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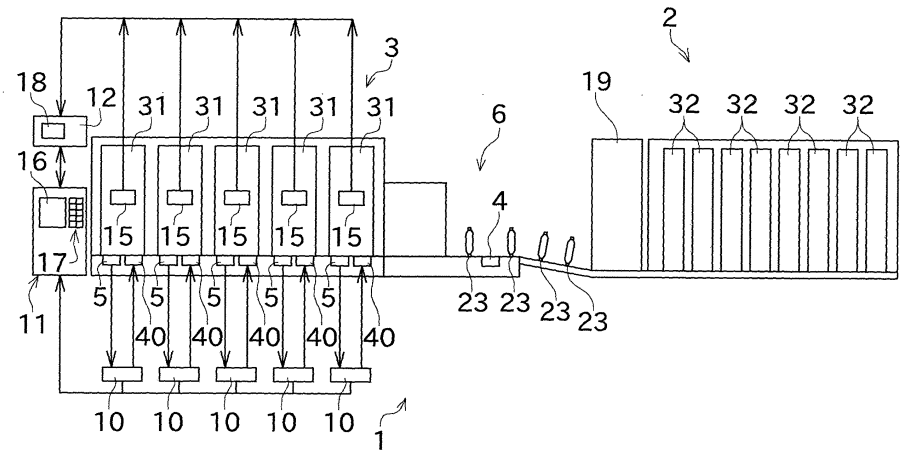
(54) MANAGEMENT SYSTEM FOR AUTOMATIC WINDER AND AUTOMATIC WINDER

(57) Provided is a management system for an automatic winder, which can reconstruct rewinding conditions that were applied before a rewinding operation has been interrupted, even in a case where a bobbin on which the rewinding operation has been interrupted is transported to another rewinding unit.

A rewinding unit (31) provided in a winder (3) unwinds a yarn wound on a bobbin (23), to form a package. A tray has an RF tag capable of recording information. The rewinding unit (31) includes an RF reader (5) for reading the information from the RF tag. In a case where the rewinding operation is interrupted halfway, a management system applied to the winder (3) of this embodiment records rewinding information indicating rewinding conditions and a rewinding status obtained at a time when the interruption occurs. When performing the rewinding operation again using the bobbin (23) on which the rewinding operation has been interrupted halfway, a unit control section (10) of the rewinding unit (13) controls the rewinding unit (31) having the bobbin transported thereto based on the rewinding information of this bobbin (23).

FIG.2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a management system applied to an automatic winder.

BACKGROUND ART

[0002] In an automatic winder including a plurality of rewinding units for unwinding spun yarns from bobbins to form packages having a predetermined length, a configuration is conventionally known in which the bobbin wound with the yarn is placed on a tray and automatically transported to a rewinding position in each rewinding unit. In this type of automatic winder, a textile machine management system for managing bobbin information is sometimes applied, to improve efficiency in transporting the bobbin. In this management system, recording means for recording information is attached to the tray, and the information recorded on the recording means can be accessed through appropriate means. An automatic winder (fine spinning winder) using such an automatic winder management system is disclosed in, for example, Patent Documents 1 and 2.

[0003] In the above-described automatic winder, the rewinding unit is configured such that if yarn breakage or the like occurs, ends of yarns are pieced to each other by a yarn piecing device and then rewinding is restarted. However, in a case where, for example, the yarn is wrapped around the bobbin, the end of the yarn of the bobbin cannot be caught. In this state, a rewinding operation of the package cannot be continued. Therefore, the rewinding unit discharges the bobbin for which catching of the yarn end has been failed to a transport path located at the outside of the automatic winder, and receives supply of a new bobbin, to restart the rewinding.

[0004] Here, in a case where the bobbin is discharged from the automatic winder as described above, the yarn that should have been rewound onto the package remains on the bobbin. Therefore, conventionally known is a bobbin transport mechanism configured to transport the tray in such a manner that the end of the yarn of the bobbin can be processed so that it can be caught by the rewinding unit and then the bobbin can be returned to the automatic winder again.

PRIOR-ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: Japanese Patent Application Laid-Open No. 2003-176081
Patent Document 2: Japanese Patent Application Laid-Open No. 62-41329 (1987)

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] From the viewpoint of stably maintaining the quality of the yarn, it is preferable that package rewinding conditions (bobbin unwinding conditions) such as a speed of drawing the yarn from the bobbin and a tension applied to the yarn are kept as constant as possible from a start to an end of a bobbin unwinding operation. However, in a configuration in which the bobbin discharged from the rewinding unit because the yarn end could not be caught is returned to the automatic winder again, it cannot always be ensured that the bobbin returned to the automatic winder is transported to the rewinding unit that has previously performed the rewinding operation (the rewinding unit that has stopped the rewinding operation). If a different rewinding unit performs the rewinding operation, the rewinding conditions may greatly change because of individual variability in the rewinding units. Thus, in terms of stabilization of the yarn quality, room for improvement remains.

[0007] The present invention is made in view of the circumstances described above, and an object of the present invention is to provide a management system for an automatic winder, which can reconstruct rewinding conditions that were applied before a rewinding operation has been interrupted, even in a case where a bobbin on which the rewinding operation has been interrupted is transported to another rewinding unit.

MEANS FOR SOLVING THE PROBLEMS AND EFFECTS THEREOF

[0008] The problem to be solved by the present invention is as described above, and next, means for solving the problem and effects thereof will be described.

[0009] In a first aspect of the present invention, in a management system for an automatic winder including a plurality of rewinding units and connected to a bobbin transport mechanism, the following configuration is provided. The rewinding units unwind yarns from bobbins, to form packages. The bobbin transport mechanism transports a transporter on which the bobbin wound with the yarn is set. The transporter includes a data recording section configured to record information. The rewinding unit includes a data reading part and a unit control section. The data reading part reads the information from the data recording section corresponding to the bobbin on which a rewinding operation is performed. In a case where the rewinding operation is interrupted halfway, the unit control section records rewinding information indicating a rewinding condition and a rewinding status obtained at a time when the interruption occurs. When performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, the unit control section controls any one of the plurality of rewinding units having the bobbin transported

thereto based on the rewinding information of said bobbin.

[0010] Accordingly, even if the bobbin on which the rewinding operation has been interrupted is transported to the rewinding unit different from the rewinding unit that originally performed the rewinding operation, the rewinding condition applied prior to the interruption is reconstructed based on the rewinding information, and the yarn can be drawn from the bobbin substantially under the same condition. Therefore, the yarn wound on the same bobbin is rewound under the same rewinding condition, which can stabilize the yarn quality.

[0011] In the management system for the automatic winder, it is preferable that the rewinding information contains remaining yarn length information concerning a yarn remaining on the bobbin.

[0012] This enables the process by the rewinding unit and the transport by the bobbin transport mechanism to be performed in accordance with a remaining yarn length of the yarn remaining on the bobbin.

[0013] It is preferable that the management system for the automatic winder is configured as follows. That is, the rewinding unit includes tension applying means configured to apply a tension to a yarn that is rewound into the package. The rewinding information contains control information of the tension applying means.

[0014] Accordingly, by considering the control information of the tension applying means obtained before the rewinding operation has been interrupted, the tension of the yarn drawn out from the bobbin can be kept substantially within a certain range from a start to an end of the unwinding operation on this bobbin.

[0015] It is preferable that the management system for the automatic winder is configured as follows. That is, the rewinding unit includes a yarn defect detection part for detecting a yarn defect. The rewinding information contains detection information concerning a detection of the defect by the yarn defect detection part.

[0016] Accordingly, by referring to the detection information, a status of the yarn wound on the bobbin can be recognized. Therefore, the process by the rewinding unit and the transport by the bobbin transport mechanism can be performed in accordance with the status of the yarn.

[0017] It is preferable that the management system for the automatic winder is configured as follows. That is, the bobbin transport mechanism includes a plurality of paths, a second data reading part, and a path switching device. The second data reading part is for reading the information recorded on the data recording section of the transporter. The path switching device switches a path based on the information read by the second data reading part.

[0018] Accordingly, a destination of transport of the bobbin can be determined based on the rewinding information recorded on the data recording section, and therefore efficiency in transporting the bobbin can be effectively improved.

[0019] It is preferable that the management system is configured as follows. That is, the rewinding unit includes a data writing part for recording the rewinding information into the data recording section of the transporter. In a case where the rewinding operation is interrupted, the rewinding information is written into the data recording section. When performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, any one of the plurality of rewinding units having the bobbin transported thereto is controlled based on the rewinding information recorded on the data recording section.

[0020] Accordingly, the rewinding information can be obtained and reflected to the rewinding operation merely by reading the rewinding information from the data recording section of the transporter. As a result, the process for reconstructing the rewinding operation that was applied prior to the interruption can be concluded at the rewinding unit side, which can achieve a simple process.

[0021] It is preferable that the management system for the automatic winder is configured as follows. That is, the automatic winder includes a storage section configured to store the rewinding information with respect to each bobbin. The data recording section of the transporter records thereon identification information for distinguishing this transporter from other transporters. When performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, the management system identifies the bobbin based on the identification information recorded on the data recording section. Then, the management system controls any one of the plurality of rewinding units having the bobbin transported thereto based on the rewinding information of the bobbin.

[0022] Accordingly, the rewinding information of the bobbin can be collectively managed by the controller side, and therefore a storage capacity of the data recording section of the transporter can be reduced. Moreover, from the viewpoint of the rewinding unit side, it is not necessary to provide any special means for storing data. Therefore, a simple configuration for reflecting the rewinding information to the rewinding operation can be achieved.

[0023] In a second aspect of the present invention, an automatic winder to which the management system is applied is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 is a schematic plan view showing a fine spinning winder including a winder according to one embodiment of the present invention, as seen from the top side thereof.

FIG. 2 contains a schematic front elevational view and a block diagram showing the fine spinning winder.

FIG. 3 is a perspective view showing external ap-

pearances of a bobbin and a tray.

FIG. 4 is a side view showing a configuration of a fine spinning unit.

FIG. 5 is a side view showing a configuration of a rewinding unit.

FIG. 6 contains a schematic front elevational view and a block diagram showing a fine spinning winder according to a modification.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0025] Next, an embodiment of the invention will be described. FIG. 1 is a schematic plan view showing a fine spinning winder 1 including a winder 3 according to one embodiment of the present invention, as seen from the top side thereof. FIG. 2 contains a schematic front elevational view and a block diagram showing the fine spinning winder 1.

