(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 168 340 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
17.05.2017 Bulletin 2017/20

(21) Application number: **15819554.5**

(22) Date of filing: **08.07.2015**

(51) Int Cl.:
D01H 1/115 *(2006.01)* ***D01H 4/02*** *(2006.01)*

(86) International application number:
PCT/JP2015/003442

(87) International publication number:
WO 2016/006240 (14.01.2016 Gazette 2016/02)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **10.07.2014 JP 2014141880**

(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi, Kyoto 601-8326 (JP)

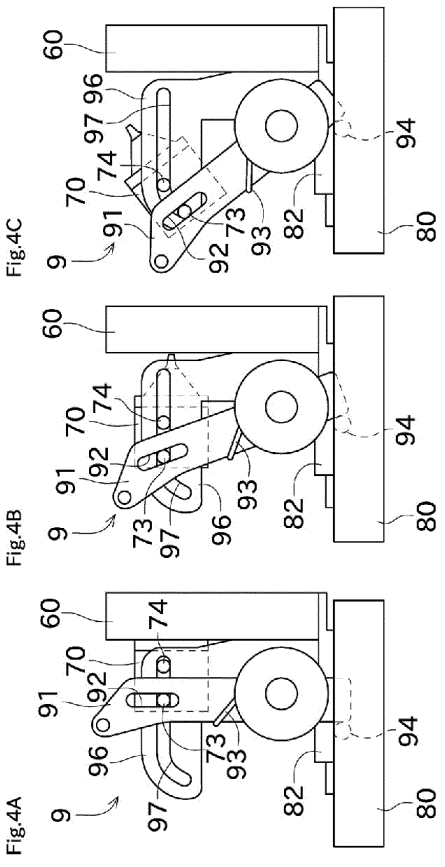
(72) Inventor: **MORI, Hideshige**
Kyoto-shi
Kyoto 612-8686 (JP)

(74) Representative: **Weickmann & Weickmann PartmbB**
Postfach 860 820
81635 München (DE)

(54) **AIR SPINNING DEVICE AND SPINNING MACHINE**

(57) An air spinning device (9) has a first block (60) and a second block (70). The first block (60) applies a swirling airflow to a fiber bundle (8). The second block (70) is arranged downstream of the first block (60) in a fiber traveling direction, and guides the fiber bundle further towards the downstream side. The second block (70) can perform a first separation operation in which the second block (70) is linearly moved away from the first block (60) along the fiber traveling direction, and a second separation operation which is performed after the first separation operation, the second separation operation being an operation in which an orientation of the second block (70) is changed while moving in a direction different from that in the first separation operation.

Fig.4



EP 3 168 340 A1

Description

TECHNICAL FIELD

[0001] The present invention mainly relates to an air spinning device in which a second block can be moved away from a first block.

BACKGROUND ART

[0002] An air spinning device of Patent Document 1 includes a nozzle holder as a first block, a spindle member as a second block, and a cylinder. The nozzle holder and the spindle member are connected via a linear guide rod. Driving the cylinder enables the spindle member to be slid along the guide rod. Accordingly, the spindle member can be moved away from the nozzle holder, and then the fiber clogged between the spindle member and the nozzle holder can be removed.

[0003] An air spinning device of Patent Document 2 includes a first block, a second block, and a cylinder. The first block generates a swirling airflow for a fiber bundle conveyed from a draft device. The second block generates a swirling airflow in a direction different from that of the first block for the fiber bundle conveyed from the first block. The first block and the second block are mounted so as to be swung around a common swinging shaft. Driving the cylinder allows the first block and the second block to be integrally swung so as to move away from the draft device. Furthermore, driving the cylinder over a certain level allows only the first block to make contact with a stopper. Thereby, the second block is swung so as to move away from the first block. Accordingly, the fiber clogged between the draft device and the first block, and the fiber clogged between the first block and the second block can be removed.

PRIOR-ART DOCUMENTS

PATENT DOCUMENTS

[0004]

PATENT DOCUMENT 1: Japanese Patent Application Laid-Open No. 1996-218233
PATENT DOCUMENT 2: Japanese Patent Application Laid-Open No. 2011-38210

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] In order to remove the fiber clogged between the first block and the second block, it is preferable to visually inspect a downstream side of the first block and an upstream side of the second block by separating the first block and the second block from each other. The air spinning device of Patent Document 1 has a configuration in which the spindle member is moved away from the nozzle holder by linearly sliding the spindle member. Therefore, a large amount of sliding is needed for visually inspecting the downstream side of the first block and the upstream side of the second block. However, in the large amount of sliding, a space in view of the sliding amount needs to be provided around the air spinning device.

[0006] In Patent Document 2, since a nozzle in a tip of the second block is a precision component, it is not preferable that the nozzle makes contact with the first block. Therefore, the second block needs to be moved away from the first block in an angle close to a straight line (in a fiber traveling direction). In this case, a swinging shaft needs to be arranged at a distance (an arm length needs to be extended). However, if the arm is extended, a size of the air spinning machine becomes large. In addition, if the second block is separated in an angle close to a straight line, a space in view of the swinging of the second block needs to be provided around the air spinning device.

[0007] A primary object of the present invention is to provide a compact configuration in an air spinning device in which the second block can be moved away from the first block.

MEANS FOR SOLVING THE PROBLEMS AND EFFECTS THEREOF

[0008] In a first aspect of the present invention, an air spinning device includes a first block and a second block. A travel path for guiding a fiber bundle is formed in the first block. The second block is arranged downstream of the first block in a fiber traveling direction, and guides the fiber bundle further downstream. The second block can perform a first separation operation and a second separation operation after the first separation operation. The first separation operation is an operation in which the second block is linearly moved away from the first block along the fiber traveling direction. The second separation operation is an operation in which the second block moves in a direction or changes its orientation different from that of the first separation operation.

[0009] Accordingly, performing the first separation operation can prevent the first block and the second block from coming in contact with each other, and in this condition, performing the second separation operation enables to set a position of the second block in a small amount of movement such that the downstream side of the first block and the upstream side of the second block can be visually inspected. Accordingly, a space provided around the air spinning device can be reduced and a size of the air spinning device can be reduced.

[0010] In the air spinning device, the first block is movable. Accordingly, the fiber clogged in the upstream side in the fiber traveling direction of the first block can be removed.

[0011] In the air spinning device, the first block is moved toward a same direction as that of the second

block at least when the second block performs the first separation operation. Accordingly, since the direction in which the first block and the second block are moved away is same, a power transmission mechanism can be simplified.

[0012] In the air spinning device, the second separation operation is a moving operation in arc motion. Accordingly, a position of the second block can be set in a smaller amount of movement such that the downstream side of the first block and the upstream side of the second block can be visually inspected.

[0013] The air spinning device includes a guide member and an insertion member. The guide member has a guide groove including a linear first portion and a second portion formed along a direction different from that of the first portion. The insertion member inserted into the guide groove is moved with the second block along the guide groove. Accordingly, the second block can perform the first separation operation and the second separation operation with a simple configuration.

[0014] The air spinning device includes a driving part that generates a power for allowing the second block to perform the first separation operation and the second separation operation. Accordingly, the power transmission mechanism can be simplified.

[0015] In the air spinning device, the driving part includes at least one of a cylinder, a ball screw and a motor, or a linear motor. Accordingly, the second block can perform the first separation operation and the second separation operation with a simple configuration.

[0016] The air spinning device includes a guide rail, a sliding part, and a sealing member. The guide rail is provided along an arrangement direction of the first block and the second block. The sliding part is moved with the second block along the guide rail by the power of the driving part. The sealing member covers a gap between the guide rail and the sliding part. Accordingly, the fiber can be prevented from adhering to the gap between the guide rail and the sliding part. Therefore, the frequency of maintenance can be decreased.

[0017] In the air spinning device, at least the first block, the second block, the driving part, the guide rail, and the sliding part are integrally removable. Accordingly, since a number of parts can be integrally removed, the maintenance performance can be improved.

[0018] In the air spinning device, the driving part adjusts the position of the second block with respect to the first block in the fiber traveling direction. Accordingly, a space between the first block and the second block can be varied depending on details of maintenance, for example.

[0019] In the air spinning device, the driving part is configured to control a moving speed of the second block with respect to the first block. Accordingly, for example, by decreasing the speed of the second block before the first block comes in contact with the second block, an impact when the first block comes in contact with the second block can be reduced.

[0020] In the air spinning device, the second separation operation is the operation in which the second block is moved in the direction different from that of the first separation operation and thereby the orientation of the second block is changed. Accordingly, a position of the second block can be set in a smaller distance such that the downstream side of the first block and the upstream side of the second block can be visually inspected.

[0021] In the air spinning device, the first block includes a swirling airflow generating nozzle for passing air that is ejected for generating a swirling airflow in a spinning chamber. The second block includes a hollow guide shaft for passing the fiber bundle that is twisted by effect of the swirling airflow in the spinning chamber. Accordingly, in the air spinning device including the first block and the hollow guide shaft, the hollow guide shaft can be moved in a compact space.

[0022] In the air spinning device, the first block includes a first nozzle for passing air that is ejected for causing effect of the swirling airflow in a first direction on the fiber bundle. The second block includes a second nozzle for passing air that is ejected for causing effect of a swirling airflow in a second direction opposing to the first direction on the fiber bundle. Accordingly, in the air spinning device in which two nozzles are arranged in straight line, the second block can be moved in a compact space.

[0023] In a second aspect of the present invention, a spinning machine includes the air spinning device, a draft device, and a winding part. The draft device drafts the fiber bundle spun by the air spinning device. The winding part winds the yarn formed by the air spinning device into a package.

[0024] Accordingly, since a space around the air spinning device can be reduced, a compact configuration of the spinning machine can be achieved.

[0025] In the spinning machine, the first block is linearly moved away from the draft device along the fiber traveling direction. Accordingly, a position where the fiber travels can be prevented from being displaced when the first block is moved away from the draft device and then returned to the original position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

[Fig. 1] A side view showing a configuration of a spinning unit including an air spinning device according to a first embodiment of the present invention.

[Fig. 2] Fig. 2A is a side view of the air spinning device. Fig. 2B is a plan view of the air spinning device.

[Fig. 3] A cross-sectional view showing an internal structure of the air spinning device.

[Fig. 4] Fig. 4A, Fig. 4B, and Fig. 4C are diagrams showing a movement of a first block and a second block.

[Fig. 5] Fig. 5A is a diagram schematically showing a configuration and movement of Prior Art 1. Fig. 5B

is a diagram schematically showing a configuration and movement of Prior Art 2.

