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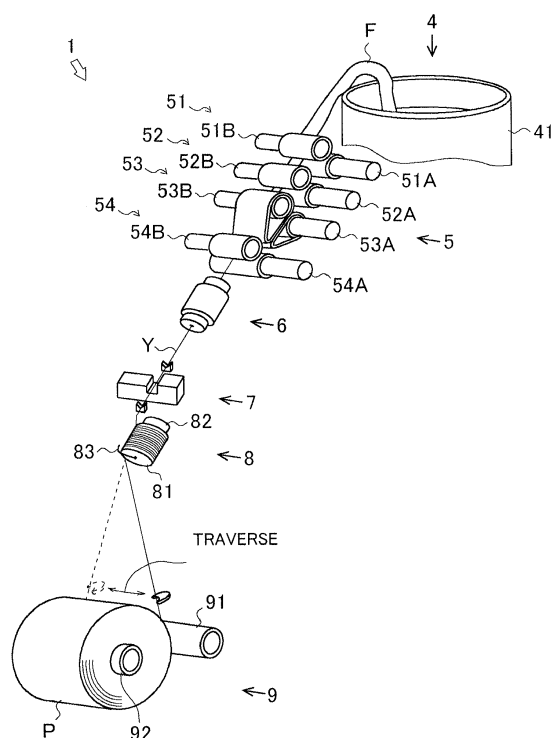
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(54) **Spinning machine**

(57) A spinning machine (100) is provided with a plurality of spinning units (1), each of which has an air-jet spinning device (6) that twists a fiber bundle F using a whirling airflow. The spinning machine (100) includes an air transporting device (21) that transports air, an air pipe (22) that guides the air transported by the air transporting device (21), an additive supplying device (3) that supplies an additive to the air pipe (22) at upstream of a branch where the air flowing through the air pipe (22) branches off towards the air-jet spinning devices (6), and a control device (C) that adjusts the volume of an additive to be supplied by the additive supplying device (3).

FIG. 2



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a technology of a spinning machine including a plurality of spinning units.

2. Description of the Related Art

[0002] An air-jet spinning device that twists a fiber bundle using a whirling airflow to produce spun yarn is conventionally known. In order to produce spun yarn, the air-jet spinning device uses a whirling airflow, which is generated by supplying air to a spinning chamber, to twist each fiber constituting a fiber bundle (as disclosed in Japanese Unexamined Patent Publication No.2009-1935, for example).

[0003] When the air-jet spinning device is used to produce a spun yarn from a fiber bundle of polyester fibers or the like with an oiling agent, the air-jet spinning device has drawbacks including accumulation of the oiling agent on an inner surface of a spinning chamber. Therefore, a technology has been proposed to add an accumulation preventing agent to the air to be supplied to the air-jet spinning device to prevent the accumulation of the oiling agent (as disclosed in Japanese Unexamined Patent Publication No.2008-95208, for example).

[0004] However, in a structure in which the accumulation preventing agent is added to the air flowing through an air pipe and the air branches off towards each air-jet spinning device, the volume of the air flowing through the air pipe varies depending on the number of the air-jet spinning devices that are actually operating (an operating number of the air-jet spinning devices). Therefore, there have been cases where the supplied volume of the accumulation preventing agent is excessive or deficient depending upon the operating number of the air-jet spinning devices. Accordingly, there has been a demand for a technology of adjusting a supplying volume of the accumulation preventing agent according to the operating number of the air-jet spinning devices.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a technology for a spinning machine including a plurality of spinning units in order to add an additive to air to be supplied to an air-jet spinning device and to adjust a volume of the additive to be supplied according to an operating number of the air-jet spinning devices. This object is achieved by a spinning machine according to claim 1.

[0006] A first aspect of the present invention relates to a spinning machine including a plurality of spinning units. Each of the spinning units includes an air-jet spinning

device adapted to twist a fiber bundle using a whirling airflow. The spinning machine includes at least an air transporting device, an air pipe, an additive supplying device, and a control device. The air transporting device is adapted to compress and transport air. The air pipe is adapted to guide the air transported by the air transporting device. The additive supplying device is adapted to supply an additive to the air pipe at upstream of a branch where the air flowing through the air pipe branches off towards each of the air-jet spinning devices. The control device is adapted to adjust a supplying volume of the additive to be supplied by the additive supplying device.

[0007] A second aspect of the present invention relates to the spinning machine according to the first aspect. The additive supplying device of the spinning machine includes an additive storage tank, an additive supplying pipe, and a pressure adjusting device. The additive storage tank is adapted to store the additive. The additive supplying pipe is adapted to guide the additive from the additive storage tank to the air pipe. The pressure adjusting device is adapted to adjust pressure inside the additive storage tank. The control device is adapted to control an operating state of the pressure adjusting device to change a flow rate of the additive guided by the additive supplying pipe to adjust the supplying volume of the additive.

[0008] A third aspect of the present invention relates to the spinning machine according to the first aspect or the second aspect. The control device increases the supplying volume of the additive according to an increase in the operating number of the air-jet spinning devices and reduces the supplying volume of the additive according to a decrease in the operating number of the air-jet spinning devices.

[0009] A fourth aspect of the present invention relates to the spinning machine according to any one of the first aspect through the third aspect. The control unit obtains the operating number of the air-jet spinning devices by receiving an electric signal transmitted from each of the spinning units.

[0010] A fifth aspect of the present invention relates to the spinning machine according to any one of the first aspect through the third aspect. The spinning machine includes an air flow-rate measuring device. The air flow-rate measuring device is adapted to measure a flow-rate of the air flowing through the air pipe. The control device obtains the operating number of the operating air-jet spinning devices based on a measurement result of the air flow-rate measuring device.

[0011] A sixth aspect of the present invention relates to the spinning machine according to any one of the first aspect through the fifth aspect. The air pipe is arranged slanted so that an additive adhering to an inner surface of the air pipe is collected at a prescribed position.

[0012] A seventh aspect of the present invention relates to the spinning machine according to the sixth aspect. The air pipe includes an additive discharge port adapted to drain the additive accumulated inside the air

pipe from the air pipe.

[0013] An eighth aspect of the present invention relates to the spinning machine according to any one of the first aspect through the seventh aspect. The additive to be supplied to the air pipe by the additive supplying device is an accumulation preventing agent that prevents oiling agent, which is applied to a fiber bundle, from adhering and accumulating.

[0014] The present invention has following effects.

[0015] According to the first aspect of the present invention, an additive can be added to the air to be supplied to the air-jet spinning devices, and the supplying volume of the additive can be adjusted. Accordingly, the volume of the additive to be supplied to the air-jet spinning devices is maintained properly so as not to be excessive and deficient, which eventually leads to improvement in quality of the spun yarn.

[0016] According to the second aspect of the present invention, the additive can be added to the air to be supplied to the air-jet spinning devices. Further, in spite of the simple structure, the supplying volume of the additive can be adjusted with high accuracy. Accordingly, the volume of the additive supplied to the air-jet spinning devices is maintained properly so as not to be excessive and deficient, which eventually leads to improvement in quality of the spun yarn.

[0017] According to the third aspect of the present invention, the additive can be added to the air to be supplied to the air-jet spinning devices, and the volume of the additive to be supplied can be adjusted depending on the operating number of the air-jet spinning devices. Accordingly, the volume of the additive supplied to the air-jet spinning devices is maintained properly so as not to be excessive and deficient, which eventually leads to improvement in quality of the spun yarn.

[0018] According to the forth aspect of the present invention, since the exact operating number of the air-jet spinning devices can be obtained, the volume of the additive to be supplied can be adjusted properly. Accordingly, the volume of the additive supplied to the air-jet spinning devices is maintained properly so as not to be excessive and deficient, which eventually leads to improvement in quality of the spun yarn.

[0019] According to the fifth aspect of the present invention, since the exact operating number of the air-jet spinning devices can be obtained, the volume of the additive to be supplied can be adjusted properly. Accordingly, the volume of the additive supplied to the air-jet spinning devices is maintained properly so as not to be excessive and deficient, which eventually leads to improvement in quality of the spun yarn.

[0020] According to the sixth aspect of the present invention, the additive adhering to the inner surface of the air pipe can be collected at a prescribed position. Accordingly, the additive adhering to the inner surface of the air pipe can be prevented from leaking into the air-jet spinning devices, which eventually leads to improvement in quality of the spun yarn.

[0021] According to the seventh aspect of the present invention, the additive accumulating in the air pipe can be drained from the air pipe. Accordingly, the additive accumulating inside the air pipe can be prevented from leaking into the air-jet spinning devices, which eventually leads to improvement in quality of the spun yarn.

[0022] According to the eighth aspect of the present invention, the oiling agent contained in fibers can be prevented from adhering to and accumulating in a spinning chamber, which eventually leads to improvement in quality of the spun yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a view illustrating an overall structure of a spinning machine.

FIG. 2 is a view illustrating a structure of a spinning unit.

FIG. 3 is a view illustrating a draft device of a spinning unit.

FIG. 4 is a view illustrating an air-jet spinning device of a spinning unit.

FIG. 5 is a view illustrating a yarn defect detecting device of the spinning unit.

FIG. 6 is a view illustrating a tension stabilizing device of the spinning unit.

FIG. 7 is a view illustrating an air distributing device and an additive supplying device.

FIG. 8 is a view describing a state in which loosely twisted yarn is produced in a case where a supplied volume of accumulation preventing agent is excessive.

FIG. 9 is a view describing a state in which loosely twisted yarn is produced in a case where the supplied volume of the accumulation preventing agent is deficient.

FIG. 10 is a chart describing a control mode in which a supplying volume of the accumulation preventing agent is adjusted according to the operating number of the air-jet spinning devices.

