



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.01.2019 Bulletin 2019/01

(51) Int Cl.:
D01H 1/115 (2006.01) **D01H 5/52 (2006.01)**
D01H 5/56 (2006.01) **D01H 15/00 (2006.01)**

(21) Application number: **18173240.5**

(22) Date of filing: **18.05.2018**

(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:
KH MA MD TN

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

(74) Representative: **Stöckeler, Ferdinand et al**
Schoppe, Zimmermann, Stöckeler
Zinkler, Schenk & Partner mbB
Patentanwälte
Radtkoferstrasse 2
81373 München (DE)

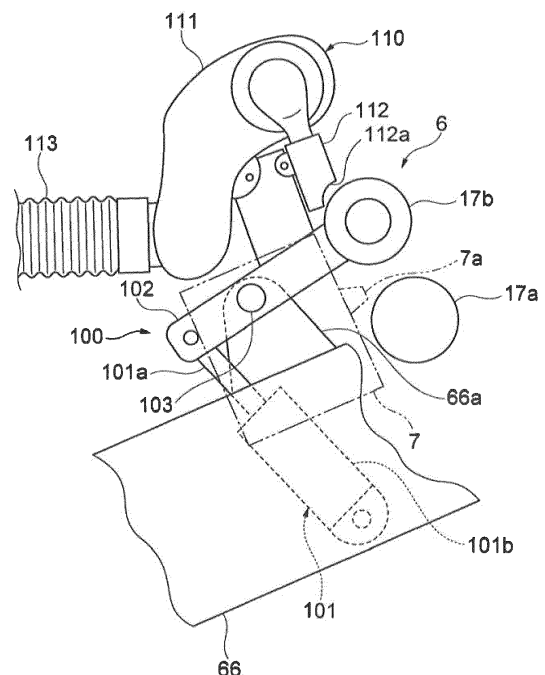
(30) Priority: **28.06.2017 JP 2017126354**

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

(54) **AIR-JET SPINNING MACHINE**

(57) An air-jet spinning machine (1) includes a draft device (6), a pneumatic spinning device (7), and a detecting device (8, 9, 36, 38, 39, 51) adapted to detect a presence or an absence of the yarn (Y). The draft device (6) includes a moving section (100) adapted to move a top roller (17b) between a contacting position and a separated position, the contacting position being a position where the top roller (17b) makes contact with a bottom roller (17a) and the separated position being a position where the top roller (17b) is located away from the bottom roller (17a) and an inlet (7a) of the pneumatic spinning device (7). The moving section (100) moves the top roller (17b) to the separated position at interruption of spinning operation.

FIG. 6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an air-jet spinning machine.

2. Description of the Related Art

[0002] An air-jet 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 a fiber bundle drafted by the draft device has been provided. Such an air-jet spinning machine is, for example, described in Japanese Unexamined Patent Publication No. 2011-38225.

BRIEF SUMMARY OF THE INVENTION

[0003] It was recognized that, when a spinning operation is interrupted, the fiber bundle fed from the draft device may accumulate between a roller pair closest to the pneumatic spinning device (most downstream) in the draft device and an inlet of the pneumatic spinning device. In such a case, a driven roller configuring the roller pair most downstream of the draft device may rub against the accumulated fiber bundle, and wear.

[0004] It is an object of the present invention to provide an air-jet spinning machine capable of preventing the driven roller most downstream of the draft device from being damaged at interruption of the spinning operation. This object is achieved by an air-jet spinning machine according to claim 1.

[0005] An air-jet spinning machine according to the present invention includes a draft device including a first roller pair and a second roller pair and adapted to draft a fiber bundle; a pneumatic spinning device adapted to produce a yarn by applying twists to the fiber bundle, fed from the first roller pair, by whirling flow of air; a withdrawal device adapted to withdraw the yarn from the pneumatic spinning device; a winding device adapted to wind the yarn withdrawn by the withdrawal device; a detecting device adapted to detect a presence or an absence of the yarn; and a yarn joining device adapted to join the yarn produced by the pneumatic spinning device and the yarn wound by the winding device, wherein the first roller pair includes a first driving roller and a first driven roller; the second roller pair includes a second driving roller and a second driven roller; the draft device includes a moving section adapted to move the first driven roller between a contacting position and a separated position, the contacting position being a position where the first driven roller makes contact with the first driving roller and the separated position being a position where the first driven roller is located away from the first driving roller and an inlet of the pneumatic spinning device, and a draft cradle

adapted to cause the second driven roller to make contact with the second driving roller; and the moving section is adapted to move the first driven roller to the separated position and the draft cradle is adapted to maintain the second driven roller in contact with the second driving roller at an interruption of a spinning operation of the yarn.

[0006] In such an air-jet spinning machine, the first driven roller is located at the separated position at the interruption of the spinning operation. In other words, even if the fiber bundle fed from the draft device at the same time as the interruption or immediately after the interruption of the spinning operation is accumulated in the vicinity of the inlet of the pneumatic spinning device, the first driven roller is prevented from being rubbed against the accumulated fiber bundle as the first driven roller is located at the separated position. Thus, the air-jet spinning machine can prevent the driven roller most downstream of the draft device from being damaged at the same time as the interruption or after the interruption of the spinning operation.

[0007] The pneumatic spinning device may include a fiber guiding section adapted to guide the fiber bundle fed from the draft device, a nozzle block including a spinning chamber in which fibers of the fiber bundle guided by the fiber guiding section are whirled by the whirling flow, and a first nozzle through which air for generating the whirling flow passes, and a hollow guide shaft body including a passage adapted to guide the fibers whirled in the spinning chamber to outside, and a second nozzle through which air to be injected into the passage passes, wherein during yarn discharge spinning in which production of the yarn is started from a state in which the fiber bundle is not fed from the draft device, the air may be injected from at least the second nozzle, and the fiber bundle drafted by the draft device may be fed into the spinning chamber from the fiber guiding section. In such a case, in the air-jet spinning machine adapted to produce the yarn by the whirling flow, a draft speed is high speed (compared to a ring spinning machine), and thus even if the yarn discharge spinning fails and the spinning operation is interrupted, for example, the driven roller most downstream of the draft device can be particularly prevented from being damaged.

[0008] The moving section may be adapted to move the first driven roller from the contacting position to the separated position when the detecting device does not detect the yarn within a prescribed period of time from start of the yarn discharge spinning. A case in which the detecting device does not detect the yarn within a prescribed period of time from the start of the yarn discharge spinning is a case in which the pneumatic spinning device fails in the yarn discharge spinning. When the yarn discharge spinning fails, since the fiber bundle is continuously fed from the draft device towards the pneumatic spinning device, the fiber bundle may accumulate in the vicinity of the inlet of the pneumatic spinning device. The driven roller is prevented from being damaged by having the moving section move the first driven roller to the sep-

arated position when the yarn discharge spinning fails.

[0009] The pneumatic spinning device may be adapted to stop the production of the yarn, and the moving section may be adapted to move the first driven roller from the contacting position to the separated position when the detecting device does not detect the yarn during the production of the yarn in the pneumatic spinning device. When the detecting device cannot detect the yarn due to yarn breakage, and the like, the first driven roller is moved to the separated position. Depending on the situation of the yarn breakage, the fiber bundle sometimes accumulates in the vicinity of the inlet of the pneumatic spinning device. Even in such a case, the driven roller is prevented from being damaged by having the moving section move the first driven roller to the separated position.

[0010] The detecting device may be adapted to further detect a presence or an absence of a yarn defect in the yarn in addition to the presence or the absence of the yarn, and the moving section may be adapted to move the first driven roller from the contacting position to the separated position when the detecting device detects the yarn defect during production of the yarn in the pneumatic spinning device. When the yarn defect is detected, a defective portion of the yarn is removed, and thereafter, the yarn joining operation is carried out by the yarn joining device. The fiber bundle fed from the draft device when the yarn is cut or immediately after the yarn is cut due to the detection of the yarn defect may accumulate in the vicinity of the inlet of the pneumatic spinning device. Even in such a case, the air-jet spinning machine can prevent the driven roller from being damaged by moving the first driven roller to the separated position.

[0011] The moving section may be adapted to move the first driven roller to the separated position under a state in which the first driven roller is rotating. In other words, the moving section rapidly moves the first driven roller to the separated position before the supply of fiber bundle to the pneumatic spinning device completely stops. Thus, the air-jet spinning machine can prevent the driven roller from being damaged by the accumulation of the fiber bundle even when the draft device is feeding the fiber bundle to the pneumatic spinning device at high speed.

[0012] The moving section may include a first pneumatic cylinder configured to be extended and retracted by air pressure, and may move the first driven roller to the separated position by the first pneumatic cylinder being extended or retracted. Generally, the pneumatic cylinder that is extended or retracted by pressure of the supplied air can be rapidly extended or retracted by increasing the air pressure. Thus, the moving section can rapidly move the first driven roller to the separated position by using the first pneumatic cylinder.

[0013] The moving section may include a lever adapted to move the first driven roller, and may move the first driven roller to the separated position by the lever being operated. In such a case, the moving section can move

the first driven roller to the separated position at, for example, timing desired by an operator operating the lever.

[0014] The draft device may further include a pressing section adapted to press the first driven roller against the first driving roller. In such a case, the draft device can have the fiber bundle sandwiched with the first roller pair under a pressed state, and thus can draft the fiber bundle without slipping at the first roller pair.

[0015] The air-jet spinning machine may further include a suction device arranged on the moving section and provided with a suction opening arranged facing the first driven roller. In such a case, the air-jet spinning machine can suck fibers attached to the first driven roller and the like with the suction device. Furthermore, the air-jet spinning machine can move the suction device accompanying the movement of the first driven roller to the separated position by the moving section.

[0016] The air-jet spinning machine may include a plurality of spinning units, each spinning unit including the draft device, the pneumatic spinning device, the withdrawal device, the winding device, and the detecting device, wherein the yarn joining device may be provided one for a prescribed number of the spinning units or each of the plurality of the spinning units, and the moving section of the draft device provided in the respective spinning units may be adapted to move the first driven roller to the separated position independently of one another. In such a case, the air-jet spinning machine can move the first driven roller of a desired spinning unit to the separated position without influencing the spinning operation of the other spinning units. For example, a replacement work, and the like of the first driven roller of the desired spinning unit can be carried out while the spinning operation of the other spinning units is continuing.

[0017] In the air-jet spinning machine, each of the plurality of the spinning units may further include a suction device arranged on the moving section and provided with a suction opening arranged facing the first driven roller. In such a case, the air-jet spinning machine can suck the fibers attached to the respective first driven roller and the like of the spinning units with the suction device arranged in each spinning unit. Furthermore, the air-jet spinning machine can move the suction device accompanying the movement of the first driven roller to the separated position by the moving section 100 in each spinning unit.

[0018] Each of the plurality of the draft devices may further include a pressing section adapted to press the first driven roller towards the first driving roller, and the respective pressing section provided in the plurality of the draft devices may be adapted to press the first driven roller against the first driving roller independently of one another. In such a case, the draft device can have the fiber bundle sandwiched with the first roller pair under a pressed state, and thus can draft the fiber bundle without slipping at the first roller pair. Furthermore, the air-jet spinning machine can press the first driven roller of the desired spinning unit against the first driving roller irrespective of the pressing state of the draft device of the

other spinning units. In other words, even if the first driven roller in another spinning unit is located at the separated position, the spinning operation can continue in the desired spinning unit.

[0019] The pressing section may include one of a second pneumatic cylinder configured to be extended and retracted by air pressure and a spring, and the first driven roller may be adapted to be pressed against the first driving roller by the second pneumatic cylinder being extended or retracted, or by an elastic force of the spring. When the pressing section includes the second pneumatic cylinder, the pressing section can easily change the pressure at which the first driven roller is pressed by adjusting the pressure of the air supplied to the second pneumatic cylinder. When the pressing section includes the spring, the pressing section can press the first driven roller against the first driving roller without receiving supply of air, and the like.

[0020] The inlet of the draft device may be located below the winding device in a height direction. In such a case, the air-jet spinning machine can wind the produced yarn while having the fiber bundle and the yarn travel from the lower side towards the upper side in the height direction of the air-jet spinning machine.

[0021] According to the present invention, the driven roller most downstream of the draft device can be prevented from being damaged at the interruption of the spinning operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a front view of a spinning machine according to one embodiment of the present invention;
 FIG. 2 is a side view of a spinning unit of the spinning machine of FIG. 1;
 FIG. 3 is a cross-sectional view of a pneumatic spinning device of FIG. 1;
 FIG. 4 is a side view illustrating a structure of a moving section and a periphery of the moving section in a state a top roller is located at a contacting position;
 FIG. 5 is a top view illustrating a structure of the moving section and the periphery of the moving section;
 FIG. 6 is a side view illustrating a structure of the moving section and the periphery of the moving section in a state the top roller is located at a separated position;
 FIG. 7 is a control block diagram of the spinning unit; and
 FIG. 8 is a side view of the spinning unit according to an alternative embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0023] An embodiment of the present invention will be hereinafter described in detail with reference to the ac-

companying drawings. The same reference numerals are denoted on the same or corresponding portions throughout the drawings, and redundant description will be omitted.

[0024] As illustrated in FIG. 1, an air-jet spinning machine 1 includes a plurality of spinning units 2, a yarn joining cart 3, a doffing cart (not illustrated), a first end frame 4, and a second end frame 5. The plurality of the spinning units 2 are arranged in a row. Each of the spinning units 2 is adapted to produce a yarn Y and to wind the yarn Y around a package P. The yarn joining cart 3 is adapted to perform a yarn joining operation in a spinning unit 2 after the yarn Y is cut, or is broken for some reason in such a spinning unit 2. The doffing cart is adapted to doff a package P and to supply a new bobbin B to a spinning unit 2 after the package P is fully-wound in such a spinning unit 2. The first end frame 4 accommodates, for example, a collecting device adapted to collect a fiber waste, a yarn waste, and the like generated in the spinning units 2.

[0025] The second end frame 5 accommodates an air supplying section 5a (see FIG. 7) adapted to adjust pressure of compressed air (air) to be supplied to each section of the air-jet spinning machine 1 and to supply the air to each section of the spinning unit 2, and the like. The second end frame 5 is provided with a machine control device 41, a display screen 42, and an input key 43. The machine control device 41 is adapted to intensively manage and control each section of the air-jet spinning machine 1. The display screen 42 is capable of displaying information relating to set contents and/or status, or the like of the spinning units 2. An operator can perform a setting operation of the spinning units 2 by performing an appropriate operation with the input key 43.

[0026] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a pneumatic spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn accumulating device (withdrawal device) 11, a waxing device 12, and a winding device 13 in this order from upstream in a travelling direction of the yarn Y. A unit controller 10 is provided for every prescribed number of the spinning units 2 and is adapted to control operations of the spinning units 2. In the present embodiment, an inlet of the draft device 6 is arranged above the winding device 13 in a height direction.

[0027] The draft device 6 is adapted to draft a sliver (fiber bundle) S to produce a fiber bundle F. The draft device 6 includes a back roller pair 14, a third roller pair 15, a middle roller pair (second roller pair) 16 and a front roller pair (first roller pair) 17 in this order from upstream in a travelling direction of the sliver S. The back roller pair 14 includes a bottom roller 14a and a top roller 14b. The third roller pair 15 includes a bottom roller 15a and a top roller 15b. The middle roller pair 16 includes a bottom roller (second driving roller) 16a, and a top roller (second driven roller) 16b. The front roller pair 17 includes a bottom roller (first driving roller) 17a and a top roller (first

driven roller) 17b. Each bottom roller 14a, 15a, 16a, 17a is rotationally driven by the drive motor provided in the second end frame 5 or by a drive motor provided in each spinning unit 2. An apron belt 18b is provided with respect to the top roller 16b of the middle roller pair 16. An apron belt 18a is provided with respect to the bottom roller 16a of the middle roller pair 16.

[0028] The top rollers 14b, 15b, 16b are rotatably supported by a draft cradle 65 arranged in the draft device 6. The draft cradle 65 can be swung with a swing shaft as a center to move to a position where the top roller 14b, 15b, 16b is respectively pressed against the bottom roller 14a, 15a, 16a, and a position where the top roller 14b, 15b, 16b is respectively separated from the bottom roller 14a, 15a, 16a. In other words, the draft cradle 65 brings the top roller 14b, 15b, 16b into contact with the bottom roller 14a, 15a, 16a, respectively.

[0029] The top roller 17b is pressed against the bottom roller 17a by a moving section 100 (see FIG. 4). The structure of the moving section 100 will be described later. In other words, the top roller 17b is pressed against the bottom roller 17a and moved away from the bottom roller 17a independent from the other top rollers 14b, 15b, 16b.

[0030] The draft device 6 drafts the sliver S by having the sliver S travel from the back roller pair 14 through the third roller pair 15 and the middle roller pair 16 and towards the front roller pair 17 to produce the fiber bundle F.

[0031] The pneumatic spinning device 7 is adapted to produce the yarn Y by applying twists to the fiber bundle F, which has been fed from the front roller pair 17 of the draft device 6, with whirling flow of air. More specifically, as illustrated in FIG. 3, the pneumatic spinning device 7 includes a nozzle block 70 and a hollow guide shaft body 80. In the nozzle block 70, the whirling flow of air acts on the fiber bundle F fed from the draft device 6 while the fiber bundle F is guided inward. The fiber bundle F applied with twists is passed through the hollow guide shaft body 80 and fed to the outside. The generation and stopping of whirling flow are controlled by the unit controller 10.

[0032] The nozzle block 70 includes a fiber guiding section 71 and a whirling flow generating section 72. The fiber guiding section 71 includes a guide hole 71a adapted to guide the fiber bundle F fed from the draft device 6. An end on the draft device 6 side of the guide hole 71a is an inlet 7a of the sliver S. The whirling flow generating section 72 includes a spinning chamber 73 and a plurality of first nozzles 74. A distal end portion 75a of a needle 75 held by the fiber guiding section 71 is located in the spinning chamber 73.

[0033] In the spinning chamber 73, a back end of fibers of the fiber bundle F introduced through the guide hole 71a is whirled by the whirling flow of air. In order to generate the whirling flow in the spinning chamber 73, air is injected from the plurality of first nozzles 74 to the spinning chamber 73. In other words, air for generating the whirling flow passes through the plurality of first nozzles 74. An opening 72a is provided in the whirling flow gen-

erating section 72 so as to be continuous with the spinning chamber 73. The opening 72a is formed in a frustoconical shape tapered towards the upstream. The needle 75 prevents twists of the fiber bundle F from being propagated towards the upstream of the pneumatic spinning device 7.

[0034] An upstream end 80a of the hollow guide shaft body 80 is formed in a frustoconical shape tapered towards the upstream, and is arranged in the opening 72a of the whirling flow generating section 72 with a gap therebetween. When a flange-shaped cap 87 attached to the hollow guide shaft body 80 makes contact with a frame-shaped holder 76 adapted to support the nozzle block 70, the hollow guide shaft body 80 is positioned with respect to the spinning chamber 73. The air injected from the plurality of first nozzles 74 to the spinning chamber 73 flows into a decompressing chamber 77 formed in the holder 76 through the gap formed between the end 80a of the hollow guide shaft body 80 and the opening 72a of the whirling flow generating section 72, and is discharged with fibers that did not become the yarn Y.

[0035] The hollow guide shaft body 80 includes a passage 81 and a plurality of second nozzles 84. The passage 81 feeds (guides) the yarn Y (fibers whirled in the spinning chamber 73) to the outside. The air is injected from the plurality of second nozzles 84 to the passage 81.

[0036] The passage 81 extends along a center axial line of the hollow guide shaft body 80, and is formed to spread from an inlet 82 towards an outlet 83. Air is supplied to each second nozzle 84 through an air supply path 86 and an air flow path 85.

[0037] In the pneumatic spinning device 7, the air is injected from at least the plurality of second nozzles 84 to the passage 81 during a yarn discharge spinning period. The fiber bundle F drafted by the draft device 6 is thereby fed to the spinning chamber 73 through the guide hole 71a. Thereafter, the air is also injected from the plurality of first nozzles 74 to the spinning chamber 73. In the spinning chamber 73, the air flows towards downstream (i.e., towards a gap formed between the end 80a of the hollow guide shaft body 80 and the opening 72a of the whirling flow generating section 72) while whirling in one direction. Thus, the fiber bundle F introduced to the spinning chamber 73 is fed to the vicinity of the inlet 82 of the passage 81 while being applied with loose false twists. Since the air flows downstream (i.e., towards the outlet 83 of the passage 81) while whirling in the other direction opposite the one direction in the passage 81, the fiber bundle F fed to the vicinity of the inlet 82 of the passage 81 is passed through the passage 81 while being spun to a fasciated yarn form, and guided out from the outlet 83.

[0038] The yarn discharge spinning is the spinning carried out at the start of or when resuming the spinning. In other words, the yarn discharge spinning is the spinning operation in which the supply of the fiber bundle F to the pneumatic spinning device 7 is started from a state the fiber bundle F is not being fed from the draft device 6 to

the pneumatic spinning device 7, and the pneumatic spinning device 7 starts the production of the yarn Y using the fiber bundle F. During a normal spinning period in which the yarn Y fed from the pneumatic spinning device 7 is wound into the package P, the air is not injected from the second nozzle 84 and the air is injected from the first nozzle 74.

[0039] An outlet sensor 51 is provided between the pneumatic spinning device 7 and the yarn monitoring device 8. The outlet sensor 51 detects a presence or an absence of the yarn Y at the outlet of the yarn Y in the pneumatic spinning device 7. The outlet sensor 51 may be omitted.

[0040] The yarn monitoring device 8 is adapted to monitor information on the travelling yarn Y between the pneumatic spinning device 7 and the yarn accumulating device 11, and to detect a presence or an absence of a yarn defect based on the information acquired by the monitoring. When detecting the yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects a thickness abnormality of the yarn Y and/or a foreign substance included in the yarn Y, for example, as the yarn defect. The yarn monitoring device 8 also detects yarn breakage (when excessive tension is applied on the yarn Y thus breaking the yarn Y), and the like. In other words, the yarn monitoring device 8 detects a presence or an absence of the yarn Y as well as a presence or an absence of a yarn defect. The yarn monitoring device 8 may detect only one of the presence or the absence of the yarn Y and the presence or the absence of the yarn defect.

[0041] 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 11, and to transmit a tension measurement signal to the unit controller 10. When the yarn Y is absent, the tension sensor 9 cannot measure the tension of the yarn Y. Therefore, the tension sensor 9 can also detect the presence or the absence of the yarn Y. When the unit controller 10 determines a presence of an abnormality based on a detection result of the yarn monitoring device 8 and/or the tension sensor 9, the yarn Y is cut in the spinning unit 2. Specifically, by stopping air supply to the pneumatic spinning device 7 to interrupt the production of the yarn Y, the yarn Y is cut. Alternatively, the yarn Y may be cut with a cutter separately provided.

[0042] The yarn accumulating device 11 is adapted to eliminate the slackening of the yarn Y between the pneumatic spinning device 7 and the winding device 13. The yarn accumulating device 11 has a function of stably withdrawing the yarn Y from the pneumatic spinning device 7, a function of preventing the yarn Y from slackening by accumulating the yarn Y fed from the pneumatic spinning device 7 at the time of the yarn joining operation or the like by the yarn joining device 26, and a function of preventing variation in the tension of the yarn Y at downstream of the yarn accumulating device 11 from being

propagated to the pneumatic spinning device 7.

[0043] Specifically, the yarn accumulating device 11 includes a yarn accumulating roller 33, an electric motor 34 for rotatably driving the yarn accumulating roller 33, and a yarn hooking member 35. The yarn Y is temporarily accumulated by being wound around an outer peripheral surface of the yarn accumulating roller 33.

[0044] The yarn hooking member 35 is attached to a downstream end of the yarn accumulating roller 33. The yarn hooking member 35 is supported in a relatively rotatable manner with respect to the yarn accumulating roller 33. A permanent magnet is attached to one of the yarn hooking member 35 and the yarn accumulating roller 33, and a magnetic hysteresis material is attached to the other one of the yarn hooking member 35 and the yarn accumulating roller 33. Such magnetic means generates a torque against the relative rotation of the yarn hooking member 35 with respect to the yarn accumulating roller 33. Therefore, only when a force greater than the torque is applied to the yarn hooking member 35 (when a yarn tension greater than or equal to a prescribed value is applied), the yarn hooking member 35 relatively rotates with respect to the yarn accumulating roller 33, and the yarn Y wound around the yarn accumulating roller 33 can be unwound. When a force greater than the torque is not applied to the yarn hooking member 35, the yarn accumulating roller 33 and the yarn hooking member 35 integrally rotate, and the yarn Y is accumulated on the yarn accumulating roller 33.

[0045] As described above, the yarn accumulating device 11 operates to unwind the yarn Y when the yarn tension at the downstream increases, and stop the unwinding of the yarn Y when the yarn tension decreases (when the yarn Y starts to slacken). Thus, the yarn accumulating device 11 can resolve the slackening of the yarn Y, and apply an appropriate tension to the yarn Y. With the yarn hooking member 35 operating to absorb variation in the tension applied to the yarn Y between the yarn accumulating device 11 and the winding device 13, as described above, the variation in the tension can be prevented from affecting the yarn Y from the pneumatic spinning device 7 to the yarn accumulating device 11.

[0046] The yarn accumulating device 11 includes an accumulation amount detection sensor 36, and an excessive winding detection sensor 37. The accumulation amount detection sensor 36 detects whether or not a minimum required yarn Y is accumulated on the yarn accumulating roller 33. The accumulation amount detection sensor 36 can detect the presence or the absence of the yarn Y at the yarn accumulating roller 33. The excessive winding detection sensor 37 detects whether or not the yarn Y exceeding a predefined amount is wound around the yarn accumulating roller 33.

[0047] The waxing device 12 is adapted to apply wax to the yarn Y between the yarn accumulating device 11 and the winding device 13. A yarn detection sensor 38 adapted to detect a presence or an absence of the yarn Y is arranged between the waxing device 12 and the

winding device 13.

[0048] The winding device 13 is adapted to wind the yarn Y withdrawn from the pneumatic spinning device 7 by the yarn accumulating device 11 around a bobbin B to form the package P. The winding device 13 includes a cradle arm 21, a winding drum 22, and a traverse guide 23. The cradle arm 21 is adapted to rotatably support the bobbin B. The cradle arm 21 is swingably supported by a supporting shaft 24 and is adapted to bring a surface of the bobbin B or a surface of the package P into contact with a surface of the winding drum 22 under appropriate pressure. A drive motor (not illustrated) provided in the second end frame 5 is adapted to simultaneously drive the winding drums 22 each provided in the plurality of the spinning units 2. Accordingly, in each spinning unit 2, the bobbin B or the package P is rotated in a winding direction. The traverse guide 23 of each spinning unit 2 is provided on a shaft 25 shared by the plurality of the spinning units 2. By driving the shaft 25 to reciprocate in a rotation axis direction of the winding drum 22 by the drive motor in the second end frame 5, the traverse guide 23 traverses the yarn Y in a prescribed width with respect to the rotating bobbin B or package P.

[0049] The air-jet spinning machine 1 includes a plurality of yarn joining carts 3. One yarn joining cart 3 is provided for a plurality of (prescribed number of) spinning units 2. Only one yarn joining cart 3 may be provided in the air-jet spinning machine 1 depending on the number of spinning units 2 arranged in the air-jet spinning machine 1. After the yarn Y is cut or is broken for some reason in a spinning unit 2, the yarn joining cart 3 travels to such a spinning unit 2 to perform the yarn joining operation. The yarn joining cart 3 includes a yarn joining device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a supporting shaft 31, and is adapted to catch the yarn Y fed from the pneumatic spinning device 7 and to guide the caught yarn Y to the yarn joining device 26. The suction mouth 28 is swingably supported by a supporting shaft 32, and is adapted to catch the yarn Y from the winding device 13 and to guide the caught yarn Y to the yarn joining device 26. The suction pipe 27 and the suction mouth 28 catch the yarn Y by sucking. A suction sensor 39 is attached in the suction pipe 27. The suction sensor 39 detects the presence or the absence of the yarn Y sucked by the suction pipe 27. In other words, the suction sensor 39 detects whether or not the yarn Y is fed from the pneumatic spinning device 7.

[0050] The yarn joining device 26 is adapted to join the guided yarns Y together. In other words, the yarn joining device 26 joins the yarn Y produced by the pneumatic spinning device 7 and the yarn Y wound by the winding device 13. The yarn joining device 26 is a splicer using the compressed air, a knotter adapted to join the yarns Y together in a mechanical manner, or the like. When the yarn joining cart 3 performs the yarn joining operation, the package P is rotated in an unwinding direction (reversely rotated). More specifically, the cradle arm 21 is

moved by a pneumatic cylinder (not illustrated) such that the package P is moved away from the winding drum 22, and the package P is reversely rotated by a reversely-rotating roller (not illustrated) provided in the yarn joining cart 3.

[0051] As described above, the outlet sensor 51, the yarn monitoring device 8, the tension sensor 9, the accumulation amount detection sensor 36, the yarn detection sensor 38, and the suction sensor 39 function as a detecting device adapted to detect a presence or an absence of the yarn Y.

[0052] Next, description will be made on a structure of the moving section 100 adapted to move the top roller 17b. As illustrated in FIGS. 4 to 6, the draft device 6 includes the moving section 100 adapted to move the top roller 17b. The moving section 100 moves the top roller 17b between a contacting position (state of FIG. 4) and a separated position (state of FIG. 6), the contacting position being a position where the top roller 17b makes contact with the bottom roller 17a and the separated position being a position where the top roller 17b is located away from the bottom roller 17a and the inlet 7a of the pneumatic spinning device 7. In FIGS. 4 and 6, the pneumatic spinning device 7 is indicated with a virtual line to illustrate the structure of the moving section 100. In FIG. 5, a frame 66 and a suction device 110 are omitted to illustrate the structure of the moving section 100.

[0053] Specifically, the moving section 100 includes a pneumatic cylinder (first pneumatic cylinder, second pneumatic cylinder) 101, and a swinging portion 102. The swinging portion 102 is attached to a fixing portion 66a provided on the frame 66 in a manner to be swingable about a shaft 103. One end of the swinging portion 102 rotatably supports the top roller 17b. The other end of the swinging portion 102 is coupled to the pneumatic cylinder 101. The frame 66 is, for example, a member adapted to support at least some devices of each spinning unit 2.

[0054] The pneumatic cylinder 101 is configured to be extended and retracted by the pressure of the supplied air. The pneumatic cylinder 101 includes a rod portion 101a and a main body portion 101b. In the present embodiment, the rod portion 101a of the pneumatic cylinder 101 moves in a direction the pneumatic cylinder 101 extends and in a direction the pneumatic cylinder 101 retracts by the air pressure. Specifically, two air supply tubes are connected to the main body portion 101b. When air is supplied from one air supply tube to the main body portion 101b, the rod portion 101a moves with respect to the main body portion 101b in the direction the pneumatic cylinder 101 extends. When air is supplied from the other air supply tube to the main body portion 101b, the rod portion 101a moves with respect to the main body portion 101b in the direction the pneumatic cylinder 101 retracts.

[0055] As the pneumatic cylinder 101 is extended by air pressure, the swinging portion 102 is swung with the shaft 103 as the center and the top roller 17b is brought

into contact with the bottom roller 17a. The front roller pair 17 drafts the sliver S under a state in which the top roller 17b is located at the contacting position. The pressure for pressing the top roller 17b against the bottom roller 17a changes by the pressure of the air supplied to the pneumatic cylinder 101. In the present embodiment, the pressure of the air supplied to the pneumatic cylinder 101 is adjusted so that the sliver S is sandwiched with the predefined pressure at the front roller pair 17. As described above, in the present embodiment, the moving section 100 also functions as a pressing section adapted to press the top roller 17b against the bottom roller 17a. When the moving section 100 functions as the pressing section, the pneumatic cylinder 101 functions as a second pneumatic cylinder adapted to press the top roller 17b against the bottom roller 17a by extending.

[0056] As the pneumatic cylinder 101 is retracted by air pressure, the swinging portion 102 is swung with the shaft 103 as the center and the top roller 17b is moved away from the bottom roller 17a. As described above, the moving section 100 moves the top roller 17b to the contacting position by extending the pneumatic cylinder 101, and moves the top roller 17b to the separated position by retracting the pneumatic cylinder 101. The moving section 100 may move the top roller 17b to the contacting position by retracting the pneumatic cylinder 101, and move the top roller 17b to the separated position by extending the pneumatic cylinder 101. When the moving section 100 functions as the pressing section in such a structure, the pneumatic cylinder 101 functions as the second pneumatic cylinder adapted to press the top roller 17b against the bottom roller 17a by retracting.

[0057] The moving section 100 is provided for each of the draft devices 6 of the plurality of spinning units 2 arranged in the air-jet spinning machine 1. The moving section 100 arranged for each spinning unit 2 moves the top roller 17b between the contacting position and the separated position independently of one another. The moving section 100 arranged for each spinning unit 2 presses the top roller 17b against the bottom roller 17a independently of one another.

[0058] The spinning unit 2 further includes the suction device 110. The suction device 110 includes a main body portion 111, a suction nozzle 112, and a flexible portion 113. The main body portion 111 is a hollow shaped member, and is fixed to the swinging portion 102. The suction nozzle 112 extends from the main body portion 111 towards the proximity of the top roller 17b. A suction port 112a is provided at a distal end portion of the suction nozzle 112. The suction port 112a is provided with respect to the top roller 17b. One end of the flexible portion 113 is connected to the main body portion 111. The other end of the flexible portion 113 is connected to a suction tube, and the like leading to the collecting device arranged in the first end frame 4. The flexible portion 113 is, for example, an accordion shaped tube, and has flexibility.

[0059] The suction device 110 is fixed to the swinging

portion 102 of the moving section 100. The suction device 110 moves accompanying the movement of the top roller 17b. The suction device 110 is provided for each of the plurality of spinning units 2 arranged in the air-jet spinning machine 1.

[0060] Next, an operation timing of the moving section 100 will be described. In the present embodiment, as illustrated in FIG. 7, the operation of the moving section 100 is controlled by the unit controller 10. Specifically, the unit controller 10 controls the supply of compressed air from the air supplying section 5a of the second end frame 5 to the pneumatic cylinder 101. The top roller 17b is moved between the contacting position and the separated position by the unit controller 10 controlling the supply of compressed air to the pneumatic cylinder 101.

[0061] The unit controller 10 moves the top roller 17b from the contacting position to the separated position by means of the moving section 100 at the interruption of the spinning operation of the yarn Y. The interruption of the spinning operation is when the spinning operation of the yarn Y in the pneumatic spinning device 7 and the winding of the yarn Y in the winding device 13 cannot be carried out. For example, the interruption of the spinning operation is when the yarn Y is not fed from the pneumatic spinning device 7 or when the yarn Y is cut or the Y is broken for some reason. The spinning operation is also interrupted when the package P is fully wound. Furthermore, the spinning operation is also interrupted when the power of the spinning unit 2 or the air-jet spinning machine 1 is turned OFF, when performing maintenance, and the like. During a period in which the spinning operation is interrupted, the draft operation of the draft device 6 and the winding operation of the winding device 13 are also interrupted.

[0062] The unit controller 10 moves the top roller 17b from the contacting position to the separated position by means of the moving section 100 based on the detection results of the outlet sensor 51, the yarn monitoring device 8, the tension sensor 9, the accumulation amount detection sensor 36, the yarn detection sensor 38, and the suction sensor 39. Even if the moving section 100 moves the top roller 17b to the separated position at the interruption of the spinning operation, the top roller 14b, 15b, 16b remains contacting the bottom roller 14a, 15a, 16a until the draft cradle 65 is operated by the operator, and the like.

[0063] The moving section 100 starts moving the top roller 17b to the separated position while the top roller 17b is rotating. In other words, the unit controller 10 moves the top roller 17b to the separated position before the rotation of the top roller 17b completely stops after the interruption of the spinning operation.

[0064] First, the control of the moving section 100 at the start of the yarn discharge spinning will be described. After the start of the yarn discharge spinning (after start of injection of air from the second nozzle 84), the yarn Y fed from the pneumatic spinning device 7 is caught by the suction pipe 27 of the yarn joining cart 3 and guided

to the yarn joining device 26. When the yarn discharge spinning fails, the yarn Y is not fed from the pneumatic spinning device 7, and the yarn Y is not caught by the suction pipe 27. Thus, when the pneumatic spinning device 7 fails in the yarn discharge spinning, the unit controller 10 moves the top roller 17b from the contacting position to the separated position by means of the moving section 100. Specifically, when the output sensor 51 does not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning, the unit controller 10 moves the top roller 17b to the separated position.

[0065] When the suction sensor 39 provided in the suction pipe 27 does not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning, the unit controller 10 may move the top roller 17b to the separated position. When the accumulation amount detection sensor 36 does not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning, the unit controller 10 may move the top roller 17b to the separated position. When the yarn monitoring device 8 does not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning, the unit controller 10 may move the top roller 17b to the separated position. In the present embodiment, the failure of the yarn discharge spinning is detected early in the order of the outlet sensor 51, the suction sensor 39, the accumulation amount detection sensor 36, and the yarn monitoring device 8.

[0066] Next, the control of the moving section 100 when the yarn Y breaks during the spinning operation will be described. A case in which the yarn Y breaks during the spinning operation is a case in which the yarn Y is no longer detected by the outlet sensor 51 and the like while the pneumatic spinning device 7 is producing the yarn Y (during normal spinning period). When the yarn Y is no longer detected by at least one of the output sensor 51, the yarn monitoring device 8, the tension sensor 9, the accumulation amount detection sensor 36, and the yarn detection sensor 38 during the spinning operation by the spinning unit 2, the unit controller 10 moves the top roller 17b from the contacting position to the separated position by means of the moving section 100. When the yarn Y is not detected, the unit controller 10 interrupts the production (spinning operation) of the yarn Y by the pneumatic spinning device 7.

[0067] Next, the control of the moving section 100 when a yarn defect is detected by the yarn monitoring device 8 during the spinning operation will be described. When the yarn defect is detected by the yarn monitoring device 8 and the unit controller 10 determines that the abnormality is present, the yarn Y is cut. In other words, when the yarn defect is detected by the yarn monitoring device 8 and the detected yarn defect is a yarn defect that needs to be removed by cutting the yarn Y, the unit controller 10 moves the top roller 17b from the contacting position to the separated position by means of the moving section 100. When the yarn defect is detected and the detected yarn defect is a yarn defect that needs to be

removed by cutting the yarn Y, the unit controller 10 interrupts the production (spinning operation) of the yarn Y by the pneumatic spinning device 7 and cuts the yarn Y.

[0068] As described above, in the air-jet spinning machine 1 of the present embodiment, the top roller 17b is moved to the separated position by the moving section 100 at the interruption of the spinning operation. In other words, even if the fiber bundle F fed from the draft device 6 at the same time as the interruption or immediately after the interruption of the spinning operation is accumulated in the vicinity of the inlet 7a of the pneumatic spinning device 7, the top roller 17b is prevented from rubbing against the accumulated fiber bundle F as the top roller 17b is located at the separated position. Thus, the air-jet spinning machine 1 can prevent the driven roller (top roller 17b), which is located most downstream of the draft device 6 and on the pneumatic spinning device 7 side, from being damaged at the same time as the interruption or after the interruption of the spinning operation.

[0069] The pneumatic spinning device 7 includes the first nozzle 74 through which air for generating the whirling flow in the spinning chamber 73 passes, and the second nozzle 84 through which air injected to the passage 81 for guiding the fibers whirled in the spinning chamber 73 to the outside passes. In such a case, the pneumatic spinning device 7 can produce the yarn Y by the whirling flow. The pneumatic spinning device 7 can carry out the yarn discharge spinning by injecting air at least from the second nozzle 84.

[0070] When the outlet sensor 51 and the like do not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning, the moving section 100 moves the top roller 17b from the contacting position to the separated position. A case in which the outlet sensor 51 and the like do not detect the yarn Y within a prescribed time from the start of the yarn discharge spinning is a case in which the pneumatic spinning device 7 fails in the yarn discharge spinning. When the yarn discharge spinning fails, the fiber bundle F is fed from the draft device 6 towards the pneumatic spinning device 7 until the draft operation of the draft device 6 is stopped. Thus, the fiber bundle F may accumulate in the vicinity of the inlet 7a of the pneumatic spinning device 7. By moving the top roller 17b to the separated position by the moving section 100 when the yarn discharge spinning fails, the top roller 17b can be prevented from being damaged. When the yarn discharge spinning is successful, the spinning operation by the pneumatic spinning device 7, and the like are continued.

[0071] When the outlet sensor 51 and the like do not detect the yarn Y during the production of the yarn Y in the pneumatic spinning device 7, the pneumatic spinning device 7 stops the production of the yarn Y, and the moving section 100 moves the top roller 17b from the contacting position to the separated position. The movement of the top roller 17b to the separated position may be started at the same time as the stopping of the production of the yarn Y. When the outlet sensor 51 and the like

cannot detect the yarn Y due to yarn breakage, and the like, the top roller 17b is caused to move to the separated position. The fiber bundle F may accumulate in the vicinity of the inlet 7a of the pneumatic spinning device 7 depending on the situation of the yarn breakage. Even in such a case, the top roller 17b can be prevented from being damaged by moving the top roller 17b to the separated position by the moving section 100.

[0072] When the yarn monitoring device 8 detects a yarn defect during the production of the yarn Y in the pneumatic spinning device 7, the moving section 100 moves the top roller 17b from the contacting position to the separated position. When the yarn defect is detected, the defective portion of the yarn Y is removed, and then the yarn joining operation is carried out by the yarn joining device 26. The fiber bundle F fed from the draft device 6 when the yarn Y is cut or immediately thereafter due to the detection of the yarn defect may accumulate in the vicinity of the inlet 7a of the pneumatic spinning device 7. Even in such a case, the top roller 17b can be prevented from being damaged by moving the top roller 17b to the separated position by the moving section 100.

[0073] The moving section 100 moves the top roller 17b to the separated position under a state in which the top roller 17b is rotating. In other words, the moving section 100 rapidly moves the top roller 17b to the separated position before the supply of the fiber bundle F to the pneumatic spinning device 7 completely stops. Thus, the air-jet spinning machine 1 can prevent the top roller 17b from being damaged by the accumulation of the fiber bundle F even if the draft device 6 is feeding the fiber bundle F to the pneumatic spinning device 7 at high speed.

[0074] The moving section 100 moves the top roller 17b to the separated position by retracting the pneumatic cylinder 101. Generally, the pneumatic cylinder that is extended and retracted by the pressure of the supplied air can be rapidly extended and retracted by increasing the air pressure. Thus, the moving section 100 can rapidly move the top roller 17b to the separated position using the pneumatic cylinder 101.

[0075] The air-jet spinning machine 1 includes a plurality of spinning units 2. The moving section 100 of the draft device 6 in each of the plurality of spinning units 2 moves the top roller 17b to the separated position independently. In such a case, the air-jet spinning machine 1 can move a top roller 17b of a desired spinning unit 2 to the separated position without influencing the spinning operation of the other spinning units 2. For example, the air-jet spinning machine 1 can carry out the replacement work and the like of a top roller 17b of a desired spinning unit 2 while the spinning operation of the other spinning units 2 is continuing.

[0076] The moving section 100 of the draft device 6 of each of the plurality of spinning units 2 also serves as a pressing section adapted to press the top roller 17b against the bottom roller 17a. In such a case, the draft device 6 can sandwich the fiber bundle F in a pressed

state with the front roller pair 17, and can draft the fiber bundle F without slipping at the front roller pair 17. Furthermore, the air-jet spinning machine 1 can press a top roller 17b of a desired spinning unit 2 against a bottom roller 17a irrespective of the pressed state of the draft device 6 of the other spinning units 2. In other words, even if the top roller 17b in another spinning unit 2 is located at the separated position, the spinning operation can continue in the desired spinning unit 2.

[0077] The moving section 100 presses the top roller 17b against the bottom roller 17a using the pneumatic cylinder 101. In such a case, the moving section 100 can easily change the pressure at which the top roller 17b is pressed, by adjusting the pressure of the air to be supplied to the pneumatic cylinder 101.

[0078] The suction device 110 attached to the moving section 100 is arranged in each of the plurality of spinning units 2. In such a case, the air-jet spinning machine 1 can suck the fibers attached to the respective top roller 17b and the like of the spinning unit 2 with the suction device 110 arranged in each spinning unit 2. Furthermore, the air-jet spinning machine 1 can move the suction device 110 accompanying the movement of the top roller 17b to the separated position by the moving section 100.

[0079] Next, description on an alternative embodiment will be made. The air-jet spinning machine 1 according to the present alternative embodiment includes a plurality of spinning units 2A illustrated in FIG. 8 in place of the spinning units 2 illustrated in FIG. 2 and the like. The spinning unit 2A illustrated in FIG. 8 includes the same devices as the spinning unit 2 along the travelling direction of the yarn Y. In the spinning unit 2A, the inlet of the draft device 6 is located below the winding device 13 in the height direction. The spinning unit 2A has a different travelling direction of the yarn Y from the draft device 6 to the winding device 13 with respect to the spinning unit 2. Each device in the spinning unit 2A is the same as each device in the spinning unit 2 described using FIG. 2 and the like, and same reference numerals as each device in the spinning unit 2 are denoted and detailed description will be omitted.

[0080] Each device arranged in the spinning unit 2A is attached to a frame 67. The spinning unit 2A includes a case storing section 68 adapted to be able to store a sliver case SC accommodating the sliver S. The case storing section 68 is configured by a space portion formed with the frame 67. The sliver case SC is located below the draft device 6 and the pneumatic spinning device 7 in the height direction. The sliver case SC is stored in the case storing section 68. The sliver S accommodated in the sliver case SC is supplied to the draft device 6 by way of a sliver guide (not illustrated).

[0081] In the present alternative embodiment, the yarn joining device 26 adapted to carry out the yarn joining operation, the suction pipe 27, and the suction mouth 28 are arranged in respective spinning units 2A. However, the air-jet spinning machine 1 may include a plurality of yarn joining carts 3 in the present alternative embodiment

as well, similar to the embodiment. One yarn joining cart 3 (yarn joining device 26) may be provided for a plurality of spinning units 2A. Only one yarn joining cart 3 may be provided in the air-jet spinning machine 1 depending on the number of spinning units 2A.

[0082] In the present alternative embodiment as well, the draft device 6 includes the moving section 100 adapted to move the top roller 17b, similar to the embodiment. Operation effects similar to the embodiment can also be obtained in the air-jet spinning machine 1 including the spinning unit 2A according to the present alternative embodiment. Furthermore, in the present alternative embodiment, the inlet of the draft device 6 is located below the winding device 13 in the height direction. In such a case, the air-jet spinning machine 1 can wind the produced yarn Y while having the fiber bundle F and the yarn Y to travel from the lower side towards the upper side in the height direction.

[0083] The embodiments of the present invention have been described above, but the present invention is not limited to the above embodiments.

[0084] The moving section 100 also serves as the pressing section adapted to press the top roller 17b against the bottom roller 17a, but the air-jet spinning machine 1 may include a pressing section separate from the moving section 100. For example, the air-jet spinning machine 1 may include a spring as the pressing section. The top roller 17b may be pressed against the bottom roller 17a by the elastic force of the spring. When the spring is provided as the pressing section, the pressing section can press the top roller 17b against the bottom roller 17a without receiving supply of air, and the like.

[0085] The moving section 100 may include a lever adapted to move the top roller 17b to the separated position. The lever may be operated by an operator. The moving section 100 can move the top roller 17b to the separated position at, for example, timing desired by the operator operating the lever. When the lever is arranged on the moving section 100, the pneumatic cylinder 101 for moving the top roller 17b may not be provided. Alternatively, the lever may be arranged on the moving section 100, in addition to the pneumatic cylinder 101. In such a case, apart from the top roller 17b being moved by the pneumatic cylinder 101 at the interruption of the spinning operation, for example, the top roller 17b can be moved to the separated position by the lever being operated by the operator and the like for maintenance work and the like. As described above, the moving section 100 may function as the pressing section, and the top roller 17b may be pressed against the bottom roller 17a by the extension or retraction of the pneumatic cylinder 101. In this case, when the lever is operated by the operator and the like, the supply of air to the pneumatic cylinder 101 is preferably stopped. Furthermore, the lever arranged on the moving section 100 may be configured to move the top roller 17b from the separated position to the contacting position when the lever is operated. The lever arranged on the moving section 100 is not limited to being

operated by the operator, and may be operated by at least one of another device arranged in the spinning unit 2, 2A, the yarn joining cart 3, and a robot.

[0086] The presence or the absence of failure of the yarn discharge spinning may be determined based on a detection result of a sensor arranged in a doffing cart. The doffing cart includes a suction nozzle (guiding section) adapted to catch the yarn Y fed from the pneumatic spinning device 7 at the time of yarn discharge spinning, and guide the yarn Y to a new bobbin B supplied to the spinning unit 2. For example, such doffing cart may guide the yarn Y caught with the suction nozzle to the new bobbin B at the same time as the supply of the new bobbin B to the spinning unit 2 or after the supply of the new bobbin B. A sensor (detecting device) adapted to detect a presence or an absence of the sucked yarn Y may be arranged with respect to the suction nozzle of the doffing cart. In this case, the presence or the absence of failure of the yarn discharge spinning may be determined based on the detection result of the sensor, similar to the outlet sensor 51 and the like.

[0087] The air-jet spinning machine 1 in the embodiment may include a service vehicle adapted to supply a new bobbin B, around which the yarn Y is not wound, to the spinning unit 2, in place of the doffing cart. The service vehicle includes a suction nozzle (guiding section) adapted to catch the yarn Y fed from the pneumatic spinning device 7 at the time of yarn discharge spinning, and guide the yarn Y to the new bobbin B. A sensor (detecting device) adapted to detect a presence or an absence of the sucked yarn Y is arranged with respect to the suction nozzle of the service vehicle. In this case, the presence or the absence of failure of the yarn discharge spinning may be determined based on the detection result of the sensor, similar to the outlet sensor 51 and the like.

[0088] The yarn joining device 26 adapted to carry out the yarn joining operation, the suction pipe 27, and the suction mouth 28 may be arranged with respect to the respective spinning unit 2 in the embodiment, similar to the alternative embodiment.

[0089] In the embodiment and the alternative embodiment, the draft device 6 may move the top roller 17b from the separated position to the contacting position, and then rotate the front roller pair 17 in a direction opposite the draft direction before resuming the draft operation. The fiber waste clogged at the inlet of the pneumatic spinning device 7 thus can be withdrawn. The withdrawn fiber waste may be sucked by a suction hole (not illustrated) provided between the bottom roller 17a and the pneumatic spinning device 7. Thereafter, the draft operation by the draft device 6, the spinning operation by the pneumatic spinning device 7 and the like are resumed.

[0090] In the embodiment and the alternative embodiment, the yarn monitoring device 8 is arranged upstream of the yarn accumulating device 11, but the yarn monitoring device 8 may be arranged downstream of the yarn accumulating device 11. Furthermore, in the embodi-

ment and the alternative embodiment, various detecting devices such as the outlet sensor 51 are arranged, but only the yarn monitoring device 8 may be arranged at the position of the waxing device 12. In such a case, the presence or the absence of the yarn Y is determined based on the detection result of the yarn monitoring device 8.

[0091] All or at least one of the outlet sensor 51, the tension sensor 9, the suction sensor 39, and the accumulation amount detection sensor 36 may be omitted. When the outlet sensor 51 is arranged, the suction sensor 39 may be omitted. When the suction sensor 39 is arranged, the outlet sensor 51 may be omitted. The detection result of the accumulation amount detection sensor 36 may not be used for the control of the moving section 100 and may be used only for the control of the rotation of the yarn accumulating roller 33. The failure of the yarn discharge spinning may be detected based on all the detection results of the yarn monitoring device 8, the outlet sensor 51, the suction sensor 39, and the accumulation amount detection sensor 36. The failure of the yarn discharge spinning may be detected based on at least one of the yarn monitoring device 8, the outlet sensor 51, the suction sensor 39, and the accumulation amount detection sensor 36.

[0092] In place of the needle 75, the pneumatic spinning device 7 may prevent the twists of the fiber bundle F from being propagated to upstream of the pneumatic spinning device 7 by a downstream end portion of the fiber guiding section 71. Furthermore, instead of the above-described configuration, the pneumatic spinning device 7 may include a pair of air-jet nozzles respectively adapted to twist the fiber bundle F in directions opposite from each other.

[0093] In the spinning unit 2, 2A, the yarn accumulating device 11 has a function of withdrawing the yarn Y from the pneumatic spinning device 7, but the yarn Y may be withdrawn from the pneumatic spinning device 7 with a delivery roller and a nip roller. In a case of withdrawing the yarn Y from the pneumatic spinning device 7 with the delivery roller and the nip roller, a slack tube adapted to absorb the slackening of the yarn Y with suction airflow, and/or a mechanic compensator or the like may be provided instead of the yarn accumulating device 11.

[0094] In the air-jet spinning machine 1, at least one of the bottom rollers in the draft device 6 and the traverse guides 23 are driven by power from the second end frame 5 (that is, common among the plurality of spinning units 2, 2A). However, each section (for example, the draft device 6, the pneumatic spinning device 7, the winding device 13, or the like) of the spinning unit 2, 2A may be driven independently for each spinning unit 2, 2A.

[0095] In the travelling direction of the yarn Y, the tension sensor 9 may be arranged upstream of the yarn monitoring device 8. The unit controller 10 may be provided for each spinning unit 2, 2A. In the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 may be omitted.

[0096] FIG. 1 illustrates the air-jet spinning machine 1 so as to wind a cheese package P, but the air-jet spinning machine 1 can also wind a conical package P. In a case of the conical package, the slackening of a yarn Y occurs by traversing the yarn Y, but the slackening can be absorbed with the yarn accumulating device 11. A material and a shape of each component are not limited to the above-mentioned material and shape, and various materials and shapes can be adopted.

[0097] In the embodiment described above, an example has been described in which the draft device 6 includes the back roller pair 14, the third roller pair 15, the middle roller pair 16, and the front roller pair 17. However, the front roller pair (roller pair arranged at the position closest to the pneumatic spinning device in a transportation path of the fiber bundle) may be configured as a part of another device. For example, the spinning unit may include a supplying device adapted to supply the fiber bundle drafted with the draft device to the pneumatic spinning device, and the front roller pair may be included as one part of the supplying device. The front roller pair may be included in the draft device adapted to draft the fiber bundle or the supplying device adapted to supply the fiber bundle to the pneumatic spinning device, or may be provided alone without being included in another device.

[0098] The spinning unit 2, 2A may be configured to carry out a warm-up operation. In this case, the draft device 6 is operated under a state in which the sliver S (fiber bundle F) is not set in the draft device 6. Specifically, when a warm-up operation instructing button (not illustrated) provided on the air-jet spinning machine 1 and/or spinning unit 2, 2A is operated, the front top roller 17a is moved to the contacting position and the draft device 6 is idled. After the warm-up operation is finished, the moving section 100 may move the front top roller 17a to the separated position.

Claims

1. An air-jet spinning machine (1) comprising:

- a draft device (6) including a first roller pair (17) and a second roller pair (16) and adapted to draft a fiber bundle (F);
- a pneumatic spinning device (7) adapted to produce a yarn (Y) by applying twists to the fiber bundle (F), fed from the first roller pair (17), by a whirling flow of air;
- a withdrawal device (11) adapted to withdraw the yarn (Y) from the pneumatic spinning device (7);
- a winding device (13) adapted to wind the yarn (Y) withdrawn by the withdrawal device (11);
- a detecting device (8; 9; 36; 38; 39; 51) adapted to detect a presence or an absence of the yarn (Y); and

a yarn joining device (26) adapted to join the yarn (Y) produced by the pneumatic spinning device (7) and the yarn (Y) wound by the winding device (13),

wherein the first roller pair (17) includes a first driving roller (17a) and a first driven roller (17b); the second roller pair (18) includes a second driving roller (18a) and a second driven roller (18b);

the draft device (6) includes:

a moving section (100) adapted to move the first driven roller (17b) between a contacting position and a separated position, the contacting position being a position where the first driven roller (17b) makes contact with the first driving roller (17a) and the separated position being a position where the first driven roller (17b) is located away from the first driving roller (17a) and an inlet (7a) of the pneumatic spinning device (7), and a draft cradle (65) adapted to cause the second driven roller (18b) to make contact with the second driving roller (18a); and

the moving section (100) is adapted to move the first driven roller (17b) to the separated position and the draft cradle (65) is adapted to maintain the second driven roller (18b) in contact with the second driving roller (18a), at an interruption of a spinning operation of the yarn (Y).

2. The air-jet spinning machine (1) as claimed in claim 1, wherein the pneumatic spinning device (7) includes:

a fiber guiding section (71) adapted to guide the fiber bundle (F) fed from the draft device (6); a nozzle block (70) including a spinning chamber (73) in which fibers of the fiber bundle (F) guided by the fiber guiding section (71) are whirled by the whirling flow, and a first nozzle (74) through which air for generating the whirling flow passes; and

a hollow guide shaft body (80) including a passage (81) adapted to guide the fibers whirled in the spinning chamber (73) to outside, and a second nozzle (84) through which air to be injected into the passage (81) passes,

wherein during yarn discharge spinning in which production of the yarn (Y) is started from a state in which the fiber bundle (F) is not fed from the draft device (6), the air is injected from at least the second nozzle (84), and the fiber bundle (F) drafted by the draft device (6) is fed into the spinning chamber (73) from the fiber guiding section (71).

3. The air-jet spinning machine (1) as claimed in claim 2, wherein the moving section (100) is adapted to move the first driven roller (17b) from the contacting position to the separated position when the detecting device (8; 9; 36; 38; 39; 51) does not detect the yarn (Y) within a prescribed period of time from a start of the yarn discharge spinning.

4. The air-jet spinning machine (1) as claimed in any one of claims 1 to 3, wherein the pneumatic spinning device (7) is adapted to stop production of the yarn (Y) and the moving section (100) is adapted to move the first driven roller (17b) from the contacting position to the separated position when the detecting device (8; 9; 36; 38; 39; 51) does not detect the yarn (Y) during production of the yarn (Y) by the pneumatic spinning device (7).

5. The air-jet spinning machine (1) as claimed in any one of claims 1 to 4, wherein the detecting device (8; 9) is adapted to further detect a presence or an absence of a yarn defect in the yarn (Y) in addition to the presence or the absence of the yarn (Y), and the moving section (100) is adapted to move the first driven roller (17b) from the contacting position to the separated position when the detecting device (8; 9) detects the yarn defect during production of the yarn (Y) by the pneumatic spinning device (7).

6. The air-jet spinning machine (1) as claimed in any one of claims 1 to 5, wherein the moving section (100) is adapted to move the first driven roller (17b) to the separated position under a state in which the first driven roller (17b) is rotating.

7. The air-jet spinning machine (1) as claimed in any one of claims 1 to 6, wherein the moving section (100) includes a first pneumatic cylinder (101) configured to be extended and retracted by air pressure, and the first driven roller (17b) is moved to the separated position by the first pneumatic cylinder (101) being extended or retracted.

8. The air-jet spinning machine (1) as claimed in any one of claims 1 to 7, wherein the moving section (100) includes a lever adapted to move the first driven roller (17b), and the first driven roller (17b) is moved to the separated position by the lever being operated.

9. The air-jet spinning machine (1) as claimed in any one of claims 1 to 8, wherein the draft device (6) includes a pressing section (100) adapted to press the first driven roller (17b) against the first driving roller (17a).

10. The air-jet spinning machine (1) as claimed in any one of claims 1 to 9, comprising a suction device

(110) arranged on the moving section (100) and provided with a suction opening (112a) arranged facing the first driven roller (17b).

11. The air-jet spinning machine (1) as claimed in any one of claims 1 to 8, comprising a plurality of spinning units (2), each spinning unit (2) including the draft device (6), the pneumatic spinning device (7), the withdrawal device (11), the winding device (13), and the detecting device (8; 9; 36; 38; 39; 51), wherein the yarn joining device (26) is provided for a predetermined number of the spinning units (2) or for each of the plurality of the spinning units (2), and the moving sections (100) of the draft device (6) provided in the respective spinning units (2) are adapted to move the first driven roller (17b) to the separated position independently of one another. 5
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12. The air-jet spinning machine (1) as claimed in claim 11, wherein each of the plurality of the spinning units (2) includes a suction device (110) arranged on the moving section (100) and provided with a suction opening (112a) arranged facing the first driven roller (17b) . 15
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13. The air-jet spinning machine (1) as claimed in claim 11 or 12, wherein each of the plurality of the draft device (6) includes a pressing section (100) adapted to press the first driven roller (17b) towards the first driving roller (17a), and the respective pressing section (100) provided in the plurality of the draft devices (6) is adapted to press the first driven roller (17b) against the first driving roller (17a) independently of one another. 30
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14. The air-jet spinning machine (1) as claimed in claim 9 or 13, wherein the pressing section (100) includes one of a second pneumatic cylinder (101) configured to be extended and retracted by air pressure and a spring, and the first driven roller (17b) is adapted to be pressed against the first driving roller (17a) by the second pneumatic cylinder (101) being extended or retracted, or by an elastic force of the spring. 40
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15. The air-jet spinning machine (1) as claimed in any one of claims 1 to 14, wherein an inlet of the draft device (6) is located lower than the winding device (13) in a height direction. 50
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FIG. 1

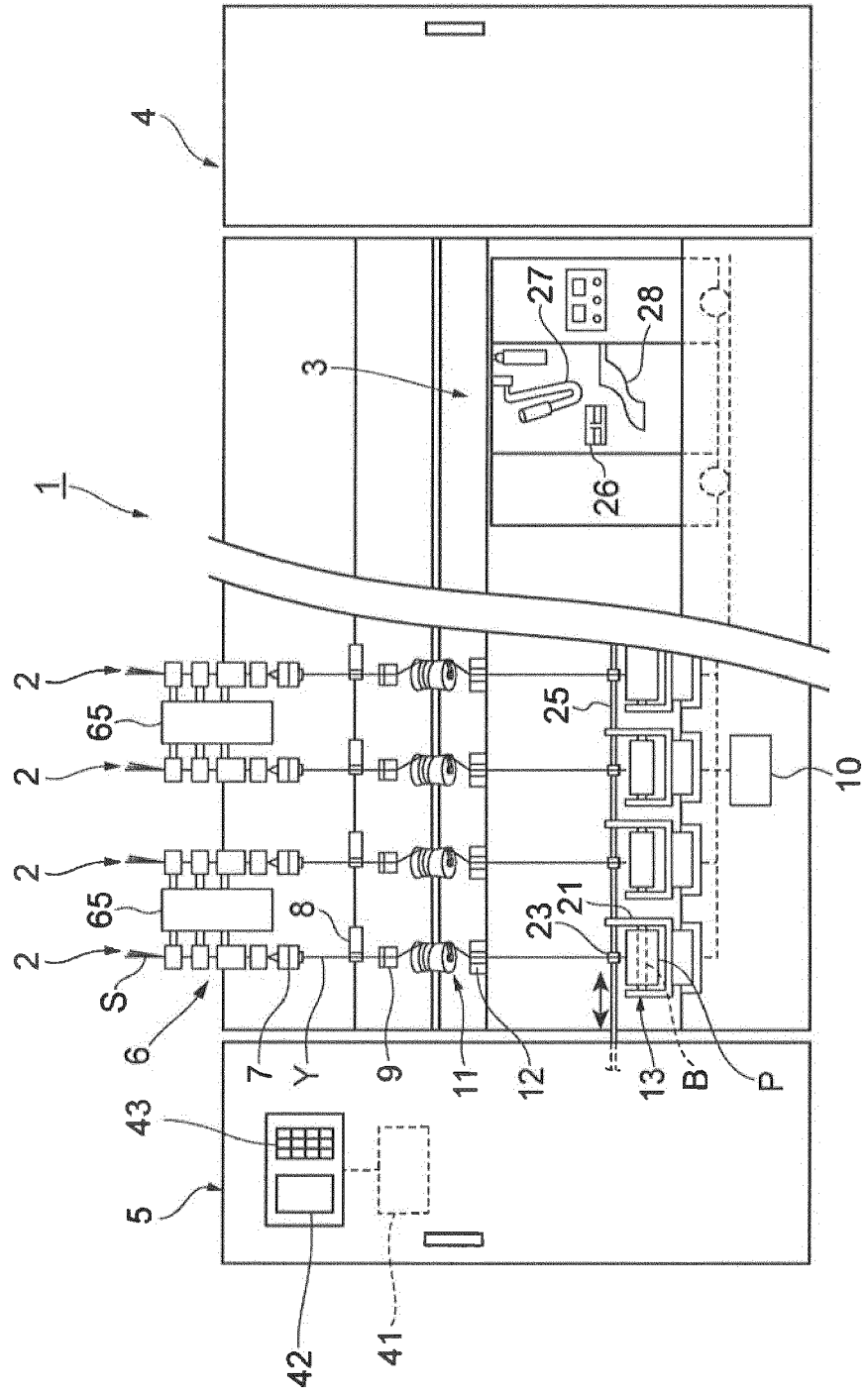


FIG. 2

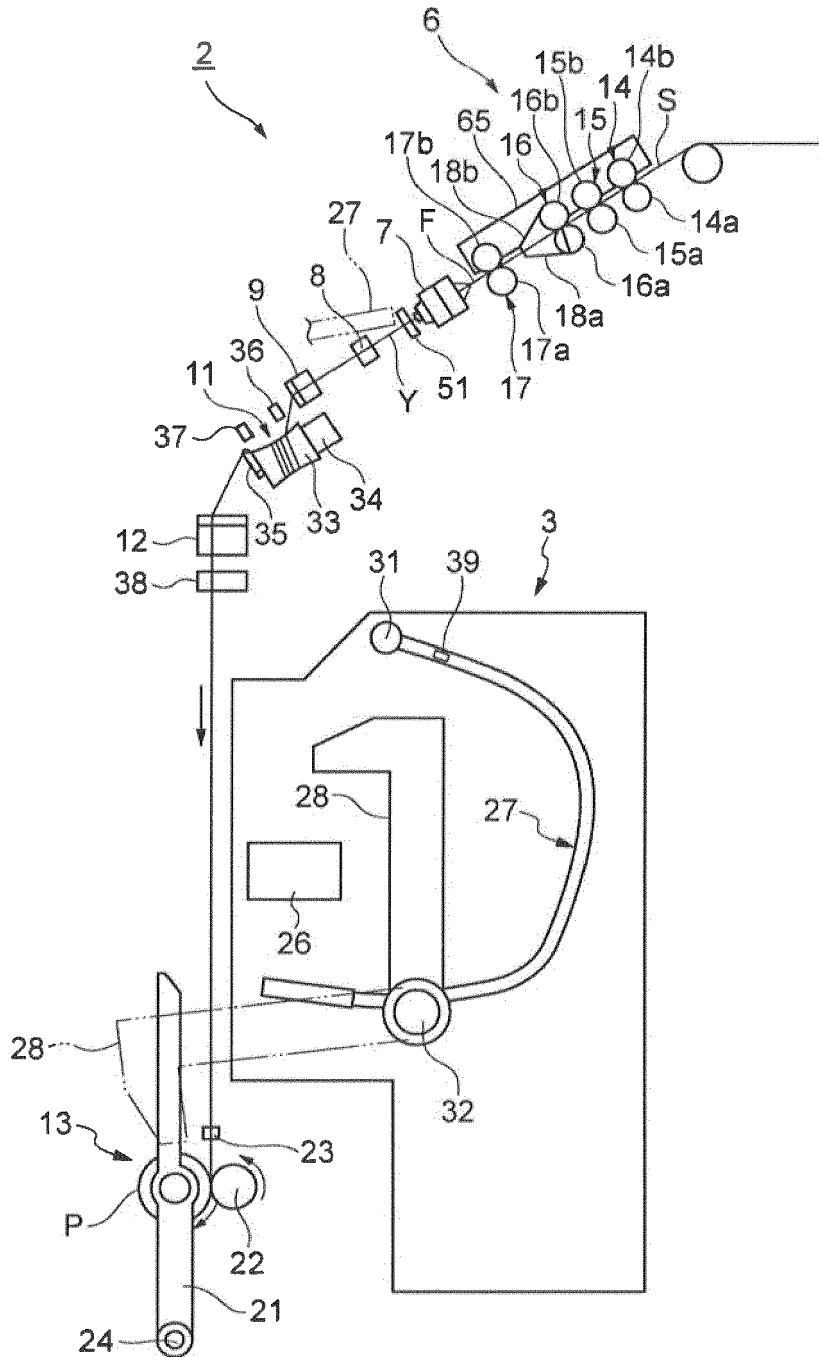


FIG. 3

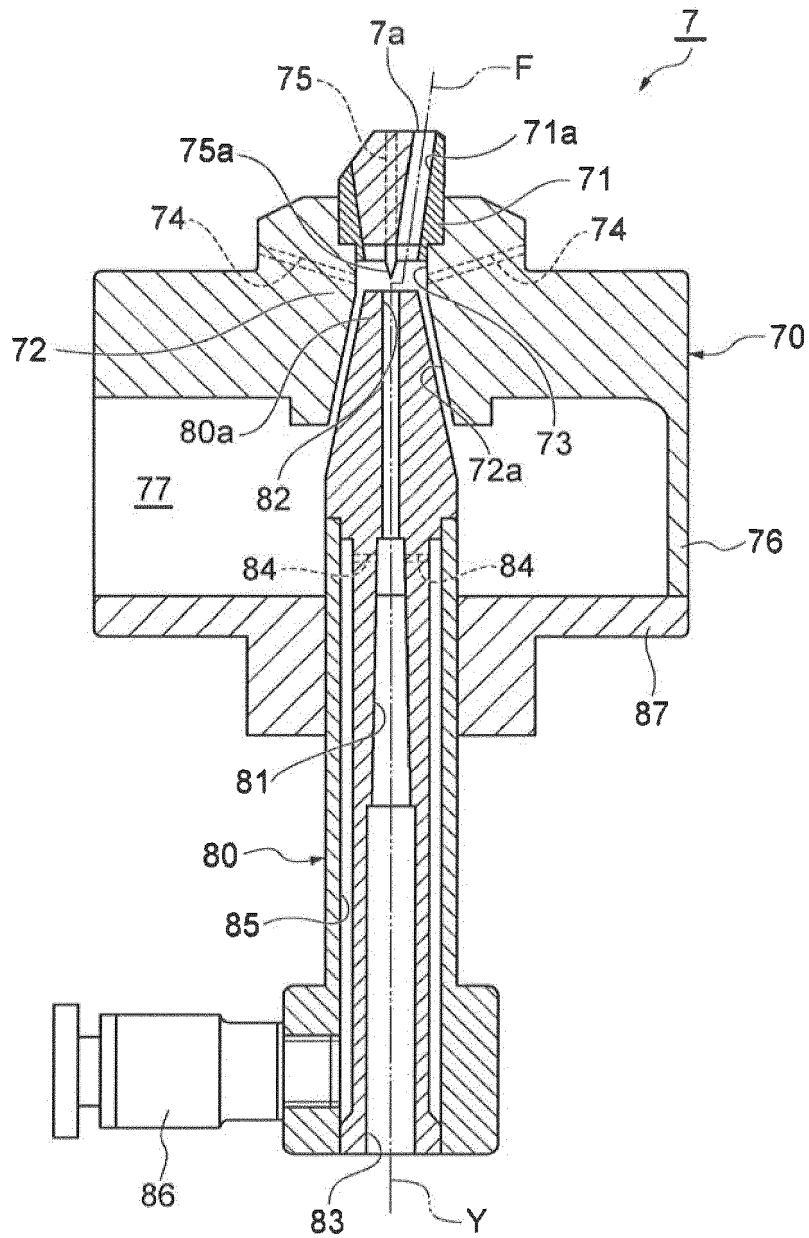


FIG. 4

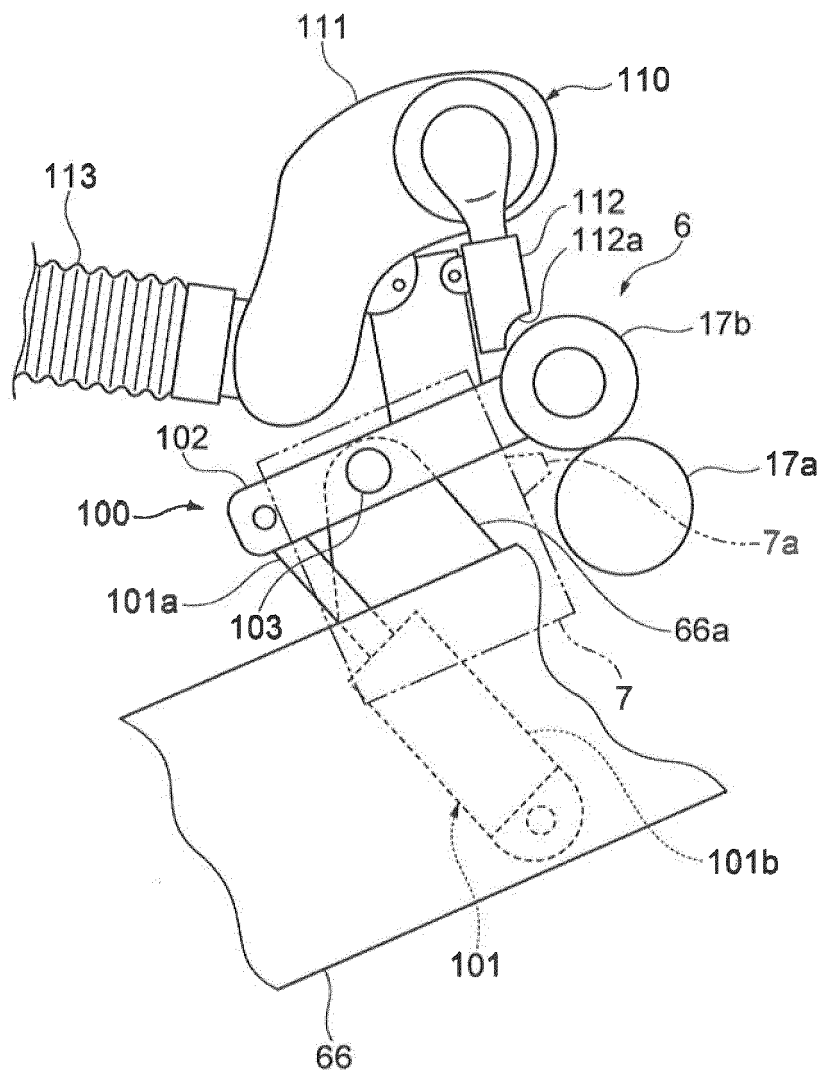


FIG. 5

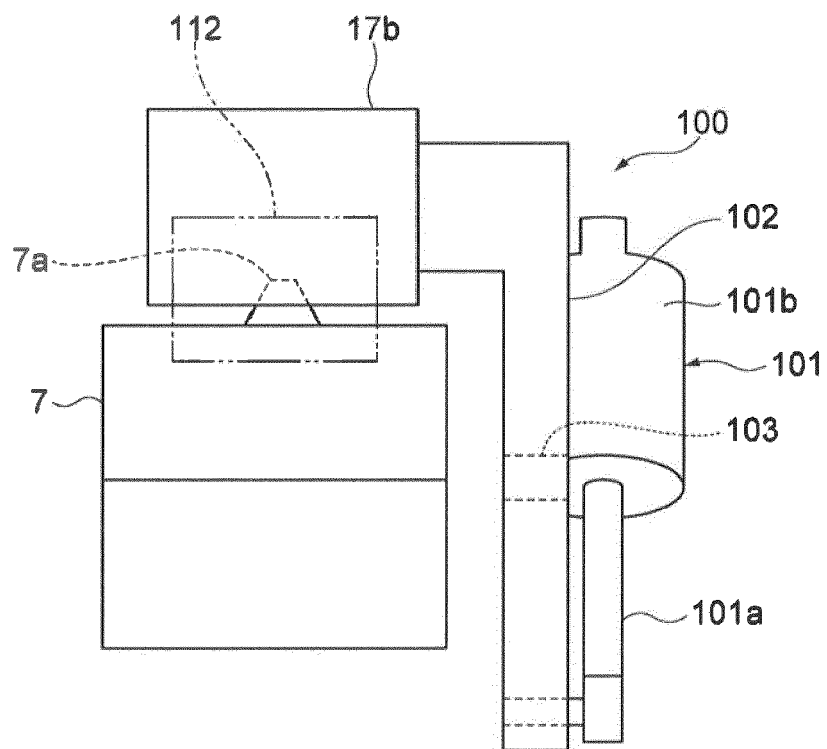


FIG. 6

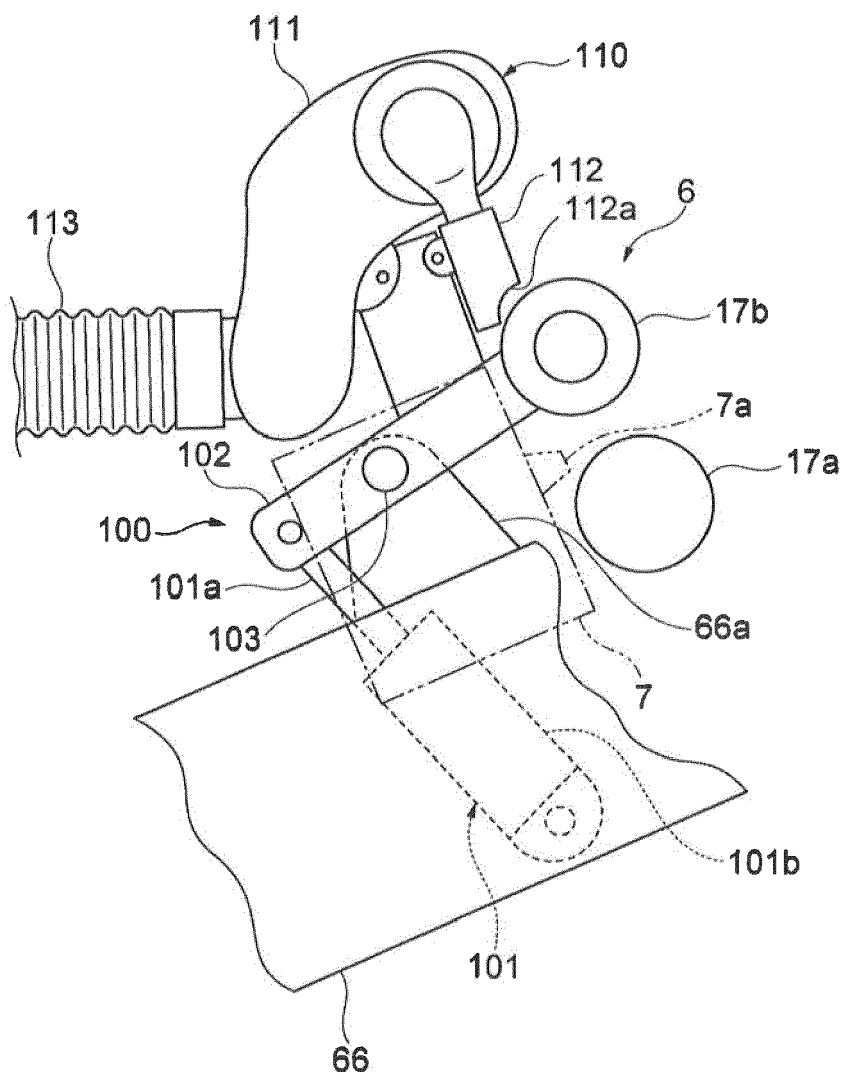


FIG. 7

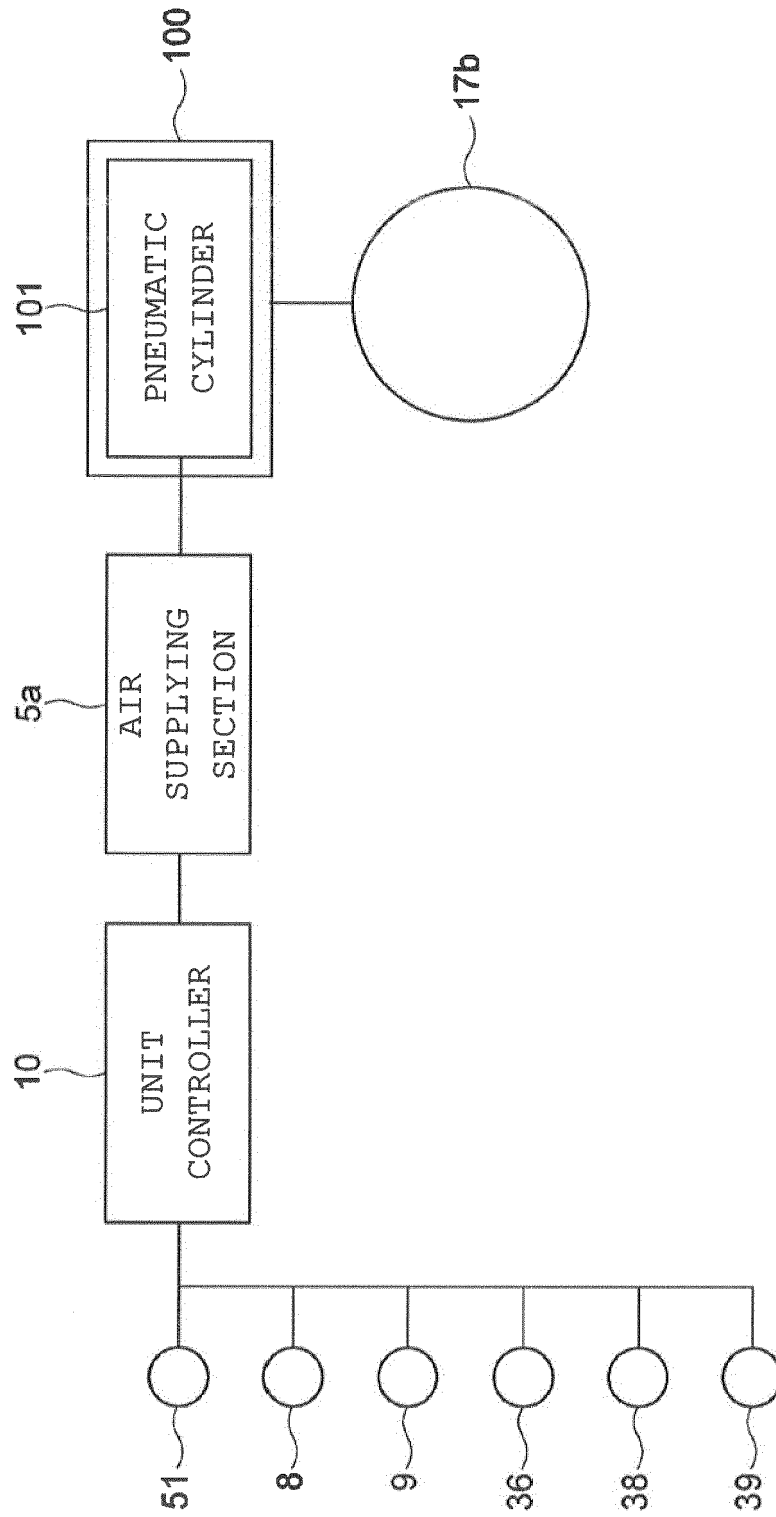
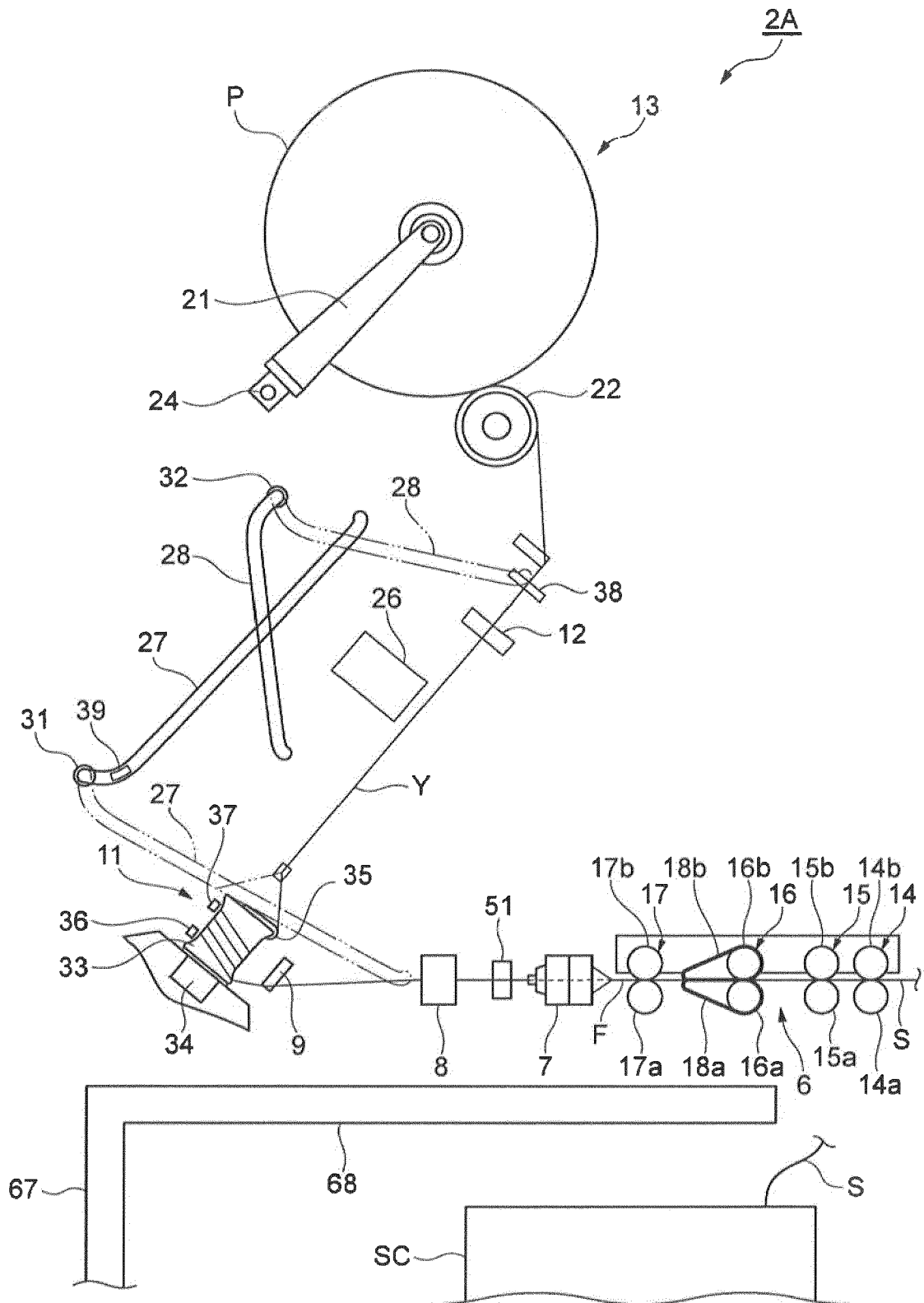


FIG. 8





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Place of search Munich		Date of completion of the search 9 November 2018	Examiner Todarello, Giovanni
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