



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.12.2010 Bulletin 2010/51

(51) Int Cl.:
E02D 17/20 (2006.01)

(21) Application number: **10163529.0**

(22) Date of filing: **21.05.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

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(30) Priority: **25.05.2009 IT MI20090919**

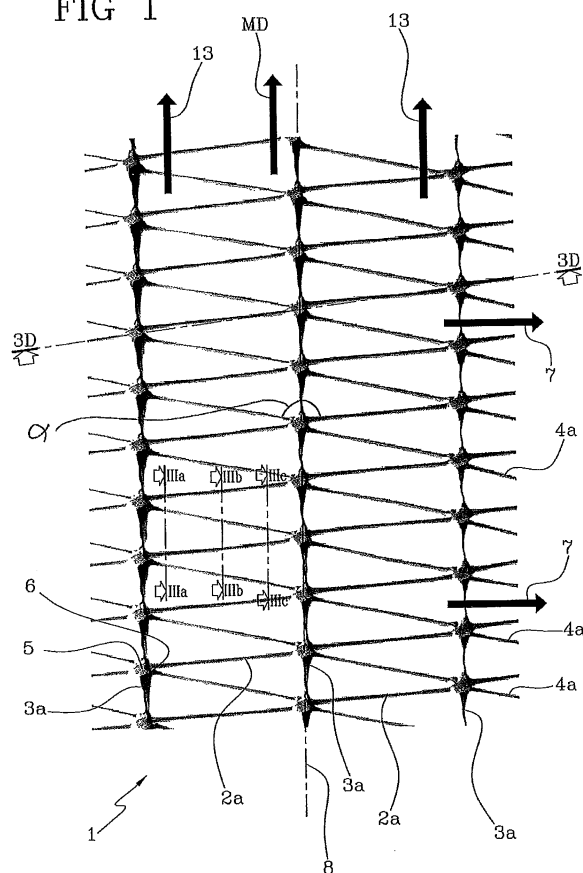
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(54) **Method for production of a net**

(57) A process for production of a three-planar net has been conceived, which net consists of a plurality of thread-like elements (2a) of a first series (2) parallel to each other and secured to a plurality of thread-like elements (3a) of a second series (3) parallel to each other and transverse to the elements of the first series (2); the elements (3a) of the second series (3) are in turn secured to elements (4a) of a third series (4) parallel to each other and transverse to the elements of the two first series. The production process contemplates a step of stretching the three-planar-net article thus obtained (10) for modifying the weight features per unit of measurement of the net itself according to the specific requirements.

FIG 1



Description

[0001] The present invention relates to a process for production of multi-planar nets.

[0002] In particular, the invention relates to a method of making a layered monobloc product in which all layers forming it are disposed in distinct planes rigidly interconnected during the same process of co-extrusion so as to form a single continuous structure.

[0003] It is known that multilayer nets obtained by an extrusion process are presently commonly used in geotechnical applications and not. For instance multi-planar nets for geotechnical use are known which have optimal features in terms of fluid drainage, in combination with an excellent resistance to compressive forces applied in a direction orthogonal to the median plane of the manufactured product.

[0004] From document No. US 5255998 it is known to produce three-planar nets consisting of three series of parallel threads disposed in planes offset from each other in such a manner as to define a monobloc product in which each of the layers is coupled to the contiguous layer at a plurality of connecting knots.

[0005] The product referred to in document US 5255998 has an optimal behaviour for fluid drainage and an optimal structural resistance.

[0006] However it is well apparent that the technical features of the above mentioned article of manufacture can be only varied by varying the product geometry, namely using threads of greater or smaller diameter, varying the number of the threads or the distance between the threads and/or the knots or modifying the geometries and coupling orientations.

[0007] It is in fact obvious that upon variation of the application for which the net is intended, a variation can occur in the technical requirements that the net must possess, and therefore a given article of manufacture that appears to be excellent for some types of applications, cannot be so in other situations.

[0008] The above involves the necessity to manufacture a plurality of different multi-planar articles of manufacture, each of them being particularly suitable for respective specific applications.

[0009] As a result of the above, different production lines are to be provided for making articles of manufacture having features of resistance to loads and weights per square meter different from each other (even if not to a great extent) or, alternatively, it is necessary to use the same article of manufacture for applications of different nature, which will give rise to a behaviour and performance that are not optimal because the article is not dedicated to the specific use.

[0010] Accordingly, the present invention aims at finding a solution for the pointed out limits.

[0011] In particular, it is an aim of the invention to make available a process for the production of multiplanar nets that can enable articles of manufacture having different weights per square meter to be obtained by substantially

utilising the same extrusion machines.

[0012] Another aim of the invention is to obtain a final product of less weight per square meter, the draining capability being the same.

[0013] Further aims of the invention contemplate the possibility of obtaining, in addition to products even of a very reduced weight per square meter, articles with a good resistance to compression, an excellent draining capability and a very high resistance to deformation in the transverse direction.

[0014] An auxiliary aim of the invention is to make available a method for production of nets that can be used in quite different sectors (such as geotechnics and packaging, for example), in any case giving the multilayer product advantageous features for the specific sector.

