United States Patent [19]

Roberts

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[54] **MULTI-PURPOSE FLUID YARN TREATING APPARATUS**

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[73] Assignee: **Celanese Corporation,** New York, N.Y.

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[52] **U.S. Cl.** **28/1.4**

[51] **Int. Cl.** **D02g 1/16**

[58] **Field of Search** 28/1.4, 72.12

[56] **References Cited**

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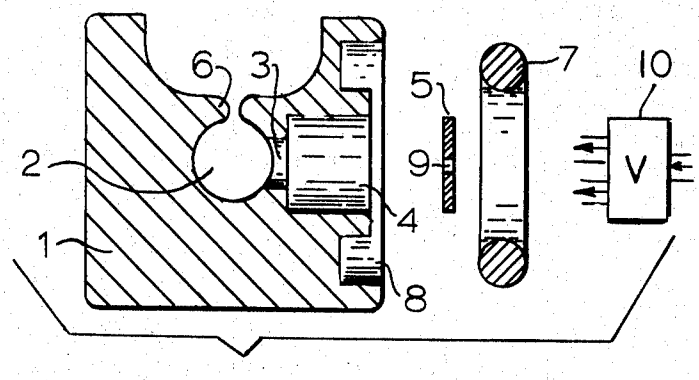
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[57] **ABSTRACT**

A multi-purpose fluid yarn treating apparatus and process, the apparatus having a yarn processing bore and at least one fluid entry port having a recess designed to accommodate any one of a plurality of inserts. The inserts have the ability to change the direction, diameter, number and cross-section of fluid entry orifices.

3 Claims, 5 Drawing Figures



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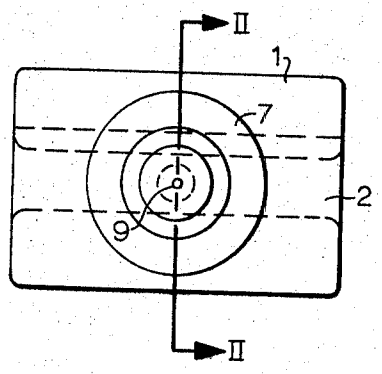


Fig. 1

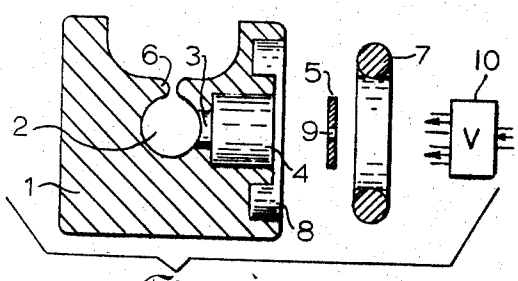


Fig. 2

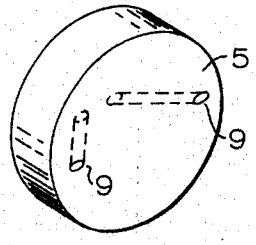


Fig. 3

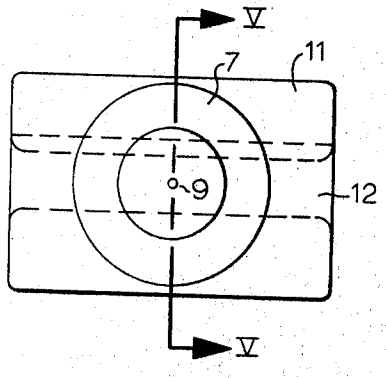


Fig. 4

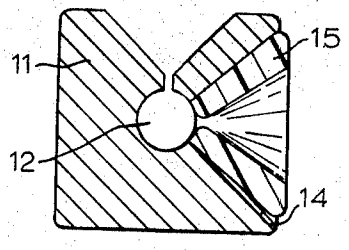


Fig. 5

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MULTI-PURPOSE FLUID YARN TREATING APPARATUS

This invention relates to fluid intermingling jets for multifilament yarns, and more specifically, to multi-purpose fluid intermingling jets and yarn intermingling processes.

Yarn producers have long sought efficient methods for processing multifilament yarns so as to either bulk these yarns or find a substitute for twisting operations.

It is well known in the textile industry that continuous filament yarn bundles in their "as spun" or zero twist configurations perform poorly in many of the common textile operations such as winding, weaving, knitting and the like, primarily due to a looseness of structure that permits individual filaments to snap and break, thus forming fluff balls, slubs, ringers, wraps, strip backs or similar defects. Zero twist yarns also have a tendency to run in the form of a ribbon over guides, rollers and so forth, whereby as a result of increased frictional contact, the yarns are more readily abraded and subject to breakage. As a result of these shortcomings, continuous filament producers usually carry out the additional step of twisting each continuous filament yarn bundle to provide an acceptable starting product in fabric weaving and knitting operations. The twisting operation serves to compact and unify the yarn bundle, thus resulting in a more cohesive structure which resists the pulling out of individual filaments. The twisting operation however, is expensive and time consuming and does not lend itself to the continuous operation which characterizes much of the manufacturing sequence in the preparation of the zero twist continuous filament yarn bundle.

It is also well known in the textile industry that a multifilament yarn bundle can be crimped by setting the yarn in a distorted configuration. However, mechanical means commonly employed for achieving the distorted configuration are time-consuming and usually have limited processing speeds inasmuch as moving parts or heavy frictional drag are often required. Such methods may also result in adverse effects on physical properties of the yarn such as reduced elongation and tenacity and fiber damage.

In order to overcome the expense of the twisting operation, and also to employ a twist substitute manufacturing operation which is adaptable to the continuous filament yarn bundles, compact interlaced yarns have recently been introduced in the textile industry. Compacted interlaced multifilament textile yarns of the type presently under discussion are set forth in U.S. Pat. No. 2,985,995. In brief, the compact interlaced multifilament textile yarns of the prior art are produced by subjecting an "as spun" substantially zero twist continuous filament bundle to the action of one or more fluid jets whereby individual filaments are randomly intermingled with adjacent filaments and groups of filaments along the length of the yarn to maintain the unity of the yarn by frictional constraint between the filaments. Yarns of this type have been demonstrated to be satisfactory for such textile operations as high speed winding and beaming.

Correspondingly, in order to overcome the expense and other disadvantages of mechanical bulking operations, and also in order to achieve new and unexpected aesthetic qualities in continuous filament yarns, the

fluid bulked continuous filament yarns have been adapted by the textile industry. Fluid bulked continuous filament yarns of the type presently under discussion are set forth in U.S. Pat. No. 2,852,906. In brief, the fluid bulked continuous filament textile yarns of the prior art are produced by subjecting a continuous filament yarn to a fluid stream jetted rapidly from a confined space to form a turbulent region. Yarn to be treated is fed into the path of the moving fluid stream so that the yarn is interacted with it and the individual filaments are separated from each other and whipped about violently in the turbulent region. The violent action produces convolutions in the yarns that are retained during withdrawal, winding and further processing.

Heretofore, because of the special nature of the compacted yarn and bulked yarn end products, separate apparatus was necessary to accomplish each of the aforementioned uses. Moreover, difficulty in fabrication has caused fluid entry ports to be circular in cross-section. In addition to the expense involved in having separate equipment to produce both types of yarn, it is also frequently desirable to produce a novelty yarn having both areas of compaction and areas of bulk; that is to say, a compacted bulked yarn.

It is therefore an object of this invention to provide a multi-purpose fluid yarn treating jet.

It is an additional object of this invention to provide a multi-purpose fluid yarn treating jet wherein the function of the apparatus may be changed by minimal changes in the apparatus.

It is a further object of this invention to provide a multi-purpose fluid yarn treating jet wherein the air entry port may be other than circular in cross-section.

It is still another object of this invention to provide a process for the preparation of alternately bulked and compacted yarn.

In accordance with this invention, it has now been discovered that a highly flexible multi-purpose fluid yarn treating apparatus is achieved by a design wherein a yarn processing bore has at least one fluid entry port which comprises a recess designed to accommodate any one of a plurality of inserts, the inserts having the ability to change the direction, diameter, number and cross section of fluid entry orifices.

The cross section of the fluid entry port may be other than circular, the configuration being achieved by stamping an insert prepared from a metal sheet thin enough to be stamped. Alternatively, a non-circular cross-section may be achieved by molding an insert from a polymeric resin. When a metal sheet is employed, it is preferred that the thickness be in the range from 0.006 to 0.02 inch. The non-circular cross-section appears to have the ability to provide greater turbulence and correspondingly greater bulk or greater compaction.

Where the insert contains a plurality of orifices, it may also be of sufficient thickness to change the direction of fluid flow through the orifices; that is to say, one orifice may be disposed so as to exert a forwarding or aspirating effect on a running yarn while another orifice may be disposed so as to exert a retarding effect on a running yarn length. When fluid flow is alternated from one orifice to the other, a running length of yarn is alternately bulked and compacted.

A better understanding of the invention may be had from the drawings wherein:

FIG. 1 is a partial phantom side view of one type of apparatus of this invention;

FIG. 2 is an exploded, not to scale, cross-section taken along the line II,II of FIG. 1;

FIG. 3 is an isometric view, not to scale, of a multi-orifice insert of this invention;

FIG. 4 is a side view of another type of apparatus of this invention;

FIG. 5 is a cross-section taken along the line V,V of FIG. 4.

Turning to FIG. 1, body member 1 is provided with a yarn processing bore 2 shown in phantom, yarn processing bore 2 having constant diameter along its entire length. Air entry port 3 is disposed on one side of body member 1. Cylindrical recess 4 is joined to air entry port 3, cylindrical recess 4 being designed to receive insert member 5. Insert member 5 which is of minimal thickness and not drawn to scale for ease of illustration, may have any of a wide variety of fluid entry orifices 9 and moreover, may have a plurality of fluid entry orifices with the same insert. The orifices, which may be punched into the thin insert member may be circular or non-circular; i.e., multilobular, rectangular, eliptical, triangular and pentagonal. The insert may also be of sufficient thickness to change flow direction and exert a forwarding action or a braking action on the yarn travelling through yarn processing bore 2. Such an insert member is illustrated in FIG. 3. Moreover, the plurality of fluid entry channels disposed within the insert member illustrated in FIG. 3 may also be used to control the positioning of the yarn bundle within yarn processing bore 2. For purposes of achieving a compacted yarn, it is preferred that the fluid flow issue from a non-circular orifice, and still more preferably a multilobular orifice and be perpendicular to the longitudinal axis of yarn processing bore 2. When however, a bulked yarn is desired, it is preferred that the passage through the insert member be at an angle to the longitudinal axis of the yarn processing bore 2 so as to provide a retarding action on the yarn passage, the retarding action being necessary in order to provide an overfeed of the yarn processing bore. As illustrated in FIG. 3, the same insert may also accommodate an orifice designed to provide a forwarding action on the yarn and when fluid flow to the orifices is alternated by suitable valve means, which are not illustrated, produce a yarn which has alternate bulked and compacted areas.

Completing the assembly of the apparatus as set forth in FIGS. 1 and 2, is slot member 6, which runs the entire length of yarn processing bore 2, slot member 6 being employed to thread a running length of yarn into yarn processing bore 2. An O-ring 7 is fitted into an annular groove 8 whereby an air or other fluid supply line may be readily joined to body member 1. If desired, a valve means 10, illustrated by a graphical symbol, may be disposed intermediate the fluid supply line and insert member 5.

An alternative form of the apparatus of this invention is set forth in FIGS. 4 and 5 wherein an insert member 15 is disposed on one side of conical cavity 14 which is positioned on one side of yarn processing bore 12. Insert member 15 which is conveniently fabricated from a synthetic polymeric resin has a dual function in that in addition to carrying one or more orifices in a plurality of designs, the insert member 15 may also serve as a seal for the fluid or air supply line to body member 11.

It should be understood that the apparatus of this invention may be employed as a single unit on a threadline or a plurality of units may be employed on a single threadline. When a plurality of units are employed on the threadline, it is preferred that the air entry port of a second or downstream unit be on the opposite side of the yarn bundle from the air entry port of the first or upstream unit.

The following specific examples are given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention.

EXAMPLE I

The apparatus of FIGS. 1 and 2 is employed, the apparatus having a 0.032 inch air entry port and a 0.093 inch yarn processing bore. The apparatus is arranged in tandem on a 55/15 dull cellulose acetate threadline with the two units having their air entry ports disposed on opposite sides of the yarn bundle. The yarn travelling at 805 meters per minute is subjected to 60 pounds per square inch gauge air pressure. A well compacted end product is obtained having a 1.0 centimeter mean compaction period, the compaction evaluation and units having been obtained according to the apparatus and process set forth in U.S. Pat. No. 3,566,683.

EXAMPLE II

The process of Example I is repeated except that a single compaction device as illustrated in FIGS. 1 and 2 is employed. A compacted yarn end product having a 2.0 centimeter mean compaction period when tested according to the apparatus and process set forth in U.S. Pat. No. 3,566,683.

EXAMPLE III

The apparatus of FIG. 1 is employed, fitted with the insert of FIG. 3, the apparatus having 0.093 inch air entry ports and 0.125 inch yarn processing bore. The apparatus is strung with 150/40 denier dull cellulose acetate yarn, the yarn travelling at 500 meters per minute. A fluidic, multi-vibrator is disposed in the airline immediately adjacent the insert. The fluidic multi-vibrator is caused to vibrate at about 280 cycles per second with air at a pressure of about 50 pounds per square inch gauge being supplied. The fluid flow thereby alternately produces a forwarding action and a retarding action. The end product is found to be alternately bulked and compacted at about 5 centimeter intervals, the degree of compaction being about 2 centimeters mean compaction period when evaulated according to the apparatus and process set forth in U.S. Pat. No. 3,566,683.

I claim:

1. A fluid yarn treating jet comprising a body member having a yarn processing bore disposed therein said yarn processing bore having a slot member running the entire length thereof and having a least one fluid entry port which is designed to receive an interchangeable insert said insert being positioned away from said slot member and designed so as to cause a processing fluid to exert both a forwarding action and a retarding action on yarn passing through said yarn processing bore.

2. The apparatus of claim 1 wherein a valve means is disposed between said insert and a fluid supply source whereby fluid flow may be alternated between said forwarding action and said retarding action.

3. The apparatus of claim 2 wherein said valve means is a fluidic multi-vibrator.

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