METHOD AND APPARATUS FOR SPINNING TEXTILE FibRES

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9 Claims. (Cl. 57—58.91)

ABSTRACT OF THE DISCLOSURE

A method and apparatus for spinning textile fibers including: substantially predrawing the fibers, electrically charging the fibers, delivering the charged fibers into an electrical field which orients the fibers toward an oppositely charged collecting means, and twisting the collected fibers into a thread. The fibers are electrically charged before or as they enter the electrostatic field and are thereby oriented, aligned, and propelled to the collecting means. The similar charges on the fibers keep them separated as they fly to the collecting means. The apparatus includes, what is called in the textile spinning art, a "false twist" element which is spinning rapidly and includes the collecting means.

This invention relates to textile fiber spinning. More particularly, it relates to spinning the fibers of a carded sliver or roving using an electrostatic field as a part of the spinning method and apparatus. This application is a continuation of our pending application Ser. No. 648,835 filed July 1, 1965, now abandoned.

In the past few years, considerable progress has been made in carding and drawing fibers to prepare them for spinning into yarn. The spinning process has also received some attention but remains a problem since recent proposals intended to improve classical spinning methods and apparatus have not been successful. The most generally used ring-pin spinning system has a number of defects but is still apparently accepted since it remains the best compromise between production economy and quality of the product.

In the ring-pin system there are important tension variations which exclude the possibility of obtaining very fine and only slightly twisted yarns. The process wears out the yarn abnormally and causes many ruptures of the yarn during fabrication. The twisting varies in accord with the yarn already wound onto the spindle. In order to obtain yarns of sufficient usable lengths, the spindle must be rewound onto larger holders with the beginning of each succeeding spindle tied on to the end of the last spindle being wound onto the holder. Recent attempts to increase the speed at which the fibers can be spun into yarn has also approached a limit in the last few years.

There are other spinning methods and apparatus such as the fly-frame system, cap spinning frame, and centrifugal coiler. All of these, although in present use, each have various disadvantages depending upon the method that is used. For example, in the fly-frame system production is low because the different pinion drivers and the weight of the fibers considerably limit the speed; the cap spinning method has disadvantages similar to the ring-pin method; and the main problem with the centrifugal coiler is the impossibility of piecing the yarn if ruptured.

Recently, methods of producing a yarn using an electrostatic field have been proposed. These methods usually involve an attempt to eliminate carding or the formation of a roving by suspending the fibers in an air stream and aligning the fibers by polarization in the electrostatic field. The electrostatic field is really used for alignment of the fibers and the fibers are then pulled into a twisting device by mechanical traction exerted by the rotating yarn.

The method according to this invention comprises using a static electric field, extended between a feed means spaced from a twisting means having an axial inlet, to electrically charge the fibers and thereby exert simultaneously on the fibers a propelling force, a pull and an orienting couple whereby the fibers are separated separately from the feed means to the inlet of the twisting means and reach the inlet in a tensioned state and in substantial alignment therewith.

In nonelectrostatic spinning methods, the roving is not separated into individual fibers. The fibers are straightened, tensioned and brought into a more parallel alignment by drawing out the yarn as it is being twisted and often twisted additionally after drawing. In the preferred embodiment of this invention, the roving, which already has the fibers substantially parallel to each other, is drawn to further orient the fibers before they are released into the electrostatic field. Such a procedure ensures a relatively balanced feed and that practically every fiber is aligned before being spun into yarn. A disadvantage of those electrostatic methods that attempt to eliminate carding or formation of a roving is the lack of control over the amount of fibers that are presented to the electrostatic field at any given time, i.e., irregular feed such as clumps and thin spots.

In this invention the electrode on the spinning device is constructed so that only a selected number of fibers are captured and spun into yarn. If too many fibers should be propelled toward the electrode on the spinning device, they reverse their charge and are propelled back toward the feeding device. The fibers are captured and twisted inside the channel of the spinner rather than be captured mechanically and partially twisted on the protruding end of the forming yarn.

The method of this invention includes charging the fibers at feed means by an electric field extending from the feed means to twisting means spaced from the feed means and having an axial inlet thereby simultaneously exerting on the fibers a pull, a propelling force and an orienting couple whereby the fibers are conveyed separately from the feed means to the inlet of the twisting means and reach the inlet in a tensioned state and in substantial alignment therewith.