[0026] As shown in FIG. 1, the fine spinning winder 1 has a tray transport path 90 for transporting a tray (transporter) 50 on which a bobbin 23 is set. A spinning frame 2, a winder 3, and an automatic bobbin feed system (bobbin transport mechanism) 6 are arranged in the tray transport path 90. The tray transport path 90 connects the spinning frame 2 and the winder 3 to each other, and is configured as a loop, so that the bobbin 23 (tray 50) circulates through the tray transport path 90. Although FIG. 1 shows only one bobbin 23 and one tray 50, actually a plurality of trays 50 are transported along the tray transport path 90.

[0027] In the following description, regarding a flow of the tray 50 through the tray transport path 90, an upstream side and a downstream side with respect to a direction of transport of the tray 50 may be simply referred to as "upstream side" and "downstream side", respectively.

[0028] Firstly, configurations of the tray 50 and the bobbin 23 transported in the tray transport path 90 will be briefly described with reference to FIG. 3. FIG. 3 is a perspective view showing external appearances of the tray 50 and the bobbin 23 used in the fine spinning winder 1 of this embodiment.

[0029] As shown in the left part of FIG. 3, the tray 50 includes a base portion 50a having a substantially circular disc shape, and a bobbin insertion portion 50b having a rod-like shape and protruding from the base portion 50a in a vertical direction. The tray 50 moves along the tray transport path 90 while a side of the tray 50 at which the insertion portion 50b protrudes faces upward.

[0030] As shown in the middle part of FIG. 3, the bobbin 23 is shaped into a long and thin cylinder, and allows the insertion portion 50b to be inserted therein. Thereby, the bobbin 23 is set on the tray 50 with a longitudinal direction of the bobbin 23 extending in the vertical direction, and can be transported along the tray transport path 90.

[0031] In the following description, a bobbin (bobbin shown in the right part of FIG. 3) on which a yarn is wound will be sometimes referred to as "actual bobbin". A bobbin in a state where no yarn is wound thereon (in a state shown in the middle part of FIG. 3) will be sometimes referred to as "empty bobbin" or "bobbin that is empty" for the purpose of especially emphasizing such a state.

[0032] In the winder 3 (fine spinning winder 1) of this embodiment, a management system (textile machine management system) is applied which manages information of the bobbin 23 set on the tray 50 by using a technique of RFID (Radio Frequency IDentification: individual identification based on a radio wave). More specifically, in each tray 50, an RF tag (data recording section) 60 in which appropriate information can be written is arranged within the base portion 50a. By writing information concerning the bobbin 23 into the RF tag 60 (of each tray 50), a status of the bobbin 23 is managed.

[0033] Next, each configuration of the fine spinning winder 1 will be described along the tray transport path 90. The tray transport path 90 includes an actual bobbin introduction path 91, an actual bobbin transport path 92, a returned bobbin transport path 93, a bobbin waiting loop 94, a bobbin supply path 95, an empty bobbin transport path 96, an empty bobbin return path 97, a defective bobbin waiting path 98, and a replaced bobbin return path 99.

[0034] The actual bobbin introduction path 91 connects the spinning frame 2 and the automatic bobbin feed system 6 to each other, and transports the tray 50 having the bobbin 23 placed thereon from the spinning frame 2 to the automatic bobbin feed system 6. Hereinafter, the spinning frame 2 will be described.

[0035] As shown in FIG. 2, the spinning frame 2 includes a large number of fine spinning units 32 arranged in parallel with one another, and a controller 19 configured to collectively control the large number of fine spinning units 32. The spinning frame 2 also includes a doffing device (not shown) for doffing the bobbin 23 (actual bobbin) on which the yarn has been wound by the fine spinning unit 32.

[0036] Next, a detailed description will be given to the fine spinning unit 32 with reference to FIG. 4. As shown in FIG. 4, the fine spinning unit 32 of this embodiment is for spinning a sliver or a rove having been generated in a prior step by imparting twist thereto. More specifically, the spinning frame 2 is configured as a ring spinning frame, and the fine spinning unit 32 is configured as a ring spinning unit including a drafting mechanism 101 and a twist imparting mechanism 102.

[0037] The drafting mechanism 101 has a plurality of drafting rollers, and the drafting rollers include top rollers 103 and bottom rollers 104. The top rollers 103 have three drafting rollers, namely, a back roller 103a, a middle roller 103b having an apron belt 105 mounted thereon, and a front roller 103c. On the other hand, the bottom rollers 104 have three drafting rollers, namely, a back bottom roller 104a, a middle bottom roller 104b having an apron belt 105 mounted thereon, and a front bottom roller 104c. As shown in FIG. 4, the top roller 103 and the bottom roller 104 are arranged so as to be opposed

to each other across a path of travel of the sliver or the rove, and are configured to nip the sliver or the rove with predetermined pressure. An output shaft of a driving source (not shown) is connected to each of the bottom rollers 104, so that the bottom rollers 104 can be driven at different speeds. By the driving of the bottom rollers 104, the sliver or the rove is, while being drawn, fed to the twist imparting mechanism 102.

[0038] The twist imparting mechanism 102 includes a spindle shaft 111, a ring rail 112, a ring 113, and a traveler 114. The spindle shaft 111 is for rotating the bobbin 23 that is set on the spindle shaft 111. The ring rail 112 is connected to a driver (not shown), and movable in the longitudinal direction of the bobbin 23. The ring 113 is fixed to the ring rail 112, and has a flange portion for the traveler 114 to be mounted thereon. The traveler 114 is supported on the flange portion of the ring 113, and movable in a circumferential direction of the ring 113.

[0039] To perform the fine spinning in the fine spinning unit 32 configured as described above, firstly, the yarn (sliver or rove having been drawn) fed from the drafting mechanism 101 is inserted into a gap between the traveler 114 and the ring 113, and an end portion of the yarn is fixed to the empty bobbin 23 by an appropriate method. In this state, the spindle shaft 111 rotates the bobbin 23, and thereby the yarn being wound on the bobbin 23 drags the traveler 114, so that the traveler 114 moves in the circumferential direction. As a result, the rotation of the traveler 114 is delayed behind the rotation of the bobbin 23, and twist is imparted to the yarn due to a difference in the number of rotations thus caused. The twisted yarn is sequentially wound on the bobbin 23. When a preset length of the yarn is wound on the bobbin 23, the rotation of the spindle shaft 111 is stopped, to terminate the winding.

[0040] The spinning frame 2 of this embodiment is of so-called simultaneous doffing type. In the spinning frame 2 of this type, a large number of bobbins 23 transported from the automatic bobbin feed system 6 through the empty bobbin return path 97 which will be described later are stocked while being arranged in a line, and when a predetermined timing comes, the large number of bobbins 23 are simultaneously set on the spindle shafts 111 of the fine spinning units 32, and yarns are simultaneously wound thereon. When the winding of the yarns is completed, the doffing device simultaneously doffs all the bobbins 23 (actual bobbins). Then, bobbins 23 that are empty are pulled away from the trays 50 having the empty bobbins 23 placed thereon, which are waiting in appropriate positions. Then, the bobbins 23 (actual bobbins) are inserted into the trays 50. Then, the pulled bobbins 23 that are empty are set on the spindle shafts 111, and the spinning frame 2 winds yarns thereon. The bobbins 23 doffed by the spinning frame 2 and placed on the trays 50 are transported through the actual bobbin introduction path 91, and thereby introduced into the automatic bobbin feed system 6.

[0041] The automatic bobbin feed system 6 receives the trays 50 having the bobbins 23 (actual bobbins) placed thereon from the spinning frame 2, and then writes appropriate information into the RF tags 60 of the trays 50. A pick finding device 7 finds pick of the bobbins 23, and then the trays 50 are supplied to the winder 3 side. Hereinafter, a detailed description will be given.

[0042] As shown in FIG. 1, an RF writer 4 is arranged at the downstream side of the spinning frame 2 in the actual bobbin introduction path 91. The RF writer 4 writes, for example, information identifying the fine spinning unit 32 that has spun the yarn on the bobbin 23, into the RF tag 60. When the tray 50 transported in the actual bobbin introduction path 91 passes through a writing position of the RF writer 4, the information identifying the fine spinning unit 32 that has wound the yarn on the bobbin 23 placed on this tray 50 is recorded on the RF tag 60 by the RF writer 4.

[0043] The fine spinning units 32 are arranged side by side in a longitudinal direction of the spinning frame 2. The bobbins 23 doffed by the simultaneous doffing are mounted on the trays 50, and then transported in the actual bobbin introduction path 91 in the same order as the order in which the fine spinning units 32 are arranged. Accordingly, by counting the order in which the bobbins 23 are introduced into the actual bobbin introduction path 91, the fine spinning unit 32 that has spun the yarn on the bobbin 23 can be identified. For example, in the first tray 50 that has passed through a reading position of the RF writer 4 after the simultaneous doffing was performed, a station number No.1 of the fine spinning unit 32 arranged most downstream is stored in the RF tag 60. In the next transported tray 50, the station number No. 2 of the fine spinning unit 32 adjacent upstream to the fine spinning unit 32 having the station number No. 1 is stored in the RF tag 60. In the subsequent trays newly transported, in the same manner, the station numbers No. 3, No. 4, ... are sequentially stored in the RF tags 60. As a result, the information (station number) identifying the fine spinning unit 32 that has wound the yarn on the bobbin 23 placed on the tray 50 is stored in the RF tag 60 of this tray 50 passing through the writing position of the RF writer 4.

[0044] The RF writer 4 of this embodiment is configured to write doffing information as well as the station number described above. Here, the doffing information means information indicating a timing of performing the doffing, such as time when the simultaneous doffing was performed or how many number of times the doffing was.

[0045] The reason why the doffing information (such as clock time when the doffing was performed) as well as the station number is recorded on the RF tag 60 is as follows. That is, in the automatic bobbin feed system 6 and the winder 3 (the downstream side of the spinning frame 2), there may be the trays 50 in which the same station number is stored in the RF tags 60. For example, this occurs in a case where, before a rewinding operation on the bobbin 23 that has been fed to the winder 3 side in the previous doffing is not completed, the next doffing

is performed so that a new group of bobbins 23 are introduced into the automatic bobbin feed system 6. In such a case, if the doffing information mentioned above is stored in the RF tag 60, the doffing information is referred to so that the bobbins 23 having the same station number can be distinctively recognized as different bobbins 23. The RF writer 4 of this embodiment can also store, in the RF tag 60, not only the above-described information but also a lot number, a number of the spinning frame 2 (a number given to each spinning frame 2 in a case where a plurality of spinning frames 2 are provided), and the like. In the following description, the information (the station number and the doffing information) identifying the bobbin 23 which is stored in the RF tag 60 may be referred to as bobbin information.

[0046] A downstream end portion of the actual bobbin introduction path 91 is connected to an upstream end portion of the actual bobbin transport path 92. The actual bobbin transport path 92 connects the automatic bobbin feed system 6 and the winder 3 to each other. The tray 50 in which predetermined information is written in the RF tag 60 thereof by the RF writer 4 is transported to the winder 3 along the actual bobbin transport path 92.

