

Fig. 1

Description

Field of application

[0001] The present invention regards a plant for producing nonwoven fabric and a process for producing nonwoven fabric, in particular in plastic material, according to the preamble of the respective independent claims.

[0002] The present plant and process for producing nonwoven fabric are intended to be advantageously employed in the field of production of strips of fibers adapted to form a nonwoven fabric, it too normally strip-like.

[0003] In particular, the plant and the process for producing nonwoven fabric, object of the present invention, are advantageously employable for producing a continuous strip of semifinished nonwoven fabric, intended to undergo subsequent transformations in order to obtain a finished product.

[0004] Such strips are normally used in particular for producing sanitary products, such as for example earphones, masks and gloves or in the field of agriculture for producing nonwoven fabric intended to be set on the ground to be cultivated, in order to prevent the formation of weeds and/or in order to protect seeds.

[0005] The invention is therefore inserted in the industrial field of production of strip-like material of nonwoven fibers, or more generally in the field of production of nonwoven fabric.

State of the art

[0006] Known for some time in the field of production of strips of fibers made of plastic material is the production of nonwoven fabric, such as for example polypropylene spunbond, polyester spunbond, polyethylene spunbond and/or other polymers, in particular for producing bandages, gauzes, earphones, masks and other sanitary products, or for example for producing nonwoven fabric intended for use in the agricultural field for covering terrain to be cultivated.

[0007] More generally, the nonwoven fabric is a semifinished product intended to undergo subsequent processing steps for producing products of various type, normally made of plastic material and in the form of strips or strip-superimposition. Such strips are formed by filaments placed in a random manner in layers and only joined together in a mechanical manner, or by means of adhesives or at least partially melted together by means of heat.

[0008] In the aforesaid technical field of production of nonwoven fabric, plants have been known for some time for producing nonwoven fabric, which normally provide for forming a plurality of plastic material filaments, which are stretched, set on a conveyor belt and then pressed one on the other in a random manner, in order to form the aforesaid strips of nonwoven fabric.

[0009] One example of a plant for producing nonwoven fabric is described in the document US 8,992,810. The

plant described herein is vertically extended along a main channel, along which different operative stations are vertically provided for the production of the aforesaid plastic material filaments.

[0010] At the upper part, a station is provided for extruding a plurality of plastic material filaments at high temperature, which are introduced within the main channel through an upper inlet mouth, at which an extrusion head is placed from which the filaments exit outward on the lower part. As is known, such extrusion head is provided on the lower part with a plurality of holes facing the upper inlet opening, from which a mass of molten plastic material exits outward in the form of filaments.

[0011] The filaments are normally extruded in the form of soft plastic material, at high temperature, normally comprised between 150°C and 280°C.

[0012] On the lower part, a cooling station is provided (known with the term "quenching" in the technical jargon of the field), into which an air flow is forcibly introduced within the main channel, by means of at least one fan placed externally with respect to the latter. The air flow introduced into the cooling station cools the filaments formed at the outlet of the extrusion head of the extrusion station.

[0013] The cooling station comprises lateral walls, normally metallic, which define a cooling volume, at a first segment of the main channel, within which the high-temperature filaments start to cool.

[0014] More in detail, the cooling station comprises an upper portion supplied by means of a first air flow and a lower portion supplied with a second air flow.

[0015] In addition, the plant of known type provides for a first supply duct placed in fluid connection with the upper portion and susceptible of being traversed by the first air flow and a second supply duct placed in fluid connection with the lower portion of the cooling station and susceptible of being traversed by the second air flow.

[0016] In order to stretch the filaments obtained by the extrusion station and subsequently cooled by the cooling station, the plant normally provides for an adjustment station, in which the air introduced into the first introduction section elongates the plastic material filaments within a reduced section segment of the main channel, up to making them reach the desired size, i.e. up to making them reach a linear density of about 1 - 5 dtex. In order to obtain the desired weave (i.e. a substantially random and uniform arrangement of the filaments) for the production of the nonwoven fabric, it is necessary to randomly weave the filaments together, forming a dense weave that is substantially without interruption.

[0017] For such purpose, the plant of known type is provided with a deposition station at a terminal segment of the main channel, which terminates on the lower part with an outlet opening opposite the inlet opening.

[0018] More in detail, the air which flows within the terminal segment of the main channel is moved in a manner such to confer a turbulent motion thereto. In this manner, the filaments are thrust by the air and are intersected with

each other in a substantially random manner in order to form aforesaid desired weave of the nonwoven fabric.

[0019] The terminal segment of the main channel is extended downward, and in particular towards the outlet opening, comprises a diffuser with substantially frusto-conical shape. The air which flows at its interior therefore encounters an increase of the duct section and slows up to taking on a turbulent motion, mixing and weaving the filaments which flow within the terminal segment itself.

[0020] Below the deposition station, the plant of known type provides for a conveyor belt placed below the outlet opening with which the terminal segment of the main channel terminates, in order to receive the filaments.

[0021] The conveyor belt is moved in order to advance, along a substantially horizontal movement direction, the filaments thus set for forming the strip of nonwoven fabric.

[0022] Subsequently, the strip of nonwoven fabric thus obtained undergoes further processing steps such as, for example, a pressing and it is then moved towards a winding station in which the strip is wound around a support core in order to form reels of nonwoven fabric, allowing a quick storage and transport thereof.

[0023] Also known from the patent EP 1323852 is a plant for producing nonwoven fabric provided with heating plates mechanically fixed to two opposite walls which define a channel for adjusting the aforesaid adjustment station.

[0024] More in detail, the walls are substantially composed of metallic plates that are opposite and placed substantially parallel to each other, which are extended between the cooling station and the deposition station.

[0025] The plant also comprises a temperature sensor of the outside environment and a weight sensor placed at the conveyor belt, both electrically connected to an electronic control unit.

[0026] The temperature sensor is adapted to generate a first electrical signal containing a temperature measurement of the outside environment and the weight sensor is adapted to generate a second electrical signal containing a specific weight measurement of the strip of nonwoven fabric formed on the aforesaid conveyor belt.

[0027] The electronic control unit is programmed for receiving and processing the first and second electrical signals and generating a corresponding third electrical signal for controlling the heating plates to bring the temperature of the walls of the adjustment station to the same temperature as the air which flows within the main channel of the plant.

[0028] In this manner, the plant allows avoiding the undesired deformation of the walls by thermal deformation due to the temperature difference between the main channel inside the plant and the temperature of the environment outside the plant, so as to obtain a strip of nonwoven fabric provided with specific weight that is substantially uniform at all points.

[0029] The plant for producing nonwoven fabric of known type, described briefly above, has in practice shown that it does not lack drawbacks.

[0030] The main drawback lies in the fact that the plant of known type does not allow an adjustment of the concentration of filaments within the main channel; actually it expressly provides for maintaining the distribution of filaments within the main channel as uniform as possible.

[0031] In this situation, the plant of known type does not allow adjusting the thickness and/or the width of the strip of nonwoven fabric that is formed on the conveyor belt.

