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(54) **DEVICE FOR HANDLING A YARN END AT A SPINNING UNIT OF A RING SPINNING MACHINE, A METHOD FOR HANDLING THE YARN END AND A RING SPINNING MACHINE**

(57) The invention relates to a yarn end (40) handling device at a spinning station of a ring spinning machine for detecting a yarn end (40) on a bobbin, which comprises a suction tube (9) with a suction mouth (90) assignable to a spinning station, the suction tube (9) is connected to a vacuum source, whereby the suction tube (9) is mounted on a positioning system for guiding the mouth (90) of the suction tube (9) to a drafting arrangement of the spinning station for the resumption of the spinning

process. The positioning system includes a supporting part (5), which is mounted reversibly linearly slidably on a vertical guide (6); a horizontal arm (7), which is mounted reversibly swingingly (swivelly) about the vertical axis (R) on the supporting part (5), whereby the suction tube (9) is mounted reversibly linearly slidably in the horizontal direction (C+, C-) on the horizontal arm (7). The invention further relates to a method for handling a yarn end (40) and it also relates to a ring spinning machine.

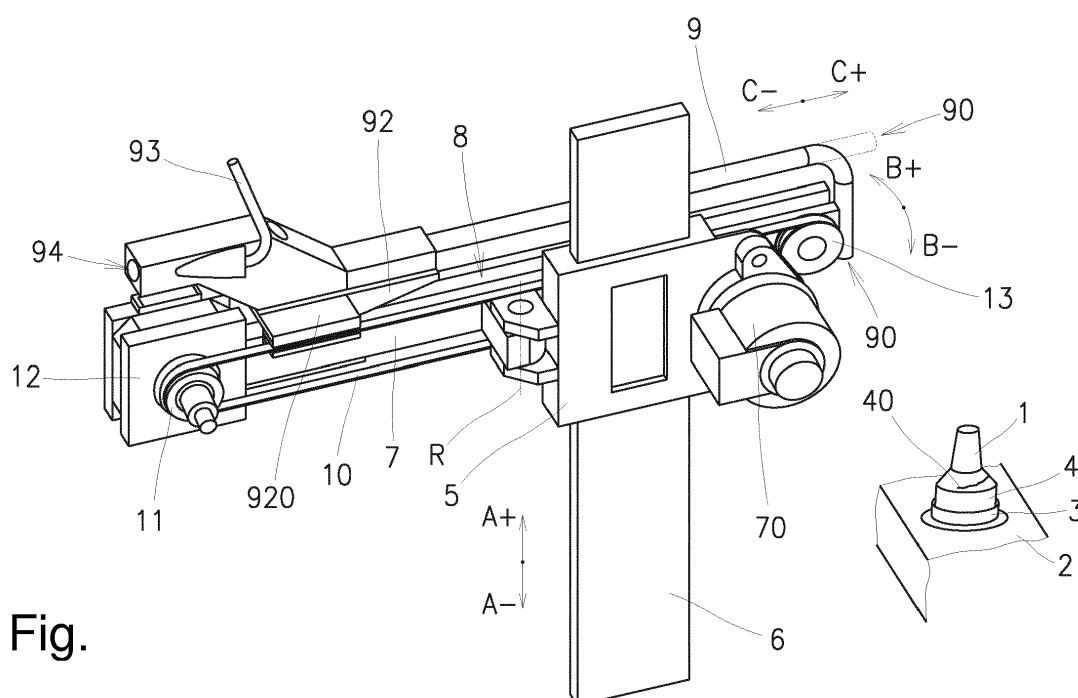


Fig.

Description

Field of the invention

[0001] The invention relates to a yarn end handling device at a spinning station of a ring spinning machine for detecting a yarn end on a bobbin, which comprises a suction tube with a suction mouth assignable to the spinning station, the suction tube being connected to a vacuum source, whereby the suction tube is mounted on a positioning system for guiding the mouth of the suction tube to a drafting arrangement of the spinning station for the resumption of the spinning process.

[0002] The invention also relates to a method for handling a yarn end by the device according to the invention at a spinning station of a ring spinning machine after finding the yarn end on the bobbin and sucking the yarn end into the mouth of the suction tube, in which the mouth of the suction tube guides the yarn end back to the drafting arrangement of the spinning station for the resumption of the spinning process.