[0047] The automatic bobbin feed system 6 includes the pick finding device 7. The pick finding device 7 is arranged on the above-described actual bobbin transport path 92 and at the upstream side of the winder 3. The pick finding device 7 finds pick of the bobbin 23 in order to make it easy for the winder 3 to catch the yarn of the bobbin 23. A brief description will be given. The pick finding device 7 applies a suction flow to the bobbin 23 placed on the tray 50 transported in the actual bobbin transport path 92, and thereby unwinds the yarn from a surface of the bobbin 23. An end of the unwound yarn is inserted into the inside of the bobbin 23 having the cylindrical shape. This makes it easy that the end of the yarn of the bobbin 23 is caught by the winder 3 arranged at the downstream side of the pick finding device 7.

[0048] The pick finding device 7 does not always succeed in the pick-finding, and may sometimes fail. In this case, the tray 50 having placed thereon the bobbin 23 for which the pick-finding has been failed is sent out to the returned bobbin transport path 93. The returned bobbin transport path 93 diverges from the actual bobbin transport path 92 immediately downstream of the pick finding device 7, and is curved in a loop so as to be connected to the upstream end portion of the actual bobbin transport path 92. Such a configuration enables the bobbin 23 for which the pick-finding has been failed to be transported along the returned bobbin transport path 93 and thereby returned to the upstream side of the pick finding device 7 again. Thus, even if the pick-finding has been failed, a pick-finding process by the pick finding device 7 is automatically performed again. Therefore, it is not necessary that each time a pick-finding error occurs, an operator deals with it.

[0049] In this embodiment, the pick finding device 7 includes a pick-finding-device RF writer 42 and a pick-finding-device RF reader 41. The pick-finding-device RF writer 42 is arranged in the actual bobbin transport path 92, and configured to write, into the RF tag 60 of the tray 50, pick-finding information indicating a failure in the pick-finding of the pick finding device 7. The pick-finding-device RF reader 41 is arranged at the upstream side of the pick-finding-device RF writer 42 in the actual bobbin transport path 92, and configured to read a storage content of the RF tag 60. Success or failure in the pick-finding is detected by a sensor (not shown) provided in the pick finding device 7.

[0050] In this configuration, when the tray having the bobbin 23 set thereon passes through a reading position of the pick-finding-device RF reader 41, the pick-finding-device RF reader 41 obtains the pick-finding information of the passing bobbin 23 from the RF tag 60. After the pick-finding is performed on this bobbin 23, the pick finding device 7 determines success or failure in the pick-finding based on a signal from the sensor.

[0051] In this embodiment, the pick-finding information stored in the RF tag 60 contains the number of consecutive failures in pick-finding. Accordingly, each time the pick finding device 7 fails in pick-finding, the number of consecutive failures in pick-finding that is stored in the RF tag 60 is counted up by one, and then stored again. On the other hand, if the pick finding device 7 succeeds in pick-finding, the number of consecutive failures in pick-finding stored in the RF tag 60 is reset to zero.

[0052] In this embodiment, if a predetermined number or more of pick-finding errors consecutively occur, it is determined that the bobbin is a defective bobbin, and the pick-finding-device RF writer 42 writes into the RF tag 60 a content indicating a defective bobbin. The tray 50 in which information indicating a defective bobbin is written is not transported to the returned bobbin transport path 93, but sent to the winder 3 side. Even though the bobbin 23 (tray 50) sent to the winder 3 side is set in the rewinding position, the rewinding unit 31 does not perform the rewinding operation thereon, and the bobbin 23 is immediately discharged into the empty bobbin transport path 96.

[0053] Next, the winder 3 will be described. As shown in FIGS. 1 and 2, the winder 3 includes a plurality of rewinding units 31, and a machine controller 11 serving as a controller. In the winder 3, an RF reader (data reading part) 5 and a rewinding-unit RF writer (data writing part) 40 are provided for each rewinding unit 31. The winder 3 also includes a clearer control box (CCB) 12 to which a clearer (yarn defect detection part) 15 of the rewinding unit 31 which will be described later is connected.

[0054] As shown in FIG. 1, in the winder 3, a plurality of bobbin supply paths 95 diverging from the actual bobbin transport path 92 are provided. The plurality of bobbin supply paths 95 are provided corresponding to the plurality of rewinding units 31 of the winder 3. The plurality of bobbin supply paths 95 allow the bobbins 23 transported in the actual bobbin transport path 92 to be distributed to the rewinding units 31. A specific description

will be given as follows.

[0055] Each bobbin supply path 95 has a predetermined length, and is configured such that a plurality of bobbins 23 can be arranged and stocked in the bobbin supply path 95. A guide member (not shown) or the like is arranged at an upstream end portion of each bobbin supply path 95, so that the bobbin 23 transported in the actual bobbin transport path 92 can be introduced into the bobbin supply path 95 by the guide member in the course of nature. If there is not a space in the bobbin supply path 95 for introduction of the bobbin 23 (if a maximum number of bobbins 23 are stocked), introduction of the new bobbin 23 into the bobbin supply path 95 is blocked by the bobbins existing in this bobbin supply path 95. At this time, the bobbin 23 blocked from being introduced into the bobbin supply path 95 is transported to the downstream side in the actual bobbin transport path 92, and introduced into another bobbin supply path 95 having a space. In this manner, the bobbins 23 fed from the spinning frame 2 can be distributed to the rewinding units 31.

[0056] On the other hand, if there is no bobbin supply path 95 having a space that allows the bobbin 23 to be introduced therein, the bobbin 23 is introduced into the bobbin waiting loop 94, and transported in the bobbin waiting loop 94. The bobbin waiting loop 94 diverges from a most downstream portion of the actual bobbin transport path 92, and is connected to a portion of the actual bobbin transport path 92 located at the upstream side of a position where the most upstream bobbin supply path 95 is diverged from the actual bobbin transport path 92. Accordingly, the bobbin 23 keeps circulating through a loop path made up of the bobbin waiting loop 94 and the actual bobbin transport path 92, until a space that allows a bobbin to be stocked therein is made in any bobbin supply path 95.

[0057] Next, a configuration of the rewinding unit 31 will be described in detail with reference to FIG. 5. As shown in FIG. 5, the rewinding unit 31 is for rewinding the yarn from the actual bobbin onto a rewinding bobbin 22 to thereby form a package 30. The rewinding unit 31 includes a rewinding drum (traverse drum) 24 for traversing the yarn and for driving the rewinding bobbin 22. In the rewinding unit 31 of this embodiment, in a path of travel of the yarn between the rewinding drum 24 and the bobbin 23 set in an appropriate position for an unwinding operation to be performed thereon, a tension applying device 13, a yarn piecing device 14, and a clearer 15 are arranged in the mentioned order from the bobbin 23 side.

[0058] The tension applying device 13 applies a predetermined tension to the traveling yarn. As the tension applying device 13, a gate type one is adopted in which a movable comb is arranged relative to a fixed comb. The movable comb is rotatable by a rotary solenoid such that the combs can be brought into an engaged state or a disengaged state. The tension of the yarn to be rewound is made constant by the tension applying device 13, and thereby the quality of the package 30 can be improved.

[0059] For example, at a time of yarn cutting that is performed by the clearer 15 upon detection of a yarn defect, or at a time of yarn breakage during unwinding of the yarn from the bobbin 23, the yarn piecing device 14 pieces a lower yarn of the bobbin 23 to an upper yarn of the package 30. Examples of the yarn piecing device 14 include a mechanical one, and one using a fluid such as a compressed air. A lower yarn guide pipe 25 for guiding the lower yarn of the bobbin 23 by sucking and catching the lower yarn and an upper yarn guide pipe 26 for guiding the upper yarn of the package 30 by sucking and catching the upper yarn are provided at the lower and upper sides of the yarn piecing device 14, respectively.

[0060] The clearer 15 is for detecting a defect and the amount of fluff in the yarn by detecting a diameter of the yarn using an appropriate sensor. The clearer 15 can also function as a sensor for simply detecting presence or absence of the yarn. Cutting means is provided near the clearer 15, so that if the clearer 15 detects a defect in the yarn, the defect can be removed.

[0061] The yarn unwound from the bobbin 23 is rewound on the rewinding bobbin 22 that is arranged at the downstream side of the yarn piecing device 14. The rewinding bobbin 22 is driven by rotational driving of the rewinding drum 24 that is opposed to the rewinding bobbin 22. A rotation sensor (not shown) is mounted to the rewinding drum 24. Each time the rewinding drum 24 is rotated through a predetermined angle, the rotation sensor outputs a rotation pulse signal to a unit control section 10. The rewinding unit 31 of this embodiment measures the number of pulses per a time period, thereby calculating a speed of rotation of the rewinding drum 24. In this embodiment, the unit control section 10 is provided for each rewinding unit 31. The unit control section 10 of each rewinding unit 31 is connected to the machine controller 11, and communicates various information such as rewinding conditions with the machine controller 11.

[0062] In the above-described configuration, the bobbin 23 transported in the bobbin supply path 95 is set in an appropriate position (rewinding position) in the rewinding unit 31, and then the rewinding drum 24 is driven, so that the yarn unwound from the bobbin 23 is rewound on the rewinding bobbin 22, to form the package 30 having a predetermined length.

[0063] An RF reader 5 is arranged in the bobbin supply path 95 so as to read the RF tag 60 of the tray 50 on which the bobbin 23 whose yarn is rewound by the rewinding unit 31 is placed. Information read by the RF reader 5 is transmitted to the unit control section 10.

[0064] The rewinding-unit RF writer 40 is arranged at a portion where the bobbin supply path 95 is connected to the empty bobbin transport path 96 such that the rewinding-unit RF writer 40 can write rewinding information into the RF tag 60 of the tray 50 having the bobbin 23 placed thereon which is sent out from the rewinding unit 31. The rewinding-unit RF writer 40 is connected to the

unit control section 10, and can write, into the RF tag 60, the rewinding information obtained from the unit control section 10.

[0065] As shown in FIG. 2, the machine controller 11 includes a display 16 serving as display means, and input keys 17 serving as operation means. The display 16 is for displaying a status of each rewinding unit 31. The input keys 17 allow the operator to set rewinding conditions and the like.

[0066] As described above, the bobbin information (the station number and the doffing information) read by the RF reader is inputted into the machine controller 11. Therefore, which of the fine spinning units 32 has wound the yarn on the bobbin 23 whose yarn is currently rewound by the rewinding unit 31 can be identified.

