



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.04.2018 Bulletin 2018/15

(51) Int Cl.:
D01H 1/20 (2006.01) B65H 67/06 (2006.01)

(21) Application number: **16802946.0**

(86) International application number:
PCT/JP2016/062638

(22) Date of filing: **21.04.2016**

(87) International publication number:
WO 2016/194509 (08.12.2016 Gazette 2016/49)

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

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(30) Priority: **05.06.2015 JP 2015115202**

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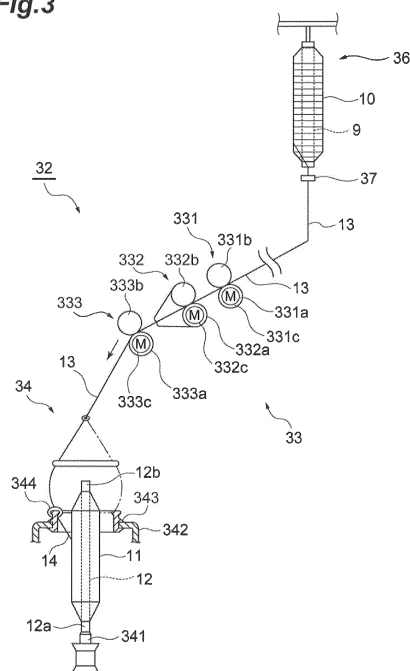
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(54) **SPINNING MACHINE, YARN WINDING SYSTEM, AND METHOD FOR MANUFACTURING YARN SUPPLY BOBBIN**

(57) The spinning frame (3) includes: a state acquisition unit (310) configured to acquire a lack of material in which a roved yarn bobbin (10) around which roved yarn (13) is wound has run out of the roved yarn; a plurality of roller pairs (331, 332, 333) configured to draft the roved yarn, the roller pairs respectively having bottom rollers (331a, 332a, 333a) and top rollers (331b, 332b, 333b); a plurality of drive units (331c, 332c, 333c) configured to drive the respective bottom rollers in the corresponding roller pairs; and a control unit (312) configured to control at least one of the drive units when the state acquisition unit acquires a lack of material such that the yarn after spinning becomes thicker before a lack of material is acquired, when the state acquisition unit acquires a lack of material.

Fig.3



Description

Technical Field

[0001] The present invention relates to a spinning frame, a yarn winding system, and a method for manufacturing a yarn supply bobbin.

Background Art

[0002] Patent Literature 1 describes a yarn winding system (spinning winder) which includes: a spinning frame including a plurality of spinning units each configured to generate yarn from a yarn raw material supplied from a previous step machine including a plurality of previous step units and wind the yarn around a bobbin to form a yarn supply bobbin; an automatic winder including a plurality of winding units each configured to unwind yarn from the yarn supply bobbin to wind the unwound yarn in a package; and a bobbin transfer device configured to place the yarn supply bobbin on a tray and supply the yarn supply bobbin from the spinning frame to each of the winding units.

[0003] The bobbin transfer device is provided with a yarn end finding device that performs a yarn end finding process so that a yarn end of the yarn supply bobbin generated in the spinning frame is easily caught in the automatic winder. The yarn end finding process is a process of unwinding yarn from the surface of a yarn supply bobbin by allowing a suction flow to act on the filled bobbin, and inserting the unwound yarn end into the inside of a tubular bobbin. Such a yarn end finding process is performed whereby the yarn end of a yarn supply bobbin can be easily caught in the automatic winder.

Citation List

Patent Literature

[0004] [Patent Literature 1] Japanese Examined Patent Publication No. 2011-20836

Summary of Invention

Technical Problem

[0005] However, yarn end finding is not always successful in the yarn end finding device. In particular, in a partial yarn supply bobbin having a winding end formed by a lack of material, which is a state in which yarn of a roved yarn bobbin runs out, the success rate of finding the yarn end of the yarn supply bobbin that is so thin to slip out tends to be low.

[0006] An object of the present invention is then to provide a spinning frame configured to form a yarn supply bobbin with an improved success rate of the yarn end finding process, a yarn winding system, and a method for manufacturing a yarn supply bobbin.

Solution to Problem

[0007] A spinning frame according to one aspect of the present invention is a spinning frame configured to wind yarn spun from roved yarn supplied from a previous step around a bobbin to form a yarn supply bobbin. The spinning frame includes: a state acquisition unit configured to acquire a first state in which a roved yarn bobbin around which the roved yarn is wound has run out of the roved yarn and/or a second state corresponding to a predetermined timing before finishing winding the yarn for performing doffing of the yarn supply bobbin around which the yarn is being wound; a plurality of roller pairs configured to draft the roved yarn; a plurality of drive units configured to drive at least one roller of the roller pair in each of the roller pairs; and a control unit configured to control at least one of the drive units such that the yarn after spinning becomes thick, when the state acquisition unit acquires the first state being reached or the second state being reached.

[0008] In the spinning frame, when a first state (a lack of material) being reached or a second state being reached is acquired, the drive unit is controlled such that yarn after spinning becomes thicker than before the first state being reached or the second state being reached is acquired. More specifically, when the first state being reached or the second state being reached is acquired, the roved yarn positioned upstream from a plurality of roller pairs is drafted to become roved yarn thicker than before the first state being reached or the second state being reached is acquired (hereinafter referred to as "thick roved yarn"). Thus, the winding end of the yarn supply bobbin is formed with yarn formed by twisting thick roved yarn. That is, at the winding end of the yarn supply bobbin, yarn thicker than before the first state being reached or the second state being reached is acquired (hereinafter referred to as "thick yarn portion") is formed. Since such a winding end of the yarn supply bobbin is formed with yarn thicker than when such control is not performed, the success rate of the yarn end finding process in the yarn end finding device can be improved.

[0009] In an embodiment, the state acquisition unit may acquire the first state being reached, based on detection of presence or absence of the roved yarn in a path of the roved yarn from a roved yarn supply unit supporting the roved yarn bobbin to the roller pairs.

[0010] In the spinning frame, the first state can be acquired with a simple configuration.

[0011] In an embodiment, the state acquisition unit may acquire the second state being reached, based on a length of the yarn wound around the yarn supply bobbin.

[0012] In the spinning frame, the second state can be acquired with a simple method.

[0013] In an embodiment, when the first state being reached or the second state being reached is acquired, the control unit may control at least one of the drive units such that feeding speed of the roved yarn fed from a roller pair disposed on a most upstream side is increased.

[0014] In the spinning frame, the thickness of yarn spun after the first state being reached or the second state being reached is acquired can be increased with simple control, compared with before the first state being reached or the second state being reached is acquired.

[0015] In an embodiment, the spinning frame may further include an output unit configured to output information for calculating the length of a thick yarn portion, which is the yarn spun after the first state being reached or the second state being reached is acquired, to an automatic winder to be supplied with the yarn supply bobbin.

[0016] In the spinning frame, since the length of a thick yarn portion, which is yarn spun after the first state being reached or the second state being reached is acquired, can be calculated in the automatic winder, unnecessary cutting of yarn of the yarn supply bobbin can be suppressed in the splicing process. In addition, since the thick yarn portion can be cut reliably in the splicing process, the quality of the splicing portion can be improved.

[0017] A yarn winding system according to one aspect of the present invention includes: the spinning frame described above; an automatic winder configured to unwind the yarn from the yarn supply bobbin to wind the unwound yarn in a package; and a bobbin transfer device configured to supply the yarn supply bobbin from the spinning frame to the automatic winder. The bobbin transfer device includes a yarn end finding process unit configured to find a yarn end of the yarn supply bobbin.

[0018] In the spinning frame of the yarn winding system, when the first state being reached or the second state being reached is acquired, the drive unit is controlled such that yarn after spinning becomes thicker than before the first state being reached or the second state being reached is acquired. More specifically, when the first state being reached or the second state being reached is acquired, roved yarn positioned upstream from a plurality of roller pairs is drafted to become thick roved yarn. Thus, the winding end of the yarn supply bobbin is formed with yarn formed by twisting thick roved yarn. That is, at the winding end of the yarn supply bobbin, a thick yarn portion is formed. Such a winding end of the yarn supply bobbin is formed with yarn thicker than when such control is not performed. As a result, in the bobbin transfer device of the yarn winding system, the success rate of the yarn end finding process in the yarn end finding device can be improved.

[0019] In an embodiment, the automatic winder may further include: an acquisition unit configured to acquire information for calculating the length of a thick yarn portion, which is yarn spun after the first state being reached or the second state being reached is acquired; and a splicing device configured to cut the thick yarn portion in the yarn supply bobbin based on the information acquired in the acquisition unit and splice together a yarn end of the cut yarn on the yarn supply bobbin side and a yarn end of yarn on the package side.

[0020] In the yarn winding system, the automatic winder that has acquired information for calculating the length

of a thick yarn portion fed from the spinning frame can calculate the length of the thick yarn portion, which is yarn spun after the first state being reached or the second state being reached is acquired. Thus, in the splicing process, unnecessary cutting of yarn of the yarn supply bobbin can be suppressed. In addition, since the thick yarn portion can be cut reliably in the splicing process, the quality of the splicing portion can be improved.

[0021] A method for manufacturing a yarn supply bobbin according to one aspect of the present invention is a method for manufacturing a yarn supply bobbin using a spinning frame including a plurality of roller pairs each configured to draft roved yarn and a plurality of drive units each configured to drive at least one roller of the roller pair in each of the roller pairs. The method includes controlling at least one of the drive units such that the yarn after spinning becomes thick, when a first state in which a roved yarn bobbin around which the roved yarn is wound has run out of the roved yarn is acquired and/or a second state corresponding to a predetermined timing before finishing winding yarn for performing doffing of the yarn supply bobbin around which the yarn is being wound is acquired.

[0022] In the method for manufacturing a yarn supply bobbin, when the first state being reached or the second state being reached is acquired, the drive unit is controlled such that yarn after spinning becomes thicker than before the first state being reached or the second state being reached is acquired. More specifically, when the first state being reached or the second state being reached is acquired, the roved yarn positioned upstream from a plurality of roller pairs is drafted to become thick roved yarn. Thus, the winding end of the yarn supply bobbin is formed with yarn formed by twisting thick roved yarn. That is, at the winding end of the yarn supply bobbin, a thick yarn portion is formed. Since such a winding end of the yarn supply bobbin is formed with yarn thicker than when such control is not performed, the success rate of the yarn end finding process in the yarn end finding device can be improved, in this method for manufacturing a yarn supply bobbin.

Advantageous Effects of Invention

[0023] According to one aspect of the present invention, a yarn supply bobbin with an improved success rate of the yarn end finding process can be formed.

Brief Description of Drawings

[0024]

FIG. 1 is a front view of a yarn winding system according to one embodiment;

FIG. 2 is a perspective view of trays, empty bobbins, and a yarn supply bobbin that are conveyed in the yarn winding system in FIG. 1;

FIG. 3 is a side view of a spinning unit of the yarn

winding system in FIG. 1;
 FIG. 4 is a side view of a winder unit of the yarn winding system in FIG. 1; and
 FIG. 5 is a functional block diagram of the yarn winding system in FIG. 1.

Description of Embodiments

[0025] One embodiment will be described in detail below with reference to the drawings. In the drawings, like or equivalent elements are designated by like numerals, and duplicate description is omitted.

[0026] As depicted in FIG. 1, a yarn winding system 1 includes a roving frame 2, a spinning frame 3, an automatic winder 4, and a bobbin transfer device 5. The roving frame 2 generates roved yarn 13 (see FIG. 3) from a sliver and winds the roved yarn 13 onto a bobbin 9 (see FIG. 3) to form a roved yarn bobbin 10 (see FIG. 3). As depicted in FIG. 3, the spinning frame 3 generates yarn 14 from the roved yarn 13, and winds the yarn 14 to form a yarn supply bobbin 11. As depicted in FIG. 4, the automatic winder 4 winds the yarn 14 from the yarn supply bobbin 11 to form a package 15. As depicted in FIG. 1, the bobbin transfer device 5 transfers the yarn supply bobbin 11 from the spinning frame 3 to the automatic winder 4, and transfers an empty bobbin 12 (bobbin around which yarn is not wound) from the automatic winder 4 to the spinning frame 3. The bobbin transfer device 5 is provided with a bobbin preparation device and a residual yarn processing device, for example. The bobbin preparation device performs preliminary preparation for the automatic winder 4 to process the yarn of the yarn supply bobbin 11. When yarn remains on the bobbin 12 that has been discharged from the yarn supply bobbin 11, the residual yarn processing device removes the yarn to form an empty bobbin 12. For this purpose, the bobbin transfer device 5 has a complicated transfer path having many curves.

[0027] The yarn supply bobbin 11 and the empty bobbin 12 are transferred in a manner being set on respective trays 6. As depicted in FIG. 2, each of the trays 6 has a disk-like base portion 61, a pin 62 protruding upward from the base portion 61, and a radio frequency (RF) tag 63 embedded in the base portion 61. The pin 62 is inserted into the bottom portion 12a of each of the bobbins 12, whereby the yarn supply bobbin 11 and the empty bobbin 12 are set on the respective trays 6 with the top portions 12b of the bobbins 12 facing upward. The RF tag 63 stores therein information on the yarn supply bobbin 11 set on the tray 6. In the yarn winding system 1, the status of the yarn supply bobbin 11 set on the tray 6 is managed by a radio frequency identification (RFID: individual identification using radio waves) technology.

[0028] As depicted in FIG. 1, the roving frame 2 includes a control device 21 configured to control operation of the roving frame 2 and a plurality of roving units 22 each configured to form a roved yarn bobbin 10. The control device 21 includes a display unit 21a such as a

display and an operation unit 21b such as input keys. The display unit 21a displays, for example, an operating status of each of the roving units 22. The operation unit 21b accepts, for example, the settings of operating conditions of each roving unit 22 from the operator.

[0029] The spinning frame 3 includes a control device 31 configured to control operation of the spinning frame 3 and a plurality of spinning units 32 each configured to form a yarn supply bobbin 11. The control device 31 includes a display unit 31a such as a display and an operation unit 31b such as input keys. The display unit 31a displays, for example, an operating status of each of the spinning units 32. The operation unit 31b accepts, for example, the settings of operating conditions of each of the spinning units 32 from the operator.

[0030] As depicted in FIG. 3, the spinning unit 32 includes a roved yarn supply unit 36, a roved yarn detecting unit (state acquisition unit) 37, a drafting device (a plurality of roller pairs) 33, and a twisting device 34.

[0031] The roved yarn supply unit 36 supports a roved yarn bobbin 10 having roved yarn 13 wound on a bobbin 9. The roved yarn detecting unit 37 detects the presence or absence of roved yarn 13 in the path of roved yarn 13 from the roved yarn supply unit 36 to the drafting device 33. The roved yarn detecting unit 37 sends the detection information as to the presence or absence of roved yarn 13 to the control device 31 (see FIG. 5). An example of the roved yarn detecting unit 37 is a photoelectric sensor.

[0032] The drafting device 33 includes a back roller pair (roller pair) 331, a middle roller pair (roller pair) 332, and a front roller pair (roller pair) 333. In the drafting device 33, the back roller pair 331, the middle roller pair 332, and the front roller pair 333 are rotated at a predetermined speed ratio, whereby roved yarn 13 that has been unwound from the roved yarn bobbin 10 is drafted.

[0033] The back roller pair 331 includes a bottom roller 331a and a top roller 331b, which are disposed to be opposed to each other with the travel path of yarn 13 interposed therebetween. A first drive motor (drive unit) 331c is connected to the bottom roller 331a through a not-illustrated output shaft.

[0034] The middle roller pair 332 includes a bottom roller 332a and a top roller 332b, which are disposed to be opposed to each other with the travel path of roved yarn 13 interposed therebetween. Around the bottom roller 332a and the top roller 332b, apron belts are each wound. A second drive motor (drive unit) 332c is connected to the bottom roller 332a through a not-illustrated output shaft.

[0035] The front roller pair 333 includes a bottom roller 333a and a top roller 333b, which are disposed to be opposed to each other with the travel path of roved yarn 13 interposed therebetween. A third drive motor (drive unit) 333c is connected to the bottom roller 333a through a not-illustrated output shaft.

[0036] An example of the first drive motor 331c, the second drive motor 332c, and the third drive motor 333c is a servo motor. The first drive motor 331c, the second

drive motor 332c, and the third drive motor 333c each have a not-illustrated rotary encoder and independently controlled by the control device 31 through a servo motor drive circuit and a servo driver.

[0037] As depicted in FIG. 5, the control device 31 includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM). As depicted in FIG. 5, the control device 31 includes an output unit 311 and a drive control unit (control unit) 312 as conceptual parts that execute a variety of control processing in the spinning frame 3. Such a conceptual part can be configured as software, for example, by loading a program stored in the ROM onto the RAM for execution by the CPU. The control device 31 may be configured as hardware formed of electronic circuits or the like.

[0038] A state acquisition unit 310 acquires a lack of material (first state), based on detection of the presence or absence of roved yarn 13 in the path of roved yarn 13 from the roved yarn supply unit 36 supporting the roved yarn bobbin 10 to the drafting device 33. In the present embodiment, the state acquisition unit 310 determines that the material has run out when acquiring information that roved yarn 13 fails to be detected from the roved yarn detecting unit 37.

[0039] When the state acquisition unit 310 acquires a lack of material, a drive control unit 312 controls at least one of the first drive motor 331c, the second drive motor 332c, and the third drive motor 333c such that the roved yarn 13 after drafting becomes thicker than before a lack of material is acquired. In the present embodiment, when the state acquisition unit 310 acquires a lack of material, the control device 31 controls the first drive motor 331c such that the feeding speed of roved yarn 13 fed from the back roller pair 331 disposed on the most upstream side in the drafting device 33 becomes higher than before a lack of material is acquired.

[0040] The output unit 311 outputs information for calculating the length of a thick yarn portion, which is yarn 14 formed from roved yarn 13 drafted after a lack of material is acquired, to the automatic winder 4 to be supplied with the yarn supply bobbin 11. The information for calculating the length of a thick yarn portion includes various draft conditions in the drafting device 33, the yarn kind, the winding condition, and the timing when the draft condition in the drafting device 33 is changed after the state acquisition unit 310 acquires a lack of material. Alternatively, the length of the thick yarn portion formed in the spinning frame 3 may be calculated or measured, and the result may be output to the automatic winder 4 to be supplied with the yarn supply bobbin 11. These pieces of information are stored as setting values, for example, in the ROM in the control device 31 or a not-illustrated storage unit.

[0041] As depicted in FIG. 3, the twisting device 34 includes a spindle shaft 341, a ring rail 342, a ring 343, and a traveller 344. The spindle shaft 341 holds the bottom portion 12a of a bobbin 12 with the top portion 12b

of the bobbin 12 facing upward, and rotates the bobbin 12. The ring rail 342 is movable in the axial direction of the bobbin 12. The ring 343 is fixed to the ring rail 342. The traveller 344 is supported by the ring 343 and is movable along the ring 343.

[0042] In the twisting device 34, roved yarn 13 that has been drafted by the drafting device 33 is inserted into a space between the ring 343 and the traveller 344, and an end portion of the roved yarn 13 is fixed to the bobbin 12. In this state, when the spindle shaft 341 rotates the bobbin 12, the traveller 344 moves along the ring 343 in a manner being pulled by the roved yarn 13. At this time, the ring rail 342 gradually moves from the bottom portion 12a side to the top portion 12b side while reciprocating within a predetermined range along the axial direction of the bobbin 12. In the twisting device 34, rotation of the traveller 344 lags behind rotation of the bobbin 12, whereby the roved yarn 13 is twisted to form yarn 14, and the yarn 14 is wound by the bobbin 12 to form a yarn supply bobbin 11.

[0043] The spinning frame 3 including the spinning units 32 each configured as described above is of what is called a simultaneous doffing type as depicted in FIG. 1. Specifically, the spinning frame 3 stocks a plurality of empty bobbins 12 transferred from the automatic winder 4 by the bobbin transfer device 5, simultaneously sets the empty bobbins 12 on the respective spinning units 32, and simultaneously starts yarn winding. When winding of yarn has been completed in the respective spinning units 32 and yarn supply bobbins 11 have been formed, the spinning frame 3 simultaneously doffs all of the yarn supply bobbins 11. Subsequently, the spinning frame 3 pulls empty bobbins 12 that have been already stocked out of the corresponding trays 6 and simultaneously sets the empty bobbins on the respective spinning units 32 again and, instead, simultaneously sets the doffed yarn supply bobbins 11 on the trays 6.

[0044] The automatic winder 4 includes a control device 41 configured to control operation of the automatic winder 4 and a plurality of winder units 42 each configured to form a package 15. The control device 41 includes a display unit 41a such as a display and an operation unit 41b such as input keys. The display unit 41a displays, for example, an operating status of each of the winder units 42. The operation unit 41b accepts, for example, the settings of operating conditions of each of the winder unit 42 from the operator. The control device 41 also controls operation of the bobbin transfer device 5.

[0045] The control device 41 includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM). As depicted in FIG. 5, the control device 41 includes an acquisition unit 411 as a conceptual part that executes various control processing in the automatic winder 4. Such a conceptual part is configured as software, for example, by loading a program stored in the ROM onto the RAM for execution by the CPU. The control device 41 may be configured as hardware formed of electronic circuits or the like.

[0046] The acquisition unit 411 is a part that acquires information for calculating the length of a thick yarn portion, which is yarn 14 formed from roved yarn 13 drafted after a lack of material is acquired. In the present embodiment, the acquisition unit 411 acquires information transmitted from the control device 31 in the spinning frame 3 through a wired or wireless network.

[0047] Examples of the information acquired by the acquisition unit 411 include, for example, various draft conditions in the drafting device 33, the yarn kind, the winding condition, and the timing when the draft condition in the drafting device 33 is changed after a lack of material is acquired by the state acquisition unit 310. In the acquisition unit 411, the length of a thick yarn portion, which is yarn 14 formed of roved yarn 13 drafted after a lack of material is acquired, based on the acquired information as described above. The acquisition unit 411 sends the calculated length of the thick yarn portion to the unit controlling unit 52 in the winder unit 42.

[0048] As depicted in FIG. 4 and FIG. 5, the winder unit 42 includes a winding device 43, a tension applying device 44, a yarn monitoring device 45, an upper yarn catching device 46, a lower yarn catching device 47, a splicing device 48, and a unit controlling unit 52.

[0049] The winding device 43 includes a cradle 43a and a winding drum 43b. The cradle 43a supports a package 15. The winding drum 43b rotates the package 15 while traversing the yarn 14. Thus, the yarn 14 is wound from a yarn supply bobbin 11 set at a predetermined position to form the package 15. The tension applying device 44 applies a predetermined tension to the yarn 14 that is travelling from the yarn supply bobbin 11 to the package 15.

[0050] The yarn monitoring device 45 monitors the travelling yarn 14 to detect a yarn defect (thickness abnormality of yarn 14, mixing of foreign matter into yarn 14, etc.). When a yarn defect has been detected, the yarn 14 is cut by a cutter separately provided. When the yarn 14 has been cut, the upper yarn catching device 46 catches a yarn end of the yarn 14 on the package 15 side, and guides the yarn end to the splicing device 48. When the yarn 14 has been cut, the lower yarn catching device 47 catches a yarn end of the yarn 14 on the yarn supply bobbin 11 side, and guides the yarn end to the splicing device 48. The splicing device 48 splices the yarn ends that have been guided by the upper yarn catching device 46 and the lower yarn catching device 47 to each other.

[0051] The unit controlling unit 52 controls the operation of the winding device 43, the tension applying device 44, the yarn monitoring device 45, the upper yarn catching device 46, the lower yarn catching device 47, the splicing device 48, and others in the winder unit 42. For example, the unit controlling unit 52 controls the splicing device 48 such that a thick yarn portion in the yarn supply bobbin 11 is cut based on the information acquired in the acquisition unit 411 and the yarn end of the cut yarn 14 on the yarn supply bobbin 11 side is spliced to a yarn end of yarn 14 on the package 15 side.

[0052] The bobbin transfer device 5 supplies a yarn supply bobbin 11 from the spinning frame 3 to the automatic winder 4. As depicted in FIG. 1, the bobbin transfer device 5 includes an RF writer 51 and a yarn end finding device (yarn end finding process unit) 53.

[0053] When a yarn supply bobbin 11 is transferred from the spinning frame 3 to the automatic winder 4, the RF writer 51 writes information on the yarn supply bobbin 11 on the RF tag 63 of the tray 6 on which the yarn supply bobbin 11 is set. The information on the yarn supply bobbin 11 includes unit identification information for identifying a spinning unit 32 that has formed the yarn supply bobbin 11 and doffing information for identifying timing of simultaneous doffing. The RF writer 51 may be provided to an exit of the spinning frame 3 in the transfer direction of the yarn supply bobbin 11. Alternatively, the RF writer 51 may be provided to every spinning unit 32.

[0054] When the yarn supply bobbin 11 has been set on the winder unit 42 of the automatic winder 4, the information written on the RF tag 63 by the RF writer 51 is read by an RF reader 49 provided to each of the winder units 42, and is transmitted to the control device 41 of the automatic winder 4. Based on this information, the control device 41 can identify the spinning unit 32 that has formed the yarn supply bobbin 11 and the timing of simultaneous doffing for the yarn supply bobbin 11 set on the winder unit 42.

[0055] The yarn end finding device 53 is disposed as a part of the bobbin preparation device in the bobbin transfer device 5. This yarn end finding device 53 is a device that performs a yarn end finding process so that yarn 14 of a yarn supply bobbin 11 can be easily caught by the automatic winder 4. The yarn end finding process is a process of unwinding yarn 14 from the surface of the yarn supply bobbin 11 by allowing a suction flow to act on the yarn supply bobbin 11 transferred on the tray 6, and inserting the unwound yarn end into the inside of a tubular bobbin 12. With this process, the yarn end of the yarn supply bobbin 11 can be easily caught in the automatic winder 4 downstream from the yarn end finding device 53.

[0056] The operation effects in the yarn winding system 1 of the foregoing embodiment and the method for manufacturing a yarn supply bobbin by the yarn winding system 1 will be described. In the foregoing embodiment, when the state acquisition unit 310 acquires a lack of material, the first drive motor 331c is controlled such that the roved yarn 13 after drafting becomes thicker than before a lack of material is acquired. More specifically, when a lack of material is acquired, roved yarn 13 positioned upstream from the drafting device 33 is drafted to become roved yarn 13 thicker than before a lack of material is acquired. Thus, the winding end of the yarn supply bobbin 11 is formed with yarn 14 formed by twisting thick roved yarn. That is, at the winding end of the yarn supply bobbin 11, yarn 14 thicker than before a lack of material is acquired (hereinafter referred to as "thick yarn portion") is formed. Since such a winding end of the yarn supply

bobbin 11 is formed with yarn 14 thicker than when such control is not performed, the yarn end finding device 53 easily catches the winding end of the yarn supply bobbin 11. That is, the success rate of the yarn end finding process in the yarn end finding device 53 can be improved.

[0057] In the foregoing embodiment, the effect of improving the success rate of the yarn end finding process is particularly high when yarn 14 of Ne30 count to Ne40 count (English cotton count) is generated.

[0058] In the foregoing embodiment, the state acquisition unit 310 determines a lack of material, based on the information from the roved yarn detecting unit 37 detecting the presence or absence of roved yarn 13 in the path of roved yarn 13 from the roved yarn supply unit 36 to the drafting device 33. A lack of material therefore can be acquired with a simple configuration.

[0059] In the foregoing embodiment, when the state acquisition unit 310 acquires a lack of material, the drive control unit 312 controls the first drive motor 331c such that the feeding speed of roved yarn 13 fed from the back roller pair 331 disposed on the most upstream side in the drafting device 33 becomes higher than before a lack of material is acquired. Thus, the thickness of roved yarn 13 drafted by the drafting device 33 after a lack of material is acquired can be increased with simple control, compared with before a lack of material is acquired.

[0060] In the foregoing embodiment, the automatic winder 4 that has acquired the information for calculating the length of a thick yarn portion fed from the spinning frame 3 can calculate the length of the thick yarn portion formed with roved yarn 13 drafted after a lack of material is acquired. Thus, in the splicing process performed by the splicing device 48, unnecessary cutting of yarn 14 of the yarn supply bobbin 11 can be suppressed. In addition, since the thick yarn portion can be cut reliably in the splicing process performed by the splicing device 48, the quality of the splicing portion can be improved.

[0061] Although an embodiment of the present invention has been described above, the present invention is not limited to the embodiment.

<First Modification>

[0062] In the foregoing embodiment, as an example of the method for increasing the thickness of roved yarn 13 after a lack of material is acquired, the first drive motor 331c is controlled such that the feeding speed of roved yarn 13 fed from the back roller pair 331 in the drafting device 33 becomes higher than before a lack of material is acquired. The present invention, however, is not limited to this example. For example, in addition to or instead of the control of the first drive motor 331c, the second drive motor 332c or the third drive motor 333c may be controlled such that the feeding speed of roved yarn 13 fed from the front roller pair 333 or the middle roller pair 332 in the drafting device 33 becomes lower than before a lack of material is acquired.

<Second Modification>

[0063] In the foregoing embodiment and modification, the back roller pair 331, the middle roller pair 332, and the front roller pair 333 are each independently driven. The present invention, however, is not limited to this example. For example, the bottom roller 331a and the bottom roller 332a are coupled to each other through a gear train, for example, to share a single drive motor. In this case, for example, the drive motor is controlled such that the feeding speed of roved yarn 13 fed from the back roller pair 331 on the most upstream side in the drafting device 33 becomes higher than before a lack of material is acquired. This configuration also can increase the thickness of roved yarn 13 after a lack of material is acquired.

<Third Modification>

[0064] In the foregoing embodiment and modifications, it is determined that the material has run out when information that roved yarn 13 fails to be detected is acquired from the roved yarn detecting unit 37. The present invention, however, is not limited to this example. For example, a lack of material may be acquired by detecting the presence or absence of roved yarn 13 wound on the bobbin 9 supported in the roved yarn supply unit 36. Alternatively, a lack of material may be acquired by predicting that the material will run out or assuming that the material has run out based on information such as the unwinding time and the unwinding speed in the roved yarn bobbin 10.

<Fourth Modification>

[0065] In the foregoing embodiment or modifications, in addition to or instead of when the state acquisition unit 310 acquires a lack of material, when the state acquisition unit 310 acquires a second state corresponding to a predetermined timing before finishing winding yarn for performing doffing of the yarn supply bobbin 11 around which yarn 14 is being wound, the drive control unit 312 may control at least one of the first drive motor 331c, the second drive motor 332c and the third drive motor 333c such that roved yarn 13 after drafting becomes thicker before the second state is acquired.

[0066] An example of "the predetermined timing before finishing winding yarn for performing doffing of the yarn supply bobbin 11 around which yarn 14 is being wound (second state)" includes "timing when the length of yarn 14 wound on the yarn supply bobbin 11 becomes a predetermined length (for example, 0.5 to 1.0 m) before doffing is performed" or "timing when the time left before doffing is performed reaches a predetermined time (for example, 2 to 3 seconds)". These timings can be acquired based on the length of yarn 14 wound around the yarn supply bobbin 11. The length of yarn 14 wound around the yarn supply bobbin 11 can be acquired, for example, by the state acquisition unit 310 acquiring that

a predetermined time is reached based on the measurement by a counter which measures the time since winding on the yarn supply bobbin 11 is started.

[0067] The start of winding on the yarn supply bobbin 11 can be acquired as appropriate, for example, from the control device 31 or a unit controlling unit (not illustrated) that controls the spinning unit 32. Alternatively, when the control device 31 or the spinning unit 32 includes a counter that measures the time since the winding on the yarn supply bobbin 11 is started, the state acquisition unit 310 may acquire the time from the control device 31 or the spinning unit 32.

[0068] Alternatively, the timing may be acquired, for example, by counting the number of revolutions of a drive motor (not illustrated) rotating the spindle shaft 341 since the winding on the yarn supply bobbin 11 is started, and determining whether the predetermined number of times is reached.

[0069] When such control in the fourth modification is performed instead of the control in the foregoing embodiment, the winding end of the yarn supply bobbin 11 formed at the time of doffing (for example, at the time of simultaneous doffing in the spinning frame 3) is formed with yarn 14 thicker than when such control is not performed, thereby improving the success rate of the yarn end finding process in the yarn end finding device 53.

[0070] When such control in the fourth modification is performed in addition to the control in the foregoing embodiment, the winding end of the (partial) yarn supply bobbin 11 formed at the time of a lack of material is formed with yarn 14 thicker than when such control is not performed. In addition, the winding end of the (full) yarn supply bobbin 11 formed, for example, at the time of doffing (for example, simultaneous doffing in the spinning frame 3) is formed with yarn 14 thicker than when such control is not performed. Thus, the success rate of the yarn end finding process in the yarn end finding device 53 can be improved.

[0071] When the state acquisition unit 310 acquires the second state whereby the draft state of the drafting device 33 is changed, the output unit 311 may transmit to the automatic winder 4 information such as various draft conditions in the drafting device 33, the yarn kind, the winding condition, the timing when the draft condition in the drafting device 33 is changed after the state acquisition unit 310 acquires that a predetermined timing before finishing winding yarn for performing doffing is reached, and the length of yarn 14 wound on the yarn supply bobbin 11 until the doffing as described above is performed. In this case, the automatic winder 4 that has acquired information for calculating the length of a thick yarn portion fed from the spinning frame 3 can calculate the length of a thick yarn portion formed by roved yarn 13 drafted after a predetermined timing before finishing winding yarn for performing doffing is reached. Thus, in the splicing process performed by the splicing device 48, unnecessary cutting of yarn 14 of the yarn supply bobbin 11 can be suppressed. In addition, since the thick yarn

portion can be cut reliably in the splicing process performed by the splicing device 48, the quality of the splicing portion can be improved.

5 <Other Modifications>

[0072] The respective drive motors (the first drive motor 331c, the second drive motor 332c and the third drive motor 333c) are connected to the bottom rollers 331a, 332a, 333a in the example in the foregoing embodiment and modifications, but may be connected to the top rollers 331b, 332b, 333b. Alternatively, respective drive motors may be connected to the bottom rollers 331a, 332a, 333a and the top rollers 331b, 332b, 333b.

[0073] In the foregoing embodiment and modifications, as an example of the information for calculating the length of a thick yarn portion, the setting values (for example, various draft conditions in the drafting device 33, the yarn kind, the winding condition, and the timing when the draft condition in the drafting device 33 is changed after the state acquisition unit 310 acquires a lack of material) have been illustrated by way of example. However, information indicating the state of yarn acquired from a sensor or the like may be used. In this case, information of yarn can be acquired in units of spinning units 32, and the accuracy can be improved.

[0074] In the splicing process in the splicing device 48, in addition to the setting value information in units of the spinning frame 3 as in the foregoing embodiment and modifications, information in units of the spinning units 32 (including, for example, the spinning condition set in units of the spinning units 32, in addition to the information of yarn acquired by a sensor or the like,) can also be used. In this case, for example, the RFID technology described above may be mediated to allow the winder unit 42 that uses the yarn supply bobbin 11 to acquire information that the yarn supply bobbin 11 is manufactured in a certain spinning unit 32.

40 Reference Signs List

[0075] 1 ... yarn winding system, 3 ... spinning frame, 31 ... control device, 310 ... state acquisition unit, 311 ... output unit, 312 ... drive control unit, 33 ... drafting device, 331 ... back roller pair (rollerpair), 331a ... bottom roller, 331b ... top roller, 331c ... first drive motor (drive unit), 332 ... middle roller pair (roller pair), 332a ... bottom roller, 332b ... top roller, 332c ... second drive motor (drive unit), 333 ... front roller pair (roller pair), 333a ... bottom roller, 333b ... top roller, 333c ... third drive motor (drive unit), 36 ... roved yarn supply unit, 37 ... roved yarn detecting unit (state acquisition unit), 4 ... automatic winder, 41 ... control device, 411 ... acquisition unit, 48 ... splicing device, 5 ... bobbin transfer device, 53 ... yarn end finding device, 10 ... roved yarn bobbin, 11 ... yarn supply bobbin, 13 ... roved yarn, 14 ... yarn, 15 ... package.

Claims

1. A spinning frame configured to wind yarn spun from roved yarn supplied from a previous step around a bobbin to form a yarn supply bobbin, the spinning frame comprising:
 - a state acquisition unit configured to acquire a first state in which a roved yarn bobbin around which the roved yarn is wound has run out of the roved yarn and/or a second state corresponding to a predetermined timing before finishing winding the yarn for performing doffing of the yarn supply bobbin around which the yarn is being wound;
 - a plurality of roller pairs configured to draft the roved yarn;
 - a plurality of drive units configured to drive at least one roller of the roller pair in each of the roller pairs; and
 - a control unit configured to control at least one of the drive units such that the yarn after spinning becomes thick, when the state acquisition unit acquires the first state being reached or the second state being reached.
2. The spinning frame according to claim 1, wherein the state acquisition unit acquires the first state being reached, based on detection of presence or absence of the roved yarn in a path of the roved yarn from a roved yarn supply unit supporting the roved yarn bobbin to the roller pairs.
3. The spinning frame according to claim 1 or 2, wherein the state acquisition unit acquires the second state being reached, based on a length of the yarn wound around the yarn supply bobbin.
4. The spinning frame according to any one of claims 1 to 3, wherein when the first state being reached or the second state being reached is acquired, the control unit controls at least one of the drive units such that feeding speed of the roved yarn fed from a roller pair disposed on a most upstream side is increased.
5. The spinning frame according to any one of claims 1 to 4, the spinning frame further includes an output unit configured to output information for calculating the length of a thick yarn portion, which is the yarn spun after the first state being reached or the second state being reached is acquired, to an automatic winder to be supplied with the yarn supply bobbin.
6. A yarn winding system comprising:
 - the spinning frame according to any one of claims 1 to 5;
 - an automatic winder configured to unwind the yarn from the yarn supply bobbin to wind the unwound yarn in a package; and
 - a bobbin transfer device configured to supply the yarn supply bobbin from the spinning frame to the automatic winder, wherein the bobbin transfer device includes a yarn end finding process unit configured to find a yarn end of the yarn supply bobbin.
7. The yarn winding system according to claim 6, wherein the automatic winder further comprising:
 - an acquisition unit configured to acquire information for calculating the length of a thick yarn portion, which is yarn spun after the first state being reached or the second state being reached is acquired; and
 - a splicing device configured to cut the thick yarn portion in the yarn supply bobbin based on the information acquired in the acquisition unit and splice together a yarn end of the cut yarn on the yarn supply bobbin side and a yarn end of yarn on the package side.
8. A method for manufacturing a yarn supply bobbin using a spinning frame including a plurality of roller pairs each configured to draft roved yarn and a plurality of drive units each configured to drive at least one roller of the roller pair in each of the roller pairs, the method comprising controlling at least one of the drive units such that the yarn after spinning becomes thick, when a first state in which a roved yarn bobbin around which the roved yarn is wound has run out of the roved yarn is acquired and/or a second state corresponding to a predetermined timing before finishing winding yarn for performing doffing of the yarn supply bobbin around which the yarn is being wound is acquired.

Fig.1

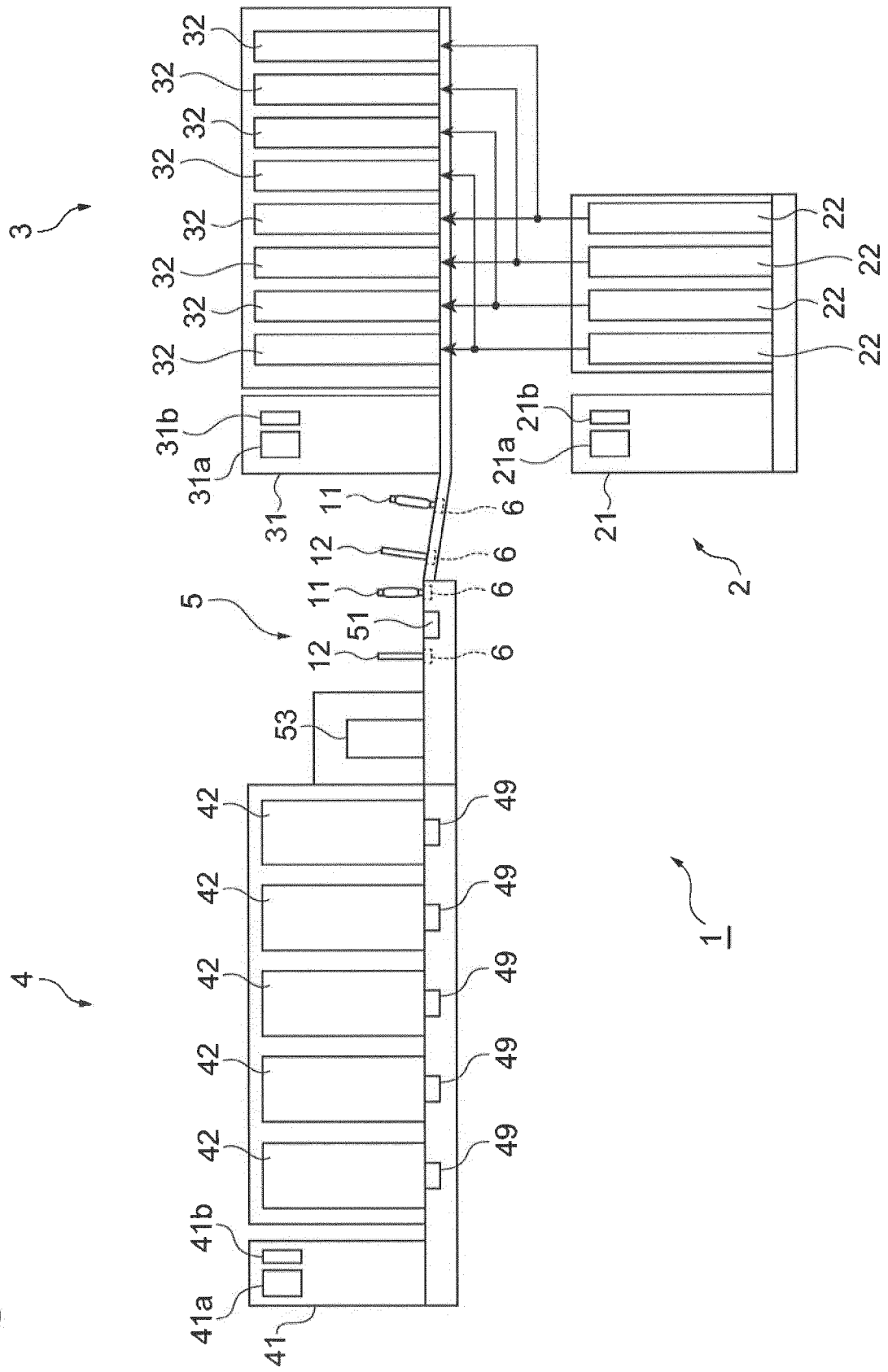


Fig.2

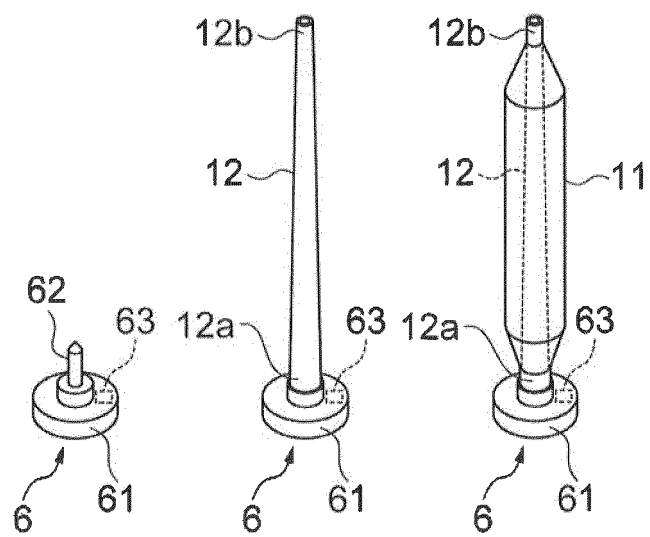


Fig.3

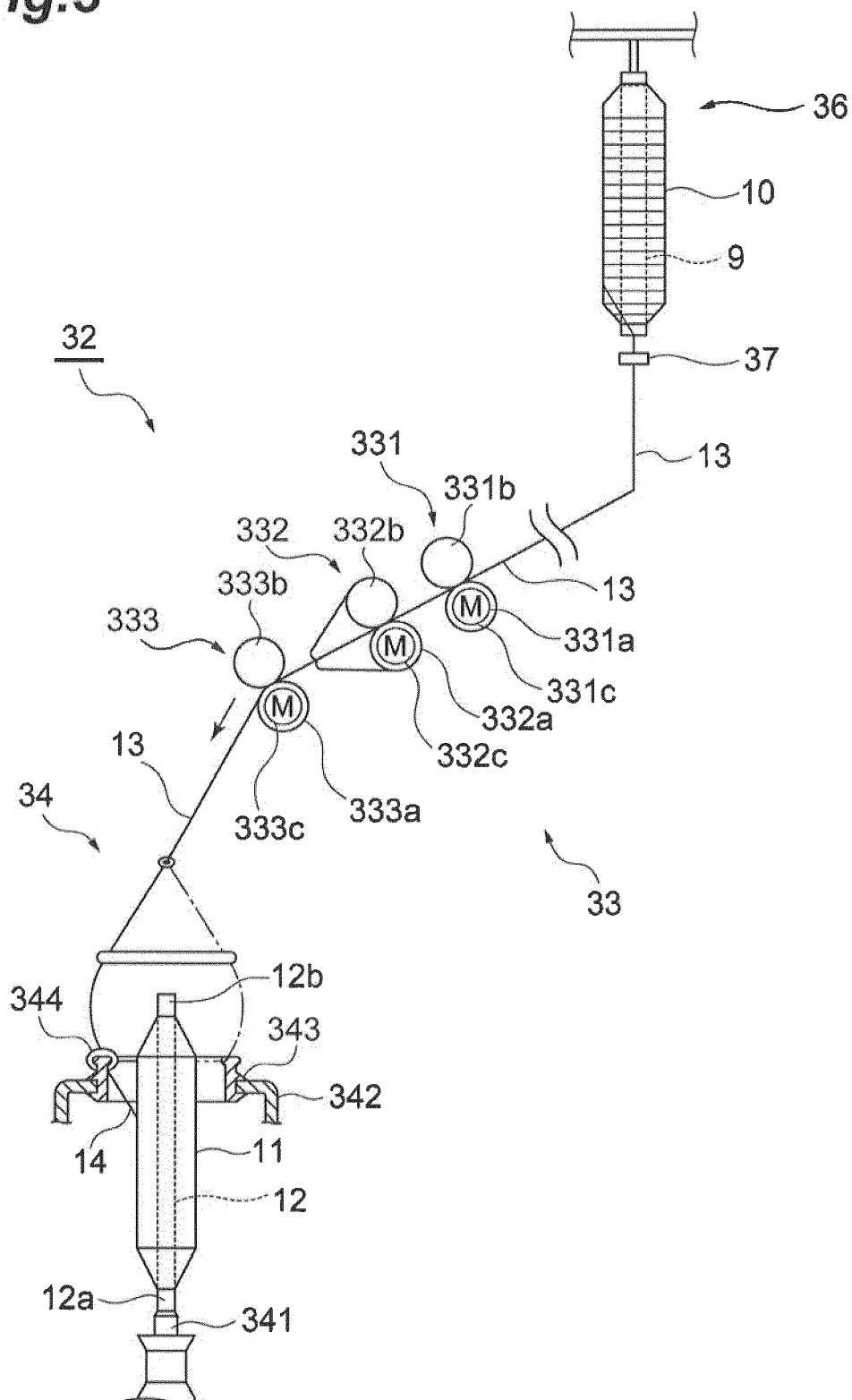


Fig.4

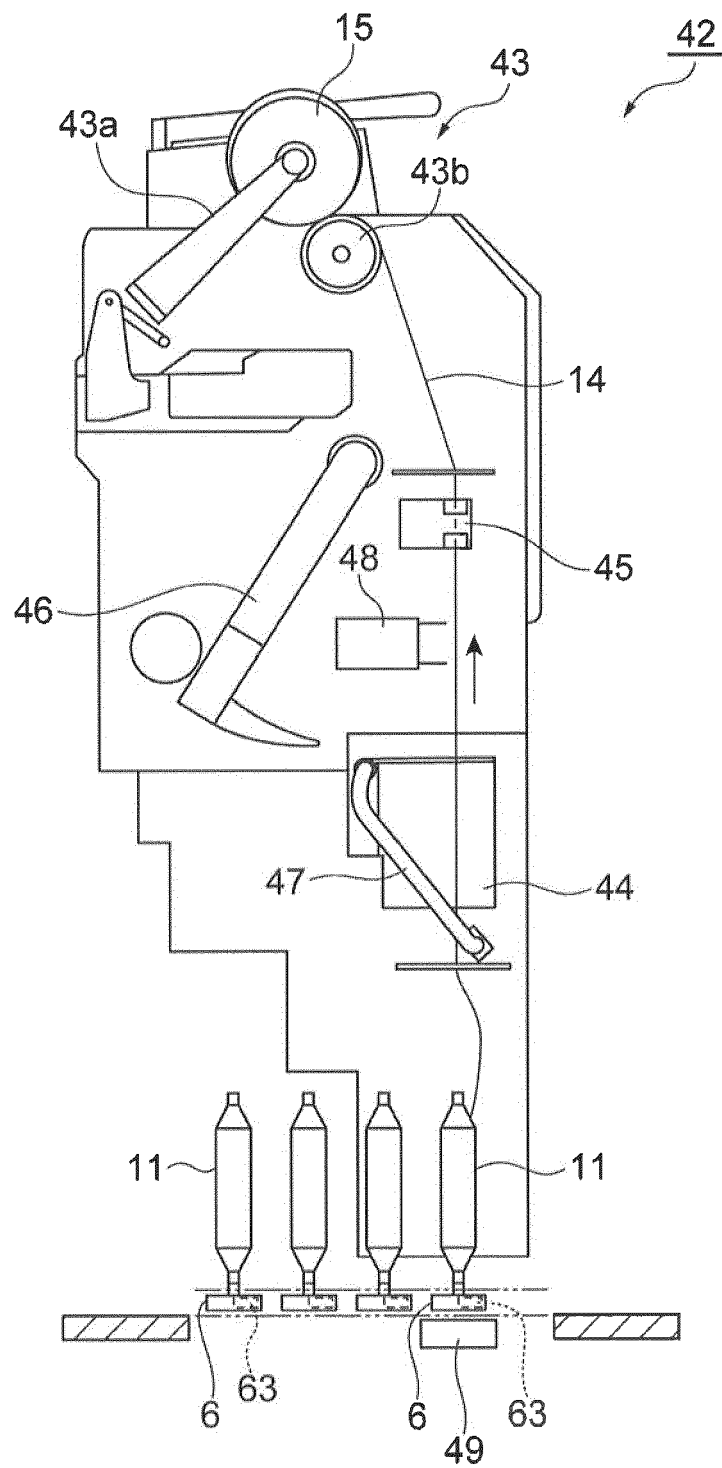
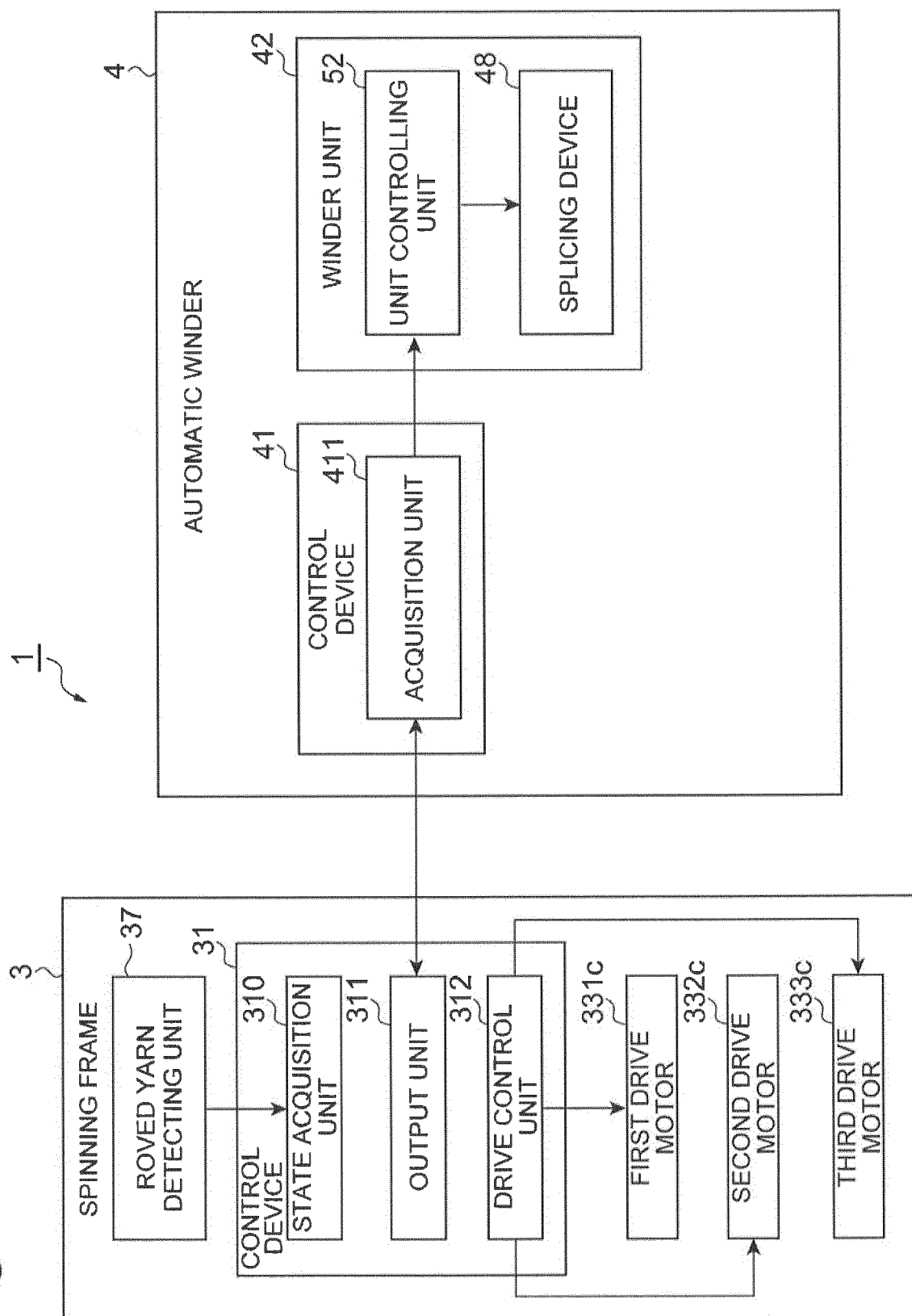


Fig.5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/062638

A. CLASSIFICATION OF SUBJECT MATTER

D01H1/20(2006.01)i, B65H67/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D01H1/00-17/02, B65H67/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
 Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-339642 A (Toyota Industries Corp.), 02 December 2004 (02.12.2004), paragraphs [0033], [0035], [0038] to [0039]; fig. 3 & EP 1477595 A2 paragraphs [0034], [0036], [0039] to [0041]; fig. 3 & CN 1550584 A	1-8
A	JP 2005-336627 A (Toyota Industries Corp.), 08 December 2005 (08.12.2005), paragraphs [0018] to [0034], [0045], [0046]; fig. 2, 4 & EP 1602756 A2 paragraphs [0016] to [0029], [0031], [0034]; fig. 2, 4 & CN 1702206 A	1-8

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
22 June 2016 (22.06.16)Date of mailing of the international search report
05 July 2016 (05.07.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/062638

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-20836 A (Murata Machinery Ltd.), 03 February 2011 (03.02.2011), paragraphs [0030], [0051]; fig. 2, 4 (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2011020836 A [0004]