June 3, 1969 E. NEGISHI 3,447,299

METHOD AND DEVICE FOR ROTARY CONVEYING OF FIBERS

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FIG. 1

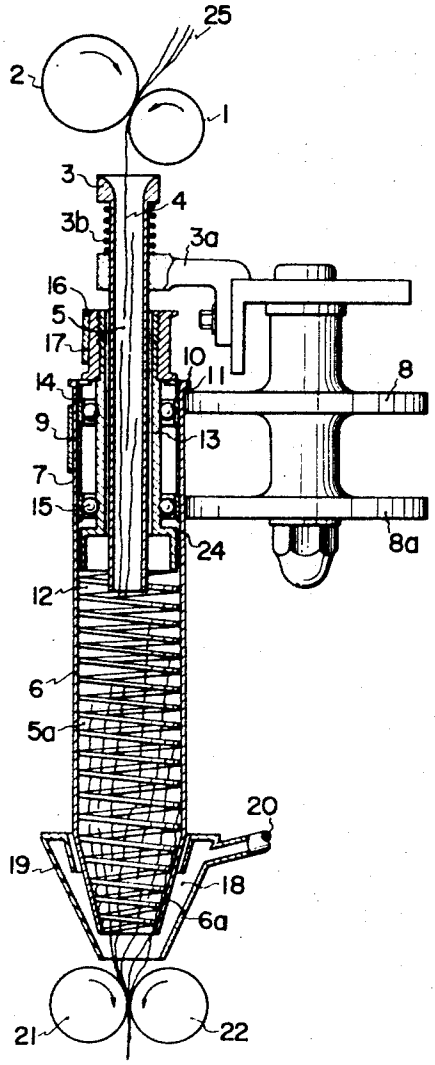

FIG. 2

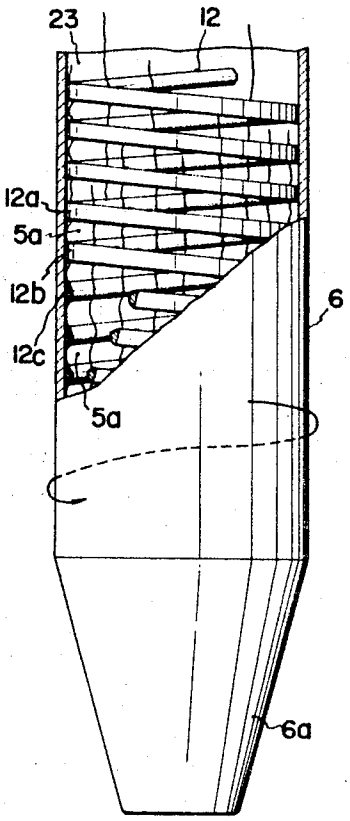

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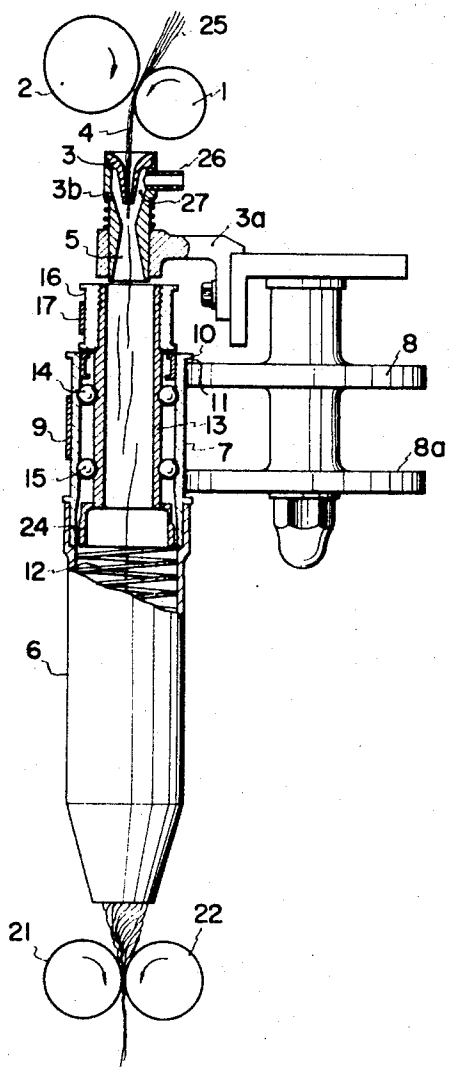
FIG. 3



United States Patent Office 3,447,299
Patented June 3, 1969

3,447,299

METHOD AND DEVICE FOR ROTARY CONVEYING OF FIBERS

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Filed Mar. 7, 1968, Ser. No. 711,294
Claims priority, application Japan, Sept. 15, 1967, 42/59,136
Int. Cl. D01h 7/00
U.S. Cl. 57—58.89 5 Claims

ABSTRACT OF THE DISCLOSURE

Fibers are introduced into the head open end of a rotary cylinder containing a coaxial coil of a wire-like member rotating in the same direction as the cylinder but at a differential speed to produce a screw conveying action toward the tail open end of the cylinder on the fibers, which are caused by centrifugal force to press against the coil and cylinder and thereby to be positively conveyed in the yarn spinning direction in an air spinning or open-end spinning as they rotate together with the cylinder.

Background of the invention

This invention relates to the field of air spinning or open-end spinning. More particularly, the invention concerns a new method and device for rotary conveying of fibers, in air spinning or open-end spinning, wherein fibers are caused to press against the inner wall surface of a rotary cylinder containing a coaxial coil of a wire-like member and thereby to rotate together with the cylinder as they are automatically and positively conveyed in a sliding manner toward the spinning direction.

Heretofore, the above mentioned so-called air spinning or open-end spinning methods have exhibited possibilities of excellent features, whereby increasing attention has been directed toward these methods, and several inventions and proposals relating thereto already exist. Examples of published patent are Japanese Patents Nos. 439,248 and 493,344, U.S. Patents Nos. 3,115,001 and 3,163,976, British Patents Nos. 978,958 and 979,930 and German Patent No. 1,172,352.

None of these methods, however, are generally and fully satisfactory from the point of view of practical use. In particular, the fibres constituting the spun yarn produced by these methods are in a shrunken state. Examples of other defects are lack of tenacity (tensile strength) of the spun yarn in comparison with standard yarn and an external appearance exhibiting much nap. Accordingly, there is still a general hesitation in adopting these methods except for special uses.

The principal reason for the above described circumstance is that in each of the above mentioned methods in the prior art, fibres which are pressed against the inner wall surface of a rotary cylinder and are rotating together with the cylinder are merely subjected to twisting as they are drawn out continuously from one end of the cylinder, and there is no action whereby the fibres within the rotating cylinder are respectively conveyed toward the delivery end of the cylinder in a sheafed state as they are caused to undergo sliding movement at a specific speed.

In other words, there is no positive action, such as that of the apron of the draft device of a known ring spinning frame, whereby the fibres are held in a sheafed state and, at the same time, are progressively conveyed in the spinning direction. Because of the lack of this action, the fibres pressed against and rotating with the inner side of the rotary cylinder are subjected to almost no draft and are merely twisted and spun. For this reason, the individual

fibres of the spun yarn are not amply stretched or extended.

Summary of the invention

In view of the above described circumstance and reason therefor, it is a prime object of the present invention to improve the spinning technique in air spinning or open-end spinning by providing a method and device for rotary conveying of fibres whereby yarn of excellent quality can be efficiently spun.

Another object of the invention is to provide a device as stated above which has relatively simple organisation and operation.

According to the present invention, briefly summarised, there are provided a method and a device as stated above wherein fibres are steadily introduced into the head open end of a rotary cylinder containing a coaxial helical coil of a wire-like member also rotating in the same direction but at a differential speed relative to the cylinder, and the fibres thus introduced are caused by centrifugal force to open dispersively toward the cylinder inner wall surface and to straddle and press against the coil and parts of the wall surface exposed between the coil turns, whereby the individual fibres are caused to rotate together with the cylinder wall and, at the same time, to be positively conveyed toward the tail open end of the cylinder by relative screw action of the coil due to the differential speed.

Brief description of the drawing

The nature, principle, details, and utility of the invention will be more clearly apparent from the following detailed description beginning with a consideration of known member employable in the practice of the invention and successively disclosing the subject matter of the invention with respect to preferred embodiments thereof, reference being made to the accompanying drawing, in which the same or equivalent members are designated by the same numerals.

In the drawing:

FIGURE 1 is an overall elevational view, for the most part in vertical section with related parts in diagrammatic form, showing one example of practice of the invention;

FIGURE 2 is a relatively enlarged elevational view, parts broken away, showing an essential part of the device shown in FIGURE 1; and

FIGURE 3 is an elevational view, wtih part in vertical section, of a modification of the device shown in FIG. 1.

In the drawing, like parts are designated by like reference numerals.

Detailed description of the invention

Referring to FIGURE 1, the device shown therein is supplied with a sliver **4** by delivery rolls **1** and **2** of known type which feed the sliver **4** therebetween in a simple manner, or as they draft the arriving rove **25**. The sliver **4** thus fed is drawn into the upper inlet mouth **3** of a induction tube **3***b* of known type by a sucking or drawing force arising from centrifugal force acting on the air within a hollow rotary cylinder **6** described hereinafter, said tube **3** being supported by a supporting arm **3***a* and the centrifugal force being due to the rotation of the rotary cylinder, or by compressed air force. This compressed air force can be produced, for example, as illustrated in FIG. 3, in which the sliver inlet mouth **3** is surrounded by an induction tube **3***b* and a compressed air is supplied through an inlet tube **26** into the gap between said mouth **3** and tube **3***b*, thereby to blow down the compressed air along the lower end of said mouth **3**. Due to the force of the compressed air introduced from the inlet tube **26**, the sliver **4** is sucked downward out of the inlet mouth **3**. Upon suction of the sliver out of the inlet mouth, this sucked sliver is forcibly pressed by the compressed air

and single fibers of the sliver are drawn and separated from the sliver by the compressed air upon a parting of tail ends of said fibers from the nip point between the rolls **1** and **2** and then introduced into the rotary cylinder.

The rotary cylinder **6** is supported by any suitable means permitting free rotation about its axis and can be driven by any suitable means in a specified direction at a specified rotational speed. For example, the rotary cylinder **6** is provided at its neck part or some other part with a cylindrical rolling contact surface **7** to be pressed against rotatable pulleys **8**, **8***a* and is driven by a belt **9** running in the tangential direction. At the same time a rim **10** at the upper edge of the rolling contact surface **7** rests on and rolls along the upper edge **11** of the pulley **8**, and rotary cylinder **6** is thereby supported against its weight.

Alternatively, the rotary cylinder **6** can be driven by another means such as suitable means to rotate the pulleys **8**, **8***a* which is caused to contact the rotary cylinder **6** and drive the same by friction.

An important feature of the invention is the provision of a method and device wherein, a helical coil of a wire-like member **12** of a suitable cross section is disposed within the rotary cylinder **6** so that it can be rotated in a slidable manner with respect to the inner wall surface **23** of the rotary cylinder **6** in the same direction but with a specific difference in rotational speed. By the resulting cooperative action of the inner wall surface **23** and the coil of wire-like member **12**, the fibres **5** supplied into the rotary cylinder **6** as described hereinabove are positively conveyed in the spinning direction as they are caused to rotate together with the rotary cylinder **6**.

More specifically, the coil or wire-like member **12** is fixed at its upper end to a flange **24** at the lower end of a hollow spindle **13** which is coaxially and rotatably supported on bearings **14** and **15** provided in the interior of the rotary cylinder **6** at the head part thereof. The hollow spindle **13** is provided at its upper part with a wharve **16** which can be driven by any of several driving means. For example, the wharve **16** can be driven by a belt **17** driven by a driving means (not shown) and moving in a direction at a specified speed. Alternatively, similarly as in the case of the rotary cylinder **6** as described above, the wharve **16** can be driven by friction by a pulley (not shown) pressed in contact with the surface of the wharve. In this manner, the coil of wire-like member **12** coupled to the wharve **16** by way of the hollow spindle **13** is caused to undergo sliding rotation relative to the inner wall surface **23** of the rotary cylinder **6** in the same direction as the surface **23** but with a specific difference in rotational speed relative thereto.

The tail end of the rotary cylinder **6** has a frusto-conical constriction with an outer surface **6***a*, which is surrounded by a cowling **19** of frusto-conical form with a specific annular space **18** interposed therebetween, the upper end of the cowling being closed, and the lower end thereof extending downward beyond the lower end of the surface **6***a*. The cowling **19** is provided at its upper part with an air inlet **20** for supplying air into the space **18** to be discharged along the surface **6***a* toward the tail end of the cylinder **6**.

The above described cowling **19** and air inlet **20** are not indispensible members of the present invention and provided for purposes such as increasing the drawing-out force on the fibres in the rotary cylinder **6** and imparting further guidance in the spinning direction to the fibres being conveyed through the rotary cylinder **6**, the necessity of this provision depending on and varying with the length of rotary cylinder or kind of fibres being spun. That is, the flow of air through the space **18** has a function similar to that of a fluid ejector to cause the air within the rotary cylinder **6** to be drawn out through the tail end opening thereof and, at the same, assists the conveying action, described hereinafter, of conveying the fibres within the rotary cylinder in their spinning direction, i.e., toward draw-out rolls **21** and **22**.

The inner wall surface **23** of the rotary cylinder **6** is made rough or provided with a large number of grooves (not shown) in a direction such as the longitudinal direction or an oblique direction thereby to prevent the fibres **5** rotating in pressed state against the surface **23** from slipping in the circumferential direction relative thereto and to cause the fibres **5** to rotate as much as possible together with the inner wall surface **23** at the same speed.

By the above described organisation and movement of parts wherein the rotary cylinder **6** and the coil of wire-like member **12** rotate with differential speed, the fibres **5** led into the rotary cylinder **6** through the induction tube **3***b* as described hereinbefore are caused to open and spread toward the inner wall surface of the rotary cylinder by centrifugal force due to the rotation thereof. At the same time, as the fibres are thus opened and spread, parts thereof are respectively caused to straddle the individual turns **12***a*, **12***b*, **12***c* etc., of the helical coil of wire-like member **12** as shown at **5***a* in FIG. 2. The remainder parts of the fibres are pressed against the exposed parts of the inner wall surface **23** of the rotary cylinder between the turns of the helical coil.

Consequently, the fibres **5** are caused to rotate as they are supported in a waveform state **5***a* along an undulating profile defined by the inner wall surface and the coil. For this reason, the fibres rotate together with the rotary cylinder **6**, and, simultaneously, a continuous slippage occurs between the fibres and the turns **12***a*, **12***b*, **12***c*, etc., of the helical coil rotating with a specific differential speed. At the same time, moreover, the coil produces a screw action whereby the fibres are conveyed progressively in the spinning direction, that is, toward the tail open end of the rotary cylinder **6**.

Thus, the present invention provides a method and device for rotary conveyance of fibres which affords a remarkable advancement relative to spinning techniques in open-end spinning known in the prior art.

In terms of the rotational speed N_1 (per minute) of the rotary cylinder **6**, the pitch P of the helical coil of wire-like member **12**, and the rotational speed N_2 (per minute) of the coil, the speed S with which the fibres are conveyed in their spinning direction can be expressed by $S=P(N_1-N_2)$ or $S=P(N_2-N_1)$.

Therefore, the fibres are all conveyed toward the tail end of the rotary cylinder **6** along the inner wall surface thereof at a speed of S. When these fibres are drawn out by the rolls **21** and **22** at the same speed S, no draft is produced between the fibres sliding past the inner wall surface of the rotary cylinder **6** and the fibres thus drawn out. On the other hand, if the drawing out speed of the rolls **21** and **22** is increased to a value n times the above mentioned conveying speed S, a draft of n times can be obtained.

The above described conveying function with respect to the fibres and the draft are, of course, interrelated and are respectively indispensible factors in the spinning of good yarn. For example, even in instances such as the starting of spinning operation or restarting after a yarn break, there is no possibility of fibres remaining stagnant in the rotary cylinder **6**. Furthermore, a specific degree of rubbing occurs between the fibres being conveyed and the fibres connected to the yarn being drawn out, and the resulting friction produces not only desirable effects such as mutual stretching or extension but also the effect whereby the fibres are successively drawn into and join, in an orderly manner, the fibres being spun.

A further important feature of the invention is that, since every fibre is automatically conveyed toward the outlet end of the rotary cylinder **6**, the outlet end is constricted in a frusto-conical form, whereby it is possible to draw out the fibres as a sheaf. This feature is highly advantageous in that it produces effects such as a contraction in the rotating radius of the fibres leaving the outlet

end of the rotary cylinder, whereby the air resistance with respect to the fibres is reduced, and, moreover, facilitation of the leading of the fibres to the draw-out rolls **21** and **22** at the time of starting of spinning. These effects, as a natural consequence, make possible the spinning of yarn of high quality and, at the same time, have the effect of increasing the spinning efficiency.

The present invention is not limited to the organisation of the example device as illustrated in the accompanying drawing, various modifications being possible within the intended purview of the invention. For example, modifications can be made in the means for supporting and means for driving the rotary cylinder **6** and the coil of wire-like member **12**, in the shape of the rotary cylinder **6** (e.g., to that of an hour glass), in the cross sectional shape of the wire-like member **12** (e.g., to a rectangular shape, half circular shape, and others), in the surface state of the wire-like member **12** (e.g., to a surface composed of a synthetic resin covering the wire), and in the configuration of or omission of the grooves in the inner wall surface of the rotary cylinder **6**.

Such changes and modifications may be made for the purpose of adapting the invention to variables such as the kind and characteristics of the fibres to be spun and to factors in the design of the device and do not constitute alterations in the fundamental nature and purport of the present invention.

What I claim is:

1. A method for rotary conveying of fibers which comprises: introducing said fibers into a hollow rotary cylinder the axial direction, said cylinder rotating at a specific speed and containing coaxially therein a helical coil of a wire-like member rotating in the same direction as the cylinder but with a speed difference relative to the inner wall surface of the cylinder; permitting the fibers thus introduced to be caused by centrifugal force to open dispersively toward said inner wall surface and to straddle and press against said coil and parts of the inner wall surface exposed between said turns of the coil; and thereby causing the individual fibers to rotate together with the inner wall surface and, at the same time, to be positively conveyed toward the tail open end of the rotary cylinder by relative screw action of the coil due to said speed difference.

2. A device for rotary conveying of fibers comprising:

a hollow rotary cylinder (**6**) rotatably supported;

means (**8, 8a, 11**) for supporting and driving said cylinder;

a helical coil (**12**) of a wire-like member rotatably and coaxially supported within the rotary cylinder;

means (**13, 16**) for driving said coil in the same direction as the rotary cylinder but with a speed difference relative to the inner wall surface of the cylinder; and

induction means (**3**) for introducing said fibers into the center of the coil and cylinder,

the fibers thus introduced being caused by centrifugal force to open dispersively toward said inner wall surface and to straddle and press against the coil and parts of the inner wall surface exposed between said turns of the coil,

the individual fibers thereby being caused to rotate together with inner wall surface and, at the same time, to be positively conveyed toward the tail open end of the rotary cylinder by relative screw action of the coil due to said speed difference.

3. The device for rotary conveying of fibers as claimed in claim **2** in which said tail open end is constricted and is surrounded around its outer surface (**6a**) by a cowling structure (**19**) forming an annular space (**18**) therebetween and having a constricted opening substantially coaxial with said tail open end of the hollow rotary cylinder, said cowling structure having an air inlet (**20**) for supply of air through said annular space and past said tail open end of the cylinder and thereby operating as a fluid ejector to draw out air through the rotary cylinder in the spinning direction for drawing out the fibers.

4. The device for rotary conveying of fibers as claimed in claim **3** in which said means for driving said coil comprises a hollow spindle (**13**) fixedly supporting the coil and rotatably supported through bearing (**14, 15**) by the inner side of the hollow rotary cylinder and driving wharve (**16**) for driving said hollow spindle.

5. The device for rotary conveying of fibers as claimed in claim **2** in which said means for driving said coil comprises a hollow spindle (**13**) fixedly supporting the coil and rotatably supported through bearings (**14, 15**) by the inner side of the rotary cylinder and driving means (**16**) for driving said hollow spindle.

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JOHN PETRAKES, *Primary Examiner.*