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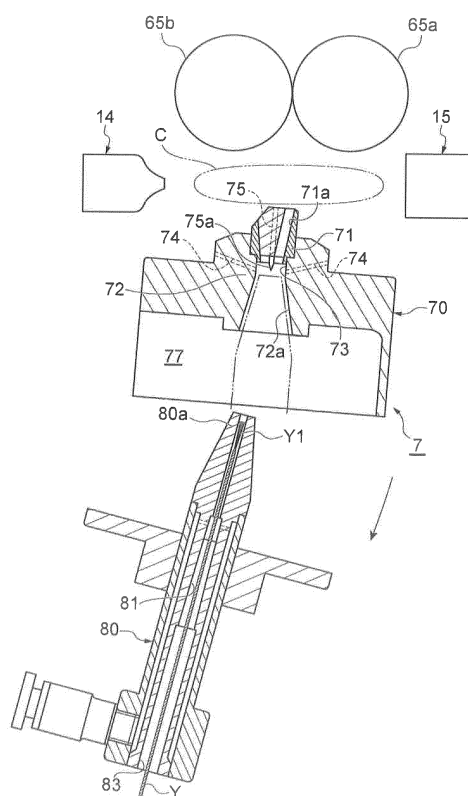
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(54) **SPINNING MACHINE AND SPINNING METHOD**

(57) A spinning unit 2 includes a draft device 6 adapted to draft a fiber bundle F and a pneumatic spinning device 7 arranged movable to a spinning position and a retracted position and adapted to produce a yarn Y by applying twists to the drafted fiber bundle F by injecting whirling flow of air to a spinning chamber while being located at the spinning position. In the spinning unit 2, at least one of a first timing, which is a timing at which injection of the air is stopped when a drafting operation of the draft device 6 is stopped, and a second timing, which is a timing at which the pneumatic spinning device 7 starts being moved from the spinning position to the retracted position when the drafting operation of the draft device 6 is stopped, is adjusted.

FIG. 5



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine and a spinning method.

2. Description of the Related Art

[0002] Conventionally, there is known a spinning machine including a draft device adapted to draft a fiber bundle and a pneumatic spinning device adapted to produce a yarn by applying twists to the drafted fiber bundle by injecting air to a spinning chamber while being located at a spinning position (see Japanese Patent Application Laid-open No. 2006-144136, for example). In such a spinning machine, for example, in a case where a yarn defect has been detected, when a drafting operation of the draft device is stopped, a fiber bundle portion to which twists have not been applied is formed at a yarn end of the yarn.

SUMMARY OF THE INVENTION

[0003] In the spinning machine as described above, for example, when accumulating the yarn in a yarn accumulating device using a yarn accumulating roller, if a length of the fiber bundle portion is excessively long, the fiber bundle portion may remain at the yarn accumulating roller. If the length of the fiber bundle portion is excessively short, a yarn end of the yarn from a winding device may not be reliably caught when performing a yarn joining operation.

[0004] An object of the present invention is to provide a spinning machine and a spinning method that are capable of adjusting the length of the fiber bundle portion to be formed at the yarn end of the yarn.

[0005] A spinning machine of the present invention includes a draft device adapted to draft a fiber bundle and a pneumatic spinning device arranged movable to a spinning position and a receded position, which is located further away from the draft device than the spinning position, and adapted to produce a yarn by applying twists to the drafted fiber bundle by injecting air to a spinning chamber while being located at the spinning position. At least one of a first timing, which is a timing at which injection of the air is stopped when a drafting operation of the draft device is stopped, and a second timing, which is a timing at which the pneumatic spinning device starts being moved from the spinning position to the receded position when the drafting operation of the draft device is stopped, is adjusted.

[0006] In the case where the drafting operation of the draft device has been stopped, when the injection of the air is stopped in the pneumatic spinning device, twists are not appropriately applied to a yarn end of the yarn in

the pneumatic spinning device, and a fiber bundle portion is formed at the yarn end of the yarn. Furthermore, in the case where the drafting operation of the draft device has been stopped, when the pneumatic spinning device starts being moved from the spinning position to the receded position, twists are not appropriately applied to the yarn end of the yarn in the pneumatic spinning device, and the fiber bundle portion is formed at the yarn end of the yarn. In the above-described spinning machine, since at least one of the first timing and the second timing is adjusted, a length of the fiber bundle portion to be formed at the yarn end of the yarn can be adjusted.

[0007] In the spinning machine of the present invention, at least one of the first timing and the second timing may be adjusted with a timing to stop the draft device as a reference. With this configuration, the length of the fiber bundle portion to be formed at the yarn end of the yarn can be easily and appropriately adjusted.

[0008] In the spinning machine of the present invention, the first timing may be adjusted such that the first timing is delayed when shortening a length of a fiber bundle portion to be formed at a yarn end of the yarn. With this configuration, the length of the fiber bundle portion to be formed at the yarn end of the yarn can be easily adjusted.

[0009] In the spinning machine of the present invention, the second timing may be set to be linked with the first timing. With this configuration, since an adjustment of the second timing is not required to be performed separately from an adjustment of the first timing, the length of the fiber bundle portion to be formed at the yarn end of the yarn can be easily adjusted.

[0010] In the spinning machine of the present invention, at least one of the first timing and the second timing may be adjusted such that the pneumatic spinning machine starts moving from the spinning position to the receded position after twists are applied to a yarn end of the yarn under a state in which the pneumatic spinning device is located at the spinning position. With this configuration, since twists are reliably applied to the yarn end of the yarn without being disturbed by the movement of the pneumatic spinning device from the spinning position to the receded position, the length of the fiber bundle portion to be formed at the yarn end of the yarn can be appropriately adjusted.

[0011] The spinning machine of the present invention may further include an injecting device adapted to inject air to a region between the draft device and the pneumatic spinning device. With this configuration, the fiber bundle can be disconnected by controlling the injecting device to inject the air. The length of the fiber bundle portion thus can be appropriately adjusted by adjusting a timing to inject the air from the injecting device.

[0012] The spinning machine of the present invention may further include a control section adapted to control an operation relating to an adjustment of at least one of the first timing and the second timing. With this configuration, the length of the fiber bundle portion can be au-

tomatically adjusted in accordance with a condition.

[0013] A spinning method of the present invention is executed in a spinning machine including a draft device adapted to draft a fiber bundle, and a pneumatic spinning device arranged movable to a spinning position and a receded position, which is located further away from the draft device than the spinning position, and adapted to produce a yarn by applying twists to the drafted fiber bundle by injecting air to a spinning chamber while being located at the spinning position. The spinning method includes adjusting at least one of a first timing, which is a timing at which injection of the air is stopped when a drafting operation of the draft device is stopped, and a second timing, which is a timing at which the pneumatic spinning device starts being moved from the spinning position to the receded position when the drafting operation of the draft device is stopped.

[0014] In the case where the drafting operation of the draft device has been stopped, when the injection of the air is stopped in the pneumatic spinning device, twists are not appropriately applied to a yarn end of the yarn in the pneumatic spinning device, and a fiber bundle portion is formed at the yarn end of the yarn. Furthermore, in the case where the drafting operation of the draft device has been stopped, when the pneumatic spinning device starts being moved from the spinning position to the receded position, twists are not appropriately applied to the yarn end of the yarn in the pneumatic spinning device, and the fiber bundle portion is formed at the yarn end of the yarn. In the above-described spinning method, since at least one of the first timing and the second timing is adjusted, a length of the fiber bundle portion to be formed at the yarn end of the yarn can be adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a front view illustrating a spinning machine according to an embodiment of the present invention;

FIG. 2 is a side view illustrating a spinning unit of the spinning machine in FIG. 1;

FIG. 3 is a vertical sectional view illustrating a pneumatic spinning device of the spinning unit in FIG. 2; FIG. 4 is a vertical sectional view illustrating the pneumatic spinning device moving from a spinning position to a receded position;

FIG. 5 is a vertical sectional view illustrating the pneumatic spinning device located at the receded position;

FIGS. 6A and 6B are each a timing chart of operations relating to an adjustment of a length of a fiber bundle portion;

FIGS. 7A and 7B are each a timing chart of operations relating to an adjustment of the length of the fiber bundle portion; and

FIGS. 8A and 8B are each a timing chart of opera-

tions relating to an adjustment of the length of the fiber bundle portion.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] A preferred embodiment of the present invention will be hereinafter described in detail with reference to the accompanying drawings. The same reference numerals are denoted on the same or corresponding portions throughout the drawings, and redundant description will be omitted.

[0017] As illustrated in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a yarn joining vehicle 3, a blower box 4, and a motor box 5. The plurality of spinning units 2 are arranged in a row, and each of the plurality of spinning units 2 is adapted to produce a yarn Y to wind around a package P. The yarn joining vehicle 3 is adapted to perform a yarn joining operation in a spinning unit 2 in which the yarn Y has been disconnected. The blower box 4 accommodates an air supply source adapted to generate, for example, suction flow and whirling flow in each section of the spinning unit 2, and the like. The motor box 5 accommodates a motor adapted to supply power to each section of the spinning unit 2, and the like.

[0018] In the following description, upstream and downstream in a travelling direction of a sliver S, a fiber bundle F, and the yarn Y are respectively referred to as "upstream" and "downstream" simply. Furthermore, a side where a travelling path of the yarn Y is located with respect to the yarn joining vehicle 3 is simply referred to as a "front side" and an opposite side thereto is simply referred to as a "back side".

[0019] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, an injecting device 14, a suction device 15, a pneumatic spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn accumulating device 50, a waxing device 11, and a winding device 12 in this order from upstream. The devices are directly or indirectly supported by a machine frame 13 such that upstream becomes an upper side in a machine height direction (in other words, such that downstream becomes a lower side in the machine height direction).

[0020] The draft device 6 is adapted to produce the fiber bundle F by drafting the sliver S. The draft device 6 includes a pair of back rollers 61, a pair of third rollers 62, a pair of middle rollers 64 each of which is provided with an apron belt 63, and a pair of front rollers 65 in this order from upstream. Each of the pairs of rollers 61, 62, 64, and 65 is adapted to transport the sliver S fed from a sliver can (not illustrated) from upstream to downstream while drafting. Among each of the pairs of rollers 61, 62, 64, and 65, the pair of front rollers 65 is arranged closest to the pneumatic spinning device 7. The pair of front rollers 65 includes a bottom roller (a drive roller) 65a and a top roller (a driven roller) 65b. Drive force is applied from a drive motor (not illustrated), and thereby the bottom

roller 65a is rotated. The top roller 65b is rotated accompanying the rotation of the bottom roller 65a.

[0021] As illustrated in FIG. 3, the pneumatic spinning device 7 is adapted to inject air and apply twists to the fiber bundle F drafted by the draft device 6 to produce the yarn Y while being located at a spinning position. The spinning position is a position where the pneumatic spinning device 7 is arranged to be close to the draft device 6 (specifically, the pair of front rollers 65) at the time of spinning, and is a position where the pneumatic spinning device 7 is located when the fiber bundle F is fed from the draft device 6 to the pneumatic spinning device 7. The pneumatic spinning device 7 includes a nozzle block 70 and a hollow guide shaft body 80. The hollow guide shaft body 80 is inserted into the nozzle block 70 from downstream. An internal space formed by the nozzle block 70 and the hollow guide shaft body 80 is a spinning chamber 73.

[0022] The nozzle block 70 includes a fiber guiding section 71 and a whirling flow generating section 72. The fiber guiding section 71 is provided with a guiding hole 71a adapted to guide the fiber bundle F fed from the draft device 6 to the spinning chamber 73. A needle 75 is provided to the fiber guiding section 71. A tip-end portion 75a of the needle 75 is located in the spinning chamber 73. The needle 75 has a function to prevent twists from propagating upstream of the spinning chamber 73. The whirling flow generating section 72 is provided with a plurality of nozzles 74 that communicate to the spinning chamber 73. The plurality of nozzles 74 are arranged such that the whirling flow is generated in the spinning chamber 73 when air is injected. The whirling flow generating section 72 is provided with a hole portion 72a through which the hollow guide shaft body 80 is inserted. The hole portion 72a is formed into a truncated cone shape that tapers off towards upstream and communicates to the spinning chamber 73.

[0023] The hollow guide shaft body 80 can be inserted into the hole portion 72a of the whirling flow generating section 72. An upper-end portion 80a of the hollow guide shaft body 80 is formed into a truncated cone shape that tapers off towards upstream. The hollow guide shaft body 80 is provided with a passage 81 extending along a central axis of the hollow guide shaft body 80. The passage 81 communicates to the spinning chamber 73 at an upstream side thereof, and is formed in a widened manner towards an exit 83 located downstream. A collecting section 77 communicates to the spinning chamber 73 via a gap formed between the upper-end portion 80a of the hollow guide shaft body 80 and the hole portion 72a of the whirling flow generating section 72.

[0024] The pneumatic spinning device 7 is movably (swingably) supported by a support shaft (not illustrated). As illustrated in FIGS. 4 and 5, the pneumatic spinning device 7 can be moved to a receded position, which is located further away from the draft device 6 than the spinning position. When the pneumatic spinning device 7 is located at the receded position, the hollow guide shaft

body 80 can be further moved from the nozzle block 70. When the pneumatic spinning device 7 is moved from the spinning position to the receded position, as illustrated in FIG. 4, the nozzle block 70 and the hollow guide shaft body 80 are integrally moved away from the draft device 6. Then, as illustrated in FIG. 5, only the nozzle block 70 stops at a predetermined position. The hollow guide shaft body 80 continues the movement in order to be located away from the nozzle block 70. Subsequently, the hollow guide shaft body 80 that has been moved away from the nozzle block 70 stops at a predetermined position.

[0025] As illustrated in FIGS. 1 and 2, the yarn monitoring device 8 is adapted to monitor the travelling yarn Y between the pneumatic spinning device 7 and the yarn accumulating device 50. The yarn monitoring device 8 transmits a yarn defect detection signal to a unit controller (a control section) 10 upon detection of a yarn defect. The yarn monitoring device 8 detects as the yarn defect, for example, an abnormality in thickness of the yarn Y and/or a foreign substance in the yarn Y. Furthermore, the yarn monitoring device 8 detects a length of the yarn Y and transmits a length detection signal to the unit controller 10. The tension sensor 9 is adapted to measure tension of the travelling yarn Y between the pneumatic spinning device 7 and the yarn accumulating device 50, and to transmit a tension measurement signal to the unit controller 10. The waxing device 11 is adapted to apply wax to the travelling yarn Y between the yarn accumulating device 50 and the winding device 12.

[0026] The unit controller 10 is formed of, for example, a Central Processing Unit (CPU) adapted to perform arithmetic processing, a Read Only Memory (ROM) and a Random Access Memory (RAM) each adapted to function as a storage section, and the like, and is provided to every spinning unit 2. The unit controller 10 receives the yarn defect detection signal transmitted from the yarn monitoring device 8. The unit controller 10 calculates a length of the yarn Y that has been wound by the winding device 12 based on the length detection signal of the yarn Y transmitted from the yarn monitoring device 8. The unit controller 10 determines based on the calculated result, whether or not the package P is fully-wound. The unit controller 10 may be provided to every predetermined number of the spinning units 2. Alternatively, a controller adapted to control the entire spinning machine 1 may be provided, and all the spinning units 2 may be controlled by such a controller.

[0027] As illustrated in FIG. 4, the injecting device 14 is adapted to inject air towards a region C between the draft device 6 and the pneumatic spinning device 7 after the pneumatic spinning device 7 starts being moved from the spinning position to the receded position. The injecting device 14 is arranged to inject the air such that the air crosses a fiber passage (a path where the fiber bundle F travels) in the region C. The injecting device 14 is preferably arranged to inject the air along a direction vertical to the fiber passage. The injecting device 14 is controlled

by the unit controller 10 to inject the air at a desired timing. The suction device 15 is arranged to face the injecting device 14 with the region C therebetween, and is adapted to suck a fiber that remains in and around the region C. The injecting device 14 is located on a side of the top roller 65b (a top roller 65b side) with respect to the region C, and the suction device 15 is located on a side of the bottom roller 65a (a bottom roller 65a side) with respect to the region C. The top roller 65b side means a region on a side where the top roller 65b is arranged with the fiber passage as a reference when seen in an axial direction of the pair of front rollers 65 (a direction penetrating a page of FIG. 3) and includes a region downstream of the top roller 65b. The bottom roller 65a side means a region on a side where the bottom roller 65a is arranged with the fiber passage as a reference when seen in the axial direction of the pair of front rollers 65 and includes a region downstream of the bottom roller 65a.

[0028] As illustrated in FIGS. 1 and 2, the yarn accumulating device 50 is adapted to accumulate the travelling yarn Y between the pneumatic spinning device 7 and the winding device 12 by winding the travelling yarn Y around a yarn accumulating roller. The yarn accumulating device 50 has a function to stably draw the yarn Y from the pneumatic spinning device 7, a function to accumulate the yarn Y fed from the pneumatic spinning device 7 to prevent the yarn Y from slackening, for example, when the yarn joining vehicle 3 performs a yarn joining operation, and a function to adjust tension of the yarn Y located downstream of the yarn accumulating device 50 to prevent variation in the tension of the downstream yarn Y from propagating to the pneumatic spinning device 7.

