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(54) **A device and a process of producing a shaped non-woven matting**

(57) In a forming cylinder for the production of mats of thermoplastic non-woven filaments, shaped with reliefs, the elements protruding radially of the forming cylinder (1) are provided with steps or indentations (5) above at least part of their walls (9A, 9B) to hold the filaments (4) and to delay their descent along the walls to improve the uniformity of the filaments distribution in the mat.

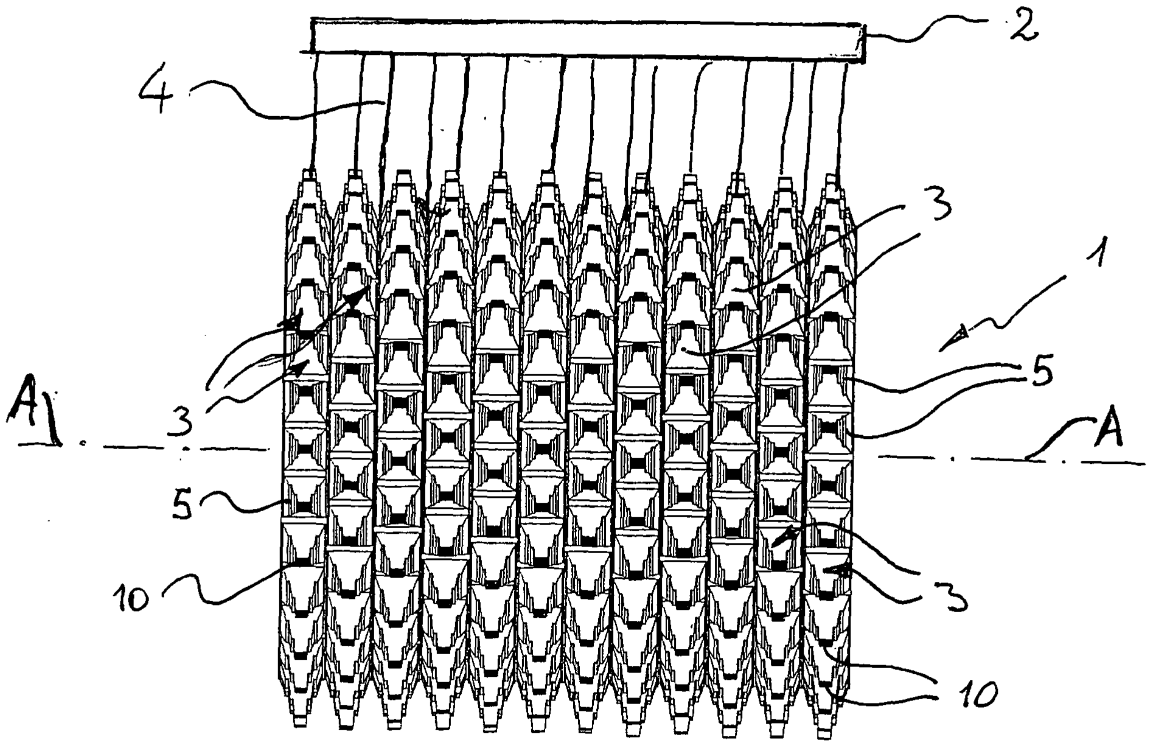

Fig. 1

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Description

[0001] The present invention relates to a device and a process for the production of high-relief mats of thermoplastic fibers fused together to form a non-woven fabric. In greater detail, the present invention relates to a process and a device for the production of mats obtained by depositing mono- or multi-component fibers onto rotating rollers fitted with pyramids or other protruding elements which act to receive a plurality of filaments extruded by a spinneret located above the roller.

[0002] Such mats have been known since the 1970s and have been produced up till now on devices that have remained substantially the same for the last thirty years. In these devices, such as that described in US-A-4252590, the extrusion head or spinneret generally extrudes a plurality of filaments with diameter inclusive between 0,1 mm and 1,5 mm at a controlled speed. The filaments fall on a rotating roller under the spinneret where they are superimposed while still heated so as to fuse together to form a mat of thermo-welded fibers.

[0003] The roller is fitted with a plurality of elements protruding radially from the same, generally pointed or in the shape of a pyramidal frustum, to impart a three-dimensional structure to the mat. In many cases - as for instance in such uses as under-roof drainage membrane or as geomembrane for soil stabilization or for road subsurface drainage - the mat is subjected to high compression stresses in use and the three-dimensional structure improves the strength of the structure and the continuity of the drainage function.

[0004] One problem of the known art is how to improve the technical characteristics of the known mats, particularly their resistance to compression and transverse forces with respect to the long direction of the mat (i.e. the direction perpendicular to the axis of the cylinder or roller forming and shaping the mat). At the same time, the structure has to conserve the characteristics of low weight, low density and the high number of spaces between the fibers necessary for use as a geomembrane or drainage membrane in general.

[0005] US-A-4212692 suggested that a base layer, obtained by an additional extrusion head and a supplementary roller, should be applied to the three-dimensional structure directly on the shaped roller for forming the mat.

[0006] This solution has the disadvantage of requiring an additional production phase and additional material, consequently increasing costs both for labor and for the final product.

[0007] Other solutions proposed depart completely from the techniques discussed here in as much as they use woven fibers; for instance, US2005/0287343 describes producing a fabric with fibers that have different behavior in heat retraction and that are woven so as to form pyramidal projections after heat-treating the fabric.

[0008] The purpose of the present invention is to resolve the problems above discussed and to provide a non-woven mat produced by extruding filaments and collecting them on a rotating cylinder; the mat should have improved mechanical characteristics compared to known mats, without increasing the weight or the production cost.

[0009] Such purpose is achieved by the present invention, that relates to a device for the production of mats of non-woven fabric by extrusion of a plurality of filaments and collecting them and bonding them together on a rotating roller provided with a plurality of protruding elements to impart a three-dimensional structure to the said mat, characterized by there being present on at least part of the walls of said protruding elements means of retaining filaments in order to retain on them some of the filaments that come into contact with said walls.

[0010] According to one aspect of the invention, the means of retaining the filaments is chosen from grooves, projections or steps that protrude from the walls of the protruding elements and are preferably tilted upward and to the outside of said protruding elements.

[0011] According to a further aspect of the invention, the elements protruding from the forming cylinder are chosen from either square-based pyramids or rectangular-based obelisks. Pyramids and obelisks are provided with two quadrilateral bases, i.e. they have a major bottom base and a minor upper base.

[0012] According to another aspect of the invention, each step or tooth defines a portion of a protruding element, each portion being different from the others in size and shape. Preferably, the horizontal width of the housings (grooves or projections or steps or notches) is at least one tenth of a millimeter and is preferably comprised in the range between 0,1 mm and 3,0 mm.

[0013] The invention furthermore relates to a process for the production of mats of non-woven fabric by the extrusion of a plurality of filaments, their collection and bonding together on a rotating cylinder provided with a plurality of protruding elements to impart a three-dimensional structure to the said mat, characterized by retaining on at least part of the walls of said protruding elements some of the filaments that come into contact with said walls by using a device of the described above type.

[0014] The mat obtained according to the aforementioned process is, therefore, a further object of the invention.

[0015] As already mentioned, the device and the process of the present invention have numerous advantages over the known art.

[0016] In the first place, the retaining of filaments on the walls of the protruding elements results in the filaments being distributed more uniformly throughout the whole area of the product and, therefore, in a more uniform distribution of the mechanical characteristics over the whole structure of the mat produced and therefore with greater resistance to stress, particularly to compression.

[0017] Furthermore, the mat produced can more easily be attached to felts or other products, thanks also to the sinusoidal distribution of truncated tops of the protruding elements.

[0018] The invention will now be described in more detail with reference to the enclosed drawings which are by way of example and not limiting, in which:

- Fig. 1 is a side view of a rotating forming cylinder according to the invention;
- Fig. 2 is a magnified view in longitudinal section of a protruding element of the cylinder according to the invention;
- Fig. 2A is a magnified detail of the element of Fig. 2;
- Fig. 2B is a view from above of the protruding element on the cylinder according to the invention;
- Fig. 3 and Fig. 4 are front and perspective views of single rings for the formation of the cylinder according to the invention; and
- Fig. 5 is a perspective view of the cylinder according to the invention, where the relative position of the protruding elements on the cylinder is clearly shown.

[0019] Figure 1 shows the forming cylinder 1 according to the present invention. The cylinder 1 is located beneath an extrusion spinneret 2 in a way already known to the art and described in, for instance, the document US-A-4252590 quoted above, and carries a plurality of protruding elements 3 that project radially from cylinder 1. The extrusion spinneret 2 presents a plurality of extrusion holes to extrude the chosen thermoplastic material in the form of filaments 4. The extruded filaments are deposited on the roller to form a layer of interlaced filaments which fuse together to give a mat; the projections on the roller impart the required protrusions and depth to the mat.

[0020] As known and as already described in US-A-4252590, the speed of rotation of the roller can be adjusted depending on the desired quantity of filaments per unit area of the mat, i.e. the faster cylinder 1 rotates, the lower the quantity and distribution of the filaments (and therefore the weight of the final product); the weight increases with decreasing speed of rotation.

[0021] According to the invention, at least some, preferably most, and most preferably all, of the protruding elements 3 are provided with means for the retaining of filaments 4; such means of retention are located on at least some of the walls of the protruding elements 3.

[0022] The protruding elements can be of various forms and dimensions, but they are preferably either pyramids and/or obelisks having major and minor polygonal bases, preferably quadrilateral. The shown preferred embodiment includes a plurality of protruding elements constituted by obelisks having each a major and a minor rectangular bases, with their longest side parallel to the axis A of forming cylinder 1.

[0023] As can best be seen in fig. 2, 2A and 2B, the means for retaining the filaments in the shown preferred embodiment include at least one filament retaining projection 5 on at least one of the sides of the element 3. Such retaining projections, or housings, 5 of the filament 4 are in the form of grooves, projections, steps or notches, generally obtained by machining and removing successive layers from the walls of the element 3 so as to form a "stepped pyramid". The pyramid (fig.2) extends from a base 6 that is preferably integral with cylinder 1 and comprises portions 3A-3C superimposed in one piece with walls staggered in different planes, narrowing at every filament retaining step 5. As mentioned above, the base 6 of the element (or pyramid) 3 is integral with the structure 8 of the cylinder 1 and is preferably by machining structure 8 so that the base line 7 of the protruding element 3 corresponds to the surface of the structure 8 of cylinder 1.

[0024] Fig. 2B shows a view from above of the visible part of a protruding element 3 mounted on the cylinder without showing the adjacent protruding elements.

[0025] The enlargement of Fig.2A shows in detail a filament retaining step 5, which is tilted (i.e. angled) upward and to the outside of the obelisk 3 so as to produce an inclination toward the center of the same and to favor the retaining of the filaments 4. The steps 5 are located on at least one side of element 3, preferably on at least two and, more preferably, on all four sides. The preferred embodiment shown is provided with two steps on two opposite sides 9A and 9B of the element 3, the sides 9A and 9B being positioned transversally to the axis A of the cylinder.

[0026] As mentioned above, the element 3 is preferably flat-topped (truncated) and the upper surface 10 is preferably provided with a plurality of ridges or similar means for roughing its surface to favor retention of the filaments on the upper surface 10.

[0027] In the embodiment shown in figures 3-5, cylinder 1 includes a plurality of rings 11 united together on a shaft (not shown) to form a cylinder 1 with the desired dimensions. On each ring 11 is provided a plurality of elements 3 that are aligned in single plane and that project radially from the support structure or base 8 of the same ring. As a result of this embodiment, i.e. due to the use of rings with a single line of elements 3, each ring can be arranged in a plurality of positions with respect to the adjacent rings to form the required overall layout of the protruding elements. For instance, in the embodiment shown the protruding elements of each ring are rotated through 0,5 - 15 degrees with respect to the initial ring, so that, going from left to right in Figs. 1 and 5, the sinusoidal arrangement seen in Fig. 5 is obtained.

[0028] Alternatively to the aforementioned solution in which rings 11 each carrying a single line of protruding elements 3 are used, rings having two or more rows of elements 3 can be placed side by side, and it is also possible to produce the elements according to the present invention by working directly on a single cylinder.

[0029] In practice, the filaments arriving from the spinneret 2 contact the protruding elements and are retained at least temporarily by the means 5, i.e. they are retained for long enough to allow them to fuse with other filaments and to form a structure distributed substantially uniformly on the whole forming cylinder.

[0030] In other words, the protruding elements according to the invention can prevent that all the filaments flow down the sides of the pyramid or obelisk and accumulate in the grooves between one protruding element 3 and that adjacent to it. The resultant mat will therefore have a more uniform structure than those known, with filaments distributed throughout the whole structure, but will not have large "holes" in the same. The structure will therefore always have a "weave" provided by the interlaced filaments and it will be free of large spaces in between them.

Claims

1. A forming cylinder device (1) for the production of a non-woven mat by the extrusion of a plurality of filaments, and their collection and bonding together (4), said cylinder (1) being provided with a plurality of protruding elements (3) to shape said mat in a corresponding way, **characterized by** there being present on at least some of the walls (9A, 9B) of said protruding elements (3) means (5) for retaining at least temporarily thereon (5) at least some of the filaments (4) that come into contact with said walls (9A, 9B).

2. A device according to Claim 1, in which said protruding elements (3) have two polygonal bases (7, 10).

3. A device according to Claim 2, in which said protruding elements (3) are rectangular-based obelisks.

4. A device according to Claim 2 or 3, in which said means (5) of retaining the filaments comprises one or more housings positioned on at least one of said sides (9A, 9B).

5. A device according to Claim 4, in which said housings are selected from grooves, projections or steps.

6. A device according to Claim 4 or 5, in which said housings extend horizontally on at least two sides (9A, 9B) of said protruding elements, said sides being positioned transversal to the axis (A-A) of said forming cylinder (1).

7. A device according to any of the preceding Claims, in which said forming cylinder (1) comprises a plurality of rings (11), each ring carrying one row of protruding elements (3).

8. A device according to any of the preceding Claims, in which said rings are mounted staggered to give a sinusoidal arrangement of the protruding elements (3).

9. A process for the production of mats of non-woven fabric by extruding, collecting and fusing together a plurality of filaments on a rotating cylinder (1) provided with a plurality of protruding elements (3) to impart a three-dimensional structure to the said mat, **characterized by** retaining at least temporarily on at least some of the walls (9A, 9B) of said protruding elements (3) some of the filaments that come into contact with said walls, by means of a device (1) according to any of the preceding Claims.

10. Non-woven mat of bonded thermoplastic fibers as obtained with a device according to any of the Claims from 1 to 8 using the process according to Claim 9.

