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(54) **CALENDER FOR EMBOSSING AND
COMPACTING A TEXTILE WEB**

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ABSTRACT

An apparatus for embossing and compacting a textile web has a calender with a body having a surface. An array of embossing formations project from the body surface and each have an outer face directed away from the body surface and formed as a narrow strip pressable into the web.

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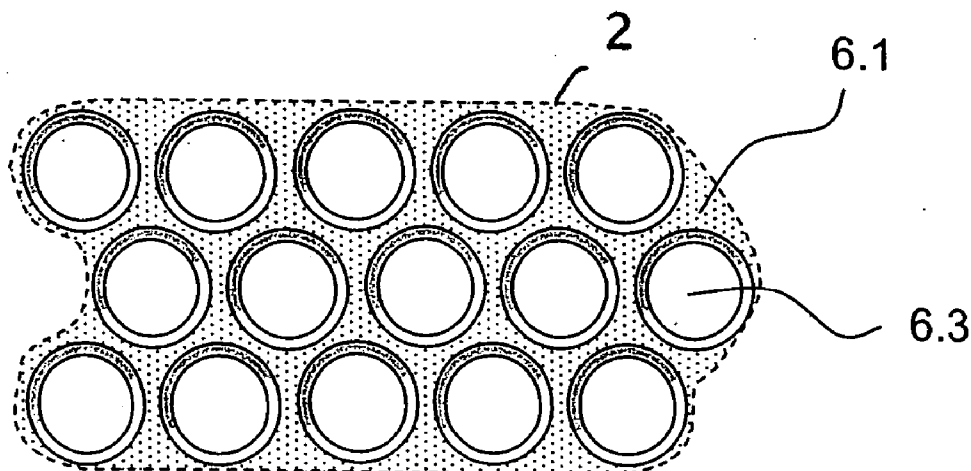


