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Landwehrkamp et al.

[11] **3,802,174**

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[54] **METHOD AND APPARATUS FOR PRODUCING OF STAPLE FIBRE YARN**

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[21] Appl. No.: **168,629**

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **57/5,** 57/35, 57/51, 57/51.3, 57/77.3, 57/140 J, 57/157 TS, 57/160, 57/164

[51] **Int. Cl.** **D01h 5/28,** D02j 3/10, D02g 3/38

[58] **Field of Search** 28/72.12; 19/244, 287; 57/51, 51.3, 51.2, 51.4, 51.5, 51.6, 156

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[57] **ABSTRACT**

A method for producing staple fibre yarn comprises positively drafting sliver to produce a staple fibre sliverlet, then twisting the staple fibre sliverlet by means of a twisting part to produce yarn which is then supplied to a bobbin and wound on the bobbin. The sliverlet is subjected to negative drafting after the positive drafting and is simultaneously twisted in the negative drafting zone in a certain direction.

25 Claims, 11 Drawing Figures

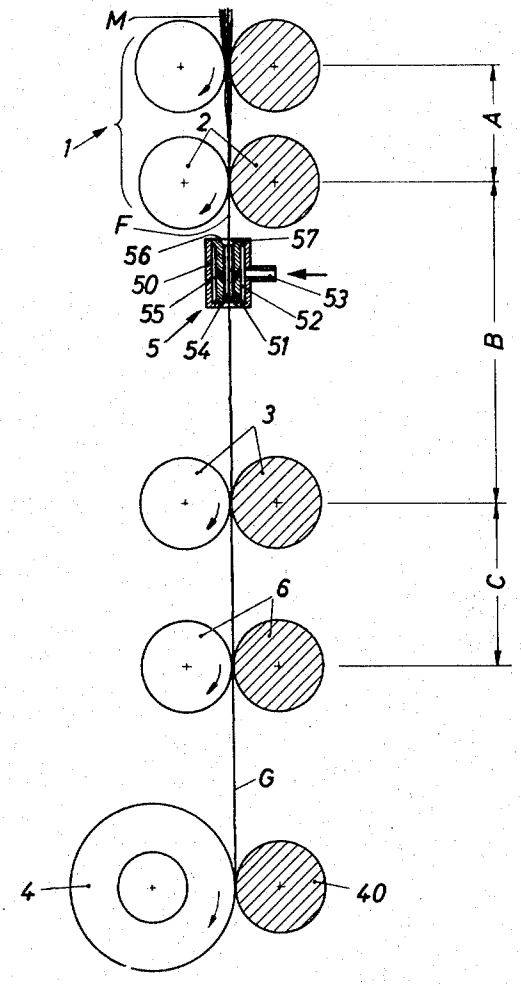

Fig. 1

