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

(11) EP 3 103 903 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**14.12.2016 Bulletin 2016/50**

(51) Int Cl.:
***D01H 4/02*** *(2006.01)* ***D01H 1/115*** *(2006.01)*
***D01H 13/30*** *(2006.01)*

(21) Application number: **16172736.7**

(22) Date of filing: **02.06.2016**

(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 MD**

(30) Priority: **11.06.2015 JP 2015118170**

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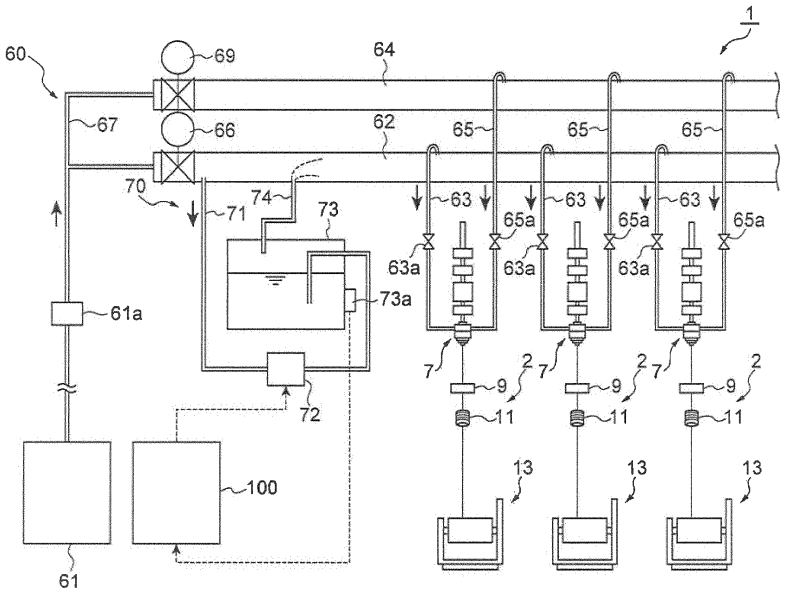
## (54) SPINNING MACHINE AND SPINNING METHOD

(57) A spinning machine includes an air spinning device (7) that generates a yarn (Y) by performing a spinning operation of applying twists to a fiber bundle (F) by using air; and a supplying device (60) that supplies agent-containing air that contains agent to the fiber bundle (F) or the yarn (Y) at a position between a position upstream of an inlet of the air spinning device (7) for the fiber bundle (F) and an outlet of the air spinning device (7) for the yarn (Y); and a controlling device (10) that controls an operation of the supplying device (60). The controlling device (10) supplies the agent-containing air from the supplying device (60) during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

FIG.6

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

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

#### 2. Description of the Related Art

**[0002]** A conventional spinning machine is disclosed in the Japanese Patent Application Laid-Open No. 2012-97391, for example. The spinning machine disclosed in the above document includes an air spinning device that twists a fiber bundle by using air, air piping that guides air compressed and fed by an air compressing and feeding device, an agent supplying device that supplies agent to the air piping at a location upstream of a point at which the air is branched toward the air spinning device, and a controlling device that adjusts an amount of the agent supplied from the agent supplying device.

**[0003]** In the above spinning machine, supply of the air to the air spinning device is stopped when a spinning operation by the air spinning device is stopped due to a yarn breakage and the like. In the above-explained situation, the agent may get clumped together in a supply pipe that branches from the air piping and supplies the air to the air spinning device. If the spinning operation by the air spinning device is restarted whereby the supply of the air from the supply pipe is restarted in a state in which the agent has been clumped together in the supply pipe, the agent that has been clumped together in the supply pipe may rush to the air spinning device at once. The way by which the twists are applied may change if the agent is excessively supplied to a fiber bundle at once, thereby leading to a drop in the quality of the yarn.

### SUMMARY OF THE INVENTION

**[0004]** In view of the above discussion, it is an object of the present invention to provide a spinning machine and a spinning method that can prevent excessive supply of the agent when restarting the spinning operation and inhibit the drop in the yarn quality.

**[0005]** This object is achieved by a spinning machine and a spinning method as defined in the independent claims.

**[0006]** A spinning machine according to an aspect of the present invention includes an air spinning device that generates a yarn by performing a spinning operation of applying twists to a fiber bundle by using air; a supplying device that supplies agent-containing air that contains agent to the fiber bundle or the yarn at a position between a position upstream of an inlet of the air spinning device for the fiber bundle and an outlet of the air spinning device for the yarn; and a controlling device that controls an operation of the supplying device. The controlling device supplies the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

**[0007]** A spinning method according to another aspect of the present invention is implemented in a spinning machine, the spinning machine includes an air spinning device that generates a yarn by performing a spinning operation of applying twists to a fiber bundle by using air; and a supplying device that supplies agent-containing air that contains agent to the fiber bundle or the yarn at a position between a position upstream of an inlet of the air spinning device for the fiber bundle and an outlet of the air spinning device for the yarn. The spinning method includes supplying the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

**[0008]** The above and other objects, features, advantages and the technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0009]**

FIG. 1 is a front view of a spinning machine according to an embodiment.

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

FIG. 3 is a cross-sectional view of the air spinning device when in a spinning position.

FIG. 4 is a cross-sectional view of the air spinning device when in a separated position.

FIG. 5 is a block diagram of the spinning machine.

FIG. 6 is a view of a configuration of an air distributing device and an agent supplying device of a spinning machine according to a first embodiment.

FIG. 7 is a view of a configuration of an air distributing device and an agent supplying device of a spinning machine according to a second embodiment.

FIGS. 8A and 8B are views of first distribution piping according to variations of the second embodiment.

### DETAILED DESCRIPTION

**[0010]** Exemplary embodiments of the present invention are explained in detail with reference to the accompanying drawings. Identical elements or corresponding elements are indicated by the same reference symbols in the drawings and redundant explanation thereof is omitted.

**[0011]** As shown in FIG. 1, a spinning machine 1 in-

cludes a plurality of spinning units 2, a yarn jointing cart 3, a not-shown doffing cart, a first-end frame 4, and a second-end frame 5. The plural spinning units 2 are arranged side-by-side. Each spinning unit 2 generates a yarn Y and winds the yarn Y into a package P. The yarn jointing cart 3 performs a yarn jointing operation in a certain spinning unit 2 in which the yarn Y is cut or becomes discontinuous for some reason. When the package P becomes fully wound in a certain spinning unit 2, the doffing cart doffs the fully wound package P and supplies a new empty bobbin B to that spinning unit 2.

**[0012]** A collecting device for collecting fiber waste, yarn waste, and the like generated in the spinning unit 2, and the like are arranged in the first-end frame 4. An air supplying section (later explained regulator 61a) that supplies air to the various components of the spinning machine 1 after appropriately adjusting an air pressure of compressed air (air) supplied to the spinning machine 1, and a driving motor that supplies driving power to the various components of the spinning unit 2 and the like are arranged in the second-end frame 5. The second-end frame 5 is provided with a machine-frame controlling device (controlling device) 100, a display screen 102, and one or more input keys 104. The machine-frame controlling device 100 centrally manages and controls the various components of the spinning machine 1. The display screen 102 displays information and the like about setting contents and / or a state of the spinning unit 2. An operator can perform various settings of the spinning unit 2 by appropriately operating the input keys 104.

**[0013]** As shown in FIGS. 1 and 2, each of the spinning units 2 includes a drafting device 6, an air spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn accumulating device 11, a waxing device 12, and a winding device 13 in this order from upstream in a traveling direction of the yarn Y. One unit controller (controlling device) 10 is arranged for a plurality of the spinning units 2, and the unit controller 10 controls operations of those spinning units 2.

**[0014]** The drafting device 6 drafts a sliver (a fiber bundle) S. The drafting device 6 includes a back roller pair 14, a third roller pair 15, a middle roller pair 16, and a front roller pair 17 in this order from upstream in a traveling direction of the sliver S. Each of the roller pairs 14, 15, 16, and 17 includes a bottom roller and a top roller. The bottom roller is rotationally driven by the driving motor arranged in the second-end frame 5 or a driving motor arranged in each of the spinning units 2. An apron belt 18a is stretched over the bottom roller of the middle roller pair 16. Another apron belt 18b is stretched over the top roller of the middle roller pair 16.

**[0015]** The air spinning device 7 generates the yarn Y by applying twists by using a swirling air current to a fiber bundle F drafted by the drafting device 6.

**[0016]** The yarn monitoring device 8 monitors, at a location between the air spinning device 7 and the yarn accumulating device 11, information about the traveling yarn Y, and detects presence / absence of a yarn defect in the yarn Y based on the monitored information. Upon 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, for example, a thickness abnormality of the yarn Y and / or a foreign substance contained in the yarn Y as the yarn defect. The yarn monitoring device 8 also detects a yarn breakage and the like. The tension sensor 9 measures, at a location between the air spinning device 7 and the yarn accumulating device 11, a tension of the traveling yarn Y, and transmits a tension measurement signal representing the measured tension to the unit controller 10. When the unit controller 10 determines, based on a detection result obtained in the yarn monitoring device 8 and / or the tension sensor 9, that an abnormality is present in the yarn Y, the yarn Y is cut in the spinning unit 2. Specifically, the yarn Y is cut by suspending the generation of the yarn Y by interrupting the supply of the air to the air spinning device 7. Alternatively, the yarn Y can be cut by using a dedicated cutter.

**[0017]** The waxing device 12 applies wax on the yarn Y at a location between the yarn accumulating device 11 and the winding device 13.

**[0018]** The yarn accumulating device 11 removes a slack of the yarn Y at a location between the air spinning device 7 and the winding device 13. The yarn accumulating device 11 has the following functions: to stably pull the yarn Y from the air spinning device 7, to prevent slacking of the yarn Y by temporarily accumulating the yarn Y fed out from the air spinning device 7 when the yarn jointing cart 3 performs the yarn jointing operation and the like, and to prevent variations in the tension of the yarn Y downstream of the yarn accumulating device 11 from being conveyed to the air spinning device 7.