Fig.1

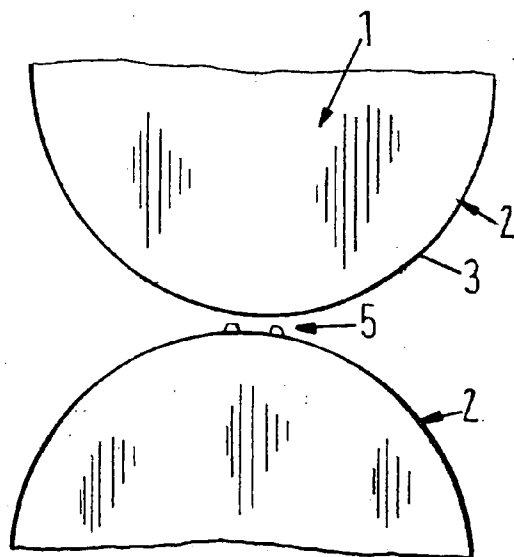


Fig.2A

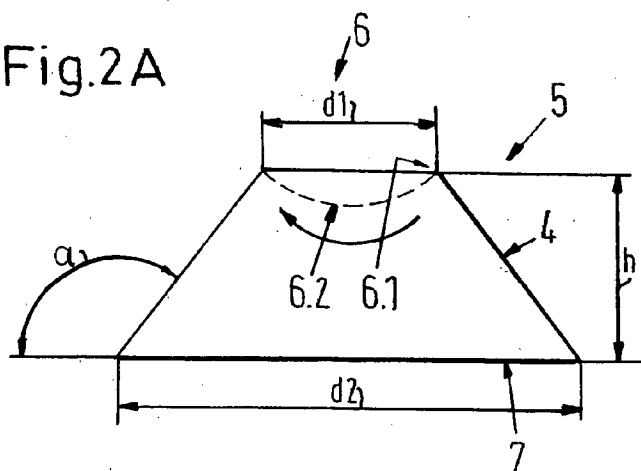


Fig.2B

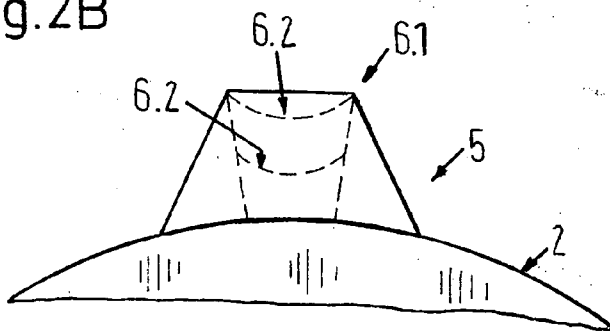


Fig.3

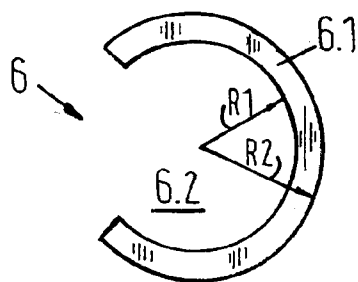


Fig.4

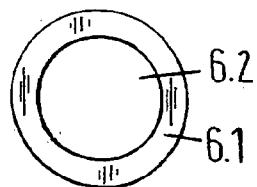


Fig.5

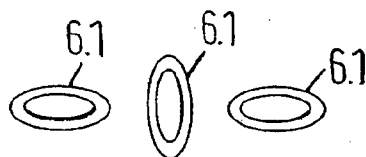


Fig.6

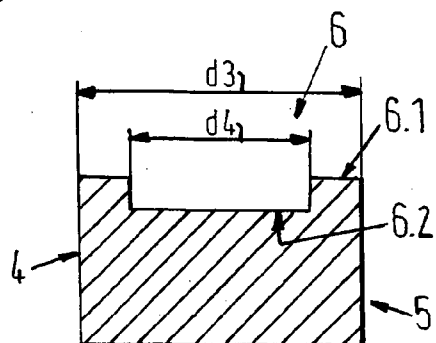