[0029] The winding device 12 is adapted to wind the yarn Y produced by the pneumatic spinning device 7 around a bobbin B to form the package P. The winding device 12 includes a cradle arm 21, a winding drum 22, and a traverse device 23. The cradle arm 21 is swingably supported by a support shaft 24 and is adapted to bring a surface of the bobbin B or the package P each of which is rotatably supported by the cradle arm 21 into contact with a surface of the winding drum 22 with an appropriate pressure. The winding drum 22 is driven by an electric motor (not illustrated) provided to every spinning unit 2, and rotates the bobbin B or the package P being in contact therewith. The traverse device 23 is adapted to be driven by a shaft 25 provided in common to the plurality of spinning units 2 and to traverse the yarn Y at a predetermined width with respect to the rotating bobbin B or the rotating package P.

[0030] The yarn joining vehicle 3 travels to a spinning unit 2 in which the yarn Y has been disconnected, and performs a yarn joining operation in such a spinning unit 2. The yarn joining vehicle 3 includes a splicer 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a support shaft 31. The suction pipe 27 sucks and catches a yarn end of the yarn Y from the pneumatic spinning device 7 and guides the

caught yarn end to the splicer 26. The suction mouth 28 is swingably supported by a support shaft 32. The suction mouth 28 sucks and catches a yarn end of the yarn Y from the winding device 12 and guides the caught yarn end to the splicer 26. The splicer 26 performs yarn joining of the guided yarn ends.

[0031] Next, operations relating to an adjustment of a length of a fiber bundle portion Y1 to be formed at a yarn end of the yarn Y will be described. As illustrated in FIG. 5, the fiber bundle portion Y1 means a region to which twists have not been applied at a yarn end of the yarn Y connected to the package P. Operations to form the fiber bundle portion Y1 are performed, for example, when spinning is interrupted upon detection of a yarn defect or when a package P is fully-wound and spinning is finished.

[0032] During spinning, air is injected from the plurality of nozzles 74 to the fiber bundle F fed to the spinning chamber 73, and whirling flow is generated in the spinning chamber 73. Accordingly, twists are applied to the fiber bundle F fed to the spinning chamber 73, and the yarn Y is produced. The produced yarn Y is discharged from the exit 83 via the passage 81. Fibers that did not become the yarn Y are collected into the collecting section 77. During spinning, the pneumatic spinning device 7 is located at the spinning position.

[0033] When a yarn defect is detected by the yarn monitoring device 8 during spinning, the yarn defect detection signal is transmitted to the unit controller 10. Upon receiving the yarn defect detection signal, the unit controller 10 controls the draft device 6 to stop driving of the pair of back rollers 61 (a drafting operation of the draft device 6). Since the pair of front rollers 65 is connected to a drive source (a drive source provided in common to pairs of front rollers 65 in other spinning units 2) different from a drive source of the pair of back rollers 61, driving of the pair of front rollers 65 is maintained. Consequently, the fiber bundle F is disconnected between the pair of back rollers 61 and the pair of front rollers 65. A timing at which the unit controller 10 controls the draft device 6 as described above is referred to as a "timing K to stop the drafting operation of the draft device 6".

[0034] The unit controller 10 then controls the pneumatic spinning device 7 to stop injection of air from the plurality of nozzles 74. When the injection of the air from the plurality of nozzles 74 has been stopped, whirling flow in the spinning chamber 73 disappears and twists are not applied to the yarn end of the yarn Y. Consequently, the fiber bundle portion Y1 to which twists have not been applied is formed at the yarn end of the yarn Y. A timing at which the unit controller 10 controls the pneumatic spinning device 7 as described above is referred to as a "first timing L to stop injection of air". The first timing L is set by the unit controller 10 with the timing K to stop the drafting operation of the draft device 6 as a reference. The unit controller 10 has a function as a setting section of the first timing L.

[0035] Subsequently, the unit controller 10 controls the pneumatic spinning device 7 to start moving from the

spinning position to the receded position (a movement process). A timing at which the unit controller 10 controls the pneumatic spinning device 7 as described above is referred to as a "second timing M to start movement of the pneumatic spinning device 7 from the spinning position to the receded position". The second timing M is set to be after an elapse of a predetermined period of time from the first timing L by the unit controller 10 so as to be linked with the first timing L to stop the injection of the air. The unit controller 10 functions as a setting section of the second timing M. The second timing M is set such that the pneumatic spinning device 7 starts moving from the spinning position to the receded position after twists are applied to the yarn end of the yarn Y under a state in which the pneumatic spinning device 7 is located at the spinning position.

[0036] Subsequently, for example, the unit controller 10 controls the injecting device 14 to inject air after the pneumatic spinning device 7 starts moving from the spinning position to the receded position (after the second timing M) (an injection process). A timing at which the unit controller 10 controls the injecting device 14 as described above is referred to as a "third timing N to inject air". The third timing N is set to be after an elapse of a predetermined period of time from the second timing M by the unit controller 10 so as to be linked with the second timing M to start movement of the pneumatic spinning device 7 from the spinning position to the receded position. The unit controller 10 has a function as a setting section of the third timing N. After the pneumatic spinning device 7 starts moving from the spinning position to the receded position, the air is injected to the fiber bundle F passing the region C between the draft device 6 and the pneumatic spinning device 7. The fiber bundle F is disconnected by the injected air. In such a manner, the fiber bundle F is disconnected between the pair of back rollers 61 and the pair of front rollers 65, and is further disconnected by the injecting device 14.

[0037] Fibers that are generated when the fiber bundle F is disconnected are sucked by the suction device 15. The unit controller 10 then controls the injecting device 14 to stop the injection of the air before the pneumatic spinning device 7 reaches the receded position.

[0038] The unit controller 10 further has a function as an adjusting section of the first timing L. The unit controller 10 can adjust the first timing L by storing data selected by an operator via an input section (not illustrated) in the storage section and performing a control program in accordance with the selected data. When lengthening a length of the fiber bundle portion Y1, as illustrated in FIG. 6A, the first timing L is adjusted to be relatively early (for example, to be earlier than the first timing L illustrated in FIG. 6B). Accordingly, since twists are not sufficiently applied to the yarn end of the yarn Y, the length of the fiber bundle portion Y1 becomes long. The length of the fiber bundle portion Y1 is lengthened, for example, in a case of reliably catching the yarn end of the yarn Y when performing the yarn joining operation. When shortening

the length of the fiber bundle portion Y1, as illustrated in FIG. 6B, the first timing L is adjusted to be relatively delayed (for example, to be later than the first timing L illustrated in FIG. 6A). Accordingly, since twists are sufficiently applied to the yarn end of the yarn Y, the length of the fiber bundle portion Y1 becomes short. The length of the fiber bundle portion Y1 is shortened, for example, in a case of preventing the fiber bundle portion Y1 from remaining at the yarn accumulating roller of the yarn accumulating device 50. In such a manner, the first timing L is adjusted by the unit controller 10 to be delayed when shortening the length of the fiber bundle portion Y1.

[0039] A case in which spinning is interrupted upon detection of a yarn defect has been described above, but similar operations are performed also in a case in which the package P is determined to be fully-wound and spinning is finished. However, in this case, the length of the fiber bundle portion Y1 is preferably shortened or the fiber bundle portion Y1 is preferably not formed such that a knot of the yarn Y is not disconnected when unwinding the package P by a warper in the following processing. As illustrated in FIG. 6B, for example, the first timing L is thus preferably adjusted to be a late timing or a further late timing.

[0040] As described above, in the spinning machine 1 and a spinning method executed in the spinning machine 1, in a case where the drafting operation of the draft device 6 has been stopped, when the injection of air is stopped in the pneumatic spinning device 7, twists are not appropriately applied to the yarn end of the yarn Y in the pneumatic spinning device 7, and the fiber bundle portion Y1 is formed at the yarn end of the yarn Y. In the spinning machine 1 and the spinning method, since the first timing L to stop the injection of the air in the pneumatic spinning device 7 when the drafting operation of the draft device 6 is stopped is adjusted, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be adjusted. "Twists are not appropriately applied to the yarn end of the yarn Y" means that twists different from twists at the time of spinning are applied to the yarn end of the yarn Y or twists are not applied to the yarn end of the yarn Y.