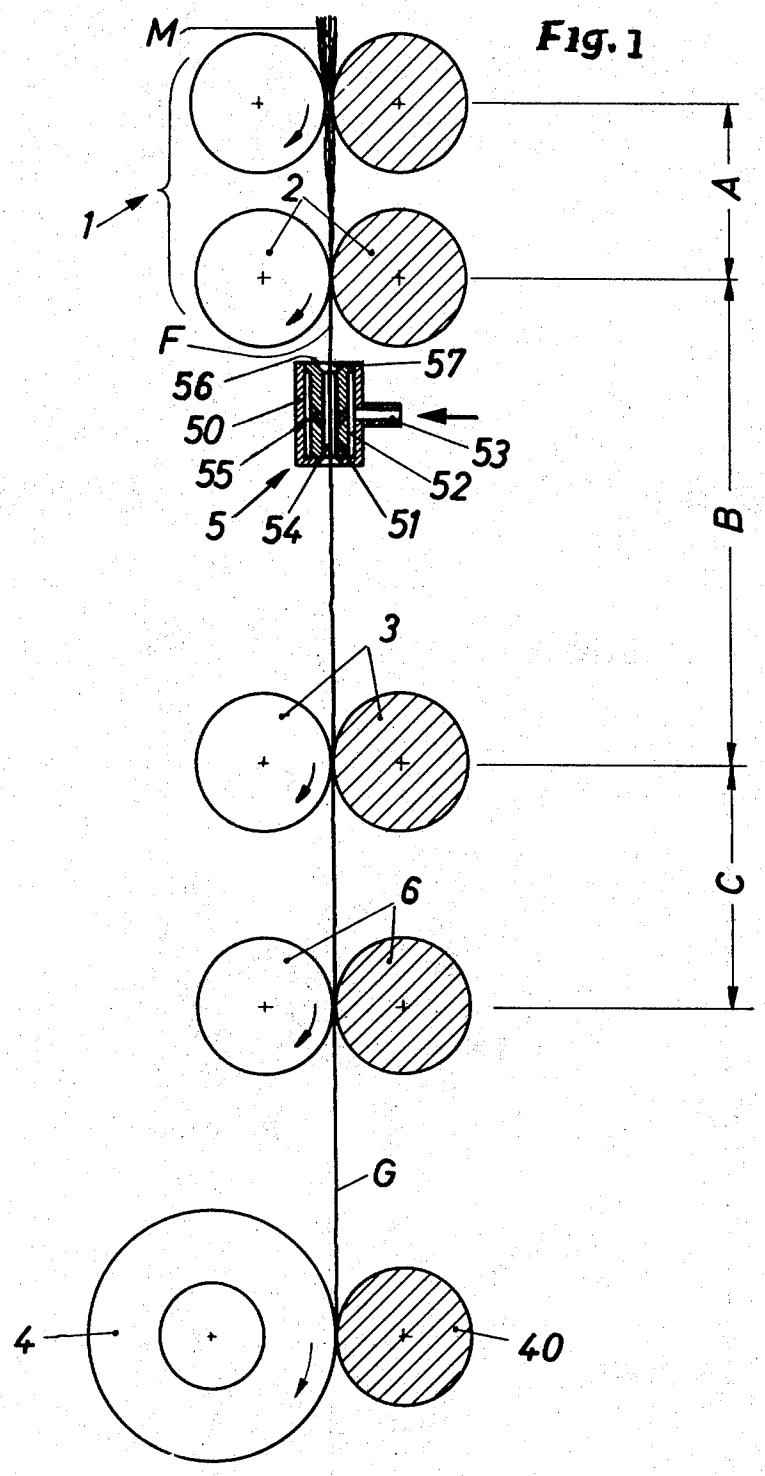

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Fig. 2

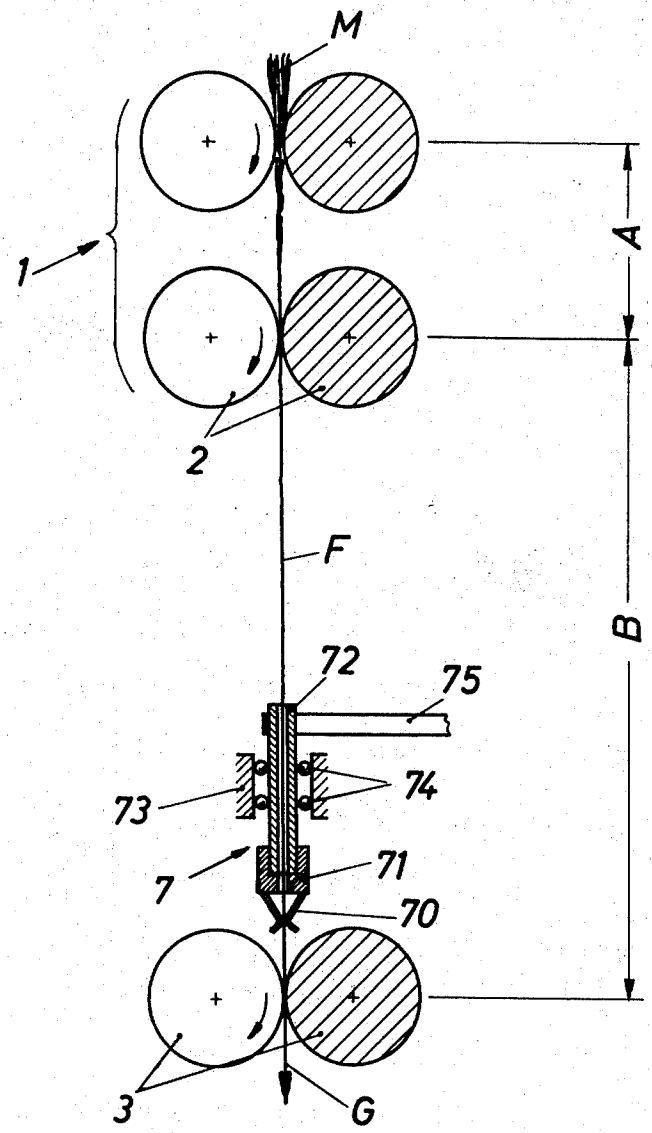

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Fig. 4

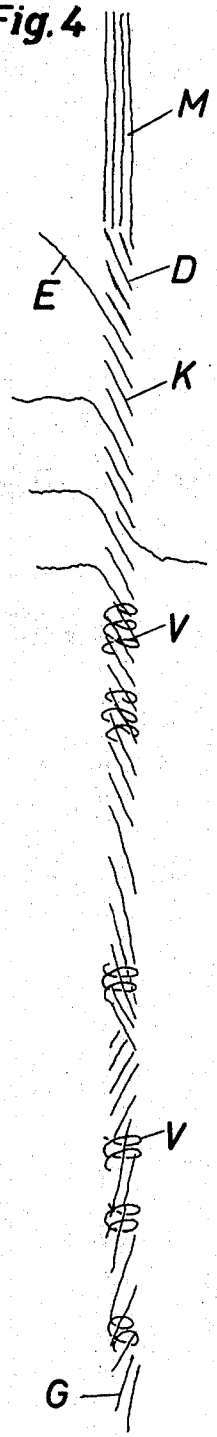

Fig. 3

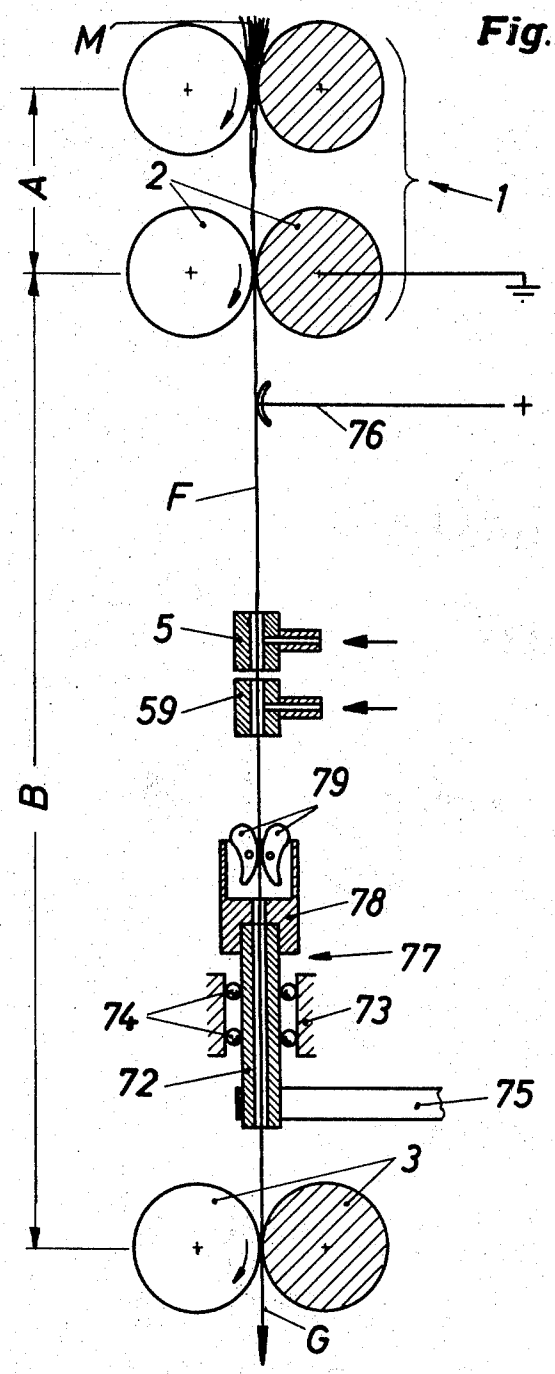

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Fig. 5

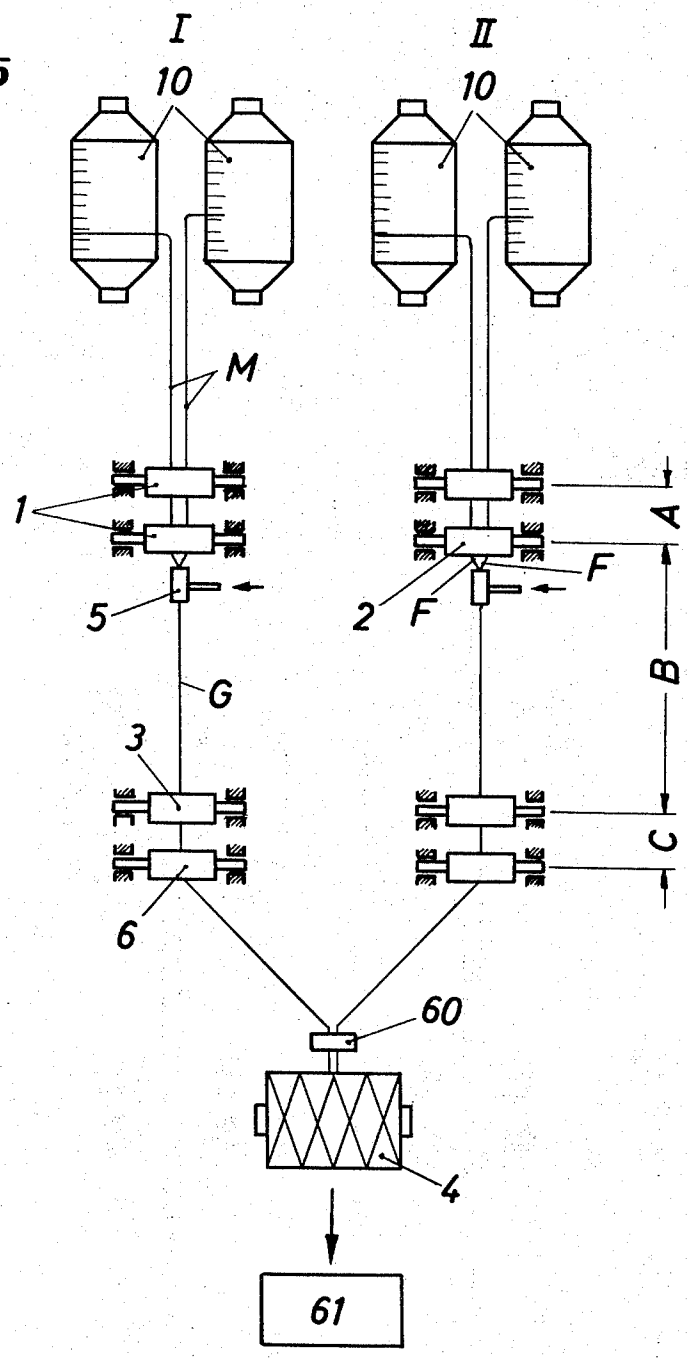

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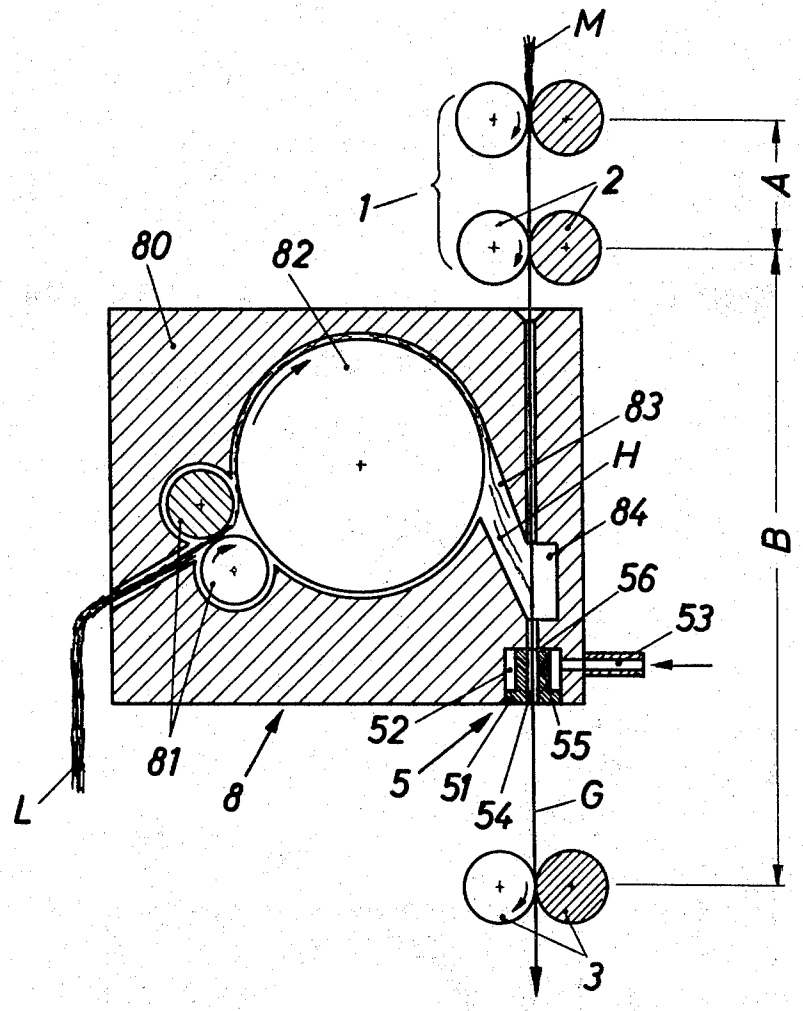
Fig. 6



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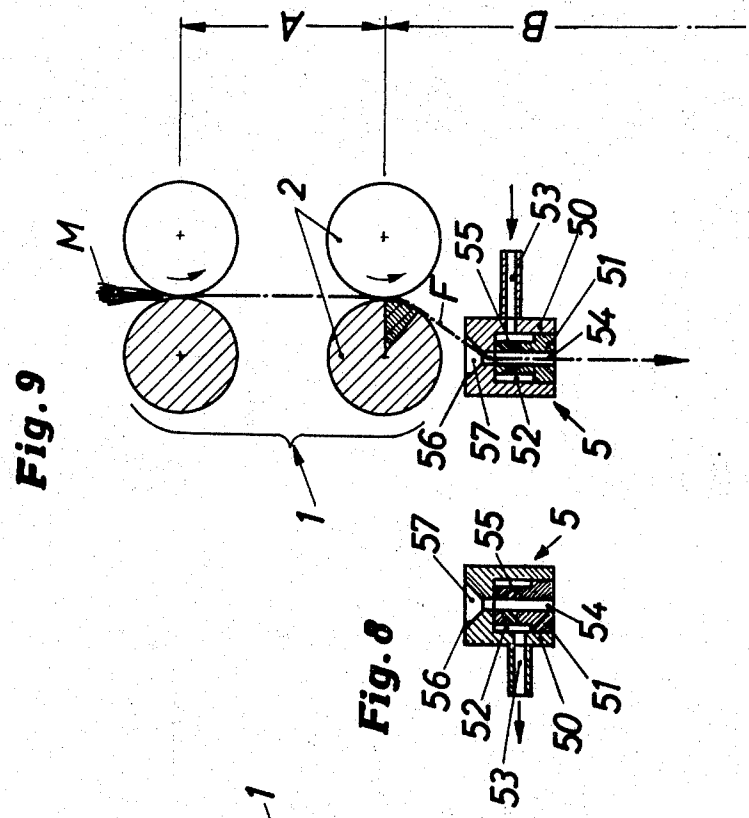