Fig. 7

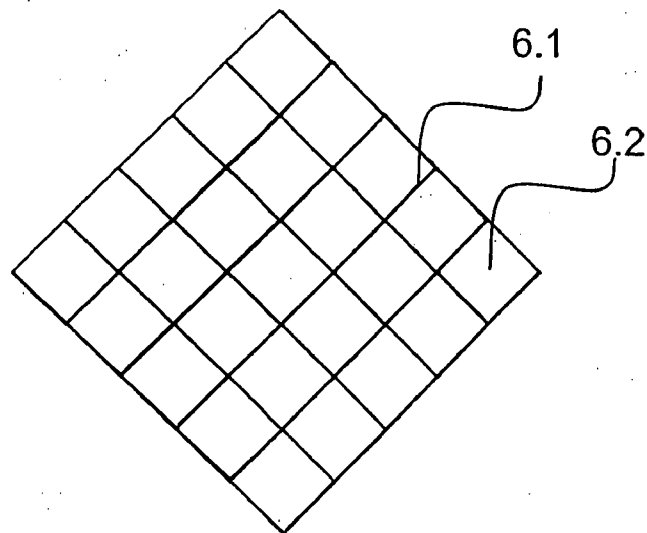


Fig. 8

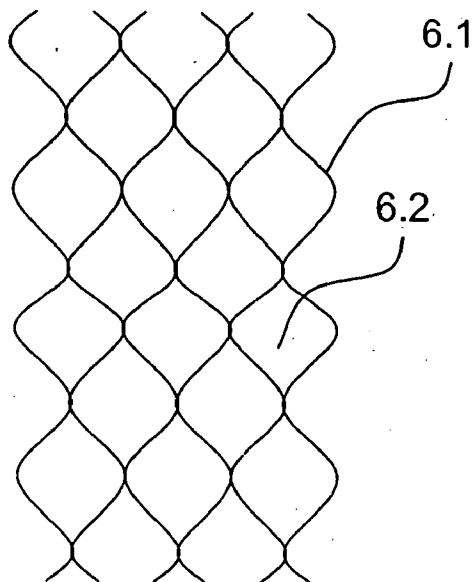


Fig. 9

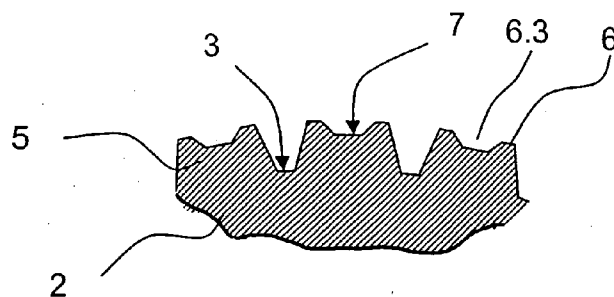


Fig. 10

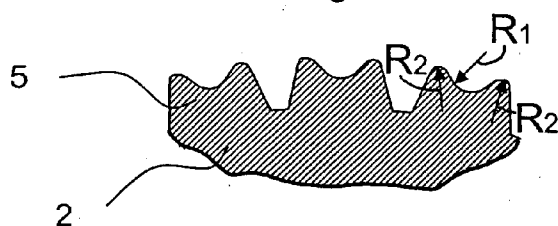


Fig. 11

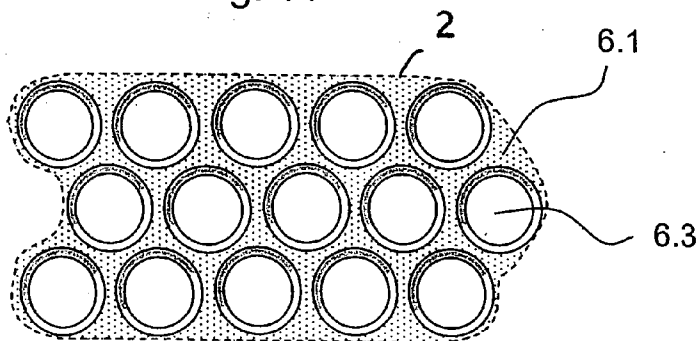


Fig. 12

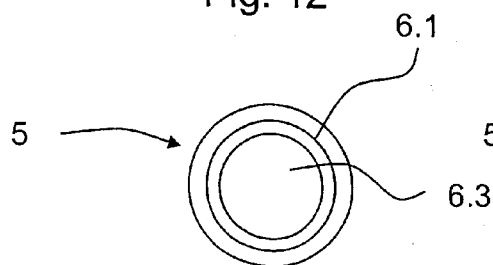
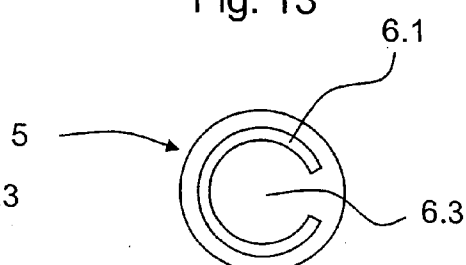