[Fig. 6] Fig. 6A and Fig. 6B are diagrams schematically showing a configuration and movement of a modification.

[Fig. 7] Fig. 7A and Fig. 7B are side views of an air spinning device of a second embodiment.

[Fig. 8] is a graph showing a change of speed when the second block is moved from a spinning position to a maintenance position.

[Fig. 9] is a graph showing a change of speed when the second block is moved from a maintenance position to a spinning position.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0027] Next, a fine spinning machine (spinning machine) according to a first embodiment of the present invention will be described with reference to the drawings. In this specification, the terms "upstream" and "downstream" mean upstream and downstream with respect to a traveling direction of a fiber bundle and a spun yarn at a time of spinning.

[0028] The fine spinning machine includes a plurality of spinning units 2 arranged side by side, a machine control device (not shown) that centrally manages the spinning units, and at least one collecting device (not shown) provided with respect to the plurality of spinning units 2. In each of the spinning units 2, a fiber bundle 8 fed from a draft device 7 is spun by an air spinning device 9, and thereby a spun yarn 10 is formed. The spun yarn 10 is wound by a winding part 26, thereby a package 50 is formed.

[0029] As shown in Fig. 1, each of the spinning units 2 includes the draft device 7, the air spinning device 9, a yarn accumulation device 22, a yarn joining device 23, a yarn monitoring device 25, and the winding part 26, which are arranged in this order from upstream to downstream. Each of the parts provided in the spinning units 2 is controlled by a unit controller 30 provided in the relevant spinning unit 2. In Fig. 1, arrows are merely illustrated with respect to some of objects controlled by the unit controller 30. Each of the parts provided in the spinning units 2 may be controlled by the machine control device.

[0030] The draft device 7 includes four draft rollers, which are a back roller 16, a third roller 17, a middle roller 19 having an apron belt 18 made of rubber, and a front roller 20, which are arranged in this order from upstream. Each of the draft rollers is rotationally driven at a predetermined rotational speed. The draft device 7 has opposing rollers that are opposed to each of the draft rollers.

[0031] The draft device 7 conveys a sliver 15 that is fed from a sliver case (not shown) via a sliver guide while sandwiching the sliver 15 between the plurality of draft rollers and the plurality of opposing rollers. Accordingly, the sliver 15 is stretched (drafted) until a predetermined amount of fibers (or thickness) is obtained, and the fiber bundle 8 is formed.

[0032] The air spinning device 9 is arranged immediately downstream of the front roller 20. The fiber bundle 8 drafted by the draft device 7 is supplied to the air spinning device 9. The air spinning device 9 applies twists to the fiber bundle 8 fed from the draft device 7, and thus produces the spun yarn 10. In this embodiment, a pneumatic spinning device which applies twists to the fiber bundle 8 by using swirling airflow is adopted. The detailed configuration of the air spinning device 9 will be described later.

[0033] A delivery roller 21 and a nip roller capable of being moved to make contact with and away from the delivery roller 21 are provided downstream of the air spinning device 9. By rotationally driving the delivery roller 21 under a state in which the spun yarn 10 fed from the air spinning device 9 is sandwiched between the delivery roller 21 and the nip roller, the spun yarn 10 can be fed to the winding part 26.

[0034] A first guide 46 that guides the spun yarn 10 is arranged downstream of the delivery roller 21. The first guide 46 guides the spun yarn 10 to the yarn accumulation device 22. The first guide 46 is movable for pulling the spun yarn 10 to the yarn accumulation device 22 at a time of yarn joining, for example.

[0035] The yarn accumulation device 22 is provided downstream of the first guide 46. The yarn accumulation device 22 includes a yarn accumulation roller 41, an electric motor 42 that allows the yarn accumulation roller 41 to be rotationally driven, and a yarn hooking member 43. The spun yarn 10 is temporally accumulated by being wound onto an outer circumferential surface of the yarn accumulation roller 41.

[0036] The yarn hooking member 43 is mounted in a downstream end portion of the yarn accumulation roller 41. The yarn hooking member 43 is rotatably supported relative to the yarn accumulation roller 41. A permanent magnet is mounted on either one of the yarn hooking member 43 or the yarn accumulation roller 41. A magnetic hysteresis material is mounted on the other one. These magnetic means lead to generation of a torque that acts against the rotation of the yarn hooking member 43 relative to the yarn accumulation roller 41. Therefore, only when force that surpasses the torque is applied (when the tension over a predetermined amount is applied) to the yarn hooking member 43, the yarn hooking member 43 rotates relatively with respect to the yarn accumulation roller 41 and the spun yarn 10 wound onto the yarn accumulation roller 41 can be unwound. When the force that surpasses the torque is not applied to the yarn hooking member 43, the yarn accumulation roller 41 rotates integrally with the yarn hooking member 43 and the spun yarn 10 is accumulated around the yarn accumulation roller 41.

[0037] As such, the yarn accumulation device 22 operates to unwind the spun yarn 10 when the yarn tension in a downstream side is increased, whereas the yarn accumulation device 22 operates to stop unwinding the

spun yarn 10 when the yarn tension is decreased (when the spun yarn 10 is likely to slack). Thereby, the yarn accumulation device 22 can eliminate a slack of the spun yarn 10 and apply an appropriate tension to the spun yarn 10. Since the yarn hooking member 43 operates to absorb a fluctuation of the tension that is applied to the spun yarn 10 located between the yarn accumulation device 22 and the winding part 26 as described above, the fluctuation of the tension can be prevented from affecting the spun yarn 10 located between the spinning device 9 and the yarn accumulation device 22.

[0038] With respect to an installation surface of the fine spinning machine, although a yarn traveling direction in an upstream side of the yarn accumulation device 22 is arranged in a substantially horizontal direction, the yarn traveling direction in a downstream side of the yarn accumulation device 22 is facing diagonally upward. Therefore, a yarn path during winding of the spun yarn 10 is largely (90° or greater) bent by the yarn accumulation device 22.

[0039] A second guide 47 that guides the spun yarn 10 unwound from the yarn accumulation roller 41 is provided downstream of the yarn accumulation roller 41.

[0040] The yarn joining device 23 is provided downstream of the second guide 47. The yarn joining device 23 performs yarn joining of the spun yarn 10 (a first yarn) from the air spinning device 9 and the spun yarn 10 (a second yarn) from the package 50 when the spun yarn 10 is disconnected between the air spinning device 9 and the package 50 for some reason. In this embodiment, the yarn joining device 23 is configured as a splicer device that twists yarn ends together using a swirling airflow generated by compressed air. However, the yarn joining device 23 is not limited to the above-described splicer device. For example, a mechanical knotter may also be used.

[0041] The spinning unit 2 includes a guide device that guides the spun yarn 10 to the yarn joining device 23. The guide device has a first guide device 27 for conveying the first yarn and a second guide device 28 for conveying the second yarn to the yarn joining device 23.

[0042] A base end portion of the first guide device 27 is swingably supported. The first guide device 27 is vertically swingable around the base end portion. The first guide device 27 having a hollow shape is connected to a blower (not shown) and can generate a suction airflow. The first guide device 27 can catch a yarn end of the first yarn fed from the delivery roller 21 by swinging downward (see a chain line in Fig. 1). At this time, although the delivery roller 21 and the nip roller are in contact with each other in this embodiment, the delivery roller 21 and the nip roller may not be making contact with each other. The first guide device 27 can convey the first yarn to the yarn joining device 23 by swinging upward after catching the first yarn.

[0043] The base end portion of the second guide device 28 is swingably supported. The second guide device 28 is vertically swingable around the base end portion. The second guide device 28 having a hollow shape is connected to a blower (not shown) and can generate a suction airflow. The second guide device 28 can catch a yarn end of the second yarn by swinging upward (see the chain line in Fig. 1). The second guide device 28 can convey the second yarn to the yarn joining device 23 by swinging downward after catching the second yarn.

[0044] By operating the yarn joining device 23 under this state, the first yarn and the second yarn are joined thereby achieving a continuous state of the spun yarn 10 between the air spinning device 9 and the package 50. Accordingly, the winding of the spun yarn 10 into the package 50 can be restarted.

[0045] The yarn monitoring device 25 is provided downstream of the yarn joining device 23. The yarn monitoring device 25 monitors a thickness of the travelling spun yarn 10 by a capacitance sensor (not shown). The yarn monitoring device 25 transmits a yarn defect detection signal to the unit controller 30 when detecting a yarn defect of the spun yarn 10 (a portion having abnormality in the thickness or the like of the spun yarn 10). When the unit controller 30 receives the yarn defect detection signal, a cutter 24 (yarn cutting device) arranged near the yarn monitoring device 25 is driven to cut the spun yarn 10. The yarn monitoring device 25 is not limited to the capacitance sensor. For example, a light transmission sensor may be used for monitoring the thickness of the spun yarn 10. Foreign substances contained in the spun yarn 10 may be monitored as the yarn defect.

[0046] The winding part 26 is arranged downstream of the yarn accumulation device 22. The winding part 26 includes a cradle arm 52 and a winding drum 53. The yarn path from the yarn accumulation device 22 to the winding part 26 is bent and guided by a downstream guide 48.

[0047] A winding tube 51 around which the spun yarn 10 is wound is rotatably supported by the cradle arm 52. The cradle arm 52 is swingable around its base end portion. Accordingly, even when a diameter of the package 50 increases accompanying the winding of the spun yarn 10 around the winding tube 51, the winding of the spun yarn 10 can be continued appropriately.

[0048] By the driving force of a winding drum driving motor (not shown) being transmitted, the winding drum 53 rotates while making contact with an outer circumferential surface of the winding tube 51 or the package 50. A traverse groove (not shown) is formed on an outer circumferential surface of the winding drum 53. The traverse groove allows the spun yarn 10 to be traversed in a predetermined width. Accordingly, the winding part 26 can form the package 50 by winding the spun yarn 10 onto the winding tube 51 while traversing the spun yarn 10.

[0049] Next, a configuration of the air spinning device 9 will be described with reference to Fig. 2A, Fig. 2B and Fig. 3.

[0050] As shown in Fig. 2A, the air spinning device 9 includes a first block 60, a second block 70, a base part

80 and a power transmission part 90.

[0051] The first block 60 is arranged in an upstream end portion of the air spinning device 9. As shown in Fig. 3, the first block 60 includes a fiber guide 61, a spinning chamber 62, and a swirling airflow generating nozzle 63.