Briefly described, the apparatus of this invention includes a fiber feed means having a delivery up location and an electrode contiguous to the delivery up location; fiber twisting means spaced from the feed means and having an axial inlet generally directed toward the delivery up location for receiving the fibers delivered up by the feed means and further having an electrode contiguous to the inlet; and a voltage source with electrical connections to the electrode to charge the fibers at the feed means and produce an electric field extending from the feed means to the twisting means for simultaneously exerting on the charged fibers a pull, propelling force and an orienting couple whereby the fibers are conveyed separately from the feed means to the inlet of the twisting means and reach the inlet in a tensioned state and in substantial alignment therewith.

An object of this invention is to provide a method and apparatus for spinning textile fibers wherein the fibers are spun into a continuous yarn to facilitate winding.

Another object of this invention is to provide a method and apparatus for spinning textile fibers wherein the fibers.
are electrically charged and an electric field is used to propel the fibers separately to the spinning means.

Another object of this invention is to provide a method and apparatus for spinning textile fibers wherein the yarn is produced at a faster rate than presently used spinning methods and apparatus.

Still other objects and advantages will be apparent from the following specification, the drawings and the claims herein set forth.

In the drawings:

FIG. 1 shows a first embodiment of apparatus for spinning textile fibres in accordance with the invention;

FIG. 2 shows a second embodiment of apparatus for spinning textile fibers in accordance with the invention;

and

FIG. 3 shows a modified construction of a portion of the apparatus illustrated in FIG. 1 or 2.

The apparatus illustrated in FIG. 1 comprises a draft system 11 providing means for preorienting the fibres of a roving 13 and then feeding the preoriented fibers to twisting means 15 of the false twist type to produce a thread 17.

The rowing 13, in entering the draft system 11 from means (generally one or more preliminary draft systems) not shown, passes between an arrangement of belts 21 and 23 driven by a roller 25 then to proceed to a pair of rollers 27 and 29, one of which is fluted, having a peripheral speed greater than that of the roller 25 thereby to subject the roving 13 to a final draft such that, upon issuing from the nip between the rollers 27 and 29, the fibers are in substantially parallel relationship in the direction of movement of the roving 13.

The twisting means 15 comprises an axial inlet-forming portion 31 generally directed towards the nip between rollers 27 and 29 and having pulley-forming portion 33 driven by a motor 35 through the intermediary of belt 37. The twisting means 15 moreover comprises a funnel 39 of insulating material axially secured to the inlet 31 having a central passage 40.

The thread 17, produced by the twisting means 31, passes, upon issuing from the latter, between a pair of drawing rollers 41 and 43, then to proceed to a bobbin 45 where it is wound up.

The rollers 27 and 29 and the portions 31 and 33 of the twisting means 15 are made of material of good electrical conductivity or are at least rendered conductive at the surface by a suitable coating to provide a first electrode contiguous with a fibre delivery up location defined by the nip between the rollers 27 and 29, and a second electrode contiguous with the inlet of the twisting means.

A source 47 of high electric voltage is connected to the electrode formed by rollers 27 and 29 through the intermediary of brushes 49 and 51 rubbing against collector rings 53 and 55 on rollers 27 and 29, and is connected to the electrode formed by the inlet-forming portion 31 through the intermediary of a brush 57 rubbing against a collector ring 59 on the pulley-forming portion 33 so as to set up a static electric field, represented by a plurality of lines of force 61, extending from the draft system 11 to the twisting means 15. In the illustrated example it is the + terminal of source 47 which is connected to the drawing rollers 27 and 29, while its - terminal is connected to the inlet 31; that is why the lines of force 65, as shown by the arrows, from the rollers 27 and 29 and end up at the inlet 31. Moreover, the + terminal of source 47 is grounded.

The preorienting and feed means 19, the fibers 13—13' become charged as they pass through the rollers 27 and 29. Thus, upon leaving the preorienting and feed means 19, the fibers 13—13' each receive a positive electric charge; each one of them is subjected to a plurality of forces which at its center of gravity, amount to a resultant that propels the fibre 13' towards the inlet 31 of the twisting means 15, and to a couple that orients it parallel to the field and that exerts a pull thereon once oriented. Consequently, the fibres 13—13' get separately conveyed to the twisting means 15 and reach the inlet 31 thereof in a tensioned state and in alignment with the inlet 31, i.e. parallel to the axis of twist; they thus satisfy the required conditions required in producing a thread 17 having a regular twist. The function of the funnel 39 is firstly to prevent any charged fibres 13—13' from striking the outer surface of the inlet-forming portion 31 from which, once uncharged, they would be repelled, and secondly to compel them to enter the axial passage 40 extending through the twisting means 15.

Since the electric field conveys the fibres 13—13' separately one by one, i.e. without touching, the twist exerted by the twisting means 15 has no effect on the roving 13, there being no mechanical connection between the thread 17 and the roving 13. It is therefore not necessary, in order to prevent the roving 13 from becoming untwisted when the thread 17 is being twisted, to tie the rotation of the twisting member 15 to that of the winding bobbin 45 as in conventional arrangements. The illustrated arrangement thus enables the movement of these two members (15 and 45) to be disjoined.

The + terminal or the — terminal of source 47 can indifferently be connected to the electrode formed by roller 27 and 29.

The draft system 11 of the above-described apparatus enables the fibres 13—13' to be preoriented prior to being delivered up into the static electric field 67. Such preorientation is applicable to the fibres of a roving. When the fibres are supplied to the apparatus in the form of a web issuing directly from a carder, the fibres are in greater disorder and it would be appropriate in this case to render them parallel by some modified form of preorienting and feed means. Such means are shown in the embodiment of FIG. 2.

In FIG. 2, a web 63 of disordered fibres is conveyed by a first conveyor belt 65 of electrically conductive material, which causes the fibres to enter a static electric field 67, termed preorienting field, set up between an electrode 69' and the belt 65 forming the associated electrode. A second conveyor belt 71, of low electrically conductive material, is arranged with its useful pass 73 extending through the preorienting field 67, the electrode 69' being located between the useful and return passes of belt 73 and spaced from the inoperative surface of the useful pass 73. This field is set up by a high voltage electric source having one terminal connected to electrode 69' and the other terminal connected to a brush 75 rubbing against a collector ring 77 in electrical contact with belt 65. The pass 73 extends also through a second field 61 set up between a pair of electrodes formed by an electrode 69' and the inlet-forming portion of twisting means 15 similar to the twisting means 15 in FIG. 1. This electrode 69' is positioned so as to be contiguous with the pass 73. The two fields 61 and 67 are preferably set up by means of single electric source 47. In such a case, the — terminal of the source 47 is connected to the brush 75, associated with the electrode-forming belt 65, and to the brush 57, associated with the twisting means 15, and its + terminal is connected to the electrodes 69 and 69'. The latter are preferably formed, as shown, by two portions of a common electrically conductive part 69. The — terminal of source 47 is moreover preferably grounded.

During operation, the fibres making up web 63 are transported up in the order, i.e. without any prior orientation, on the belt 65 to a discharge location in the field 67. Under the action of the latter, they stand up parallel to the lines of force, become negatively charged and, through being attracted by the positive electrode 69', are transferred to the belt 71 to adhere separately by one of their ends, in substantially parallel relationship, to the operative surface of the useful pass 73 at a receiving location traversed by
pass 73, which adherence is obtained by positioning the electrode 69' at a distance such from the pass 73 that the fibres 63—63' will not lose their negative charge through the belt 71. The pass 73 then shifts the adhering fibres 63—63' to a delivery up location, also traversed by pass 73, where they are introduced into the field 61 and come to be positioned very close to electrode 69'. The field 61 has a value such as to cause the fibres to lose their negative charge through the belt 71 and to acquire a positive charge. They are then subjected by the field 61 simultaneously to a propelling force, a pull and an orienting couple whereby the fibres 63—63' as in the preceding embodiment, are separately conveyed from the belt 71 to the twisting means 15 and reach the inlet thereof in a tensioned state and in substantial alignment with this inlet.

It will be observed that this embodiment, in relation to the preceding one, has the advantage of eliminating the drawing roller trains for progressively orienting the fibres. This results in a saving of several mechanical components that are costly to service; this advantage, coupled with the increased production made possible by dissociating the twisting and winding movements, renders this method particularly interesting.

In either embodiment at least one high voltage source is needed, i.e. that required to set up the field 61. FIG. 3 shows a particular arrangement enabling this source to be combined with the twisting means 15 by using as a source an electrostatic machine of the Van de Graaff type. This machine comprises a hollow, substantially spherical, electrically conductive body 101 carried by an insulated support 103 secured to a base 105. A charging belt 107 of insulating material passes over a lower roller 109 that is electrically connected to, and rotatably mounted on, the base 105, over an upper driven roller 111, that is electrically connected to, and rotatably mounted inside the body 101, and through a first opening 113 formed in the body 101. Combs 115 and 117 are respectively intended to eliminate towards the base 105 through the sphere 101 the electric charges of opposite sign carried by the upward and downward passes of belt 107. The latter is driven by roller 109 powered by a motor 119. The upper roller 111 is axially solid with the rotary portion of the twist means whose inlet-forming portion 31 terminates in a first opening 113 formed in body 101, flush with the outer surface of the latter. The body 101 thus forms the electrode of the twisting means with the edge of the opening surrounding the inlet-forming portion 31 being contiguous to, although slightly spaced from, the inlet per se. As in FIGS. 1 and 2, a funnel 39 of electrically insulating material is axially mounted on portion 15 and extends outside body 101. The roller 111 and the rotary portion of the twisting means are formed with an axial passage 40 to enable the thread 17 produced by the twisting means to pass therethrough, and an insulating sleeve 121 then guides the thread 17 out of the body 101. When this Van de Graaff machine is operating, the electrode-forming body 101, and with it the rotary portion of the twisting means 15 which is electrically connected thereto, become charged at high voltage. This arrangement thus, for example, combines the high voltage source 47 and the twisting means 15 of FIG. 1. Once the spherical body 101 is so positioned that the inlet-forming portion 31 occupies the position shown in FIG. 1, it suffices to connect electrically the base 105 of the electrostatic machine to the brushes 49 and 51 to set up the static electric field 61.

It will be understood, of course, that, while the form of the invention herein shown and described constitutes the preferred embodiments of the invention, it is not intended herein to illustrate all of the possible equivalent forms or ramifications of the invention. It will also be understood that the words used are words of description rather than of limitation, and that various changes, such as changes in shape, relative size, and arrangement of parts may be substituted without departing from the spirit or scope of the invention herein disclosed.

What is claimed is:

1. A method of spinning textile fibers comprising the steps of:
   (a) delivering textile fibers into an electric field;
   (b) electrically charging said textile fibers before they are released by said delivering step;
   (c) connecting fiber collecting means to an electrode of said electric field said electrode having an electric charge opposite to the electric charge on said electrically charged textile fibers whereby said electrically charged textile fibers are tensioned, aligned, and propelled to said fiber collecting means by said electric field;
   (d) rotating said fiber collecting means and capturing the textile fibers as they are collected;
   (e) twisting the fibers to form a thread within the collecting means.

2. A method of spinning textile fibers comprising the steps of:
   (a) electrically charging the textile fibers;
   (b) delivering the electrically charged textile fibers into an electric field;
   (c) connecting fiber collecting means to an electrode of said electric field said electrode having an electric charge opposite to the electric charge on said electrically charged textile fibers whereby said electrically charged textile fibers are tensioned, aligned, and propelled to said fiber collecting means by said electric field;
   (d) rotating said fiber collecting means and capturing the textile fibers as they are collected;
   (e) twisting the fibers to form a thread within the collecting means.

3. A method of spinning textile fibers, comprising the steps of:
   (a) substantially prealigning the textile fibers by drawing out the fibers from a sliver of textile fibers;
   (b) electrically charging the textile fibers;
   (c) delivering the electrically charged textile fibers into an electric field;
   (d) connecting fiber collecting means to an electrode of said electric field said electrode having an electric charge opposite to the electric charge on said electrically charged textile fibers whereby said electrically charged textile fibers are tensioned, aligned, and propelled to said fiber collecting means by said electric field;
   (e) rotating said fiber collecting means and capturing the textile fibers as they are collected;
   (f) twisting the fibers to form a thread within the collecting means.

4. A method of spinning textile fibers, comprising the steps of:
   (a) electrically charging disoriented textile fibers with a first electrical charge;
   (b) delivering the electrically charged textile fibers into a first electric field;
   (c) positioning fiber receiving means in said first electric field between an electrode, having a charge opposite the electrical charge on the electrically charged textile fibers, and the delivered disoriented electrically charged fibers whereby the disoriented electrically charged fibers are propelled to said fiber receiving means, aligned and held in substantially parallel relationship on said fiber receiving means;
   (d) moving said fiber receiving means out of said first electric field;
   (e) recharging the textile fibers with a second electrical charge opposite to said first electrical charge;
   (f) delivering the textile fibers with the second electrical charge into a second electric field;
   (g) connecting fiber collecting means to an electrode of said second electric field said electrode having
an electric charge opposite to the second electric charge on the textile fibers whereby said textile fibers with the second electric charge are tensioned, aligned, and propelled to said fiber collecting means by said electric field; and
(h) rotating said fiber collecting means and capturing the textile fibers as they are collected thereby twisting the fibers together to form a thread.

5. Apparatus for spinning textile fibers, comprising:
(a) fiber feed means having a discharge end;
(b) fiber twisting means spaced from said feed means and having an axial inlet generally directed toward said discharge end of said feed means for receiving fibers discharged by said feed means;
(c) a funnel of electrically insulating material in axial alignment with said axial inlet, the apex of said funnel being contiguous to said axial inlet; and
(d) an electrical field produced by a voltage source having a first electrode connected to said discharge end to produce an electric charge on said fibers while passing through said feed means whereby upon said fibers being discharged from said feed means said electric field between said feed means and said axial inlet exerts a pulling force on said fibers simultaneously straightening and aligning the fibers with the axial inlet and causing said fibers to move across the space between said feed means and said axial inlet where the straightened aligned fibers are twisted into thread by said twisting means.

6. Apparatus for spinning textile fibers comprising:
(a) fiber preorienting means for preorienting the textile fibers in substantially parallel relationship;
(b) feed means contiguous to, and for receiving said fibers from said fiber preorienting means, said feed means having a discharge end;
(c) fiber twisting means spaced from said feed means and having an axial inlet generally directed toward said discharge end of said feed means for receiving fibers discharged by said feed means; and
(d) an electrical field produced by a voltage source having a first electrode connected to said feed means and a second electrode connected to said discharge end to produce an electric charge on said fibers while passing through said feed means whereby upon said fibers being discharged from said feed means said electric field between said feed means and said axial inlet exerts a pulling force on said fibers simultaneously straightening and aligning the fibers with the axial inlet and causing said fibers to move across the space between said feed means and said axial inlet where the straightened aligned fibers are twisted into thread by said twisting means.

7. Apparatus for spinning textile fibers according to claim 6 wherein said feed means are positioned to feed said fibers axially into said electric field.

8. Apparatus for spinning textile fibers according to claim 6 wherein said preorienting means is at least two moving belts positioned to carry the fibers between their opposite surfaces and a pair of rollers having a surface speed greater than the surface speed of said belts, one of said pair of rollers being fluted, said pair of rollers additionally being said feed means.

9. Apparatus for spinning textile fibers, comprising:
(a) fiber feed means having a discharge end and an electrode contiguous to said discharge end;
(b) fiber twisting means spaced from said feed means and having an axial inlet generally directed toward said discharge end of said feed means for receiving the fibers discharged by said feed means and further having an electrode contiguous to said inlet;
(c) a voltage source provided by an electrostatic machine of the Van de Graaff type for providing an electrical field and including a hollow, substantially spherical, electrically conductive body having a first opening and a second opening forming the electrode for said twisting means, an insulating support carrying said body, a driven roller rotatably mounted outside said body, and a charging belt of insulating material passing over said rollers and through said first opening, said twisting means having a rotary portion inside said body and axially solid with said driven roller, and said rotary portion and said driven roller having an axial passage extending through said body, said passage terminating at the rotary portion thereof in said second opening to form said axial inlet, and said driven roller and said driving roller having electrical connections respectively with said body and with the electrode of said feed means to form a static electric field extending from said feed means to said twisting means whereby the electrodes at said feed means produce a charge on said fibers and said electric field exerts a pulling force on said fibers simultaneously straightening and aligning the fibers with the axial inlet and causing said fibers to move across the space between said feed means and said axial inlet where the straightened aligned fibers are twisted into thread by said twisting means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,411,284
November 19, 1968

André Corbaz et al.

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

Column 7, line 19, after "having a first electrode" insert -- connected to said feed means and a second electrode --.

Signed and sealed this 31st day of March 1970.

(SEAL)
Attest:

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