FIG. 11 is another view illustrating the structure of an air distributing device and an additive supplying device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] With reference to FIG. 1, a description will be made on a spinning machine 100 according to an embodiment of the present invention. As illustrated in FIG. 1, the spinning machine 100 mainly includes a plurality of spinning units 1. The spinning machine 100 includes an air distributing device 2 (not illustrated in FIG. 1, see FIG. 7) and an additive supplying device 3 (not illustrated in FIG. 1, see FIG. 7).

[0025] First, by referring to FIG. 2, the structure of the

spinning units 1 will be described in detail.

[0026] The spinning unit 1 is a spinning machine that produces a spun yarn Y from a fiber bundle (hereinafter referred to as "sliver") F and forms a package P. The spinning unit 1 includes a sliver supplying unit 4, a draft device 5, an air-jet spinning device 6, a yarn defect detecting device 7, a tension stabilizing device 8, and a winding device 9, all of which are arranged in this order along the direction in which the sliver F and the spun yarn Y are fed.

[0027] The sliver supplying unit 4 feeds the sliver F, which is the raw material for the spun yarn Y, to the draft device 5. The sliver supplying unit 4 mainly includes a sliver case 41 and a sliver guide 42 (refer to FIG. 3). The sliver F stored in the sliver case 41 is guided by the sliver guide 42 and fed to the draft device 5.

[0028] The draft device 5 equalizes the thickness of the sliver F by drafting the sliver F. As indicated in FIG. 3, the draft device 5 includes four pairs of draft rollers, namely, a back roller pair 51, a third roller pair 52, a middle roller pair 53, and a front roller pair 54, all of which are arranged in this order along the direction in which the sliver F is fed. The arrows in the drawing indicate the direction in which the sliver F is fed.

[0029] The four pairs of the draft rollers 51, 52, 53 and 54 consist of bottom rollers 51A, 52A, 53A and 54A and top rollers 51B, 52B, 53B and 54B, respectively. The bottom roller 53A and the top roller 53B constituting the middle roller pair 53 are respectively wound with apron bands 53C and 53C made of leather or synthetic rubber.

[0030] All of the bottom rollers 51A, 52A, 53A and 54A are rotated by a driving device (not illustrated) toward the same direction. The top rollers 51B, 52B, 53B and 54B are rotated in response to the rotation of the bottom rollers 51A, 52A, 53A and 54A toward the same direction. The rotation speed of the draft roller pairs 51, 52, 53 and 54 is set such that the rotation speed becomes higher along a feeding direction of the sliver F.

[0031] According to such a configuration, a feeding speed of the sliver F, which is nipped among the draft roller pairs 51, 52, 53 and 54, accelerates as the sliver F passes through each of the draft roller pairs 51, 52, 53 and 54. Accordingly, the sliver F is drafted between the adjacent draft roller pairs. The draft device 5 equalizes the thickness of the sliver F by drafting the sliver F as described above.

[0032] The air-jet spinning device 6 produces the spun yarn Y by twisting the drafted sliver F. As illustrated in FIG. 4, the air-jet spinning device 6 mainly includes a fiber guide 61, a spindle 62, and a nozzle block 63. The black arrows in FIG. 4 indicate the direction in which the sliver F and the spun yarn Y are fed. The white arrows in FIG. 4 indicate the direction in which the supplied air flows.

[0033] The fiber guide 61 constitutes a portion of the spinning chamber SC. The fiber guide 61 guides the sliver F drafted by the draft device 5 to the spinning chamber SC. Specifically, the fiber guide 61 guides the sliver F to

the spinning chamber SC through a fiber introducing passage 61g that is connected to the spinning chamber SC. The fiber guide 61 is provided with a needle 61n, which protrudes into the spinning chamber SC and also guides the sliver F.

[0034] The spindle 62 constitutes a portion of the spinning chamber SC. The spindle 62 guides the sliver F twisted in the spinning chamber SC, that is, the spun yarn Y, to the yarn defect detecting device 7. Specifically, the spindle 62 guides the spun yarn Y to the yarn defect detecting device 7, which is arranged downstream in a feeding direction, through a fiber passage 62s connected to the spinning chamber SC.

[0035] The nozzle block 63 constitutes a portion of the spinning chamber SC. The nozzle block 63 guides the air compressed and transported by an air transporting device 21, which will be described later, to the spinning chamber SC. Specifically, the nozzle block 63 guides the air to the spinning chamber SC through air holes 63a connected to the spinning chamber SC. Each air hole 63a of the nozzle block 63 is connected to the spinning chamber SC so that the air ejected from the air holes 63a flows toward the same direction around a central axis of the spinning chamber SC. Therefore, a whirling airflow is generated in the spinning chamber SC (see the white arrows in FIG. 4.)

[0036] The spinning chamber SC will be described hereafter in detail. The spinning chamber SC is a space surrounded by the fiber guide 61, the spindle 62, and the nozzle block 63. Specifically, the spinning chamber SC is a space formed by being surrounded by the substantially conical spindle 62, which is inserted from one direction toward a substantially conical through-hole 63p of the nozzle block 63, and the fiber guide 61, which is inserted from the opposite direction.

[0037] The spinning chamber SC is divided into two sections, i.e., a space SC1, which is formed between the fiber guide 61 and the spindle 62, and a space SC2, which is formed between the spindle 62 and the nozzle block 63. In the space SC1, a trailing end of each fiber constituting the sliver F is reversed by a whirling airflow (refer to two-dot chain lines in FIG. 4). In the space SC2, the trailing end of the reversed fiber is rotated by the whirling airflow (refer to two-dot chain lines in FIG. 4).

[0038] According to such a configuration, the trailing end of each fiber constituting the sliver F, which is guided along the needle 61n, is rotated and gradually wound around core fibers. The air-jet spinning device 6 can twist the sliver F using the whirling airflow and produces the spun yarn Y. The air-jet spinning device 6 may be provided with the fiber guide 61 not having the needle 61n. In this case, the fiber guide 61 performs the function of the needle 61n by a downstream end edge of the fiber guide 61.

[0039] The yarn defect detecting device 7 detects a defective portion occurred in the spun yarn Y. As indicated in FIG. 5, the yarn defect detecting device 7 mainly includes a light source section 71, a light receiving section

72, and a casing 73. The arrows in FIG. 5 indicate the direction of the light irradiated from the light source section 71.

[0040] The light source section 71 is a semiconductor element that produces light by a voltage being applied in a forward direction, that is, a light emitting diode. The light source section 71 is arranged so as to irradiate the light to the spun yarn Y.

[0041] The light receiving section 72 is a semiconductor element, that enables control of an electric current with a light signal, that is, a phototransistor. The light receiving section 72 is arranged so as to receive the light irradiated by the light source section 71.

[0042] The casing 73 holds the light source section 71 and the light receiving section 72 at a prescribed position. The casing 73 is provided with a yarn passage 73a where the spun yarn Y passes through. The casing 73 holds the light source section 71 and the light receiving section 72 so as to face one another across the spun yarn Y.

[0043] According to such a configuration, the light volume that the light receiving section 72 receives is a value that is calculated by subtracting the light volume shielded by the spun yarn Y from the volume of the light irradiated from the light source section 71 to the spun yarn Y. The yarn defect detecting device 7 is connected to the control device C via an electric line (refer to FIG. 7). The control device C recognizes a defective portion of the spun yarn Y by receiving a detection signal from the yarn defect detecting device 7.

[0044] The defects that the yarn defect detecting device 7 can detect include: a portion of the spun yarn Y that is too thick or too thin, and foreign bodies, such as polypropylenes, contained in the spun yarn Y. The yarn defect detecting device 7 may also adopt a capacitive sensor instead of an optical sensor as described above.

[0045] The tension stabilizing device 8 stabilizes the tension of the spun yarn Y by properly maintaining the tension. As illustrated in FIG. 6, the tension stabilizing device 8 mainly includes a roller 81, a driving section 82, and an unwinding member 83. The arrows in FIG. 6 indicate the direction in which the spun yarn Y is fed.

[0046] The roller 81 is a rotor in a substantially cylindrical shape that withdraws the spun yarn Y from the air-jet spinning device 6 and winds the spun yarn Y. The roller 81 is attached to a rotating axis 82a of the driving section 82, and is rotated by the driving section 82. The spun yarn Y withdrawn from the air-jet spinning device 6 is wound around an outer peripheral surface of the roller 81.

[0047] The driving section 82 is an electric motor activated by power. The driving section 82 rotates the roller 81 and also maintains a rotating speed thereof at a certain level. Accordingly, the winding speed of the spun yarn Y around the roller 81 can be maintained at a prescribed speed.

[0048] The unwinding member 83 is a yarn hooking member that assists unwinding of the wound spun yarn Y by rotating integrally or independently from the roller

81. One end of the unwinding member 83 is attached on a rotating axis 84 of the roller 81. The other end of the unwinding member 83 is formed to curve toward the outer peripheral surface of the roller 81. The spun yarn Y is hooked to the curved portion, enabling the unwinding member 83 to unwind the spun yarn Y from the roller 81. A permanent magnet, which generates a resistance force against the rotation of the unwinding member 83, is provided at the base of the rotating axis 84 where the unwinding member is attached.

[0049] According to such a configuration, when the tension acting upon the spun yarn Y is low and the unwinding member 83 cannot overcome the above-described resistance force, the unwinding member 83 rotates integrally with the roller 81. On the other hand, when the tension acting upon the spun yarn Y is high and the unwinding member 83 can overcome the above-described resistance force, the unwinding member 83 rotates independently from the roller 81. As described above, the unwinding member 83 can be rotated integrally with or independently from the roller 81 according to the tension acting upon the spun yarn Y, and the tension stabilizing device 8 can adjust the unwinding speed of the spun yarn Y. Thus, the tension stabilizing device 8 stabilizes the tension acting upon the spun yarn Y by properly maintaining the tension.

[0050] As described above, the tension stabilizing device 8 also functions to withdraw the spun yarn Y from the air-jet spinning device 6. However, a delivery roller and a nip roller may be provided downstream of the air-jet spinning device 6, and the spun yarn Y may be withdrawn by the delivery roller and the nip roller. Further, the tension stabilizing device 8 may be provided downstream of the delivery roller and the nip roller, and the spun yarn Y may be withdrawn and accumulated. Alternatively, the tension stabilizing device 8 may be omitted, and the spun yarn Y may be withdrawn by the winding device 9.

[0051] The winding device 9 produces a substantially cylindrical (cheese-shaped) package P by winding the spun yarn Y. The winding device 9 mainly includes a driving roller 91 and a cradle (not illustrated). The cradle rotatably supports the bobbin 92.

[0052] The driving roller 91 is a rotating body that rotates the bobbin 92 and the package P. The driving roller 91 adjusts its rotating speed in accordance with a change in an outer diameter of the package P and thus maintains a peripheral speed of the package P at a constant speed.

[0053] The bobbin 92 is a substantially cylindrical rotating body that winds the spun yarn Y by being rotated. The bobbin 92 is rotated by the rotating driving roller 91 that rotates while being in contact with an outer peripheral surface of the bobbin 92 or the package P. The winding device 9 traverses the spun yarn Y with a traverse device (not illustrated) so as to prevent the spun yarn Y from being uneven in the package P.

[0054] According to such a configuration, the spun yarn Y guided to the bobbin 92 is wound around the outer

peripheral surface of the bobbin 92 without being uneven. Accordingly, the winding device 9 can produce a substantially cylindrical (cheese-shaped) package P. The winding device 9 can produce other shapes of a package P, such as a substantially conical (cone-shaped) package P, other than the cylindrical package P illustrated in FIG. 2.

[0055] Next, with reference to FIG. 7, configurations of an air distributing device 2 and an additive supplying device 3 will be described in detail. The arrows in FIG. 7 indicate the direction of airflow.

[0056] As described above, the spinning machine 100 includes one air distributing device 2. The air distributing device 2 mainly includes an air transporting device 21, a first air pipe 22, a first distribution pipe 23, a second air pipe 24 and a second distribution pipe 25.

[0057] The air transporting device 21 compresses air and transports the air. The air transporting device 21 mainly includes an electric compressor that compresses air by basically activating an electric motor. The pressure of the air compressed and transported by the air transporting device 21 is controlled by a pressure adjusting valve 211.

[0058] The first air pipe 22 functions as an air passage where the air compressed and transported by the air transporting device 21 is guided through. The first air pipe 22 is mounted horizontally or substantially horizontally along the direction in which each spinning unit 1 is allocated.

[0059] The first distribution pipe 23 functions as an air passage where the air flowing through the first air pipe 22 branches off and then is guided to the air-jet spinning device 6. One end of the first distribution pipe 23 is connected to the air-jet spinning device 6. The other end of the first distribution pipe 23 is connected to the intermediate portion of the first air pipe 22. Accordingly, the first distribution pipe 23 can branch off the air flowing through the first air pipe 22 and guide the air to the air-jet spinning device 6. Further, the quantity of the air to be guided to the air-jet spinning device 6 through the first distribution pipe 23 is controlled by an open/close valve 231, which is provided at the intermediate portion of the first distribution pipe 23.

[0060] The second air pipe 24 functions as an air passage where the air compressed and transported by the air transporting device 21 is guided. The second air pipe 24 is mounted horizontally or substantially horizontally along the direction in which each spinning unit 1 is allocated.

[0061] The second distribution pipe 25 functions as an air passage where the air flowing through the second air pipe 24 branches off and then is guided to the air-jet spinning device 6. One end of the second distribution pipe 25 is connected to the air-jet spinning device 6. The other end of the second distribution pipe 25 is connected to the intermediate portion of the second air pipe 24. Accordingly, the second distribution pipe 25 can branch off the air flowing through the second air pipe 24 and guide

the air to the air-jet spinning device 6. Further, the quantity of the air to be guided to the air-jet spinning device 6 through the second distribution pipe 25 is controlled by an open/close valve 251, which is provided at the intermediate portion of the second distribution pipe 25.

[0062] As described above, an air distributing device 2 can supply the air compressed and transported by the air transporting device 21 to the air-jet spinning device 6 through the first air pipe 22 or the second air pipe 24. As an alternative embodiment of the present invention, the second distribution pipe 24 may be omitted, or a larger number of air pipes may be provided than the spinning machine 100 according to the present embodiment.

[0063] Further, as described above, the spinning machine 100 includes one additive supplying device 3. The additive supplying device 3 mainly includes a branching pipe 31, a pressure adjusting device 32, an additive storage tank 33, and an additive supplying pipe 34.

[0064] The branching pipe 31 functions as an air passage where the air flowing through the first air pipe 22 branches off and then is guided to the additive storage tank 33. One end of the branching pipe 31 is connected to the additive storage tank 33. The other end of the branching pipe 31 is connected to the intermediate portion of the first air pipe 22. Accordingly, the branching pipe 31 can branch off the air flowing through the first air pipe 22 and guide the air to the additive storage tank 33. The flow rate of the air to be guided to the additive storage tank 33 through the branching pipe 31 is adjusted by an open/close valve 311, which is provided at the intermediate portion of the branching pipe 31.

[0065] The pressure adjusting device 32 compresses the air to be guided to the additive storage tank 33 and adjusts the pressure inside the additive storage tank 33.

The pressure adjusting device 32 mainly includes a booster valve or the like that compresses air using a sliding piston. Alternatively, an electric compressor may be used to compress the air. The pressure adjusting device 32 is connected to the control device C via an electric line. The control device C appropriately controls an operating status of the pressure adjusting device 32 by transmitting a control signal to the pressure adjusting device 32.

[0066] The additive storage tank 33 is a container that stores an additive. The additive storage tank 33 is provided with a level sensor 331 that detects the stored volume of the additive. The level sensor 331 is connected to the control device C via an electric line. The control device C obtains the stored volume of the additive by receiving a detection signal from the level sensor 331.

[0067] The additive supplying pipe 34 functions as an air passage where the additive stored in the additive storage tank 33 is guided to the first air pipe 22. One end of the additive supplying pipe 34 is arranged to be opened at the bottom of the additive storage tank 33. The other end of the additive supplying pipe 34 is connected to upstream of a branch where the air flowing through the first air pipe 22 branches off to the air-jet spinning device

6.

[0068] Accordingly, the additive supplying device 3 can supply the additive stored in the additive storage tank 33 to the first air pipe 22. The additive supplying device 3 also can adjust the supplying volume of the additive by controlling the internal pressure of the additive storage tank 33.

[0069] According to such a configuration, the spinning machine 100 can add the additive to the air to be supplied to the air-jet spinning device 6. Further, in spite of the simple structure, the spinning machine 100 can adjust the supplying volume of the additive with high accuracy. Thus, the volume of the additive supplied to the air-jet spinning device 6 is maintained at a desired level so as not to be excessive or deficient, which eventually leads to improvement of quality of the spun yarn Y.

[0070] The spinning machine 100 according to the present embodiment can supply air to the air-jet spinning device 6 using only the first air pipe 22 by opening the valve 221, which is located upstream of the first air pipe 22, and by closing the valve 241, which is located upstream of the second air pipe 24. Accordingly, the spinning machine 100 can supply only the air including the additive to the air-jet spinning machine 6.

[0071] Meanwhile, the spinning machine 100 according to the present embodiment can supply air to the air-jet spinning device 6 using only the second air pipe 24 by closing the valve 221, which is located upstream of the first air pipe 22 and by opening the valve 241, which is located upstream of the second air pipe 24. Accordingly, the spinning machine 100 can supply only the air not including the additive to the air-jet spinning device 6.

[0072] Next, with reference to FIG. 8, a description will be made on how loosely twisted spun yarn Y is produced in a case where the volume of the additive supplied to the air-jet spinning device 6 is excessive. The black arrows in FIG. 8 indicate the direction in which the sliver F and the spun yarn Y are fed. The white arrows in FIG. 8 indicate the direction in which the supplied air flows. The additive supplied to the first air pipe 22 is described as an accumulation preventing agent that prevents accumulation of the oiling agent, which is applied to the sliver F.

[0073] As described above, the air supplied to the spinning chamber SC through the air holes 63a of the nozzle block 63 creates a whirling airflow in the spinning chamber SC (refer to the white arrows in FIG. 8). At this time, the accumulation preventing agent supplied to the air-jet spinning device 6 with the air forms a film over a peripheral surface of the spindle 62 or the like, and prevents accumulation of the oiling agent contained in the fibers. However, when the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes excessive, that is, when the volume of the accumulation preventing agent contained in the air supplied to the air-jet spinning device 6 exceeds a prescribed volume, the accumulation preventing agent starts adhering to the peripheral surface of the spindle 62 or the like as

liquid droplets. Therefore, the trailing end of the fiber, which has been reversed in the spinning chamber SC, becomes difficult to be rotated by the whirling airflow. As a result, loosely twisted spun yarn Y is produced.

[0074] Specifically, in a case where the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 exceeds a certain volume, the accumulation preventing agent adheres to the peripheral surface of the spindle 62 or the like as liquid droplets. As a result, the adhered accumulation preventing agent becomes a resistance to the fiber that whirls around the spindle 62 (refer to the two-dot chain lines in FIG. 8). Therefore, the trailing end of the fibers, which has been reversed in the spinning chamber SC, becomes difficult to be rotated by the whirling airflow, and cannot wind sufficiently around the core fiber. In a case where the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes excessive, the rear end of the reversed fiber is guided into the fiber passage 62s before being sufficiently wound around the core fiber, loosely twisted spun yarn Y is produced.

