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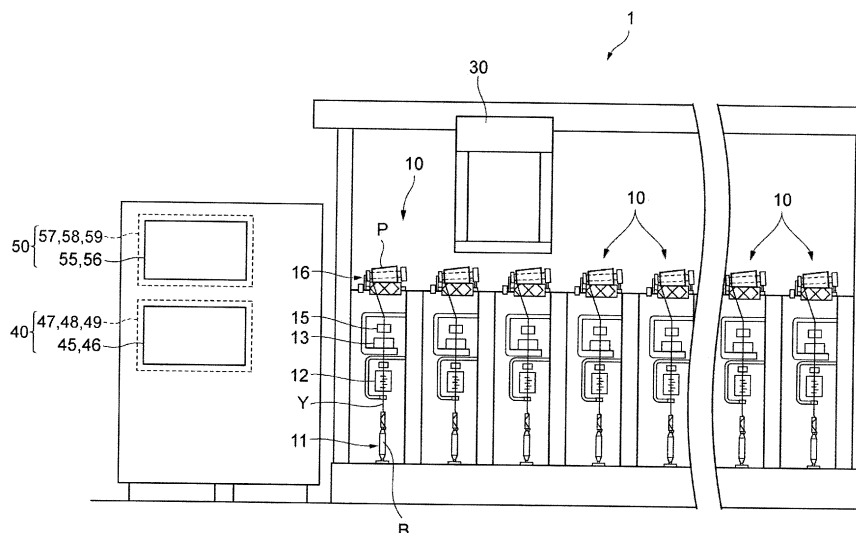
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(54) **PRODUCTIVITY DISPLAY CONTROL DEVICE, METHOD THEREOF, AND AUTOMATIC WINDER**

(57) A productivity display control device (40,50) to be provided in a yarn winding machine (1) including a plurality of winding units (10) each of which includes a yarn feeder (11) that supplies yarn (Y), a winding device (16) that winds the yarn (Y) supplied from the yarn feeder (11) to form a package, and a clearer (15) that detects a yarn defect of the yarn (Y) between the yarn feeder (11) and the winding device (16) and determines whether to remove the yarn defect based on a set clearing condition. The productivity display control device (40,50) includes

an arithmetic unit (47,57) that calculates productivity of the yarn winding machine (1) based on a winding condition set in the yarn winding machine (1), operation data of the yarn winding machine (1), and the number of removals of the yarn defects removed based on the clearing condition, and includes a display controller (48,58) that causes a display device to display information concerning the productivity calculated by the arithmetic unit (47,57).

Fig.1



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a productivity display control device, a method thereof, and an automatic winder.

BACKGROUND

[0002] In a yarn winding machine provided with yarn clearers, it has been known that a yarn defect is cut and removed in accordance with clearing conditions, and that the number of removals thereof is displayed (for example, see Paragraph 0045 of Japanese Unexamined Patent Publication No. 2007-211363, and Paragraph 0044 and FIG. 4 of Japanese Unexamined Patent Publication No. 2013-227155). A user of the yarn winding machine can, by observing the displayed number of removals of yarn defects, presume the productivity (capacity) of the yarn winding machine according to the clearing conditions.

SUMMARY

[0003] The accuracy of such a presumption of productivity is entrusted to the experience of the user. However, it is desirable that the user can directly (easily and appropriately) comprehend the productivity depending on the clearing conditions, without being dependent on experience that the user gained and without accruing an individual difference by the user. Furthermore, it is preferable that the productivity can be calculated without depending on the clearing conditions and can be presented to the user and that the user can simulate the productivity depending on the changes in the clearing conditions and winding conditions.

[0004] Thus, an object of the present disclosure is to provide a productivity display control device, a method thereof, and an automatic winder for which the user can directly comprehend the productivity.

[0005] A productivity display control device of the present disclosure is a productivity display control device that is to be provided in a yarn winding machine including a plurality of winding units each of which includes a yarn feeder configured to supply yarn, a winding device configured to wind the yarn supplied from the yarn feeder to form a package, and a clearer configured to detect a yarn defect of the yarn between the yarn feeder and the winding device and determine whether to remove the yarn defect based on a set clearing condition, the productivity display control device including an arithmetic unit configured to calculate productivity of the yarn winding machine based on a winding condition set in the yarn winding machine, operation data of the yarn winding machine, and the number of removals of the yarn defects removed based on the clearing condition, and a display controller configured to cause a display device to display information concerning the productivity calculated by the arith-

metic unit.

[0006] According to such a productivity display control device, the user of the yarn winding machine can directly comprehend the productivity of the yarn winding machine.

[0007] The productivity display control device of the present disclosure may further include a receiving unit configured to receive a change operation of at least one of the clearing condition, the winding condition, and the operation data, and the arithmetic unit may calculate a prediction of the productivity based on at least one of the number of removals of the yarn defects removed based on the clearing condition after change, the winding condition after change, and the operation data after change.

[0008] According to such a productivity display control device, the user can directly comprehend how the productivity changes by the changes in the clearing condition, the winding condition, and the operation data, and can also simulate the productivity.

[0009] In the productivity display control device of the present disclosure, the arithmetic unit may calculate the productivity based on at least a winding speed of the winding device winding the yarn, the number of the winding units, and the number of removals that is the number of the yarn defects determined to be removed based on the clearing condition.

[0010] According to such a productivity display control device, the user can directly comprehend the productivity depending on the changes in the clearing condition.

[0011] In the productivity display control device of the present disclosure, the display controller may cause the display device to display information concerning the productivity together with at least one of the clearing condition and the winding condition.

[0012] An automatic winder of the present disclosure is an automatic winder that includes a plurality of winding units each of which includes a yarn feeder configured to supply yarn, a winding device configured to wind the yarn supplied from the yarn feeder to form a package, and a clearer configured to detect a yarn defect of the yarn between the yarn feeder and the winding device and determine whether to remove the yarn defect based on a set clearing condition, and that includes the above-described productivity display control device. The yarn feeder supports a yarn wound body and supplies the yarn wound around the yarn wound body to the winding device, and the arithmetic unit calculates productivity of the automatic winder based on the winding condition set in the automatic winder, the operation data of the automatic winder, and the number of removals of the yarn defects removed based on the clearing condition.

[0013] According to such an automatic winder, in the automatic winder for which the difference in the clearing condition and the winding condition affects the productivity, the user can usefully comprehend the productivity of the automatic winder.

[0014] The automatic winder of the present disclosure may include a machine control device configured to in-

tegrally manage the plurality of winding units, and a clearer upper control device configured to integrally manage the plurality of clearers. The machine control device may include a winding setting unit configured to set the winding condition, and a first communication unit configured to perform communication with the clearer upper control device, and the clearer upper control device may include a clearing setting unit configured to set the clearing condition and a second communication unit configured to perform communication with the machine control device. The machine control device and the clearer upper control device may be configured to be capable of performing transmitting and receiving with each other via the first communication unit and the second communication unit, and at least one of the machine control device and the clearer upper control device may serve as the productivity display control device to calculate the productivity.

[0015] In the automatic winder of the present disclosure, by a bobbin transportation device that couples the automatic winder to a ring spinning frame configured to simultaneously start building and doff a plurality of spinning bobbins at a certain spinning cycle, the doffed spinning bobbin may be transported to the automatic winder; and the yarn feeder may support the spinning bobbin transported by the bobbin transportation device as the yarn wound body.