[0041] Accordingly, the length of the fiber bundle portion Y1 can be adjusted, for example, such that the fiber bundle portion Y1 does not remain at the yarn accumulating roller of the yarn accumulating device 50 located downstream of the pneumatic spinning device 7. Furthermore, the length of the fiber bundle portion Y1 can be adjusted such that the yarn end of the yarn Y can be reliably caught when performing the yarn joining operation. On the other hand, when the package P is fully-wound, the length of the fiber bundle portion Y1 can be shortened such that a knot of the yarn Y is not disconnected when unwinding the package P by the warper in the following process.

[0042] In the spinning machine 1, the first timing L is adjusted with the timing K to stop the drafting operation of the draft device 6 as a reference. With this configura-

tion, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be easily and appropriately adjusted.

[0043] In the spinning machine 1, the first timing L is adjusted to be delayed when shortening the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y. With this configuration, since relation of the first timing L and the length of the fiber bundle portion Y1 is clear, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be easily adjusted.

[0044] In the spinning machine 1, the second timing M is set to be linked with the first timing L. With this configuration, since adjustment of the second timing M is not required to be performed separately from adjustment of the first timing L, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be easily adjusted.

[0045] The second timing M is set such that the pneumatic spinning device 7 starts moving from the spinning position to the receded position after twists are applied to the yarn end of the yarn Y under the state in which the pneumatic spinning device 7 is located at the spinning position. With this configuration, since twists are reliably applied to the yarn end of the yarn Y without being disturbed by the movement of the pneumatic spinning device 7 from the spinning position to the receded position, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be appropriately adjusted. At least one of the first timing L and the second timing M may be adjusted such that the pneumatic spinning device 7 starts moving from the spinning position to the receded position after twists are applied to the yarn end of the yarn Y while being located at the spinning position.

[0046] The spinning machine 1 includes the injecting device 14 that injects air to the region C between the draft device 6 and the pneumatic spinning device 7. With this configuration, the fiber bundle F can be disconnected by controlling the injecting device 14 to inject the air. The length of the fiber bundle portion Y1 thus can be appropriately adjusted by adjusting the third timing N to inject the air from the injecting device 14.

[0047] The spinning machine 1 includes the unit controller 10 that controls operations relating to the adjustment of the first timing L. With this configuration, the length of the fiber bundle portion Y1 can be automatically adjusted in accordance with a condition set for the case in which spinning is interrupted upon detection of a yarn defect, the case in which the package P is determined to be fully-wound and spinning is finished, or the like.

[0048] An embodiment of the present invention has been described above, but the present invention is not limited to the above-described embodiment.

[0049] In the above-described embodiment, the second timing M is set to be after an elapse of the predetermined period of time from the first timing L, but may be adjustable by the unit controller 10. When lengthening the length of the fiber bundle portion Y1, as illustrated in

FIG. 7A, the second timing M is adjusted to be relatively early (for example, to be earlier than the second timing M illustrated in FIG. 7B). Accordingly, since twists are not sufficiently applied to the yarn end of the yarn Y, the length of the fiber bundle portion Y1 becomes long. The length of the fiber bundle portion Y1 is lengthened, for example, in the case of reliably catching the yarn end of the yarn Y when performing the yarn joining operation, or the like. On the other hand, when shortening the length of the fiber bundle portion Y1, as illustrated in FIG. 7B, the second timing M is adjusted to be relatively delayed (for example, to be later than the second timing M illustrated in FIG. 7A). Accordingly, since twists are sufficiently applied to the yarn end of the yarn Y, the length of the fiber bundle portion Y1 becomes short. The length of the fiber bundle portion Y1 is shortened, for example, in the case of preventing the fiber bundle portion Y1 from remaining at the yarn accumulating roller of the yarn accumulating device 50, or the like. In such a manner, the second timing M may be adjusted by the unit controller 10 to be delayed when shortening the length of the fiber bundle portion Y1.

[0050] In the spinning machine 1 according to the above-described alternative embodiment and the spinning method executed in the spinning machine 1, in the case where the drafting operation of the draft device 6 has been stopped, when the pneumatic spinning device 7 starts being moved from the spinning position to the receded position, twists are not appropriately applied to the yarn end of the yarn Y in the pneumatic spinning device 7, and the fiber bundle portion Y1 is formed at the yarn end of the yarn Y. In the spinning machine 1 and the spinning method thereof, since the second timing M to start movement of the pneumatic spinning device 7 from the spinning position to the receded position when the drafting operation of the draft device 6 is stopped is adjusted, the length of the fiber bundle portion Y1 to be formed at the yarn end of the yarn Y can be adjusted. Both of the first timing L and the second timing M also may be adjusted.

[0051] In the above-described embodiment, the third timing N is set to be after an elapse of the predetermined period of time from the second timing M, but may be adjustable by the unit controller 10. When shortening the length of the fiber bundle portion Y1, as illustrated in FIG. 8A, the third timing N is adjusted to be relatively early (for example, to be earlier than the third timing N illustrated in FIG. 8B). Accordingly, since a length of the yarn end of the yarn Y to be disconnected by the injecting device 14 becomes long, the length of the fiber bundle portion Y1 becomes short. The length of the fiber bundle portion Y1 is shortened, for example, in the case of preventing the fiber bundle portion Y1 from remaining at the yarn accumulating roller of the yarn accumulating device 50, or the like. On the other hand, when lengthening the length of the fiber bundle portion Y1, as illustrated in FIG. 8B, the third timing N is adjusted to be relatively delayed (for example, to be later than the third timing N illustrated

in FIG. 8A). Accordingly, since the length of the yarn end of the yarn Y to be disconnected by the injecting device 14 becomes short, the length of the fiber bundle portion Y1 becomes long. The length of the fiber bundle portion Y1 is lengthened, for example, in the case of reliably catching the yarn end of the yarn Y when performing the yarn joining operation, or the like. In such a manner, the third timing N may be adjusted by the unit controller 10 to be early when shortening the length of the fiber bundle portion Y1.

[0052] In the above-described embodiment and the above-described alternative embodiment, the unit controller 10 controls the operations relating to the adjustments of the first timing L, the second timing M, and the third timing N. However, an adjustment mechanism to adjust at least one of the first timing L, the second timing M, and the third timing N may be arranged separately from the unit controller 10, and an operator may directly adjust at least one of the first timing L, the second timing M, and the third timing N by such an adjustment mechanism without the unit controller 10. For example, in the pneumatic spinning device 7 in which a length of an air path that communicates to the plurality of nozzles 74 can be adjusted, the length of the air path may be adjusted by the operator. Since a timing at which air is injected from the plurality of nozzles 74 is varied by adjusting the length of the air path, the first timing L can be adjusted. Alternatively, in the spinning machine 1 in which positional relation of an actuator (an air cylinder, for example) adapted to move the pneumatic spinning device 7 to the spinning position and the receded position, and the pneumatic spinning device 7 can be adjusted, the positional relation may be adjusted by the operator. Since a timing at which the actuator starts acting on the pneumatic spinning device 7 is varied by adjusting the positional relation, the second timing M can be adjusted. In such a manner, at least one of the first timing L, the second timing M, and the third timing N may be directly adjusted without the unit controller 10.

[0053] In the above-described embodiment, the first timing L is adjusted with the timing K as a reference, but the first timing L may be adjusted with a timing at which the yarn defect detection signal is input from the yarn monitoring device 8 as a reference. In the same manner, the second timing M may be adjusted with the timing at which the yarn defect detection signal is input from the yarn monitoring device 8 as a reference.

[0054] In the above-described embodiment, the injecting device 14 is located on the side of the top roller 65b with respect to the region C, and the suction device 15 is located on the side of the bottom roller 65a with respect to the region C, but positions of the injecting device 14 and the suction device 15 may be reversed.

[0055] In the above-described embodiment, the fiber bundle F is disconnected by injection of air from the injecting device 14, but the injection of the air by the injecting device 14 is not required to be performed.

[0056] Various materials and shapes may be applied

to a material and a shape of each component of the spinning machine 1 without being limited to the above-described material and shape. The needle 75 may be omitted, and a downstream end of the fiber guiding section 71 may have a function of the needle 75. Furthermore, the pair of front rollers 65 is not required to be connected to the drive source provided in common to the pairs of front rollers 65 in other spinning units 2, and drive force may be respectively applied from individual drive sources. Without being limited to the pair of front rollers 65, drive force may be respectively applied from individual drive sources to other pairs of rollers 61, 62, and 64 in the same manner.