[0075] Next, with reference to FIG. 9, a description will be made on reasons why loosely twisted spun yarn Y is produced in a case where the volume of the additive supplied to the air-jet spinning device 6 becomes deficient. The black arrows in FIG. 9 indicate the direction in which the sliver F and the spun yarn Y are fed. The white arrows in FIG. 9 indicate the direction in which the supplied air flows. The description will be also made provided that the additive supplied to the first air pipe 22 is an accumulation preventing agent that prevents accumulation of the oiling agent, which is applied to the sliver F.

[0076] As described above, the air supplied to the spinning chamber SC through the air holes 63a of the nozzle block 63 creates a whirling airflow in the spinning chamber SC (refer to the white arrows in FIG. 9). At this time, the accumulation preventing agent supplied to the air-jet spinning device 6 with the air forms a film over a peripheral surface of the spindle 62 or the like to prevent accumulation of the oiling agent. However, when the volume of accumulation preventing agent supplied to the air-jet spinning device 6 becomes deficient, that is, when the accumulation preventing agent included in the air is less than the prescribed volumes, the oiling agent applied to the sliver F adheres and accumulated on the peripheral surface of the spindle 62 or the like. Therefore, the trailing end of the fiber reversed in the spinning chamber SC becomes difficult to be rotated by the whirling airflow. As a result, the loosely-twisted spun yarn Y is produced.

[0077] Specifically, in a case where the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes deficient, the oiling agent applied to the sliver F adheres and accumulated on the peripheral surface of the spindle 62 or the like. Therefore, the accumulated oiling agent increases a resistance to the fiber that whirls around the spindle 62 (refer to two-dot chain lines in FIG. 9). Accordingly, since the trailing end of the fiber reversed in the spinning chamber SC

becomes difficult to be rotated by the whirling airflow, the trailing end of the fiber cannot be sufficiently wound around the core fiber. When the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes deficient, since the trailing end of the reversed fiber is guided into the fiber passage 62s before being sufficiently wound around the core fibers, the loosely twisted spun yarn Y is produced.

[0078] Thus, in order to prevent the loosely twisted spun yarn Y from being produced and to improve quality of the spun yarn Y, prevention of the volume of the accumulation preventing agent supplied to the air-jet spinning devices 6 from being excessive or deficient becomes essential. Furthermore, in a case where the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes excessive, the accumulation preventing agent may soak into the spun yarn Y to cause a dyeing defect. Therefore, a technology of properly adjusting the supplying volume of the accumulation preventing agent has been demanded. However, as in the structure of the spinning machine 100, in a structure in which the accumulation preventing agent is added to the air flowing through an air pipe (the first air pipe 22 in the spinning machine 100) and branching off the air towards each air-jet spinning device 6, the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 was difficult to be optimized.

[0079] Specifically, since a winding-start period and a winding-end period of the package P differs among each spinning unit 1 of the spinning machine, the operating number of the air-jet spinning devices 6 varies. For example, when changing a lot of the spinning machine 100, winding operation is stopped from a spinning unit 1 that has completed winding of the package P. Therefore, the operating number of the air-jet spinning devices 6 gradually decreases. Meanwhile, when few air-jet spinning devices 6 first carry out spinning and then the rest of the air-jet spinning devices 6 start spinning, the operating number of the operating air-jet spinning devices 6 gradually increases. When the operating number of the air-jet spinning devices 6 varies, the volume of the air flowing through the first air pipe 22 also varies due to the change in required air. At this time, if the volume of the accumulation preventing agent supplied by the additive supplying device 3 is constant, the volume of the accumulation preventing agent supplied to the air-jet spinning device 6 becomes excessive or deficient. Thus, the spinning machine 100 adjusts the supplying volume of the accumulation preventing agent depending on the operating number of the air-jet spinning devices 6.

[0080] With reference to FIG. 10, a description will be made on a control mode for adjusting the supplying volume of the accumulation preventing agent according to the operating number of the air-jet spinning devices 6. The horizontal axis in FIG. 10 indicates the operating number of the air-jet spinning devices 6. The vertical axis in FIG. 10 indicates a ratio of the actually supplied volume with respect to the supplying volume of the accumulation

preventing agent when all of the air-jet spinning devices 6 are operating.

[0081] The spinning machine 100 increases the supplying volume of the accumulation preventing agent according to an increase in the operating number of the air-jet spinning devices 6. Specifically, the control device C of the spinning machine 100 increases the supplying volume of the accumulation preventing agent according to an increase in the operating number of the air-jet spinning devices 6 by controlling the pressure adjusting device 32 of the additive supplying device 3.

[0082] Meanwhile, the spinning machine 100 reduces the supplying volume of the accumulation preventing agent according to a decrease in the operating number of the air-jet spinning devices 6. Specifically, the control device C of the spinning machine 100 reduces the supplying volume of the accumulation preventing agent according to the decrease in the operating number of the air-jet spinning devices 6 by controlling the pressure adjusting device 32 of the additive supplying device 3.

[0083] As indicated by the solid line in FIG. 10, the spinning machines 100 adjusts the supplying volume of the accumulation preventing agent step by step (gradually) depending on the operating number of the air-jet spinning devices 6. With respect to a problem of a loosely twisted spun yarn Y being produced, the supplied volume of the accumulation preventing agent does not have a great impact, and thus the control mode is simplified. However, as indicated by the dashed-line in FIG. 10, the spinning machine 100 can also continuously adjust the supplying volume of the accumulation preventing agent. The control device C adjusts the supplying volume of the accumulation preventing agent by controlling a ratio of operational time to nonoperational time per unit time, namely, a duty ratio of the pressure adjusting device 32. The supplying volume of the accumulation preventing agent may be adjusted by adjusting a differential pressure using a regulator or by directly controlling the volume of the additive to be supplied by the additive supplying device 3.

[0084] According to such a configuration, the spinning machine 100 can add the accumulation preventing agent to the air to be supplied to the air-jet spinning devices 6, and also adjust the supplying volume of the accumulation preventing agent according to the operating number of the air-jet spinning devices 6. Accordingly, the supplied volume of the accumulation preventing agent can be maintained so as not to be excessive or deficient, which eventually leads to improvement in quality of the spun yarn Y.

[0085] Next, a description will be made on how the control device C of the spinning machine 100 obtains the operating number of the air-jet spinning devices 6.

[0086] The control device C obtains the operating number of the air-jet spinning devices 6 by receiving an electric signal transmitted from each spinning unit 1. More specifically, the control device C obtains the operating number of the air-jet spinning devices 6 by receiving

an operation signal indicating an operating status transmitted from each spinning unit 1. Alternatively, the control device C obtains the operating number of the air-jet spinning devices 6 by receiving a yarn travelling signal transmitted from the yarn defect detecting device 7. Furthermore, a sensor may be provided to the draft device 5 or the like, and the operating number of the air-jet spinning devices 6 may be obtained by a yarn travelling signal from such a sensor.

[0087] The control device C can also obtain the operating number of the air-jet spinning devices 6 in accordance with a measurement result of an air flow-rate measuring device 222 provided to the first air pipe 22. In this case, the control device C uses a correlation between the volume of the air flowing through the first air pipe 22 and the operating number of the air-jet spinning devices 6 described above. A hot-wire flowmeter or a pressure-differential type flowmeter or the like may be used as the air flow-rate measuring device 222, and a measuring method is not limited.

[0088] According to such a configuration, the spinning machine 100 can correctly obtain the operating number of the air-jet spinning devices 6, and properly adjust the supplying volume of the accumulation preventing agent. Accordingly, the volume of the accumulation preventing agent supplied to the air-jet spinning devices 6 is adjusted so as not to be excessive or deficient, which eventually leads to improvement in quality of the spun yarn Y.

[0089] Next, with reference to FIG. 11, a description will be made on a structure capable of preventing the accumulation preventing agent adhering in the first air pipe 22 from leaking into the air-jet spinning devices 6.

[0090] As described above, an additive such as the accumulation preventing agent is supplied to the first air pipe 22 by the additive supplying device 3. Therefore, a large volume of the additive adhering in the first air pipe 22 may possibly flow into the air-jet spinning device 6. In the embodiment of the present invention, the first air pipe 22 is mounted inclined so that the additive adhering to the first air pipe 22 is guided to a prescribed area. According to such a configuration, the spinning machine 100 can accumulate the additive adhering to the first air pipe 22 at the prescribed area. Accordingly, the additive adhering to the first air pipe 22 can be prevented from flowing into the air-jet spinning device 6, which eventually leads to improvement in quality of the spun yarn Y.

[0091] The first air pipe 22 is provided with an additive discharge port 223 that drains the additive from the first air pipe 22. According to such a configuration, the spinning machine 100 can drain the additive stored in the first air pipe 22. Accordingly, the additive accumulating in the first air pipe 22 can be prevented from flowing into the air-jet spinning devices 6, which eventually leads to improvement in quality of the spun yarn Y.

[0092] In an embodiment illustrated in FIG. 11, the air pipe 22 is arranged inclined downward further with an increasing distance from the additive supplying device 3. The first air pipe 22 is not limited to this embodiment,

and may be arranged inclined upward further with an increasing distance from the additive supplying device 3. In this case, the additive discharge port 223 is provided close to the additive supplying device 3. Alternatively, the additive adhering in the first air pipe 22 may be collected to the additive storage tank 33 through the additive discharge port 223.

[0093] The spinning machine 100 according to the present embodiment includes one additive supplying device 3. However, when a plurality of spinning units 1 are classified into a plurality of groups, each group of the spinning units 1 may have one additive supplying device 3 and one air transporting device 21. The structure including one additive supplying device 3 and one air transporting device 21 for a plurality of the spinning units 1 allows the spinning machine 100 to be simplified and not to be enlarged.

[0094] In the spinning machine 100 according to the embodiment of the present invention, the sliver F is fed from an upward position to a downward position. However, the spinning machine 100 according to the present invention is not limited to such an embodiment. For example, a can where the sliver F is stored may be placed at a lower part of the spinning machine 100, and the winding device 9 may be arranged at an upper part of the spinning machine 100.

Claims

1. A spinning machine comprising:

a plurality of spinning units (1), each spinning unit (1) including an air-jet spinning device (6) adapted to twist a fiber bundle by supplying air, an air transporting device (21) adapted to transport air, an air pipe (22) adapted to guide the air transported by the air transporting device (21), an additive supplying device (3) adapted to supply additive to the air pipe (22) at upstream of a branch where the air flowing through the air pipe (22) branches towards each of the air-jet spinning devices (6), and a control device (C) adapted to adjust a supplying volume of the additive to be supplied by the additive supplying device (3).

2. The spinning machine according to claim 1, wherein the additive supplying device (3) includes an additive storage tank (33) adapted to store the additive, an additive supplying pipe (34) adapted to guide the additive from the additive storage tank (33) to the air pipe (22), and a pressure adjusting device (32) adapted to adjust pressure inside the additive storage tank (33), wherein the control device (C) adapted to control an operating state of the pressure adjusting device (32) to change a flow rate of the additive guid-

ed by the additive supplying pipe (34) to adjust the supplying volume of the additive.

3. The spinning machine according to claim 1, wherein the control device (C) adapted to increase the supplying volume of the additive according to an increase in an operating number of the air-jet spinning devices (6) and to decrease the supplying volume of the additive according to a decrease in the operating number of the air-jet spinning devices (6). 5
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4. The spinning machine according to one of claim 1 through claim 3, wherein the control device (C) adapted to receive an electric signal transmitted from each of the spinning units (1) and to obtain the operating number of the air-jet spinning devices (6). 15
5. The spinning machine according to one of claim 1 through claim 3, further comprising an air flow-rate measuring device (222) adapted to measure the flow-rate of the air flowing through the air pipe (22), wherein the control device (C) adapted to obtain the operating number of the air-jet spinning devices (6) in accordance with a measurement result of the air flow-rate measuring device (22). 20
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6. The spinning machine according to one of claim 1 through claim 5, wherein the air pipe (22) is arranged slanted so that the additive adhering to an inner surface of the air pipe (22) is collected at a prescribed position. 30
7. The spinning machine according to claim 6, wherein the air pipe (22) includes an additive discharge port (223) adapted to drain the additive accumulated inside the air pipe (22) to outside. 35
8. The spinning machine according to one of claim 1 through claim 7, wherein the additive to be supplied to the air pipe (22) by the additive supplying device (3) is an accumulation preventing agent that prevents oiling agent, which is applied to the fiber bundle, from adhering and accumulating. 40