**[0019]** The winding device 13 winds the yarn Y around the bobbin B thereby forming the package P. The winding device 13 includes a cradle arm 21, a winding drum 22, and a traversing guide 23. The cradle arm 21 rotatably supports the bobbin B. The cradle arm 21 is pivotably supported by a support shaft 24. By pivoting the cradle arm 21, a surface of the bobbin B or a surface of the package P can be caused to contact a surface of the winding drum 22 at an appropriate pressure. The not-shown driving motor provided in the second-end frame 5 drives the winding drums 22 of a plurality of the spinning units 2 all at once. When the winding drums 22 of the spinning units 2 are rotated, the bobbin B or the package P is rotated in a direction that allows winding the yarn Y into the package P. The traversing guides 23 of a plurality of the spinning units 2 are arranged on one shaft 25 that is shared by those spinning units 2. The traversing guide 23 traverses the yarn Y by a predetermined width on the rotating bobbin B or the package P when the driving motor arranged in the second-end frame 5 causes the shaft 25 to perform a reciprocating movement along a direction of a rotation axis of the winding drum 22.

**[0020]** When the yarn Y is cut or when a breakage occurs in the yarn Y in a certain spinning unit 2 due to some

reason, the yarn jointing cart 3 travels to that spinning unit 2 and performs a yarn jointing operation in that spinning unit 2. The yarn jointing cart 3 includes a yarn jointing device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is pivotably supported by a support shaft 31. The suction pipe 27 catches the yarn Y from the air spinning device 7 and guides the caught yarn Y to the yarn jointing device 26. The suction mouth 28 is pivotably supported by a support shaft 32. The suction mouth 28 catches the yarn Y from the winding device 13 and guides the caught yarn Y to the yarn jointing device 26. The yarn jointing device 26 joints the yarns Y guided thereto. The yarn jointing device 26 can be a splicer that uses compressed air, a knotter that mechanically joints the yarn Y, and the like.

**[0021]** When the yarn jointing cart 3 performs the yarn jointing operation, the package P is rotated in a direction that allows unwinding of the yarn Y from the package P (reverse rotation). In doing so, the cradle arm 21 is moved by a not-shown air cylinder so that the package P and the winding drum 22 are separated from each other, and the package P is caused to perform the reverse rotation by a not-shown reverse-rotation roller arranged in the yarn jointing cart 3.

**[0022]** The air spinning device 7 is explained below in detail. As shown in FIGS. 3 and 4, the air spinning device 7 includes a nozzle block 40 and a hollow guiding shaft 50.

**[0023]** The nozzle block 40 includes a fiber guiding section 41 and a swirling current generating section 42. The fiber guiding section 41 includes a guide hole 41a to guide the fiber bundle F supplied from the drafting device 6. The swirling current generating section 42 includes a spinning chamber 43 and a plurality of first nozzles 44. A needle 45 is held by the fiber guiding section 41. A tip end 45a of the needle 45 is positioned in the spinning chamber 43.

**[0024]** Rear ends of the fibers of the fiber bundle F are introduced into the spinning chamber 43 via the guide hole 41a and whirled by the action of the swirling current of the air (i.e., mist air or dry air described below). Air is jetted into the spinning chamber 43 from the first nozzles 44 to produce the swirling current in the spinning chamber 43. The swirling current generating section 42 includes an opening 42a that is continuous with the spinning chamber 43.

**[0025]** An upstream end 50a of the hollow guiding shaft 50 is formed into a truncated cone shape tapering upstream. The upstream end 50a is arranged inside the opening 42a of the swirling current generating section 42 with a gap between the wall of the opening 42a. A flange-shaped cap 57 is attached to the hollow guiding shaft 50. When the cap 57 contacts a frame-shaped holder 46 that supports the nozzle block 40, the hollow guiding shaft 50 is positioned with respect to the spinning chamber 43. The air jetted from the first nozzles 44 in the spinning chamber 43 flows into a pressure-reduced chamber 47 arranged in the holder 46 via the gap provided between the end 50a of the hollow guiding shaft 50 and the opening 42a in the swirling current generating section 42. This air is discharged along with the fiber that did not turn into the yarn Y.

**[0026]** The hollow guiding shaft 50 is provided with a passage 51 and a plurality of second nozzles 54. The passage 51 guides the yarn Y (i.e., the fiber swirled in the spinning chamber 43) to the outside (downstream with respect to the yarn travelling direction). For example, when the yarn Y is to be generated newly after interruption of the spinning operation, air is jetted into the passage 51 from the second nozzles 54.

**[0027]** Air is supplied to each of the second nozzles 54 via an air supplying path 56 and an air flowing path 55. The air supplying path 56 is connected to a downstream end 50b of the hollow guiding shaft 50. The air flowing path 55 is arranged, when seen along a center axis of the hollow guiding shaft 50, in the hollow guiding shaft 50 so as to surround the passage 51.

**[0028]** The air spinning device 7 can cause the hollow guiding shaft 50 to move toward and away from the spinning chamber 43. The air spinning device 7, as shown in FIG. 5, includes an actuator (a moving section) 58 that can move the hollow guiding shaft 50 to a spinning position at which the hollow guiding shaft 50 is positioned when the spinning operation is performed and to a separated position that is further away from the spinning chamber 43 than the spinning position. The spinning position is the position of the hollow guiding shaft 50 shown in FIG. 3 (i.e., the position shown with a broken line in FIG. 4). The separated position is the position of the hollow guiding shaft 50 shown in FIG. 4. The hollow guiding shaft 50 is located outside the pressure-reduced chamber 47 when in this position. The actuator 58 is, for example, an air cylinder, a stepping motor, and the like. The operation of the actuator 58 is controlled by the unit controller 10.

**[0029]** In a period from a time point at which the spinning operation is stopped to a time point at which the spinning operation is restarted, for example, which can happen when the yarn Y is cut in the spinning unit 2 and the yarn is jointed by the yarn jointing cart 3 by performing the yarn jointing operation, the air spinning device 7 causes the hollow guiding shaft 50 to be moved away from the spinning chamber 43.

**[0030]** As shown in FIG. 6, the spinning machine 1 further includes an air distributing device (a supplying device) 60 and an agent supplying device (a supplying device) 70. The air distributing device 60 includes first air piping 62, first distribution piping (supply piping) 63, second air piping 64, and second distribution piping 65.

**[0031]** An air compressing and feeding device 61 is arranged in the factory where the spinning machine 1 is installed. The air compressing and feeding device 61 is, for example, an electric compressor that pressurizes and feeds air by driving an electric motor. The pressure of the air pressurized and fed by the air compressing and feeding device 61 is regulated by a regulator 61a.

**[0032]** The first air piping 62 guides mist air (agent-containing air). The mist air is the air in which agent is mixed in the air pressurized and fed by the air compressing and feeding device 61 and supplied to the spinning machine 1 through air piping 67. The first air piping 62 extends parallel or substantially parallel to an arrangement direction of the spinning units 2. The first air piping 62 is arranged in the upper part of the spinning machine 1. Specifically, the first air piping 62 is arranged at an upper level than the air spinning device 7.

**[0033]** The first distribution piping 63 guides the mist air flowing in the first air piping 62 to each of the air spinning devices 7. One end of the first distribution piping 63 is connected to the air spinning device 7. Other end of the first distribution piping 63 is connected to a middle part of the first air piping 62. The amount of the mist air guided through the first distribution piping 63 to the air spinning device 7 is regulated by an opening and closing valve 63a provided in the first distribution piping 63. The unit controller 10 controls the operation of the opening and closing valve 63a. A mist spinning operation (an agent spinning operation) is performed by using the mist air in the air spinning device 7 to which the mist air has been supplied.

**[0034]** The second air piping 64 guides dry air (air) that does not contain agent. The dry air is also the air pressurized and fed by the air compressing and feeding device 61. The second air piping 64 extends parallel or substantially parallel to the arrangement direction of the spinning units 2. The second air piping 64 is arranged at a higher level than the air spinning device 7. However, the second air piping 64 can be arranged at a lower level than the air spinning device 7 or at the same level as the air spinning device 7.

**[0035]** The dry air flowing in the second air piping 64 is guided through the second distribution piping 65 to each of the air spinning devices 7. One end of the second distribution piping 65 is connected to the air spinning device 7. Other end of the second distribution piping 65 is connected to a middle part of the second air piping 64. The amount of the dry air guided through the second distribution piping 65 to the air spinning device 7 is regulated by an opening and closing valve 65a provided in the second distribution piping 65. The unit controller 10 controls the operation of the opening and closing valve 65a. A dry spinning operation is performed by using the dry air in the air spinning device 7 to which the dry air is supplied.

**[0036]** For example, in the spinning machine 1, by operating the input keys 104, the operator can select whether to perform the mist spinning operation or the dry spinning operation. Until completion of winding of one package P in one spinning unit 2, the fiber bundle F is spun by the method selected among the mist spinning operation and the dry spinning operation, and the generated yarn Y is wound. When the mist spinning operation has been selected, until completion of winding of one package P, the mist air is basically continually (without interruption) jetted from the first nozzles 44. However, when a later-explained stopping member 106 is operated, the jetting of the mist air in a corresponding one of the air spinning devices 7 is temporarily interrupted.

**[0037]** As shown in FIG. 6, the agent supplying device 70 includes branching piping 71, a pressure adjusting device 72, an agent tank 73, and agent supply piping 74.

**[0038]** The branching piping 71 branches the air flowing in the first air piping 62 so as to guide the air to the agent tank 73. One end of the branching piping 71 is connected to the agent tank 73. Other end of the branching piping 71 is connected to a middle part of the first air piping 62.

**[0039]** The pressure adjusting device 72 regulates an internal-pressure in the agent tank 73 by pressurizing the air guided to the agent tank 73. The pressure adjusting device 72 is, for example, a pressure booster valve that pressurizes air by driving a sliding piston. Alternatively, the pressure adjusting device 72 can be an electric compressor that pressurizes air by driving an electric motor. The pressure adjusting device 72 is connected to the machine-frame controlling device 100 by electric wiring. The machine-frame controlling device 100 controls the pressure adjusting device 72 by transmitting a control signal to the pressure adjusting device 72.

**[0040]** The agent tank 73 is a container for storing the agent. In the present embodiment, the agent is, for example, lubricant. However, the agent is not limited to the lubricant. Any agent (chemical agent) that can make the yarn Y antibacterial, deodorant, anti-deodorant, easy to unwind (waxing), and the like, can be used. Alternatively, any agent (chemical agent) that can prevent stacking of oily agent or remove stacked oily agent in / from the air spinning device 7 can be used. The agent tank 73 includes a stored-amount detecting section 73a that detects an amount of the agent that has been currently stored in the agent tank 73.

**[0041]** The agent supply piping 74 guides the agent stored in the agent tank 73 to the first air piping 62. One end of the agent supply piping 74 is connected to the agent tank 73. Other end of the agent supply piping 74 is connected to the first air piping 62 at a point that is upstream of the points at which the air flowing through the first air piping 62 is branched to each of the air spinning devices 7.

**[0042]** The agent supplying device 70 sprays the agent stored in the agent tank 73 into the first air piping 62. The agent supplying device 70 regulates a spraying amount of the agent by controlling the pressure adjusting device 72. The agent supplying device 70 is controlled by the machine-frame controlling device 100. The machine-frame controlling device 100 can be caused to control the agent supplying device 70 to regulate the spraying amount of the agent based on, for example, raw material of the sliver S.

**[0043]** The air distributing device 60 supplies the mist air to the air spinning device 7 from only the first air piping 62 by opening a valve 66 arranged in an upstream part

of the first air piping 62 and closing a valve 69 arranged in an upstream part of the second air piping 64. The air distributing device 60 supplies the dry air to the air spinning device 7 from only the second air piping 64 by closing the valve 66 and opening the valve 69. The positions and / or the numbers of those valves are not limited to those mentioned in the above embodiment as long as they allow switching of the supply of the air.

**[0044]** The sliver S spun in the spinning machine 1 can include at least one among natural fiber, regenerated fiber, semi-synthetic fiber, and synthetic fiber (e.g., polyester fiber, polyamide fiber, and polyacrylonitrile fiber). The natural fiber is, for example, seed hair fiber or bast fiber, and specifically includes cotton, flax, and the like. The regenerated fiber is, for example, regenerated cellulose type, and specifically includes rayon, special rayon (polynosic, HWM rayon), cupra, and the like. The semi-synthetic fiber is, for example, cellulose type, and specifically includes acetate, triacetate, and the like. The synthetic fiber is, for example, specifically polyester, nylon, acryl, acrylic, and the like.

**[0045]** As shown in FIG. 5, the spinning machine 1 includes the stopping member 106 and an operating member 108. The stopping member 106 stops the supply of the mist air from the first air piping 62 to the air spinning device 7. The stopping member 106 includes, for example, a button arranged in each of the spinning units 2. The stopping member 106 can be arranged in the second-end frame 5 and the like. When operated by the operator, the stopping member 106 outputs a stop signal to the unit controller 10. Upon receiving the stop signal output from the stopping member 106, the unit controller 10 stops the supply of the mist air from the first air piping 62 to the air spinning device 7. Specifically, the unit controller 10 closes the opening and closing valve 63a.

**[0046]** The operating member 108 stops the mist spinning operation in the air spinning device 7. The operating member 108 includes, for example, a button (an icon) displayed on the display screen 102, and is realized with a computer program. When selected by operation of the input keys 104, the operating member 108 outputs a stop signal to the unit controller 10. Upon receiving the stop signal from the operating member 108, the unit controller 10 stops the supply of the mist air from the first air piping 62 to the air spinning device 7 and starts the supply of the dry air from the second air piping 64. Specifically, the unit controller 10 closes the opening and closing valve 63a and opens the opening and closing valve 65a. After having supplied the dry air to the air spinning device 7 for a predetermined time (e.g., ten minutes), the unit controller 10 closes the opening and closing valve 65a. As a result, the supply of the dry air to the air spinning device 7 is stopped.

**[0047]** A spinning method used in the spinning machine 1 is explained below. A method to generate the yarn Y by use of the mist air is explained below as an example.

**[0048]** At first, by using the input keys 104, the operator inputs the type of the raw material of the sliver S. The machine-frame controlling device 100 regulates an addition amount of the agent in the agent supplying device 70 based on the inputted type of the raw material of the sliver S.

**[0049]** Upon receiving input from the input keys 104 of an instruction to start the spinning operation by the spinning unit 2, based on an instruction from the machine-frame controlling device 100, the air distributing device 60 opens the valve 66 and closes the valve 69 to supply the air to the first air piping 62. The agent supplying device 70 sprays the agent stored in the agent tank 73 into the first air piping 62. The unit controller 10 opens the opening and closing valve 63a provided in the first distribution piping 63. As a result, the mist air is supplied to the air spinning device 7.

**[0050]** When a predetermined time (e.g., ten minutes) has elapsed after starting the supply of the mist air to the air spinning device 7, the machine-frame controlling device 100 instructs the unit controller 10 to start the spinning operation. Accordingly, the unit controller 10 causes the spinning unit 2 to start the mist spinning operation. Specifically, the unit controller 10 causes the drafting device 6, the yarn accumulating device 11, and the winding device 13 to start their respective operation.

**[0051]** In the mist spinning operation, the sliver S is drafted by the drafting device 6, and the drafted sliver S is guided to the air spinning device 7. The yarn Y generated by the air spinning device 7 is accumulated in the yarn accumulating device 11, and the yarn Y is wound into the package P by the winding device 13.

**[0052]** When the yarn Y is cut in the spinning unit 2, the unit controller 10 interrupts the mist spinning operation that is being performed in the spinning unit 2. Specifically, the unit controller 10 stops the operation of the drafting device 6 and the winding device 13 when the yarn Y is cut in the spinning unit 2. Moreover, the unit controller 10 operates the actuator 58 of the air spinning device 7 to move the hollow guiding shaft 50 to the separated position. When a signal indicating cutting of the yarn Y is output from the unit controller 10, the machine-frame controlling device 100 causes the yarn jointing cart 3 to perform the yarn jointing operation. In doing so, the unit controller 10 keeps open the opening and closing valve 63a, which is provided in the first distribution piping 63, whereby there is a continuous supply of the mist air from the first distribution piping 63 to the air spinning device 7. When the yarn jointing operation by the yarn jointing cart 3 is finished, the unit controller 10 causes the spinning unit 2 to restart the mist spinning operation.

**[0053]** When the stopping member 106 is operated while, for example, the mist spinning operation by the spinning unit 2 has been interrupted, the unit controller 10 closes the opening and closing valve 63a provided in the first distribution piping 63. With this operation, the supply of the mist air to the corresponding air spinning device 7 is temporarily stopped. The operator can perform maintenance activities and the like with respect to

the air spinning device 7 in a state where jetting of the mist air from the first nozzles 44 has been stopped. After the maintenance activities by the operator have been finished, the control of the stopping member 106 is released whereby the mist spinning operation is restarted in the spinning unit 2. Because the maintenance activities by the operator are finished in a short time, even if the supply of the mist air is temporarily stopped, the agent that has been clumped together is not supplied to the air spinning device 7 when the mist spinning operation is restarted. Restarting of the mist spinning operation here means restarting of the mist spinning operation that was temporarily interrupted although the mist spinning operation should have been continued by the air spinning device 7. Temporary interruption here means stopping of the mist spinning operation for a short period, in order to perform, for example, the yarn jointing operation, the maintenance activities, and the like, while the yarn Y is being generated in the air spinning device 7 based on a predetermined lot.

**[0054]** In the spinning machine 1, after finishing the mist spinning operation, if there is a need to remove the agent which may have remained in each of the air spinning devices 7, for example, it is allowable to supply the dry air to the air spinning devices 7. When the operating member 108 is selected by operation of the input keys 104, based on an instruction from the machine-frame controlling device 100, the air distributing device 60 closes the valve 66 and opens the valve 69. The unit controller 10 closes the opening and closing valve 63a and opens the opening and closing valve 65a. As a result, the supply of the mist air from the first air piping 62 to the air spinning device 7 is stopped, and supply of the dry air from the second air piping 64 to the air spinning device 7 is started. When the predetermined time has elapsed after starting the supply of the dry air to the air spinning device 7, the unit controller 10 closes the opening and closing valve 65a. As a result, the supply of the dry air from the second air piping 64 to the air spinning device 7 is stopped.

**[0055]** In the spinning machine 1, when the dry spinning operation that is being performed in the air spinning devices 7 is interrupted, the unit controller 10 closes the opening and closing valve 65a arranged in the second distribution piping 65 to stop the supply of the dry air from the second air piping 64 to the air spinning device 7. However, the unit controller 10 need not stop, in the same manner as in the case of the mist spinning operation, the supply of the dry air.

**[0056]** As explained above, in the spinning machine 1 according to the present embodiment, the unit controller 10 continues the supply of the mist air from the first air piping 62 to the air spinning device 7 when the mist spinning operation that is being performed by the air spinning device 7 is interrupted. That is, the unit controller 10 continues the supply of the mist air from the first air piping 62 to the air spinning device 7 when the mist spinning operation was performed in the air spinning device 7, during the period for which the mist spinning operation was interrupted, and from a time point from which the mist spinning operation is restarted. In this manner, by continuing the supply of the mist air to the air spinning device 7 even when the mist spinning operation has been interrupted, it is prevented that the agent is clumped together inside the first distribution piping 63. That is, when the dry spinning operation is restarted in the air spinning device 7, the ratio of the agent contained in the mist air supplied to the air spinning device 7 can be inhibited from changing. In other words, the amount of the agent contained in the mist air supplied to the air spinning device 7 can be maintained at a fixed amount or within a predetermined range. Therefore, when restarting the mist spinning operation, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7. As a result, the quality of the yarn Y generated by the air spinning device 7 can be stabilized.

**[0057]** In this embodiment, the spinning machine 1 includes the yarn jointing cart 3 that performs, when the yarn Y is cut, the yarn jointing operation of jointing a yarn Y from the air spinning device 7 to a yarn Y from the winding device 13. The unit controller 10 continues the supply of the mist air from the first air piping 62 to the air spinning device 7 while the yarn jointing operation is being performed by the yarn jointing cart 3. Generally, during the yarn jointing operation, the supply of the air to the air spinning device 7 is also stopped as the spinning operation is stopped. In the spinning machine 1, clumping together of the agent is prevented by continuing the supply of the mist air even during the yarn jointing operation. Therefore, when restarting the mist spinning operation, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7.

**[0058]** In the present embodiment, the spinning unit 2 of the spinning machine 1 includes the drafting device 6 that drafts the sliver S. When the mist spinning operation has been interrupted, the unit controller 10 stops the operation of the drafting device 6 but continues the supply of the mist air from the first air piping 62 to the air spinning device 7. Generally, when the operation of the drafting device 6 is stopped, the supply of the air to the air spinning device 7 is also stopped as the spinning operation is stopped. In the spinning machine 1 according to the present embodiment, clumping together of the agent is prevented by continuing the supply of the mist air even when the operation of the drafting device 6 is stopped. Therefore, when restarting the mist spinning operation, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7.