Claims

1. A spinning machine (1) comprising:
 - a draft device (6) adapted to draft a fiber bundle (F); and
 - a pneumatic spinning device (7) arranged movable to a spinning position and a receded position, and adapted to produce a yarn (Y) by applying twists to the drafted fiber bundle (F) by injecting air to a spinning chamber (73) while being located at the spinning position, the receded position being located further away from the draft device (6) than the spinning position, wherein the spinning machine (1) is configured to adjust at least one of a first timing (L) and a second timing (M), the first timing (L) being a timing at which injection of the air is stopped when a drafting operation of the draft device (6) is stopped, and the second timing (M) being a timing at which the pneumatic spinning device (7) starts being moved from the spinning position to the receded position when the drafting operation of the draft device (6) is stopped.
2. The spinning machine (1) according to claim 1, wherein the spinning machine (1) is configured to adjust at least one of the first timing (L) and the second timing (M) with a timing (K) to stop the draft device (6) as a reference.
3. The spinning machine (1) according to claim 1 or claim 2, wherein the spinning machine (1) is configured to adjust the first timing (L) such that the first timing (L) is delayed when shortening a length of a fiber bundle portion (Y1) to be formed at a yarn end of the yarn (Y).
4. The spinning machine (1) according to claim 3, wherein the second timing (M) is set to be linked with the first timing (L).
5. The spinning machine (1) according to any one of

claim 1 through claim 4, wherein the spinning machine is configured to adjust at least one of the first timing (L) and the second timing (M) such that the pneumatic spinning device (7) starts moving from the spinning position to the receded position after twists are applied to a yarn end of the yarn (Y) under a state in which the pneumatic spinning device (7) is located at the spinning position.

6. The spinning machine (1) according to any one of claim 1 through claim 5, further comprising an injecting device (14) adapted to inject air to a region (C) between the draft device (6) and the pneumatic spinning device (7).

7. The spinning machine (1) according to any one of claim 1 through claim 6, further comprising a control section (10) adapted to control an operation relating to an adjustment of at least one of the first timing (L) and the second timing (M).

8. A spinning method executed in a spinning machine (1) comprising a draft device (6) adapted to draft a fiber bundle (F); and a pneumatic spinning device (7) arranged movable to a spinning position and a receded position, and adapted to produce a yarn (Y) by applying twists to the drafted fiber bundle (F) by injecting air to a spinning chamber (73) while being located at the spinning position, the receded position being located further away from the draft device (6) than the spinning position, the spinning method comprising:

adjusting at least one of a first timing (L) and a second timing (M), the first timing (L) being a timing at which injection of the air is stopped when a drafting operation of the draft device (6) is stopped, and the second timing (M) being a timing at which the pneumatic spinning device (7) starts being moved from the spinning position to the receded position when the drafting operation of the draft device (6) is stopped.

