Dec. 25, 1973 KARL-HEINZ FELTGEN ET AL 3,781,393

PROCESS FOR THE CONTINUOUS PRODUCTION OF A RANDOM-FILAMENT FLEECE

Original Filed Sept. 7, 1968

2 Sheets-Sheet 1

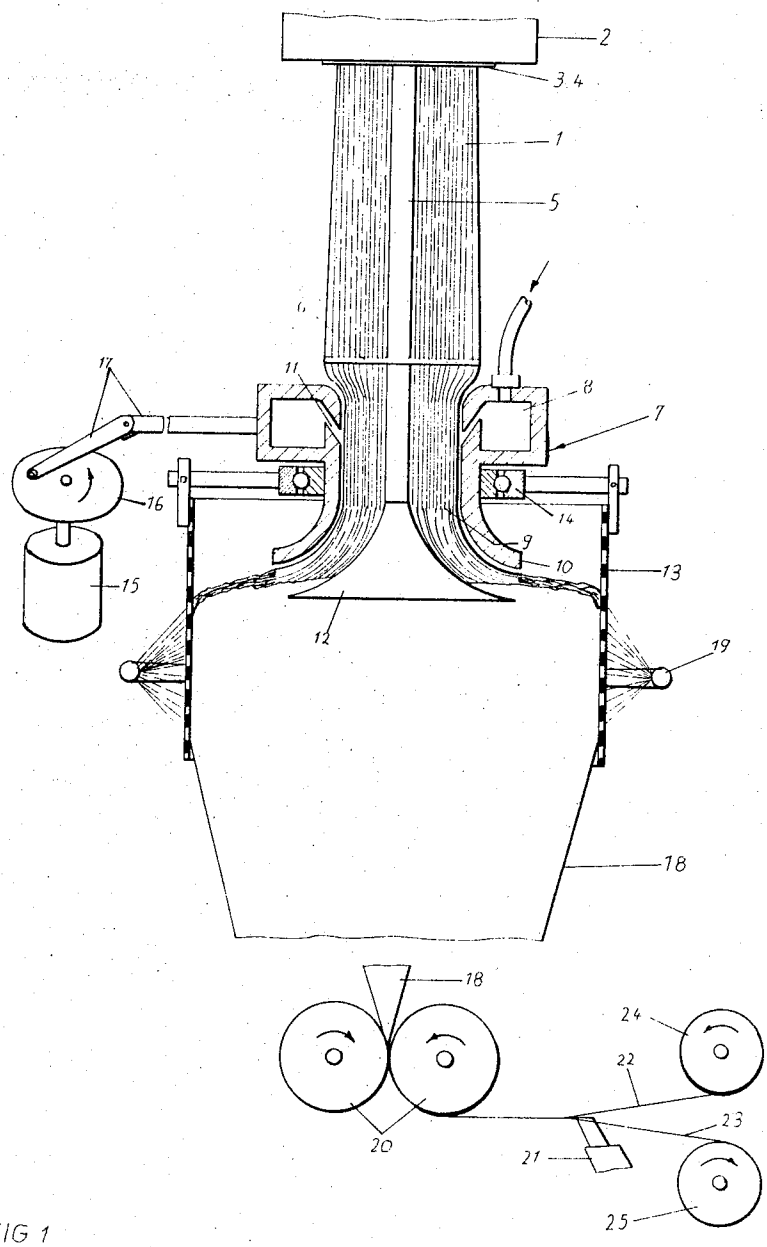


FIG 1

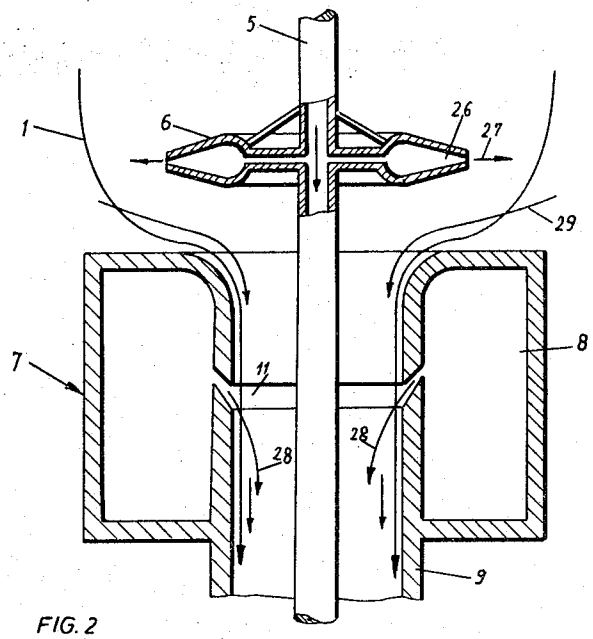


FIG. 2

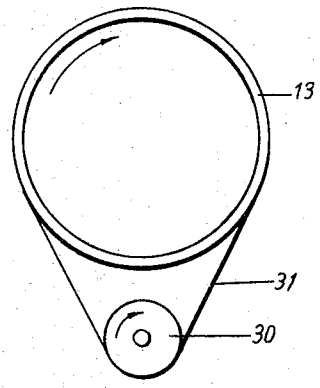


FIG. 3

United States Patent Office 3,781,393 Patented Dec. 25, 1973

3,781,393

PROCESS FOR THE CONTINUOUS PRODUCTION OF A RANDOM-FILAMENT FLEECE

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Original application Sept. 7, 1968, Ser. No. 848,138, now Patent No. 3,621,531. Divided and this application July 15, 1971, Ser. No. 165,779

Claims priority, application Germany, Sept. 7, 1968, P 17 85 302.0

Int. Cl. B29c 17/04

U.S. Cl. 264—89 6 Claims

ABSTRACT OF THE DISCLOSURE

Process for forming a random-filament fleece by supplying filaments to a trumpet-shaped aerodynamic take-off which throws the filaments against a collecting means where the filaments adhere to form a tubular fleece.

This application is a division of U.S. Ser. No. 848,138, filed Sept. 7, 1968, now U.S. Pat. 3,621,531.

A process for the continuous production of a random-filament fleece.

There are numerous processes for producing random-filament fleeces from endless filaments arranged at random, for example from synthetic high polymers. In all these processes, a bunch of endless filaments is continuously run off either directly from a melt- or dry-spinning machine for the corresponding polymer or from an element used for the after-treatment of filaments such as these, for instance rollers or cylinders, and is deposited in a random arrangement, but with as uniform a density as possible, for example onto a porous revolving conveyor belt. The take-off forces required are applied mechanically, for example by means of a pair of rollers, or aerodynamically to the filaments, and their irregular random distribution can be obtained either aerodynamically by utilizing turbulence or even electrostatically by the repulsion of similarly charged filaments, thus preventing them from bunching, or by a combination of both measures.

If they are to be economically further processed, random-filament fleeces such as these, for instance textile sheet structures, must in practice have a minimum width of approximately 1 metre. Some applications require widths of up to 3 metres and more. One difficulty common to all manufacturing techniques lies in the difficulty of achieving economic production of these widths coupled with uniform density over the entire width and the