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(54) **PROCESS AND APPARATUS FOR PRODUCING A SPUNBOND NONWOVEN FABRIC**

(57) Process for producing a nonwoven fabric by means of an apparatus for producing a nonwoven fabric comprising a spinneret for extruding filaments, a drawing duct arranged below said spinneret, a movable support permeable to gases and adapted to define a deposition region for said filaments and configured to move said filaments away from the deposition region along a feed direction, a suction device comprising a main suction channel and at least one first group of suction channels downstream of said main suction channel. This process comprises the steps of:
(a) extruding a plurality of filaments from the spinneret, said filaments being preferably at least bicomponent filaments;
(b) drawing said filaments by means of said drawing duct;
(c) depositing the drawn filaments on the movable support to form a nonwoven fabric, and operating said suction device so as to suction gas below said movable support;
wherein in said step c) the suction speed between the channels of the first group of channels gradually decreases in the feed direction of the movable support, said suction speed of the channels of the first group of suction channels being less than the suction speed of the main suction channel.

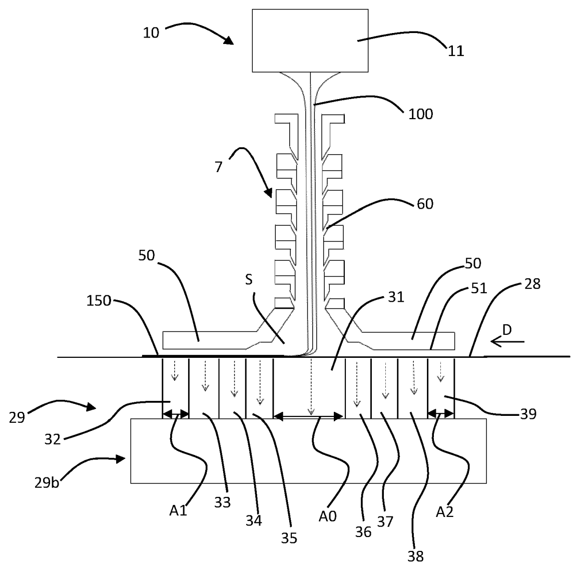

Fig. 1

Description

[0001] The present invention relates to a process and apparatus for producing a spunbond nonwoven fabric.

[0002] A spunbond nonwoven fabric can be used in various fields, such as for example the medical and sanitary ones, but also in the geotechnical field, in civil engineering, in building construction. Depending on the application, the nonwoven fabric can have different mechanical characteristics in terms of finishing, resistance to particular agents, etc., so as to meet the different requirements of the sectors of use. Nonwoven fabrics made from filaments formed by of two or more materials, so as to be able to exploit the different characteristics of the materials used, are known in the art.

[0003] Typically, an apparatus for producing a spunbond nonwoven fabric comprises a filament spinning head (spinneret) fed by extruders of two or more components, a drawing unit in which filaments are drawn by air flows which can be controlled according to the production requirements of a particular nonwoven fabric, a depositing unit for the drawn filaments that typically comprises a movable support which then receives the filaments drawn by the drawing unit. The movable support is usually an air-permeable belt where the filaments are deposited in a deposition region. Immediately downstream of the deposition region there is typically a calender which allows the nonwoven fabric to be mechanically compacted. In particular, the calender not only compacts the filaments for the first time, but also promotes even distribution of the filaments in the nonwoven fabric by mechanically deforming the nonwoven fabric. The deposition region is typically delimited within a substantially enclosed region of the apparatus, typically formed by a cover arranged at a minimum distance from the movable support. Therefore, the calender is typically arranged at the exit of this enclosed region and, in addition to the functions discussed above, prevents or at least obstructs the inflow of outside air into the deposition region, which could adversely affect the formation of the nonwoven fabric on the movable support.

[0004] However, the calender has high operating and maintenance costs, being a large moving component. Furthermore, the calender is typically heated during its operation in order to improve its performance, leading to additional energy consumption. Moreover, the maintenance of a moving body having considerable size is a complex and expensive operation.

[0005] The calender can also have high volumetric dimensions within an apparatus for producing nonwoven fabric.

[0006] Object of the present invention is to solve the above mentioned problems and to provide an apparatus and process for producing a spunbond nonwoven fabric having an even distribution of filaments, wherein the filaments are at least partially compacted, in a simple and economical way.

[0007] These and other objects are solved by the present invention by means of a process and apparatus according to one or more of the appended claims.

[0008] In particular, an apparatus and process according to the independent claims are object of the present invention. Preferred aspects are set forth in the dependent claims.

[0009] According to an aspect the present invention is directed to a process for producing a nonwoven fabric by means of an apparatus for producing a nonwoven fabric comprising a spinneret for extruding filaments, a drawing duct arranged below said spinneret, a movable support permeable to gases and adapted to define a deposition region for said filaments and configured to move said filaments away from the deposition region along a feed direction, a suction device comprising a main suction channel and at least one first group of suction channels downstream of said main suction channel. This process comprises the steps of:

(a) extruding a plurality of filaments from the spinneret, wherein the filaments are preferably at least bicomponent filaments;

(b) drawing said filaments by means of the drawing duct;

(c) depositing the drawn filaments on the movable support to form a nonwoven fabric, and operating the suction device so as to suction gas below said movable support.

[0010] In step c), the suction speed between the channels of the first group of channels decreases progressively between the various channels in the feed direction of the movable support. Moreover, the suction speed of the channels in the first group of suction channels is less than the suction speed of the main suction channel.

[0011] The main suction channel is placed, in use, below the movable support and is positioned to suction gases at least in the filament deposition region.

[0012] In the first group of channels, which is arranged immediately downstream of the main channel, the suction speed of the individual channels decreases progressively in the feed direction of the movable support. In other words, each channel in the first group of channels has suction speed lower than the channel located upstream of it. The suction speed of the channel of the first group of channels arranged immediately downstream of the main channel is lower than that of the main channel.

[0013] As the number of channels in the first group of channels increases, the possibility of a fine control of the degree of progressive decrease in suction speed increases. In other words, as the number of channels in the first channel group increases, the possibility of too high discontinuities in the suction speed values, which could cause undesirable effects on the formation of nonwoven fabric such as tears and delaminations, decreases. During step c), the suction of gas below the movable support contributes to the effective deposition of the drawn filaments, such as by promoting the accumulation of the drawn filaments in the deposition region; the suction also helps to hold the filaments in place and allows the drawn filaments to be compacted for the first time while promoting an even distribution of the filaments.

[0014] Advantageously, the suction speed between the channels of the first group of channels decreases progressively in the feed direction of the movable support. In the deposition region, where the stretched filaments come into contact with the movable support, it is advantageous to reduce the movement of the filaments in order to contribute to homogeneous formation of the nonwoven fabric. The movement of the filaments decreases as they move away from the deposition region, so that less airflow rate is required to hold in place the nonwoven fabric. In addition, less suction also allows the nonwoven fabric to extend in the direction of its thickness. A gradual decrease in air suction is achieved by a gradual decrease in suction speed in the channels of the first group of channels.

[0015] According to a possible aspect, the suction speed of the main channel is between 40 m/s and 120 m/s and the suction speed of each channel of the first group of channels is between 45 and 85 m/s.

[0016] According to a possible aspect, the suction speed of each channel of the first group of channels is at least 10% less than the suction speed of the channel arranged upstream of that channel.

[0017] Advantageously, the suction speed in the channels can be regulated according to the characteristics desired for the final nonwoven fabric.

[0018] The suction speed between the different channels of the first channel group can decrease gradually, for example in a substantially linear manner. In other words, the suction speed of each channel in the first group of channels can gradually decrease by a constant factor, so that each channel has a suction speed 10% lower than the suction speed of the channel arranged upstream of that channel.

[0019] However, alternative solutions in which the decrease is nonlinear are not excluded. In these embodiments, the suction difference between two successive channels of the first group may be different for each pair of consecutive channels.

[0020] According to a possible aspect, the suction device comprises a second group of channels upstream of the main channel, and the suction speed of the channels in the second group of channels increases progressively between the channels in the feed direction of the movable support.

[0021] The suction speed of the channels in the second group of suction channels is less than the suction speed of the main suction channel.

[0022] In other words, in the second group of channels, which is arranged immediately upstream of the main channel, considering the feed direction of the movable support, each channel has lower suction speed than the channel immediately downstream. The suction speed of the channel of the second group of channels in contact with the main channel is lower than that of the main channel.

[0023] According to a possible aspect, the suction speed of each channel of the second group of channels is between 45 m/s and 85 m/s.

[0024] According to a possible aspect, the suction speed of the second group of channels is at least 10% less than the channel arranged downstream of that channel.

[0025] Similarly to what discussed for the first group of channels, the suction speed between the various channels in the second group of channels can increase in a substantially linear manner in the feed direction of the movable support.

[0026] However, the possibility that the suction speed increases non-linearly between the various channels is not excluded.

[0027] According to a possible aspect, the apparatus for producing a nonwoven fabric comprises a covering structure arranged above the first group of channels and the second group of channels, if any. The covering structure comprises a lower surface substantially parallel to said movable support and arranged spaced at a distance between 1.5 mm and 5 mm, preferably between 1.5 mm and 4 mm, from the movable support.

[0028] For example, suitable distances are between 1.5 mm and 2 mm or between 3 mm and 4 mm, or between 1.5 mm and 5 mm.

[0029] Typically, all channels arranged downstream of the main channel and below the covering structure have lower suction speed than that of the channel immediately upstream, considering the feed direction of the movable support.

[0030] Similarly, according to a preferred aspect, all channels arranged upstream of the main channel and below the covering structure have lower suction speed than that of the channel immediately downstream, considering the feed direction of the movable support.

[0031] Advantageously, such a cover prevents or at least obstructs, together with the suction provided by the channels, the inflow to the deposition region of outside air, which could move the falling filaments and/or alter the characteristics of the air in the deposition region, e.g., density, temperature, humidity, and thus negatively affect the formation of the nonwoven fabric on the movable support.

[0032] According to a possible aspect, the width of the main channel is greater than the width of each channel of the first group of channels and greater than the width of each channel, if any, of the second group of channels.

[0033] Advantageously, the main channel is arranged so as to operate at the entire deposition region, that is, to suction air at the entire region where the filaments can be deposited as they fall from the spinneret and following the drawing step.

[0034] Each channel of the first group channels and of the second group of channels, if any, has a width less than the width of the main channel so that a finer regulation of the suction speed downstream (and possibly also upstream) of the deposition region can be made.

[0035] According to a possible aspect, the width of the main channel is equal to or greater than the width of the deposition region, wherein said width of the deposition region is measured in the same direction as the width of the main channel.

[0036] According to a possible aspect, the nonwoven fabric is not calendered at said main suction channel nor at said first group of suction channels.

[0037] Typically, nonwoven fabric does not provide calendering of a nonwoven fabric arranged at the channels of the suction device.

[0038] The absence of the calender at the channels of the suction device avoids mechanical treatment of the nonwoven fabric immediately after the deposition, and reduces the energy consumption of the structure while ensuring effective formation of the nonwoven fabric. In addition, the inflow of outside air into the deposition region is drastically limited or prevented despite the absence of calendars.

[0039] According to a possible aspect, in step (b) the air speed in at least part of the drawing duct is between 40 m/s and 180 m/s, preferably between 90 m/s and 150 m/s.

[0040] The regulation of the drawing speed in the drawing duct allows various properties of the filaments, such as the degree of crystallinity, elasticity (e.g. Young's modulus), breaking strength, etc. to be adjusted. The regulation of the drawing speed in the drawing duct can also help to define the final linear density of the filaments in the nonwoven fabric. In particular, an increase of the drawing speed generally results in a reduction of the linear density of the filaments.

[0041] According to a possible aspect, during the step of drawing the filaments, the air speed in the drawing duct can be regulated by means of venturi channels equipped with at least one adjustable narrowing.

[0042] As a matter of fact, the drawing channel preferably has venturi ducts at air inlets within the channel itself. In particular, the air passage duct of the venturi duct preferably has a narrowing having adjustable size. Such adjustable narrowing causes a change in the speed of air flowing out of the venturi channel downstream of the narrowing. The incoming air from the venturi duct mixes with the air already flowing in the drawing channel. Therefore, regulating the air flowing into the venturi helps to change the speed of the air flowing within the drawing duct, which, as discussed, performs filament drawing. Air introduced by the venturi ducts increases the drawing speed of the filaments.

[0043] In general, the regulation of the venturi ducts provides control over the drawing speed of the filaments, and thus allows the drawing step of the filaments, which can, for example, be varied depending on the filament-forming materials and/or the desired properties for the nonwoven fabric, to be regulated.

[0044] Embodiments alternative to that of depositing the filaments directly on the movable support involve depositing the filaments in step (c) on a second nonwoven fabric which is arranged at the deposition region and typically carried by the movable support at that region.

[0045] The second nonwoven fabric can have the same structural and mechanical characteristics as the nonwoven fabric produced according the above process. Alternatively, the second nonwoven fabric could have different characteristics so that, together with the nonwoven fabric formed by the filaments deposited thereon, it would form a composite nonwoven fabric with characteristics (e.g., mechanical and/or geometric) according to production requirements.

[0046] Advantageously, such embodiments provide the presence of the second group of channels, so as to maintain the second nonwoven fabric in such a position to allow the filaments falling from the spinneret to be effectively deposited onto that second nonwoven fabric.

[0047] A further aspect of the present invention relates to an apparatus for producing a nonwoven fabric of filaments, comprising a spinneret to extrude a plurality of filaments, a drawing duct arranged below the spinneret to draw the filaments, and a gas-permeable movable support to collect the drawn filaments and form a nonwoven fabric.

[0048] The apparatus further comprises a suction device comprising a plurality of channels and a suction element comprising a main channel and at least one first group of channels downstream of the main channel. The suction device is configured so that, in use, the suction speed between the channels of the first group of channels decreases progressively in the feed direction of the movable support. The suction speed of the suction channels is less than the suction speed of the main suction channel. According to a possible aspect, the suction device comprises a second group of channels upstream of the main channel; the suction speed of the channels of the second group of channels progressively increases in the feed direction of the movable support and the suction speed of the channels of the second group of suction channels is less than the suction speed of the main suction channel.

[0049] According to a possible aspect, the drawing duct comprises venturi channels to regulate the drawing speed of the filaments by a regulation of air acceleration in the drawing duct.

[0050] Hereinafter, referring to the appended figures, exemplary and non-limiting embodiments of the present invention will be described, in which:

- figure 1 is a schematic view of an apparatus for producing a spunbond nonwoven fabric according to a first embodiment of the present invention;
- figure 2 is a schematic view of a portion of the apparatus in figure 1 in which filament deposition is performed on a second nonwoven fabric.

[0051] An apparatus 10 for producing a nonwoven fabric 150 comprises a spinneret 11 for extruding a plurality of filaments 100.

[0052] The apparatus 10 further comprises a drawing duct 7 arranged below the spinneret 11 to draw the filaments 100.

[0053] Generally, a cooling element, not shown in the figures and known per se in the art, is arranged upstream of the drawing duct 7 to direct air flows toward the filaments 100 in order to cool them before the drawing step in the drawing duct 7.

[0054] According to a possible aspect, the drawing duct 7 comprises venturi channels 60 to regulate the drawing speed of the filaments 100 by a regulation of air speed in the drawing duct 7.

[0055] Typically, the venturi channels 60 are channels formed by walls that define a necking adapted to accelerate the air flowing into the venturi channel. Preferably, at least part of the walls of the venturi channels 60 is movable relative to each other, so that the section of the venturi channels can vary. Such movement is carried out by means of elements known in the art, such as screw adjusting systems that allow the section of the channels venturi 60 to be adjusted. As discussed, adjusting the section of the venturi channels, typically at least the section at the necking, allows the acceleration of the air flowing into the drawing duct 7 to be regulated and, as a result, allows control over the drawing step of the filaments 100 to be carried out.

[0056] The apparatus 10 further comprises a gas-permeable movable support 28 to collect the drawn filaments, so that the filaments 100 can be deposited in a deposition region 30 and hence form a nonwoven fabric 150. Specifically, the movable support 28 is configured to move forward along a feed direction D.

[0057] Typically, the movable support 28 is a conveyor belt.

[0058] The apparatus 10 further comprises a suction device 29 comprising a main channel 31 and at least one first group of channels 32-35 downstream of the main channel 31, considering the feed direction D of the movable support 28.

[0059] Preferably, the main channel 31 has a width A0 and the width of each channel in the first group of channels 32-35 is less than that of the main channel. According to a possible aspect, the channels of the first group of channels 32 - 35 have same width A1. The widths A0, A1 of the channels are measured at the center of the channel section along the feed direction D of the movable support 28. In other words, the widths of the channels are the distance between the inner walls of the channels in a direction substantially parallel to the feed direction D of the movable support 28, measured on a straight line passing through the center of each channel.

[0060] Preferably, the width A0 of the main channel is equal to or greater than the width of the deposition region 30 (measured in the same direction as the width of the main channel). In other words, the apparatus is configured so that, in use, the filaments are deposited on the movable support 28 at a region arranged above the main channel 31. The apparatus 10 can further comprise a second group of channels 36 - 39 which is arranged upstream of the main channel 31.

[0061] Preferably, the width of each of the channels in the second group of channels 36-39 is smaller than that of the main channel 31, typically each channel has the same width A2.

[0062] The number of channels in the first group (and in the second group, if any) may vary in different embodiments.

[0063] Typically, as in the embodiment shown, the number of channels in the first group of channels 32 - 35 is equal to the number of channels in the second group of channels 36 - 39, although in different embodiments a number of channels in the first group can be different from the number of channels in the second group.

[0064] The suction device 29 comprises a suction element 29b adapted to form a flow of gas, typically air, within the various channels 31 to 39 of the apparatus 10. Specifically, this airflow has a different speed (referred to herein and below as "suction speed") among the various channels.

[0065] The suction device 29 can be configured so that, in use, the suction speed for each channel 31 - 35 (possibly also 36 - 39) is constant or time-varying.

[0066] In general, the suction device 29 is configured so that, in use, the suction speed of the first group of channels 32-35 gradually decreases between the various channels in the feed direction D of the movable support 28, and is lower than the suction speed, i.e., the speed of each channel is lower than that of the channel arranged upstream of it.

[0067] This speed difference between the various channels can be achieved in different ways. For example, the suction element 29b can be configured so as to generate a different suction for each channel (e.g. by means of a single suction device for each channel). In addition or as an alternative, the suction device 29 can be equipped with adjusting elements (adapted, for example, to create a necking in each channel, or movable elements adapted to locally vary the channel section, or elements adapted to cause localized pressure drops, etc.) adapted to obtain different suction speeds of the first group of channels 32 - 35. In such a case, the same suction device can be provided for several channels, and in that case the different suction speed is obtained basically exclusively by means of the adjusting elements.

[0068] As discussed, according to a possible aspect, the suction device 29 comprises a second group of channels 36-39 upstream of the main channel 31.

[0069] The suction device is configured so that the suction speed of the second group of channels 36-39 increases progressively between the various channels in the feed direction D of the movable support 28.

[0070] The suction speed of the channels in the second group of channels 36 - 39 is less than the suction speed of the main channel 31.

[0071] A different suction speed between the channels of the second group of channels 36 - 39 can be obtained in a similar way as described for the first group of channels 32 - 35.

[0072] According to a possible aspect, the suction speed of each channel of the second group of channels 36-39 is between 45 m/s and 85 m/s.

[0073] According to a possible aspect, the suction speed of the second group of channels 32-35 is at least 10% less than the channel arranged downstream of that channel. According to a possible aspect, the apparatus 10 comprises a covering structure 50 arranged above at least part of the first group of channels 32-35 and at least part of the second group of channels 36-39, if any.

[0074] The covering structure 50 preferably covers all channels 31 - 39 of the suction device 29.

[0075] Such a covering structure 50 is typically made integral with the drawing channel 7, or otherwise is an element connected to the drawing channel 7.

[0076] The covering structure 50 comprises a surface 51 substantially parallel to the movable support 28 and arranged at a distance H typically between 1.5 mm and 5 mm, preferably between 1.5 mm and 4 mm.

[0077] As a result of the deposition, the filaments 100 are then arranged within a space S between that covering structure 50 (or at any rate the set of drawing channel 7 and covering structure 50) and the movable support 28.

[0078] Preferably, in order to avoid mechanical treatment of the nonwoven fabric 150 immediately after the deposition of the filaments 100, the nonwoven fabric 150 is not subjected to calendering at the main channel 31 nor at the first group of channels 32-35. In particular, according to a preferred aspect, the filaments 100 leave the space S defined by the covering structure 50 without undergoing calendering.

[0079] Preferably, the covering structure 50 and gas suction via the main channel 31 and the first group of channels 32-35 prevent, or at least obstruct, the inflow of outside air, even without a calender arranged at the exit of the nonwoven fabric from the S space. In use, filaments 100 are extruded from the spinneret 11. Preferably, the filaments 100 are bicomponent (or multi-component) filaments. The filaments 100 are then drawn through a drawing duct 7 and then deposited on a movable support 28 to form a nonwoven fabric 150.

[0080] According to a possible aspect, the filaments 100 are drawn in the drawing duct 7 by means of an air speed between 40 m/s and 180 m/s, preferably between 90 m/s and 150 m/s.

[0081] During the deposition, the main channel is operated in such a way as to suction gas (usually air) through the movable support 28.

[0082] The movable support 28 moves forward along the direction D so as to feed the deposited filaments, that is, the nonwoven fabric formed by the filaments deposited on the movable support itself.

[0083] The first group of channels 32 - 35 performs additional suction on the filaments deposited downstream of the deposition region.

[0084] As discussed, the suction speed decreases progressively between the channels of the first group of channels 32 - 35. Preferably, the suction speed of each channel of the first group of channels 32-35 is at least 10% less than the suction speed of the channel arranged upstream of that channel. As regards the channel 35 immediately downstream of the main channel 31, this channel has speed at least 10% lower than the suction speed of the main channel 31.

[0085] According to a possible aspect, in the first group of channels 32 - 35, each pair of consecutive channels has the same difference in suction speed, so the suction speed decreases in a substantially linear manner between the channels in the first group of channels 32 - 35.

[0086] However, embodiments in which the speed does not decrease linearly are possible, that is, embodiments in which, in the first group of channels, there are at least two pairs of consecutive channels in which the difference of speed between the two channels of the pair is different from one pair to the other.

[0087] Similarly to what discussed for the first group of channels 32-35, the suction speed between the various channels of the second group of channels 36-39 can increase in a substantially linear manner in the feed direction D of the movable support 28, although embodiments with a nonlinear increase of the suction speed between the various channels of the second group of channels 36-39 in the feed direction D of the movable support 28 are possible.

[0088] The cover 50, if any, together with the suction provided by the main channel 31, the first group of channels 32-35 and the second group of channels 36-39, if any, prevents, or at least obstructs, the inflow of outside air towards the deposition region 30, thus allowing the filaments 100 of the nonwoven fabric to be compacted and evenly distributed in the space S.

[0089] It should be noted that a filament deposition on the movable support 28 has been discussed so far. Such deposition may be direct or indirect. A direct deposition provides, as in the embodiments discussed so far, that the filaments 100 falling from the spinneret 1 come into direct contact with the movable support 28.

[0090] However, embodiments providing an indirect deposition on the movable support 28 are possible, i.e. providing the deposition of filaments on an element arranged, in turn, on the movable support. Typically such an element is a second nonwoven fabric. This second nonwoven fabric can be made in various ways and can be, for example, a single-layer nonwoven fabric or a composite nonwoven fabric made by means of multiple layers.

[0091] In possible embodiments, the second nonwoven fabric can be made by an apparatus similar to what discussed so far.

[0092] The second nonwoven fabric is typically arranged at the deposition region 30, so that the deposition of filaments 100 on the upper surface of the second nonwoven fabric takes place in a deposition region 30 arranged above the main channel 31, as, for example, in the embodiment of Figure 2.

[0093] In general, downstream of the first group of channels, there are typically additional devices for processing a nonwoven fabric which are known in the art and are not discussed in detail herein.

Claims

1. Process for producing a nonwoven fabric (150) by means of an apparatus for producing a nonwoven fabric (150) comprising a spinneret (11) for extruding filaments (100), a drawing duct (7) arranged below said spinneret, a movable support (28) permeable to gases and adapted to define a deposition region (30) for said filaments and configured to move said filaments away from the deposition region along a feed direction (D), a suction device (29) comprising a main suction channel (31) and at least one first group of suction channels (32-35) downstream of said main suction channel (31), comprising the steps of:

    (a) extruding a plurality of filaments (100) from the spinneret (11), said filaments being preferably at least bicomponent filaments;
    (b) drawing said filaments (100) by means of said drawing duct (7);
    (c) depositing the drawn filaments on the movable support (28) to form a nonwoven fabric (150), and operating said suction device so as to suction gas below said movable support;

    wherein in said step c) the suction speed between the channels of the first group of channels (32-35) gradually decreases in the feed direction (D) of the movable support (28), said suction speed of the channels of the first group of suction channels (32-35) being less than the suction speed of the main suction channel (31), the suction speed of each channel of the first group of channels (32-35) being preferably at least 10% less than the suction speed of the channel arranged upstream of that channel.

2. Process according to claim 1, wherein the suction speed of the main channel (31) is between 40 m/s and 120 m/s and the suction speed of each channel of the first group of channels (32-35) is between 45 m/s and 85 m/s.

3. Process according to any one of the preceding claims, wherein the suction device (29) comprises a second group of channels (36-39) upstream of said main channel (31), wherein the suction speed of the channels of the second group of channels (36-39) increases progressively in the feed direction (D) of the movable support (28), said suction speed of the channels of said second group of suction channels (36-39) being less than the suction speed of the main suction channel (31), wherein preferably the suction speed of the second group of channels (36 - 39) is at least 10% less than the channel arranged downstream of that channel.

4. Process according to claim 3, wherein the suction speed of each channel of the second group of channels (36-39) is between 45 m/s and 85 m/s.

5. Process according to any one of the preceding claims, wherein the apparatus comprises a covering structure (50) arranged above at least part of the first group of channels (32-35) and at least part of the second group of channels (36-39), if any, wherein said covering structure (50) comprises a lower surface (51) substantially parallel to said movable support and arranged spaced from the movable support (28) at a distance (H) between 1.5 mm and 5 mm, preferably between 1.5 mm and 4 mm.

6. Process according to any one of the preceding claims, wherein the width (A0) of the main channel (31) is greater than the width (A1) of each channel of the first group of channels (32-35) and greater than the width (A2) of each channel, if any, of the second group of channels (36-39).

7. Process according to any one of the preceding claims, wherein the width (A0) of the main channel (31) is equal to or greater than the width of the deposition region (30).

8. Process according to any one of the preceding claims, wherein the nonwoven fabric (150) is not calendered at said main suction channel (31) nor at said first group of suction channels (32-35).

9. Process according to any one of the preceding claims, wherein in said step (b) the air speed in at least part of the drawing duct (7) is between 40 m/s and 180 m/s, preferably between 90 m/s and 150 m/s.

10. Process according to any one of the preceding claims, wherein during the step of drawing the filaments (100), the air speed in the drawing duct (7) can be regulated by means of Venturi channels (60) equipped with at least one adjustable narrowing.

11. Process according to any one of the preceding claims, wherein in said step (c), the deposition of the drawn filaments (100) is on a second nonwoven fabric arranged at the deposition region (30).

12. Apparatus (10) for producing a nonwoven fabric

(150), comprising a spinneret (11) for extruding a plurality of filaments, a drawing duct (7) arranged below the spinneret (11) for drawing said filaments, a movable support (28) permeable to gases for collecting the drawn filaments and forming a nonwoven fabric, a suction device (29) comprising a main channel (31) and at least one first group of channels (32-35) downstream of said main channel (31), and a suction element (29b), wherein the suction device (29) is configured so that, in use, the suction speed between the channels of the first group of channels (32-35) progressively decreases in the feed direction (D) of the movable support (28), said suction speed of the suction channels (32-35) being less than the suction speed of the main suction channel (31).

13. Apparatus according to claim 12, wherein the suction device (29) comprises a second group of channels (36-39) upstream of said main channel (31), wherein the suction speed of the channels of the second group of channels (36-39) progressively increases in the feed direction (D) of the movable support (28), said suction speed of the channels of said second group of suction channels (36-39) being less than the suction speed of the main suction channel (31).

14. Apparatus according to claim 12 or 13, wherein the drawing duct (7) comprises Venturi channels (60) to regulate the drawing speed of the filaments (100) by a regulation of air acceleration in the drawing duct (7).

15. Apparatus according to claim 12, wherein said apparatus is without calenders in the suction region and the regions adjacent thereto.

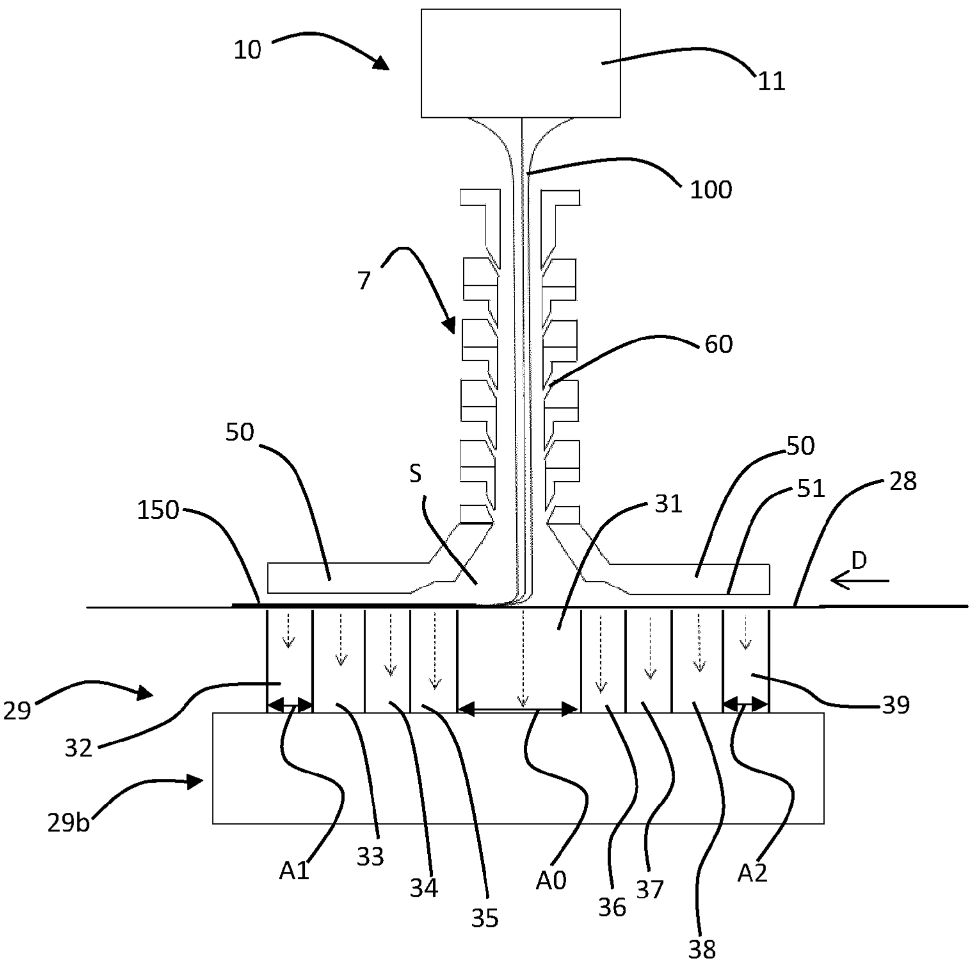
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Fig. 1

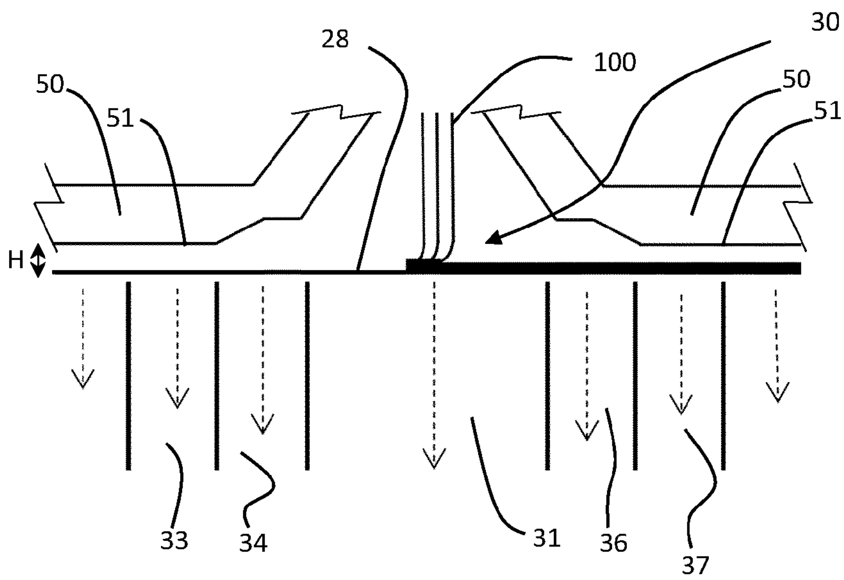
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Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 6355

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	23 April 2024	Van Beurden-Hopkins

CATEGORY OF CITED DOCUMENTS

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