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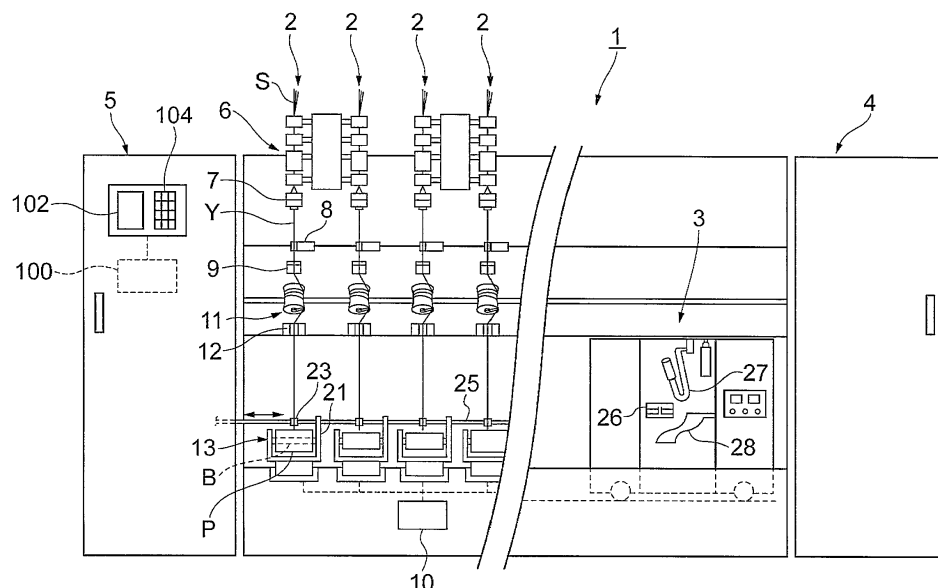
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(54) **SPINNING MACHINE AND SPINNING METHOD**

(57) A spinning machine 1 includes: a plurality of spinning units 2 each including an air-jet spinning device 7 and a winding device 13; an air pipe 62; a feeding device 70 configured to feed an additive to the air pipe 62; and a control device 100 configured to control operation of the feeding device 70. When the operating number of the air-jet spinning devices 7 is smaller than a predetermined number, the control device 100 controls the feeding de-

vice 70 such that the additive is fed by intermittent control, thereby increasing the amount of the additive to be fed as the operating number increases or reducing the amount of the additive to be fed as the operating number decreases. When the operating number is equal to or greater than the predetermined number, the control device 100 controls the feeding device 70 such that a certain amount of the additive is continuously fed.

Fig.1



DescriptionTECHNICAL FIELD

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

BACKGROUND

[0002] As a conventional spinning machine, a spinning machine disclosed in Japanese Unexamined Patent Publication No. 2012-97391, for example, is known. The spinning machine described in Japanese Unexamined Patent Publication No. 2012-97391 includes: a plurality of spinning units each including an air-jet spinning device configured to twist a fiber bundle with air; an air pumping device configured to compress and deliver air; an air pipe configured to guide the air compressed and delivered by the air pumping device; a feeding device configured to feed an additive into the air pipe at upstream of a branch where the air flowing through the air pipe branches off toward the air-jet spinning device; and a control device configured to adjust the amount of the additive to be fed by the feeding device.

SUMMARY

[0003] In the spinning machine described above, when an instruction to start spinning operations of the spinning units is input, spinning operations are sequentially started from a spinning unit for which preparation (e.g., yarn joining operation performed by a yarn joining carrier) has been completed. Thus, in the spinning machine, it takes time until spinning operations have been started in all spinning units that are planned to be operated. The feeding device feeds an additive of an amount that is set for a planned operating number of spinning units (air-jet spinning devices). Thus, in this conventional spinning machine, in a period after the input of the start instruction and when the number of spinning units that have started spinning operations is small, an excessive amount of additive may be fed to air-jet spinning devices of spinning units that had started spinning operations in an early stage. If an excessive amount of additive is fed to a fiber bundle, the state of twist changes, for example, which may change the quality of yarn.

[0004] It is an object of one aspect of the present disclosure to provide a spinning machine and a spinning method that enable an additive to be stably fed.

[0005] A spinning machine according to one aspect of the present disclosure includes: a plurality of spinning units each including an air-jet spinning device configured to perform spinning operation of twisting a fiber bundle with air to generate yarn and a winding device configured to wind the yarn around a bobbin to form a package; an air pipe configured to allow the air to flow therethrough and connected to upstream sides of a plurality of feeding pipes through which the air is supplied to the respective air-jet spinning devices of the spinning units; a feeding device configured to feed an additive to the air pipe; and a control device configured to control operation of the feeding device. When an operating number that is the number of air-jet spinning devices being operating among the air-jet spinning devices is smaller than a predetermined number, the control device controls the feeding device such that the additive is fed by intermittent control, so as to increase the amount of the additive to be fed as the operating number increases or reduce the amount of the additive to be fed as the operating number decreases. When the operating number is equal to or greater than the predetermined number, the control device controls the feeding device such that a certain amount of the additive is continuously fed.

[0006] In the spinning machine according to one aspect of the present disclosure, the control device increases or reduces the amount of the additive to be fed depending on the operating number of the air-jet spinning devices when the operating number is smaller than the predetermined number, and causes a certain amount of the additive to be fed when the operating number is equal to or greater than the predetermined number. Thus, in the spinning machine, the additive of an amount according to the operating number of air-jet spinning devices that are actually operating (spinning) is fed into the air pipe, whereby the amounts of the additive to be fed to the respective air-jet spinning devices can be made uniform. Thus, in the spinning machine, the additive can be prevented from being excessively fed to the air-jet spinning devices of the spinning units. Consequently, in the spinning machine, the additive can be stably fed.

[0007] In one embodiment, the control device may linearly increase or reduce the amount of the additive to be fed depending on the operating number when the operating number is smaller than the predetermined number. By linearly increasing or reducing the amount to be fed in this manner, the intermittent control can be easily performed.

[0008] In one embodiment, the feeding device may feed the additive into the air pipe by applying a certain pressure to the additive. The control (adjustment) of pressure can be eliminated, whereby the configuration and the control can be simplified.

[0009] In one embodiment, when an instruction to start the spinning operation is input after start-up of the machine or after lot change, the control device may control the feeding device such that the amount of the additive to be fed increases as the operating number increases. In a period before stoppage of the machine or before lot change when the operating

number is smaller than the predetermined number, the control device may control the feeding device such that the amount of the additive to be fed decreases as the operating number decreases. After start-up of the spinning machine or after lot change, spinning operations of the spinning units are sequentially started. Before stoppage of the machine or before lot change, operations of the spinning units are sequentially stopped. Thus, by controlling the amount of the additive to be fed depending on the operating number, variations in the amount of the additive to be fed to the air-jet spinning devices of spinning units that are performing spinning operations can be reduced.

[0010] In one embodiment, when the operating number is smaller than the predetermined number, the control device may set the amount of the additive to be fed based on a relation expressed by $(\text{a period when the additive is to be fed} / \text{an intermittent cycle period}) = (\text{the operating number} / \text{a planned operating number that is the number of air-jet spinning devices planned to be operated among the air-jet spinning devices})$. When the operating number is equal to or greater than the predetermined number, the control device may set the amount of the additive to be fed based on the planned operating number of the air-jet spinning devices and an optimum amount of the additive that is an amount optimum for one air-jet spinning device. By setting the amount of the additive to be fed in this manner, the amounts of the additive to be fed to the respective air-jet spinning devices can be made uniform.

[0011] In one embodiment, the air pipe may be single, and the air pipe may extend along a direction in which the spinning units are aligned. In this configuration, the amount of the additive to be fed into one air pipe only needs to be controlled, and thus the amount to be fed can be accurately and simply controlled.

[0012] In one embodiment, the control device may acquire the operating number based on a yarn travelling signal output from each spinning unit. Thus, the operating number of the air-jet spinning devices can be accurately acquired.

[0013] In one embodiment, the spinning machine may further include a flow-rate measuring device configured to measure a flow rate of the air flowing through the air pipe, and the control device may acquire the operating number based on a measurement result of the flow-rate measuring device. The flow rate flowing through the air pipe is low when the operating number is small, and the flow rate flowing through the air pipe is high when the operating number is large. Thus, based on the measurement result of the flow-rate measuring device, the operating number can be accurately acquired.

[0014] In one embodiment, the air containing the additive may be supplied only to an air-jet spinning device that is operating among the air-jet spinning devices. In this configuration, because the air containing the additive is not supplied to an air-jet spinning device that is not operating, the amount to be fed based on the operating number can be accurately controlled.

[0015] In one embodiment, after the operating number reached the predetermined number or more, when operations of the air-jet spinning devices temporarily stop and the operating number becomes smaller than the predetermined number, the control device may continue operation of causing a certain amount of the additive to be continuously fed. If yarn breakage, yarn cut, or doffing, for example, has occurred in a spinning unit, operation of the corresponding air-jet spinning device is temporarily interrupted. Even if the operating number has become smaller than the predetermined number due to such temporary stoppage, the operation of causing a certain amount of the additive to be continuously fed is continued, whereby a shortage in the amount of the additive to be fed to the air-jet spinning devices of the other spinning units due to this temporary decrease in the operating number can be avoided.