[0052] The fiber guide 61 guides the fiber bundle 8 drafted by the draft device 7 toward the inside of the air spinning device 9. The fiber guide 61 has a fiber inlet port 61a, a guide needle 61b, and a travel path 61c. The fiber bundle 8 drafted by the draft device 7 is introduced from the fiber inlet port 61a, passed through the travel path 61c so as to wrap around the guide needle 61b, and guided into the spinning chamber 62. In the air spinning device 9, the air from the swirling airflow generating nozzle 63 is ejected into the spinning chamber 62 and thereby the swirling airflow acts upon the fiber bundle 8 within the spinning chamber 62.

[0053] The second block 70 includes a hollow guide shaft 71 and a yarn passage 72. The yarn passage 72 is formed on the axial center of the hollow guide shaft 71. The swirling airflow that is caused by the air ejected from the swirling airflow generating nozzle 63 allows a rear end of the fibers in the fiber bundle 8 to be swung around a distal end of the hollow guide shaft 71. Accordingly, twists are applied to the fiber bundle 8 and the spun yarn 10 is formed. The spun yarn 10 is fed through the yarn passage 72 and out from a downstream yarn outlet (not shown) to the outside of the air spinning device 9.

[0054] As shown in Fig. 2A, the second block 70 includes a first pin (an insertion member) 73 and a second pin 74 which protrude toward left direction and right direction (direction orthogonal to a fiber traveling direction) respectively. The first pin 73 is arranged downstream of the second pin 74. At a time of spinning (a state shown in Fig. 2A), the first pin 73 and the second pin 74 are arranged so as to have a substantially same distance (height) from the base part 80.

[0055] The base part 80 is a rectangular frame-shaped member. The base part 80 is included in an end portion at one side (at a lower side in this embodiment) of the air spinning device 9. As shown in Fig. 2A and Fig. 2B, two guide rails 81, a sliding part 82, and a cylinder (driving part) 83 are mounted to the base part 80.

[0056] Each of two guide rails 81 is a rod-like member, and arranged such that the longitudinal direction of the guide rails 81 coincides with (is parallel to) the fiber traveling direction. The total of two guide rails 81 are arranged parallel to each other.

[0057] The sliding part 82 supports the first block 60 and the second block 70. The sliding part 82 has rail insertion holes 82a for receiving the guide rails 81 (see an enlarged cross-sectional view in Fig. 2A). As shown in the enlarged cross-sectional view, the guide rails 81 are supported by the sliding part 82 via bushes 82b. Felt seals (sealing members) 82c are mounted on the outer side of the bushes 82b (in spaces between openings (inlets) of the rail insertion holes 82a and the bushes 82b). Accordingly, the fiber can be prevented from entering the inside of the bushes 82b. Instead of the felt seals 82c, sealing members made of materials other than the felt may be used.

[0058] The cylinder 83 enables a cylinder rod to be moved by the air being supplied via a pipe (not shown). The sliding part 82 is configured to be moved integrally with the cylinder rod. Accordingly, by controlling the supply of the air to the cylinder 83, the sliding part 82 can be slid.

[0059] The power transmission part 90 includes two first guide plates 91 and two second guide plates (guide members) 96. One of the first guide plates 91 and one of the second guide plates 96 are arranged at one side with respect to the fiber traveling path. The other first guide plate 91 and the other second guide plate 96 are arranged at the other side with respect to the fiber traveling path. Two first guide plates 91 and two second guide plates 96 that are mounted to the sliding part 82 via a predetermined member are slidable integrally with the sliding part 82.

[0060] First guide groove 92 is formed through each of the first guide plates 91. The longitudinal direction of the first guide groove 92 is identical with the vertical direction (a direction perpendicular to the fiber traveling direction in a side view). The first guide groove 92 receives the above-described first pin 73.

[0061] A coil spring 93 is mounted on each of the first guide plates 91. The coil spring 93 urges each of the first guide plates 91 toward the direction shown by a bold arrow in Fig. 2A. A restricting member 94 that restricts the sliding or swinging of the first guide plates 91 is arranged at a lower end (a base end, an end portion in base part 80 side) of at least one of the first guide plates 91. In a state shown in Fig. 2A (a normal state during the spinning or the like), the first guide plates 91 are restricted so as not to rotate over a restricted position by the restricting member 94. The restricting member 94 is mounted to the base part 80. Even when the sliding part 82 is slid, a position of the restricting member 94 is not changed. Therefore, when the sliding part 82 is slid, the lower ends of the first guide plates 91 are pushed by the restricting member 94 and thereby a force that surpasses an urging force of the coil spring 93 acts. As a result, the first guide plates 91 can be swung counterclockwise (in a direction in which the second block 70 is moved away from the first block 60) (see Fig. 4A to Fig. 4C that will be described later). As shown in Fig. 2B, the two first guide plates 91 are connected to each other by a coupling part 95.

[0062] Two second guide plates 96 are arranged parallel to two first guide plates 91, and arranged inside with respect to the two first guide plates 91 (at a position closer to the second block 70 than the first guide plates 91). Each of the second guide plates 96 has a second guide groove (guide groove) 97. The second guide groove 97 includes a linear portion 97a formed in an upstream-side and an arc-like portion 97b formed in a downstream side. The linear portion 97a is a linear groove parallel to or

substantially parallel to the fiber traveling direction. The arc-like portion 97b is an arc-like groove formed in a direction curved downstream and downward (a direction away from the yarn path). Each of the second guide grooves 97 receives the first pin 73 and the second pin 74. The first pin 73 is inserted in both of the first guide groove 92 and the second guide groove 97.

[0063] As described above, in the air spinning device 9 of this embodiment, all parts including the cylinder 83 are mounted to the base part 80. That is, the air spinning device 9 is modularized. Therefore, since the air spinning device 9 can alone be removed from the fine spinning machine with a small number of processes, the maintenance can be easily performed.

[0064] Next, a method for moving the first block 60 and the second block 70 at a time of maintenance will be described with reference to Fig. 4A to Fig. 4C.

[0065] For example, when the operator instructs to perform the maintenance from a machine control device or an operation part connected to the unit controller 30, or when the sensor detects that the fiber is clogged in the air spinning device 9, the unit controller 30 controls that the air is supplied to the cylinder 83 and allows the sliding part 82 to be slid downstream. The first block 60, the second block 70 and the power transmission part 90 are moved integrally with the sliding part 82 toward downstream (see Fig. 4B).

[0066] Accordingly, the first block 60 can be moved away from the draft device 7. Since the first block 60 is linearly slid along the fiber traveling direction, a traveling path (yarn path) of the fiber bundle 8 is not changed even if a position where the first block 60 is returned is slightly displaced from a position before separation.

[0067] The sliding part 82 is slid downstream, and thereby each of the lower ends of the two first guide plates 91 receives a force from the restricting member 94 and two first guide plates 91 are swung in a counterclockwise direction of Fig. 4B (see Fig. 4B). Accordingly, since each of the first guide grooves 92 in the two first guide plates 91 pushes the first pin 73, the second block 70 is moved downstream. Since the two first guide plates 91 are swung around each of the lower ends, the distance of sliding of the second block 70 is larger than the distance of sliding of the first block 60. Accordingly, the second block 70 can be moved away from the first block 60.

[0068] Since the first pin 73 and the second pin 74 are moved along the linear portion 97a in each of the second guide grooves 97 until the distance of sliding reaches a predetermined value, the second block 70 is linearly moved (first separation operation). Accordingly, a tip end (the hollow guide shaft 71) in the second block 70 can be prevented from coming in contact with the first block 60.

[0069] Then, the sliding part 82 is slid further downstream, and thereby the first pin 73 is moved along each of the arc-like portions 97b and the second block 70 is moved in arc motion (swinging motion) (second separation operation). At this time, since the second pin 74 keeps moving along each of the linear portions 97a, the second block 70 is turned upward. That is, the second block 70 changes its orientation. To be specific, the tip end in the hollow guide shaft 71 (the fiber inlet port 61a) is moved away from the yarn path. Accordingly, the hollow guide shaft 71 can be moved with a small distance of sliding into a state in which the maintenance of the hollow guide shaft 71 can be easily performed.

[0070] Next, a comparison between a conventional separation method and the separation method in this embodiment will be described with reference to schematic views of Fig. 5A and Fig. 5B.

[0071] The configuration of Prior Art 1 shown in Fig. 5A is similar to that of Patent Document 1. The air spinning device of Prior Art 1 includes a first block 101, a rail 102, a second block 103 and a cylinder 104. The rail 102 is arranged in a direction parallel to the fiber traveling direction. Driving the cylinder 104 enables the second block 103 to be linearly moved along the rail 102.

[0072] However, in the configuration of Prior Art 1, the second block 103 cannot be positioned such that the downstream side of the first block 101 and the upstream side of the second block 103 can be visually inspected unless the amount of movement of the cylinder 104 is large. Therefore, it is necessary that a space for sliding the second block 103 is provided around the air spinning device.

[0073] The configuration of Prior Art 2 shown in Fig. 5B is similar to that of Patent Document 2. The air spinning device in Prior Art 2 includes a first block 111, a second block 112 and a cylinder 113. The first block 111 and the second block 112 can be swung around their lower ends. A restricting member 114 is arranged between the first block 111 and the second block 112. Accordingly, the second block 112 can be moved away from the first block 111.

[0074] In Prior Art 2, in order to prevent a hollow guide shaft of the second block 112 from coming in contact with the first block, it is necessary that the first block 111 and the second block 112 are elongated and the tip end portion of the first block 111 and the tip end portion of the second block 112 are substantially linearly moved. Thus, the air spinning device is enlarged in size. In this case, the second block 112 cannot be positioned such that the downstream side of the first block 111 and the upstream side of the second block 112 can be visually inspected unless the amount of sliding is large, similarly to Prior Art 1. Therefore, it is necessary that a space is provided around the air spinning device.

[0075] As described above, in the present embodiment, the first block 60 is linearly moved parallel to the fiber traveling direction by the cylinder 83. The second block 70 is at first linearly moved parallel to the fiber traveling direction and then moved in an arc motion. Accordingly, since there is no need to obtain a large distance of sliding and no need to elongate the length of each of the blocks as in the Prior Arts, a size of the air spinning device 9 can be made compact.

[0076] The direction of movement of the first block 60 and the second block 70 is not limited to the direction shown in this embodiment. For example, as shown in a modification in Fig. 6A and Fig. 6B, a first block 121 may be moved in arc motion. Fig. 6A is a diagram showing a position of each part before being moved. Fig. 6B is a diagram showing a position of each part after being moved. The air spinning device in the modification shown in Fig. 6A and Fig. 6B includes the first block 121, a second block 122, a second block guide lever 123, a second block guide rail 124, a cylinder 125 and a restricting member 126.