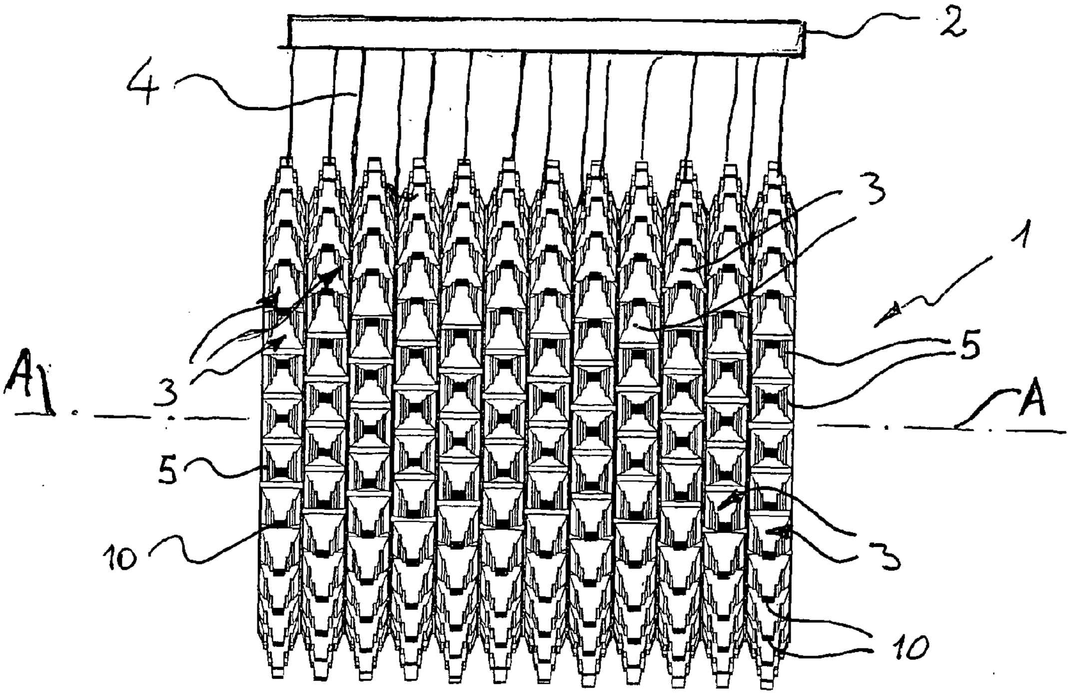


Fig. 1

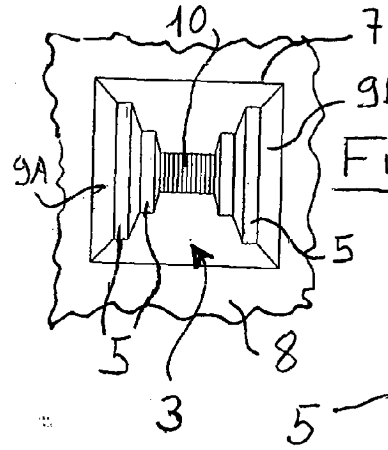
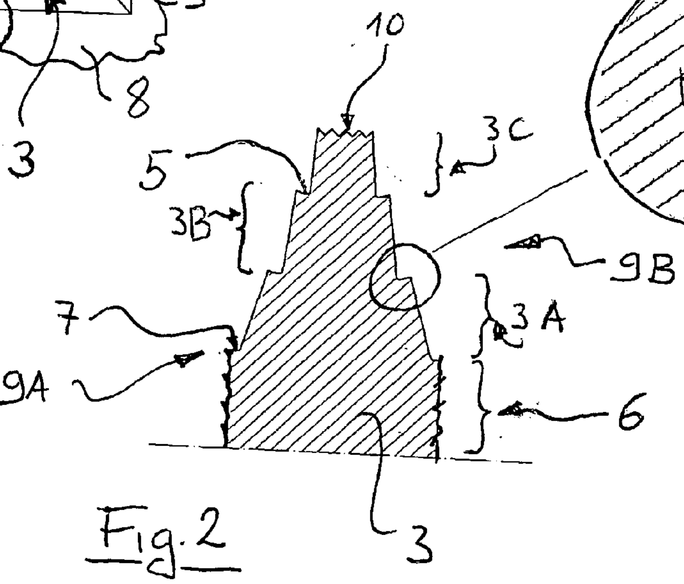


Fig. 2B



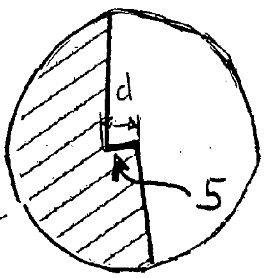


Fig. 2A

Fig. 2

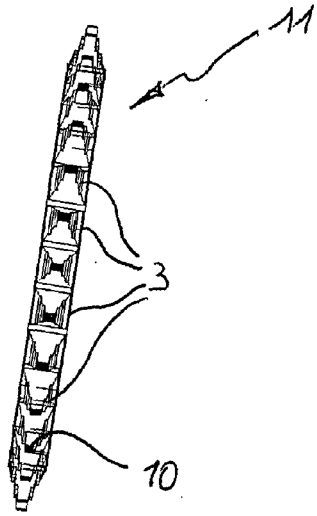
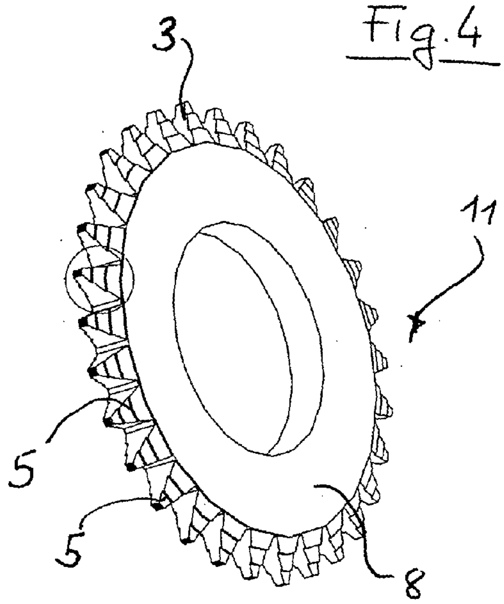


Fig. 3

Fig. 4



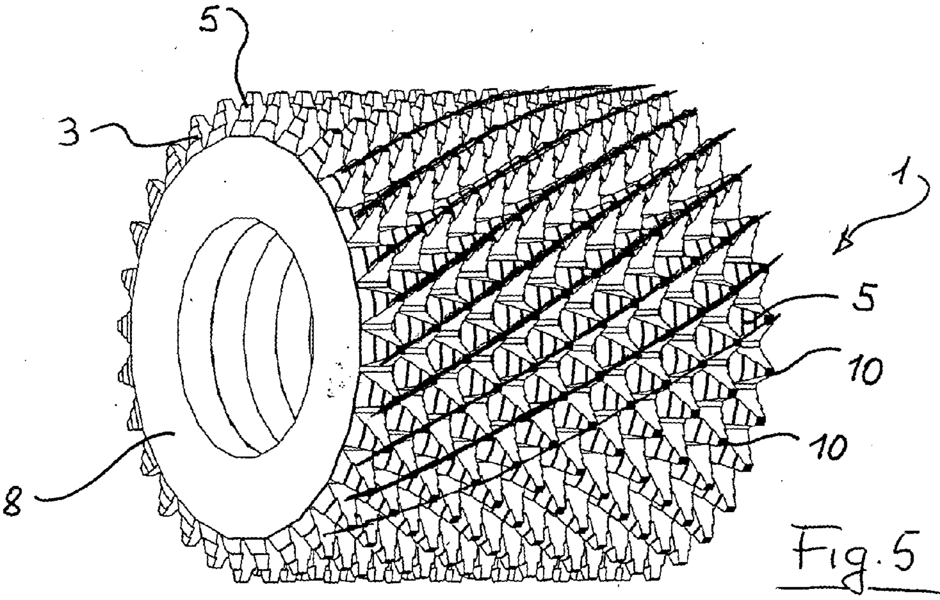


Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5700

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TECHNICAL FIELDS SEARCHED (IPC)

D04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 January 2007	Joly, Florence

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 42 5700

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