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(54) **PLANT FOR THE PRODUCTION OF NON-WOVEN FABRIC**

(57) A non-woven fabric production plant comprise a support structure provided with a main channel (3) extending along a vertical axis (Y) from an upper inlet (4) to a lower outlet (5); a feeding station (6) placed above said main channel (3) communicating with said upper inlet(4) for feeding into said main channel (3) non-woven forming filaments a cooling station (8), which is placed along said main channel (3) inferiorly to said feeding station (6) and comprises a containment body (11) extending along said vertical axis (Y) between an upper end (19) and a lower end (20), and extending around said vertical axis (Y) delimiting at least a cooling chamber (12) within said main channel (3) and defining internally at least an expansion chamber (7); cooling means fluidically connected with said expansion chamber (7) and with said cooling chamber (12) and suitable to introduce into said cooling chamber (12) at least a first air flow rate (10) for cooling filaments susceptible to pass through said cooling chamber (12); homogenising means (13) housed within said expansion chamber (7) and configured to intercept said first air flow rate (10) and generate a second substantially homogeneous air flow rate (14); said homogenizing means (13) comprising at least a grid (15) provided with at least a plurality of wires defining between them a plurality of crossing paths for said first air flow rate (10) to generate said second substantially homogeneous air flow rate (14); wherein each crossing path of said plurality of crossing paths extends inclined with respect to a horizontal axis (X).

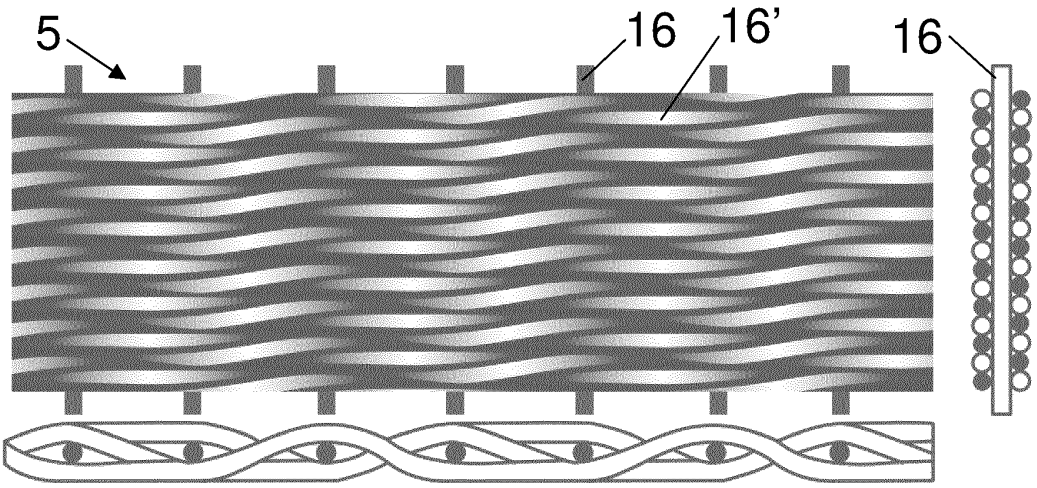

FIG. 8

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Description

TECHNICAL FIELD

[0001] The present invention relates to a non-woven fabric production plant, in particular in plastic material, according to the preamble of independent claim number 1.

[0002] The non-woven fabric production plant in question is intended to be advantageously employed in the production fibre tapes field to form a non-woven fabric, normally in the form of tapes. Such tapes are normally used for the production of sanitary products, such as headgear, masks and gloves, or in the agricultural sector for the production of non-woven fabric to be laid on the soil to be cultivated, to prevent weed growth and/or to protect seeds.

[0003] More specifically, the non-woven fabric production plant covered by the present invention is advantageously employable to produce a continuous tape of semi-finished non-woven fabric, which is intended to undergo subsequent processing to obtain a finished product.

[0004] The invention therefore relates the industrial field of non-woven fibre tape material production, or more generally, into the field of non-woven fabric production.

BACKGROUND ART

[0005] In the relevant technical field, the production of mechanically connected fibres tapes, normally made of plastic material, for the production of non-woven fabrics, such as 'spunbond' of polypropylene, polyester and/or other polymers, has long been known, in particular for the production of bandages, gauze, gauze masks and other sanitary products, or for example for the production of non-woven fabrics for use in the agricultural field to cover land for cultivation.

[0006] More generally, non-woven fabric is a semi-finished product intended to undergo subsequent processing steps to produce various kinds of products, normally made of plastic material and in the form of tapes or overlapping tapes. Such tapes are made up of filaments arranged randomly in layers and joined usually mechanically, or by adhesives, or at least partially fused together by heat.

[0007] More clearly, non-woven fabric (NWF) is the term well known in the technical field to indicate an industrial product similar to a fabric but obtained by processes other than weaving and/or knitting. More specifically, in a non-woven fabric, the filaments composing it are mechanically bound together in a random pattern, without defining any ordered structure, unlike the filaments and/or fibres composing a fabric. In the technical field, non-wovens are known to be produced, for example, in which the filaments and/or fibres are arranged in layers or criss-crossed and mechanically joined together, e.g. by needle punching or using adhesives or similar. Sometimes, non-woven fabric is also referred by the term 'nonwoven', which is also well known to the skilled person in the art. In the aforementioned technical field of non-woven fabric production, non-woven plants have long been known which normally involve the formation of a plurality of plastic filaments, which are stretched, laid on a conveyor belt and then pressed one on top of the other in a random manner, to form the aforementioned non-woven tapes.

[0008] An example of a plant to produce non-woven fabric is described in document EP 3831989. The plant described there develops vertically along a main channel, along which several operating stations to produce the above plastic filaments are planned vertically in succession.

[0009] Above, there is provided an extrusion station for extruding a plurality of filaments of high temperature plastic material, which are fed into the main channel through an upper inlet opening, at which there is an extrusion head from which the filaments exit inferiorly. As is well known, this extrusion head is equipped at the bottom with a plurality of holes facing the upper inlet opening from which a mass of molten plastic material in the form of filaments exits.

[0010] The filaments are normally extruded in the form of a pasty plastic material at a high temperature, normally between 150°C and 280°C.

[0011] At the bottom there is a cooling station (normally known as 'quenching' or 'quench' in the technical term of the field), wherein an air flow rate is forced into the main channel by means of at least a fan placed outside the latter.

[0012] The air flow rate fed into the cooling station cools the filaments formed at the extrusion station's extrusion head.

[0013] The cooling station comprises side walls, usually metallic, which define a cooling volume within which the high-temperature filaments begin to cool.

[0014] In order to stretch the filaments obtained from the extrusion station and subsequently cooled by the cooling station, the system normally comprise a rectification station, in which the air injected into the first feed section stretches the plastic filaments within a reduced section of the main channel until they reach the desired size, i.e. until they reach a linear density of approximately 1 - 5 dtex.

[0015] In order to obtain the desired weave (i.e. an essentially random and homogeneous arrangement of the filaments) for the production of the non-woven fabric, it is necessary to randomly weave the filaments together, forming an essentially seamless dense weave. For this purpose, the plant of the known type is equipped with a deposition station at an end section of the main channel, which terminates at the bottom with an outlet opening opposite the inlet opening.

[0016] More specifically, the air flowing within the end section of the main channel is moved in such a way as to give it a turbulent motion. In this way, the filaments are

propelled by the air and intertwine with each other in an essentially random manner to form the desired weave of the nonwoven fabric.

[0017] The end section of the main channel extends downwards, and in particular towards the outlet opening, comprises a diffuser with a substantially truncated cone shape.

[0018] The air flowing through it therefore encounters an increase in the cross-section of the channel and slows down to a turbulent motion, mixing and entangling the filaments flowing through the end section itself.

[0019] The plant of the known type comprises a conveyor belt below the deposition station, with which the end section of the main channel for receiving filaments ends.

[0020] The conveyor belt is moved to run along a substantially horizontal direction of movement the filaments thus laid to form the non-woven tape.

[0021] Subsequently, the non-woven tape thus obtained undergoes further processing steps such as pressing and is then moved to a winding station where the tape is wound around a support core to form reels of non-woven fabric, allowing it to be quickly stored and transported.

[0022] As is well known, in the cooling station it is necessary to distribute the air evenly over substantially the entire surface area facing the main channel, to cool the filaments uniformly and to avoid the risk of moving the filaments with respect to their vertical direction of advance within the main channel.

[0023] Homogenising means housed within an air expansion chamber, which remains defined within the cooling station, are known from plants currently on the market. Such known homogenising means comprise perforated metal plates, which extend parallel to the vertical axis of the plant.

[0024] An example of perforated metal plates housed in the expansion chamber of the cooling station used to homogenise the cooling air flow rate are described in document EP 3575469. The perforated metal plates described therein are provided with a plurality of through holes, which are made transverse to the vertical axis. These through holes allow the cooling air flow rate to decrease in velocity before reaching the cooling chamber of the main channel.

[0025] Further examples of non-woven fabric production plant are described in documents CN207468781U, CN206308453U, CN211734550U. All these examples have proved to be not without drawbacks.

[0026] The main drawback lies in the fact that the perforated metal plates of known homogenising means do not allow for optimal air homogenisation. In fact, the provision of holes and/or openings transverse to the vertical axis actually fragment the air flow rate into a plurality of parallel flows.

[0027] Such parallel and imperfectly homogeneous flows tend to punctually displace the filaments flowing through the cooling chamber of the main channel, thus invalidating the goodness of the non-woven fabric thus created.

[0028] In fact, the punctual velocity of each parallel flow fragmented by the main air flow rate increases, finding no obstruction as it passes through the corresponding hole and/or through opening.

[0029] A further drawback of the known type of plant lies in the fact that the perforated metal plates of the homogenising means, in order to give a satisfactory result, must be provided with numerous holes and/or openings, in particular up to 40% empty over full. This makes the plates mechanically weak and/or very flexible and brittle.

PURPOSES OF THE INVENTION

[0030] The purpose of the present invention is to propose a non-woven fabric production plant that overcomes, at least in part, the drawbacks of the above-mentioned background art. A further purpose of the invention is to provide a non-woven fabric production plant that allows filaments to be cooled within the main channel optimally.

[0031] A further purpose of the invention is to provide a non-woven fabric production plant that enables the generation of a cooling air flow rate that is homogeneous across the entire extent of the main channel cooling chamber.

[0032] A further purpose of the invention is to provide a non-woven fabric production plant that is structurally completely reliable.

[0033] A further purpose of the invention is to provide a non-woven fabric production plant that is functionally completely reliable.

[0034] A further purpose of the present invention is to provide a non-woven fabric production plant that is simple and/or economical to manufacture.

[0035] A further purpose of the present invention is to provide a cost-effective non-woven fabric production plant.

[0036] A further purpose of the present invention is to provide a non-woven fabric production plant that is industrially feasible.

[0037] A further purpose of the present invention is to provide a non-woven fabric production plant that is an alternative and/or an improvement on traditional solutions.

[0038] Another purpose of the present invention is to provide a non-woven fabric production plant that has an alternative and/or improved layout, both in terms of construction and function, compared to traditional solutions.

[0039] All of these purposes, either singly or in any combination thereof, and others which will result from the description below are achieved, according to the invention, by a non-woven fabric production plant having the features set forth in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] The present invention is further described herein in some of its preferred embodiments, shown for illustrative and non-limiting purposes only with reference to the attached drawings, wherein:

- Figure 1 shows a schematic front view of an embodiment of the non-woven fabric production plant according to the present invention;
- Figure 2 shows a schematic view of a plant cooling station according to the present invention;
- Figure 3 shows a schematic cross-sectional view of the cooling station of the plant according to the present invention, realised along track III-III of figure 2;
- Figure 4 shows an enlarged view of plant homogenising means according to the present invention;
- Figure 5 shows a detailed view of the homogenising means illustrated in figure 4;
- Figure 6 shows a side view of the homogenising means in Figures 4 and 5;
- Figure 7 shows a front view, a side view, and a cross-sectional view of the homogenising means in a first embodiment;
- Figure 8 shows a front view, a side view and a cross-sectional view of the homogenising means in a second embodiment;
- Figure 9 shows a front view, a side view, and a cross-sectional view of the homogenising means in a third embodiment;
- Figure 10 shows a front view, a side view, and a cross-sectional view of the homogenising means in a fourth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0041] With reference to the attached drawings, a non-woven fabric production plant according to the present invention has been designated as number 1.

[0042] The plant according to the invention is intended to be advantageously used for the production of non-woven fabrics of different types and materials, such as in particular spunbond made of plastic material, e.g. polypropylene and/or polyethylene, and in particular polyethylene terephthalate (PET in the technical jargon of the industry).

[0043] In the following, reference will be made to a plant 1 for the production of non-woven fabric of plastic material, in accordance with the preferred embodiment illustrated in the attached figures. However, the plant 1 of the present invention may also be advantageously employed to produce non-woven fabrics of other nature, which are in themselves well known to the person skilled in the art and therefore not described in detail below.

[0044] Therefore, in the following the term 'non-woven fabric' is to be understood as an essentially tape-like material composed of a plurality of filaments compressed one over the other in an essentially random manner. Non-woven fabric (NWF) is the generic term used in the technical field to indicate an industrial product similar to a fabric, but obtained by processes other than weaving (which involve the crossing of warp and weft threads on a loom) and knitting. In fact, in a non-woven fabric, the fibres and/or filaments present a random pattern, without the identification of any orderly structure, typically filaments and/or fibres are arranged in layers or criss-crossed, which are mechanically joined together (e.g. with needles, by needle-punching), or with adhesives or by thermal processes. Sometimes the term is also referred as 'nonwoven'.

[0045] In particular, non-woven fabric is normally composed of a plurality of plastic filaments mechanically joined together, e.g. by pressing.

[0046] The non-woven fabric production plant according to the invention comprises a support structure provided with a main channel 3, which extends along a vertical axis Y from an upper inlet 4 to a lower outlet 5.

[0047] Advantageously, the support structure is intended to rest on the ground and is preferably made of metal material, such as steel and in particular stainless steel (inox), such as AISI 304 or AISI 431 steel.

[0048] More specifically, main channel 3 extends vertically along the aforementioned vertical Y-axis.

[0049] In the following, it is to be understood that the main channel 3 may be delimited by a substantially tubular body defined, in accordance with the preferred embodiment illustrated in the attached figures, by a plurality of substantially tubular sections vertically aligned with each other along the vertical Y-axis and susceptible to be crossed by filaments (as described in detail below) for their treatment.

[0050] The plant 1 comprises a feeding station 6 located above main channel 3 and in communication with upper inlet 4 to feed non-woven forming filaments into main channel 3.

[0051] Preferably, the feeding station 6 comprises means for forming molten plastic material placed in fluid connection with the upper inlet 4 of the main channel 3 and comprising an extruder (in itself well known to the person skilled in the art and therefore not described in detail below) preferably supported by the support structure, capable of forming a continuous flow of molten plastic material and an extrusion head 29 mechanically supported by the support structure, placed in fluid connection with the extruder and provided with an extrusion plate facing the upper inlet 4 of the main channel 3.

[0052] The extrusion plate of the extrusion head 29 of the feeding station 6 is advantageously equipped with a plurality of through holes, which can be passed through by the flow of molten plastic material to form filaments.

[0053] Operationally, the filaments thus formed pass through upper inlet 4 and enter main channel 3 to allow them to be processed through a plurality of operating stations, as described in detail below.

[0054] Advantageously, the plant 1 object of the

present invention comprises a fume expulsion station provided below the feeding station 6, to expel from the main channel 3 any fumes produced during the extrusion of the plastic material from the extrusion head 29 through a chimney (not illustrated), which connects the main channel 3 of the plant 1 with the external environment.

[0055] More specifically, the fume expulsion station comprises at least an expulsion channel placed to intercept the main channel 3, in particular fluidically communicating with the extrusion plate of the extrusion head 29, to convey the fumes produced by the latter to the aforementioned chimney.

[0056] The expulsion channel is designed to convey the fumes and vapours produced by the molten plastic material, extruded in filaments from the extrusion head, which could adhere to the inner walls of the main channel 3, forming fouling.

[0057] Preferably, the fume expulsion station also comprises a water-to-air type heat exchanger to cool the fumes and vapours coming from the extrusion head 29 of the feeding station 6 and to collect any condensate fluid formed as a result of this cooling.

[0058] Appropriately, plant 1 comprise a cooling station 8, which is located along the aforementioned main channel 3 below the feeding station 6.

[0059] The cooling station 8 comprises a containment body 11 extending along the vertical axis Y between an upper end 19 and a lower end 20 and extends around the vertical axis Y delimiting a cooling chamber 12 within the main channel 3.

[0060] In accordance with the preferred embodiment shown in the attached figures, the cooling chamber 12 preferably corresponds to a first section of the main channel 3.

[0061] Advantageously, the cooling station 8 comprises two containment bodies 11 opposing each other with respect to the vertical axis Y, in accordance with the attached figure 1. Therefore, all the features described below with reference to a containment body 11 of the cooling station 8 are to be understood as being described for both containment bodies 11 of the preferred embodiment.

[0062] The cooling station 8 also comprises cooling means in fluidically connected with the cooling chamber 12 capable of supplying the cooling chamber 12 with a first air flow rate 10 to cool the filaments likely to pass through the cooling chamber 12.

[0063] Preferably, the cooling station 8 is equipped with at least a first outlet opening 9 which connects the cooling chamber 12 of the main channel and the expansion chamber 7 defined by the containment body 11.

[0064] In accordance with the preferred embodiment illustrated in the attached figures, the first outlet opening 9 is provided at an internal wall 21 of the containment body 11 which delimits the main channel 3 and in particular at least partially defines the cooling chamber 12.

[0065] More specifically, the first outlet opening 9 is advantageously realised by means of a plurality of through holes cut in the internal wall 21, at the first section of the main channel 3.

[0066] Otherwise, in accordance with a further embodiment of the plant 1 not illustrated in the attached figures, the internal wall 21 of the containment body 11 can be realised by means of a grid, or a honeycomb wall, whose substantially honeycombed openings define the aforementioned first outlet opening 9.

[0067] Advantageously, the cooling station 8 comprises ventilation means (not shown) fluidically connected with the first outlet opening 9 to feed the first air flow rate 10 into the cooling chamber 12, in particular through the expansion chamber 7 defined by the containment body 11.

[0068] Preferably, the ventilation means comprise a rotary fan, the type of which is in itself well known to the skilled person in the art and therefore not described in detail below. This fan is configured to generate the first air flow rate 10 and feed it into the cooling chamber 12 through the first outlet opening 9. Furthermore, the ventilation means preferably comprise a heat exchanger interposed between the fan and the first outlet opening 9. More in detail, the heat exchanger is placed to intercept the first air flow rate 10 generated by the fan and is designed to vary the temperature and humidity of the first air flow rate 10 itself.

[0069] In accordance with a preferred embodiment of the present invention, the heat exchanger is a water to air heat exchanger type, in particular a water to air shell and tube heat exchanger type. Preferably, the heat exchanger is capable of bringing the first air flow rate 10 to a constant temperature between 20°C and 30°C and in particular between 22°C and 25°C.

[0070] Preferably, the heat exchanger is mechanically supported by the support structure of the plant 1 in a raised position and substantially aligned with the first outlet opening 9 of the containment body 11.

[0071] Suitably, the cooling station 8 comprises said a containment body 11 extending along said vertical axis Y between an upper end 19 and a lower end 20, and extends around said vertical axis Y delimiting at least said cooling chamber 12 within said main channel 3 and defining internally at least an expansion chamber 7.

[0072] Appropriately, containment body 11 extends between an inlet opening 17 (visible on the right in the attached Figures 2, 3) and an outlet opening 9 (visible on the left in the attached Figures 2, 3).

[0073] The plant 1 comprises cooling means in fluidically connected with said expansion chamber 7 and with said cooling chamber 12 and capable of introducing into said cooling chamber 12 at least a first air flow rate 10 for cooling filaments susceptible to pass through said cooling chamber 12.

[0074] The expansion chamber 7 is configured to receive the first air flow rate 10 generated by the cooling means and allow it to expand, in order to slow down its speed for more homogeneous filament cooling.

[0075] For this purpose, the plant 1 comprises homog-

enising means 13 housed within said expansion chamber 7 and configured to intercept said first air flow rate 10 and generate a second substantially homogenous air flow rate 14, preferably at least parallel to said vertical axis Y.

[0076] In other words, the second air flow rate 14 is intended to be substantially vertically homogeneous, i.e. it has substantially the same features (e.g. velocity and/or pressure and/or temperature) along the entire height of the outlet opening 9 of the expansion chamber 7.

[0077] Appropriately, said homogenising means 13 comprise at least one grid 15 having at least one plurality of wires 16 defining between them a plurality of crossing paths for said first air flow rate 10 to generate said second homogenous air flow rate 14.

[0078] In this way, the plant 1 according to the invention allows to homogenise the first air flow rate 10 into a second homogenous air flow rate 14 due to the presence of the aforementioned crossing paths defined between the wires 16 of the at least one grid 15 of homogenisation means. In fact, the plurality of crossing paths forces the first air flow rate 10 to slow down, pass through the grid 15 with an equal velocity at each point along the internal extension of the grid 15, generating at the outlet of the homogenising means 13 the aforementioned second homogenised air flow rate 14, which is substantially the same throughout the entire extension of the grid 15, at the same pressure and/or velocity.

[0079] In other words, the first air flow rate 10 in passing through the homogenising means 13, is forced to pass through pathways that perform the function similar to channels. In particular, such channels are realised, along a cross direction to the axis Y, by preferably juxtaposing a plurality of grids 15 parallel to each other in such a way as to create a plurality of paths, created between the interstices of a weft wire and a warp wire or vice versa (as described in detail below), which preferably extend substantially parallel to each other and to the axis Y and which cover at least partially the transversal length (i.e. parallel to the axis Y) of the expansion chamber 7.

[0080] Advantageously, the grids 15 arranged as just described, essentially create a kind of 'diffuser' for the first air flow rate 10, resulting in homogeneity.

[0081] Therefore, the term 'homogeneous air flow rate' must be understood to mean an air flow rate that has essentially the same pressure and preferably the same velocity over the entire cross-sectional area of the channel that passes through, in the case at hand, the expansion chamber 7 of the containment body.

[0082] Advantageously, said grid 15 of said homogenising means 13 comprises at least a first plurality of wires 16, extending parallel to each other and parallel to said vertical axis Y, and at least a second plurality of wires 16', woven transversely with said first plurality of wires 16.

[0083] Preferably, the first plurality of wires 16' is made of metallic material, such as iron or steel. Similarly, preferably, the second plurality of wires 16' is made of metallic material, such as iron or steel.

[0084] Preferably, the first and second plurality of wires are woven together according to a weaving method, wherein the first plurality of wires defines the weft and the second plurality of wires defines the warp of the grid 15.

[0085] Suitably, in accordance with the preferred embodiments illustrated in the attached figures, said first plurality of wires 16 and said second plurality of wires 16' of said grid 15 of said homogenising means 13 define said plurality of crossing paths for said first air flow rate 10 among themselves.

[0086] Appropriately, the grid 15 of homogenising means 13 does not define openings for the passage of the first air flow rate 10. In fact, the term openings are to be understood as through openings, having an axis of horizontal extension (or in any case cross with respect to the Y axis), e.g. circular through holes made on a plate of a known type.

[0087] In contrast, the crossing paths defined by grid 15 comprise passage labyrinths, and/or passing lights, inclined to each other and to a horizontal axis X and crossed to the vertical axis Y.

[0088] Appropriately, each crossing path of said plurality of crossing paths extends inclined with respect to a horizontal axis X.

[0089] In fact, as is clearly visible from the attached Figures 4 - 6, which show photographic representations of a preferred embodiment of the invention, no through opening can be identified on the grid 15, as the first plurality of wires 16 and the second plurality of wires 16' are tightly interwoven with each other, such that the passage paths for air are defined by oblique, branched spans along the folds that the wires 16, 16' follow in their weaving. With particular reference to the attached figure 5, which shows an enlarged frontal view of a grid 15 in its preferred form, the wires 16, 16' are woven together in such a way that no opening in the grid can be identified.

[0090] The purpose of this provision is to improve the homogenisation of the second air flow rate 14, which does not reach optimal levels with the perforated plates of the known type. In fact, the prediction of a plurality of narrow labyrinths (i.e. the passageways defined above) forces an intimate and substantially perfect homogenisation of the first air flow rate 10 passing through the grid 15 of homogenising means 13 according to the invention. Advantageously, said containment body 11 extends between an inlet opening 17 and an outlet opening 9 for said first air flow rate 10. Advantageously, said homogenising means 13 comprise two or more of said grids 15 arranged parallel to the vertical axis Y between said inlet opening 17 and said outlet opening 9, wherein at least one grid proximal to said inlet opening 17 and at least one grid proximal to said outlet opening 9.

[0091] In accordance with the preferred embodiment of the present invention, the homogenisation means comprise at least four grids 15 parallel to each other and preferably comprise seven grids 15 parallel to each other housed within the expansion chamber 7 of the contain-

ment body 11.

[0092] In accordance with a first embodiment of the present invention, said grids 15 proximal to said inlet opening 17 comprises said plurality of wires 16 each having a first diameter; said grids 15 proximal to said outlet opening 9 comprises said plurality of wires 16 each having a second diameter smaller than said first diameter.

[0093] In other words, the diameter of the wires 16, 16' that make up the grids 15 preferably decreases as the grid placed closer to the outlet opening 9.

[0094] Advantageously, said grid 15 proximal to said inlet opening 17 defines fewer crossing paths for said first air flow rate 10 than the number of crossing paths defined by said grid 15 proximal to said outlet opening 9.

[0095] Advantageously, the larger diameter 16, 16' wires define fewer crossing paths than the number of crossing paths defined by the smaller diameter 16, 16' wires.

[0096] In accordance with an embodiment of the present invention and with particular reference to the appended Figure 3B, the cooling station 8 of the plant 1 according to the invention comprises at least one partition wall 18 extending in overhang from said inlet opening 17, defining a first expansion zone 7' provided with a first extension D1 defined between said upper end 19 and said partition wall 18 and a second expansion zone 7" provided with a second extension D2 between said partition wall 18 and said lower end 20 other than said first extension D1.

[0097] Preferably, in accordance with this embodiment, the ratio between said first extension D1 of said first expansion zone 7' and said second extension D2 of said second expansion zone 7' is between 0,4 and 0,7 and preferably between 0,5 and 0,6 and even more preferably around 0,56-0,57.

[0098] In other words, advantageously, the first extension D1 of the first expansion zone 7' is about 0,2 to 0,5 of the total extension of the expansion chamber 7 between the upper end 19 and the lower end 20 of the containment body, and preferably about 0,4 of the total extension and even more preferably about 0,37 to 3,38.

[0099] The attached figures 8 - 10 show different embodiments of the grid 15 of the homogenising means 13 according to the present invention. In more detail, these different embodiments show different types of weaving of the first plurality of wires 16 and the second plurality of wires 16'. In particular, Figure 8 shows a touraille type weaving, Figure 9 shows a panzertresse type weaving and Figure 10 shows a cross panzertresse type weaving.

[0100] Advantageously, said partition wall 18 extends between a first end 18' extending from said inlet opening 17, a second end 18' placed at the division of at least one of said grids 15. Preferably, the partition wall 18 divides at least one grid 15 of the homogenising means 13 crosswise.

[0101] Preferably, the homogenising means 13 comprise five to ten grids 15 and appropriately the partition wall 18 divides at least two to five grids 15 crosswise.

[0102] In particular, in accordance with the embodiment illustrated in the attached figures, the partition wall 18 divides at least five of the seven grids 15 of the homogenising media 13 crosswise.

[0103] Preferably, the partition wall 18 is made of a metal sheet. Advantageously, the metal sheet of the partition wall 18 is provided with a substantially Z-bent cross-section.

[0104] Preferably, each grid 15 of the homogenising means 13 may comprise more than one sheet of woven wires 16, 16' between them. In particular, the sheets are side-by-side and mechanically fastened together to form said grid 15. Advantageously, each grid 15 comprises at least two and preferably at least three sheets of woven wires 16, 16'.

[0105] In accordance with the design form shown in the attached Figure 3B, the cooling station 8 comprises a barrier element 25 housed within the expansion chamber 7 of the containment body 11.

[0106] In more detail, the barrier element 25 is interposed between the inlet opening 17 and the homogenising means 13 and is advantageously configured to intercept the first air flow rate 10 entering from the inlet opening 17 and preferably lower its velocity before it reaches the at least one grid 15.

[0107] Preferably, the barrier element 25 defines at least one passage gap 26 for the passage of the first air flow rate 10. Preferably, the barrier element 25 defines two passage gaps 26, a first passage gap with the upper end 19 of the containment body 11 and a second passage gap with the lower end 20 of the same containment body 11.

[0108] Advantageously, the barrier element 25 is substantially tile-shaped and extends parallel to the vertical axis Y within the expansion chamber 7 of the cooling station 8. Advantageously, the plant 1 object of the present invention comprises a stretching station 27 provided with a stretching channel 28 extending along said vertical axis Y mechanically associated with a lower edge of the containment body 11.

[0109] Advantageously, the plant 1 which is the subject matter of the present invention further comprises a deposition station 30 located inferiorly to the stretching station 27, along the main channel 3 and terminating with the filament lower outlet 5. The deposition station 30 suitably comprises a diffuser 31. The diffuser 31 of the deposition station 42 extends by enlarging from the stretching station 27, terminating with the filament lower outlet 5 for depositing filaments onto a conveyor belt 32.

[0110] Operationally, the filaments passing through the diffuser 31 of the deposition station 30 tend to intertwine with each other and are therefore deposited on the conveyor belt 32 in the form of a non-woven tape.

[0111] From what has been said, it is clear that the non-woven fabric production plant, according to the invention, is particularly advantageous because:

- can overcome, at least partially, the drawbacks of

the above-mentioned known technique.