**[0059]** In the present embodiment, the air spinning device 7 includes the nozzle block 40, the hollow guiding shaft 50, and the actuator 58. The actuator 58 can move the hollow guiding shaft 50 to any of the spinning position and the separated position. The spinning position is a position at which the hollow guiding shaft 50 is positioned when the spinning operation is performed. The separated position is a position that is further away from the spinning chamber 43 than the spinning position and at which the

hollow guiding shaft 50 is positioned when the spinning operation is interrupted. In the state that the hollow guiding shaft 50 is positioned at the separated position, the unit controller 10 continues the supply of the mist air from the first air piping 62 to the air spinning device 7. Generally, when the hollow guiding shaft 50 is positioned at the separated position, the supply of the air to the air spinning device 7 is stopped as no spinning operation is performed. In the spinning machine 1, clumping together of the agent is prevented by continuing the supply of the mist air even when the hollow guiding shaft 50 is positioned at the separated position. Therefore, when restarting the mist spinning operation, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7.

**[0060]** In the present embodiment, the spinning machine 1 includes the stopping member 106 that stops the supply of the mist air from the first air piping 62 to the air spinning device 7. Upon receiving the stop signal from the stopping member 106, the unit controller 10 stops the supply of the mist air from the first air piping 62 to the air spinning device 7. With this arrangement, the supply of the mist air can be stopped by operating the stopping member 106.

**[0061]** In the present embodiment, the second air piping 64 of the air distributing device 60 supplies the dry air to the air spinning device 7. The air spinning device 7 generates the yarn Y by performing the dry spinning operation of applying twists to the fiber bundle F by the action of the dry air supplied from the second air piping 64. When there is an interruption in the dry spinning operation, the unit controller 10 stops the operation of the drafting device 6 and stops the supply of the dry air from the second air piping 64 to the air spinning device 7. With this arrangement, consumption of the dry air can be reduced; because, the dry air is not supplied when the dry spinning operation is not performed.

**[0062]** In the present embodiment, the unit controller 10 supplies the mist air from the first air piping 62 to the air spinning device 7 for the predetermined time before starting the mist spinning operation in the air spinning device 7. This operation is performed in all the situations except in a situation where the mist spinning operation has been restarted from a state in which the mist spinning operation was interrupted. As a result, because the mist air can sufficiently reach every corner of the air spinning device 7, the mist spinning operation can be performed satisfactorily right from the start of the mist spinning operation. The following can be listed as examples of the situations except the situation where the mist spinning operation has been restarted from the state in which the mist spinning operation was interrupted. That is, for example, the mist spinning operation is started for the first time after the power of the spinning machine 1 is turned on, the mist spinning operation is started after the dry spinning operation is switched to the mist spinning operation, the mist spinning operation is restarted after a predetermined time from a time point at which the last mist spinning operation was stopped because of disablement of the spinning unit 2.

**[0063]** In the present embodiment, the spinning machine 1 includes the operating member 108 that can stop the mist spinning operation in the air spinning device 7. Upon receiving the stop signal from the operating member 108, the unit controller 10 stops the supply of the mist air from the first air piping 62 to the air spinning device 7 and starts the supply of the dry air, and stops the supply of the dry air after having supplied the dry air for the predetermined time. With this arrangement, even if the agent gets stuck to the air spinning device 7, because the dry air is supplied for the predetermined time after the supply of the mist air is stopped, the agent can be removed from the air spinning device 7. Therefore, it can be prevented that the agent sticks to the fiber bundle F when the dry spinning operation is subsequently performed in the air spinning device 7.

**[0064]** The above embodiment explains an example in which the supply of the mist air from the first air piping 62 to the air spinning device 7 is continued for the entire time during which the mist spinning operation has been interrupted. However, the supply of the mist air from the first air piping 62 to the air spinning device 7 can be continued for only a part of the time during which the mist spinning operation has been interrupted. Moreover, for example, the supply of the mist air from the first air piping 62 to the air spinning device 7 can be performed intermittently.

**[0065]** A second embodiment is explained below. As shown in FIG. 7, a spinning machine 1A according to the second embodiment includes an air distributing device 60A and an agent supplying device 70. The agent supplying device 70 has the same configuration as in the first embodiment.

**[0066]** The air distributing device (a supplying device) 60A includes first air piping 62A, first distribution piping (supply piping) 63A, second air piping 64, and second distribution piping 65. The second air piping 64 and the second distribution piping 65 have the same configuration as in the first embodiment.

**[0067]** The first air piping 62A guides the air that is pressurized and fed by the air compressing and feeding device 61. The first air piping 62A extends parallel or substantially parallel to an arrangement direction of the spinning units 2. The first air piping 62A is arranged in the lower part of the spinning machine 1A. Specifically, the first air piping 62A is arranged at a lower level than the air spinning device 7 in the height direction of the spinning unit 2.

**[0068]** The first distribution piping 63A guides the air flowing in the first air piping 62A to each of the air spinning devices 7. One end of the first distribution piping 63A is connected to the air spinning device 7. Other end of the first distribution piping 63A is connected to a middle part of the first air piping 62A. The amount of air guided from the first distribution piping 63A to the air spinning device 7 is regulated by an opening and closing valve 63Aa pro-

vided in the first distribution piping 63A.

**[0069]** The first distribution piping 63A is arranged at a lower level than the air spinning device 7 in the height direction of the spinning unit 2. Specifically, the first distribution piping 63A is arranged at a lower level than inlets of the first nozzles 44 of the air spinning device 7. The first distribution piping 63A is arranged so as to rise in the direction of flow of the mist air from the first air piping 62A toward the air spinning device 7. That is, the first distribution piping 63A is arranged so as to rise, in the entire region from the other end to the one end thereof, in the direction of flow of the mist air from the first air piping 62A toward the air spinning device 7. In different words, the first distribution piping 63A has no part whose height lowers in the direction of flow of the mist air from the first air piping 62A toward the air spinning device 7. The first distribution piping 63A is arranged so that a connecting part (one end) thereof connected to the air spinning device 7 is located at the highest level than any other part thereof. That is, the first distribution piping 63A has no bends, and any given part of the first distribution piping 63A is located at a higher level than any other part located upstream as one goes from the other end thereof connected to the first air piping 62A toward the one end connected to the air spinning device 7.

**[0070]** As explained above, in the spinning machine 1A according to the present embodiment, the first distribution piping 63A is arranged so as to rise in the direction of flow of the mist air from the first air piping 62A toward the air spinning device 7. With this arrangement, even if the agent gets clumped together when the supply of the mist air is stopped because the mist spinning operation is interrupted, the agent flows toward the first air piping 62A. Therefore, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7 when the mist spinning operation is restarted in the air spinning device 7.

**[0071]** In the present embodiment, the first air piping 62A is arranged at a lower level than the air spinning device 7 in the height direction of the spinning unit 2. With this arrangement, it can be prevented that the agent that has been clumped together is supplied from the first air piping 62A to the air spinning device 7. It is not necessary that the first air piping 62A is arranged at the position shown in FIG. 7. That is, the first air piping 62A can be arranged at any position in the height direction of the spinning machine 1A as long as it is located between the air spinning device 7 and an installation surface (floor) where the spinning machine 1A has been installed.

**[0072]** In the present embodiment, the first distribution piping 63A is arranged below the air spinning device 7 in the height direction of the spinning unit 2. With this arrangement, it can be further restrained that the agent that has been clumped together is supplied from the first distribution piping 63A to the air spinning device 7.

**[0073]** In the above embodiment, an example has been explained in which, any given part of the first distribution piping 63A is located at a higher level than any other part located upstream as one goes from the other end thereof connected to the first air piping 62A toward the one end connected to the air spinning device 7. However, as shown in FIG. 8A, first distribution piping 63B can have a flat part. Even in this configuration, when the mist spinning operation is interrupted, even if the supply of the mist air is stopped and the agent is clumped together, the agent flows toward the first air piping 62A.

**[0074]** As shown in FIG. 8B, an outlet part 63E from where the agent can be discharged can be provided at an apex of a portion 63D that is convex downward in the middle of first distribution piping 63C. With this arrangement, when the mist spinning operation is interrupted, even if the supply of the mist air is stopped whereby the agent is clumped together, the agent can be discharged from the outlet part 63E. Therefore, it can be prevented that an excessive amount of the agent is supplied to the air spinning device 7 when the mist spinning operation is restarted in the air spinning device 7.

**[0075]** Even in the second embodiment, the supply of the mist air to the air spinning device 7 is continued when the mist spinning operation is interrupted. That is, even in the second embodiment, the supply control of the mist air to the air spinning device 7 is performed in the same manner as in the first embodiment.

**[0076]** The embodiments of the present invention are explained above. The present invention, however, is not limited to the above embodiments.

**[0077]** The first distribution piping 63, 63A, 63B, 63C of the air distributing devices 60, 60A can supply the mist air to the fiber bundle F or the yarn Y at a point that is between a position upstream of a part (the spinning chamber 43) where the spinning operation is performed in the air spinning device 7 and an outlet from where the yarn Y is discharged from the air spinning device 7. For example, the first distribution piping 63, 63A, 63B, 63C can supply the mist air to the fiber bundle F at a position between the front roller pair 17 of the drafting device 6 and an inlet of the air spinning device 7. When this configuration is adopted, the air spinning device 7 performs the dry spinning operation by using the dry air supplied from the second distribution piping 65 on the fiber bundle F to which the agent has been applied.

**[0078]** An example of a configuration in which the spinning machines 1, 1A are provided with one air distributing device 60, 60A and one agent supplying device 70 is explained above. However, each of the spinning units 2 can be provided with one air distributing device and one agent supplying device. Alternatively, one air distributing device and one agent supplying device can be provided corresponding to each group of a plurality of the spinning units 2. In these variations, each of the agent supplying devices can be caused to add an agent that is different from the agents added by the other agent supplying devices. Moreover, one spinning machine can include spinning units that can perform the dry spinning operation and spinning units that can perform the mist spinning operation.

**[0079]** In the first embodiment and / or the second embodiment, the second air piping 64 can be omitted. If the second air piping 64 is omitted, the agent supplying device 70 supplies the dry air by using the first air piping 62, 62A.

