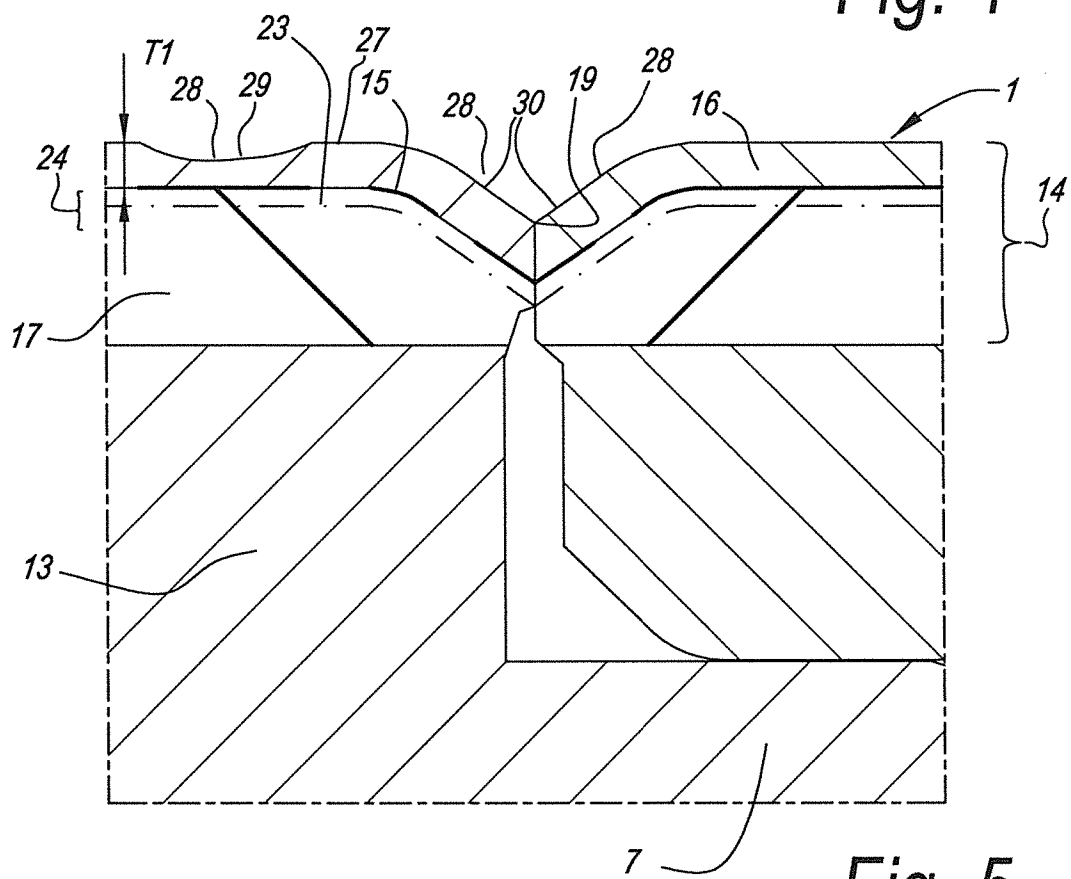


Fig. 5

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