absence of seams. Seams are obtained when the fleece web is formed from several narrow bands simultaneously deposited alongside one another, or when a relatively narrow random-filament band is deposited in a zig-zag or meandering arrangement from an element, for example a slot die, reciprocating perpendicularly to the direction of movement of the fleece web in the course of formation, the length of stroke corresponding to the required width of the fleece.

On account of the necessity for consistency of speed over the length of the stroke, all reciprocating movements require mechanisms that are not only complicated but also prone to wear. Depending on the kinematics involved in traversing, more or less wide zones of high or low density are always formed along the edges of the fleece web. These zones have to be cut off and are discarded as waste. Compared, however, with all the possible obvious alternatives for making the width of the bundle of filaments to be deposited equal to the required width of the fleece from the outset, the traversing method has certain advantages. As will readily be appreciated, a marked anisotropy of the physical properties such as strength, elongation and shrinkage is peculiar to a fleece prepared by the first method on account of the preferential orientation of the filaments in the longitudinal direction, i.e. in the direction of travel of the fleece web produced. Both in aerodynamic and in electrostatic processes for the production of random-filament fleeces, allowance must always be made for the possibility of the deposition length not being uniformly covered by filaments. Differences in density such as these would result in elongated streaks in the final fleece if no precautions were taken i.e. by traversing across the fleece as it is being formed, to ensure that every part of the depositing mechanism passes over every part of the fleece being formed.

In order, therefore, to avoid the aforementioned disadvantages, all conventional processes for the production of random-filament fleeces tolerate the difficulties of traversing mechanisms referred to earlier on.

The object of the present invention is to provide a process and an apparatus not employing any of these traversing mechanisms. The process according to the invention not only makes it possible to obviate the aforementioned disadvantages without any need for complicated mechanisms, it also embodies some important modifications which simplify the apparatus as compared with conventional apparatus for the production of random-filament fleeces.

The process according to the invention for the continuous production of a random-filament fleece employs the method whereby a plurality of filaments is drawn of aerodynamically by means of a gas jet. The inventive feature is that, by using at least one annular jet which, after engaging the bundle of filaments, is deflected axially symmetrically, the filaments are blown in one plane on to the wall of a collecting unit, randomly to all sides, but in a uniform density, and form a tube which is continuously drawn off.

In this way, a tubular random-filament fleece is formed which is uniform in density over its entire periphery, and the uniform density is also constant over its entire length providing the manufacturing conditions remain constant.

Preferably, the gas is removed through gas-permeable walls in the collecting unit. This is of particular advantage in the production of random-filament fleeces of fairly high density, because this measure prevents the tubular structure formed from "fluttering."

In one particularly advantageous embodiment of the process, the bundle of filaments sucked in and the tubular fleece formed are privoted or rotated with respect to one another. In this way, a further improvement relating isotrophy of the fleece generated is being achieved.

In another particular embodiment of the process according to the invention, the tubular fleece formed is moistened, for example with steam or a liquid, thus increasing cohesion of the fleece during draw-off.

According to another embodiment of the process, the tubular fleece formed is preferably cut up in order to obtain a single-layer fleece web. In another embodiment of the process, the tubular fleece is cut into a plurality of webs in order to obtain suitable processing widths.

The main advantage of the process according to the invention does not, however, lie only in the homogeneous density of the fleece webs, but also in the possibility of using all the material produced without any waste because no irregular, useless marginal zones are formed.

In terms of known features, the apparatus for carrying out the process according to the invention comprises a

filament or yarn dispenser, preferably in the form of a spinning head or a frame with supply rollers and take-off cylinders, an aerodynamic take-off means and means for collecting the random-filament fleece.

The inventive feature is that the aerodynamic take-off means comprise a tube into whose wall opens at least one annular slot die arranged concentrically to the axis of the tube, the outlet end of the tube being widened like a trumpet and surrounded at a distance by the collecting means.

In one advantageous embodiment, the outlets for the filaments paid out by the dispenser are uniformly distributed over an annular surface, thus ensuring uniform density of filaments along the inlet circumference of the aerodynamic take-off jet-device.

In order to further enhance this uniformity, a distributor element is arranged above the inlet end of the take-off means. This distributor element comprises, for example, a disc surrounded externally by the filament, or a ring being touched by the running filaments either from inside or from outside. The distributor element may also be provided with guide grooves for each individual filament. Preferably, it is arranged at a variable distance from the take-off means.

The distributor element is alternatively provided around its periphery with an encircling blow nozzle connected to a source for pressurized preferably heated, gas. This ensures that the filaments are guided in the total absence of friction. The object of heating the filaments with a heated gas issuing from the nozzle is to increase the temperature of the filaments traveling past to such an extent that, under filament tension produced by the resistance to drafting in the melting zone just beneath the spinneret an additional molecular orientation going beyond the quick draft is obtained by heat-stretching.

A displacement means is preferably arranged in the trumpet-like widening of the tube of the take-off means. It is possible in this way more effectively to deflect the gas stream, axisymmetrically together with the filaments, and to minimize energy losses.

In another particular embodiment of the apparatus, the collecting means comprises a perforated jacket arranged concentrically to the central axis of the take-off means. The carrier gas can penetrate through this perforated jacket. Preferably, the perforated jacket is removably attached so that perforated jackets of different diameter can be selective used for the production of tubular random-filament fleeces of corresponding diameter. In one embodiment, the perforated jacket is in the form of a contractible sleeve. In this embodiment, however, the join in the perforated jacket adversely affects formation of the fleece, and additional precautions have to be taken to cover this join.

In another preferred embodiment, the collecting means is coupled with a moistening means, for example in the form of spray nozzles for steam or liquid.

At least one cutter unit is preferably arranged, on or behind the collecting means, for cutting up the tubular fleece into one or more single-layer webs.

In another advantageous embodiment, the collecting means is heatable to enable the filaments to weld together.

Preferably, the take-off means is, with advantage mounted in such a way that it can be pivoted or rotated. Alternatively to or in combination with this, the collecting means is pivotally or rotatably mounted. The pivoting range and speed or the rotational speed are preferably variable.

The random-filament fleece according to the invention is distinguished by the fact that it is in the form of a seamless tube. In a particular embodiment, the random-filament fleece comprises a web cut from a seamless tube.

The process according to the invention and the apparatus according to the invention are diagrammatically illustrated by way of example in the accompanying drawings, wherein:

FIG. 1 is a longtiudinal section through the apparatus,

FIG. 2, which is drawn on a larger scale, shows a particular embodiment of the distributor element in the form of a blow nozzle with a take-off means, and

FIG. 3 is a plan view of the collecting means with rotary drive.

As shown in FIG. 1, a bundle of up to several thousand individual filaments **1** issues from a spinning head acting as filament dispenser **2**, the holes of the spinneret **3** being uniformly distributed over an annular surface **4**. A distributor element **6** which is mounted concentrically to the annular surface **4** and which uniformly distributes the filaments **1** before they are drawn into an aerodynamic take-off means **7**, is arranged on a vertical shaft **5** attached to the spinning head at a sufficient distance beneath the spinning head **2**. The aerodynamic take-off means comprises an annular chamber **8** into which flows compressed air at 28 to 85 p.s.i. atms. The annular chamber **8** surrounds a tube **9** and forms parts of the wall of this tube **9**, which at its lower end is widened like a trumpet at **10**. An annular slot die **11** is arranged in the tube **9**, extending over its entire periphery. On leaving the slot die **11**, the compressed air expands into thin high-speed jet flowing along in contact with the wall of the tube **9**, taking the filaments **1** with it. The jet remains in contact with the wall even in the trumpet-like widening **10** of the tube **9** because provision is made for an adequate pressure all over the free sides of the jet so that the radial pressure gradient required for curving the flow line can be supported. This effect is enhanced by a displacement means **12** inserted into the trumpet-like widening **10** of the tube **9**. In this way, the quantity of secondary air taken in from above is limited by the resulting reduction in cross-section, with the result that the partial vacuum in the tube **9** is reduced. On the other hand, the displacement means **12** ensures that any air entrained flows off in an orderly axially symmetrical manner. The flow pattern is thus similar, for example, to an axially symmetrical flow of the kind developed when a jet or stream impinges vertically on a plate. The bundle of filaments **1** follows this flow pattern and is thrown at random against a collecting means **13** comprising a perforated jacket. The take-off means **7** is rotatably mounted in the bearings **14** and is periodically pivoted back and forth by a drive **15** in conjunction with a cam **16** and crank arms **17**. In this way, an extremely uniform texture is imposed upon the tubular random-filament fleece **18** which is removed at the lower end of the collecting means **13**. The air penetrates through the holes in the perforated jacket **13** and in doing so presses the filaments **1** and the tubular hose **18** in the process of formation against the wall of the perforated jacket **13**. The tubular hose **18** is moistened with steam or liquid, or possibly with a special preparing liquid, by means of a nozzle ring **19**. Moistening promotes adhesion of the filaments although, with certain fibre polymers, it gives rise to some shrinkage so that the tubular fleece **18** readily detaches itself from the perforated jacket **13**. The tubular fleece **18** is folded by means of two take-off rollers **20**, behind which there is a cutter unit **21** which cuts up the tubular fleece **18** so that two fleece webs **22** and **23** are formed, being wound up on to the rollers **24** and **25**.

The take-off means **7** is shown on an enlarged scale in FIG. 2. The distributor element **6** is provided around its periphery with a blow nozzle **26**, the shaft **5** being hollow for the delivery of gas or air. The filaments **1** are held apart by the jet of air **27** issuing from the blow nozzle **26** so that there is no friction on the distributor element **6**. The filaments **1** and the propellent jet **28** take secondary air with them.

FIG. 3 shows purely diagrammatically how the collecting means **13** is rotated by the drive **30** in conjunction with belt **31**, in order to impart to the tubular fleece **18**

in the course of formation a spiral texture superimposed upon the meander texture imparted by the reciprocating take-off unit 7.

What is claimed is:

1. A process for the continuous production of a random-filament fleece which comprises aerodynamically drawing off a plurality of filaments from a filament dispenser by means of a gas jet and then deflecting said filaments axially symmetrically with at least one annular gas jet and blowing said filaments in one plane on to the wall of a collecting unit at random to all sides, and in a uniform density.

2. The process of claim 1 wherein the gas is removed through the wall of the collecting unit.

3. The process of claim 1 wherein the bundle of filaments and the tubular fleece formed therefrom are rotated or pivoted with respect to one another.

4. The process of claim 1 wherein the tubular fleece formed is moistened.

5. The process of claim 1 wherein the tubular fleece formed is cut up.

6. The process of claim 1 wherein the tubular fleece is cut into a plurality of webs.

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U.S. Cl. X.R.

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