THE

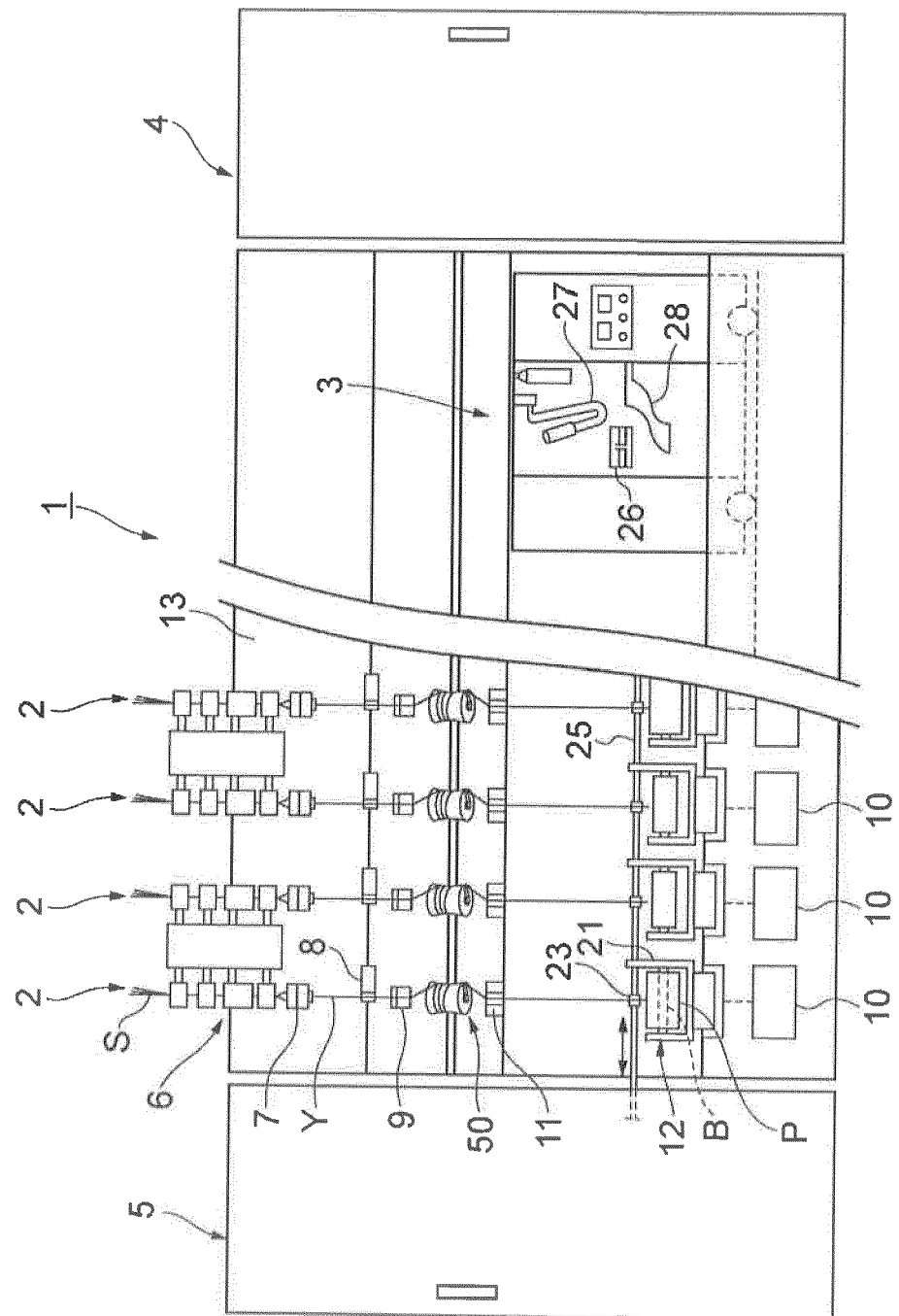


FIG. 2

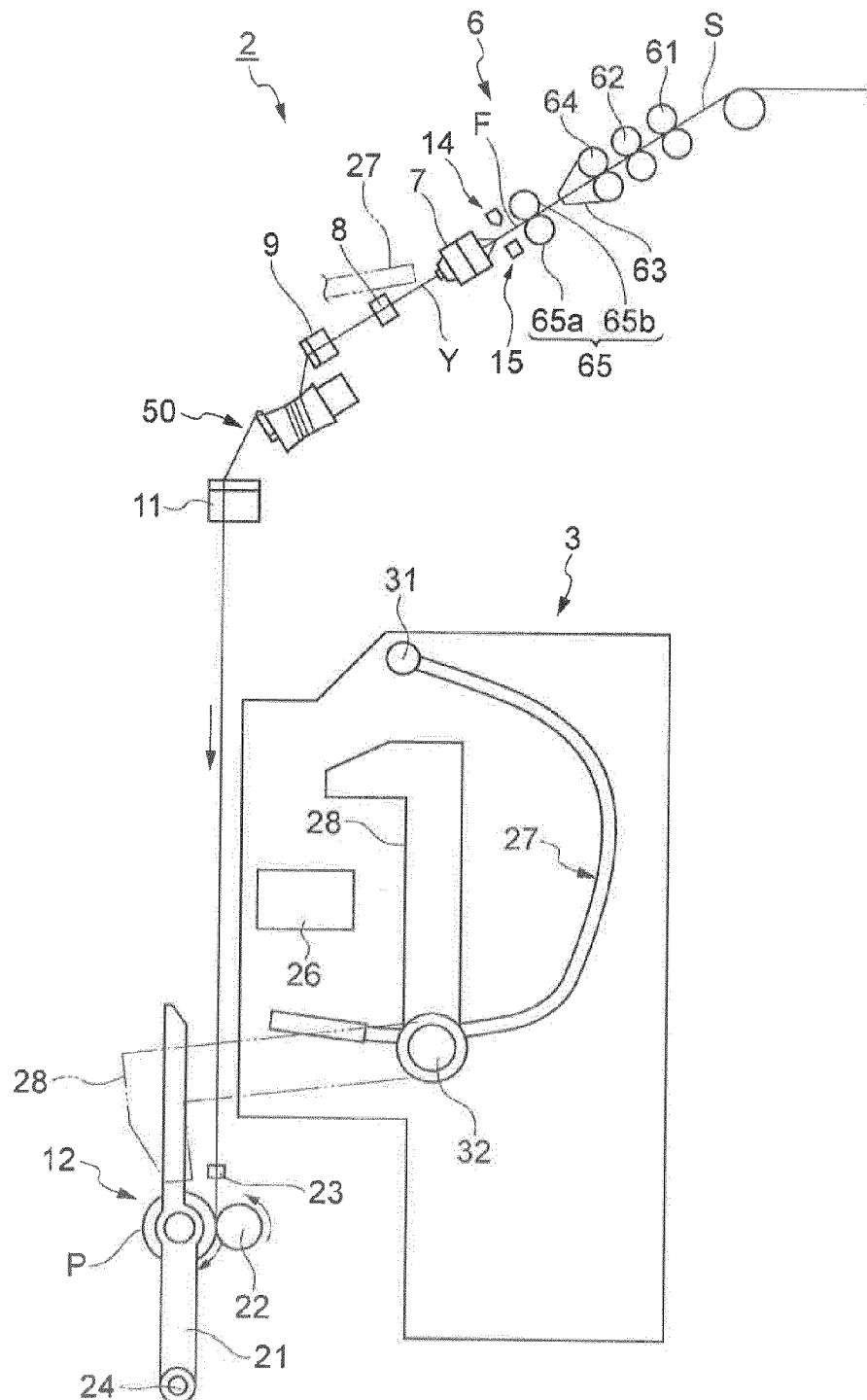


FIG. 3

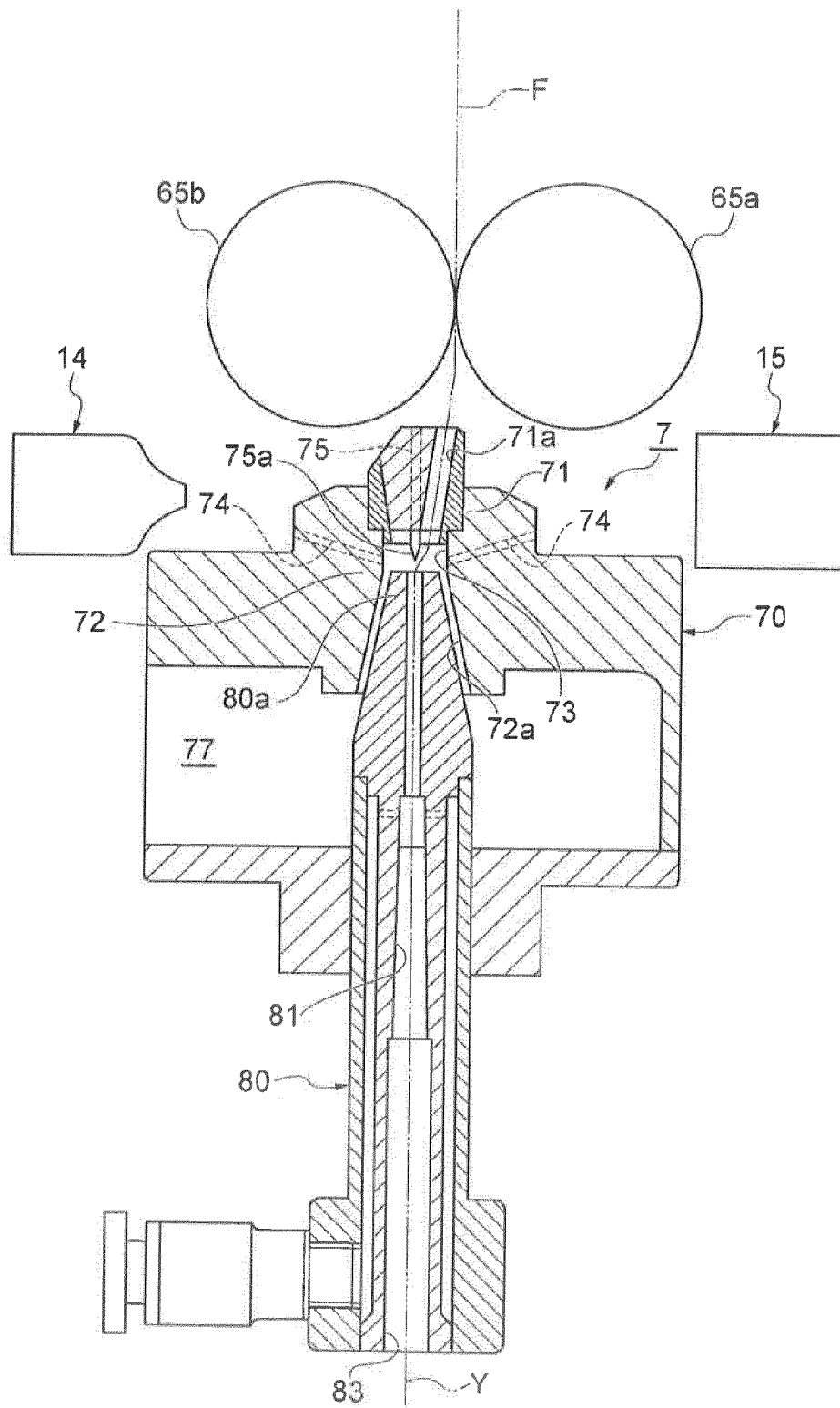


FIG. 4

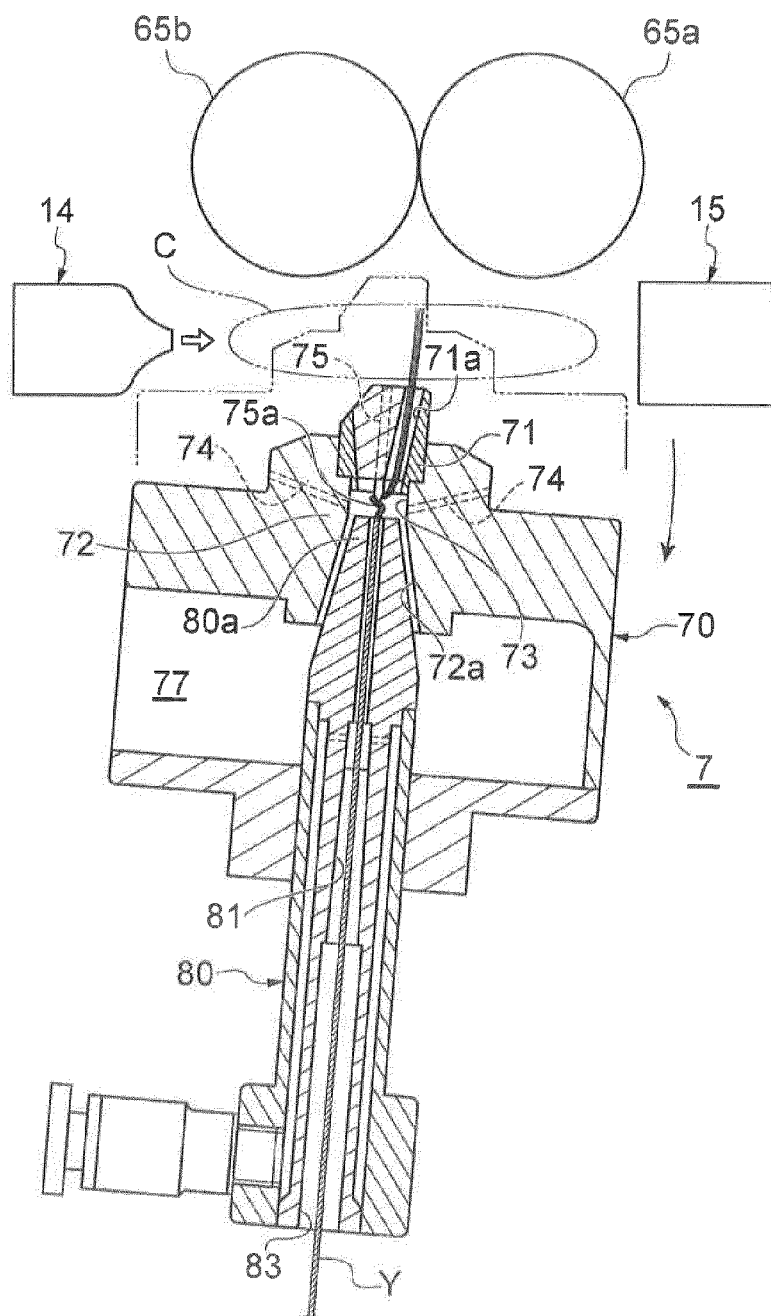


FIG. 5