- allows the filaments within the main channel to be optimally cooled.
- generates an even cooling air flow rate across the entire extent of the main channel cooling chamber;
- is structurally completely reliable.
- is functionally completely reliable;
- is simple and/or cheap to implement;
- is cost-effective;
- is industrially feasible;
- is an alternative and/or an improvement on traditional solutions;
- has an alternative and/or improved layout, both in terms of construction and function, compared to traditional solutions.

[0112] The present invention has been illustrated and described in its preferred embodiment, but it is understood that variations in execution may be made to it in practice, without, however, going beyond the scope of protection of this patent for industrial invention.

Claims

1. Non-woven fabric production plant, comprising:

- a support structure with a main channel (3) extending along a vertical axis (Y) from an upper inlet (4) to a lower outlet (5);
- a feeding station (6) located above said main channel (3) and communicating with said upper inlet (4) to feed non-woven forming filaments into said main channel (3);
- a cooling station (8), which is located along said main channel (3) below said feeding station (6) and comprises:

  - a containment body (11) extending along said vertical axis (Y) between an upper end (19) and a lower end (20), and extending around said vertical axis (Y) delimiting at least a cooling chamber (12) within said main channel (3) and defining internally at least an expansion chamber (7);
  - cooling means fluidically connected with said expansion chamber (7) and with said cooling chamber (12) and capable of introducing into said cooling chamber (12) at least a first air flow rate (10) to cool the filaments liable to pass through said cooling chamber (12);
  - homogenising means (13) housed within said expansion chamber (7) and configured to intercept said first air flow rate (10) and generate a second substantially homogenous air flow rate (14);

  said homogenising means (13) comprise at least one grid (15) having at least a plurality of wires defining between them a plurality of crossing paths for said first air flow rate (10) to generate said second homogenised air flow rate (14);

  characterised in that each crossing path of this plurality of crossing paths extends inclined to a horizontal axis (X).

2. Non-woven fabric production plant according to claim 1, **characterised in that** said grid (15) of said homogenising means (13) comprises at least a first plurality of wires (16), extending from each other parallel and parallel to said vertical axis (Y) and at least by a second plurality of wires (16'), weaved transversely with said first plurality of wires (16).

3. Non-woven fabric production plant according to claim 2, **characterised in that** said first plurality of wires (16) and said second plurality of wires (16') of said grid (15) of said homogenising means (13) define said plurality of crossing paths for said first air flow rate (10) with each other.

4. Non-woven fabric production plant according to one or more of the preceding claims, wherein said containment body (11) extends between an inlet opening (17) and an outlet opening (9) for said first air flow rate (10), **characterised in that** said homogenising means (13) comprise two or more of said grids(15) arranged parallel to the vertical axis (Y) between said inlet opening (17) and said outlet opening (9), wherein at least one grid proximal to said inlet opening (17) and at least one grid proximal to said outlet opening (9).

5. Non-woven fabric production plant according to claim 4, **characterised in that** said grid (15) proximal to said inlet opening (17) comprises said plurality of wires (16) each having a first diameter; said grid (15) proximal to said outlet opening (9) comprises said plurality of wires (16) each having a second diameter smaller than said first diameter.

6. Non-woven fabric production plant according to claim 5, **characterised in that** said grid (15) proximal to said inlet opening (17) defines a number of crossing paths for said first air flow rate (10) smaller than the number of crossing paths defined by said grid (15) proximal to said outlet opening (9).

7. Non-woven fabric production plant according to any one of claims 4 to 6, **characterised in that** it comprises at least one curtain wall (18) extending protruding from said inlet opening (17), defining a first expansion zone (7') provided with a first extension (D1) defined between said upper end (19) and said

curtain wall (18) and a second expansion zone (7") provided with a second extension (D2) between said curtain wall (18) and said lower end (20) different from said first extension (D1).

8. Non-woven fabric production plant according to claim 7, **characterised in that** the ratio of said first extension (D1) of said first expansion zone (7') to said second extension (D2) of said second expansion zone (7") is between 0,4 and 0,7 and preferably between 0,5 and 0,6.

9. Non-woven fabric production plant according to claim 8, **characterised in that** said curtain wall (18) extends between a first end (18') extending from said inlet opening (17), and a second portion (18") placed at the division of at least one of said grids (15).

10. Non-woven fabric production plant according to one or more of the preceding claims, **characterised in that** said cooling station (8) comprises a barrier element (25) housed within the expansion chamber (7) of said containment body (11).

11. Non-woven fabric production plant according to claim 10, **characterised in that** said barrier element (25) is interposed between the inlet opening (17) and the homogenising means (13) and is configured to intercept the first air flow rate (10) incoming from the inlet opening (17) and preferably lower its speed before it reaches the at least one grid (15).

12. Non-woven fabric production plant according to claim 11, **characterised in that** said barrier element (25) defines at least one slot passage (26) for the passage of the first air flow rate (10).

