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(71) Applicant: **Fabio Perini S.p.A.**
55100 Lucca (IT)

(72) Inventor: **Gelli, Mauro**
55066 Capannori
Lucca (IT)

(74) Representative: **Mannucci, Michele et al**
Ufficio Tecnico Ing.A. Mannucci S.r.l.
Via della Scala 4
50123 Firenze (IT)

(54) Embossed paper material, method and device for the production thereof

(57) The multi-ply paper material comprises at least a first ply (V1) of tissue paper, embossed and joined by gluing to at least a second ply (V2) of tissue paper. The first ply (V1) comprises at least a first series of embossing protuberances (P1) protruding from a base surface toward the second ply (V2). Glue (C) is applied to the protuberances (P1) of the first series to join the first ply and the second ply. Moreover, the first ply presents a second series of embossing protuberances (P2) protruding from said base surface (SV1) toward the outside of the material on the opposite side with respect to the protuberances of the first series.

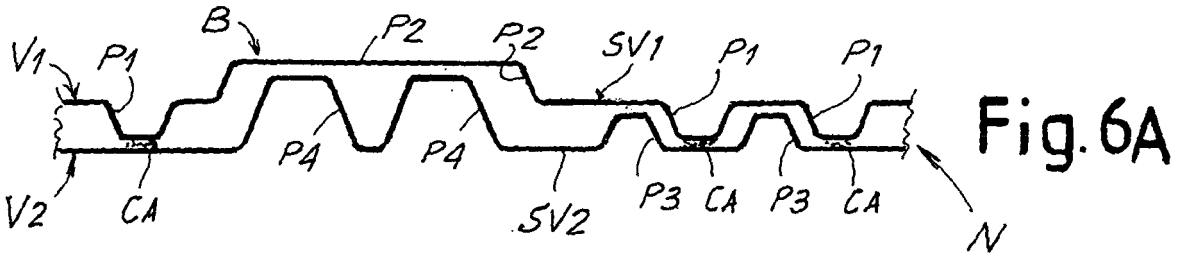


Fig. 6A

EP 2 018 959 A2

Description

Technical Field

[0001] The present invention relates to an embossed web material, in particular a paper material and specifically a multi-ply tissue paper material.

[0002] The invention also relates to improvements to methods and to devices for processing paper web materials, in particular tissue paper.

State of the art

[0003] Embossing is one of the operations that are normally performed on plies or sheets of tissue paper, to produce paper articles for personal and household cleaning and hygiene, or also for commercial and industrial use, such as toilet paper, kitchen towels, paper napkins and handkerchiefs and the like.

[0004] Embossing is an operation that is performed for the dual purpose of improving aesthetic properties and increasing functional properties, in particular the softness, smoothness, absorption capacity or thickness of the finished material.

[0005] Normally, a tissue paper material, such as kitchen towel or toilet paper, is produced from two or more plies of paper embossed separately and subsequently joined together by applying glue and laminating the plies between counter-rotating rollers defining a lamination nip.

[0006] Embossing is typically performed by feeding each ply between an embossing roller, equipped with protuberances, and a pressure roller with an outer surface coated in yielding material, typically rubber. In this case this is known as steel to rubber embossing, as the embossing roller is typically made of steel. In some cases embossing is performed between two rollers made of steel or another hard material, one provided with protuberances and the other with corresponding recesses. The protuberances of the embossing roller produce corresponding protuberances or protrusions in the paper ply. The protuberances formed in the two outermost plies are facing the inside of the finished product.

[0007] According to a possible technique (known as "tip-to-tip"), the two plies of paper web material are joined by making the protuberances of one ply coincide with protuberances of the other ply, having previously applied glue to the protuberances of one of the two plies, or to at least to some of these protuberances. In practice, two embossing rollers that emboss two paper plies separately by means of respective pressure rollers, form therebetween a lamination nip, through which the two embossed plies are fed before being detached from these rollers. In the lamination nip the protuberances of one roller coincide with the protuberances of the other roller and the reciprocal distance between the rollers is such as to cause localized compression of the plies at said protuberances.

[0008] A tip-to-tip embossing unit for obtaining a product of this type is described in US-A-3,414,459. The tip-to-tip embossing technique has gradually been perfected and improved, in order to solve particular problems arising with this processing method. US-A-5,096,527 describes, for example, a technique to reduce the vibrations and wear in tip-to-tip embossing units. US-A-6,113,723 describes a distribution of protuberances having the object of increasing the adhesion strength through a particular arrangement of the protuberances. US-A-5,736,223 describes a method for producing a paper article in sheet form comprising three layers or plies of tissue paper.

[0009] US-A-5,173,351; US-A-6,032,712; US-A-6,245,414; US-A-6,053,232 describe embossing-laminating units which with particular measures prevent concentrated wear of the protuberances also when these do not completely coincide, but give rise to a partial correspondence in areas, between some of the protuberances of one roller and some of the protuberances of the other. US-A-3,961,119 describes a tip-to-tip embossing unit, wherein two mutually cooperating embossing rollers are equipped with helical projections. The projections of one embossing roller has protrusions that mesh with recesses provided in the helical projections of the opposed embossing roller.

[0010] According to a different technique, the two plies are embossed separately, each between an embossing roller and a counter-roller or pressure roller. The two plies are then mutually joined so that the protuberances of one ply are nested between the protuberances of the other ply. This is known as "nested" embossing. Lamination of the two plies is obtained between one of the embossing rollers and a laminating roller, while the two embossing rollers are not in contact to one another. Examples of embossing-laminating devices of this type are described in US-A-3,556,907; US-A-3,867,225; US-A-5,339,730.

[0011] Some embossing units can alternatively perform embossing according to the nested technique or according to the tip-to-tip technique.

[0012] Initially, embossing was performed according to very simple geometric patterns, with uniform distribution of frusto-conical or frusto-pyramidal shaped protuberances. This embossing had a prevalently technical function, used to produce a product of adequate thickness and with sufficient softness and absorption capacity.

[0013] A new embossing technique that makes it possible to obtain particularly refined and easily interchangeable motifs is described in US-A-6,755,928 and in US-A-6,681,826.

[0014] GB-A-2132141 describes an embossing system wherein a multi-ply web material, composed of two plies previously joined by gluing, is fed through an embossing nip defined between two embossing rollers made of steel or the like. The two embossing rollers have protuberances and recesses that mutually mesh to form on the multi-ply web material, which is fed therebetween,

protrusions or protuberances that extend from one or other of the two faces of the web material.

[0015] The product that is obtained is not particularly voluminous and moreover is stiff, due to the presence of large quantities of glue. Machining the embossing rollers or cylinders is complex and the need to angularly adjust them precisely to make the protrusions of one mesh with the recesses of the other substantially limits the type of embossing patterns obtainable with this technique.

Objects and summary of the invention

[0016] According to one aspect, an object of an embodiment of the invention is to provide a multi-ply paper material made of embossed tissue paper or the like, which presents particular properties of softness and thickness.

[0017] According to one embodiment of the invention, there is provided a multi-ply paper material comprising at least a first paper ply, preferably tissue paper, embossed and joined by gluing to at least a second paper ply, preferably tissue paper, wherein the first ply comprises at least a first series of embossing protuberances protruding from a base surface toward the second ply, and wherein glue is applied to the protuberances of the first series to join said first ply and said second ply. The first ply has a second series of embossing protuberances protruding from the base surface toward the outside of the material on the opposite side with respect to the protuberances of the first series.

[0018] Preferably, the second ply is also embossed.

[0019] In one embodiment, the second ply comprises embossing protuberances protruding from a base surface toward the inside of the material and toward said first ply, at least partly nested in recesses defined between embossing protuberances of said first series of embossing protuberances of the first ply.

[0020] For example, the second ply can be provided with embossing protuberances protruding toward the first ply, inserted in recesses of the first ply forming the inside of the embossing protuberances of said second series of embossing protuberances of the first ply.

[0021] In one embodiment, the second ply comprises embossing protuberances protruding from a base surface toward the inside of the material and having two different heights.

[0022] In some embodiments the embossing protuberances of the second series of protuberances of the first ply have a rounded outer surface.

[0023] In some embodiments at least some of the embossing protuberances of the second series of protuberances of the first ply are at least partly surrounded by linear protuberances protruding toward the inside of the material, provided with glue and joined to the second ply. The first series of embossing protuberances of the first ply can comprise a plurality of truncated-cone or truncated-pyramid shaped protuberances. In some embodiments the embossing protuberances of the second series of protuberances of said first ply have variable heights.

[0024] In some embodiments of the material according to the invention the protuberances of the second series have a linear shape. They can be joined together to form mutually connected continuous lines.

[0025] Further features and advantageous embodiments of the material according to the invention are set forth in the dependent claims and some embodiment are described hereunder with reference to the accompanying drawings.

[0026] According to a different aspect, the invention provides for a method for the production of a multi-layer embossed paper material, comprising the steps of:

- embossing a first ply between a first embossing roller and a first pressure roller, said first embossing roller being provided with embossing protrusions extending toward the outside from a surface of the embossing roller, which penetrate an elastically yielding coating of the first pressure roller, generating a first series of embossing protuberances protruding from a base surface of said ply;
- applying glue to the protuberances of said first series of protuberances;
- gluing a second ply to said first ply.

[0027] An embodiment of the method according to the invention provides for generating on the first ply, by the first embossing roller and the first pressure roller, a second series of embossing protuberances protruding from an opposite side of said base surface with respect to said first series of protuberances. The second series of embossing protuberances is generated by penetration of said elastically yielding coating of the first pressure roller inside recesses extending toward the inside of said surface of the first embossing roller.

[0028] In some embodiments that provide for embossing of the second ply, the embossing protuberances of the second ply can be inserted in recesses of the first ply forming the inside of the embossing protuberances of said second series of protuberances of the first ply.

[0029] In some embodiments, on said second ply there are generated embossing protuberances of at least two different heights, facing said first ply.

[0030] Some embodiments of the method according to the invention provide for generating on the second ply, by a pressure roller and an embossing roller, a first series of embossing protuberances and a second series of embossing protuberances, protruding from opposite sides of a base surface, said embossing roller presenting protrusions extending toward the outside with respect to a base surface of the embossing roller and recesses extending toward the inside of the embossing roller from said base surface, and said pressure roller presenting a yielding coating cooperating with the protrusions and the recesses of said embossing roller.

[0031] Further features and possible embodiments of the method according to the invention are indicated in

the appended claims.

[0032] According to a further aspect, the invention relates to an embossing unit comprising:

- a first embossing roller equipped with a series of embossing protrusions, extending from a base surface of the embossing roller toward the outside and a series of embossing recesses extending from the base surface toward the inside of the embossing roller;
- a first pressure roller defining with said first embossing roller a first embossing nip and provided with an elastically yielding coating;
- a first path for a first paper ply, extending through said first embossing nip;
- a second path for a second paper ply;
- a glue applicator, cooperating with said first embossing roller and disposed downstream of said first embossing nip;
- a system to join said second ply to said first ply by glue applied by said applicator to embossing protuberances generated on said first ply by said first series of embossing protrusions.

[0033] Further embodiments of the embossing unit according to the invention are indicated in the appended claims.