[0015] The foregoing and further aims that will become more apparent in the course of the following description are substantially achieved by a method or process for production of multiplanar nets in accordance with the invention.

[0016] Further features and advantages will be best understood from the detailed description of an embodiment of a process for producing multiplanar nets according to the invention.

[0017] The description will be carried out hereinafter with reference to the accompanying figures, given by way of non-limiting example, in which:

- Fig. 1 shows a photo from above of the multiplanar net in accordance with the invention;
- Figs. 2 and 2a show photos in a perspective view of a net obtained with the method in accordance with the invention;
- Figs. 3a-3d are diagrammatic views of sections of the photo seen in Fig. 1 in planes indicated therein;
- Fig. 4 shows a net-like article of manufacture constituting an intermediate product in the method according to the invention; and
- Fig. 5 shows a photo in plan view of a light net for packaging obtained with the method of the invention.

[0018] With reference to the mentioned figures, a multiplanar net obtained following the process of the invention has been generally identified by reference numeral 1.

[0019] The method in accordance with the invention first of all contemplates production of a multiplanar net-like article of manufacture 10 (preferably a three-planar article) that can be obtained by a co-extrusion process using known machines equipped with a rotary head.

[0020] In particular, the net-like article of manufacture (a semi-finished product) 10 obtained by co-extrusion can be of the type shown in Fig. 4.

[0021] As it is possible to see from this image, the net-like article 10 comprises a first, a second and a third series 2, 3, 4 of thread-like elements 2a, 3a, 4a.

[0022] Each series lies in a respective plane A, B, C that is parallel and offset relative to the plane of the ad-

jacent series (Fig. 3d).

[0023] In addition, the thread-like elements 2a, 3a, 4a of each series 2, 3, 4 are substantially parallel to each other.

[0024] It is also possible to view from Fig. 4, that the elements of the first series 2 are inclined to the elements of the second and third series, 3 and 4 respectively, while the elements of the second series 3 in turn are inclined to the elements of the third series 4.

[0025] Moreover, the thread-like elements 2a of the first series 2 are rigidly fastened to the thread-like elements 3a of the second series 3 at respective knots 5.

[0026] Likewise, the thread-like elements 3a of the second series 3 are rigidly fastened to the thread-like elements 4a of the third series 4 at respective corresponding knots 6.

[0027] Due to the above, a monobloc multiplanar net can be defined which is rigidly interconnected and defines a plurality of meshes.

[0028] It is also to be pointed out that the thread-like elements of the second series 3 (interposed between those of the first and the third series) are oriented in the extrusion direction (MD = machine direction); vice versa the elements of the first and third series come out of the extrusion head in such a manner that in the planar-made product the opposite and like angles are inclined to the extrusion direction.

[0029] Looking in particular at the figures, it is then possible to notice that the knots 5 between the first and second series 2, 3 and the knots 6 connecting the second and third series 3, 4 of thread-like elements are disposed at corresponding positions in such a manner as to define true coupling regions wherein the first, second and third series are connected to each other.

[0030] Looking at the net-like article of manufacture 10 thus obtained from the top, it is possible to see a mesh structure in which the first and third series of thread-like elements define rhomboidal meshes, while the thread-like elements of the second series actually are the bisectors of opposite angles of these rhomboidal meshes.

[0031] Yet, in other words, the mesh structure is rather uniform and the three series of elements are coupled at corresponding knots.

[0032] Advantageously, the process for making the multiplanar nets being the object of the invention contemplates that, once the net-like article of manufacture 10 described above has been made, in particular by co-extrusion of said thread-like elements by means of a known and appropriate rotary head, at least one further stretching step of the net-like article of manufacture 10 thus obtained is carried out at least in a first stretching direction 7.

[0033] The above can be in particular accomplished while the article of manufacture is still in a plastic state.

[0034] Defined as MD (machine direction) the extrusion direction parallel to (coincident with) the moving forward or feeding direction of the net-like article of manufacture 10 coming out of the extruder, the first stretching

direction 7 is substantially transverse to such an extrusion direction.

[0035] In particular, the stretching direction 7 will be orthogonal to the feeding direction MD previously mentioned, so that the elements of the first and third series (2, 4) will be mainly acted upon.

[0036] Actually, the first stretching direction 7 is not coincident with any longitudinal extension direction of the three series of threads of the product.

[0037] Accomplishment of this net stretching action implies two effects from a geometric point of view: the parallel elements of the second series go on being parallel, but they are spaced apart a greater distance than the same distance in the semi-finished net-like article of manufacture 10.

[0038] In addition, the thread-like elements 2a and 4a of the first and third series 2, 4 are correspondingly extended, while maintaining the geometric relation of mutual parallelism. The above means that, upon examination of a section at different points of a mesh it is possible to see that the greater section is at the knots 5, 6, then said section becomes increasingly smaller (even if the geometry thereof is partially uneven) until it reaches a mid-line region where it starts increasing again as far as in the vicinity of the immediately following knot.

[0039] From a technical point of view, the stretching operation reduces the weight of the article of manufacture per dimensional unit.

[0040] It is further to be noted that the three-planar net is in particular stretched at least in two stretching directions where the second stretching direction 13 is transverse to the first stretching direction 7.

[0041] In greater detail, the second stretching direction is parallel to the feeding direction of the machine (MD) and actually it is coincident with the longitudinal extension direction 8 of the thread-like elements 3a of the second series 3.

[0042] In this manner, the thread-like elements of the second series too modify their geometry and the section varies from a maximum value at the knots to a minimum value at a mid-line region between two consecutive knots.

[0043] In this case too there is a further reduction in weight of the net per square meter.

[0044] Optionally, the production method may also comprise a step of engaging at least one layer of filtering material 12 with the net-like article of manufacture 10, which layer can be associated either with the first series 2 or with the third series 4 of the thread-like elements (in a further embodiment it could be associated with both series).

[0045] It will be recognised that at the end of the stretching operations the net meshes do not show variations in the angles between the threads themselves and therefore the product does not modify its orientation relative to the machine direction (MD).

[0046] In addition, the two layers 2, 4 placed upon and under the central one 3 respectively have threads that

are not oriented in a direction orthogonal to the machine direction (MD), but according to an angle of at least 15° and they form with each other an angle in which the

[0047] MD direction is substantially the bisector.

[0048] Relative to a merely extruded three-planar product, the capability of orienting the net in a direction at least orthogonal to the extrusion direction enables a final product to be obtained which has a lower weight per square meter, the draining capability being the same.

[0049] In the application for draining fluids, the pressure variation to which the product is submitted that would lead to a greater crushing in a direction orthogonal to the median plane of the article of manufacture can be easily counteracted by a reduction in the width of the channels (and therefore the free bending length of the threads), by merely varying the value of the stretching ratio (provided a good assembly of thread sizes, angles between the threads and correct stretching ratio is always maintained) and no longer by modifying the number of the longitudinal threads of the article of manufacture.

[0050] It is then to be pointed out that the stretched product at all events has substantially taut threads, knots substantially maintaining the original thickness (in particular the thickness loss is less than 15% and on average contained around 10%) and therefore the channels have wide dimensions and keep a good resistance to compression.

[0051] The thread of the second series 3 maintains a substantially rectilinear direction and therefore goes on representing the bisector of the angle formed by the two outermost orders of threads.

[0052] It should be appreciated that the object of the invention can be used for a great number of types of functions.

[0053] In fact, the net in question can be used as a geogrid where it is possible to utilise the volume capacity within the channels between the threads of the order oriented in the machine direction and the higher containing capacity of the ground particles in a transverse direction (appearing from the overall thickness of the product) and in an orthogonal direction from the median plane of the orders of threads composing the article of manufacture (due to the presence of the outermost orders of threads, each of which passes through the mesh traced by the opposite thread orders).

[0054] In particular, the present invention allows the object of the mentioned US patent to be improved by maintaining the same draining capability while at the same time being more flexible from the production point of view, as it is possible to obtain the necessary resistance capacity to the pressure of the article of manufacture merely by correctly modifying the stretching ratio in a direction transverse to advancing of the threads in the machine and by reducing the free bending length of the threads themselves.

[0055] Exactly for the geotechnique application it is useful or in any case possible to couple the invention with some geotextile fabric on at least one of the sides of the

product.

[0056] It should be further recognised that nets obtained using the process of the invention can have many advantages also in other sectors.

5 **[0057]** In the packaging field with extruded nets having a low weight per square meter the mesh shape has a great importance because the mechanical and containment features vary to a great extent.

10 **[0058]** With a square mesh a net can be obtained that has an optimal resistance to pressure (and poor resistance to deformation) in the longitudinal and transverse direction; with a rhomboidal mesh a very deformable net can be obtained, which feature has a positive aspect in terms of capability of adapting it to the contents thereof but a negative aspect as to the difficulty of manipulating the product.

15 **[0059]** For example, as far as packaging of fruit and vegetable products is concerned, these products show a modification in time of their geometrical and volumetric features due to the loss of liquids.

20 **[0060]** A possible use of the inventive net having a low weight per square meter is therefore that for packaging products such as hay or fruit and vegetables.

25 **[0061]** The light weight of the net and the marked thinness of the threads disposed according to the previously described specifications give the net an optimal containing elasticity combined with a great strength of the threads oriented in the machine direction (Fig. 5).

30 **[0062]** The intrinsic elasticity given to the net, due to the particular arrangement and working of the orders of threads, enables a possible reduction in weight/volume of the wrapped product to be taken up, for instance when packaging of vegetables is concerned, by adapting the wrapping element to the sizes of the contents without the package losing its mechanical strength.

35 **[0063]** A net for this type of applications is shown in Fig. 5; it is a light net having three orders of threads disposed as previously described and is obtained following the process in accordance with the invention.

Claims

45 1. A process for manufacturing multiplanar nets comprising the following steps:

- making a monobloc net-like article of manufacture by at least the following sub-steps:

- providing a first, a second and a third series (2, 3, 4) of thread-like elements (2a, 3a, 4a), each series (2, 3, 4) having thread-like elements (2a, 3a, 4a) parallel to each other;
- coupling the first series (2) of thread-like elements (2a) to the second series (3) of thread-like elements (3a) in such a manner that the elements (2a) of the first series (2) are inclined to the elements (3a) of the sec-

- ond series (3), the elements of the first series (2) being in a lying plane (A) different from the elements of the second series (3), the coupling regions between the thread-like elements (2a) of the first series (2) and the thread-like elements (3a) of the second series (3) defining a plurality of knots (5) between the first and second series;
- coupling said second series (3) of thread-like elements (3a) to said third series (4) of thread-like elements (4a) in such a manner that the elements of the second series (3) are inclined to the elements of the third series (4), the elements of the first series (2), the second series (3) and the third series (4) lying in different lying planes (A, B, C) respectively, the elements of the second series (3) being interposed between the elements of the first series (2) and the elements of the third series (4), the elements of the second series and the elements of the third series defining a plurality of connecting knots (6) between the second and third series (3, 4); **characterised in that** it further comprises a step of stretching the net-like article of manufacture (10) thus obtained in at least one first stretching direction (7).
2. A process as claimed in the preceding claim, **characterised in that** the steps of making said first series (2), second series (3) and third series (4) of thread-like elements and the step of associating said first series with said second series and third series are substantially simultaneous.
 3. A process as claimed in anyone of the preceding claims, **characterised in that** said step of making a net-like article of manufacture (10) is obtained by an extrusion step, the thread-like elements (3a) of the second series (3) having an extension direction substantially parallel to the moving forward direction (MD) of the net-like article of manufacture (10) coming out of the extruder.
 4. A process as claimed in anyone of the preceding claims, **characterised in that** the thread-like elements of the first series (2) and the thread-like elements of the third series (4) are such made that they have mutually inclined extension axes (9, 11), the elements of the second series (3) being inclined to the elements of the first and third series (2, 4).
 5. A process as claimed in anyone of the preceding claims, **characterised in that** the connecting knots (5) between the first and second series (2, 3) and the connecting knots (6) between the second and third series (3, 4) are made in such a manner that they are at corresponding locations thus defining connecting knots between the first, second and third series.
 6. A process as claimed in anyone of the preceding claims, **characterised in that** the elements of the second series (3) substantially define a bisector of the angle (α) formed between the elements of the first and third series (2, 4).
 7. A process as claimed in anyone of the preceding claims, **characterised in that** it further comprises a further stretching step for stretching the net-like article of manufacture (10) in an additional direction (13) transverse to the first stretching direction (7), preferably the first stretching direction (7) is not parallel to any extension direction of the thread-like elements of the first, second and third series.
 8. A process as claimed in anyone of the preceding claims, **characterised in that** said first stretching direction (7) is substantially transverse and preferably orthogonal to the moving forward direction (MD) during manufacture, and to the longitudinal extension (8) of the thread-like elements of the second series (3).
 9. A process as claimed in anyone of the preceding claims, **characterised in that** said additional stretching direction (13) is transverse and preferably orthogonal to said first stretching direction (7), most preferably said additional stretching direction (13) being parallel to the longitudinal extension direction (8) of the thread-like elements of the second series (3).
 10. A process as claimed in anyone of the preceding claims, **characterised in that** it further comprises a step of associating at least one layer of filtering material (12) with the stretched net-like article of manufacture, said layer of filtering material (12) being preferably associated with said first series (2) of thread-like elements and/or said third series (4) of thread-like elements.
 11. A multiplanar net, in particular for draining fluids, comprising:
 - at least one first, one second and one third series (2, 3, 4) of thread-like elements (2a, 3a, 4a), the thread-like elements (2a) of the first series (2) being parallel to each other, the thread-like elements (3a) of the second series (3) being parallel to each other and the thread-like elements (4a) of the third series (4) being parallel to each other, the thread-like elements of the first series (2) lying in a first lying plane (A), the thread-like elements of the second series (3) lying in a second lying plane (B) and the elements

of the third series (4) lying in a third lying plane (C), said lying planes (A, B, C) being mutually offset,

- connecting knots (5) between the thread-like elements of the first series (2) and the thread-like elements of the second series (3);
- connecting knots (6) between the thread-like elements of the second series (3) and the thread-like elements of the third series (4), **characterised in that** the thread-like elements (3a) of the second series (3) are stretched along their major extension direction (8), having a section, in a plane orthogonal to the major extension direction, decreasing and then increasing on moving from a knot to the next one.

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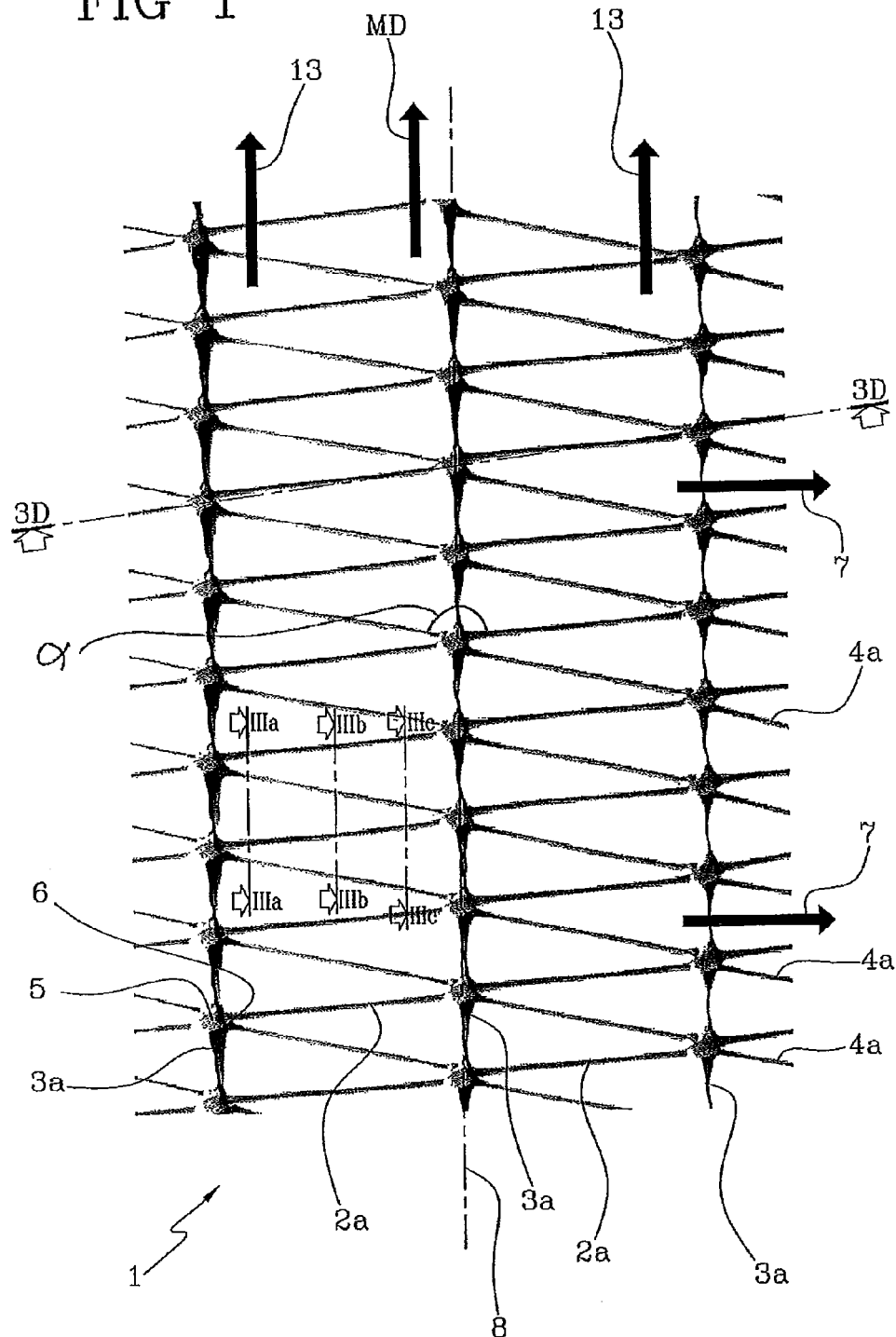
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FIG 1



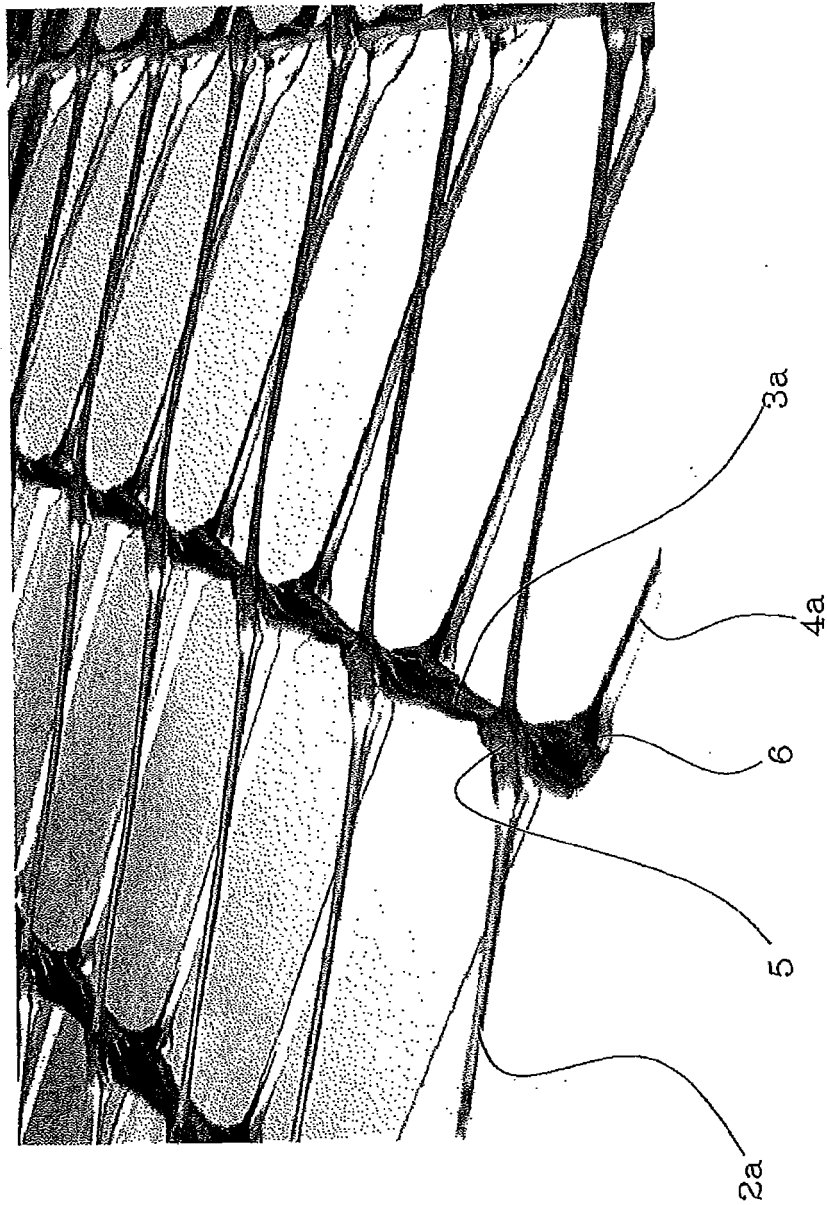


FIG 2

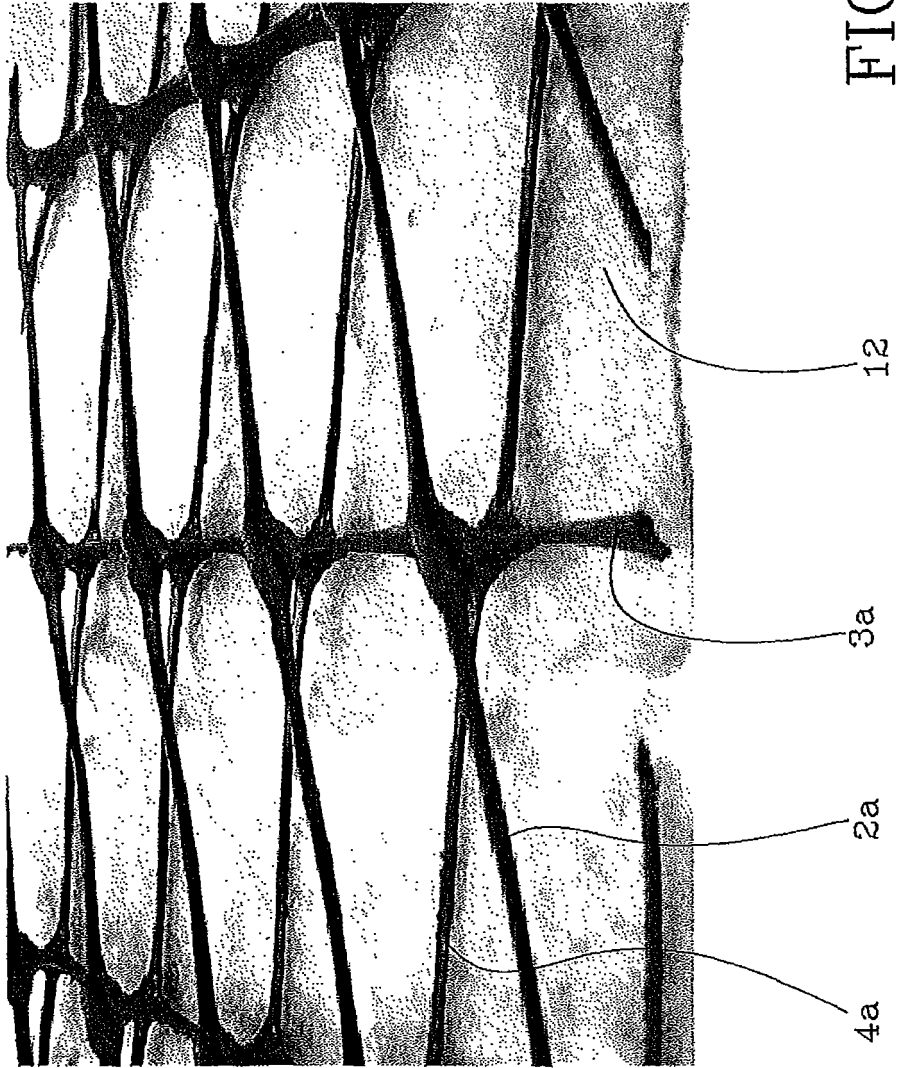


FIG 3a

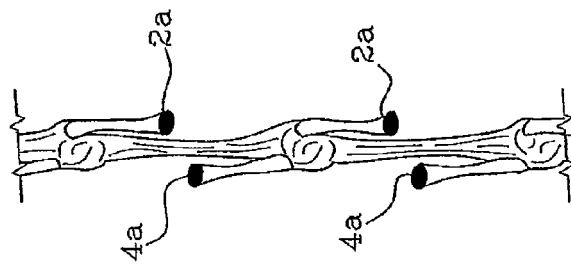


FIG 3b

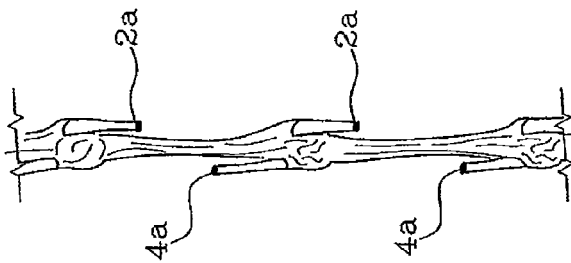


FIG 3c

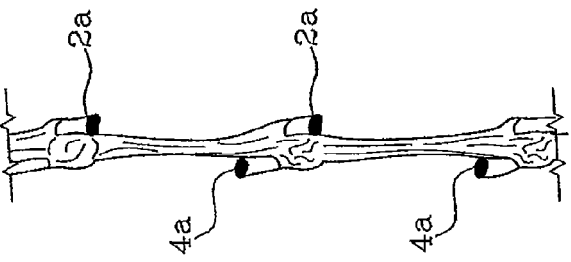


FIG 3d

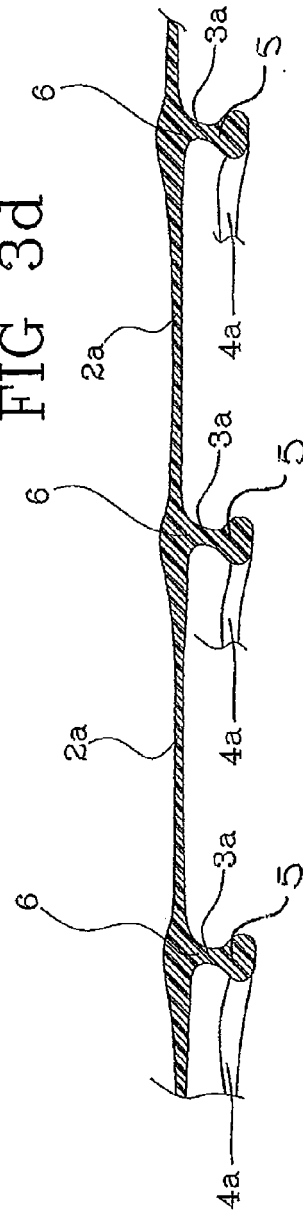


FIG 4

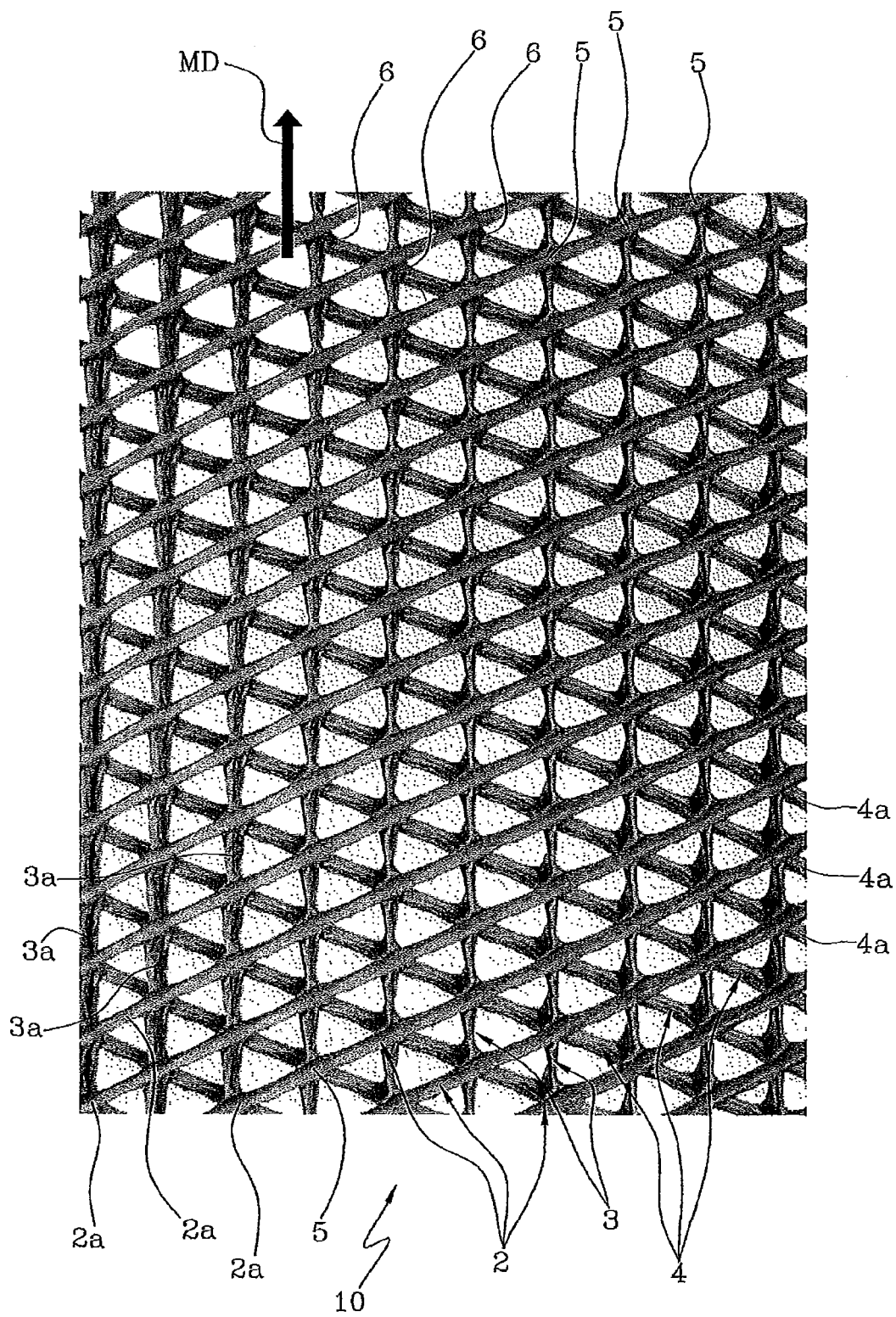
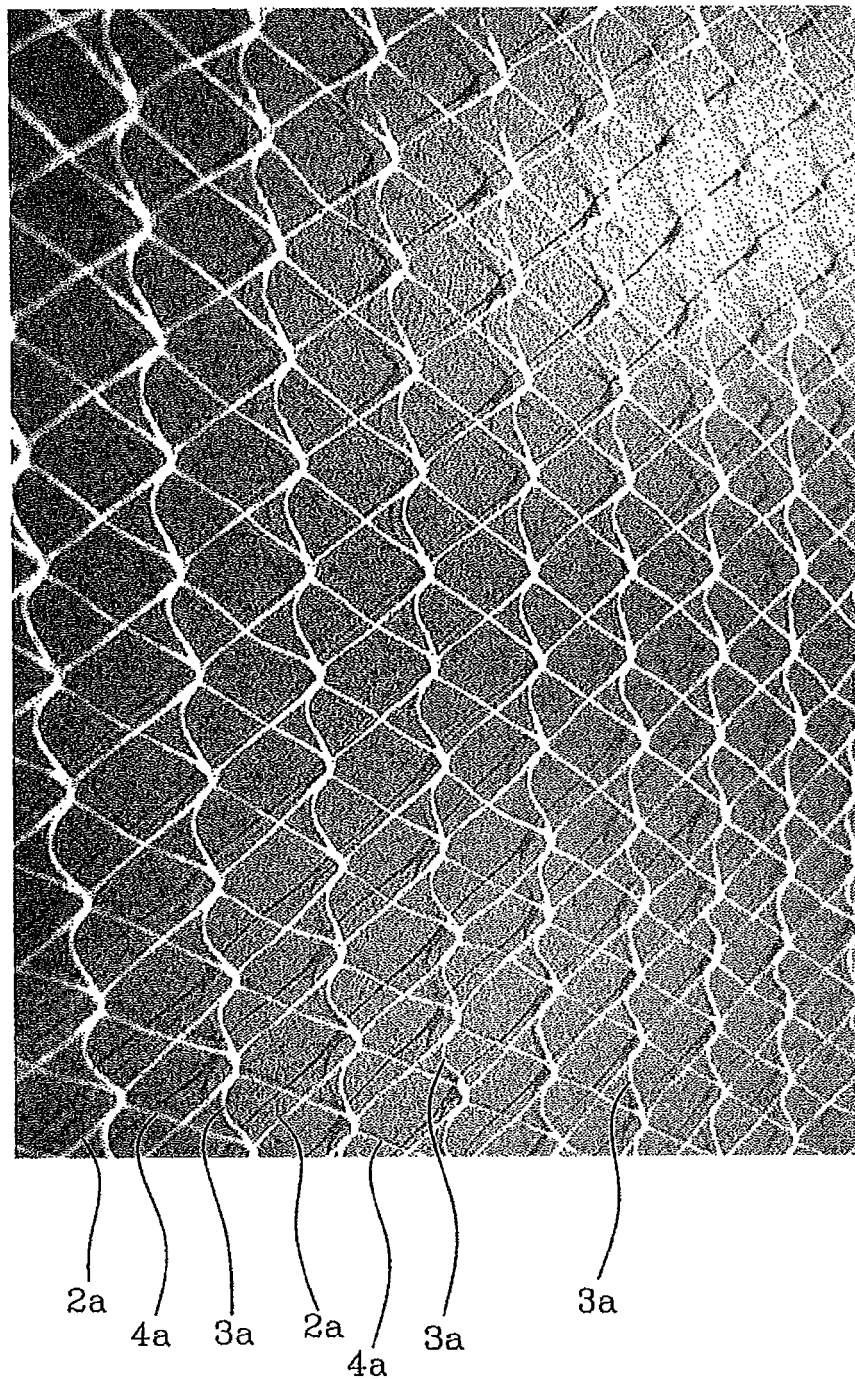


FIG 5





EUROPEAN SEARCH REPORT

 Application Number
 EP 10 16 3529

DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
Munich		24 September 2010	Geiger, Harald
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 10 16 3529

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24-09-2010

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REFERENCES CITED IN THE DESCRIPTION

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