**[0080]** In the air spinning device 7, the hollow guiding shaft 50 can be fixed to the nozzle block 40. In other words, the air spinning device 7 can be devoid of the actuator 58. When the actuator 58 is omitted, the supply of the mist air to the air spinning device 7 is performed, when the mist spinning operation has been interrupted, in the state in which the spinning chamber 43 is not open to the outside.

**[0081]** The stopping member 106 can be omitted.

**[0082]** The yarn jointing device 26 can be a piecer that uses a seed yarn.

**[0083]** The air spinning device 7 can prevent the twist of the fiber bundle from being conveyed to the upstream of the air spinning device, instead of using the needle 45, by using a downstream end portion of the fiber guiding section 41. Furthermore, in the air spinning device 7, instead of the above configuration, a pair of air jet nozzles that twist the fiber bundle F in mutually opposite directions can be arranged. The spinning machines 1, 1A can be an open-ended spinning machine.

**[0084]** In the spinning unit 2, the yarn accumulating device 11 is used to pull the yarn Y from the air spinning device 7; however, a delivery roller and a nip roller can be used to pull the yarn Y from the air spinning device 7. In a configuration in which the yarn Y is pulled from the air spinning device 7 with the delivery roller and the nip roller, instead of the yarn accumulating device 11, a slack tube that absorbs the slack of the yarn Y by using suction airflow, a mechanical compensator, and the like can be provided.

**[0085]** In the spinning machines 1, 1A, various devices are arranged such that the yarn Y supplied from the upper side is wound on the lower side in the height direction of the machine frame. However, those devices can be arranged such that the yarn Y supplied from the lower side is wound on the upper side. When this arrangement is adopted, it is preferable that the first air piping and the first distribution piping are arranged at a lower level than the air spinning device 7 in the height direction of the spinning unit 2. Moreover, it is preferable that the first distribution piping is arranged so that the connecting part (one end) connected to the air spinning device is located at the highest level than any other part thereof.

**[0086]** In the spinning machines 1, 1A, the traversing guide 23 and at least one bottom roller of the drafting device 6 are driven by a power source arranged in the second-end frame 5 (i.e., the power source is shared among a plurality of the spinning units 2). However, each component (e.g., the drafting device, the air spinning device, the winding device, and the like) of each spinning unit 2 can be driven independently in each spinning unit 2.

**[0087]** The tension sensor 9 can be arranged upstream of the yarn monitoring device 8 in the travelling direction of the yarn Y. One unit controller 10 can be arranged for each spinning unit 2. Moreover, in the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 can be omitted.

**[0088]** In FIG. 1, the spinning machine 1 is shown to wind the yarn Y into a cheese-shaped package P; however, it is possible to wind the yarn Y into a cone-shaped package. The yarn may be slacken when traversing the yarn for winding the cone-shaped package; however, such slack can be absorbed by the yarn accumulating device 11. The material and shape of various components explained above are not limited to those mentioned here, and it is possible to adopt various materials and shapes. As long as the mist air can be supplied to each of the spinning units 2, the configuration of the air distributing device 60, the agent supplying device 70, and the like is not limited to the one explained in the embodiments.

**[0089]** According to an aspect of the present invention, a spinning machine includes an air spinning device that generates a yarn by performing a spinning operation of applying twists to a fiber bundle by using air; a supplying device that supplies agent-containing air that contains agent to the fiber bundle or the yarn at a position between a position upstream of an inlet of the air spinning device for the fiber bundle and an outlet of the air spinning device for the yarn; and a controlling device that controls an operation of the supplying device. The controlling device supplies the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

**[0090]** In the above spinning machine, by supplying the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is temporarily interrupted, clumping together of the agent can be prevented. Therefore, it can be prevented that an excessive amount of the agent is supplied to the fiber bundle, for example, when the spinning operation is restarted.

**[0091]** In the above aspect, the controlling device can continue the supply of the agent-containing air from the supplying device when the spinning operation was performed in the air spinning device, during the period for which the spinning operation has been interrupted, and from a time point from which the spinning operation is restarted. In this manner, by continuing the supply of the agent-containing air, clumping together of the agent is further restrained.

**[0092]** In the above aspect, the spinning machine can further include a winding device that forms a package by winding the yarn on a bobbin. In this spinning machine, the yarn generated by the air spinning device can be wound into the package.

**[0093]** In the above aspect, the spinning machine can further include a yarn jointing device that performs a yarn jointing operation, when the yarn is cut, of jointing a yarn

from the air spinning device and a yarn from the winding device, and the controlling device can continue the supply of the agent-containing air from the supplying device during at least a part of a time period during which the yarn jointing operation is being performed by the yarn jointing device. In this spinning machine, by supplying the agent-containing air during at least a part of a time period during which the yarn jointing operation is being performed, clumping together of the agent can be prevented. Therefore, it can be prevented that an excessive amount of the agent is supplied to the fiber bundle, for example, when the spinning operation is restarted.

**[0094]** In the above aspect, the spinning machine can further include a drafting device that drafts the fiber bundle, and the controlling device can stop an operation of the drafting device during a period for which the spinning operation is interrupted, and continue the supply of the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is interrupted. Generally, when the operation of the drafting device is stopped, the supply of the air is also stopped as the spinning operation is stopped. In this spinning machine, by supplying the agent-containing air during at least a part of a time period during which the operation of the drafting device is stopped, clumping together of the agent can be prevented. Therefore, it can be prevented that an excessive amount of the agent is supplied to the fiber bundle, for example, when the spinning operation is restarted.

**[0095]** In the above aspect, the supplying device can supply the agent-containing air to a part of the air spinning device where the spinning operation is performed, and the air spinning device can generate the yarn by performing an agent spinning operation of applying twists to the fiber bundle by using the agent-containing air. With this arrangement, the agent can be efficiently applied to the fiber bundle.

**[0096]** In the above aspect, the air spinning device can include a nozzle block including a spinning chamber in which the fiber bundle is whirled by the action of a swirling current of the agent-containing air, and a nozzle for jetting the agent-containing air in the spinning chamber to produce the swirling current; a hollow guiding shaft having a passage to guide the fiber bundle whirled in the spinning chamber to outside; and a movement section capable of moving the hollow guiding shaft to a spinning position at which the hollow guiding shaft is positioned when the agent spinning operation is performed and to a separated position that is further away from the spinning chamber than the spinning position, and the controlling device can continue the supply of the agent-containing air from the supplying device to the air spinning device during at least a part of a time period during which the hollow guiding shaft is positioned at the separated position. Generally, when the hollow guiding shaft is positioned at the separated position, the supply of the air to the air spinning device is stopped as no spinning operation is performed. In this spinning machine, by supplying the agent-containing air during at least a part of a time period during which the hollow guiding shaft is positioned at the separated position, clumping together of the agent can be prevented. Therefore, it can be prevented that an excessive amount of the agent is supplied to the air spinning device, for example, when the spinning operation is restarted.

**[0097]** In the above aspect, the spinning machine can further include a stopping member capable of stopping the supply of the agent-containing air from the supplying device, and the controlling device can stop the supply of the agent-containing air from the supplying device upon receiving a stop signal from the stopping member. With this arrangement, the supply of the agent-containing air can be stopped by operating the stopping member.

**[0098]** In the above aspect, the supplying device can supply air that does not contain the agent to the air spinning device, and the controlling device can stop the supply of the air from the supplying device to the air spinning device when the spinning operation is interrupted. With this arrangement, consumption of the air can be reduced; because, the air is not supplied when the spinning operation is not performed.

**[0099]** In the above aspect, the spinning machine can further include an operating member that stops the spinning operation being performed by the air spinning device, and the controlling device, upon receiving a stop signal from the operating member, stops the supply of the agent-containing air from the supplying device and starts the supply of the air, and can stop the supply of the air after having supplied the air for a predetermined period. With this arrangement, even if the agent gets stuck to the air spinning device, because the air is supplied for the predetermined time after the supply of the agent-containing air has been stopped, the agent can be removed from the air spinning device. Therefore, it can be prevented that the agent sticks to the fiber bundle when the spinning operation is subsequently performed in the air spinning device.

**[0100]** In the above aspect, the controlling device can supply the agent-containing air from the supplying device for a predetermined period before starting the spinning operation by the air spinning device in a situation except in a situation where the spinning operation has been restarted from a state in which the spinning operation was interrupted in a situation in which the spinning operation should have been continued. With this arrangement, because the agent-containing air can be sufficiently supplied to the fiber bundle, the spinning operation can be performed satisfactorily right from the start of the spinning operation.

**[0101]** In the above aspect, the spinning machine can further include a plurality of spinning units. The supplying device can include a supply piping through which the agent-containing air flows and the supply piping can have one end connected to the air spinning device of each of the spinning units. The supply piping can be arranged so that the supply piping rises as one goes toward the one end of the supply piping in a direction of flow of the agent-

containing air in the supply piping. With this arrangement, it can be prevented that an excessive amount of the agent is supplied when the spinning operation is restarted.

**[0102]** In the above aspect, the supplying device can include air piping that extends along an arrangement direction of the spinning units. Other end of the supply piping can be connected to the air piping. With this arrangement, it can be prevented that an excessive amount of the agent is supplied when the spinning operation is restarted.

**[0103]** In the above aspect, the air piping can be arranged at a lower level than the air spinning device in a height direction of the spinning unit. With this arrangement, it can be prevented that an excessive amount of the agent is supplied when the spinning operation is restarted.

**[0104]** In the above aspect, the supply piping can be arranged at a lower level than the air spinning device in the height direction. With this arrangement, it can be prevented that an excessive amount of the agent is supplied when the spinning operation is restarted.

**[0105]** In the above aspect, the supply piping can be arranged so as to rise, in the entire region from the other end to the one end thereof, in the direction of flow of the agent-containing air. With this arrangement, it can be prevented that an excessive amount of the agent is supplied when the spinning operation is restarted.

**[0106]** In the above aspect, the spinning machine can further include an opening and closing valve arranged in a middle of the supply piping. The controlling device can control an operation of the supplying device by controlling the opening and closing valve.

**[0107]** According to another aspect of the present invention, a spinning method is implemented in a spinning machine. The spinning machine includes an air spinning device that generates a yarn by performing a spinning operation of applying twists to a fiber bundle by using air; and a supplying device that supplies agent-containing air that contains agent to the fiber bundle or the yarn at a position between a position upstream of an inlet of the air spinning device for the fiber bundle and an outlet of the air spinning device for the yarn. The spinning method includes supplying the agent-containing air from the supplying device during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

**[0108]** With this spinning method, clumping together of the agent can be prevented, and, for example, it can be prevented that an excessive amount of the agent is supplied to the fiber bundle when the spinning operation is restarted.