Brief description of the drawings

[0034] The invention will be better understood by following the description and accompanying drawing, which shows practical non-limiting embodiments of the invention. More in particular, in the drawing:

Fig.1 shows a schematic side view of an embossing unit to which the present invention can be applied;
Fig.2 shows a flat layout of a portion of the first embossing roller of an embossing unit according to the invention;
Fig.3 shows an enlarged and schematic section according to III-III of Fig.2;
Fig.4 shows a flat layout of a portion of the second embossing roller;
Fig.5 shows a greatly enlarged schematic section according to V-V of Fig.4;
Fig.6A shows a cross section of an article or multiply web material obtained with an embossing unit as in Fig.1 equipped with embossing rollers as shown in Figs. 2 to 5;
Fig.6B shows a plan view of a portion of the multiply web material of Fig.6A
Fig.7 shows a plan view of a flat layout of a portion of the cylindrical surface of an embossing roller in a variant of embodiment of the invention;
Fig.8 shows a schematic enlarged section according to VII-VII of Fig.7, in which two portions of two matched embossing rollers with mirror image symmetry in the lamination area are visible;
Fig.9 shows a schematic enlarged section of a multiply article obtained with the rollers of Figs. 7 and 8 in an embossing unit as in Fig.1;
Fig.10 shows a section of a product or multi-ply web material in a variant of embodiment similar to that of Fig.9;
Fig.11 shows a plan view of a flat layout of a portion of an embossing roller in a variant of embodiment;
Fig.12 shows an enlarged schematic section according to XII-XII of Fig.11;
Fig.13 shows a flat layout of an embossing roller in a further variant of embodiment;
Fig.14 shows a further flat layout of a portion of an embossing roller in a variant of embodiment;
Fig.15 shows a schematic enlarged section according to XV-XV of Fig.14;
Figs. 15A and 15B show schematic and greatly enlarged cross sections of modified embodiments of the multi-ply paper web material according to the invention;
Figs.16 and 17 show views of flat layouts of portions of a pair of embossing rollers in a variant of embodiment;
Fig.18 shows a greatly enlarged cross section of the article obtained with the rollers of Figs.16 and 17;
Fig.18A shows a section analogous to the section of Fig.18 in a variant of embodiment;
Figs.18B, 18C show cross sections of the embossing rollers engraved to obtain the product of Fig.18A;
Fig.19 shows the flat layout of a further variant of embodiment of an embossing roller according to the invention; and
Figs.20 and 21 show schematic sections according to XX-XX and XXI-XXI of Fig.19.

Detailed description of embodiments of the invention

[0035] Fig.1 schematically shows, in a side view, an embossing unit to which the invention can be applied. In a possible embodiment, the embossing unit, indicated as a whole with 1, has a first embossing roller 3 and a second embossing roller 5, rotating about respective substantially parallel axes 3A and 5A. The two embossing rollers 3 and 5 are equipped on the cylindrical surfaces thereof with arrangements of protuberances and recesses as described in greater detail hereunder with reference to Figs.2 to 5.

[0036] The first embossing roller 3 cooperates with a first pressure roller 7, equipped with a coating in yielding material 7A on the cylindrical surface thereof cooperating with the cylindrical surface of the embossing roller 3. The embossing roller 5 cooperates with a second pressure roller 9, also equipped with a coating in yielding material indicated with 9A, which coats the surface thereof cooperating with the cylindrical surface of the embossing roller 5. Along the circumferential extension of the embossing roller 3, downstream of the pressure roller 7, there is arranged a glue dispenser schematically indicated with 11,

of type known per se and not described in greater detail.

[0037] In one embodiment, indicated with a broken line, the embossing unit can also include a laminating or marrying roller 13 cooperating with the embossing roller 3 to mutually laminate two plies embossed separately between the pair of rollers 3, 7 and 5, 9 respectively.

[0038] The embossing unit 1 has a first path for a first ply V1 that extends around the pressure roller 7, around the first embossing roller 3 and through the nip between the embossing rollers 3 and 5. The embossing unit 1 also has a second path for a second ply V2, path that extends around the second pressure roller 9, around the second embossing roller 5 and through the nip between the rollers 3 and 5.

[0039] In one embodiment the first embossing roller 3 has a base surface 3S (Fig.3) with substantially cylindrical extension. A first series of protrusions S3 of height H extend from the surface 3S toward the outside of the embossing roller 3. Moreover, recesses C3 of depth P extend toward the inside of the embossing roller 3 from the base surface 3S thereof. In the embossing nip between the first embossing roller 3 and the first pressure roller 7 sufficient pressure is exerted between the two rollers to make the protrusions S3 of the embossing roller 3 penetrate the elastically yielding material 7A of the first pressure 7 and to make the elastically yielding material of this coating penetrate the recesses C3 of the embossing roller 3. In this manner, the ply V1 fed through the embossing nip between the rollers 3 and 7 is embossed generating protuberances that protrude from one side and from the other side with respect to a base surface of the ply V1, as will be described in greater detail with reference to Figs. 6A and 6B.

[0040] In one embodiment, the second embossing roller 5 has a substantially cylindrical base surface 5S, from which there protrude a first series of protrusions S5 of height H, in the example shown substantially the same as the height H of the protrusions S3 provided on the first embossing roller 3. In one embodiment, protrusions SS5 of height H1, greater than the height H of the protrusions S5 and of the protrusions S3, also extend from the same base surface 5S of the second embossing roller 5.

[0041] In the embossing nip, between the second embossing roller 5 and the second pressure roller 9, as a result of the reciprocal pressure exerted between the two rollers 5 and 9, the protrusions SS5 and S5 penetrate the depth of the elastically yielding material forming the coating 9A of the second pressure roller 9, thereby embossing the second ply V2 forming protrusions or protuberances all facing in a same direction starting from the base surface of the ply V2, as will be explained hereunder.

[0042] Fig.6A very schematically shows a greatly enlarged cross section of a multi-ply web material N obtained by joining two plies V1 and V2 separately embossed in the embossing nips 3, 7 and 5, 9 respectively of the embossing unit 1 of Fig.1. The ply V1 has a base surface SV1 from which a first series of protuberances P1, generated by the protrusions S3 of the embossing roller 3, protrude toward the inside of the multi-ply paper web material N. A second series of protuberances P2, formed by penetration of the elastically yielding material of the coating 7A of the pressure roller 7 inside the recesses C3 of the embossing roller 3, protrude on the opposite side of the base surface SV1 of the ply V1. Ultimately, therefore, the ply V1 is embossed in two directions: on the outside with the protuberances P2 and on the inside with the protuberances P1. On the latter, before the ply V1 is moved away from the embossing roller 3, the dispenser 11 applies glue or adhesive CA to mutually join the two plies V1 and V2. The glue can be applied to all the protuberances P2, or only to some of them, for example using a roller with patterns, or cliché roller, to distribute the glue according to a predetermined pattern. The protuberances P1 adhere by means of the glue CA to the base surface SV2 of the second embossed ply V2. This ply V2 has, all protruding from the same side toward the inside of the web material N, protuberances P3 generated by the protrusions S5, nested between the protuberances P1 of the ply V1, and protuberances P4 generated by the protrusions SS5 of the embossing roller 5. The arrangement is such that the protuberances P3 are nested between the protuberances P1 of the ply V1, while the protuberances P4 are located inside the recesses defined within the protuberances P2, facing the outside, formed on the ply V1. As the protuberances P4 generated by the protrusions SS5 are of greater height than the protuberances P3 generated by the protrusions S5, the protuberances P4 form a backing for the front portion of the protuberances P2 generated on the ply V1, preventing collapse, i.e. crushing, thereof, notwithstanding the fact that the protuberances P2 are facing the outside of the web material.

[0043] The height of the protuberances P4 is approximately the same as the height H1 of the protrusions SS5 of the embossing roller 5, said height being approximately the equivalent to the sum of the depth P of the recesses C3 of the embossing roller 3 and of the height H of the protrusions S3 of this embossing roller 3.

[0044] Fig.6B shows a plan view of a portion of web material N obtained with the rollers of Figs. 2 to 5. As can be seen in this figure, in the example of embodiment the protuberances P2 generated by the recesses C3 of the embossing roller 3 have in the plan view (and therefore in cross section) an extension substantially greater than that of the remaining protuberances.

[0045] In one embodiment the protuberances P1 and P3 have a truncated-cone or truncated-pyramid shaped extension, while the recesses C3 and consequently the protuberances P2 generated thereby can have an extension with an approximately square or rectangular section, with more or less curvilinear sides as shown in Fig.6B. In one embodiment the protuberances P2 have rounded edges B, due to the fact that these protrusions are obtained as a result of penetration of the elastically yielding material forming the coating 7A inside the recesses C3.

[0046] In the embodiment described above, joining of the two plies V1 and V2 takes place with a nested arrangement. Therefore, the embossing unit 1 will be equipped in this case with a laminating roller 13 that defines a lamination nip between said roller 13 and the first embossing roller 3. The plies V1 and V2 are fed through said nip, the ply V2 having been detached from the second embossing roller 5 and laid on the first ply V1, which instead is still adhering to and engaged with the protrusions and recesses of the embossing roller 3. The pressure exerted by the laminating roller 13 in the area of the ply V1 corresponding to the protrusions S3 causes lamination and reciprocal gluing of the two plies V1 and V2.

[0047] Figs.7, 8 and 9 show a further modified embodiment of the invention. Fig.7 shows a plan view of a flat layout of a portion of one of the two embossing rollers 3 and 5 in this modified embodiment. The two rollers can be substantially symmetrical with respect to each other. S3 and S4 indicate protrusions of different heights of the embossing roller 3. These protrusions are visible in greater detail in the schematic cross section of Fig.8, in which the embossing roller 3 is shown opposed to and cooperating with the embossing roller 5. C3 once again indicates recesses that extend from the base surface 3S of the embossing roller 3 toward the inside of this roller, while the protrusions S4 and S3 from the base surface 3S are facing the outside of the roller. The height of the protrusions S3 is indicated with H, while the height of the protrusions S4 is indicated with h.

[0048] As shown in Fig.8, the embossing roller 5 is engraved substantially with mirror image symmetry to that of the embossing roller 3. C5 indicates recesses protruding toward the inside of the roller 5 starting from a base surface 5S, while S5 and S6 indicate the protrusions, facing the outside starting from the base surface 5S of the embossing roller 5.

[0049] The arrangement in this case is of the tip-to-tip type, with the protrusions S3 and S5 arranged in mutual correspondence in the nip between the rollers 3 and 5. In this configuration the marrying and laminating roller 13 can be omitted or left idle, moving it away from the cylindrical lateral surface of the first embossing roller 3. The plies V1 and V2 are joined by lamination directly between the embossing rollers 3 and 5.

[0050] In one embodiment of the invention, the recesses C3 and C5 of the embossing rollers 3 and 5 have a linear shape as shown schematically in Fig.7 for the recesses C3 of the first embossing roller 3. Linear recesses are intended as recesses presenting an extension according to the length thereof substantially greater than the extension according to the width thereof. In one embodiment, the ratio between length and width can be at least 5 to 1, and preferably at least 10 to 1 or greater, i.e. the extension in length of the recesses is five times or more the dimension in width.