[0077] The first block 121 can be swung around its lower end by receiving a power of the cylinder 125. The second block guide lever 123 corresponds to the first guide plate 91 of this embodiment. The second block guide lever 123 receives a power from the first block 121 and its lower end position is restricted by the restricting member 126, thereby the second block guide lever 123 can be swung around its lower end. The second block guide rail 124 corresponds to the second guide groove 97 of this embodiment. The second block guide lever 123 is swung and thereby the second block guide rail 124 allows the second block 122 to be moved in an arc motion after being moved linearly parallel to the fiber traveling direction.

[0078] In the above description, the second blocks 70 and 122 are moved in arc motion after being moved linearly parallel to the fiber traveling direction. Instead of this, the second block may be moved linearly in a different direction after being moved linearly parallel to the fiber traveling direction. The second block may be moved in arc motion after being moved linearly parallel to the fiber traveling direction, and then the second block may be moved linearly again. The orientation of the second block may be changed (for example, upward) without changing the position after being moved linearly parallel to the fiber traveling direction. The second block may be moved in arc motion with a small diameter after being moved in arc motion with a large diameter. In this specification, the linear motion of the second block (first separation operation) includes the linear motion slightly displaced from the fiber traveling direction, and the arc motion regarded as the linear motion because of the large diameter, in addition to the linear motion that coincides with the fiber traveling direction. The arc motion is not limited to a motion in circular orbit. For example, elliptic motion or other motion in a curve may be adopted.

[0079] As described above, the air spinning device 9 of this embodiment includes the first block 60 and the second block 70. The first block 60 has a fiber guide 61 that guides the fiber bundle 8. The second block 70 arranged downstream of the first block 60 in the fiber traveling direction guides the fiber bundle 8 further downstream. The second block 70 can perform the first separation operation and the second separation operation after the first separation operation. The first separation operation is the operation in which the second block 70 is linearly moved away from the first block 60 parallel to the fiber traveling direction. The second separation operation is the operation in which the second block 70 is moved or changes its orientation in a direction different from that of the first separation operation.

[0080] Accordingly, performing the first separation operation can prevent the first block 60 from coming in contact with the second block 70. In addition, performing the second separation operation enables the second block 70 to be moved in a small amount of movement such that the downstream side of the first block 60 and the upstream side of the second block 70 can be visually inspected. Accordingly, a space provided around the air spinning device 9 can be reduced and a size of the air spinning device 9 itself can be reduced.

[0081] In the air spinning device 9 of this embodiment, when at least the second block 70 performs the first separation operation, the first block 60 is moved toward the same direction as the second block 70. Since the direction in which the first block 60 and the second block 70 are moved away is the same, a power transmission mechanism can be simplified. For example, the first block 60 and the second block 70 can be merely fixed to the sliding part 82.

[0082] The air spinning device 9 of this embodiment includes the second guide plate 96 and the first pin 73. The second guide plate 96 has the second guide groove 97 including the linear portion 97a and the arc-like portion 97b. The first pin 73 inserted into the second guide groove 97 is moved with the second block 70 along the second guide groove 97. Accordingly, the second block 70 can perform the first separation operation and the second separation operation with a simple configuration.

[0083] In the air spinning device 9 of this embodiment, at least the first block 60, the second block 70, the cylinder 83, the guide rail 81, and the sliding part 82 are integrally removable. Accordingly, since at least the first block 60, the second block 70, the cylinder 83, the guide rail 81, and the sliding part 82 can be integrally removed from the spinning machine, the maintenance performance can be improved.

[0084] Next, a second embodiment will be described with reference to Fig. 7. In the following description, the parts identical or similar to those of the above-described first embodiment will be denoted by the same reference numerals, and descriptions thereof may be omitted.

[0085] As shown in Fig. 7A, the power transmission part 90 of this embodiment includes a stepping motor 131 and a ball screw 135 as a driving part for driving the second block 70. The stepping motor 131 is controlled by the unit controller 30 or the machine control device. Specifically, the stepping motor 131 includes an output shaft 132. The stepping motor 131 allows the output shaft 132 to be rotated in accordance with the number of pulse received from the unit controller 30 or the machine control device. By controlling the stepping motor 131 by the unit controller 30, the second block 70 can be moved independently for each spinning unit 2. By controlling the step-

ping motor 131 by the machine control device, the second blocks 70 can be moved simultaneously in the plurality of spinning units 2.

[0086] The power transmission part 90 includes the ball screw 135. The ball screw 135 allows the second block 70 to be moved using driving force of the stepping motor 131. The ball screw 135 includes a screw shaft 135a and a movable part 135b.

[0087] The driving force of the stepping motor 131 is transmitted to a transmission shaft 134 via the output shaft 132 and a transmission belt 133. The transmission shaft 134 is coaxial with the screw shaft 135a. The screw shaft 135a is rotated by rotation of the transmission shaft 134. In the above-described configuration, the movable part 135b can be slid parallel to the fiber traveling direction by driving the stepping motor 131. The driving force in the stepping motor 131 can be transmitted to the ball screw 135 without using the transmission belt 133.

[0088] The power transmission part 90 includes a guide rail 136 parallel to the screw shaft 135a, and a sliding part 137 slidable along the guide rail 136. A first guide plate 138 is fixed to the sliding part 137. The first guide plate 138 has the configuration similar to that of the first guide plate 91 in the above-described first embodiment. In the above-described configuration, the second block 70 can be moved to and away from the first block 60 by using the driving force of the stepping motor 131.

[0089] The first block 60 is slidable along the guide rail 136, as well as the second block 70. The second block 70 is urged toward the first block 60 by a spring 139 provided in an end portion of the guide rail 136. The second guide plate 96 functions as a stopper, and thereby a movable range of the first block 60 is restricted. A portion that functions as the stopper is not limited to the second guide plate 96.

[0090] Next, the motion of the first block 60 and the second block 70 at a time of driving the stepping motor 131 will be described. From a state in which the first block 60 and the second block 70 are located away from one another (Fig. 7A), if the second block 70 is moved toward the first block 60, the second block 70 comes in contact with the first block 60. Since the first block 60 is urged toward the second block 70, in this state, if the second block 70 is moved further toward the first block 60, the first block 60 and the second block 70 can be integrally moved toward the front roller 20. (see Fig. 7B). By transmitting the pulse corresponding to the amount of movement of the second block 70, the unit controller 30 can stop the first block 60 and the second block 70 at a desired position. Since any configuration is adoptable for stopping the first block 60 and the second block 70, the configuration is not limited to the rotation control of the stepping motor 131. For example, a mechanical brake may be used.

[0091] As described above, the distance between the first block 60 (air spinning device 9) and the front roller 20 (draft device 7) can be adjusted. By changing the frequency in which pulses are transmitted to the stepping motor 131, the speed of rotation in the output shaft 132 (eventually the moving speed of the second block 70) can be controlled. Although how the moving speed of the second block 70 is changed is preset, it can be also changed by an operation of the operator.

[0092] Next, a control of the position and the moving speed in the second block 70 will be described with reference to Fig. 8 and Fig. 9. In the following description, the spinning position means the position of the second block 70 at a time of spinning by the air spinning device 9. A first maintenance position and a second maintenance position are defined as a position of the second block 70. The first maintenance position is a position for the maintenance performed under a state in which the tip end of the hollow guide shaft 71 is not directed upward. For example, the air is ejected from the swirling airflow generating nozzle 63 toward the hollow guide shaft 71 positioned in the first maintenance position, and the cleaning operation of the hollow guide shaft 71 is performed. The second maintenance position is a position for the maintenance performed under a state in which the tip end of the hollow guide shaft 71 is directed upward. For example, the operator directly accesses to the hollow guide shaft 71 positioned in the second maintenance position and then performs cleaning of the hollow guide shaft 71 or removes the hollow guide shaft 71. The first maintenance position and the second maintenance position may be referred to collectively as a maintenance position.

[0093] The power transmission part 90 has an origin sensor (not shown) for detecting an original position of movement of the movable part 135b at a predetermined position (for example, a position where the first block 60 and the second block 70 come in contact with each other). The first maintenance position, the second maintenance position, the spinning position and the like are defined based on an output from the origin sensor. These positions can be adjusted by the operation of the operator. In this configuration, the position of the first block 60 with respect to the front roller 20 can be adjusted with high accuracy. The position of the second block 70 can be identified, based on the impact and the like when the second block 70 comes in contact with the first block 60, without providing the origin sensor.

[0094] When the maintenance of the air spinning device 9 is started, the second block 70 is moved from the spinning position to the maintenance position. At this time, as shown in Fig. 8, the moving speed of the second block 70 is controlled. Firstly, the unit controller 30 accelerates the second block 70 in the spinning position in the direction of being moved away from the front roller 20. Then, by reaching a first block separation position, the first block 60 comes in contact with the second guide plate 96, and the first block 60, and the second block 70 are separated.

[0095] Controlling the moving speed or acceleration rate of the second block 70 can suppress the impact when

the first block 60 comes in contact with the second guide plate 96. For example, the acceleration rate can be set small until the second block 70 reaches the first block separation position. Accordingly, the moving speed of the second block at a time of contacting can be reduced.

[0096] Then, the second block 70 continues to be moved in the direction away from the first block 60 while increasing the moving speed, and then reaches a predetermined moving speed. The second block 70 starts to decelerate from a position located a predetermined distance before a target position (the first maintenance position or the second maintenance position). Accordingly, since a sudden stopping can be prevented, a damage of the second block 70 can be prevented.

[0097] After the maintenance of the air spinning device 9 is completed, the second block 70 is moved from the maintenance position to the spinning position. At this time, as shown in Fig. 9, the moving speed of the second block 70 is controlled. Firstly, the unit controller 30 accelerates the second block 70 in the maintenance position in the direction of being moved toward the first block 60. After the moving speed of the second block reaches a predetermined speed, the second block starts to decelerate from a position located a predetermined distance before a position of contacting with the first block. Accordingly, the impact when the second block 70 comes in contact with the first block 60 can be reduced. Then, the first block 60 and the second block 70 are moved in a direction toward the front roller 20, and then decelerated again from a position located a predetermined distance before the spinning position. Accordingly, since the sudden stopping of the first block 60 and the second block 70 can be prevented, the damage of the first block 60 and the second block 70 can be prevented. In addition, the first block 60 can be prevented from coming in contact with the front roller 20.

[0098] In this embodiment, there are two maintenance positions, however, one maintenance position, or three or more maintenance positions may be adopted. In this embodiment, a description has been made that the second block 70 is moved at a time of starting of maintenance or completion of maintenance, however, the second block 70 may be slightly moved during the spinning depending on a type of the spun yarn 10 to be produced.

