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(54) **EMBOSSING METHOD**

PRÄGEVERFAHREN

METHODE DE GAUFRAGE

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Description

TECHNICAL FIELD

[0001] Disclosed herein are methods and machines for the production of multi-ply cellulose web material, for example and in particular web material made of tissue paper. Also disclosed are products made of multi-ply tissue paper.

BACKGROUND ART

[0002] In the tissue paper sector, plies of cellulose material are embossed and bonded together by means of various techniques, specifically by gluing, in order to obtain a multi-ply web material. Rolls of toilet paper, paper towels and other items made of tissue paper are produced in this way.

[0003] The multi-ply cellulose web material must meet often mutually contrasting requirements of a technical and aesthetic nature. In particular, the embossing pattern must be such as to impart the required characteristics of softness, liquid absorption capacity, thickness, crush resistance. Moreover, the embossing pattern shall be appropriately designed to provide appropriately distributed gluing spots, so that the plies that form the web material are bonded together effectively but with a limited amount of glue, both to reduce production costs and to avoid excessively stiffening the cellulose material. In particular, the glue should hold the plies of the web material bonded along the edges of the web material and along the perforation lines, when provided, for example in products in roll form.

[0004] Great efforts are expended in the design of the embossing rollers to obtain embossing patterns that satisfactorily meet these contrasting requirements. Examples of embossing methods of the current art are disclosed in EP1609589 and EP2080611. This latter discloses a method according to the preamble of claim 1.

[0005] In some cases, to obtain a cellulose product with better appearance and hence able to attract consumers' attention, printed patterns are combined with the embossed designs. These usually require the use of printing machines placed in line with the embossing unit. Printing machines are complex, expensive, difficult to operate and maintain and can have limited production rates, causing a reduction of the overall productivity of the line.

[0006] Therefore, there is a need to devise methods and cellulose products capable of overcoming or alleviating the limits of existing methods and products.

SUMMARY OF THE INVENTION

[0007] According to the invention, a method for producing a multi-ply web material is provided, including the features of claim 1. Further embodiments and features are set forth in the dependent claims.

[0008] According to another aspect, a multi-ply cellulose web material is provided, formed by a plurality of sheets joined along transverse perforation lines and having a first longitudinal edge and a second longitudinal edge. The material comprises at least a first ply and a second ply of embossed cellulose material. In embodiments disclosed herein, the first ply comprises a first colored decorative pattern and a second decorative pattern defined by embossed protrusions oriented toward the second ply and on which glue is applied. The embossed protrusions to which the glue is applied are arranged, with respect to the longitudinal edges and to the transverse perforation lines, so that each sheet is provided with: at least one gluing spot in a rectangular area adjacent to each transverse perforation line, having a width of 10 mm and preferably of 5 mm; and at least one gluing spot in a rectangular area adjacent to each edge having a width of 10 mm and preferably of 5 mm.

[0009] Embodiments of the invention disclosed herein allow obtaining combined printed and embossed decorative patterns, using solely embossing rollers, with no need to use actual printing units, which are a critical point of the converting line, also because of their low production rates.

[0010] Using embossing units in sequence, not necessarily in phase with each other, with particular configurations of the embossing protuberances, exemplifying embodiments whereof will be described below, a multi-ply cellulose product is obtained with an optimal distribution of the embossing protuberances, on which a glue is applied to join the plies, and a distribution of preferably colored decorations, which can appear, to the naked eye, as printed decorations, but which instead are obtained by embossing rollers, combined with distributors of ink or more in general of a colored liquid.

[0011] To obtain particular effects, the glue can also be colored, preferably with a color different from the colored liquid used for decoration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention will be better understood following the description and the accompanying drawings, which illustrate and exemplifying and non-limiting embodiment of the invention. More in particular, the drawings show:

Fig. 1, a diagram of an embossing machine in a lateral view;

Fig. 2, a view of a portion of the lateral surface of a first embossing roller of the machine of Fig. 1 in one embodiment;

Figs. 3A, 3B, 3C, enlarged sections according to the lines IIIA-IIIA IIIB-IIIB and IIIC-IIIC of Fig. 2;

Fig. 4, a view of a portion of the lateral surface of a first embossing roller of the machine of Fig. 1 in one embodiment;

Figs. 5A, 5B, enlarged sections according to the lines VA-VA and VB-VB of Fig. 4;

Figs. 6A and 6B, enlarged schematic sections of two embodiments of an embossed product obtainable with the machine of Figs. 1-5B;

Fig. 7, a view of a portion of the lateral surface of the first embossing roller of the machine of Fig. 1 in an additional embodiment;

Fig. 8, an enlarged section according to the line VIII-VIII of Fig. 7;

Fig. 9, a view of a portion of the lateral surface of the second embossing roller of the machine of Fig. 1 in an additional embodiment;

Fig. 10, an enlarged section according to the line X-X of Fig. 9;

Figs. 11A and 11B, enlarged schematic sections of two embodiments of an embossed product obtainable with the machine of Figs. 1, 7, 8, 9 and 10;

Fig. 12, a view of a portion of the lateral surface of the first embossing roller of the machine of Fig. 1 in yet an additional embodiment;

Fig. 13, an enlarged section according to the line XIII-XIII of Fig. 12;

Fig. 14, a view of a portion of the lateral surface of the second embossing roller of the machine of Fig. 1 in yet an additional embodiment;

Fig. 15, an enlarged section according to the line XV-XV of Fig. 14;

Figs. 16A and 16B, enlarged schematic sections of two embodiments of an embossed product obtainable with the machine of Figs. 1, 12, 13, 14 and 15;

Fig. 17, an axonometric view of a roll of tissue paper obtained with a web material produced with a machine according to Fig. 1; and

Fig. 18, a schematic enlargement of a portion of the web material of the roll of Fig. 17.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Fig. 1 schematically shows a first embodiment of a machine 1 for the production of an embossed web material made of tissue paper. The machine 1 can comprise a first embossing unit 3 and a second embossing unit 5. In some embodiments, the machine 1 comprises a third embossing unit 7.

[0014] In the embodiment of Fig. 1, the first embossing unit 3 comprises a first embossing roller 11, which can be provided with embossing protuberances 13. The first embossing roller 11 is adapted to rotate around a respective rotation axis 11A in the direction indicated by the arrow f11. The first embossing roller 11 can be driven into rotation by a respective motor, not shown.

[0015] To the first embossing roller 11 can be associated a distributor 15 to distribute a liquid substance. The distributor can be adapted to distribute a water-base liquid. For example, the distributor 15 can be adapted to distribute an ink. As used herein, the term "ink" indicates any liquid substance, preferably water-based, containing a pigment. Preferably, the distributor 15 distributes a liquid not containing glue.

[0016] With the first embossing roller 11 cooperates a first pressure roller 17, adapted to rotate according to the arrow f17 around a respective rotation axis 17A. The first pressure roller 17 can be provided with a lateral surface coated with a coating 17R, preferably made of elastically yielding material. The coating 17R can be made for example of rubber, synthetic rubber, or other suitable elastomeric material. The first embossing roller 11 and the first pressure roller 17 define a first embossing nip 21, through which passes a first path for a ply V1 of web material, for example a ply of tissue paper. The ply V1 can consist of a single layer or of a plurality of layers of cellulose material. For example, the first ply V1 can have a grammage between 10 g/m^2 and 50 g/m^2, preferably between 12 g/m^2 and 30 g/m^2.

[0017] The first pressure roller 17 and the first embossing roller 11 are pressed against each other so that the embossing protuberances 13 penetrate in the elastically yielding coating 17R of the pressure roller 17 imparting a permanent deformation to the ply V1 of tissue paper that passes through the first embossing nip 21. The distributor 15 is able to apply the liquid substance on at least some embossed protrusions formed on the ply V1 by the embossing protuberances 13 of the embossing roller 11.

[0018] In the embodiment of Fig. 1, the second embossing unit 5 comprises a second embossing roller 23, provided with embossing protuberances 25 and able to rotate around a rotation axis 23A according to arrow f23. The second embossing roller 23 can be driven into rotation by a motor, not shown. To the second embossing roller 23 is associated a distributor 26 of a liquid substance, for example adapted to apply a glue on embossed protrusions generated by the second embossing roller 23 on the first ply of tissue paper V1, as described farther on.

[0019] The second embossing roller 23 cooperates with a second pressure roller 27, adapted to rotate around a respective rotation axis 27A according to the arrow f27. The second pressure roller 27 can be provided with a coating 27R made of elastically yielding material, analogous or similar to the coating 17R of the first pressure roller 17. The second embossing roller 23 and the second pressure roller 27 form between them a second embossing nip 29 through which extends the path of the first ply V1. In the second embossing nip, the first ply V1 can be subjected to a second embossing, i.e. mechanical deformation operation by effect of the penetration of the embossing protuberances 25 of the second embossing roller 23 in the elastically yielding coating 27R of the second pressure roller 27, which is pressed against the second embossing roller 23.

[0020] In the embodiment illustrated in Fig. 1, the second embossing unit 5 comprises a third embossing roller 31, adapted to rotate according to the arrow f31 around a rotation axis 31A, by means of a motor, not shown. The third embossing roller 31 is provided with embossing protuberances 33. The third embossing roller 31 cooperates with a third pressure roller 35, adapted to rotate

around a respective rotation axis 35A according to the arrow f35. The third pressure roller 35 can be provided with an elastically yielding coating 35R, analogous or similar to the coating 17R of the first pressure roller 17 and to the elastically yielding coating 27R of the second pressure roller 27. Between the third embossing roller 31 and the third pressure roller 35 is defined an embossing nip 37, whereat the embossing protuberances 33 of the third embossing roller 31 press against the elastically yielding coating 35R of the third pressure roller 35 and penetrate in said coating 35R, so as to emboss a second ply of tissue paper V2, which is fed along a respective feed path. The second ply of tissue paper V2 can have a grammage between 10 g/m^2 and 50 g/m^2, preferably between 12 g/m^2 and 30 g/m^2.

[0021] The path of the second ply of tissue paper V2 extends around the third pressure roller 35 and around the third embossing roller 31 and thence towards the second embossing roller 23. After being embossed between the third embossing roller 31 and the third pressure roller 35, the second ply V2 is detached from the third embossing roller 31 and follows the path towards the second embossing roller 23. The path of the ply V1 and the path of the ply V2 join in a lamination nip 38, defined between the second embossing roller 23 and a laminating roller 39, adapted to rotate around a respective rotation axis 39A according to the arrow f39. The laminating roller 39 can be coated with an elastically yielding material, for example an elastomer, a natural or synthetic rubber, preferably having greater hardness than the hardness of the coating 17R of the first pressure roller 17 and of the coating 27R of the second pressure roller 27. In other embodiments, the laminating roller 39 can have a rigid cylindrical surface. The term "rigid" means, in this context, a surface that does not undergo detectable compression deformations at the pressure that is generated between the embossing protuberances 25 of the second embossing roller 23 and the laminating roller 39.

[0022] In some embodiments, the laminating roller 39 is mounted idle and driven in rotation by pressure with the embossing roller. In other embodiments, the laminating roller 39 can be motorized.

[0023] In the laminating nip 38, the second ply V2 is pressed against the first ply V1 can cause the mutual gluing of the plies, as described in more detail below.

[0024] The third embossing unit 7, if present, can comprises a fourth embossing roller 41 adapted to rotate according to the arrow f41 around its own rotation axis 41A and provided with embossing protuberances 43. The fourth embossing roller can be made to rotate by a motor, not shown. The fourth embossing roller 41 cooperates with a fourth pressure roller 45 adapted to rotate according to the arrow f45 around a respective rotation axis 45A. The fourth pressure roller 45 can be provided with an elastically yielding coating 45R, similarly to the pressure rollers 17, 27, 35. The fourth embossing roller 41 and the fourth pressure roller 45 are pressed against each other at a fourth embossing nip 47. Through the fourth embossing nip 47 extends the path of a third ply of tissue paper V3, which is embossed by effect of the protuberances 43 of the fourth embossing roller 41 which penetrate in the elastically yielding coating 45R of the fourth pressure roller. The third ply of tissue paper V3 can have a grammage between 10 g/m^2 and 50 g/m^2, preferably between 12 g/m^2 and 30 g/m^2.

[0025] While in Fig. 1 the embossing roller 31 is positioned above the pressure roller 45, a reverse configuration, where the embossing roller 43 is under the pressure roller 45, is not excluded and in fact it may be preferred. If the embossing roller 41 is in a higher position, the protrusions generated thereby on the ply V3 are oriented opposite with respect to the ply V1. If the embossing roller 41 is positioned in a lower position, i.e. under the pressure roller 45, the protrusions generated by the embossing unit 7 are oriented towards the ply V1.

[0026] The path of the third ply V3 can join the path of the first ply V1 to advance, together with it, towards the second pressure roller 27 of the second embossing unit 5. The numeral 49 indicates a guide roller on which the paths of the plies V1 and V2 can converge.

[0027] Figs. 2, 3A, 3B and 3C show a front view and a local section according to III-III of Fig. 2 of a portion of the cylindrical surface of the first embossing roller 11 in one embodiment.

[0028] In the embodiment illustrated in Figs. 2 and 3A, 3B, 3C the embossing protuberances 13 comprise a first series of protuberances 13.1 and a second series of protuberances 13.2. In some embodiments, the protuberances 13.1 can have a height H1 (Fig. 3A), for example between about 0.3 and about 2 mm, preferably between about 0.8 and about 1.3 mm. The protuberances 13.1 can for example have a frusto-conical shape, with a circular or elliptic cross section, or frusto-pyramidal shaped with polygonal, for example quadrangular, cross section. In general, the protuberances 13.1 can be dot-shaped and define a micro-embossing pattern.

[0029] In possible embodiments, the cross section, i.e. the section orthogonal to the height of the protuberances 13.1 can have a maximum dimension and a minimum dimension, or a constant dimension. For example, in the case of frusto-conical shaped protuberances with a circular cross section, the dimension of the cross section is constant (equal to the diameter), variable (decreasing) from the base (maximum diameter) to the head (minimum diameter) of the protuberance. If the cross section is elliptic, at each height of the protuberance the cross section will be characterized by a smaller transverse dimension and by a greater transverse section, corresponding respectively to the minor axis and to the major axis of the ellipse. In this case, too, the section reduces (the major and minor axes decrease) along the height development from the base to the head of the protuberance. In case of protuberances with square or rectangular section, the greater transverse dimension is equal to the diagonal and the smaller transverse dimension is equal to the side of the square, or to the smaller side

of the rectangle. The aforesaid dimensions decrease from the base to the head of the protuberance.

