June 27, 1972 SHIGEO KATSUYAMA ETAL 3,672,819

PROCESS FOR SHAPING A BUNDLE OF WET-SPUN CONTINUOUS FILAMENTS

Filed Dec. 2, 1969 4 Sheets-Sheet 1

FIG. 1A

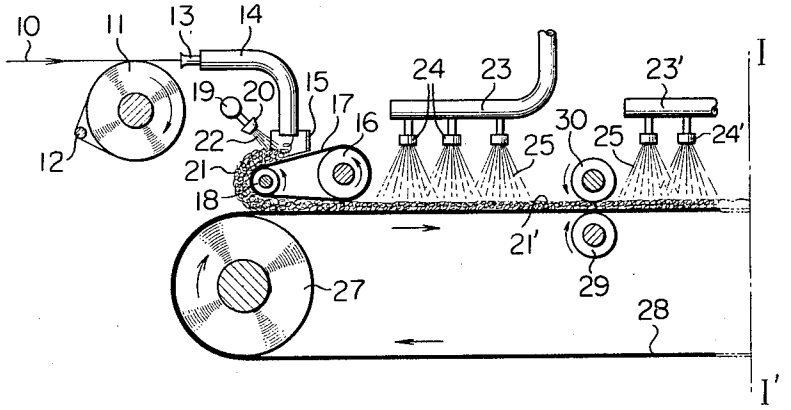


FIG. 2A

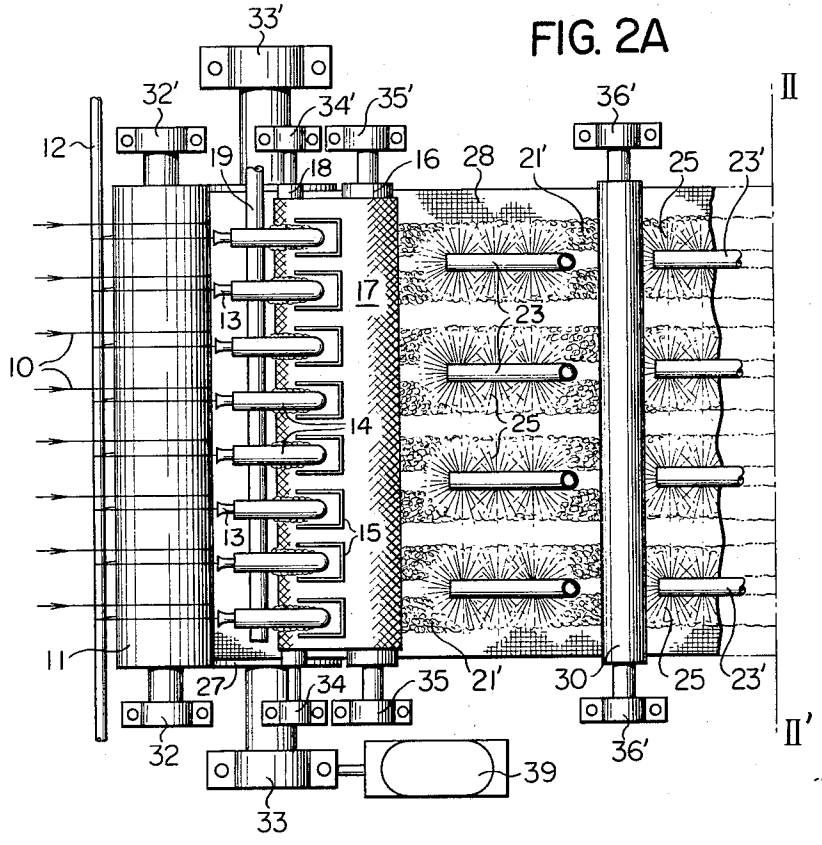


FIG. 1B

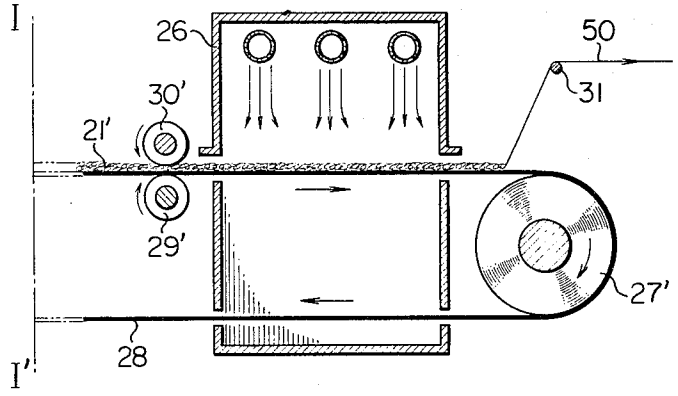
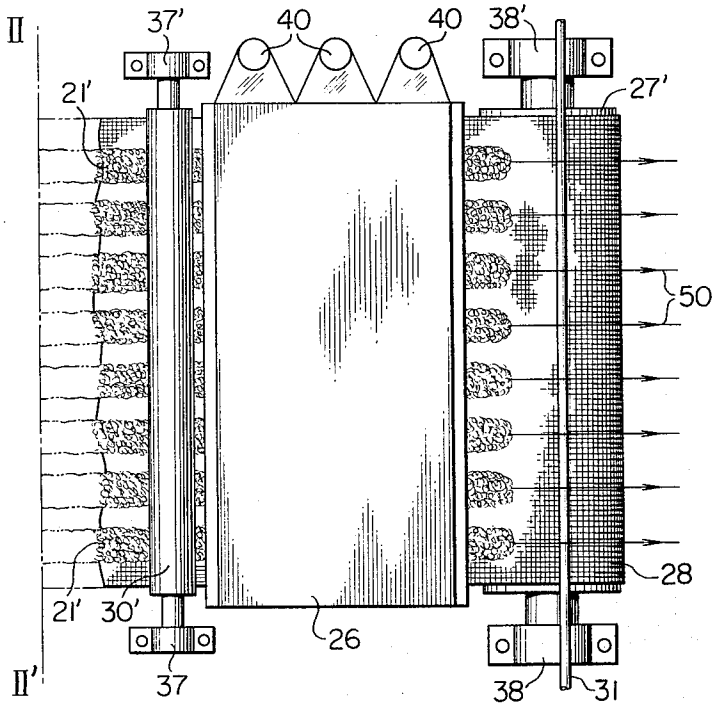

I
26
50
30'
31
21'
29'
27'
28
I'

FIG. 2B


II
37'
40
40
38'
21'
27'
50
28
21'
30'
26
37
38
31
II'

PROCESS FOR SHAPING A BUNDLE OF WET-SPUN CONTINUOUS FILAMENTS

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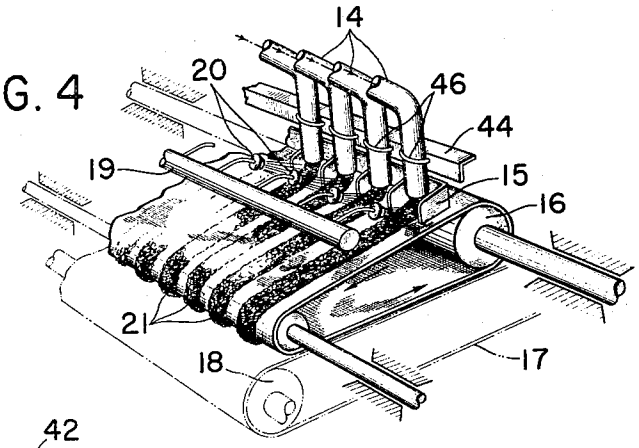
FIG. 4



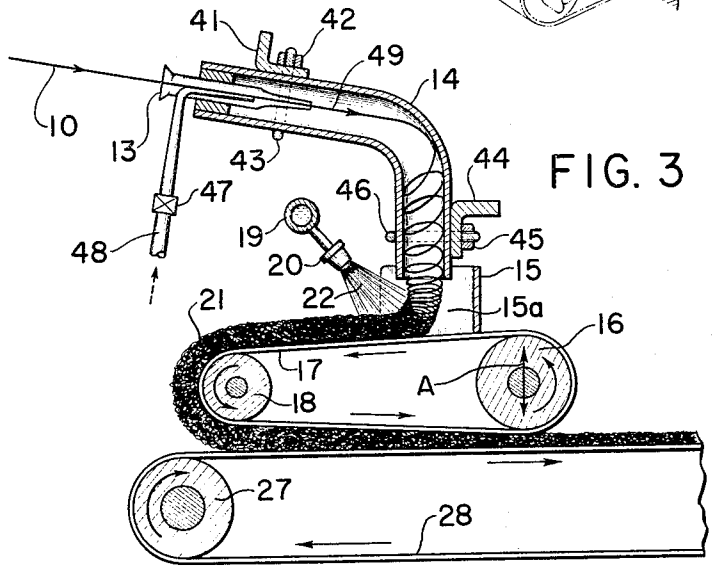
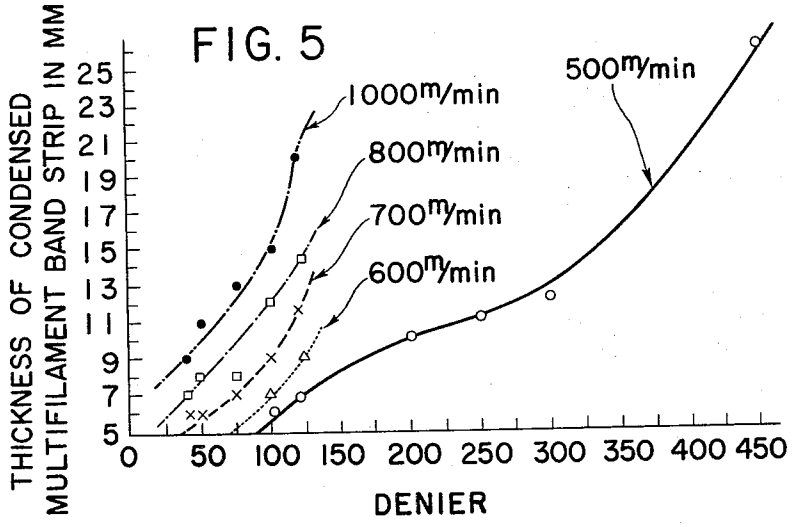


FIG. 3

FIG. 5



PROCESS FOR SHAPING A BUNDLE OF WET-SPUN CONTINUOUS FILAMENTS

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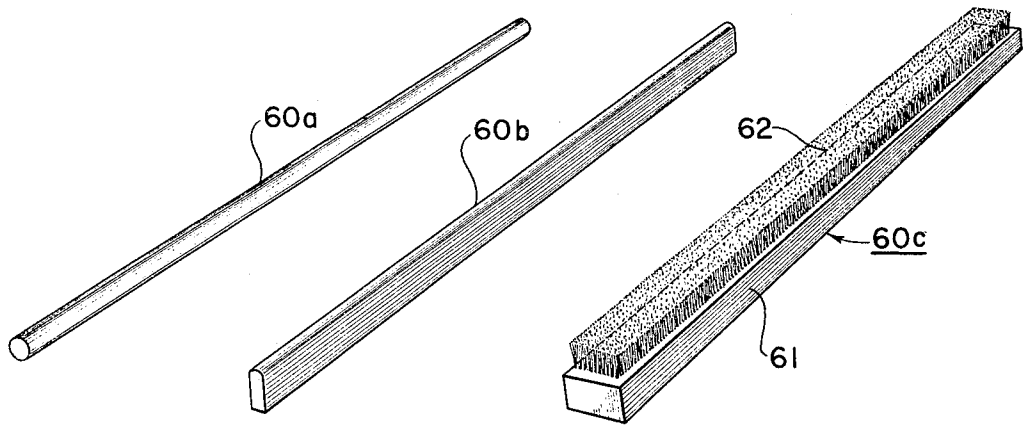
FIG. 6



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3,672,819

PROCESS FOR SHAPING A BUNDLE OF WET-SPUN CONTINUOUS FILAMENTS

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Claims priority, application Japan, Dec. 3, 1968, 43/88,229
Int. Cl. B08b 3/00
U.S. Cl. 8—137 4 Claims

ABSTRACT OF THE DISCLOSURE

A process for the shaping of wet-spun continuous multifilament bundles wherein said bundles are arranged in a plurality of elongated and parallel fleece mat strips on a pervious endless belt, each of said strips having a thickness of at least 5 mm. and 100–1,000 crossings of multifilament bundles.

This invention relates to an improved process for the shaping of wet-spun continuous filament bundles, at a high speed and in a continuous way and an apparatus for carrying out the same.

The invention should be applied to fine filaments, each having a denier less than 10 d., the overall denier of the filament bundle being limited to less than 1,000 denier.

In the following, the description will be directed, for the simplification thereof, substantially to the case of the shaping of continuous regenerated filament bundles to which the principles of the invention may be most advantageously applied prior to a scouring or other liquid treatment. It should be however easily understood from the whole description of the present specification to be set forth that the invention may be equally applied to other kind of wet-spun continuous filament bundles.

There is nowadays such an appreciable tendency that the rayon manufacturing industry is falling behind the synthetic fiber industry which has taken an amazingly fast pace in its development. We have carried out a considerable and profound investigation into the development of rayon manufacturing technique from all possible sides thereof for keeping pace with the comparative synthetic fiber production technique.

As a step in the investigation in the above sense, various problems in carrying out the scouring of continuous rayon filaments subsequent to the spinning formation thereof were investigated.

While otherwise disclosed in the literature, the scouring treatments of spun rayon filaments are performed almost exclusively by relying upon the cake scouring technique wherein the filament bundles in the shape of a cake or cakes per se are subjected to the treatment. In this case, the filament mass will be disadvantageously and differently treated at various points thereof, indeed, by virtue of uneven and different modes of contact with the treating liquid, thereby inviting uneven and localized yarn characteristics of the finished products. In order to obviate such conventional drawbacks, the continuous spinning process has already been proposed and carried into effect in practical technique, in place of the traditional cake bleaching process.

It should be noted that during scouring treatment of continuous wet-spun filament bundles arranged in linear state, the speed of treatment amounts generally to 100 m./min. or so, thus the economical merit of the process is too small to be accepted. For this reason, we have devoted ourselves to develop an amazingly improved and continuously workable process and apparatus for the scouring of continuous wet-spun filament bundles for the realization of processing speed in the range of 500–1,000 m./min.

It is commonly known to carry continuous filament bundles on an endless conveyor net for the continuous treatment of these bundles at a high operating speed. According to this prior technique the filament bundles are placed in their zigzag shape on the conveyor net and various treating liquids are fed in several successive stages onto the travelling filament bundles.

According to a similar prior proposal, continuous filament bundles are successively supplied on a travelling conveyor so as to take each a combination of two or more kinds of curved or looped plane configurations having various plane sizes for subjecting them to successive liquid treatments.

The filament bundles carried on the pervious conveyor belt take according to the prior technique zigzag, rought loops or the like simpler forms and are stacked to form only two or three layers when seen at a certain point as a measuring reference.

Therefore, when it is desired to subject these stacked filament loops or the like to a treatment such as bleaching the required whole processing will consume a considerably long period, thus the conveyor destined for the carrier means being considerably long and the required floor space being too large to be economically accepted, even when the correspondingly large investment capital for fitting the necessary liquid or the like treatment appliances is ignored. Therefore, it can be concluded that this kind of improvement may be carried into effect only with poor economical and productive efficiency.

It is therefore the main object of the invention to provide a highly improved technique for the shaping of wet-spun continuous filament bundles continuously and at a high operating efficiency as high as at 500–1,000 meters per minute prior to scouring treatment.

A further object of the invention is to provide an improved technique of the above kind for bleaching treatment of wet-spun continuous filament bundles with a very small requirement of floor space and at a considerably small operating cost.

The method according to this invention has its broadest coverage, residing, indeed, in a process for the shaping of wet-spun continuous filament bundles prior to scouring treatment, each of said filaments having 10 denier at the maximum and each of said bundles having less than 2,000 denier, in the shape of parallel bands on a pervious conveyor means, said process being characterized in that the band comprised of said filament bundle is in the shape of an elongated and thick fleece mat having a thickness of at least 5 mm. and 100–1,000 crossings of multifilament bundles when measured at any point along the length of said band and in the state of the band of filament bundle as projected from a casting nozzle onto and deposited in position on said conveyor means by means of water spray jet.

For carrying out the said process in a more advantageous way, a plurality of wet-spun continuous filament bundles are blown onto the surface of a travelling endless and pervious conveyor means in a thickly stacked three-dimensional band having a thickness larger than 5 mm. by blowing each bundle through an air jet means, while at the same time a liquid jet stream is blown onto the stacked fibrous band in such a way that the air jet stream and the liquid jet stream cross at least partially with each other on the conveyor means for practically setting the relative position of the blown-on fiber bundles constituting said band of the continuous filament bundle and then the band-shaped fiber stack is subjected to bleaching on the conveyor band.

The apparatus adapted according to this invention for carrying out the above process may comprise in combination, a hollow projecting cylinder means arranged for receiving and delivering a continuous filament bundle; an air ejector having its outlet end opening into the interior space of said projecting cylinder; a conveyor means of pervious nature for receiving the projected filament bundle delivered together with ejected air streams from said cylinder, said filament bundle being shaped on the conveyor means into an elongated stack of elongated fleece mat of filament bundles as the conveyor means proceeds; and a spray nozzle for provisionally setting said fleece structure of three-dimensional nature having a thickness of at leats 5 millimeters by means of water jet streams impinged on the fleece band as it is formed on said conveyor means.

In contrast to the above inventive concept as proposed for attaining the aforementioned objects, those skilled in the art have had the thought that when a multilayer densely stacked fiber loop band of three-dimensional nature consisting of several tens or even hundreds of complex looped multifilament layers, having an overall thickness larger than 5 millimeters when specified in case of fine continuous filaments less than 10 denier or so may result in frequent tanglings and breakages when taken out at a high winding speed such as 500–1,000 m./min. at the delivery end of the travelling carrier conveyor upon which the thickly stacked and densely condensed fleece fiber band is formed and maintained throughout successive after-treatment steps, thus having been deemed as completely impractical.

In practice of the inventive process as proposed, it is important to set provisionally in a lesser or greater fixed manner, the once formed dense and heavily thicker fleece band formation of the complex looped multifilaments by virtue of the spraying water jet streams acting as a kind of most economical setting medium onto the conveyor means through the whole thickness of the fiber fleece band formed under the utilization of the energy of air jet streams delivered from the outlet or lowermost end of the projecting cylinder.

The term "pervious" as used throughout the specification and appended claims means such nature of the conveyor or of the densely looped and stacked multifilament fleece band means that it allows passage therethrough of air, water or the like liquid medium, or the both.

It would be conceivable that when the thick and densely looped multifilament fleece band having an overall thickness at least 5 mm. is formed, maintained and subjected to successive after-treatments, the resulted effects thereof can be uneven or subjected to appreciable modification and alteration in the mutual position of the multifilament loops caused by unintentional application of foreign forces in the course of travel of the conveyor means carrying the densely looped fibrous band. According to our practical experiments, however, it has been found that there is substantially no fear of such troubles, thanks to the provisional setting of the mutual multifilament loop structure by means of water jet streams applied to the newly shaped multifilament loops stacked below the delivery end of the projector cylinder, on the one hand, and to the highly pervious nature of the densely looped fleece mat, on the other hand.

In order to avoid fear of tangling and breakage of filament bundle in the course of the winding operation after passage through the scouring and drying stages, it is most advantageous to provide a second conveyor means with its receiving end placed in a lightly overlapped manner with and below the delivery end of the first conveyor means.

According to our practical experiments, the overall thickness of the densely looped fleece mat band amounts at its upper limit to as large as about 20 mm. This upper limit will be further increased under still further improved operating conditions. Therefore, it would be easily conceivable that the densely looped band is practically a kind of fleece mat. It is highly advantageous to so arrange that the fleece band is transferred in its up-and-down state from the first conveyor means to the second conveyor means.

According to the process of the invention, it has been succeeded to arrange as many as 100 band strips of condensed multifilament fleece mat on a pervious conveyor means of 2 meter width, practically there being almost no idle space between each two neighboring fleece bands. Such arrangement provided a considerably high operation efficiency in the practice of scouring of wet-spun multifilament bundles with a comparatively small floor space and with a possible minimum capital investment.

These and further objects, features of the invention will become more apparent as the description proceeds by reference to the accompanying drawings, in which:

FIGS. 1A and 1B represent a single figure in combination, the coincidence line being shown at I–I', which figure is a substantially sectional side view of a preferred embodiment of the arrangement adapted for carrying out the process according to this invention.

FIGS. 2A and 2B represent in combination a single figure, the coincidence line being shown at II–II', which is a plan view of the arrangement shown in FIG. 1.

FIG. 3 is an enlarged sectional view of essential parts of the mechanism for the formation of multifilament condensed fleece mat band, said mechanism being a constituent of the arrangement shown in FIGS. 1–2.

FIG. 4 is a perspective view of a plurality of said mechanisms shown in FIG. 3.

FIG. 5 is a chart showing several examples of condensed multifilament fleece mat band shown in its thickness in function of the denier of multifilament bundle.

FIG. 6 shows several preferred embodiments of scraper means.

Now referring to FIGS. 1–2, the numeral **10** denotes a wet-spun continuous filament bundle, made preferably of regenerated cellulose, especially viscose rayon. This filament is supplied from a proper source, such as rayon cakes, not shown. The multifilament **10** is supplied through feed roller **11** and guide **12** to a supply ejector **13**, the introductory part of which projects from a projector cylinder **14**, while the main part and the delivery end of ejector **13** are positioned within the interior of said cylinder **14**.

Compressed air is supplied to the ejector **13** from a supply source, not shown, through a feed piping **48** fitted with a regulator valve **47**, thus the multifilament bundle **10** being introduced by the suction effect. The introduced bundle **10** is delivered from the outlet or lowermost end of the ejector **13** together with the delivered air jet streams, said delivered bundle being projected substantially in a straight line at **49** and impinging against the curved inside wall surface of the cylinder **14**. The compressed air streams perform in this region swirling motion within the interior of said cylinder, thereby the filament bundle being transformed into a series of continuous loops as shown especially in FIG. 3. In this way, filament yarn loops are continuously and successively projected onto the surface of a travelling end-

less belt 17 from the lowermost end of the projector tube 14 under the influence of the downwardly issuing air jet streams. This belt 17 is made of a pervious material such as wire net or the like.

Numerals 41 and 44 show supporting brackets which are fixedly mounted, although the fixing and mounting means have been omitted from the drawing, although not shown. For rigidly and stationarily positioning the projector cylinder 14 together with the ejector 13 as shown, there are provided fixing steel band strips 43 and 46 and fixing nut means 42 and 45.

Although in the foregoing, the multifilament fleece mat forming unit utilizing the air jet and the swirling motion thereof has been shown and described in singular only, a plurality of such units or mechanisms are arranged in practice for a workable plant, as only schematically and partially illustrated in FIG. 4. The number of such units may amount to 100 or more. These units are generally arranged in line laterally of the pervious endless belt 17. On certain occasions, however, they are arranged in two or more rows and in some offset manner, although not illustrated.

The numeral 19 denotes a water supply pipe or distributor from which water is fed under pressure to the corresponding number of spray nozzles 20. The water spray jet 22 delivered from the outlet end of each of the nozzles 20 is projected against the newly formed multifilament fleece mat 21 as it is formed just below the projector tube 14 on the surface of said travelling belt 17. The nozzle 20 is so directed and arranged that the projected area of water jet onto the fleece mat as formed crosses the air jet area projected against the conveyor belt 17. By employing this measure, the continuously projected multifilament loops from the lower or outlet end of the projector cylinder 14 at a heavy speed is avoided from being strongly disturbed and entangling which may be caused by the rushingly discharged air jet streams from the projector cylinder and thus the looped multifilament can be accumulated on the surface of the conveyor belt 17 without being blown off. The shape of the multifilament loop is highly variable and may take the form of circles, ellipses, eights or even the shape of almost overlapped slits. In this way, however, the multifilament loops are accumulated and deposited on the surface of the travelling conveyor belt 17 in a thick and elongated fleece mat 21 having a thickness of 5–20 mm. or more, as was referred to hereinbefore. Therefore, the water jets act as the medium for setting provisionally the mutual position of the condensedly deposited multifilament fleece structure. The fleece mat 21 represents 100–2,000 crossings of the multifilament when measured at a certain point downstream of the deposited area. When selecting properly the feeding speed of the multifilament, the pressure and delivered quantity of the projecting compressed air and the travelling speed of the conveyor belt 17.

At the outlet end of the projector cylinder 14, a limiter 15, made into the form of a channel, is fixedly attached thereto by any conventional means as welding, said limiter acting so as to limit the width of the projected fleece band 21 to a certain predetermined dimension such as 8–60 mm. Under certain operating conditions, however, this limiter can be dispensed with without prejudice. In the preferred embodiment shown in FIG. 4, the limiter consists of a series of limiter elements arranged in a lateral row and made into a single piece adapted for cooperation with the multi-unit system. The vertical walls 15*a* of the limiter serve in practice for the width limiting purpose.

The pervious conveyor belt 17 is driven in the counter clockwise direction when seen in FIGS. 1, 3 and 4, said belt being threaded for this purpose around a drive roller 16 and a driven roller 18, although the prime mover has been omitted from the drawing only for simplicity.

In the embodiment shown, the drive roller 16 is larger than the driven roller 18 and arranged adjustable in its vertical position as hinted by a double headed arrow "A."

When the travelling speed of the conveyor belt 17 is adjusted to 0.5–1.0 m./min., as an example, and by selecting the bore of projector cylinder 14, the blowing speed and pressure of the swirling compressed air to proper values, the elongated band strip of fleece mat 21 will represent a thickness of 5–20 mm. or more, width of 8–60 mm. and multifilament crossings 100–2,000. Thus, the fleece band strip 21 represents a three-dimensional, highly condensed multilayer construction.

When the conveyor belt 17 turns over at the place of the follower roller 18 so as to change the travelling direction from left to right in FIG. 3, the wet fleece band strip 21 is transferred in its up-and-down reversed state onto the surface of a second pervious conveyor belt 28, this fleece transfer being carried out without appreciable alteration of the general structure thereof, indeed, thanks to the provisional setting effect provided by the application of the water jet streams. If this application should not be adopted, the fleece structure could be substantially damaged and thus considerable difficulty in untangled and smooth take-up of the multifilament would be encountered at the combined final stage of the scouring and drying state to be described for winding up of the multifilament on a bobbin.

While the up-and-down reversed multifilament fleece band strip 21 is conveyed on the second pervious belt 28 from left to right in FIGS. 1–3, it is more compacted by the pressure exerted from upper by the drive roller 16 and the depositing and setting effect will be further accentuated. In this case, also, the contained water content in the fleece will provide an important role in the prevention of the unintentional scattering of the compacted fleece construction. By this pressurizing operation, the preserving effect of the mutual fleece construction of the highly multitudinously crossed multifilament texture is substantially maintained when the fleece strip is subjected to a scouring operation on the second conveyor belt 28.

There are provided two distributor pipes 23 and 23′ adapted for supplying scouring liquor of known composition to a number of spray nozzles 24, 24′ which shower the fleece layer strip with said liquor. In this way, the fleece strip 21 is subjected to an even scouring effect. The scouring spray streams are shown at 25. The thus treated fleece strip is passed through two pairs of squeezing rollers 29, 30 and 29′, 30′.

The squeezed fleece layer strip is then conveyed by means of the second conveyor 28 into a tunnel dryer 26 for being dried up. At this stage of the operation, the conveyor 28 is practically covered fully with a large number of the parallel fleece strips having a large thickness and substantially compacted structure, the drying thermal efficiency will be highly improved in comparison with the prior art.

In this respect, it should be noted that in all the figures the interstrip idle gaps were shown in a rather accentuated manner for avoiding any possible confusion in the drawing, and the practical value amounts to a very small neglectable one.

The multifilament bundle, upon leaving from the outlet end of drier 26 is taken out in the form of a continuous line-shape as at 50 through a yarn guide 31 and for the purpose of winding-up on a bobbin, not shown. This winding-up operation can be effected at a high speed of 500–1,000 m./min. without fear of yarn tangling and breakage.

In FIG. 5 are several examples of the multifilament fleece band strip provided by the novel teaching, showing the preferred mutual relationship among the specified data concerning denier of multifilament, thickness of fleece band strip and winding-up speed. These data were ascertained by our practical experiments. From these data, a highly improved scouring efficiency may well be supposed.

Upon checking the processed multifilaments, it was ascertained that the scouring and drying effects were highly

even and superior. Thus, the overall quality of the yarn could be substantially improved.

The supply roller **11** is rotatably mounted at its both ends by bearing means **32, 32'**. Bearing means **33, 33'** are provided in the same way for conveyor drive roller **27**, and those of **34, 34'** for the follower roller **18**. Several bearing means **35, 35'; 36, 36'; 37, 37'; 38, 38'** are also provided for drive roller **16**, squeezing roller **30, 30'** and conveyor drive roller **27'**, respectively.

Numeral **39** represents a conventional mechanism for the prevention of fluctuation of travelling of conveyor means **28**. The numeral **40** represents several fans which deliver hot air to the drier **26**.

In FIG. 6, several preferred embodiments of scraper means are shown at **60***a*, **60***b* and **60***c*. The first one at **60***a* consists of a rigid round bar made preferably of stainless steel. The second one at **60***b* consists of plastic material such as semi-rigid bar having substantially a rectangular cross-section. The third one shown at **60***c* comprises an elongated rigid bar-like base **61** embedded with brush hair **62**.

One or more of these scraper means are arranged at an intermediate portion between the ends of the second conveyor belt **28** and in physical contact with the lower surface of the upper travelling zone thereof. These scrapers are arranged laterally of the belt **28** in the similar way as the rollers **29, 29'**. During the scouring treatment, the liquid will frequently fill the meshes of the conveyor net **28** or the like pervious carrier means. By the provision of these scraper means, the thus filling liquor film can be effectively broken, thus a possible lateral flow of the scouring liquor on the surface of the melt being effectively avoided.

Several numerical examples of the process according to this invention will be given in the following for better understanding of the invention. The results are shown in FIG. 5.

Examples

The operation was carried out under the following conditions:

(1) width of the projected and deposited multifilament fleece band strip: 27 mm.
(2) travelling speed of first conveyor belt: 0.5 m./min.
(3) scouring period (length of scouring section: 7.5 m.): 15 m./min.;
(4) drying-up period (length of drier section: 5.5 m.): 11 min.
(5) humidifying period (length of humidifier section: 5.0 m.): 10 min.

When operated, the results concerning supply speed of the fed multifilament, denier of the multifilament bundle and thickness of the projected and deposited fleece mat strip were as shown in the following Table I.

There is a certain prior art which recommends the use of a mechanical rotatable means such as a rotatable disk formed with a yarn guide opening for supplying a looped yarn layer on a travelling endless belt. Use of such mechanical means would injure considerably the nature of the yarn if the latter comprises a finer multifilament of regenerated cellulose than 10 d. per filament. According to this invention, such defect can well be avoided.

It will thus be seen that the scouring process and apparatus according to this invention will provide substantial progress in the art.

TABLE I

	Filament supply speed (m./min.)				
	500	600	700	800	1,000
Stacked Density (mm.)	1 1,000	1 1,200	1 1,200	1 1,400	1 1,600
Denier:					
40	3	4	6	7	9
50	3	4	6	8	11
75	4	5	7	8	13
100	6	7	9	12	15
120	7	9	12	15	20
200	10				
250	11				
300	12				
450	26				

The embodiments of the invention in which an exclusive property or privilege is claimed are as follows:

1. In a process for depositing and shaping wet-spun continuous multifilament bundles in the shape of parallel bands on a continuously moving pervious conveyor means, the improvement comprises in combination the following steps of:

(1) selecting each of said multifilaments to have 10 denier at the maximum, each of said bundles amounting to less than 2,000 denier, and

(2) shaping each of said bands into an elongated and thick and condensed fleece mat having a thickness of at least 5 mm. and representing 100–1,000 crossings of multifilament bundles when measured at any point along the length of said band.

2. Process according to claim **1** further comprising: projecting said multifilament bundle from a casting cylinder onto said conveyor means in the form of a thick band by utilizing the energy of air jet streams.

3. Process according to claim **2**, further comprising: setting provisionally the state of said band as projected from said casting cylinder onto said conveyor means by means of water jet streams.

4. A process for depositing and shaping wet-spun continuous multifilament bundles in the shape of parallel bands on a continuously moving pervious conveyor means comprising blowing each bundle through an air jet means onto said conveyor means in a looped manner and provisionally setting the looped bundle into an elongated band by directing a liquid jet onto said band transversely to the direction of the air jet.

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MAYER WEINBLATT, Primary Examiner

U.S. Cl. X.R.

8—139, 139.1, 149.1; 68—202; 101—172; 118—325; 28—59; 19—66

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,672,819 Dated June 27, 1972

Inventor(s) Shigeo Katsuyama et al

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

In The Heading:

The second Priority Date was omitted. Should be:

February 13, 1969 Japan.....10212/1969

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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