[0051] In the embodiment shown in Fig.7 the recesses C3 can extend linearly according to closed lines (square in the example shown) or according to open lines (interrupted composed of a series of consecutive sides). Recesses of this shape are particularly advantageous as therewith protuberances P2 facing the outside of the web material are obtained on the embossed ply which are particularly resistant to crushing, even in the absence of supporting protuberances, such as the protuberances P4 in the embodiment shown in Fig.6A.

[0052] In fact, in this case, as shown in particular in the schematic section of Fig.9, as the two plies V1 and V2 are in tip-to-tip and not in nested arrangement, they are characterized by protuberances P2 on the ply V1 and P4 on the ply V2 approximately mutually corresponding and facing the outside of the web material N formed by joining the plies V1 and V2. The limited width of the protuberances P2, P4 and the considerable extension in length thereof, combined with the presence of a high number of mutually corresponding protuberances P1 and P3 bonded together by the glue CA, makes the multi-ply web material N particularly resistant to crushing. The protuberances P1 and P3 are generated by the protrusions S3 and S5 of greater height of the embossing rollers 3 and 5. Therefore, these protuberances are in mutual contact and bonded by the glue CA applied by the glue dispenser 11 to the protuberances P1 when these are still adhering to the embossing roller 3. The protrusions S4 and S6 of lesser height generate, on the two plies V1 and V2, protuberances P6 and P8 of lesser height with respect to the protuberances P1 and P3. Therefore, the protuberances P6 and P8 do not receive glue and are not in reciprocal contact with each other.

[0053] In this manner a very thick and very soft multi-ply tissue paper web material is obtained with protuberances protruding toward the inside and toward the outside of the product, joined by bonding at the tips P1, P3 disposed in a tip-to-tip arrangement. This embodiment is particularly advantageous in the case of multi-ply products, in which the upper ply and the lower ply are each composed of a double ply of tissue paper.

[0054] In a modified embodiment of the invention the protrusions S3, S4 of the first embossing roller 3 and the protrusions S5, S6 of the second embossing roller 5 can be all of the same height, and in this case a multi-ply web material as shown in Fig.10 is obtained, in which the ply V1 has protuberances P2 protruding toward the outside from a base surface SV1 and protuberances P1 protruding toward the inside of the web material N from the base surface SV1. With mirror image symmetry, the ply V2 has protuberances P4 facing the outside of the ply V2 starting from a base surface SV2 and protuberances P3 protruding toward the inside of the web material N starting from said base surface SV2. The arrangement is once again tip-to-tip with glue CA applied to the front surfaces of the protuberances P1, at which reciprocal bonding between the plies V1 and V2 takes place.

[0055] Fig.11 shows a flat layout of a portion of the cylindrical surface of one or other of the two embossing rollers 3 and 5 in a modified embodiment. In the plan view the pattern of the protrusions and of the recesses is sub-

stantially the same as that of Fig.7. However, in the section of Fig.12 it can be see how in this case the roller 3 (although the roller 5 can be designed with identical engraving) has recesses C3 of an elongated linear shape, extending toward the inside of the roller starting from a base surface 3S and protrusions S3 facing the outside of the roller 3 starting from the base surface 3S, all of the same height H, but with different plan dimensions for the three types of protrusions which can, for example, be produced pyramid-shaped with a square or rectangular base.

[0056] Fig.13 shows an engraving similar to that of Figs. 7 or 11, where C3 indicates the recesses with linear extension and S3 and S4 indicate the protrusions radially facing the outside from a base surface 3S. In this case, the recesses C3 with linear extension are arranged so that they never cut through the protrusions S3, S4, i.e. the recesses C3 extend according to lines parallel to the alignments of the protrusions S3 and S4 and without interfering therewith.

[0057] The two rollers 3 and 5 can be produced to be mutually matched with mirror image symmetry as indicated schematically in Fig.8.

[0058] Fig.14 instead shows a modified embodiment, in which one or other or both the embossing rollers 3 have individual protrusions S3, i.e. composed, for example, of truncated-pyramid or truncated-cone shaped protuberances, or in general having a limited extension and mutually separated. These protrusions S3 are combined with linear protrusions S8 facing the outside starting from a base surface indicated with 3S (Fig.15). The embossing roller 5 can be designed to have mirror image symmetry. In this case, the recesses C3 again present a linear shape similar to that shown in Fig.13. However, in this embodiment the recesses C3 have the particularity of being side by side with, and totally or partly surrounded by, the linear protrusions S8. These protrusions S8 generate in the ply V1, embossed by the roller 3 and/or in the ply V2 embossed by the roller 5, protuberances preferably substantially of the same height as the protuberances generated by the protrusions S3. The glue dispenser 11 applies glue to the front surfaces of all these protuberances. By mutually joining these two plies, high resistance to crushing of the protuberances formed by the recesses C3 of the roller 3 or by the new recesses C5 of the roller 5 is thus obtained. This is due to the fact that these protuberances protruding toward the outside of the web material N are surrounded along the bases thereof by lines of glue corresponding to the linear extension of the protrusions S8.

[0059] Fig.15A very schematically shows in a greatly enlarged cross section a portion of web material N obtained by two embossing rollers 3, 5 engraved with substantially mirror image symmetry of the type shown in Fig.15. The same numbers indicate the same or equivalent parts to those of Fig.9. P1 and P3 indicate the protuberances generated by the protrusions S3 and S8 of the embossing roller 3 and by the corresponding protrusions of the embossing roller 5 matching the roller 3 with mirror image symmetry.

[0060] In a modified embodiment, the second ply V2 could also be unembossed, or embossed with micro-embossing. In a modified embodiment the micro-embossing or other base embossing can be characterized by protrusions all of the same height and all protruding toward the inside of the web material.

[0061] Fig.15B schematically shows a greatly enlarged cross section of a portion of web material obtained with a first ply V1 embossed with an embossing roller 3 configured as in Fig.15, joined to a smooth ply V2. The same numbers indicate the same or equivalent parts to those in Figure 15A. It must be understood that web materials with an embossed ply V1 and a smooth ply V2 can also be obtained using engraved embossing rollers as shown in the preceding figures.

[0062] Figs.16 and 17 show the flat layout of portions of two embossing roller 3 and 5 engraved with a different embossing pattern. The same numbers indicate the same or equivalent parts to those of the previous embodiments. In particular, in Fig.16 C3 indicates the linear recesses protruding radially toward the inside starting from the base surface 3S of the roller 3. S8 indicates the linear protrusions surrounding the linear recesses C3, while S3 indicates truncated-cone or truncated-pyramid shaped and individual, i.e. mutually isolated, protrusions of small dimensions.

[0063] Fig.17 shows the engraving of the embossing roller 5, with 5S indicating the base surface from which truncated-cone or truncated-pyramid shaped protrusions S5 and linear shaped protrusions S6 protrude toward the outside. The arrangement is such that the plies embossed separately by the two rollers 3 and 5 with the respective pressure rollers 7 and 9 are mutually joined in nested arrangement as shown schematically in the section of Fig.18. P1 indicates a first series of protuberances facing the inside of the web material N formed of the protrusions S3 of the roller 3 on the ply V1, while P2 indicates the protrusions or linear bulges protruding toward the outside of the ply V1, formed by means of the linear recesses C3. The protuberances or bulges P2 are surrounded by linear protrusions P1' facing the inside of the web material N, to which glue C is applied, formed by the protrusions S8 of the roller 3. The protuberances P1' have the same height as the protuberances P1, also provided with glue C. The ply V2 has protuberances P4 (formed by the protrusions S5) inserted in the protuberances P2 of the ply V1 and protuberances P3 of lesser height (formed by the protrusions S6), which are inserted between protuberances P1, P1' of the ply V1.

[0064] In one embodiment, the recesses C3 of the roller 3 can have different widths from one another, as shown in Fig.16 and also different depths. In one embodiment the recesses C3 of greater width are also of greater depth. For example, in one embodiment the recesses C3 can have widths of 3 mm, 2.5 mm, 2 mm respectively with depths of 1 mm, 0.75 mm and 0.5 mm with respect to the plane of the base surface 3S. The roller 5 can have

protuberances of variable heights, to obtain a final product of nested type, with protrusions of the ply V2 of variable heights that are inserted in the protuberances of protrusions in the form of bulges protruding from the ply V1, also of variable heights.

[0065] The finished product thus obtained is shown in a schematic cross section in Fig.18A. It has on the outside of the ply V1 protuberances or bulges with linear extension P21, P22, P23, of different heights and widths obtained by embossing in the linear recesses of the roller 3. The cross section of the roller 3 is shown in Fig.18B. C31, C32, C33 indicate the linear recesses that generate the protuberances or linear bulges P21, P22, P23, while H1, H2 and H3 indicate the heights of the protuberances P21, P22 and P23 respectively. The recesses C31, C32, C33 have variable depths in a manner corresponding to the variation of the heights H1, H2, H3. Inside the protuberances P21, P22, P23 of the ply V1 there are nested protuberances P41 P42, P43, also of different heights, produced by protrusions of the roller 5, indicated with S51, S52 and S53 in the section of Fig.18C, which shows a portion of the roller 5. In addition to the protrusions S51, S52, S53, the roller 5 has protrusions S6, of lesser height, preferably with linear extension, which generate protuberances P3, facing the inside of the web material N and which nest between the protuberances P1 of the ply V1. The protuberances or bulges P21, P22, P23 with linear extension are surrounded by continuous lines of glue that make these bulges more resistant to compression.

[0066] This embossing pattern with variable embossing depths (heights H1, H2, H3) allows a product to be obtained which, at least on the outer part thereof (considering the product as wound in a roll, with the ply V1 facing the outside), has an irregular surface, i.e. not flattened to the same height, but formed of depressed craters in the central part of each rhomboidal figure, which is delimited by a peripheral frame formed by the linear protuberances protruding from the web material, obtained along continuous channels C3 of the embossing roller (Fig.16). In this manner, the paper product obtained presents raised and depressed areas and, at the same time, the base paper material presents a different degree of absorbency, as the fibers thereof are deformed and stressed in a different manner from area to area, i.e. to a greater extent on the peripheral frame of each rhomboidal figure and to a lesser extent in the central part thereof.

[0067] In final use the product thus obtained has superior properties of performance than conventional products, due both to the different form and to the different absorbency capacity. In fact, by bringing the upper part of the composite product (i.e. on the side of the ply V1) into contact with a surface to be cleaned, if the material to be removed is principally liquid the areas of the product with greater absorbency are the first to be involved - as they protrude to a greater extent - and therefore as soon as they come into contact with the liquid substance they allow rapid diffusion thereof toward the innermost areas of the product, conveying the liquid substance toward the center of each rhomboidal figure. If, on the other hand, the material to be removed is principally solid or pulverulent, the composite product, owing to the form thereof, generates pockets or spaces inside the contact lines formed by the linear protrusions corresponding to the linear recesses C3, which facilitate elimination of the material to be removed.

[0068] Advantageously, in some embodiments the recesses hollowed out of the embossing roller (such as the recesses C3) are partly or fully surrounded by protuberances or protrusions (such as those indicated with S8, Fig.15), so that on the embossed web material the protrusions in the form of bulges of the tissue paper or other base material forming the plies, generated at the recesses C3 are made more stable and less susceptible to collapse, due to the presence of continuous or almost continuous lines along the base of these protrusions or bulges.

