



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.10.2018 Bulletin 2018/42

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

(21) Application number: **18166108.3**

(22) Date of filing: **06.04.2018**

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

(72) Inventors:
• **SAWADA, Harutoshi**
Kyoto-shi, Kyoto 612-8686 (JP)
• **SHIRAKAWA, Masahiko**
Kyoto-shi, Kyoto 612-8686 (JP)

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

(30) Priority: **11.04.2017 JP 2017078072**

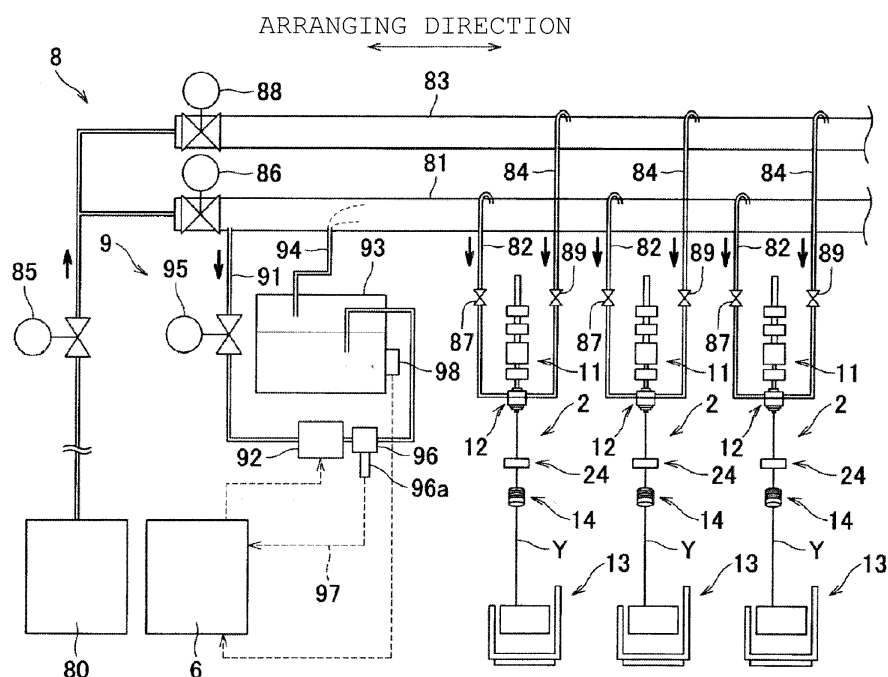
(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi,
Kyoto 601-8326 (JP)

(54) **SPINNING MACHINE**

(57) An additive supplying device (9) adapted to supply additive to be supplied to a prescribed position between an outlet of a draft device (11) and an outlet of a spinning device (12) is provided with a first detecting section (96) adapted to detect information relating to supply-

ing state of the additive supplied by the additive supplying device (9). A control device (6) is adapted to determine presence or absence of an abnormality in the additive supplying device (9) in accordance with a detection signal of the first detecting section (96) .

FIG. 6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine including an additive supplying device.

2. Description of the Related Art

[0002] For example, a spinning machine described in Japanese Unexamined Patent Publication No. 2012-97391 is provided with an additive supplying device adapted to supply an additive to a spinning device. In such a spinning machine, an amount of additive to be supplied to the spinning device is prevented from becoming too much or too little by adjusting the amount of additive supplied by the additive supplying device according to a number of operating spinning devices.

[0003] When some kind of abnormality generates in the additive supplying device and the additive cannot be supplied, a yarn formed by the spinning device mixedly includes a portion supplied with the additive and a portion not supplied with the additive. However, in Japanese Unexamined Patent Publication No. 2012-97391, detection of abnormality of the additive supplying device is not particularly described, and a low quality yarn mixedly including the portion supplied with the additive and the portion not supplied with the additive tends to be formed, as described above.

BRIEF SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to prevent quality of the yarn from being lowered by the abnormality of the additive supplying device.

[0005] This object is achieved by the spinning machine according to claim 1.

[0006] A spinning machine of the present invention includes a draft device adapted to draft a fiber bundle; a spinning device adapted to form a yarn by performing a spinning operation in which the yarn is formed by applying twists using airflow to the fiber bundle drafted by the draft device; a winding device adapted to wind the yarn formed by the spinning device; an additive supplying device adapted to supply additive to be supplied to a prescribed position between an outlet of the draft device and an outlet of the spinning device; a first detecting section arranged in the additive supplying device and adapted to detect information relating to supplying state of the additive supplied by the additive supplying device; and a control device adapted to determine presence or absence of abnormality in the additive supplying device in accordance with a detection signal of the first detecting section.

[0007] According to the present invention, when abnormality is present in the additive supplying device, the

control device can acquire the abnormality in the additive supplying device in accordance with the detection signal of the first detecting section and perform an appropriate process. Thus, quality of the yarn can be prevented from being lowered by the abnormality of the additive supplying device.

[0008] In the present invention, the control device is preferably adapted to, when determining the presence of the abnormality in the additive supplying device, prohibit the spinning operation of the spinning device if the spinning device has not yet started the spinning operation, and stop the spinning operation of the spinning device if the spinning device is performing the spinning operation.

[0009] Thus, forming of a defective yarn in a state where the additive is not supplied can be prevented.

[0010] In the present invention, the control device is preferably adapted to control the spinning device to start the spinning operation when determining that the additive supplying device is properly supplying the additive.

[0011] The spinning machine thus can form a yarn having stable quality.

[0012] In the present invention, the spinning machine further preferably includes a yarn joining device adapted to join the yarn disconnected between the spinning device and the winding device, wherein the control device is preferably adapted to control the spinning device to start a spinning operation, the yarn joining device to perform a yarn joining, and the winding device to start winding of the yarn.

[0013] In the present invention, the defective yarn is not formed even if an abnormality is generated in the additive supplying device, as described above. Therefore, the defective yarn does not need to be removed when performing the yarn joining, and the winding can be promptly started.

[0014] In the present invention, the first detecting section preferably includes an output section, and the control device and the output section are preferably connected via an electric connection.

[0015] Therefore, the detection signal of the first detecting section can be stably transmitted to the control device via the output section and the electric connection.

[0016] In the present invention, the additive supplying device preferably includes a tank adapted to store the additive, and a pressure adjusting device adapted to adjust inner pressure of the tank, and the first detecting section preferably includes a pressure sensor adapted to detect a secondary pressure of the pressure adjusting device.

[0017] The amount of additive to be supplied by the additive supplying device is determined according to the inner pressure of the tank. Therefore, by detecting the secondary pressure of the pressure adjusting device substantially equal to the inner pressure of the tank, the control device can accurately acquire the supplying state of the additive, and furthermore, can accurately determine the presence or absence of abnormality of the additive

supplying device. Furthermore, since the secondary pressure of the pressure adjusting device is detected, the presence or absence of abnormality of the additive supplying device can be determined at an early stage.

[0018] In the present invention, the additive supplying device preferably includes a tank adapted to store the additive, and a pressure adjusting device including a pressure increasing valve adapted to adjust an inner pressure of the tank, wherein the first detecting section is preferably adapted to monitor movement of the pressure increasing valve of the pressure adjusting device.

[0019] In this case, the inner pressure of the tank is not appropriately increased if the pressure increasing valve is not moving, and the inner pressure of the tank is appropriately increased if the pressure increasing valve is moving. Therefore, the supplying state of the additive supplied by the additive supplying device can be directly detected by monitoring the movement of the pressure increasing valve. As a result, the presence or absence of abnormality of the additive supplying device can be accurately determined. Furthermore, since the pressure increasing valve is directly detected, the presence or absence of abnormality of the additive supplying device can be determined at an early stage.

[0020] The additive supplying device preferably includes a tank adapted to store the additive, an additive supplying pipe adapted to supply the additive from the tank, an air supplying pipe adapted to supply air to the tank, and a pressure adjusting device arranged in the air supplying pipe and adapted to adjust inner pressure of the tank, wherein the first detecting section is preferably a flow rate sensor arranged in at least one of a portion of the air supplying pipe, the portion being located downstream of the pressure adjusting device in a direction in which the air flows, and the additive supplying pipe.

[0021] By arranging the flow rate sensor at the above-described portion in the air supplying pipe, and determining the presence or absence of abnormality in the flow rate of the air supplied to the tank, the presence or absence of abnormality of the additive supplying device can be determined. By arranging the flow rate sensor on the additive supplying pipe, and determining the presence or absence of abnormality in the amount itself of the additive supplied from the additive supplying device, the presence or absence of abnormality of the additive supplying device can be determined. One flow rate sensor may be arranged on each of the air supplying pipe and the additive supplying pipe.

[0022] The additive supplying device preferably includes a tank adapted to store the additive, the first detecting section is preferably a level sensor adapted to detect an amount of the additive stored in the tank, and the control device is preferably adapted to determine that an abnormality has generated in the additive supplying device when determining that the amount of the additive has not decreased in accordance with a detection signal of the level sensor.

[0023] Thus, determination can be made that the ad-

ditive supplying device is properly operating when the amount of additive is decreasing, and that the abnormality has generated in the additive supplying device when the amount of additive is not decreasing.

[0024] In the present invention, the spinning machine further preferably includes a second detecting section adapted to detect a status of the yarn at downstream of the prescribed position in a yarn travelling direction.

[0025] When the defect of the yarn is detected by the second detecting section, it was conventionally difficult to distinguish whether a cause of defect is due to the abnormality (state in which the additive is not supplied) of the additive supplying device or due to other reasons. However, in the present invention, as described above, since the presence or absence of abnormality of the additive supplying device can be determined in accordance with the detection signal of the first detecting section, the cause of defect can be easily specified and an appropriate measure can be promptly taken.

[0026] In the present invention, the additive supplying device preferably further includes a third detecting section adapted to detect that a stored amount of the additive has become equal to or less than a prescribed amount.

[0027] Thus, the stored amount of the additive does not need to be detected by the first detecting section, and the first detecting section can concentrate on detecting the abnormality of the additive supplying device.

[0028] In the present invention, the spinning machine preferably further includes a display section adapted to display abnormality of the additive supplying device when the control device determines a presence of abnormality in the additive supplying device.

[0029] Thus, the operator can promptly recognize the abnormality of the additive supplying device.

[0030] In the present invention, the spinning machine preferably includes a plurality of spinning units, each of which includes the draft device, the spinning device and the winding device, and the spinning machine preferably includes a guiding pipe adapted to guide the additive from the additive supplying device to the prescribed position of the respective spinning units.

[0031] Thus, one additive supplying device merely needs to be arranged with respect to the plurality of spinning units. Furthermore, even after the additive is no longer supplied due to the abnormality of the additive supplying device, the additive remaining in the guiding pipes is supplied to the prescribed position for a while, and thus forming of the defective yarn in a state where the additive is not supplied can be more reliably prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

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

FIG. 2 is a side view of a spinning unit and a yarn

joining cart;

FIG. 3 is a side view illustrating a state of sucking and holding a yarn;

FIG. 4 is a side view illustrating a state of guiding the yarn to the yarn joining device;

FIG. 5 is a cross-sectional view of a spinning device;

FIG. 6 is a schematic view illustrating a structure of an air distributing device and an additive supplying device; and

FIG. 7 is a flowchart illustrating a control when abnormality has generated in the additive supplying device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0033] A spinning machine according to one embodiment of the present invention will be described with reference to the drawings. A spinning machine 1 illustrated in FIG. 1 includes a plurality of spinning units 2 arranged side by side in a prescribed arranging direction, a yarn joining cart 3 adapted to be movable in the arranging direction, a blower box 4 arranged on one end side of the arranging direction, and a motor box 5 arranged on the other end side of the arranging direction. Furthermore, although not illustrated in FIG. 1, the spinning machine 1 also includes an air distributing device 8 and an additive supplying device 9 (see FIG. 6).

[0034] Each spinning unit 2 spins a fiber bundle T fed from a draft device 11 with a spinning device 12 to form a yarn Y, and winds the yarn Y around a bobbin B with a winding device 13 to form a package P. When yarn breakage or yarn cut occurs in one of the spinning units 2, the yarn joining cart 3 moves to the relevant spinning unit 2 to perform the yarn joining. The blower box 4 accommodates a suction device (not illustrated) and the like adapted to supply a negative pressure to the spinning units 2 and the yarn joining cart 3. The motor box 5 accommodates a driving source (not illustrated), a control device 6 and the like common to each spinning unit 2. Each spinning unit 2 may include a dedicated driving source. On a front surface of the motor box 5, there are provided a display section 7 adapted to display an operational status, etc. of the spinning machine 1, and an operating section (not illustrated) arranged for performing various types of setting of the spinning machine 1.

[0035] As illustrated in FIG. 2, the spinning unit 2 includes, as main components, a draft device 11, a spinning device 12, a yarn accumulating device 14, and a winding device 13 arranged in this order from upstream to downstream in a travelling direction of the fiber bundle T or the yarn Y (hereinafter referred to as "yarn travelling direction").

[0036] The draft device 11 is arranged in proximity to an upper end of a frame 15 of the spinning machine 1. The draft device 11 includes four pairs of draft rollers 16 to 19, i.e., a pair of back rollers 16, a pair of third rollers 17, a pair of middle rollers 18, and a pair of front rollers

19 in this order from the upstream. A rubber apron belt 20 is provided on each roller of the pair of middle rollers 18. The four pairs of draft rollers 16 to 19 are respectively configured by bottom rollers 16a to 19a rotatably driven by a driving device (not illustrated) and top rollers 16b to 19b rotated accompanying the rotation of the bottom rollers 16a to 19a. The rotation speed of the pair of draft rollers 16 to 19 is set such that the rotation speed sequentially becomes higher along a feeding direction of a sliver S. The draft device 11 thereby conveys the sliver S, which is a material of the fiber bundle T, while sandwiching the sliver S with the pair of draft rollers 16 to 19, and stretches (drafts) the sliver S to a prescribed thickness to obtain the fiber bundle T.

[0037] The spinning device 12 is arranged immediately downstream of the pair of front rollers 19. The spinning device 12 is adapted to form the yarn Y by the spinning operation in which twists are applied to the fiber bundle T drafted by the draft device 11. In the present embodiment, a pneumatic spinning device that applies twists to the fiber bundle T using a whirling airflow is adopted for the spinning device 12, but other types of spinning device can be adopted. Details of the spinning device 12 will be described later.

[0038] The yarn accumulating device 14 is arranged between the spinning device 12 and the winding device 13 in the yarn travelling direction. The yarn accumulating device 14 includes an accumulating roller 21, a yarn hooking member 22, and a motor 23. The accumulating roller 21 is configured to wind a certain amount of yarn Y around an outer peripheral surface thereof to temporarily accumulate the yarn Y, and is rotatably driven by the motor 23. In this case, the yarn hooking member 22 is integrally rotated with the accumulating roller 21 with the yarn Y hooked thereto, so that the yarn Y is accumulated on the accumulating roller 21. The yarn accumulating device 14 pulls out the yarn Y from the spinning device 12 by applying tension on the yarn Y. A pair of pull-out rollers such as a delivery roller may be provided between the spinning device 12 and the yarn accumulating device 14, and the yarn Y may be pulled out from the spinning device 12 with the pair of pull-out rollers. In this case, the yarn accumulating device 14 may be omitted.

[0039] A yarn monitoring device 24 adapted to monitor the status of the yarn Y is arranged between the spinning device 12 and the yarn accumulating device 14 in the yarn travelling direction. The yarn monitoring device 24 is configured to monitor the thickness of the travelling yarn Y and/or presence or absence of foreign substances in the travelling yarn Y with an optical sensor (not illustrated). The yarn monitoring device 24 thus can detect a yarn defect such as presence of abnormality in the thickness of the yarn Y and/or presence of foreign substances in the yarn Y, and the like. The yarn monitoring device 24 is not limited to the optical sensor, and for example, may be a capacitance sensor.

[0040] When the yarn defect of the yarn Y is detected by the yarn monitoring device 24, the spinning unit 2 stops

the supply of air to the spinning device 12 and interrupts forming of the yarn Y to cut the yarn Y. Alternatively, a cutter may be arranged in proximity to the yarn monitoring device 24 and the yarn Y may be cut with the cutter. Alternatively, the rotation of the pair of back rollers 16 of the draft device 11 may be stopped to cut the yarn Y.

[0041] The winding device 13 is arranged downstream of the yarn accumulating device 14, and is adapted to wind the yarn Y around the bobbin B while traversing the yarn Y to form the package P. The winding device 13 includes a cradle arm 25, a winding drum 26, and a traverse device 27.

[0042] The cradle arm 25 is supported to be swingable about a supporting shaft 25a. The cradle arm 25 can rotatably support the bobbin B (package P) for winding the yarn Y. The winding drum 26 is rotatably driven at a constant rotation speed in a prescribed direction. The cradle arm 25 can bring the outer peripheral surface of the bobbin B (package P) into contact with or move the outer peripheral surface of the bobbin B (package P) away from the winding drum 26 by being swung about the supporting shaft 25a. When the outer peripheral surface of the bobbin B (package P) is brought into contact with the rotatably driven winding drum 26, the bobbin B (package P) is rotated in the winding direction accompanying the rotation of the winding drum 26, thus winding the yarn Y around the outer peripheral surface of the bobbin B (package P).

[0043] The traverse device 27 includes a traverse guide 28 that can guide the yarn Y. The traverse guide 28 is configured to reciprocate in a direction parallel to an axial direction of the winding drum 26 by a driving source (not illustrated) (see FIG. 1). Since the traverse guide 28 is driven and reciprocated while the winding drum 26 is rotatably driven, the yarn Y can be wound into the package P while being traversed. In place of arranging the traverse device 27, a traverse groove may be formed in the winding drum 26 so that the yarn Y can be traversed with the winding drum 26.

[0044] Next, a description will be made on the yarn joining cart 3. The yarn joining cart 3 can travel along the arranging direction of the plurality of spinning units 2. When yarn breakage or yarn cut occurs in a spinning unit 2, the yarn joining cart 3 is moved to the relevant spinning unit 2 to perform the yarn joining of the disconnected yarn Y. As illustrated in FIGS. 2 to 4, the yarn joining cart 3 includes a yarn joining device 30, a suction pipe 31, a suction mouth 32, and a reverse rotation roller 33.

[0045] The suction pipe 31 is configured to be vertically swingable with a shaft 31a as a center. As illustrated in FIG. 3, when the suction pipe 31 is swung to the upper side, a distal end of the suction pipe 31 is located in proximity to the downstream of the spinning device 12, and thus the suction pipe 31 can suck and hold the yarn (upper yarn) Y spun from the spinning device 12. Furthermore, as illustrated in FIG. 4, the suction pipe 31 can guide the upper yarn Y to the yarn joining device 30 by being swung to the lower side while sucking and holding the upper

yarn Y spun from the spinning device 12.

[0046] The suction mouth 32 is configured to be vertically swingable with a shaft 32a as a center. As illustrated in FIG. 3, when the suction mouth 32 is swung to the lower side, a distal end of the suction mouth 32 is located in proximity to the outer peripheral surface of the package P, and thus can suck and hold the yarn (lower yarn) Y pulled out from the package P. Furthermore, as illustrated in FIG. 4, the suction mouth 32 can guide the lower yarn Y to the yarn joining device 30 by being swung to the upper side while sucking and holding the lower yarn Y pulled out from the package P.

[0047] The reverse rotation roller 33 is rotatably driven in a reverse direction with respect to a rotation direction of the winding drum 26. As illustrated in FIG. 3, when the reverse rotation roller 33 is brought into contact with the package P spaced apart from the winding drum 26, the package P can be rotated in a pull-out direction, which is a reverse direction of the winding direction. By rotating the package P in the pull-out direction, the suction mouth 32 can suck a yarn end of the lower yarn Y wound around the package P and guide the lower yarn Y to the yarn joining device 30.

[0048] When the yarn Y is disconnected, the yarn joining device 30 joins the upper yarn Y guided by the suction pipe 31 and the lower yarn Y guided by the suction mouth 32, as illustrated in FIG. 4. In the present embodiment, a splicer that forms a joint by applying twists to the yarn ends of the upper yarn Y and the lower yarn Y by the whirling airflow is used as the yarn joining device 30. The yarn joining device 30 is not limited to the splicer, and for example, may be a knotter adapted to knot the upper yarn Y and the lower yarn Y, or a piecer adapted to guide the lower yarn Y to the spinning device 12 and resume the spinning of the spinning device 12 to connect the upper yarn Y and the lower yarn Y.

[0049] As illustrated in FIG. 5, the spinning device 12 includes a fiber guide 41, a spindle (hollow guide shaft body) 42, a nozzle block 43, and a spinning chamber 44. A vertical direction of FIG. 5 is the yarn travelling direction (see black arrows), where the upper side is the upstream in the yarn travelling direction and the lower side is the downstream in the yarn travelling direction.

[0050] The fiber guide 41 guides the fiber bundle T drafted by the draft device 11 to the spinning chamber 44. The fiber guide 41 is provided with a fiber introducing path 41a along the yarn travelling direction, so that the fiber bundle T is guided into the spinning chamber 44 by the fiber introducing path 41a. The fiber guide 41 is provided with a guide needle 41b, which protrudes into the spinning chamber 44 and also guides the fiber bundle T.

[0051] The spindle 42 guides the fiber bundle T twisted in the spinning chamber 44, that is, the spun yarn Y to the yarn monitoring device 24. The spindle 42 is provided with a fiber passage 42a along the yarn travelling direction, so that the spun yarn Y is guided to the yarn monitoring device 24 by the fiber passage 42a.

[0052] The nozzle block 43 guides the air fed from the

air distributing device 8, which will be described later, to the spinning chamber 44. The nozzle block 43 is provided with a substantially conical accommodation space 43a, and a distal end portion of a substantially conical spindle 42 is accommodated in the accommodation space 43a. The nozzle block 43 is provided with a plurality of nozzles 43b around the spinning chamber 44. By injecting air from the plurality of nozzles 43b to the spinning chamber 44 (see white arrows in FIG. 5), the whirling airflow can be generated in the spinning chamber 44.

[0053] The spinning chamber 44 is a space surrounded by the fiber guide 41, the spindle 42, and the nozzle block 43. Specifically, the spinning chamber 44 is divided into a space 44a, which is formed between the fiber guide 41 and the spindle 42, and a space 44b, which is formed between the spindle 42 and the nozzle block 43. In the space 44a, a trailing end of each fiber constituting the fiber bundle T is reversed by the whirling airflow (see two-dot chain lines in FIG. 5). In the space 44b, the reversed trailing end of each fiber is whirled by the whirling airflow (see two-dot chain lines in FIG. 5).

[0054] In the spinning device 12, the trailing end of each fiber constituting the fiber bundle T, which is guided along the guide needle 41b, is whirled in the spinning chamber 44 and gradually wound around core fibers. In this manner, the spinning device 12 forms the spun yarn Y by applying twists to the fiber bundle T using the whirling airflow (spinning operation). In the spinning device 12, the fiber guide 41 may not be provided with the guide needle 41b. In this case, an edge of a downstream end of the fiber guide 41 serves as the guide needle 41b.

[0055] Next, a structure of the air distributing device 8 and the additive supplying device 9 arranged in the spinning machine 1 will be described with reference to FIG. 6. An arrow illustrated in FIG. 6 indicates the direction in which the air flows.

[0056] The air distributing device 8 includes a first air pipe 81, a plurality of first distributing pipes 82, a second air pipe 83, and a plurality of second distributing pipes 84. An air pressurizing and feeding device 80 adapted to pressurize and feed air is arranged in a spinning facility where the spinning machine 1 is installed, and the air is pressurized and fed from the air pressurizing and feeding device 80 to the air distributing device 8. Pressure of air fed by the air pressurizing and feeding device 80 is adjusted by a pressure adjusting valve 85.

[0057] The first air pipe 81 extends along the arranging direction of the plurality of spinning units 2, and is adapted to guide air pressurized and fed by the air pressurizing and feeding device 80 to each spinning unit 2. An open/close valve 86 is provided at an upstream end of the first air pipe 81. The first distributing pipe 82 branches off the air flowing through the first air pipe 81, and guides the air to the spinning device 12 of each spinning unit 2. The upstream end of the first distributing pipe 82 is connected to a middle portion of the first air pipe 81, and the downstream end of the first distributing pipe 82 is connected to the nozzle 43b of the spinning device 12. The

flow rate of the air fed to the spinning device 12 by the first distributing pipe 82 is adjusted by a flow rate adjusting valve 87 arranged in the middle portion of the first distributing pipe 82.

[0058] The second air pipe 83 extends along the arranging direction of the plurality of spinning units 2, and is adapted to guide the air pressurized and fed by the air pressurizing and feeding device 80 to each spinning unit 2. An open/close valve 88 is provided at an upstream end of the second air pipe 83. The second distributing pipe 84 branches off the air flowing through the second air pipe 83 and guides the air to the spinning device 12 of each spinning unit 2. The upstream end of the second distributing pipe 84 is connected to a middle portion of the second air pipe 83, and the downstream end of the second distributing pipe 84 is connected to the nozzle 43b of the spinning device 12. The flow rate of the air fed to the spinning device 12 by the second distributing pipe 84 is adjusted by a flow rate adjusting valve 89 arranged in the middle portion of the second distributing pipe 84.

[0059] As described above, the air distributing device 8 can supply the air pressurized and fed from the air pressurizing and feeding device 80 to the spinning device 12 through the first air pipe 81 or the second air pipe 83.

The second air pipe 83 may be omitted or three or more air pipes may be arranged in the air distributing device 8.

[0060] The additive supplying device 9 includes a branching pipe (air supplying pipe 91), a pressure adjusting device 92, a tank 93, a supplying pipe (additive supplying pipe) 94, and a pressure sensor 96.

[0061] The branching pipe 91 branches off the air flowing through the first air pipe 81 and guides the air to the tank 93. The upstream end of the branching pipe 91 is connected to a middle portion of the first air pipe 81, and the downstream end of the branching pipe 91 is connected to the tank 93. The flow rate of the air fed to the tank 93 by the branching pipe 91 is adjusted by a flow rate adjusting valve 95 arranged in the middle portion of the branching pipe 91.

[0062] The pressure adjusting device 92 is arranged in the middle portion of the branching pipe 91, and adjusts the pressure of the air fed to the tank 93. In other words, the inner pressure of the tank 93 is adjusted by the pressure adjusting device 92. The pressure adjusting device 92 is configured by a pressure increasing valve and the like adapted to drive a sliding piston to pressurize air. Alternatively, the pressure adjusting device 92 may be an electric compressor adapted to drive a motor to pressurize air. The operation of the pressure adjusting device 92 is controlled by the control device 6.

[0063] The pressure sensor 96 is arranged at the middle portion of the branching pipe 91, and specifically, is arranged downstream of the pressure adjusting device 92 in the direction in which the air flows. The pressure sensor 96 is configured to detect a secondary pressure of the pressure adjusting device 92. The pressure sensor 96 includes an output section 96a adapted to connect an electric connection 97. One end of the electric connection

97 is connected to the output section 96a, and the other end of the electric connection 97 is connected to the control device 6. The control device 6 receives a detection signal from the pressure sensor 96 via the output section 96a and the electric connection 97 to acquire a supplying state of the additive supplied by the additive supplying device 9, and can determine presence or absence of abnormality of the additive supplying device 9.

[0064] The tank 93 is a container adapted to store liquid additive. In the tank 93, the liquid additive is converted to mist. The additive that has been converted to mist is supplied to the first air pipe 81 via the supplying pipe 94 according to the inner pressure of the tank 93. The tank 93 is provided with a level sensor 98 adapted to detect the stored amount of additive. The control device 6 acquires the stored amount of additive by receiving a detection signal from the level sensor 98.