Fig. 9

Fig. 8

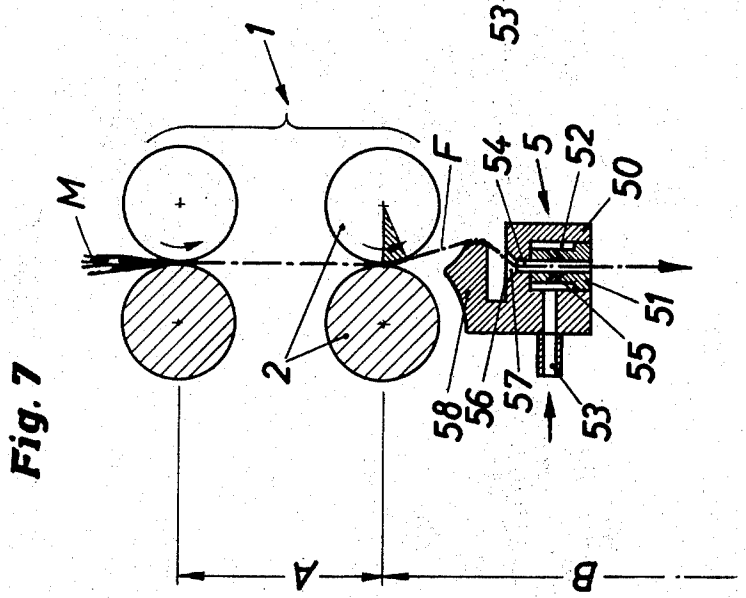

Fig. 7

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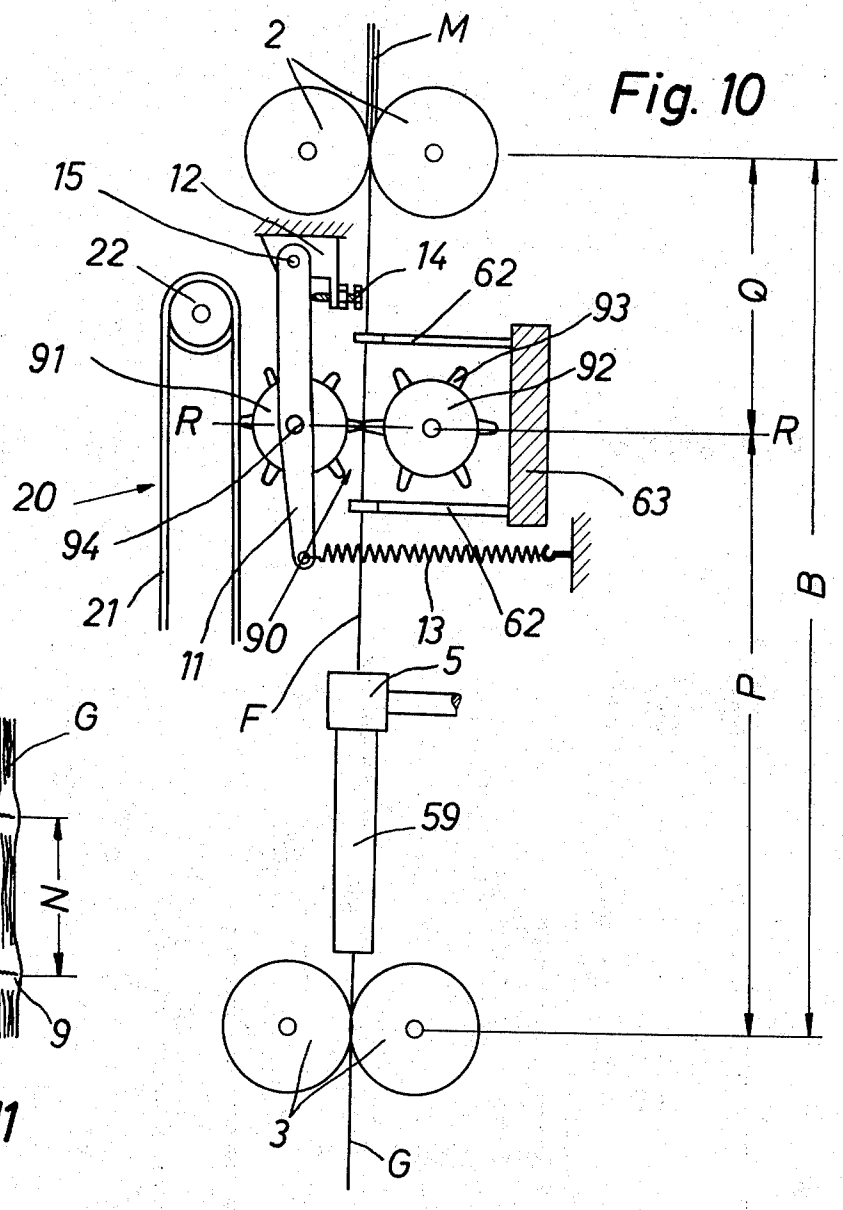

Fig. 10

Fig. 11

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METHOD AND APPARATUS FOR PRODUCING OF STAPLE FIBRE YARN

BACKGROUND OF INVENTION

1. Field to which invention relates

The invention relates to the production of staple fibre yarn more particularly by drafting fibre sliver, twisting it by means of a twister and then supplying it to a bobbin for winding up.

An object of the invention is to be able to produce staple fibre yarn as economically as possible with a high speed of production without the yarn produced having disadvantageous characteristics and without having essential departures from the characteristics of yarns produced in ring spinning frames as concerns the range of application.

2. The prior art

The open-end-spinning method for producing yarns of staple fibres, more particularly using a rotating spinning chamber, produces a thread with a comparatively high speed of spinning. The thread has a high degree of evenness but its tensile strength is about 20 percent less than that of ring spun yarn. Animal fibres, especially wool, which have a high content of fat, can only be processed by this method with great difficulty. Furthermore there are certain limits as regards the speed of spinning owing to the speed of rotation of the spinning chamber and the yarn tension occurring. This difficulty makes itself felt more especially in the production of fine yarn.

In accordance with a previous proposal fibre sliver was to be twisted alternately in opposite directions and the twist was to be stabilised or fixed in the sliver by bringing it together with another sliver so that the two slivers became twisted together (see German Specification 1,510,562). Although in this manner it is possible to produce a thread at a high speed, the product has alternating directions of twist which bring about certain difficulties in further processing, for example, in the case of dyeing the alternate directions of twist become visible. Furthermore breakages in the thread can only be removed by knots which are always apparent.

In accordance with a still further prior proposal a bundled yarn was to be produced by drafting staple fibres, twisting in a twister with the help of a fluid flowing with at least half the speed of sound, and wound up. In this case the staple fibres were to be drafted by the drafting rollers in a flat sliver form with a breadth of at least 7.6 mm and passed from the drafting rollers by means of suction nozzle to the twister (see German Patent Publication 1,287,984). The yarn produced in this manner has a substantially untwisted fibre core, which is held together by irregularly twisted encasing fibres.

SUMMARY OF INVENTION

One aim of the invention is that of producing a yarn in an economic manner with a high speed of production, which yarn has a twisted structure over its whole cross-section.

The present invention consists in a method for producing staple fibre yarn comprising positively drafting sliver to produce a staple fibre sliverlet, then twisting the staple fibre sliverlet by means of a twisting part to produce yarn which is then supplied to a bobbin and wound on the bobbin, the sliverlet being subjected to

negative drafting after the positive drafting and simultaneously being twisted in the negative drafting zone in a certain direction. In this manner an extremely even yarn which is twisted throughout its structure is produced without disadvantageous effects due to alternating twist being present. In order to achieve a still smoother and more even surface of the yarn and increasing the strength, the twisted fibre sliverlet can be drafted before winding on to a bobbin.

By supplying separated fibres into the zone of negative draft, changes in the mixture and structure of the yarn can be brought about.

The strength of the yarn can also be increased by adopting the feature that fibres of the staple fibre sliverlet are joined together by bonding in the zone of negative drafting with a spacing which is less than the mean staple fibre length. Although the adhesion of the yarn can be carried out practically at points so that there are no difficulties in winding up owing to the different coils on the bobbin sticking together, it may be convenient in many cases for the staple fibre sliverlet to be dried after bonding but before leaving the zone of negative drafting.

In accordance with a further feature of the invention the doubling does not occur, as is conventional, in a separate working process, but the yarns of several spinning stations are doubled before being wound on to a single bobbin. For better maintaining the twist it is also possible to set the yarn before the drafting operation. Furthermore the produced yarn can individually or together with several yarns be subjected to a twisting process in order to achieve a greater tensile strength.