[0069] Similarly, the recesses C5 provided on the embossing roller 5 (Fig. 17) can have different widths and depths. In one embodiment the channel, i.e. linear recesses C3 and/or the linear recesses C5 can all have the same width and the same depth, or different widths and the same depths, or the same widths and different depths.

[0070] Fig.19 shows a modified embodiment with respect to that shown in Fig.16 and represents a flat layout of a portion of engraved surface of the embossing roller 3. In this case, protrusions S10 with linear extension that form a generic motif have been produced in some areas of the roller. The lowered portions of the roller 3, between the linearly extending protrusions S10, have variable depth. As can be observed in the sections according to XX-XX and XXI-XXI, the upper ply V1 obtained by embossing by the roller 3 of Fig.19 in this manner has protuberances or bulges P21, P22, P23 of different heights facing the outside of this ply, obtained in the depressed areas between the linear protrusions S10 of the roller 3. In the protuberances or bulges P21, P22, P23 protuberances are nested, facing the inside of the web material generated on the ply V2, also of different heights, obtained by the protrusions of the roller 5. The protrusions S10 of the roller 3 have a discontinuous curvilinear linear shape. Wide areas of the embossing roller 3, surrounding the generic motifs obtained by the curvilinear protruding lines S10 again have recesses and protrusions of the same type as that shown in Fig.16. Therefore, as in the case of Fig.18A, also in this embodiment the ply V1 has protuberances or bulges P21, P22, P23 of variable heights facing the outside, obtaining an effect in terms of performances of the product similar to that described with reference to the product of Fig.18A.

[0071] To produce one or other of the rollers 3, 5 engraved as described above, in a possible embodiment a process of the following type is used. On a roller with a smooth cylindrical surface, the recesses intended to form, by embossing on the respective ply, the protuber-

ances facing the outside of the web material are first produced by chemical etching. Once these recesses, for example the recesses C3, C5, have been engraved, the protrusions S3, S4, S5, S6, S8 are engraved, again using an acid etching process or by mechanical machining by means of chip removal. The base surface 3S or 5S of the embossing roller 3, 5 is therefore represented by the bottom of the second engraving. It is understood that in the first step the recesses C3, C5 are engraved with a depth with respect to the initial cylindrical surface equivalent to the sum of the depth P of the recesses with respect to the base surfaces 3S or 5S and the height of the protrusions extending from said base surface toward the outside of the roller.

[0072] It is understood that the drawing only shows an example given by way of a practical demonstration of the invention, as said invention can vary in forms and arrangements without however departing from the scope of the concept underlying the invention. Any reference numbers in the appended claims are provided to facilitate reading of the claims with reference to the description and to the drawing, and do not limit the scope of protection represented by the claims.

Claims

1. A multi-ply paper web material, comprising at least a first ply of tissue paper embossed and joined by gluing to at least a second ply of tissue paper, wherein said first ply comprises at least a first series of embossing protuberances protruding from a base surface toward the second ply, a glue being applied to the protuberances of the first series to join said first ply and said second ply, **characterized in that** said first ply has a second series of embossing protuberances protruding from said base surface toward the outside of the material on the opposite side with respect to the protuberances of the first series.

2. Multi-ply paper material as claimed in claim 1, **characterized in that** said second ply is embossed and comprises embossing protuberances protruding from a base surface toward the inside of the material and toward said first ply, at least partly nested in recesses defined between embossing protuberances of said first series of embossing protuberances of the first ply.

3. Multi-ply paper material as claimed in claim 1 or 2, **characterized in that** said second ply is embossed and comprises a first series of embossing protuberances protruding from a base surface toward the inside of the material and toward the first ply, and a second series of embossing protuberances protruding from said base surface toward the outside of the material on the opposite side with respect to the first ply.

4. Multi-ply paper material as claimed in claim 1, 2 or 3, **characterized in that** said first ply and said second ply are reciprocally joined in a tip-to-tip arrangement, said second ply being embossed.

5. Multi-ply paper material as claimed in one or more of the preceding claims, **characterized in that** said first ply has a third series of embossing protuberances protruding from the base surface of the first ply toward the inside of the material and toward the second ply, the embossing protuberances of said third series of protuberances of the first ply having substantially no glue.

6. Multi-ply paper material as claimed in one or more of the preceding claims, **characterized in that** at least some of said embossing protuberances of the second series of protuberances of the first ply have a linear extension, preferably having a longitudinal dimension at least five times and preferably at least ten times greater than a transverse dimension.

7. Multi-ply material as claimed in one or more of the preceding claims, **characterized in that** at least some of the embossing protuberances of said second series of protuberances are at least partly surrounded by lines of glue.

8. Multi-ply paper material as claimed in one or more of the preceding claims, **characterized by** presenting variable embossing areas, with different properties of absorbency, preferably obtained by variable heights of the protuberances of the second series.

9. Method for the production of a multi-ply paper material, comprising the steps of:

   a. embossing a first ply between a first embossing roller and a first pressure roller, said first embossing roller being provided with embossing protrusions extending toward the outside from a surface of the embossing roller, which penetrate an elastically yielding coating of the first pressure roller, generating a first series of embossing protuberances protruding from a base surface of said ply;
   b. applying glue to the protuberances of said first series of protuberances;
   c. gluing a second ply to said first ply;

   characterized by generating on said first ply, by said first embossing roller and said first pressure roller, a second series of embossing protuberances protruding from an opposite side of said base surface with respect to said first series of protuberances, said second series of embossing protuberances being generated by penetration of said elastically yielding coating of the first pressure roller inside recesses

extending toward the inside of said surface of the first embossing roller.

10. Method as claimed in claim 9, **characterized by** embossing said second ply before mutually gluing said first and said second ply, forming at least some embossing protuberances facing said first ply, preferably at least partly nested between embossing protuberances of the first series of protuberances of said first ply.

11. Method as claimed in claim 9 or 10, **characterized by** joining said first ply to said second ply in a tip-to-tip arrangement.

12. Method as claimed in claim 9, 10 o 11, **characterized in that** said embossing protuberances of the second series of protuberances have a linear extension, preferably with a longitudinal dimension at least five times and more preferably at least ten times the transverse dimension.

13. Method as claimed in one or more of claims 9 to 12, **characterized by** embossing at least said first ply with variable embossing depths, to obtain variable properties of absorbency along the extension of the paper material.

14. An embossing unit comprising:

- a first embossing roller equipped with a series of embossing protrusions, extending from a base surface of the embossing roller toward the outside and a series of embossing recesses extending from the base surface toward the inside of the embossing roller;
- a first pressure roller defining with said first embossing roller a first embossing nip and provided with an elastically yielding coating;
- a first path for a first paper ply, extending through said first embossing nip;
- a second path for a second paper ply;
- a glue applicator, cooperating with said first embossing roller and disposed downstream of said first embossing nip;
- a system to join said second ply to said first ply by glue applied by said applicator to embossing protuberances generated on said first ply by said first series of embossing protrusions.

15. Embossing unit as claimed in claim 14, wherein: along said second path there are disposed a second embossing roller and a second pressure roller, defining a second nip through which said second ply is fed and in which said second ply is embossed; said second embossing roller comprises embossing protrusions extending from a base surface of said second embossing roller toward the outside and embossing recesses extending from said base surface toward the inside of the embossing roller and said second pressure roller comprises an elastic coating cooperating with said protrusions and recesses of the embossing roller; preferably said embossing protrusions of the second embossing roller have at least two different heights; and preferably said embossing protrusions of the first embossing roller have at least two different heights.