[0032] A further drawback lies in the fact that the sensors and the heating plates of the plant of known type do not provide for an operation in the event in which the outside temperature is equal to or greater than the temperature inside the main channel, actually incurring the risk of malfunctioning of the plant if it is installed in zones with a high environmental temperature.

[0033] A further drawback lies in the fact that the heating plates of the plant of known type must be placed along the entire extension of the walls of the adjustment station, considerably weighing down such walls and therefore requiring corresponding support structures.

Presentation of the invention

[0034] In this situation, the problem underlying the present invention is therefore that of overcoming the drawbacks manifested by the plants for producing nonwoven fabric of known type, by providing a plant and a process for producing nonwoven fabric, which allow adjusting the distribution of filaments within the main channel.

[0035] A further object of the present invention is that of providing a plant and a process for producing nonwoven fabric which allow making a strip of nonwoven fabric provided with a distribution of filaments that is variable with respect to the width of the strip itself.

[0036] A further object of the present invention is that of providing a plant and a process for producing nonwoven fabric which are structurally and operatively simple, entirely reliable and capable of functioning in any operating condition.

[0037] A further object of the present invention is to provide a plant for producing nonwoven fabric which is simple for operators to use.

Brief description of the drawings

[0038] The technical characteristics of the invention, according to the aforesaid objects, can be clearly seen in the contents of the below-reported claims and the advantages thereof will be more evident in the following detailed description, made with reference to the enclosed drawings, which represent a merely exemplifying and non-limiting embodiment of the invention, in which:

- figure 1 shows a schematic front view of a plant for producing nonwoven fabric, object of the present invention;

- figure 2 shows a schematic front view of a detail of the plant for producing nonwoven fabric illustrated in figure 1, regarding deformation means placed at an adjustment station and a deposition station of the plant of figure 1;
- figure 3 shows a sectional view of the detail of the plant of figure 2 made along the trace III-III of figure 2 itself, with the deformation means in a rest configuration;
- figure 4 shows a sectional view of the detail of the plant of figure 2 made along the trace III-III of figure 2 itself, with the deformation means in a first deformation configuration;
- figure 5 shows a sectional view of the detail of the plant of figure 2 made along the trace III-III of figure 2 itself, with the deformation means in a second deformation configuration.

Detailed description of a preferred embodiment

[0039] With reference to the enclosed drawings, reference number 1 overall indicates a plant for producing nonwoven fabric, according to the present invention.

[0040] This is intended to be employed for producing nonwoven fabric of different type and material, such as in particular spunbond of plastic material, e.g. polypropylene and/or polyethylene, and in particular polyethylene terephthalate (PET in the technical jargon of the field).

[0041] Hereinbelow reference will be made to a plant 1 for producing nonwoven fabric in plastic material, in accordance with the preferred embodiment illustrated in the enclosed figures. Nevertheless, the plant 1 of the present invention can also be advantageously employed for producing nonwoven fabric of another type, per se well-known to the man skilled in the art and therefore not described in detail hereinbelow.

[0042] Therefore, hereinbelow with the term "nonwoven fabric" it must be intended a substantially strip-like material composed of a plurality of filaments that are compressed one on the other in a substantially random manner.

[0043] In particular, the nonwoven fabric is normally composed of a plurality of plastic material filaments joined together by means of a mechanical action, for example by means of crushing.

[0044] With reference to the example of figure 1, the plant 1 for producing nonwoven fabric according to the invention comprises a support structure 2 (illustrated in a schematized manner in figure 1) provided with a main channel 3 extended along a vertical axis Y from an upper inlet mouth 4 for the introduction of filaments for forming a nonwoven fabric to a lower outlet mouth 5 for the expulsion of the filaments.

[0045] Advantageously, the support structure 2 is intended to be abutted against the ground and preferably is made of strong metal material, such as for example steel and in particular stainless steel, such as for example

AISI 304 steel or AISI 431 steel.

[0046] The plant 1 advantageously comprises a supply station 6 placed above the main channel 3 and in communication with the inlet mouth 4 of the latter in order to introduce filaments in the main channel 3 for forming a nonwoven fabric.

[0047] Preferably, the supply station 6 comprises means for forming molten plastic material (not illustrated in the enclosed figures) placed in flow connection with the inlet mouth 4 of the main channel 3 and comprising an extruder (per se well-known to the man skilled in the art and therefore not described in detail hereinbelow), preferably supported by the support structure 2, adapted to form a continuous flow of molten plastic material and an extrusion head 6', preferably mechanically supported by the support structure 2, placed in connection with the extruder and provided with an extrusion plate facing towards the inlet mouth 4 of the main channel 3.

[0048] The extrusion plate of the extrusion head 6' of the supply station 6 is advantageously provided with a plurality of through holes, susceptible of being traversed by the flow of molten plastic material in order to form the filaments. The filaments are normally extruded in soft plastic material form, at high temperature, normally comprised between 150°C and 280°C.

[0049] In operation, the filaments thus formed pass through the inlet mouth 4 and enter into the main channel 3 in order to allow a processing thereof through a plurality of operating stations, as described in detail hereinbelow.

[0050] In accordance with the preferred embodiment illustrated in the enclosed figure 1, the plant 1 comprises a cooling station 22, which is placed along the main channel 3 below the inlet mouth 4 and defines, in the main channel 3 itself, a cooling chamber 23. Advantageously, the cooling chamber 23 defines a corresponding longitudinal section (parallel to the vertical axis Y) of the main channel 3. As discussed in detail hereinbelow, in the aforesaid cooling chamber 23, a cooling gas (e.g. air) is susceptible of being forcibly introduced in order to cool the filaments coming from the outlet of the extrusion head 6' of the supply station 6.

[0051] According to the invention, the plant 1 comprises an adjustment station 7, which is extended along the vertical axis Y below the inlet mouth 4 and comprises at least two stretch walls 9, which are extended opposite each other with respect to the vertical axis Y, i.e. they are preferably substantially mirrored with respect to the vertical axis Y, with particular reference to the enclosed figure 1, and are provided with two respective internal faces 9', which define between them a stretch section 8 in the main channel 3, and with two opposite external faces 9'' externally directed with respect to the main channel 3.

[0052] Advantageously, the stretch section 8 of the main channel 3 is defined on a section plane defined orthogonal to the vertical axis Y.

[0053] Suitably, the width of the stretch section 8 is defined by the distance between the internal faces 9' of

the two stretch walls 9.

[0054] Preferably, for the purpose of increasing the speed of the air within the stretch section 8, the stretch walls 9 of the adjustment station 7 are extended (towards the outlet mouth 5) tilted with respect to the vertical axis Y, in particular they are extended, defining the aforesaid stretch section 8 provided with transverse width with respect to the vertical axis Y which is progressively decreased along a top-bottom direction.

[0055] In this manner, the provision of a decreasing width of the stretch section 8 of the main channel 3 allows, due to the well-known Bernoulli's law, an acceleration and therefore an increase of the speed of the air that flows therein.

[0056] The air that accelerates in the stretch section 8 simultaneously drives the filaments, elongating them and bringing them to the desired thickness, in particular comprised between about 1 - 5 dtex.