**[0109]** According to the present invention, excessive supply of the agent when restarting the spinning operation can be prevented and the drop in the yarn quality can be inhibited.

**[0110]** In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

**[0111]** Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching of the claims.

## Claims

1. A spinning machine comprising:

   an air spinning device (7) configured to generate a yarn (Y) by performing a spinning operation of applying twists to a fiber bundle (F) by using air;
   a supplying device (60; 60A) configured to supply agent-containing air that contains an agent to the fiber bundle (F) or the yarn (Y) at a position between a position upstream of an inlet of the air spinning device (7) for the fiber bundle (F) and an outlet of the air spinning device (7) for the yarn (Y); and
   a controlling device (10) configured to control an operation of the supplying device (60; 60A), wherein
   the controlling device (10) is configured to supply the agent-containing air from the supplying device (60; 60A) during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

2. The spinning machine as claimed in Claim 1, wherein the controlling device (10) is configured to continue the supply of the agent-containing air from the supplying device (60; 60A) when the spinning operation was performed in the air spinning device (7), during the period for which the spinning operation has been interrupted, and from a time point from which the spinning operation is restarted.

3. The spinning machine as claimed in Claim 1 or 2, further comprising a winding device (13) configured to form a package (P) by winding the yarn (Y) on a bobbin (B).

4. The spinning machine as claimed in Claim 3, further comprising a yarn jointing device (26) configured to perform a yarn jointing operation, when the yarn (Y) is cut, of jointing a yarn (Y) from the air spinning device (7) and a yarn (Y) from the winding device (13), wherein
   the controlling device (10) is configured to continue the supply of the agent-containing air from the supplying device (60; 60A) during at least a part of a time period during which the yarn jointing operation is being performed by the yarn jointing device (26).

5. The spinning machine as claimed in any one of Claims 1 to 4, further comprising a drafting device (6) configured to draft the fiber bundle (F), wherein
the controlling device (10) is configured to stop an operation of the drafting device (6) during a period for which the spinning operation is interrupted, and continues the supply of the agent-containing air from the supplying device (60; 60A) during at least a part of a time period during which the spinning operation is interrupted.

6. The spinning machine as claimed in any one of Claims 1 to 5, wherein
the supplying device (60; 60A) is configured to supply the agent-containing air to a part of the air spinning device (7) where the spinning operation is performed, and
the air spinning device (7) is configured to generate the yarn (Y) by performing an agent spinning operation of applying twists to the fiber bundle (F) by using the agent-containing air.

7. The spinning machine as claimed in Claim 6, wherein the air spinning device includes
a nozzle block (40) including a spinning chamber (43) in which the fiber bundle (F) is whirled by the action of a swirling current of the agent-containing air, and a nozzle (44) for jetting the agent-containing air in the spinning chamber (43) to produce the swirling current;
a hollow guiding shaft (50) having a passage (51) to guide the fiber bundle (F) whirled in the spinning chamber (43) to outside; and
a movement section (58) capable of moving the hollow guiding shaft (50) to a spinning position at which the hollow guiding shaft (50) is positioned when the agent spinning operation is performed and to a separated position that is further away from the spinning chamber (43) than the spinning position, and
the controlling device (10) is configured to continue the supply of the agent-containing air from the supplying device (60; 60A) to the air spinning device (7) during at least a part of a time period during which the hollow guiding shaft (50) is positioned at the separated position.

8. The spinning machine as claimed in any one of Claims 1 to 7, further comprising a stopping member (106) capable of stopping the supply of the agent-containing air from the supplying device (60; 60A), wherein
the controlling device (10) is configured to stop the supply of the agent-containing air from the supplying device (60; 60A) upon receiving a stop signal from the stopping member (106).

9. The spinning machine as claimed in any one of Claims 1 to 8, wherein the supplying device (60; 60A) is configured to supply air that does not contain the agent to the air spinning device (7), wherein
the controlling device (10) is configured to stop the supply of the air from the supplying device (60; 60A) to the air spinning device (7) when the spinning operation is interrupted.

10. The spinning machine as claimed in any one of Claims 1 to 9, further comprising an operating member (108) configured to stop the spinning operation being performed by the air spinning device (7), wherein
the controlling device (10), upon receiving a stop signal from the operating member (108), is configured to stop the supply of the agent-containing air from the supplying device (60; 60A) and is configured to start the supply of the air, and is configured to stop the supply of the air after having supplied the air for a predetermined period.

11. The spinning machine as claimed in any one of Claims 1 to 10, wherein the controlling device (10) is configured to supply the agent-containing air from the supplying device (60; 60A) for a predetermined period before starting the spinning operation by the air spinning device (7) in a situation except in a situation where the spinning operation has been restarted from a state in which the spinning operation was interrupted in a situation in which the spinning operation should have been continued.

12. The spinning machine as claimed in any one of Claims 1 to 11, further comprising a plurality of spinning units (2), wherein
the supplying device (60A) includes a supply piping (63A; 63B; 63C) configured to allow a flow of agent-containing air therethrough, the supply piping (63A; 63B; 63C) having a first end connected to the air spinning device (7) of the spinning unit (2), and
the supply piping (63A; 63B; 63C) is arranged so as to rise towards the first end of the supply piping (63A; 63B; 63C) in a direction of a flow of the agent-containing air in the supply piping (63A; 63B; 63C).

13. The spinning machine as claimed in Claim 12, wherein
the supplying device (60; 60A) includes an air piping (62A) that extends along an arrangement direction of the spinning units (2), and
a second end of the supply piping (63A; 63B; 63C) is connected to the air piping (62A).

14. The spinning machine as claimed in Claim 13, wherein the air piping (62A) is arranged at a lower level than the air spinning device (7) in a height direction of the spinning unit (2).

15. The spinning machine as claimed in Claim 14,

wherein the supply piping (63A; 63B; 63C) is arranged at a lower level than the air spinning device (7) in the height direction.

**16.** The spinning machine as claimed in Claim 15, wherein the supply piping (63A; 63B; 63C) is arranged so as to rise, in the entire region from the second end to the first end thereof, in the direction of flow of the agent-containing air.

**17.** The spinning machine as claimed in any one of Claims 1 to 16, further comprising an opening and closing valve (63a; 63Aa) arranged in a middle of the supply piping (63; 63A; 63B; 63C), and
the controlling device (10) configured to control an operation of the supplying device (60; 60A) by controlling the opening and closing valve (63a; 63Aa).

**18.** A spinning method implemented in a spinning machine,
the spinning machine including

an air spinning device (7) that generates a yarn (Y) by performing a spinning operation of applying twists to a fiber bundle (F) by using air; and a supplying device (60; 60A) that supplies agent-containing air that contains agent to the fiber bundle (F) or the yarn (Y) at a position between a position upstream of an inlet of the air spinning device (7) for the fiber bundle (F) and an outlet of the air spinning device (7) for the yarn (Y),

the spinning method comprising supplying the agent-containing air from the supplying device (60; 60A) during at least a part of a time period during which the spinning operation is temporarily interrupted in a situation in which the spinning operation should have been continued.

FIG.1

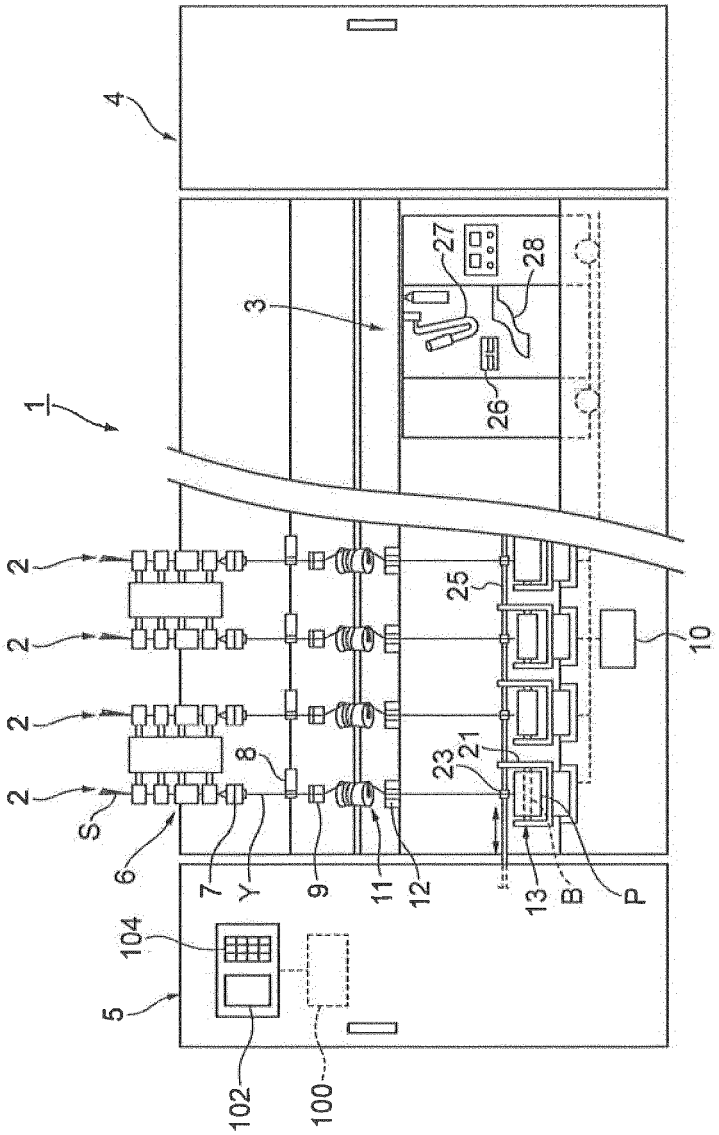


FIG.2

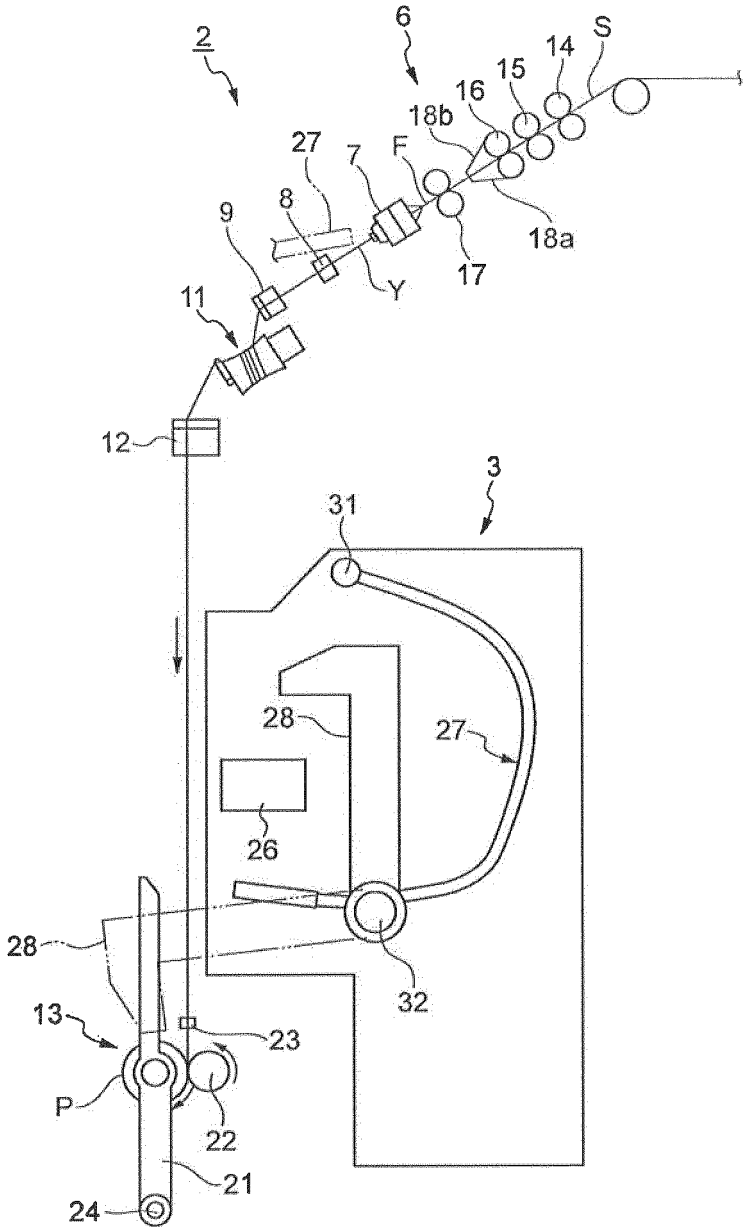

2
6
S
14
15
16
18b
27
7
F
8
9
18a
17
Y
11
12
3
31
28
27
26
28
32
13
23
P
22
21
24

FIG.3

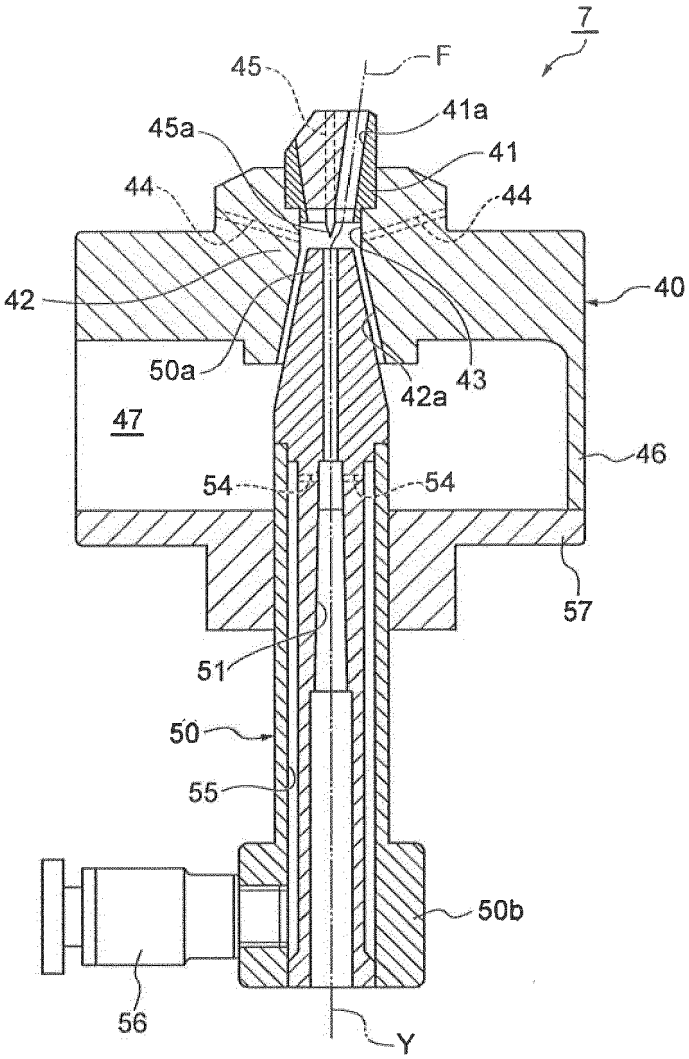

7
F
45
41a
45a
41
44
44
40
42
50a
43
42a
47
46
54
54
57
51
50
55
50b
56
Y

FIG.4

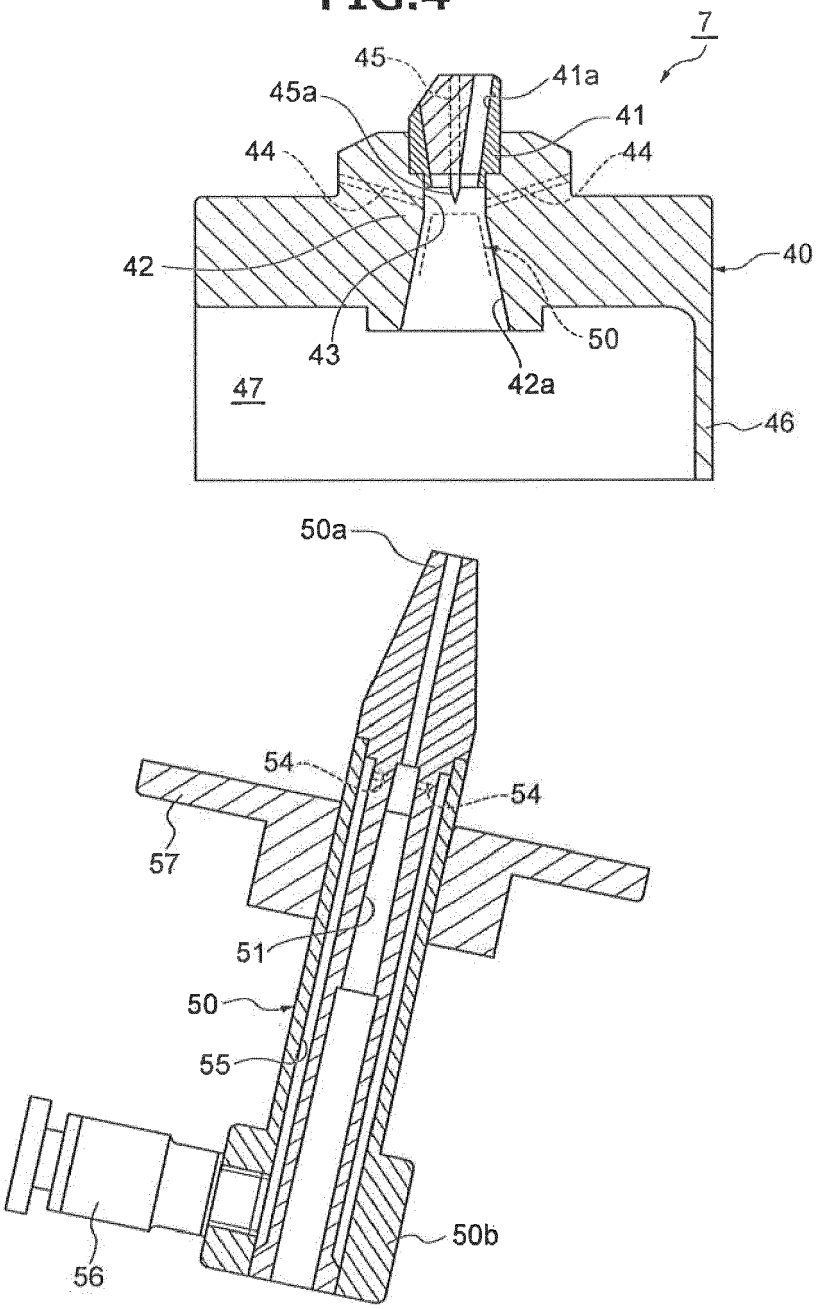

7
45
41a
45a
41
44
44
42
40
43
50
42a
47
46
50a
54
54
57
51
50
55
50b
56

FIG.5

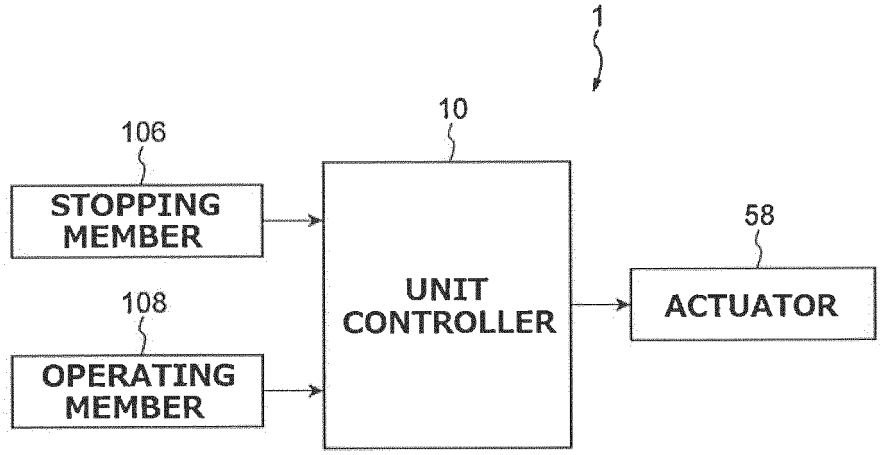

1
10
106
STOPPING MEMBER
108
OPERATING MEMBER
UNIT CONTROLLER
58
ACTUATOR

FIG.6

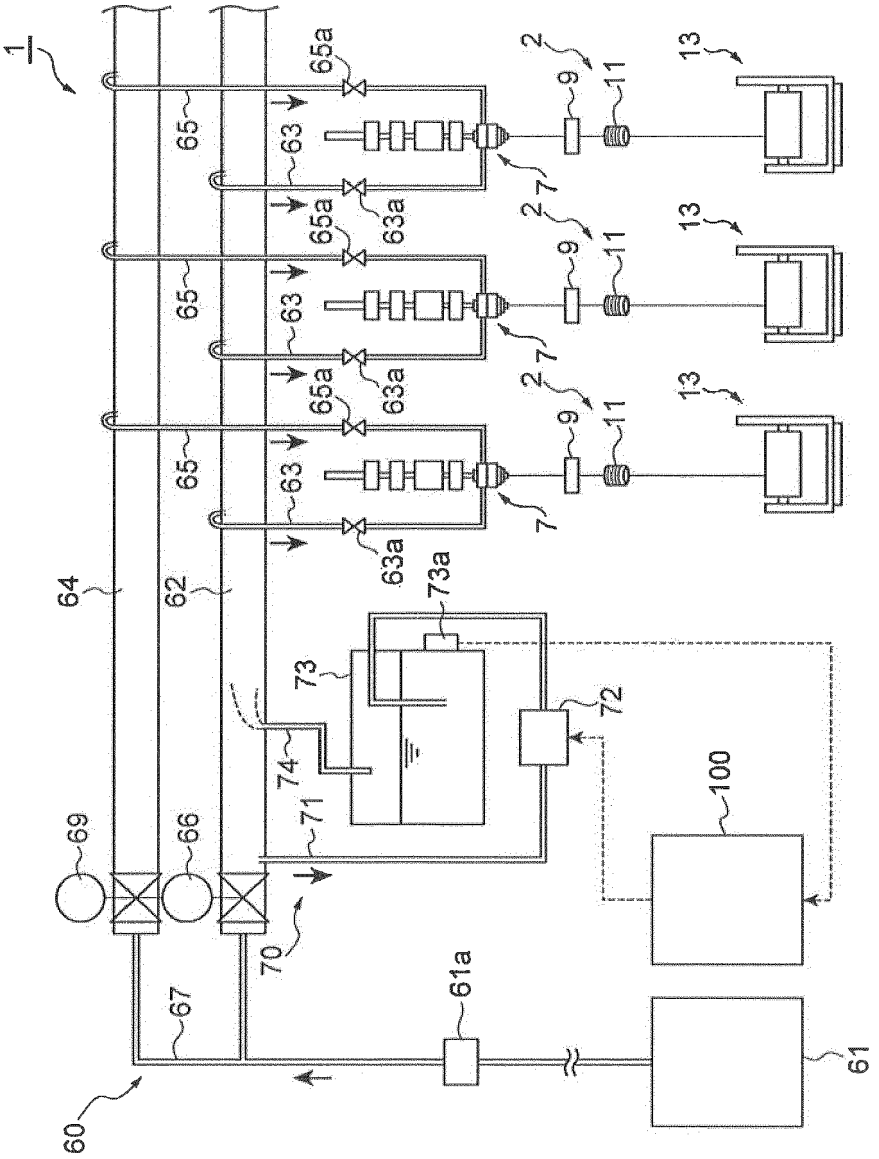

1
2
7
9
11
13
60
61
61a
62
63
63a
64
65
65a
66
67
69
70
71
72
73
73a
74
100

FIG.7

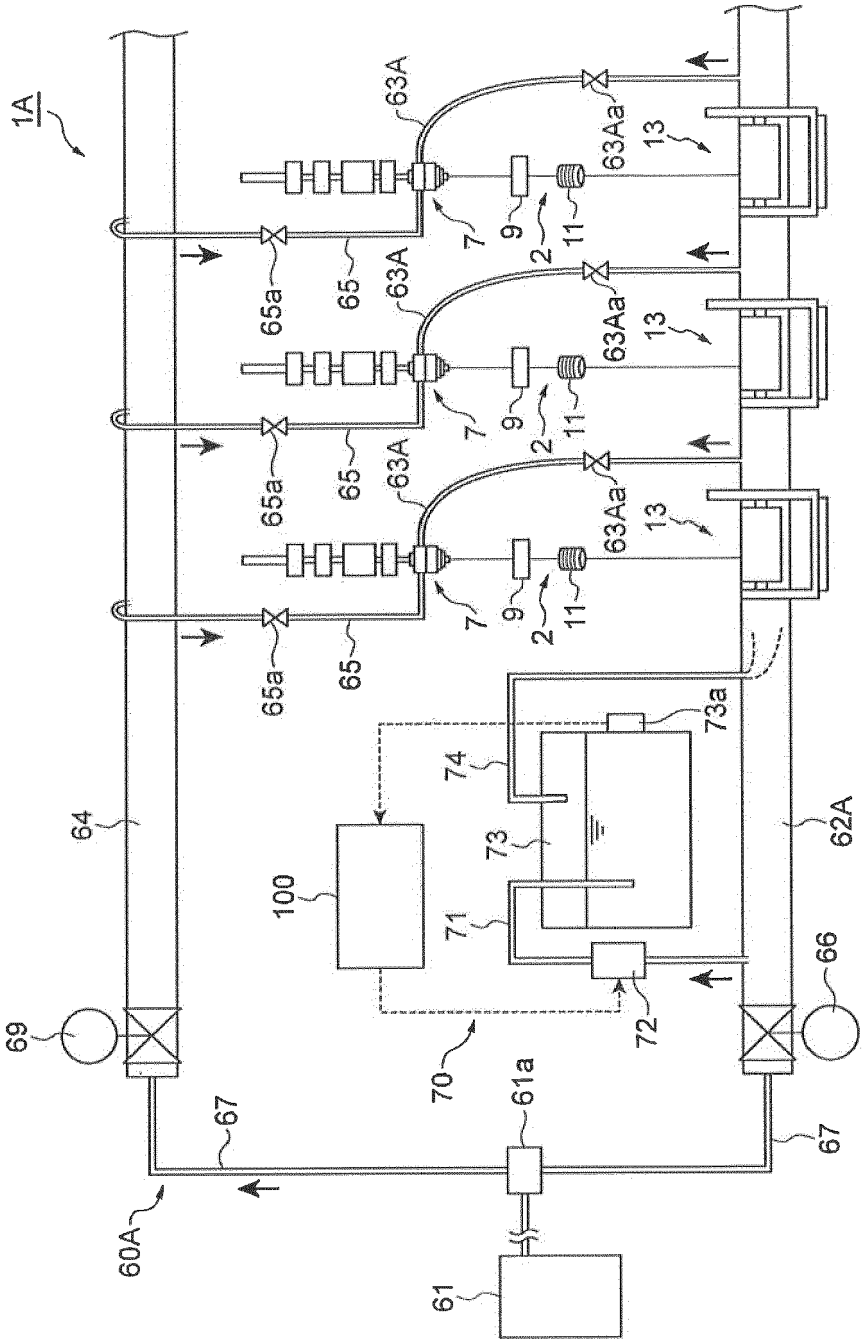

1A
63A
63Aa
13
7
9
2
11
65a
65
64
62A
73a
74
73
71
72
100
66
69
70
61a
67
60A
61

FIG.8B

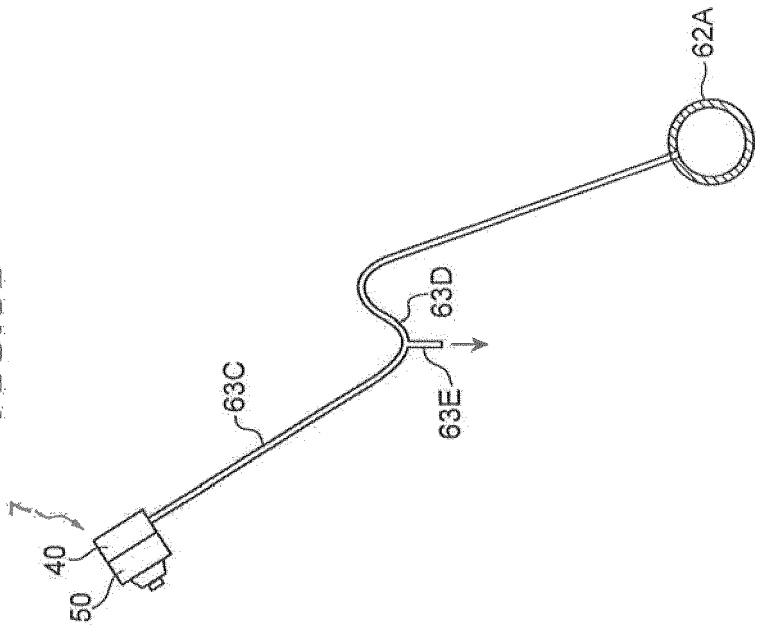
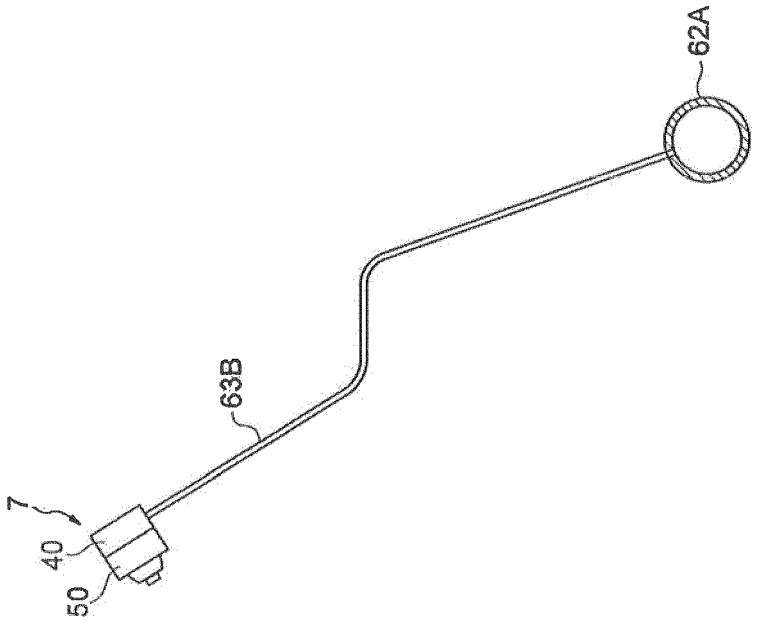



FIG.8A



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Application Number
EP 16 17 2736

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|---|---|---|
| Munich | 26 October 2016 | Humbert, Thomas |

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