Fig. 1

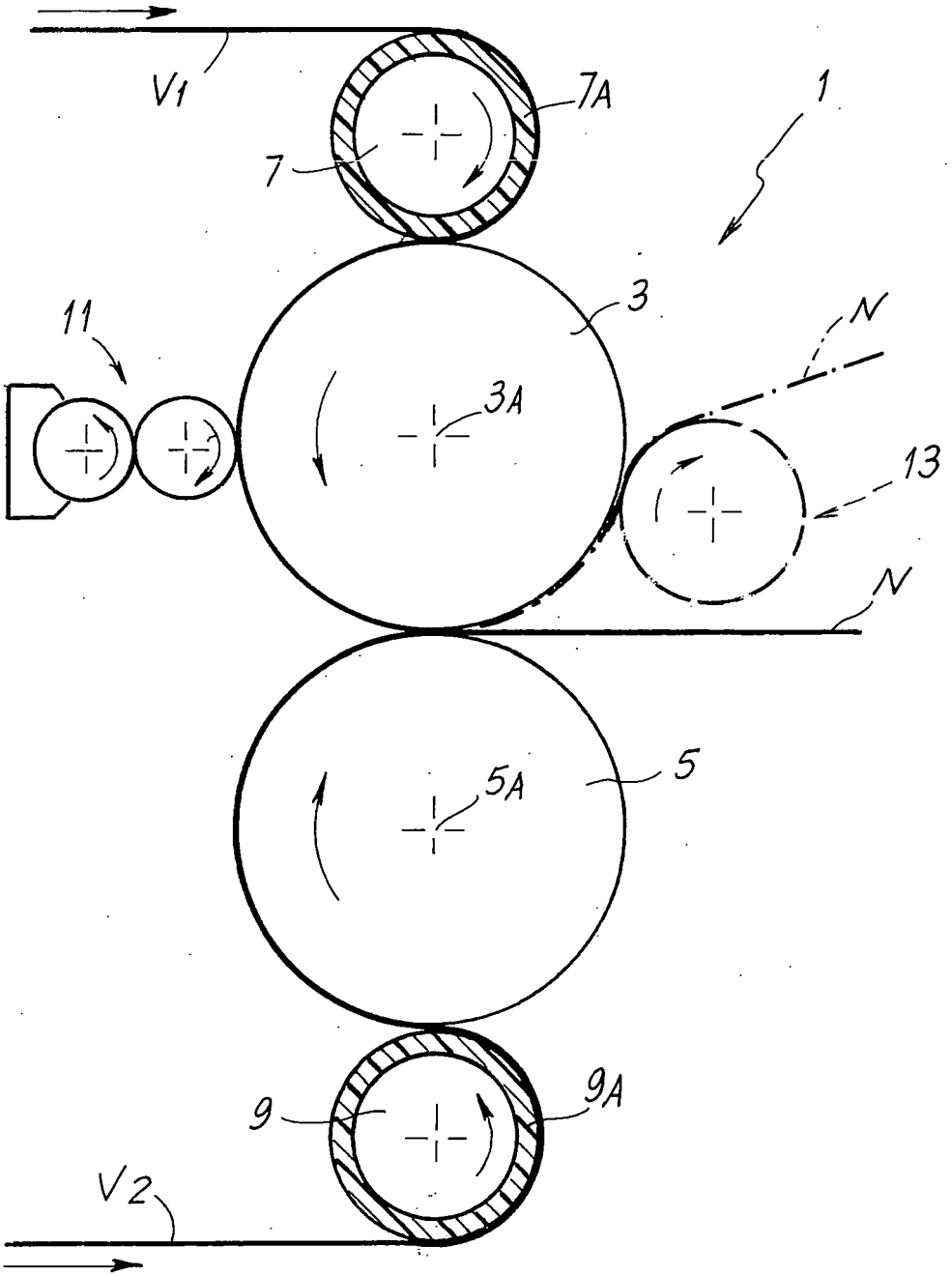


Fig. 2

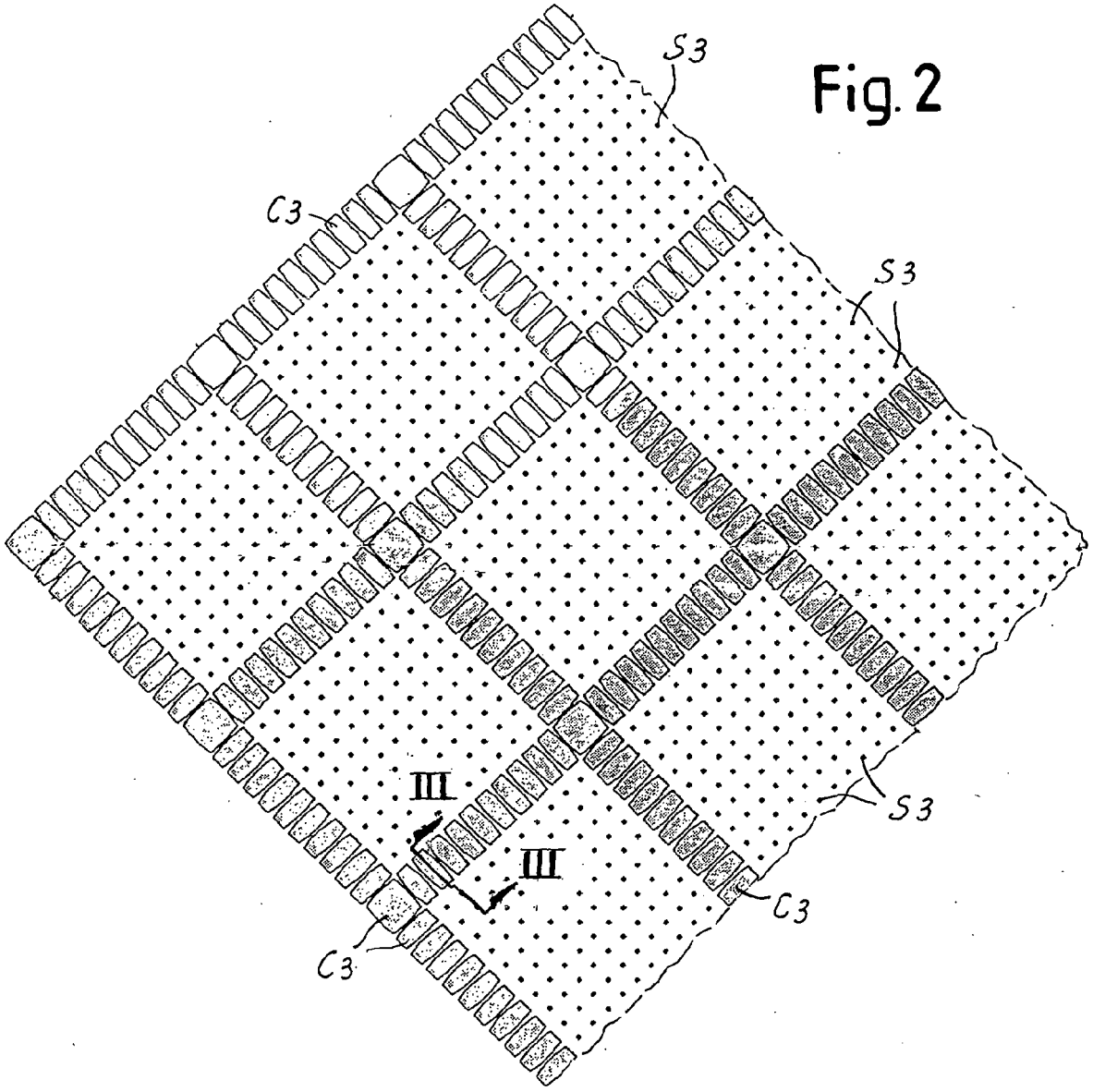
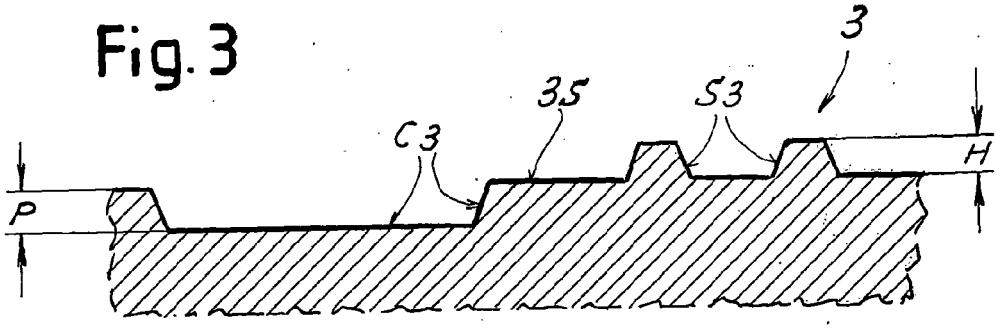


Fig. 3



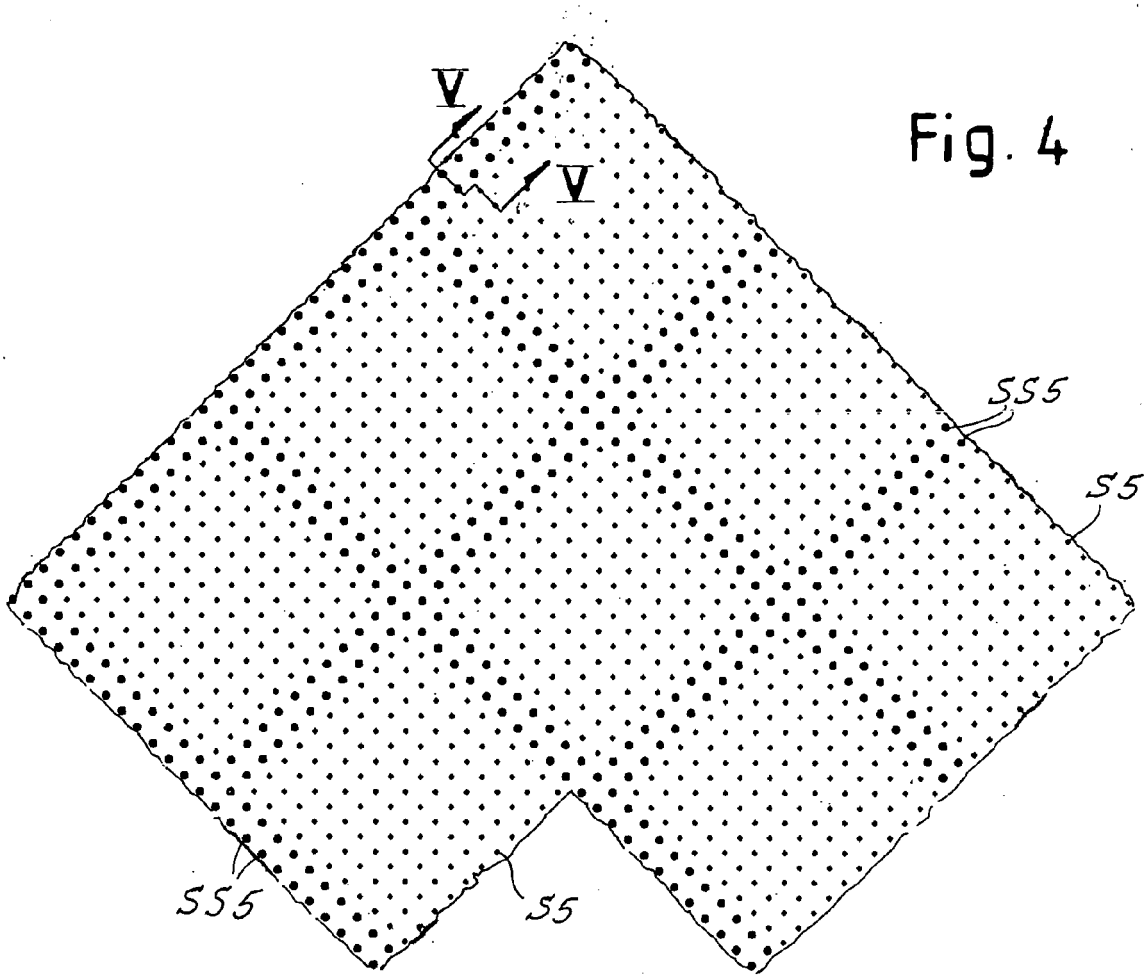


Fig. 4

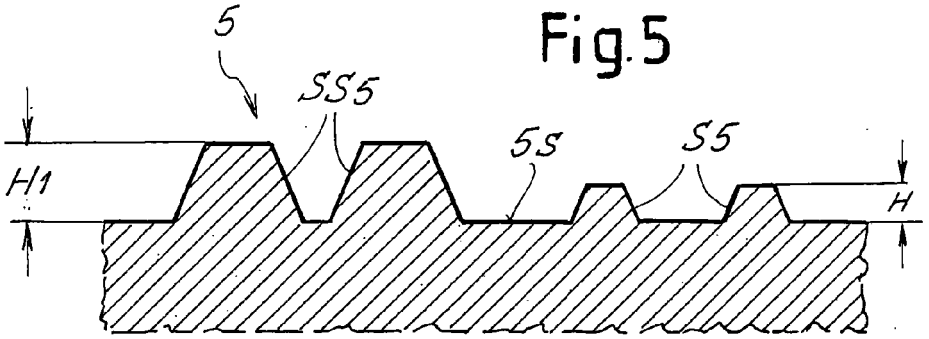


Fig. 5

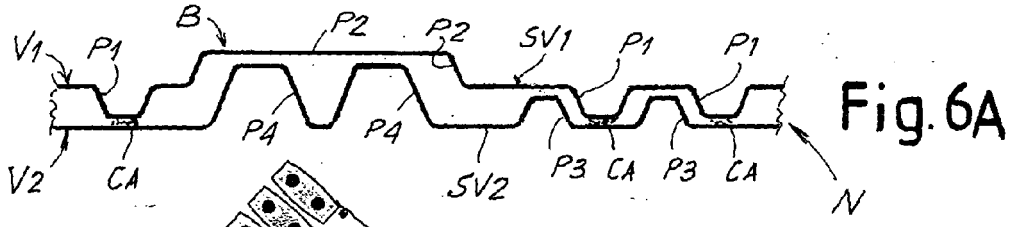


Fig. 6A

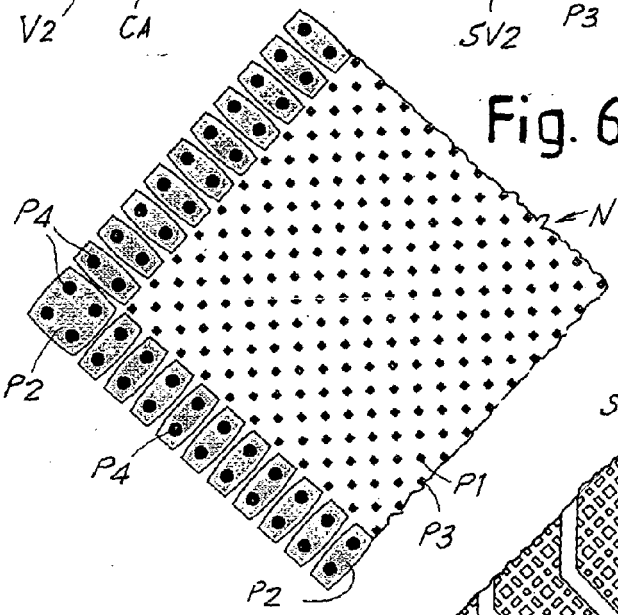


Fig. 6B

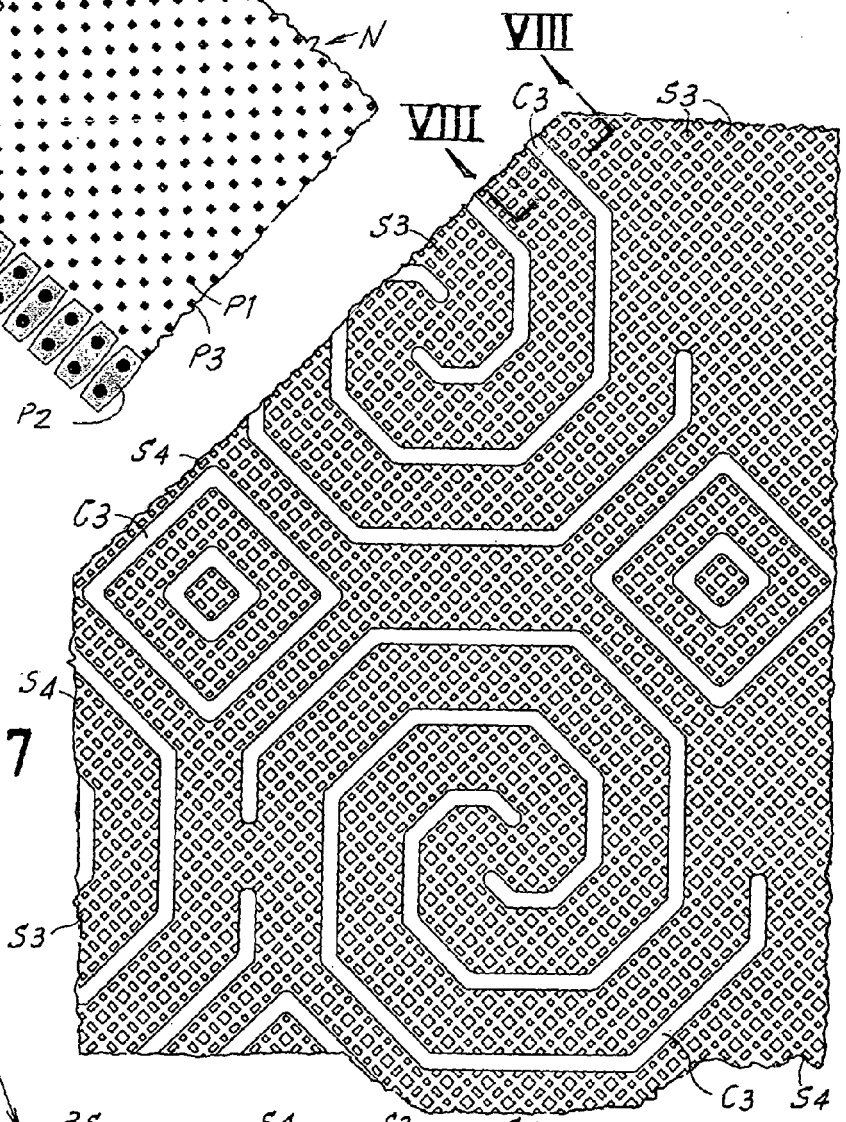
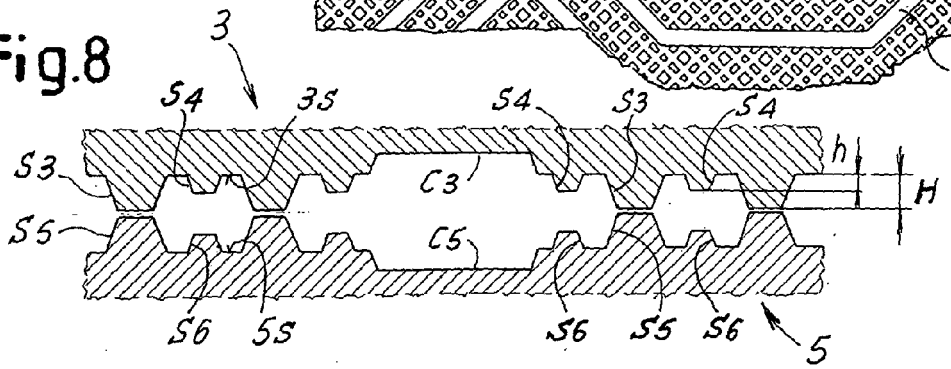


Fig. 7

Fig.8



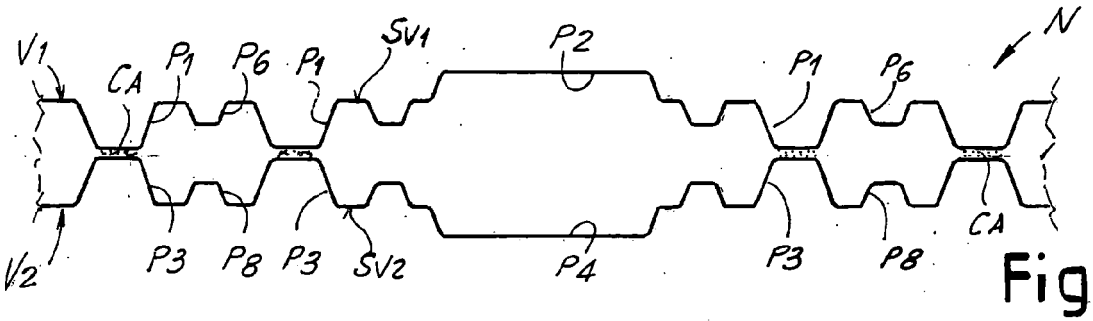


Fig.9

Fig.10

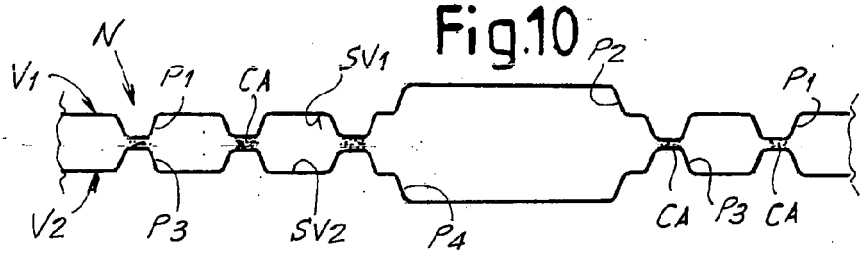


Fig.11

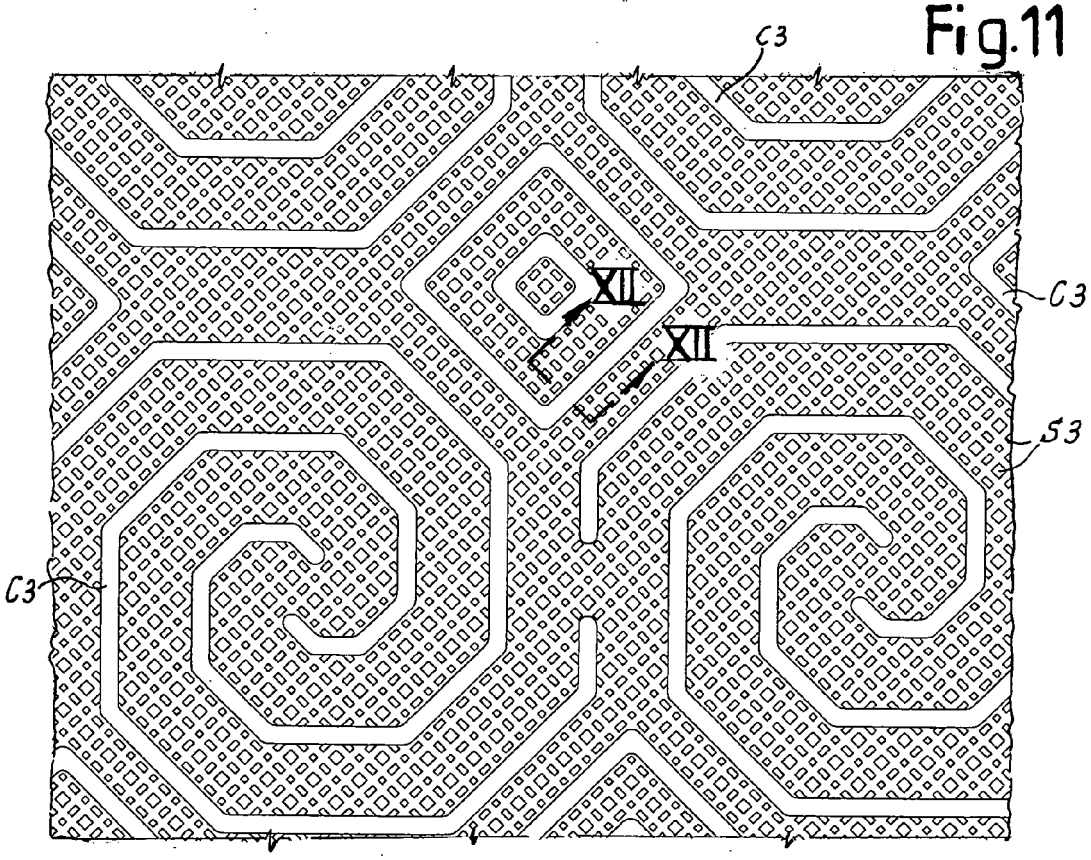


Fig.12

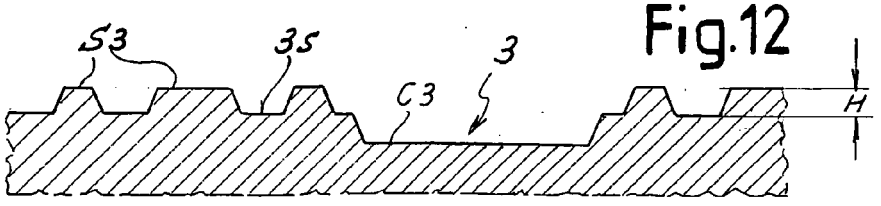
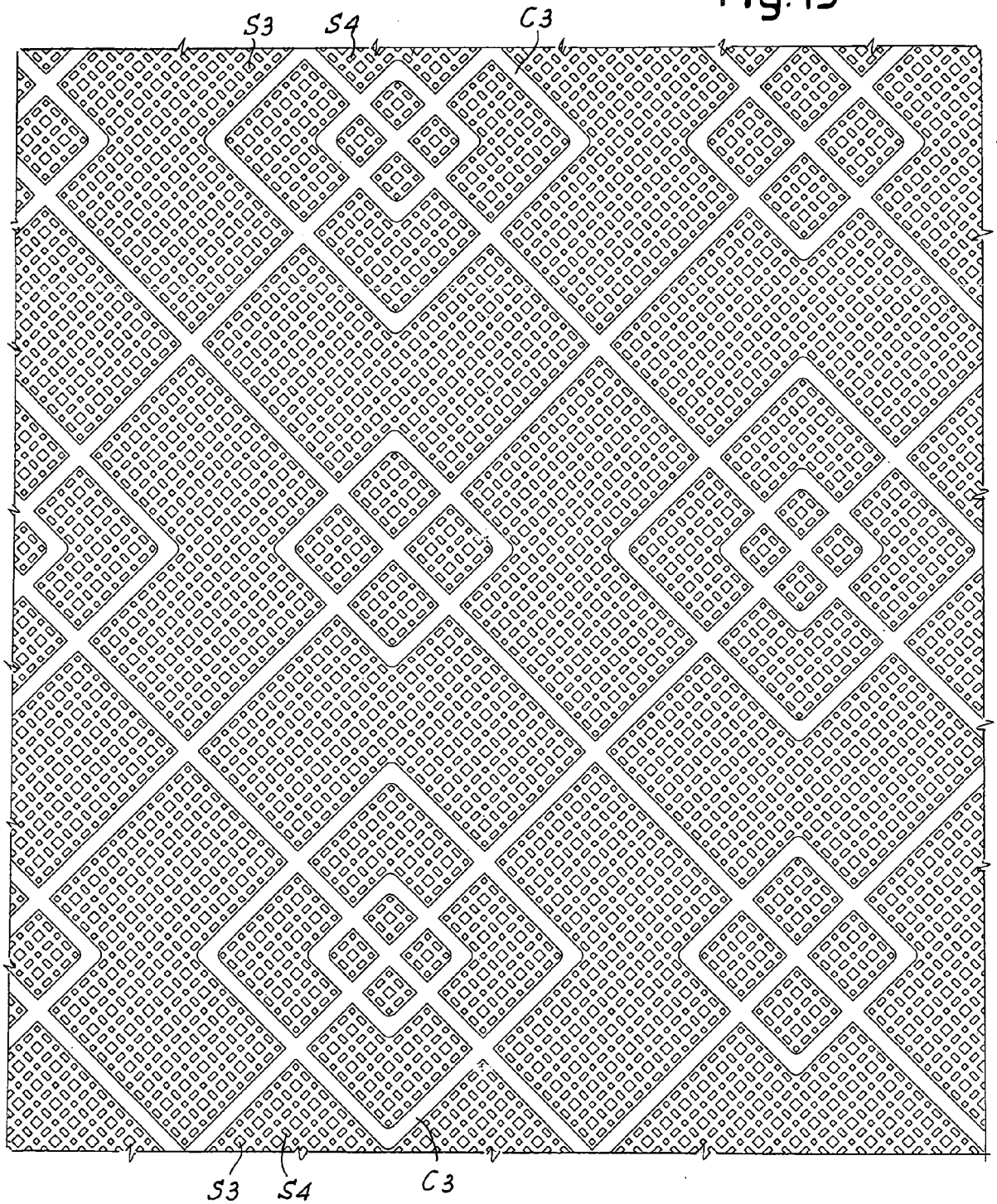