[0016] In one embodiment, control of continuously feeding the additive may be performed for a period longer than that of the intermittent control. The intermittent control can become a load on the feeding device. During a period when the spinning machine is operating, by continuously feeding the additive for a longer period, the load on the feeding device can be reduced, and thus the life of the feeding device can be increased.

[0017] A spinning method according to one aspect of the present disclosure is a spinning method performed in a spinning machine including: a plurality of spinning units each including an air-jet spinning device configured to perform spinning operation of twisting a fiber bundle with air to generate yarn and a winding device configured to wind the yarn around a bobbin to form a package; an air pipe configured to allow the air to flow therethrough and connected to upstream sides of a plurality of feeding pipes through which the air is supplied to the respective air-jet spinning devices of the spinning units; and a feeding device configured to feed an additive to the air pipe. The spinning method includes: when an operating number that is the number of air-jet spinning devices being operating among the air-jet spinning devices is smaller than a predetermined number, controlling the feeding device such that the additive is fed by intermittent control, so as to increase the amount of the additive to be fed as the operating number increases or reduce the amount of the additive to be fed as the operating number decreases; and when the operating number is equal to or greater than the predetermined number, controlling the feeding device such that a certain amount of the additive is continuously fed.

[0018] In the spinning method according to one aspect of the present disclosure, the amount of the additive to be fed is increased or reduced depending on the operating number when the operating number of the air-jet spinning devices is smaller than the predetermined number, and a certain amount of the additive is fed when the operating number is equal to or greater than the predetermined number. Accordingly, the additive of an amount according to the operating number of air-jet spinning devices that are actually operating (spinning) is fed into the air pipe, whereby the amounts of the additive to be fed to the respective air-jet spinning devices can be made uniform. Thus, the additive can be prevented

from being excessively fed to the air-jet spinning devices of the spinning units. Consequently, the additive can be stably fed.
[0019] According to one aspect of the present disclosure, the additive can be stably fed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a front view of a spinning machine according to one embodiment;
 FIG. 2 is a side view of a spinning unit of the spinning machine in FIG. 1;
 FIG. 3 is a diagram illustrating configuration of an air distributing device and a feeding device of the spinning machine;
 FIG. 4A is a graph illustrating a relation between the number of units and the total amount to be fed, and FIG. 4B is a graph representing the number of units and the amount to be fed per unit; and
 FIG. 5A is a graph illustrating a relation between the number of units and the total amount to be fed, and FIG. 5B is a graph representing the number of units and the amount to be fed per unit.

DETAILED DESCRIPTION

[0021] One embodiment will now be described in detail with reference to the attached drawings. In the description of the drawings, like or equivalent elements are designated by like numerals, and duplicate description is omitted.

[0022] As depicted in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a yarn joining carrier 3, a doffing carrier (not depicted), a first end frame 4, and a second end frame 5. The spinning units 2 are aligned in a row. Each spinning unit 2 generates yarn Y and winds the yarn Y into a package P. When yarn Y is cut or the yarn Y is broken for some reason in a certain spinning unit 2, the yarn joining carrier 3 performs yarn joining operation in the spinning unit 2. When a package P has been fully wound in a certain spinning unit 2, the doffing carrier doffs the package P, and supplies a new bobbin B to the spinning unit 2. The first end frame 4 accommodates, for example, a collection device configured to collect fiber waste, yarn waste, and the like generated in the spinning units 2.

[0023] The second end frame 5 accommodates, for example, an air supply unit configured to adjust air pressure of compressed air (air) supplied to the respective sections in the spinning machine 1 and supply the air to the respective sections and a drive motor configured to supply power to the respective sections in the spinning units 2. The second end frame 5 includes a machine control device 100, a display screen 102, and input keys 104. The machine control device 100 centrally manages and controls the respective sections of the spinning machine 1. The display screen 102 can display, for example, information on settings and/or the states of the spinning units 2. An operator can make the settings of the spinning units 2 by performing appropriate operations with the input keys 104.

[0024] As depicted in FIG. 1 and FIG. 2, each spinning unit 2 includes, in the order from the upstream side in a direction in which the yarn Y travels, a draft device 6, an air-jet spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn storage device 11, a waxing device 12, and a winding device 13. A unit controller 10 is provided for every predetermined number of spinning units 2, and controls operations of the spinning units 2.

[0025] The draft device 6 drafts a sliver (fiber bundle) S. The draft device 6 includes, in the order from the upstream side in a direction in which a sliver S travels, a back roller pair 14, a third roller pair 15, a middle roller pair 16, and a front roller pair 17. Each pair of the roller pairs 14, 15, 16, and 17 have a bottom roller and a top roller. The bottom roller is driven and rotated by a drive motor provided in the second end frame 5 or a drive motor provided in each spinning unit 2. Around the top roller of the middle roller pair 16, an apron belt 18b is provided. Around the bottom roller of the middle roller pair 16, an apron belt 18a is provided.

[0026] The air-jet spinning device 7 generates yarn Y by twisting a fiber bundle F drafted by the draft device 6 using swirling airflow. More specifically (although not depicted), the air-jet spinning device 7 includes a spinning chamber, a fiber guiding portion, a swirling-airflow generating nozzle, and a hollow guide shaft member. The fiber guiding portion guides a fiber bundle F supplied from the draft device 6 on the upstream side into the spinning chamber. The swirling-airflow generating nozzle is disposed around a path through which the fiber bundle F travels. The swirling-airflow generating nozzle injects air, thereby generating swirling airflow in the spinning chamber. By this swirling airflow, the respective fiber ends of a plurality of fibers constituting the fiber bundle F are reversed and swirled. The hollow guide shaft member guides yarn Y from the inside of the spinning chamber to the outside of the air-jet spinning device 7.

[0027] The yarn monitoring device 8 monitors information on the travelling yarn Y between the air-jet spinning device 7 and the yarn storage device 11 to detect the presence or absence of a yarn defect on the basis of the monitored information. When a yarn defect is detected, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects, as a yarn defect, thickness abnormality of the yarn Y and/or foreign matter contained in the yarn Y, for example. While the yarn Y is being detected, the yarn monitoring device 8 outputs a yarn travelling signal indicating that the yarn Y is travelling between the air-jet spinning device 7 and the yarn storage device 11. The yarn monitoring device 8 also detects yarn breakage, for example.

[0028] The tension sensor 9 measures the tension of the travelling yarn Y between the air-jet spinning device 7 and the yarn storage device 11, and transmits a tension measurement signal to the unit controller 10. When the unit controller 10 determines a presence of abnormality based on a result of detection by the yarn monitoring device 8 and/or the tension sensor 9, the yarn Y is cut in the spinning unit 2. Specifically, supply of air to the air-jet spinning device 7 is stopped and generation of yarn Y is interrupted, whereby the yarn Y is cut. Alternatively, the yarn Y may be cut by a cutter provided separately.

[0029] The waxing device 12 applies wax to yarn Y between the yarn storage device 11 and the winding device 13.

[0030] The yarn storage device 11 eliminates slack in yarn Y between the air-jet spinning device 7 and the winding device 13. The yarn storage device 11 has a function of stably pulling out yarn Y from the air-jet spinning device 7, a function of retaining yarn Y fed from the air-jet spinning device 7 during, for example, the yarn joining operation performed by the yarn joining carrier 3 to prevent the yarn Y from slackening, and a function of preventing variations in tension of yarn Y on the downstream side of the yarn storage device 11 from being propagated to the air-jet spinning device 7.

[0031] The winding device 13 winds the yarn Y around a bobbin B to form a package P. The winding device 13 includes a cradle arm 21, a winding drum 22, and a traverse guide 23. The cradle arm 21 rotatably supports the bobbin B. The cradle arm 21 is swingably supported by a support shaft 24, and makes the surface of the bobbin B or the surface of the package P to contact with the surface of the winding drum 22 with an appropriate pressure. A drive motor (not depicted) provided in the second end frame 5 simultaneously drives the winding drums 22 of the spinning units 2. Accordingly, in each spinning unit 2, a bobbin B or a package P is rotated in the winding direction. The traverse guide 23 of each spinning unit 2 is provided on a shaft 25 that is shared among the spinning units 2. The drive motor of the second end frame 5 drives the shaft 25 so as to reciprocate in the rotation axis direction of the winding drum 22, and thus the traverse guide 23 traverses yarn Y with respect to the rotating bobbin B or the package P at a predetermined width.

[0032] When the yarn Y is cut or the yarn Y is broken for some reason in a certain spinning unit 2, the yarn joining carrier 3 travels to the spinning unit 2 to perform yarn joining operation. The yarn joining carrier 3 includes a yarn joining device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a support shaft 31, and catches the yarn Y from the air-jet spinning device 7 to guide the yarn Y to the yarn joining device 26. The suction mouth 28 is swingably supported by a support shaft 32, and catches the yarn Y from the winding device 13 to guide the yarn Y to the yarn joining device 26. The yarn joining device 26 joins the guided yarns Y to each other. The yarn joining device 26 is, for example, a splicer using compressed air, a piecer using a seed yarn, or a knotter configured to mechanically join the yarns Y.

[0033] When performing the yarn joining operation, the yarn joining carrier 3 rotates a package P in the direction opposite to the winding direction (reversely rotates the package P). In this case, the cradle arm 21 is moved by an air cylinder (not depicted) such that the package P separates from the winding drum 22, and the package P is reversely rotated by a reverse rotation roller (not depicted) provided to the yarn joining carrier 3.

[0034] As depicted in FIG. 3, the spinning machine 1 further includes an air distributing device 60 and a feeding device 70. The air distributing device 60 includes a first air pipe (air pipe) 62, first distribution pipes (feeding pipes) 63, a second air pipe 64, and second distribution pipes 65.

[0035] In a factory where the spinning machine 1 is installed, an air pumping device 61 is provided. The air pumping device 61 is, for example, an electric compressor configured to compress and deliver air by activating an electric motor. The pressure of the air compressed and delivered by the air pumping device 61 is adjusted by a regulator 61a.

[0036] The first air pipe 62 guides misted air (additive-containing air). The misted air is air that has been compressed and delivered by the air pumping device 61 and has been supplied to the spinning machine 1 through an air supply pipe 67, and into which an additive has been added. The first air pipe 62 extends along the direction in which the spinning units 2 are aligned, in parallel or substantially parallel therewith. The first air pipe 62 is positioned above the air-jet spinning devices 7. The first air pipe 62 may be provided so as to be positioned below the air-jet spinning devices 7, or may be provided at the same height as that of the air-jet spinning devices 7.

[0037] The first distribution pipes 63 guide the misted air flowing through the first air pipe 62 to the respective air-jet spinning devices 7. One end of each first distribution pipe 63 is connected to the corresponding air-jet spinning device 7. Specifically, one end of each first distribution pipe 63 is connected to a shuttle valve (not depicted) connected to the swirling-airflow generating nozzle of the corresponding air-jet spinning device 7. The other end (on the upstream side in the flowing direction of the misted air) of each first distribution pipe 63 is connected to an intermediate portion of the first air pipe 62. The flow rate of the misted air guided by each first distribution pipe 63 to the corresponding air-jet spinning device 7 is adjusted by an open/close valve 63a provided to the first distribution pipe 63. The unit controller 10 controls operation of the open/close valve 63a. In each air-jet spinning device 7 to which the misted air is supplied, mist spinning operation (additive spinning operation) using the misted air is performed.

[0038] The second air pipe 64 guides dry air (air) that has been compressed and delivered by the air pumping device 61 and does not contain the additive. The second air pipe 64 extends along the direction in which the spinning units 2 are aligned, in parallel or substantially parallel therewith. The second air pipe 64 is positioned above the air-jet spinning devices 7. The second air pipe 64 may be provided so as to be positioned below the air-jet spinning devices 7, or may

be provided at the same height as that of the air-jet spinning devices 7.

[0039] The second distribution pipes 65 guide dry air flowing through the second air pipe 64 to the respective air-jet spinning devices 7. One end of each second distribution pipe 65 is connected to the corresponding air-jet spinning device 7. Specifically, one end of each second distribution pipe 65 is connected to the shuttle valve connected to the swirling-airflow generating nozzle of the corresponding air-jet spinning device 7. In other words, the first distribution pipe 63 and the second distribution pipe 65 are connected to the same shuttle valve. The other end of each second distribution pipe 65 is connected to an intermediate portion of the second air pipe 64. The flow rate of the dry air guided by each second distribution pipe 65 to the corresponding air-jet spinning device 7 is adjusted by an open/close valve 65a provided to the second distribution pipe 65. The unit controller 10 controls operation of the open/close valve 65a. In each air-jet spinning device 7 to which dry air is supplied, dry spinning operation using the dry air is performed.

[0040] In the spinning machine 1, the operator can select which of the mist spinning operation and the dry spinning operation is to be performed, by operating the input keys 104, for example. During a period until one spinning unit 2 has completed winding of one package P, a fiber bundle F is spun by the mist spinning operation or the dry spinning operation that has been selected, and the resulting yarn Y generated thereby is wound.

[0041] As depicted in FIG. 3, the feeding device 70 includes a branching pipe 71, a pressure adjusting device 72, a storage tank 73, an additive feeding pipe 74, and an adjusting valve 75.

[0042] The branching pipe 71 causes air flowing through the first air pipe 62 to branch off to be guided to the storage tank 73. One end of the branching pipe 71 is connected to the storage tank 73. The other end of the branching pipe 71 is connected to an intermediate portion of the first air pipe 62.

[0043] The pressure adjusting device 72 compresses air guided to the storage tank 73 to adjust the pressure inside the storage tank 73. The pressure adjusting device 72 is, for example, a booster valve configured to compress air by driving a sliding piston. Alternately, the pressure adjusting device 72 may be an electric compressor configured to compress air by activating an electric motor. The pressure adjusting device 72 is connected to the machine control device 100 via an electric line. The machine control device 100 controls the pressure adjusting device 72 by transmitting a control signal to the pressure adjusting device 72.

[0044] The storage tank 73 is a container configured to store an additive. In the present embodiment, the additive is a lubricant, for example. The additive is not limited to the lubricant, and various additives (agents) that can add at least one of, for example, antibacterial, odor-eliminating, deodorizing, unwinding (waxing) functions to the yarn Y and/or an additive (agent) that can prevent or solve deposition of oil in the air-jet spinning devices 7 may be used. Alternatively, the additive may be water. The storage tank 73 includes a storage amount detection section 73a configured to detect the amount of the additive stored therein.

[0045] The additive feeding pipe 74 guides the additive stored in the storage tank 73 to the first air pipe 62. One end of the additive feeding pipe 74 is connected to the storage tank 73. The other end of the additive feeding pipe 74 is connected to an intermediate portion of the first air pipe 62 on the upstream side of portions where the air flowing through the first air pipe 62 branches off toward the respective air-jet spinning devices 7.

[0046] The adjusting valve 75 is provided in the branching pipe 71. The amount of the additive to be fed into the first air pipe 62 through the additive feeding pipe 74 is adjusted by the adjusting valve 75. The machine control device 100 controls operation of the adjusting valve 75.

[0047] The feeding device 70 feeds (sprays) the additive stored in the storage tank 73 to the first air pipe 62. The feeding device 70 adjusts the amount of the additive to be fed using the pressure adjusting device 72. The feeding device 70 is controlled by the machine control device 100. For example, the machine control device 100 may control the feeding device 70 to control the amount of the additive to be fed depending on the raw material of the sliver S. In the present embodiment, the amount to be fed is the amount of the additive to be fed from the feeding device 70.

[0048] The air distributing device 60 supplies misted air to the air-jet spinning devices 7 using only the first air pipe 62 by opening a valve 66 disposed in an upstream portion of the first air pipe 62 and closing a valve 69 disposed in an upstream portion of the second air pipe 64. The air distributing device 60 supplies dry air to the air-jet spinning devices 7 using only the second air pipe 64 by closing the valve 66 and opening the valve 69. If the air distributing device 60 is configured to be able to switch which of the air is to be supplied, the positions where the respective valves are provided and/or the number thereof are not limited to those in the embodiment illustrated in FIG. 3.

[0049] A sliver S to be spun by the spinning machine 1 may contain at least one of natural fiber, regenerated fiber, semi-synthetic fiber, and synthetic fiber (e.g., polyester fiber, polyamide fiber, and polyacrylonitrile fiber). Examples of the natural fiber include seed hair fiber and bast fiber, and specifically include cotton and flax, etc. Examples of the regenerated fiber include regenerated cellulose fiber, and specifically include rayon, special rayon (polynosic, HWM rayon), and cupra, etc. Examples of the semi-synthetic fiber include cellulose fiber, and specifically include acetate and triacetate, etc. Examples of the synthetic fiber specifically include polyester, nylon, acryl, and acrylic fiber, etc.

[0050] Next, a spinning method using the spinning machine 1 will be described. In the following description, a method of generating the yarn Y by using the misted air after start-up of the machine or after lot change in the spinning machine 1 is described as one example. The term "lot" herein means a setting of spinning conditions, and the expression "after

lot change" can be rephrased as "after changing the type of yarn to be produced".

[0051] First, using the input keys 104, the operator sets spinning units 2 to be operated (in which the spinning operation is to be performed) (inputs the number of spinning units 2 or unit numbers thereof). Using the input keys 104, the operator inputs the type of raw material of a sliver S. Depending on the type of the raw material of the sliver S, the machine control device 100 controls the amount of the additive to be fed by the feeding device 70.

[0052] When an instruction to start spinning operations of the spinning units 2 is input with the input keys 104, based on an instruction from the machine control device 100, the air distributing device 60 opens the valve 66 and closes the valve 69, thereby supplying air into the first air pipe 62. Based on an instruction from the machine control device 100, the feeding device 70 adjusts opening and closing of the adjusting valve 75, and sprays the additive stored in the storage tank 73 into the first air pipe 62. At this time, based on an instruction from the machine control device 100, the pressure adjusting device 72 adjusts the pressure inside the storage tank 73 to be a constant value (high pressure). The unit controller 10 opens the open/close valves 63a provided to the first distribution pipes 63 provided to the spinning units 2 in which the spinning operations are to be performed. Accordingly, the misted air is supplied to all air-jet spinning devices 7 in which the spinning operations are to be performed.

[0053] The machine control device 100 instructs the unit controller 10 to start the spinning operations. The unit controller 10 causes the spinning units 2 to start the mist spinning operations. Specifically, the unit controller 10 causes the draft devices 6, the yarn storage devices 11, and the winding devices 13 to start operations. Start timings of the mist spinning operations of the spinning units 2 are different amongst the spinning units 2. Thus, in the spinning machine 1, when the machine control device 100 instructs the unit controller 10 to start the spinning operations, spinning operations are sequentially started from a spinning unit 2 in which preparation (e.g., yarn joining operation performed by the yarn joining carrier 3) has been completed. When the mist spinning operation is started, the sliver S is drafted by the corresponding draft device 6, and the drafted fiber bundle F is delivered to the corresponding air-jet spinning device 7. The yarn Y generated by the air-jet spinning device 7 is stored in the corresponding yarn storage device 11, and is wound into a package P by the corresponding winding device 13.