[0016] In the automatic winder of the present disclosure, the productivity that the arithmetic unit calculates may be at least one of the number of packages produced per unit time; the weight of packages produced per unit time; the length of the yarn wound as the packages per unit time; the weight of the yarn wound as the packages per unit time; the winding time needed for a certain number of winding units to wind the yarn of the spinning bobbins that are doffed by the ring spinning frame in a single spinning cycle to form the packages; the waiting time until the spinning bobbins to be doffed by the ring spinning frame at a subsequent spinning cycle are supplied to the automatic winder after a certain number of winding units wind the yarn of the spinning bobbins that were doffed by the ring spinning frame at a previous spinning cycle to form the packages; and the number of the winding units needed for winding the spinning bobbins that were doffed by the ring spinning frame at a previous spinning cycle to form the packages until the spinning bobbins to be doffed by the ring spinning frame at a subsequent spinning cycle are supplied to the automatic winder.

[0017] A productivity display control method of the present disclosure is a productivity display control method that is executed by the above-described productivity display control device, and the method includes a first step of changing the clearing condition; a second step of calculating the number of removals of the yarn defects predicted based on the clearing condition that was changed at the first step and data of the detected yarn defect; a third step of calculating a prediction of productivity based on the number of removals calculated at the

second step, the winding condition, and operation data of the yarn winding machine; and a fourth step of causing the display device to display a prediction of the productivity calculated at the third step.

[0018] According to such a productivity display control method, the user of the yarn winding machine can directly comprehend the productivity of the yarn winding machine that is predicted when the clearing condition is changed.

[0019] According to the present disclosure, the user can directly comprehend the productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a front view of an automatic winder of one embodiment.

FIG. 2 is a schematic diagram illustrating a configuration in which the automatic winder of the one embodiment and a ring spinning frame are coupled.

FIG. 3 is a control block diagram of the automatic winder of the one embodiment.

FIG. 4 is a diagram illustrating a clearing-condition setting screen of the one embodiment.

FIG. 5 is a control flow diagram illustrating a productivity display control method of the one embodiment.

FIG. 6 is a diagram illustrating a productivity display screen as another embodiment.

DETAILED DESCRIPTION

[0021] The following describes an exemplary embodiment of the present disclosure with reference to the accompanying drawings. In the respective drawings, identical or equivalent portions are given identical reference signs and redundant explanations are omitted.

[0022] In a textile machinery factory to which a productivity display control device of the present embodiment is applied, as illustrated in FIG. 2, at least a single automatic winder 1 and at least a single ring spinning frame 2 (hereinafter simply referred to as spinning frame also) are installed. The single automatic winder 1 and the single ring spinning frame 2 are coupled via a bobbin transportation device 3. The automatic winder 1, as illustrated in FIGS. 1 and 2, winds yarn Y from a spinning bobbin B prepared by the spinning frame 2 to form a package P.

Configuration of Ring Spinning Frame

[0023] The spinning frame 2 is a preceding process machine of the automatic winder 1 and includes a plurality of spinning units 20 that build the spinning bobbins B and a control device that controls the respective spinning units 20. Each spinning unit 20 includes a drafting device and a twisting device.

[0024] The spinning frame 2 is configured as what is called a simultaneous doffing type. The spinning frame 2 simultaneously starts building and doffs (doffing) a plu-

ality of spinning bobbins B at a certain spinning cycle, by the plurality of spinning units 20. The spinning frame 2 performs, in a single spinning cycle, setting of empty bobbins (bobbins on which yarn is not wound) E to the respective spinning units 20, building of the spinning bobbins B, and doffing.

[0025] That is, the spinning frame 2 stocks a plurality of empty bobbins E, simultaneously sets the empty bobbins E to the respective spinning units 20, and simultaneously starts the spinning and the winding. When the winding of the yarn Y is completed and when the spinning bobbins B are built in the respective spinning units 20, the spinning frame 2 doffs all of the spinning bobbins B simultaneously.

[0026] In the spinning frame 2, until subsequent doffing from previous doffing, the empty bobbins E from the automatic winder 1 are transported by the bobbin transportation device 3 in a state in which the empty bobbins E are set to trays T, in the spinning frame 2, the empty bobbins E are stocked.

[0027] The spinning frame 2 takes out the stocked empty bobbins E from the trays T and sets them again to the respective spinning units 20 simultaneously, and in place of those, sets the spinning bobbins B that have been doffed to the trays T simultaneously. The doffed spinning bobbins B are transported to the automatic winder 1 via the bobbin transportation device 3.

Configuration of Bobbin Transportation Device

[0028] The bobbin transportation device 3, as in the foregoing, transports the spinning bobbins B from the spinning frame 2 to the automatic winder 1 and transports the empty bobbins E from the automatic winder 1 to the spinning frame 2.

[0029] The bobbin transportation device 3 has a transportation guidepath on which the trays T are transported. The respective spinning bobbins B and the empty bobbins E are transported along the transportation guidepath, in a state in which they are set to the trays T.

Configuration of Automatic Winder

[0030] The automatic winder 1, as illustrated in FIGS. 1 and 3, includes a plurality of winding units 10 that form the package P from the spinning bobbin B, a doffer 30 that doffs the package P, a machine control device (productivity display control device) 40 that controls the respective winding units 10 and the doffer 30, and a clearer upper control device 50.

1. Winding Unit

[0031] The winding unit 10 includes, in order from the upstream side toward the downstream side of a yarn path, a yarn feeder 11, a tension applying device 12, a yarn joining device 13, a yarn clearer (clearer) 15 (hereinafter simply referred to as clearer), and a winding device

16.

[0032] The yarn feeder 11 is a device that supports the spinning bobbin B as a yarn wound body and supplies the yarn Y to the winding device 16.

5 **[0033]** The tension applying device 12 is a device that applies a certain tension to the yarn Y that runs from the yarn feeder 11 toward the winding device 16.

[0034] The yarn joining device 13 is a device that connects ends of the yarn Y that have been severed for some reason, such as the yarn Y was cut as a yarn defect was detected.

10 **[0035]** The clearer 15 monitors, between the yarn feeder 11 and the winding device 16, the state of the yarn Y running from the yarn feeder 11 toward the winding device 16, and detects a yarn defect (for example, abnormality in yarn thickness, and mixing of foreign matters into yarn). The clearer 15 determines, based on clearing conditions that have been set, whether to remove a detected yarn defect. When it is determined that the yarn defect be removed, the yarn Y is cut (severed) by a cutter in order to remove the relevant yarn defect. The cutter is fixed on the clearer 15. However, the cutter may be provided separately from the clearer 15.

15 **[0036]** The clearer 15 transmits data concerning the yarn defect (yarn defect data) to the clearer upper control device 50. The yarn defect data is the information on respective yarn defects and the number of removals of yarn defects, for example. The information on yarn defects is the thickness (diameter or equivalent of the amount of fibers) and the length of the respective yarn defects, for example. That is, the information on yarn defects represents yarn defect distribution. The clearer 15 may transmit to the machine control device 40 the number of removals of yarn defects, that is, the number of times of clearer's cut that is the number of times that the clearer 15 has cut the yarn. In this case, the machine control device 40 can comprehend the total number of removals of yarn defects that were actually removed by the plurality of clearers 15 in the automatic winder 1.

20 **[0037]** The winding device 16 is a device that winds the yarn Y supplied from the yarn feeder 11 to form the package P.

2. Doffer

25 **[0038]** The doffer 30 is a device that doffs the package P formed by the respective winding units 10, and is provided for the winding units 10. The doffer 30 dispenses the doffed package P to a certain location (a conveyer provided behind the machine, for example).

3. Machine Control Device

30 **[0039]** The machine control device 40 includes a first storage unit, a first display unit (display device) 45, a first operating unit (receiving unit, winding setting unit) 46, a first arithmetic unit (arithmetic unit) 47, a first display controller (display controller) 48, and a first communication

unit 49. The first storage unit, the first arithmetic unit 47, the first display controller 48, and the first communication unit 49 are constituted by an electronic control unit that includes a central processing unit (CPU), a read only memory (ROM), a random-access memory (RAM), an electrically erasable programmable read only memory (EEPROM), a communication device, and a storage device.

[0040] The first communication unit 49 performs communication with a second communication unit 59 in the clearer upper control device 50 and can receive data that the clearer upper control device 50 retains. The first communication unit 49 can further transmit, to the clearer upper control device 50, data that the machine control device 40 retains. In the present embodiment, the first communication unit 49 transmits to the clearer upper control device 50 the productivity that is calculated as described later.

[0041] In the first storage unit, winding conditions, operation data, and the number of removals of yarn defects are stored. The winding conditions are, for example, a winding speed, a count of spinning bobbins B, and the number of the winding units 10, and are set and stored for each lot. The winding conditions are set by a user via the first operating unit 46. The operation data are, for example, the number of times of various misses, miss rates, the number of times of various alarms, and various efficiencies. The number of removals of yarn defects is the total number of removals of yarn defects that are removed by the plurality of clearers 15 in the automatic winder 1. Furthermore, the number of removals of yarn defects includes the actual value, and a predicted value (the predicted number of removals) which will be described later. The number of times of misses and the miss rates are the number of misses in yarn joining and the miss rate of the yarn joining, for example. The number of times of alarms is the number of times of alarms due to misses in pick finding of yarn end and the number of times of alarms due to misses in yarn joining, for example. The alarm due to a miss in pick finding of yarn end is an alarm that is raised as the capturing of a yarn end of the yarn wound around the package P (or the yarn wound around the spinning bobbin B) by a yarn-end capturing member is consecutively failed and as the number of times of consecutive failures exceeds the prescribed number of times. The efficiencies are "the ratio (SEF%) of winding time of the winding device 16 winding the yarn Y to the blower operating time" and "the ratio (AEF%) of the winding time of the winding device 16 winding the yarn Y to the shift time", for example. As for the efficiencies (SEF%, AEF%), when the clearing conditions and the number of removals of yarn defects for example are changed, the values are changed. As for the operation data to use for the calculation of the productivity, it is preferable to use at least one of the above-described various operation data. However, the operation data is not limited to the above-described specific examples. In the first storage unit, the calculated productivity is also

stored.

[0042] The first arithmetic unit 47 calculates the productivity of the automatic winder 1 based on the winding conditions, the operation data, and the number of removals of yarn defects that are removed based on the clearing conditions.

[0043] Specifically, the first arithmetic unit 47 calculates the current productivity based on at least the current winding speed and the number of the winding units 10 that are stored in the first storage unit, the operation data, and the actual number of removals of yarn defects by the current clearing conditions. This actual number of removals may be received from the clearer upper control device 50 or may be the number of times of clearer's cut that is the number of times the clearer 15 has cut the yarn Y that the machine control device 40 itself retains, without depending on the clearer upper control device 50. The number of removals of yarn defects used for the calculation of productivity is the total number of removals of yarn defects that are removed by the plurality of clearers 15 in the automatic winder 1.

[0044] Furthermore, the first arithmetic unit 47 calculates a prediction of the productivity based on at least the current winding speed and the number of winding units 10 that are stored in the first storage unit, the operation data, and the number of removals of yarn defects (the predicted number of removals) by the clearing conditions after change that is received from the clearer upper control device 50. That is, the prediction of the productivity is the productivity that is predicted assuming that the yarn Y is wound based on the clearing conditions and others after change.

[0045] In the first display unit 45, at least the winding conditions and the operation data are displayed.

[0046] The first operating unit 46 is a portion that is operated by the user. The user can newly set and change the winding conditions and change the operation data, by operating the first operating unit 46. The change of operation data is enabled for the purpose of productivity simulation. The change of winding conditions is also enabled for the purpose of productivity simulation in addition to the normal setting change. As just described, the first operating unit 46 receives the input (new setting operation, change operation) of the winding conditions and the operation data.

[0047] The first display unit 45 and the first operating unit 46 in the present embodiment are made up of a touch panel. However, the configuration of the first display unit 45 and the first operating unit 46 is not limited to the touch panel.

[0048] The first display unit 48 causes the first display unit 45 to display at least the winding conditions and the operation data.

4. Clearer Upper Control Device

[0049] The clearer upper control device 50 is a device that integrally manages the plurality of clearers 15. Each

of the clearers 15, as in the foregoing, detects a yarn defect in the respective winding units 10.

[0050] The clearer upper control device 50 includes a second storage unit, a second display unit (display device) 55, a second operating unit (receiving unit, clearing setting unit) 56, a second arithmetic unit (arithmetic unit) 57, a second display controller (display controller) 58, and a second communication unit 59. The second storage unit, the second arithmetic unit 57, the second display controller 58, and the second communication unit 59 are constituted by an electronic control unit that includes a central processing unit (CPU), a read only memory (ROM), a random-access memory (RAM), an electrically erasable programmable read only memory (EEPROM), a communication device, and a storage device.

[0051] The second communication unit 59 performs communication with the respective clearers 15 and can receive from each clearer 15 the yarn defect data that the respective clearers 15 retain and transmit the clearing conditions to the respective clearers 15. Furthermore, the second communication unit 59 performs communication with the first communication unit 49 and can transmit to the machine control device 40 the data that the clearer upper control device 50 retains. Moreover, the second communication unit 59 can receive, from the machine control device 40, the data that the machine control device 40 retains. In the present embodiment, the second communication unit 59 transmits to the machine control device 40 the number of removals of yarn defects as the clearing data.

[0052] The second arithmetic unit 57 calculates the actual value and a predicted value of the number of removals of yarn defects. The calculation includes a count. The actual value and the predicted value of the number of removals of yarn defects that the second arithmetic unit 57 calculates are the total number of removals of yarn defects that are removed by the plurality of clearers 15 in the automatic winder 1. That is, the second arithmetic unit 57 calculates the actual value of the number of removals of yarn defects by summing the actual number of removals of yarn defects transmitted from the respective clearers 15. For example, the second arithmetic unit 57 calculates, as the predicted value of the number of removals of yarn defects, the total number of removals of yarn defects that are predicted when the yarn defects are removed by the plurality of clearers 15 based on certain clearing conditions.

[0053] In the second storage unit, the clearing conditions that have been set, the information on yarn defects transmitted from the respective clearers 15, the number of removals of yarn defects, and others are stored.

[0054] In the second display unit 55, displayed is a clearing-condition setting screen as illustrated in FIG. 4. In the clearing-condition setting screen, displayed on a two-dimensional field Sf are yarn defect distribution and clearing limits Lc and Ln that are the clearing conditions.

[0055] The two-dimensional field Sf is a coordinate system with the length and thickness of yarn defects as

the respective coordinate axes. The length of the yarn defect is an X-axis and the thickness (ratio to a reference thickness of the yarn) of the yarn defect is a Y-axis. The clearing limits Lc and Ln are boundary lines of whether to remove a yarn defect that the clearer 15 detected.

[0056] Out of the yarn defects displayed on the two-dimensional field Sf, the yarn defects that are in an area on the opposite side of the reference thickness side (the thickness of yarn defect is on the 0% X-axis side) of the yarn with respect to the clearing limits Lc and Ln are the yarn defects to be removed, and the yarn defects that are in the area on the reference thickness side of the yarn are the yarn defects allowed to remain without being removed.

[0057] The second operating unit 56 is a portion that is operated by the user for changing the clearing conditions. The user can newly set and change the clearing conditions, by operating the second operating unit 56. That is, the second operating unit 56 receives the input (new setting operation, change operation) of the clearing conditions.

[0058] The second display unit 55 and the second operating unit 56 in the present embodiment are made up of a touch panel. However, the configurations thereof are not limited to the touch panel.

[0059] The second display controller 58 generates the two-dimensional field Sf, and causes the second display unit 55 to display the clearing limits Lc and Ln by lines in an overlapping manner on the two-dimensional field Sf.

[0060] Furthermore, the second display controller 58 determines, based on the information on yarn defects stored in the second storage unit, the positions of the respective yarn defects in the two-dimensional field Sf, and causes the second display unit 55 to display the yarn defect distribution by dots (in the present embodiment, white circles and black squares). The display method of the yarn defect distribution is not limited to dots.

[0061] The second display controller 58 further causes the second display unit 55 to display current value fields Sc and new value fields Sn.

[0062] In the current value fields Sc, the number of removals of yarn defects and the productivity are displayed as a result of yarn processing by the current clearing conditions.

[0063] The number of removals of yarn defects in the current value fields Sc is the actual number of removed yarn defects (equivalent to the number of times of clearer's cut) and is equivalent to the number of dots of yarn defects that are in the area on the opposite side of the reference thickness side with respect to the current clearing limit Lc.

[0064] In the new value fields Sn, the number of removals of yarn defects and the productivity are displayed as the prediction of yarn processing by the clearing conditions after change. The clearing conditions after change may be either of the clearing conditions for which the change has been decided and the clearing conditions that are in simulation and for which the change has not

yet been established.

[0065] The number of removals of yarn defects in the new value fields S_n is a predicted value based on the information on the yarn defects currently retained (yarn defect distribution data) and on the clearing conditions after change, and is equivalent to the number of dots of yarn defects that are in the area on the opposite side of the reference thickness side (the thickness of yarn defect is on the 0% X-axis side) of the yarn with respect to the clearing limit L_n after change.

[0066] The number of removals of yarn defects displayed in the respective fields may be a value converted into per unit length (for example, 100 km), may be a value converted into per unit time or per unit period (for example, for each 1 hour, for each shift, or for each spinning cycle), or may be a total number of removals subsequent to the setting of the current clearing conditions.

[0067] As for the number of removals of yarn defects, the value for each kind of yarn defects (for example, respective numbers of nep N, slub S, long L, and thin T) and a total value (ALL) are displayed. However, as for the number of removals of yarn defects, only either one of the value for each kind of yarn defects and the total value may be displayed.

[0068] In the present embodiment, as the productivity, the production number of packages P per unit time and the winding time that is needed for the winding devices 16 to wind the yarn Y of the spinning bobbins B that are doffed in a single spinning cycle to form the packages P are displayed.

[0069] The second arithmetic unit 57, when the clearing conditions are changed, calculates the number of removals of yarn defects (also referred to as the predicted number of removals) that is predicted based on the clearing conditions after change.

[0070] The second communication unit 59 transmits the predicted number of removals to the machine control device 40 when the clearing conditions are changed and when the second arithmetic unit 57 calculated the predicted number of removals.

Control Flow

[0071] Next, one example of the productivity display control method according to the above-described configuration will be described. FIG. 5 illustrates a control flow that calculates and displays a prediction of the productivity when the clearing conditions are changed.

[0072] First, when the clearing conditions are changed in the clearer upper control device 50 (Step S01: first step), the clearer upper control device 50 calculates the predicted number of removals corresponding to the clearing conditions after change (Step S02: second step). Then, the clearer upper control device 50 transmits the predicted number of removals to the machine control device 40.

[0073] The machine control device 40, after receiving the predicted number of removals, calculates a prediction

of the productivity of the automatic winder 1 based on the predicted number of removals received, the winding conditions, and the operation data (Step S03: third step). Then, the machine control device 40 transmits the calculated prediction of the productivity to the clearer upper control device 50.

[0074] The clearer upper control device 50, after receiving the prediction of the productivity, displays the productivity on the second display unit 55 (Step S04: fourth step). As illustrated in FIG. 4, the productivity and the clearing conditions are displayed at the same time.

Effects by Embodiment

[0075] According to the automatic winder 1 of the present embodiment, when the clearing conditions are changed, in the clearing-condition setting screen, the number of removals of yarn defects corresponding to the clearing conditions after change and the predicted value of productivity (prediction of productivity) are displayed.

[0076] Consequently, the user can comprehend the productivity corresponding to the clearing conditions directly, easily, and appropriately.

[0077] Furthermore, according to the automatic winder 1 of the present embodiment, because the productivity can be calculated by using the number of times of clearer's cut that the storage unit of the machine control device 40 stores therein as the actual value of the number of removals of yarn defects in place of the predicted value of the number of removals of yarn defects that the clearer upper control device 50 calculates, it is also possible to calculate the current productivity without depending on the clearing conditions and provide it to the user.

[0078] Moreover, according to the automatic winder 1 of the present embodiment, the user can change the clearing conditions via the second operating unit 56 and simulate the productivity corresponding to this change. The user can further change the winding conditions via the first operating unit 46 and simulate how the productivity changes in response to this change. The user can further change the operation data via the first operating unit 46 and simulate how the productivity changes in response to this change. For example, in a pre-arranged simulation mode, when at least one of the winding conditions and the operation data is changed by the user via the first operating unit 46, the first arithmetic unit 47 of the machine control device 40 calculates a prediction of the productivity, and the first display controller 48 causes the first display unit 45 to display the calculated prediction of the productivity.

Modifications

[0079] As in the foregoing, one embodiment of the present disclosure has been described. However, the embodiment of the disclosure is not limited thereto. For example, the embodiment can be modified as follows.

Control Device to Calculate Productivity

[0080] In the above-described embodiment, the clearer upper control device 50 transmitted the number of removals of yarn defects as the clearing data to the machine control device 40, and the machine control device 40 calculated the productivity. However, the device that calculates the productivity is not limited to the machine control device 40. For example, the machine control device 40 may transmit the winding conditions and the operation data to the clearer upper control device 50, and the second arithmetic unit 57 of the clearer upper control device 50 (productivity display control device) may calculate the productivity. Furthermore, a control device that is separate from the machine control device 40 and the clearer upper control device 50 may serve as the productivity display control device to calculate the productivity.

[0081] The machine control device 40 and the clearer upper control device 50 may be not separate devices but a single (common) control device.

Display Device to Display Productivity

[0082] In the above-described embodiment, the second display controller 58 of the clearer upper control device 50 caused the second display unit 55 to display the productivity. The display device on which the productivity is displayed is not limited thereto. For example, the first display controller 48 of the machine control device 40 may cause the first display unit 45 to display the productivity. At this time, as illustrated in FIG. 6, the productivity may be displayed together with the winding conditions. However, the productivity may be displayed together with the operation data.

[0083] The display unit of the machine control device 40 and the display unit of the clearer upper control device 50 may be not separate display units but a single (common) display unit.

[0084] The productivity may be displayed on a display device other than the first display unit 45 of the machine control device 40 and the second display unit 55 of the clearer upper control device 50. At this time, the control device including the arithmetic unit that calculated the productivity may transmit the information on the productivity to the relevant display device (for example, mobile terminal) and control the relevant display device so as to be able to display the productivity.

Method of Display

[0085] The display of productivity is not limited to displaying in numerical values. For example, the productivity may be presented to the user, by changing the color of the clearing-condition setting screen. More specifically, in displaying the clearing limits after change in the clearing-condition setting screen, if the predicted value of the productivity is lower than a predetermined certain value

(if the productivity is inferior to a threshold value), the background color of the clearing-condition setting screen may be displayed in red, or the clearing limits themselves may be displayed in red.

[0086] In response to the changes in the clearing conditions, character messages such as "productivity deterioration" and "productivity improvement" may be displayed on the display unit.

[0087] The productivity may be displayed at the same time on the display unit identical to the display unit that displays the clearing conditions, may be displayed on the identical display unit by shifting the time, or may be displayed on a separate display unit at the same time or with a time lag. For example, as illustrated in FIG. 1, in a case where the second display unit 55 of the clearer upper control device 50 and the first display unit 45 of the machine control device 40 are installed in juxtaposition at the machine end portion of the automatic winder 1, in conjunction with displaying the clearing conditions after change on the second display unit 55 of the clearer upper control device 50, the productivity corresponding to the clearing conditions after change may be displayed on the first display unit 45 of the machine control device 40.

Kinds of Productivity

[0088] In the above-described embodiment, as the productivity, the production number of packages P per unit time, and the winding time are displayed. However, at least one of the items listed below may be displayed as the productivity. The items listed below, however, are one example and the other items may be calculated and displayed as the productivity.

- The number of the packages P produced per unit time.
- The weight of the packages P produced per unit time.
- The length of the yarn Y wound as the packages P per unit time.
- The weight of the yarn Y wound as the packages P per unit time.
- The winding time needed for a certain number of the winding units 10 to wind the yarn Y of the spinning bobbins B that are doffed by the ring spinning frame 2 in a single spinning cycle to form the packages P.
- The waiting time until the spinning bobbins B to be doffed by the ring spinning frame 2 at a subsequent spinning cycle are supplied to the automatic winder 1 after a certain number of the winding units 10 wind the yarn Y of the spinning bobbins B that were doffed by the ring spinning frame 2 at a previous spinning cycle to form the packages P.

- The number of winding units needed for winding the spinning bobbins B that were doffed by the ring spinning frame 2 at a previous spinning cycle to form the packages P until the spinning bobbins B to be doffed by the ring spinning frame 2 at a subsequent spinning cycle are supplied to the automatic winder 1.

[0089] In a single textile machinery factory, it is normal that a plurality of ring spinning frames 2 and a plurality of automatic winders 1 are installed. Then, the ring spinning frame 2 and the automatic winder 1 are not coupled by the bobbin transportation device 3, and the supply (transportation) of the spinning bobbins B to the automatic winder 1 is often performed manually. Even in such a case, by considering the entire factory, the winding time, which is needed for winding the spinning bobbins B that all or any number of the spinning frames 2 or the spinning units 20 installed in the factory doff at one time by all or any number of the automatic winders 1 or the winding units 10 installed in the factory, or the waiting time may be calculated. When the automatic winder 1 is not coupled to the ring spinning frame 2 by the bobbin transportation device 3, the calculated productivity may be any one of four kinds of package production quantity of the number of the packages P produced per unit time, the weight of the packages P produced per unit time, the length of the yarn Y wound as the packages P per unit time, and the weight of the yarn Y wound as the packages P per unit time. When the respective automatic winders 1 and the respective winding units 10 perform winding in different lots, the respective time may be calculated in units of lot.

Others

[0090] The productivity is not limited to be calculated and displayed for each machine of the automatic winder 1, and it may be calculated and displayed in units useful for the user such as in units of a certain group, in units of lot, and in units of shift.

[0091] The yarn wound body that the yarn feeder 11 supports is not limited to the spinning bobbin B, and it may be a yarn feeding package.

[0092] The clearer upper control device 50 may transmit, as the clearing data, a clearing condition name together with the yarn defect data to the machine control device 40 or have no need to transmit it.

[0093] The clearer upper control device 50, when the machine control device 40 calculates the current productivity, may have no need to transmit the number of removals of yarn defects as the clearing data. The machine control device 40 can receive the actual values of the number of removals of yarn defects from the respective winding units 10.

[0094] The clearing data may be directly input by the user by manually operating the first operating unit 46 of the machine control device 40. That is, the machine control device 40 and the clearer upper control device 50

may be configured to be unable to perform communication.

[0095] Furthermore, in the configuration in which the automatic winder 1 and the ring spinning frame 2 are coupled by the bobbin transportation device (coupling unit) 3 as illustrated in FIG. 2, a sensor (hereinafter referred to as spinning sensor) that acquires information by which the quality of the spinning bobbin B can be determined is installed in the ring spinning frame 2. Then, in this configuration, the yarn Y of the spinning bobbin B that is determined to be defective based on the information acquired by the spinning sensor may be ejected without winding it by the winding unit 10 of the automatic winder 1.

[0096] For example, only a single spinning sensor may be provided in a set of the spinning units 20, or one or more of the spinning sensors may be provided for the spinning units 20, and the spinning sensor may be configured such that the information concerning the speed (for example, the rotational speed of traveller and the rotational speed of spinning bobbin) of building the spinning bobbin in each spinning unit 20, the state of each device or component (for example, installation failure, and wear-and-tear of the device or the component), or surrounding environment (for example, temperature and humidity) is detectable.

[0097] Then, it is arranged such that, in each winding unit 10 of the automatic winder 1, at a stage before starting to wind the yarn Y of the spinning bobbin B that is determined to be defective (hereinafter referred to as defective bobbin) based on the acquired information, the defective bobbin can be ejected. The position and the mechanism to eject the defective bobbin can be designed in any desired manner. For example, the ejection mechanism that ejects the defective bobbin may be provided in the spinning frame 2, may be provided in the bobbin transportation device 3, or may be provided in the yarn feeder 11 of the respective winding units 10 of the automatic winder 1. The ejection mechanism may be formed as a dedicated transportation guidepath for defective bobbins, or an existing transportation guidepath (for example, transportation guidepath for empty bobbins) provided in the automatic winder 1 may be used, for example.

[0098] A determination unit (controller) that determines the quality of the spinning bobbin B based on the information acquired by the spinning sensor may be owned by each spinning sensor itself, may be the control device of the spinning frame 2, may be a spinning-sensor upper control device that integrally manages the plurality of spinning sensors, maybe the machine control device 40, or may be a unit controller of each winding unit 10.

[0099] For example, when one spinning bobbin B is determined to be defective by the determination unit under the spinning sensor, a writer provided in the bobbin transportation device 3 writes defect information to the tray of the relevant defective bobbin. Subsequently, when the defective bobbin is transported to the automatic wind-

er 1 by the bobbin transportation device 3 and is further supplied to any of the winding unit 10, a reader provided in the relevant winding unit 10 reads the defect information written by the writer. Then, the winding unit 10 may eject the defective bobbin to the transportation guidepath for empty bobbins without winding the yarn Y from the defective bobbin. Alternatively, after the defect information is written to the tray of the defective bobbin by the writer, a reader provided in the bobbin transportation device 3 reads the defect information. Then, the bobbin transportation device 3 may transport the defective bobbin by branching to a transportation guidepath separate from the transportation guidepath for empty bobbins and eject it, without supplying the defective bobbin to the winding unit 10 (without supplying it to the automatic winder 1).

Application to Pneumatic Spinning Frame

[0100] The productivity display control device of the present disclosure can be applied to yarn winding machines other than the automatic winder 1 such as an pneumatic spinning frame.

[0101] The pneumatic spinning frame includes a plurality of spinning units (winding units), and one or more yarn joining carriers.

[0102] Each spinning unit includes a yarn feeder that supplies the yarn, a winding device that winds the yarn supplied from the yarn feeder to form the package, and a clearer that detects yarn defects between the yarn feeder and the winding device and determines whether to remove the yarn defects based on the set clearing conditions. The yarn feeder is a drafting device that drafts slivers and a spinning device that spins the drafted slivers by air flow to form the yarn.

[0103] The yarn joining carrier is provided so as to be able to travel along the juxtaposed direction of the plurality of spinning units and stops in front of a certain spinning unit and performs yarn joining.

[0104] In the pneumatic spinning frame, as one of the winding conditions, the productivity is calculated by adding the number of yarn joining carriers provided on a single spinning frame. Because the number of spinning units that can perform yarn joining at a time is limited by the number of yarn joining carriers, the number of yarn joining carriers affects the productivity of the pneumatic spinning frame.

[0105] Note that at least a part of the above-described embodiment and modifications may be combined in any desired manner.

Claims

1. A productivity display control device (40, 50) for a yarn winding machine (1) including a plurality of winding units (10), each of which including a yarn feeder (11) configured to supply yarn (Y), a winding

device (16) configured to wind the yarn (Y) supplied from the yarn feeder (11) to form a package (P), and a clearer (15) configured to detect a yarn defect of the yarn (Y) between the yarn feeder (11) and the winding device (16) and determine whether to remove the yarn defect based on a set clearing condition, the productivity display control device (40, 50) comprising:

an arithmetic unit (47, 57) configured to calculate a productivity of the yarn winding machine (1) based on a winding condition set in the yarn winding machine (1), operation data of the yarn winding machine (1), and a number of removals of yarn defects removed based on the clearing condition; and
a display controller (48, 58) configured to cause a display device (45, 55) to display information concerning the productivity calculated by the arithmetic unit (47, 57).

2. The productivity display control device (40, 50) according to claim 1, further comprising:

a receiving unit (46, 56) configured to receive a change operation of at least one of the clearing condition, the winding condition, and the operation data, wherein
the arithmetic unit (47, 57) is configured to calculate a prediction of the productivity based on at least one of the number of removals of yarn defects removed based on the clearing condition after change, the winding condition after change, and the operation data after change.

3. The productivity display control device (40, 50) according to claim 1 or 2, wherein the arithmetic unit (47, 57) is configured to calculate the productivity based on at least a winding speed of the winding device (16) winding the yarn (Y), a number of the winding units (10), and a number of removals that is a number of the yarn defects determined to be removed based on the clearing condition.

4. The productivity display control device (40, 50) according to any one of claims 1 to 3, wherein the display controller (48, 58) is configured to cause the display device (45, 55) to display information concerning the productivity together with at least one of the clearing condition and the winding condition.

5. An automatic winder (1) comprising:

a plurality of winding units (10) each including a yarn feeder (11) configured to supply yarn (Y), a winding device (16) configured to wind the yarn (Y) supplied from the yarn feeder (11) to form a package (P), and a clearer (15) configured to

- detect a yarn defect of the yarn (Y) between the yarn feeder (11) and the winding device (16) and determine whether to remove the yarn defect based on a set clearing condition; and the productivity display control device (40, 50) according to any one of claims 1 to 4, wherein the yarn feeder (11) is configured to support a yarn wound body (B) and to supply the yarn (Y) wound around the yarn wound body (B) to the winding device (16), and the arithmetic unit (47, 57) is configured to calculate the productivity of the automatic winder (1) based on the winding condition set in the automatic winder (1), the operation data of the automatic winder (1), and the number of removals of yarn defects removed based on the clearing condition.
6. The automatic winder (1) according to claim 5, further comprising:
- a machine control device (40) configured to integrally manage the plurality of winding units (10); and
 - a clearer upper control device (50) configured to integrally manage the plurality of clearers (15), wherein the machine control device (40) includes
 - a winding setting unit (46) configured to set the winding condition, and
 - a first communication unit (49) configured to perform communication with the clearer upper control device (50),
 - the clearer upper control device (50) includes
 - a clearing setting unit (56) configured to set the clearing condition, and
 - a second communication unit (59) configured to perform communication with the machine control device (40),
 - the machine control device (40) and the clearer upper control device (50) are configured to be capable of communicating with each other via the first communication unit (49) and the second communication unit (59), and
 - at least one of the machine control device (40) and the clearer upper control device (50) serves as the productivity display control device (40, 50) to calculate the productivity.
7. The automatic winder (1) according to claim 5 or 6, wherein
- a bobbin transportation device (3) coupling the automatic winder (1) to a ring spinning frame (2) configured to simultaneously start building and doff a plurality of spinning bobbins (B) at a certain spinning cycle, is configured to transport the doffed spinning bobbin (B) to the automatic winder (1), and the yarn feeder (11) is configured to support the spinning bobbin (B) transported by the bobbin transportation device (3) as the yarn wound body (B).
8. The automatic winder (1) according to claim 7, wherein the productivity that the arithmetic unit (47, 57) is configured to calculate is at least one of a number of the packages (P) produced per unit time, a weight of the packages (P) produced per unit time, a length of the yarn (Y) wound as the packages (P) per unit time, a weight of the yarn (Y) wound as the packages (P) per unit time, winding time needed for a certain number of the winding units (10) to wind the yarn (Y) of the spinning bobbins (B) that are doffed by the ring spinning frame (2) in a single spinning cycle to form the packages (P), a waiting time until the spinning bobbins (B) to be doffed by the ring spinning frame (2) at a subsequent spinning cycle are supplied to the automatic winder (1) after a certain number of the winding units (10) wind the yarn (Y) of the spinning bobbins (B) that were doffed by the ring spinning frame (2) at a previous spinning cycle to form the packages (P), and a number of the winding units (10) needed for winding the spinning bobbins (B) that were doffed by the ring spinning frame (2) at a previous spinning cycle to form the packages (P) until the spinning bobbins (B) to be doffed by the ring spinning frame (2) at a subsequent spinning cycle are supplied to the automatic winder (1).
9. A productivity display control method executed by the productivity display control device (40, 50) according to any one of claims 1 to 4, the method comprising:
- a first step of changing the clearing condition;
 - a second step of calculating a number of removals of yarn defects predicted based on the clearing condition that was changed at the first step and data of the detected yarn defect;
 - a third step of calculating a prediction of productivity based on the number of removals calculated at the second step, the winding condition, and operation data of the yarn winding machine (1); and
 - a fourth step of causing the display device (45, 55) to display a prediction of the productivity calculated at the third step.

Fig.1

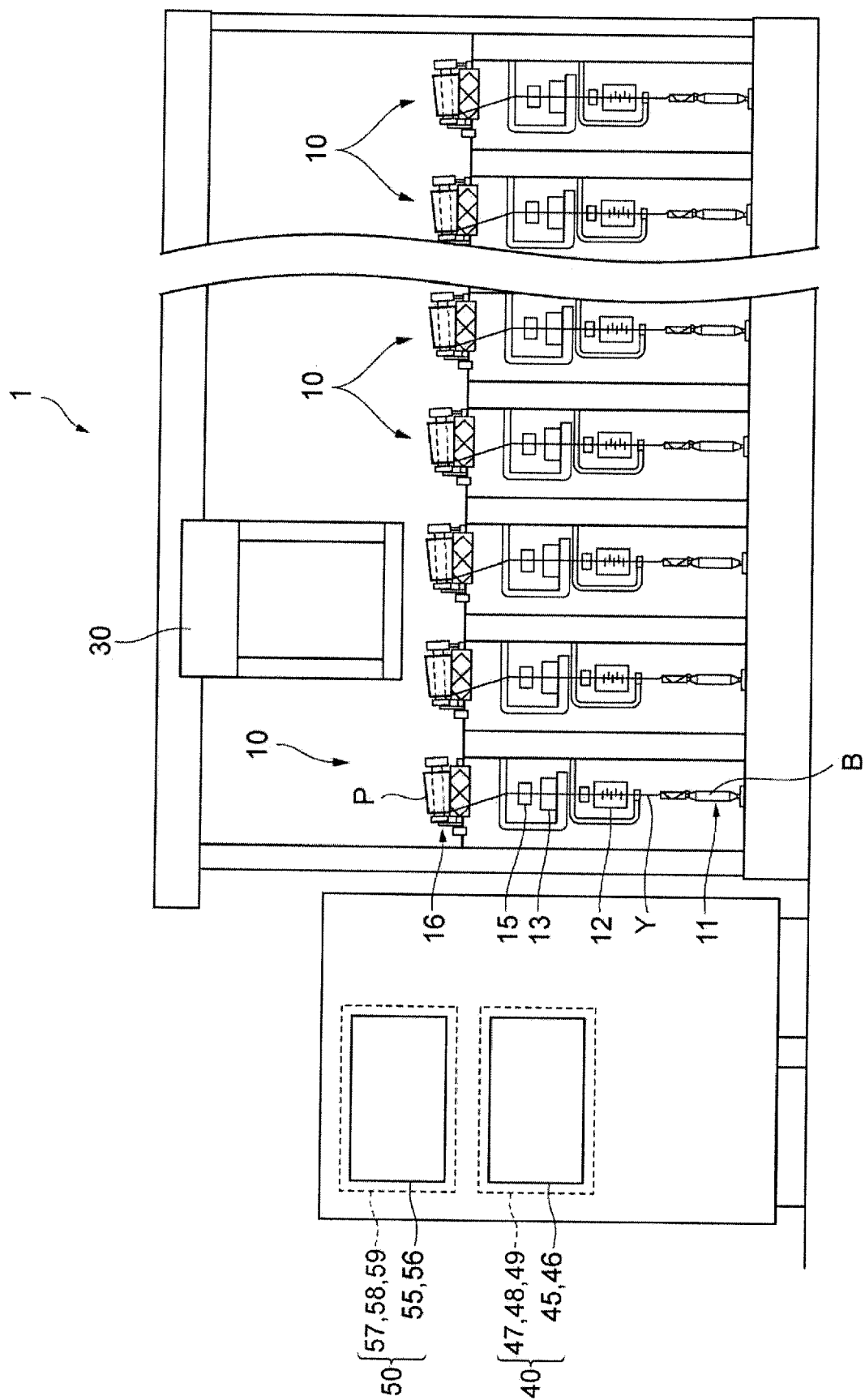


Fig.2

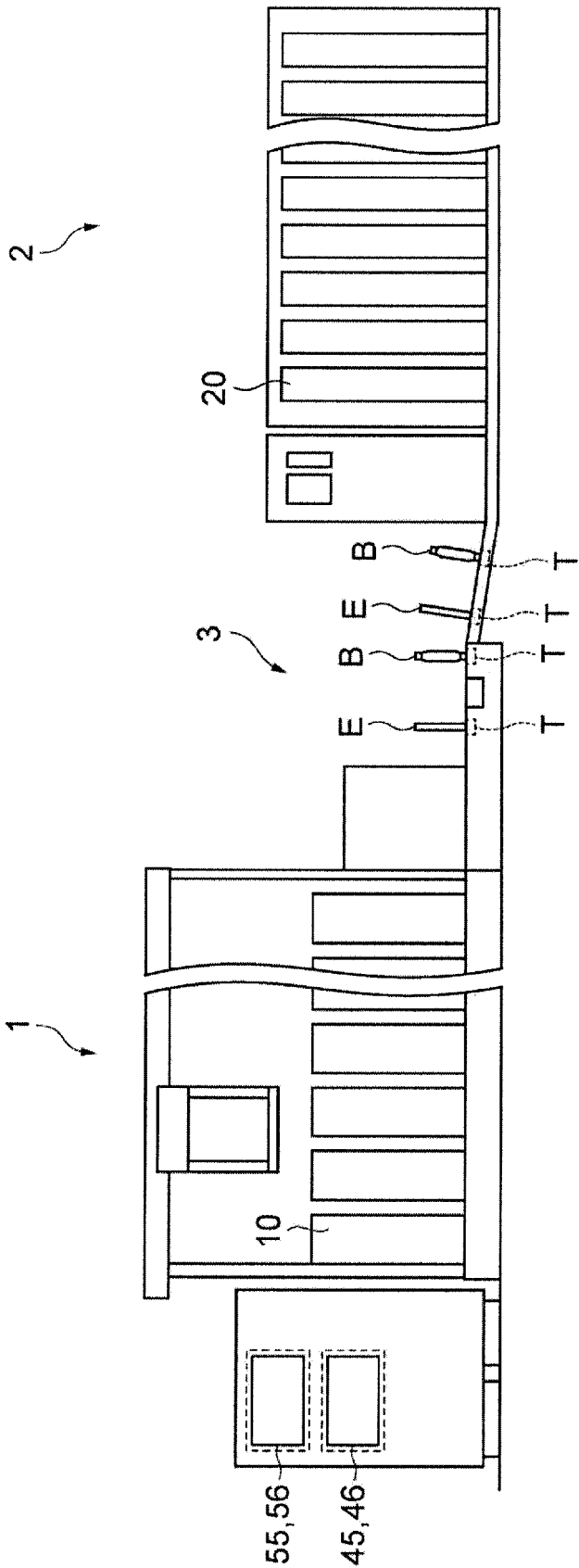


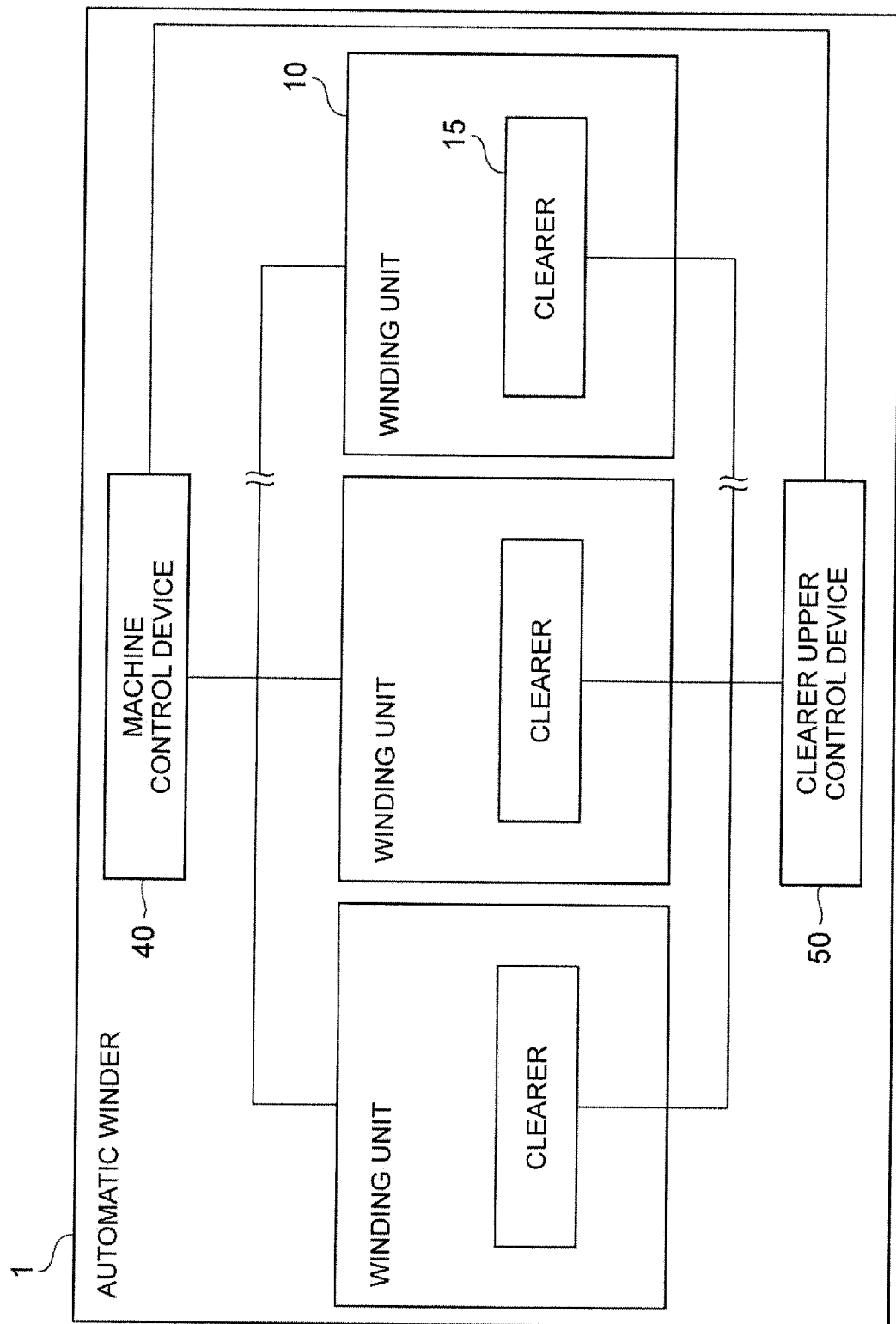
Fig.3

Fig.4

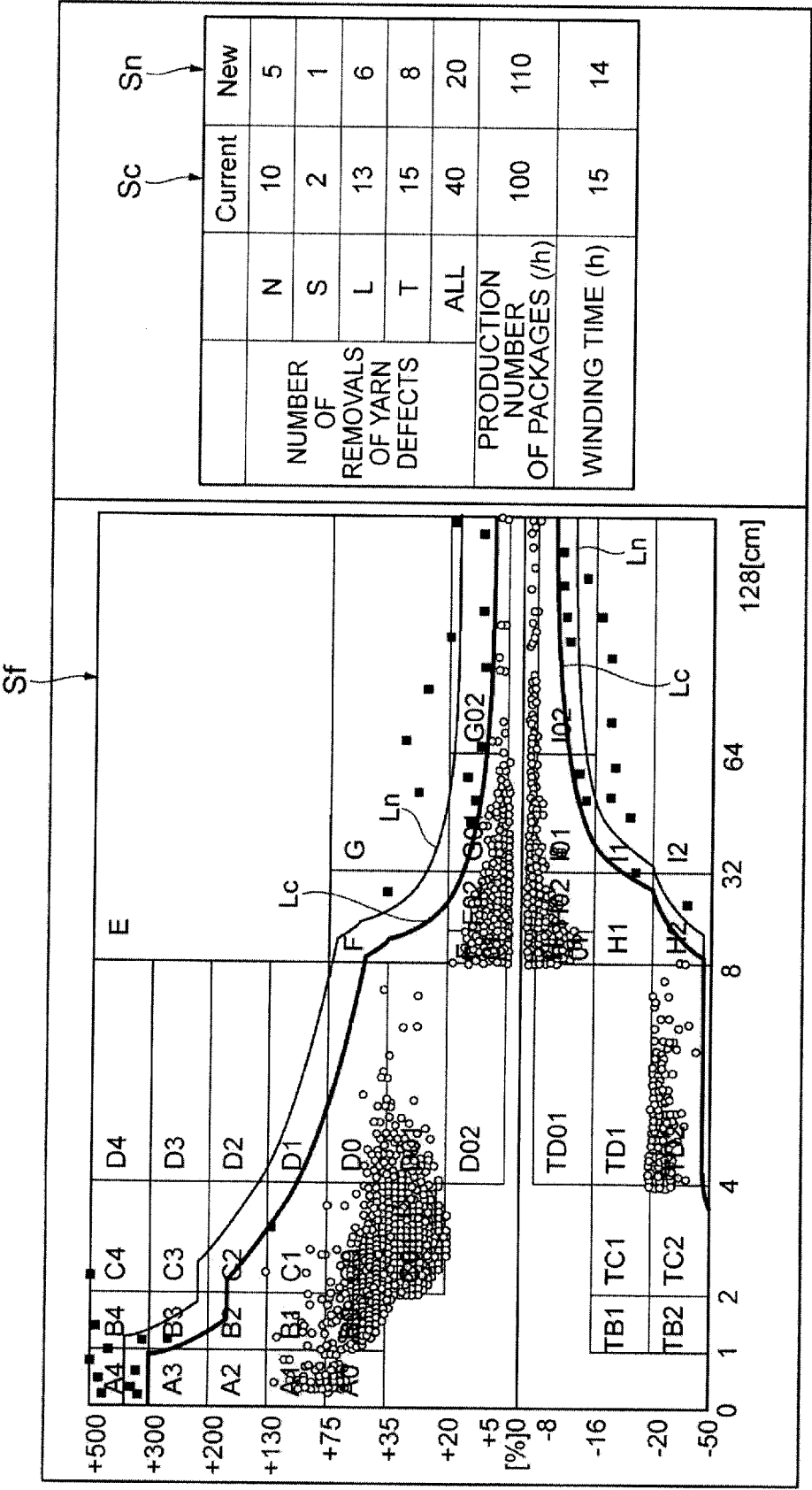


Fig.5

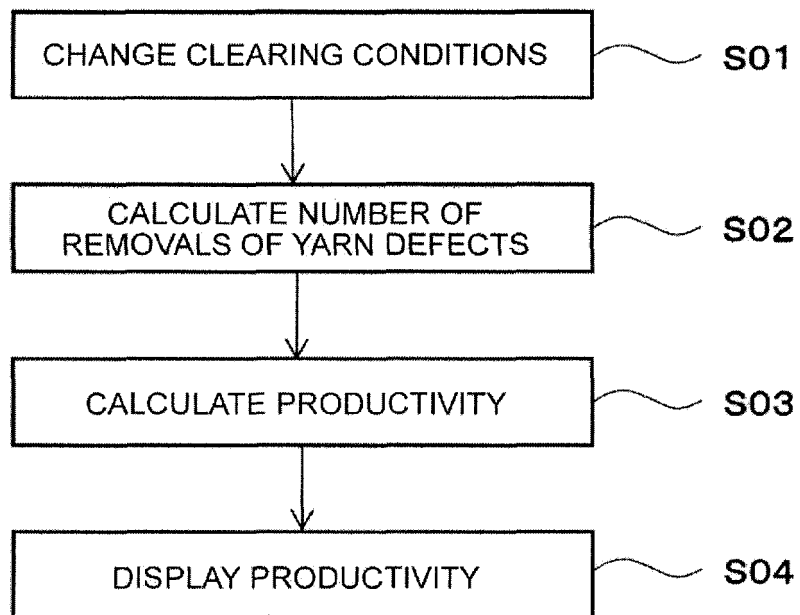


Fig.6

		Lot1	Lot2
WINDING CONDITIONS	WINDING SPEED (m/s)	1500	1500
	NUMBER OF WINDING UNITS	60	60
CLEARING DATA	CLEARING CONDITION NAME	α	β
	NUMBER OF REMOVALS OF YARN DEFECTS	40	20
PRODUCTIVITY	PRODUCTION NUMBER OF PACKAGES (/h)	100	110
	WINDING TIME (h)	15	14



EUROPEAN SEARCH REPORT

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Place of search The Hague		Date of completion of the search 19 October 2018	Examiner Guisan, Thierry
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