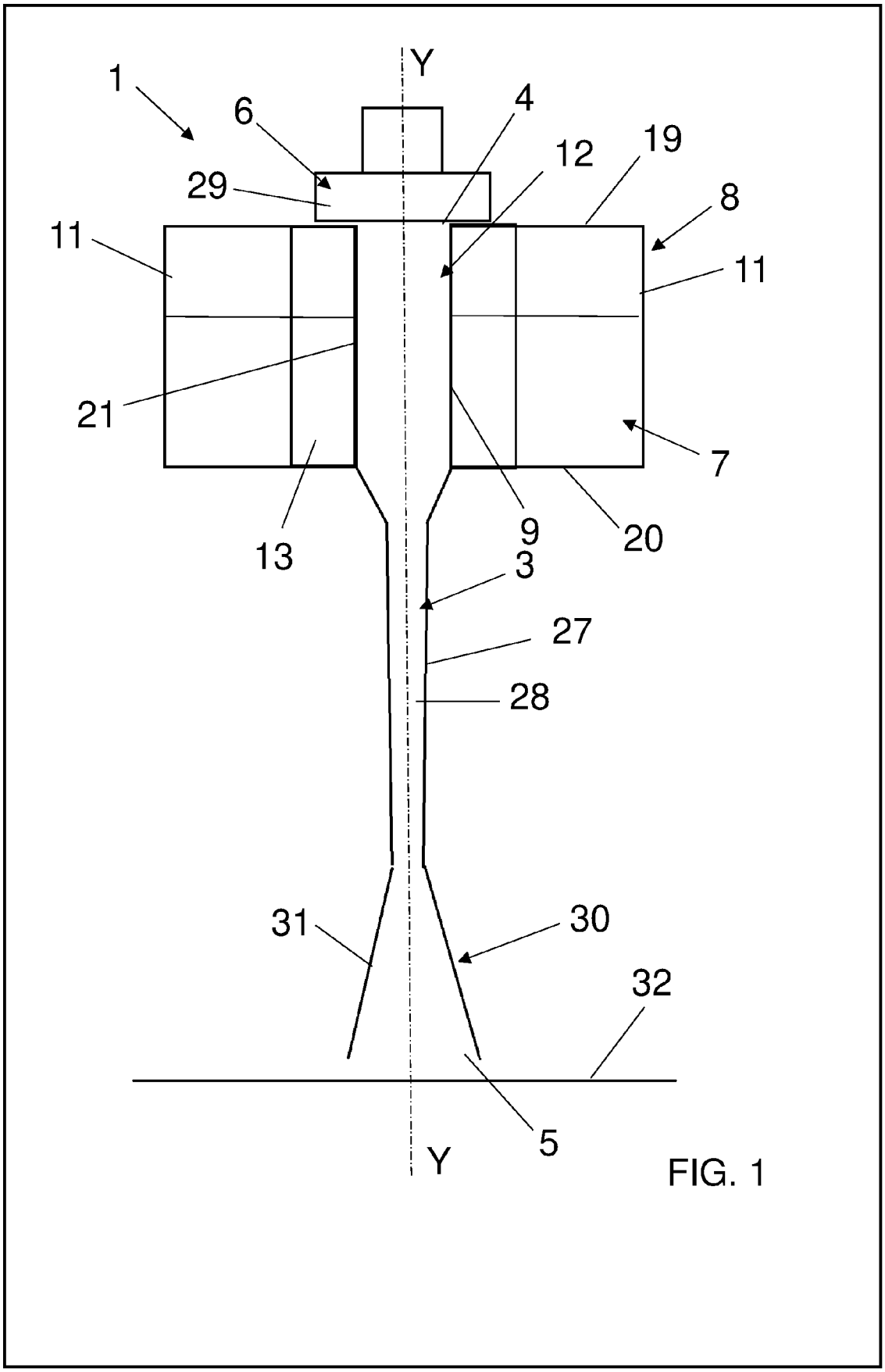

FIG. 1

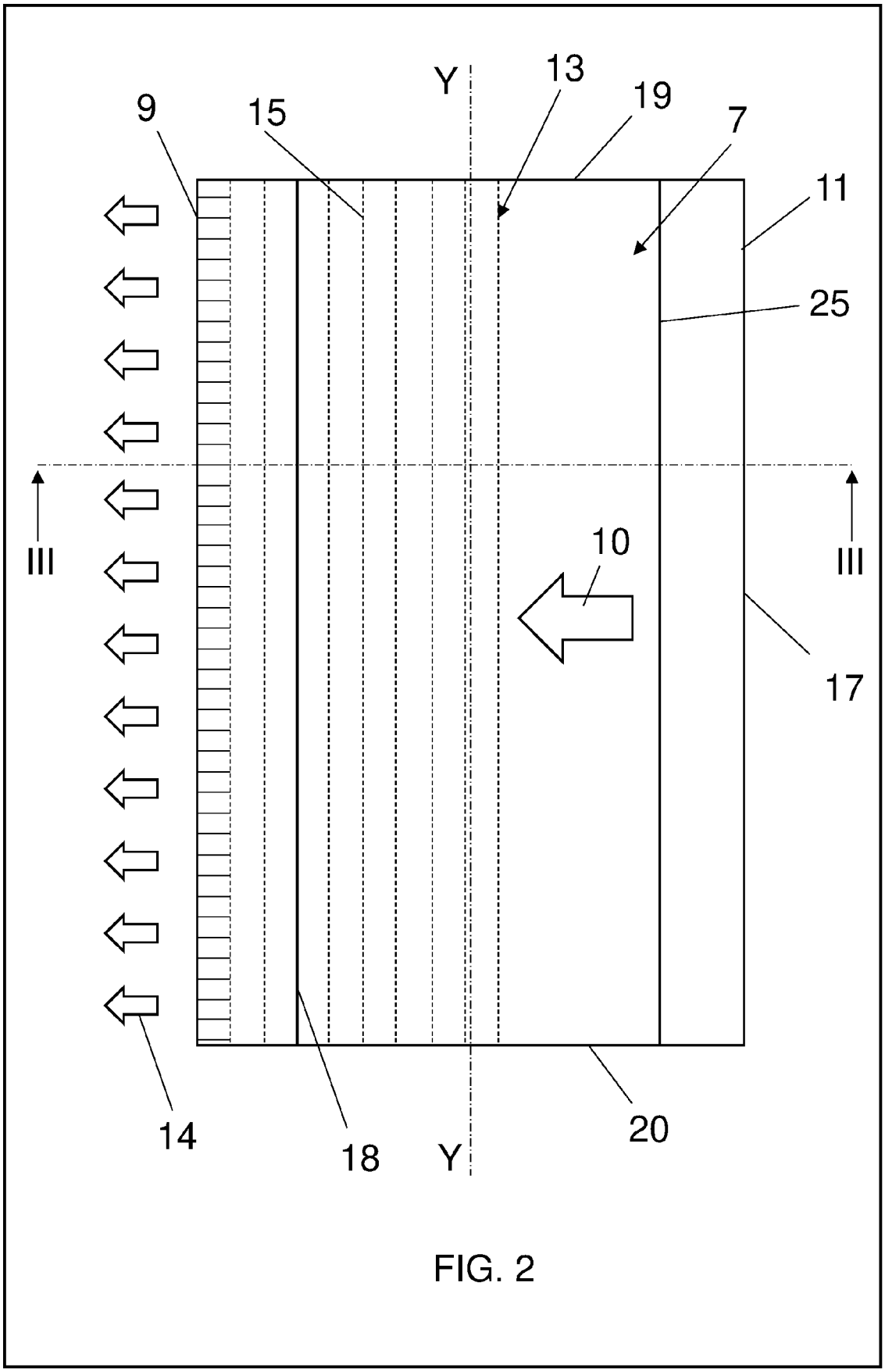

FIG. 2

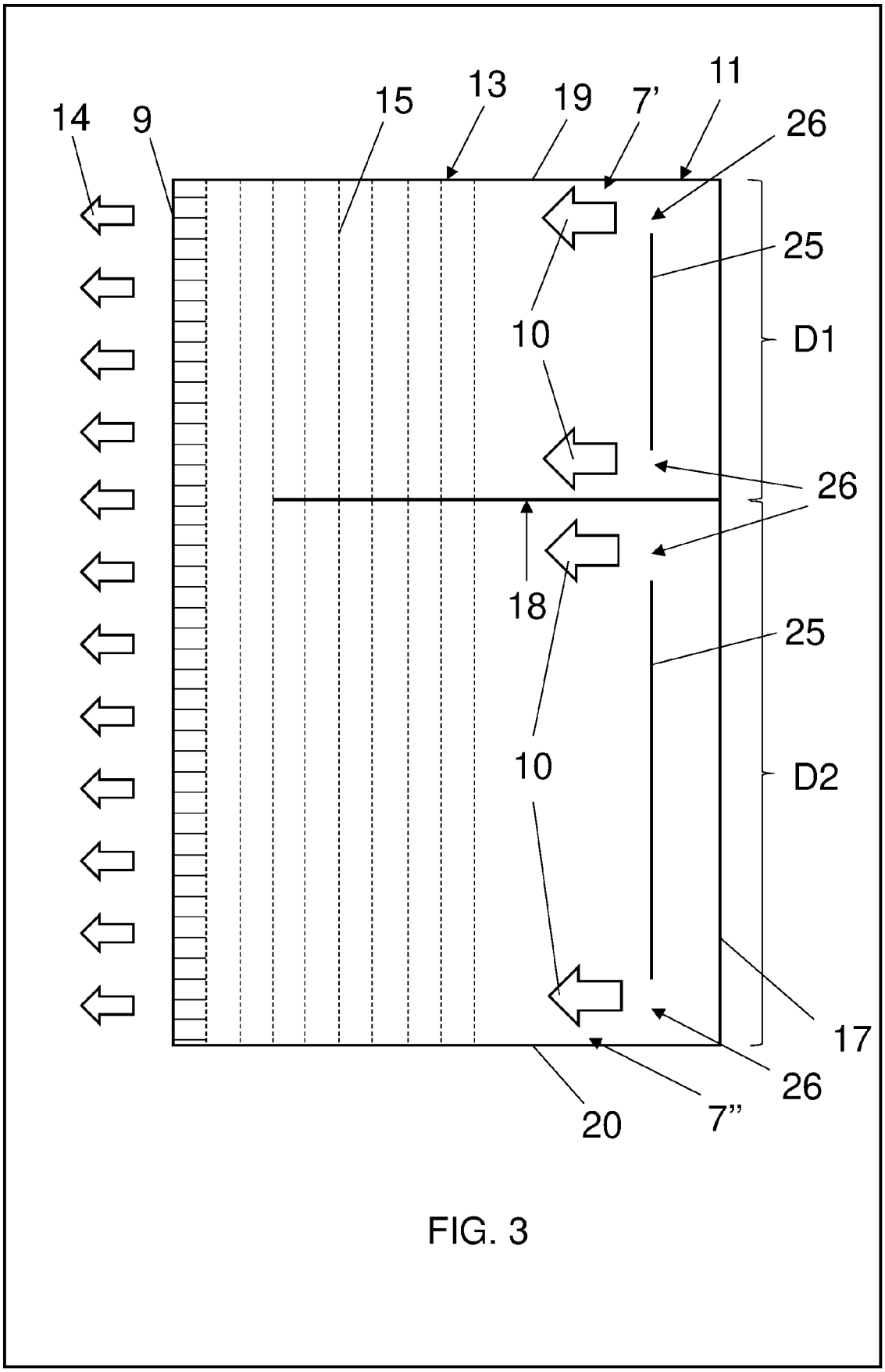

FIG. 3

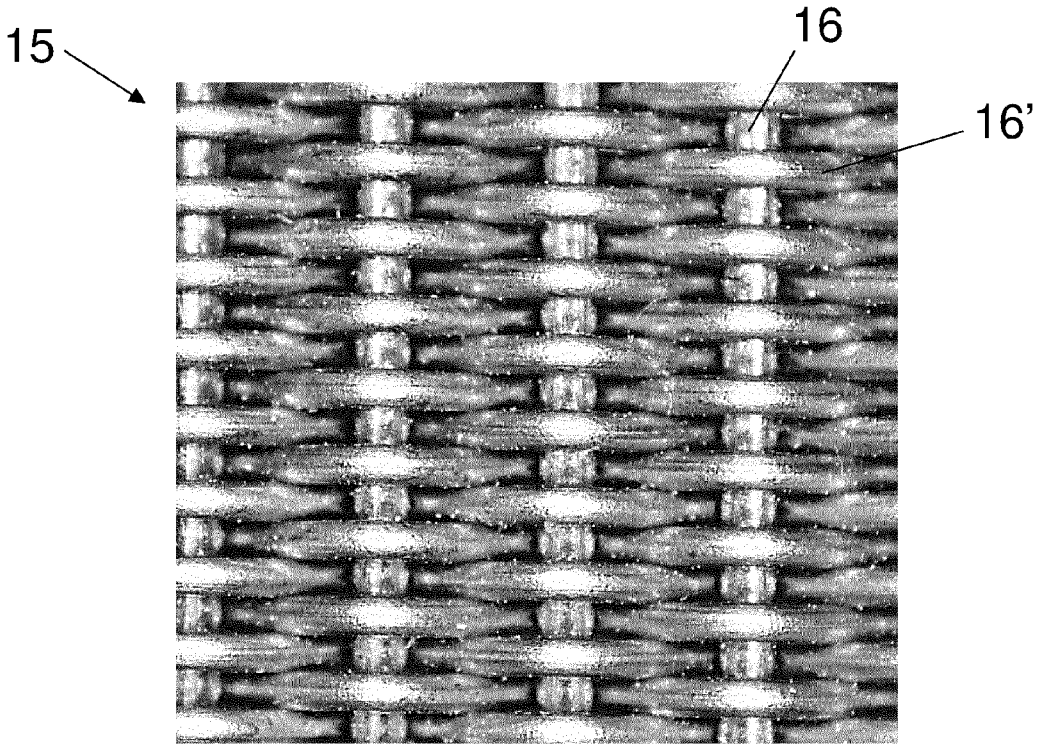

FIG. 4

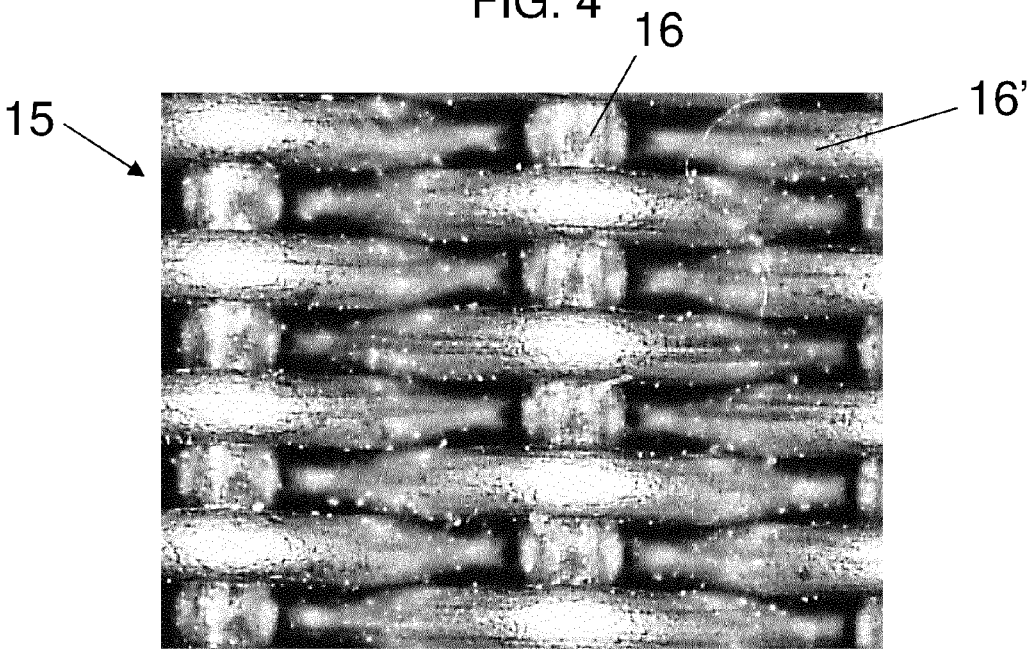

FIG. 5

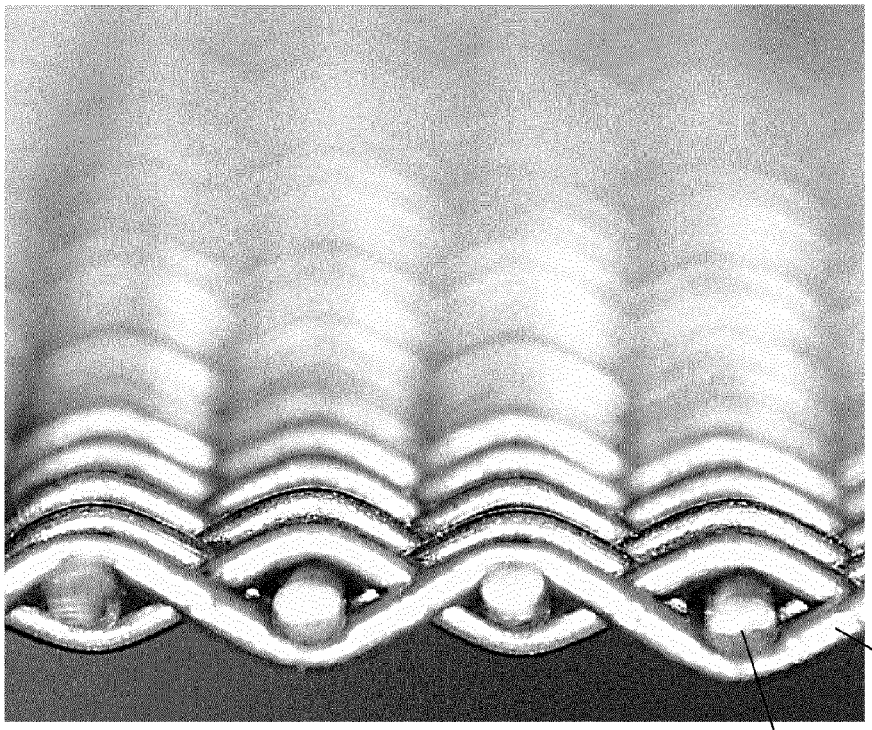

FIG. 6

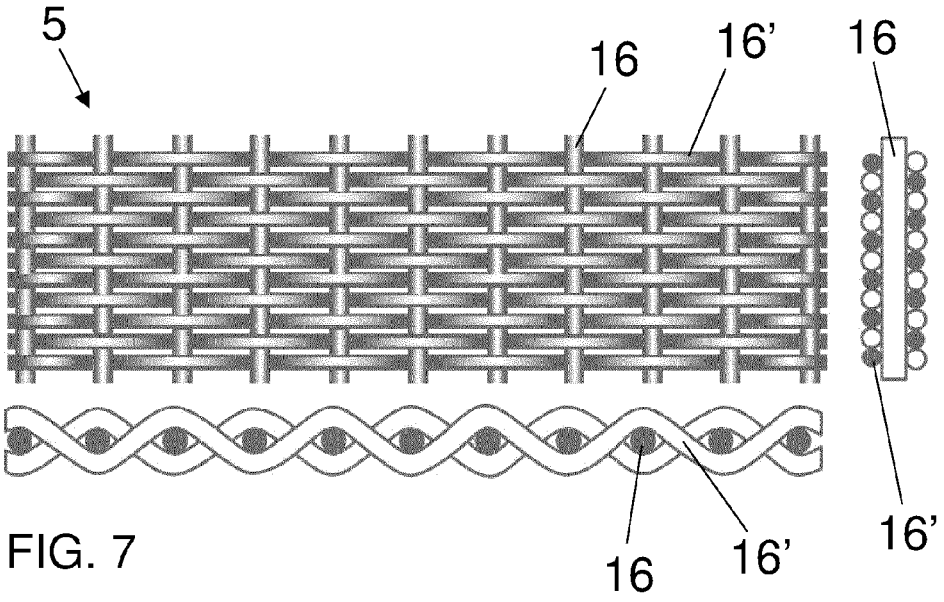

FIG. 7

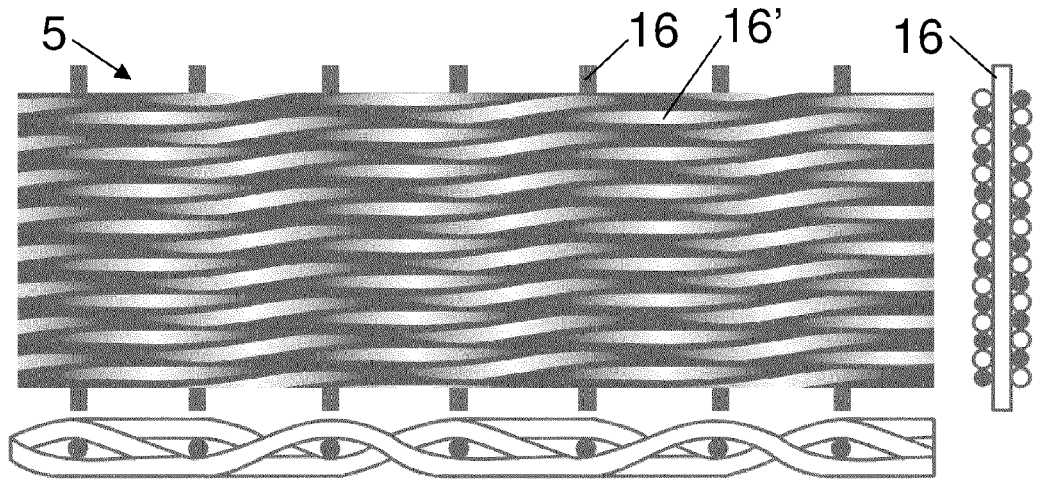

FIG. 8

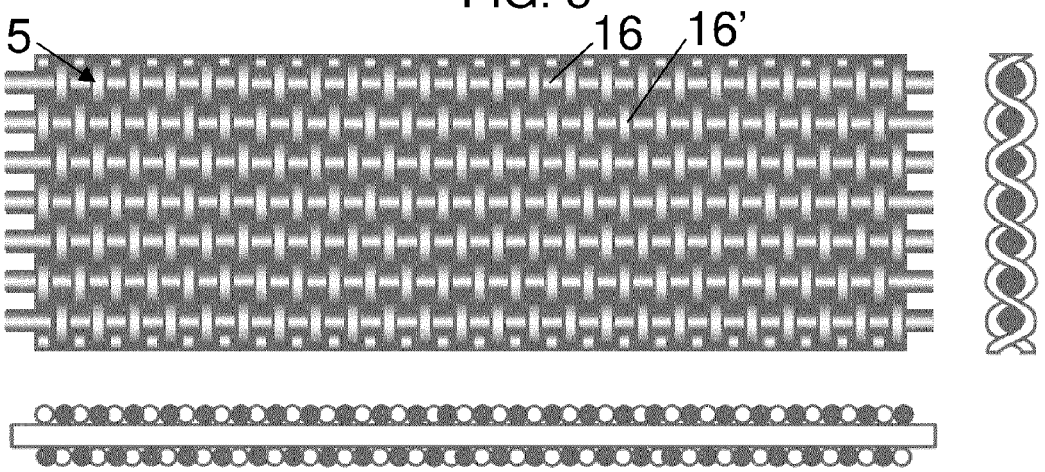

FIG. 9

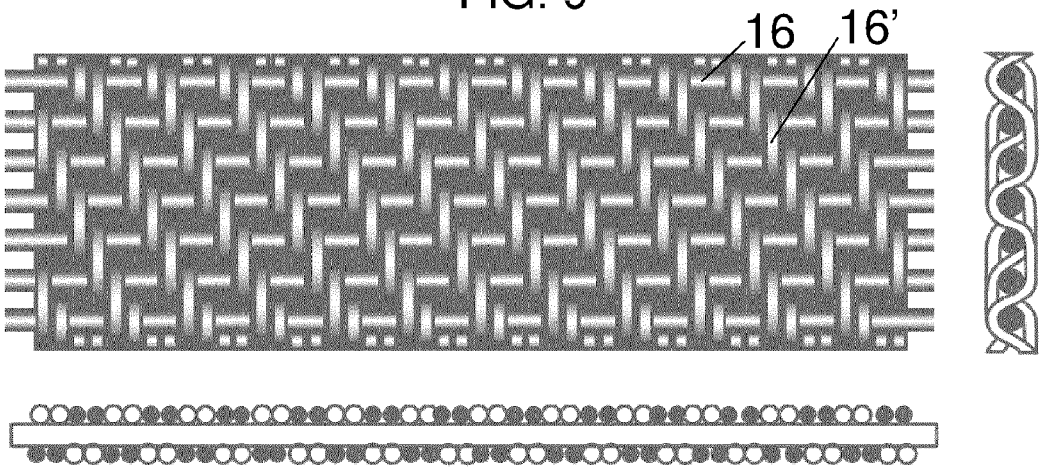

FIG. 10

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EUROPEAN SEARCH REPORT

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