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FIG. 1

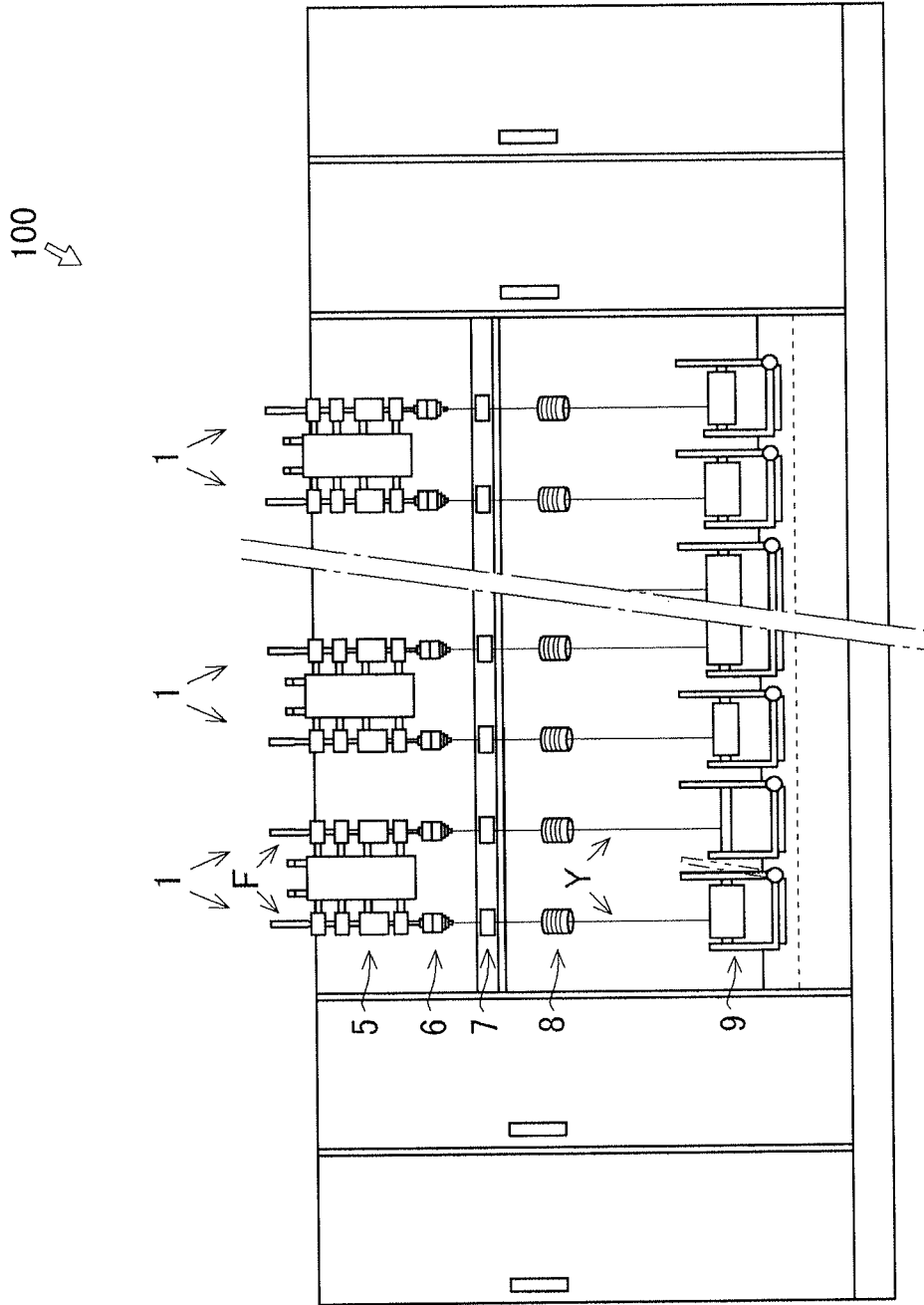


FIG. 2

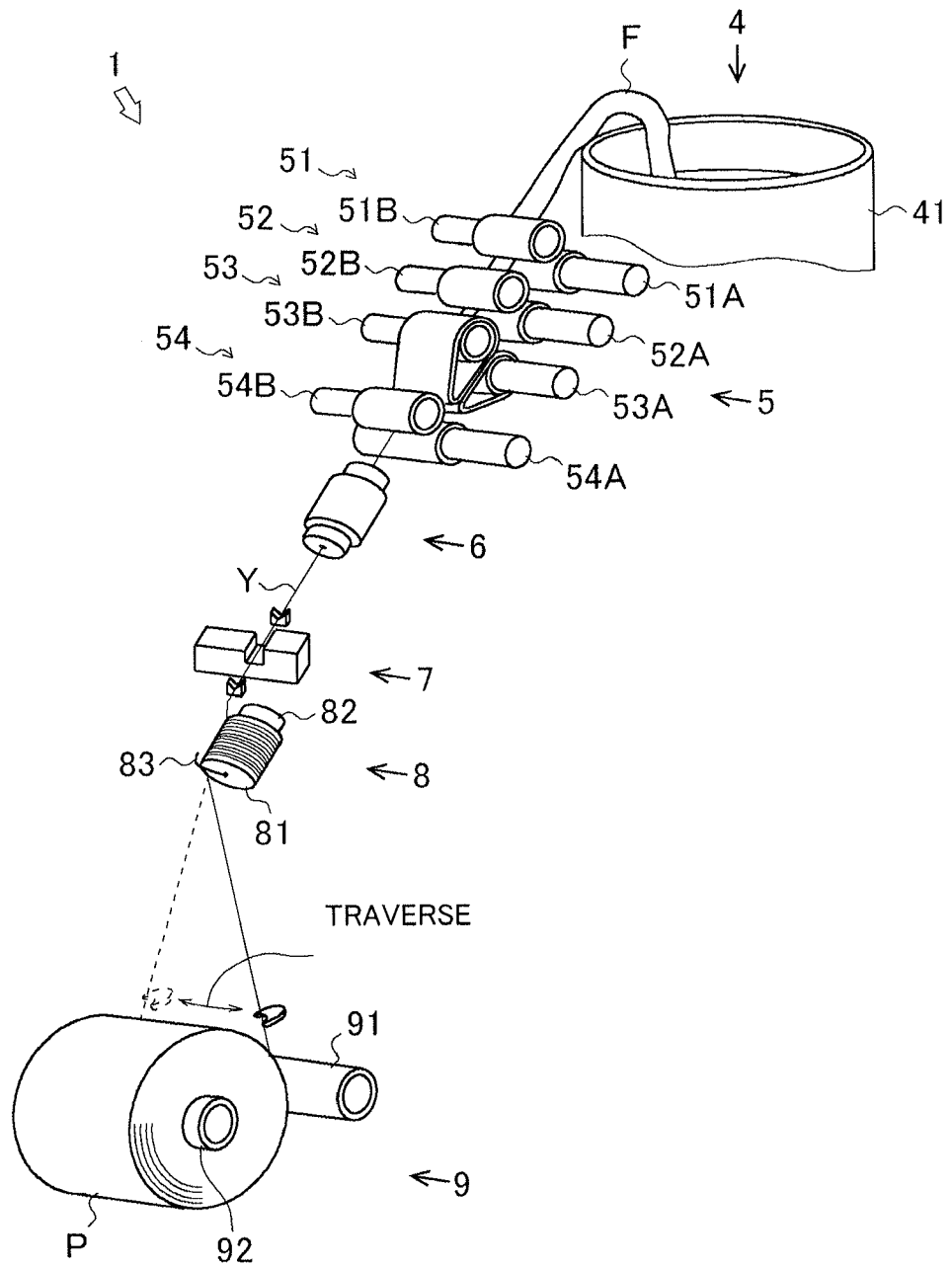


FIG. 3

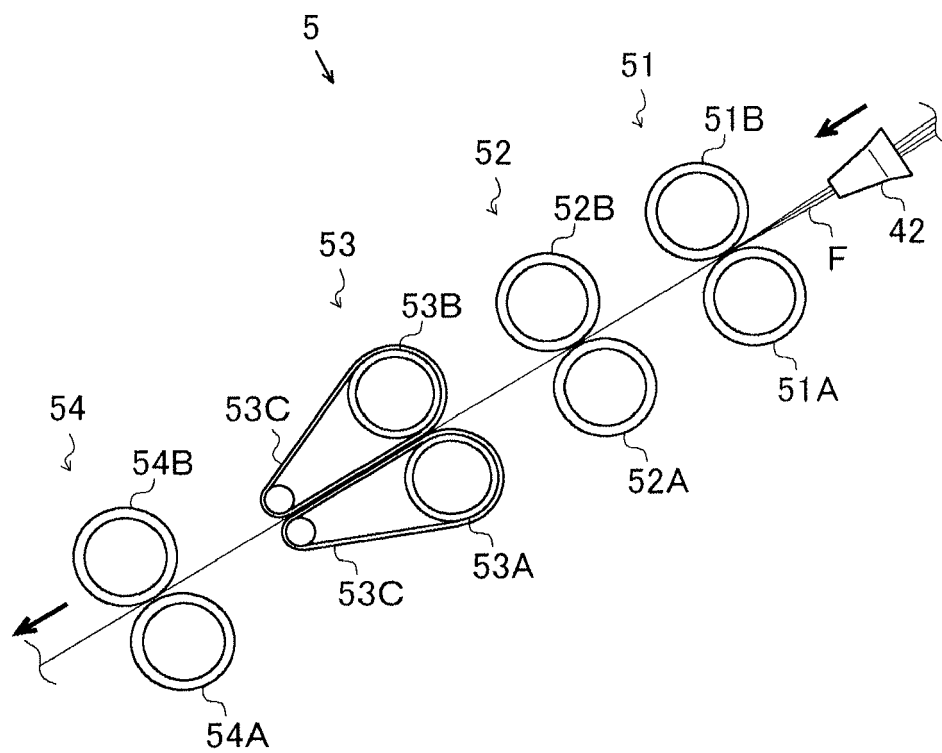


FIG. 4

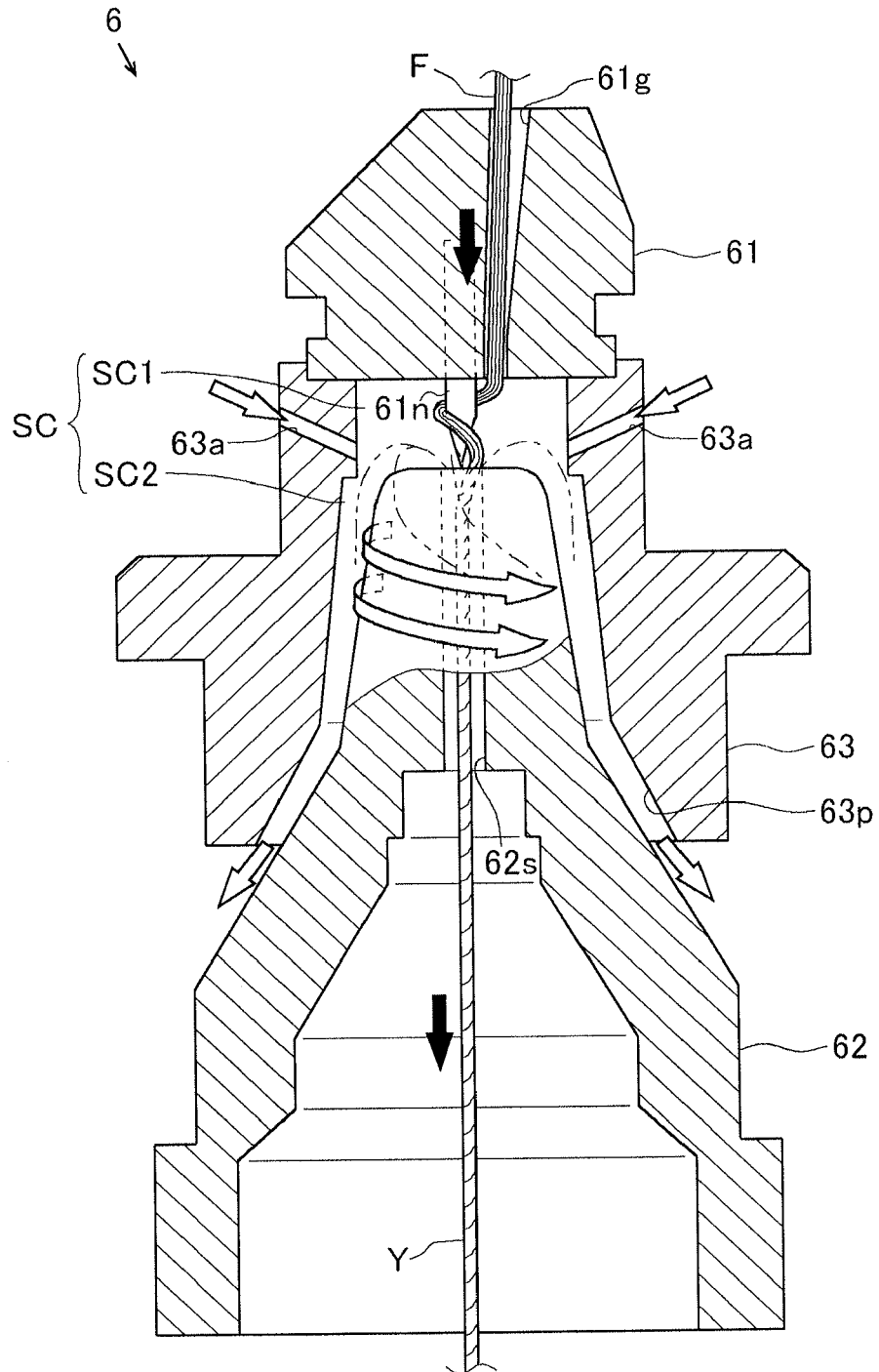