The invention also includes apparatus for producing staple fibre yarn including means for positively drafting fibre sliver to produce a staple fibre sliverlet; means for twisting the sliverlet to produce a yarn; means for winding up the yarn on a bobbin; the improvement comprising means for subjecting the sliverlet to negative drafting after the positive drafting and including a pair of draw-off rollers and a preceding pair of supply cylinders having a higher peripheral speed than the draw-off rollers, the means for twisting the sliverlet being arranged between such supply cylinders and the draw-off rollers and exerting a continuous twisting operation in a predetermined direction. In order to subject the twisted yarn to subsequent drafting, at least one pair of drafting rollers is provided downstream from the pair of draw-off rollers, having a higher peripheral speed than its supply rollers.

In order to be able to bond the staple fibre sliverlet with a spacing which is less than the mean staple fibre length, a pair of rollers can be arranged in the negative draft zone, of which at least one roller has peripherally evenly distributed ribs for the intermittent nipping or pinching of the staple fibre sliverlet with a spacing which is less than the mean staple fibre length so that the staple fibre sliverlet is bonded, each time it is nipped or pinched. For supplying an adhesive, or an activator for an adhesive already contained in the fibre sliverlet, the ribs can be arranged to be engaged tangentially by a supply conveyor. For activating such an adhesive or for carrying out the intermittent bonding operation at least one of the rollers can be provided with heating means. In order to bring about a more rapid drying of the adhesive joints in the fibre sliverlet it is possible to provide a heated zone downstream from the pair of rollers.

A fibre opening or separating device can be provided which opens into a mixing chamber arranged between the pair of supply cylinders and the pair of draw-off rollers in order to provide additionally separated fibres to the spinning process; the mixing chamber is preferably arranged upstream from the means for twisting the sliverlet.

As means for twisting the sliverlet it is possible to make use of conventional devices such as those used for imparting a false twist. They can be mechanical and mechanically or pneumatically driven. However, it is preferred to make use of a pneumatic twisting nozzle, for the method in accordance with the invention, for example as described in the German Patent Specification 1,287,984 or 1,062,153. Conveniently the pneumatic twisting nozzle is adapted to produce a subatmospheric pressure at its fibre sliver inlet in order to exert a sucking action on the yarn or the fibres emerging from the mixing chamber. This can be carried out by constructing the twisting nozzle as an injector or by connecting it with a source of vacuum or suction. The means for twisting the fibre sliverlet has preferably a flat inlet opening operating as a condenser which is so arranged with respect to the pair of supply cylinders that the fibre sliver emerging from the pair of supply cylinders is deflected. This leads to a satisfactory twisting action being exerted on the sliver.

It is possible to double the yarn already on the spinning machine by providing one winding device to cooperate with several spinning stations consequently a separate doubling machine is not necessary.

By the use of a setting device, which can be of conventional construction, upstream from the winding up device the twist imparted is set.

LIST OF SEVERAL VIEWS OF DRAWINGS

Further details of the invention will be gathered from the following description referring to the accompanying drawings.

FIG. 1 shows a spinning device in accordance with the invention in principle with a negative drafting zone and a subsequent drafting action.

FIG. 2 shows a spinning device with a mechanical twisting part.

FIG. 3 shows a spinning device with a fibre spreading device and several twisting nozzles together with a mechanical twister.

FIG. 4 shows diagrammatically the structure of yarn produced in accordance with the invention.

FIG. 5 shows the whole yarn producing process diagrammatically, extending from a twin sliver supply to the threads produced.

FIG. 6 shows a spinning device with a mixing chamber.

FIGS. 7 to 9 show various constructions and arrangements of the fibre inlet end of the twisting part.

FIG. 10 shows a spinning device or apparatus with a bonding device operating intermittently.

FIG. 11 shows diagrammatically the structure of a yarn produced with the device in accordance with FIG. 10.

DESCRIPTION OF PREFERRED EMBODIMENTS

In accordance with the present invention for the production of staple fibre yarn the supplied material is firstly subjected to positive drafting and then subsequently to negative drafting, which is equivalent to overfeed. In the negative drafting zone the drafted material is simultaneously continuously twisted in a given direction. In this manner a very even yarn which is twisted throughout is produced which is wound on a yarn bobbin.

Apparatus in accordance with the invention for carrying out this method is shown in FIG. 1. In accordance with the actual type of the material to be spun it comprises a conventional long or short staple drafting mechanism 1, which can be constructed in the form of a multiroller or belt drafting mechanism. The positive drafting zone A constituted by the drafting mechanism 1 is followed by a negative drafting zone B, which is delimited on the one hand by a pair of supply cylinders 2 and a pair of draw-off rollers 3 on the other hand. As can be seen from FIG. 1 the pair of supply cylinders 2 is preferably arranged to serve simultaneously as the last pair of rollers of the preceding drafting mechanism 1.

The pair of draw-off rollers 3 has a lower peripheral speed than the pair of supply cylinders 2 so that between the latter and the pair of draw-off rollers 3 a negative drafting action results preferably in the order of magnitude of 0.7 to 0.98, that is to say the peripheral speed of the pair of draw-off rollers 3 is 0.7 to 0.98 times the peripheral speed of the pair of supply cylinders 2. This negative drafting or overfeed action is an important feature of the method in accordance with the invention.

In the negative drafting zone B, that is to say between the pair of supply cylinders 2 and the pair of draw-off rollers 3 there is a pneumatic twisting nozzle 5 which, as can be seen from FIG. 1, comprises a stationary cylindrical casing 50 in which an insert 51 of substantially cylindrical form is arranged. Between the casing 50 and the insert 51 an air chamber 52 is provided owing to the shape of these two parts. This air chamber 52 is connected via a pipe 53 with a source of compressed air which is not shown. The insert 51 has a central hole 54 for the fibre sliverlet F, which hole 54 is connected with the air chamber 52 by means of air channels 55 opening tangentially into the hole 54 for producing a vortex. The channels 55 are preferably inclined toward hole 54 in the direction of movement of the fibre sliverlet. In this manner a vacuum is produced at the fibre inlet end 56 and this vacuum facilitates the introduction of the fibre sliverlet F into the twisting nozzle 5.

The apparatus whose construction has just been described operates in the following manner.

The supplied material M (flyer roving or drafted sliver) is drafted in the drafting mechanism 1 to produce a fibre sliverlet F which has the same thickness as that of the yarn to be produced. After leaving the pair of supply cylinders 2, the sliverlet is passed into the negative drafting zone B through the twisting nozzle 5. Owing to the air vortex in the twisting nozzle 5 the piece of fibre material between the twisting nozzle 5 and the supply rollers 2 is twisted. After leaving the twisting nozzle 5 the thread tends to become completely untwisted again. This is, however, prevented since in the twisting nozzle 5 fibre ends, edge fibres and partially projecting or free fibres are wound around the thread G and thus at least in a certain zone of the thread bring about a fixation of the twist. The thread G is twisted throughout its cross-section and thus has a true twist.