[0067] The CCB 12 performs a determination process for determining, for example, whether or not a yarn defect is occurring, based on information transmitted from the clearer 15. As shown in FIG. 2, the CCB 12 has a display 18 serving as display means, so that various information, such as information concerning a yarn defect and information generated based on a yarn defect, can be displayed on the display 18. The CCB 12 is electrically connected to the machine controller 11, and communicates various information with the machine controller 11.

[0068] As shown in FIG. 5, the bobbin supply path 95 is laid under the rewinding unit 31. The bobbin 23 supplied to the rewinding unit 31 is transported to the above-mentioned rewinding position by this bobbin supply path 95. During the rewinding of the yarn, the bobbin 23 is stopped in the rewinding position, and therefore the transport of the tray 50 by the bobbin supply path 95 is temporarily stopped.

[0069] As described above, the bobbin supply path 95 is configured such that a plurality of bobbins 23 can be stocked therein. As shown in FIG. 5, the stocked bobbins 23 are arranged in a line on the bobbin supply path 95. The most downstream one of the bobbins 23 in the bobbin supply path 95 is an object of yarn rewinding performed by the rewinding unit 31. In FIG. 5, the position of the rightmost one of the plurality of bobbins is the above-mentioned rewinding position.

[0070] The unwinding of the yarn from the bobbin 23 is performed with the bobbin 23 being placed on the tray 50, as shown in FIG. 5. If the yarn of the bobbin 23 runs out and the bobbin 23 becomes empty, the bobbin supply path 95 transports the tray 50. Thereby, the bobbin 23 that is empty is fed to the downstream side while being placed on the tray 50, and discharged into the empty bobbin transport path 96 (which will be described later).

[0071] Along with the bobbin 23 that is empty and placed in the rewinding position being fed to the downstream side, each bobbin 23 stocked in the bobbin supply path 95 is also fed to the downstream side. As a result, a new bobbin 23 is set in the rewinding position, and the yarn is unwound from the new bobbin 23. Thus, the rewinding can be restarted. By discharging the empty bobbin 23 from the bobbin supply path 95, a new space allowing the bobbin 23 to be stocked therein is made in the bobbin supply path 95. Thus, the bobbin supply path 95 is replenished with the bobbin 23 transported in the actual bobbin transport path 92.

[0072] As shown in FIG. 1, a downstream end portion of each of the plurality of bobbin supply paths 95 joins the empty bobbin transport path 96. The empty bobbin transport path 96 connects the winder 3 and the automatic bobbin feed system 6 to each other. The empty bobbin 23 discharged from each rewinding unit 31 is transported through the empty bobbin transport path 96, and thereby returned to the automatic bobbin feed system 6.

[0073] In the automatic bobbin feed system 6, the empty bobbin transport path 96 is connected to a middle of the returned bobbin transport path 93. In the returned bobbin transport path 93, the empty bobbin return path 97 diverges therefrom at a position downstream of a position where the empty bobbin transport path 96 is connected to the returned bobbin transport path 93. The empty bobbin returned to the automatic bobbin feed system 6 through the empty bobbin transport path 96 passes through a part of the returned bobbin transport path 93, and then is introduced into the empty bobbin return path 97 by a path switching mechanism (not shown) which will be described later. The empty bobbin return path 97 connects the automatic bobbin feed system 6 and the spinning frame 2 to each other. In the automatic bobbin feed system 6, the bobbin 23 that is empty is transported in the empty bobbin return path 97, and thereby the bobbin 23 that is empty is returned to the spinning frame 2.

[0074] As described above, due to the loop-shaped tray transport path 90 that connects the spinning frame 2 and the winder 3 to each other, the bobbin 23 can circulate between the spinning frame 2 and the winder 3.

[0075] Actually, bobbins transported in the empty bobbin transport path 96 include not only the empty bobbins, but the actual bobbins and defective bobbins are randomly mixed therein. Therefore, a configuration is required that sorts and appropriately processes the empty bobbin, the actual bobbin, and the defective bobbin that are mixed in transport. In the following, this point will be described in detail.

[0076] Firstly, a description will be given to a case where the actual bobbin (bobbin on which the yarn remains) is transported in the empty bobbin transport path 96. For example, if yarn breakage occurs during rewinding of the yarn in the rewinding unit 31, the yarn piecing device 14 performs yarn piecing. At this time, the rewinding unit 31 causes a suction flow to occur in a distal end portion of the lower yarn guide pipe 25, thereby sucking and catching an end of the yarn of the bobbin 23, then guiding the end of the yarn to the yarn piecing device 14. Then, the yarn piecing device 14 pieces the yarn to the upper yarn.

[0077] However, in a case where the end of the yarn of the bobbin 23 cannot be sucked and caught by the lower yarn guide pipe 25, for example, in a case where

the end of the yarn is wrapped around the bobbin 23 or in a case where the yarn is broken at a position near the bobbin 23, the lower yarn guide pipe 25 cannot catch the end of the yarn, and therefore the yarn piecing device 14 cannot perform the yarn piecing. In such a case, the rewinding unit 31 abandons catching the end of the yarn of the bobbin 23, and discharges the bobbin 23 whose yarn end could not be caught, to the empty bobbin transport path 96. In a description given below, a bobbin on which the rewinding by the rewinding unit 31 is interrupted and that is thus discharged may be referred to as "interrupted bobbin". In this embodiment, at a time of discharging the interrupted bobbin, predetermined information (rewinding information which will be described below) is written into the RF tag 60 of the tray 50.

[0078] Next, rewinding information will be described. In this embodiment, the rewinding information written into the RF tag 60 by the rewinding-unit RF writer 40 contains remaining yarn information, rewinding speed information, tension information, and yarn defect information.

[0079] The remaining yarn information is information indicating a remaining yarn length of the yarn that remains on the bobbin 23. The remaining yarn length is calculated by subtracting an unwound yarn length from the length of the yarn wound on the bobbin 23 in the fine spinning unit 32.

[0080] The unwound yarn length herein means the length of the yarn unwound from the actual bobbin (the length of the yarn rewound from the actual bobbin into the package 30), which can be calculated by the following method. As described above, the rotation sensor mounted to the rewinding drum 24 inputs the rotation pulse signal to the unit control section 10 (see FIG. 5). The unit control section 10 counts the rotation pulse signal, and based on a count value, calculates the unwound yarn length. This count value is reset at a timing when a new actual bobbin on which the rewinding operation is not yet performed is transported or at a timing when the yarn is entirely unwound from the actual bobbin. The counting is started based on a timing of unwinding the yarn from a new actual bobbin.

[0081] In this embodiment, a predetermined length of the yarn wound on one bobbin 23 by the fine spinning unit 32 is preliminarily stored as a set yarn length in the unit control section 10. Therefore, the remaining yarn length can be obtained by subtracting the unwound yarn length from the set yarn length. In this embodiment, the remaining yarn length calculated in this manner is written as the remaining yarn information into the RF tag 60.

[0082] The rewinding speed information is information indicating a speed of rotation of the rewinding drum 24 until the rewinding operation has been interrupted. The rewinding speed information can be expressed as, for example, data in which a change in a rewinding speed until the rewinding operation has been interrupted is chronologically arranged. The rewinding speed information may be data indicating an average value of the rewinding speed at a time when the speed has reached a steady speed so that a change in the speed can fall within a certain range. In this manner, the rewinding speed information is set based on information concerning the rewinding speed of the rewinding drum 24.

[0083] The tension information is information indicating the tension applied to the traveling yarn by the tension applying device 13. The tension applying device 13 of this embodiment is configured such that the tension applied to the yarn can be changed depending on the magnitude of a current value. The tension information is set based on the current value. For example, if a change in the current value until the rewinding operation is interrupted is stored as the tension information in the RF tag 60, the degree of tension the tension applying device 13 has applied to the yarn unwound from the bobbin 23 can be recognized. The rewinding unit 31 of this embodiment can control the tension applied to the yarn by the tension applying device 13, based on the storage content of the RF tag 60.

[0084] The yarn defect information (detect information) is information indicating a defect in the yarn that was drawn out from the bobbin 23 until the rewinding operation has been interrupted. By referring to the yarn defect information, a state (quality) of the yarn unwound from the bobbin 23 can be recognized. For example, the number of times the clearer 15 detected a yarn defect and the yarn was cut, or the number of times yarn breakage occurred, can be contained as the yarn defect information. In this manner, the yarn defect information is information concerning clearing, and is data indicating the quality of the yarn wound on the bobbin 23. The yarn defect information is used for determination of a defective bobbin. For example, in a case where a combination of a yarn defect portion obtained until the rewinding operation has been interrupted and a yarn defect portion obtained after the rewinding operation has been restarted exceeds a certain percentage of the set yarn length, it is determined that the bobbin is a defective bobbin.

[0085] As described above, the rewinding information is information containing control information of the rewinding unit 31 at the time when the yarn drawn out from the bobbin 23 is unwound, and information indicating a status of the yarn wound on the bobbin 23. The rewinding information is not limited to the above-described information. Depending on circumstances, appropriate information may be added to the rewinding information. The unwinding operation on the bobbin 23 using this rewinding information will be described later.

[0086] In the rewinding position, a new bobbin 23 that has been stocked is set so as to replace the bobbin 23 on which the rewinding operation is interrupted. Since this new bobbin 23 has been subjected to the pick-finding in the pick finding device 7, an end of the yarn can be easily caught, so that the yarn piecing can be performed. In this manner, even if the end of the yarn cannot be caught at the time of yarn breakage, the bobbin 23 whose yarn end could not be caught is discharged, and instead, a new bobbin 23 can be set, thereby enabling the yarn

piecing and restarting the rewinding.

[0087] The bobbin 23 whose yarn end could not be caught is transported in the empty bobbin transport path 96. In the empty bobbin transport path 96, as described above, the empty bobbins sent out from the other rewinding units 31 are also transported. Accordingly, the bobbin 23 whose yarn end could not be caught is transported together with the empty bobbins in the empty bobbin transport path 96, and then introduced into the returned bobbin transport path 93.

[0088] As shown in FIG. 1, in the returned bobbin transport path 93, an empty bobbin determination device 8 is provided at a position upstream of the position where the empty bobbin return path 97 diverges from the returned bobbin transport path 93. The empty bobbin determination device (third data reading part) 8 of this embodiment can read a storage content of the RF tag 60, and by reading the rewinding information (remaining yarn information) stored in the RF tag 60, can determine whether or not a bobbin is an empty bobbin. Additionally, a path switching mechanism (not shown) is provided at the position where the empty bobbin return path 97 diverges from the returned bobbin transport path 93. The path switching mechanism sends out a bobbin 23 to the empty bobbin return path 97 side if the empty bobbin determination device 8 determines that the bobbin 23 is an empty bobbin, and keeps a bobbin 23 transported in the returned bobbin transport path 93 if the empty bobbin determination device 8 determines that the bobbin 23 is not an empty bobbin.

[0089] In the above-described configuration, only the empty bobbin can be returned to the spinning frame 2. The bobbin 23 (bobbin on which the yarn remains) determined to be not an empty bobbin by the empty bobbin determination device 8 is transported in the returned bobbin transport path 93. The bobbin 23 having a sufficient amount of remaining yarn is subjected to the pick-finding process in the pick finding device 7. In the bobbin 23 for which it is determined that the amount of remaining yarn is extremely small based on the rewinding information (remaining yarn information) in the RF tag 60, the extremely small amount of remaining yarn is removed by a remaining yarn processing device (not shown). In this manner, even if the end of the yarn of the bobbin 23 could not be caught in the rewinding unit 31, the bobbin 23 is subjected to the pick-finding in the pick finding device 7, and thereby the rewinding unit 31 can perform unwinding again. The configuration may further include a remaining yarn amount detection device, so that the amount of remaining yarn is measured by the remaining yarn amount detection device.

[0090] Next, a description will be given to the unwinding operation on the bobbin 23 (rewinding operation on the package 30) using the rewinding information stored in the RF tag 60.

[0091] When a new bobbin 23 is supplied in the rewinding position, the RF reader 5 reads the bobbin information and the rewinding information from the RF tag 60 of the tray 50. Based on these information, the unit control section 10 determines whether or not this bobbin is an interrupted bobbin.

[0092] If the bobbin 23 is an interrupted bobbin and additionally the yarn remains on this bobbin, the RF reader 5 transmits the remaining yarn information, the rewinding speed information, and the tension information that are read from the RF tag 60, to the unit control section 10. Then, the unit control section 10 reflects the received rewinding information to the control of each part. For example, based on the rewinding speed information stored in the RF tag 60, a target rewinding speed is set, and drive means of the rewinding drum 24 is controlled such that the steady speed can reach this rewinding speed. Based on the tension information, the tension applied to the yarn unwound from the bobbin 23 is controlled so as to reach the same tension as the tension applied before the rewinding operation has been interrupted.

[0093] In a configuration including a large number of rewinding units 31 as in this embodiment, it cannot always be ensured that, when the interrupted bobbin is transported to the winder 3 side again, the interrupted bobbin is transported to the same rewinding unit 31 as the rewinding unit 31 that has originally performed the rewinding operation. On the other hand, from the viewpoint of achieving a uniform quality, it is preferable that the bobbins 23 whose yarns are spun by the same fine spinning unit 32 are subjected to the unwinding operation under the same conditions. In this respect, the configuration of this embodiment allows the rewinding conditions to be reconstructed by reading the rewinding information stored in the RF tag 60 of the tray 50 that is transporting the bobbin 23. Therefore, even if the interrupted bobbin is transported to the rewinding unit 31 different from the rewinding unit 31 that originally performed the rewinding operation, the rewinding information can be obtained from the RF tag 60 without the need to exchange information between the unit control sections 10.

[0094] Next, a description will be given to a case where a defective bobbin (bobbin from which a defective yarn is rewound) is transported in the empty bobbin transport path 96.

[0095] In the fine spinning unit 32, if damage, abrasion, or the like, occurs in the apron belt 105 for example, the yarn manufactured by the fine spinning unit 32 may have a non-uniform diameter. Additionally, there is a tendency that the amount of fluff in the yarn increases as the traveler 114 is abraded away. In a description given below, it is considered that a yarn having a non-uniform diameter and a yarn having a large amount of fluff is a defective yarn of low commercial value, and a bobbin 23 having such a defective yarn wound thereon may be referred to as "defective bobbin". It is desired that the rewinding unit 31 automatically detects and removes the defective bobbin, in order to prevent the defective yarn to be mixed into the package 30.

[0096] In this embodiment, therefore, the diameter and the fluff of the yarn unwound from the bobbin 23 are de-

tected by the clearer 15, as described above. In this embodiment, if the magnitude of variation in the yarn diameter or the amount of fluff, which is detected by the clearer 15 of the rewinding unit 31, is beyond a predetermined allowable range, it is determined that the bobbin on which the rewinding unit 31 currently performs rewinding is a defective bobbin.

[0097] If a defective bobbin is detected, the rewinding unit 31 does not unwind the yarn any longer, and discharges the defective bobbin as it is (with the yarn left thereon) to the empty bobbin transport path 96, and then starts unwinding the yarn from another bobbin 23 stocked in the bobbin supply path 95. This can prevent the yarn having a non-uniform diameter or the yarn having a large amount of fluff from being mixed into the package 30.

[0098] Here, if the defective bobbin sent out from the rewinding unit 31 into the empty bobbin transport path 96 was introduced into the returned bobbin transport path 93, the empty bobbin determination device 8 would determine that this defective bobbin is not an empty bobbin (because the yarn remains on this defective bobbin), and this defective bobbin would be supplied through the pick finding device 7 to the winder 3 again. Therefore, the automatic bobbin feed system 6 is configured such that when the defective bobbin is transported in the empty bobbin transport path 96, the defective bobbin is not introduced into the returned bobbin transport path 93 and escaped into the defective bobbin waiting path 98.

[0099] A specific description is as follows. If a defective bobbin is detected in a certain rewinding unit 31, the machine controller 11 stores, in the RF tag 60, information indicating that this bobbin 23 is a defective bobbin. As described above, when the rewinding unit 31 rewinds the yarn from the bobbin 23, the storage content of the RF tag 60 of the tray 50 having this bobbin 23 mounted thereon is read, and if the information indicating a defective bobbin is detected, this bobbin 23 is discharged from the rewinding position into the empty bobbin transport path 96. Whether or not a bobbin is a defective bobbin can be determined based on the yarn defect information, too. For example, it may be acceptable that a bobbin in which a predetermined amount or more of yarn defects are detected during the rewinding operation is determined to be a defective bobbin.

[0100] On the other hand, as shown in FIG. 1, the defective bobbin waiting path 98 is provided so as to diverge from the empty bobbin transport path 96 at a position upstream of a position where the empty bobbin transport path 96 joins the returned bobbin transport path 93. In this diverging position, a path switching mechanism (path switching device) 43 is provided, so that a path of transport of the bobbin 23 transported in the empty bobbin transport path 96 can be switched by the path switching mechanism 43. Additionally, in the empty bobbin transport path 96, an RF reader 9 (second data reading part) is arranged at a position upstream of the position where the defective bobbin waiting path 98 diverges from the empty bobbin transport path 96. The RF reader 9 reads a storage content of the RF tag 60 of the tray 50 that is transported in the empty bobbin transport path 96, and transmits the information to the path switching mechanism 43. Based on the content stored in the RF tag 60, the path switching mechanism 43 determines whether or not the bobbin 23 transported in the empty bobbin transport path 96 is a defective bobbin.

[0101] If the information indicating a defective bobbin is stored in the RF tag 60, it is determined that the bobbin 23 transported in the empty bobbin transport path 96 is a defective bobbin. Based on a result of this determination, the bobbin 23 is sent out to the defective bobbin waiting path 98 side. If it is determined that the bobbin 23 is not a defective bobbin, the bobbin 23 is kept transported in the empty bobbin transport path 96.

[0102] The defective bobbin waiting path 98 has a certain length, and a downstream end portion of the defective bobbin waiting path 98 is a closed end. Therefore, a plurality of trays 50 having defective bobbins placed thereon can wait in the defective bobbin waiting path 98.

[0103] When the trays 50 having the defective bobbins placed thereon are reserved to a certain extent in the defective bobbin waiting path 98, the operator removes the defective bobbins from the trays 50, and replaces them with empty bobbins. Then, the operator performs an appropriate operation, to thereby drive the defective bobbin waiting path 98 in reverse. As a result, the trays 50 reserved in the defective bobbin waiting path 98, on which the replacing empty bobbins are placed, are introduced into the replaced bobbin return path 99.

[0104] As shown in FIG. 1, the replaced bobbin return path 99 diverges from a middle of the defective bobbin waiting path 98, and is connected to the empty bobbin return path 97. The tray 50 on which the defective bobbin has been replaced with the empty bobbin is introduced through the replaced bobbin return path 99 into the empty bobbin return path 97, and then returned to the spinning frame 2.

[0105] As described above, the winder 3 of this embodiment can distinguish the transported bobbin 23 into any of the empty bobbin, the actual bobbin, and the defective bobbin, based on the storage content of the RF tag 60. Thereby, even if the empty bobbin, the actual bobbin, and the defective bobbin are mixed in the automatic bobbin feed system 6 and the winder 3, each bobbin can be appropriately distributed so that the bobbin 23 can be appropriately transferred between the fine spinning frame 2 and the winder 3, without stopping the transport of the tray 50.

[0106] As shown above, the winder 3 of this embodiment is configured as follows. That is, the winder 3 includes the plurality of rewinding units 31, and is connected to the automatic bobbin feed system 6. The rewinding unit 31 unwinds the yarn wound on the bobbin 23, to form the package 30. The automatic bobbin feed system 6 transports the tray 50 on which the bobbin 23 wound with the yarn is set. The tray 50 has a RF tag 60 capable of recording information. The rewinding unit 31 includes the

RF reader 5 and the unit control section 10. The RF reader 5 reads the information from the RF tag 60 of the tray 50 having set thereon the bobbin 23 on which the rewinding operation is being performed. In a case where the rewinding operation is interrupted halfway, the unit control section 10 records the rewinding information indicating the rewinding conditions and a rewinding status obtained at a time when the interruption occurs. When performing the rewinding operation again using the bobbin 23 on which the rewinding operation has been interrupted halfway, the unit control section 10 controls any one of the plurality of rewinding units 31 having the bobbin transported thereto, based on the rewinding information of this bobbin 23.

[0107] Accordingly, even if the bobbin 23 on which the rewinding operation has been interrupted is transported to the rewinding unit 31 different from the rewinding unit 31 that originally performed the rewinding operation, the rewinding conditions applied prior to the interruption are reconstructed based on the rewinding information, and the yarn can be drawn from the bobbin 23 substantially under the same conditions. Therefore, the yarn wound on the same bobbin 23 is rewound under the same rewinding conditions, which can stabilize the yarn quality.

[0108] In the management system for the winder 3 of this embodiment, the rewinding information contains remaining yarn length information concerning the yarn remaining on the bobbin 23.

[0109] This enables the process by the rewinding unit 31 and the transport by the automatic bobbin feed system 6 to be performed in accordance with the remaining yarn length of the yarn remaining on the bobbin 23.

[0110] The rewinding unit 31 provided in the winder 3 of this embodiment includes the tension applying device 13 configured to apply a tension to the yarn that is being rewound into the package 30. The rewinding information contains the tension information in the tension applying device 13.