[0099] In the air spinning device 9 of this embodiment, at least the first block 60, the second block 70, the stepping motor 131, the ball screw 135, the guide rail 136, and the sliding part 137 are integrally removable, similarly to the above-described first embodiment.

[0100] Although some preferred embodiments of the present invention have been described above, the above-described configurations can be changed, for example, as follows.

[0101] In the above-described first and second embodiments, although the present invention is applied to the air spinning device 9 that performs the spinning operation by the swirling airflow generating nozzle 63 and the hollow guide shaft 71, the present invention may be applied to an air spinning device that performs the air spinning operation by other methods. For example, the present invention can be applied to the air spinning device that performs the air spinning operation by applying two swirling airflows having different directions as shown in Patent Document 2. In this case, an upstream holder (first block) includes a first nozzle for passing the air ejected for applying the swirling airflow in a first direction to the fiber bundle. A downstream holder (second block) includes a second nozzle for passing the air ejected for applying the swirling airflow in a second direction opposing to the first direction to the fiber bundle.

[0102] The guide needle 61b may be omitted. In such a case, the downstream end portion of the fiber guide 61 may function as the guide needle 61b.

[0103] In the above-described first embodiment, as an example, the pneumatic cylinder is described as the driving part for sliding. In the above-described second embodiment, as an example, the ball screw and the stepping motor are described as the driving part. However, the driving part is not limited to the above-described parts. For example, instead of the pneumatic cylinder, a hydraulic cylinder, a solenoid or the like may be adoptable. A servomotor or the like may be adopted as a motor for driving the ball screw. Instead of the cylinder and the ball screw, a linear motor may be adopted.

[0104] In the above-described first embodiment, the second guide groove 97 provided in the second guide plate 96 defines the direction of the first separation operation and the second separation operation. However, the direction of the first separation operation and the second separation operation may be defined by using a configuration other than the second guide groove 97.

[0105] In the above-described first embodiment, the cylinder 83 allows the first block 60 to be slid, and thereby the first block 60 and the second block 70 are moved. In the above-described second embodiment, when the stepping motor 131 allows the second block 70 to be slid and adjusts a position relationship with respect to the front roller 20, the second block 70 and the first block 60 are slid. The driving part may allow only the first block 60 to be moved, only the second block 70 to be moved, or both of first block 60 and the second block 70 to be moved.

[0106] Instead of a configuration in which the yarn joining device 23 is arranged for every spinning unit 2, a work cart that is movable to the plurality of spinning units 2 may be provided in the fine spinning machine. In such a case, the work cart may perform the yarn joining.

[0107] The fiber that is not formed into the spun yarn 10 among the fiber bundle 8 spun in the spinning chamber 62 of the air spinning device 9 passes through a space between the second block 70 and the hollow guide shaft 71, and is then collected by the collecting device (not shown) provided within the spinning machine via a suction pipe connected to the downstream side of the space and a pipe or the like provided in common for the plurality of spinning units 2.

[0108] In each of the spinning units 2, the suction pipe has a first pipe and a second pipe. The first pipe is provided within the first block 60 and extends parallel to the longitudinal direction of the first block 60. The second pipe is provided so as to extend in the direction substantially parallel to the longitudinal direction of the linear portion 97a in the second guide groove 97. The second pipe may have an extensible pipe portion that is extensible in the moving direction so as to permit movement of the air spinning device 9. In a case in which the second pipe has the extensible pipe portion, the damage of the second pipe due to the movement of the air spinning device 9 can be prevented.

[0109] The spinning unit 2 may further have a suction device that includes a third pipe having a suction port capable of sucking a fiber waste generated around the air spinning device 9. Specifically, the suction port is positioned in a side where the fiber inlet port 61a is provided with respect to the air spinning device 9, and in a side where the front roller 20 is provided with respect to the traveling path of the fiber bundle 8. A portion where the suction port is provided in the third pipe may be independently provided or may be mounted to the first block 60. The third pipe is connected to the second pipe. Accordingly, the fiber waste sucked from the suction port is also collected by the collecting device.

[0110] A specific description of the third pipe will be given. The third pipe includes an upstream pipe having a suction port and a downstream pipe that extends toward a direction different form that of the upstream pipe. The longitudinal direction of the downstream pipe is parallel to or substantially parallel to the longitudinal direction of the third pipe (the longitudinal direction of the linear portion 97a or the fiber traveling direction). In a portion where the first pipe is connected to the second pipe, the first pipe has a portion arranged parallel to or substantially parallel to the downstream pipe. Accordingly, the flow of the air from the air spinning device 9 and thus the flow of the air from the suction device can be stabilized.

[0111] The third pipe of the suction device may be connected to a pipe other than the second pipe. The suction device may be omitted.

DESCRIPTION OF THE REFERENCE NUMERALS

[0112]

7	draft device
8	fiber bundle
9	air spinning device
10	spun yarn
60	first block
63	swirling airflow generating nozzle
70	second block
71	hollow guide shaft
73	first pin (insertion member)
80	base part
81	guide rail
82	sliding part
82c	felt seal (sealing member)
83	cylinder (driving part)
90	power transmission part
96	second guide plate (guide member)
97	second guide groove (guide groove)

Claims

1. An air spinning device comprising:

a first block having a travel path that guides a fiber bundle; and
a second block that is arranged downstream of the first block in a fiber traveling direction, and that guides the fiber bundle further toward a downstream side; wherein
the second block can perform a first separation operation and a second separation operation after the first separation operation, the first separation operation being an operation in which the second block is linearly moved away from the first block along the fiber traveling direction, and
the second separation operation being an operation in which the second block is moved or changes its orientation in a direction different from that of the first separation operation.

2. The air spinning device according to claim 1, wherein the first block is movable.

3. The air spinning device according to claim 2, wherein the first block is moved toward the same direction as that of the second block when at least the second block performs the first separation operation.

4. The air spinning device according to any one of claims 1 to 3, wherein
the second separation operation is a moving operation in arc motion.

5. The air spinning device according to any one of claims 1 to 3 comprising:

a guide member having a guide groove including a linear first portion and a second portion along a direction different from that of the first portion; and
an insertion member that is inserted in the guide groove, and that is moved with the second block along the guide groove.

6. The air spinning device according to any one of claims 1 to 5 comprising:

a driving part that generates power for allowing the second block to perform the first separation

operation and the second separation operation.

7. The air spinning device according to claim 6, wherein the driving part includes at least one of a cylinder, a ball screw and a motor, or a linear motor.

8. The air spinning device according to claim 6 or 7 comprising:

a guide rail provided along an arrangement direction of the first block and the second block;
a sliding part that is moved with the second block along the guide rail by the power of the driving part; and
a sealing member that covers a gap between the guide rail and the sliding part.

9. The air spinning device according to claim 8, wherein at least the first block, the second block, the driving part, the guide rail, and the sliding part are integrally removable.

10. The air spinning device according to any one of claims 6 to 9, wherein
the driving part adjusts a position of the second block with respect to the first block in the fiber traveling direction.

11. The air spinning device according to any one of claims 6 to 10, wherein
the driving part is configured to control a moving speed of the second block with respect to the first block.

12. The air spinning device according to any one of claims 1 to 11, wherein
the second separation operation is the operation for changing the orientation of the second block after the second block is moved toward the direction different from that of the first separation operation.

13. The air spinning device according to any one of claims 1 to 12, wherein
the first block includes a swirling airflow generating nozzle for passing air that is ejected for generating a swirling airflow by ejecting the air in a spinning chamber, and
the second block includes a hollow guide shaft for passing the fiber bundle that is twisted by the swirling airflow in the spinning chamber.

14. The air spinning device according to any one of claims 1 to 13, wherein
the first block includes a first nozzle for passing air that is ejected for causing effect of a swirling airflow in a first direction on the fiber bundle,
the second block includes a second nozzle for passing air that is ejected for causing effect of a swirling airflow in a second direction opposing to the first direction on the fiber bundle.

15. A spinning machine comprising:

the air spinning device according to any one of claims 1 to 14;
a draft device that drafts the fiber bundle spun by the air spinning device; and
a winding part that winds a yarn formed by the air spinning device into a package.

16. The spinning machine according to claim 15, wherein
the first block is linearly moved away from the draft device along the fiber traveling direction.