Fig. 13



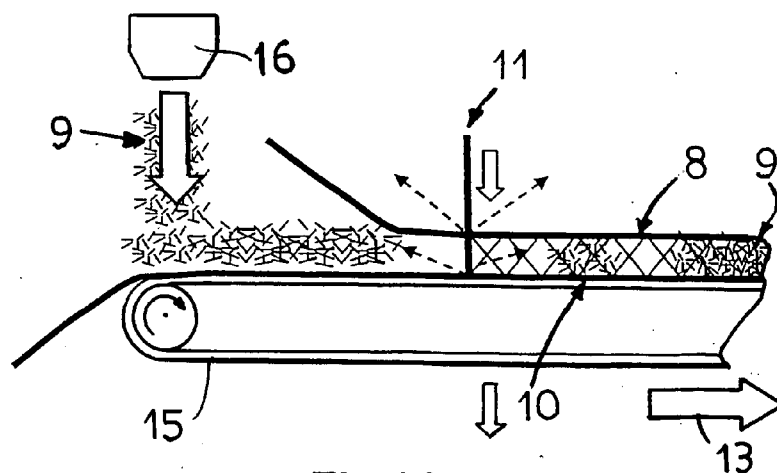


Fig. 14 PRIOR ART

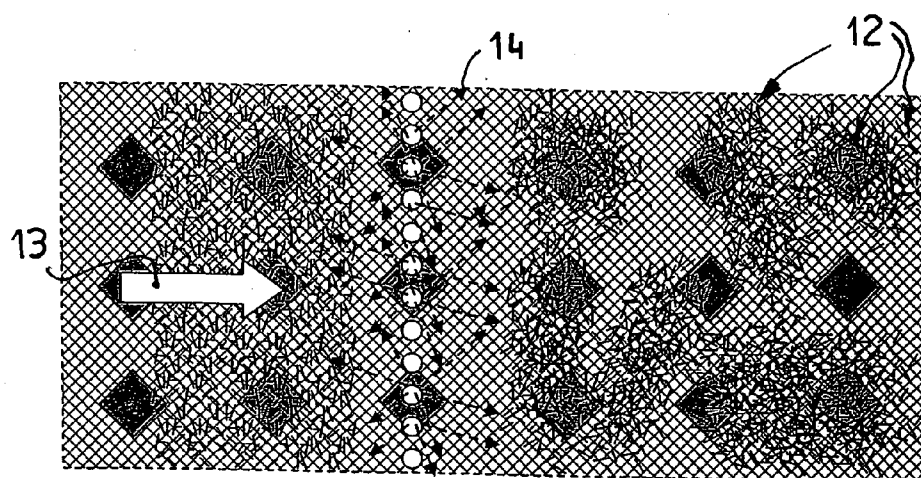


Fig. 15 PRIOR ART

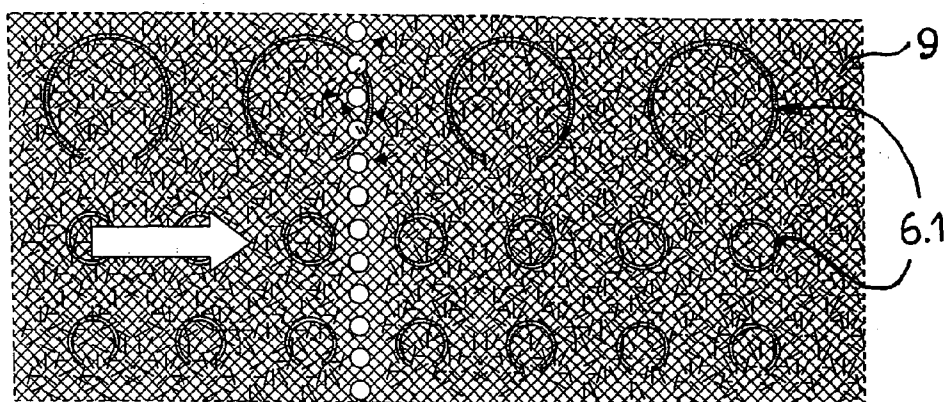


Fig. 16

CALENDER FOR EMBOSSEING AND COMPACTING A TEXTILE WEB

FIELD OF THE INVENTION

[0001] The present invention relates to a calender. More particularly this invention concerns such a calender roll for embossing and compacting a textile web.

BRIEF DESCRIPTION OF THE DRAWING

[0002] In the drawing:

[0003] FIG. 1 is largely diagrammatic end view of a calender assembly according to the invention;

[0004] FIGS. 2a and 2B are detail views illustrating bumps in accordance with the invention;

[0005] FIGS. 3, 4, and 5 are top views of further calender bumps according to the invention;

[0006] FIG. 6 is a section through another calender bump according to the invention;

[0007] FIGS. 7 and 8 are small scale top views of calender formations in accordance with the invention;

[0008] FIGS. 9 and 10 are sections illustrating calender bumps according to the invention;

[0009] FIG. 11 is a top view of a portion of a calender roll with bumps according to the invention;

[0010] FIGS. 12 and 13 are top views of bumps according to FIGS. 4 and 3, respectively;

[0011] FIG. 14 is a schematic side view illustrating the manufacture of a prior-art three-layer textile web;

[0012] FIG. 15 is a top view of the prior-art web of FIG. 14; and

[0013] FIG. 16 is a view like FIG. 15 of the web according to the invention.

BACKGROUND OF THE INVENTION

[0014] A standard calender roll or calender belt for embossing and/or compacting textiles, nonwoven fabrics, in particular spun-bonded fabrics and/or paper materials, has an outer surface provided with bumps, elevations, or flat embossing formations that project outward from the surface of the calender roll or belt. At least a portion of the surfaces of the bumps or of the embossing formations are pressed during embossing/compaction into the web being treated.

[0015] Such a roll for compacting a nonwoven textile web by means of heat and/or solvents is known from German utility model 83 20 960. It has ribs on its outer surface bumps or ribs that project outward. The bumps have inclined flanks and expand toward their bases. The flanks of the bumps have two portions with different flank angles. A portion closer to the outer end has a more acute angle to a centerline than the portion closer to the base. The aim of the broader bases of the bumps is to enable good heat transfer to the flat upper ends of the bumps, thereby allowing the rolls to be used over a long period of time. The end faces of the bumps are rectangular. The outer faces are flat and continuous. One disadvantage is caused by the punctiform and planar, i.e. completely flat, design of the bumps, so that

during water-jet needling the fibers or pulp is completely washed off in the region compacted by the end faces.

[0016] It is also generally known to use calender rolls for calendering or compacting textiles, nonwoven fabrics, and in particular spun-bonded fabrics. The known calender rolls are provided with bumps for this purpose. However, these are not adequate for compacting all the fibers, in particular short fibers on the surface of the textiles, so that no fibers project from the surface of the nonwoven fabric and the pilling effect is avoided.

[0017] As shown in FIGS. 14 and 15, in a standard prior-art process a lower web 10 is advanced in a travel direction 13, a mass of fibers 9 are deposited on it, and an upper web 8 is laid atop the fibers 9. Presuming that the three-layer assembly is then calendered together with the system such as shown in the above-cited German utility model that presses an array of small flat areas into the laminate, the subsequent water-jet needling as done at 11 will wash out the filaments in the embossed areas and cause them to bunch up therebetween as shown at 12. Obviously this is an inferior product since some areas will have no fibers 9 and others will have too many fibers 9.

OBJECTS OF THE INVENTION

[0018] It is therefore an object of the present invention to provide an improved calender for embossing and compacting a textile web.

[0019] Another object is the provision of such an improved calender for embossing and compacting a textile web that overcomes the above-given disadvantages, in particular that eliminates these disadvantages and, among other things, produces a two-layer nonwoven fabric containing pulp or fibers and a spun-bonded fabric as the outer layer, or a three-layer nonwoven fabric containing pulp as intermediate layer and a spun-bonded fabric as outer layers, where the pulp is not washed away at the embossed locations during water-jet bonding, so that fiber-free spots are no longer formed at these location which, as has been the case heretofore, give the surface of the nonwoven fabric an irregularly patterned appearance

[0020] Another object of the invention is to design the calender roll for embossing and/or compacting textiles, nonwoven fabrics, in particular spun-bonded fabrics, in such a way that when such calendered textiles or spun-bonded fabrics are used, no fibers or loose filaments project from the surface of the textiles. The fibers are no longer washed away during water jet bonding, so that no fibers-free points or faces are formed which, as has been the case heretofore, gives the surface of the nonwoven fabric an irregularly patterned appearance. In addition to these visual characteristics according to the invention, the use characteristics are also significantly improved due to a more uniform absorption rate.

SUMMARY OF THE INVENTION

[0021] In an apparatus for embossing and compacting a textile web, a calender has according to the invention a body having a surface, and an array of embossing formations projecting from the body surface and each having an outer face directed away from the body surface and formed as a narrow strip pressable into the web.

[0022] With the apparatus using the calender of this invention no loose fibers or filaments appear on the surface of the nonwoven fabric. In addition, such a strip-shaped outer face is simple and economical to manufacture, while the very good heat transport through the embossing formations according to the invention to their outer faces is maintained due to the advantageous shape.

[0023] To this end, it is advantageous for the outer faces of the formations to be smaller than the remaining outwardly directed portions of the bump, or of depressions provided in the outer faces. A low-wear embossing formation is obtained as a result of this design. Use of central depressions ensures that no loose fibers or filaments appear on the surface of the nonwoven fabric, even in the region where the formations engage and emboss the web.

[0024] The water-jet bonding is advantageously performed before calendering, since calendering is not meaningful after the water jet bonding due to the fact that the fusible fibers acts as a separating layer between the two layers.

[0025] For this purpose it is advantageous when the distance between the outer end face and the surface of the calender roll is greater than the remaining portion of the outwardly directed face of the depression in the embossing formation. Such a depression is very easily manufactured.