[0065] The supplying pipe 94 guides the additive converted to mist in the tank 93 to the first air pipe 81. An upstream end of the supplying pipe 94 is connected to the tank 93. A downstream end of the supplying pipe 94 is connected to the first air pipe 81. Specifically, in the direction in which the air flows in the first air pipe 81, a connecting portion with the branching pipe 91, a connecting portion with the supplying pipe 94, and a connecting portion with the most upstream first distributing pipe 82 are arranged in this order.

[0066] Thus, the additive supplying device 9 can supply the additive stored in the tank 93 to each spinning device 12 via the air distributing device 8. In the present embodiment, by opening the open/close valve 86 and closing the open/close valve 88, the air can be supplied to each spinning device 12 using only the first air pipe 81. Accordingly, only the air containing the additive can be supplied to each spinning device 12. On the other hand, by closing the open/close valve 86 and opening the open/close valve 88, the air can be supplied to each spinning device 12 using only the second air pipe 83. Accordingly, only the air not containing the additive can be supplied to each spinning device 12. In this case, the control device 6 does not carry out the determination on the presence or absence of abnormality of the additive supplying device 9, to be described later.

[0067] In the present embodiment, an anti-deposition agent for preventing deposition of oil is used for the additive supplied by the additive supplying device 9. If oil contained in the fiber bundle T attaches to the distal end portion of the spindle 42 of the spinning device 12 and is deposited thereat, the whirling of the fibers of the fiber bundle T is inhibited and the twists become loose, which may lower the quality of the spun yarn Y. A coating of the anti-deposition agent can be formed at the distal end portion of the spindle 42 by supplying the anti-deposition agent to the spinning chamber 44 through the nozzle 43b, and the oil can be prevented from depositing at the distal end portion of the spindle 42.

[0068] As described above, in the spinning machine 1 of the present embodiment, the additive supplying device

9 is provided with the pressure sensor 96 adapted to detect the secondary pressure of the pressure adjusting device 92, that is, the inner pressure of the tank 93. The additive converted to mist in the tank 93 is supplied according to the inner pressure of the tank 93. If some kind of abnormality generates in the additive supplying device 9 and the additive cannot be appropriately supplied, the inner pressure of the tank 93 indicates an abnormal value. Therefore, the control device 6 can determine the presence or absence of abnormality of the additive supplying device 9 (presence or absence of supply of additive) by receiving the detection signal of the pressure sensor 96. Specifically, the control device 6 determines that the abnormality has generated in the additive supplying device 9 (additive is not supplied or amount of supplied additive is too little) when the pressure detection value of the pressure sensor 96 is smaller than a prescribed threshold value, and determines that the abnormality has not generated in the additive supplying device 9 (additive is appropriately supplied) when the pressure detection value is equal to or greater than the threshold value. A different value may be set for the threshold value according to, for example, the type of fiber bundle T to be spun by the spinning machine 1.

[0069] A control performed when abnormality has generated in the additive supplying device 9 during the spinning operation of the plurality of spinning units 2 will be described with reference to FIG. 7. The control device 6 determines that the abnormality has generated in the additive supplying device 9 (YES in step S101) when the pressure detection value of the pressure sensor 96 is smaller than the threshold value, and stops the spinning operation of the plurality of spinning units 2 and displays the abnormality of the additive supplying device 9 on the display section 7 (step S102). By displaying the abnormality of the additive supplying device 9 on the display section 7, the operator can be notified of the abnormality of the additive supplying device 9 and urged to take an appropriate measure. While the spinning operation is stopped, the winding operation of the package P is also stopped.

[0070] The control device 6 continuously receives the detection signal of the pressure sensor 96 even after determining that the abnormality has generated in the additive supplying device 9. The control device 6 determines that the abnormality of the additive supplying device 9 is resolved (YES in step S103) when the pressure detection value of the pressure sensor 96 becomes equal to or greater than the threshold value, and activates the plurality of spinning units 2 to resume the spinning operation (step S104). In each spinning unit 2, the yarn Y is in a disconnected state due to stopping of the spinning operation in step S102, and hence the control device 6 controls the yarn joining cart 3 to perform the yarn joining (step S105) and the winding device 13 to start the winding of the yarn Y (step S106).

[0071] If the spinning machine 1 is not in operation and the spinning machine 1 is not yet activated (the plurality

of spinning units 2 have not yet started the spinning operation), the control device 6 prohibits the spinning operation of the plurality of spinning units 2 when determining that the abnormality has generated in the additive supplying device 9.

[0072] The spinning machine 1 of the present embodiment is provided with a first detecting section (the pressure sensor 96 in the present embodiment) adapted to detect information (inner pressure of the tank 93 in the present embodiment) relating to the supplying state of the additive supplied by the additive supplying device 9. Therefore, when abnormality is present in the additive supplying device 9, since the control device 6 can acquire the abnormality in accordance with the detection signal of the first detecting section 96 and perform an appropriate process, the quality of the yarn Y can be prevented from being lowered by the abnormality of the additive supplying device 9.

[0073] In the present embodiment, the control device 6 is adapted to, when determining the presence of the abnormality in the additive supplying device 9, prohibit the spinning operation of the spinning device 12 if the spinning device 12 has not yet started the spinning operation, and stops the spinning operation of the spinning device 12 if the spinning device 12 is performing the spinning operation. Thus, forming of a defective yarn in a state where the additive is not supplied can be prevented. Since the defective yarn is not formed under a state in which the abnormality exists in the additive supplying device 9, the sliver S is not wastefully consumed.

[0074] In the present embodiment, the control device 6 causes the spinning device 12 to start the spinning operation when determining that the additive supplying device 9 is properly supplying the additive. The spinning machine 1 thus can form the yarn Y having stable quality.

[0075] In the present embodiment, the control device 6 controls the spinning device 12 to start the spinning operation, the yarn joining device 30 to perform the yarn joining, and the winding device 13 to start the winding of the yarn Y. As described above, the defective yarn is not formed even if the abnormality has generated in the additive supplying device 9. Thus, the defective yarn does not need to be removed when performing the yarn joining, and the winding can be promptly started.

[0076] In the present embodiment, the first detecting section 96 includes the output section 96a, and the control device 6 and the output section 96a are connected via the electric connection 97. Therefore, the detection signal of the first detecting section 96 can be stably transmitted to the control device 6 via the output section 96a and the electric connection 97.

[0077] In the present embodiment, the additive supplying device 9 includes the tank 93 adapted to store the additive, and the pressure adjusting device 92 adapted to adjust the inner pressure of the tank 93, and the first detecting section includes the pressure sensor 96 adapted to detect the secondary pressure of the pressure adjusting device 92. The amount of additive to be supplied

by the additive supplying device 9 is determined according to the inner pressure of the tank 93. Therefore, by detecting the secondary pressure of the pressure adjusting device 92 substantially equal to the inner pressure of the tank 93, the control device 6 can accurately acquire the supplying state of the additive and furthermore, can accurately determine the presence or absence of abnormality of the additive supplying device 9. Furthermore, since the secondary pressure of the pressure adjusting device 92 is detected, the presence or absence of abnormality of the additive supplying device 9 can be determined at an early stage.

[0078] In the present embodiment, the spinning machine 1 (each spinning unit 2) includes a second detecting section (the yarn monitoring device 24 in the present embodiment) adapted to detect the status of the yarn Y at the downstream in the yarn travelling direction of a prescribed position (the nozzle 43b in the present embodiment) where the additive is supplied. When the defect of the yarn Y is detected by the second detecting section 24, it has been conventionally difficult to distinguish whether the cause of defect is due to the abnormality (state in which the additive is not supplied) of the additive supplying device 9 or due to other reasons. However, in the present embodiment, as described above, since the presence or absence of abnormality of the additive supplying device 9 can be determined in accordance with the detection signal of the first detecting section 96, the cause of defect can be easily specified and an appropriate measure can be promptly taken.

[0079] In the present embodiment, the additive supplying device 9 includes, apart from the first detecting section 96, a third detecting section (the level sensor 98 in the present embodiment) adapted to detect that a stored amount of the additive has become equal to or less than a prescribed amount. Thus, the stored amount of the additive does not need to be detected by the first detecting section 96, and the first detecting section 96 can concentrate on detecting the abnormality of the additive supplying device 9.

[0080] In the present embodiment, the spinning machine 1 includes the display section 7 adapted to display abnormality of the additive supplying device 9 when the control device 6 determines a presence of abnormality in the additive supplying device 9. Thus, the operator can promptly recognize the abnormality of the additive supplying device 9.

[0081] In the present embodiment, a guiding pipe (the first air pipe 81 and a plurality of first distributing pipes 82 in the present embodiment) adapted to guide the additive from the additive supplying device 9 to a prescribed position of the plurality of spinning units 2 is arranged, and thus one additive supplying device 9 merely needs to be arranged with respect to the plurality of spinning units 2. Furthermore, even after the additive is no longer supplied due to the abnormality of the additive supplying device 9, the additive remaining in the guiding pipes 81 and 82 is supplied to the prescribed position for a while,

and thus forming of the defective yarn in a state where the additive is not supplied can be more reliably prevented.

[0082] Alternative embodiments in which various modifications are made on the embodiment described above will be described.

[0083] In the embodiment described above, the pressure sensor 96 serving as the first detecting section is arranged on the branching pipe 91, but the present invention is not limited to this arrangement. The pressure sensor 96 may be arranged in the tank 93. Furthermore, the pressure sensor 96 may detect a differential pressure of the primary pressure and the secondary pressure of the pressure adjusting device 92, and the control device 6 may determine the presence or absence of abnormality of the additive supplying device 9 in accordance with the detected differential pressure.

[0084] In the embodiment described above, the pressure sensor 96 is arranged as the first detecting section adapted to detect the information relating to the supplying state of the additive supplied by the additive supplying device 9. However, a specific configuration of the first detecting section is not limited to the pressure sensor 96 described above. For example, the first detecting section may detect the information relating to the supplying state of the additive by directly monitoring the movement of the pressure increasing valve (movement of sliding piston) of the pressure adjusting device 92. In this case, the inner pressure of the tank 93 is not appropriately increased if the pressure increasing valve is not moving, and the inner pressure of the tank 93 is appropriately increased if the pressure increasing valve is moving. Therefore, the supplying state of the additive supplied by the additive supplying device 9 can be directly detected by monitoring the movement of the pressure increasing valve. As a result, the presence or absence of abnormality of the additive supplying device 9 can be accurately determined. Furthermore, since the pressure increasing valve is directly detected, the presence or absence of abnormality of the additive supplying device 9 can be determined at an early stage.

[0085] Alternatively, a flow rate sensor may be arranged on the branching pipe (air supplying pipe) 91 (specifically, a portion located downstream of the pressure adjusting device 92 in the direction in which the air flows) or the supplying pipe (additive supplying pipe) 94, and such a flow rate sensor may be used as the first detecting section. By arranging the flow rate sensor at the above-described portion in the branching pipe 91, and determining the presence or absence of abnormality of air supplied to the tank 93, the presence or absence of abnormality of the additive supplying device 9 can be determined. By arranging the flow rate sensor on the supplying pipe 94, and determining the presence or absence of abnormality in the amount itself of the additive supplied from the additive supplying device 9, the presence or absence of abnormality of the additive supplying device 9 can be determined. One flow rate sensor may be ar-

ranged on each of the branching pipe 91 and the supplying pipe 94.

[0086] Alternatively, the level sensor 98 may be used as the first detecting section, and determination may be made that the abnormality has generated in the additive supplying device 9 when the detection signal of the level sensor 98 indicates that the additive is not consumed. Thus, determination can be made that the additive supplying device 9 is properly operating when the amount of additive is decreasing, and that the abnormality has generated in the additive supplying device 9 when the amount of additive is not decreasing.

[0087] In the embodiment described above, the anti-deposition agent is used for the additive supplied by the additive supplying device 9, but the additive is not limited to the anti-deposition agent. For example, medical agent, wax, water, or the like that provides antibacterial function, deodorization function and/or odor eliminating function to the yarn Y may be used as the additive.

[0088] In the embodiment described above, the additive is supplied to the nozzle 43b of the spinning device 12, but the prescribed position where the additive is supplied may be other positions between an outlet of the draft device 11 and an outlet of the spinning device 12. For example, the additive may be supplied to the fiber bundle T between the outlet of the pair of front rollers 19 of the draft device 11 and an inlet of the spinning device 12, or if a nozzle is formed in the spindle 42, the additive may be supplied to such nozzle.

[0089] In the embodiment described above, the additive is supplied only while the spinning device 12 is performing the spinning operation, but the additive may be supplied at times other than during the spinning operation. For example, when the medical agent used for cleaning the spinning device 12 is used as the additive, the additive may be supplied only during the cleaning and the supply of additive may be stopped after the spinning operation is started. Alternatively, the spinning chamber 44 may be opened to outside air (the nozzle block 43 and the spindle 42 may be separated) while the spinning operation is interrupted, and the supply of additive may be continued under such a state.

[0090] In the embodiment described above, the control device 6 determines that an abnormality has generated in the additive supplying device 9 when the pressure detection value of the pressure sensor 96 is smaller than the threshold value. When activating the plurality of spinning units 2, each spinning unit 2 is activated in order, and the amount of additive to be supplied is changed according to the number of activated spinning units 2. In this case, the pressure adjusting device 92 is intermittently operated, and a duty ratio is adjusted according to the number of activated spinning units 2 to adjust the amount of additive to be supplied. In this case, instead of determining that abnormality has generated when the pressure detection value of the pressure sensor 96 becomes smaller than the threshold value once, determination may be made that abnormality has generated

when the pressure detection value is continuously smaller than the threshold value for a prescribed time.

[0091] In the embodiment described above, the first detecting section 96 and the control device 6 are connected via the electric connection 97. However, the first detecting section 96 and the control device 6 may be connected to be capable of carrying out wireless communication.

[0092] In the embodiment described above, one additive supplying device 9 is arranged with respect to the plurality of spinning units 2. However, the additive supplying device 9 may be arranged with respect to each spinning unit 2, or one additive supplying device 9 may be arranged for every prescribed number of spinning units 2.

[0093] In the embodiment described above, each process is performed by the control device 6 accommodated in the motor box 5. However, each process or some processes may be performed by another control device (e.g., unit control device adapted to control the spinning unit 2).

[0094] In the embodiment described above, the abnormality of the additive supplying device 9 is displayed on the display section 7. However, in place of the display section 7, the abnormality of the additive supplying device 9 may be displayed by lighting or flashing a display lamp arranged on the spinning machine 1. Alternatively, the abnormality of the additive supplying device 9 may be displayed on a display section arranged in each spinning unit 2.

[0095] In the embodiment described above, the spinning machine 1 includes one yarn joining cart 3, but a plurality of yarn joining carts 3 may be arranged according to the number of spinning units 2. Alternatively, each spinning unit 2 may include the yarn joining device 30, the suction pipe 31, and the suction mouth 32.

[0096] In the embodiment described above, the yarn travelling direction is directed from the top to the bottom of the spinning machine 1. However, each device may be arranged so that the yarn travelling direction is directed from the bottom to the top of the spinning machine 1.

Claims

1. A spinning machine (1) comprising:

a draft device (11) adapted to draft a fiber bundle (T);
 a spinning device (12) adapted to form a yarn (Y) by performing a spinning operation in which the yarn (Y) is formed by applying twists using airflow to the fiber bundle (T) drafted by the draft device (11);
 a winding device (13) adapted to wind the yarn (Y) formed by the spinning device (12);
 an additive supplying device (9) adapted to supply additive to be supplied to a prescribed position between an outlet of the draft device (11)

and an outlet of the spinning device (12);
 a first detecting section (96, 98) arranged in the additive supplying device (9) and adapted to detect information relating to supplying state of the additive supplied by the additive supplying device (9); and
 a control device (6) adapted to determine a presence or an absence of an abnormality in the additive supplying device (9) in accordance with a detection signal of the first detecting section (96, 98).

2. The spinning machine (1) as claimed in claim 1, wherein the control device (6) is adapted to, when determining the presence of the abnormality in the additive supplying device (9), prohibit the spinning operation of the spinning device (12) if the spinning device (12) has not yet started the spinning operation, and stop the spinning operation of the spinning device (12) if the spinning device (12) is performing the spinning operation.

3. The spinning machine (1) as claimed in claim 1 or 2, wherein the control device (6) is adapted to control the spinning device (12) to start the spinning operation when determining that the additive supplying device (9) is properly supplying the additive.

4. The spinning machine (1) as claimed in claim 3, comprising a yarn joining device (30) adapted to join the yarn (Y) disconnected between the spinning device (12) and the winding device (13), wherein the control device (6) is adapted to control the spinning device (12) to start a spinning operation, the yarn joining device (30) to perform yarn joining, and the winding device (13) to start winding of the yarn (Y).

5. The spinning machine (1) as claimed in any one of claims 1 to 4, wherein the first detecting section (96) includes an output section (96a), and the control device (6) and the output section (96a) are connected via an electric connection (97).

6. The spinning machine (1) as claimed in any one of claims 1 to 5, wherein the additive supplying device (9) includes a tank (93) adapted to store the additive, and a pressure adjusting device (92) adapted to adjust inner pressure of the tank (93), and the first detecting section (96) includes a pressure sensor adapted to detect a secondary pressure of the pressure adjusting device (92).

7. The spinning machine (1) as claimed in any one of claims 1 to 5, wherein the additive supplying device (9) includes a tank (93) adapted to store the additive, and a pressure adjusting device (92) including a pressure increasing valve adapted to adjust an inner

pressure of the tank (93),
wherein the first detecting section (96) is adapted to
monitor movement of the pressure increasing valve
of the pressure adjusting device (92).

5

8. The spinning machine (1) as claimed in any one of
claims 1 to 5, wherein the additive supplying device
(9) includes:

a tank (93) adapted to store the additive, 10
an additive supplying pipe (94) adapted to sup-
ply the additive from the tank (93),
an air supplying pipe (91) adapted to supply air
to the tank (93), and
a pressure adjusting device (92) arranged in the 15
air supplying pipe (91) and adapted to adjust
inner pressure of the tank (93),
wherein the first detecting section is a flow rate
sensor arranged in at least one of a portion of
the air supplying pipe (91), the portion being lo- 20
cated downstream of the pressure adjusting de-
vice (92) in a direction in which the air flows, and
the additive supplying pipe (94).

9. The spinning machine (1) as claimed in any one of 25
claims 1 to 5, wherein the additive supplying device
(9) includes a tank (93) adapted to store the additive,
the first detecting section (98) is a level sensor adapt-
ed to detect an amount of the additive stored in the
tank (93), and 30
the control device (6) is adapted to determine that
an abnormality has generated in the additive supply-
ing device (9) when determining that the amount of
the additive has not decreased in accordance with
a detection signal of the level sensor (5). 35

10. The spinning machine (1) as claimed in any one of
claims 1 to 8, wherein the additive supplying device
(9) includes a further detecting section (98) adapted
to detect that a stored amount of the additive has 40
become equal to or less than a prescribed amount.

11. The spinning machine (1) as claimed in any one of
claims 1 to 10, comprising a second detecting sec- 45
tion (24) adapted to detect a status of the yarn (Y)
at downstream of the prescribed position in a yarn
travelling direction.

12. The spinning machine (1) as claimed in any one of
claims 1 to 11, comprising a display section (7) 50
adapted to display the abnormality of the additive
supplying device (9) when the control device (6) de-
termines a presence of the abnormality in the addi-
tive supplying device (9).

55

13. The spinning machine (1) as claimed in any one of
claims 1 to 12, comprising a plurality of spinning units
(2), each of which includes the draft device (11), the

spinning device (12) and the winding device (13),
the spinning machine (1) includes a guiding pipe (82)
adapted to guide the additive from the additive sup-
plying device (9) to the prescribed position of the
respective spinning units (2).

