Nov. 19, 1968 A. CORBAZ ET AL 3,411,284

METHOD AND APPARATUS FOR SPINNING TEXTILE FIBRES

Original Filed July 1, 1965 2 Sheets-Sheet 1

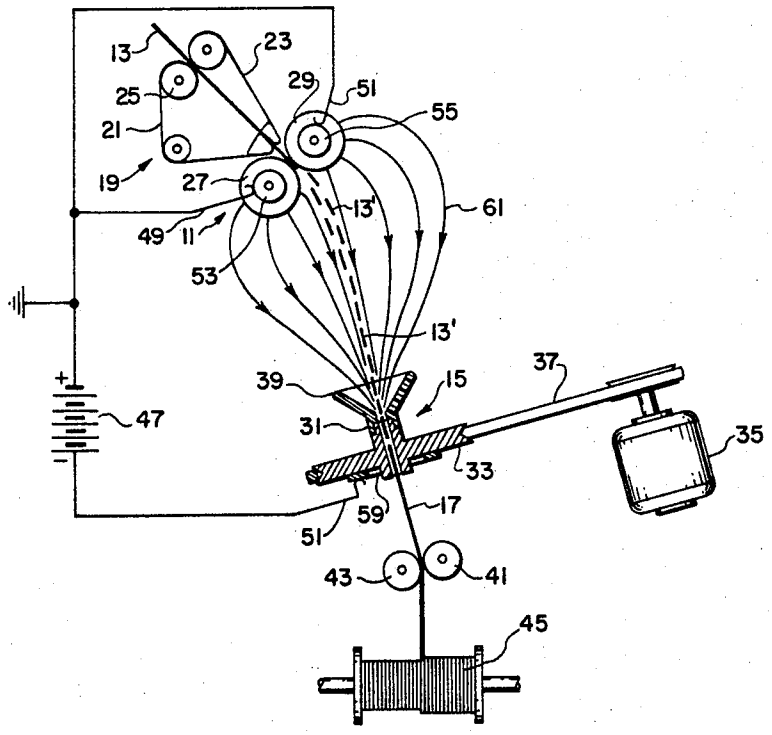

Fig. 1

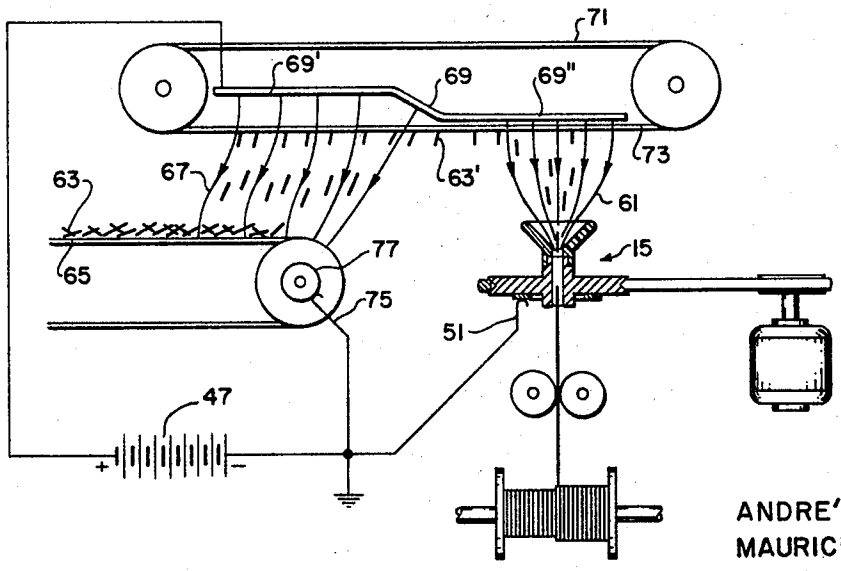

Fig. 2

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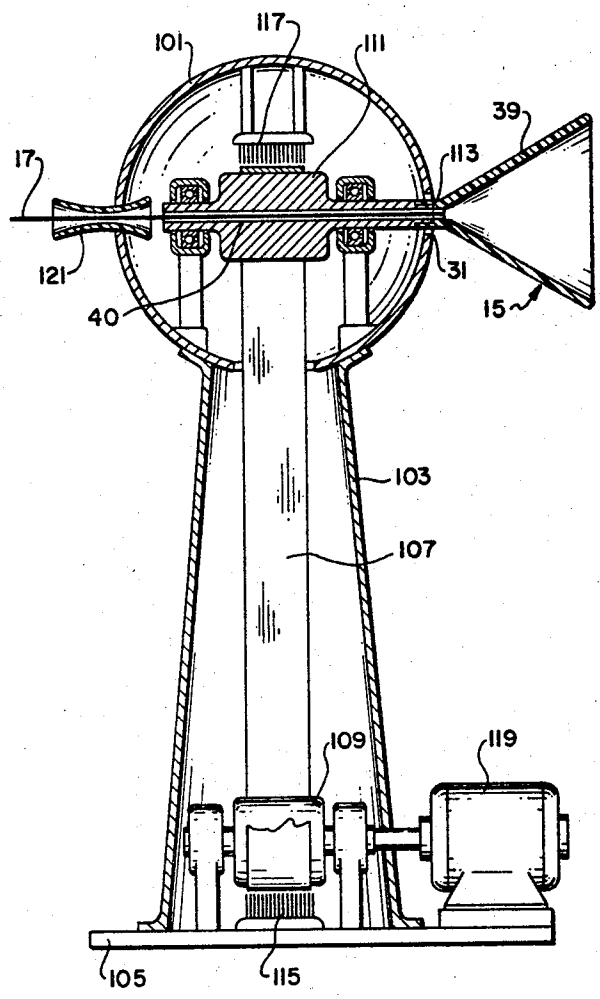

Fig. 3

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United States Patent Office 3,411,284 Patented Nov. 19, 1968

3,411,284

METHOD AND APPARATUS FOR SPINNING TEXTILE FIBRES

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Continuation of application Ser. No. 468,835, July 1, 1965. This application July 13, 1966, Ser. No. 564,845
Claims priority, application Switzerland, July 3, 1964, 8,786/64
9 Claims. (Cl. 57—58.91)

ABSTRACT OF THE DISCLOSURE

A method and apparatus for spinning textile fibers including: substantially prealigning the fibers, electrically charging the fibers, delivering the charged fibers into an electrical field which propels 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 texitle 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 copending application Ser. No. 468,835 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 had little success or acceptance. 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 that 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 drives and the weight of the flyers 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 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.

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 preorient 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 is 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 electrodes 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 fibres 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 fibres 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 **19** 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 directly 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 contingent with a fibre delivery up location defined by the nip between the rollers **27** and **29**, and a second electrode contingent 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 **25** emerge, 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 formed by the draft system **11** are constructed to deliver up the fibres **13'—13'** substantially separately, i.e. with substantially no contact with one another. The fibres **13'—13'** become charged as they pass through the rollers **27** and **29**. Thus, upon leaving the preorienting and feed means **19**, the fibres **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 for 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 them 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 rollers **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 **61**. 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 fibers 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 **71** 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 contingent 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 in disorder, 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 preorienting 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; and
(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; and
(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; and
(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 electrical 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 electrical 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 electrical charge are tensioned, aligned, and propelled to said fiber collecting means by said second 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 axial inlet 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 axial inlet 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 therethrough, said passage terminating at the rotary portion end 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 produces 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:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents