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

(11) EP 3 333 109 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.06.2018 Bulletin 2018/24

(51) Int Cl.:
B65H 54/74 *(2006.01)* ***D01H 9/18*** *(2006.01)*

(21) Application number: **17203581.8**

(22) Date of filing: **24.11.2017**

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

(30) Priority: **02.12.2016 JP 2016234996**

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

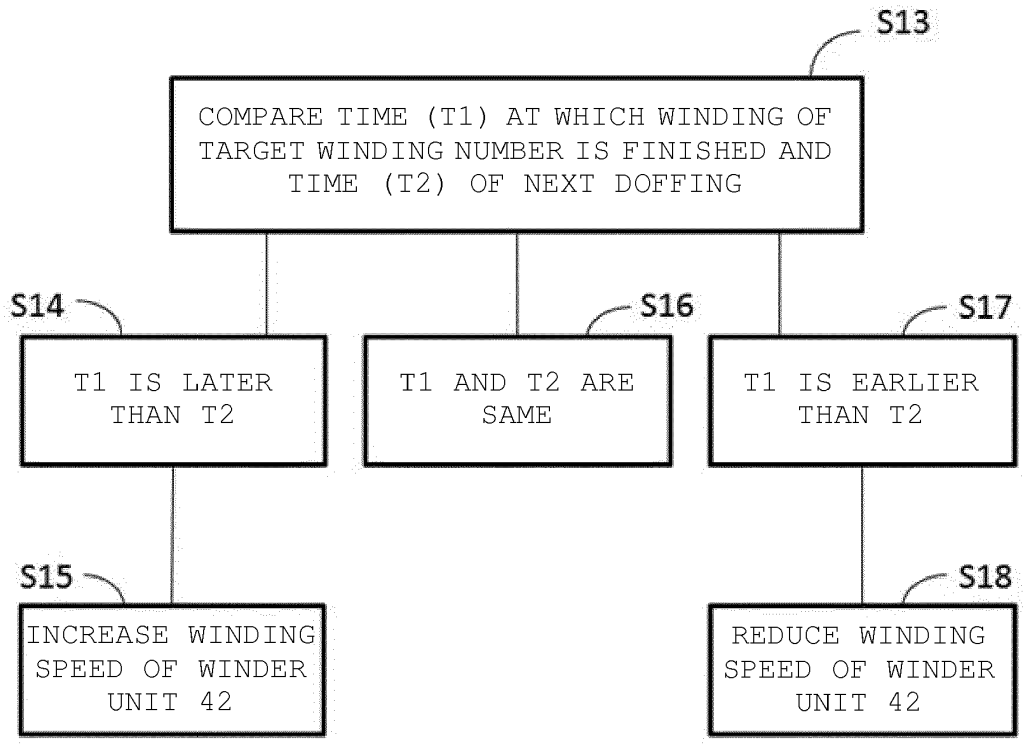
(72) Inventor: **MURAYAMA, Kenichi**
Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Weickmann & Weickmann PartmbB**
Postfach 860 820
81635 München (DE)

(54) AUTOMATIC WINDER AND WINDING SPEED CONTROL METHOD OF AUTOMATIC WINDER

(57) An automatic winder (4) includes an input section (100) adapted to input spinning information including information relating to at least one of a processing status of formation of a yarn supplying bobbin (11) and a doffing execution signal; and a control section (41) adapted to determine a winding speed of when a winding unit (42) winds a yarn from the yarn supplying bobbin (11) based on the spinning information input by the input section (101).

FIG. 8



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an automatic winder and a winding speed control method of the automatic winder.

2. Description of the Related Art

[0002] Conventionally, there is known a yarn winding system including a spinning machine with a plurality of spinning units adapted to form a yarn supplying bobbin, and an automatic winder including a plurality of winding units adapted to wind the yarn from the yarn supplying bobbin to form a package (see e.g., Japanese Examined Patent Publication No. H6-76177). In the yarn winding system described in Japanese Examined Patent Publication No. H6-76177, a medium is arranged on a bobbin mounting tray that is transported in a circulating manner between the spinning machine and the automatic winder, and yarn processing information of the winder is written to the medium by a writing device. The yarn processing information written to the medium is read by a reading device, and managed by a management computer.

[0003] In the yarn winding system described above, it is desired to optimize an operation control of the automatic winder in terms of enhancing production efficiency and work quality.

[0004] Optimizing the operation control includes, for example, appropriately switching a processing speed of the automatic winder according to a processing status of the spinning machine, which is a pre-stage machine of the automatic winder, or appropriately operating the automatic winder according to completion condition of spinning in the spinning machine.

[0005] The optimization of the operation control of the automatic winder is realized by transmitting spinning information of the spinning machine to the automatic winder through wired communication or wireless communication.

[0006] However, the spinning machines at the pre-stage of the automatic winder include various types of spinning machines with different specifications. Thus, in the spinning machine that does not have a communication function for transmitting the spinning information or the spinning machine having a different communication standard, the automatic winder cannot receive the spinning information of the spinning machine, and the operation control of the automatic winder cannot be optimized.

BRIEF SUMMARY OF THE INVENTION

[0007] An automatic winder of the present invention includes a plurality of winding units adapted to wind a yarn from the yarn supplying bobbin formed by a spinning machine to form a package. The automatic winder includes an input section adapted to input spinning information including information relating to at least one of a processing status of formation of the yarn supplying bobbin and a doffing execution signal; and a control section adapted to determine a winding speed of when the winding unit winds a yarn from the yarn supplying bobbin based on the spinning information input by the input section.

[0008] The spinning information including the information relating to at least one of the processing status of the formation of the yarn supplying bobbin and the doffing execution signal is input to the automatic winder. The automatic winder controls the operation of the automatic winder based on the input spinning information. Thus, the optimization of the operation control of the automatic winder can be realized by carrying out the operation control of the automatic winder based on the input spinning information.

[0009] The control section controls an operation of the winding unit to wind the yarn from the yarn supplying bobbin at the determined winding speed based on the information relating to the processing status of the formation of the yarn supplying bobbin.

[0010] The automatic winder can obtain the spinning status of the spinning machine based on the input information relating to the processing status of the formation of the yarn supplying bobbin. The automatic winder thus can realize the operation control adapted to the spinning status of the spinning machine.

[0011] The control section obtains a time point of next doffing of the spinning machine based on the information relating to the processing status of the formation of the yarn supplying bobbin, obtains a yarn supplying bobbin processing time, which is a time required for the winding unit to wind one yarn supplying bobbin, based on a target winding number, which is a number of yarn supplying bobbins to be wound by the time point of the next doffing, and further calculates a time required to process the target winding number to determine a winding speed of when the winding unit winds the yarn from the yarn supplying bobbin.

[0012] The control section calculates a time point at which winding of the target winding number is finished from the time required to process the target winding number, increases the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing, reduces the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and does not change the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within the predetermined time.

[0013] In the automatic winder of the present invention, a time point of the next doffing of the spinning machine is obtained, and a time required to process the target winding number is calculated from the target winding number, which is the number of yarn supplying bobbins to be wound by the time point of the next doffing, and the yarn supplying bobbin processing time, which is the time required for the winding unit to wind one yarn supplying bobbin. The winding step of the automatic winder thus can be more accurately adapted to the spinning step of the spinning machine.

[0014] The control section calculates doffing information based on the doffing execution signal serving as the spinning information input by the input section, and determines the winding speed of when the winding unit winds a yarn from the yarn supplying bobbin based on the calculated doffing information. The control section obtains a time point of next doffing of the spinning machine based on the calculated doffing information, obtains a yarn supplying bobbin processing time, which is a time required for the winding unit to wind one yarn supplying bobbin, based on a target winding number, which is a number of yarn supplying bobbins to be wound by the time point of the next doffing, and further calculates a time required to process the target winding number to determine a winding speed of when the winding unit winds the yarn from the yarn supplying bobbin. Furthermore, the control section calculates a time point at which winding of the target winding number is finished from the time required to process the target winding number, increases the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing, reduces the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and does not change the winding speed of the winding unit when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within the predetermined time.

[0015] In the automatic winder of the present invention, even if the information obtained from the spinning machine is only the doffing execution signal, the winding process of the automatic winder can be more accurately adapted to the spinning step of the spinning machine.

[0016] The control section changes the winding speed of the winding unit within a range of a fluctuation restriction that restricts a changing range of the winding speed.

[0017] In the automatic winder of the present invention, the winding state of the package can be prevented from being greatly changed by the rapid speed change, and the change in the winding state of the package can be avoided. The quality of the package thus will not be downgraded.

[0018] The fluctuation restriction can be changed by the input section. As the rate of speed change can be changed in accordance with the type of yarn to be wound, the winding speed range suitable for the type of yarn and the winding conditions will not be exceeded. The quality of the package thus will not be downgraded.

[0019] According to the present invention, the optimization of the operation control of the automatic winder can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a front view of a yarn winding system of a first embodiment of the present invention;

FIG. 2 is a perspective view of a tray, an empty bobbin, and a yarn supplying bobbin transported in the yarn winding system of FIG. 1;

FIG. 3 is a side view of a spinning unit of the yarn winding system of FIG. 1.

FIG. 4 is a side view of a winding unit of the yarn winding system of FIG. 1;

FIG. 5 is a block diagram illustrating a functional configuration of the yarn winding system of FIG. 1;

FIG. 6 is a flowchart illustrating an operation of the yarn winding system of FIG. 1;

FIG. 7 is a flowchart illustrating an operation of an automatic winder of a second embodiment of the present invention; and

FIG. 8 is a flowchart illustrating the operation of the automatic winder of the second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0021] A first embodiment of the present invention will be hereinafter described in detail with reference to the accompanying drawings. The same reference numerals are denoted on the same or corresponding portions throughout the drawings, and redundant description will be omitted.

[0022] As illustrated in FIG. 1, a yarn winding system 1 includes a roving machine 2, a spinning machine 3, and an automatic winder 4. The roving machine 2 is adapted to produce a rove from a sliver, and wind the rove to form a roving bobbin. The spinning machine 3 is adapted to produce a yarn from the rove, and wind the yarn to form a yarn supplying bobbin 11. The automatic winder 4 is adapted to wind the yarn from the yarn supplying bobbin 11 to form a package 15. The automatic winder 4 includes a bobbin transferring device (bobbin transferring section) 5. The bobbin transferring device 5 is adapted to transfer the yarn supplying bobbin 11 from the spinning machine 3 to the automatic winder 4, and transfer an empty bobbin 12 (bobbin around which a yarn is not wound) from the automatic winder 4 to the spinning machine 3. The bobbin transferring device 5 includes a bobbin preparing device (bobbin preparing section) 7 and

a remaining yarn processing device, and the like. The bobbin preparing device 7 is adapted to carry out a preliminary preparation for the automatic winder 4 to process the yarn of the yarn supplying bobbin 11. If the yarn remains on the bobbin 12 discharged from the yarn supplying bobbin 11, the remaining yarn processing device removes the yarn to obtain the empty bobbin 12. Thus, the bobbin transferring device 5 has a complex transportation path with many curves.

[0023] The yarn supplying bobbin 11 and the empty bobbin 12 are respectively transferred while being set on a tray 6. As illustrated in FIG. 2, the tray 6 includes a circular plate shaped base portion 61, a pin 62 that projects out toward an upper side from the base portion 61, and an RF (Radio Frequency) tag 63 incorporated in the base portion 61. When the pin 62 is inserted into a bottom portion 12a of the bobbin 12, the yarn supplying bobbin 11 and the empty bobbin 12 are respectively set on the tray 6 with a top portion 12b of the bobbin 12 facing the upper side. The RF tag (recording section) 63 stores information relating to the yarn supplying bobbin 11 set on the tray 6. In the yarn winding system 1, the status of the yarn supplying bobbin 11 set on the tray 6 is managed by an RFID (Radio Frequency Identification: Identification by radio wave) technique.

[0024] As illustrated in FIG. 1, the roving machine 2 includes a control device 21 adapted to control the operation of the roving machine 2, and a plurality of roving units 22 adapted to form the roving bobbin. The control device 21 includes a display section 21a such as a display, and an operation section 21b such as input keys. The display section 21a displays an operational status of each roving unit 22, and the like. The operation section 21b is provided for an operator to carry out setting of the operational conditions of each roving unit 22, and the like.

[0025] The spinning machine 3 includes a control device 31 adapted to control the operation of the spinning machine 3, and a plurality of spinning units 32 adapted to form the yarn supplying bobbin 11. The control device 31 includes a display section 31a such as a display, and an operation section 31b such as input keys. The display section 31a displays an operational status of each spinning unit 32, and the like. The operation section 31b is provided for an operator to carry out setting of the operational conditions of each spinning unit 32, and the like.

[0026] As illustrated in FIG. 3, the spinning unit 32 includes a draft device 33 and a twist applying device 34.

[0027] The draft device 33 includes a pair of back rollers 33a, a pair of middle rollers 33b, and a pair of front rollers 33c. The pair of back rollers 33a, the pair of middle rollers 33b, and the pair of front rollers 33c are each configured by a bottom roller and a top roller. An apron belt is provided on each roller configuring the pair of middle rollers 33b. In the draft device 33, the rove 13 unwound from the roving bobbin is drafted by rotating the pair of back rollers 33a, the pair of middle rollers 33b, and the pair of front rollers 33c at a predetermined speed ratio.

[0028] The twist applying device 34 includes a spindle shaft 35, a ring rail 36, a ring 37, and a traveler 38. The spindle shaft 35 is adapted to hold the bottom portion 12a of the bobbin 12 with the top portion 12b of the bobbin 12 facing the upper side, and rotate the bobbin 12. The ring rail 36 is movable in an axis line direction of the bobbin 12. The ring 37 is fixed to the ring rail 36. The traveler 38 is supported by the ring 37, and is movable along the ring 37.

[0029] In the twist applying device 34, the rove 13 drafted by the draft device 33 is inserted into a gap between the ring 37 and the traveler 38, and an end of the rove 13 is fixed to the bobbin 12. The spindle shaft 35 rotates the bobbin 12 in such a state, whereby the traveler 38 moves along the ring 37 as if being pulled by the rove 13. In this case, the ring rail 36 gradually moves from the bottom portion 12a side toward the top portion 12b side while reciprocating within a predetermined range along the axis line direction of the bobbin 12. In the twist applying device 34, the rotation of the traveler 38 is delayed from the rotation of the bobbin 12 so that twists are applied to the rove 13 and a yarn 14 is produced. Then, the yarn 14 is wound around the bobbin 12 to form the yarn supplying bobbin 11.

[0030] The spinning machine 3 including a plurality of spinning units 32 configured as above is configured as a so-called simultaneous doffing type. In other words, the spinning machine 3 stocks a plurality of empty bobbins 12 transferred from the automatic winder 4 by the bobbin transferring device 5, simultaneously sets the empty bobbin 12 in each spinning unit 32, and simultaneously starts the winding of the yarn. When the winding of the yarn is completed in each spinning unit 32 and the yarn supplying bobbin 11 is formed, the spinning machine 3 simultaneously doffs (doffing) all the yarn supplying bobbins 11. Then, the spinning machine 3 extracts the empty bobbins 12 stocked in the meantime from the tray 6, and again simultaneously sets such empty bobbin in each spinning unit 32, and simultaneously sets the doffed yarn supplying bobbins 11 on the tray 6 instead.

[0031] As illustrated in FIG. 1, the automatic winder 4 includes a control device 41 adapted to control the operation of the automatic winder 4, a plurality of winding units 42 adapted to form packages 15, and the bobbin transferring device 5. The control device 41 includes a display section 41a such as a display, and an operation section 41b such as input keys. The display section 41a displays an operational status of each winding unit 42, and the like. The operation section 41b is provided for an operator to carry out setting of the operational conditions of each winding unit 42, and the like. The control device 41 also controls the operation of the bobbin transferring device 5.

[0032] As illustrated in FIG. 4, the winding 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, and a yarn joining device 48.

[0033] The winding device 43 includes a cradle 43a

and a winding drum 43b. The cradle 43a supports the package 15. The winding drum 43b rotates the package 15 while traversing the yarn 14. The yarn 14 is thereby wound from the yarn supplying bobbin 11 set at a predetermined position to form the package 15. The tension applying device 44 applies a predetermined tension on the yarn 14 travelling from the yarn supplying bobbin 11 to the package 15.

[0034] The yarn monitoring device 45 is adapted to monitor the travelling yarn 14 to detect yarn defects (thickness abnormality of the yarn 14, mixing of foreign substance to the yarn 14, etc.) . When the yarn defect is detected, the yarn 14 is cut with a separately provided cutter. When the yarn 14 is cut, the upper yarn catching device 46 catches a yarn end of the yarn 14 from the package 15 and guides the yarn end to the yarn joining device 48. When the yarn 14 is cut, the lower yarn catching device 47 catches a yarn end of the yarn 14 from the yarn supplying bobbin 11 and guides the yarn end to the yarn joining device 48. The yarn joining device 48 joins the yarn ends guided by the upper yarn catching device 46 and the lower yarn catching device 47.

[0035] As illustrated in FIG. 1, the bobbin transferring device 5 includes an RF writer 51. When the yarn supplying bobbin 11 is transferred from the spinning machine 3 to the automatic winder 4, the RF writer 51 writes information relating to the relevant yarn supplying bobbin 11 to the RF tag 63 of the tray 6 on which the relevant yarn supplying bobbin 11 is set. The information relating to the yarn supplying bobbin 11 includes unit identification information for specifying the spinning unit 32 that formed the yarn supplying bobbin 11, and doffing information (timing information) for specifying timing of simultaneous doffing. More specifically, the doffing information is information indicating the timing at which the doffing is carried out such as the time for which the simultaneous doffing is carried out, how many times doffing has been carried out from a time point set as a reference, or the like. The RF writer 51 may be arranged at an exit in the transferring direction of the yarn supplying bobbin 11 of the spinning machine 3. Furthermore, the RF writer 51 may be provided for every spinning unit 32.

[0036] The information written on the RF tag 63 by the RF writer 51 is read by an RF reader (reading section) 49 arranged on each winding unit 42, and transmitted to the control device 41 of the automatic winder 4 when the yarn supplying bobbin 11 is set on the winding unit 42 of the automatic winder 4. The control device 41 then can specify the spinning unit 32 that formed the relevant yarn supplying bobbin 11 and the timing of simultaneous doffing with respect to the yarn supplying bobbin 11 set on the winding unit 42.

[0037] Next, a mechanism in which the spinning machine 3 transmits the spinning information (to be described in detail later) to the automatic winder 4, and the automatic winder 4 controls the operation of the automatic winder 4 (i.e., operation of each winding unit 42 and the bobbin preparing device 7) based on the spinning information will be described with reference to FIGS. 5 and 6.

[0038] As illustrated in FIG. 5, the spinning machine 3 includes a control device (generating section) 31 and a transmitting section 31c as a functional element for realizing the mechanism described above. Furthermore, the automatic winder 4 includes a control device (control section) 41, each winding unit 42, the bobbin preparing device 7 arranged on the bobbin transferring device 5, an RF reader 7a arranged on the bobbin preparing device 7, and a receiving section 41c.

[0039] The control device 31 is an electronic control unit including a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and the like. The control device 31 loads a program stored in the ROM to the RAM and executes the program with the CPU to execute various types of controls. The control device 31 may be configured by a plurality of electronic control units. The control device 31 functions as a generating section that generates the spinning information including information relating to at least one of the processing status of the formation of the yarn supplying bobbin 11 and the completion condition of spinning of the yarn supplying bobbin 11.

[0040] The information relating to the processing status of the formation of the yarn supplying bobbin 11 (hereinafter referred to as "processing status information") is, for example, information indicating a remaining time until the yarn supplying bobbins 11 are simultaneously doffed in the plurality of spinning units 32 by the simultaneous doffing. The control device 31 refers to the setting relating to the monitoring of the operational status of each spinning unit 32 and the operation of each spinning unit 32, for example, to obtain the processing status information described above.

[0041] The information relating to the completion condition of spinning of the yarn supplying bobbin 11 (hereinafter referred to as "completion condition information") is, for example, information relating to the condition (doffing condition) to be satisfied when doffing the yarn supplying bobbin 11 in each spinning unit 32. The completion condition information is, for example, information relating to a state of a winding end of the yarn in the yarn supplying bobbin 11. The information relating to the state of the winding end of the yarn is, for example, information indicating whether or not a so-called bunch winding process is performed, whether or not the yarn supplying bobbin 11 is formed in a half bobbin, or the like in the state of the winding end of the yarn in the yarn supplying bobbin 11.

[0042] In the present embodiment, by way of example, the control device 31 generates data including the processing status information and the completion condition information described above, and the doffing information for specifying the timing at which the yarn supplying bobbin 11 is formed, as the spinning information, and transmits the data to the automatic winder 4 through the transmitting section 31c. Although the timing at which

the control device 31 generates the spinning information and transmits the spinning information to the automatic winder 4 is arbitrary, in the present embodiment, the control device 31 periodically generates the spinning information at a predetermined interval defined in advance and transmits the spinning information to the automatic winder 4, by way of example. The automatic winder 4 thus can obtain the processing status of the spinning machine 3 on a timely basis, and can appropriately control the winding speed of the winding unit 42 each time (to be described in detail later).

[0043] The transmitting section 31c transmits the spinning information generated by the control device 31 to the automatic winder 4. The transmission by the transmitting section 31c may be carried out in a wired manner by a cable and the like, or may be carried out in a wireless manner. When carrying out wireless transmission by the transmitting section 31c, radio wave, infrared ray, or light may be adopted for a transmission medium. In FIG. 5, the transmitting section 31c is illustrated as an element separate from the control device 31, but the transmitting section 31c may be configured to be included in the control device 31. That is, the transmitting section 31c may be a communication function incorporated in the control device 31.

[0044] The receiving section 41c is adapted to receive the spinning information transmitted from the spinning machine 3. The reception by the receiving section 41c may be carried out in a wired manner by a cable and the like, or may be carried out in a wireless manner. When carrying out wireless reception by the receiving section 41c, radio wave, infrared ray, or light may be adopted for a transmission medium. In FIG. 5, the receiving section 41c is illustrated as an element separate from the control device 41, but the receiving section 41c may be configured to be included in the control device 41. That is, the receiving section 41c may be a communication function incorporated in the control device 41.

[0045] The control device 41 is an electronic control unit including the CPU, the ROM, the RAM, and the like. The control device 41 loads a program stored in the ROM to the RAM, and executes the program with the CPU to execute various types of controls . The control device 41 may be configured by a plurality of electronic control units . The control device 41 controls the operation of the automatic winder 4 based on the spinning information received by the receiving section 41c. Specifically, the control device 41 determines the operation of each winding unit 42 based on the spinning information, and transmits a control signal indicating the determined operation to each winding unit 42 on a timely basis to control the operation of each winding unit 42.

[0046] The control device 41 determines the winding speed of when each winding unit 42 winds the yarn from the yarn supplying bobbin 11 based on the processing status information included in the spinning information, and controls the operation of each winding unit 42 so as to wind the yarn from the yarn supplying bobbin 11 at the determined winding speed.

[0047] As described above, the yarn supplying bobbin 11 is transferred from the spinning machine 3 to the automatic winder 4, and the empty bobbin 12 is transferred from the automatic winder 4 to the spinning machine 3. It is to be noted that if a pace (supply pace) at which the yarn supplying bobbin 11 is transferred from the spinning machine 3 to the automatic winder 4 per unit time is slower than a pace (discharge pace) at which the empty bobbin 12 is transferred from the automatic winder 4 to the spinning machine 3 per unit time, this means that the process of the automatic winder 4 has a margin. In other words, this means that the winding speed of each winding unit 42 can be reduced. On the other hand, if the supply pace is faster than the discharge pace, this means that the process of the automatic winder 4 does not have a margin. In other words, the winding speed of each winding unit 42 needs to be increased in order to balance the processing speeds of the spinning machine 3 and the automatic winder 4.

[0048] The control device 41 calculates the supply pace of the yarn supplying bobbin 11 based on the processing status information included in the spinning information, and determines the winding speed of each winding unit 42 so that the supply pace and the pace of the winding process in each winding unit 42 (i.e., discharge pace of the empty bobbin 12) are balanced. Thus, when the supply pace is faster than the discharge pace, the control device 41 can balance the process of the spinning machine 3 and the process of the automatic winder 4 by increasing the winding speed of each winding unit 42. Furthermore, when the supply pace is slower than the discharge pace, the control device 41 can enhance the winding quality (i.e., quality of package 15) in each winding unit 42 by reducing the winding speed of each winding unit 42.

[0049] Furthermore, the control device 41 controls the preparatory operation of the bobbin with respect to the yarn supplying bobbin 11 in the bobbin preparing device 7 arranged on the bobbin transferring device 5 based on the information relating to the winding end of the yarn included in the spinning information. For example, the control device 41 specifies whether or not the bunch winding process is carried out in the yarn supplying bobbin 11 from the information relating to the winding end of the yarn. When specified that the bunch winding process is carried out in the yarn supplying bobbin 11, the control device 41 controls the operation of the bobbin preparing device 7 so as to omit the operations that become unnecessary when the bunch winding process is carried out (e.g., operations such as cutting of the yarn end of the yarn supplying bobbin 11 by a yarn end cutting device (not illustrated) arranged on the bobbin preparing device 7, suction of the yarn end of the yarn supplying bobbin 11 by a yarn end suction device (not illustrated) arranged on the bobbin preparing device 7, etc.). Thus, the useless operations can be prevented from being carried out in the bobbin preparing device 7.

[0050] For example, the control device 41 specifies whether or not the yarn supplying bobbin 11 is formed in the half bobbin from the information relating to the winding end of the yarn. When specified that the yarn supplying bobbin 11 is formed to a half bobbin, the control device 41 controls the operation of the bobbin preparing device 7 so that, for example, a search operation (operation for searching the yarn end of the yarn supplying bobbin 11) of the yarn end cutting device and the yarn end suction device described above is carried out within a range corresponding to the half bobbin (e.g., predetermined range on the bottom portion 12a side) . Thus, the search operation can be prevented from being carried out in a useless range, and the yarn end can be promptly found. The optimization of the operation of the bobbin preparing device 7 can be realized by controlling the preparatory operation of the bobbin in the bobbin preparing device 7 according to the state of the winding end of the yarn in the yarn supplying bobbin 11 as described above.

[0051] The completion condition of spinning of the yarn supplying bobbin 11 may differ for every timing of simultaneous doffing in the spinning machine 3. For example, the completion condition of spinning may be set so that the bunch winding process is carried out in the yarn supplying bobbin 11 in the simultaneous doffing at a first timing, and the bunch processing is not carried out in the yarn supplying bobbin 11 in the simultaneous doffing at a second timing after the first timing. The reason the bunch winding process is not carried out in the yarn supplying bobbin 11 in the simultaneous doffing at the second timing may include a case in which the rove wound around the roving bobbin set in the spinning machine 3 is used up by multiple spinning units 32, a case in which the doffing needs to be carried out in a halfway state due to the trouble of the spinning machine 3, and the like. The yarn supplying bobbins 11 formed at the first timing and the second timing, which have different completion conditions of spinning, may be mixed and transferred to the bobbin preparing device 7. In such a case, when carrying out the preparatory work with respect to the yarn supplying bobbin 11 formed at the first timing, the control device 41 needs to control the operation of the bobbin preparing device 7 based on the completion condition information (i.e., completion condition information applied to the yarn supplying bobbin 11 formed at the first timing) included in first spinning information including the doffing information indicating the first timing. Similarly, when carrying out the preparatory work with respect to the yarn supplying bobbin 11 formed at the second timing, the control device 41 needs to control the operation of the bobbin preparing device 7 based on the completion condition information (i.e., completion condition information applied to the yarn supplying bobbin 11 formed at the second timing) included in second spinning information including the doffing information indicating the second timing. The automatic winder 4 is configured to be able to realize such control. The mechanism will be described below.

[0052] First, the control device 41 periodically receives the spinning information from the spinning machine 3 through the receiving section 41c, and accumulates the first spinning information including the doffing information indicating the first timing and the second spinning information including the doffing information indicating the second timing. When the yarn supplying bobbin 11 is supplied to the bobbin preparing device 7, the RF reader 7a arranged on the bobbin preparing device 7 reads the information written on the RF tag 63 provided on the tray 6 transferring the yarn supplying bobbin 11, and transmits the information to the control device 41. The control device 41 thereby acquires the doffing information indicating the timing at which the yarn supplying bobbin 11 supplied to the bobbin preparing device 7 is formed.

[0053] Then, the control device 41 extracts the spinning information including the doffing information that coincides with the doffing information (doffing information indicating the timing at which the yarn supplying bobbin 11 is formed, for example, information specifying how many times the doffing has been carried out until the relevant yarn supplying bobbin 11 is doffed) received from the RF reader 7a from the accumulated spinning information, and controls the operation of the bobbin preparing device 7 based on the spinning information. Specifically, when the doffing information received from the RF reader 7a indicates the first timing (e.g., first doffing), the control device 41 controls the preparatory operation of the bobbin of the bobbin preparing device 7 based on the completion condition information included in the first spinning information. When the doffing information received from the RF reader 7a indicates the second timing (e.g., second doffing), the control device 41 controls the preparatory operation of the bobbin of the bobbin preparing device 7 based on the completion condition information included in the second spinning information. Thus, the preparatory operation of the bobbin by the bobbin preparing device 7 can be appropriately controlled based on the completion condition of spinning (e.g., information relating to the winding end of the yarn such as whether or not the bunch winding process is carried out, whether or not the yarn supplying bobbin 11 is formed in the half bobbin, etc.) applied to the yarn supplying bobbin 11 supplied to the bobbin preparing device 7.

[0054] Next, the operation of the yarn winding system 1 (operation including the yarn winding method according to present embodiment) will be described with reference to FIG. 6. As illustrated in FIG. 6, first, the control device 31 of the spinning machine 3 generates the spinning information including at least one of the processing status information or the completion condition information (step S1, generating step). Then, the transmitting section 31c of the spinning machine 3 transmits the spinning information generated in step S1 to the automatic winder 4 (step S2, transmitting step).

[0055] Then, the receiving section 41c of the automatic winder 4 receives the spinning information (step S3, receiving step). The spinning information received by the

receiving section 41c is provided to the control device 41. The control device 41 then controls the winding speed of each winding unit 42 based on the processing status information included in the spinning information (step S4, controlling step). Specifically, the control device 41 calculates the supply pace of the yarn supplying bobbin 11 based on the processing status information included in the spinning information, and determines the winding speed of each winding unit 42 so that the supply pace and the pace of the winding process in each winding unit 42 (i.e., discharge pace of the empty bobbin 12) are balanced. The control device 41 then controls the operation of each winding unit 42 to wind the yarn from the yarn supplying bobbin 11 at the determined winding speed.

[0056] Furthermore, when the yarn supplying bobbin 11 is supplied to the bobbin preparing device 7, the RF reader 7a arranged on the bobbin preparing device 7 reads the doffing information written on the RF tag 63 provided on the tray 6 transferring the yarn supplying bobbin 11, and transmits the doffing information to the control device 41 (step S5). Then, the control device 41 controls the preparatory operation of the bobbin by the bobbin preparing device 7 based on the spinning information including the doffing information that coincides with the doffing information received from the RF reader 7a (step S6, controlling step). Specifically, as described above, the control device 41 controls the operation of the bobbin preparing device 7 based on, for example, the information relating to the winding end of the yarn of the yarn supplying bobbin 11 included in the spinning information.

[0057] A second embodiment of the present invention will now be described. In the second embodiment, the description on the configurations common with the first embodiment will be omitted.

[0058] The automatic winder 4 of the second embodiment further includes an input section 100 and a notifying section 101. In the configuration in which the receiving section 41c of the automatic winder 4 cannot receive the spinning information from the spinning machine 3, the operator can input the spinning information to the input section 100. The configuration in which the receiving section 41c of the automatic winder 4 cannot receive the spinning information from the spinning machine 3 includes, for example, a case in which the spinning machine 3 does not include the transmitting section 31c for communicating with the automatic winder 4, a case in which the spinning machine 3 includes the transmitting section 31c but the communication function does not operate due to malfunction, and the like.

[0059] As illustrated in FIG. 7, the operator can input a doffing number (number of yarn supplying bobbins 11 which can be supplied by the spinning machine 3 in one doffing), and the doffing information (time point of next doffing, or time required for one doffing) to the input section 10 as the spinning information (step S7).

[0060] The control device 41 of the automatic winder 4 calculates number of yarn supplying bobbins to be wound by the time point of the next doffing (target winding number) from the input information (step S8). The target winding number can be easily calculated by subtracting, from the doffing number, the number of yarn supplying bobbins 11, in which the winding process is completed on the bobbin supplied by the previous doffing.

[0061] The control device 41 then obtains the time required for the winding unit 42 to wind one yarn supplying bobbin 11 (yarn supplying bobbin processing time) from the winding information (step S9). The yarn supplying bobbin processing time can be obtained by counting the number of winding processed bobbins returned from the automatic winder 4 to the spinning machine at a predetermined time interval. Furthermore, the yarn supplying bobbin processing time can also be obtained by counting the actual time required by the winding unit 42 to process the yarn supplying bobbin. Furthermore, in view of the yarn supplying bobbin processing time and the number of winding units 42 arranged in the automatic winder 4, the control device 41 computes a time required to process the yarn supplying bobbin 11 of the target winding number (step S10). The control device 41 then calculates a time point at which the winding of the target winding number is finished (step S11), and compares it with the time point of the next doffing (step S12).

[0062] As illustrated in FIG. 8, when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing (step S14), the control device 41 increases the winding speed of the winding unit 42 (step S15). Furthermore, when the time point at which the winding of the target winding number is finished is considerably earlier than the time point of the next doffing (step S17), the control device reduces the winding speed of the winding unit 42 (step S18). Furthermore, when the time point at which the winding of the target winding number is finished is substantially the same time point as the time point of the next doffing (step S16), the control device does not change the winding speed of the winding unit 42. Thus, the optimization of the operation control of the automatic winder 4 can be realized by controlling the operation of the automatic winder 4 based on the spinning information input by the operator. Herein, "considerably early" means early by more than or equal to a predetermined time set as a threshold value. "Substantially the same time point" means early within the predetermined time. The time point referred to herein includes the concept such as "time", "the moment after predetermined time from the current time", and the like.

[0063] When changing the winding speed of the winding unit 42, a restriction (fluctuation restriction) for preventing the winding state of the package 15 from greatly changing by the rapid speed change is preferably provided. For example, since the change in the winding state of the package 15 can be avoided by restricting the change in the winding speed to within $\pm 10\%$, the quality of the package will not be downgraded.

[0064] Furthermore, the fluctuation restriction can be

freely changed by the input section 100.

[0065] The control device 41 can be configured so as not to automatically change the speed when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing or when the time point at which the winding of the target winding number is finished is considerably earlier than the time point of the next doffing, and notify the speed change to the operator by the notifying section 101. A specific example of the notifying section 101 includes a patrol lamp and the like. Furthermore, when the input section 100 includes a liquid crystal display screen, a configuration for notifying the necessity of speed change as characters on the liquid crystal display screen may be adopted. According to such a configuration, the operator can freely set the winding speed intended by the operator. For example, if notified that the time point at which the winding of the target winding number is finished is considerably earlier than the time point of the next doffing when maintenance is to be performed on some winding units 42 of the automatic winder, the operator can set the winding speed of the automatic winder 4 to slow. Furthermore, instead of reducing the winding speed, the operator can stop the winding units 42 to which maintenance is to be performed. The winding efficiency of the automatic winder 4 is thereby lowered, but this can be canceled out with the time for which the automatic winder 4 is in a stopped state when the time point at which the winding of the target winding number is finished is considerably earlier than the time point of the next doffing. According to such a configuration, the operator can have more options, and flexible response can be made.

[0066] In the second embodiment of the present invention, the control device 41 calculates the time point at which the winding of the target winding number is finished from the time required to process the target winding number. Next, the winding speed of the winding unit 42 is increased when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing, the winding speed of the winding unit 42 is reduced when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and the winding speed of the winding unit 42 is not changed when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within a predetermined time.

[0067] A third embodiment of the present invention will now be described. In the third embodiment, description on the configurations common with the first embodiment and the second embodiment will be omitted.

[0068] In the third embodiment, the receiving section 41c of the automatic winder 4 is configured to receive only the fact that the doffing is executed from the transmitting section 31c of the spinning machine 3. Even in the general spinning machine 3 that does not have the function of transmitting the processing status information, the completion condition information, or the doffing information relating to the time until the next doffing, only the fact that the doffing is executed (doffing execution signal) can be transmitted. In the present embodiment, the control device 41 of the automatic winder 4 calculates the doffing information (time point of the next doffing or time required for one doffing) from the doffing execution signals received by the receiving section 41c in the past. The doffing number (number of yarn supplying bobbins 11 which can be supplied by the spinning machine 3 in one doffing) is input from the input section 100 by the operator. That is, in the case of the present embodiment, the receiving section 41c also functions as the input section. When the time point at which the winding of the target winding number is finished is later than the calculated time point of the next doffing, the control device 41 increases the winding speed of the winding unit 42. Furthermore, when the time point at which the winding of the target winding number is finished is considerably earlier than the calculated time point of the next doffing, the control device reduces the winding speed of the winding unit 42. The optimization of the operation control of the automatic winder 4 can be realized by controlling the operation of the automatic winder 4 based on the spinning information input by the operator.

[0069] Three embodiments of the present invention have been described above, but the present invention is not limited to such embodiments. For example, the transmission of the spinning information from the spinning machine 3 to the automatic winder 4 may not necessarily be carried out directly between the spinning machine 3 and the automatic winder 4, and for example, may be carried out via a predetermined relay device. In the embodiment described above, an example of controlling the operation (winding speed) of each winding unit 42 based on the processing status information has been described, but the control device 41 may control the operation of the bobbin preparing device 7 based on the processing status information. Similarly, in the embodiment described above, an example of controlling the preparatory operation of the bobbin preparing device 7 based on the completion condition information has been described, but the control device 41 may control the operation of each winding unit 42 based on the completion condition information.

Claims

1. An automatic winder (4) including a plurality of winding units (42) each adapted to wind a yarn from a yarn supplying bobbin (11) formed by a spinning machine (3) to form a package (15), the automatic winder (4) **characterized by** comprising:

   an input section (100) adapted to input spinning information including information relating to at

least one of a processing status of formation of the yarn supplying bobbin (11) and a doffing execution signal; and
a control section (41) adapted to determine a winding speed of when the winding unit (42) winds a yarn from the yarn supplying bobbin (11) based on the spinning information input by the input section (100) .

2. The automatic winder (4) according to claim 1, **characterized in that** the control section (41) is adapted to control an operation of the winding unit (42) to wind the yarn from the yarn supplying bobbin (11) at the determined winding speed based on the information relating to the processing status of the formation of the yarn supplying bobbin (11).

3. The automatic winder (4) according to claim 1 or 2, **characterized in that**
the control section (41) is adapted to:

- obtain a time point of next doffing of the spinning machine (3) based on the information relating to the processing status of the formation of the yarn supplying bobbin (11),
- obtain a yarn supplying bobbin processing time, which is a time required for the winding unit (42) to wind one yarn supplying bobbin (11), based on a target winding number, which is a number of yarn supplying bobbins (11) to be wound by the time point of the next doffing, and
- calculate a time required to process the target winding number to determine a winding speed of when the winding unit (42) winds the yarn from the yarn supplying bobbin (11).

4. The automatic winder (4) according to claim 3, **characterized in that**
the control section (41) is adapted to:

- calculate a time point at which winding of the target winding number is finished from the time required to process the target winding number,
- increase the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing,
- reduce the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and
- not to change the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within the predetermined time.

5. The automatic winder (4) according to claim 1, **characterized in that**
the control section (41) is adapted to:

- calculate doffing information based on the doffing execution signal serving as the spinning information input by the input section (100), and
- determine the winding speed of when the winding unit (42) winds a yarn from the yarn supplying bobbin (11) based on the calculated doffing information.

6. The automatic winder (4) according to claim 5, **characterized in that**
the control section (41) is adapted to:

- obtain a time point of next doffing of the spinning machine (3) based on the calculated doffing information,
- obtain a yarn supplying bobbin processing time, which is a time required for the winding unit (42) to wind one yarn supplying bobbin (11), based on a target winding number, which is a number of yarn supplying bobbins (11) to be wound by the time point of the next doffing, and
- calculate a time required to process the target winding number to determine a winding speed of when the winding unit (42) winds the yarn from the yarn supplying bobbin (11).

7. The automatic winder (4) according to claim 6, **characterized in that**
the control section (41) is adapted to:

- calculate a time point at which winding of the target winding number is finished from the time required to process the target winding number,
- increase the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing,
- reduce the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and
- not to change the winding speed of the winding unit (42) when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within the predetermined time.

8. The automatic winder (4) according to claim 4 or 7, **characterized in that** the control section (41) is adapted to change the winding speed of the winding unit (42) within a range of a fluctuation restriction that restricts a changing range of the winding speed.

9. The automatic winder (4) according to claim 8, **characterized in that** the fluctuation restriction is changeable by the input section (100) .

10. A winding speed control method for an automatic winder (4), the method comprising:

a first step of obtaining a time point of next doffing of a spinning machine (3) based on information relating to a processing status of formation of a yarn supplying bobbin (11);
a second step of calculating a target winding number, which is a number of yarn supplying bobbins (11) to be wound by the time point of the next doffing;
a third step of obtaining a yarn supplying bobbin processing time, which is a time required for the winding unit (42) to wind one yarn supplying bobbin (11); and
a fourth step of calculating a time required to process the target winding number to determine a winding speed of when the winding unit (42) winds the yarn from the yarn supplying bobbin (11).

11. The winding speed control method for the automatic winder (4) according to claim 10, **characterized in that**
in the fourth step, a time point at which winding of the target winding number is finished is calculated from the time required to process the target winding number,
the winding speed of the winding unit (42) is increased when the time point at which the winding of the target winding number is finished is later than the time point of the next doffing,
the winding speed of the winding unit (42) is reduced when the time point at which the winding of the target winding number is finished is earlier than the time point of the next doffing by greater than or equal to a predetermined time, and
the winding speed of the winding unit (42) is not changed when the time point at which the winding of the target winding number is finished is the same time point as the time point of the next doffing or earlier within the predetermined time.

FIG. 1

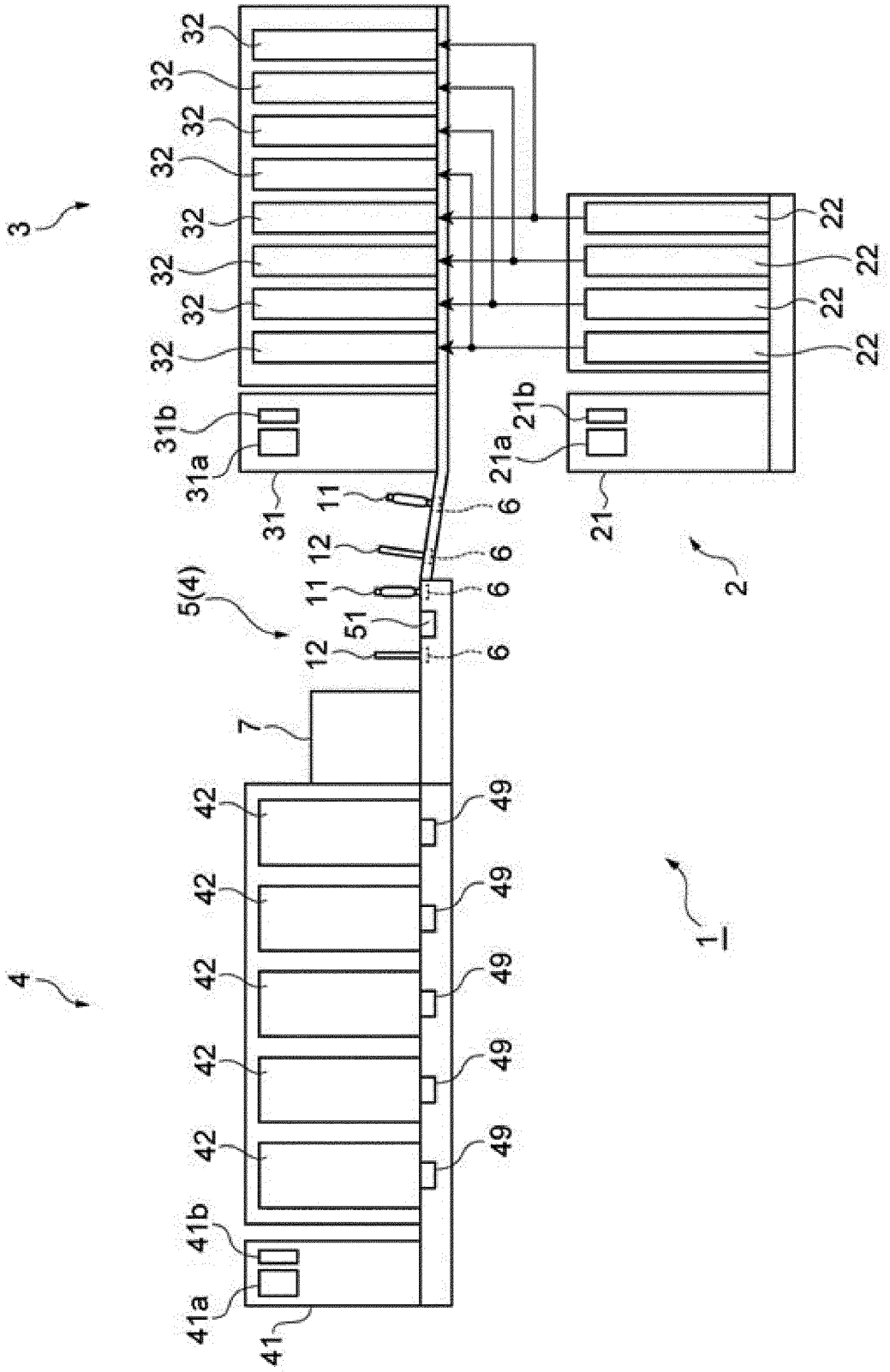


FIG. 2

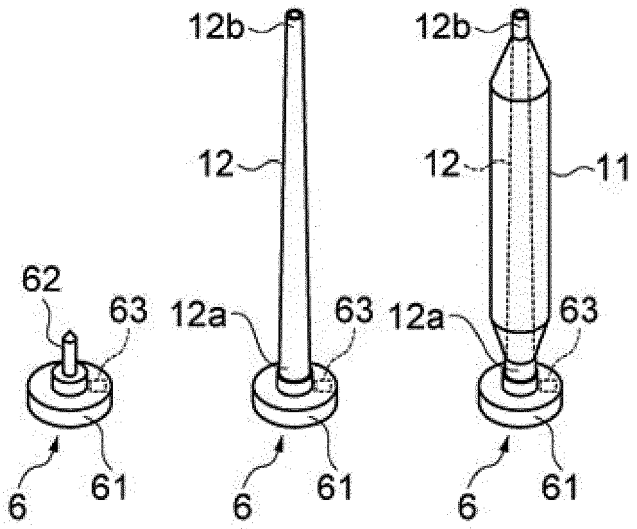


FIG. 3

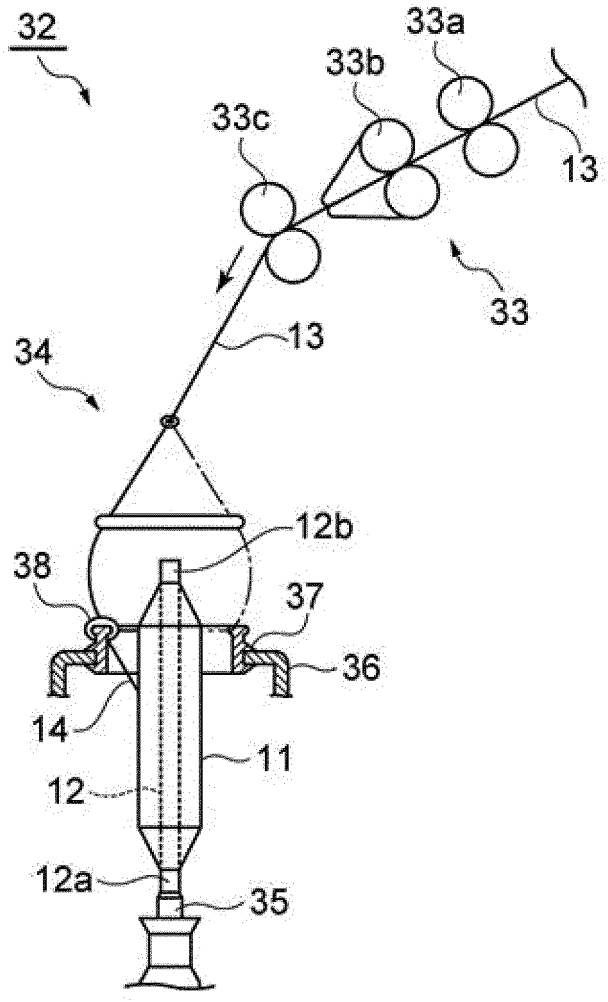


FIG. 4

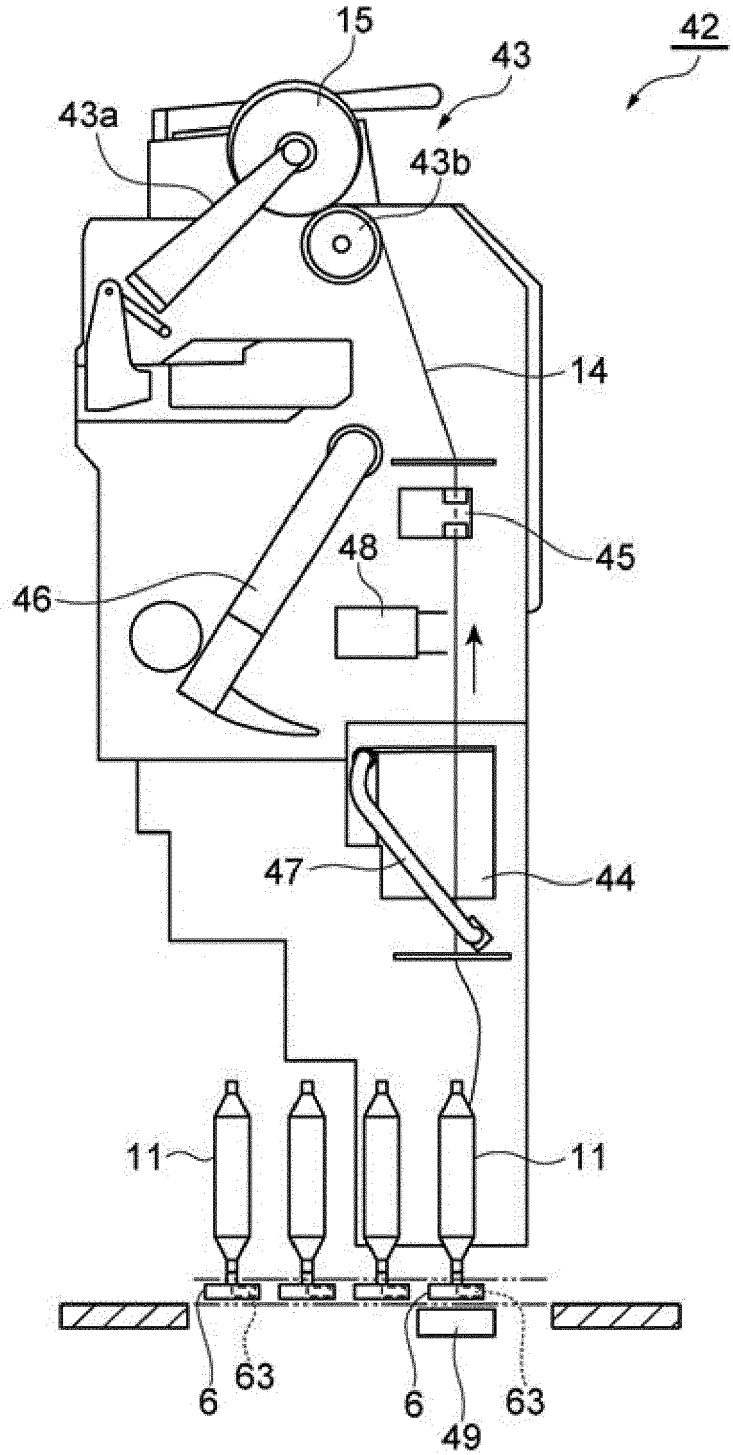


FIG. 5

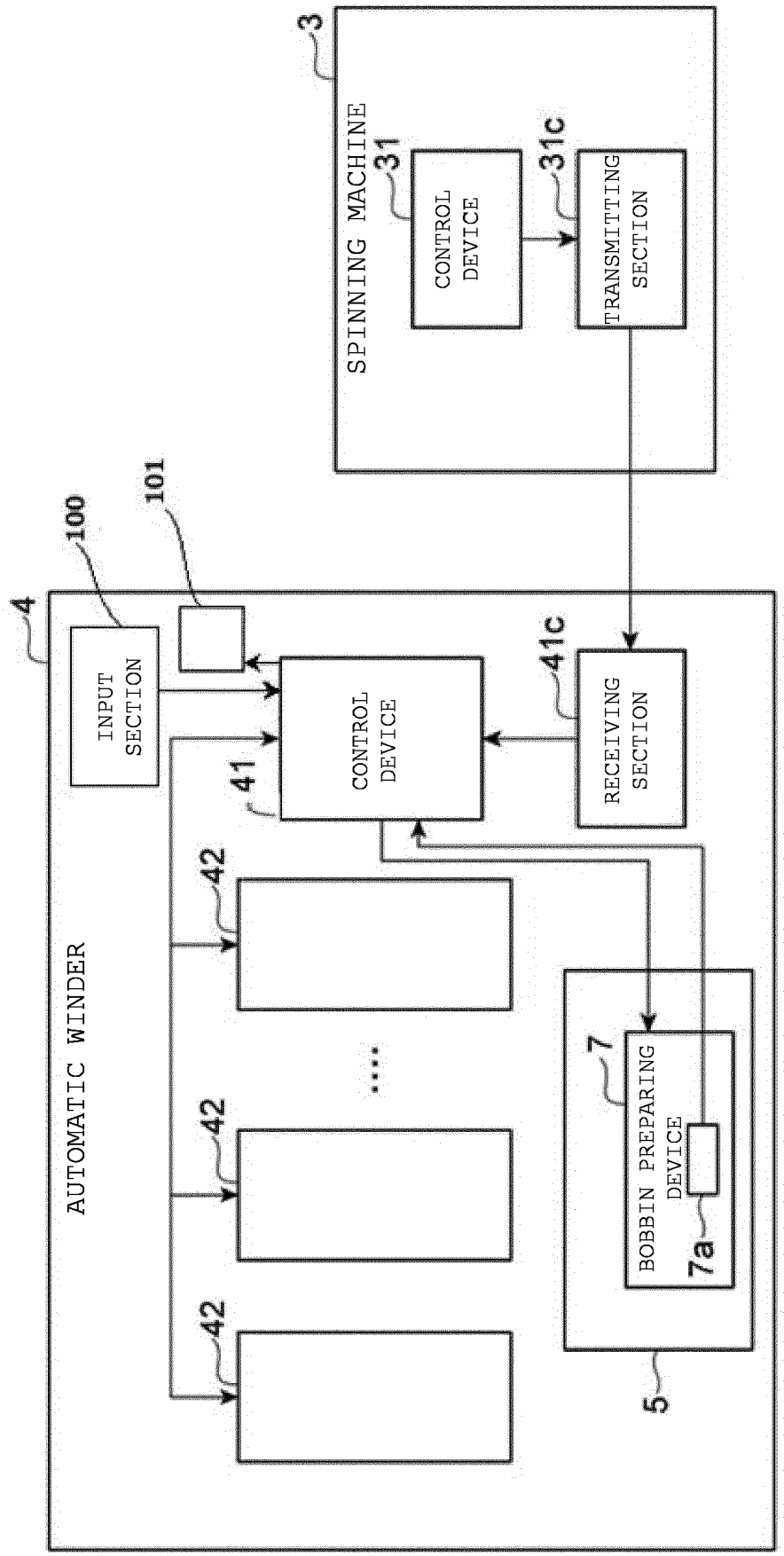

3
SPINNING MACHINE
31
CONTROL DEVICE
31c
TRANSMITTING SECTION
100
101
4
INPUT SECTION
41
CONTROL DEVICE
41c
RECEIVING SECTION
42
42
42
AUTOMATIC WINDER
7
BOBBIN PREPARING DEVICE
7a
5

FIG. 6

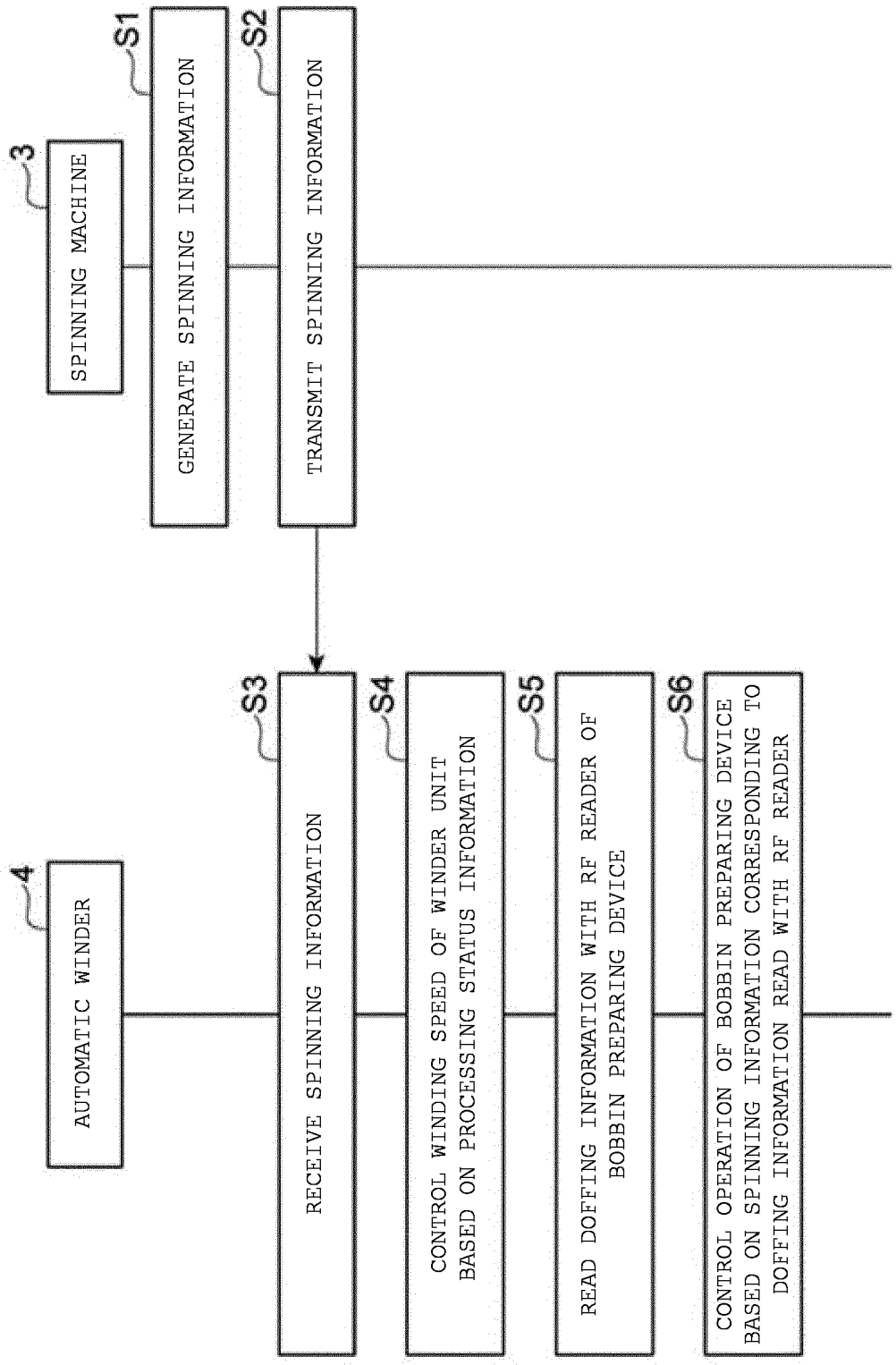

3
SPINNING MACHINE
S1
GENERATE SPINNING INFORMATION
S2
TRANSMIT SPINNING INFORMATION
4
AUTOMATIC WINDER
S3
RECEIVE SPINNING INFORMATION
S4
CONTROL WINDING SPEED OF WINDER UNIT BASED ON PROCESSING STATUS INFORMATION
S5
READ DOFFING INFORMATION WITH RF READER OF BOBBIN PREPARING DEVICE
S6
CONTROL OPERATION OF BOBBIN PREPARING DEVICE BASED ON SPINNING INFORMATION CORRESPONDING TO DOFFING INFORMATION READ WITH RF READER

FIG. 7

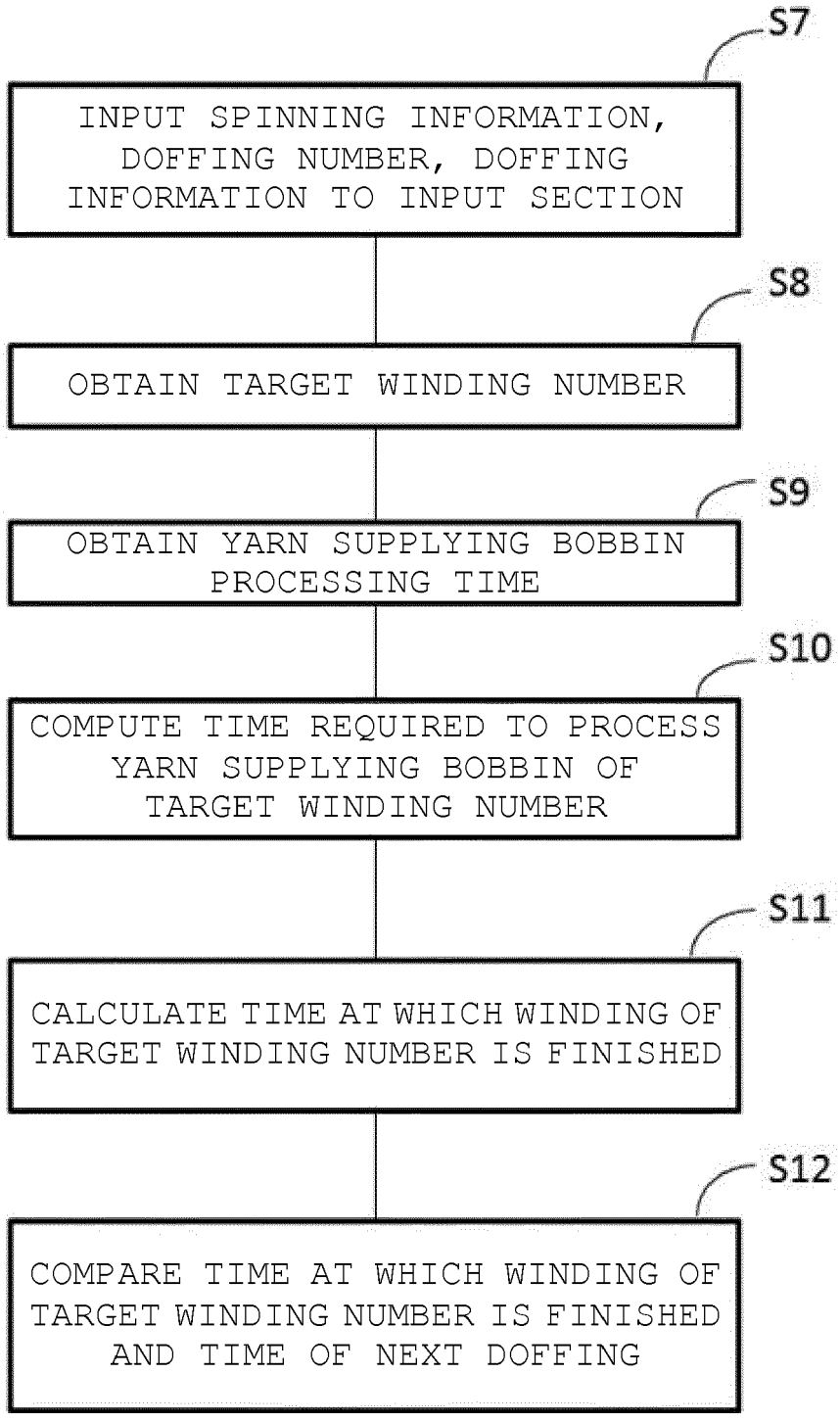
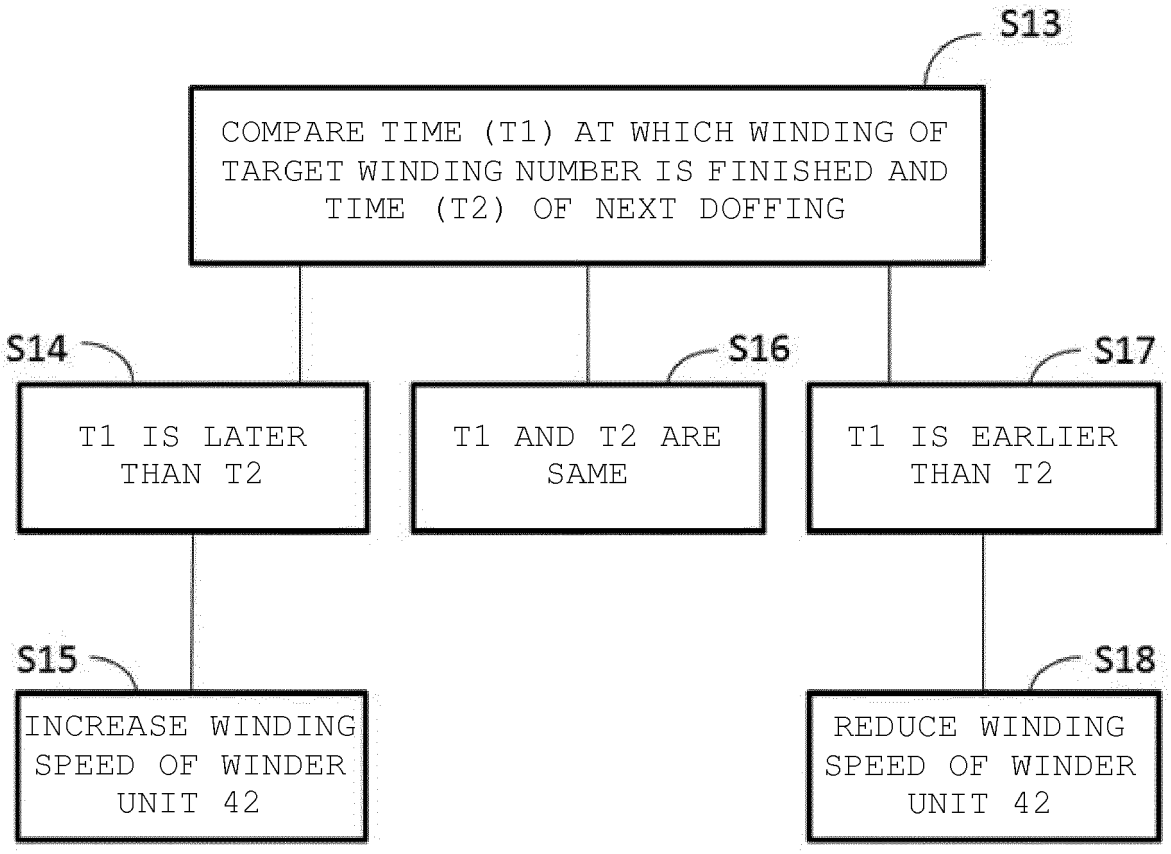

S7
INPUT SPINNING INFORMATION, DOFFING NUMBER, DOFFING INFORMATION TO INPUT SECTION
S8
OBTAIN TARGET WINDING NUMBER
S9
OBTAIN YARN SUPPLYING BOBBIN PROCESSING TIME
S10
COMPUTE TIME REQUIRED TO PROCESS YARN SUPPLYING BOBBIN OF TARGET WINDING NUMBER
S11
CALCULATE TIME AT WHICH WINDING OF TARGET WINDING NUMBER IS FINISHED
S12
COMPARE TIME AT WHICH WINDING OF TARGET WINDING NUMBER IS FINISHED AND TIME OF NEXT DOFFING

FIG. 8


S13
COMPARE TIME (T1) AT WHICH WINDING OF TARGET WINDING NUMBER IS FINISHED AND TIME (T2) OF NEXT DOFFING
S14
T1 IS LATER THAN T2
S16
T1 AND T2 ARE SAME
S17
T1 IS EARLIER THAN T2
S15
INCREASE WINDING SPEED OF WINDER UNIT 42
S18
REDUCE WINDING SPEED OF WINDER UNIT 42

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 3581

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 511 158 A1 (RIETER AG MASCHF [CH]) 28 October 1992 (1992-10-28) * column 1, lines 14-18 * * column 2, lines 27-31 * * column 3, lines 2-38 * * column 7, line 35 - column 8, line 14 * * column 14, lines 11-16; figures *	1-11	INV. B65H54/74 D01H9/18
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E	EP 3 305 953 A1 (MURATA MACHINERY LTD [JP]) 11 April 2018 (2018-04-11) * paragraphs [0038], [0040], [0042], [0044] - [0046], [0052], [0053], [0056]; claims 1,2; figures *	1,2,5	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 April 2018	Lemmen, René

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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26-04-2018

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