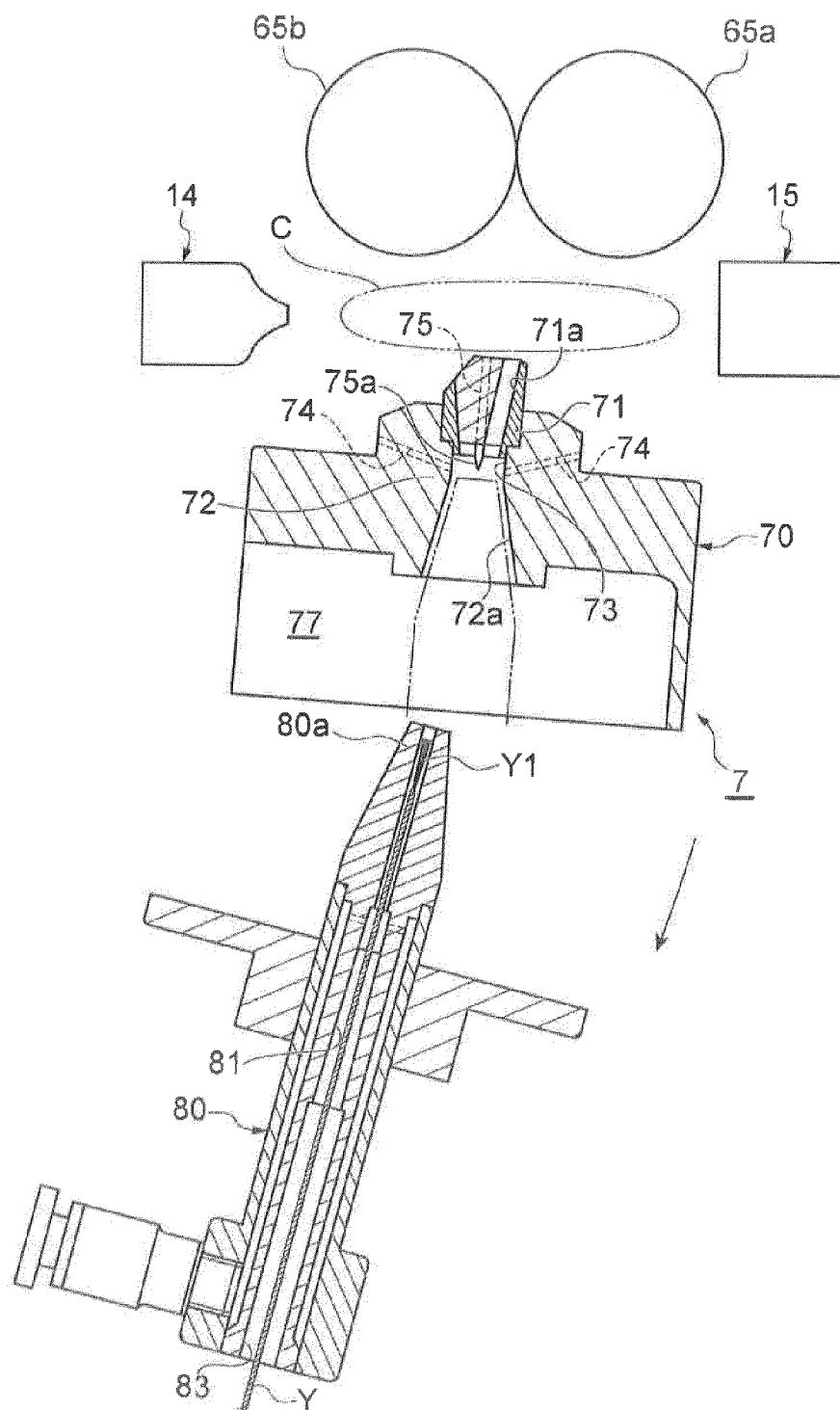


FIG. 6A

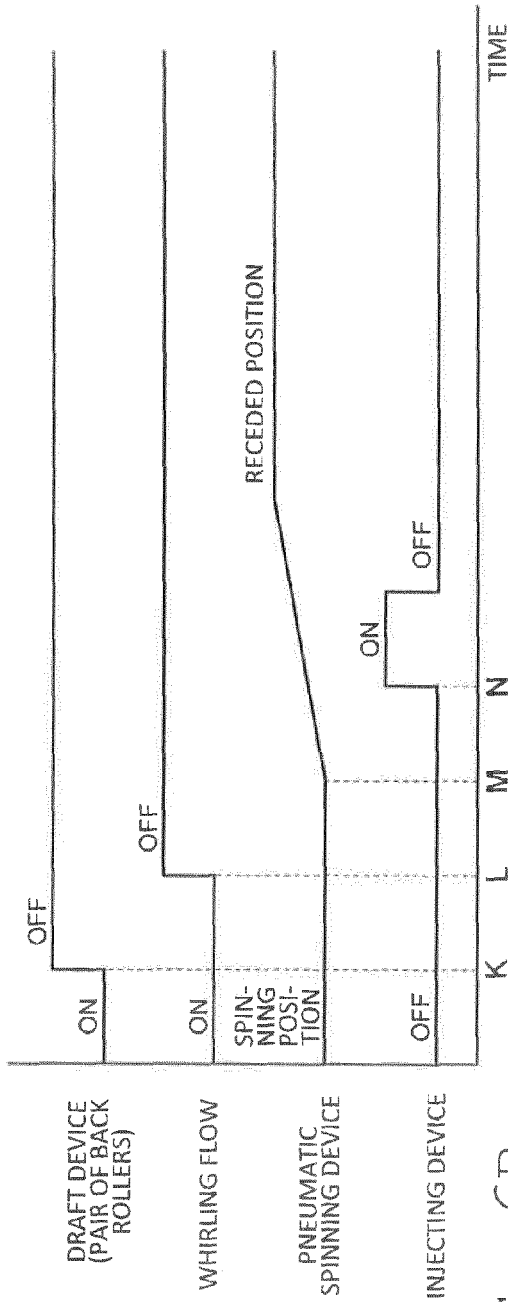


FIG. 6B

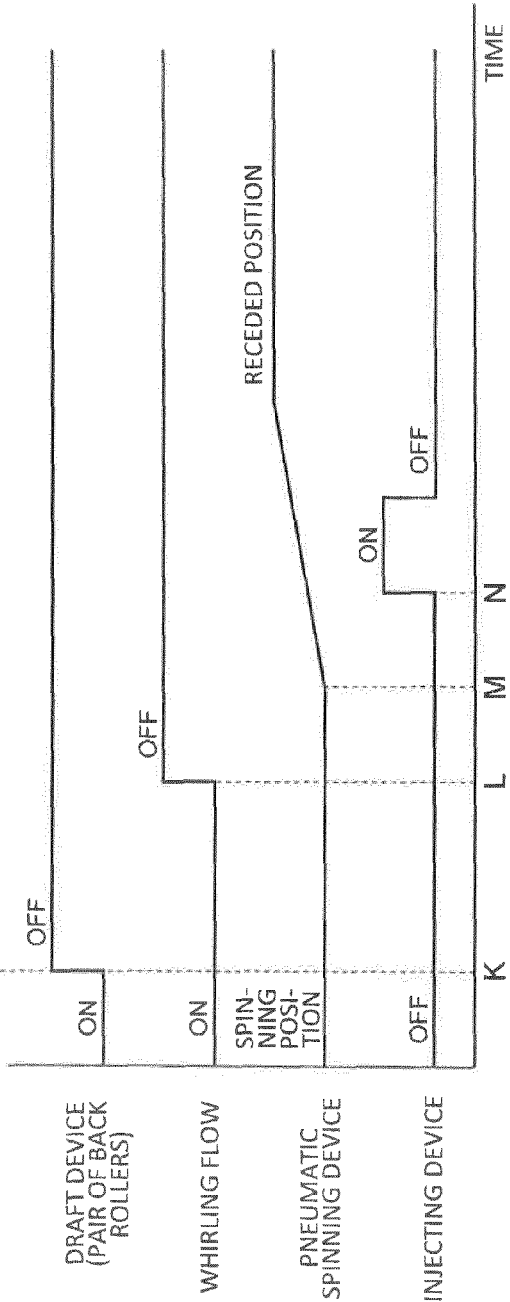


FIG. 7A

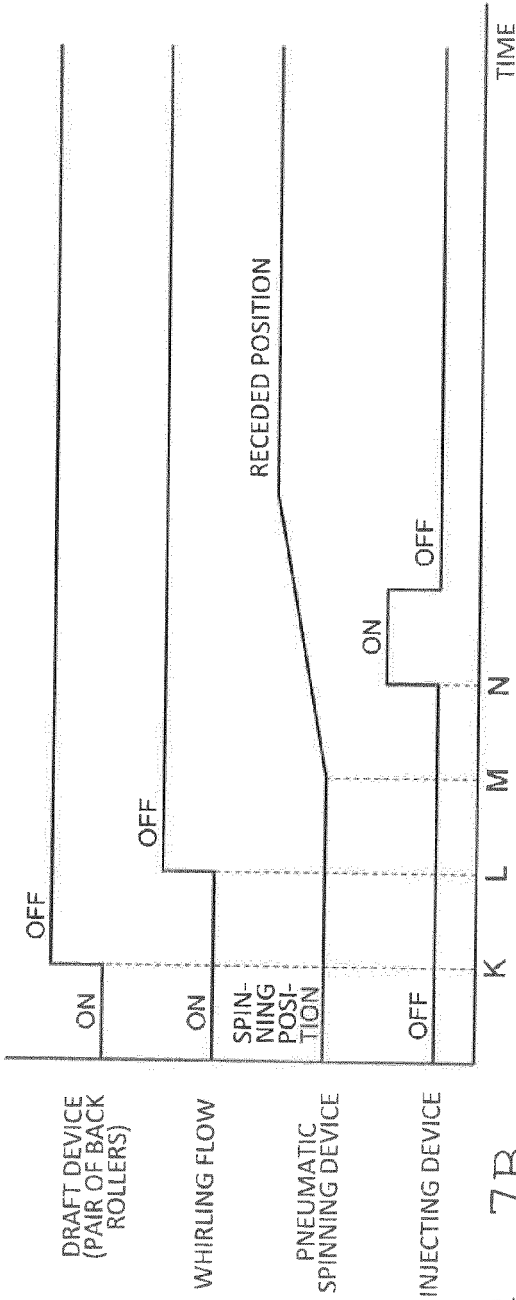


FIG. 7B

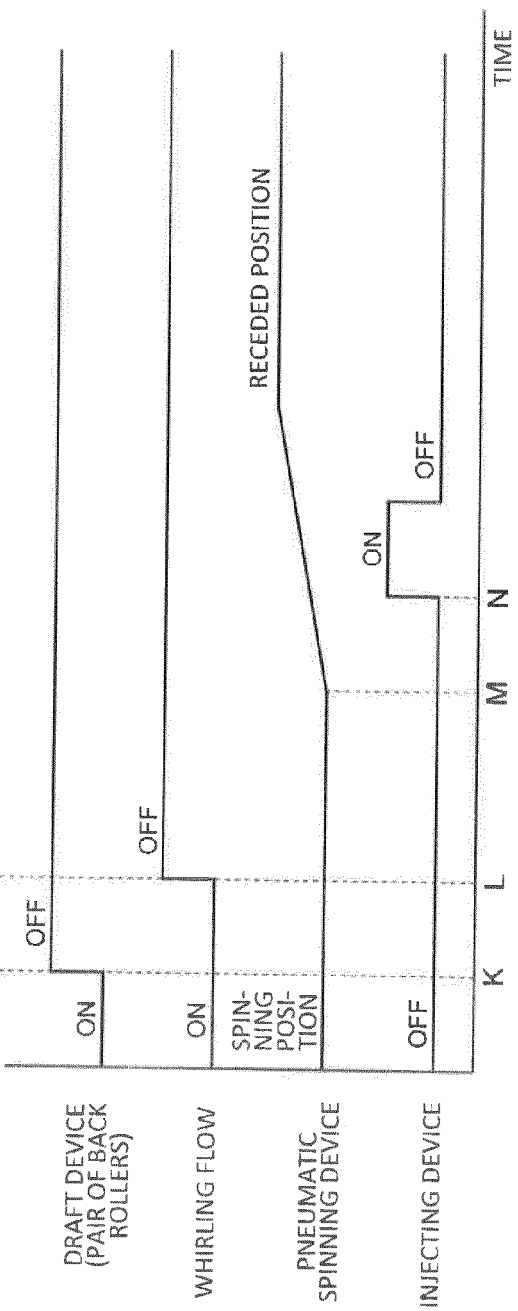