FIG. 1

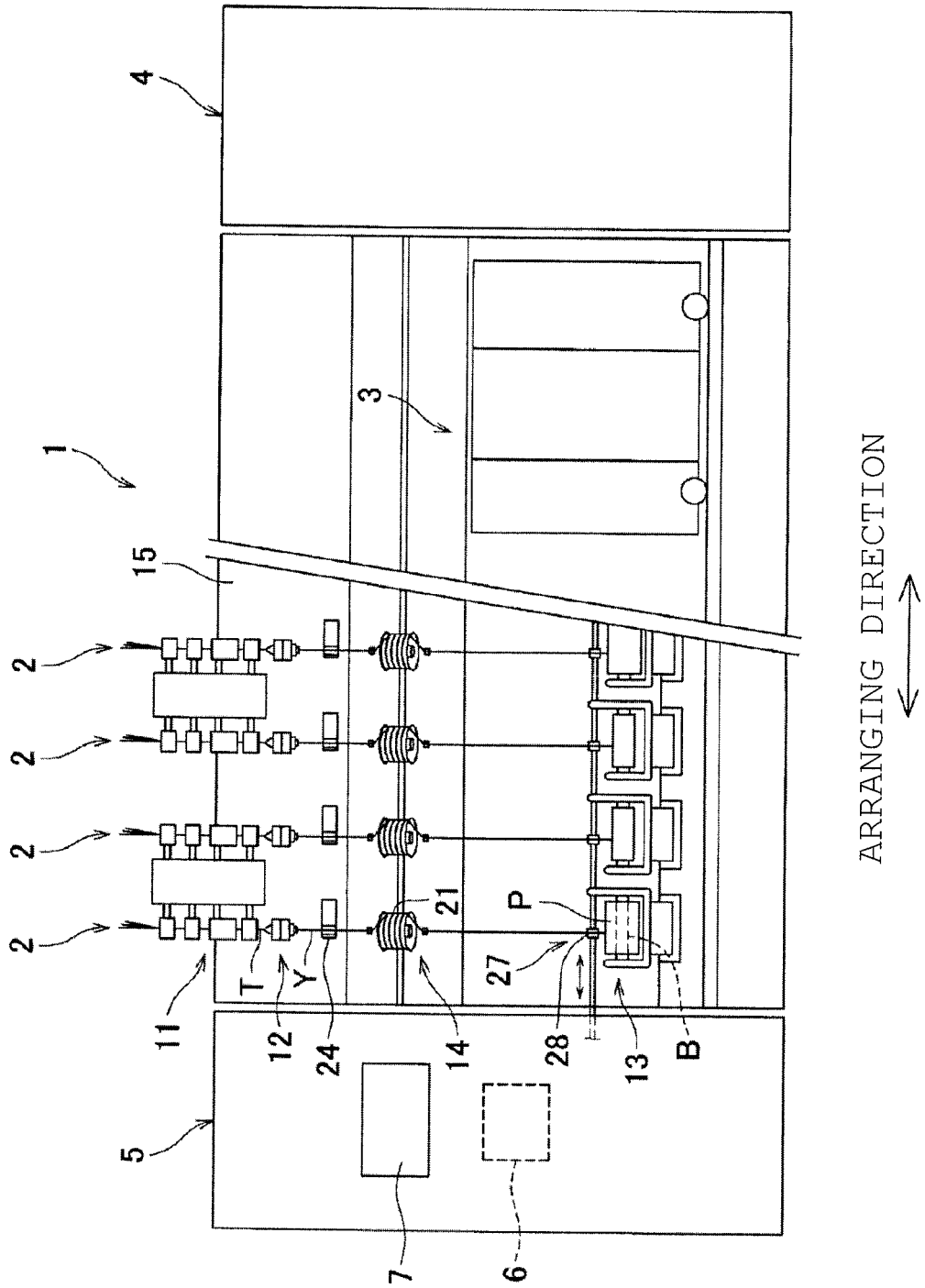


FIG. 2

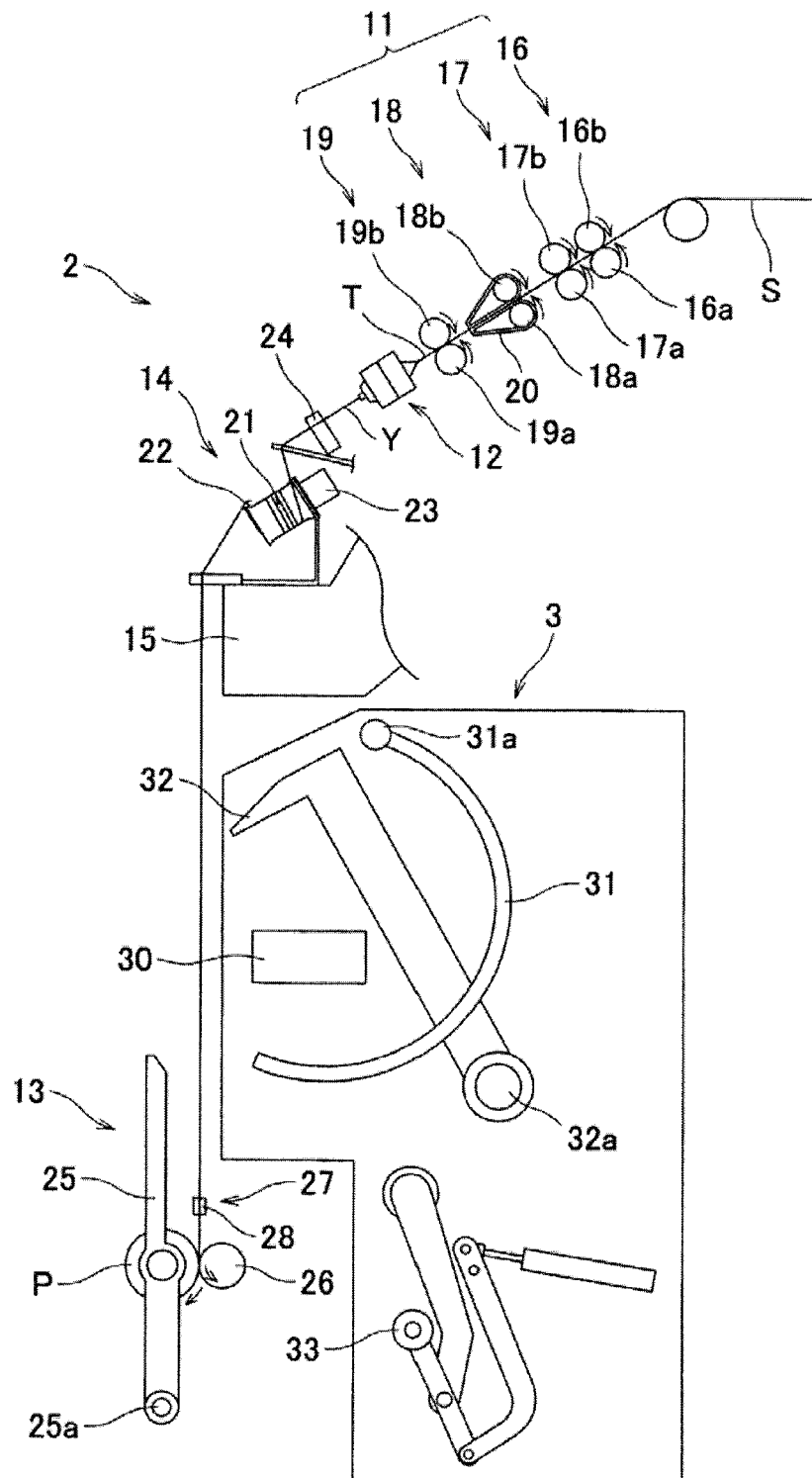


FIG. 3

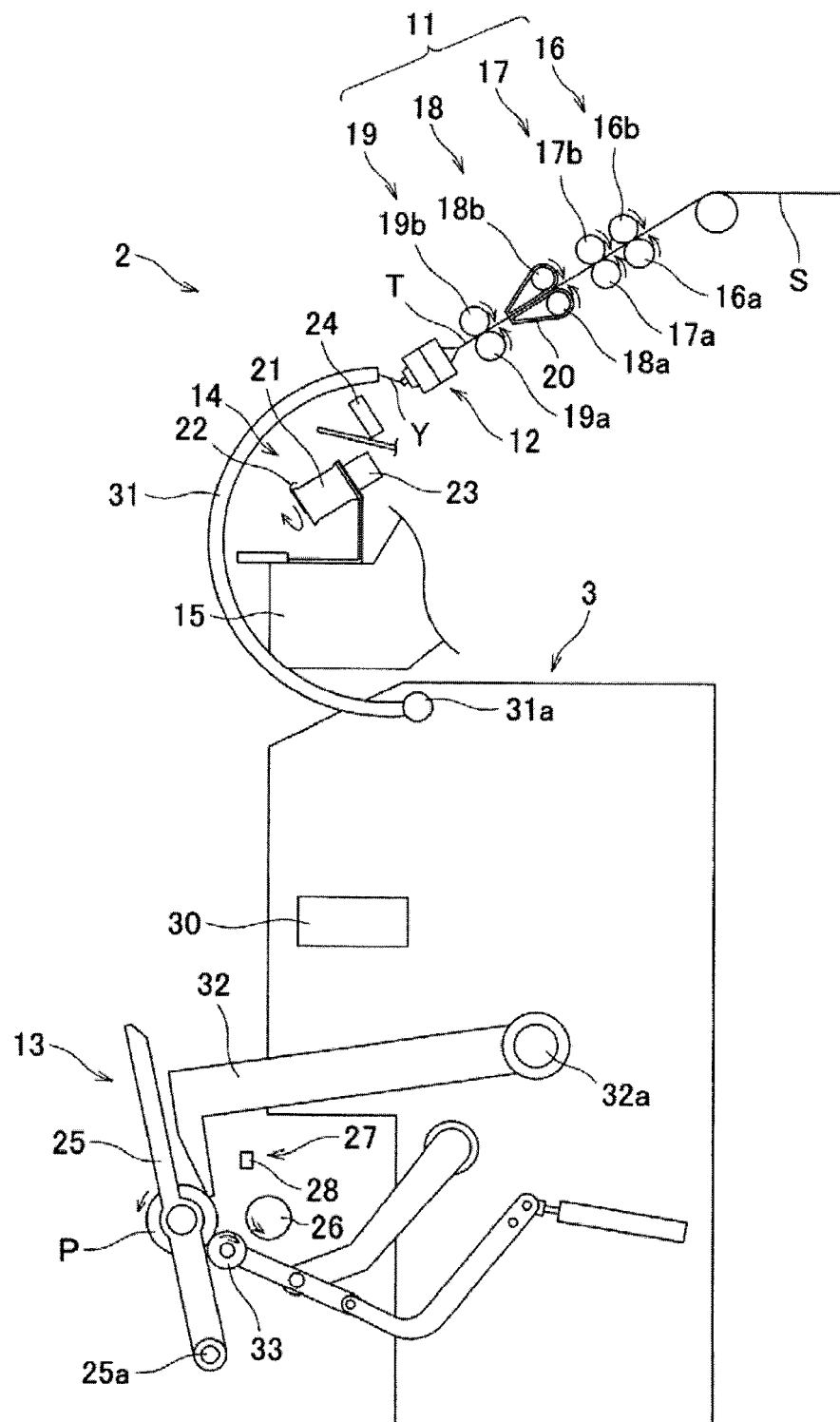


FIG. 4

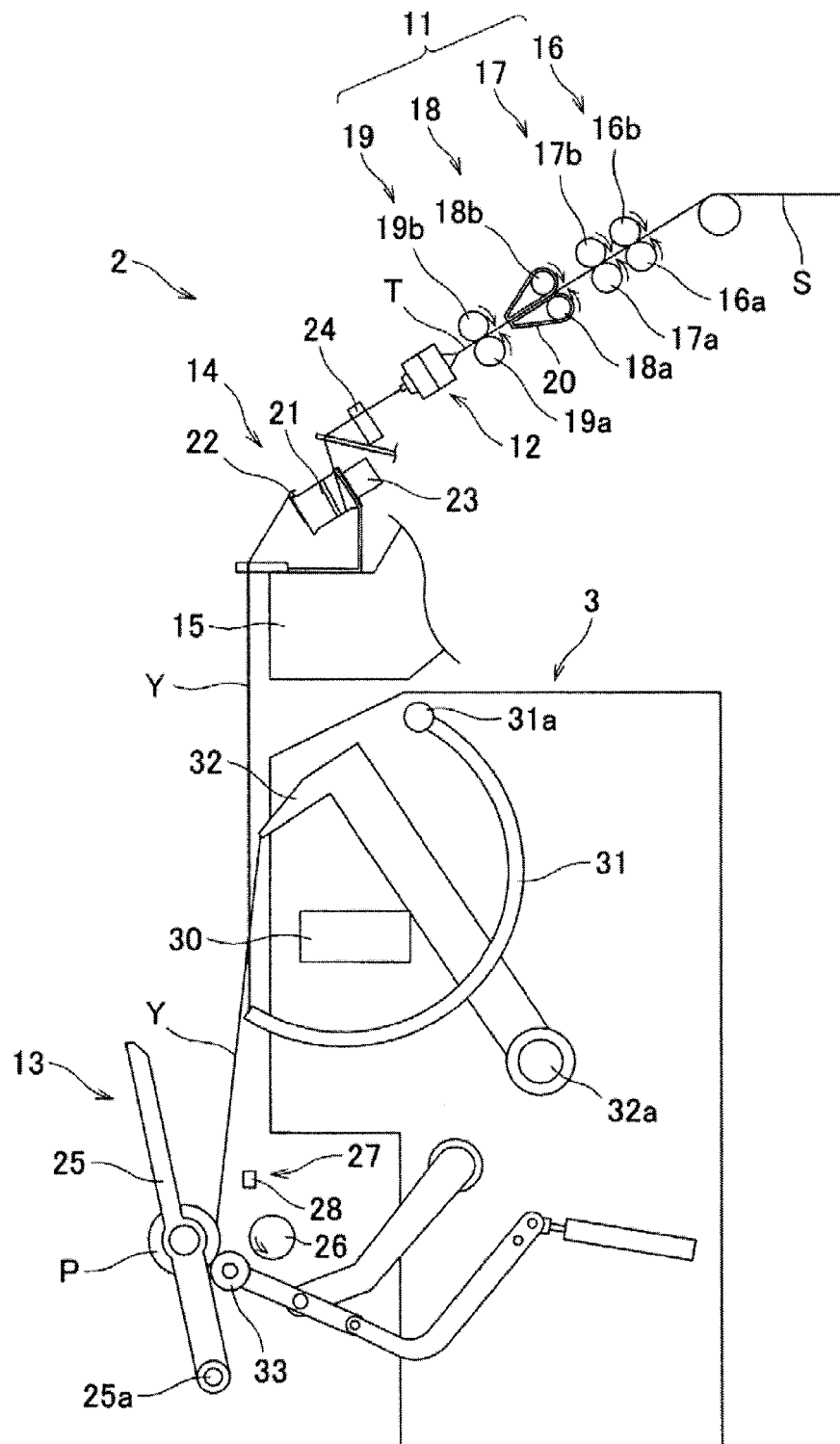


FIG. 5

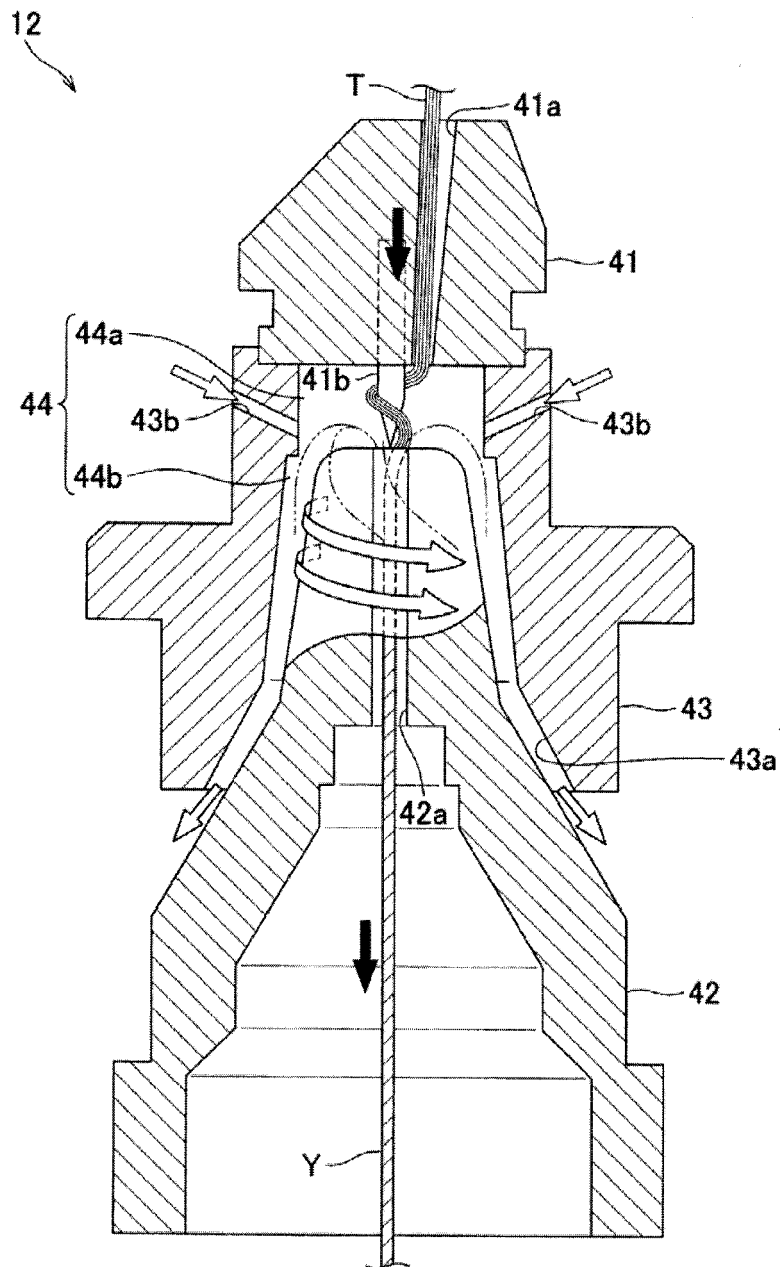


FIG. 6

ARRANGING DIRECTION
↔

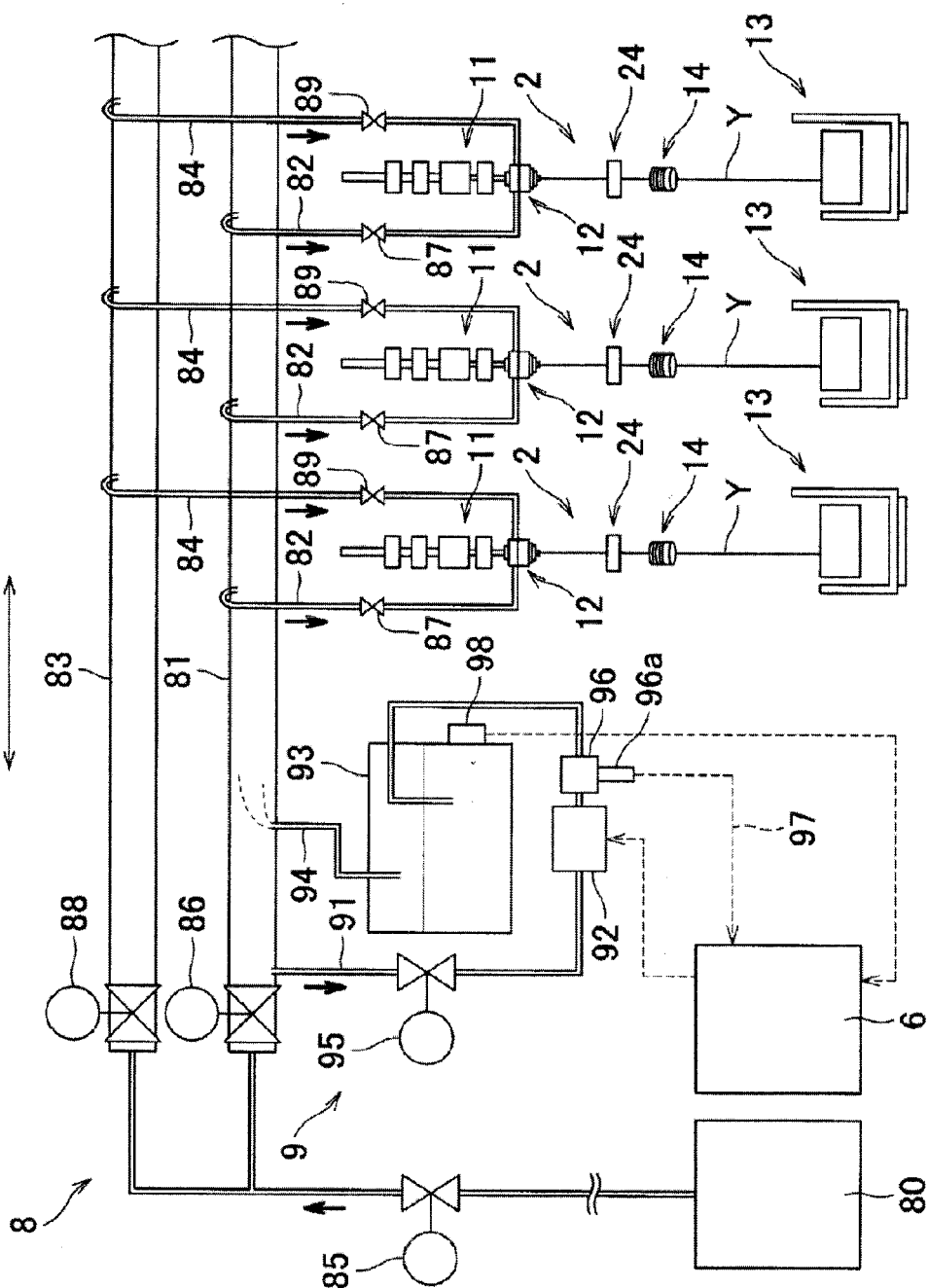
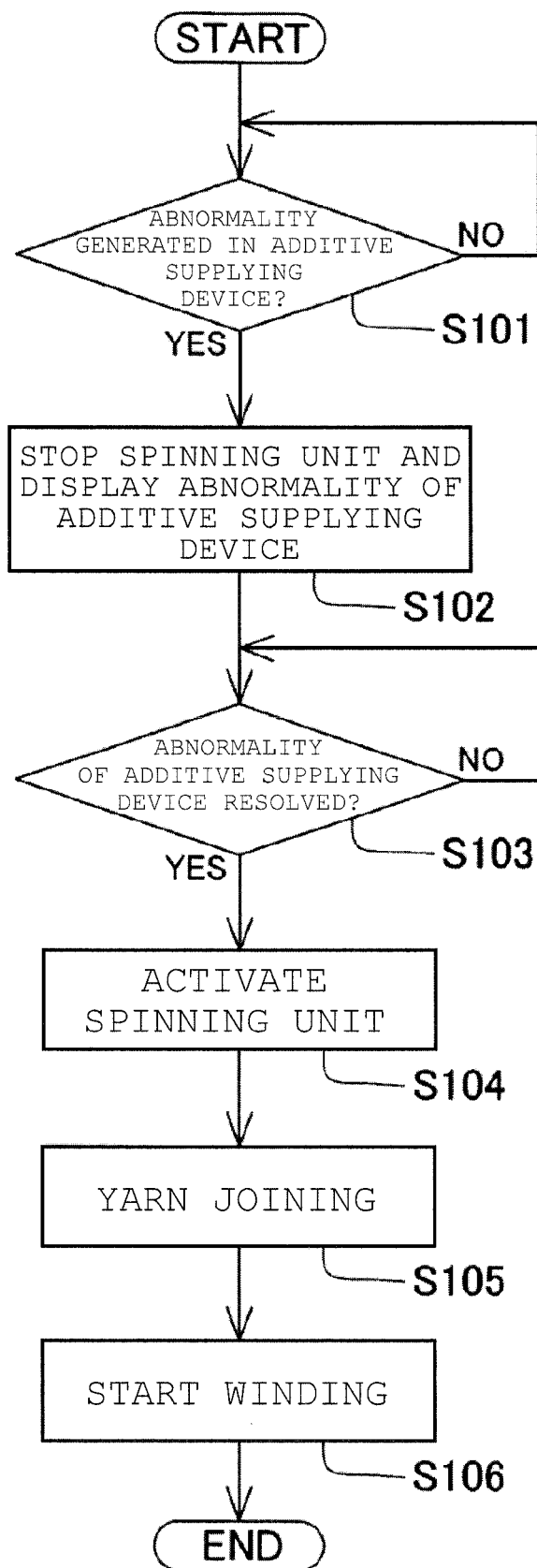


FIG. 7





EUROPEAN SEARCH REPORT

Application Number
EP 18 16 6108

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 302 114 A2 (MURATA MACHINERY LTD [JP]) 30 March 2011 (2011-03-30)	1-5,10, 11,13 12	INV. D01H1/115 D01H4/02 D01H13/30
Y	* abstract * * paragraph [0015] * * paragraph [0026] * * paragraph [0038] * * paragraph [0054] * * figures 1,4 *		
Y	EP 2 949 795 A2 (MURATA MACHINERY LTD [JP]) 2 December 2015 (2015-12-02) * abstract * * paragraph [0021] - paragraph [0022] * * figure 1 *	12	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 August 2018	Examiner Humbert, Thomas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 16 6108

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-08-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 2302114	A2	30-03-2011	CN	102021688 A	20-04-2011
			CN	104328539 A	04-02-2015
			CN	105463635 A	06-04-2016
			CN	105568445 A	11-05-2016
			EP	2302114 A2	30-03-2011
			EP	2865793 A1	29-04-2015
			JP	2011084854 A	28-04-2011

EP 2949795	A2	02-12-2015	CN	105316810 A	10-02-2016
			EP	2949795 A2	02-12-2015
			JP	2015224402 A	14-12-2015

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2012097391 A [0002] [0003]