Fig.1

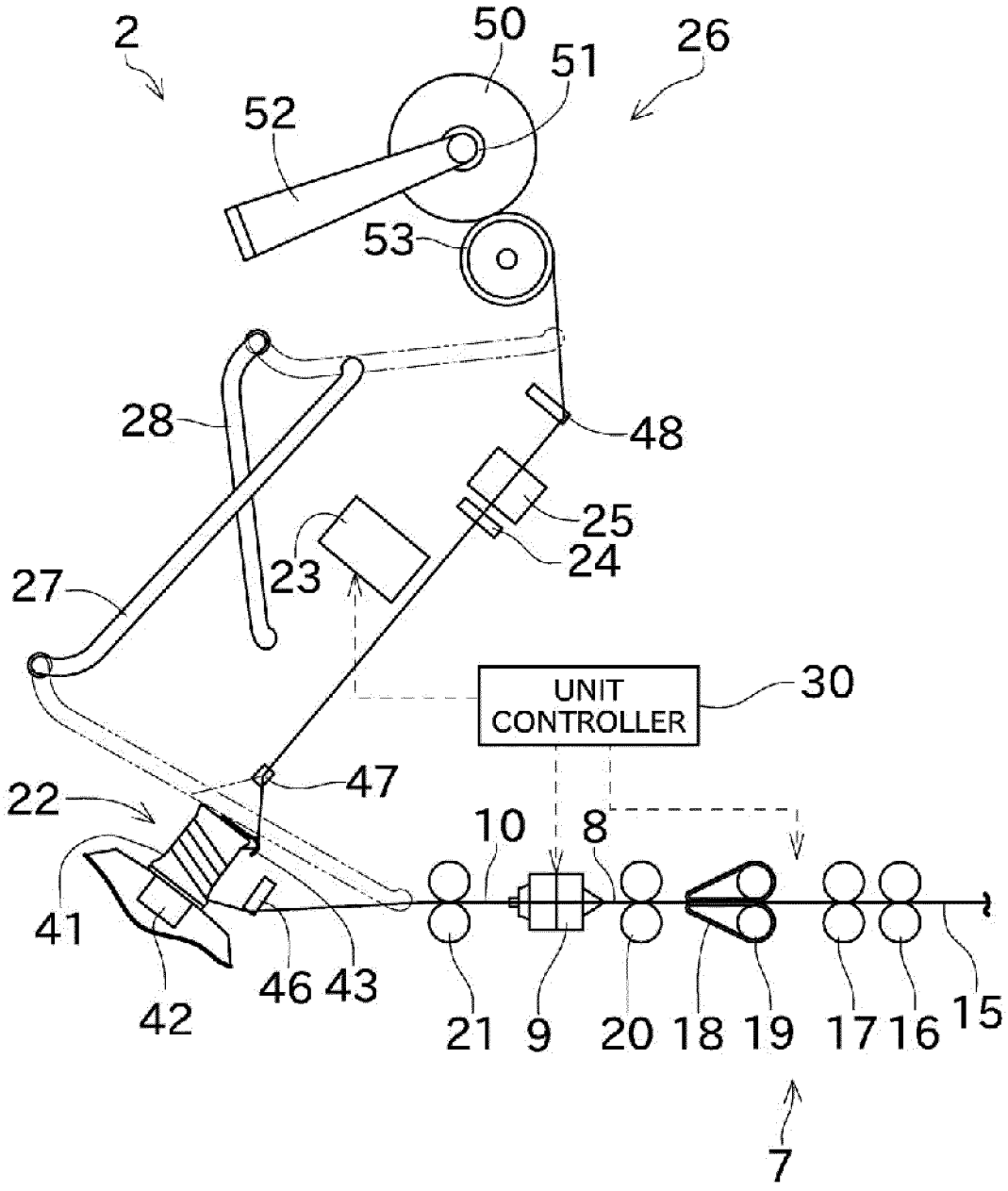

2
50
51
26
52
53
28
48
25
24
23
27
UNIT CONTROLLER
30
47
22
10
8
41
42
46
43
21
9
20
18
19
17
16
15
7

Fig.2

Fig.2A

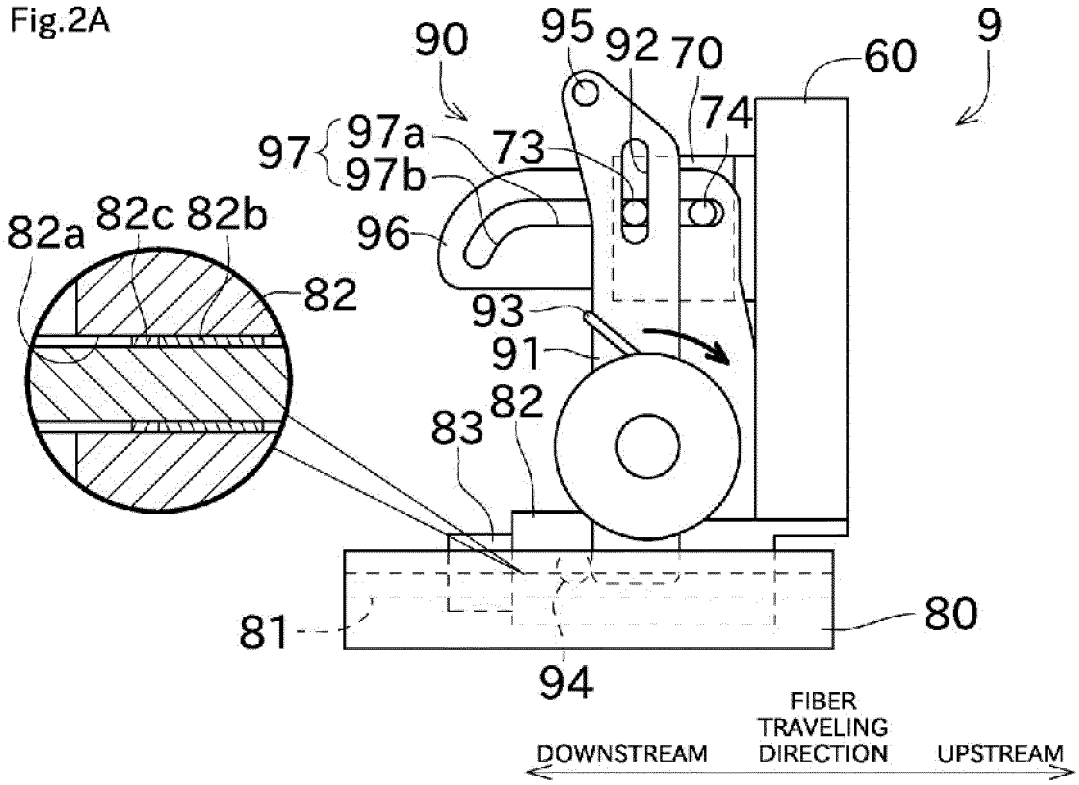


Fig.2B

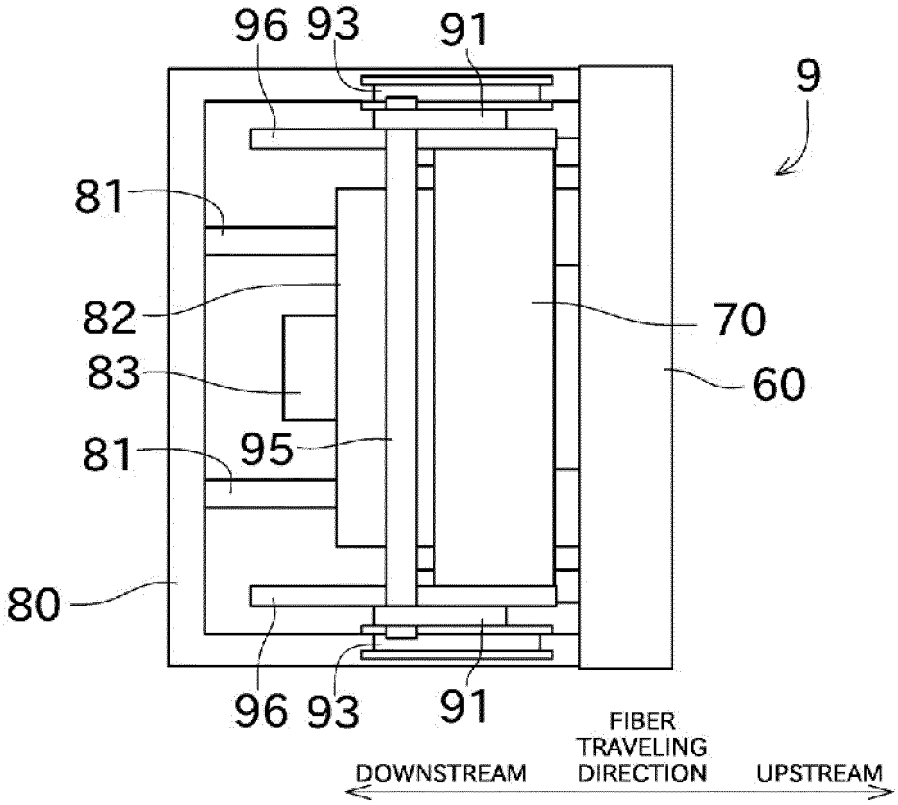