[0111] Accordingly, by considering the tension information concerning the tension that was applied by the tension applying device 13 before the rewinding operation has been interrupted, the tension of the yarn drawn out from the bobbin 23 can be kept substantially within a certain range from the start to the end of the unwinding operation on this bobbin 23.

[0112] The rewinding unit provided in the winder 3 of this embodiment includes the clearer 15 for detecting a yarn defect. In the management system of this embodiment, the rewinding information contains the yarn defect information concerning a detection of the defect by the clearer 15.

[0113] Accordingly, by referring to the yarn defect information, the status of the yarn wound on the bobbin 23 can be recognized. Therefore, the process by the rewinding unit 31 and the transport by the automatic bobbin feed system 6 can be performed in accordance with the status of the yarn. The yarn defect information of this embodiment also contains cutting data concerning yarn cutting and the like (information indicating the number of times the clearer 15 detected a yarn defect and the yarn was cut).

[0114] The automatic bobbin feed system 6 connected to the winder 3 of this embodiment includes the plurality of paths (tray transport path 90), the RF reader 9, and the path switching mechanism 43. The RF reader 9 is for reading information recorded on the RF tag 60 of the tray 50. The path switching mechanism 43 switches a path based on the information read by the RF reader 9.

[0115] Accordingly, a destination of transport of the bobbin 23 can be determined based on the rewinding information recorded on the RF tag 60, and therefore efficiency in transporting the bobbin 23 can be effectively improved.

[0116] The rewinding unit provided in the winder 3 of this embodiment includes the rewinding-unit RF writer 40 for recording the rewinding information on the RF tag 60 of the tray 50. In a case where the rewinding operation is interrupted, the rewinding information is written into the RF tag 60. When performing the rewinding operation again using the bobbin 23 on which the rewinding operation has been interrupted halfway, the management system of this embodiment controls any one of the plurality of rewinding units 31 having the bobbin transported thereto, based on the rewinding information recorded on the RF tag 60.

[0117] Accordingly, the rewinding information can be obtained and reflected to the rewinding operation merely by reading the rewinding information from the RF tag 60 of the tray 50. As a result, the process for reconstructing the rewinding operation that was applied prior to the interruption can be concluded at the rewinding unit 31 side, which can achieve a simple process.

[0118] While the fine spinning winder 1 including the winder 3 according to one embodiment of the present invention has been described above, the configuration of the winder 3 can be appropriately modified depending on circumstances, as long as the management system of the present invention is applied thereto. In a possible modification, for example, the rewinding-unit RF writer 40 arranged for each rewinding unit 31 of the winder 3 may be omitted, and instead the machine controller 11 may manage the rewinding information of each bobbin 23. Next, a modification in which the machine controller 11 manages the rewinding information of each bobbin 23 will be described with reference to FIG. 6. FIG. 6 contains a schematic front elevational view and a block diagram showing the fine spinning winder 1 according to the modification. Since the modification which will be described below is identical to the above-described embodiment except that the machine controller 11 manages the rewinding information of each bobbin 23 and that the rewinding-unit RF writers 40 are omitted, the identical parts will not be described.

[0119] The machine controller 11 provided in a winder 203 according to the modification includes a storage section (not shown), and is configured to store in this storage

section the bobbin information for identifying the bobbin in association with the rewinding information of the bobbin 23 corresponding to this bobbin information. As shown in FIG. 6, the information read by the RF reader 5 is inputted to the machine controller 11 with respect to each rewinding unit 31.

[0120] In the following, a specific description will be given by taking, as an example, a case where the defective bobbin is detected. If a defective bobbin is detected in a certain rewinding unit 31, the machine controller 11 stores information indicating the detection of the defective bobbin in the certain rewinding unit 31. As described above, while the yarn is rewound from the bobbin 23 in the rewinding unit 31, the information (including the information for identifying the bobbin 23) recorded on the RF tag 60 of the tray 50 having this bobbin 23 mounted thereon is read by the RF reader 5, and the information is inputted to the machine controller 11. If a defective bobbin is detected in the rewinding unit 31, the machine controller 11 stores the information indicating the detection in association with the bobbin information of the bobbin 23 (the defective bobbin described above) on which the rewinding unit 31 currently performs rewinding. As a result, information indicating which bobbin 23 is a defective bobbin is stored in the machine controller 11.

[0121] The machine controller 11 checks the information transmitted from the RF reader 9 against the information stored in the machine controller 11 itself (the information indicating which bobbin 23 is a defective bobbin), and thereby determines whether or not the bobbin 23 placed on the tray 50 that is passing through the position of the RF reader 9 is a defective bobbin. The path switching mechanism 43 sends out a bobbin 23 to the defective bobbin waiting path 98 side if the machine controller 11 determines that the bobbin 23 is a defective bobbin, and keeps a bobbin 23 transported in the empty bobbin transport path 96 if the machine controller 11 determines that the bobbin 23 is not a defective bobbin. A subsequent route for transporting the defective bobbin is the same as that of the embodiment described above, and therefore a description thereof will be omitted.

[0122] As shown above, the machine controller 11 provided in the winder 203 according to the modification includes the storage section that can store the rewinding information with respect to each bobbin 23. The RF tag 60 of the tray 50 records thereon the bobbin information (the station number and the doffing information) for distinguishing the tray 50 from other trays 50. When performing the rewinding operation again using the bobbin 23 on which the rewinding operation has been interrupted halfway, the management system identifies the bobbin 23 based on the identification information recorded on the RF tag 60. Then, based on the rewinding information of the bobbin 23, the management system controls any one of the plurality of rewinding units 31 having the bobbin 23 transported thereto.

[0123] Accordingly, the rewinding information of the bobbin 23 can be collectively managed by the machine controller 11 side, and therefore a storage capacity of the RF tag 60 of the tray 50 can be reduced. Moreover, from the viewpoint of the rewinding unit 31 side, it is not necessary to provide any special means for storing data. Therefore, a simple configuration for reflecting the rewinding information to the rewinding operation can be achieved.

[0124] Although the embodiment of the present invention has been described above, the above-described configuration may be modified as follows.

[0125] Although in the embodiment described above, the station number and the doffing information are stored in the RF tag 60 so that the fine spinning unit is identified, this configuration may be appropriately modified depending on circumstances. For example, a unique identification number may be given to the tray 50, so that the bobbin 23 is identified based on the identification number.

[0126] In a possible configuration, notification means such as a warning light or a buzzer may be provided in the automatic bobbin feed system 6, so that if the automatic bobbin feed system 6 determines that pick-finding in the bobbin cannot be performed, the notification means is actuated to give notification to the operator.

DESCRIPTION OF THE REFERENCE NUMERALS

[0127]

1	fine spinning winder
2	spinning frame
3	winder (automatic winder)
4	RF writer
5	RF reader (data reading part)
6	automatic bobbin feed system (bobbin transport mechanism)
9	RF reader (second data reading part)
11	machine controller
15	clearer (yarn defect detection part)
16	display (notification means)
23	bobbin
31	rewinding unit
32	fine spinning unit
40	rewinding-unit RF writer (data writing part)
43	path switching mechanism (path switching device)
50	tray (transporter)
60	RF tag (data recording section)

Claims

1. A management system for an automatic winder,
the automatic winder comprising a plurality of rewinding units for unwinding yarns wound on bobbins, to form packages,
the automatic winder being connected to a bobbin transport mechanism for transporting a transporter on which the bobbin is set,
the transporter including a data recording section

configured to record information,
the rewinding unit comprising:

a data reading part for reading the information from the data recording section corresponding to the bobbin on which a rewinding operation is performed; and
a unit control section for, when the rewinding operation is interrupted halfway, recording rewinding information indicating a rewinding condition and a rewinding status obtained at a time when the interruption occurs, and when performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, controlling any one of the plurality of rewinding units having the bobbin transported thereto based on the rewinding information of said bobbin.

2. The management system for the automatic winder according to claim 1, wherein
the rewinding information contains remaining yarn length information concerning a yarn remaining on the bobbin.

3. The management system for the automatic winder according to claim 1 or 2, wherein
the rewinding unit includes tension applying means configured to apply a tension to a yarn that is rewound into the package,
the rewinding information contains control information of the tension applying means.

4. The management system for the automatic winder according to claim 1 or 2, wherein
the rewinding unit includes a yarn defect detection part for detecting a yarn defect,
the rewinding information contains detection information concerning a detection of the defect by the yarn defect detection part.

5. The management system for the automatic winder according to claim 1 or 2, wherein
the bobbin transport mechanism comprises:

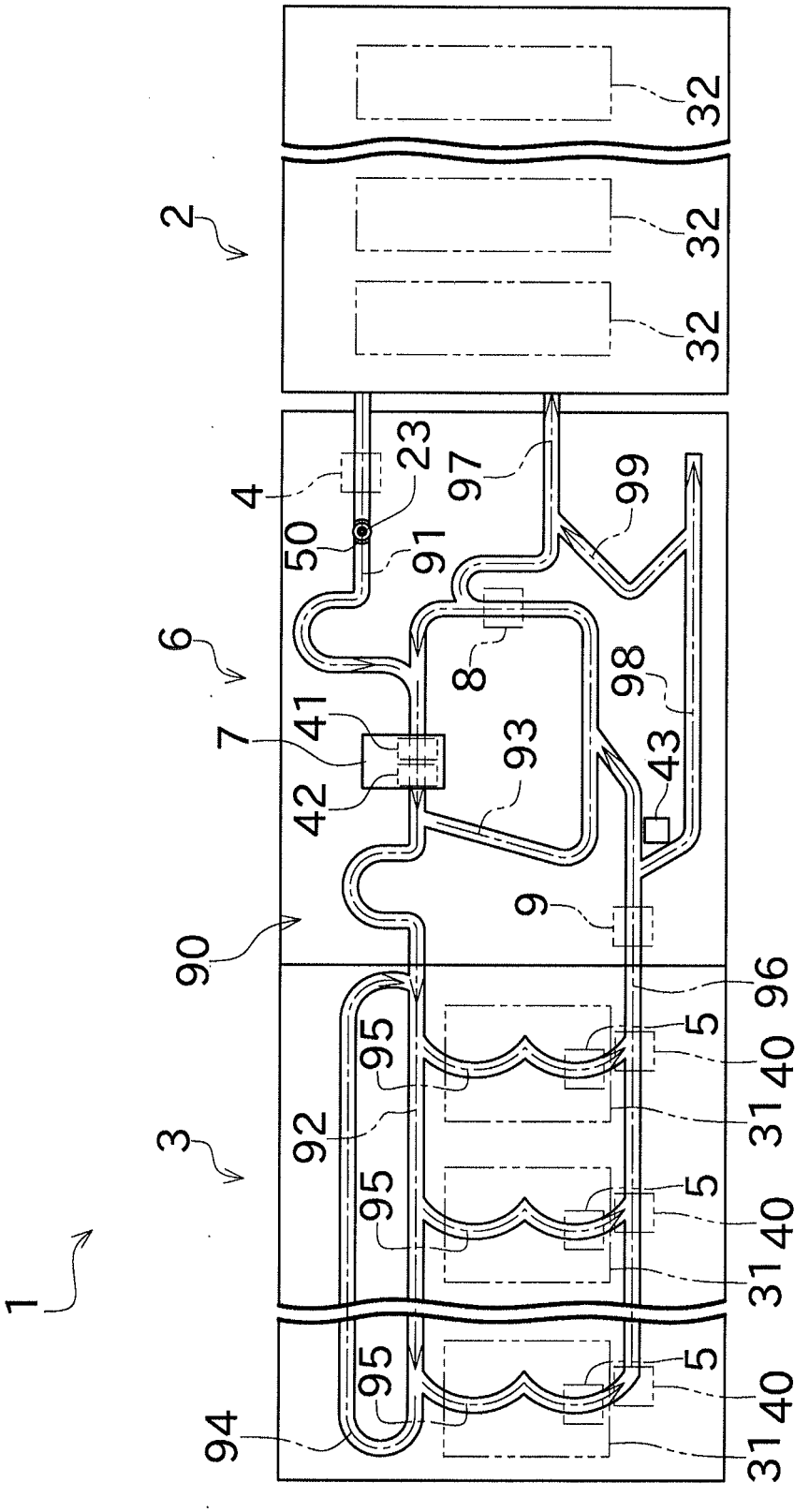
a plurality of paths;
a second data reading part for reading the information recorded on the data recording section of the transporter; and
a path switching device for switching a path based on the information read by the second data reading part.

6. The management system for the automatic winder according to claim 1 or 2, wherein
the rewinding unit includes a data writing part for recording the rewinding information into the data recording section of the transporter,
in a case where the rewinding operation is interrupted, the rewinding information is written into the data recording section,
when performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, any one of the plurality of rewinding units having the bobbin transported thereto is controlled based on the rewinding information recorded on the data recording section.

7. The management system for the automatic winder according to claim 1 or 2, wherein
the management system comprises a storage section configured to store the rewinding information with respect to each bobbin,
the data recording section of the transporter records thereon identification information for distinguishing said transporter from other transporters,
when performing the rewinding operation again using the bobbin on which the rewinding operation has been interrupted halfway, the management system identifies the bobbin based on the identification information recorded on the data recording section,
the management system controls any one of the plurality of rewinding units having the bobbin transported thereto based on the rewinding information of the bobbin.

8. An automatic winder to which the management system according to claim 1 or 2 is applied.

FIG.1



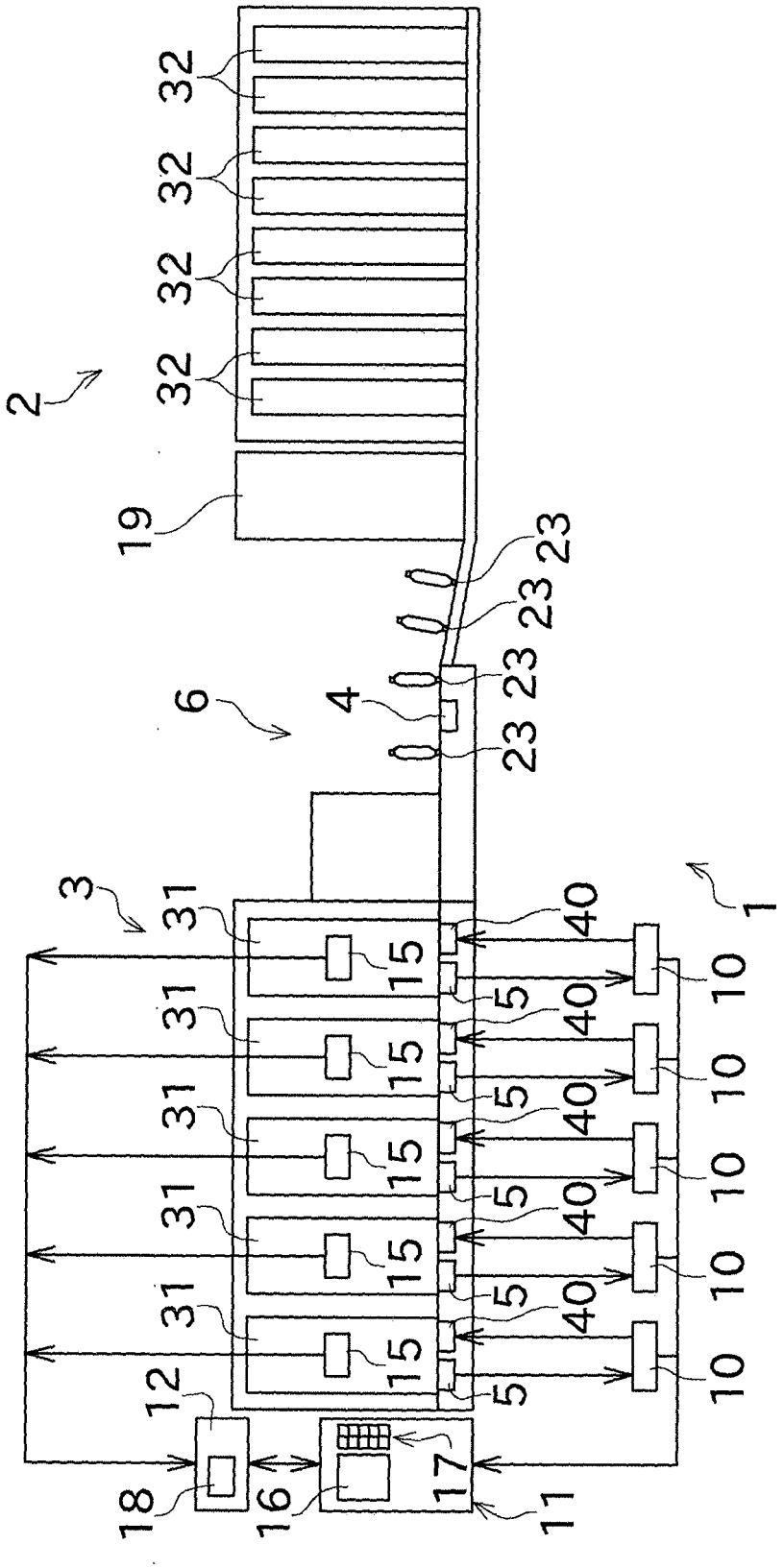

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FIG.2

FIG.3

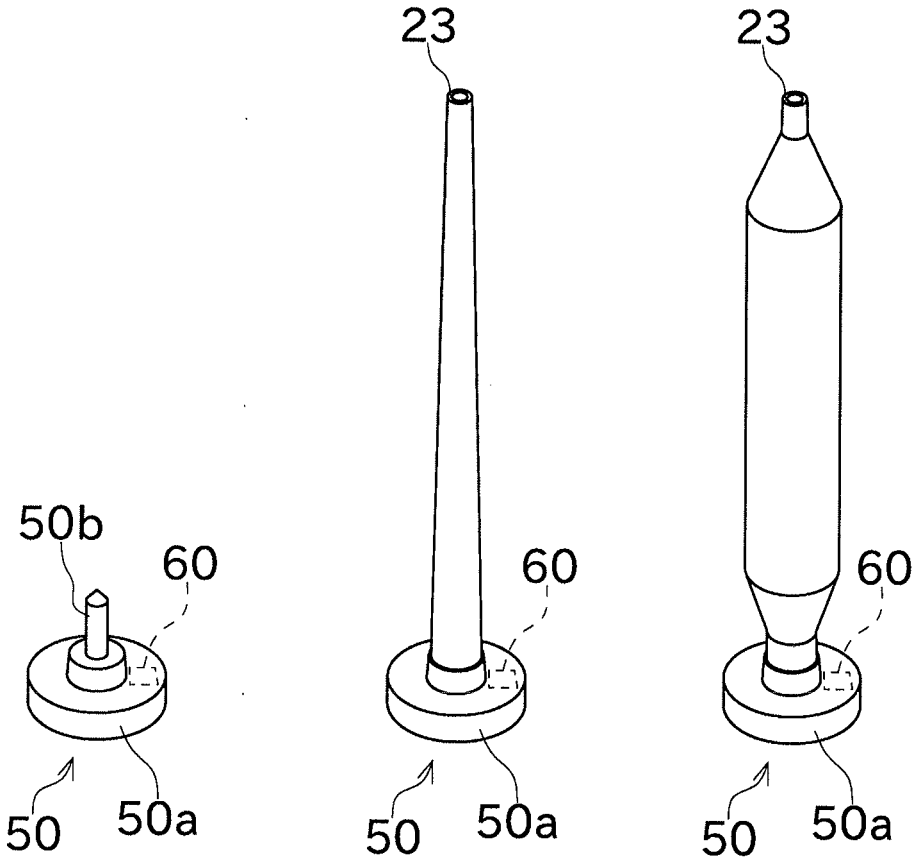

FIG.4

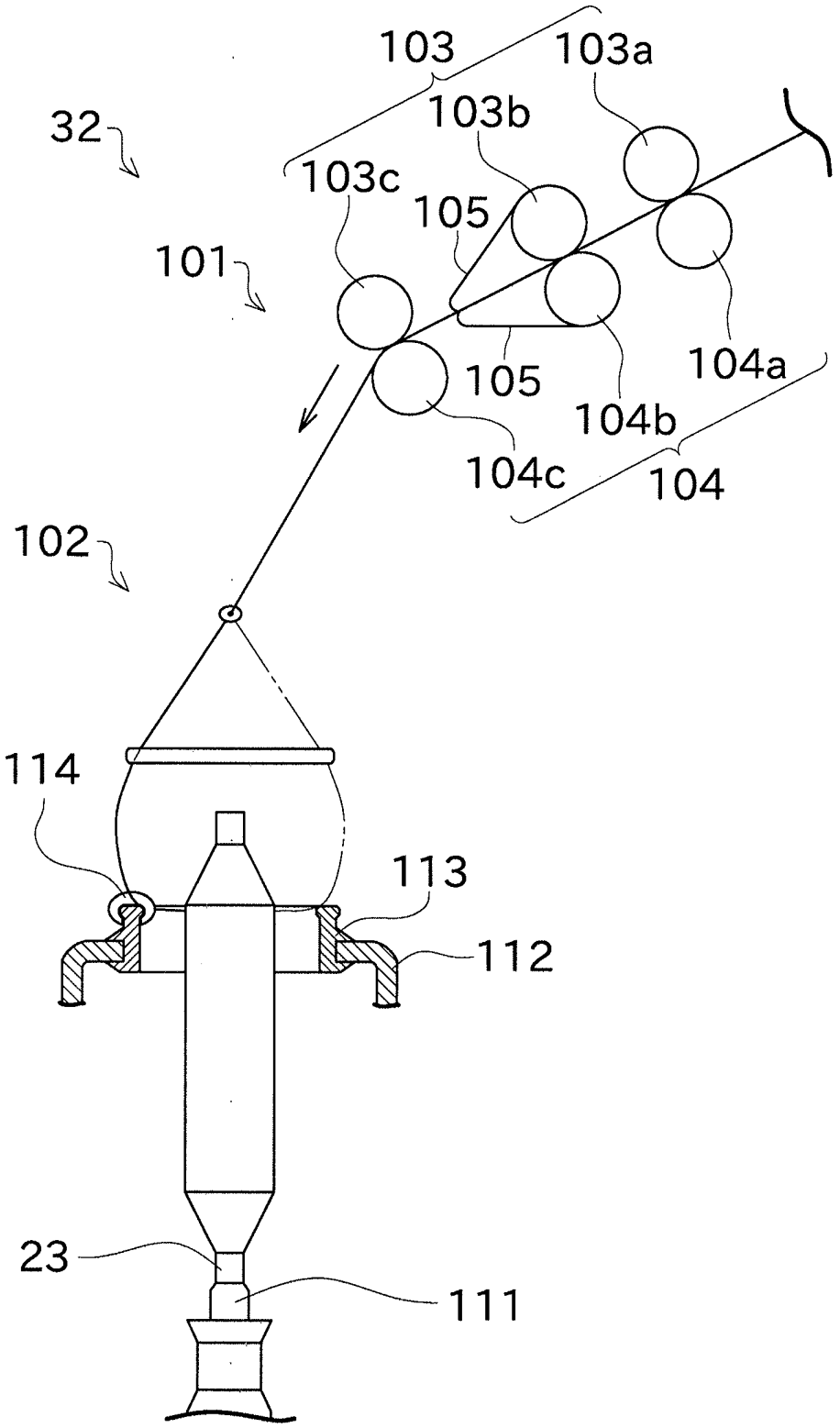
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FIG.5

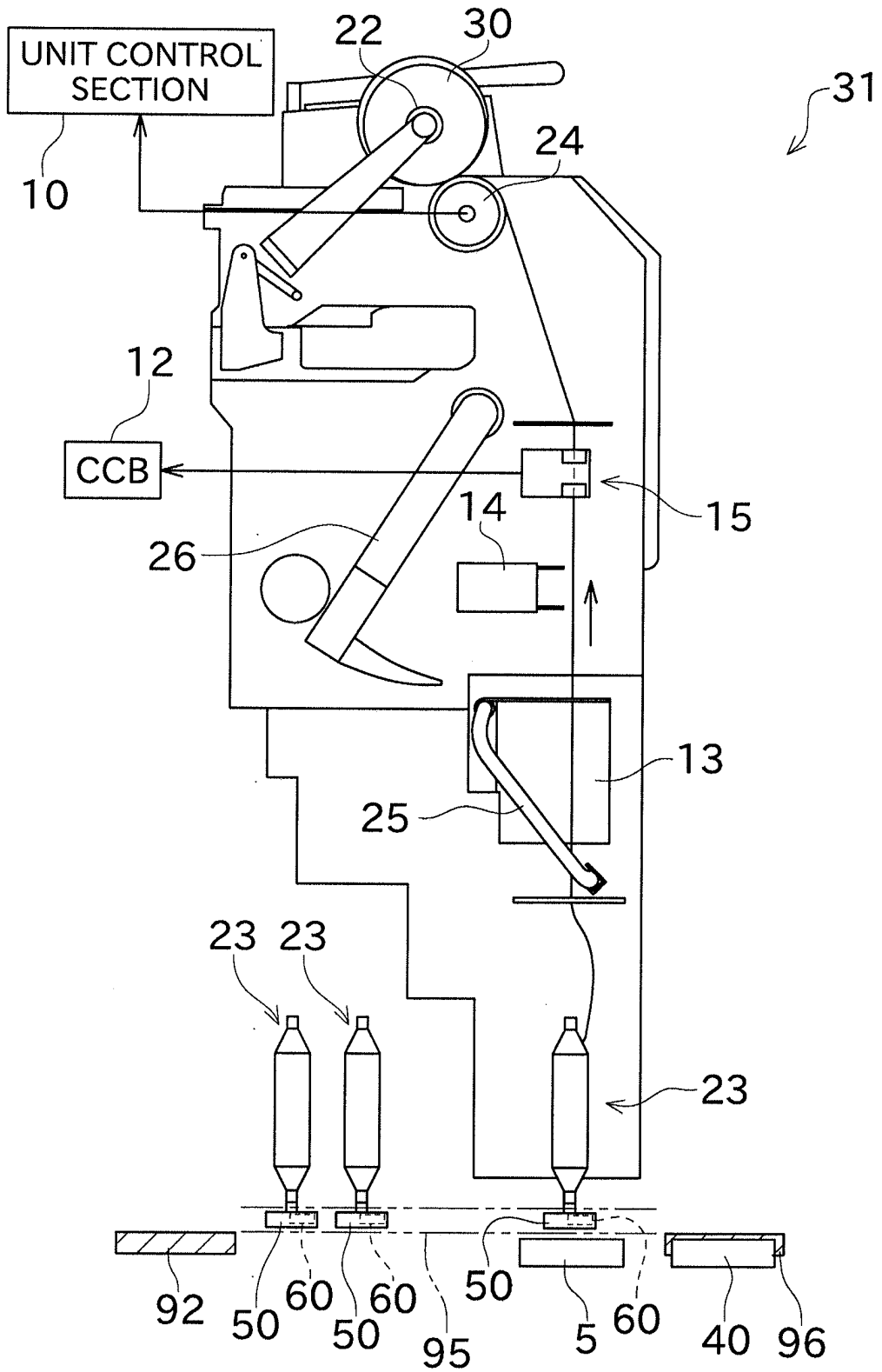
UNIT CONTROL SECTION
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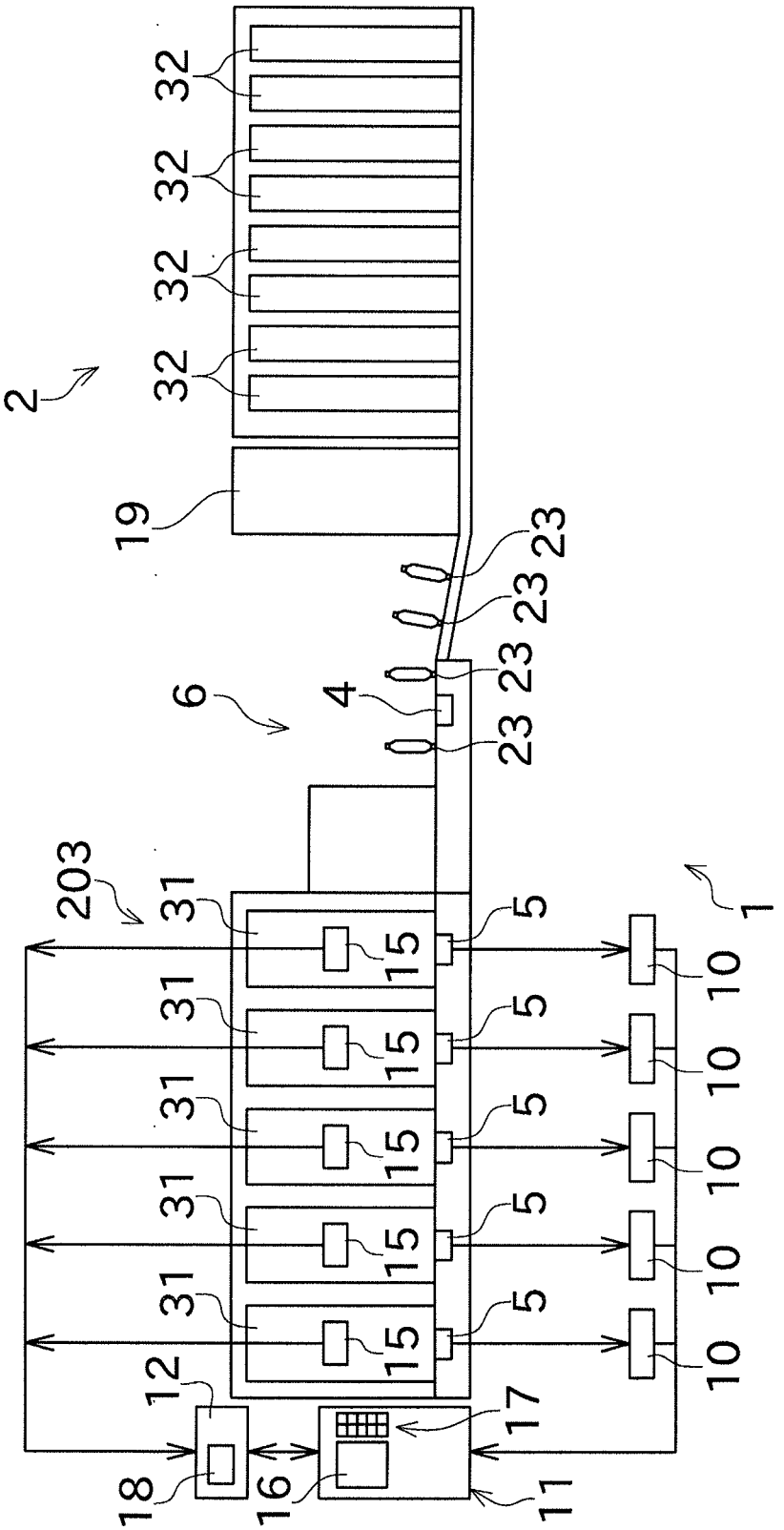
FIG.6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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/004319

A. CLASSIFICATION OF SUBJECT MATTER
B65H67/06(2006.01)i, *B65H54/70*(2006.01)i, *B65H63/06*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H67/06, B65H54/70, B65H63/06

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 8-175763 A (Murata Machinery Ltd.), 09 July 1996 (09.07.1996), paragraphs [0030] to [0044] (Family: none)	1-8
A	JP 4-341465 A (Murata Machinery Ltd.), 27 November 1992 (27.11.1992), paragraphs [0005] to [0017] (Family: none)	1-8
A	JP 2007-210776 A (Murata Machinery Ltd.), 23 August 2007 (23.08.2007), paragraphs [0022] to [0023] (Family: none)	1-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search 31 August, 2010 (31.08.10)	Date of mailing of the international search report 07 September, 2010 (07.09.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2003176081 A **[0005]**
- JP 62041329 A **[0005]**