[0057] Suitably, the stretch walls 9 of the adjustment station 7 have a depth-wise extension that is extended orthogonally to the vertical axis Y and orthogonally to the direction of the width of the stretch section 8.

[0058] Advantageously, with reference to the example of figure 1, the adjustment station 7 is placed, along the main channel 3, below the cooling station 22, in order to elongate the filaments 7 coming from the latter. In particular, the adjustment station 7 is provided with a stretch duct at the stretch section 8 of the main channel 3 (which can be of the type per se known to the man skilled in the art) extended along the vertical axis Y and extended between the cooling chamber 9 and the outlet mouth 5 of the main channel 3. Below the outlet mouth 5 of the main channel 3, a deposition zone 24 is arranged which is adapted to receive the filaments exiting from the stretch section 8, and comprising for example a conveyor belt 25. The deposition zone 24 therefore defines an area with an abutment surface that faces the outlet mouth 5 of the main duct 3 and has substantially rectangular shape.

[0059] Advantageously, in accordance with the preferred embodiment illustrated in particular in the enclosed figure 1, the plant 1, object of the invention, comprises a deposition station 17, which is extended along the vertical axis Y between the adjustment station 7 and the aforesaid outlet mouth 5 of the main channel 3.

[0060] More in detail, such deposition station 17 comprises at least two deposition walls 18, which are extended opposite each other with respect to the vertical axis Y (i.e. they result substantially mirrored with respect to each other, with respect to the vertical axis Y) and are provided with two respective internal faces 18' which define between them a deposition section 19 in the main channel 3 and two opposite external faces 18'' externally directed with respect to the main channel 3.

[0061] Advantageously, the deposition walls 18 of the deposition station 17 are extended tilted with respect to the vertical axis Y, in particular they are extended mutually moved away, with respect to a top-bottom extension

direction.

[0062] More in detail, the width of the deposition section 19 increases along a top-bottom direction, i.e. along a direction from the inlet mouth 4 to the outlet mouth 5.

[0063] In this manner, the air flow which travels through the main channel 3 reduces its speed, opening the filaments, which are thrust to occupy the entire width of the outlet mouth 5 before being collected by the deposition zone 24.

[0064] Preferably, the plant 1 comprises a monomer suction station 60 placed at the inlet mouth 4 of the main channel 3, comprising suction means (not illustrated) placed in fluid communication with the main channel 3 in order to suction a suction flow.

[0065] More in detail, the monomer suction station 60 is configured for expelling, by means of the suction flow, possible fumes from the main channel 3 that were produced during the extrusion of the plastic material from the extrusion head 6' through a stack (not illustrated), which connects the main channel 3 of the plant 1 with the outside environment.

[0066] According to the idea underlying the present invention, the plant 1 comprises first deformation means 10 mechanically constrained to the external faces 9'' of the stretch walls 9 of the adjustment station 7 in order to deform the stretch section 8 of the main channel 3.

[0067] The first deformation means 10 according to the invention comprise at least one first deformable member 11' mechanically fixed on the external face 9'' of a first stretch wall 9A of the stretch walls 9 and extended at least along a first transverse axis X' orthogonal to the vertical axis Y.

[0068] The first deformation means 10 according to the invention also comprise at least one second deformable member 11'' mechanically fixed on the external face 9'' of a second stretch wall 9B of the stretch walls 9 and extended at least along a second transverse axis X'' orthogonal to the vertical axis Y and parallel to the first transverse axis X'.

[0069] In particular, the first and second transverse axes X', X'' are extended along the depth-wise direction of the stretch walls 9, and in particular transversely to the direction of the width of the stretch section 8 of the main channel 3.

[0070] According to the invention, the first deformable member 11' and the second deformable member 11'' are actuatable at least between a rest configuration, in which they are extended substantially parallel to each other, and a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the stretch section 8 of the main channel 3.

[0071] In particular, in the deformation configuration, the first and second deformable members 11', 11'' have a respective curvature in the direction of the corresponding first and second transverse axis X', X'', being extended, along such first and second transverse axes X', X'', with curved extension.

[0072] Advantageously, the two curved profiles, which

are defined by the first and second deformable members 11', 11" in deformation configuration, are extended along the first and second transverse axes X', X" respectively of the first and of the second deformable member 11', 11" themselves.

[0073] In particular, the curved profiles defined by the first and second deformable members 11', 11" are identified on a section plane orthogonal to the vertical axis Y.

[0074] In this manner, the plant, object of the present invention, allows varying the form of the stretch section 8, in particular its transverse shape with respect to the vertical axis Y, so as to adjust the distribution of filaments within the main channel 3.

[0075] Indeed, the different shape of the stretch section 8 involves a different distribution of the air flow within the main channel 3 and, consequently, a different distribution of the filaments driven by the air flow itself.

[0076] Advantageously, each of the first deformable member 11' and the second deformable member 11" comprises a bar 12 fixed on the external face 9" of the stretch wall 9 of the adjustment station 7 and extended transversely to the vertical axis Y and in particular along, respectively, the first transverse axis X' and the second transverse axis X".

[0077] In addition, each first deformable member 11' and each second deformable member 11" advantageously comprises actuator means 13 mechanically connected to the bar 12 and actuatable for moving the bar 12 between the rest configuration and the deformation configuration.

[0078] The actuator means 13 can be of any type known to the man skilled in the art, suitable for deforming the bar 12 in order to bring it into the deformation configuration.

[0079] For example, in accordance with an embodiment not illustrated in the enclosed figures, the actuator means 13 can be of hydraulic and/or pneumatic type comprising at least one hydraulic and/or pneumatic piston mechanically connected to the bar 12 and actuatable to move the bar 12 itself in the deformation configuration.

[0080] In accordance with the preferred embodiment illustrated in the enclosed figures, the bar 12 is advantageously made of metallic material, or more generally of a thermally conductive material, and the actuator means 13 of each of the first deformable member 11' and of the second deformable member 11" comprise at least one heating body 14 mechanically fixed on the bar 12.

[0081] In this manner, the heating body 14 is actuatable to heat the bar 12, which increases the volume thereof by thermal expansion and takes on the aforesaid deformation configuration.

[0082] Advantageously, the actuator means 13 also comprise at least one temperature sensor 15 operatively associated with the bar 12 and placed for detecting at least one first temperature measurement of the bar 12 and generating a corresponding first electrical signal.

[0083] The actuator means 13 advantageously also comprise a logic control unit 16 operatively connected to

the temperature sensor 15 and to the heating body 14 and programmed for receiving and analyzing the first electrical signal of said temperature sensor 15 and generating at least one first corresponding control signal for controlling the heating body 14 to heat the bar 12 up to a predetermined threshold temperature.

[0084] Preferably, the logic control unit 16 comprises a microprocessor, in particular a PLC, which is provided with a memory in which at least one algorithm is saved comprising the aforesaid predetermined threshold temperature value.

[0085] Advantageously, the algorithm saved within the electronic control unit is of closed loop feedback type, in which the heating bodies 14 are controlled to reach the aforesaid predetermined temperature value in a continuous manner, constantly comparing the measured value of the temperature sensor 15 with the predetermined threshold value and generating the corresponding electrical control signal.

[0086] With particular reference to the enclosed figures 3 - 5, the bar 12 of the actuator means 13 is advantageously extended between a fixing portion 12', proximal with respect to the vertical axis Y and mechanically constrained to the external face 9" of the stretch wall 9 and a free portion 12" that is distal with respect to the vertical axis Y.

[0087] More in detail, each bar 12 of the actuator means 13 is a bar with "H" transverse section mechanically fixed at its fixing portion 12' on the corresponding external face 9" of the stretch wall 9 of the adjustment station 7.

[0088] Advantageously in addition, the actuator means 13 of each of the first deformable member 11' and of the second deformable member 11" comprise a first plurality of heating bodies 14' mechanically fixed on the fixing portion 12' of the bar 12 and aligned with each other parallel to the first transverse axis X', and a second plurality of heating bodies 14" mechanically fixed on the free portion 12" of the bar 12 and aligned with each other parallel to the first plurality of heating bodies 14'.

[0089] Advantageously, the heating bodies 14, 14', 14" comprise heating elements electrically connected to an electrical power supply source (per se well-known to the man skilled in the art and not illustrated in the enclosed figures) configured for electrically power supplying the heating elements and generating a heating via ohmic effect.

[0090] Of course, the heating bodies 14, 14', 14" can be of any type known to the man skilled in the art and suitable to heat the bar 12 of the actuator means 13 without departing from the protective scope of the present patent.

[0091] Advantageously, the logic control unit 16 is programmed for controlling one from among the first plurality of heating bodies 14' and the second plurality of heating bodies 14" to heat the corresponding fixing portion 12' or free portion 12" of the bar 12.

[0092] In this manner, with particular reference to the

enclosed figures 4 and 5, the plant 1 according to the invention allows moving the stretch walls 9 of the adjustment station into at least two different deformation configurations.

[0093] More in detail, in a first embodiment, the logic control unit 16 is programmed for controlling the first plurality of heating bodies 14' to heat the corresponding fixing portion 12' of the bar 12, as illustrated in the enclosed figure 5, in which the first heating bodies 14' are depicted darker than the second heating bodies 14", in order to indicate their higher temperature.

[0094] In this situation, the fixing portion 12' of the bar 12 increases volume following the well-known thermal expansion effect.

[0095] More in detail, the bar 12 is moved in a first deformation configuration in which it defines a curved shape with concavity directed externally with respect to the main channel 3 of the plant 1.

[0096] In operation, the air within the main channel 3 of the plant 1 tends to accumulate the filaments at the center of the main channel 3 itself, inducing a greater thickness at the center of the strip of nonwoven fabric that is formed on the deposition zone 24. Otherwise, with particular reference to the enclosed figure 4, the logic control unit 16 is programmed for controlling the second plurality of heating bodies 14" to heat the corresponding free portion 12" of the bar 12, as illustrated in the enclosed figure 4, in which the second heating bodies 14" are depicted darker than the first heating bodies 14', in order to indicate their higher temperature.

[0097] In this situation, the free portion 12" of the bar 12 increases volume following the well-known thermal expansion effect.

[0098] More in detail, the bar 12 is moved into a second deformation configuration in which it defines a curved shape with concavity directed internally with respect to the main channel 3 of the plant 1, i.e. directed towards the main channel 3 itself.

[0099] In operation, the air within the main channel 3 of the plant 1 tends to accumulate the filaments at the lateral ends of the main channel 3 itself, inducing a greater thickness at the lateral edges of the strip of nonwoven fabric that is formed on the deposition zone 24.

[0100] Therefore, by suitably programming the logic control unit for controlling the first and the second heating bodies 14', 14" to heat the bar 12 to a predetermined threshold temperature, it is possible to deform the stretch walls 9 of the adjustment station 7, obtaining any type of distribution of the filaments in order to form the strip of nonwoven fabric.

[0101] In order to adjust in an even finer manner the distribution of the filaments within the central channel 3 and therefore obtain a strip of nonwoven fabric provided with the desired thickness and density characteristics, the plant 1 advantageously comprises second deformation means 20 mechanically constrained to the external faces 18" of the deposition walls 18 of the deposition station 17 in order to deform the deposition section 19 of

the main channel 3.

[0102] Advantageously, the second deformation means 20 comprise at least one third deformable member 21' mechanically fixed on the external face 18" of a first deposition wall 18A of the deposition walls 18 and extended at least parallel to the first transverse axis X' orthogonal to the vertical axis Y.

[0103] In addition, the second deformation means 20 advantageously comprise at least one fourth deformable member 21" mechanically fixed on the external face 18" of a second deposition wall 18B of the deposition walls 18 and extended at least parallel to the second transverse axis X" orthogonal to the vertical axis Y and parallel to the first transverse axis X'.

[0104] The third deformable member 21' and the fourth deformable member 21", in a manner entirely analogous to the first deformable member 11' and the second deformable member 11" of the first deformation means 10, are actuatable at least between a rest configuration, in which they are extended substantially parallel to each other and a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the deposition section 19 of the main channel 3.

[0105] In this manner, it is possible to vary in a controlled manner also the shape of the deposition section 19.

[0106] Of course, all the characteristics described above with particular reference to the first deformation means 10, are equally applicable, mutatis mutandis, to the second deformation means 20.

[0107] More in detail, the second deformation means 20 are entirely analogous to the first deformation means 10 and preferably comprise a second bar 26 fixed on the external face 18" of the deposition wall 18 of the deposition station 17 and extended transversely to the vertical axis Y and second actuator means 27 mechanically connected to the second bar 26 and actuatable for moving the second bar 26 between the rest configuration and the deformation configuration.

[0108] In addition, in a manner entirely analogous to the first deformation means 10, the second bar 26 is made of metal material, and more generally of a thermally conductive material, and the second actuator means 27 of each of the third deformable member 21' and fourth deformable member 21" comprise at least one aforesaid heating body 14 mechanically fixed on the second bar 26, at least one aforesaid temperature sensor 15 operatively associated with the second bar 26 and placed for detecting at least one second temperature measurement of the second bar 26 and generating a corresponding first electrical signal, in particular containing the aforesaid second measurement, the aforesaid logic control unit 16, operatively connected to the temperature sensor 15 and to the heating body 14 and programmed for receiving and analyzing the second electrical signal of the temperature sensor 15 associated with the second bar 26 and generating at least one second corresponding control signal for controlling the corresponding heating body 14

to heat the second bar 26 up to a predetermined threshold temperature.

[0109] Advantageously, the first deformation means 10 and the second deformation means 20 are provided at least in proximity to a junction zone between the adjustment station 7 and the deposition station 17.

[0110] More in detail, the stretch walls 9 of the adjustment station 7 terminate below an upper end of the corresponding deposition walls 18 of the deposition station 17.

[0111] In order to obtain a uniform deformation of the main channel 3, and more particularly in order to obtain a first deformed configuration of the stretch section 8 congruent with the second deformed configuration of the deposition section 19 of the central channel 3, the first bars 12 and the second bars 26 are deformed in order to define substantially congruent concavities.