[0026] It is also advantageous for the depression in the embossing formation to be designed in the shape of an internal cavity whose surface tapers into the embossing ridge or gradually merges into the surface of the embossing ridge, that is part-spherical. The rounded edges formed at this location ensure that the nonwoven fabric is not subjected to intense stress during processing.

[0027] In a further embodiment of the invention, it is advantageous for the outwardly directed surface of the indentation or cavity in the embossing formation to be recessed with respect to the outer end face of the embossing formation, in the direction of the surface of the calender roll or the calender belt. This also prevents material accumulation from occurring at certain locations on the nonwoven fabric.

[0028] It is also advantageous for the bumps to have outwardly tapered lateral surfaces running at right angles or in an inclined manner with respect to a surface of the calender roll, and at least one outer, outwardly directed closed outer end face that encloses the indentation. The closed outer end face may form a closed circle or any given shape, so that after the calendering no loose fibers or filaments appear on the surface.

[0029] In a further embodiment of the invention, it is advantageous for the bumps to be composed of a truncated pyramidal body that is provided with a round, oval, or polygonal base and/or the outer outwardly directed round, oval, or polygonal surface in which the indentation is provided, the indentation being enclosed by the embossing ridge that may have lateral openings or passages at one or more locations so that the fibers cannot be rinsed away to the side in large quantities, but instead are rinsed to the side only in the region of the outer end face, i.e. the strips in the embossing formations, in particular in the center of the embossing formations. As a result, large fiber-free regions are no longer formed in the nonwoven fabric.

[0030] Thus, during calendering of the nonwoven fabric a satisfactory bonding of the fibers, i.e. the short filaments, to the upper and lower nonwoven fabric is achieved in a simple and more economical manner. Since the embossing formations or lines as viewed from above have an annular design, or a circular or similar cross-sectional shape, during water needling there is no displacement of the fibers in the region of the embossing formations; i.e. the fibers are not horizontally dislocated or laterally shifted, particularly since during needling of the nonwoven fabric the water jet can also penetrate through the calendered locations, since these locations on account of their annular design are provided with an opening through which the water jet can enter, impinge on the fibers, and stitch-bond same to the upper and/or lower layer.

[0031] According to another illustrated embodiment, it is advantageous that the calender roll or calender belt for the apparatus for embossing and/or compacting textiles, nonwoven fabrics, in particular spun-bonded fabrics and/or paper materials, has bumps or flat embossing formations on its surface that are outwardly oriented or upright relative to the surface of the calender roll, at least a portion of the surface of the bumps, i.e. calender elevations, being designed as a outer end face, and that the outer end face is a narrow, oblong, linearly extending embossing ridge that is positioned in such a way that, at least together with an adjacent or adjoining embossing ridge, it completely or at least partially encloses a recessed face that is formed by the surface of the calender roll or calender belt, or by an indentation provided in the bump. Such a embossing ridge prevents the described washing away of the fibers in a particularly advantageous manner.

[0032] According to one refinement of the invention, another possibility is that the outer end face of the embossing ridge extends on a line that as viewed from above forms a circle, rectangle, oval, or a polygonal, undulating, or meandering shape, or a flat pattern. In this manner, in a very small region of the nonwoven fabric outer end faces are produced; i.e., compaction of the nonwoven fabrics is achieved. In this case the base is identical to the surface of the calender roll.

[0033] It is also advantageous when the embossing ridge is composed of upright or band-shaped bodies on the surface of the calender roll or calender belt, which viewed from above form a straight and/or a nonstraight line. Various embossings are thus obtained in the nonwoven fabric in a simple manner. Although this hardly has a measurable influence on the washing-away effect, it provides an important possibility for designing a more attractive appearance and for imparting various products with an individual character.

[0034] It is of particular importance for the present invention that the bumps include the surface that contains the flat, outwardly directed indentation whose face is approximately parallel to the base of the bump or the surface of the calender roll.

[0035] For this purpose it is advantageous when the base of the bump is slightly larger than the outwardly directed face thereof. The uniformity of the fibers as well as the visual character of the product may be modified by means of the ratio of these two faces.

