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Senturk et al.

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[54] **METHOD AND APPARATUS FOR PRODUCING COMPOSITE YARN**

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[73] Assignee: **Electrospin Corporation**, Columbus, Ohio

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[21] Appl. No.: **250,024**

[52] **U.S. Cl.** **57/5**, 57/160

[51] **Int. Cl.** **D01h 1/12**

[58] **Field of Search** ..... 57/3, 5, 6, 11, 34 R, 77.3, 57/156, 160, 58.81, 58.89, 51, 51.6, 58.91, 58.95

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Primary Examiner—Donald E. Watkins

[57] **ABSTRACT**

A process and apparatus for producing a composite yarn in which an inner continuous core yarn is covered with a layer of tightly wrapped staple fiber, the core is fed into a false twisting device located between the source of the core and its take-up point and staple fibers are conveyed by means of an applied electrostatic field to the surface of the core as it is twisted on the up-stream side of the twisting device.

8 Claims, 2 Drawing Figures

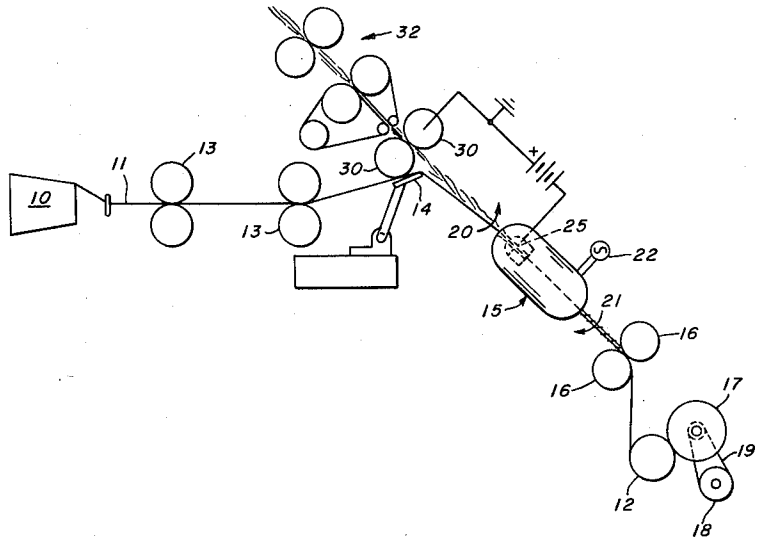

FIG. 1.

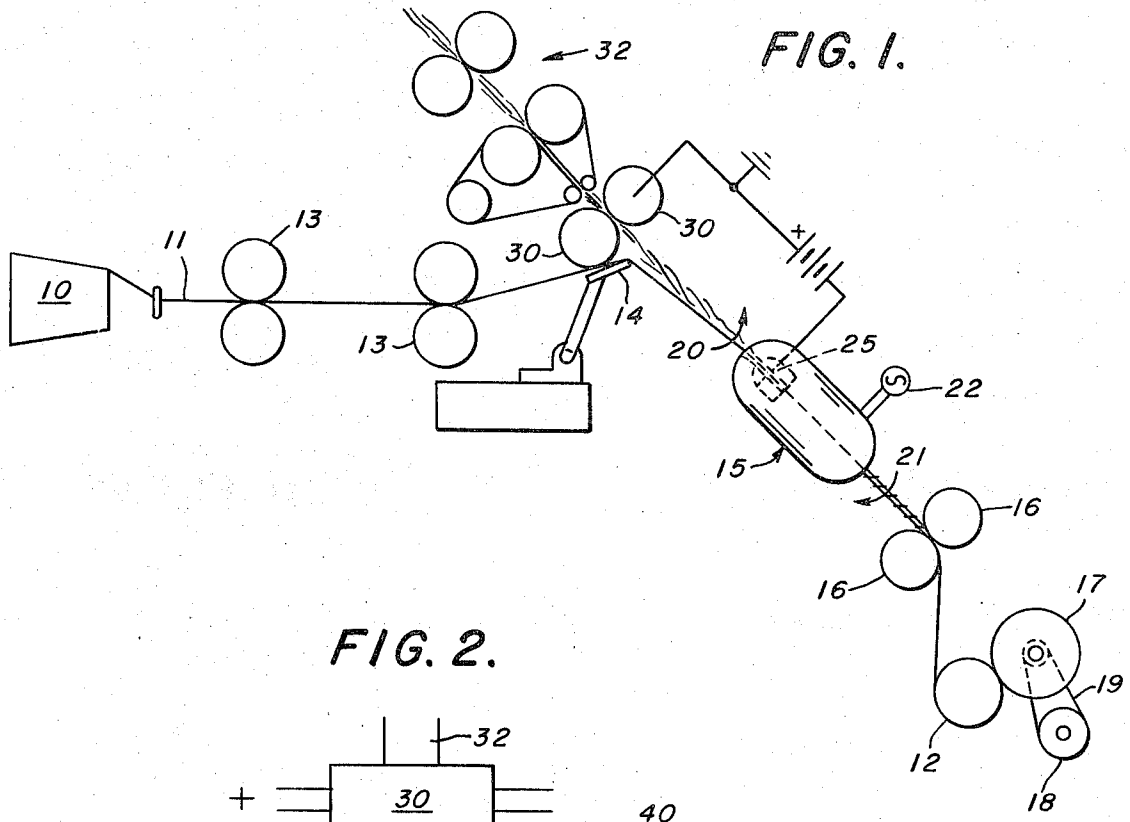
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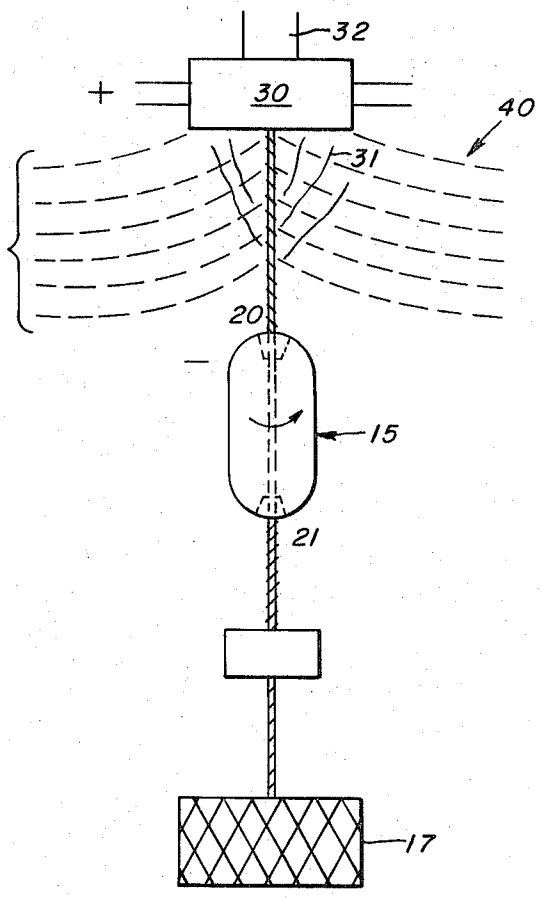
FIG. 2.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METHOD AND APPARATUS FOR PRODUCING COMPOSITE YARN

BACKGROUND OF THE INVENTION

With the development of the many and varied types of continuous filament synthetic yarns, principally, it has become desirable to alter in many cases the appearance and feel of these yarns. One method by which these properties could be altered was by covering them with a layer of any natural or synthetic staple fiber, such as cotton, wool, polyester and nylon. The composite yarn thus produced generally had better physical and mechanical properties from some end uses than yarns made completely of synthetic continuous filament fiber and staple fiber yarns but still had the more desirable appearance and feel.

Although the process is described in connection with the use of man-made filament as the core material, it is apparent that it would as effectively be used in conjunction with natural fiber yarns as well.

In the past, most composite yarns of the type described have been produced by adaptations of the usual ring spinning processes. In ring spinning, a continuous sheath of staple fibers are fed into contact with the core yarn being twisted so that it thereby becomes twisted about the surface of the core. Unfortunately, in such a twisted yarn, the core receives twist along with the fibers that cover the core. Often the end product is one with irregular covering of the core and an excessive number of fiber clumps and related surface irregularities. Furthermore, when the cover content of the composite yarn is increased above a certain level, the cover fibers do not adhere to the core yarn unless very excessive twist levels are employed.

Other systems that have been proposed for producing staple fiber covered core yarns include passing the yarn through a fluid slurry, which contains a suspension of staple fibers, while the yarn is being twisted, and also passing yarn while it is being twisted through an air chamber which carries a flowing stream of fibers suspended in the air. These systems represented potential improvements over the usual ring spinning process in that irregularities of surface deposition should be substantially reduced. On the other hand, as fibers are assembled on the surface of the core, the volume in the conveying medium immediately surrounding the core becomes depleted of fiber and no more can be attached to the passing core until a change in the fluid medium has been effected. The control of flow rates, suspension ratios, etc., are parameters that are difficult to control accurately and the result is a product with non-uniform application of fibers to the core surface. Further, because of the inherent operational nature of these processes, production rates are somewhat low and the process is limited to very long length staple fiber covering. Therefore, it is a principal object of this invention to provide an improved process for depositing any length and chemical nature staple fiber on a core yarn in a tightly wrapped and uniform fashion and considerably at higher production rates.

An additional object of this invention is to provide an improved process for fiber deposition on a traveling core fiber by conveying the fibers to the point of assembly on the traveling yarn by means of a cooperating electrostatic field.

A further object of this invention is to provide an improved apparatus for effecting the process of the invention.

Other objects and advantages of this invention will be in part obvious and in part explained by reference to the accompanying specification and drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic side elevation of a system effective for carrying out the process of this invention; and

FIG. **2** is a schematic front elevation illustrating part of the apparatus of FIG. **1** and showing the manner in which the core travels with respect to the electrostatic lines of equipotential.

For a more detailed explanation of the apparatus and process of this invention, reference is made initially to FIG. **1** of the drawings in which numeral **10** represents a source of supply of core yarn, the yarn being indicated by the numeral **11.** Core yarn **11** is fed from source **10** through a plurality of other mechanical feeding and twisting devices, to be explained, to an ultimate point of collection **12,** where it is wound once again into an integral package. Yarn **11** is withdrawn from source **10** by means of two pairs of feed rolls **13,** two pairs of rolls being shown only by way of example and not by way of limitation, and around a diverter plate **14** which alters the direction of travel of yarn **11** toward a twisting device **15.** On the other, or downstream, side of twisting device **15** is a set of take-up rolls **16** which feeds the material to the previously mentioned storage or collection point **12.** The storage package is driven frictionally by wheel **17** that is shown as being rotated by motor **18** through belt **19.**

The twisting device **15** is at a site located between the source of supply **10** and the point of collection **12** so that twists of opposite directions are created in the yarn, as indicated schematically by numerals **20** and **21.** Twister **15** may be driven by any suitable means, such as for example, an integral motor or by means of a friction belt drive not shown. In the present instance for the sake of simplicity, we have shown the twisting device **15** as including an electric motor and being appropriately connected to a source of electricity **22.** The device **15** will also include, among other things, a yarn gripper (not shown) which permits movement of the yarn parallel to the axis of the twisting device. It is apparent that more than one twisting device can be used in series fashion, if desired, to produce yarns having selected, predetermined special characteristics.

Also within the twisting device is an electrode which cooperates with an opposed electrode at a suitable distance away from the twisting device to create the electrostatic field. In this case, the electrode is indicated generally by the numeral **25** and is shown as being mounted in approximately the same region as where gripping of the textile fiber outer cover would occur. It is obvious that the electrode need not be located actually within the twisting device but could be located nearby. It is preferable, however, that the electrode be located as closely as possible to the actual twisting device so that concentration of electrostatic force lines will occur to thereby optimize the attraction of the staple fibers to the surface of the core yarn **11.**

The other electrode is in this case shown as being the fiber feed rolls **30** from which staple fibers **31** are ejected into the field created by electrodes **25** and **30.**

Fibers are fed into the feed rolls **30** from a conventional drafting apparatus indicated generally by **32.** The material being fed can be in the form of sliver, roving, or the like. The electrical system indicated at **33** again is shown only by way of illustration, since alternative systems could be used to develop the electrostatic field. Further, if desired, fibers could be fed into the electrostatic field by some means other than the mechanical means shown, such as an air stream, or by other mechanical means. The important aspect of delivering the fibers into the field is not the apparatus by which they are introduced, but rather that they be introduced in separated fashion, so that there are discontinuities in the flow of incoming fibers to enable rotation of the core material independent of the incoming fibers. This characteristic of the system is called "open endness" and it overcomes the occurrence of fiber bridging between the core and the fiber input unit.

So that attraction of the fibers being transported to yarn **11** for assembly thereon will be optimized, the lines of equipotential of the electrostatic field are caused to assume the distribution indicated generally by numeral **40** in FIG. **2** of the drawings. It is an established fact that fibers travel normal to the lines of equipotential thus reaching the yarn tail **11** as illustrated in FIG. **2** of the drawings. Such fiber approach to the tail provides the focusing of fibers on to the tail thus enabling the optimization of fiber trajectories. In this case, the fibers **31** are exiting from the feed rolls **30,** only one of which is shown, and are drawn inwardly toward the yarn for assembly on its outer surface. The yarn with the fibers twisted thereabout in one direction enters into the twisting element **15** and passes through the gripper contained within the twisting device. The gripper is not shown in detail in this application but for one gripper and twisting system which is suitable for application in the present process, reference is made to U.S. Pat. No. 3,552,112, which issued Jan. 5, 1971 to Chabot.

Obviously since the yarn is being twisted between its source of supply and its take-up or storage point, direction of twist **20** in the yarn portion above the twister will be opposite of the direction of twist **21** in the yarn portion below the twister **15** (as viewed in FIG. **2**). This phenomenon is referred to as false twisting and it causes the fibers on the outer surface of the core to become tightly twisted about the core and to possess true twist, during twist reversal.

Thus, the process of this invention is first of all continuously feeding core yarn from a source of supply to a point of collection, in this case the source of supply is located upon cone **10** and the point of collection by take-up package **12.** Between the supply and point of collection, the yarn is twisted in a fashion that causes it to have opposite twists on each side of the twisting mechanism. A portion of the length of core yarn located between the source and site of twisting is subjected to an electrostatic field that is created by the opposed electrodes, the electrodes conveniently being located at the fiber source and at the twisting site. Finally, staple fibers are fed into the electrostatic field which then convey the fibers into contact with the core where the twisting of the core causes them to become tightly wrapped about it. When the yarn is reverse twisted below the gripper, surface fibers follow the reverse twist action and consequently attain true twist, while the core yarn has zero twist along its length.

Although the present invention has been described in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

We claim:

1. A process for producing a composite yarn having an inner continuous core yarn and an outer layer of staple fibers wrapped tightly and uniformly along the length of the core, said process comprising:

a. continuously feeding core yarn from a source of supply to a point of collection,

b. twisting the yarn at a site located between the source of supply and the point of collection so that twists of opposite directions are created in the yarn,

c. subjecting at least a portion of the length of core yarn located between the source and the site of twisting to an electrostatic field created between opposite electrodes, and

d. feeding staple fibers into the electrostatic field with the field conveying the fibers into contact with the core between said source and said twisting site for twisting thereabout.

2. A process as defined in claim **1** wherein said portion of the length of core yarn is subjected to an electrostatic field having lines of equipotential which are substantially normal to the direction of travel of the core yarn.

3. Apparatus for producing composite yarn comprising:

a. a source for supplying core yarn;

b. means for collecting the core yarn at a location spaced from said source of core yarn;

c. false twisting means disposed between said source of core yarn and said collecting means for twisting the core yarn;

d. separate electrode means generating an electrostatic field and positioned with respect to the length of core yarn extending from said source to said twisting means that the electrostatic lines of equipotential are substantially normal to the direction of travel of core yarn; and

e. a source of staple fibers positioned for delivering fibers into said electrostatic field.

4. An apparatus as defined in claim **3** wherein one of said separate electrode means is mounted in operative association with said twisting means.

5. An apparatus according to claim **4** wherein the other of said electrodes is spaced from the source end of said twisting means and fixed relative to rotation about the core axis.

6. A process according to claim **1** wherein one of said opposite electrodes is simultaneously rotated in operative association with a rotatably driven twister at said twisting site.

7. A process according to claim **6** wherein the other electrode is maintained non-rotatably relative to the core axis and spaced from the supply source end of said twisting site.

8. An apparatus for producing composite yarn, comprising:

a. a source for supplying core yarn;

b. means for collecting the core yarn at a location spaced from said source of core yarn;

c. rotatably driven false twisting means disposed between said source of core yarn and said collecting means for twisting the core yarn;

d. separate electrode means generating an electrostatic field positioned with respect to the length of core yarn extending from said source to said twisting means so that the electrostatic lines of equipotential are substantially normal to the direction of travel or core yarn, one electrode of said electrode means being mounted in operative association with said twisting means and the other electrode of said electrode means being non-rotatable about the axis of the core; and

e. a source of staple fibers positioned for delivering fibers into said electrostatic field.

* * * * *

Dedication

3,845,611.—*Necdet Senturk*, Norwood, and *Frank A. Aschenbrenner*, Framingham, Mass. METHOD AND APPARATUS FOR PRODUCING COMPOSITE YARN. Patent dated Nov. 5, 1974. Dedication filed Mar. 23, 1977, by the assignee, *Electrospin Corporation.*

Hereby dedicates to the Public the entire term of said patent.

[*Official Gazette May 10, 1977.*]