[0030] The protuberances 13.1 can have such a cross section that the greater dimension and the smaller dimension of each cross section are substantially of the same order of magnitude. For example, the ratio between greater dimension and smaller dimension of each cross section can be equal to or smaller than about 5, preferably equal to or smaller than about 3, more preferably equal to or smaller than about 2. Advantageously, the cross section can be circular, hence with a ratio of 1 between greater dimension and smaller dimension.

[0031] Preferably, the protuberances 13.1 are isolated from each other, i.e. each protuberance has a head surface and a lateral surface that extends from the head surface towards the base of the protuberance.

[0032] In this sense, the protuberances 13.1 are dot-shaped and can define a background embossing patter, for example a micro-embossing pattern. The background embossing or micro-embossing can impart technical characteristics to the product, for example and in particular characteristics of fluffiness, softness, absorption capacity.

[0033] Vice versa, in some embodiments each protuberance 13.2 can have a complex shape, characterized by a body 13.6 and by pluralities of tips or appendages 13.3 that project from an upper surface, or head surface, 13.4 of the body 13.6 and that have a head surface 13.5. As shown in particular in Fig. 2, the body 13.6 of each protuberance 13.2 has a very ample plan dimension, so that multiple tips 13.3 can be present on the upper surface 13.4 of each protuberance 13.2.

[0034] In Fig. 2, the protuberances 13.2 define a decorative motif.

[0035] The protuberances of the second series of embossing protuberances 13.2 can have a total height H2 greater than the height H1 of the protuberances 13.1. In the embodiment of Figs. 3A, 3B, 3C the embossing protuberances 13.2 have a body 13.6 having a height H1, from which the appendages or tips 13.3 project. The total height H2 is the height measured between the base of the embossing protuberance 13.2 and the head surface 13.5 of the tips 13.3. The difference H2-H1 can measure some tens of a millimeter, for example between about 0.2 and about 0.6 mm, preferably around about 0.3 mm. Even though the body 13.6 of the protuberances 13.2 has, in the illustrated example, a height H1 equal to the height of the protuberances 13.1, this is not necessary. It is advantageous that the total height H2 of the protuberances 13.2 be greater than the height H1 of the protuberances 13.1, for the purposes that will be clarified farther on.

[0036] In some embodiments, the area of the surface 13.4 of each protuberance 13.2 is equal to a multiple of the total surface area of the head surfaces 13.5 of the tips 13.3. For example, on a surface 13.4 of a single protuberance 13.2 some tens or many tens of tips 13.3 distanced from each other can be arranged.

[0037] In the exemplary embodiment of Fig. 2 the protuberances 13.2 form decorative images, in the example hot air balloons and airplanes. Each decorative image can be formed by a protuberance 13.2 whose body 13.6 has a contour corresponding to the contour of the decorative image. Inside the contour, the protuberance 13.2 can have a continuous flat surface at a height H1, or it can have inner cavities, as shown for example in 13.7, to reduce the total surface area of the upper surface 13.4.

[0038] Figs. 3A, 3B, 3C, show local sections according to the lines IIIA-IIIA, IIIB-IIIB and IIIC-IIIC of Fig.2, respectively. The section of Fig. 3A is carried out in an area that comprises a protuberance 13.1, a surface portion 14 of the embossing roller 11 lacking protuberances, a portion of a protuberance 13.2, with tips 13.3 (only one of which is visible in Fig. 3A). Fig. 3B shows a section carried out along the line IIIB-IIIB of a solid decorative protuberance 13.2, with an ample upper surface 13.4 that is at a height H1 from the base and that occupies the entire surface delimited by the perimeter of the figure (in this case, a hot air balloon). On the upper surface 13.4 are positioned rows of tips 13.3 suitably spaced from one another.

[0039] Fig. 3C shows a cross section according to IIIC-IIIC of Fig. 2, along a line that cuts a portion of a decorative protuberance 13.2 that, similarly to the one partially visible in Fig. 3A, has zones with a height H1 and inner cavities 13.7.

[0040] In all the sections of Figs. 3A, 3B, 3C, the upper surface 13.4 of the decorative protuberances 13.2 is far greater, even greater by one or two orders of magnitude, than the head surface of the protuberances 13.1.

[0041] If the upper surface 13.4 of each protuberance 13.2 is far greater, for example greater by one or two orders of magnitude, than the head surface of the protuberances 13.1, the penetration of the protuberances 13.2 in the elastically yielding coating 17R of the pressure roller 17 is limited and can entail a modest permanent deformation of the cellulose material forming the ply V1, or nearly no permanent deformation at all. As will be clarified in greater detail hereafter, in this case the pattern formed by the protuberances 13.2 gives rise to a colored design on the ply V1, which can be perceived by the eye of the consumer as a print, rather than as an embossing. Hence, a print decoration effect is obtained using an embossing unit, instead of a printing machine, with the advantages that come from avoiding the use of this latter type of machine which can entail several drawbacks in the converting line, for example a lower production rate.

[0042] In some embodiments, the area of the head surface of each protuberance 13.1 can be equal to or greater than, for example about double or triple the area of the head surface 13.5 of the protuberances 13.2. The protuberances 13.1 can have, for example, a circular head surfaces with a diameter between about 0.4 mm and about 0.6 mm and the tips 13.3 can have a circular head surface with a diameter between about 0.2 mm and about 0.6 mm.

[0043] With an arrangement of the type described, the

ply V1 is embossed by penetration of the protuberances 13.1 and of the tips 13.3 in the elastically yielding coating 17R. As observed above, in some embodiments the penetration of the main body 13.6 of the protuberances 13.2 in the elastically yielding coating 17R is limited by effect of the extensive area of the head surface 13.4 of these protuberances. Consequently, the ply V1 can be embossed in a deeper manner at the protuberances 13.1 and only lightly at the tips 13.3, remaining substantially smooth around the tips 13.3. Since the height H2 is greater than the height H1, the distributor 15 of liquid substance applies the liquid substance only on the radially more projecting surfaces of the embossed ply V1, which correspond to the head surfaces 13.5 of the tips 13.3, so that the ply V1 is colored in points at these tips 13.3. Making the appendages or tips 13.3 with small transverse dimensions, hence with a small head surface, it is possible to obtain very fine patterns that on the ply V1 are visible as small points (pixels) of color, pigmented with the liquid substance applied by the distributor 15.

[0044] In embodiment variants, the liquid applied by the distributor 15 can be colorless and/or can comprise an adhesive substance; hence it can have a gluing capability. In the case of an adhesive substance, the glue can be highly diluted, for example it can be 2 to 10 times more diluted than normal glue used for mutually gluing embossed cellulose plies made of tissue paper.

[0045] The application of a colorless liquid, or of a liquid contained a certain amount of adhesive substance, can facilitate the subsequent mutual gluing of the plies in the second embossing unit, as described in more detail hereafter.

[0046] The protuberances 13.1 of the first series of protuberances can form a background embossing or micro-embossing. For example, the protuberances 13.1 can be distributed with a density between about 15 and about 200 protuberances/cm^2, preferably between about 30 and about 60 protuberances/cm^2. Each protuberance 13.1 can have a head surface area for example between about 0.1 and about 1 mm^2. This embossing or micro-embossing formed by the protuberances 13.1 imparts technical characteristics of fluffiness, thickness and/or absorption to the cellulose material that forms the ply V1. As shown in Fig. 2, the protuberances 13.1 are not distributed uniformly on the surface of the embossing roller 11, because they are absent in the area in which the embossing protuberances 13.2, of the second series, are positioned. The density indicated above is referred to areas in which there is a continuous distribution of protuberances 13.1.

[0047] In some embodiments, the protuberances 13.2 are positioned in areas of the embossing roller 11 devoid of protuberances 13.1, so that on the embossed ply V1 the cellulose material remains smooth around and inside the decorative motifs formed by the coloration of the ply V1 at the tips 13.3. In Fig. 2, the areas of the roller 11 devoid of protuberances 13.1 are indicated by the numeral 14. On the ply V1 to this area corresponds a substantially smooth area of the ply V1, which gives more emphasis to the decorative motifs obtained from the application of the liquid substance on the areas of the ply V1 deformed by the tips 13.3.

[0048] In Figs. 2 and 3A-3C, the decorative motifs are generated by protuberances 13.2 that have tips 13.3 on their head surfaces, so as to reduce the surface of the cellulose ply on which the colored liquid substance L is applied. However, in other embodiments, each protuberance 13.2, or at least some of them, may have a substantially flat head surface and a height H2 from the base of the protuberance 13.2. In this way, a coarser decoration is obtained.

[0049] Fig. 4 is a front view of a possible embodiment of the second embossing roller 23. Fig. 5A shows a section according to VA-VA of Fig. 4, of one of the embossing protuberances 25. Fig. 5B shows a local section according to the line VB-VB of Fig. 4. The embossing protuberances 25 can have a body 25.1 with a head surface 25.3 from which tips 25.2 project. The reference H3 indicates the height of the body 25.1 the reference H4 indicates the total height of the tips 25.2 of each protuberance 25, i.e. the distance of the head surfaces of the tips 25.2 from the base of the protuberances 25. In other embodiments, the protuberances 25 (or some of them) can have a simple shape, similar to the protuberances 13.1 shown in Fig. 3, and a height H4.

[0050] The heights H3 and H4 can be equal to the heights H1 and H2, respectively. In other embodiments, the height H3 can be different from the height H1 and/or the height H4 can be different from the height H2.

[0051] The glue distributor 26 applies glue on the areas of the ply V1 that correspond to the tips 25.2 of the protuberances 25 of the second embossing roller 23. These glued areas are pressed against the other plies V2 and V3 in the lamination nip 38 to cause mutual gluing of the plies V1, V2 and V3 and obtain the multi-ply web material N at the output of the machine 1. Gluing takes place at head surfaces 25.4 of the tips 25.2, hence in very limited areas with respect to the area of the head surfaces 25.3 of the bodies 25.1 of the protuberances 25.

[0052] As shown in Fig. 4, the body 25.1 of the protuberances 25 can have a linear development, i.e. in plan view the protuberances 25 can have a smaller dimension (width) and a greater dimension (length), where the greater dimension is a multiple of the smaller dimension, for example at least five times the smaller dimension. Preferably, the greater dimension can be at least one order of magnitude greater than the smaller dimension, i.e. at least ten times greater. The protuberances 25 can extend according to closed lines, which define the contour of a motif of large dimensions.

[0053] Preferably, the protuberances 25 define decorative motifs, as shown in Fig. 4. The tips 25.2 with which the protuberances 25 are provided serve the function of limiting the surface area of the ply V1 on which glue is applied by the glue distributor 26. In this way, a decorative effect is obtained, given by the distribution of the tip 25.2

along the protuberances with decorative effect 25, in particular if colored glue is used. In addition, good gluing is obtained thanks to the distribution of the glue in spots, and a reduced consumption of glue, with consequent cost reduction and obtainment of a softer product, thanks to the fact that the glued surface, which typically stiffens the treated material, is only a fraction of the front surface of the protuberances 25.

[0054] The third embossing roller 31 and the fourth embossing roller 41, if present, can be provided with micro-embossing protuberances with uniform distribution, so as to obtain plies V2 and V3 provided with embossed micro-protrusions. In other embodiments, the ply V2 and/or the ply V3 can be smooth. The micro-embossing of the plies V3 and V2, as well as that of the ply V1, can have a density of embossed protrusions from 15 to 200 protrusions/cm^2, preferably between 20 and 100 protrusions/cm^2, most preferably between 30 and 60 protrusions/cm^2. The height of the embossing protrusions formed on the plies V2 and V3 can be smaller than those of the protrusions formed on the ply V1. However, products with only two plies may be produced, hence omitting the ply V3. In other embodiments, the ply V3 may follow the same path as the ply V1 through the embossing unit 3.

[0055] Moreover, each of the plies V1, V2, V3 can, independently of the others, consist of a single layer or of multiple layers.

[0056] Fig. 6A shows a schematic cross section of a multi-ply web material N obtained from coupling the plies V1, V2 and V3 embossed and decorated with the machine of Fig. 1. The protrusions generated in the plies are indicated with the letter P followed by the number corresponding to the reference number used to indicate the embossing protuberance or the tips that generated them. Hence, for example the ply V1 has protrusions P13.1 generated by the protuberances 13.1 and protrusions P13.3 generated by the tips 13.3. By way of example, Fig. 6A shows an embossing P13.6 around the protrusions P13.3, which can be generated by the body 13.6 of the embossing protuberances 13.2, if they succeed in at least partially penetrating in the elastically yielding coating 17R of the first pressure roller 17. In general, the large transverse dimension of the bodies 13.6 of the protuberances 13.2 causes them to penetrate to a small extent in the elastically yielding coating 17R and hence they impart little or nearly no permanent deformation to the cellulose ply V1.

[0057] In advantageous embodiments, the embossed protrusions 13.3 have reduced dimensions, with a circular, elliptic or quadrangular shape, for example, with a maximum dimension preferably not greater than 1 mm, preferably not greater than 0.5 mm, for example of the order of 0.3 mm. In this way, a decoration made of dots is obtained, i.e. substantially a decoration consisting of colored pixels, the combination whereof forms complex and colored decorative motifs of large dimensions. In this way, there is an extended decoration on the web material N with a limited consumption of colored liquid.

[0058] The area of the cellulose ply V1 surrounding the protrusions P13.3 is substantially free of embossing, because it corresponds to the areas 14 (Fig. 2). At a distance from the non-embossed areas that surround the protrusions P13.3 the ply V1 is provided with embossing protrusions P13.1 formed by the protuberances 13.1. Moreover, on the ply V1 are provided protrusions P25 with head protrusions P25.2, formed by the protuberances 25 and respective tips 25.2. The surface of the cellulose ply V1 of the protrusions P25.2 is provided with glue C, which glues the plies V2 and V3 to the ply V1. As noted above, gluing is obtained by laminating the plies V1, V2, V3 in the laminating nip between the second embossing roller 23 and the laminating roller 39.

[0059] Fig. 6A schematically shows the micro-embossing P33 generated on the ply V2 by the embossing protuberances 33 of the embossing roller 31. Moreover, Fig. 6A schematically shows the micro-embossing P43 formed on the ply V3 by the protuberances P43 of the embossing roller 41.

[0060] While Fig. 6A shows an embossed product whose ply V1 has an embossing, i.e. deformation, both at the protuberances 25 of the embossing roller 23, and at the protuberances 13.1 and 13.2 of the embossing roller 11, as noted above in some embodiments the shape and the dimension of the protuberances 13.2 and of the related tips 13.3 can be such as not to impart a permanent deformation to the ply V1 at the working pressure used and with the hardness selected for the elastically yielding coating 17R of the pressure roller. Alternatively, the aforesaid parameters (dimensions and shapes of the protuberances, embossing pressure, hardness of the coating 17R) are such as to impart a very limited deformation, for example a deformation only at the tips 13.3.

[0061] Fig. 6B shows a cross section similar to that of Fig. 6A, where however the embossed protrusions P13.6 are practically invisible and only light embossed protrusions P13.3 are present. In some situations on the finished product the protrusions P13.3 could be practically invisible to the naked eye, by effect of the weak penetration of the tips 13.3 in the coating 17R of the pressure roller 17 and of the elastic recovery of the cellulose material forming the ply V 1.

[0062] In the embodiment of Figs. 2 and 6B, the first embossing roller 11 comprises embossing protuberances 13.1 and 13.2 having different heights H1 and H2, while the second embossing roller 23 comprises embossing protuberances 25 all of the same height H4. However, this is not the only possible embodiment.

[0063] With continuing reference to Fig. 1, Figs. 7 and 8 show a front view and a section according to VIII-VIII of a grooved surface of the first embossing roller 11 in another embodiment. Figs. 9 and 10 show a front view and a sectional view according to the line X-X of the second embossing roller 23 in a different embodiment.

[0064] In the embodiment of Figs. 7 to 10, the first embossing roller can be provided with embossing pro-

tuberances 13 with an elongated linear shape and a constant height H6. The shape of protuberances 13 is linear and elongated in the sense that in a plan view (Fig. 7) the width of each protuberance is much smaller than the length thereof. In practice, the protuberances 13 generate on the ply V1 linear decorations, whereat the web material V1 can be slightly embossed, to apply the pigmented liquid substance L through the distributor 15 only at the head surfaces 13A of the protuberances 13. The protuberances 13 can have a height H6 for example between about 0.4 and about 2.2 mm, preferably between about 1 mm and 2 mm, for example between about 1.3 mm and about 1.8 mm.

[0065] The area of the head surfaces 13A of the protuberances 13 of Fig. 7 and the pressure between the embossing roller 11 and the pressure roller 17 can be such that the deformation imparted in the embossing nip 21 to the ply V1 and that remains in the finished product can be barely perceptible or even imperceptible for consumers, for example thanks to the fact that the deformation imparted during processing in the embossing nip 21 is entirely or nearly entirely in the elastic deformation range of the cellulose material forming the ply V1. In this case, using a colored liquid distributed by the distributor 15 on the areas of the ply V1 corresponding to the head surfaces 13A of the protuberances 13, a substantially printing effect, instead of an embossing effect, is obtained. The minimum deformation of the ply V1 in the nip 21 is sufficient to cause the colored liquid to be applied by the distributor 15 only along the head surfaces 13A of the protuberances 13.

[0066] The second embossing roller 23 shown in Figs. 9 and 10 can have embossing protuberances 25 having two different heights. More specifically, in the illustrated example, the embossing protuberances 25 comprise a first series of protuberances 25.6 and a second series of protuberances 25.7. In some embodiments, the protuberances 25.6 can be cone frustum shaped or pyramid frustum shaped, or otherwise with simple dot geometric shape, with a cross section, according to a plane orthogonal to the height of the protuberances, having a greater dimension and a smaller dimension, the ratio of the greater and smaller dimension being preferably equal to or smaller than 5, more preferably equal to or smaller than 2, still more preferably lower than 1.5 and in particular equal to about 1. They are substantially dot-shaped, non linear, protuberances. They have a height H7 for example between about 0.5 and about 1.5 mm, preferably between about 0.8 mm and about 1.2 mm. The maximum transverse dimension (i.e., in the case of cone frustum shaped protuberances with elliptic section, the major axis) of the head surface of the protuberances 25.6 can for example be between about 0.1 and about 1 mm, preferably between about 0.3 and about 0.7 mm.

[0067] The protuberances 25.7 can have a body 25.8 with a head surface 25.11, from which tips 25.9 project, having respective head or frontal surfaces 25.10. The total height of the protuberances 25.7 is indicated as H8 and it is greater, for example by about 0.1-0.5 mm, preferably by about 0.2-0.4 mm to the height of the body 25.8. In the illustrated example, the height of the body 25.8 is equal to H7, but this is not necessary. In other embodiments, the body 25.8 of the protuberances 25.7 can have a height greater than or smaller than H7.

[0068] As shown in Fig. 9, the protuberances 25.7 can have a linear extension, i.e. they extend for a length (in the front view of Fig. 9) along the cylindrical surface of the embossing roller 23, which is many times greater, for example greater by at least one order of magnitude, or greater by two orders of magnitude, than the width of the protuberances 25.7. In some embodiments, the protuberances 25.7 can intersect each other, as shown in Fig. 9, forming closed areas. In some embodiments, a micro-embossing formed by the protuberances 25.6 can be located inside the closed areas delimited by the protuberances having linear development 25.7.

[0069] In some embodiments, the total height H8 of the protuberances 25.7 is greater than the height H6 of the protuberances 13.

[0070] Thanks to the height difference H8-H7, when the ply V1 is embossed in the embossing nip 29, the portions of ply V1 corresponding to the head surfaces 25.10 of the tips 25.9 are displaced radially outwards more than the remaining surface of the ply V1 and hence only these portions receive the glue applied by the distributor 26. In the laminating nip 38, the ply V1 is bonded by lamination and gluing to the plies V2 and V3 by effect of the pressure between the tips 25.9 and the laminating roller 39. The plies V2 and V3 can be embossed or micro-embossed, and for this purpose the embossing rollers 31 and 41 as described above can be used.

[0071] The surface of the ply V1 not occupied by the embossing formed by the protuberances 25.7 is at least in part occupied by the micro-embossing formed by the protuberances 25.6.

[0072] Fig. 11A schematically shows a section of the web material N obtained with the embossing rollers of Figs. 7 to 10. The plies of the web material are indicated with V1, V2 and V3, as in Fig. 1. On ply V1 embossed protrusions P13 are formed, generated by the embossing protuberances 13 of the first embossing roller 11, and embossed protrusions P25.7 with tips P25.9 generated by the double-height embossing protuberances 25.7, 25.9. A colored liquid L is applied on the head surfaces of the embossed protrusions P13. A glue C is applied on the most deformed areas of the plies V1, corresponding to the tips 25.9 of the protuberances 25.7. By means of the glue C the ply V1 is glued to the plies V2 and V3, thanks to the pressure generated in the laminating nip 38, between the second embossing roller 23 and the laminating roller 39. On the ply V2 embossed protrusions P33 are formed, generated by the third embossing roller 31 with the embossing protuberances 33. On the third ply V3, positioned between the first ply V1 and the second ply V2, embossed protrusions P43 are formed, generated by the embossing protuberances 43 of the fourth embossing

roller 41.

[0073] As noted above, the penetration of the linear protuberances 13 in the elastically yielding coating 17R of the pressure roller 17 can be very limited, for example such as not to leave an impression (permanent deformation) visible or perceptible by the naked eye on the finished product. In this way, by means of the colored liquid applied by the distributor 15, an effect similar to printing is obtained on the finished product. Fig. 11B shows a section similar to the section of Fig. 11A, in which the embossed protrusions P13 are practically invisible, in the sense that they almost entirely disappear once the compression effect exercised by the protuberances 13 on the elastically yielding coating 17R ceases. In Fig. 11B, the reference L indicates the dye applied by the distributor 15.

[0074] Figs. 12 to 16B show a further embodiment of the embossing rollers and of the product obtainable therewith. The rollers used therein are different from the preceding one mainly because the protuberances of the roller 11 are dot-shaped instead of linear. Fig. 12 shows a front view of the embossing protuberances 13 of the first embossing roller 11, which can be in the form of cone frustum or pyramid frustum shaped tips with height H9 (Fig. 13). The protuberances 13 form areas delimited on the ply V1 in which the distributor 15 applies the colored liquid, to form a dotted decoration. In other embodiments, the decoration can be formed by continuous lines obtained by means of linear embossing protuberances.

[0075] The shape of the protuberances 13 and the pressure between the embossing roller 11 and the pressure roller 17 can be such that in the embossing nip 21 the ply V1 undergoes a very small deformation and one such that, as in the embodiments described above, allows to apply with the distributor 15 a colored liquid in limited areas, thanks to the deformation of the ply V1, but such that (once the ply V1 has been detached from the embossing roller 11) the deformation is completely or partially reabsorbed by effect of the elastic recovery of the cellulose material forming the ply V1, giving rise to a ply apparently decorated by printing and not embossed at the areas on which the embossing protuberances 13 acted.

[0076] Fig. 14 shows a front view of a portion of the cylindrical surface of the second embossing roller 23, which in this case is provided with two series of embossing protuberances, indicated with reference numbers 25.12 and 25.13 in the section of Fig. 15. The references H12 and H13 indicate the heights of the protuberances 25.12 and 25.13. Preferably, H12 is greater than H13. Preferably, the protuberances 25.12 with greater height have linear development, i.e. they have, in a plan view, a greater dimension that is a multiple of the smaller dimension, for example a greater longitudinal dimension (length), which is greater by one or more orders of magnitude than the smaller transverse dimension (width). In some embodiments, around the protuberances 25.12 there can be areas 24 lacking protuberances 25.13. The latter can be micro-embossing protuberances and can for example have a pyramid frustum or cone frustum shape with very small dimensions, for example with a cross section having smaller transverse dimension with respect to the smaller transverse dimension of the protuberances 25.12. The protuberances 25.13 can in practice be dot-shaped.

[0077] The protuberances 25.12 form on the ply V1 embossing protrusions of greater height, on which glue is applied by the distributor 26. By means of this glue, in the laminating nip 38 the ply V1 is bonded by gluing with the plies V2 and V3 by effect of the pressure of the head surfaces of the protuberances 25.12 against the laminating roller 39.

[0078] Fig. 16A shows a schematic section of the web material N obtained with the rollers having the protuberances described with reference to Figs. 12 to 15. Adopting the same criterion of the preceding figures, in Fig. 16 the ply V1 has embossed protrusions P13 formed by the embossing protuberances 13 of the first embossing roller 11. These embossed protrusions P13 can have very small height. On the ply V1 embossed protrusions P25.12 are also present, formed by the embossing protuberances 25 of the second embossing roller 23, glued with the glue C to the plies V2 and V3. The reference P25.13 indicate embossed protrusions formed by the embossing protuberances 25.13. The ply V2 is provided with embossed protrusions P33 formed by the embossing protuberances 33 of the third embossing roller 31, while the third ply V3 is provided with embossed protrusions P43 formed by the embossing protuberances 43 of the fourth embossing roller 41. In the areas of bonding by gluing (head surfaces of the embossed protrusions P25.12, glue C), the embossed protrusions P33 and P43 can be crushed. As in the embodiments described above, the density of the embossed protrusions P43 and P33, and hence the density of the respective embossing protuberances 43 and 33, can typically be those of a background micro-embossment, with density for example between 20 protrusions/cm^2 and 200 protrusions/cm^2, preferably between 25 protrusions/cm^2 and 50 protrusions/cm^2, for example.

[0079] Fig. 16B shows an embodiment in which the protrusions P13 generated by the embossing roller 11 with the embossing protuberances 13 are practically imperceptible. The reference L indicates the dye applied on these protrusions by the applicator 15.

[0080] In all cases shown hitherto, there is never any relationship between the mutual position of one embossing with respect to the others, i.e. the mutual positioning of an embossing on the materials in plies with respect to the other embossing is random. This holds true both for the decorative subjects, and for micro-embossments. The embossing units 3, 5, 7 may also be in phase with each other, in transverse direction with respect to the direction of advance of the plies, or in longitudinal direction, or in both directions, so that the multi-ply product N at

the output of the last embossing unit has decorations and/or micro-embossments that are in phase with each other or free.

[0081] In the examples described above, the embossing unit 5 is a "nested" unit, in which the protuberances generated by the embossing roller 31 on the ply V2 tend primarily to be inserted between protuberances formed on the set of the plies V1, V3 by the embossing roller 23. This configuration can in certain cases be preferred, because it does not require a precise correspondence between embossing protuberances of the rollers 31 and 23 and hence it does not require a mutual phasing. However, it is possible for the embossing protuberances 33 of the embossing roller 31 to be arranged in atip-to-tip arrangement with the embossing protuberances 25 of the embossing roller 23.

[0082] The web material N is transformed in a known manner to obtain rolls of wound web material. Fig. 17 schematically shows a roll R of material N. In general, the roll R is obtained by winding the web material in "logs" that are subsequently cut, orthogonally to the axis of winding, to obtain rolls R of the desired axial length A. The web material N of the roll R is divided by transverse perforation lines LP into individual sheets F detachable from one another at the time of use by tearing along the perforation lines.

[0083] To obtain a high quality product, the distribution of the embossed protrusions must be such as to obtain a correct application of glue. The critical areas in this respect are the longitudinal edges B1, B2 of the web material N forming the roll R and the area adjacent to the perforation lines LP. In use, the individual plies V1, V2, V3 that form the web material N should not be detached from each other along the edge lines B1, B2 and along the lines obtained by tearing at the perforation lines LP.

[0084] Fig. 18 shows a portion of web material N comprising a sheet F and a portion of the two adjacent sheets. In Fig. 17 and Fig. 18, the embossing patterns are omitted for the sake of drawing simplicity. In Fig. 18, rectangularly shaped areas or bands AP adjacent to each perforation line LP are indicated. Each area AP is delimited by the perforation line LP, by the two longitudinal edges B1, B2 and by a line L1, parallel to the perforation line LP and positioned at a distance l_{AP} therefrom.

[0085] On each sheet, the reference AB indicates lateral areas consisting of longitudinal bands or strips extending along the edges B1, B2 of the web material N forming the roll R. Each of the two longitudinal bands or strips has a width l_{AB}.

[0086] Hence, on each sheet F are defined two transverse bands or strips AP with width l_{AP} and two longitudinal bands or strips with width l_{AB}.

[0087] According to advantageous embodiments, the protuberances of the second embossing roller 23, which define the embossed protrusions on which the glue C is applied are arranged in such a way as to obtain an appropriate distribution of the glued zones in the areas AB and AP, as described below.

[0088] According to advantageous embodiments, the distribution of the embossed protrusions generated by the embossing protuberances 25 is such that in any band or strip AP is present at least one gluing spot, independently of the axial dimension A of the roll. In advantageous embodiments, the width l_{AP} of the bands or strips AP is equal to 10 mm and preferably equal to 5 mm. This means, substantially, that the distribution of the glue is such that in any strip AP with dimension l_{AP} = 10 mm, or preferably l_{AP} =5 mm, glue is present to keep the plies bonded adjacently to the perforation line LP. This allows obtaining a product whose plies V1, V2, V3 do not tend to delaminate along the perforation lines.

[0089] According to advantageous embodiments, in a similar manner the distribution of the protuberances 25 of the second embossing roller 23 are such that on each lateral band or strip AB having a width l_{AB} at least one gluing spot is present. In advantageous embodiments, the width l_{AB} is equal to 10 mm, preferably 5 mm. This means that on each sheet F of web material N the glue is distributed in such a way that there is at least one glue spot in a band having a width of 10 mm along each of the edges B1, B2 and preferably, a glue spot in each band having a width of 5 mm along each of the edges B1, B2.

Claims

1. A method for producing a multi-ply web material (N), comprising the following steps:

- feeding a first ply (V1) into a first embossing nip (21), between a first embossing roller (11) and a first pressure roller (17);
- deforming the first ply (V1) by means of embossing protuberances (13.1; 13.2; 13) of the first embossing roller (11);
- applying a colored liquid to the first ply (V1) at the embossing protuberances (13.1; 13.2; 13);
- feeding the first ply (V1) into a second embossing nip (29), between a second embossing roller (23) and a second pressure roller (27) arranged downstream of the first embossing nip (21) along a feed path of the first ply (V1);
- embossing the first ply (V1) by means of embossing protuberances (25) of the second embossing roller (23), forming embossed protrusions (P25) on the first ply (V1);
- applying a glue (C) to at least some of the embossed protrusions (P25);
- bonding the first ply (V1) to a second ply (V2) by gluing;

characterized in that the embossing protuberances (13.1; 13.2; 13) of the first embossing roller (11) comprise a first series of embossing protuberances (13.1) and a second series of embossing protuberances (13.2), having a height (H2) greater than the

height (H1) of the protuberances of the first series of embossing protuberances (13.2), and the step of applying the colored liquid comprises the step of applying the colored liquid at the protuberances of the second series of embossing protuberances (13.2).

2. The method of claim 1, wherein the glue is colored and has a color different from the colored liquid.

3. The method of claim 1, 2 or 3, wherein the protuberances of the second series of embossing protuberances (13.2) comprise a body (13.6) with a head surface (13.4), from which embossing tips (13.3) protrude, defining a pattern of pixels, and wherein the colored liquid is applied at the embossing tips (13.3).

4. The method of one or more of the preceding claims, comprising the step of generating a background micro-embossing on the first ply (V1) by means of the first series of embossing protuberances (13.1) of the first embossing roller 11, wherein preferably the first series of embossing protuberances (13.1) has a density greater than about 15 protuberances/cm^2, more preferably greater than 30 protuberances/cm^2, in particular comprised between about 15 and about 200 protuberances/cm^2, preferably between about 30 and about 60 protuberances/cm^2.

5. The method of claim 4, comprising the step of defining an area without background micro-embossing surrounding the area of application of the colored liquid to the first ply (V1).

6. The method of one or more of the preceding claims, wherein the embossing protuberances (25) of the second embossing roller (23) comprise linear protuberances.

7. The method of claim 6, wherein the linear protuberances (25) comprise a body (25.1) with a head surface (25.3), from which embossing tips (25.2) protrude, and wherein the glue is applied only to the areas of the first ply (V1) corresponding to the embossing tips (25.2).

8. The method of one or more of the preceding claims, wherein the embossing protuberances (25) of the second embossing roller (23) comprise a first series of embossing protuberances (25.6) and a second series of embossing protuberances (25.7).

9. The method of claim 8, wherein the protuberances (25.6) of the first series of protuberances of the second embossing roller (23) have a height less than the protuberances (25.7) of the second series, the glue being applied at the protuberances of the second series.

10. The method of claim 9, wherein the protuberances (25.6) of the first series are dot-shaped protuberances.

11. The method of claim 10, wherein the protuberances (25.7) of the second series are linear protuberances.

12. The method of one or more of claims 8 to 11, wherein the protuberances of the second series (25.7) comprise a body (25.8) with a head surface (25.11) from which embossing tips (25.9) project, and wherein the glue is applied only at the embossing tips (25.9).

13. The method of one or more of claims 8 to 12, wherein the protuberances (25.6) of the first series define a background micro-embossing, preferably with a density greater than about 15 protuberances/cm^2, more preferably greater than 30 protuberances/cm^2, in particular comprised between about 15 and about 200 protuberances/cm^2, preferably between about 30 and about 60 protuberances/cm^2.

Patentansprüche

1. Verfahren zur Herstellung eines mehrlagigen Bahnmaterials (N), umfassend die folgenden Schritte:

- Zuführen einer ersten Lage (V1) in einen ersten Prägespalt (21) zwischen einer ersten Prägewalze (11) und einer ersten Druckwalze (17);
- Verformen der ersten Lage (V1) mit Hilfe von Prägevorsprüngen (13.1; 13.2; 13) der ersten Prägewalze (11);
- Auftragen einer farbigen Flüssigkeit auf die erste Lage (V1) an den Prägevorsprüngen (13.1; 13.2; 1);
- Zuführen der ersten Lage (V1) in einen zweiten Prägespalt (29), zwischen einer zweiten Prägewalze (23) und einer zweiten Druckwalze (27), die stromabwärts des ersten Prägespalts (21) entlang eines Zuführungspfads der ersten Lage (V1) angeordnet sind;
- Prägen der ersten Lage (V1) mittels Prägevorsprüngen (25) der zweiten Prägewalze (23), welches auf der ersten Lage (V1) geprägte Vorsprünge (P25) bildet;
- Auftragen eines Klebstoffs (C) auf mindestens einige der geprägten Vorsprünge (P25);
- Verkleben der ersten Lage (V1) mit einer zweiten Lage (V2) durch Verkleben,

dadurch gekennzeichnet, dass
die Prägevorsprünge (13.1; 13.2; 13) der ersten Prägewalze (11) eine erste Reihe von Prägevorsprüngen (13.1) und eine zweite Reihe von Präge-

vorsprüngen (13.2), die eine Höhe (H2) aufweisen, die größer ist als die Höhe (H1) der Vorsprünge der ersten Reihe von Prägevorsprüngen (13.2), und der Schritt des Auftragens der gefärbten Flüssigkeit den Schritt des Auftragens der gefärbten Flüssigkeit an den Vorsprüngen der zweiten Reihe von Prägevorsprüngen (13.2) umfasst.

2. Verfahren nach Anspruch 1, wobei der Klebstoff gefärbt ist und eine andere Farbe als die gefärbte Flüssigkeit hat.

3. Verfahren nach Anspruch 1, 2 oder 3, wobei die Vorsprünge der zweiten Reihe von Prägevorsprüngen (13.2) einen Körper (13.6) mit einer Kopffläche (13.4) umfassen, aus der Prägespitzen (13.3) herausragen, die ein Muster von Pixeln definieren, und wobei die farbige Flüssigkeit an den Prägespitzen (13.3) aufgebracht wird.

4. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, umfassend den Schritt des Erzeugens einer Hintergrund-Mikroprägung auf der ersten Lage (V1) mit Hilfe der ersten Reihe von Prägevorsprüngen (13.1) der ersten Prägewalze 11, wobei vorzugsweise die erste Reihe von Prägevorsprüngen (13.1) eine Dichte von mehr als etwa 15 Protuberanzen/cm^2 besitz, bevorzugter mehr als 30 Protuberanzen/cm^2, insbesondere zwischen etwa 15 und etwa 200 Protuberanzen/cm^2 umfasst, vorzugsweise zwischen etwa 30 und etwa 60 Protuberanzen/cm^2.

5. Verfahren nach Anspruch 4, das den Schritt umfasst, einen Bereich ohne Hintergrund-Mikroprägung zu definieren, der den Bereich des Auftragens der farbigen Flüssigkeit auf die erste Lage (V1) umgibt.

6. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei die Prägevorsprünge (25) der zweiten Prägewalze (23) lineare Vorsprünge umfassen.

7. Verfahren nach Anspruch 6, wobei die linearen Vorsprünge (25) einen Körper (25.1) mit einer Kopffläche (25.3) umfassen, aus der Prägespitzen (25.2) herausragen, und wobei der Klebstoff nur auf die Bereiche der ersten Lage (V1) aufgetragen wird, die den Prägespitzen (25.2) entsprechen.

8. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei die Prägevorsprünge (25) der zweiten Prägewalze (23) eine erste Reihe von Prägevorsprüngen (25.6) und eine zweite Reihe von Prägevorsprüngen (25.7) umfassen.

9. Verfahren nach Anspruch 8, wobei die Vorsprünge (25.6) der ersten Reihe von Vorsprüngen der zweiten Prägewalze (23) eine geringere Höhe haben als die Vorsprünge (25.7) der zweiten Reihe, wobei der Klebstoff an den Vorsprüngen der zweiten Reihe aufgetragen wird.

10. Verfahren nach Anspruch 9, wobei die Vorsprünge (25.6) der ersten Reihe punktförmige Vorsprünge sind.

11. Verfahren nach Anspruch 10, wobei die Vorsprünge (25.7) der zweiten Reihe lineare Vorsprünge sind.

12. Verfahren nach einem oder mehreren der Ansprüche 8 bis 11, wobei die Vorsprünge der zweiten Reihe (25.7) einen Körper (25.8) mit einer Kopffläche (25.11) aufweisen, von der Prägespitzen (25.5) abstehen, und wobei der Klebstoff nur an den Prägespitzen (25.9) aufgetragen wird.

13. Verfahren nach einem oder mehreren der Ansprüche 8 bis 12, wobei die Vorsprünge (25.6) der ersten Serie eine Hintergrund-Mikroprägung definieren, vorzugsweise mit einer Dichte von mehr als etwa 15 Protuberanzen/cm^2, mehr bevorzugt mehr als 30 Protuberanzen/cm^2, insbesondere zwischen etwa 15 und etwa 200 Protuberanzen/cm^2 umfassend, vorzugsweise zwischen etwa 30 und etwa 60 Protuberanzen /cm^2.

Revendications

1. Un procédé de production d'un matériau en bande à plusieurs couches, comprenant les étapes suivantes consistant à :

- faire avancer une première couche (V1) dans un premier espace de gaufrage (21), entre un premier rouleau de gaufrage (11) et un premier rouleau presseur (17) ;
- déformer la première couche (V1) au moyen de protubérances de gaufrage (13.1; 13.2 ; 13) du premier rouleau de gaufrage (11) ;
- appliquer un liquide coloré à la première couche (V1) au niveau des protubérances de gaufrage (13.1; 13.2 ; 13) ;
- faire avancer la première couche (V1) dans un deuxième espace de gaufrage (29), entre un deuxième rouleau de gaufrage (23) et un deuxième rouleau presseur (27) agencé en aval du premier espace de gaufrage (21) le long d'une piste d'avancement de la première couche (V1) ;
- gaufrer la première couche (V1) au moyen de protubérances de gaufrage (25) du deuxième rouleau de gaufrage (23), pour former des projections gaufrées (P25) sur la première couche (V1) ;
- appliquer une colle (C) au niveau d'au moins

certaines des projections (P25) ;
- lier la première couche (V1) à une deuxième couche (V2) par collage ;

caractérisé en ce que les protubérances de gaufrage (13.1; 13.2 ; 13) du premier rouleau de gaufrage (11) comprennent une première série de protubérances (13.1) et une deuxième série de protubérances (13.2) ayant une hauteur (H2) supérieure à la hauteur (H1) des protubérances de la première série de protubérances de gaufrage (13.2) et l'étape d'application du liquide coloré comprend une étape d'application du liquide coloré au niveau des protubérances de la deuxième série de protubérances de gaufrage (13.2).

2. Le procédé selon la revendication 1, dans lequel la colle est colorée et a une couleur différence de celle du liquide coloré.

3. Le procédé selon la revendication 1, 2 ou 3, dans lequel les protubérances de la deuxième série de protubérances de gaufrage (13.2) comprennent un corps (13.6) avec une surface frontale (13.4) à partir de laquelle des pointes de gaufrage (13.3) font saillie, formant un motif de pixels, et dans lequel le liquide coloré est appliqué au niveau des pointes de gaufrage (13.3).

4. Le procédé selon l'une ou plusieurs des revendications précédentes, comprenant l'étape de génération d'un micro-gaufrage de filigrane sur la première couche (V1) au moyen de la première série de protubérances de gaufrage (13.1) du premier rouleau de gaufrage (11), la première série de protubérances de gaufrage (13.1) ayant de préférence une densité supérieure à environ 15 protubérances/cm^2, plus préférentiellement supérieure à 30 protubérances/cm^2, en particulier comprise entre environ 15 et environ 200 protubérances/cm^2, de préférence entre environ 30 et environ 60 protubérances/cm^2.

5. Le procédé selon la revendication 4, comprenant l'étape consistant à former une zone sans microgaufrage de filigrane entourant la zone d'application du liquide coloré sur la première couche (V1).

6. Le procédé selon l'une ou plusieurs des revendications précédentes, dans lequel les protubérances de gaufrage (25) du deuxième rouleau de gaufrage (25) comprennent des protubérances linéaires.

7. Le procédé selon la revendication 6, dans lequel les protubérances linéaires (25) comprennent un corps (25.1) avec une surface frontale (25.3), à partir de laquelle des pointes de gaufrage (25.2) font saillie et dans lequel la colle est appliquée seulement sur des zones de la première couche (V1) correspondant aux pointes de gaufrage (25.2).

8. Le procédé selon l'une ou plusieurs des revendications précédentes, dans lequel les protubérances de gaufrage (25) du deuxième rouleau de gaufrage (23) comprennent une première série de protubérances de gaufrage (25.6) et une deuxième série de protubérances de gaufrage (25.7).

9. Le procédé selon la revendication 8, dans lequel les protubérances (25.6) de la première série de protubérances du deuxième rouleau de gaufrage (23) ont une hauteur inférieure à celle des protubérances (25.7) de la deuxième série, la colle étant appliquée sur les protubérances de la deuxième série.

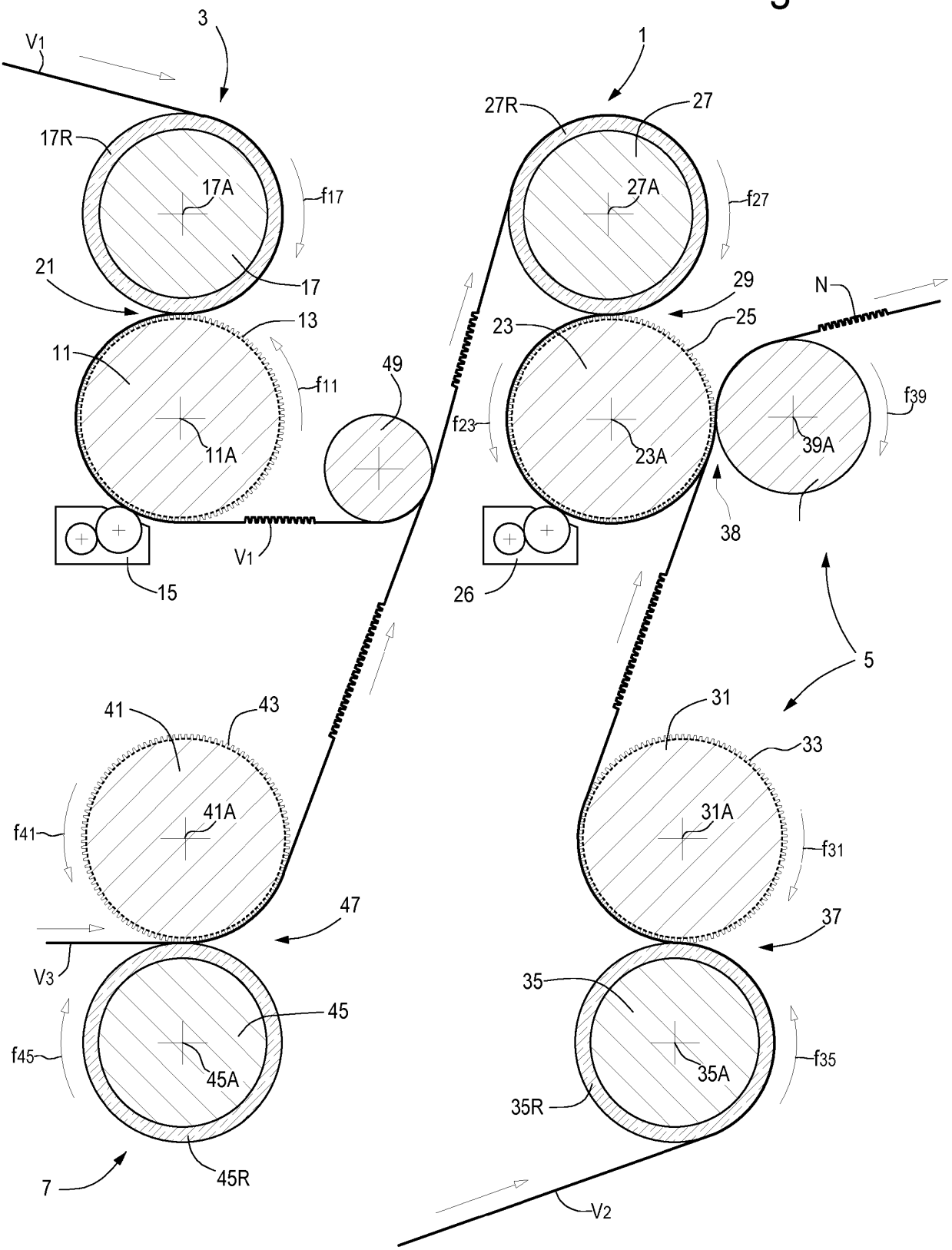
10. Le procédé selon la revendication 9, dans lequel les protubérances (25.6) de la première série sont des protubérances en forme de point.

11. Le procédé selon la revendication 10, dans lequel les protubérances (25.7) de la deuxième série sont des protubérances linéaires.

12. Le procédé selon l'une ou plusieurs des revendications 8 à 11, dans lequel les protubérances de la deuxième série (25.7) comprennent un corps (25.8) avec une surface frontale (25.11) à partir de laquelle de pointes de gaufrage (25.9) font saillie et dans lequel la colle est appliquée seulement au niveau des pointes de gaufrage (25.9).

13. Le procédé selon l'une ou plusieurs des revendications 8 à 12, dans lequel les protubérances (25.6) de la première série forment un micro-gaufrage de filigrane, de préférence avec une densité supérieure à environ 15 protubérances/cm^2, plus préférentiellement supérieure à 30 protubérances/cm^2, en particulier comprise entre environ 15 et environ 200 protubérances/cm^2, de préférence entre environ 30 et 60 protubérances/cm^2.

Fig.1


3
V1
17R
17A
f17
17
21
13
11
f11
11A
49
V1
15
1
27R
27
27A
f27
29
N
23
25
f23
23A
f39
39A
38
26
5
41
43
41A
f41
47
V3
45
f45
45A
45R
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33
31A
f31
37
35
35A
f35
35R
V2

Fig.2

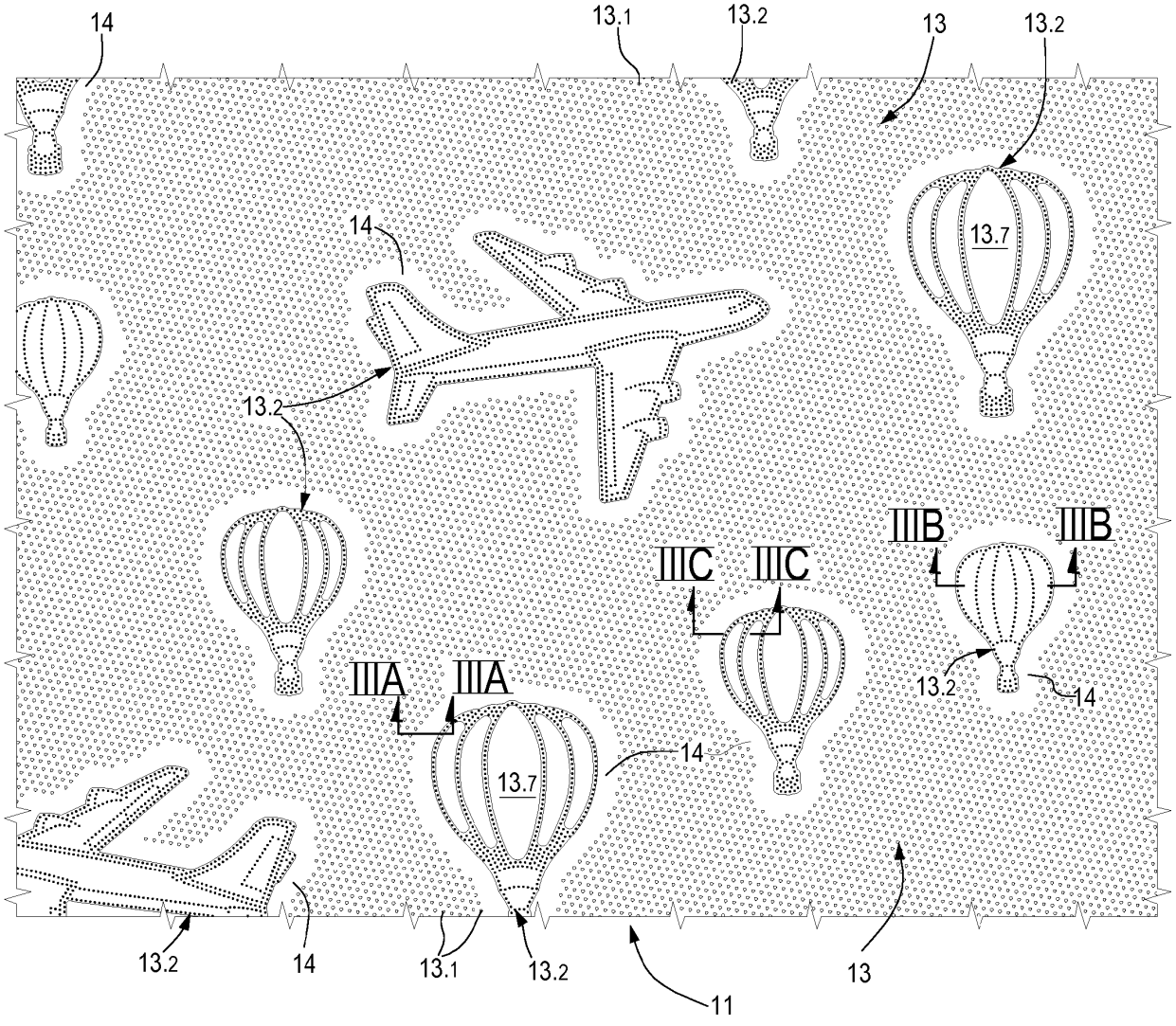

14
13.1
13.2
13
13.2
13.7
14
13.2
IIIB
IIIB
IIIC
IIIC
13.2
14
IIIA
IIIA
13.7
14
13.2
14
13.1
13.2
11
13

Fig.3A

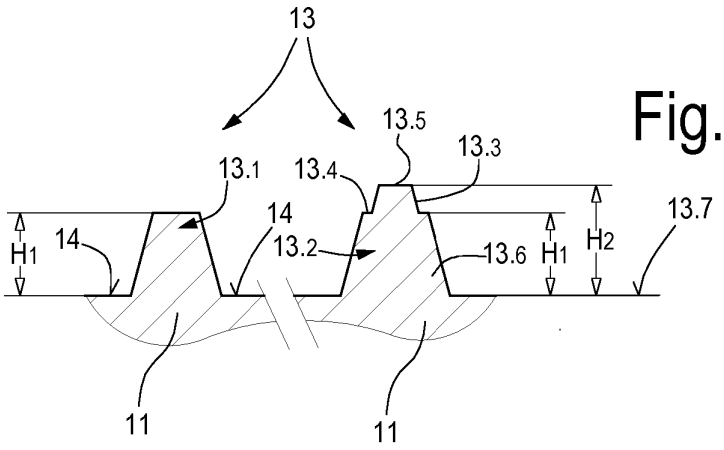


Fig.3B

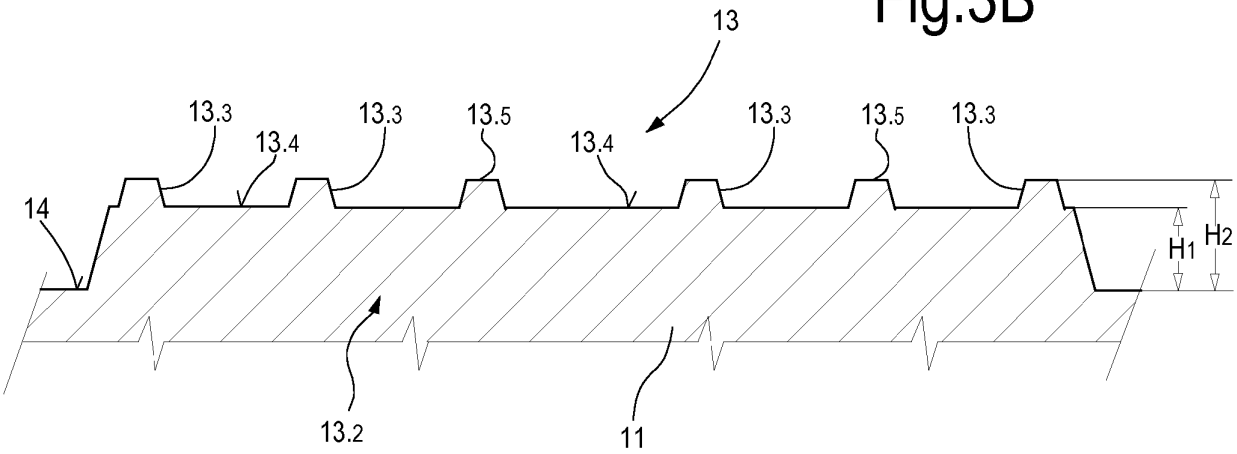


Fig.3C

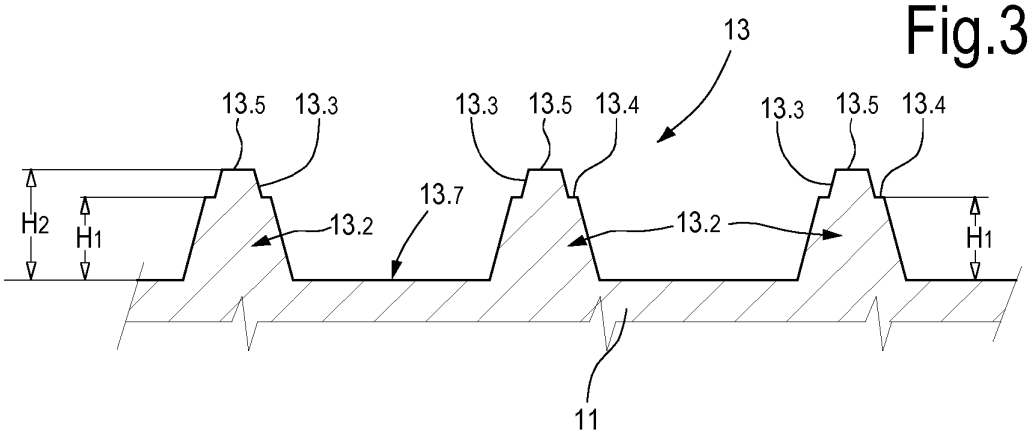


Fig.4

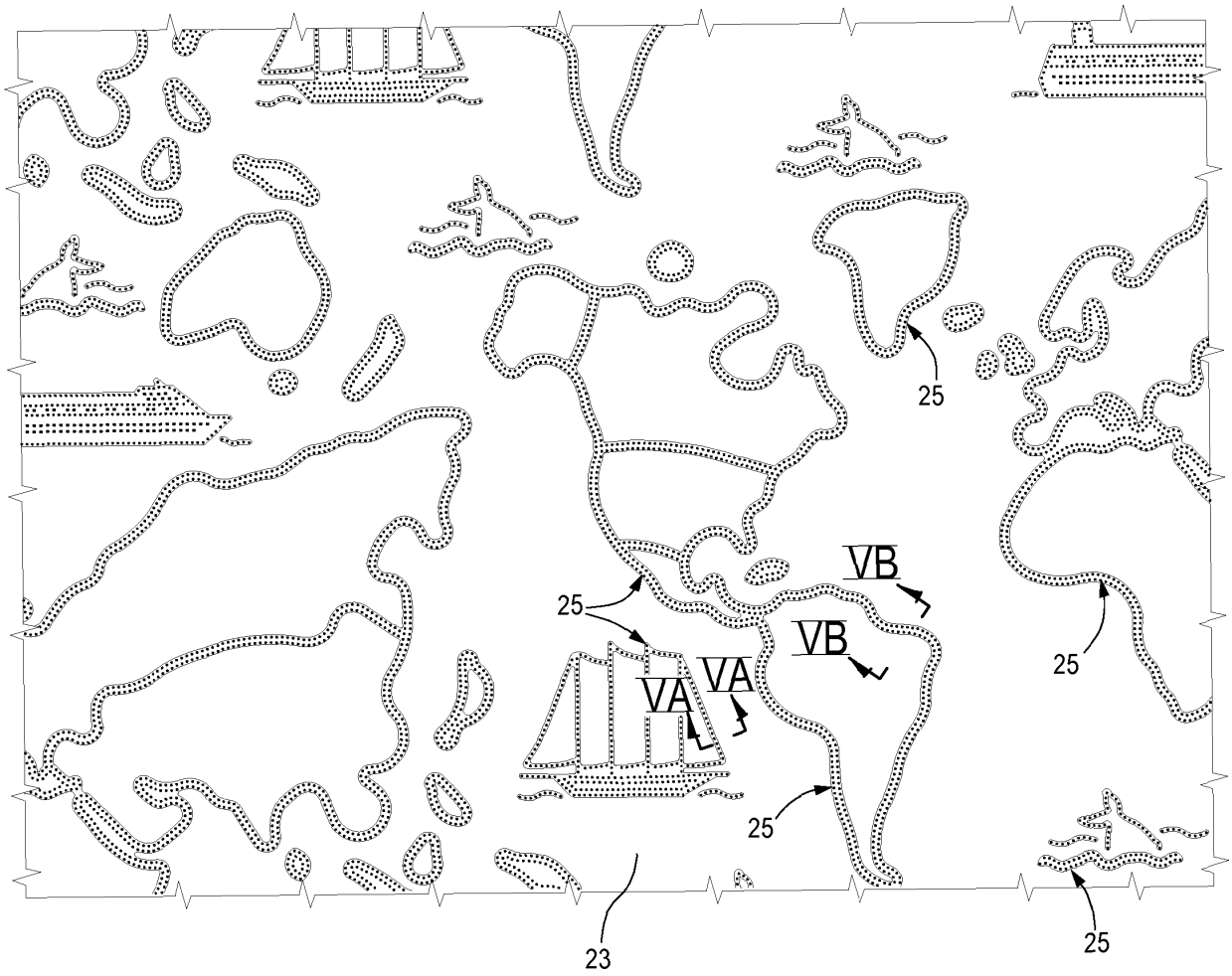


Fig.5A

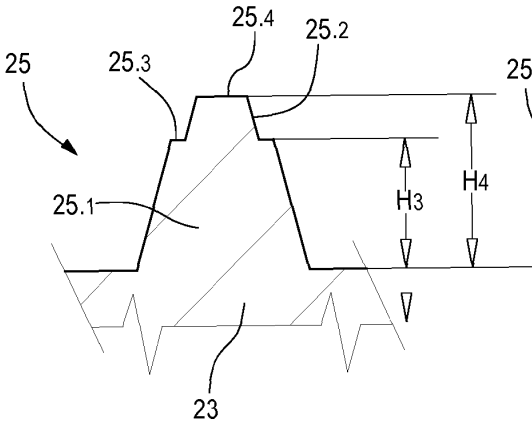


Fig.5B

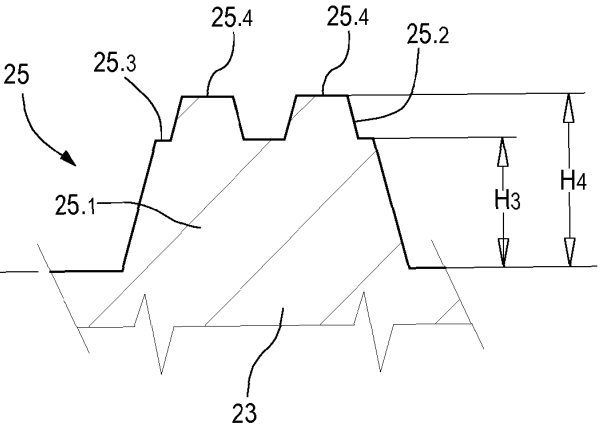
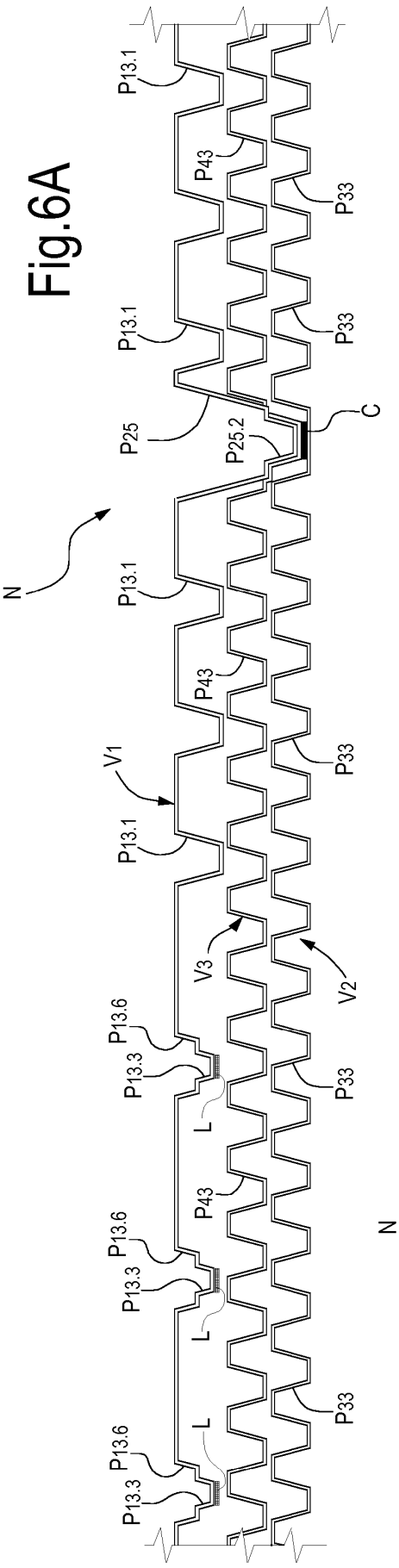


Fig.6A


N
P13.1
P43
P33
P13.1
P33
P25
P25.2
C
P13.1
P43
P33
V1
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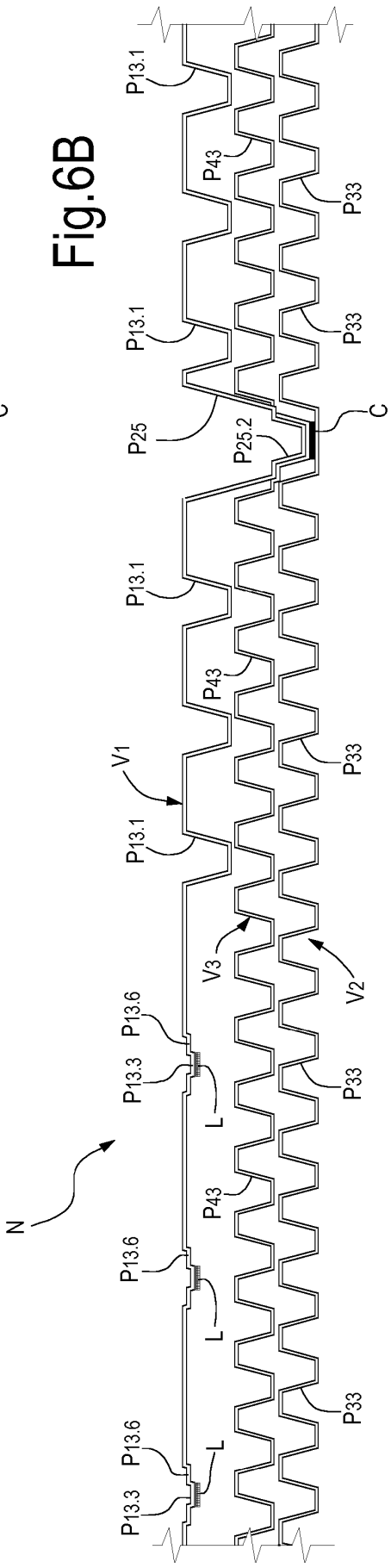
V3
V2
P13.6
P13.3
L
P33
P43
P13.6
P13.3
L
P33
P13.6
P13.3
L
P33

Fig.6B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P33
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P33
P25
P25.2
C
P13.1
P43
P33
V1
P13.1
V3
V2
P13.6
P13.3
L
P33
N
P43
P13.6
L
P13.6
P13.3
L
P33

Fig.7

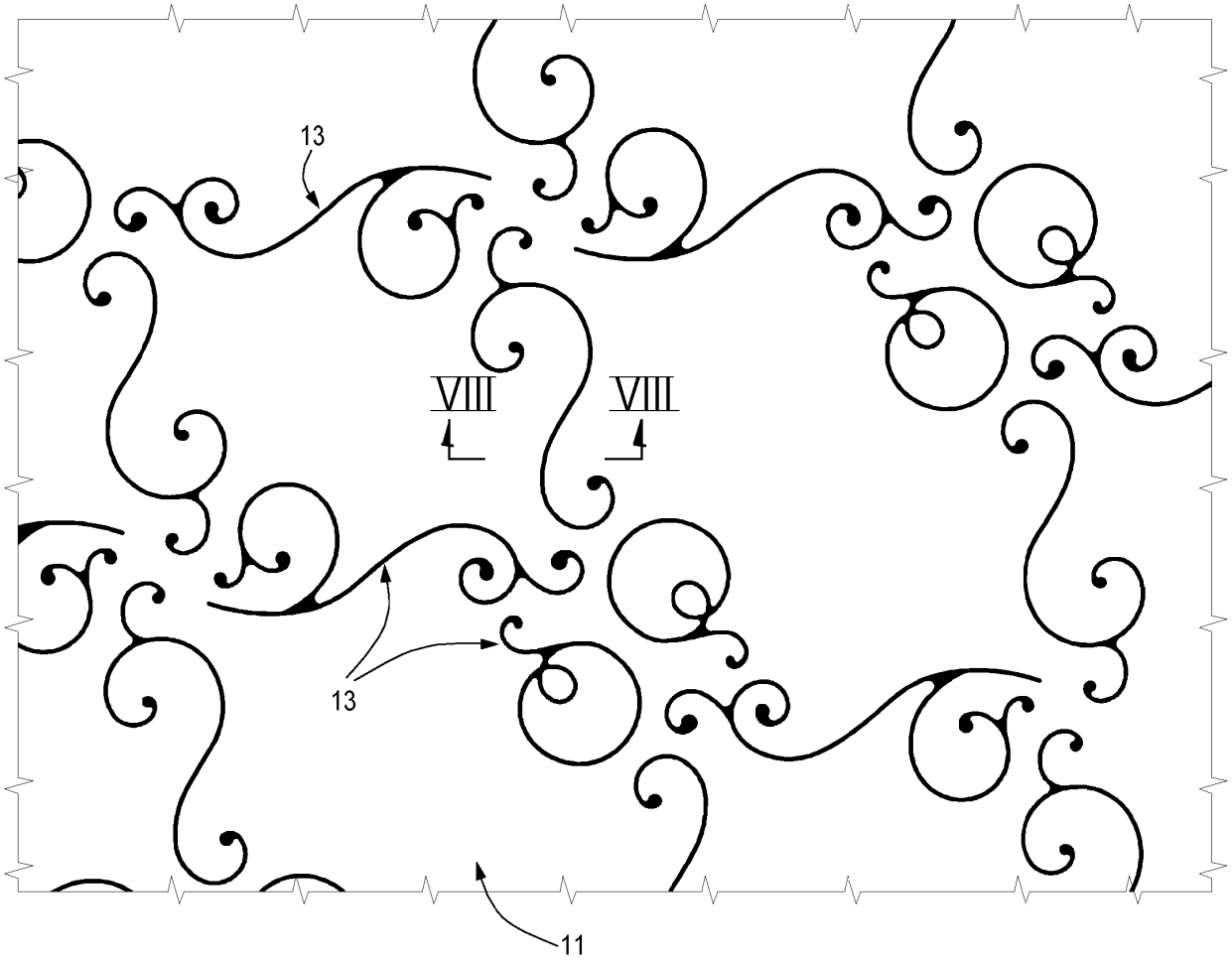


Fig.8

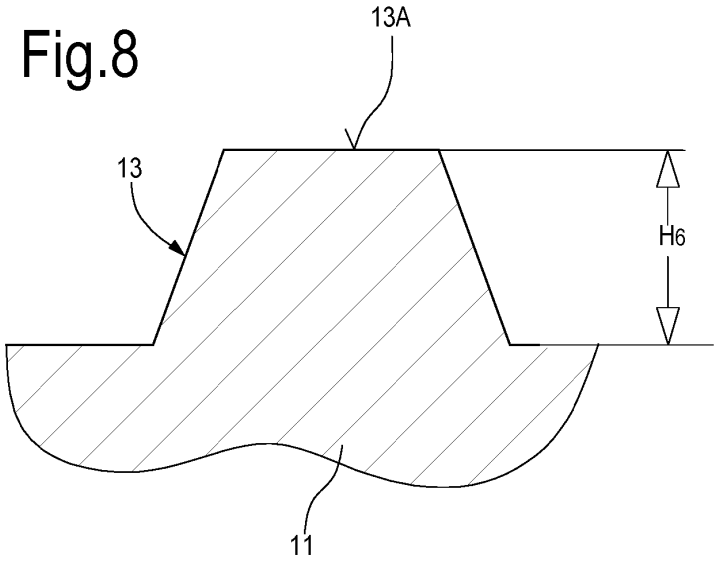


Fig.9

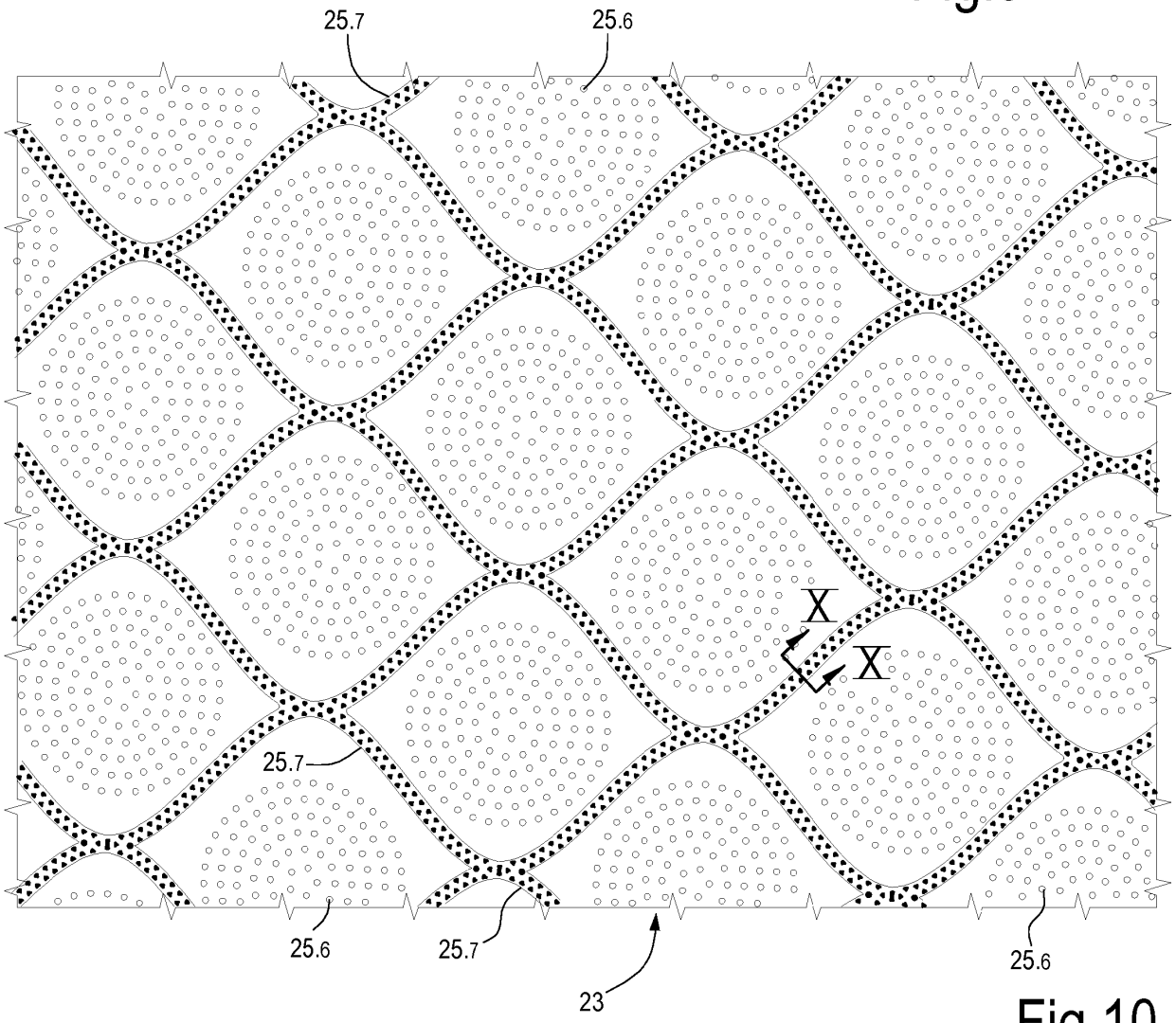

25.7
25.6
X
X
25.7
25.6
25.7
25.6
23

Fig.10

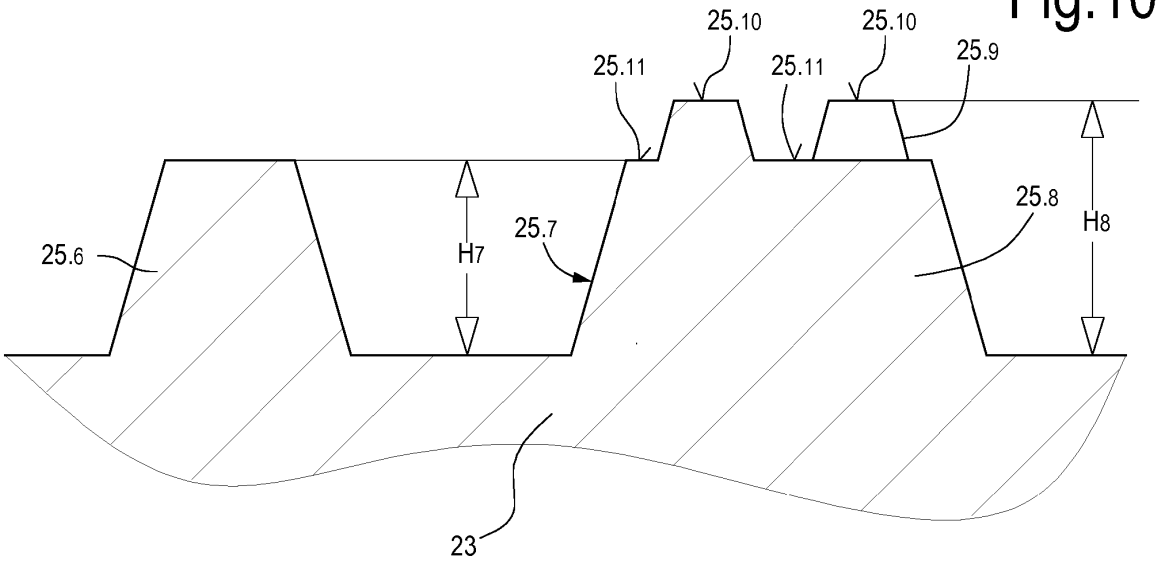

25.10
25.10
25.11
25.11
25.9
25.8
H8
25.6
H7
25.7
23

Fig.11B

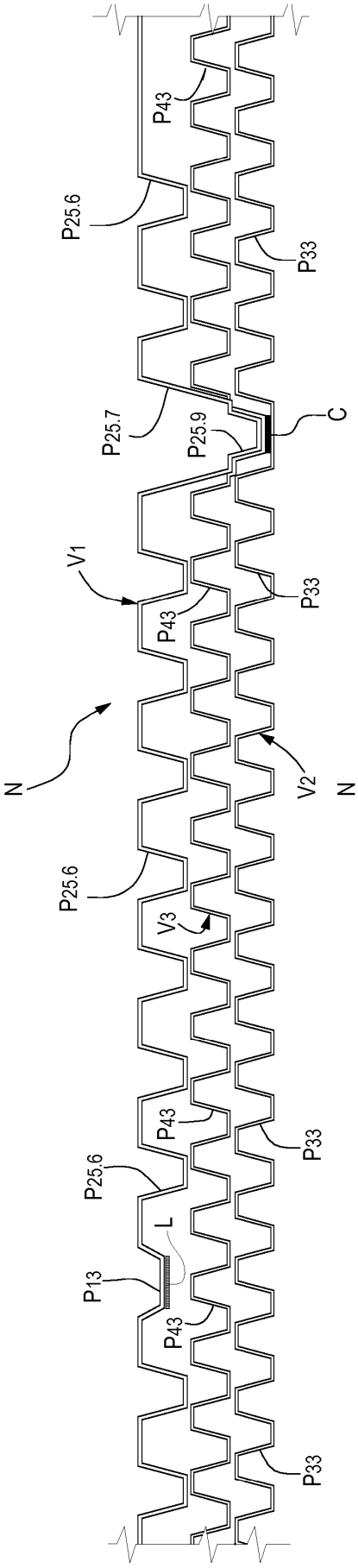


Fig.11A

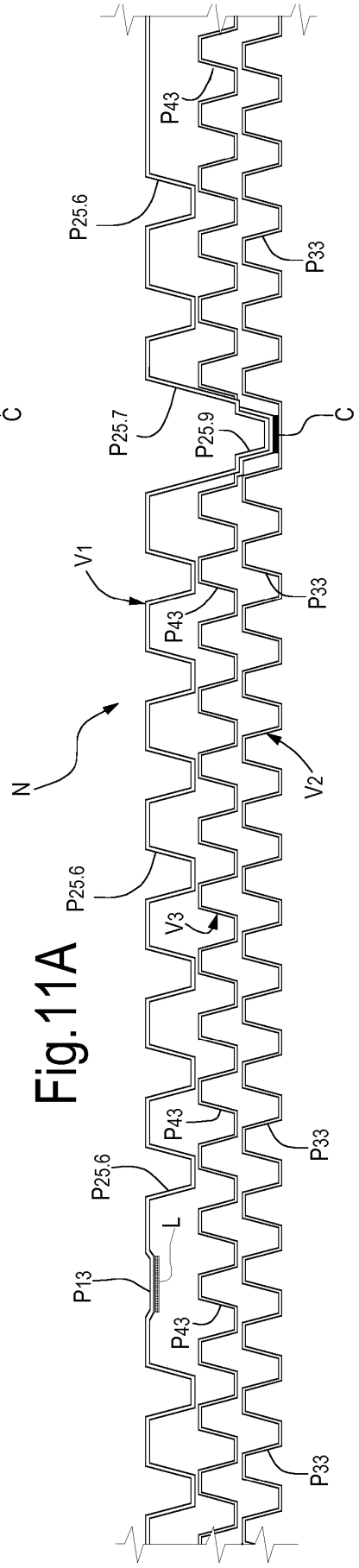


Fig.12

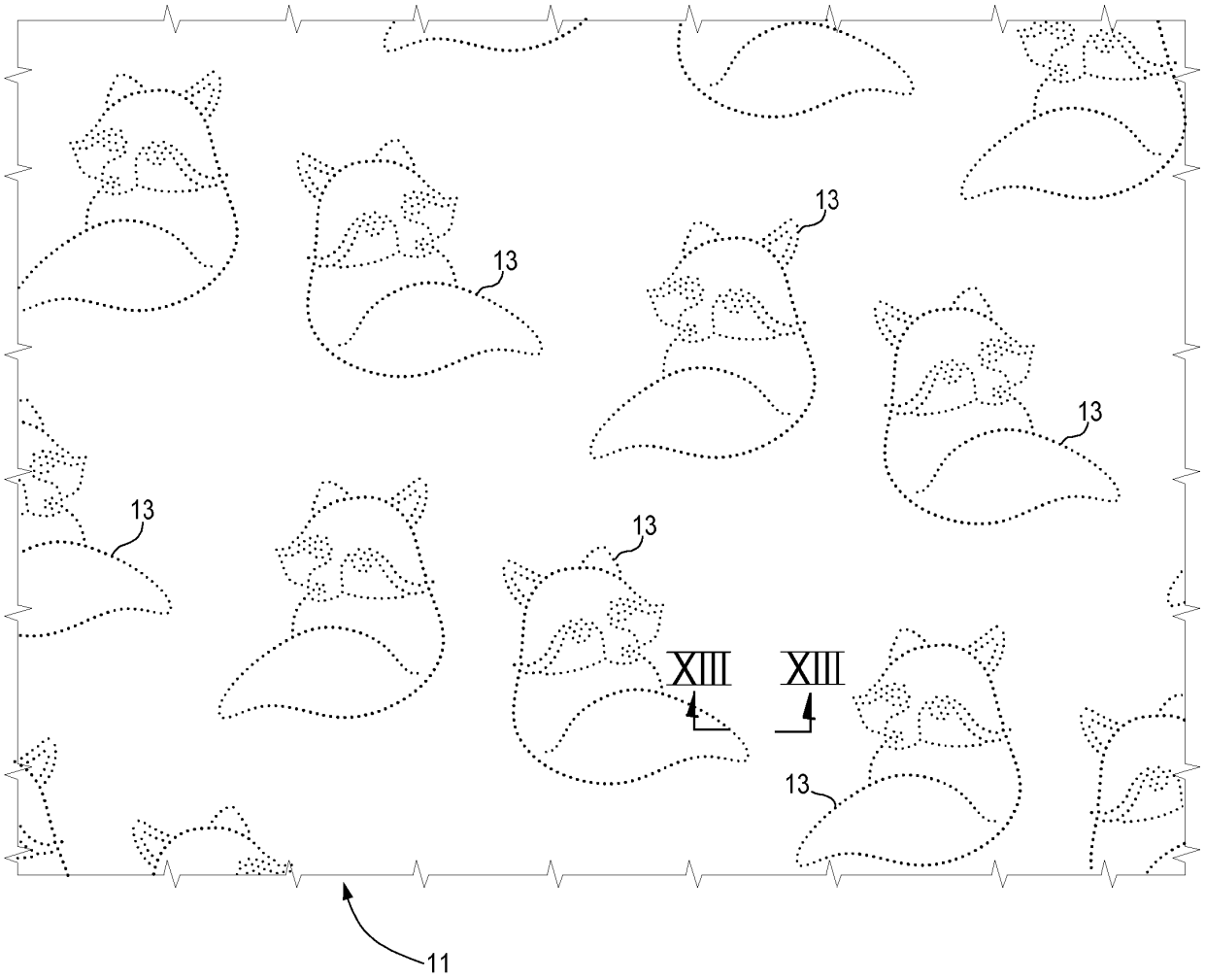


Fig.13

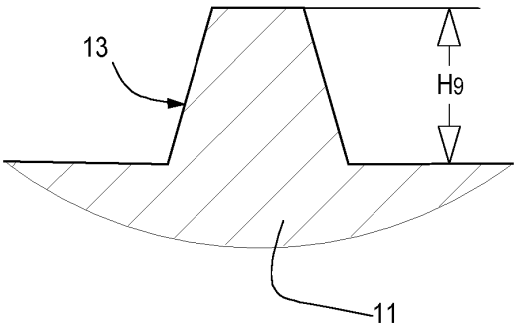
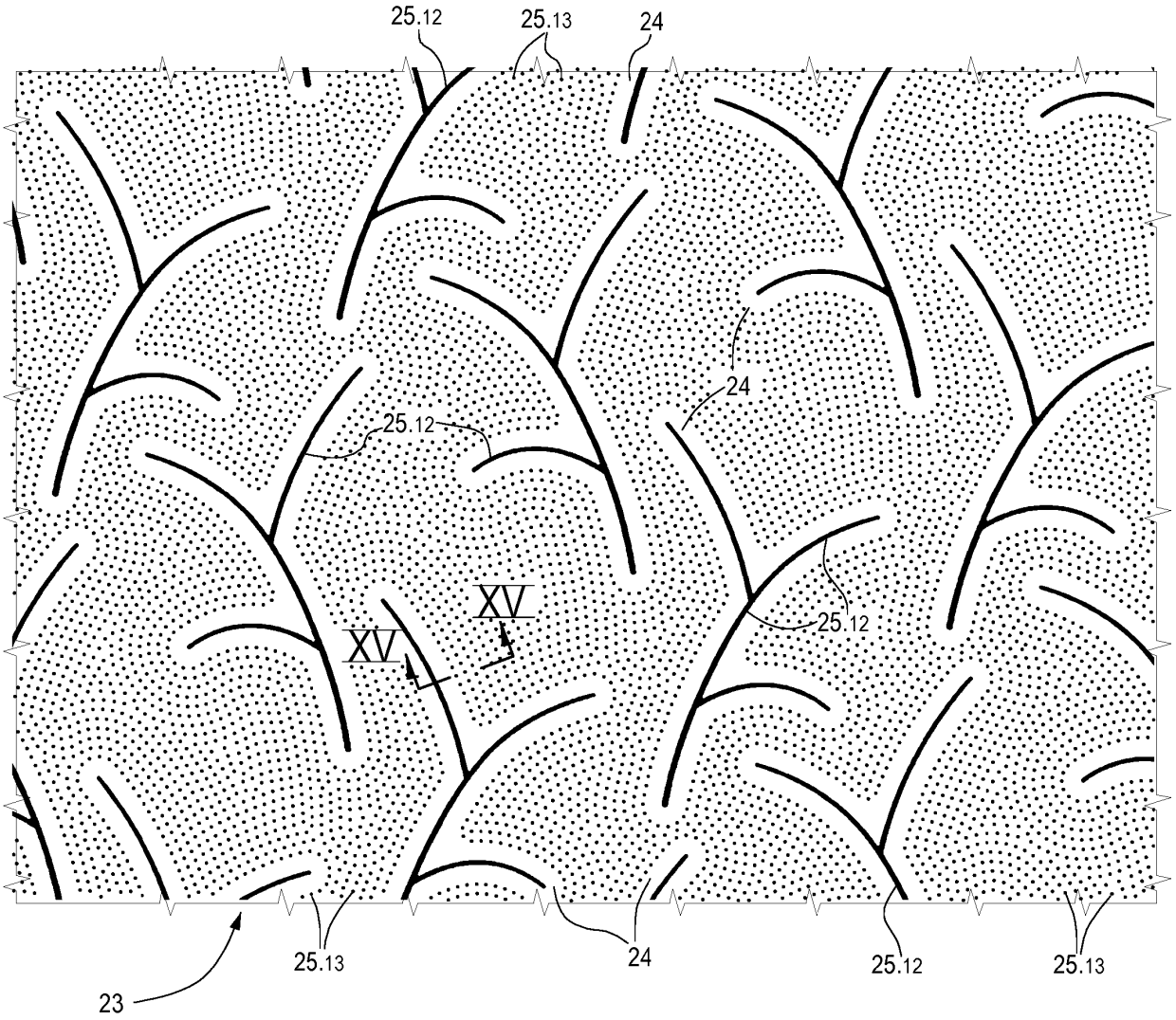


Fig.14


25.12
25.13
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25.12
XV
XV
25.12
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25.13
24
25.12
25.13

Fig.15

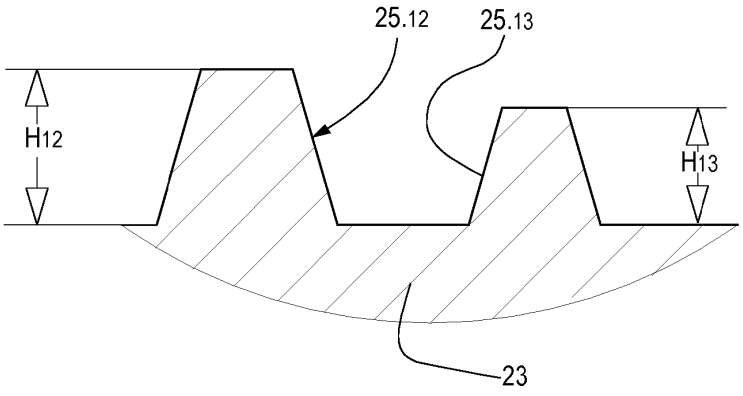

25.12
25.13
H12
H13
23

Fig.16B

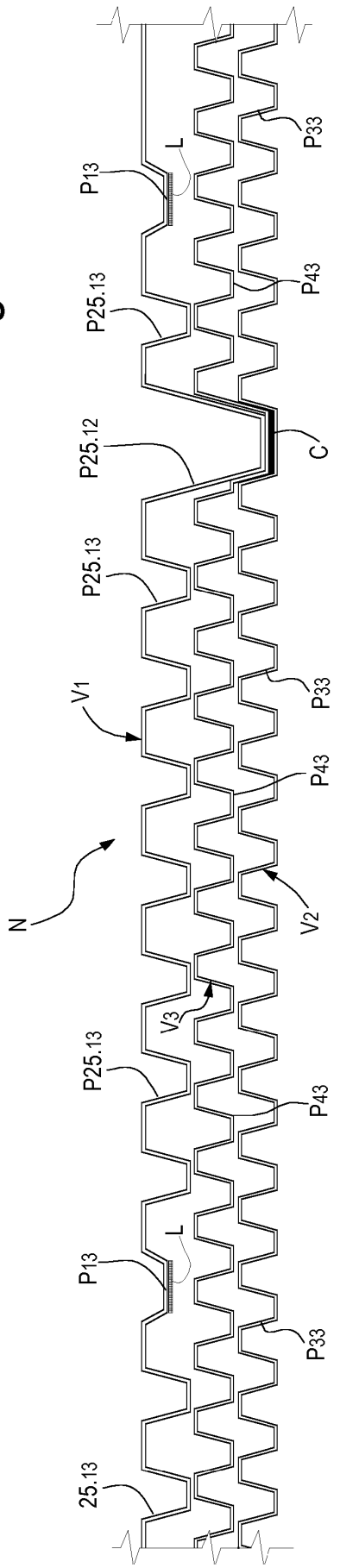


Fig.16A

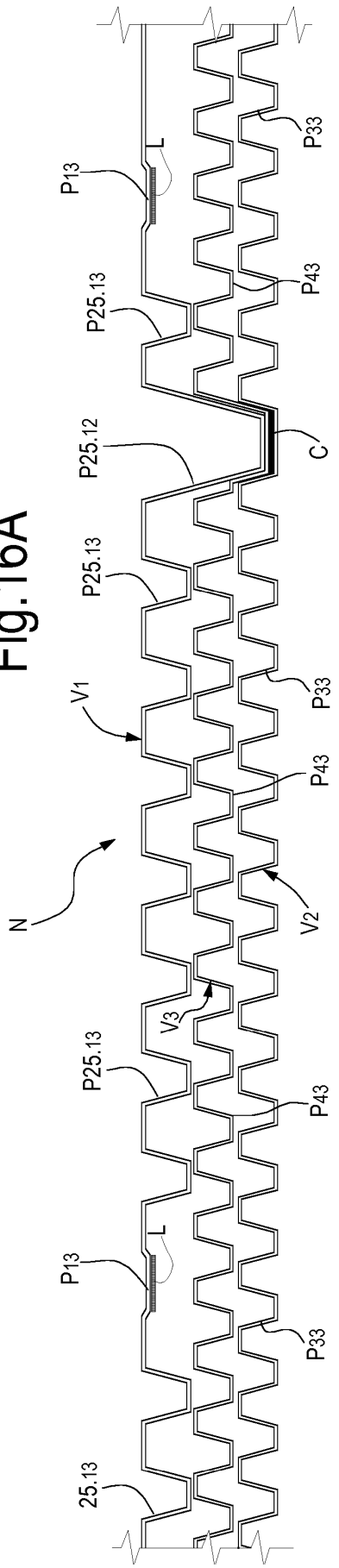


Fig.17

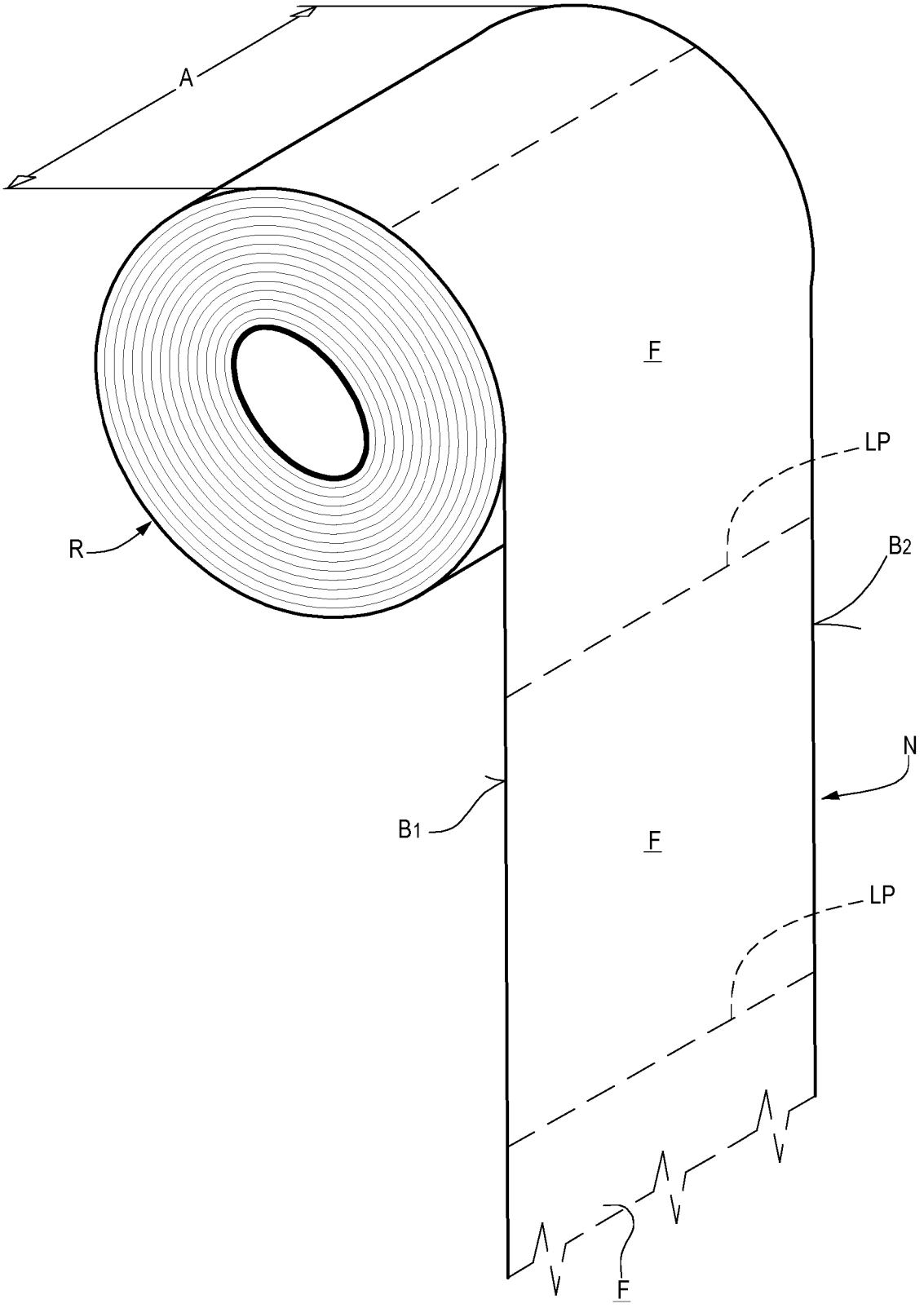
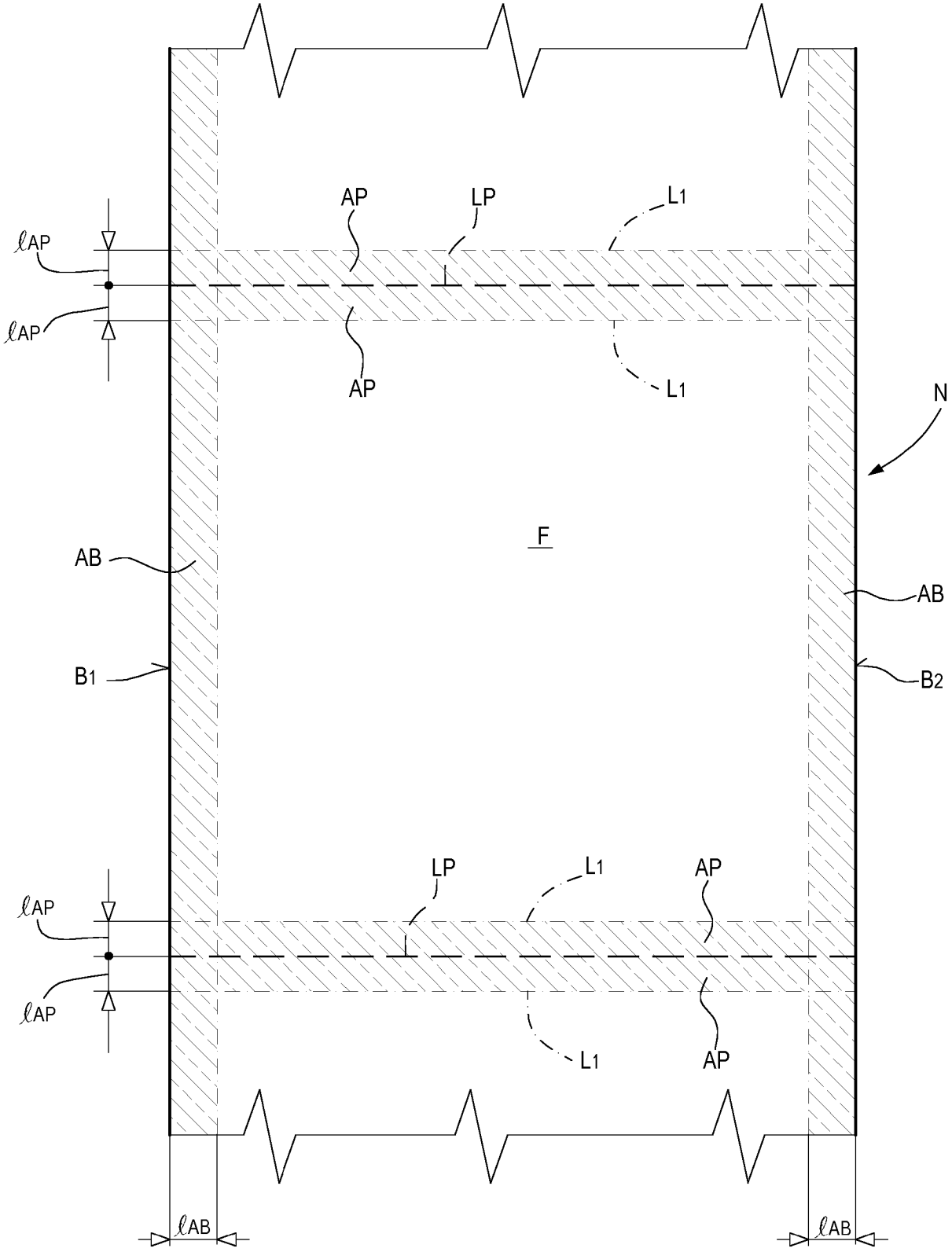


Fig.18



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- EP 2080611 A **[0004]**