Fig.3

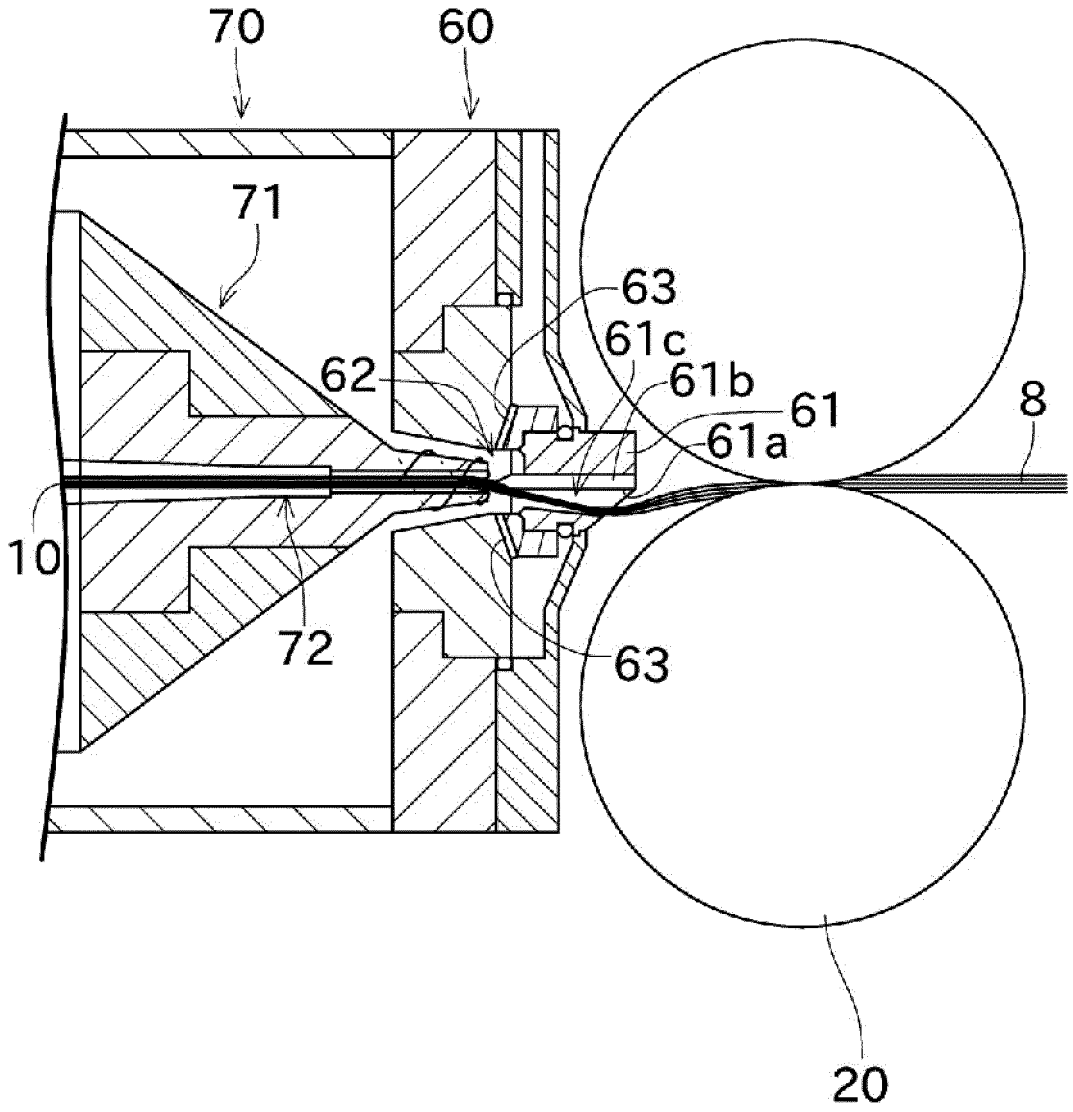


Fig.4

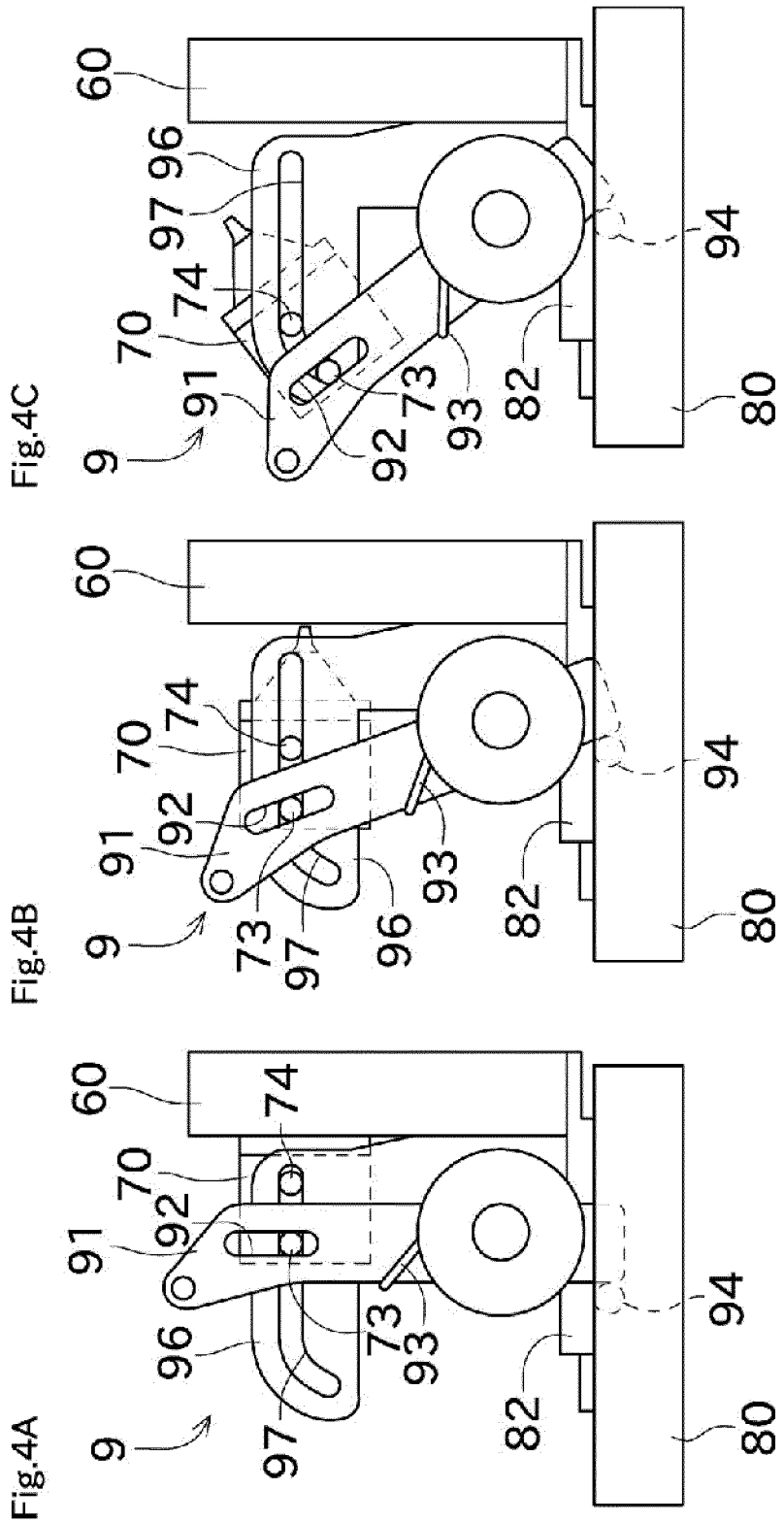


Fig.4C
60
96
97
74
70
91
9
92
73
93
82
94
80
Fig.4B
60
74
70
92
91
9
73
97
96
93
82
94
80
Fig.4A
60
74
70
92
91
96
9
97
73
93
82
94
80

Fig.5

Fig.5A

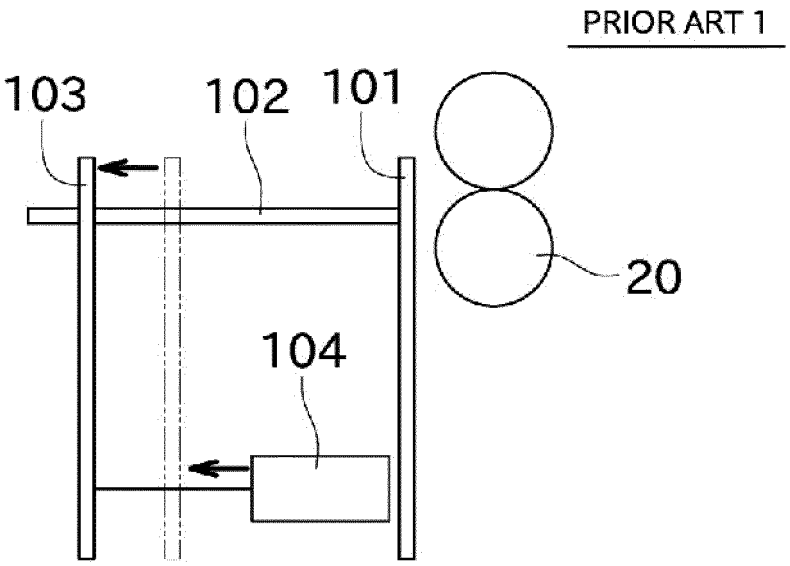


Fig.5B

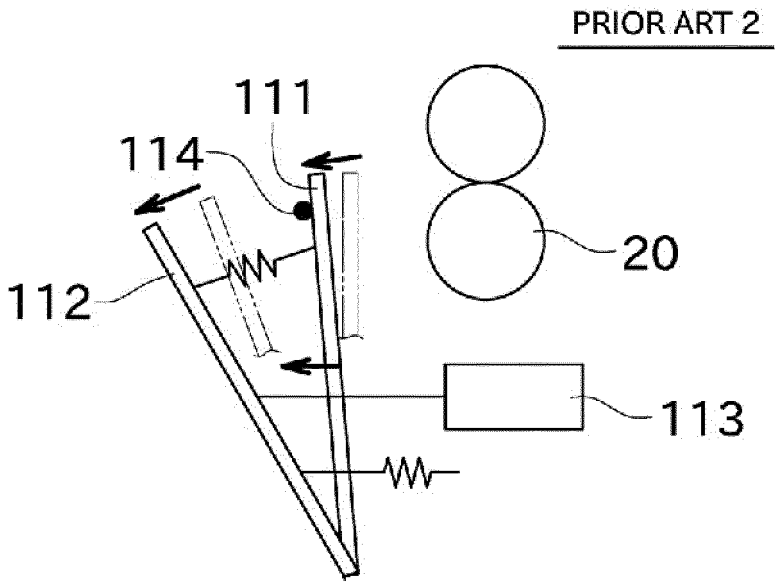


Fig.6

Fig.6A

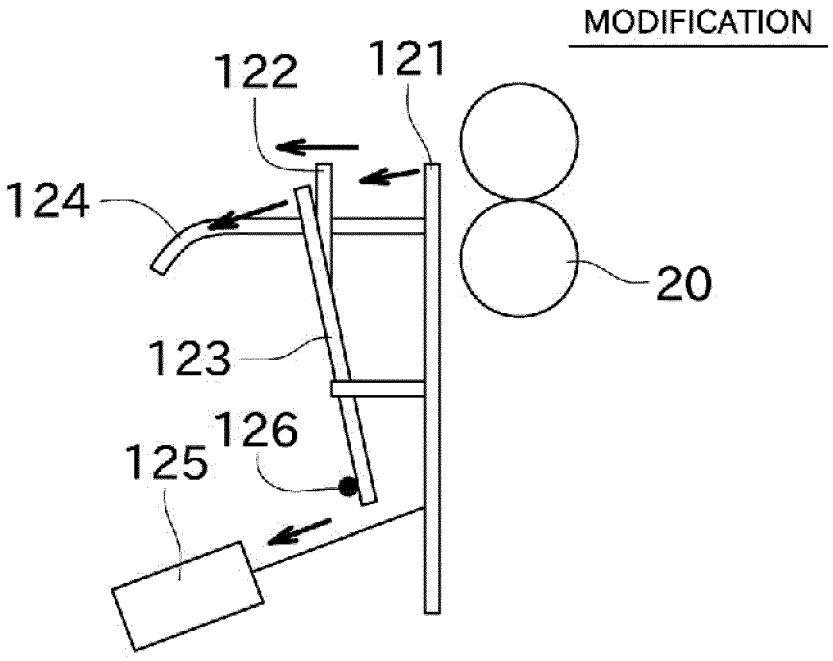


Fig.6B

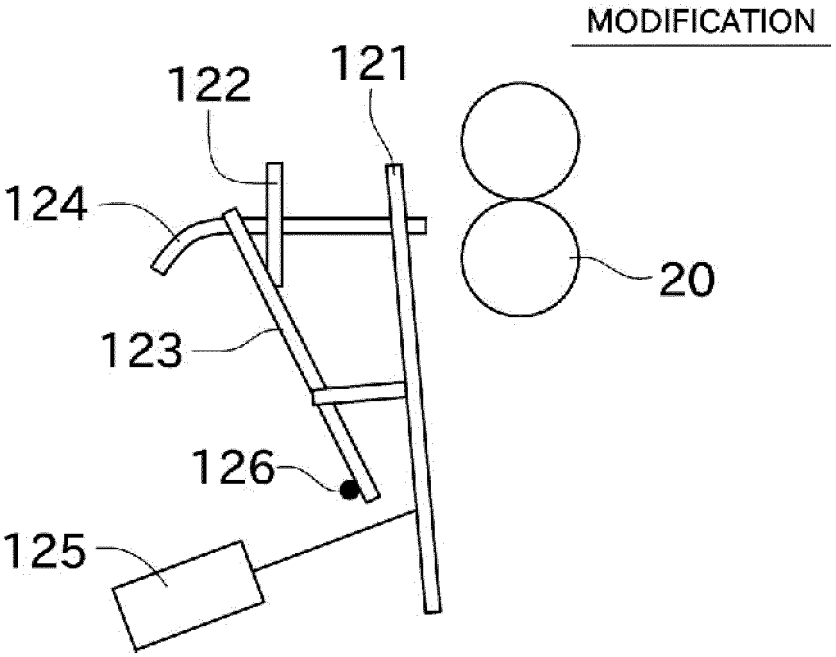


Fig.7

Fig.7A

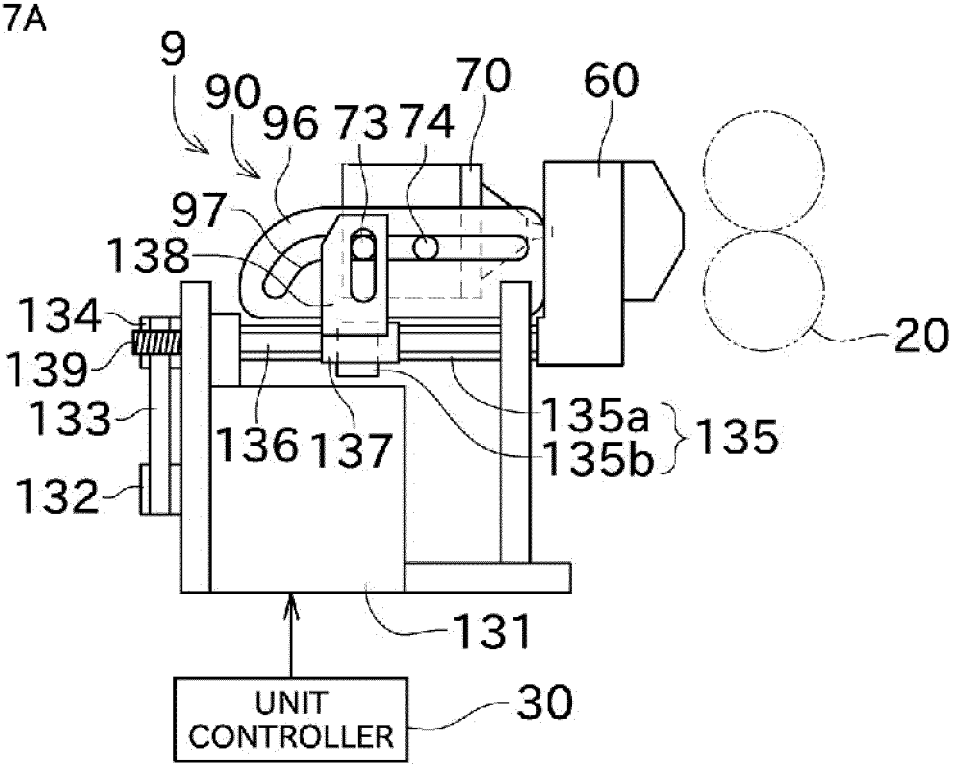


Fig.7B

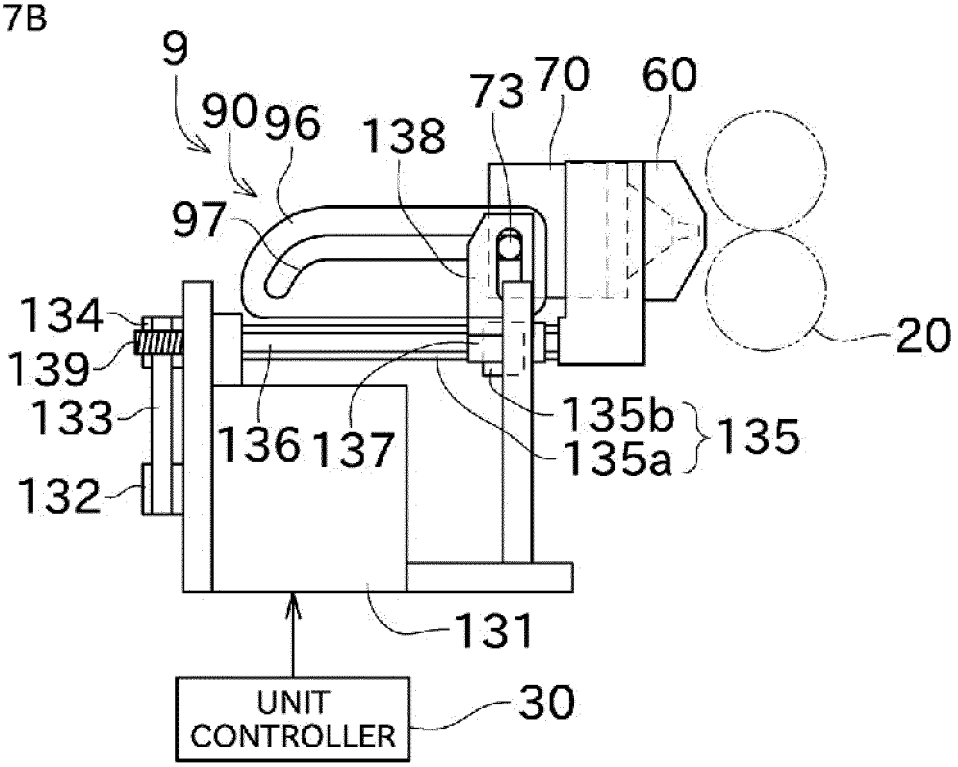


Fig.8

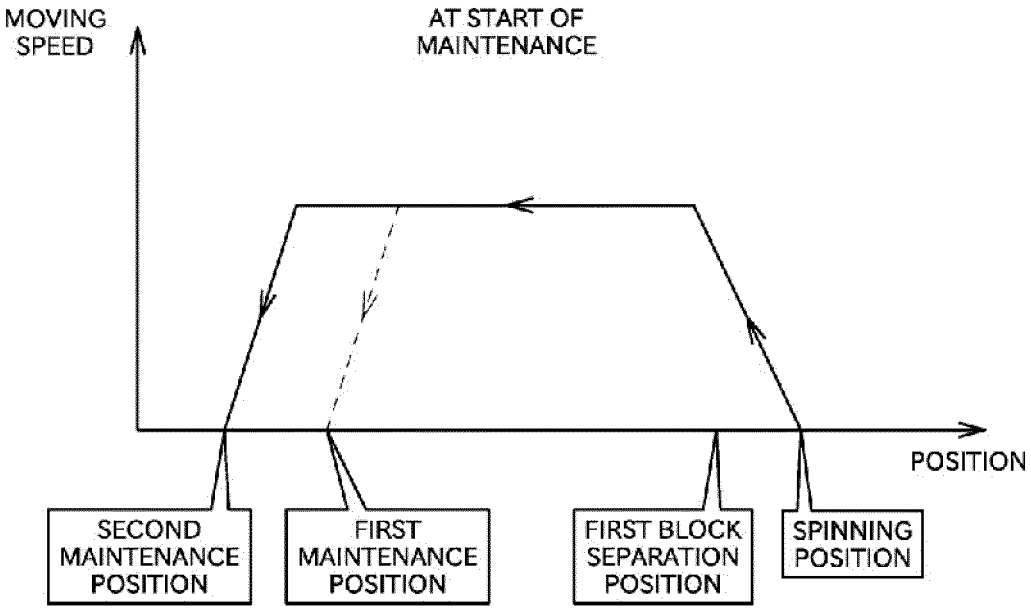
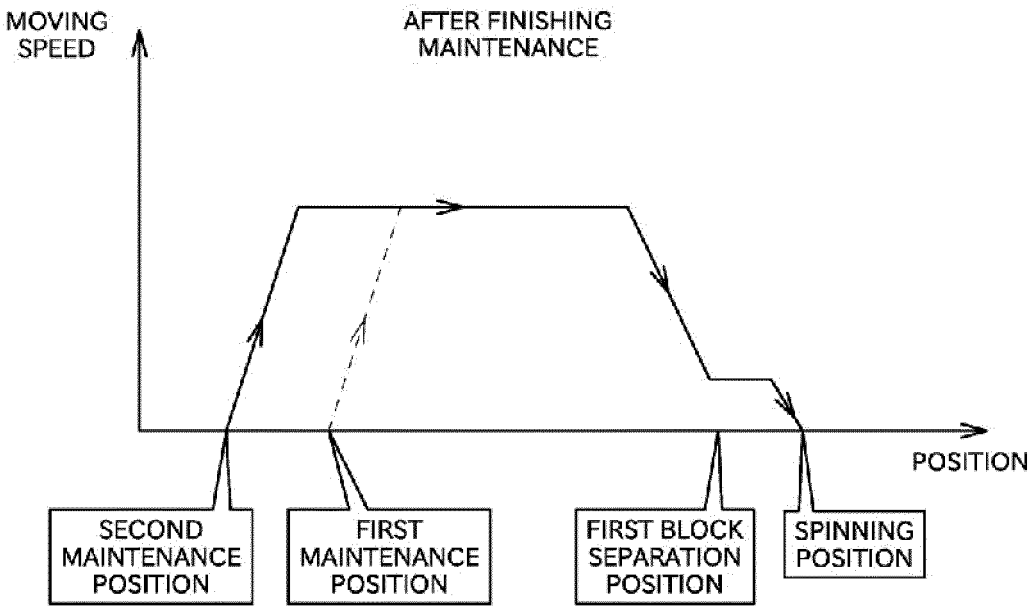

MOVING SPEED
AT START OF MAINTENANCE
POSITION
SECOND MAINTENANCE POSITION
FIRST MAINTENANCE POSITION
FIRST BLOCK SEPARATION POSITION
SPINNING POSITION

Fig.9


MOVING SPEED
AFTER FINISHING MAINTENANCE
POSITION
SECOND MAINTENANCE POSITION
FIRST MAINTENANCE POSITION
FIRST BLOCK SEPARATION POSITION
SPINNING POSITION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003442

A. CLASSIFICATION OF SUBJECT MATTER
D01H1/115(2006.01)i, *D01H4/02*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D01H1/115, D01H4/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 8-218233 A (Murata Machinery Ltd.), 27 August 1996 (27.08.1996), entire text; all drawings (Family: none)	1-16
A	JP 2001-64831 A (Murata Machinery Ltd.), 13 March 2001 (13.03.2001), paragraphs [0021] to [0030]; fig. 1 (Family: none)	1-16
A	JP 2011-38210 A (Murata Machinery Ltd.), 24 February 2011 (24.02.2011), entire text; all drawings & CN 101994172 A	1-16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 September 2015 (16.09.15)	06 October 2015 (06.10.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003442

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2009-242972 A (Murata Machinery Ltd.), 22 October 2009 (22.10.2009), paragraphs [0037], [0109]; fig. 3, 5 & EP 2107141 A2 & CN 101550617 A	1-16

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 8218233 A **[0004]**
- JP 2011038210 A **[0004]**