FIG. 8A

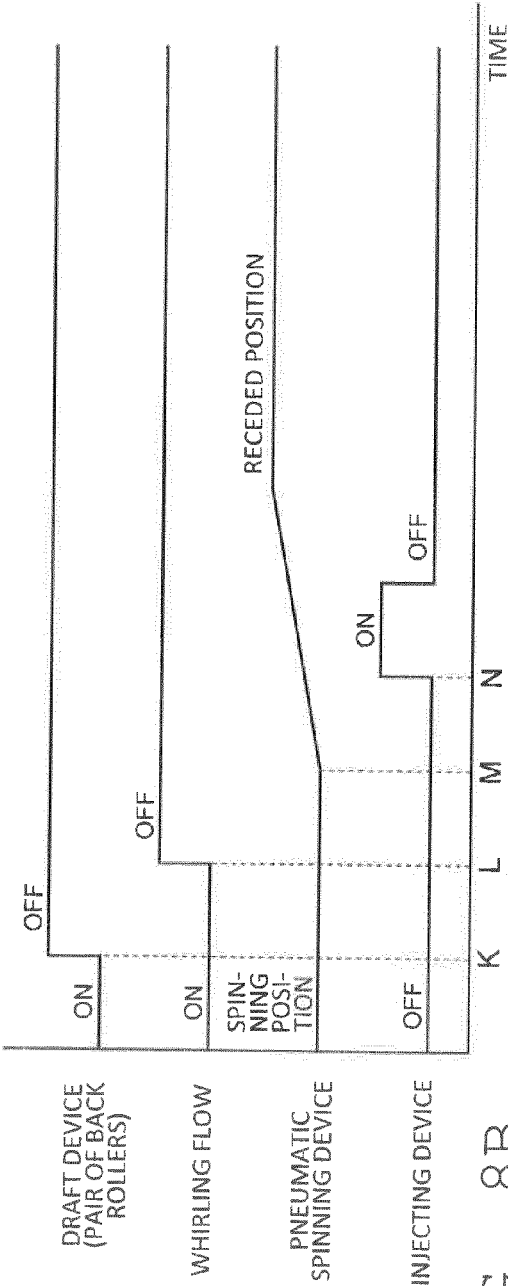
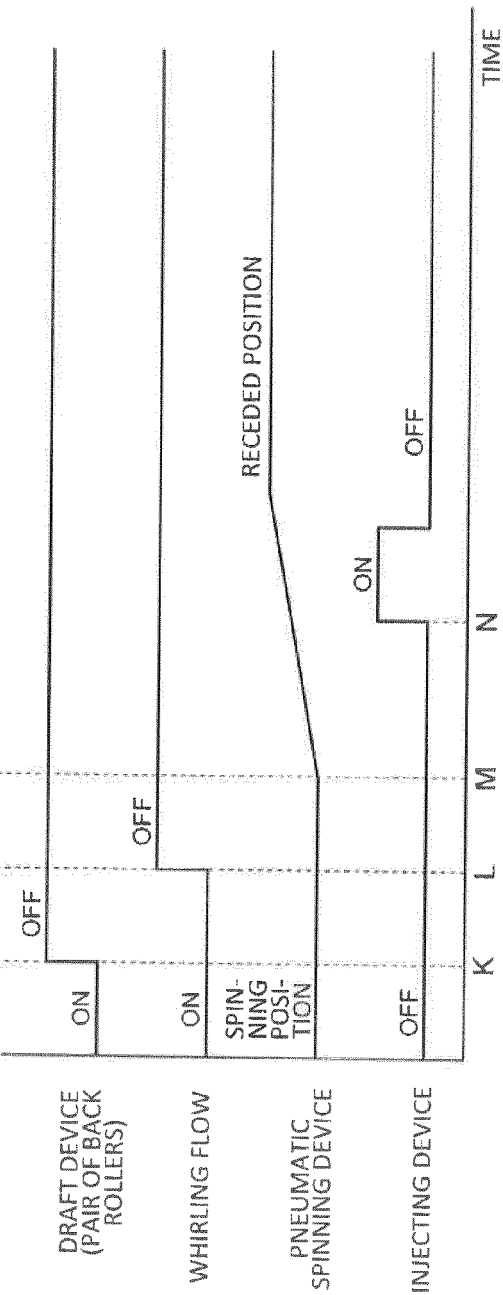


FIG. 8B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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