The finished thread G is then wound in a conventional manner with a slight stretching or drafting effect on the yarn bobbin **4.**

Owing to the twisting around the thread G of fibre ends and groups of fibres there is a so-called corkscrewing in the partial twisting-up of the thread G following the twisting nozzle. The reason for this is that one group of fibres twists up and thus becomes longer while another group of fibres becomes twisted together and is therefore shorter. In order to avoid the formation of such corkscrew structures the actual spinning process can be advantageously followed by a subsequent drafting process as is shown in FIG. **1.** In this respect the thread G passes through a second positive drafting zone C. This drafting zone C can be between, for example, two pairs of rollers or even two rollers which have the thread extending partially around them. In accordance with FIG. **1** this drafting zone extends between the pair of draw-off rollers **3** and a pair of drafting rollers **6** following the pair of draw-off rollers **3.**

The twisting nozzle **5** can be constructed in various different forms and be arranged in various different fashions. Preferably the sliver inlet end **56** has a flat inlet opening **57** acting as a condenser.

A satisfactory twisting of the material is achieved by causing the fibre sliverlet F emerging from the pair of supply rollers **2** to be bent or deflected from its direct path of movement. For this purpose the twisting nozzle **5** can either be tilted or can be arranged so as to be offset with respect to the line running between the nip of supply cylinders **2** and the nip of draw-off rollers **3** (see FIG. **9**), or, as a further possibility, it can be provided with a guide part **58** arranged above the nozzle **57** (see FIG. **7**). This guide part deflects the fibre sliverlet F from the connecting line running between the nip of delivery cylinders **2** and passage **54** through the twisting nozzle **5.**

The twisting nozzles described up till now are all constructed as injectors and connected with a supply of compressed air. The suction effect or vacuum at the nozzles **57** can also be produced by connection of the air chamber **52** with a source of vacuum. In this case the channels **55** are inclined outwardly from passage **54** in the direction of passage of the fibre sliver, as can be seen from FIG. **8.**

Instead of a pneumatic twisting nozzle, it is also possible to provide a twister constructed in the form of a mechanically acting strip spring gripping device **7** arranged in the negative drafting zone B, as shown in FIG. **2.** The strip spring gripping device **7** can comprise, for example, strip springs **70** arranged in a circular fashion in a carrier **71.** These strip springs **70** are biased so as to be pressed from all sides on to the thread G and they exert a gripping action on it. The carrier **71** with the strip springs **70** is arranged at the end of a tube **72,** which is journalled in a stationary part **73** of the apparatus by means of ball bearings **74** and is driven by means of a belt **75.**

It is not absolutely essential for the twister **5** or **7,** respectively, to be arranged immediately downstream from the pair of delivery cylinders **2.** The thread G can also be spun with an arrangement in accordance with FIG. **2.** In the case of the use of a mechanically acting twister it is, however, necessary for the distance between the twister and the nip of the pair of draw-off rollers **3** to be less than the length of the staple fibers, as otherwise the strength of the yarn is not sufficient to overcome the gripping pressing action. In order to be able to supply as many projecting fibre ends to the twisting nozzle as possible the feature is adopted (see FIG. **3**) of supplying the thread G with a false twist over a contacting part **76** connected with a source of high voltage so that all free fibre ends stand out from the core of the thread. The voltage can be between 5,000 and 30,000. Although this voltage is not dangerous owing to the very low currents, it is naturally possible to provide insulation. For example the twister **5** or **7** can be insulated from the rest of the apparatus and be connected with the high voltage.

It is of no importance for the invention where the contacting part **76** is arranged in the negative drafting zone B, since in the thread G a false twist is produced both upstream and also downstream from the twister **5** or **7.** In accordance with FIG. **3** the contacting part **76** is arranged upstream from the twisting part but it can also be arranged between the twister and the pair of draw-off rollers **3.**

In order to intensify the wrapping action it is also possible to arrange several twisters one after the other. In this respect the direction of twist of each twister is not important.

In the construction shown the "false twist" D (FIG. **4**) is applied by the twister which is constructed as a mechanically acting centrifugal gripping device **77** upstream from the pair of draw-off rollers **3.** The centrifugally acting gripping device **77** can be of conventional construction and has a pair of two-armed gripping elements **79** held in a carrier **78.** One arm of each element **79** is thrown outwards by centrifugal force so that its other arm presses the thread G against the corresponding arm of the other gripping element **79.** The high voltage applied by the contacting part **76** causes the fibre ends E to become erect (FIG. **4**) and they are wrapped about the fibre core K which is also twisted, in the pneumatic twisting nozzle or nozzles **5** and **59.** After leaving the centrifugally acting gripping device **77,** the fibre G becomes partially untwisted but is hindered from becoming completely untwisted owing to the wrappings or entanglements V. The thread G produced in this manner has a completely irregular twist structure, but this twist is distributed both along the length and also over the cross-section. The thread G therefore appears in surface view to have an even structure.

The threads G produced in accordance with the present invention are then cleaned and doubled in a conventional manner on a doubling machine and finally twisted in a twisting frame.

It is naturally also possible to double the threads G of two or more spinning stations directly on the spinning frame before winding up on to a yarn bobbin **4** and thus save a separate working step.

The apparatus for carrying out this method is shown in FIG. **5.** The material M supplied for example on bobbins **10** is positively drafted in the drafting zone A of the drafting mechanism **1** and then passes into the negative drafting zone B. In order to encourage the formation of entanglements V in this negative drafting zone B two or more pieces of roving or drafted slivers are fed to a common twister which can be constructed, for example, as a pneumatic twisting nozzle **5.** The thread G of a spinning station I run off by the pair of draw-off rollers **3** can, if desired, be drafted again in a further positive drafting zone C and is then doubled with the thread or threads G of further spinning stations II etc.

before being wound up onto a common yarn bobbin **4.** The threads G can be set before the doubling so that the twist is set. For this purpose it is possible to make use of a conventional setting device **60.**

The thread G wound on the yarn bobbin **4** can then be subjected to a twisting process individually or together with other threads in order to obtain a high tensile strength in this manner. This working step of "twisting" is indicated diagrammatically at **61** in FIG. **5.**

For the additional information of free fibres H, which in the spinning zone formed by the negative drafting zone B can be wound about the thread G, a conventional fibre opening device **8** (FIG. **6**) is arranged in the spinning zone which feeds small quantities of individual fibres H to the pre-twisted thread G. With this construction the ratio of the free fibres H to the thread core K can be set very precisely and be made to suit the respective spinning conditions and yarn characteristics desired.

The fibre opening device **8** consists in a conventional manner of a housing **80,** in which the supply rollers **81** and the opening roller **82** are journalled. The fibre opening device **8** has a duct **83** opening into a mixing chamber **84** which is located between the pair of supply cylinders **2** and the pair of draw-off rollers **3.** In the negative drafting zone B there is again a twister which is preferably constructed as a pneumatic twisting nozzle **5.** In principle the twisting nozzle **5** can be arranged upstream from the mixing chamber **84** but it is convenient for the mixing chamber **84** to be arranged upstream from the twisting nozzle **5.** In this manner the vacuum produced and acting upon the sliver inlet end **56** aids the transport of the fibres H, detached by the opening roller **82** from the supplied fibre band L, to the mixing chamber **84.**

The thread G produced in accordance with the method of the invention shown in FIG. **6** consists of a mixture of true and falsly twisted fibre parts.

Numerous modifications of the method and the device in accordance with the invention are possible. Thus, the various described methods can be combined with each other as may be desired. A second positive drafting zone C can also be provided in the embodiments of FIGS. **2, 3** and **6,** and also it is possible for the winding up device **4, 40** to be provided for several spinning stations I, II etc. in the case of the devices shown in FIGS. **1** to **3** and **6.** Also, the twister can be constructed as may be desired as a pneumatic twisting nozzle **5** or as a strip spring gripping means **7** or a centrifugal gripping means **77,** or in any other suitable manner.

In order to increase the tensile strength of the yarn the staple fibre sliver F can be bonded with a spacing which is less than the mean staple fibre length **0.** A thread G produced in this manner is shown in FIG. **11.** As can be clearly seen from this figure, the points **9** at which bonding has been carried out on the thread G are spaced at a distance N which is less than the mean staple fibre length **0** of the processed material M.

A device with which such a thread G can be produced is shown in FIG. **10.** In the negative drafting zone B, in addition to the twisting nozzle **5,** the strip spring gripping means **7** (FIG. **2**) or the centrifugal gripping means **77** (FIG. **3**), a pair of rollers **90** is provided. Both rollers **91** and **92** of this pair of rollers **90** are driven positively with the same peripheral speed; and the roller peripheries have evenly spaced ribs **93** with the pitch or circumferential spacing N.

The two rollers are so arranged in relation to each other that their ribs **93** adjacent to each other always come to be located simultaneously on the plane R—R passing through the axes of the rollers **91** and **92.** Furthermore, one of the rollers **91** and **92** is provided with a conveying means **20** which is tangent to the ribs **93** in their path of travel. This conveying means can be variously constructed, for example in the form of a rib-contacting roller, or a transport belt **21** which is driven over an idler roller **22** and supplies a viscous or liquid adhesive to the ribs **93** of the roller **91.**

The staple fibre sliverlet F is thus, as just described, twisted by the twisting nozzle **5** so that the twist proceeds as far as the supply cylinders **2** on the one hand and the pair of draw-off rollers **3** on the other hand as long as the fibre sliverlet is not gripped by the pair of rollers **90.** The rollers **91** and **92** which are both positively driven regularly pinch the thread G with the distance N, this being the distance between the ribs **93** of the rollers. Since the ribs **93** have previously been provided with a coating of adhesive by the transport belt **21,** the staple fibre sliverlet is also wetted by the ribs **93** with the adhesive and the fibres are connected with each other in an even better manner. At the instant of bonding by application of adhesive the twist imparted by the twisting nozzle **5** can no longer progress towards the pair of supply cylinders **2** but can only progress as fas as the pinch line of the pair of rollers **90** so that twist is only imparted for the instant in the zone P. In the zone Q there is, however, so much twist as to be sufficient for ensuring a reliable binding in of the fibres as the material leaves the pair of supply cylinders **2.** As the pinching action exerted on the thread G between the ribs **93** ceases, the twist can proceed further along the whole negative drafting zone B so that the brief pinching of the thread G has no disadvantageous effect on the binding in of the fibres. Since the fibres are furthermore not open in the negative drafting zone B but are twisted, the fibres will not be picked off by the rollers **91** and **92.**

The thread G is wound with the help of the winding roller **40** with substantial crossing on the yarn spool **4,** when it has been drawn off by the pair of draw-off rollers **3** from the negative drafting zone B. Since the bonding locations are very small, there is no sticking together of the individual lengths of thread.

The rollers of the pair of rollers **90** can be constructed in different fashions. Thus, for example, one of the rollers can have a smooth surface and only the other roller is provided with ribs **93.** If both rollers which are driven positively are provided with ribs **93,** they can be angularly off-set so that the ribs **93** of the one roller make contact with the other roller precisely in the middle between two adjacent ribs **93.** The distance between two consecutively following ribs **93** is in this case twice as large as in the case with the embodiment shown in FIG. **10.** The staple fibre sliverlet F is in this case pinched alternately between one rib **93** of the left-hand roller **91** engaging the periphery of right-hand roller **92** and then one rib **93** of the right-hand roller **92** engaging the periphery of left-hand roller **91.**

In order to make the bonding locations **9** as short as possible, the ribs **93** preferably have a rounded profile.

For guiding the staple fibre sliverlet F in the pair of rollers **90** the ribs **93** can have small notches or grooves running in the peripheral direction of the rollers. Preferably, however, a respective guide element **62** is provided above and below the pair of rollers **90**, which guide elements are preferably arranged so that they can be twisted with a common rail **63** parallel to the nip line of the pair of rollers **90** in order to avoid an uneven running-in of the rollers and ribs **93.**

In accordance with a convenient feature of the invention one of the rollers of the pair of rollers **90** is resiliently journalled. For example the opposite ends of one roller of the pair of rollers **90** are carried by a pair of levers **11** which are attached to a bracket **12.** The example in FIG. **10** shows roller **91** being so carried, with only one lever of the pair being visible. A spring **13** draws the left-hand roller **91** towards the right-hand roller **92** and the minimum distance between the rollers can be adjusted by means of a setting screw **14** which is arranged in the bracket **12** and serves to provide an abutment or stop for one end of lever **11.**

In order to guarantee satisfactory driving despite the adjustment of the roller **91** the roller is driven in a conventional manner by means of a sprocket chain drive with a jockey roller or with the help of a gear wheel mounted on the shaft **94,** which meshes with a gear wheel mounted on the shaft **15** of the pair of levers **11** and is rocked with this pair of levers **11.** Such drives can be of a conventional construction and are therefore not shown.

Instead of, or in addition to, the resilient means carrying the roller **91,** the ribs of one or both rollers of the pair of rollers **90** can consist of elastic material such as for example hard rubber or a suitable plastic material.

The adhesive can be supplied in various different ways. Instead of the adhesive being supplied by a belt **21** or by a roller to the ribs **93,** it can be mixed with the supply material M as a non-active powder form and be made active with the help of a suitable material for activation supplied with the help of the conveyor belt **21** or a roller and the ribs **93.** The belt **21** or roller or other conveying means can, however, be dispensed with and instead one or both of the rollers **91** and **92** can be constructed as a heating element so that the adhesive supplied with the supply material is activated by the action of heat. For this purpose it is possible either to provide a heating element in each roller **91, 92** to heat them or the rollers can be constructed as tubes and in this case hot air or steam is passed through them.

For drying the adhesive joints the pair of rollers **90** can be followed by a heating zone. It is advantageous, for this purpose, to connect the twisting nozzle **5** with a drying tube **59** or nozzle, which is supplied with dry-heating air via the pipe **53** and the twisting nozzle **5.** The air then passes through the tube or nozzle **59.** The heating zone can also be in the form of a heated roller which has the staple sliverlet F looped partially or completely around it and the heating also takes place with the help of the heating element or a current of hot air or steam, which is passed through the roller. In this case the roller may possibly replace the pair of draw-off rollers **3.**

The further processing of the thread G produced in this manner can be carried out in the manner of procedure already described in connection with FIG. **5.** After further processing by knitting or weaving the adhesive is dissolved out of the thread G again by the finishing process. Therefore, the most suitable adhesives are water-soluble starches or glues.