[0054] The control of the adjusting valve 75 performed by the machine control device 100 will be described in detail. When the operating number of air-jet spinning devices 7 that are actually operating (spinning) is smaller than a predetermined number, the machine control device 100 controls the adjusting valve 75 such that the additive is fed by intermittent control. Specifically, the machine control device 100 increases the amount of the additive to be fed as the operating number increases, or reduces the amount of the additive to be fed as the operating number decreases. More specifically, the machine control device 100 changes a duty ratio in the intermittent control depending on the operating number, so as to increase the amount of the additive to be fed in accordance with the operating number until the operating number reaches the predetermined number or more, or reduce the amount of the additive to be fed in accordance with the operating number until the operating number decreases to zero. When the operating number is equal to or greater than the predetermined number, the machine control device 100 controls the adjusting valve 75 such that the additive is continuously fed, and causes a certain amount (the same amount) of the additive to be fed. The predetermined number is, for example, 70% of the total number of the air-jet spinning devices 7 installed. The predetermined number may be determined in consideration of durability of the feeding device 70, for example.

[0055] After instructing the unit controller 10 to start the spinning operations, the machine control device 100 acquires the operating number of the air-jet spinning devices 7. After the air-jet spinning devices 7 have started the spinning operations, the unit controller 10 outputs yarn travelling signals output from the corresponding yarn monitoring devices 8 to the machine control device 100. Based on the yarn travelling signals, the machine control device 100 acquires the operating number of the air-jet spinning devices 7 in the spinning machine 1. While the yarn travelling signals are being output from the yarn monitoring devices 8, the machine control device 100 determines that the air-jet spinning devices 7 of the spinning units 2 are operating.

[0056] When the operating number of the air-jet spinning devices 7 is acquired, the machine control device 100 determines whether the operating number is smaller than the predetermined number. When the machine control device 100 determines that the operating number is smaller than the predetermined number, the machine control device 100 performs intermittent control of the adjusting valve 75. The intermittent control is control of alternately opening and closing the adjusting valve 75. Specifically, by the intermittent control, a period during which the adjusting valve 75 is opened such that the additive is fed into the first air pipe 62 (hereinafter called "ON period") and a period during which the adjusting valve 75 is closed such that the additive is not fed into the first air pipe 62 (hereinafter called "OFF period") are periodically repeated. Thus, the additive is intermittently fed into the first air pipe 62. The machine control device 100 adjusts the ON period and the OFF period in the adjusting valve 75, thereby adjusting (changing) the amount of the additive to be fed into the first air pipe 62.

[0057] When the operating number of the air-jet spinning devices 7 is smaller than the predetermined number, the machine control device 100 changes the duty ratio between the ON period and the OFF period in the intermittent control depending on the operating number, so as to increase or reduce the amount of the additive to be fed depending on the operating number. In the present embodiment, the machine control device 100 linearly increases or reduces the amount

of the additive to be fed depending on the operating number. Specifically, the machine control device 100 sets the amount of the additive to be fed (ON period) on the basis of the following relation:

$$(\text{ON period} / \text{intermittent cycle period}) = (\text{the operating number} / \text{the planned operating number of air-jet spinning devices}).$$

[0058] The intermittent cycle period is a period of one cycle consisting of one ON period and one OFF period. The intermittent cycle period is appropriately set. The planned operating number is the number of air-jet spinning devices 7 in which the mist spinning operations are to be performed (the number of air-jet spinning devices planned to be operated), and is a number that is set by the operator's operation or is automatically set. The maximum planned operating number is the total number of the air-jet spinning devices 7 installed. The machine control device 100 calculates an ON period on the basis of the relation described above, and controls the adjusting valve 75 on the basis of the ON period.

[0059] When a determination is made that the operating number is equal to or greater than the predetermined number, the machine control device 100 controls the adjusting valve 75 such that the additive is continuously fed. The machine control device 100 causes the first air pipe 62 to feed a certain amount of the additive. Specifically, the machine control device 100 sets the amount of the additive to be fed on the basis of the planned operating number of the air-jet spinning devices 7 and the optimum amount of the additive for one air-jet spinning device 7. More specifically, the machine control device 100 controls the adjusting valve 75 such that the additive is fed in the amount of which equals to the product of (the planned operating number of the air-jet spinning devices 7) $\times$ (the optimum amount). The optimum amount is appropriately set depending on the type of sliver S, for example.

[0060] After the operating number reached the predetermined number or more, when the operations of the air-jet spinning devices 7 temporarily stop and accordingly the operating number becomes smaller than the predetermined number, the machine control device 100 continues control of the adjusting valve 75 such that the additive is continuously fed. If yarn breakage, yarn cut, or doffing, for example, has occurred in a spinning unit 2, operation of the corresponding air-jet spinning device 7 is temporarily interrupted. After the operating number reached the predetermined number or more, if a signal is input indicating that yarn breakage, yarn cut, or doffing, for example, has occurred in a spinning unit 2, the machine control device 100 maintains a state in which the adjusting valve 75 is open. In other words, if the operating number becomes smaller than the predetermined number due to such temporary stoppage of operation of an air-jet spinning device 7, the machine control device 100 does not carry out the intermittent control.

[0061] In the spinning machine 1, for example, in order to remove an additive that might be remaining in each air-jet spinning device 7 after the end of the mist spinning operation, dry air may be supplied to the air-jet spinning device 7. When predetermined keys among the input keys 104 are operated, based on an instruction from the machine control device 100, the air distributing device 60 closes the valve 66 and opens the valve 69. The unit controller 10 closes the corresponding open/close valve 63a and opens the corresponding open/close valve 65a. Accordingly, supply of the misted air from the first air pipe 62 to the air-jet spinning device 7 is stopped, and supply of the dry air from the second air pipe 64 to the air-jet spinning device 7 is started. When a predetermined period of time elapses after the start of the supply of the dry air to the air-jet spinning device 7, the unit controller 10 closes the open/close valve 65a. Accordingly, the supply of the dry air from the second air pipe 64 to the air-jet spinning device 7 is stopped. In the spinning method described above, in the spinning machine 1, control of continuously supplying the additive is performed for a longer period of time than the intermittent control.

[0062] As described above, in the spinning machine 1 according to the present embodiment, when the operating number of air-jet spinning devices 7 that are actually operating is smaller than the predetermined number, the machine control device 100 changes the duty ratio in the intermittent control of the adjusting valve 75 depending on the operating number, so as to increase or reduce the amount of the additive to be fed depending on the operating number. When the operating number is equal to or greater than the predetermined number, the machine control device 100 controls the adjusting valve 75 such that a certain amount of the additive is fed.

[0063] As depicted in FIG. 4A, when the operating number of the air-jet spinning devices 7 is smaller than the predetermined number (smaller than 40 in FIG. 4A), the machine control device 100 controls the feeding device 70 such that the amount of the additive to be fed (total sprayed amount) linearly increases. When the operating number reaches the predetermined number or more (40 or more), the machine control device 100 controls the feeding device 70 such that a certain amount of the additive is fed. Accordingly, as depicted in FIG. 4B, in the spinning machine 1, the additive of an amount according to the operating number of the air-jet spinning devices 7 is fed into air, whereby the amounts of the additive to be fed to the respective air-jet spinning devices 7 can be made uniform. Thus, in the spinning machine 1, the additive can be prevented from being excessively fed to the air-jet spinning devices 7 of the spinning units 2. Consequently, in the spinning machine 1, the additive can be stably fed.

[0064] The predetermined number is 40 in one example depicted in FIG. 4A, and a mode has been described as one

example in which a certain amount of the additive is fed when the operating number reaches 40 or more. When the predetermined number is set to 40 or more, as depicted in FIG. 5A, the machine control device 100 controls the feeding device 70 such that the amount of the additive to be fed linearly increases until the operating number reaches the predetermined number or more. In this case, as depicted in FIG. 5B, in the spinning machine 1, the additive of an amount according to the operating number of the air-jet spinning devices 7 is fed into the air, whereby the amounts of the additive to be fed to the respective air-jet spinning devices 7 are made uniform.

[0065] In the spinning machine 1 according to the present embodiment, when the operating number reaches the predetermined number or more, the machine control device 100 controls the adjusting valve 75 such that the additive is continuously fed. In other words, the machine control device 100 keeps the adjusting valve 75 open. Accordingly, in the spinning machine 1, opening and closing of the adjusting valve 75 are not repeated when the operating number reaches the predetermined number or more, and thus, for example, wear of the adjusting valve 75 can be reduced. As a result, the life (usable years) of the adjusting valve 75, and consequently the life of the feeding device 70 can be increased.

[0066] In the spinning machine 1 according to the present embodiment, when an instruction to start spinning operation is input after start-up of the machine or after lot change, the unit controller 10 controls the adjusting valve 75. After start-up of the spinning machine 1 or after lot change, spinning operations of the spinning units 2 are sequentially started. Thus, in order to reduce variations in the volume of the misted air supplied to the air-jet spinning devices 7, it is particularly effective to control the amount to be fed depending on the operating number after start-up of the spinning machine 1 or after lot change.

[0067] In the spinning machine 1 according to the present embodiment, when the operating number is smaller than the predetermined number, the machine control device 100 controls the feeding device 70 such that the amount of the additive to be fed linearly increases or decreases depending on the operating number as depicted in FIG. 4A. By linearly increasing or reducing the amount to be fed in this manner, the intermittent control can be easily performed.

[0068] In the spinning machine 1 according to the present embodiment, the feeding device 70 feeds the additive into the first air pipe 62 by applying pressure to the additive. The pressure adjusting device 72 of the feeding device 70 keeps the pressure inside the storage tank 73 constant. Thus, the control (adjustment) of the pressure can be eliminated, whereby the configuration and the control can be simplified.

[0069] In the spinning machine 1 according to the present embodiment, when the operating number is smaller than the predetermined number, the machine control device 100 sets the amount of the additive to be fed on the basis of the relation: $(\text{ON period} / \text{intermittent cycle period}) = (\text{the operating number} / \text{the planned operating number of air-jet spinning devices})$. When the operating number is equal to or greater than the predetermined number, the machine control device 100 sets the amount of the additive to be fed on the basis of the planned operating number of the air-jet spinning devices 7 and the optimum amount of the additive for one air-jet spinning device 7. By setting the amount of the additive to be fed in this manner, the amounts of the additive to be fed to the respective air-jet spinning devices 7 can be made uniform.

[0070] In the spinning machine 1 according to the present embodiment, only one first air pipe 62 is used to supply the misted air to the air-jet spinning devices 7. In this configuration, the amount of the additive to be fed into one first air pipe 62 only needs to be controlled, and thus the amount to be fed can be accurately and simply controlled.

[0071] In the spinning machine 1 according to the present embodiment, after the operating number reached the predetermined number or more, when operations of the air-jet spinning devices 7 temporarily stop and accordingly the operating number becomes smaller than the predetermined number, the machine control device 100 continues the operation in which a certain amount of the additive is continuously fed. If yarn breakage, yarn cut, or doffing, for example, has occurred in a spinning unit 2, operation of the corresponding air-jet spinning device 7 is temporarily interrupted. Even if the operating number becomes smaller than the predetermined number due to such temporary stoppage, the operation of causing a certain amount of the additive to be continuously fed is continued, whereby a shortage in the amount of the additive to be fed to the air-jet spinning devices 7 of the other spinning units 2 due to this temporary decrease in operating number can be avoided.

[0072] In the spinning machine 1 according to the present embodiment, control of continuously feeding the additive may be performed for a period longer than that of the intermittent control. The intermittent control can become a load on the adjusting valve 75 of the feeding device 70. During a period when the spinning machine 1 is operating, by continuously feeding the additive for a longer period, the load on the adjusting valve 75 of the feeding device 70 can be reduced, and thus the life of the feeding device 70 can be increased.

[0073] Although one embodiment of the present invention has been described above, the present invention is not limited to the embodiment.

[0074] In the embodiment, a mode has been described as one example in which the machine control device 100 linearly increases or reduces the amount of the additive to be fed depending on the operating number when the operating number is smaller than the predetermined number. However, the method of increasing or reducing the amount of the additive to be fed is not limited to this, and the amount may be increased or reduced stepwise, for example.

[0075] In the embodiment, a mode has been described as one example in which the machine control device 100

acquires the operating number of the air-jet spinning devices 7 on the basis of yarn travelling signals output from the yarn monitoring devices 8. However, each spinning unit 2 may additionally include a sensor configured to detect travelling of yarn Y.

[0076] The machine control device 100 may acquire the operating number of the air-jet spinning devices 7 by another method. For example, the spinning machine 1 may include a flow-rate measuring device configured to measure the flow rate of the air flowing through the first air pipe 62. The flow-rate measuring device is provided, for example, upstream of the valve 66 between the air supply pipe 67 and the first air pipe 62. In this case, based on a measurement result of the flow-rate measuring device, the machine control device 100 acquires the operating number of the air-jet spinning devices 7. There is an interrelation between the flow rate of the air flowing through the first air pipe 62 and the operating number of the air-jet spinning devices 7. Thus, the machine control device 100 can acquire the operating number of the air-jet spinning devices 7 from the measurement result of the flow-rate measuring device.

[0077] In the embodiment, a mode has been described as one example in which each first distribution pipe 63 and the corresponding second distribution pipe 65 are connected to the corresponding swirling-airflow generating nozzle via the same shuttle valve. However, each first distribution pipe 63 and the corresponding second distribution pipe 65 may be independently connected to the corresponding air-jet spinning device 7. Specifically, for example, the first distribution pipe 63 may be directly connected to the air-jet spinning device 7 (a swirling-airflow generating nozzle provided in a nozzle block (e.g., the swirling-airflow generating nozzle that opens to the spinning chamber)), and the second distribution pipe 65 may be connected to the air-jet spinning device 7 (a nozzle that is different from the swirling-airflow generating nozzle to which the first distribution pipe 63 is connected) via a check valve. In this configuration, paths through which the misted air and the dry air flow are different, and thus the additive remaining from the mist spinning does not mix into the dry air when dry spinning is performed. Thus, influence of the additive can be prevented during the dry spinning. Furthermore, the configuration of the spinning machine 1 can be simplified. Because the second distribution pipe 65 is connected to the air-jet spinning device 7 via the check valve, the misted air is prevented from flowing into the second distribution pipe 65.

[0078] In the embodiment, a mode has been described as one example in which the pressure adjusting device 72 of the feeding device 70 adjusts the pressure inside the storage tank 73 at a constant value on the basis of an instruction from the machine control device 100. However, the pressure inside the storage tank 73 may be varied.

[0079] In the embodiment, a mode has been described as one example in which the pressure adjusting device 72 is a booster valve or an electric compressor. However, the pressure adjusting device 72 may be an electronic regulator. By this configuration, the pressure adjusting device 72 can steplessly adjust the pressure inside the storage tank 73 by compressing air guided to the storage tank 73, for example, depending on the operating number of the spinning units 2. Specifically, when receiving signals (e.g., yarn travelling signals) relating to the operating number of the spinning units 2 output from the machine control device 100, the pressure adjusting device 72 adjusts the pressure inside the storage tank 73 on the basis of the signals. Accordingly, the misted air of an amount according to the operating number of the spinning units 2 is supplied into the first air pipe 62. The pressure adjusting device 72 may adjust the pressure inside storage tank 73 according to the type of the sliver S (yarn type) and/or the yarn count.

[0080] In the embodiment, a mode has been described as one example in which the misted air is used to generate yarn Y after start-up of the spinning machine 1 or after lot change. In other words, a mode has been described as one example in which the machine control device 100 controls the adjusting valve 75 when an instruction to start spinning operation is input after start-up of the machine or after lot change. However, the machine control device 100 may control the adjusting valve 75 before stoppage of the machine or before lot change (when the operating number of the spinning units 2 decreases). The period before stoppage of the machine or before lot change is a period during which operations of the spinning units 2 are sequentially stopped. Thus, in order to reduce variations in the amount of the misted air supplied to the air-jet spinning devices 7, it is particularly effective to control the amount to be fed depending on the operating number. As described above, in the present embodiment, during a period when the operating number of the spinning units 2 changes (when an instruction to start spinning operations is input after start-up of the machine or after lot change (when the operating number of the spinning units 2 increases), and/or before stoppage of the machine or before lot change (when the operating number of the spinning units 2 decreases)), the machine control device 100 controls the adjusting valve 75 (feeding device).

[0081] In the embodiment, a mode has been described as one example in which the additive is applied to the fiber bundle F by injecting the misted air from the swirling-airflow generating nozzle of each air-jet spinning device 7. However, for example, the additive may be applied to a fiber bundle F (yarn Y) by injecting the misted air from a nozzle formed so as to be open to a yarn path in the hollow guide shaft member of each air-jet spinning device 7. Alternatively, for example, the additive may be applied to a fiber bundle F by supplying the misted air from a supply port provided between the front roller pair 17 and the air-jet spinning device 7.

[0082] In the embodiment, the second air pipe 64 and the second distribution pipes 65 may be omitted. In this case, when performing the dry spinning (in a mode in which the additive is not used), the first air pipe 62 and the first distribution pipes 63 are used to supply the dry air.

[0083] In each spinning unit 2, yarn Y that has been disconnected may be made continuous by reversely delivering the yarn Y from a package P to the corresponding air-jet spinning device 7 and then restarting drafting operation of the corresponding draft device 6.

[0084] Each air-jet spinning device 7 may include a needle that is supported by the corresponding fiber guiding portion and a tip of which is disposed in the corresponding spinning chamber. The needle may be omitted, and a downstream end portion of the fiber guiding portion may be configured to prevent a twist of a fiber bundle F from propagating to the upstream of the air-jet spinning device 7. Instead of the configuration described above, the air-jet spinning device may include a pair of air-jet nozzles configured to twist a fiber bundle F in directions opposite to each other. The spinning machine may be an open-end spinning machine.

[0085] In each spinning unit 2, the corresponding yarn storage device 11 has a function of pulling out the yarn Y from the corresponding air-jet spinning device 7. However, the yarn Y may be pulled out from the air-jet spinning device 7 by a delivery roller and a nip roller. When the yarn Y is pulled out from the air-jet spinning device 7 by a delivery roller and a nip roller, instead of the yarn storage device 11, a slack tube using suction airflow to absorb slack of the yarn Y or a mechanical compensator, for example, may be provided.

[0086] In the spinning machine 1, the respective devices are disposed such that yarn Y supplied from the upper side is wound in the lower side in the height direction. However, the respective devices may be disposed such that yarn supplied from the lower side is wound in the upper side.

[0087] In the spinning machine 1, at least one of the bottom rollers of each draft device 6 and the corresponding traverse guide 23 are driven by power from the second end frame 5 (i.e., driven in common amongst a plurality of spinning units 2). However, the respective devices (e.g., the draft device, the air-jet spinning device, the winding device) of each spinning unit 2 may be driven independently for each spinning unit 2.

[0088] In the travelling direction of yarn Y, the tension sensor 9 may be provided upstream of the yarn monitoring device 8. The unit controller 10 may be provided to each of the spinning units 2. In each spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 may be omitted.

[0089] In FIG. 1, the spinning machine 1 is illustrated to wind a cheese (cylindrical) shaped package P, but may wind a cone-shaped package. In the case of a cone-shaped package, slack of the yarn Y is generated by traversing the yarn Y, but this slack can be absorbed by the yarn storage device 11. The materials and shapes of the respective components are not limited to those described above, and various types of materials and shapes may be used. As long as the misted air can be supplied to the respective spinning units 2, the configurations of the air distributing device 60 and the feeding device 70, for example, are not limited to the configurations thereof in the embodiment described above.

Claims

1. A spinning machine (1) comprising:

a plurality of spinning units (2) each including an air-jet spinning device (7) configured to perform spinning operation of twisting a fiber bundle (F) with air to generate yarn (Y) and a winding device (13) configured to wind the yarn (Y) around a bobbin (B) to form a package (P);

an air pipe (62) configured to allow the air to flow therethrough and connected to upstream sides of a plurality of feeding pipes (63) through which the air is supplied to the respective air-jet spinning devices (7) of the spinning units (2);

a feeding device (70) configured to feed an additive to the air pipe; and

a control device (100) configured to control operation of the feeding device (70), **characterized in that**

when an operating number that is the number of air-jet spinning devices (7) being operating among the air-jet spinning devices (7) is smaller than a predetermined number, the control device (100) controls the feeding device (70) such that the additive is fed by intermittent control, so as to increase the amount of the additive to be fed as the operating number increases or reduce the amount of the additive to be fed as the operating number decreases, and

when the operating number is equal to or greater than the predetermined number, the control device (100) controls the feeding device (70) such that a certain amount of the additive is continuously fed.

2. The spinning machine (1) according to claim 1, wherein the control device (100) linearly increases or reduces the amount of the additive to be fed depending on the operating number when the operating number is smaller than the predetermined number.

3. The spinning machine (1) according to claim 1 or 2, wherein the feeding device (70) feeds the additive into the air pipe (62) by applying a certain pressure to the additive.

4. The spinning machine (1) according to any one of claims 1 to 3, wherein
when an instruction to start the spinning operation is input after start-up of the machine (1) or after lot change, the control device (100) controls the feeding device (70) such that the amount of the additive to be fed increases as the operating number increases, and
in a period before stoppage of the machine (1) or before lot change when the operating number is smaller than the predetermined number, the control device (100) controls the feeding device (70) such that the amount of the additive to be fed decreases as the operating number decreases.
5. The spinning machine (1) according to any one of claims 1 to 4, wherein
when the operating number is smaller than the predetermined number, the control device (100) sets the amount of the additive to be fed based on a relation expressed by (a period when the additive is to be fed / an intermittent cycle period) = (the operating number / a planned operating number that is the number of air-jet spinning devices (7) planned to be operated among the air-jet spinning devices (7)), and
when the operating number is equal to or greater than the predetermined number, the control device (100) sets the amount of the additive to be fed based on the planned operating number of the air-jet spinning devices (7) and an optimum amount of the additive that is an amount optimum for one air-jet spinning device (7).
6. The spinning machine (1) according to any one of claims 1 to 5, wherein
the air pipe (62) is single, and
the air pipe (62) extends along a direction in which the spinning units (2) are aligned.
7. The spinning machine (1) according to any one of claims 1 to 6, wherein the control device (100) acquires the operating number based on a yarn travelling signal output from each spinning unit (2) .
8. The spinning machine (1) according to any one of claims 1 to 6 further comprising a flow-rate measuring device configured to measure a flow rate of the air flowing through the air pipe (62), wherein
the control device (100) acquires the operating number based on a measurement result of the flow-rate measuring device.
9. The spinning machine (1) according to any one of claims 1 to 7, wherein the air containing the additive is supplied only to an air-j et spinning device (7) that is operating among the air-j et spinning devices (7).
10. The spinning machine (1) according to any one of claims 1 to 9, wherein
after the operating number reached the predetermined number or more, when operations of the air-jet spinning devices (7) temporarily stop and the operating number becomes smaller than the predetermined number, the control device (100) continues operation of causing a certain amount of the additive to be continuously fed.
11. The spinning machine (1) according to any one of claims 1 to 10, wherein control of continuously feeding the additive is performed for a period longer than that of the intermittent control.
12. A spinning method performed in a spinning machine (1) including: a plurality of spinning units (2) each including an air-jet spinning device (7) configured to perform spinning operation of twisting a fiber bundle (F) with air to generate yarn (Y) and a winding device (13) configured to wind the yarn (Y) around a bobbin (B) to form a package (P); an air pipe (62) configured to allow the air to flow therethrough and connected to upstream sides of a plurality of feeding pipes (63) through which the air is supplied to the respective air-jet spinning devices (7) of the spinning units (2); and a feeding device (70) configured to feed an additive to the air pipe (62), the spinning method comprising:

when an operating number that is the number of air-jet spinning devices (7) being operating among the air-jet spinning devices (7) is smaller than a predetermined number, controlling the feeding device (70) such that the additive is fed by intermittent control, so as to increase the amount of the additive to be fed as the operating number increases or reduce the amount of the additive to be fed as the operating number decreases; and
when the operating number is equal to or greater than the predetermined number, controlling the feeding device (70) such that a certain amount of the additive is continuously fed.

Fig.1

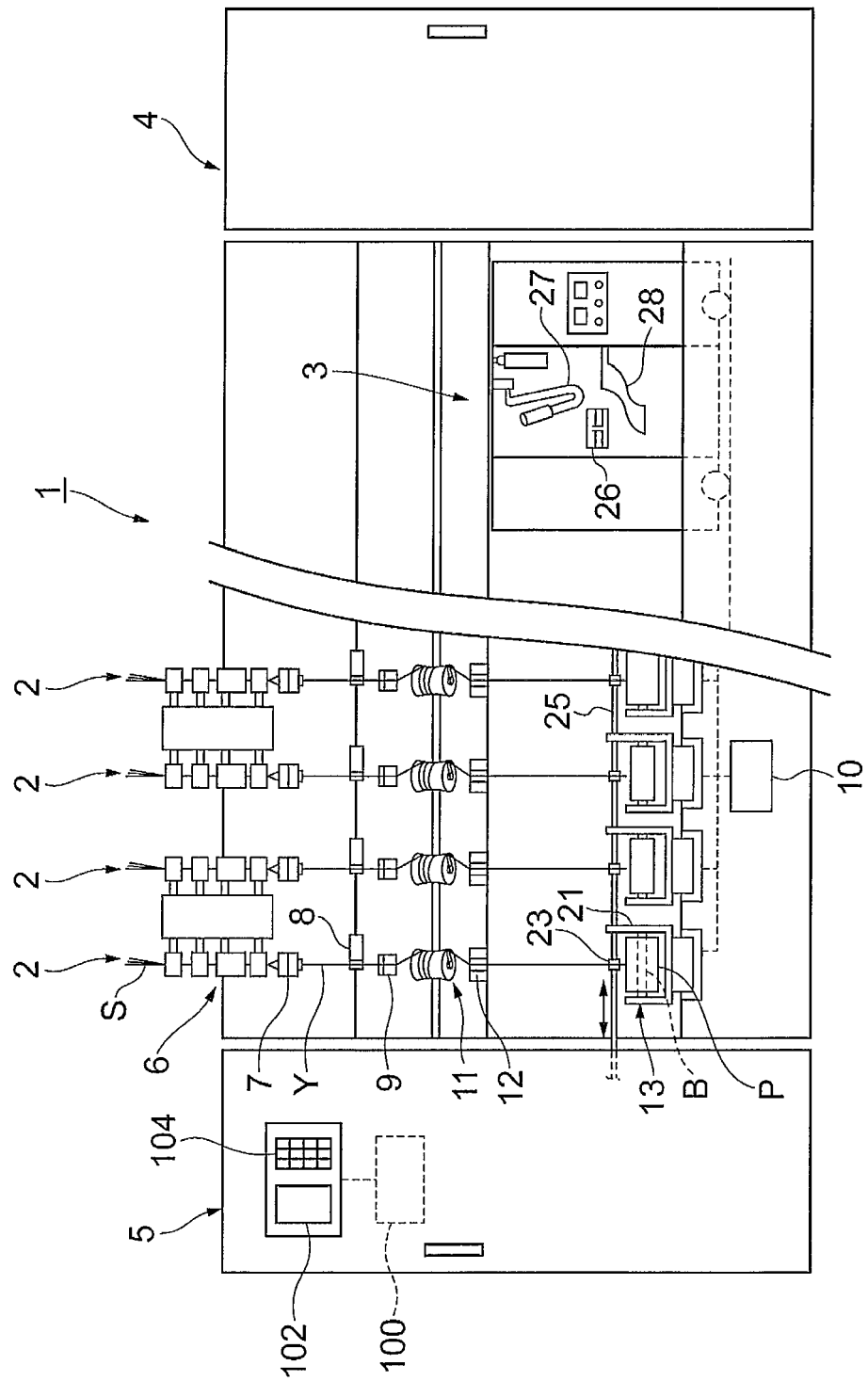
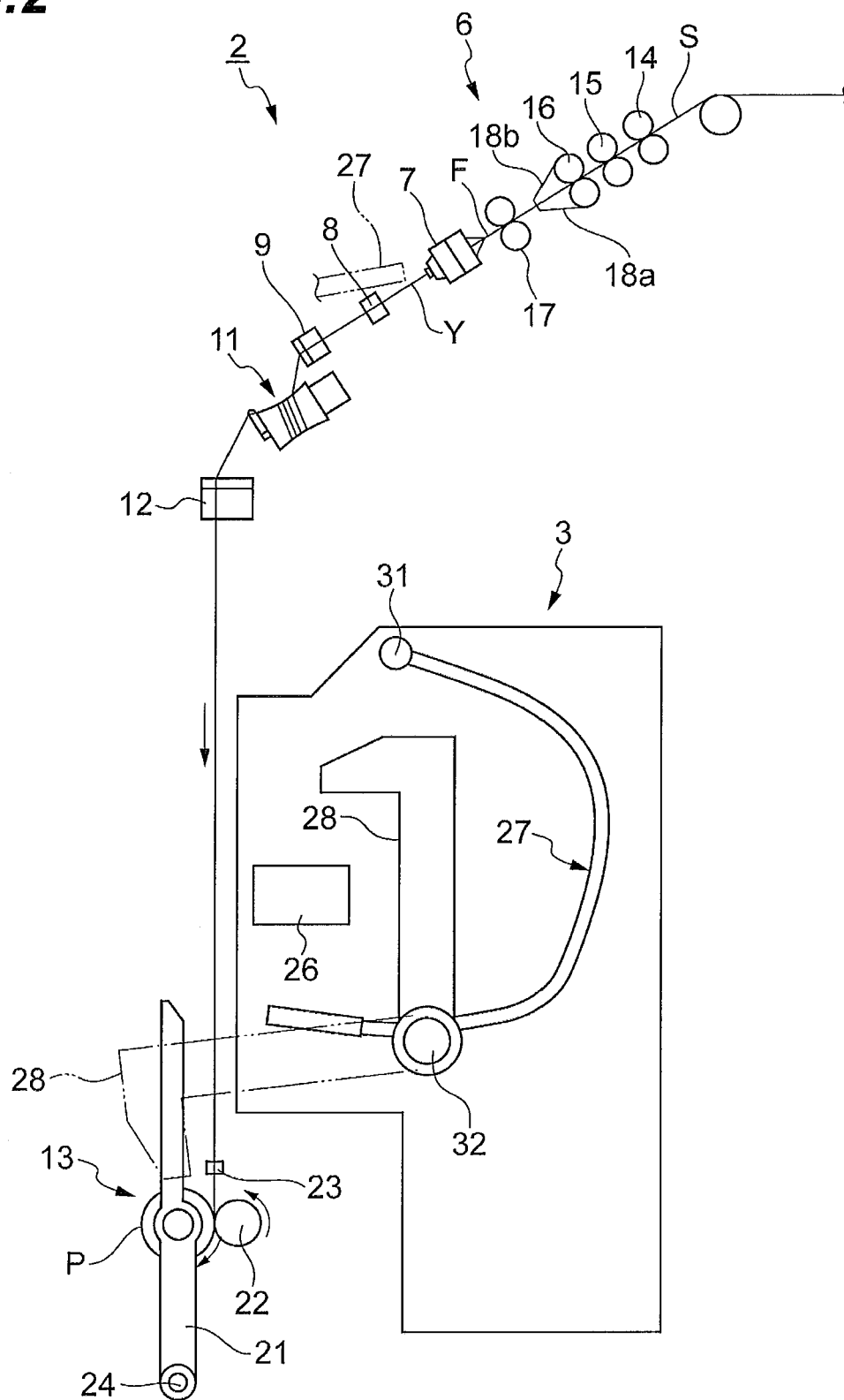


Fig.2



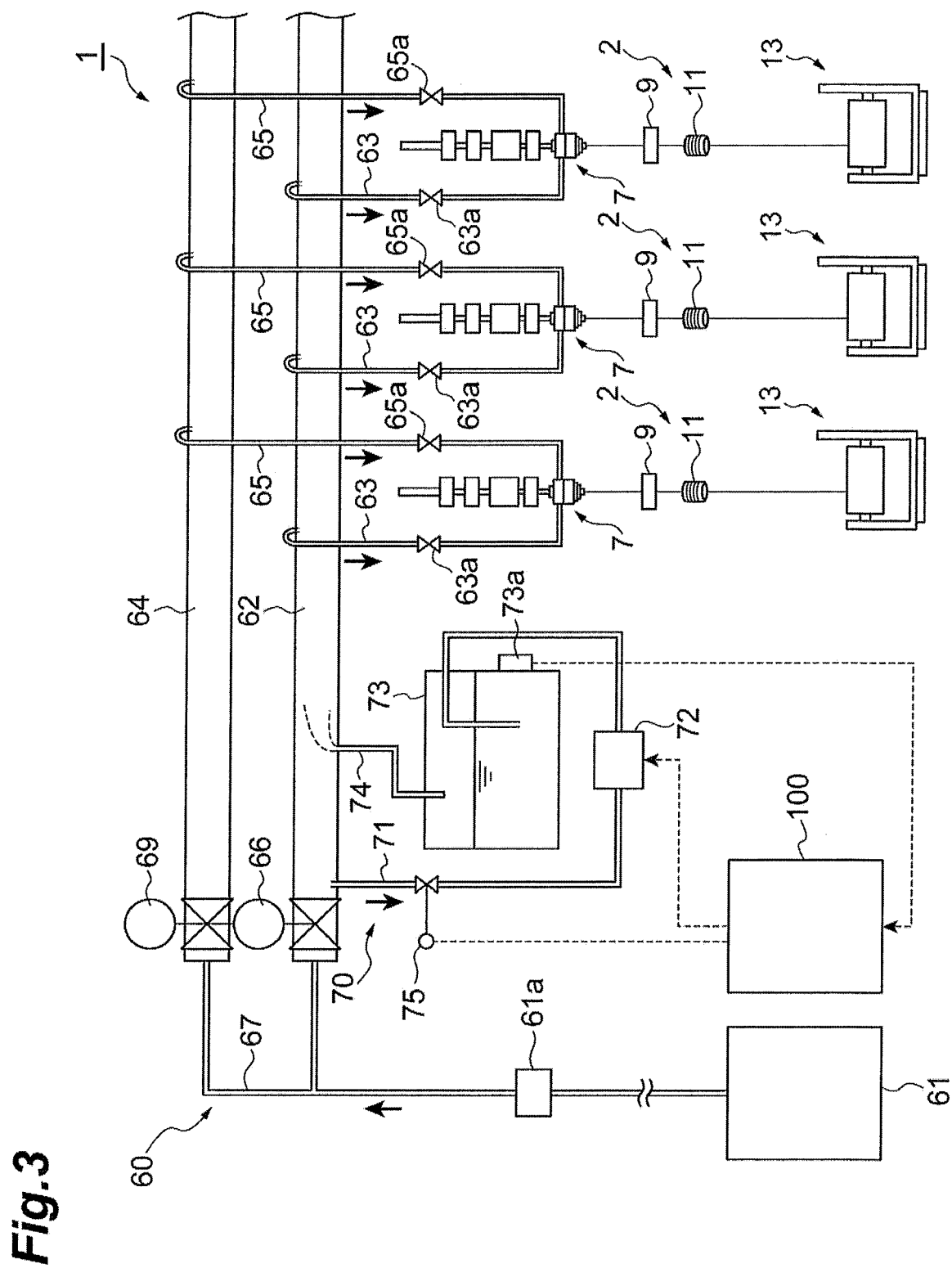


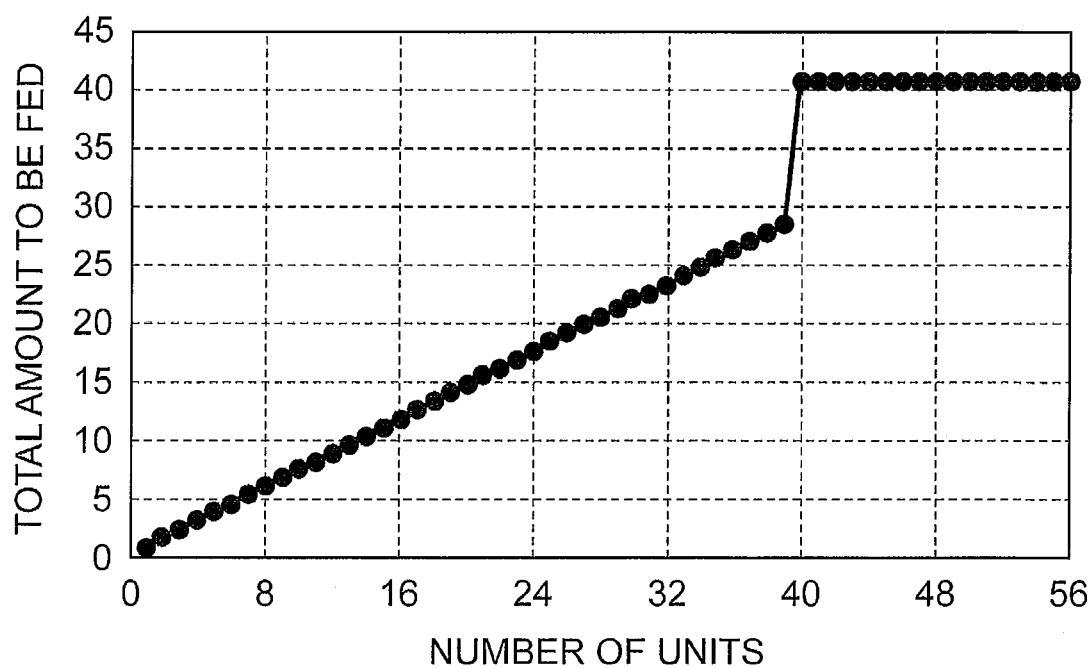
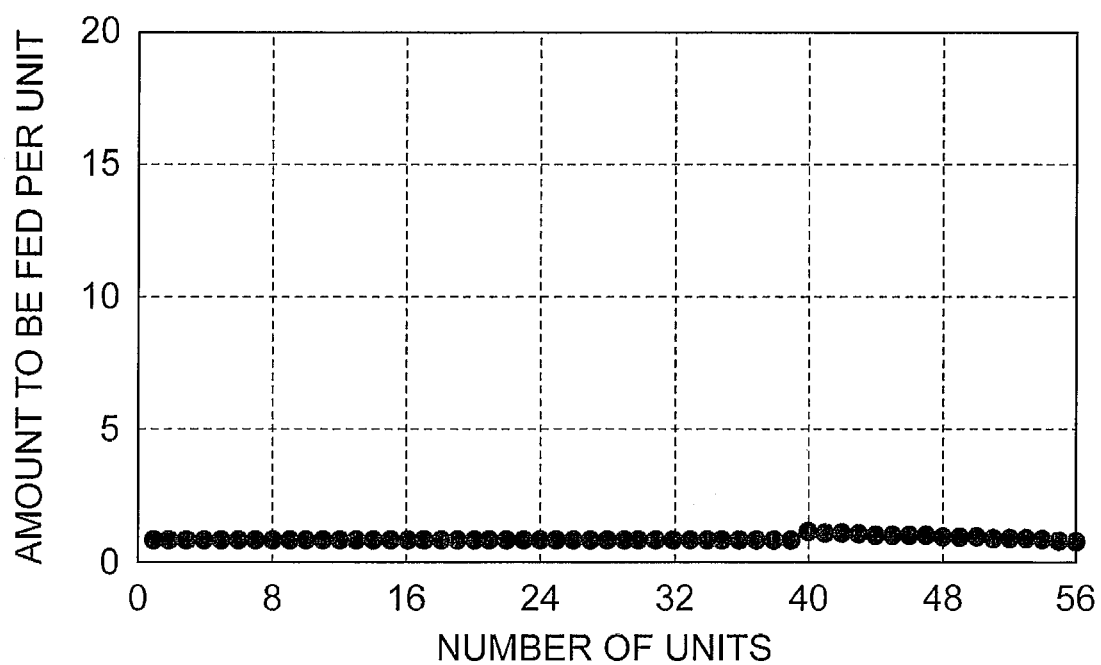
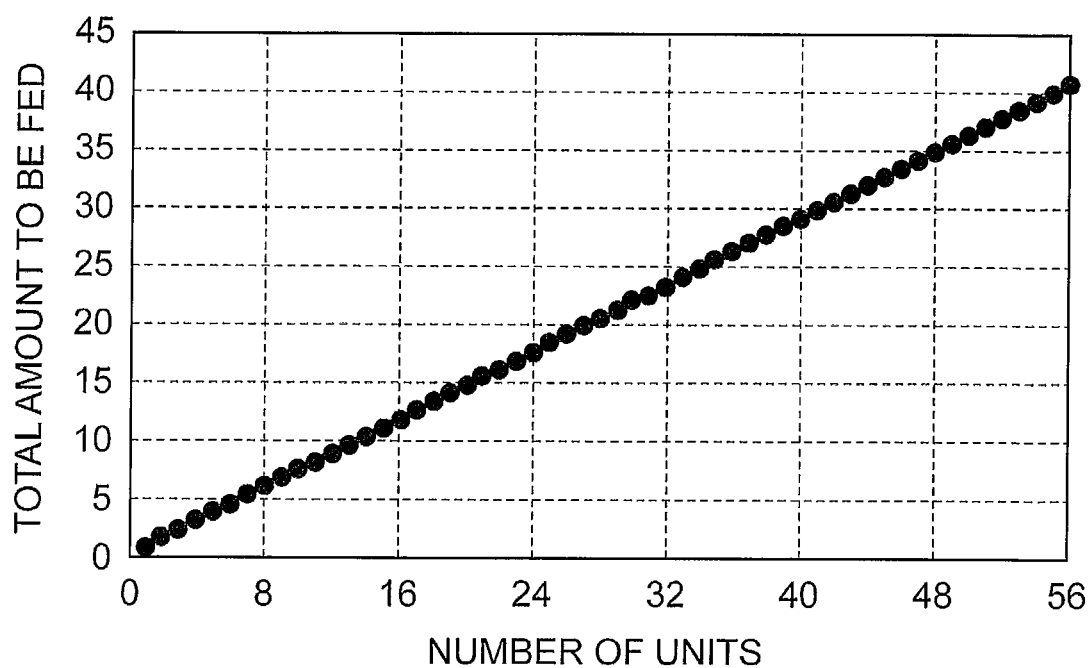
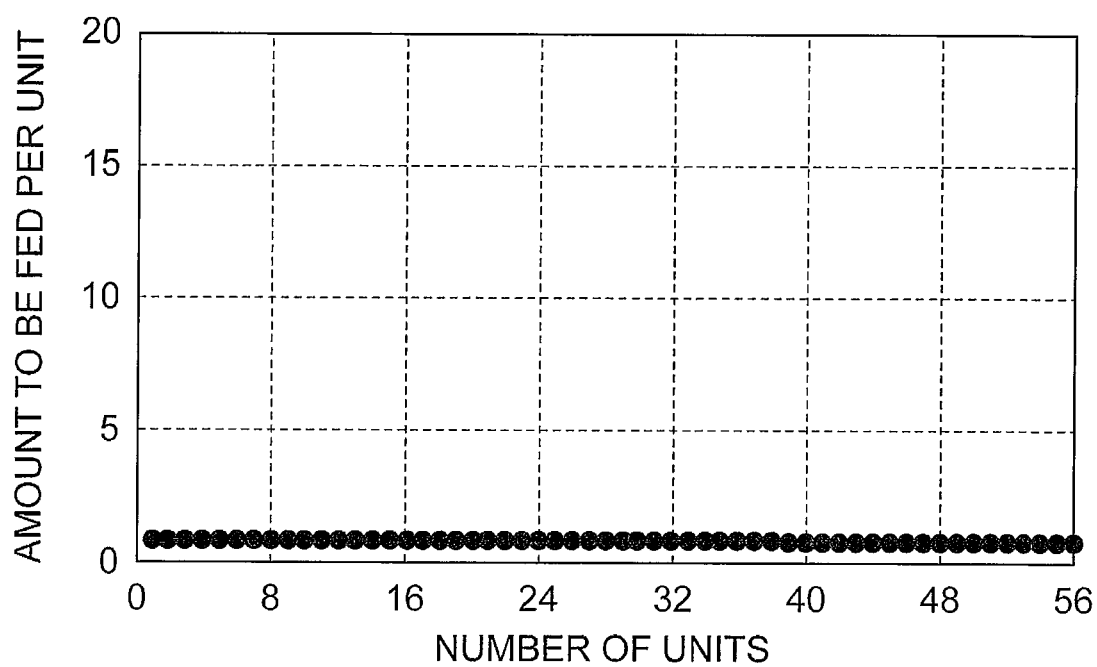
Fig.4A**Fig.4B**

Fig.5A**Fig.5B**



EUROPEAN SEARCH REPORT

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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 2 573 256 A2 (MURATA MACHINERY LTD [JP]) 27 March 2013 (2013-03-27) * paragraph [0050] - paragraph [0052] * * paragraph [0065] - paragraph [0073] * * figures 1,7,9 *	1-4,6-9,12	INV. D01H1/115 D01H13/30
A	CH 707 560 A1 (RIETER AG MASCHF [CH]) 15 August 2014 (2014-08-15) * paragraph [0010] * * paragraph [0021] - paragraph [0022] * * paragraph [0028] - paragraph [0029] * * paragraph [0031] - paragraph [0032] * * figure 3 * * paragraph [0038] *	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 16 March 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			

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EPO FORM 1503 03/82 (P04C01)

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

EP 17 19 9812

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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
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16-03-2018

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2573256 A2	27-03-2013	CN 103014938 A	03-04-2013
		EP 2573256 A2	27-03-2013
		JP 2013067893 A	18-04-2013
CH 707560 A1	15-08-2014	NONE	

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012097391 A [0002]