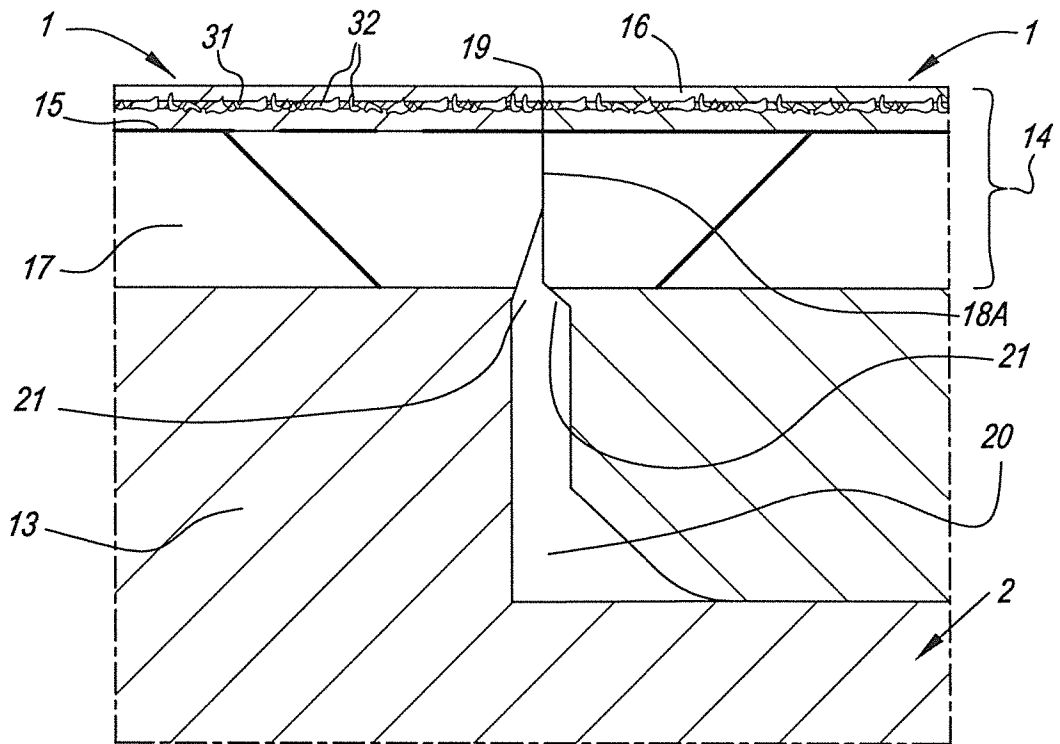


Fig. 6

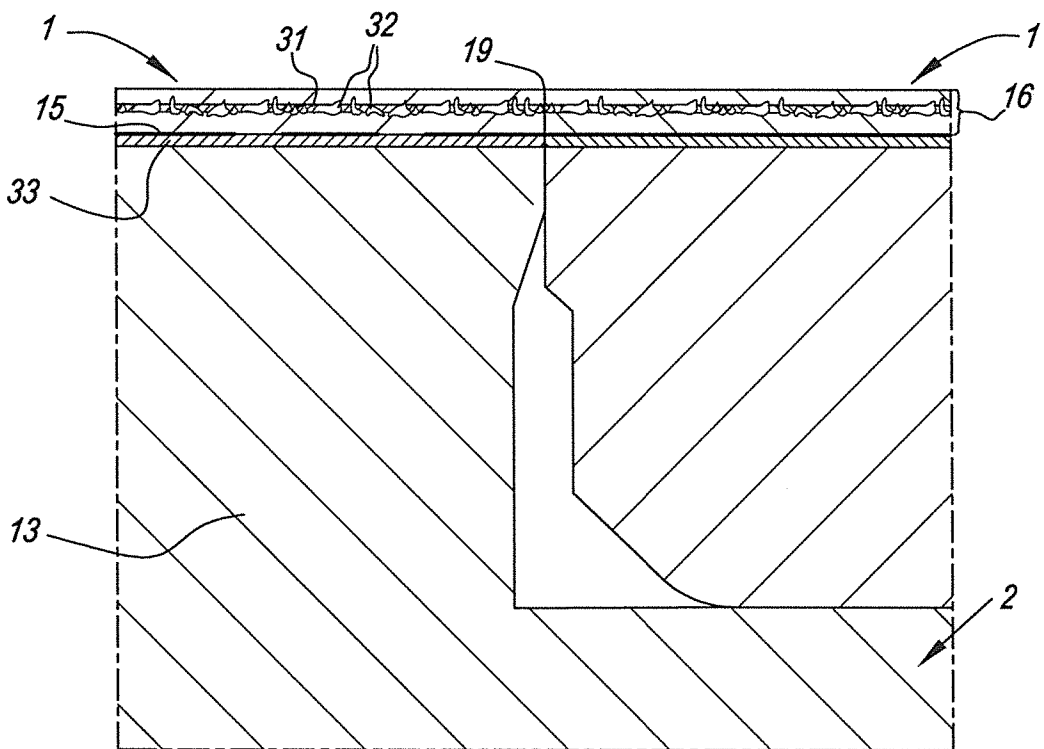


Fig. 7