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APPARATUS FOR INTERLACING MULTI-FILAMENT YARN

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2 Sheets-Sheet 1

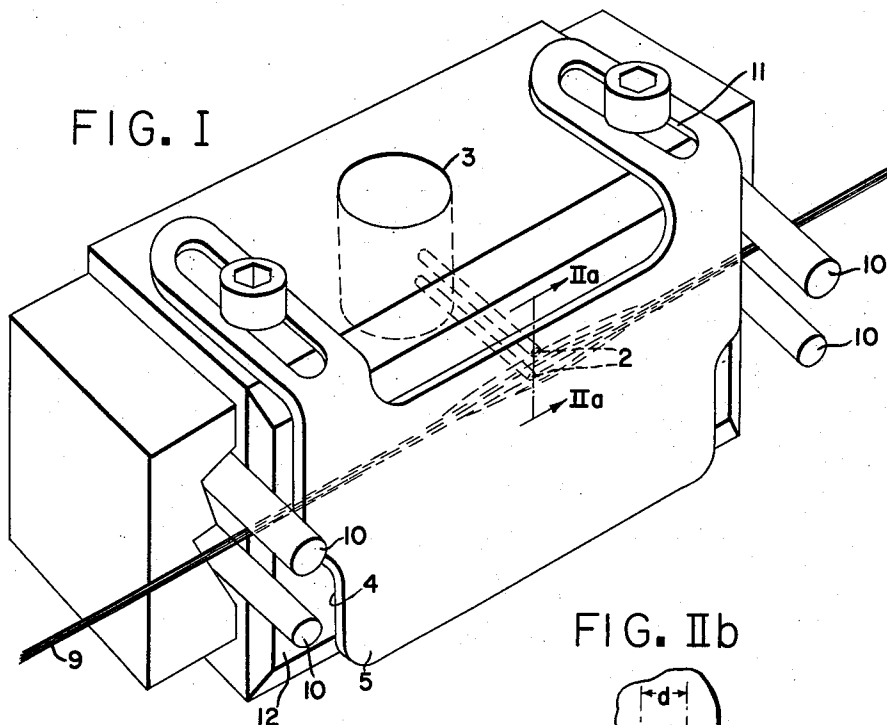


FIG. IIb

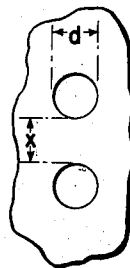


FIG. IIa

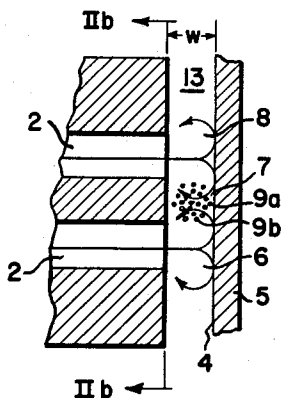
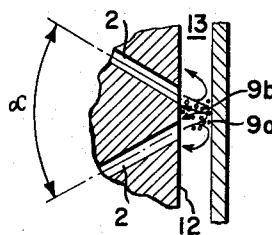


FIG. III



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FIG. IV

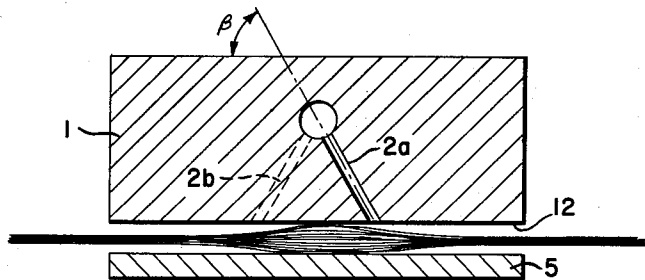


FIG. V

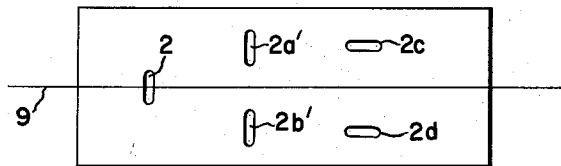
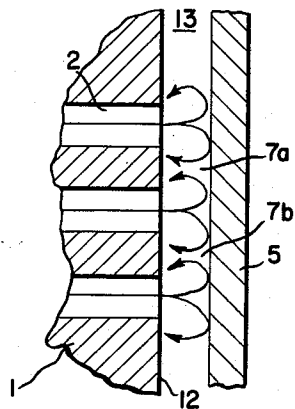


FIG. VI



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APPARATUS FOR INTERLACING MULTIFILAMENT YARN

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8 Claims. (Cl. 28—1)

This invention relates to yarn production and handling, and is particularly concerned with an apparatus for treating as-spun or zero twist yarn in a continuous manner to produce a compact unitary strand without bundle twisting. This application is a continuation-in-part of our co-pending application Serial No. 5,811, filed February 1, 1960, now abandoned.

Multifilament yarn producers have long sought a method which would obviate the need for twisting and/or slashing such yarn to insure adequate handling characteristics. As-spun or zero twist yarn performs poorly in many of the common textile operations, such as winding, weaving, and knitting, due in the main to a looseness of structure which permits individual filaments to snag and break out, thence forming fluff balls, slubs, ringers, wraps, strip backs, or similar defects. Moreover, zero twist yarn runs in the form of a ribbon over guides, rollers, etc., and the attendant increase in friction often results in abraded yarn which is even more prone to mechanical failure. As a result of these shortcomings, the textile trade is extremely reluctant to use zero twist yarn, and yarn producers must carry out the additional step of twisting each yarn to provide the trade with an acceptable product. Twisting, of course, serves to compact and unify a yarn bundle, resulting in a more cohesive structure which resists the pulling out of individual filaments. However, conventional true twisting is expensive and time-consuming and, being a discontinuous operation, adds disproportionately to the cost of the yarn. Also, the mechanics of true twisting and the additional handling required often results in yarn of lower quality. Although false twisting permits the temporary accumulation of twist in a continuously running yarn line, such twist is of transitory nature and the product of that process is only zero twist yarn exhibiting little improvement in handling and running characteristics.

It is an object of this invention to provide apparatus useful for producing interlaced yarn, that is, yarn which even at zero bundle twist has handling and running characteristics at least the equal of conventional true twisted yarn.

In its preferred embodiment, the fluid interlacing apparatus of this invention comprises two coplanar fluid conduits positioned to direct two streams of high velocity fluid against a planar surface, thereby forming contiguous fluid vortices. In operation, a yarn is passed axially between the two streams and parallel to the planar surface.

The invention will be more easily understood by reference to the drawings.

FIGURE I shows an isometric view of a preferred fluid interlacing apparatus of this invention.

FIGURE IIa shows in vertical cross section the relative positions of the yarn passageway and fluid conduits of FIGURE I.

FIGURE IIb is a view of FIGURE IIa, viewed along line IIb.

FIGURE III shows an alternative arrangement of fluid conduits relative to the yarn passageway.

FIGURES IV, V, and VI show other variations in arrangements of the fluid conduits relative to the axis of yarn passing through the apparatus.

Referring to FIGURE I, which depicts a simple but

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preferred apparatus of this invention, body 1 contains two cylindrical fluid passageways 2 communicating with fluid manifold 3 which may be supplied with fluid, preferably air, from any convenient source not shown. In this embodiment, fluid conduits 2 are parallel with equal cross-sectional areas but as will be described hereinafter these fluid conduits need not be parallel nor in the same plane nor of equal size. Indeed, there may be more than two fluid conduits and all may have the same size and configuration or each may be different in size and configuration and orientation from each of the remainder. Fluid conduits 2 are positioned to direct fluid against the inner face 4 of wall member 5, thereby forming fluid vortices at 6, 7, and 8 which act to interlace yarn 9 as the latter passes through the apparatus. Guide pins 10 direct the yarn axis between the axes of fluid conduits 2 but such guide means are not essential to the operation of the apparatus since once the yarn is placed within area 7 it will tend to remain there until forcibly removed, so that any conventional guide means tending to hold the yarn in the general vicinity of the fluid vortices may be used. Wall member 5 contains slots 11 which permit adjustment of the spacing between its inner face 4 of wall member 5 and face 12 of body 1 to vary the width of the yarn passageway. The axis of yarn 9 passing through passageway 13 is preferably equidistant from the axes of fluid conduits 2.

FIGURE IIa shows in cross section the relative positions of fluid conduits 2, yarn filaments 9a, 9b, etc., wall member 5, and body face 12. In FIGURE IIb the distance "x" between the closest points on the circumferences of fluid conduits 2 may vary from zero to about ten times "d," the diameter of each of the fluid conduits, or their average diameter, where they are unequal. When using the conditions of operation referred to herein, distance "x" is preferably within the range of 1 to 5 times "d," and the most preferred values are numerically between about 2d and 3d. The diameter "d" of the fluid conduits may range from about 0.020 to about 0.10 inch. As the width "w" of the yarn passageway is increased, fluid density entering this passageway must be increased to provide the same interlacing effect. In the processing of yarns of from about 20 to 2000 denier the width "w" may range from 0.008 to 0.120 inch, the greater widths being used, of course, with the higher denier yarns. FIGURE IIa also shows how the filaments 9a, 9b, etc., are separated while passing through fluid vortex 7.

FIGURE III illustrates a preferred fluid conduit arrangement in which the fluid conduits are not parallel. As indicated in FIGURE III, each fluid conduit may vary from 0° to 80° from the horizontal (assuming that yarn is passing through the apparatus axially in a horizontal direction). With this arrangement the relationship between "x" and "d" is the same as stated with respect to the parallel fluid conduits of FIGURE IIa. Angle alpha, the included angle defined by the conduit axes, may vary from 0° to 160° and width "w" should be between 0.008 and 0.120. In FIGURE III the axes of both conduits 2 lie in the same plane which is the plane of the paper and perpendicular to the strand axis. This plane, or either of the conduits, however, may be angled forward or backward along the path of strand travel so long as the axis of each conduit forms an acute angle with the planar surface of face 12 of at least 10°.

FIGURE IV is a cross-sectional top view of an embodiment of this invention showing fluid conduits 2a and 2b angled forward and backward, respectively, along the yarn line and the angle beta between the axis of each of these fluid conduits and face 12 should be at least 10°.

According to a preferred embodiment of the invention, the fluid conduits are inclined towards each other,

so that the fluid streams entering the yarn passageway impinge on the yarn to help maintain the yarn in the plural vortices, and the conduits are also at an angle to the direction of yarn travel to help maintain tension on the yarn. For example, referring to FIGURES III and IV, the angle α will preferably be about 60° to 90° and the angle β about 45° to 90°. The conduits are preferably about 0.03 to 0.07 inch in diameter and at a spacing distance x of 0.125 inch. The width of the yarn passageway between the planar surfaces is preferably 0.080 inch for 840 denier, 140 filament yarn and 0.045 inch for 200 denier, 20 filament yarn. Air supplied to the conduits at 20 pounds per square inch gage pressure will effectively interlace yarn fed through the apparatus at high speed. An additional fluid conduit on the normal centerline of the yarn will help to open the yarn bundle to increase the degree of interlacing provided by the treatment. This additional conduit is preferably perpendicular to planar face 12, of a diameter from about 0.010 inch up to about one-half the average diameter of the other two conduits, and located about 0.125 to 0.500 inch upstream on the yarn line from the center of the other two conduits. When treating 200 denier, 20 filament yarn under the above conditions, this additional conduit has been found to increase the degree of interlacing about 50%, as measured by the hook-drop test described in our U.S. Patent No. 2,985,995, dated May 30, 1961.

FIGURE V shows an arrangement containing five fluid conduits 2, 2a', 2b', 2c, 2d and the relative position of yarn 9 to these openings when passing through an apparatus with this arrangement.

FIGURE VI shows a vertical cross-section of an apparatus of this invention having three fluid conduits 2 arranged one above the other. This arrangement is particularly useful when operating under conditions where the yarn line vibrates considerably so that whereas yarn might normally pass through the turbulent area of 7a, vibration of the yarn line would simply move it into the area of 7b rather than disengaging it entirely from an area of interlacing turbulence.

In operating the apparatus of this invention, the interlacer is preferably positioned in between suitable yarn forwarding means, i.e., means capable of advancing the strand through the interlacer at controlled positive tension. The yarn is fed through the interlacer at an overfeed less than about 10% using fluid at room temperature and less than about 20% if the fluid is heated. While passing through the zone of controlled fluid turbulence formed by the two or more fluid vortices within the apparatus, the yarn bundle is opened (the filaments are separated) and the filaments are interlaced so that they become individually and collectively twisted, intertwined, and entangled in a random manner, thereby consolidating the yarn bundle to a compact unitary strand which maintains its unity even when the bundle is at zero twist. The strand is believed to maintain its unity solely due to frictional constraint between adjacent filaments and, of course, there is no need for adhesives or bonding or fusing of fibers in any way in order for the yarn to maintain its compact unity. The interlaced yarn thus produced has a bulk not substantially different (usually less than 10% greater) than ordinary true twist yarn prepared from the same starting yarn, that is, a yarn having the same number of identical filaments with the same cross-sectional configuration.

Preferably, interlacing is carried out as an adjunct to one or more of the common textile operations such as spinning and/or drawing, packaging, etc., thereby taking advantage of existing suitable yarn forwarding means. The unity and compactness of the strands produced with this apparatus provide such a very stable consolidated structure that the yarn may be handled as a unitary strand in the same manner as a true twist yarn conven-

tionally utilized in textile operations. A detailed discussion of the process of interlacing yarns and the interlaced product produced thereby is contained in our U.S. Patent No. 2,985,995, dated May 30, 1961. The apparatus of the present invention may be utilized in carrying out any of the procedures disclosed in that patent.

The fluid treating apparatus of this invention is substantially different from known apparatus of this type in that it does not possess any tubular yarn passageway or any other means for confining the yarn circumferentially during impingement of the fluid jet upon the yarn surface. In its simplest form the apparatus of this invention comprises simply two spaced plates, which may be angled but are preferably parallel or substantially parallel (not more than 10° out of parallel) for maximum interlace efficiency, one of the plates possessing an orifice for directing a jet of high velocity fluid against the face of the opposing plate. This construction greatly facilitates string-up in that the yarn may be introduced into the turbulent fluid vortices from either side and spent fluid may exhaust from the apparatus in all radial directions from the axes of the fluid conduits. Still more important, the fluid interlacer of this invention permits production of interlaced strands of greater uniformity than prior interlacing jets using troughs or tubular yarn passageways. The self-guiding character of the interlacer of this invention also reduces abrasion of filamentary materials being processed.

Although not essential, guide means are preferred for directing the strand through the interlacer and preferably so that the strand axis is perpendicular to a line joining the axes of the conduit pair on the interlacer face. However, the strand may lie anywhere within 20° of this position.

Since many different embodiments of the invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited by the specific illustrations except to the extent defined in the following claims.

We claim:

1. An apparatus for interlacing multifilament yarn, including in combination a body member having a planar surface, a wall member having a planar surface spaced from the body member so that said planar surfaces are positioned in opposed relationship to form a yarn passageway, yarn guide means for controlling the direction of yarn travel through said passageway, and conduit means for introducing fluid into said yarn passageway to form plural vortices, said conduit means comprising at least one pair of fluid conduits intercepting the yarn passageway from within said body member through the planar surface thereof so that the conduit axes define an included angle of 0° to 160° and the axis of each conduit forms an acute angle with the planar surface of at least 10°, and the points of interception with the planar surface are on a line approximately at right angles to the direction of yarn travel and separated by a distance of up to about 10 times the average diameter of the conduits, the width of the yarn passageway between the planar surfaces at said point of interception being between about 0.008 and about 0.120 inch.

2. The apparatus of claim 1 containing two cylindrical fluid conduits only, said conduits having axes lying in the same plane at an angle of 45° to 90° with the path of yarn travel, and the conduit axes define an included angle of 60° to 90°.

3. The apparatus of claim 1 containing two cylindrical fluid conduits only, said conduits having parallel axes.

4. The apparatus of claim 3 in which the axes of the two cylindrical conduits are perpendicular to the planar face of the body member.

5. The apparatus of claim 4 in which each of the conduits has the same diameter of between 0.020 and 0.10 inch.

6. The apparatus of claim 4 in which said yarn guide means are attached to the body member to direct yarn axially between the axes of the two fluid conduits.

7. The apparatus of claim 1 containing a plurality of pairs of fluid conduits.

8. The apparatus of claim 1 wherein the axes of said fluid conduits are inclined towards each other so that

fluid streams impinge as they enter the yarn passageway to help maintain yarn in the plural vortices.

References Cited in the file of this patent

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