[0112] In this manner, the plant 1 allows preventing the risk of defining undesired steps between the lower ends of the stretch walls 9 and the upper ends of the deposition walls 18.

[0113] Also forming the object of the present invention is a process for producing nonwoven fabric, attainable in particular by means of a plant 1 of the type described up to now and regarding which the same reference number will be maintained for the sake of description simplicity.

[0114] The process according to the invention provides for a step of supplying the main channel 3 with a plurality of plastic material filaments through the inlet mouth 4.

[0115] The process then provides for a step for adjusting the filaments, passing within the stretch section 8 of the adjustment station 7, in which an air flow passing within the main channel 3 stretches and elongates the filaments.

[0116] In addition, the process then provides for a depositing step, in which the filaments traverse the outlet mouth 5 for the formation of a strip of nonwoven fabric comprising the aforesaid filaments.

[0117] According to the idea underlying the present invention, the process also provides for at least one first deformation step, in which the first deformable member 11' and the second deformable member 11'' are actuated from a rest configuration, in which they are extended substantially parallel to each other, to a deformation configuration, in which they define two corresponding curved profiles, in order to vary at least the shape of the stretch section 8 of the main channel 3.

[0118] Advantageously, the deformation step provides for actuating the logic control unit 16 to receive and analyze the first electrical signal of the temperature sensor 15 and generate at least one first corresponding control signal for controlling the heating body 14 to heat the bar 12 in order to reach a predetermined threshold temperature.

[0119] Preferably, the logic control unit 16 comprises a microprocessor, in particular a PLC, which is provided with a memory in which at least one algorithm is saved comprising the aforesaid predetermined threshold tem-

perature value.

[0120] The deformation step suitably provides for receiving the electrical signal containing the first temperature value of the bar 12 of the actuator means 13, comparing it with the predetermined threshold temperature value, generating the second electrical control signal in order to increase or decrease the temperature of the heating bodies 14, so as to bring the temperature to the desired value.

[0121] In this manner, the process according to the invention allows deforming the bars 12, 26 in a controlled and substantially automatic manner.

[0122] More in detail, the deformation step provides that the difference between the threshold temperature and the ambient temperature is at least 50°C.

[0123] Suitably, the process, object of the present invention, preferably comprises a second deformation step, in which the third deformable member 21' and the fourth deformable member 21'' are actuated at least from a rest configuration, in which they are extended substantially parallel to each other, to a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the deposition section 19 of the main channel 3.

[0124] The invention thus conceived therefore attains the pre-established objects.

Claims

1. Plant (1) for the production of nonwoven fabric, comprising:

- a support structure (2) provided with a main channel (3) extended along a vertical axis (Y) from an upper inlet mouth (4) for the introduction of filaments for forming a nonwoven fabric, to a lower outlet mouth (5) for the expulsion of said filaments;
- an adjustment station (7), which is extended along said vertical axis (Y) below said inlet mouth (4) and comprises at least two stretch walls (9), which are extended opposite each other with respect to said vertical axis (Y) and are provided with two respective internal faces (9'), which define between them a stretch section (8) in said main channel (3), and with two opposite external faces (9'') externally directed with respect to said main channel (3);

said plant (1) being **characterized in that** it comprises first deformation means (10) mechanically constrained to the external faces (9'') of the stretch walls (9) of said adjustment station (7) in order to deform the stretch section of said main channel (3) and comprising:

- at least one first deformable member (11') me-

chanically fixed on the external face (9") of a first stretch wall (9A) of said stretch walls (9) and extended at least along a first transverse axis (X') orthogonal to said vertical axis (Y);

- at least one second deformable member (11") mechanically fixed on the external face (9") of a second stretch wall (9B) of said stretch walls (9) and extended at least along a second transverse axis (X") orthogonal to said vertical axis (Y) and parallel to said first transverse axis (X'); 5 10

said first deformable member (11') and said second deformable member (11") being actuatable at least between a rest configuration, in which they are extended substantially parallel to each other, and a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the stretch section (8) of said main channel (3).

2. Plant (1) according to claim 1, **characterized in that** each said first deformable member (11') and said second deformable member (11") comprises: 20

- a bar (12) fixed on the external face (9") of the stretch wall (9) of said adjustment station (7) and extended transversely to said vertical axis (Y); 25
- actuator means (13) mechanically connected to said bar (12) and actuatable for moving said bar (12) between the rest configuration and the deformation configuration. 30

3. Plant (1) according to claim 2, **characterized in that** said bar (12) is made of metal material and the actuator means (13) of each of said first deformable member (11') and of said second deformable member (11") comprise: 35

- at least one heating body (14) mechanically fixed on said bar (12);
- at least one temperature sensor (15) operatively associated with said bar (12) and placed for detecting at least one first temperature measurement of said bar (12) and generating a corresponding first electrical signal; 40
- a logic control unit (16) operatively connected to said temperature sensor (15) and to said heating body (14) and programmed for receiving and analyzing the first electrical signal of said temperature sensor (15) and generating at least one first corresponding control signal for controlling 45
said heating body (14) to heat said bar (12) up to a predetermined threshold temperature. 50

4. Plant (1) according to claim 3, **characterized in that** each said bar is extended between a fixing portion (12'), proximal with respect to said vertical axis (Y) and mechanically constrained to the external face (9") of said stretch wall (9) and a free portion (12") 55

that is distal with respect to said vertical axis (Y); the actuator means (13) of each of said first deformable member (11') and of said second deformable member (11") comprise:

- a first plurality of heating bodies (14') mechanically fixed on the fixing portion (12') of said bar (12), aligned with each other parallel to said first transverse axis (X');
- a second plurality of heating bodies (14") mechanically fixed on the free portion (12") of said bar (12), aligned with each other parallel to said first plurality of heating bodies (14'); 5

said logic control unit (16) being programmed for controlling one between said first plurality of heating bodies (14') and said second plurality of heating bodies (14") to heat the corresponding fixing portion (12') or free portion (12") of said bar (12).

5. Plant (1) according to any one of the preceding claims, comprising a deposition station (17), which is extended along said vertical axis (Y) between said adjustment station (7) and said outlet mouth (5) and comprises at least two deposition walls (18), which are extended opposite each other with respect to said vertical axis (Y) and are provided with two respective internal faces (18'), which define between them a deposition section (19) in said main channel (3), and with two opposite external faces (18") externally directed with respect to said main channel (3);

said plant (1) being **characterized in that** it comprises second deformation means (20) mechanically constrained to the external faces (18") of the deposition walls (18) of said deposition station (17) for deforming the deposition section of said main channel (3) and comprising:

- at least one third deformable member (21') mechanically fixed on the external face (18") of a first deposition wall (18A) of said deposition walls (18) and extended at least parallel to said first transverse axis (X') orthogonal to said vertical axis (Y);
- at least one fourth deformable member (21") mechanically fixed on the external face (18") of a second deposition wall (18B) of said deposition walls (18) and extended at least parallel to said second transverse axis (X") orthogonal to said vertical axis (Y) and parallel to said first transverse axis (X'); 5

said third deformable member (21') and said fourth deformable member (21") being actuatable at least between a rest configuration, in which they are extended substantially parallel to each other and a deformation configuration, in which they define two cor-

responding curved profiles, in order to vary the shape of the deposition section (19) of said main channel (3).

6. Plant (1) according to claim 5, **characterized in that** said first deformation means (10) and said second deformation means (20) are provided in proximity to a junction zone between said adjustment station (7) and said deposition station (17).

7. Process for the production of nonwoven fabric, attainable by means of a plant (1) according to any one of the preceding claims, said process providing for:

- a step of supplying said main channel with a plurality of plastic material filaments through said inlet mouth (4);
- a step of adjusting said filaments, in which said filaments pass within the stretch section (8) of said adjustment station (7), in which an air flow passing within said main channel (3) stretches and elongates said filaments;
- a depositing step, in which said filaments traverse said outlet mouth (5) for the formation of a strip of nonwoven fabric comprising said filaments;

said process being **characterized in that** it comprises at least one first deformation step, in which said first deformable member (11') and said second deformable member (11'') are actuated from a rest configuration, in which they are extended substantially parallel to each other, to a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the stretch section (8) of said main channel (3).

8. Process according to claim 7, attainable by means of a plant (1) according to claim 3 or 4, **characterized in that** said deformation step provides for actuating said logic control unit (16) to receive and analyze the first electrical signal of said temperature sensor (15) and generate at least one first corresponding control signal for controlling said heating body (14) to heat said bar (12) in order to reach a predetermined threshold temperature.

9. Process according to claim 8, **characterized in that** said deformation step provides that the difference between said threshold temperature and the ambient temperature is at least 50°C.

10. Process according to claim 7, attainable by means of a plant (1) according to claim 5 or 6, **characterized in that** it comprises a second deformation step, in which said third deformable member (21') and said fourth deformable member (21'') are actuated at

least from a rest configuration, in which they are extended substantially parallel to each other, to a deformation configuration, in which they define two corresponding curved profiles, in order to vary the shape of the deposition section (19) of said main channel (3).

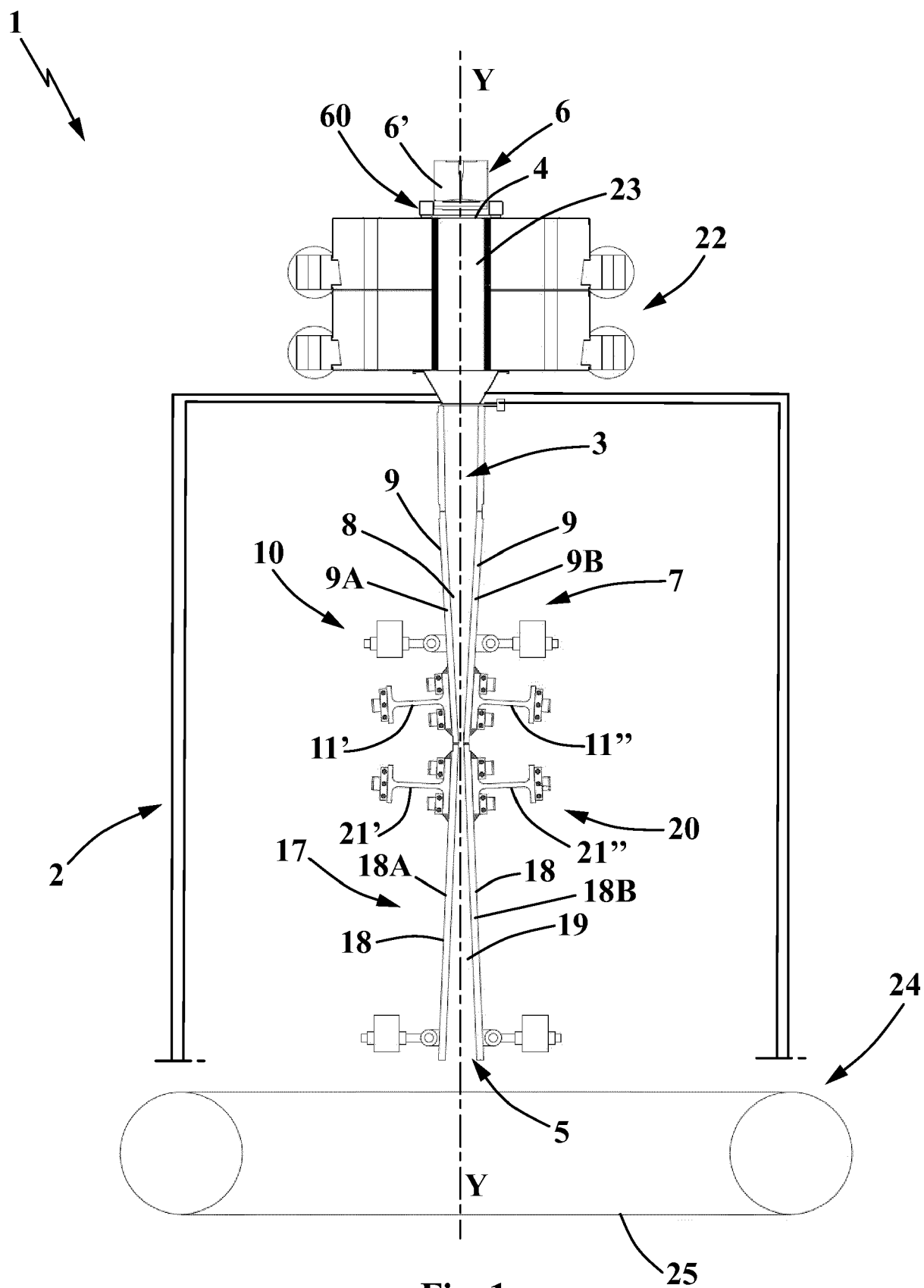
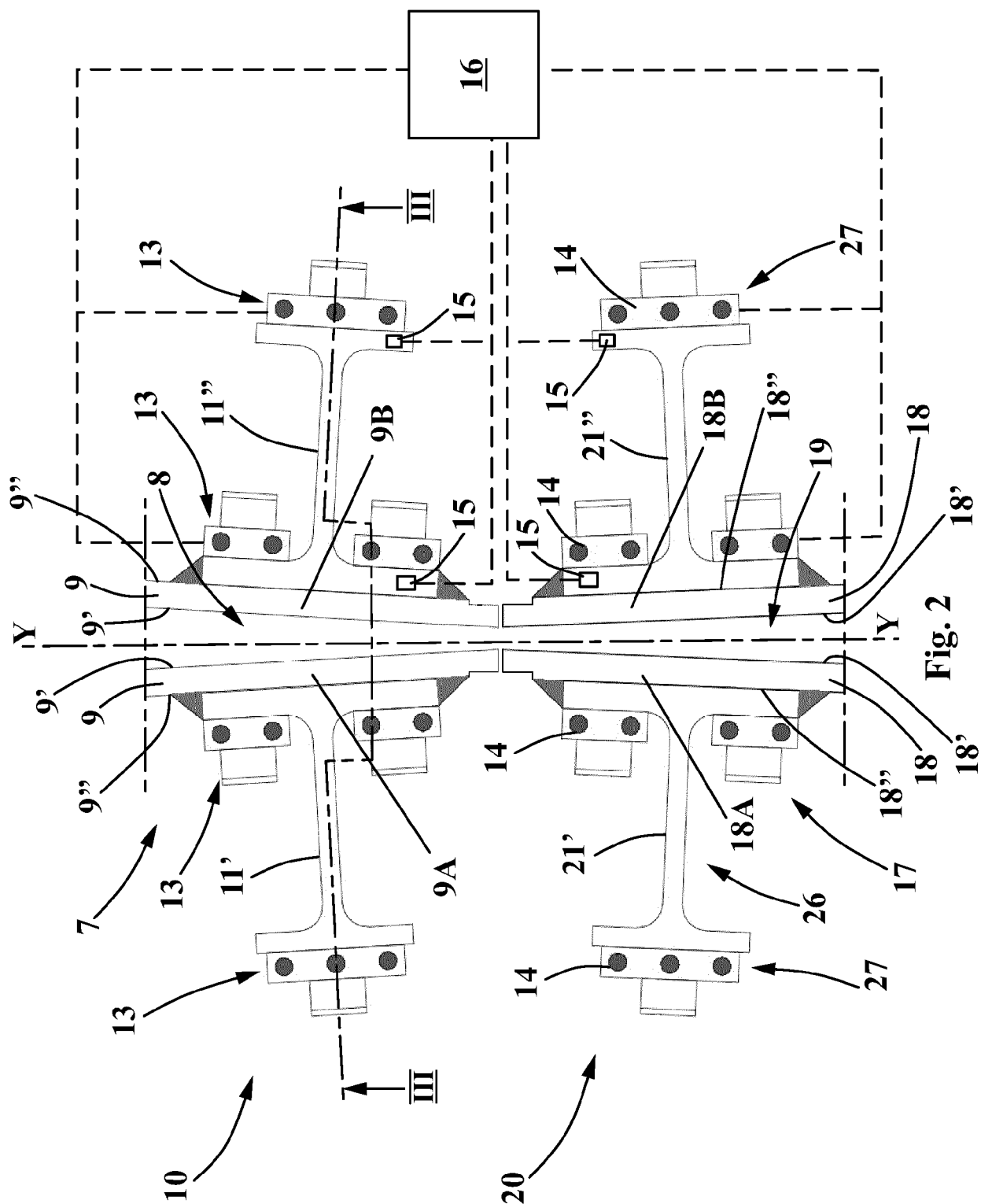