[0003] In addition, the invention relates to a ring spinning machine comprising a row of spinning stations, each of which has a drafting arrangement, and the machine comprises a service robot arranged reversibly displaceably along the row of spinning stations, whereby the service robot is provided with the yarn end handling device according to the invention.

Description of related art

[0004] Ring spinning machines comprise a row of spinning stations arranged next to each other, each of which comprises a roving drafting arrangement, from which the processed roving is carried to a twisting device, from which the produced yarn is withdrawn and wound in a winding device to form a package on a tube placed on a rotatable spindle, thereby forming a bobbin, or, in other words, cop, i.e., a tube with a yarn package. If the yarn production is interrupted, e.g., owing to a yarn break, it is necessary to resume yarn production at a given spinning station. During the renewal of the spinning process at the spinning station, where, after the interruption of spinning, roving feed rollers of the drafting arrangement are stopped, or the drafting arrangement is working and the fibers from the roving are sucked into waste, etc., also the motion of a traveller on a flange of a ring is terminated, which is usually recorded by a sensor of the traveler motion. Subsequently, it is necessary to find the yarn end being wound on the package on the bobbin, unwind the yarn from the package, thread it through the traveler, a balloon limiter and a guide eyelet and finally bring the yarn end back between the end rollers of the roving drafting arrangement in such a manner that during the spinning resumption the yarn end is joined to the end of the roving and the spinning station is thereby prepared for the renewal of the yarn production. All these service operations are performed during permanent reversible

vertical motion of a ring bench and a balloon limiter carrier, because the other spinning stations continue to produce the yarn. Various handling devices are used for handling a yarn end from the moment of finding the yarn end on a package on a bobbin till the moment of passing it to the means of the spinning station, such as the handling devices according to EP391110 or according to US3,540,200 and others. By their very nature, these are yarn end handling devices performing general motion in space.

[0005] There is very little space at a spinning station of a ring spinning machine, because the spacing between the spinning stations is, e.g., only 70 or 75 mm, and so the requirements in terms of the dimensions and movability put considerable limitations on the handling devices. Moreover, great demands for reliability and simplicity are placed on the handling device.

Brief summary of the invention

[0006] It is the aim of the invention to provide a simple and efficient, lightweight and reliable device for handling a yarn end at a spinning station of a ring spinning machine after finding the yarn end on a bobbin.

[0007] The aim of the invention is achieved by a yarn end handling device at a spinning station of a ring spinning machine according to the preamble of the corresponding independent device claim, which characterized in a supporting part, which is linear displaceably mounted on a vertical guide and a horizontal arm, which is mounted swivelly about a vertical axis on the supporting part, wherein the suction tube is mounted on the horizontal arm and linear displaceably in a horizontal direction.

[0008] Preferably, the supporting part is coupled to a drive for vertical linear motion, which is formed by a rotary stepper motor.

[0009] Preferably, the horizontal arm is by its central part mounted on the supporting portion.

[0010] Preferably, the horizontal arm is coupled to a drive mounted on the supporting part.

[0011] Preferably, the drive of the horizontal arm is formed by a linear stepper motor or by rotary stepper motor with conversion of rotary motion into linear motion.

[0012] Preferably, the suction tube is in a rear part remote from mouth provided with a guide element, which is mounted slidably on a linear guide on the horizontal arm, and which is coupled to a drive for the linear motion of the suction tube in horizontal direction.

[0013] Preferably, the guide element is provided with a lateral carrier, which is fixed to one branch of a toothed belt, the belt is situated at a lateral side of the horizontal arm and at the rear end of the horizontal arm is wrapped around a driven gear pulley, which is mounted on an output shaft of the rotary drive, whereby at the front end of the horizontal arm the toothed belt is wrapped around a freely rotatable gear pulley.

[0014] Preferably, the drive of the linear horizontal motion of the suction pipe is formed by a rotary stepper mo-

tor.

[0015] Preferably, the suction tube is in a rear part connected to a suction inlet of an ejector, the ejector is connected to a source of compressed air.

[0016] Preferably, in the suction tube is arranged a mechanical yarn gripping device coupled to a drive and control and/or in the suction tube is arranged an yarn cutting device coupled to a drive and control.

[0017] The aim of the invention is achieved by a method for handling a yarn end at a spinning station of a ring spinning machine according to the preamble of the corresponding independent method claim, characterized in that the mouth of the suction tube is moved by a vertical linear movement, a horizontal linear movement or a swiveling about the vertical axis in a horizontal plane, simultaneously with all three movements or simultaneously with at least two movements and subsequently the remaining movement or successively with individual movements of any of the three movements.

[0018] Preferably, during the movement of the mouth of the suction tube, the yarn end is sucked into the suction tube.

[0019] Preferably, the yarn end is guided back to the drafting arrangement and the yarn is cut in the suction pipe by yarn cutting device.

[0020] Preferably, after the yarn end is guided back to the drafting arrangement, the suction tube is brought back to a resting position.

[0021] The principle of a ring spinning machine comprising a row of spinning stations, each of which has a drafting arrangement, and the service robot is arranged reversibly displaceably along the row of spinning stations, consists in that the service robot is provided with the yarn end handling device according to the invention.

[0022] The device moves in simple motions so that it is easily controllable in the space and it is possible to carry out all positioning and motion operations replacing the human hand when guiding the yarn into the working path at the spinning station for the resumption of spinning, whereby these operations include threading the yarn end into a traveler on the ring flange, threading the yarn end into all the elements at the spinning station, while avoiding contact with the other mechanisms of the spinning station, as well as of the service robot and, finally, guiding the yarn end to the drafting arrangement and the resulting resumption of the spinning process. The simple layout ensures a sufficient speed of motion, durability of individual system components, and good operating times. Last but not least, the low weight, which is made possible by simple construction using electronic and pneumatic elements, is also advantageous.

Brief description of the drawings

[0023] The invention is schematically represented in the drawing, wherein the only Fig. shows an arrangement of a yarn end handling device at a spinning station of a ring spinning machine.

Detailed Description of the invention

[0024] The invention will be described with reference to an exemplary embodiment of a yarn end handling device at a spinning station (also understood as a spinning unit) of a ring spinning machine.

[0025] The ring spinning machine comprises a row of identical spinning stations arranged next to each other. On principle, the spinning station is well-known and therefore the entire spinning station will only be described hereinafter in a simplified manner. Those parts, elements and nodes of the spinning station that are of significance to the present invention will be described in greater detail. The spinning station comprises an unillustrated roving drafting arrangement, below which a yarn twisting and winding device is arranged. The roving is fed from an unillustrated supply package to the drafting arrangement, behind which the yarn being formed passes through a guide eyelet, a balloon limiter and then through a traveler which circulates around the circumference of a flange of a ring 3 which is mounted in a holder on a ring bench 2. After the passage through the traveler, the produced yarn is wound on a package 4 on a tube 1, thus forming a bobbin or cop, which is placed on a vertical spindle, which rotates about its vertical longitudinal axis. The yarn package on the tube 1 forms a bobbin, whereby the package 4 on the tube 1 is formed by a continuous reversible vertical linear motion of the ring bench 2 in the interaction with the yarn winding device after the passage of the yarn through the traveler (not shown), which circulates around the bobbin 1 on the flange of the ring 3, whereby due to the traveler being delayed behind the revolutions of the spindle, a twist is created on the yarn, thereby changing the processed roving into the yarn of the desired properties wound on the bobbin. The spindle is usually driven in its lower portion by means of a flat belt driven by a drive shaft.

[0026] A service robot is displaceably arranged along the row of spinning stations. The service robot comprises mechanisms and means for performing individual service operations at the spinning station or for performing at least some of the service operations at the spinning station, where the service operations serve to put the spinning station into operation to produce yarn. The service robot is capable of stopping at a selected spinning station.

[0027] One of these service operations is handling the yarn end after it has been detected on the bobbin or on the package 4 on the tube 1, by means of an unillustrated detecting device.

[0028] For the purposes of handling the yarn end at the spinning station, the service robot is provided with a yarn end handling device at a spinning station of a ring spinning machine.

[0029] The operation of detecting the yarn end as such is performed in a suitable manner and using suitable means, for example after removing the bobbin from the spinning station and after transferring the bobbin to a yarn end searching position by the device for detecting

the yarn end 40 on the bobbin.

[0030] After finding the yarn end 40 on the bobbin, the yarn end detecting device is approached by the mouth 90 of the suction tube 9, which is part of the yarn end 40 handling device and which sucks the detected yarn end 40 from the detecting device into its inner space, thereby taking over this yarn end 40.

[0031] The yarn end 40 handling device then handles the yarn end 40 in the space relative to the individual means of the spinning station, as well as relative to the individual means of the service robot depending on the sequence of the service operations, such as threading the yarn end 40 into the traveler, threading the yarn end 40 into the balloon limiter, threading the yarn end 40 into the guide eyelet of yarn above the bobbin and bringing the yarn end 40 between the end rollers of the roving drafting arrangement such that during the resumption of the spinning process the yarn end 40 is joined to the end of the roving, by which means the yarn production is resumed.

[0032] The device for the above-described handling the yarn end 40 relative to the spinning station, as well as relative to the means of the service robot is provided with a supporting part 5, which is mounted reversibly vertically linearly displaceably in the direction A+ and A- on the vertical linear guide 6 on the service robot of a ring spinning machine. The supporting part 5 is coupled to an unillustrated drive of its reversible vertical linear motion. This unillustrated drive of the supporting part 5 consists of a rotary or linear drive, which is coupled to a control device, ideally it consists of a rotary stepper motor. By means of this drive, the supporting part 5 is controllably reversibly vertically linearly positionable on the vertical linear guide 6.

[0033] A horizontal arm 7 is mounted reversibly swinging about the vertical axis R on the supporting part 5. The horizontal arm 7 is reversibly swinging in a horizontal plane in the direction B+ and B-. The horizontal arm 7 is mounted reversibly swinging in a horizontal plane on the supporting part 5 in its central portion for moment balancing. The reversibly swinging motion of the horizontal arm 7 in a horizontal plane is controlled by a drive 70 mounted primarily due to dynamic forces and acceleration on the supporting part 5, whereby the movable part of the drive 70 is coupled to the horizontal arm 7. The drive 70 of the reversibly swinging motion of the horizontal arm 7 is preferably formed by a stepper motor or consists of a rotary stepper motor with conversion of rotary motion into linear motion.

[0034] On the horizontal arm 7, a linear guide 8 is arranged in the direction of the length of the horizontal arm 7, on which a suction tube 9 connected to a vacuum source is mounted reversibly slidably in the horizontal direction C + and C-, i.e. in the direction of the length of the horizontal arm 7. The suction tube 9 is thus mounted on the positioning system and is controllably assignable by its mouth 90 to the spinning station of the ring spinning machine, to the individual means of the spinning station

during the handling of the yarn end 40 sucked by the suction mouth 90 into the suction tube 9 when the yarn end 40 is returned to the drafting arrangement of the spinning station and it is also controllably positionable relative to the other elements of the service device, such as the yarn end 40 detecting device, etc. The mouth 90 of the suction tube 9 is either straight, as shown by the dashed line in the drawing, or bent, as shown in solid line in the drawing, or otherwise suitably shaped according to the arrangement of the spinning station and other cooperating elements.

[0035] The suction tube 9 is coupled to the drive of its reversible horizontal linear motion on the linear guide 8 on the horizontal arm 7.

[0036] In the exemplary embodiment shown, the suction tube 9 is in its rear part, i.e., in the region of the connection to the vacuum source, provided with a guide element 92, by means of which it is reversibly horizontally linearly slidably mounted on the horizontal arm 7. The guide element 92 is provided with a side carrier 920, which is fixedly connected to one branch of the toothed belt 10. The toothed belt 10 is at the rear end of the horizontal arm 7 wrapped around the driven toothed pulley 11, which is mounted on the output shaft of the rotary drive, ideally a rotary stepper motor 12. At the front end of the horizontal arm 7 the toothed belt 10 is wrapped around a freely rotatable toothed pulley 13. As the side carrier 920 of the guide element 92 of the suction tube 9 is connected to one branch of the toothed belt 10, rotation of the reversibly slidable drive of the suction tube 9 results in the reversible horizontal linear motion of the suction tube 9 in the direction C+ and C-.

[0037] If we introduce a rectangular coordinate system in the assembly of the service robot at a spinning machine of a ring spinning machine, where the axis X is the direction perpendicular to the row of spinning stations, i.e., the direction from the service robot to the spinning station, the axis Y is the direction along the row of spinning stations, i.e., the direction of the motion of the service device along the row of spinning stations, and the axis Z is the direction of the height of the spinning machine, of the spinning station or of the spinning stations, then the supporting part 5 is reversibly linearly slidable in the axis Z, the horizontal arm 7 is reversibly swinging about the vertical axis R in a horizontal plane which is movable in the direction of the axis Y, and the suction tube 9 is reversibly horizontally linearly slidably in the direction of the axis X.

[0038] The vacuum source of the suction tube 9 is in the illustrated example of embodiment an ejector (not shown), which is, for example, mounted on a guide element 92, whereby the ejector is connected via a conduit 93 to a source of compressed air and the ejector suction port is connected to the rear end of the suction tube 9. Consequently, the air sucked in by ejector suction port due to the compressed air from the conduit 93 is sucked in by the mouth 90 of the suction tube 9 and is blown out by the outlet opening 94 behind the ejector. The outlet opening 94 behind the ejector is, for example, connected

to the waste space to prevent the waste sucked in by the suction tube 9 from being dispersed into the surroundings of the machine.

[0039] In an unillustrated example of embodiment, the suction tube 9 is connected by a suitable hose or tube to an external vacuum source, etc.

[0040] In the inner space of the suction tube 9, at an appropriate distance from the mouth 90 of the suction tube 9, is arranged an unillustrated mechanical yarn clamp for the intentional capturing of the yarn for the purposes of performing appropriate handling steps with the yarn to avoid, for example, untwisting due to the suction, etc. The clamp is connected to a drive and a control.

[0041] Furthermore, in the inner space of the suction tube 9, at an appropriate distance from the mouth 90 of the suction tube 9 is arranged an unillustrated yarn splitting device, which serves to divide the yarn end sucked in the waste into shorter length sections, and possibly also serves to separate the end portion of the yarn end damaged by, for example, being untwisted due to the suction, or otherwise damaged, from the undamaged portion of the yarn end for later resumption of the spinning process. The yarn splitting device is connected to a drive and a control.

[0042] Preferably, both the clamp and the yarn splitting device are driven by compressed air, therefore they are connected to a source of compressed air, which allows to further reduce the weight of the entire assembly.

[0043] The device works in such a manner that if need arises to handle the yarn end 40, the mouth 90 of the suction tube 9 by carrying out a set of consecutive or at least two simultaneous separate motions moves the yarn end 40 of the yarn sucked in the suction tube 9 relative to the spinning station and to the other means of the service robot, performing the desired trajectory at the desired times, speeds, etc. The spatial motion of the suction pipe 9, particularly with respect to the instantaneous spatial positions of the mouth 90 of the suction pipe 9, is controlled by not shown control device to which the individual drives of the device are coupled. The control device is provided with means for controlling the direction, speed, acceleration, etc., of the individual drives. For better control, the device is provided with position sensors for individual movable elements, such as position sensors for individual drives. During the above-described handling, the yarn end 40 at the spinning station of a ring spinning machine after finding the yarn end 40 on the bobbin and after sucking the yarn end 40 into the mouth 90 of the suction tube 9, the mouth 90 of the suction tube 9 is moved in the space of the spinning station and in the space of the service robot to gradually guide the yarn end 40 back into the working path at the spinning station of a ring spinning machine and resume the spinning process. The mouth 90 of the suction tube 9 is moved by reversible vertical linear motion, reversible horizontal linear motion and reversible swinging motion in a horizontal plane, whereby all the three motions are carried out simultaneously, or at least two motions simultaneously and

subsequently the remaining motion are carried out, or the mouth is moved in successive individual motions, which results in complex 3-D motion of the mouth 90 of the suction tube 9 relative to the individual elements of the spinning station as well as to the individual elements of the service robot. At the same time, during the motion of the mouth 90 of the suction tube 9, the yarn end 40 is acted upon by the suction of the suction tube 9 and after guiding the yarn end 40 to the drafting arrangement, the yarn end 40 in the suction tube 9 is separated by the splitting device and sucked off. Next, after guiding the yarn end 40 to the drafting arrangement, the suction tube 9 returns to its initial resting position and the entire positioning device also returns to its initial position outside the spinning station. To avoid unwanted contact between the elements of the handling device according to the invention and the other elements of the spinning station or of the service station, which may also be moving or standing, and also to avoid unwanted contact between the yarn tightened during the motion of the mouth 90 of the suction tube 9 between the suction tube 9 and the package on the bobbin 1 and, optionally, or also through other means of the spinning station, active obstacle-avoidance and positioning motions of the mouth 90 of the suction tube 9 are carried out during the motion of the suction tube 9.

Reference numbers

[0044]

1	Tube
2	Ring bench
3	Ring
4	Package
40	Yarn end
5	Supporting part
6	Vertical linear guide
7	Horizontal arm
70	Drive
8	Linear Guide
9	Suction tube
90	Mouth
92	Guide element
920	Lateral carrier
93	Source
94	Outlet
10	Toothed belt
11	Gear pulley
12	Stepper motor
13	Gear pulley
R	Vertical Axis
A ⁺ -A ⁻	Movement of guide 6
B ⁺ -B ⁻	Movement
C ⁺ -C ⁻	Movement of arm 7

Claims

1. A device for handling a yarn end at a spinning unit of a ring spinning machine after searching the yarn end on a bobbin, the device comprises a suction pipe (9) with suction mouth (90) assignable to spinning unit, the tube (9) is connected to a source of vacuum, wherein the suction tube (9) is mounted on a positioning system in order to guide the mouth (90) of the suction tube (9) to a drafting arrangement of the spinning unit for resuming the spinning process, said positioning system is **characterized in** a supporting part (5), which is linear displaceably mounted on a vertical guide (6) and a horizontal arm (7), which is mounted swivelly about a vertical axis (R) on the supporting part (5), wherein the suction tube (9) is mounted on the horizontal arm (7) and linear displaceably in a horizontal direction (C⁺-C⁻).
 2. The device for handling a yarn end according to claim 1, **characterized in that** the supporting part (5) is coupled to a drive for vertical linear motion, which is formed by a rotary stepper motor.
 3. The device for handling a yarn end according to claim 1 or 2, **characterized in that** the horizontal arm (7) is by its central part mounted on the supporting portion (5).
 4. The device for handling a yarn end according to any one of claims 1 to 3, **characterized in that** the horizontal arm (7) is coupled to a drive (70) mounted on the supporting part (5).
 5. The device for handling a yarn end according to claim 4, **characterized in that** the drive (70) of the horizontal arm (7) is formed by a linear stepper motor or by rotary stepper motor with conversion of rotary motion into linear motion.
 6. The device for handling a yarn end according to any one of claims 1 to 5, **characterized in that** the suction tube (9) is in a rear part remote from mouth (90) provided with a guide element (92), which is mounted slidably on a linear guide (8) on the horizontal arm (7), and which is coupled to a drive (12) for the linear motion of the suction tube (9) in horizontal direction.
 7. The device for handling a yarn end according to claim 6, **characterized in that** the guide element (92) is provided with a lateral carrier (920), which is fixed to one branch of a toothed belt (10), the belt (10) is situated at a lateral side of the horizontal arm (7) and at the rear end of the horizontal arm (7) is wrapped around a driven gear pulley (11), which is mounted on an output shaft of the rotary drive (12), whereby at the front end of the horizontal arm (7) the toothed belt (10) is wrapped around a freely rotatable gear pulley (13).
 8. The device for handling a yarn end according to claim 6 or 7, **characterized in that** the drive (12) of the linear horizontal motion of the suction pipe (9) is formed by a rotary stepper motor.
 9. The device for handling a yarn end according to any one of claims 1 to 8, **characterized in that** the suction tube (9) is in a rear part connected to a suction inlet of an ejector, the ejector is connected to a source (93) of compressed air.
 10. The device for handling a yarn end according to any one of claims 1 to 9, **characterized in that** in the suction tube (9) is arranged a mechanical yarn gripping device coupled to a drive and control and/or in the suction tube (9) is arranged a yarn cutting device coupled to a drive and control.
 11. A ring spinning machine containing a row of spinning units, each having a drafting arrangement and a service robot arranged reversibly movable along the row of spinning units, the service robot is provided with a device for handling the yarn end according to any one of claims 1 to 10.
 12. A method of handling a yarn end with a device according to any one of claims 1 to 10 at the spinning unit of ring spinning machine after searching the yarn end on a bobbin and sucking the yarn end into a mouth (90) of a suction pipe (9), wherein the mouth (90) of the suction tube (9) guides the yarn end back to a drafting arrangement of the spinning unit for resuming the spinning process, **characterized in that** the mouth (90) of the suction tube (9) is moved by a vertical linear movement (C⁺-C⁻), a horizontal linear movement (A⁺-A⁻) or a swiveling about the vertical axis (R) in a horizontal plane (B⁺-B⁻), simultaneously with all three movements or simultaneously with at least two movements and subsequently the remaining movement or successively with individual movements of any of the three movements.
 13. The method according to claim 12, **characterized in that** during the movement of the mouth (90) of the suction tube (9), the yarn end is sucked into the suction tube (9).
 14. The method according to claim 12 or 13, **characterized in that** after the yarn end is guided back to the drafting arrangement, the yarn is cut in the suction pipe (9) by yarn cutting device.
 15. The method according to any of claims 12 to 14, **characterized in that** after the yarn end is guided

back to the drafting arrangement, the suction tube (9) is brought back to a resting position.

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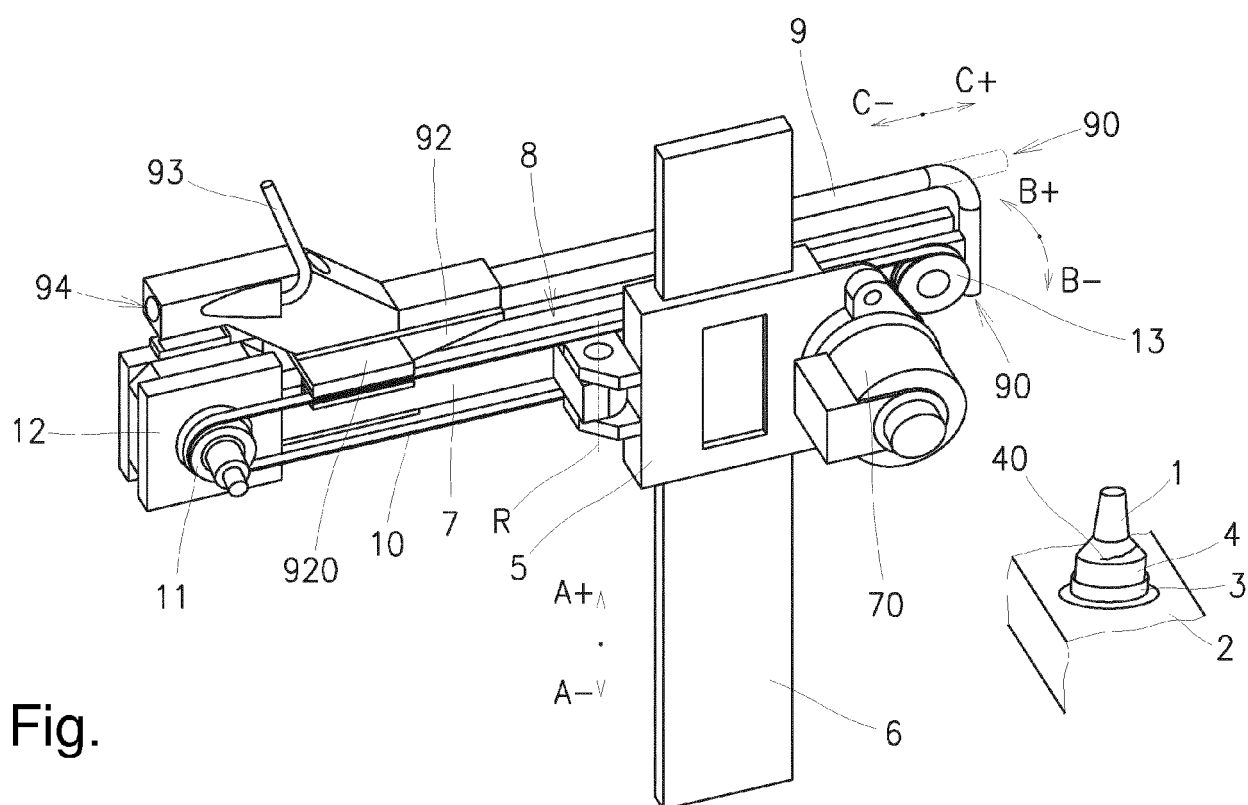
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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 2787

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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