United States Patent

Feltgen et al.

[15] **3,698,610**

[45] **Oct. 17, 1972**

[54] **PROCESS AND DEVICE FOR THE MANUFACTURE OF A NON-WOVEN MATTED WEB FROM SYNTHETIC YARN**

[72] Inventors: **Karl-Heinz Feltgen,** Dormagen; **Günther Espanion,** Cologne, Mauenheim, both of Germany

[73] Assignee: **Farbenfabriken Bayer Aktiengesellschaft,** Leverkusen, Germany

[22] Filed: **June 17, 1969**

[21] Appl. No.: **833,934**

[30] **Foreign Application Priority Data**

June 22, 1968 Germany..........P 17 60 713.5

[52] **U.S. Cl.**...**226/7,** 226/97

[51] **Int. Cl.**...**B65h 51/16**

[58] **Field of Search**........................226/97, 7; 28/1.4

[56] **References Cited**

UNITED STATES PATENTS

3,079,663 3/1963 Dyer et al.....................28/1.4

Primary Examiner—Allen N. Knowles

Attorney—Plumley & Tyner

[57] **ABSTRACT**

A process and apparatus for the manufacture of a non-woven matted web from synthetic yarn is provided wherein a set of doffed filaments is deflected through an angle of about 15° to 40° by a supersonic jet.

8 Claims, 3 Drawing Figures

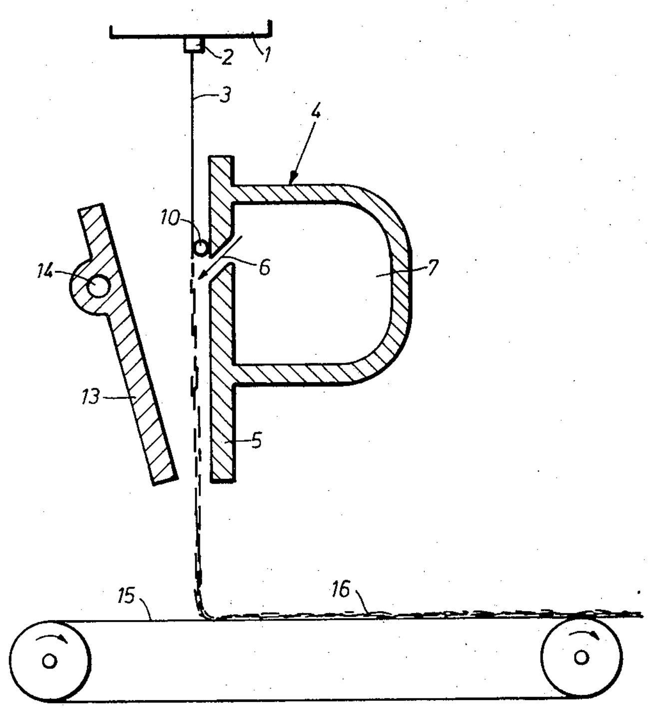


FIG. 1

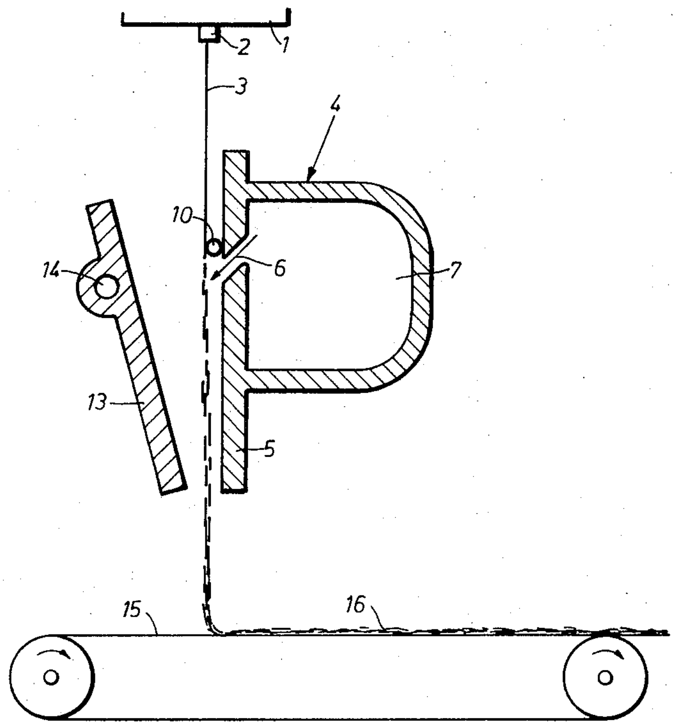
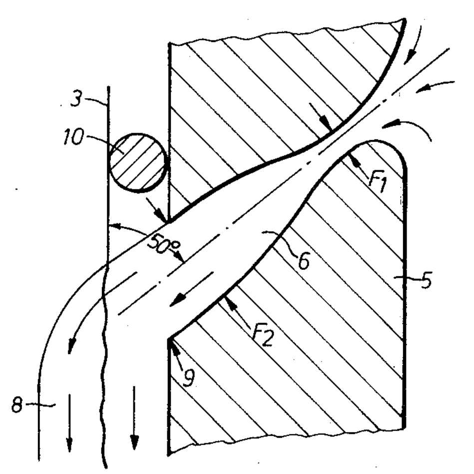


FIG. 2



INVENTORS:

KARLHEINZ FELTGEN, GÜNTER ESPANION.

BY:

Burgess, Dinklage & Sprung
Attorneys

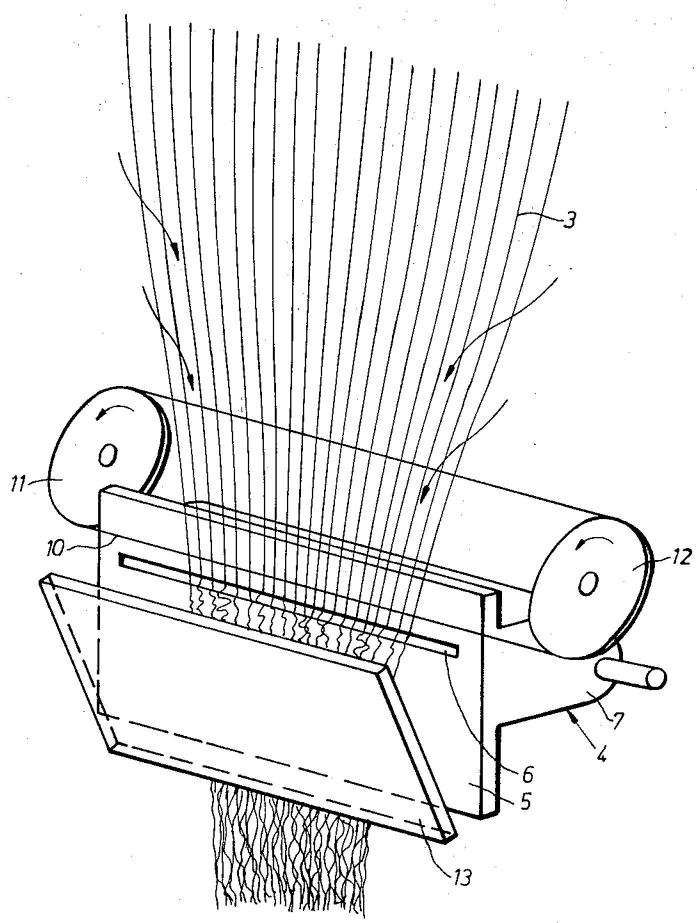


FIG. 3

INVENTORS:
Karlheinz Feltgen and Günter Espanion
BY:
Burgess, Dinklage & Sprung
Attorneys

PROCESS AND DEVICE FOR THE MANUFACTURE OF A NON-WOVEN MATTED WEB FROM SYNTHETIC YARN

The present invention relates to a process for the manufacture of a non-woven matted or tangled web from synthetic yarn which is drawn off, in the form of a silver, out of the spinnerets of a spinning head, or from drafting rolls or supply rolls or the like, by means of a strip-shaped air jet, and deposited on a backing.

The invention also relates to a device for performing this process which comprises a spinning head or supply rolls, followed by a doffing device, and also of a depositing device.

Such non-woven matted webs are manufactured from continuous filaments made from, for example, high-polymer substances, such as polyolefines, polyethylene terephthalates or polyamides.

It is known to produce non-woven textile planar structures, i.e., non-woven matted or tangled webs, by sucking filaments spun from a melt of synthetic high polymers through an ejector fed with gas or air. The ejector is positioned after the point at which the filaments emerge out of the spinneret and at a distance from the latter which is sufficient to allow the filaments to solidfy. They are then blown in tangled form on to a travelling backing, special devices being provided to ensure adequate width of the webs produced and adequate uniformity of the weight per unit area over the width.

It is the task of the ejector (or of a plurality of such ejectors) both to draw off or doff the filaments at maximum velocity (several thousand r.p.m.), since the molecular orientation thereby achieved in the filaments has an advantageous influence on their tensile strength and tenacity and since high velocities are more economical and also to blow the individual elementary filaments on to the backing, with a minimum of bundling and a degree of density which is highly uniform.

It has also been proposed to draw off the sliver or set of filaments leaving a row of spinnerets relatively slowly, at approximately 600 to 1,200 m/min., in low turbulence, flowing air and therefore without filaments intertwining and bundling, and to achieve the desired molecular orientation in the individual filaments by providing jets of hot air in the direction of the filament travel which act on the individual filaments, directly following their emergence out of the spinnerets, and which provide for acceleration of the melt from the emergence velocity up to the doffing velocity over an extremely short travel path of approximately 5 mm. In this way the molecular orientation produced by the large velocity gradients is fixed or set during the immediately following cooling. This arrangement has the disadvantage of a limited doffing velocity as well as needing large apparatus dimensions as a result of the considerable blowing-on length necessary in the relatively slowly flowing air.

In order to avoid these disadvantages, according to the present invention the gas or air jet emerges at a supersonic velocity out of a nozzle, so as to be deflected through an angle between 15° and 40° and to flow along a face, the sliver or set of filaments entering the gas or air jet at the deflecting point thereof.

With this process, any desired number of filaments may be doffed at a high velocity of several thousand m/min. and blown, free from bundling, on to a backing or support, for example a travelling belt. As compared with the prior-known processes, the doffing effect is not achieved in accordance with the ejector principle. In an ejector, the impulse of a high-velocity air jet is transferred, by turbulent mixing, to the secondary air accompanying the filaments to be doffed and subjected with them to suction. In the process according to the invention, on the contrary, the filaments are introduced directly into a supersonic air jet having an extremely small cross-section.

The invention exploits the theoretically known capability of a supersonic air jet to expand about a sharp edge. Furthermore, the so-called Coanda effect is exploited, according to which a thin high-velocity jet emerging out of a slot in a wall inclined at an angle relatively to the latter, is deflected towards the wall and flows along the latter. At that point at which the jet emerges out of the nozzle and is automatically deflected into the direction given by the wall, the set of filaments enters the jet concentrically, so that the aerodynamic forces are exploited, as doffing forces, directly, i.e., without mixing with secondary air.

According to one particular way of performing the process according to the invention, the supplementary means generate a secondary air flow by means of which the outer or marginal filaments of the set of filaments are drawn in towards the center of the set. In this way the width of the set of filaments in the air jet is regulated in a simple manner, so as to influence the marginal zone density of the web to be produced.

According to another aspect of the process according to the invention, the filaments are aligned shortly before entry into the gas or air jet, so that they enter the jet precisely in the center plane thereof.

A doffing device according to the invention, comprises walls aligned parallel to the filament doffing direction and formed with a slot nozzle which generates a supersonic jet, extends transversely over the walls and the central plane of which is at an angle of between 15° and 40° to the entering set of filaments.

The advantages which can be achieved by means of this constructional form of embodiment of the device according to the invention have already been discussed.

Preferably, the slot nozzle for generating the supersonic velocity of the gas or air jet is designed as a Laval nozzle. For each ratio of the pressure before the nozzle to that pressure obtaining behind the nozzle—the latter is generally atmospheric pressure—there is an optimum cross-section ration F_2/F_1 of the cross-sections of the nozzle, F_1 designating the narrowest cross-section and F_2 the outlet cross-section. With this precise optimum ratio, impact and after-expansion free acceleration (i.e., involving minimum losses) of the gas is achieved. It has been found that it is expedient, with a given cross-section ratio F_2/F_1 (for example 1.25, corresponding to a Mach number of the emerging jet, with correct expansion, of Mach 1.60) to adjust the feed pressure before the nozzle to be higher than would otherwise be suitable. The pressure in the outlet cross-section F_2 will then be higher than atmospheric pressure and the gas jet will after-expand and, due to the geometry at the outlet cross-section, will do so, in the manner of Prandtl-Meyer expansion, about the sharp boundary edge between the nozzle and the walls, downwardly along the walls. It has for example been found that with a gap width of the narrowest nozzle cross-section F_1 of the Laval nozzle of 0.3 to 0.4 mm. and with a pressure before the nozzle of approximately 3.5 atmospheres excess pressure, the zone of extremely high velocity of the air jet, even when it is 100 mm. away from the nozzle mouth, still has a thickness of not more than 1 mm.

According to a further development of the invention, there is arranged opposite the walls a plate adjustably spaced therefrom. It is preferably mounted so as to be pivotal and lockable about an axis parallel to the slot nozzle.

Since the walls formed with the slot nozzle possess a finite width, the ends of the slot nozzle constitute, relatively to the flow pattern, singular points differing from the remaining central portion of the flow so that there exists, in these marginal zones, a tendency for undesirable bundling of the filaments, resulting in "yarn formation." By adjusting the aforementioned plate, in a suitable manner which is readily ascertained by testing, the secondary air sucked by the rapid doffing gas jet at the marginal zones receives velocity components directed towards the center of the set of filaments, so that the marginal filaments are drawn in towards the center into the zone of the uniform, central flow. The non-woven web formed exhibits, due to the uniform filament spacing achieved in the gas jet, a filament density which is homogeneous over the entire width. The secondary air mentioned here must not be confused with that secondary air which appears in the doffing devices operating in accordance with the prior-known ejector principle.

It is to be understood that the entire doffing device may be guided to and fro in a manner known per se. The non-woven web thus produced then exhibits for example a zig-zag or meandering structure, depending on how the traversing stroke velocity and moving belt velocity are synchronized with each other.

According to an especially advantageous embodiment of the device a spacer is arranged above the slot nozzle. In this way, the friction of the filaments on the walls is kept at a low level, since the spacer guides the filaments into the central plane of the gas jet. The spacer consists, most simply, of a tensioned wire having a diameter of only a few tenths of a millimeter. It is preferably applied on the walls and in this case its thickness corresponds to half the thickness of the gas jet.

The material from which synthetic filaments are spun often contains delustring agents, for example titanium dioxide, which would exert a highly abrasive effect on the spacer. In order to avoid the rubbing-in of glues, according to the invention the spacer is preferably provided with a reciprocating displacement device. According to an alternative embodiment, the spacer is designed in the form of an endless wire rotating over guide pulleys.

An example of embodiment of the invention will now be diagrammatically illustrated and explained with reference to drawings, wherein:

FIG. 1 shows the device, in its entirety, as a lateral elevation, illustrating the doffing of filaments out of a spinning head,

FIG. 2 shows the slot nozzle and also the spacer, in cross-section and drawn to a larger scale, and

FIG. 3 shows the doffing device, in a perspective view, and with a spacer designed in the form of an endless, rotating wire.

Synthetic filaments **3** are doffed or drawn off from a spinning head through spinnerets **2** by means of a doffing device **4**. Arranged in a wall system **5** is a Laval nozzle **6** before which there is arranged a pressure chamber **7**.

The Laval nozzle **6** (FIG. **2**) includes an angle of 50° with the central plane of the entering set of filaments **3**. The inlet cross-section F_1 is in a predetermined ratio to the outlet cross-section F_2 whereby supersonic velocity is imparted to the emerging gas jet **8** and the latter expands about the sharp edge **9** but remains in contact against the wall system **5**. At the deflection point having been aligned by an endless wire, designed as a spacer **10** and rotating over guide pulleys **11** and **12** (FIG. 3.).

For the drawing-in of the marginal filaments **3** (FIG. 3) artificial secondary air is sucked into the marginal zones of the gas jet **8** by means of an adjustable plate **13** which is rotatable and lockable about the pivot **14**. Thereby the filaments **3** of the marginal zones are drawn in, in such a way, as to avoid bundling and yarn formation before they are deposited on a moving belt **15**, on which the non-woven web **16** is formed. (FIG. 1).

For uniform appearance of the non-woven web (so that the structure of the web is hardly perceptible) the disordered or tangled position of all the filaments is especially important. Adjacent filaments should not extend in the same direction over distances longer than corresponds to statistic probability. The aforementioned bundling of individual filaments produces, on the contrary, an undesired, coarse-structured appearance of the web. Experience has shown that the two requirements, i.e., a high doffing velocity and bundle-free depositing of the filaments during the simultaneous drawing off of a multiplicity of individual filaments in an air flow, can be satisfied only with difficulty. For drafting it is necessary to increase the yarn velocity in the still-liquid portion to approximately 100 to 1,000 times the velocity of emergence out of the spinneret bores. The air flow is only able to transmit the necessary force to the filaments if the filaments present themselves to it in undulating or sinuous form, i.e., if they are subjected to blowing, more or less transversely, over substantial portions of their length. Subjecting drawn dilaments to a purely longitudinal flow, simply by surface friction, does not transmit adequate forces even at extremely high air velocities (supersonic velocities). However, the above-mentioned sinuous yarn position assists the undesirable phenomena of snarling and bundling of individual filaments.

It has therefore been proposed to charge the sliver or set of filaments emerging out of a multi-bore spinneret plate electrostatically. The charging is effected after the filaments have already solidified but above the ejector. They, similarly charged individual filaments repel each other mutually, after leaving the ejector, and in this way bundling is avoided. The charging, however, necessitates the use of extremely high voltages of 30 kV and more, and therefore of bulky safety and protective devices.

We claim:

1. A process for the manufacture of a matted or tangled non-woven bonded web from synthetic filaments drawn off or doffed, in the form of a set of filaments, from spinnerets of a spinning head, from drafting rolls or from supply rolls or the like, by means of a strip-shaped gas or air jet and deposited on a support, characterized in that the gas or air jet emerges at a supersonic velocity from a nozzle, is deflected through an angle of from 15° to 40° and flows along a face, the set of filaments entering the gas or air jet at the deflection point thereof, further characterized in that a secondary air flow is produced, by means of which the outer filaments of the set of filaments are drawn in towards the center.

2. A process according to claim 1, characterized in that the filaments are aligned shortly before entering the gas or air jet.

3. A device for the manufacture of a matted filament web from synethic filaments, the device comprising spinnerets of a spinning head or supply rolls, a doffing device connected downstream therefrom, and a depositing device wherein the doffing device comprises a wall system aligned parallel to the filament doffing direction said wall system having a slot nozzle which generates a supersonic flow velocity, said slot nozzle extending transversely over the wall system and the center plane of said slot nozzle forming an angle of from about 50° to about 75° with the center plane of the entering set of filaments and wherein a plate is arranged opposite to the wall system said plate having means for adjusting its position relative to the wall system.

4. A device according to claim 3, characterized in that the slot nozzle is designed as a Laval nozzle.

5. A device according to claim 3, characterized in that the plate is mounted for pivoting and locking about a pivot extending parallel to the slot nozzle.

6. A device according to claim 3, characterized in that a spacer is arranged above the slot nozzle.

7. A device according to claim 3, characterized in that the spacer is equipped with a reciprocating displacement device.

8. A device according to claim 3, characterized in that the spacer (10) is designed as an endless wire rotating over guide pulleys.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,698,610

DATED : October 17, 1972

INVENTOR(S) : Karl-Heinz Feltgen

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 40, the entire page 2 of the Specification has been omitted.

Column 2, line 53, "ration" should read ---ratio---.

Column 4, lines 29-67, this is the omitted portion (Page 2 of the Specification) should be moved to Column 1, line 40.

Column 6, line 21, delete "(10)".

Signed and Sealed this

twentieth **Day of** *April 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks