Oct. 27, 1970 E. A. BROWN 3,535,755

TEXTILE APPARATUS

Original Filed Jan. 5, 1968

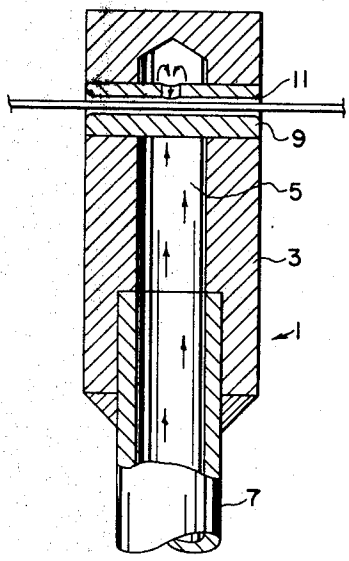


FIG. 1

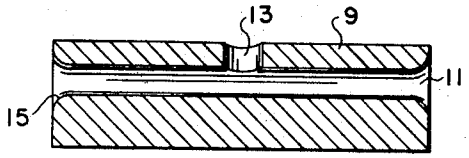


FIG. 2

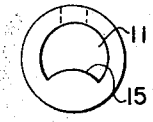


FIG. 3

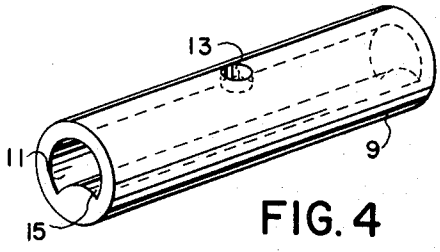


FIG. 4

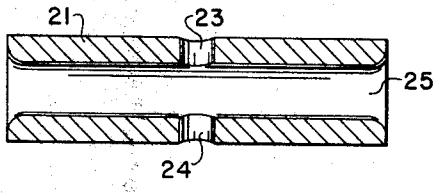


FIG. 5
PRIOR ART

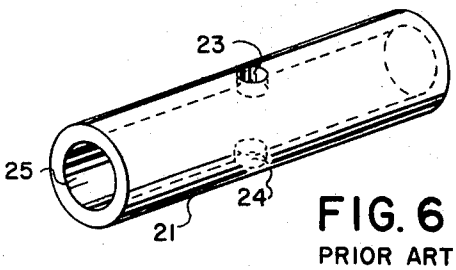


FIG. 6
PRIOR ART

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TEXTILE APPARATUS

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Original application Jan. 5, 1968, Ser. No. 695,898, now Patent No. 3,449,903, dated June 17, 1969. Divided and this application Nov. 20, 1968, Ser. No. 793,632

Int. Cl. D02g 1/16

U.S. Cl. 28—1.4 8 Claims

ABSTRACT OF THE DISCLOSURE

The apparatus disclosed is a body member having a concavo-convex passageway therethrough which has the general shape of a partially eclipsed disc. Further, the body member has a gas inlet opening communicating with the passageway to permit gas to be forced into the passageway to randomly entangle the filaments of a multifilament yarn being passed through the passageway.

This invention is a division of application Ser. No. 695,898, filed Jan. 5, 1968, now U.S. Pat. 3,449,903, granted June 17, 1969 and relates to the manufacture of entangled multifilament yarn and is particularly concerned with an apparatus for the continuous treatment of the yarn to produce a novel entangled multifilament yarn characterized in that it is easily processable and which does not exhibit the variability in width and uniformity normally found in entangled yarns.

Treatment of continuous filament textile yarn by means of jets utilizing high velocity gasses to entangle the individual filaments of continuous filament yarn has become commonplace in the textile industry. These jets are known as TF jets and are particularly useful to intermittently entangle filaments of continuous filament yarn to impart coherency to the yarn thereby eliminating or reducing the need for twisting of yarns. An example of some of the prior art jets may be found in U.S. Pat. 3,286,321. The yarn entangled by means of jets of the type disclosed in U.S. Pat. 3,288,321 usually exhibits a wide variance as to the distance between entanglement sites and a wide variance between the relative diameter or width of the yarn along its length. This variance is believed to be the cause of TF flashes in fabrics made from such yarn.

Fabrics made from yarns which have been entangled in accordance with my invention are characterized by good appearance and very few TF flashes. The TF flashes when viewed in a fabric tend to appear as light spots or streaks in the fabric and tend to simulate the general effect of a skip-dent weave. By transmitted light the fabric appears to contain a thick and thin type yarn with randomly occurring short lengths of thin yarn appearing throughout the fabric. This change of luster of the yarn is believed to be caused by sites of very tight entanglement.

In any event, I have found that yarn, entangled with conventional jets having orifices of the types described in the prior art, when converted into fabrics, produce fabrics which are not of the best quality from an appearance viewpoint. Usually the fabrics exhibit TF flashes and are sometimes streaky and the overall appearance is usually not very good.

The novel TF jets disclosed in this specification may be characterized as a body member having an outer surface and an inner surface forming an opening through the body member. The inner surface of the body member defining the first opening is in part concave and in part convex wherein at least a portion of the opening in cross section is generally shaped like a partially eclipsed disc.

The body member has a second opening formed therein and extending through to join the first opening, the junction of the openings being located opposite the convex surface. Gas forced through the second opening into the first opening will impinge on yarn passing through the first opening and on the convex surface to create turbulence in the flowing gas to result in the entangling of individual filaments in the yarn.

These jets when used in accordance with my invention produce continuous filament yarns which may be characterized as a multifilament textile yarn adapted to be processed on conventional textile equipment. The yarn being randomly entangled at sites spaced apart from 1–8 inches along the length of the yarn to give coherency thereto. The entangled yarn is further characterized in that the variability in width within three-inch lengths thereof is no greater than about two times the variability in width within three-inch lengths of a like reference yarn having no entanglements or twist.

The desired degree of entanglement of filaments of a multifilament yarn necessary to protect the filaments during processing will vary according to the processes to which the yarn will be subjected. However, it is generally desirable to use as much entanglement as possible without impairing the appearance of the finished product. The yarn produced in accordance with this invention exhibits a greater uniformity in width variation than do yarns entangled with known entangling devices. The novel yarns of this invention have the advantage of having more entanglement and consequently give greater protection to the individual filaments during processing. The increase in the degree of entanglement without a resulting impairment in the appearance of the final fabrics is highly desirable. The reason that my novel yarn produces this effect is because the entanglements are more uniform and non-uniformity is believed to be the major contributor to poor fabric appearance.

The novel jet used to produce the novel yarn disclosed herein has, in addition to its ability to give more uniform entanglement of the filaments, added advantages. One important advantage is that the amount of compressed air or gas being exhausted through the jet is reduced since a lower pressure can be used to obtain yarns having equal entanglement levels, with the yarn also exhibiting less variance in width than does a yarn made with prior art jets.

The jets of this invention are particularly useful for warp yarns since such yarns tend to more noticeably exhibit their non-uniformity, especially in satin constructions. Especially good results are obtained in the denier range of 50 to 150 since this range of deniers is more commonly used in warps. However, the invention is applicable to yarns useful in the manufacture of knitting yarns and filling yarns in deniers ranging from about 50 to 300 denier.

In the drawings which illustrate a specific embodiment of the invention:

FIG. 1 is a side elevation illustration in partial cross section of my novel jet;

FIG. 2 is a side elevation in cross section of a specific embodiment of the insert used in the novel jet;

FIG. 3 is an end view of the jet shown in FIG. 2.

FIG. 4 is an isometric illustration of the jet insert shown in FIG. 2.

FIG. 5 is a side elevation in cross section of a prior art jet insert; and

FIG. 6 is an isometric view of the jet of FIG. 5.

Referring to FIG. 1 there is shown one embodiment of the novel jet assembly of this invention. The jet assembly includes mounting means for a jet body member. The mounting means comprises a block **3** having an air inlet bore **5** formed therein by means of drilling and

counter-boring to receive a pressured gas conduit **7**. The mounting block further has been drilled to receive a jet body member **9**, in such a manner that the center portion of the body member is in communication with the bore **5**. As shown in FIGS. 1–4, the jet body member **9** is generally cylindrical in shape and has a first opening **11** formed therethrough. The inner surface of the body member being in part concave and in part convex to define the general cross sectional shape of first opening to be like that of a partially eclipsed disc. The body member **9** further has a second opening **13** formed therein and extending through to join the first opening **11**. The junction of the openings **11** and **13** are located opposite the convex portion **15** of the inner surface of the body member. However, if I wish to place some tension on the yarn I simply cant the second opening so that the longitudinal axis thereof is in the same plane as is the longitudinal axis of the first opening but is not perpendicular thereto. While I have illustrated the convex portion as a continuous rib, it is to be understood that various modifications could be made thereto such as making the convex surface so that it is a protrusion. However, I prefer the continuous rib because the ease of manufacture since one has to be able to withdraw a core if one is molding the jet insert.

In FIGS. 5 and 6, I have illustrated a prior art jet insert **21** which is tubular in shape and has two inlets **23, 24** communicating with a treatment chamber **25**, this jet insert being shown in U.S. Pat. 3,286,321. There is also shown in U.S. Pat. 3,286,321, the jet having the same general structure as the jet shown in FIGS. 5 and 6 except that it has a single air inlet opening. However, such jets are not in wide commercial use due to relatively poor performance as compared to the jets shown in FIGS. 5 and 6. The jet shown in FIGS. 5 and 6 is one type of jet that is in wide commercial use and is the type of jet used to produce a large amount of TF yarn in the industry. Yarn which has been entangled with a jet having the two opening structure will generally, when used as the warp yarn, produce fabrics which exhibit poor appearance and a large amount of TF flashes or streaks. This comparison will be set forth in detail hereinafter.

I will now describe a cycle of operation of the jet apparatus and will also describe the yarn product produced thereby. A 150 denier/38 filament cellulose acetate yarn was run through my novel jet apparatus at a speed of about 700 meters/minute. The air directed onto the yarn through opening **13** in the jet apparatus was 9 p.s.i.g. This set of conditions resulted in a yarn having an average 2.6 inches between entanglements as determined by the "pick test." The "pick test" technique for determining the spacing between entanglements in TF yarn is as follows:

Packages to be tested are usually those which have been checked for denier. If not, packages are run back for one minute prior to testing (to remove yarn on outside of package which is not twined). Filaments are separated into two bundles with a hand stylus or pick. No more than ¼" along strand is separated in this manner. The two filament bundles are then placed around the horizontal needle on the TF pick test instrument. (This needle is pivoted and calibrated so that a force of 1.0 gram±0.03 gram is required to pull needle downward from the bar against which it rests.) With strand around needle at proper position against guide bar, the end is pulled downward with slow, smooth motion. When an entanglement in the strand pulls the needle away from the guide bar, the distance between the entanglement and the point held by the inspector (original point where filaments were separated) is measured by reading from the scale mounted on the instrument.

Results are recorded to nearest inch. If distance is under ½", record as 0. If distance is over ½" but less than 1½", record as 1, etc. The yarn strand is grasped just under the pigtail guide at top of instrument for each successive reading. If filaments are damaged, begin again and repeat. Normally, this routine is repeated ten times on each package checked, and results are averaged.

The jet apparatus used had an opening therethrough shaped like that shown in FIGS. 1–4. The concave inner surface defining the opening had a radius of curvature that was about equal to the radius of curvature of the convex portion. The jet insert was made from nylon.

The yarn produced, when randomly entangled at sites spaced apart from 1–8 inches, was evaluated as to variability in width within three-inch lengths thereof as compared to the variability in width within three-inch lengths of like yarn having no twist or entanglement therein and it was found that the variability in width within three-inch lengths of the yarn of the invention was no more than about two times the variability in width within three-inch lengths of the reference yarn having no twist or entanglement.

I found that yarn having an average of about 2.6 inches between sites of entanglement when processed as set forth in my novel jet apparatus had a variance in width within three-inch lengths of only 1.6 times the variability in width within three-inch lengths of a like reference yarn.

The variability was measured by the Optical TF Detector test. The test is as follows:

The measuring apparatus comprised a base having on one end first yarn guide and second yarn guide spaced laterally from and slightly below the first yarn guide and on the other end of the base a corresponding pair of yarn guides was mounted in mirror image relationship. Between the two yarn guides lying adjacent each other was mounted a glass tube filled with black velvet. This tube was five-sixteenths of an inch in diameter. This tube was spaced laterally and vertically from the second guide. The yarn to be tested was passed through the first guide and through the second guide. The lateral and vertical spacing of the two guides being such that the included angle formed between the base and the yarn strand was about 40°. The yarn was then passed over the glass rod and down through the mirror image second guide and then up and through the mirror image first guide and on to a take-up roll having a constant surface speed. The included angle formed by the base and the yarn as it extends from the second guide to the glass tube is about 30°. The corresponding angles formed as the yarn passes through the second set or mirror image guides are equal to the earlier described angles. The path taken by the yarn as it passes through the apparatus may be described as a flattened W shape with the glass tube being at the center high point of the W.

With the yarn being so aligned on the apparatus and passing over the glass rod at a constant speed of one foot/second and under a constant tension of five grams it was illuminated with a high intensity American Optical microscope illuminator. The bulb used in illuminator was a GE 1493. The illuminator was supplied with a five volt D.C. current from a stable D.C. power supply. The yarn was illuminated at an angle of about 45° at a distance of about 4 inches from the longitudinal axis of the glass tube and was viewed with an American Optical Student microscope using a 10× objective lens. The eye piece in the microspoce was replaced with a light sensitive receptor which contained a RCA 929 vacuum photo tube. An anode voltage of approximately 150 volts D.C. was supplied to the photo tube and a signal of approximately one-tenth volt was obtained across a 10 megohm load resistor in series with the photo tube. The signal was then passed through two Philbrick UPA–2 amplifiers where is was amplified approximately two-hundred times. A bias voltage was applied to the amplifier to compensate for any stray light entering the photo tube. This signal was then fed into a Brush RB 5612–11 recording oscillograph where it was recorded on chart paper. The resultant recorded signal was proportional to the width of the yarn as it passed over the glass tube.

To illustrate the improvement in fabric appearance made from my novel yarn and conventional yarns a group

of fabrics was made and graded. The fabrics were made under the same conditions with only the yarn being changed as set forth in Table I below. The fabrics were each a five harness Sweetheart Satin with a 75 denier TF acetate warp (200 end/inch) and 150 denier acetate filling (50 picks/inch) and were evaluated for overall appearance, streaks, and TF flashes by independent fabric experts.

TABLE I.—WARP YARN

Fabric	Average entanglement inches between entanglements	Entangled by jet of Figs. 1–4	Entangled by jet of Figs. 5–6	Overall[1] fabric appearance
A	6.24	Yes	No	10
B	3.04	Yes	No	8
C	2.95	No	Yes	4

[1] Overall fabric appearance values are as follows:
10=Excellent appearance, no TF flashes and absence of streaks.
8=Good appearance, few TF flashes or slightly streaky.
6=Fair appearance, moderate amount of TF flashes or moderately streaky.
4=Poor appearance, large amount of TF flashes or streaks:
2=Unsatisfactory in all respects.

In considering the fabrics we see that fabric A had a warp yarn which had an average 6.24 inches between entanglements and received the best grade on overall appearance. The warp yarn of fabric B had an average of 3.04 inches between entanglements which is more than twice the number of entanglements in fabric A. The grade given was 8 (good appearance, few TF flashes or slightly streaked). Fabric C was made using a warp yarn that had an average of 2.95 inches between entanglements (note similarity to warp yarn in fabric B in this respect) but received a grade of 4 (poor appearance, large amount of TF flashes or streaks).

Textile mills would be inclined to choose the warp yarn used to make fabric B over the other since the more frequent entanglements would improve yarn coherency and would therefore improve weaving efficiency with a small loss in appearance in the finished fabrics. The warp yarn used in fabric C apparently caused the poor appearance and TF flashes due to its inherent and high variability of width caused by the tight entanglement at the site of each entanglement.

This invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. Apparatus for the production of entangled multifilament yarn comprising, a body member having an outer surface and an inner surface forming an opening through said body member, the inner surface of said body member defining said first opening being in part concave and in part convex wherein at least a portion of said opening in cross section is generally shaped like a partially eclipsed disc, said body member having a second opening formed therein and extending through to join said first opening, the junction of said openings being located opposite said convex surface, whereby gas forced through said second opening into said first opening will impinge on yarn passing through said first opening and on said convex surface to create turbulence in the flowing gas to result in the entangling of individual filaments in said yarn.

2. Apparatus of claim **1**, wherein said convex surface is located immediately opposite the portion of the concave surface where said second opening joins said first opening, said convex surface being in alignment with the longitudinal axis of said second opening.

3. Apparatus of claim **2**, wherein said convex surface is symmetrical.

4. Apparatus of claim **1**, wherein said convex surface is shaped as a continuous rib and extends the full length of said first opening.

5. Apparatus of claim **1**, wherein the radius of curvature of said concave surface and said convex surface is approximately equal.

6. Apparatus of claim **5** wherein the high point of the convex surface does not extend through the center of curvature of said concave surface.

7. Apparatus of claim **1**, wherein said body member is formed from nylon.

8. Apparatus of claim **1**, wherein the longitudinal axes of said openings are in perpendicular relationship .

References Cited

UNITED STATES PATENTS

3,220,082	11/1965	Fletcher et al.	28—1.4
3,238,590	3/1966	Nicita et al.	28—1.4
3,436,798	4/1969	Nicita	28—72.12 X

LOUIS K. RIMRODT, Primary Examiner