FIG. 5

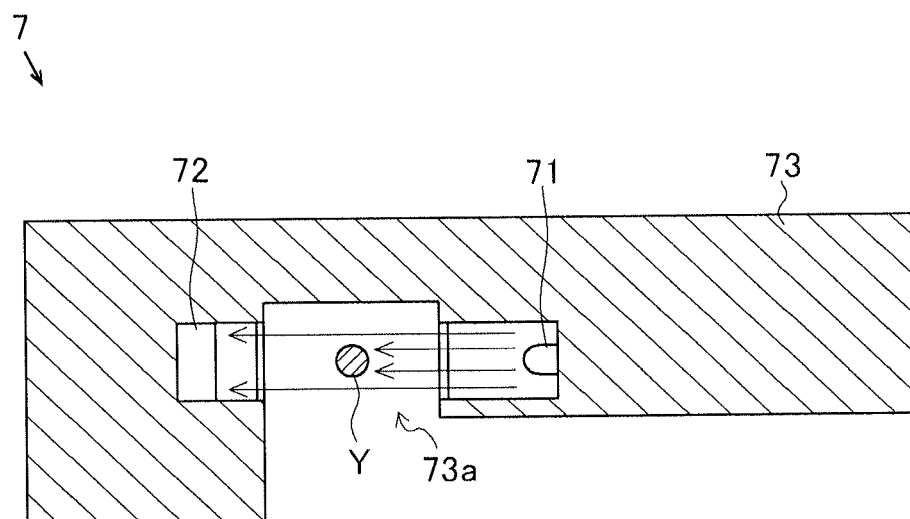


FIG. 6

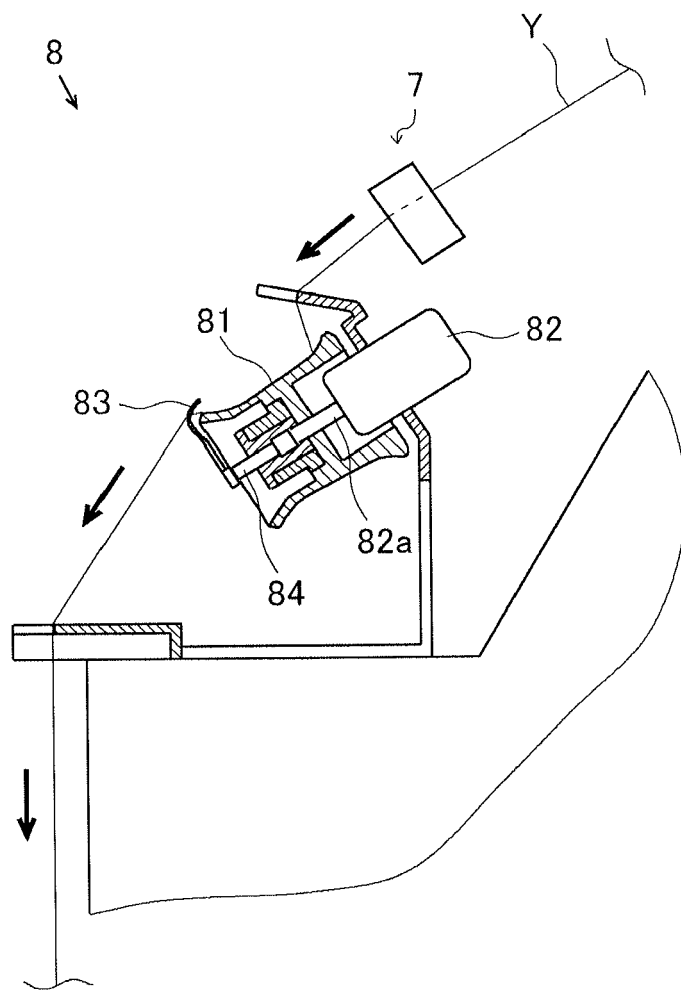


FIG. 7

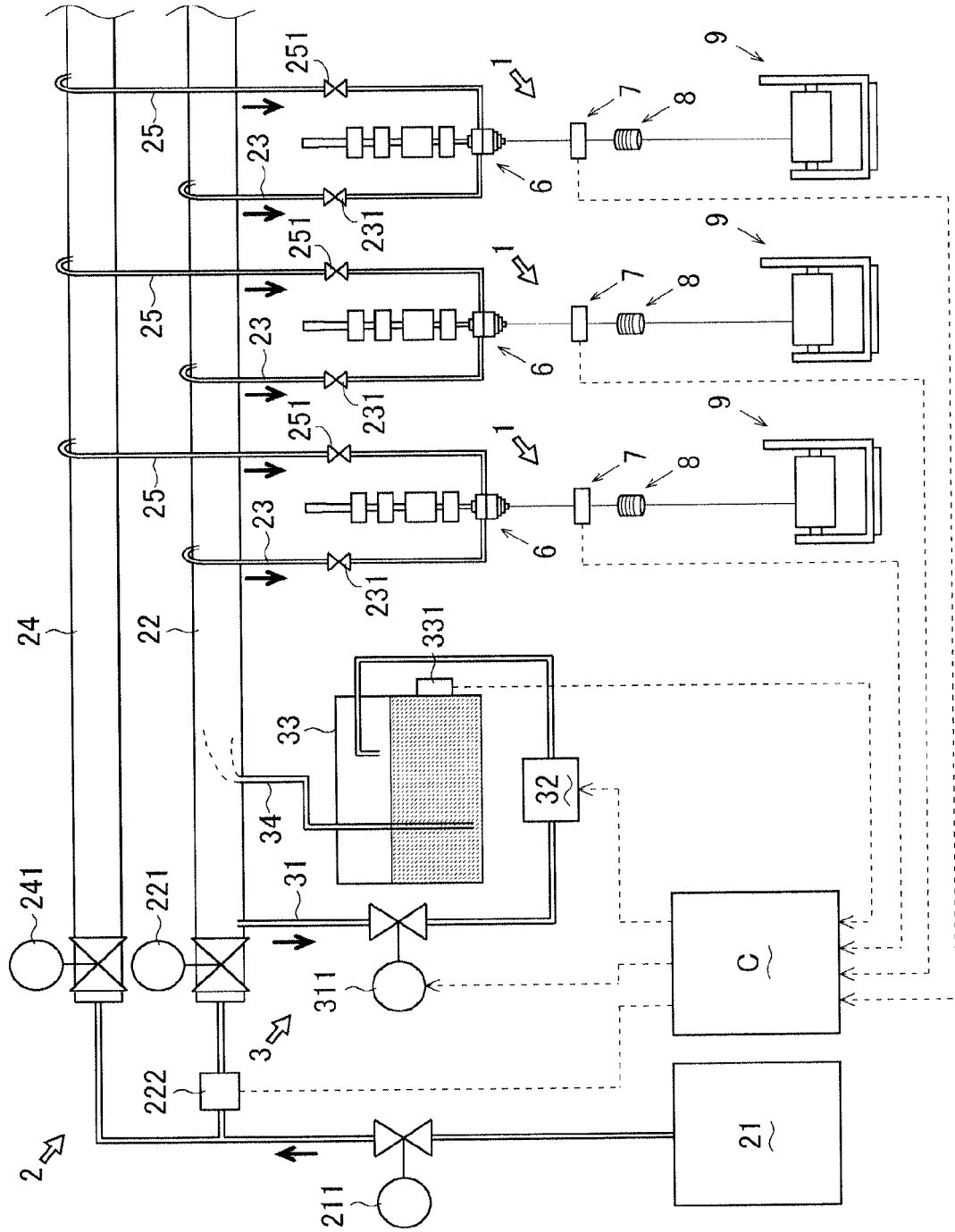


FIG. 8

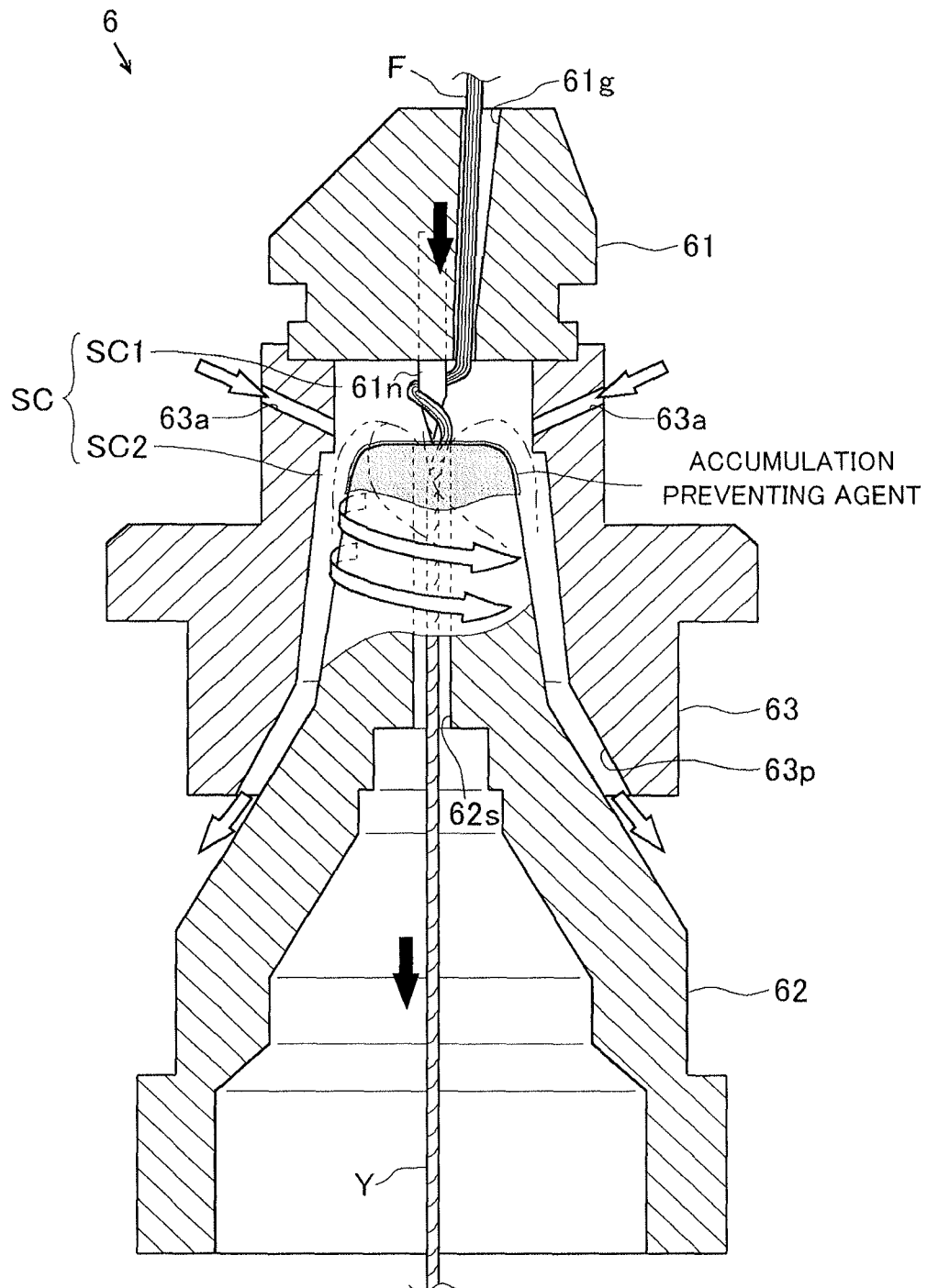


FIG. 9

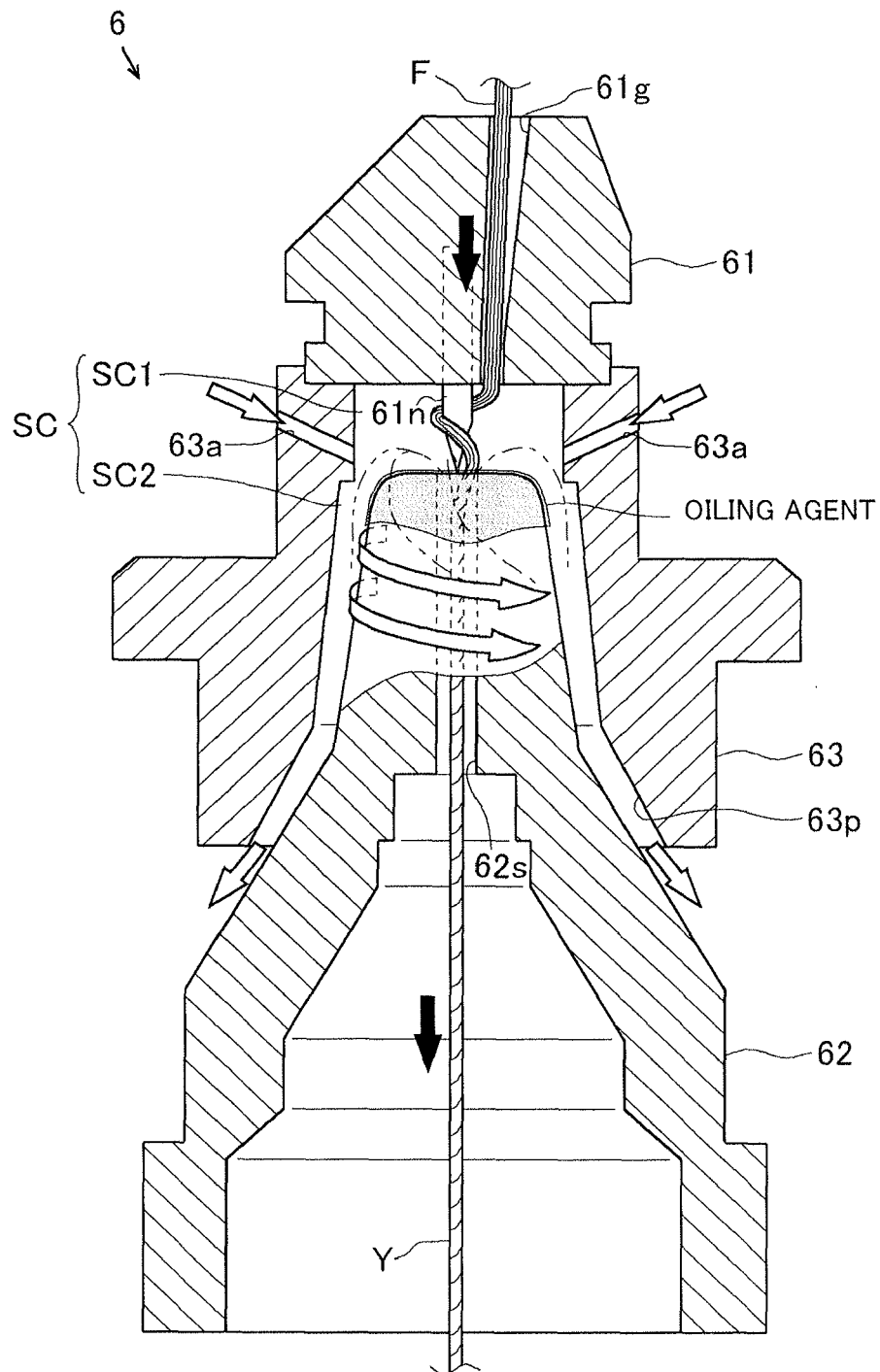


FIG. 10

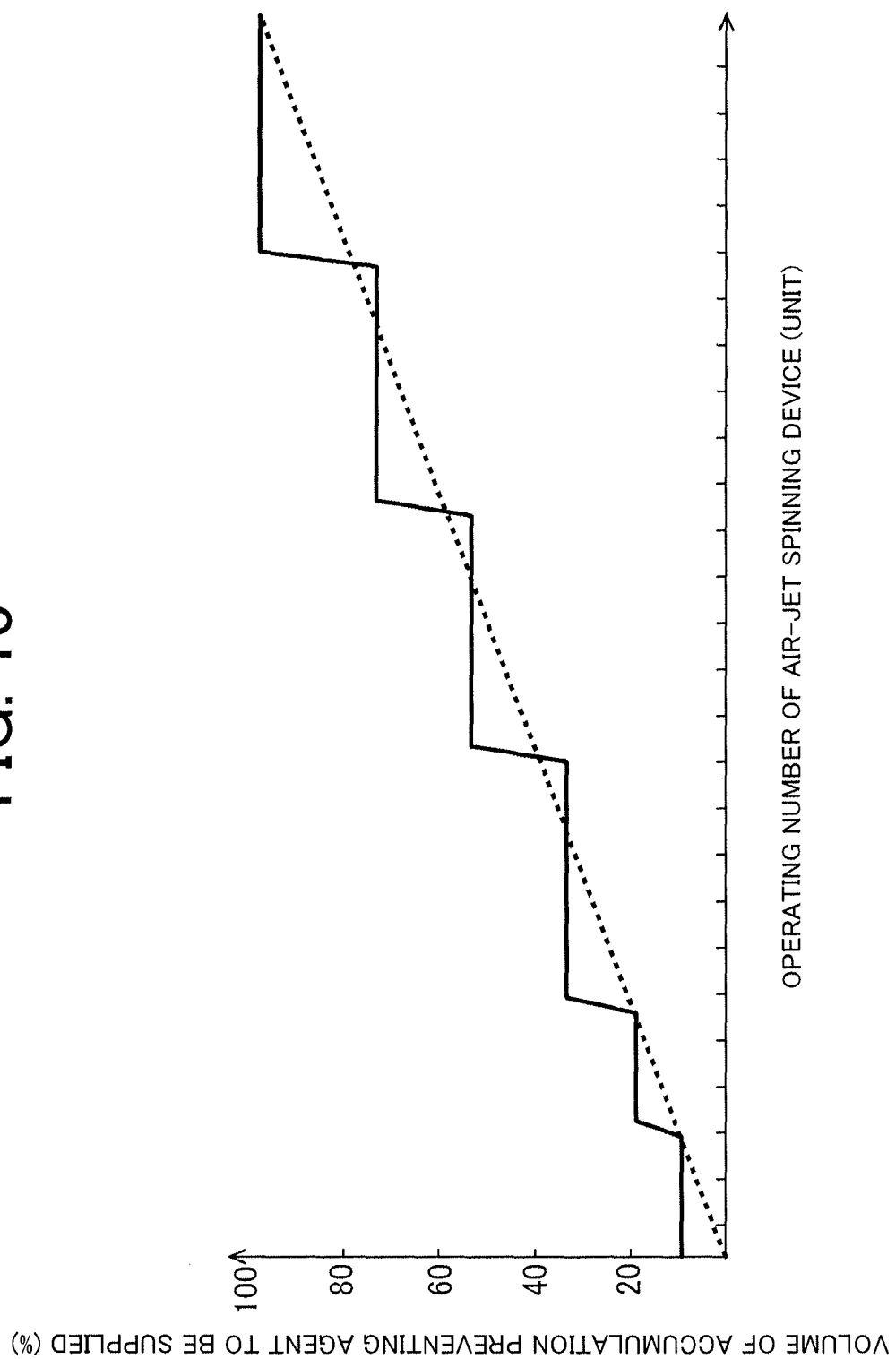
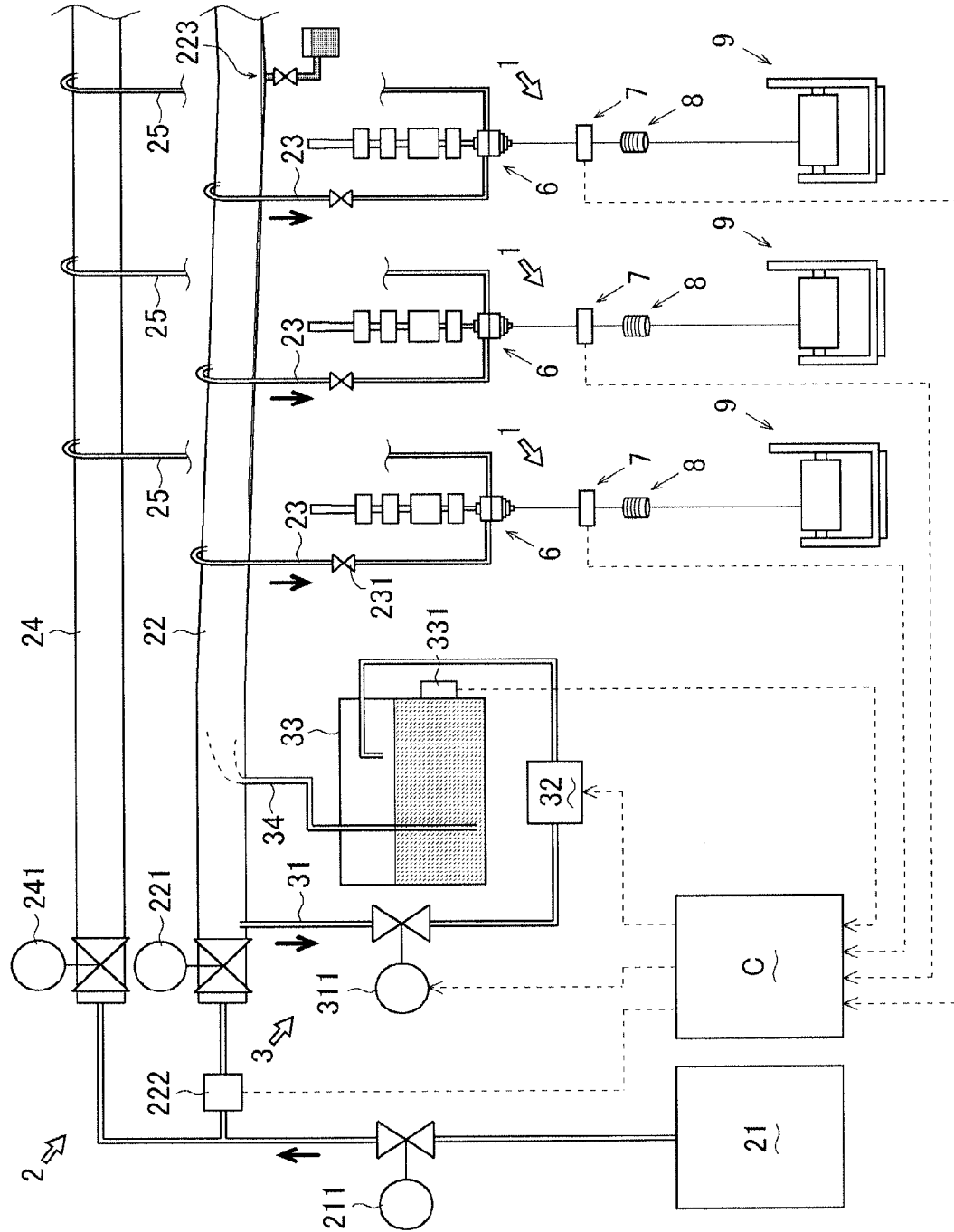


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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