[0036] According to one refinement of the invention, a preferred possibility is for the base of the bump to be between 1.2 and 3 times larger than the outwardly directed face thereof.

[0037] It is also advantageous when the distance between centers of two adjacent bumps is 2 to 5 times larger than the average diameter of the body of the bump.

[0038] It is also advantageous when the lateral surface of the bump, which is tapered or inclined or also straight, forms an angle with the base that is between 0° and 60°, in particular between 15° and 45°.

[0039] Last, according to one preferred embodiment of the approach according to the invention a two-layer nonwoven fabric containing fibers and a spun-bonded fabric is laid on a deposition belt as an outer layer, or a three-layer nonwoven fabric containing fibers as intermediate layer and a spun-bonded fabric as each outer layer, is calendered after bonding by means of a water jet and/or after a drying process by use of the calender rolls having the bump according to the invention.

[0040] It is of particular importance for the present invention that the bumps are provided on the surface of the calender rolls in such a way that the bonding is performed in a pattern that is round, oval, diamond-shaped, polygonal, linear, and/or having broken lines, or in the shape of a pattern or surface pattern.

SPECIFIC DESCRIPTION

[0041] As seen in FIG. 1 a calender apparatus 1 for embossing and/or compacting textiles, nonwoven fabrics, in particular spun-bonded fabrics and/or paper materials, comprises a two spacedly adjacent calender rolls 2 that may be positioned by hand. Numerous uniformly spaced embossing formations, referred to below as bumps 5, are provided on a surface 3 of the calender roll 2.

[0042] According to FIG. 2, the bumps or elevations, i.e. embossing formations, 5 may each comprise a truncated pyramid whose base 7 has a diameter d2 that is approximately twice as large as an outer diameter d1 of a surface 6 having an outer end face 6.1. The sloping side surface 4 of the bump 5 forms an angle α with the base that may be between 0° and 140°. The angle α is preferably between 90° and 130°.

[0043] According to FIGS. 2a, 2b, and 3 through 6, each bump 5 or its outwardly directed face 6, may also be provided with an internal depression or cavity 6.2, thereby forming the annular embossing ridge 6.1. According to FIGS. 2a, 2b, and 6 the recessed center surface 6.2 may have different depths, and according to FIG. 6 may be modified so that a circular cylindrical body is produced.

[0044] The embossing ridge 6.1 is illustrated in FIGS. 2 through 6 with reference to various examples. According to FIGS. 3 and 13, the embossing ridge 6.1 may also be open on one side, giving it a C-shape rather than the O-shape of FIGS. 4 and 12. The embossing ridge may also be designed strictly as a straight or undulating line that may be broken at several locations.

[0045] The flat surface 6 of each bump 5 extends approximately parallel to the base 7 of the bump 5.

[0046] According to the invention the base 7 of the bump 5 may be between 1.2 and 3 times larger than the outwardly directed face 6 thereof.

[0047] In addition, the distance between centers of two adjacent bumps 5 may be 2 to 5 times larger than the average diameter of the body of the bump.

[0048] As previously mentioned, according to a further illustrated embodiment corresponding to FIG. 6 the body of the bump may also have the vertically extending surface 4, resulting in a cylindrical shape.

[0049] A diameter d3 of the bump 5 is only slightly larger than a diameter d4 of the recessed surface 6.2, so that a relatively narrow embossing ridge 6.1 is formed. The width of the embossing ridge 6.1 is between 0.3 and 0.8 mm. A height h of the bump 5 may be between 0.01 and 3 mm.

[0050] The two- or three-layer composite material is made by laying as described with respect to the prior art and shown in FIG. 14 a lower layer 10 on a deposition belt 15 and a hopper 16 or the like for loading fibers 9 onto the lower outer layer 10. After calendering, drying, and optional application of a top outer layer 8 the composite is subjected to water-jet needling 11.

[0051] In FIGS. 7 and 8 the outer end face 6.1 is a narrow, oblong, linearly extending embossing ridge that is positioned such that, at least together with an adjacent or adjoining embossing ridge 6.1, it completely or at least partially encloses a recessed face 6.2 that is formed by the outer surface of the calender roll 2 or calender belt, or by an indentation 6.3 provided in the bump 5. In FIG. 7 the embossing ridges form a rectangular shape, and in FIG. 8 form a slightly elongated parallelogrammatic shape.

[0052] The outer end face of the embossing ridge 6.1 extends on a line that as viewed from above according to FIGS. 7, 8, 12, and 13 forms a circle, rectangle, oval, or a polygonal, undulating, or meandering shape, or a flat pattern. Only a few embodiments are illustrated in the drawing. The embossing ridge 6.1 forms an upright or hand-shaped body on the surface of the calender roll 2 or calender belt, which in the view from above forms a straight (FIG. 7) or a non-straight (FIGS. 8, 11, 12) line.

[0053] According to FIGS. 7 through 10 and FIGS. 12 and 13, the bumps or elevations 5 include the surface 6 that contains the flat, outwardly directed indentation 6.2 that is approximately parallel to the base 7 of the bump 5 or the surface of the calender roll 2.

[0054] In FIG. 16 the embossing formations pressed into the composite web are illustrated in view from above, similar to that shown in FIGS. 1 through 2b and FIGS. 3 through 6, where some embossing formations are closed and some are open on the side. Use of the advantageous design of the embossing ridges 6.1 ensures that the fibers 9 is not washed away as in FIGS. 14 and 15 when the nonwoven fabric according to 14 is bonded by the water needling 11. According to FIG. 16 a uniformly distributed fibers intermediate layer 9 is obtained.

[0055] As previously mentioned, the distance between the center axis of two adjacent bumps 5 may be 2 to 5 times larger than the average diameter of the body of the bump. According to the examples in FIGS. 7, 8, and 11 through 13, the outer end face of the embossing ridge 6.1 extends on a

line that as viewed from above forms a circle, rectangle, oval, or a polygonal, undulating, or meandering shape, or a flat pattern.

[0056] In addition, the bump 6 may include the flat, outwardly directed surface 6 containing the indentation 6.3, whose face is approximately parallel to the base 7 of the bump 5 or the surface 3 of the calender roll 2.

I claim:

1. In an apparatus for embossing and compacting a textile web, a calender comprising:

a body having a surface; and

an array of embossing formations projecting from the body surface and each having an outer face directed away from the body surface and formed as a narrow strip pressable into the web.

2. The calender defined in claim 1 wherein the formations are substantially uniformly spaced over the body.

3. The calender defined in claim 2 wherein the body is a roller adapted to be rotated about a central axis, and the body surface is substantially cylindrical.

3. The calender defined in claim 1 wherein each formation has a base at the body surface that is wider than the respective outer face.

4. The calender defined in claim 3 wherein each base is between 1.2 and 3 times wider than the respective end face.

5. The calender defined in claim 1 wherein the outer faces are generally C- or O-shaped.

6. The calender defined in claim 5 wherein the outer faces are substantially circular.

7. The calender defined in claim 5 wherein the formations are frustoconical bumps.

8. The calender defined in claim 5 wherein the formations are cylindrical bumps.

9. The calender defined in claim 5 wherein the outer faces are oval.

10. The calender defined in claim 5 wherein each formation had a center recessed toward the body surface from the respective outer face.

11. The calender defined in claim 10 wherein the centers are generally part spherical.

13. The calender defined in claim 10 wherein the centers extend substantially parallel to the body surface and to the respective end faces.

14. The calender defined in claim 1 wherein the formations are bumps and are spaced apart on the body surface on center by a spacing equal to between 2 and 5 times a diameter of the end faces.

15. The calender defined in claim 1 wherein the formations project between 0.01 and 4 mm from the body surface.

16. The calender defined in claim 1 wherein the formations have side flanks inclined at an angle of between 15° and 45° to the body surface.

17. The calender defined in claim 1 wherein the formations are an array of ridges.

18. The calender defined in claim 1 wherein the ridges cross and define an array of recessed lands.

19. The calender defined in claim 1 wherein the apparatus further comprises

means for forming a two-layer fleece having at least one outer layer and a mass of fibers thereon; and

means for passing the fleece past the calender while pressing the formations into the fleece.

20. The calender defined in claim 19 wherein the apparatus further comprises:

means for water-jet needling the fleece upstream of the calender.

* * * * *