Fig.13



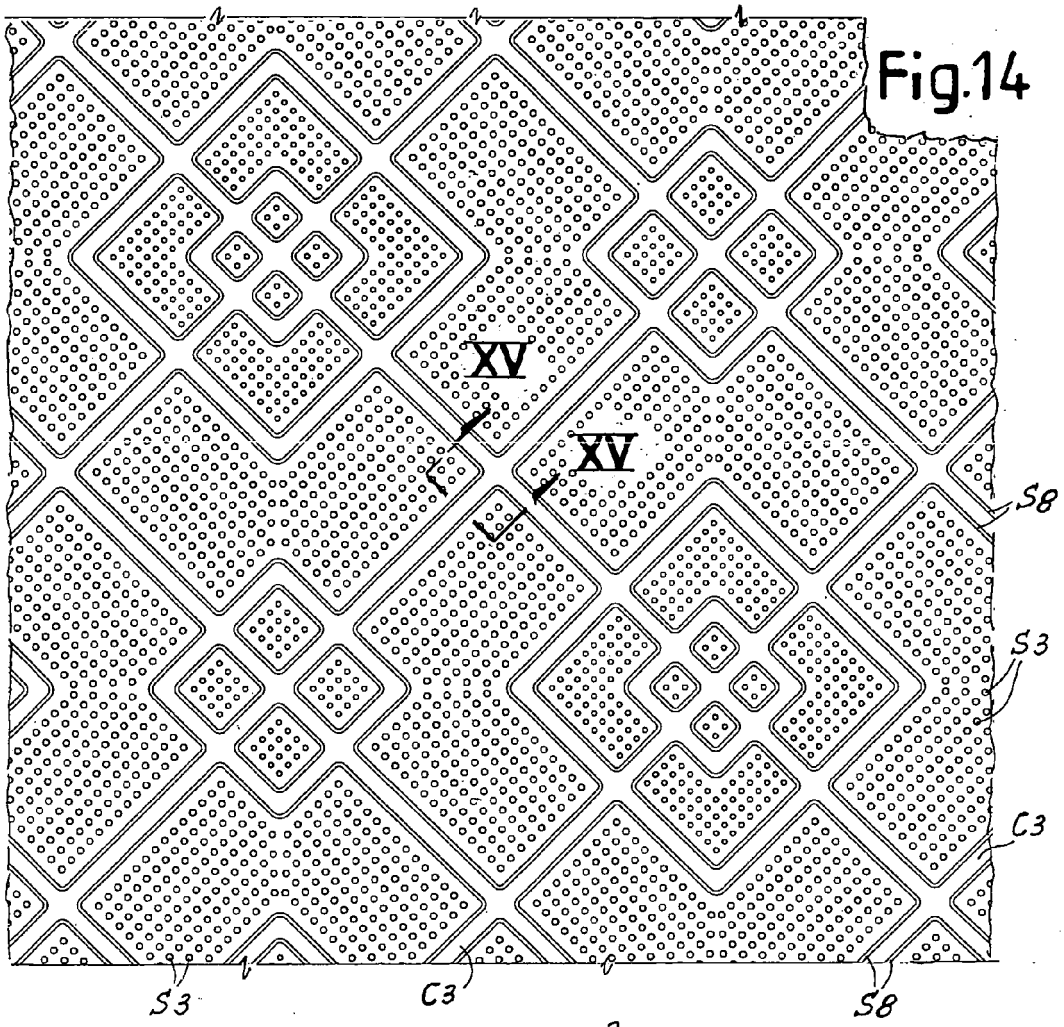


Fig.14

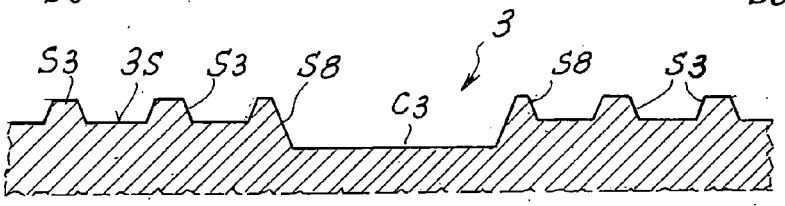


Fig.15

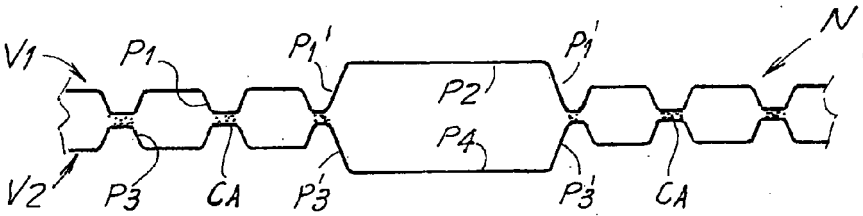


Fig.15A

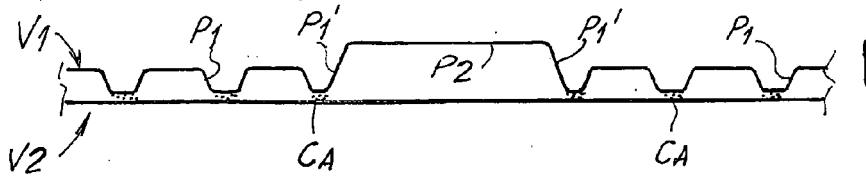


Fig.15B

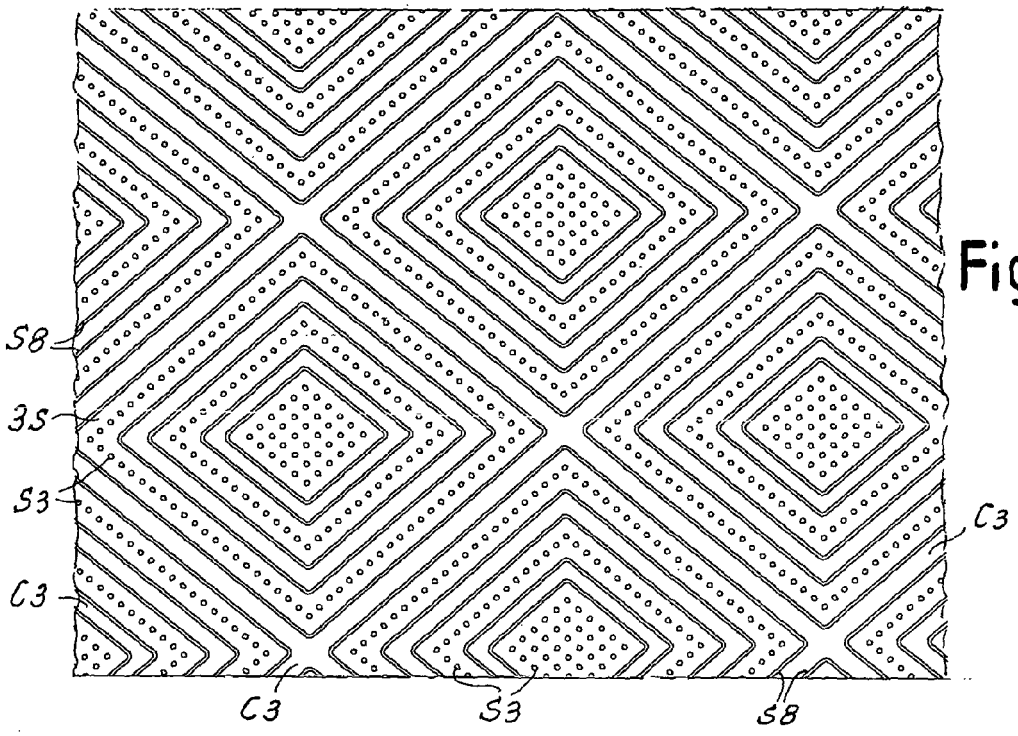


Fig.16

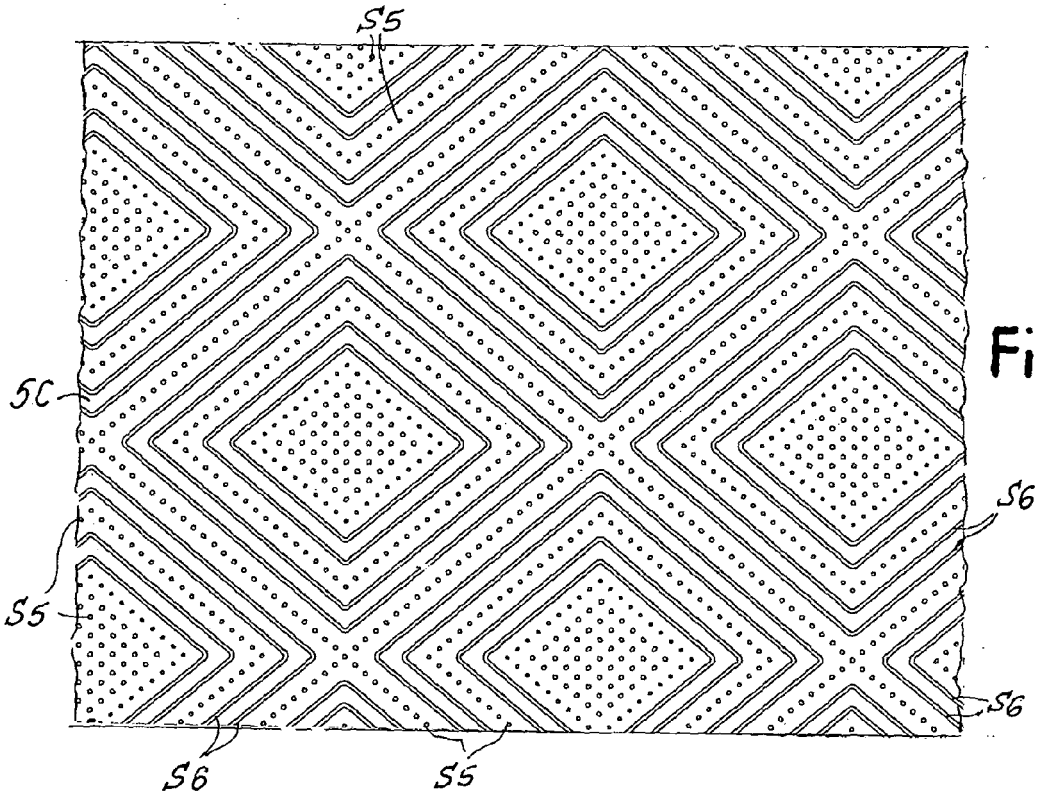


Fig.17

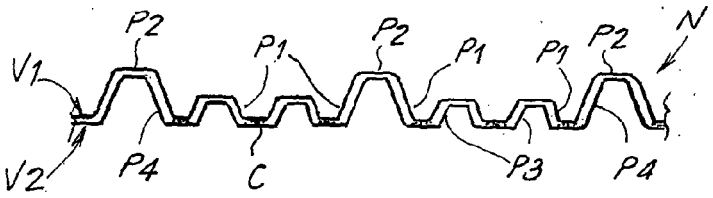


Fig.18

Fig.18A

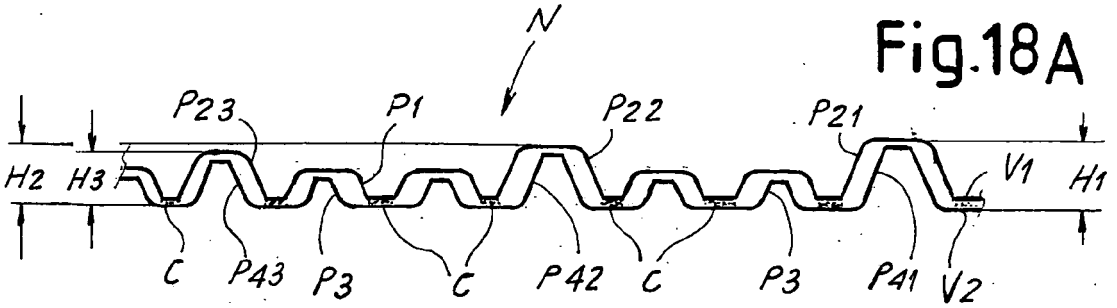


Fig.18B

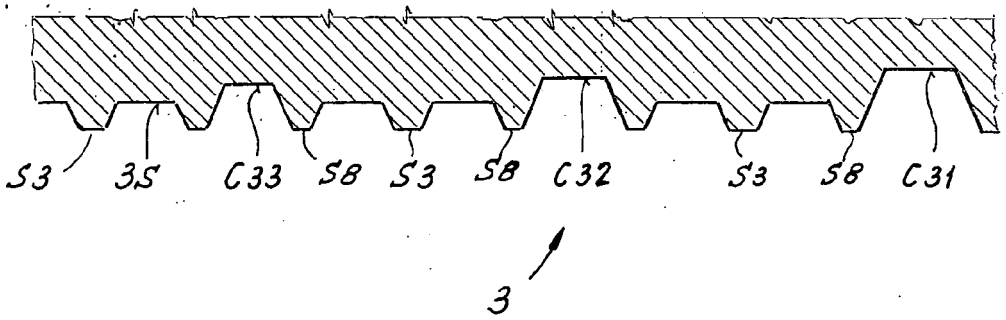
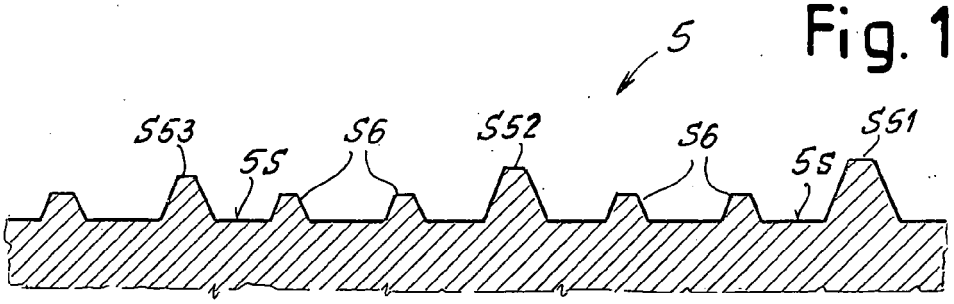


Fig.18C



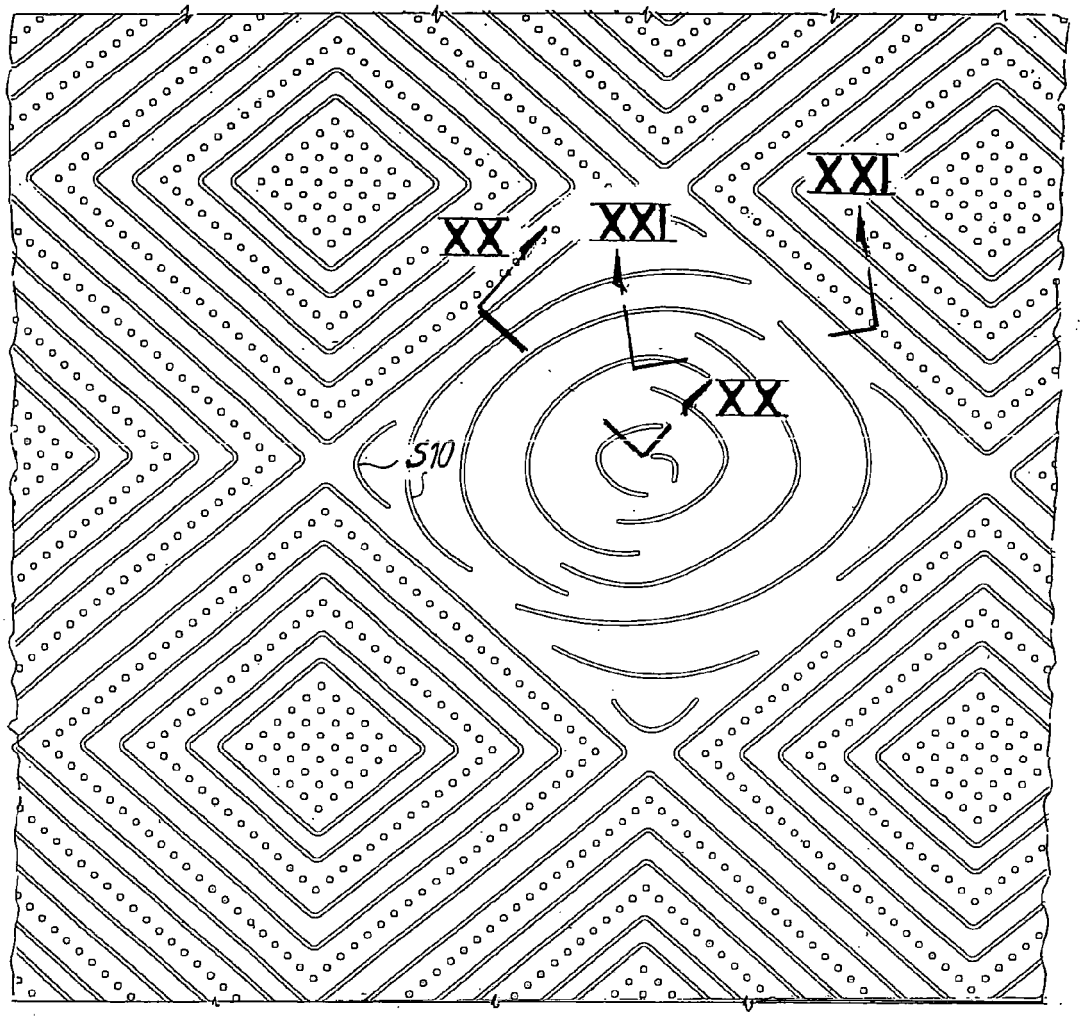


Fig. 19

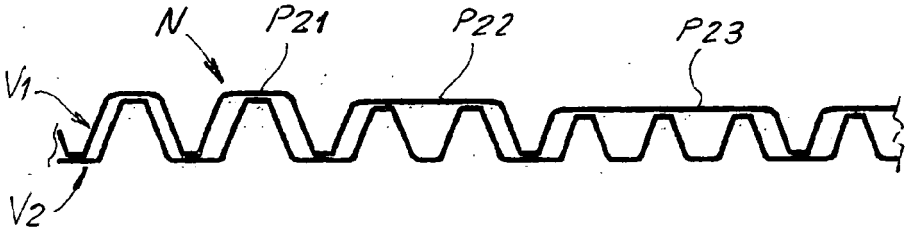


Fig. 20

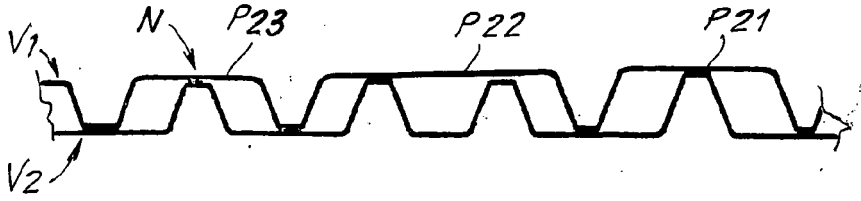


Fig. 21

REFERENCES CITED IN THE DESCRIPTION

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