Fig. 1



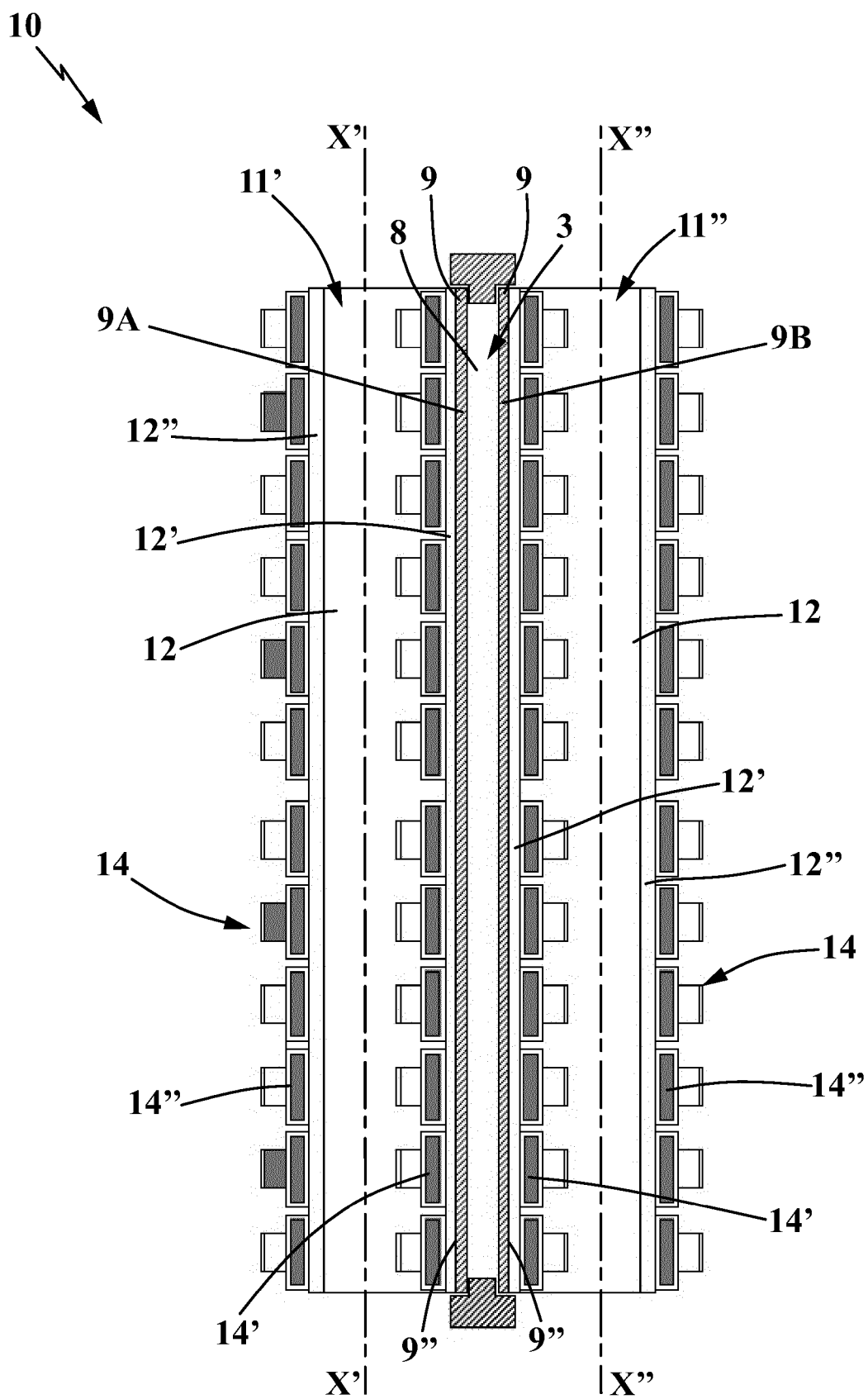


Fig. 3

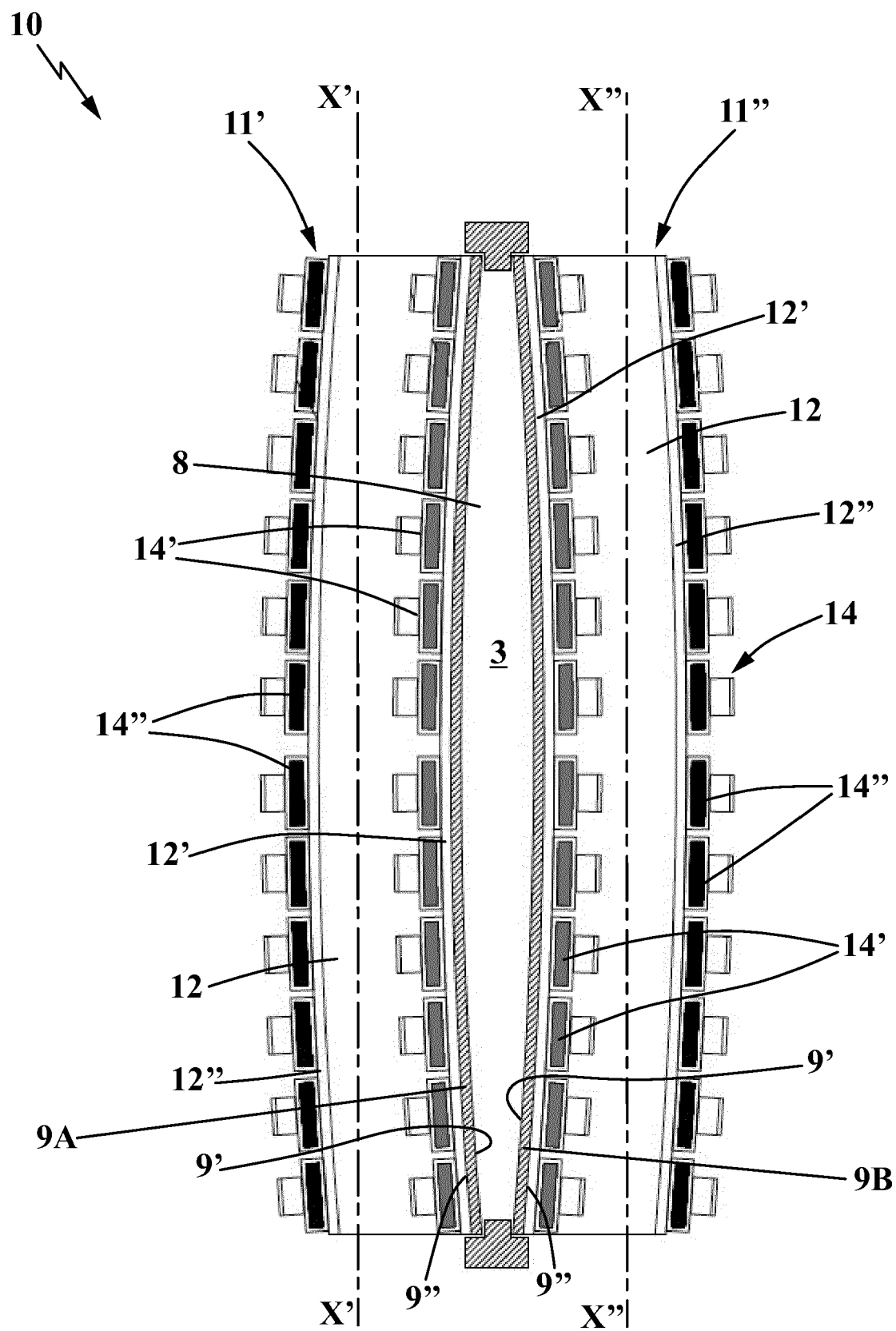


Fig. 4

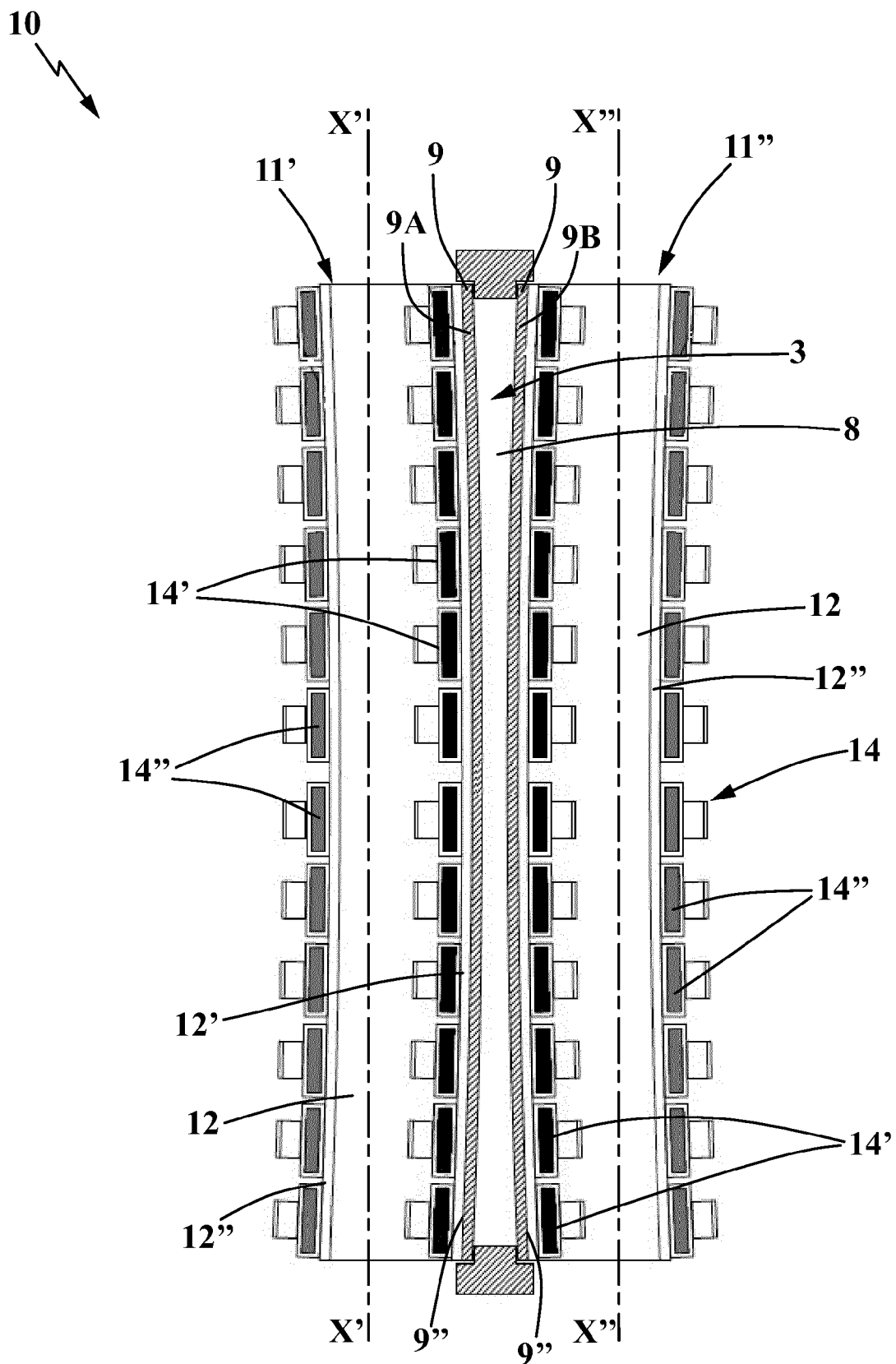


Fig. 5



EUROPEAN SEARCH REPORT

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			D04H D01D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 June 2021	Examiner Demay, Stéphane
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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