The connection of the fibres of the staple sliverlet F can be carried out by welding instead of applying adhesive. For this purpose the rollers must be capable of being heated. This method can be used for the spinning of pure synthetics as for example polyamide, polyester, polypropylene, polyacryl and also from mixtures of synthetic and natural fibres. In accordance with the invention an endless synthetic thread can be added to a supply of staple fibres. The synthetic thread is supplied to the outlet pair of cylinders **2** of the drafting mechanism **1** and runs together with the staple sliverlet F through the negative drafting zone B, where it is caused to become soft or is melted at points by the pair of rollers **90** so that the staple fibres are connected together.

The welded joints, by means of which the fibres are connected together, cannot afterwards be removed but do not show in the case of certain final products, such as rough goods.

We claim:

1. A method for producing staple fibre yarn comprising the steps of positively drafting sliver to produce a staple fibre sliverlet, negatively drafting the sliverlet after the positive drafting and simultaneously with negative drafting twisting the sliverlet in a predetermined direction to produce yarn, and supplying the yarn to a bobbin for winding thereon.

2. The method defined in claim **1,** and the step of positively drafting the twisted sliverlet before supplying the sliverlet to a bobbin.

3. The method defined in claim **2,** and the step of supplying separated fibres to the sliverlet in the negative drafting zone.

4. The method defined in claim **1,** and the step of bonding the staple fibre sliverlet in the negative drafting zone at locations spaced apart a distance less than the mean staple fibre length.

5. The method defined in claim **4,** in which the bonding is by adhesive, and the step of drying the sliverlet after the bonding step but before the sliverlet leaves the negative drafting zone.

6. The method defined in claim **1,** and the step of doubling the yarn from a plurality of negative drafting zones before supplying the yarn to a bobbin.

7. The method defined in claim **6,** and the step of setting the twist before the yarn is doubled.

8. The method defined in claim **1,** and the further step of again twisting the yarn after negative drafting.

9. Apparatus for producing staple fibre yarn including means for positively drafting fibre sliver to produce a staple fibre sliverlet, having a drafting zone, means for twisting the sliverlet to produce yarn, and means for winding the yarn on a bobbin, the improvement comprising negative drafting means following the positive drafting means drafting zone in the direction of sliverlet travel and including a pair of draw-off rollers and a pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers and exerting a continuous twisting operation on the sliverlet in a predetermined direction.

10. The apparatus defined in claim 9, in which the means for twisting the sliverlet is a pneumatically operated twisting nozzle.

11. The apparatus defined in claim 10, in which the means for twisting the sliverlet includes a flat sliverlet inlet opening and means for deflecting the sliverlet relative to a line tangent to the nip of the pair of supply rollers as the sliverlet emerges from the nip of the supply rollers.

12. The apparatus defined in claim 10, in which the means for twisting includes pneumatic fluid supply means for supplying pneumatic fluid for flow through the pneumatic twisting nozzle in a direction to produce a pressure at the nozzle fibre sliverlet inlet end lower than the pressure at the nozzle outlet end.

13. The apparatus defined in claim 12, in which the means for twisting the sliverlet includes suction means connected to the pneumatic twisting nozzle.

14. The apparatus defined in claim 12, in which the means for twisting the sliverlet includes a source of compressed air connected to the pneumatic twisting nozzle.

15. Apparatus for producting staple fibre yarn including means for positively drafting fibre sliver to produce a staple fibre sliverlet, having a drafting zone, means for twisting the sliverlet to produce yarn, and means for winding the yarn on a bobbin, the improvement comprising negative drafting means following the positive drafting means drafting zone in the direction of sliverlet travel and including a pair of draw-off rollers and a first pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers, and second positive drafting means following the negative drafting means in the direction of sliverlet travel and including a second pair of supply rollers and a pair of drafting rollers having a higher peripheral speed than the peripheral speed of said second pair of supply rollers.

16. The apparatus defined in claim 15, in which the negative drafting means draw-off rollers constitute the second positive drafting means supply rollers.

17. Apparatus for producing staple fibre yarn including means for positively drafting the fibre sliver to produce a staple fibre sliverlet having a drafting zone, means for twisting the sliverlet to produce yarn, and means for winding the yarn on a bobbin, the improvement comprising negative drafting means following the positive drafting means drafting zone in the direction of sliverlet travel and including a pair of draw-off rollers and a pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers, and bonding means for joining the fibres of the fibre sliverlet together at locations spaced apart a distance less than the mean staple length.

18. The apparatus defined in claim 17, in which the bonding means include a pair of rollers arranged between the pair of supply rollers and the pair of draw-off rollers, at least one roller of said pair of bonding means rollers having a plurality of rib means evenly spaced about such roller periphery for cooperating with the other bonding means roller to intermittently pinch the sliverlet and thereby to produce the spaced joined locations.

19. The apparatus defined in claim 18, in which the bonding means includes conveying means having a portion disposed tangentially of the cylinder defined by the rib means of one bonding roller for intermittent engagement with such rib means.

20. The apparatus defined in claim 19, in which the bonding means includes means for heating at least one of the bonding rollers.

21. The apparatus defined in claim 19, in which the bonding means includes a heating zone following the bonding means rollers in the direction of sliverlet travel, and means in the heating zone for heating the bonded fibre material.

22. Apparatus for producing staple fibre yarn including means for positively drafting fibre sliver to produce a staple fibre sliverlet having a drafting zone, means for twisting the sliverlet to produce yarn, and means for winding the yarn on a bobbin, the improvement comprising negative drafting means following the positive drafting means drafting zone in the direction of sliverlet travel and including a pair of draw-off rollers and a pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers, a fibre opening device, and mixing chamber means arranged between said pair of supply rollers and said pair of draw-off rollers into which said fibre opening device is arranged to discharge fibres.

23. The apparatus defined in claim 22, in which the mixing chamber means is located between the supply rollers and the means for twisting the sliverlet.

24. The combination of a plurality of apparatuses for producing staple fibre yarn each including means for positively drafting fibre sliver to produce a staple fibre sliverlet including a drafting zone and means for twisting the sliverlet to produce yarn, the improvement comprising negative drafting means following the positive drafting means drafting zone of each apparatus in the direction of sliverlet travel and including a pair of draw-off rollers and a pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers, and yarn winding means common to the plurality of pairs of draw-off rollers for collecting together several yarns.

25. Apparatus for producing staple fibre yarn including means for positively drafting fibre sliver to produce a staple fibre sliverlet having a drafting zone, means for twisting the sliverlet to produce yarn, and means for winding the yarn on a bobbin, the improvement comprising negative drafting means following the positive drafting means drafting zone in the direction of sliverlet travel and including a pair of draw-off rollers and a pair of supply rollers preceding said draw-off rollers and having a higher peripheral speed than the peripheral speed of said draw-off rollers, the means for twisting the sliverlet being arranged between said supply rollers and said draw-off rollers, and a twist setting device located before the winding means relative to the direction of sliverlet travel.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,802,174 Dated April 9, 1974

Inventor(s) Hans Landwehrkamp and Friedrich Schuster

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

Title page, under the section for References Cited, the last reference, change patent number to --2,515,299--.

Column 10, line 55, cancel the comma after "sliverlet".

Column 11, line 23, cancel "producting" and insert --producing--; line 25, cancel the comma after "sliverlet".

Column 12, line 63, change "twist setting" to --twist-setting--.

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents