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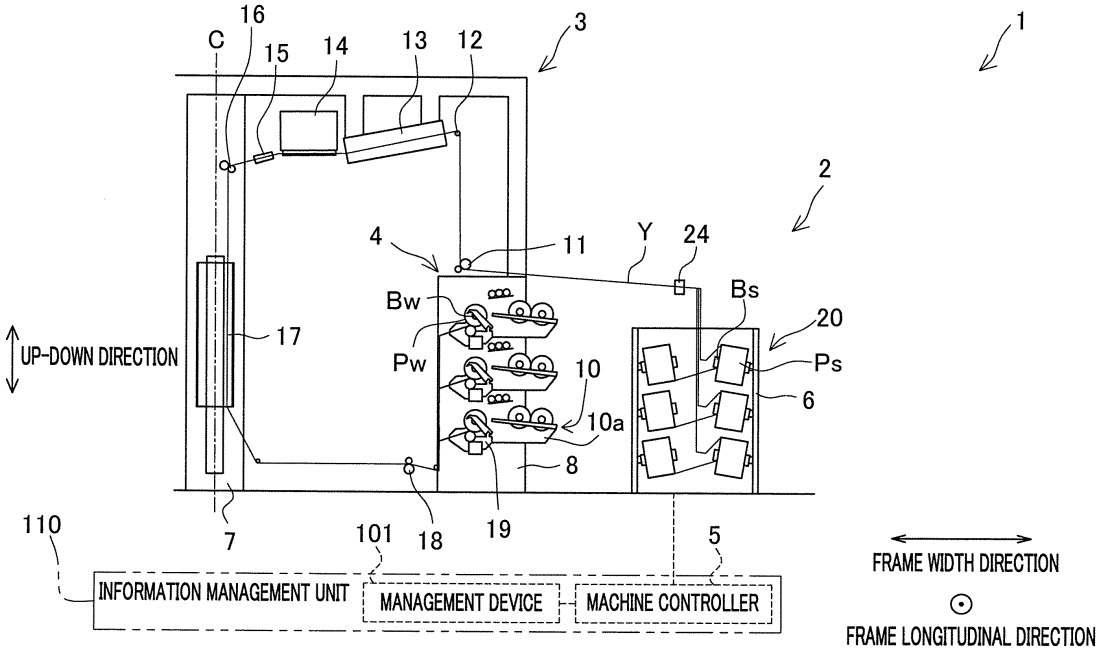
(54) YARN PROCESSING FACILITY

(57) A yarn processing facility which is able to significantly improve production management is provided. An information management unit 110 of a yarn processing facility 100 is able to acquire initial amount information regarding an initial amount of a yarn Y in a yarn supply package Ps before the start of unwinding of the yarn Y, an unwinding unit amount information regarding an amount of the yarn Y unwound from the yarn supply package Ps per unit the, and unwinding unit amount information regarding an unwinding start time at which the unwinding of the yarn Y from the yarn supply package Ps starts. By performing a calculation using these sets of information, it is possible to, for example, precisely predict a timing of the end of the unwinding of the yarn Y from the yarn supply package Ps and to regularly estimate the progress of the unwinding of the yarn Y.

FIG.3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn processing facility.

[0002] Patent Literature 1 (Published Japanese Translation of a PCT application No. 2003-526584) discloses an apparatus (yarn processing facility) which is configured to form a winding assembly (wound package) by processing a yarn unwound from a yarn supply package (supply bobbin in Patent Literature 1) which is formed by winding the yarn onto the yarn supplying bobbin and then winding the yarn onto a winding bobbin. The yarn processing facility is arranged to be able to support two yarn supply packages for one winding bobbin. In such a yarn processing facility, when a terminal portion of a yarn in one of the two yarn supply packages is tied (connected) to a start end portion of a yarn in the other one of the two yarn supply packages, it is possible to uninterruptedly supply the yarn from the other yarn supply package when the one yarn supply package becomes empty. To be more specific, immediately after the end of the supply of the yarn from the one of the yarn supply packages, the node of the two yarns (i.e., yarn connection part) is pulled and unwinding of the yarn from the other yarn supply package starts. In this way, the yarn is uninterruptedly supplied.

SUMMARY OF THE INVENTION

[0003] In the technical field of yarn processing, various improvements has been done to increase the productivity and the quality of products. The inventors of the subject application have continued diligent efforts to develop a yarn processing facility having a novel added value.

[0004] An object of the present invention is to provide a yarn processing facility which is able to significantly improve production management.

[0005] According to a first aspect of the invention, a yarn processing facility includes: a yarn processor including: a yarn supplying unit including at least one yarn supply package retaining portion capable of supplying at least one yarn; a processing unit configured to process the at least one yarn supplied from the yarn supplying unit; and a winding unit configured to form a wound package by winding the at least one yarn processed by the processing unit onto a winding bobbin; and an information management unit which is configured to manage information regarding the yarn processor, each of the at least one yarn supply package retaining portion being capable of uninterruptedly supplying the at least one yarn, when plural yarn supply packages are attachable to and detachable from the each of the at least one yarn supply package retaining portion and a terminal portion of a yarn in one yarn supply package is connected to a start end portion of a yarn in another yarn supply package from which the yarn is to be unwound next to the one yarn supply package, and the information management unit being capable of acquiring initial amount information regarding an initial amount of a yarn in a yarn supply package before unwinding of the yarn from the yarn supply package starts, unwinding unit amount information regarding an amount of a yarn unwound from a yarn supply package per unit time, and unwinding start time information regarding an unwinding start time at which unwinding of a yarn from a yarn supply package starts.

[0006] When the initial amount information, the unwinding unit amount information, and the unwinding start time information are acquired, by performing a calculation using these sets of information, it is possible to, for example, precisely predict a timing of the end of the unwinding of the yarn from the yarn supply package and to regularly estimate the progress of the unwinding of the yarn. The initial amount information can be acquired, for example, at the time of attachment of the yarn supply package to the yarn supplying unit. The unwinding unit amount information can be acquired when an operation setting of the yarn processing facility is performed. The unwinding start time information can be acquired by, for example, detecting switching of a yarn supply package from which a yarn is unwound, by using a sensor or the like. Alternatively, when unwinding start time information of a given yarn supply package has been known, unwinding start time information of another yarn supply package from which a yarn is to be unwound next can be estimated by a calculation by using initial amount information, unwinding unit amount information, and unwinding start time information regarding the given yarn supply package. It is therefore possible to obtain a yarn processing facility which is able to significantly improve production management. In order to acquire initial amount information, for example, a weight sensor for measuring the weight of a yarn supply package may be provided for each yarn supplying unit. This, however, disadvantageously increases the cost of the facility. The present invention makes it possible to avoid such cost increase.

[0007] According to a second aspect of the invention, the yarn processing facility of the first aspect is arranged such that the information management unit acquires, as the initial amount information, information of initial weight and fineness of a yarn in a yarn supply package, and as the unwinding unit amount information, information of unwinding speed indicating the length of a yarn unwound from a yarn supply package per unit time.

[0008] Typically, because information of initial weight of a yarn supply package can be easily acquired by setting or measurement, such information is easily dealt with as initial amount information. Similarly, because information of unwinding speed can be easily acquired by setting or measurement, such information is easily dealt with as unwinding unit amount information. However, while the initial weight has a dimension of mass, the unwinding speed has a dimension

of length. In this case, calculations regarding time and/or remaining amount cannot be performed based only on initial weight, unwinding speed, and an unwinding start time, because the units cannot be unified. In this regard, according to the present invention, information of fineness (weight per unit length) that can be acquired in advance is acquired as initial amount information. This makes it easy to unify the units in calculations of time and/or remaining amount. As such, sets of information that are easily acquired and easily unified in terms of the units can be used for various calculations.

[0009] According to a third aspect of the invention, the yarn processing facility of the first or second aspect is arranged such that the information management unit acquires, by a calculation using at least the initial amount information, the unwinding unit amount information, and the unwinding start time information, at least one of: predicted unwinding end time information regarding a predicted unwinding end time at which unwinding of a yarn from a yarn supply package ends; remaining time information regarding remaining time in which unwinding of a yarn from a yarn supply package is possible at a given reference time; and remaining amount information regarding a remaining amount of a yarn in a yarn supply package at the reference time.

[0010] According to the aspect, it is possible to predict a time (unwinding end time) when unwinding of a yarn from a yarn supply package ends and to regularly estimate a remaining time and/or a remaining amount. Such information that is predicted and/or estimated can be used for managing various operations performed until the end of the unwinding of the yarn from the yarn supply package (e.g., preparation of a schedule of replacement of the yarn supply package).

[0011] According to a fourth aspect of the invention, the yarn processing facility of the third aspect is arranged such that, based on the remaining time information regarding all yarn supply packages attached to a predetermined yarn supply package retaining portion among the at least one yarn supply package retaining portion, the information management unit acquires information of a predicted original yarn disappearance time at which the all yarn supply packages attached to the predetermined yarn supply package retaining portion become empty.

[0012] By utilizing the information of the predicted original yarn disappearance time acquired by the aspect, advanced control regarding operations such as replacement of yarn supply packages or advanced facility operation management is realized.

[0013] According to a fifth aspect of the invention, the yarn processing facility of the fourth aspect further includes a yarn supply package conveyance device which is configured to convey a new yarn supply package to the yarn supplying unit and to perform yarn supply package replacement of replacing an empty yarn supply package from which a yarn is fully unwound with the new yarn supply package, the information management unit managing operation of the yarn supply package conveyance device so that the yarn supply package replacement at the predetermined yarn supply package retaining portion is finished before the predicted original yarn disappearance time regarding the predetermined yarn supply package retaining portion comes.

[0014] This aspect of the invention makes it possible to prevent the shortage of yarn supply packages attached to a predetermined yarn supply package retaining portion.

[0015] According to a sixth aspect of the invention, the yarn processing facility of the fifth aspect is arranged such that the yarn supplying unit includes a plurality of yarn supply package retaining portions as the at least one yarn supply package retaining portion, the yarn supply package conveyance device is capable of performing the yarn supply package replacement for the plurality of yarn supply package retaining portions, and the information management unit managing operation of the yarn supply package conveyance device so that the yarn supply package replacement at each of the plurality of yarn supply package retaining portions is finished before the predicted original yarn disappearance time regarding each of the plurality of yarn supply package retaining portions comes.

[0016] According to this aspect, in an arrangement in which plural yarn supply package retaining portions are provided, it is possible to prevent the shortage of yarn supply packages at each yarn supply package retaining portion.

[0017] According to a seventh aspect of the invention, the yarn processing facility of the fourth aspect further includes: a first output unit which is capable of outputting information; and a first output controller which is configured to control the first output unit, at a replacement notification time that is earlier than the predicted original yarn disappearance time by a predetermined period of time, the first output controller causing the first output unit to output information that prompts an operator to replace a yarn supply package at the predetermined yarn supply package retaining portion.

[0018] This aspect of the invention makes it possible to prompt the operator to perform the yarn supply package replacement at a suitable timing. It is therefore possible to prevent the shortage of yarn supply packages attached to the yarn supply package retaining portion. The first output controller may be included in the information management unit or may be provided to be independent from the information management unit.

[0019] According to an eighth aspect of the invention, the yarn processing facility of any one of the third to seventh aspects further includes: a connection information acquisition unit which is capable of acquiring information regarding whether a terminal portion of a yarn in a predetermined yarn supply package is connected to a start end portion of a yarn in a reserve yarn supply package from which the yarn is to be unwound next to the predetermined yarn supply package; a second output unit which is capable of outputting information; and a second output controller which is configured to control the second output unit, based on information acquired by the connection information acquisition unit, the second output controller causing the second output unit to output information by which connection of the start

end portion with the terminal portion is prompted, when the start end portion is not connected to the terminal portion and the remaining time regarding the predetermined yarn supply package is decreased to a predetermined period of time or less.

[0020] This aspect of the invention makes it possible to prevent the operator, etc. from forgetting to perform the connection. The first output unit and the second output unit may be identical with each other or different from each other. The first output controller and the second output controller may be identical with each other or different from each other. The second output controller may be included in the information management unit or may be provided to be independent from the information management unit.

[0021] According to a ninth aspect of the invention, the yarn processing facility of any one of the third to eighth aspects is arranged such that the information management unit is capable of acquiring: information of a winding start time at which winding of a yarn onto a predetermined winding bobbins starts; and information regarding at least one of a planned winding end time at which the winding of the yarn onto the predetermined winding bobbin ends, a planned wound amount of the yarn wound onto the predetermined winding bobbin, and a planned winding time during which the yarn is wound onto the predetermined winding bobbin, and the information management unit (110) predicts that a yarn connecting portion formed by connection of the start end portion with the terminal portion is to be mixed into a predetermined wound package formed by winding the yarn onto the predetermined winding bobbin, when the predicted unwinding end time exists between the winding start time and the planned winding end time, when the remaining amount regarding a yarn supply package from which a yarn is being unwound at the winding start time is smaller than the planned wound amount, or when the remaining time regarding the yarn supply package from which the yarn is being unwound at the winding start time is shorter than the planned winding time.

[0022] This prediction result acquirable by the aspect of the invention can be used for managing the operations of the facility related to the formation of the wound package. For example, it is possible to control the operation of the winding unit so that the mixture of a yarn connecting portion into a wound package yarn connecting portion is avoided. Furthermore, it is possible to estimate a location where a yarn connecting portion is mixed in a wound package.

[0023] According to a tenth aspect of the invention, the yarn processing facility of the ninth aspect is arranged such that the information management unit manages a timing to end a winding process of winding the yarn onto the predetermined winding bobbin, in accordance with a timing at which it is predicted that the yarn connecting portion is to be mixed into the predetermined wound package.

[0024] The aspect of the invention makes it possible to avoid the mixture of the yarn connecting portion into the wound package. Alternatively, as a yarn connecting portion is intentionally mixed into a radially outer part of a wound package, the yarn connecting portion can be easily removed from the wound package. The qualities of the wound packages are therefore uniformized.

[0025] According to an eleventh aspect of the invention, the yarn processing facility of any one of the third to tenth aspects is arranged such that, based on the remaining amount information, the information management unit is able to acquire yarn layer information indicating to which part of a yarn layer of a yarn supply package suppling the yarn to the predetermined winding bobbin the yarn wound onto the predetermined winding bobbin belonged, at the reference time.

[0026] The aspect of the invention makes it possible to associate information of the yarn in the wound package with yarn layer information of the yarn included in the yarn supply package, by utilizing the remaining amount information. Such information is useful for, for example, quality management of wound packages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a schematic plan view of a yarn processing facility of an embodiment.

FIG. 2 is a block diagram of an electric configuration of the yarn processing facility.

FIG. 3 is a profile of a false-twist texturing machine.

FIG. 4 is a schematic diagram of the false-twist texturing machine, expanded along paths of yarns.

FIG. 5(a) and FIG. 5(b) are graphs each of which shows the relationship between a remaining amount of a yarn in a yarn supply package and time. FIG. 5(c) is a graph showing the relationship between an amount of a yarn wound onto a winding bobbin and time.

FIG. 6 is a partially enlarged view of FIG. 5(c).

FIG. 7(a) is a table showing how sets of information such as yarn supply package individual information and individual information of a package attachment unit are associated with one another. FIG. 7(b) is a table showing how individual information of a package attachment unit and sets of information of time are associated with one another.

FIG. 8(a) is a table showing how yarn supplying bobbin individual information and sets of information are associated with one another. FIG. 8(b) is a table showing how wound package individual information and sets of information of time are associated with one another.

FIG. 9 is a graph related to a reference example and shows the relationship between an amount of a yarn wound onto a winding bobbin and time, when a mixture avoidance process of avoiding mixture of a node is performed.
FIG. 10 relates to a modification and is a schematic diagram of a false-twist texturing machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Outline of Yarn Processing Facility)

[0028] The following will describe an embodiment of the present invention. A yarn processing facility 100 of the present embodiment will be outlined with reference to a schematic plan view in FIG. 1 and a block diagram in FIG. 2. As shown in FIG. 1 and FIG. 2, the yarn processing facility 100 includes false-twist texturing machines 1 (yarn processors of the present invention), a management device 101, a creel robot 102 (yarn supply package conveyance device of the present invention), and a wound package conveyance device 103. The false-twist texturing machines 1 are aligned along a predetermined frame longitudinal direction, for example. Each false-twist texturing machine 1 can perform false twisting of a yarn Y (see, e.g., FIG. 3) made of synthetic fibers such as polyester and nylon (polyamide fibers). As described below, each false-twist texturing machine 1 is configured to form a wound package Pw by processing a yarn Y supplied from a yarn supplying unit 2 by a processing unit 3 and winding the yarn Y onto a winding bobbin Bw attached to a winding unit 4. Each false-twist texturing machine 1 is controlled by a machine controller 5 that is a computer device mounted on each false-twist texturing machine 1.

[0029] The management device 101 is a host computer used for integrally controlling information (detailed later) acquired by the machine controllers 5. The management device 101 includes a management input unit 101a (e.g., a keyboard), a management output unit 101b (e.g., a display), and a management storage unit 101c (e.g., a hard disk). The management output unit 101b may include an unillustrated printer. A combination of the management device 101 and the machine controllers 5 is an information management unit 110 of the present embodiment. The information management unit 110 is electrically connected to a creel controller 102a of the creel robot 102. The information management unit 110 is electrically connected to an unillustrated controller of the wound package conveyance device 103. The information handled by the information management unit 110 will be detailed later.

[0030] The creel robot 102 is arranged to be able to convey a yarn supply package Ps attached to the yarn supplying unit 2 (i.e., a package formed by winding a yarn Y onto a yarn supplying bobbin Bs). The creel robot 102 may be arranged to convey plural yarn supply packages Ps at once. The creel robot 102 is arranged to be movable in a factory in which the false-twist texturing machines 1 are provided. For example, the creel robot 102 is arranged to be able to perform reciprocal movement between an unillustrated yarn supply package stocker in which a yarn supply package Ps is stored and each false-twist texturing machine 1. The creel robot 102 is arranged so that a yarn supply package Ps stored in the yarn supply package stocker can be mounted on the robot by an operator, for example. Alternatively, the creel robot 102 may be arranged to be able to acquire a yarn supply package Ps from the yarn supply package stocker without needing human workforce. The creel robot 102 is arranged to be able to attach a yarn supply package Ps to the yarn supplying unit 2 of each false-twist texturing machine 1 and to detach the yarn supply package Ps therefrom. To put it differently, the creel robot 102 is arranged to be able to replace a yarn supply package Ps at the yarn supplying unit 2. The creel controller 102a controlling the creel robot 102 is electrically connected to the management device 101 (see FIG. 2). The creel controller 102a receives a command signal from the information management unit 110 and controls the creel robot 102 in accordance with the command signal.

[0031] The wound package conveyance device 103 is arranged to collect a wound package Pw formed at the winding unit 4 of each false-twist texturing machine 1. The wound package conveyance device 103 may be arranged to convey plural wound packages Pw at once. The wound package conveyance device 103 is arranged to convey a formed wound package Pw to, for example, an unillustrated discharge port. A controller (not illustrated) controlling the wound package conveyance device 103 is electrically connected to the management device 101. The wound package conveyance device 103 receives a command signal from the information management unit 110 and collects a formed wound package Pw in accordance with the command signal.

(Overall Structure of False-Twist Texturing Machine)

[0032] The overall structure of the false-twist texturing machine 1 will be described with reference to FIG. 3 and FIG. 4. FIG. 3 is a profile of the false-twist texturing machine 1. FIG. 4 is a schematic diagram of the false-twist texturing machine 1, expanded along paths of yarns Y (yarn paths). A direction vertical to the sheet of FIG. 3 is defined as the above-described frame longitudinal direction, and a left-right direction in the sheet is defined as a frame width direction. A direction orthogonal to the frame longitudinal direction and the frame width direction is defined as the up-down direction (vertical direction) in which the gravity acts. A direction in which a yarn Y runs will be referred to as a yarn running direction. The false-twist texturing machine 1 includes a yarn supplying unit 2 for supplying yarns Y, a processing unit

3 which performs processing (false twisting) of the yarns Y supplied from the supplying unit 2, a winding unit 4 which winds the yarns Y processed by the processing unit 3 onto winding bobbins Bw, and a machine controller 5.

[0033] The yarn supplying unit 2 includes a creel stand 6 retaining yarn supply packages Ps, and supplies the yarns Y to the processing unit 3. The processing unit 3 is arranged to unwind yarns Y from the yarn supplying unit 2 and process the yarns Y. In the processing unit 3, the following members are placed in this order from the upstream in a yarn running direction: first feed rollers 11; twist-stopping guides 12; first heaters 13; coolers 14; false-twisting devices 15; second feed rollers 16; second heaters 17; and third feed rollers 18. Each of these elements of the processing unit 3 is provided for, for example, each of later-described spindles 9 (see FIG. 4). The winding unit 4 includes a plurality of winding devices 19. Each winding device 19 winds the yarn Y for which the false winding has been performed at the processing unit 3 onto the winding bobbin Bw and forms a wound package Pw. The winding unit 4 is provided with automatic doffers 10 that correspond to the respective winding devices 19 and are configured to replace formed wound packages Pw with empty winding bobbins Bw.

[0034] The machine controller 5 is configured to control the yarn supplying unit 2, the processing unit 3, and the winding unit 4. The machine controller 5 is, for example, a typical computer device. The machine controller 5 includes a machine input unit 5a, a machine output unit 5b, and a machine storage unit 5c. The machine input unit 5a is, for example, an unillustrated touch panel and/or keyboard, and is arranged to be operable by an operator. The machine output unit 5b includes, for example, an unillustrated display and is arranged to be able to output information. The machine output unit 5b may include an unillustrated printer. The machine storage unit 5c is arranged to store sets of information used for controlling the yarn supplying unit 2, the processing unit 3, and the winding unit 4. Based on the sets of information, the machine controller 5 controls the yarn supplying unit 2, the processing unit 3, and the winding unit 4. Alternatively, the machine controller 5 may indirectly control the yarn supplying unit 2, the processing unit 3, and the winding unit 4 through unillustrated controllers that are configured to control these members. The machine controller 5 is electrically connected to the management device 101 that is a host computer. The management device 101 is able to perform later-described determinations and/or calculations by utilizing the information acquired by the machine controller 5.

[0035] The false-twist texturing machine 1 includes a main frame 7 and a winding base 8 that are spaced apart from each other in the frame width direction. The main frame 7 and the winding base 8 are substantially identical in length in the frame longitudinal direction. The main frame 7 and the winding base 8 oppose each other in the frame width direction. The false-twist texturing machine 1 includes units which are termed spans each of which includes a pair of the main frame 7 and the winding base 8. In one span, each device is placed so that the yarns Y running while being aligned in the frame longitudinal direction can be false-twisted at the same time. In the false-twist texturing machine 1, the spans are placed in a left-right symmetrical manner to the sheet, with a center line C of the frame width direction of the main frame 7 being set as a symmetry axis (main frame 7 is shared between the left span and the right span). The spans are aligned in the frame longitudinal direction.

[0036] A group of elements through which a single yarn Y supplied from the yarn supplying unit 2 passes before reaching the winding unit 4 is termed a spindle. To put it differently, the false-twist texturing machine 1 includes spindles 9 (see FIG. 4), the number of which is identical with the number of wound packages Pw that can be formed simultaneously. Roughly speaking, the spindles 9 are aligned along the frame longitudinal direction. The inclusion relation is as follows: one false-twist texturing machine 1 includes plural spans, and each of the spans includes plural spindles 9.

(Yarn Supplying Unit)

[0037] The structure of the yarn supplying unit 2 will be described with reference to FIG. 3 and FIG. 4. The creel stand 6 of the yarn supplying unit 2 includes yarn supply package retaining portions 20 (see FIG. 4) which are provided to correspond to the respective spindles 9. Each yarn supply package retaining portion 20 is arranged so that two yarn supply packages Ps are attachable thereto and detachable therefrom. In other words, the yarn supply package retaining portion 20 has two package attachment units 21. For the sake of convenience, one of the two package attachment units 21 is termed a first attachment unit 22, and the other one of the units is termed a second attachment unit 23. Each of the first attachment unit 22 and the second attachment unit 23 is arranged so that one yarn supply package Ps is attachable thereto and detachable therefrom. The attachment and detachment of a yarn supply package Ps to and from the package attachment unit 21 is performed by the above-described creel robot 102.

[0038] Each yarn supply package retaining portion 20 of the yarn supplying unit 2 is arranged to be able to uninterruptedly supply the yarn Y, in a manner described below. For example, as shown in FIG. 4, a first yarn supply package PsA (given yarn supply package of the present invention) which is one of yarn supply packages Ps is attached to the first attachment unit 22. Meanwhile, a second yarn supply package PsB (another yarn supply package of the present invention) different from the first yarn supply package PsA is attached to the second attachment unit 23. A yarn Y is unwound from the first yarn supply package PsA. The terminal portion of the yarn Y in the first yarn supply package PsA is tied (connected) to the start end portion of the yarn Y in the second yarn supply package PsB. With this arrangement, a node K (yarn connecting portion)is formed between the two yarns Y. This makes it possible to uninterruptedly supply

the yarn Y from the second yarn supply package PsB after the first yarn supply package PsA becomes empty. To be more specific, immediately after the supply of the yarn Y from the first yarn supply package PsA ends and the first yarn supply package PsA becomes empty, the node K is pulled toward the downstream side in the yarn running direction (i.e., toward the winding device 19 side), with the result that the yarn Y is unwound from the second yarn supply package PsB. In this way, the yarn supply package Ps from which the yarn Y is supplied is switched (yarn supply package switching). The yarn Y is therefore uninterruptedly supplied. Thereafter, the yarn supply package Ps (yarn supplying bobbin Bs) having become empty is replaced with a new yarn supply package Ps by the creel robot 102.

[0039] On the downstream side in the yarn running direction of the yarn supply package retaining portions 20, a yarn detection sensor 24 is provided. The yarn detection sensor 24 is arranged to be able to detect which one of the attachment units, the first attachment unit 22 or the second attachment unit 23, is supplying the yarn Y. As shown in FIG. 4, the yarn detection sensor 24 includes a first detection unit 25 and a second detection unit 26. The first detection unit 25 is arranged to be able to detect whether the yarn Y is being supplied from the first attachment unit 22. The second detection unit 26 is arranged to be able to detect whether the yarn Y is being supplied from the second attachment unit 23. Each of the first detection unit 25 and the second detection unit 26 is, for example, an optical sensor configured to optically detect the yarn Y. For details of the yarn detection sensor 24, see Japanese Patent No. 5873105, for example. Alternatively, each of the first detection unit 25 and the second detection unit 26 is a contact sensor, for example.

(Processing Unit)

[0040] The structure of the processing unit 3 will be described also with reference to FIG. 3 and FIG. 4. The following will describe a part of the processing unit 3, which corresponds to one spindle 9.

[0041] The first feed roller 11 is arranged to unwind the yarn Y from the yarn supply package Ps attached to the yarn supplying unit 2 and supply the yarn Y to the first heater 13. The first feed roller 11 is provided upstream of the twist-stopping guide 12 in the yarn running direction. The conveyance speed of the first feed roller 11 conveying the yarn Y is substantially identical with the unwinding speed V (see FIG. 4) at which the yarn Y is unwound from the yarn supply package Ps.

[0042] The twist-stopping guide 12 is provided to prevent twist of the yarn Y formed by the false-twisting device 15 from being propagated to the upstream in the yarn running direction of the twist-stopping guide 12. The twist-stopping guide 12 is placed downstream of the first feed roller 11 in the yarn running direction and upstream of the first heater 13 in the yarn running direction.

[0043] The first heater 13 is configured to heat the yarn Y supplied from the first feed roller 11. The first heater 13 is placed downstream of the twist-stopping guide 12 in the yarn running direction and upstream of the cooler 14 in the yarn running direction. For the sake of simplicity, the first heater 13 of the present embodiment is arranged to heat a single yarn Y. The disclosure, however, is not limited to this arrangement. The first heater 13 may be able to simultaneously heat plural yarns Y.

[0044] The cooler 14 is configured to cool the yarn Y heated by the first heater 13. The cooler 14 is placed downstream of the first heater 13 in the yarn running direction and upstream of the false-twisting device 15 in the yarn running direction. For the sake of simplicity, the cooler 14 of the present embodiment is arranged to cool a single yarn Y. The disclosure, however, is not limited to this arrangement. The cooler 14 may be able to simultaneously cool plural yarns Y.

[0045] The false-twisting device 15 is arranged to twist the yarn Y. The false-twisting device 15 is, for example, a so-called disc-friction false-twisting device, but the disclosure is not limited to this arrangement. The false-twisting device 15 is placed downstream of the cooler 14 in the yarn running direction and upstream of the second feed roller 16 in the yarn running direction.

[0046] The second feed roller 16 is arranged to feed the yarn Y processed at the false-twisting device 15 to the second heater 17. The conveyance speed of conveying the yarn Y by the second feed rollers 16 is higher than the conveyance speed of conveying the yarn Y by the first feed roller 11. The yarn Y is therefore drawn between the first feed roller feed roller 11 and the second feed roller 16.

[0047] The second heater 17 is configured to heat the yarn Y supplied from the second feed roller 16. The second heater 17 extends along the vertical direction. For the sake of simplicity, the second heater 17 of the present embodiment is arranged to heat a single yarn Y. The disclosure, however, is not limited to this arrangement. The second heater 17 may be able to simultaneously heat plural yarns Y.

[0048] The third feed roller 18 is arranged to feed the yarn Y heated by the second heater 17 to the winding device 19. The conveyance speed of conveying the yarn Y by the third feed roller 18 is lower than the conveyance speed of conveying the yarn Y by the second feed roller 16. The yarn Y is therefore relaxed between the second feed roller 16 and the third feed roller 18.

[0049] In the processing unit 3 described above, the yarn Y which has been drawn between the first feed roller 11 and the second feed roller 16 is twisted at the false-twisting device 15. The twist formed by the false-twisting device 15 propagates to the twist-stopping guide 12 but does not propagate to the upstream of the twist-stopping guide 12 in the

yarn running direction. The yarn Y which is twisted and drawn is heated at the first heater 13 and thermally set. After that, the yarn Y is cooled at the cooler 14. The yarn Y is untwisted at the downstream of the false-twisting device 15. However, each filament is maintained to be wavy in shape on account of the thermal setting described above. Subsequently, the yarn Y false-twisted by the false-twisting device 15 is thermally set by the second heater 17 while being relaxed between the second feed roller 16 and the third feed roller 18, and then the yarn Y is guided to the downstream side in the yarn running direction. Finally, the yarn Y sent from the third feed roller 18 is wound onto the winding bobbin Bw by the winding device 19. As a result, the wound package Pw is formed.

(Winding Unit)

[0050] The structure of the winding unit 4 will be described with reference to FIG. 3 and FIG. 4. The winding unit 4 includes the winding devices 19 each of which is configured to wind the yarn Y onto the winding bobbin Bw and the automatic doffers 10 (see FIG. 3) which are provided to correspond to the respective winding devices 19. One winding device 19 belongs to one spindle 9 (see FIG. 4). Each winding device 19 includes, for example, a fulcrum guide 31, a traverse unit 32, a cradle 33, and a winding roller 34. The fulcrum guide 31 is a guide which is a fulcrum when the yarn Y is traversed. For example, the traverse unit 32 can traverse the yarn Y by a traverse guide 35 which is attached to an endless belt driven in a reciprocating manner by a motor. The cradle 33 can support the winding bobbin Bw (wound package Pw) to be rotatable. The winding roller 34 is configured to rotate the wound package Pw and apply contact pressure to the surface of the wound package Pw. The winding roller 34 is, for example, rotationally driven by an unillustrated motor while being in contact with the surface of the wound package Pw. As a result of this, the wound package Pw is rotationally driven by the friction force and the shape of the wound package Pw is adjusted by the contact pressure applied to the surface of the wound package Pw. Instead of rotationally driving the winding roller 34, the wound package Pw may be directly rotated by an unillustrated motor.

[0051] The automatic doffer 10 is configured to detach the wound package Pw from the winding device 19 and attach an empty winding bobbin Bw to the winding device 19. To put it differently, the automatic doffer 10 is able to replace a wound package Pw having been formed with an empty winding bobbin Bw at the winding unit 4. The automatic doffer 10 is provided with unillustrated cutter which is able to cut the yarn Y in the vicinity of the wound package Pw. As the running yarn Y is cut by the cutter, the formation of the wound package Pw is finished. After the cutting of the yarn by the cutter, the yarn Y is kept supplied to the winding device 19 side. The automatic doffer 10 includes an unillustrated suction which is able to suck, capture, and retain the running yarn Y supplied to the winding device 19, in a period from the finish of the formation of the wound package Pw to the start of the winding of the yarn Y onto the next winding bobbin Bw. Before the yarn Y is threaded to the winding bobbin Bw to which the yarn Y is to be wound next, a part of the yarn Y sucked by the suction is sucked and removed. The automatic doffer 10 further includes a stocker 10a which is arranged to be able to temporarily store the wound package Pw detached from the corresponding winding device 19. The stocker 10a faces a space formed between the creel stand 6 and the winding base 8, for example. The wound package Pw stored in the stocker 10a is collected by the above-described wound package conveyance device 103. For details of the structure of the automatic doffer 10, etc., for example, see Japanese Laid-Open Patent Publication No. H6-212521.

[0052] In the winding unit 4 structured as above, the yarn Y which is sent from the third feed roller 18 described above is wound onto the winding bobbin Bw by each winding device 19, and the wound package Pw is formed (winding process). As the cutter of the automatic doffer 10 cuts the yarn Y, the winding process of winding the yarn Y onto the winding bobbin Bw is finished. Almost at the same time, the yarn Y supplied to the winding device 19 is sucked and retained by the suction, and the wound package Pw is detached from the cradle 33 by the automatic doffer 10. Immediately thereafter, the automatic doffer 10 attaches a new winding bobbin Bw to the cradle 33. To put it differently, after a wound package Pw is formed, the wound package Pw (winding bobbin Bw) is replaced with a new winding bobbin Bw by the automatic doffer 10 (winding bobbin replacement). Thereafter, it becomes possible to start the winding of the yarn Y onto the new winding bobbin Bw.

[0053] The inventors of the subject application conceived of the idea described below, in order to significantly improve production management as compared to known production management. The inventors of the subject application conceived of providing a means for knowing a time (remaining time) in which the yarn Y can be supplied from the yarn supply package Ps and/or a remaining amount of the yarn Y (yarn remaining amount) after part of the yarn Y is unwound from the yarn supply package Ps, at a desired timing. With the knowledge of such information, for example, further improvement in the management of the operation of the yarn processing facility 100 and/or further improvement in the management of the quality of wound packages Pw become possible. A means for correctly and inexpensively knowing the remaining time and/or the remaining amount at a desired timing was not established. For example, when an operator visually estimates the remaining amount of a yarn Y, the estimated amount disadvantageously varies. For this reason, it is difficult to correctly estimate the remaining time. Meanwhile, when, for example, a weight sensor which is able to directly measure the weight of a yarn supply package Ps at any time is provided, the number of weight sensors must be increased as the number of the package attachment units 21 is increased. This disadvantageously increases the

production cost.

[0054] Due to this, in the present embodiment, the information management unit 110 acquires later-described information in order to correctly acquire information regarding the remaining time and/or remaining amount at a desired timing. In a specific example, the information management unit 110 acquires and manages sets of information regarding matters shown in graphs of FIG. 5(a) to FIG. 5(c). Unless otherwise stated, the following explanation deals with only a predetermined spindle 9.

(Specific Example of Matters)

[0055] Before specifically explaining the information acquired by the information management unit 110, matters shown in the graphs of FIG. 5(a) to FIG. 5(c) as examples and times at which the respective matters occur will be described first, in order to assist the understanding of the explanation. The information management unit 110 acquires information of at least one of matters shown in the graphs of FIG. 5(a) to FIG. 5(c). (The details will be given later.)

[0056] FIG. 5(a) is a graph showing the relationship between a remaining amount (vertical axis) of the yarn Y in the yarn supply package Ps (to be more specific, the yarn supply package Ps1, Ps3) attached to the first attachment unit 22 and time (horizontal axis). FIG. 5(b) is a graph showing the relationship between a remaining amount (vertical axis) of the yarn Y in the yarn supply package Ps (to be more specific, the yarn supply package Ps2, Ps4) attached to the second attachment unit 23 and time (horizontal axis). FIG. 5(c) is a graph showing the relationship between a wound amount (vertical axis) of the yarn Y onto the winding bobbin Bw (to be more specific, the winding bobbin Bw1, Bw2, Bw3, Bw4, Bw5, Bw6) and time (horizontal axis). In all of the graphs of FIG. 5(a) to FIG. 5(c), a time t0 at which the winding of the yarn Y onto the winding bobbin Bw1 starts is the origin. In the present embodiment, the weight (initial weight) of each yarn supply package Ps in a state in which the yarn Y is not unwound from each yarn supply package Ps at all is always WF for simplicity in explanation. In reality, in a step before the formation of yarn supply packages Ps, the formation of a yarn supply package Ps may be discontinued before the completion due to a reason such as yarn breakage. On this account, the initial weights of the yarn supply packages Ps may not be identical in reality.

[0057] To begin with, at a time t0, a yarn supply package Ps1 has been attached to the first attachment unit 22. Meanwhile, a yarn supply package Ps2 has been attached to the second attachment unit 23. The weight of the remaining yarn Y in the yarn supply package Ps1 is W0 (which is smaller than the initial weight WF). The weight of the remaining yarn Y in the yarn supply package Ps2 is identical with the initial weight WF. The terminal portion of the yarn Y in the yarn supply package Ps1 is tied (connected) to the start end portion of the yarn Y in the yarn supply package Ps2, and hence a node K is formed.

[0058] At a time t0 (time ts1), the attachment of a winding bobbin Bw1 to the cradle 33 by the automatic doffer 10 is completed and the winding of the yarn onto the winding bobbin Bw1 starts. Therefore the time ts1 is a winding start time at which the winding of the yarn Y onto the winding bobbin Bw1 starts. At the same time, the yarn Y is unwound from the yarn supply package Ps1. The remaining amount of the yarn Y (remaining weight) in the yarn supply package Ps1 decreases and the wound amount (wound weight) of the yarn Y wound on the winding bobbin Bw1 increases over time. At a time te1, as the cutter of the automatic doffer 10 cuts the yarn Y, the winding process of winding the yarn Y onto the winding bobbin Bw1 is finished. Therefore the time te1 is a winding end time at which the winding of the yarn Y onto the winding bobbin Bw1 ends (i.e., the formation of the wound package Pw1 is finished). The remaining weight of the yarn supply package Ps1 at this stage is W1. Onto the winding bobbin Bw1, only the yarn Y supplied from the yarn supply package Ps1 is wound. The cutting of the yarn Y by the cutter, the sucking and capturing of the yarn Y by the suction (i.e., start of sucking and removal of the yarn Y), and the detachment of the winding bobbin Bw1 (wound package Pw1) from the cradle 33 are almost simultaneously done. Subsequently, at a time ts2 immediately after the time te1, the attachment of a winding bobbin Bw2 to the cradle 33 by the automatic doffer 10 is completed and the winding of the yarn Y onto the winding bobbin Bw2 starts (i.e., the winding bobbin replacement is completed). There is a slight time lag tL (see FIG. 6) between the winding end time (time te1) of the winding bobbin Bw1 and the winding start time (time ts2) of the winding bobbin Bw2 onto which the yarn Y is wound next to the winding bobbin Bw1.

[0059] At a time ta1 that is later than the time ts2, the yarn supply package Ps1 attached to the first attachment unit 22 becomes empty. Therefore the time ta1 is an unwinding end time at which the unwinding of the yarn Y from the yarn supply package Ps1 ends. At the same time as the yarn supply package Ps1 becomes empty, at the time tb1 (=time ta1), a node K formed as the yarn Y in the yarn supply package Ps1 is tied with the yarn Y in the yarn supply package Ps2 is pulled toward the winding device 19. As a result, the yarn Y starts to be unwound from the yarn supply package Ps2 attached to the second attachment unit 23. Therefore the time tb1 is an unwinding start time at which the unwinding of the yarn Y from the yarn supply package Ps2 starts (i.e., the yarn Y starts to be unwound). Thereafter, at a time te2, the winding process of winding the yarn Y onto the winding bobbin Bw2 (i.e., formation of a wound package Pw2) ends. The remaining weight of the yarn supply package Ps2 at this stage is W2. Onto the winding bobbin Bw2, both the yarn Y unwound from the yarn supply package Ps1 and the yarn Y unwound from the yarn supply package Ps2 are wound. The wound package Pw2 includes the node K. Thereafter, at a time ts3, a winding process of winding the yarn Y onto

a winding bobbin Bw3 starts. When at a time te3 the winding process of winding the yarn Y onto the winding bobbin Bw3 (i.e., formation of a wound package Pw3) ends, the remaining weight of the yarn supply package Ps2 is W3. Onto the winding bobbin Bw3, only the yarn Y unwound from the yarn supply package Ps2 is wound.

[0060] At a time ta2 that is later than the time ta1 and is before the yarn supply package Ps2 becomes empty, the creel robot 102 performs detachment of the yarn supply package Ps1 from the first attachment unit 22 and attachment of a yarn supply package Ps3 to the first attachment unit 22 (yarn supply package replacement). The remaining weight of the yarn supply package Ps3 at this stage is WF. Thereafter, at a suitable timing, the terminal portion of the yarn Y in the yarn supply package Ps2 is tied with the start end portion in the yarn supply package Ps3 and the node K is formed. For the sake of convenience, it is assumed that an operator performs a tying operation (connecting operation) immediately after the creel robot 102 performs the yarn supply package replacement. The operator may manually perform the tying operation. Alternatively, the operator may perform the tying operation by operating an unillustrated portable tying device, for example. Alternatively, the creel robot 102 may include an automatic tying device (not illustrated) which is capable of performing the tying operation. In this way, the tying operation is not manually performed but performed by the creel robot 102.

[0061] The matters subsequent to the above will be described. The matters regarding the winding unit 4 are as follows. The yarn Y is wound onto a winding bobbin Bw4 from a time ts4 to a time te4 (i.e., a wound package Pw4 is formed). The yarn Y is wound onto a winding bobbin Bw5 from a time ts5 to a time te5 (i.e., a wound package Pw5 is formed). The yarn Y is wound onto a winding bobbin Bw6 from a time ts6 to a time te6 (i.e., a wound package Pw6 is formed). The matters regarding the yarn supplying unit 2 are as follows. At a time tb2 (=time ta3) between the time ts4 and the time te4, the yarn supply package Ps2 becomes empty and unwinding of the yarn Y from the yarn supply package Ps3 starts. Thereafter, at a time tb3, the yarn supply package Ps2 is replaced with a yarn supply package Ps4. At a time ta4 (=time tb4) between the time ts6 and the time te6, the yarn supply package Ps3 becomes empty and unwinding of the yarn Y from the yarn supply package Ps4 starts.

(Outline of Basic Information Acquired by Information Management Unit)

[0062] In consideration of the matters above, to begin with, the outline of basic information acquired by the information management unit 110 in order to perform determinations and/or calculations will be described. As the basic information, the information management unit 110 acquires initial amount information, unwinding unit amount information, and unwinding start time information of each yarn supply package Ps (a specific method of acquiring each set of information will be described later). The initial amount information is information regarding an initial amount (initial weight or initial length) of the yarn Y in a yarn supply package Ps before the start of unwinding of the yarn Y. The unwinding unit amount information is information regarding an amount of the yarn Y unwound from a yarn supply package Ps per unit time. The unwinding start time information is information of a time (unwinding start time) at which unwinding of the yarn Y from the yarn supply package Ps from which the yarn Y is being unwound starts. These sets of information are used for enabling acquisition of sets of information that are a predicted unwinding end time, a remaining time, a remaining amount, and a predicted original yarn disappearance time (detailed later) used for performing various managements concerning the yarn processing facility 100.

(Required Information)

[0063] The following will describe information required when the information management unit 110 actually acquires the basic information (the initial amount information, the unwinding unit amount information, and the unwinding start time information). To be more specific, the following will describe information regarding a yarn supply package Ps attached to and detached from a package attachment unit 21, information which is input to the machine controller 5 in advance, and information acquired by the machine controller 5 during a winding process. In addition to this, the following will describe information regarding a wound package Pw formed by the winding device 19. The information regarding the wound package Pw is used for performing various types of management related to the yarn processing facility 100, along with the sets of information that are the predicted unwinding end time, the remaining time, the remaining amount, and the predicted original yarn disappearance time.

(Information Regarding Yarn Supply Package Conveyed By Creel Robot)

[0064] The information management unit 110 manages individual information of a yarn supply package Ps conveyed by the creel robot 102 and information associated with the individual information, in a manner as described below. To begin with, when or before a fully-would yarn supply package Ps stored in the yarn supply package stocker is mounted on the creel robot 102 by the operator, yarn supply package individual information corresponding to that yarn supply package Ps is input to the creel controller 102a by the operator. For example, the yarn supply package individual

information may be input in such a way that the operator reads an ID tag attached to each yarn supply package Ps by using an ID reader (not illustrated) electrically connected to the creel controller 102a. Alternatively, the yarn supply package individual information may be input in such a way that the operator operates the creel controller 102a based on visual information displayed on each yarn supply package Ps. Alternatively, the creel robot 102 may be provided with an unillustrated ID reader, and the creel robot 102 may read the ID tag by using the ID reader.

[0065] The information recorded in the ID tag or displayed on the yarn supply package Ps includes information of the initial weight of the yarn Y in the yarn supply package Ps (i.e., weight before the yarn Y is unwound from the yarn supply package Ps) and information of the fineness of the yarn Y (i.e., weight per unit length). In the present embodiment, the information of fineness is included in the initial amount information. Hereinafter, the weight of the yarn Y in the yarn supply package Ps will be simply referred to as the weight of the yarn supply package Ps. The creel controller 102a stores the yarn supply package individual information, the information of the initial weight of each yarn supply package Ps, and the information of the fineness of the yarn Y in each yarn supply package Ps, in association with each yarn supply package Ps (see FIG. 7(a)). As described above, the initial weight of each yarn supply package Ps is always WF for the sake of convenience. The unit of the weight of the yarn supply package Ps is kilogram, for example. Furthermore, the fineness of the yarn Y of each yarn supply package Ps is always F. The unit of the fineness is dtex (decitex), for example. Decitex indicates the weight (gram) of a yarn Y per 10000 meters.

[0066] When the creel robot 102 attach a yarn supply package Ps to the package attachment unit 21, the information management unit 110 receives information such as the individual information of that yarn supply package Ps (see FIG. 7(a)) from the creel controller 102a. The information management unit 110 then associates the information such as the individual information of the yarn supply package Ps with the individual information of the package attachment unit 21 to which that yarn supply package Ps is attached. The individual information of the package attachment unit 21 is information indicating (i) to which one of the spindles 9 the package attachment unit 21 to which the yarn supply package Ps is attached belongs and (ii) whether the package attachment unit 21 is the first attachment unit 22 or the second attachment unit 23. As such, the information management unit 110 manages the individual information of the yarn supply package Ps conveyed by the creel robot 102, in association with the operation of the creel robot 102.

[0067] When a new yarn supply package Ps is attached to the package attachment unit 21, the machine controller 5 acquires yarn supply package attachment time information regarding a yarn supply package attachment time at which that yarn supply package Ps is attached to the package attachment unit 21. The yarn supply package attachment time is, for example, the above-described time ta2 or tb3. The machine controller 5 stores the yarn supply package individual information, the individual information of the package attachment unit 21, and the yarn supply package attachment time information in association with each yarn supply package Ps (see FIG. 7(a)).

[0068] After a new yarn supply package Ps is attached to one of the package attachment units 21, the operator ties the start end portion of the yarn Y in that yarn supply package Ps with the terminal portion of the yarn Y in the yarn supply package Ps attached to the other one of the package attachment units 21, so as to form a node K. The operator then provides the node K at a predetermined position. Subsequently, the operator inputs, to the machine controller 5, information indicating that the node K has been provided at the predetermined position. Based on the input information, the machine controller 5 stores information indicating that the node K has been provided at the predetermined position.

(Information Regarding Wound Package)

[0069] The information management unit 110 manages the individual information of a wound package Pw in the following manner, for example. To begin with, the machine controller 5 stores a time at which a winding bobbin Bw is attached to the winding device 19 as a winding start time at which winding of the yarn Y onto that winding bobbin Bw starts. When the winding process of winding of the yarn Y onto that winding bobbin Bw ends (i.e., when the formation of a wound package Pw ends), the machine controller 5 attaches individual information (wound package individual information) to that wound package Pw. To be more specific, as the individual information of that wound package Pw, the machine controller 5 acquires, for example, information of a machine number (identification number of the false-twist texturing machine 1) and information of identification number of the spindle 9. The machine controller 5 then stores these sets of individual information, the winding start time, and a time when the winding process ends (winding end time) in association with one another. In association with these sets of information, the machine controller 5 may acquire a predetermined management number as wound package individual information and attach the acquired information to each wound package Pw. For example, as shown in FIG. 8(b), provided that Pw1 to Pw6 described above are management numbers (wound package individual information), each management number is associated with a winding start time and a winding end time. (It is noted that a machine number and identification number of a spindle 9 are not shown in the figure). Furthermore, the machine controller 5 prints these sets of information on an unillustrated label. The label can be attached to the winding bobbin Bw by the operator.

[0070] As another way of acquiring wound package individual information, for example, an unillustrated ID tag may be attached to an empty winding bobbin Bw in advance. In this way, wound package individual information may be

attached to a winding bobbin Bw in advance before the winding process. Furthermore, the automatic doffer 10 may include an unillustrated ID reader. For example, when the automatic doffer 10 attaches a winding bobbin Bw to the winding device 19 or detaches a wound package Pw from the winding device 19, the ID reader reads an ID tag attached to that winding bobbin Bw and the individual information of that winding bobbin Bw is sent to the machine controller 5. Alternatively, in place of the automatic doffer 10, the operator may read an ID tag by using an unillustrated ID reader. Alternatively, instead of reading an ID tag by using the ID reader, the operator may manually input the individual information of the winding bobbin Bw to the machine controller 5.

(Information Input in Advance to Machine Controller)

[0071] The following will describe information input in advance to the machine controller 5 before the winding process. As information regarding the processing unit 3, the operator inputs processing conditions to the machine controller 5 in advance. For example, the operator inputs information of the rotation numbers of the first feed roller 11, the second feed roller 16, and the third feed roller 18 to the machine controller 5 (not illustrated). The rotation number of each of these rollers is in proportion to the yarn feeding speed of feeding the yarn Y to the downstream side in the yarn running direction. In particular, the rotation number of the first feed roller 11 is in proportion to the unwinding speed V (see FIG. 4) of unwinding the yarn Y from the yarn supply package Ps. For the sake of convenience, the unwinding speed V is assumed to be substantially constant in the present embodiment. The unit of the unwinding speed is m/min, for example. For example, the machine controller 5 acquires information of the unwinding speed V based on the information of the rotation number of the first feed roller 11.

[0072] As information regarding the winding unit 4, the operator inputs in advance, to the machine controller 5, information regarding, for example, target weight (planned wound amount) of the yarn Y to be wound onto the winding bobbin Bw. The information input by the operator may include, for example, a time required from the start of the winding process to the end of the winding process (i.e., a planned winding time). Alternatively, the planned winding time may be calculated by the machine controller 5 based on input information such as a planned wound amount. The machine controller 5 assumes that the winding process of winding the yarn Y onto a winding bobbin Bw ends at a planned winding end time which is a time at which the planned winding time elapses from the winding start time of the winding bobbin Bw. Alternatively, for example, the winding unit 4 may include an unillustrated sensor to detect a parameter (e.g., the diameter of the wound package) regarding an amount of the yarn Y wound onto the winding bobbin Bw. In this case, the machine controller 5 may determine a timing to end the winding based on a detection result of the sensor.

(Information Acquired by Machine Controller During Winding Process)

[0073] Now, the following will describe sets of information acquired by the machine controller 5 during the winding process of winding the yarn Y onto the winding bobbin Bw. These sets of information are combined with the above-described information input to the machine controller 5 and used for acquiring unwinding start time information and unwinding end time information that are described later.

[0074] Based on a detection result of the yarn detection sensor 24, the machine controller 5 determines whether yarn supply package switching, i.e., switching of the yarn supply package Ps supplying the yarn Y has occurred. For example, in FIG. 5(a) and FIG. 5(b), a matter that the yarn supply package Ps1 becomes empty and the yarn Y is unwound first from the yarn supply package Ps2 is the yarn supply package switching. The machine controller 5 determines that yarn supply package switching has occurred when the state of the yarn detection sensor 24 is switched from (i) a state of detecting the yarn Y by one of the first detection unit 25 and the second detection unit 26 to (ii) a state of detecting the yarn Y by the other one of the first detection unit 25 and the second detection unit 26. When the machine controller 5 determines that the yarn supply package switching has occurred, the machine controller 5 acquires and stores the following sets of information shown in the table of FIG. 7(b). The machine controller 5 stores (i) individual information of the package attachment unit 21 which starts to supply the yarn Y when the yarn supply package switching occurs (either the first attachment unit 22 or the second attachment unit 23) and (ii) a time at which the yarn supply package switching occurs, in association with each other. In regard to the package attachment unit 21 that starts to supply the yarn Y, the time at which the yarn supply package switching occurs is dealt with as an unwinding start time. Furthermore, the machine controller 5 stores (i) individual information of the package attachment unit 21 which finishes the supply of the yarn Y at the yarn supply package switching and (ii) the time at which the yarn supply package switching occurs, in association with each other. In regard to the package attachment unit 21 that finishes the supply of the yarn Y, the time at which the yarn supply package switching occurs is dealt with as an unwinding end time. When determining that the yarn supply package switching has occurred, the machine controller 5 stores information indicating that the node K has moved from the predetermined position.

[0075] By using the information of the yarn supply package attachment time and the information of the time at which the yarn supply package switching occurs, the machine controller 5 acquires the unwinding start time information by the

following steps. For example, when acquiring the unwinding start time information of the yarn supply package Ps3, the machine controller 5 acquires individual information of the package attachment unit 21 (first attachment unit 22) to which the yarn supply package Ps3 is attached and information of the yarn supply package attachment time (time ta2). The machine controller 5 then acquires, as the unwinding start time of the yarn supply package Ps3, information of a time (ta3; see FIG. 5(a) and FIG. 5(b)) that is later than the time ta2 and is the earliest one among unwinding start times of the yarn supply packages Ps attached to the first attachment unit 22. Furthermore, the machine controller 5 acquires information of the unwinding end time (time ta4) associated with that unwinding start time, as the unwinding end time of the yarn supply package Ps3. In this way, the individual information, the unwinding start time information, and the unwinding end time information of the yarn supply package Ps3 are acquired in association with one another (see FIG. 8(a)). These sets of information can be acquired not only for the yarn supply package Ps3 but also for each of the yarn supply packages Ps.

[0076] As described above, the information management unit 110 acquires sets of basic information such as initial amount information, unwinding unit amount information, and unwinding start time information for each yarn supply package Ps (see FIG. 8(a)).

(Remaining Amount Information, Remaining Time Information, and Predicted Unwinding End Time Information)

[0077] The following will describe a method of acquiring information that is acquired based on the above-described basic information (initial amount information, unwinding unit amount information, and unwinding start time information). The information management unit 110 acquires at least one of remaining amount information, remaining time information, and predicted unwinding end time information by means of a calculation using the initial amount information, the unwinding unit amount information, and the unwinding start time information. These sets of information are used for managing the operation of the yarn processing facility 100 by the information management unit 110 (details of the management will be given later).

[0078] The remaining amount indicates the remaining amount of the yarn Y in each yarn supply package Ps attached to each package attachment unit 21 at a given reference time. The remaining time indicates the length of time during which the yarn Y can be unwound from each yarn supply package Ps attached to each package attachment unit 21 at a given reference time. The predicted unwinding end time is a predicted time at which the unwinding of the yarn Y from the yarn supply package Ps from which the yarn Y is being unwound ends. The information management unit 110 is therefore able to predict a time at which the unwinding of the yarn Y from each yarn supply package Ps ends, before acquiring the information of an actual unwinding end time of each yarn supply package Ps.

(Remaining Amount Information)

[0079] To begin with, the following will describe an example of a method of acquiring remaining amount information of each yarn supply package Ps at a reference time. For example, the current time at which remaining amount information is acquired is dealt with as a reference time. When the current time is a time t1 (see FIG. 5(b)), based on a detection result of the yarn detection sensor 24, the information management unit 110 determines that the yarn Y is being unwound from a yarn supply package Ps (to be more specific, the yarn supply package Ps2) attached to the second attachment unit 23. In this case, the yarn supply package Ps2 is equivalent to a predetermined yarn supply package of the present invention.

[0080] Furthermore, as shown in FIG. 8(a), in regard to the yarn supply package Ps2, the information management unit 110 acquires information of initial weight WF, information of fineness F, information of unwinding speed V at which the yarn Y is unwound, and information of an unwinding start time (time tb1), in association with one another. The information of the unwinding speed V regarding the yarn supply package Ps2 is equivalent to unwinding unit amount information of the present invention. The unwinding unit amount information is, for example, stored in the machine controller 5 as an operation setting of the yarn processing facility 100.

[0081] When the remaining amount (remaining weight) of the yarn supply package Ps2 at the time t1 is Wr1 (see FIG. 5(b)), the remaining weight Wr1 is calculated based on an equation below. In the equation, A is a coefficient by which the unit of a result of a calculation in curly brackets is converted to kilogram. For simplifying the explanation, the calculation assumes that the yarn Y is continuously unwound from the time tb1 (unwinding start time) to the time t1 (reference time), i.e., the winding process is not interrupted.

$$Wr1=WF-\{A\times V\times F\times (t1-tb1)\}$$

[0082] In the equation above, WF is included in the initial amount information of the present invention. V×F indicates the weight of the yarn Y unwound from the yarn supply package Ps2 per unit time. t1-tb1 is information (cumulative time

information) of the total time (cumulative time) of the unwinding of the yarn Y from the yarn supply package Ps2 until the time t1. In this way, by using the initial amount information, the unwinding unit amount information, the unwinding start time information, and the reference time information, the information management unit 110 acquires the information (remaining amount information) of the remaining weight of the yarn supply package Ps2 (predetermined yarn supply package) at the time t1 (reference time). Furthermore, the information management unit 110 calculates the remaining amount of the yarn supply package Ps (yarn supply package Ps1) attached to the other package attachment unit 21 (first attachment unit 22), too. At the time t1, an empty yarn supply package Ps1 is still attached to the first attachment unit 22. The unwinding start time (not illustrated) of the yarn supply package Ps1 is a lot earlier than the unwinding start time of the yarn supply package Ps2. the remaining amount of the yarn supply package Ps1 at the time t1 is less than zero when it is calculated in the same manner as the remaining amount of the yarn supply package Ps2. When the calculation result of the remaining amount is equal to or less than zero in this way, the information management unit 110 sets the remaining amount of the yarn supply package Ps1 at the time t1 to be zero.

[0083] When, for example, the current time is the time t2 (see FIG. 5(b)), the remaining weight Wr2 at the time t2 can also be calculated in a similar manner. At the time t2, a new yarn supply package Ps3 has been attached to the first attachment unit 22. At the time t2, unwinding of the yarn Y from the yarn supply package Ps3 has not started. On this account, the remaining amount in the yarn supply package Ps3 at the time t2 is WF.

[0084] The unit of the remaining amount may not be weight. As the remaining amount information, for example, information of the length of the yarn Y remaining in the yarn supply package Ps may be acquired. Alternatively, information of a percentage of the remaining weight of the yarn Y in the yarn supply package Ps (i.e., information of the ratio of the remaining weight to the initial weight) may be acquired.

(Remaining Time Information)

[0085] The following will describe a method of acquiring remaining time information. When the remaining time in which the yarn Y can be supplied from the yarn supply package Ps2 at the time t1 is tr1, the remaining time tr1 can be calculated by the equation below (remaining time information) with the use of Wr1.

$$tr1=Wr1/(A\times V\times F)$$

[0086] Alternatively, tr1 may be calculated by the equation below without using Wr1.

$$tr1=[WF-\{A\times V\times F\times(t1-tb1)\}]/(A\times V\times F)$$

[0087] The remaining time in which the yarn Y can be supplied from the yarn supply package Ps1 is zero at the time t1. This is because, as described above, the remaining amount in the yarn supply package Ps1 is zero at the time t1. The information management unit 110 is able to acquire later-described predicted original yarn disappearance time information by using the remaining time information.

[0088] Furthermore, for example, when the remaining time regarding the yarn supply package Ps2 at the time t2 is tr2 (see FIG. 5(b)), the remaining time tr2 can be calculated based on the remaining weight Wr2 in the same manner as above. At the time t2, unwinding of the yarn Y from the yarn supply package Ps3 has not started. On this account, when the remaining time regarding the yarn supply package Ps3 at the time t2 is tF, the remaining time tF can be calculated by using the initial weight WF (see FIG. 5(b)).

(Predicted Unwinding End Time Information)

[0089] The information management unit 110 is able to estimate a time at which unwinding of the yarn Y from the yarn supply package Ps from which the yarn Y is being unwound at the reference time ends. For example, at the time t1, the yarn Y is being unwound from the yarn supply package Ps2. The information management unit 110 acquires information of a time calculated by adding the remaining time tr1 to the time t1, as predicted unwinding end time information. Alternatively, instead of calculating the predicted unwinding end time by using the remaining time information, the information management unit 110 may calculate the predicted unwinding end time based on a predetermined mathematical expression by using basic information. The predicted unwinding end time is substantially identical with an actual unwinding end time (time tb2 described above) regarding the yarn supply package Ps2. The predicted unwinding end time is substantially identical with an actual unwinding start time (ta3 described above) of the yarn supply package Ps3 from which the yarn Y is to be unwound next to the yarn supply package Ps2. Therefore, when the unwinding start time of a given yarn supply package Ps is known, the information management unit 110 is able to estimate (predict) the

unwinding start time of the yarn supply package Ps from which the yarn Y is to be unwound next to that package Ps. For example, the information management unit 110 may acquire unwinding start time information of the yarn supply package Ps3 by calculation, based on the initial amount information, the unwinding unit amount information, and the unwinding start time information regarding the yarn supply package Ps2.

(Management of Operation of Yarn Processing Facility by Information Management Unit)

[0090] Now, the following will describe specific management of the operation of the yarn processing facility 100 by the information management unit 110. As an example, a process performed from the start of winding of the yarn Y onto a winding bobbin Bw to the end of the winding will be described. The management will be outlined first. The winding bobbin Bw2 (see FIG. 5(c)) is taken as an example. At the winding start time (time ts2) of the winding bobbin Bw2, the yarn Y is supplied from the yarn supply package Ps1 attached to the first attachment unit 22. Meanwhile, the yarn supply package Ps2 has been attached to the second attachment unit 23. The terminal portion of the yarn Y in the yarn supply package Ps1 is tied (connected) to the start end portion of the yarn Y in the yarn supply package Ps2, and hence a node K is formed. The node K is provided at a predetermined position. Information indicating that the node K is provided at the predetermined position is input to the machine controller 5 in advance by the operator.

[0091] At the time ts2, the winding process of winding the yarn Y onto the winding bobbin Bw2 starts. Almost at the same time as the start of the winding process, the information management unit 110 acquires the remaining amount of the yarn Y in the yarn supply package Ps1 (remaining weight W1; see FIG. 5(a)) at the time ts2 (winding start time) and stores the acquired information in the machine storage unit 5c, for example.

[0092] During the winding process, the information management unit 110 regularly updates the remaining amount information, the remaining time information, and the predicted unwinding end time information that are described above. Furthermore, the information management unit 110 regularly updates later-described predicted original yarn disappearance time information. Furthermore, the information management unit 110 determines whether the node K is mixed, whether the yarn remaining amount is decreased, and whether the formation of a node has been done. A specific method of updating each set of information and details of each determination will be described later.

[0093] In this example, the yarn supply package switching occurs during the winding process. In other words, during the winding process, the state in which the yarn Y is being unwound from the yarn supply package Ps1 is switched to the state in which the yarn Y is being unwound from the yarn supply package Ps2 (see FIG. 5(a) to FIG. 5(c)). As described above, the information management unit 110 determines whether the yarn supply package switching has occurred, based on a detection result of the yarn detection sensor 24. In this case, the yarn supply package Ps1 is equivalent to the predetermined yarn supply package of the present invention. The yarn supply package Ps2 is equivalent to a reserve yarn supply package of the present invention.

[0094] When the winding process ends (time ts2), the information management unit 110 acquires the remaining amount information at the winding end time of the yarn supply package Ps2 which supplied the yarn Y until the winding end time. Lastly, the information management unit 110 stores, in the machine storage unit 5c, for example, information of yarn layers supplied from the yarn supply packages Ps1 and Ps2 to the winding bobbin Bw2 (i.e., yarn layer information). Specifically, the yarn layer information may be information of weight. In this example, parts of the yarn Y having the remaining weight of 0 to W1 have been supplied to the winding bobbin Bw2 from the yarn supply package Ps1 (see FIG. 5(a) to FIG. 5(c)). Furthermore, parts of the yarn Y having the remaining weight of W2 to WF have been supplied to the winding bobbin Bw2 from the yarn supply package Ps2 (see FIG. 5(a) to FIG. 5(c)). In this way, based on the remaining amount information, the information management unit 110 is able to acquire the yarn layer information indicating to which part of the yarn layers of the yarn supply packages Ps suppling the yarn Y to a predetermined winding bobbin Bw the yarn Y wound onto the predetermined winding bobbin Bw belonged. In this case, the winding start time and the winding end time are equivalent to the reference time of the present invention.

(Update of Sets of Information)

[0095] The following will describe how the above-described sets of information are updated. During the winding process, the information management unit 110 regularly updates the total time (cumulative time) of the unwinding of the yarn Y from the yarn supply package Ps from which the yarn Y is being supplied. In this case, the time to be updated is equivalent to the reference time of the present invention. From which yarn supply package Ps the yarn Y is being unwound at the reference time (i.e., which yarn supply package Ps is the predetermined yarn supply package) is determined at any time based on the reference time and the unwinding start time information regarding each yarn supply package Ps. The cumulative time is also updated while the automatic doffer 10 is performing the winding bobbin replacement. This is because, as described above, the yarn Y is being supplied to the winding device 19 side (i.e., the yarn Y is being unwound from the yarn supply package Ps) while the winding bobbin replacement is being performed, too.

[0096] After the cumulative time is updated, the information management unit 110 calculates (updates) the remaining

amount, the remaining time, the predicted unwinding end time, and the predicted original yarn disappearance time, based on the basic information and the updated cumulative time. To be more specific, the information management unit 110 calculates the remaining amount information and the remaining time information regarding both yarn supply packages Ps attached to the two package attachment units 21. The information management unit 110 calculates a predicted unwinding end time of a yarn supply package Ps from which the yarn Y is being unwound.

[0097] In addition to the above, the information management unit 110 calculates a predicted original yarn disappearance time. The predicted original yarn disappearance time is a time at which all of the yarn supply packages Ps attached to a given yarn supply package retaining portion 20 (predetermined yarn supply package retaining portion 20) are estimated to become empty. The predicted original yarn disappearance time is acquired by adding the remaining times regarding the both yarn supply packages Ps to the reference time no matter whether the yarns Y in the two yarn supply packages Ps attached to the yarn supply package retaining portion 20 are tied with each other. In other words, the predicted original yarn disappearance time regarding a predetermined yarn supply package retaining portion 20 is acquired based on the remaining time information of all yarn supply packages Ps attached to the predetermined yarn supply package retaining portion 20. For example, at the time t1, the remaining time during which the yarn Y can be unwound from the yarn supply package Ps1 attached to the first attachment unit 22 is zero. At the time t1, the remaining time in which the yarn Y can be unwound from the yarn supply package Ps2 attached to the second attachment unit 23 is tr1 described above. The information management unit 110 is able to acquire information of a time acquired by adding the remaining time tr1 to the time t1, as predicted original yarn disappearance time information predicted at the time t1.

[0098] For example, at the time t2, the remaining time regarding the yarn supply package Ps3 attached to the first attachment unit 22 is tF. At the time t2, the remaining time regarding the yarn supply package Ps2 attached to the second attachment unit 23 is tr2 as described above. The information management unit 110 is able to acquire information of a time calculated by adding the remaining time tF and the remaining time tr2 to the time t2, as predicted original yarn disappearance time information at the time t2.

(Determination on Mixture of Node)

[0099] The following will describe determination on the mixture of a node K into a winding bobbin Bw onto which the yarn Y is being wound, and a process after the determination. The information management unit 110 determines whether it is predicted that a node K will be mixed into a wound package Pw formed on a winding bobbin Bw for which a winding process is performed. To be more specific, one of the following three processes is performed. For example, when a predicted unwinding end time exists between a winding start time and a planned winding end time, it is predicted that a node K will be mixed into a wound package Pw. Alternatively, when the remaining amount of a yarn supply package Ps from which the yarn Y is being unwound at the winding start time of the winding bobbin Bw is smaller than a planned wound amount, it is predicted that a node K will be mixed into the wound package Pw. Alternatively, when the remaining time of a yarn supply package Ps from which the yarn Y is being unwound at the winding start time is shorter than a planned winding time, it is predicted that a node K will be mixed into the wound package Pw. When it is predicted that a node K will be mixed into the wound package Pw, the information management unit 110 determines whether the current time will reach the predicted unwinding end time. The term "reach" indicates that the predicted unwinding end time will come after a predetermined time elapses from the current time. Alternatively, the term "reach" may indicate that the predicted unwinding end time has just come. Alternatively, the information management unit 110 may determine whether the current time reaches the predicted unwinding end time by determining whether the yarn supply package switching has occurred based on a detection result of the above-described yarn detection sensor 24.

[0100] When determining that the current time reaches the predicted unwinding end time, the information management unit 110 (machine controller 5) executes, for example, a process described below (mixture avoidance process of avoiding mixture of a node K; hereinafter, this process will be simply referred to as a mixture avoidance process), so as to avoid mixture of the node K into the wound package Pw. To begin with, the machine controller 5 causes the automatic doffer 10 to cut the yarn Y by using the cutter immediately before a time at which a node K is predicted to reach the winding device 19 (i.e., a timing earlier by a predetermined duration of time than the predicted time). As a result of this, the winding process of winding to the winding bobbin Bw attached to the winding device 19 ends. Almost at the same time as the cutting of the yarn Y, the running yarn Y (supplied to the winding device 19 side) is sucked and retained by the suction of the automatic doffer 10 as described above. On this account, it is possible to suck and remove part of the yarn Y including the node K by using the suction, while the automatic doffer 10 is performing winding bobbin replacement (i.e., during a time period in which the above-described time lag occurs). In other words, the node K can be removed without being wound into the winding bobbin Bw. As such, it is possible to manage the timing to end the winding process in accordance with the timing at which it is predicted that the node K will be mixed. In this way, the mixture of the node K into the wound package Pw is avoided. As a reference example, if the mixture avoidance process is performed for a winding bobbin Bw4, as shown in the graph of FIG. 9, the winding process of winding the yarn Y onto the winding bobbin Bw4 ends earlier than usual. To be more specific, when the mixture avoidance process is performed for the winding

bobbin Bw4, the winding end time regarding the winding bobbin Bw4 (see the time te4a in FIG. 9) is earlier than the above-described time te4 (see FIG. 5(c)). The winding start time regarding the next winding bobbin Bw5 (see the time ts5a in FIG. 9) is earlier than the above-described ts5 (see FIG. 5(c)), too. Even when a node K is unintentionally included in a wound package Pw, if the mixture avoidance process has been performed, the node K locates at the outermost yarn layer or neighboring layers (i.e., an outer layer portion) in the radial direction of the wound package Pw. It is therefore possible to easily remove the node K mixed into the wound package Pw. When the mixture avoidance process is performed, the following problem may occur if the winding bobbin replacement is completed before a node K that is a target of removal by sucking is actually sucked and removed by the automatic doffer 10. A node K may be mixed in the innermost layer or its neighboring yarn layers (i.e., an inner layer portion) in the radial direction of a wound package Pw which is to be formed by winding the yarn Y to the next winding bobbin Bw. In such a case, it is difficult to remove the node K from that wound package Pw. In consideration of this problem, the information management unit 110 may cause the automatic doffer 10 to cut the yarn Y by using the cutter at a time at which it is estimated that the node K reaches the winding device 19 or immediately after that time (i.e., after a predetermined period of time elapses from that time). In other words, at a timing when a node K is intentionally mixed into an outer layer portion of a wound package Pw in production, the formation of that wound package Pw may be terminated.

(Determination of Decrease of Remaining Amount)

[0101] Now, the following will describe determination of decrease of the remaining amount of the yarn Y in a yarn supply package Ps and a process after the determination. This determination is performed to cause the creel robot 102 to perform the replacement of a yarn supply package Ps. The information management unit 110 determines whether a package replacement instruction time has come. The package replacement instruction time is earlier than a predicted original yarn disappearance time of a yarn supply package retaining portion 20 of a spindle 9 by a predetermined period of time (e.g., first time). When determining that the package replacement instruction time has come, the information management unit 110 outputs a command signal to cause the creel robot 102 to perform yarn supply package replacement.

[0102] By this determination and the process, it is possible to cause the creel robot 102 to perform the yarn supply package replacement at a timing when the yarn supply package replacement is required. This process is particularly effective when the yarn supplying unit 2 includes plural yarn supply package retaining portions 20 and/or when the yarn processing facility 100 includes plural false-twist texturing machines 1 (i.e., includes plural yarn supplying units 2). The information management unit 110 manages the operation of the creel robot 102 based on information of predicted original yarn disappearance times regarding plural yarn supply package retaining portions 20. To be more specific, the information management unit 110 manages the operation of the creel robot 102 so that yarn supply package replacement is completed at each yarn supply package retaining portion 20 before a predicted original yarn disappearance time of each yarn supply package retaining portion 20 comes. The information management unit 110 generates a schedule for replenishing yarn supply packages Ps, and controls the operation of the creel robot 102 based on the generated schedule. When generating the schedule, the information management unit 110 determines a package replacement instruction time in consideration of various conditions such as the type and number of yarn supply packages Ps to be replenished, places where the packages are replenished, and the operation route of the creel robot 102. This arrangement makes it possible to perform the yarn supply package replacement at a timing suitable for each yarn supply package retaining portion 20.

[0103] Alternatively, the information management unit 110 may perform yarn supply package replacement after waiting for a timing suitable for performing the yarn supply package replacement. For example, when the package attachment unit 21 is arranged so that the distance between two package attachment units 21 is intentionally narrow in order to downsize the facility, yarn supply packages Ps may interfere with each other when the two yarn supply packages Ps are simultaneously attached to the package attachment units 21. In this arrangement, only after one yarn supply package Ps is attached to one of the two package attachment units 21 and a certain amount of the yarn Y is unwound from the one yarn supply package Ps, it becomes possible to attach the other yarn supply package Ps to the other one of the two package attachment units 21. In such an arrangement, if the above-described control is performed, it is possible to wait for an instruction of yarn supply package replacement until it becomes possible to attach a new yarn supply package Ps.

(Determination of Tying Oversight)

[0104] Now, the following will describe determination of tying oversight and a process after the determination. The tying oversight (connection oversight) indicates a state in which, after the operator newly attaches a yarn supply package Ps to the yarn supply package retaining portion 20, the new yarn supply package Ps is left without a tying operation. The determination is done to prompt the operator to perform the tying operation. When the information management unit 110 determines that, in the winding process in a spindle 9, a node K is not formed in that spindle 9, the information

management unit 110 further determines whether the remaining time regarding a yarn supply package Ps (predetermined yarn supply package) from which the yarn Y is being unwound in that spindle 9 is not longer than a predetermined period of time (e.g., a second time). When the information management unit 110 determines that the remaining time is not longer than the predetermined period of time, the machine controller 5 controls the machine output unit 5b to cause the machine output unit 5b to output information indicating that the formation of a node K needs to be done. When it is determined that a node K has been formed in the spindle 9 or when it is determined that the remaining time is longer than the predetermined period of time, the control for the machine output unit 5b is not performed. The information management unit 110 is equivalent to a connection information acquisition unit of the present invention. The machine controller 5 is equivalent to a second output controller of the present invention. The machine output unit 5b is equivalent to a second output unit of the present invention. Alternatively, the output of the information may be done by the management output unit 101b of the management device 101. In this case, the management device 101 is equivalent to the second output controller of the present invention and the management output unit 101b is equivalent to the second output unit of the present invention.

[0105] As described above, the information management unit 110 correctly and easily acquire the initial amount information, the unwinding unit amount information, an the unwinding start time information. By performing a calculation using these sets of information, it is possible to, for example, precisely predict a timing of the end of the unwinding of the yarn Y from the yarn supply package Ps and to regularly estimate the progress of the unwinding of the yarn Y. It is therefore possible to provide a novel yarn processing facility 100 which is able to significantly improve production management. Furthermore, even when the remaining amount of the yarn Y after part of the yarn Y has been unwound from the yarn supply package Ps cannot be directly measured, it is possible to correctly acquire information regarding the management of the yarn processing facility at a desired timing.

[0106] The information management unit 110 acquires information of the initial weight and fineness of the yarn Y included in each yarn supply package Ps as initial amount information, and acquire information of unwinding speed as unwinding unit amount information. This makes it easy to unify the units in calculations of time and/or remaining amount. As such, sets of information that are easily acquired and easily unified in terms of the units can be used for various calculations.

[0107] In addition to the above, the information management unit 110 is able to predict an unwinding end time and regularly estimate a remaining time and/or a remaining amount. Such information that is predicted and/or estimated can be used for managing various operations performed until the end of the unwinding of the yarn Y from the yarn supply package Ps (e.g., preparation of a schedule of replacement of the yarn supply package Ps).

[0108] Based on remaining time information regarding all yarn supply packages Ps attached to a predetermined yarn supply package retaining portion 20, the information management unit 110 acquires information of a predicted original yarn disappearance time at which all yarn supply packages Ps attached to the predetermined yarn supply package retaining portion 20 become empty. By utilizing the information of the predicted original yarn disappearance time, advanced control regarding operations such as replacement of yarn supply packages Ps or advanced facility operation management is realized.

[0109] The information management unit 110 manages the operation of the creel robot 102 so that yarn supply package replacement is completed at each yarn supply package retaining portion 20 before a predicted original yarn disappearance time of each yarn supply package retaining portion 20 comes. On this account, in an arrangement in which plural yarn supply package retaining portions 20 are provided, it is possible to prevent the shortage of yarn supply packages Ps at each yarn supply package retaining portion 20.

[0110] When the remaining time regarding a predetermined yarn supply package Ps decreases to a predetermined period of time or less while a tying operation is not performed, the machine controller 5 causes the machine output unit 5b to output information prompting an operator, etc. to perform the tying operation, based on the information acquired by the information management unit 110. This makes it possible to prevent the operator, etc. from forgetting to perform the tying operation.

[0111] The information management unit 110 predicts that a node K will be mixed into a predetermined wound package Pw. This prediction result can be used for managing the operations of the facility related to the formation of the wound package Pw. For example, it is possible to control the operation of the winding unit 4 so that the mixture of a node K into a wound package Pw is avoided.

[0112] The information management unit 110 controls a timing to end the winding process of winding a yarn onto a predetermined winding bobbin Bw in accordance with a timing at which it is predicted that a node K will be mixed into a predetermined wound package Pw. In this way, the mixture of the node K into the wound package Pw is avoided. Alternatively, as a yarn connecting portion is intentionally mixed into a radially outer part of a wound package, the yarn connecting portion can be easily removed from the wound package. The qualities of the wound packages Pw are therefore uniformized.

[0113] In addition to the above, based on the remaining amount information, the information management unit 110 is able to acquire the yarn layer information indicating to which part of the yarn layers of the yarn supply package Ps

suppling the yarn Y to a predetermined winding bobbin Bw the yarn Y wound onto the predetermined winding bobbin Bw belonged. It is therefore possible to associate information of the yarn Y in the wound package Pw with yarn layer information of the yarn Y included in the yarn supply package Ps. Such information is useful for, for example, quality management of wound packages Pw.

[0114] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals, and the explanations thereof are not repeated.

(1) In the embodiment above, whether yarn supply package switching has occurred is determined based on a detection result of the yarn detection sensor 24 including the first detection unit 25 and the second detection unit 26. The disclosure, however, is not limited to this arrangement. For example, as shown in FIG. 10, a yarn supplying unit 2a of a false-twist texturing machine 1a may include, for each spindle 9a, a switching detector 41 which is different in arrangement from the yarn detection sensor 24. The switching detector 41 includes, for example, a supply sensor 42 (supply detector of the present invention) and a node part sensor 43 (connecting portion detector of the present invention). The supply sensor 42 is arranged to be able to detect whether the yarn Y is being supplied from the first attachment unit 22 (one attachment unit of the present invention). The node part sensor 43 is arranged to be able to detect a node K provided to be still at a predetermined position. This arrangement makes it possible to determine that yarn supply package switching has occurred when the node K moves from the predetermined position and the node K is no longer detected by the node part sensor 43. Furthermore, from which one of the attachment units, the first attachment unit 22 or the second attachment unit 23, the yarn Y is supplied at the yarn supply package switching is detectable based on a detection result of the supply sensor 42. In this way, by using a detection result of the node K, it is possible to reliably detect from which one of the attachment units, the first attachment unit 22 or the second attachment unit 23, the yarn Y is supplied. The node part sensor 43 may be arranged to be able to detect a moving node K. In this modification, the node part sensor 43 is equivalent to the connection information acquisition unit of the present invention.

(2) In the embodiment above, the information management unit 110 determines whether yarn supply package switching has occurred based on a detection result of the yarn detection sensor 24 or the switching detector 41. The disclosure, however, is not limited to this arrangement. The information management unit 110 may determine whether yarn supply package switching has occurred by utilizing a predicted unwinding end time, for example.

(3) In the embodiment above, the information management unit 110 acquires unwinding start time information and unwinding end time information based on information of a yarn supply package attachment time and information of a time at which yarn supply package switching occurred. In other words, the information management unit 110 associates the yarn supplying bobbin attachment time with the unwinding start time. The disclosure, however, is not limited to this arrangement. The information management unit 110 may associate (i) individual information of a package attachment unit 21 which starts to supply the yarn Y at the occurrence of yarn supply package switching, (ii) individual information of a yarn supply package Ps attached to that package attachment unit 21, and (iii) a time at which the yarn supply package switching occurred, with one another. The unwinding start time information may be acquired by this arrangement. In such a case, the information management unit 110 may not acquire information of a yarn supply package attachment time. In other words, when the yarn supply package Ps is attached to the yarn supply package retaining portion 20, the information management unit 110 may simply acquire individual information of the yarn supply package Ps and individual information of the package attachment unit 21.

(4) In the embodiment above, yarn supply package replacement is performed by the creel robot 102. Furthermore, winding bobbin replacement is performed by the automatic doffer 10. The disclosure, however, is not limited to this arrangement. The yarn supply package replacement may be performed by an operator. Required information such as individual information of the yarn supply package Ps and initial weight of the yarn supply package Ps may be input by an operator to, for example, the machine controller 5. When the yarn supply package replacement is performed by the operator, the information management unit 110 may perform an output for prompting the operator to perform the yarn supply package replacement, in place of output of a command signal that causes the creel robot 102 to perform the yarn supply package replacement. In this case, the above-described package replacement instruction time is equivalent to a replacement notification time of the present invention. This arrangement makes it possible to prompt the operator to perform the yarn supply package replacement at a suitable timing. It is therefore possible to prevent the shortage of yarn supply packages Ps attached to the yarn supply package retaining portion 20. The above-described output may be performed such that the machine controller 5 of a false-twist texturing machine 1 having a yarn supply package retaining portion 20 where the yarn supply package replacement is to be performed controls the machine output unit 5b. In this case, the machine controller 5 is equivalent to a first output controller and the machine output unit 5b is equivalent to a first output unit of the present invention. Alternatively, the output may be performed by the management output unit 101b of the management device 101. In this case, the management device 101 is equivalent to the first output controller of the present invention and the management

output unit 101b is equivalent to the first output unit of the present invention. The first output unit and the second output unit of the present invention may be identical with each other or different from each other. The first output controller and the second output controller of the present invention may be identical with each other or different from each other. The first output controller and the second output controller of the present invention may be included in the information management unit 110 as described above or may be provided to be independent from the information management unit 110. The attachment and detachment of a winding bobbin Bw may be performed by the wound package conveyance device 103 or by the operator. Required information such as wound package individual information may be input by the operator to, for example, the machine controller 5. When the winding bobbin replacement is performed by the wound package conveyance device 103, the information management unit 110 outputs a command signal that instructs the wound package conveyance device 103 to perform the winding bobbin replacement. When the winding bobbin replacement is performed by the operator, the information management unit 110 may perform an output that prompts the operator to perform the winding bobbin replacement. This output may be performed by the machine output unit 5b of the machine controller 5. The output controller by which winding bobbin replacement is prompted may be identical with or different from the first output controller or the second output controller.

(5) In the embodiment above, when it is predicted that a node K will be mixed into a wound package Pw, the information management unit 110 terminates the winding process when the current time reaches the predicted unwinding end time. The disclosure, however, is not limited to this arrangement. The following will describe another example. When performing determination regarding mixture of a node K, the information management unit 110 performs the following processes. Based on a detection result of the yarn detection sensor 24 or the switching detector 41, the information management unit 110 determines whether yarn supply package switching has occurred. When determining that yarn supply package switching has occurred, the information management unit 110 may simply record a time at which the yarn supply package switching occurred. Because in this case the winding process is continued, a node K is mixed into a wound package Pw. The information management unit 110 may specify a location where the node K is mixed by calculating the winding amount at the time when the yarn supply package switching occurred.

(6) While in the embodiment above the information management unit 110 acquires information of initial weight of the yarn Y in a yarn supply package Ps as initial amount information, the disclosure is not limited to this arrangement. For example, the information management unit 110 may acquire information of initial length of the yarn Y in the yarn supply package Ps as initial amount information. In this case, as the remaining amount information, the information management unit 110 may calculate information of the length of the yarn Y remaining in the yarn supply package Ps. In the case above, furthermore, the information management unit 110 may not acquire information of fineness of the yarn Y. This is because, even if the information of the fineness of the yarn Y is not available, the remaining amount information and the remaining time information can be acquired in this case at least by using initial amount information (initial length), unwinding unit amount information (unwinding speed), unwinding start time information, and reference time information.

(7) While in the embodiment above the information management unit 110 acquires both the remaining amount information and the remaining time information, the disclosure is not limited to this arrangement. The information management unit 110 may acquire only one of the remaining amount information and the remaining time information. In other words, the remaining time information management unit 110 may acquire at least one of the remaining amount information and the remaining time information. While the information management unit 110 performs determinations and/or calculations by using the remaining amount information and/or the remaining time information, the disclosure is not limited to this arrangement. The information management unit 110 may simply acquire the remaining amount information and/or the remaining time information.

(8) While in the embodiment above the information management unit 110 acquires information of the unwinding speed V based on the information of the rotation number of the first feed roller 11, the disclosure is not limited to this arrangement. As another example, the machine controller 5 may store information of the rotation number of the second feed roller 16 and information of the ratio of the rotation number of the first feed roller 11 to the rotation number of the second feed roller 16. The information management unit 110 may acquire the information of the unwinding speed based on these sets of information. Alternatively, as the unwinding unit amount information, the information management unit 110 may acquire information of the weight of the yarn Y unwound from the yarn supply package Ps per unit time, in place of the information of the unwinding speed. Such information may be input to the machine controller 5 in advance by, for example, an operator.

(9) While in the embodiment above the information management unit 110 includes the plural machine controllers 5 and the management device 101, the disclosure is not limited to this arrangement. The information management unit 110 may include a computer device (not illustrated) in addition to the machine controller 5 and the management device 101. Alternatively, the information management unit 110 may include only the machine controller 5 or the management device 101. In other words, only one of the machine controller 5 and the management device 101

may acquire required information.

(10) in the embodiment above, the information management unit 110 acquires initial amount information of a yarn supply package Ps and individual information of that yarn supply package Ps in association with each other. The disclosure, however, is not limited to this arrangement. For example, each machine controller 5 of the information management unit 110 may be able to store initial amount information shared between all yarn supply packages Ps of all spindles 9 of the corresponding false-twist texturing machine 1 in advance. This makes it possible to manage the remaining amount information, etc. by a simple program, with the assumption that all yarn supply packages Ps have substantially the same initial weight. Alternatively, for example, the spindles 9 may be grouped into plural groups. The machine controller 5 may be arranged so that initial amount information is set for each of these groups.

(11) While in the embodiment above the yarn processing facility 100 has plural false-twist texturing machines 1, the disclosure is not limited to this arrangement. The yarn processing facility 100 may include only one false-twist texturing machine 1. Furthermore, the management device 101 may not be provided. In this case, the false-twist texturing machine1 is equivalent to the yarn processing facility of the present invention. While the false-twist texturing machine 1 includes plural spindles 9, the disclosure is not limited to this arrangement. In other words, the number of spindles 9 in the false-twist texturing machine 1 may be one. To put it differently, the number of yarn supply package retaining portions 20 in the yarn supplying unit 2 may be one. Even in this case, the information management unit 110 may manage the operation of the creel robot 102 so that yarn supply package replacement at the one yarn supply package retaining portion 20 is finished before a predicted original yarn disappearance time regarding the one yarn supply package retaining portion 20 (predetermined yarn supply package retaining portion of the present invention) comes. This makes it possible to prevent the shortage of yarn supply packages Ps attached to that yarn supply package retaining portion 20.

(12) The present invention may be applied not to the yarn processing facility 100 including the false-twist texturing machine 1 but to another yarn processing facility including a yarn processor. For example, the present invention may be applied to a yarn processing facility including an air texturing machine (yarn processor) recited in Japanese Laid-Open Patent Publication No. 2002-088605.

Claims

1. A yarn processing facility (100) comprising:

a yarn processor (1) including: a yarn supplying unit (2) including at least one yarn supply package retaining portion (20) capable of supplying at least one yarn (Y); a processing unit (3) configured to process the at least one yarn (Y) supplied from the yarn supplying unit (2); and a winding unit (4) configured to form a wound package (Pw) by winding the at least one yarn (Y) processed by the processing unit (3) onto a winding bobbin (Bw); and an information management unit (110) which is configured to manage information regarding the yarn processor (1),

each of the at least one yarn supply package retaining portion (20) being capable of uninterruptedly supplying the at least one yarn (Y), when plural yarn supply packages (Ps) are attachable to and detachable from the each of the at least one yarn supply package retaining portion (20) and a terminal portion of a yarn (Y) in one yarn supply package (Ps) is connected to a start end portion of a yarn (Y) in another yarn supply package (Ps) from which the yarn (Y) is to be unwound next to the one yarn supply package (Ps), and

the information management unit (110) being capable of acquiring

initial amount information regarding an initial amount of a yarn (Y) in a yarn supply package (Ps) before unwinding of the yarn (Y) from the yarn supply package (Ps) starts,

unwinding unit amount information regarding an amount of a yarn (Y) unwound from a yarn supply package (Ps) per unit time, and

unwinding start time information regarding an unwinding start time at which unwinding of a yarn (Y) from a yarn supply package (Ps) starts.

2. The yarn processing facility (100) according to claim 1, wherein,

the information management unit (110) acquires

as the initial amount information, information of initial weight (WF) and fineness (F) of a yarn (Y) in a yarn supply package (Ps), and

as the unwinding unit amount information, information of unwinding speed (V) indicating the length of a yarn (Y) unwound from a yarn supply package (Ps) per unit time.

3. The yarn processing facility (100) according to claim 1 or 2, wherein,

the information management unit (110) acquires,
by a calculation using at least the initial amount information, the unwinding unit amount information, and the unwinding start time information, at least one of:

predicted unwinding end time information regarding a predicted unwinding end time at which unwinding of a yarn (Y) from a yarn supply package (Ps) ends;
remaining time information regarding remaining time in which unwinding of a yarn (Y) from a yarn supply package (Ps) is possible at a given reference time; and
remaining amount information regarding a remaining amount of a yarn (Y) in a yarn supply package (Ps) at the reference time.

4. The yarn processing facility (100) according to claim 3, wherein, based on the remaining time information regarding all yarn supply packages (Ps) attached to a predetermined yarn supply package retaining portion (20) among the at least one yarn supply package retaining portion (20), the information management unit (110) acquires information of a predicted original yarn disappearance time at which the all yarn supply packages (Ps) attached to the predetermined yarn supply package retaining portion (20) become empty.

5. The yarn processing facility (100) according to claim 4, further comprising

a yarn supply package conveyance device (102) which is configured to convey a new yarn supply package (Ps) to the yarn supplying unit (2) and to perform yarn supply package replacement of replacing an empty yarn supply package (Ps) from which a yarn (Y) is fully unwound with the new yarn supply package (Ps),
the information management unit (110) managing operation of the yarn supply package conveyance device (102) so that the yarn supply package replacement at the predetermined yarn supply package retaining portion (20) is finished before the predicted original yarn disappearance time regarding the predetermined yarn supply package retaining portion (20) comes.

6. The yarn processing facility (100) according to claim 5, wherein,

the yarn supplying unit (2) includes a plurality of yarn supply package retaining portions (20) as the at least one yarn supply package retaining portion (20),
the yarn supply package conveyance device (102) is capable of performing the yarn supply package replacement for the plurality of yarn supply package retaining portions (20), and
the information management unit (110) managing operation of the yarn supply package conveyance device (102) so that the yarn supply package replacement at each of the plurality of yarn supply package retaining portions (20) is finished before the predicted original yarn disappearance time regarding each of the plurality of yarn supply package retaining portions (20) comes.

7. The yarn processing facility (100) according to claim 4, further comprising:

a first output unit (5b) which is capable of outputting information; and
a first output controller (5) which is configured to control the first output unit (5b),
at a replacement notification time that is earlier than the predicted original yarn disappearance time by a predetermined period of time, the first output controller (5) causing the first output unit (5b) to output information that prompts an operator to replace a yarn supply package (Ps) at the predetermined yarn supply package retaining portion (20).

8. The yarn processing facility (100) according to any one of claims 3 to 7, further comprising:

a connection information acquisition unit (110) which is capable of acquiring information regarding whether a terminal portion of a yarn (Y) in a predetermined yarn supply package (Ps) is connected to a start end portion of a yarn (Y) in a reserve yarn supply package (Ps) from which the yarn is to be unwound next to the predetermined yarn supply package (Ps);
a second output unit (5b) which is capable of outputting information; and
a second output controller (5) which is configured to control the second output unit (5b),
based on information acquired by the connection information acquisition unit (110), the second output controller

(5) causing the second output unit (5b) to output information by which connection of the start end portion with the terminal portion is prompted, when the start end portion is not connected to the terminal portion and the remaining time regarding the predetermined yarn supply package (Ps) is decreased to a predetermined period of time or less.

9. The yarn processing facility (100) according to any one of claims 3 to 8, wherein,
the information management unit (110) is capable of acquiring:

information of a winding start time at which winding of a yarn (Y) onto a predetermined winding bobbins (Bw) starts; and
information regarding at least one of a planned winding end time at which the winding of the yarn (Y) onto the predetermined winding bobbin (Bw) ends, a planned wound amount of the yarn (Y) wound onto the predetermined winding bobbin (Bw), and a planned winding time during which the yarn (Y) is wound onto the predetermined winding bobbin (Bw), and
the information management unit (110) predicts that a yarn connecting portion (K) formed by connection of the start end portion with the terminal portion is to be mixed into a predetermined wound package (Pw) formed by winding the yarn (Y) onto the predetermined winding bobbin (Bw), when the predicted unwinding end time exists between the winding start time and the planned winding end time, when the remaining amount regarding a yarn supply package (Ps) from which a yarn (Y) is being unwound at the winding start time is smaller than the planned wound amount, or when the remaining time regarding the yarn supply package (Ps) from which the yarn (Y) is being unwound at the winding start time is shorter than the planned winding time.

10. The yarn processing facility (100) according to claim 9, wherein, the information management unit (110) manages a timing to end a winding process of winding the yarn (Y) onto the predetermined winding bobbin (Bw), in accordance with a timing at which it is predicted that the yarn connecting portion (K) is to be mixed into the predetermined wound package (Bw).

11. The yarn processing facility (100) according to any one of claims 3 to 10, wherein, based on the remaining amount information, the information management unit (110) is able to acquire yarn layer information indicating to which part of a yarn layer of a yarn supply package (Ps) suppling the yarn (Y) to the predetermined winding bobbin (Bw) the yarn (Y) wound onto the predetermined winding bobbin (Bw) belonged, at the reference time.

FIG.1

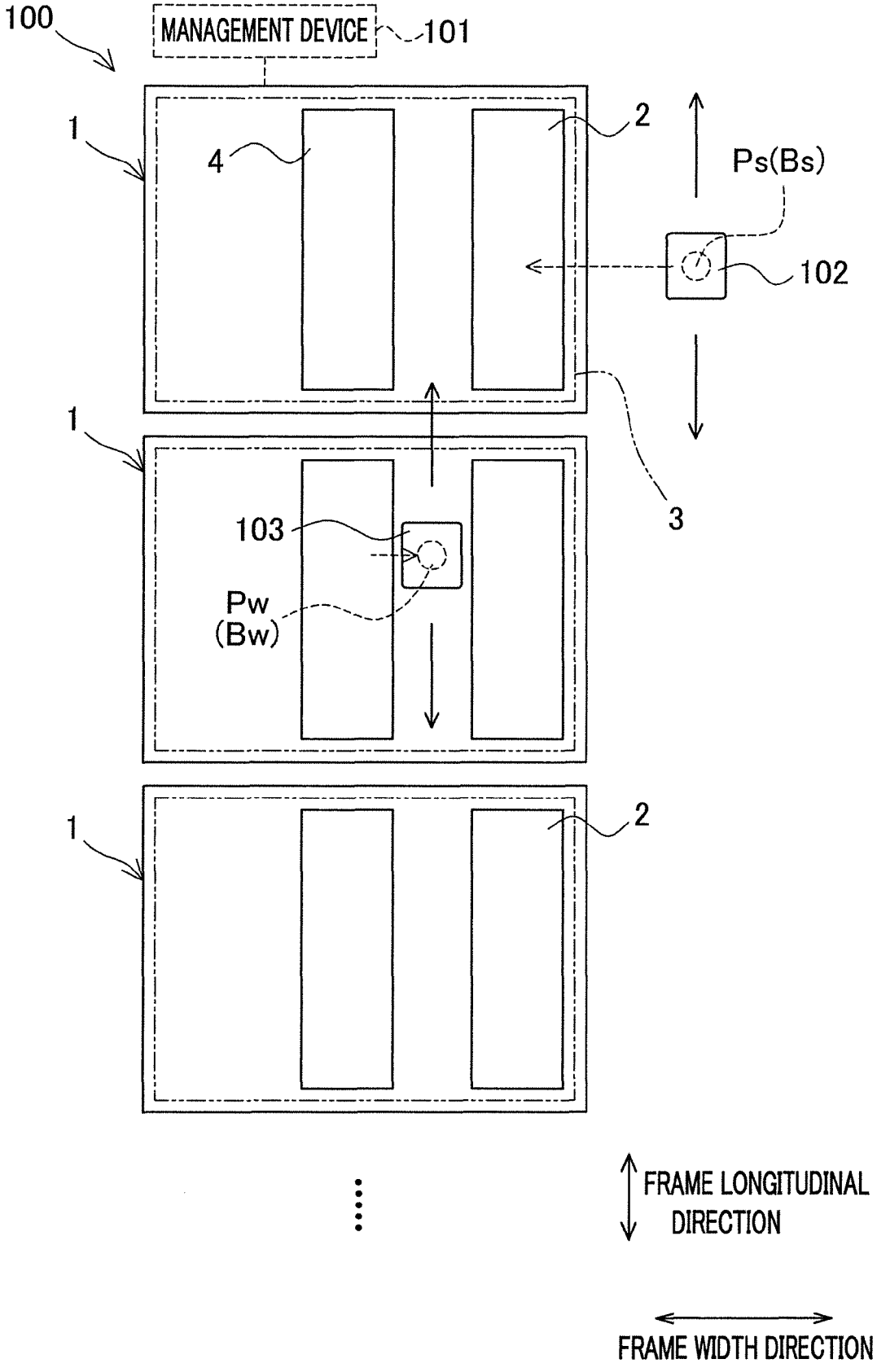

100
MANAGEMENT DEVICE
101
1
4
2
Ps(Bs)
102
1
3
103
Pw
(Bw)
1
2
FRAME LONGITUDINAL DIRECTION
FRAME WIDTH DIRECTION

FIG.2

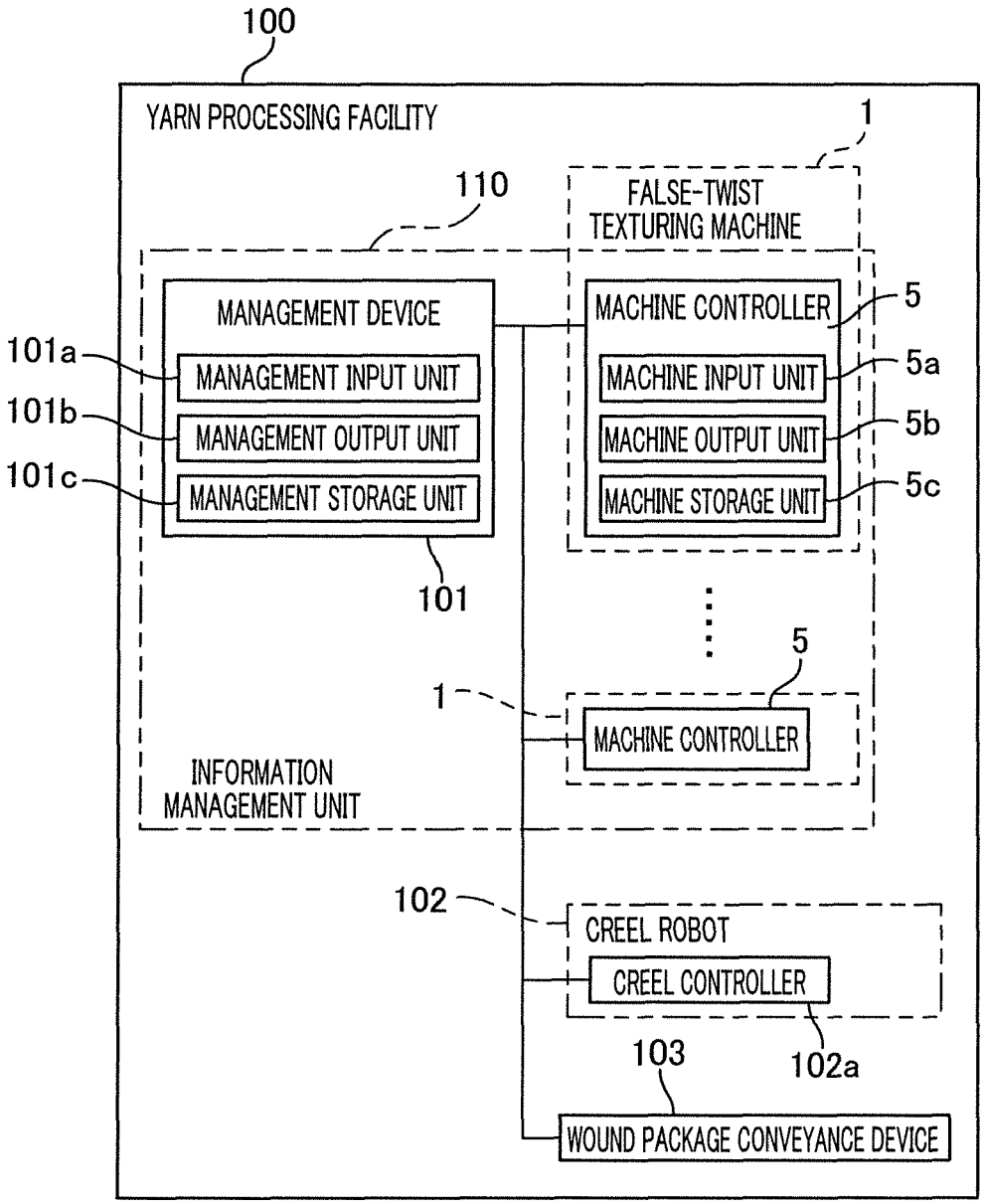

100
YARN PROCESSING FACILITY
1
110
FALSE-TWIST TEXTURING MACHINE
MANAGEMENT DEVICE
MACHINE CONTROLLER
5
101a
MANAGEMENT INPUT UNIT
MACHINE INPUT UNIT
5a
101b
MANAGEMENT OUTPUT UNIT
MACHINE OUTPUT UNIT
5b
101c
MANAGEMENT STORAGE UNIT
MACHINE STORAGE UNIT
5c
101
5
1
MACHINE CONTROLLER
INFORMATION MANAGEMENT UNIT
102
CREEL ROBOT
CREEL CONTROLLER
103
102a
WOUND PACKAGE CONVEYANCE DEVICE

FIG.3

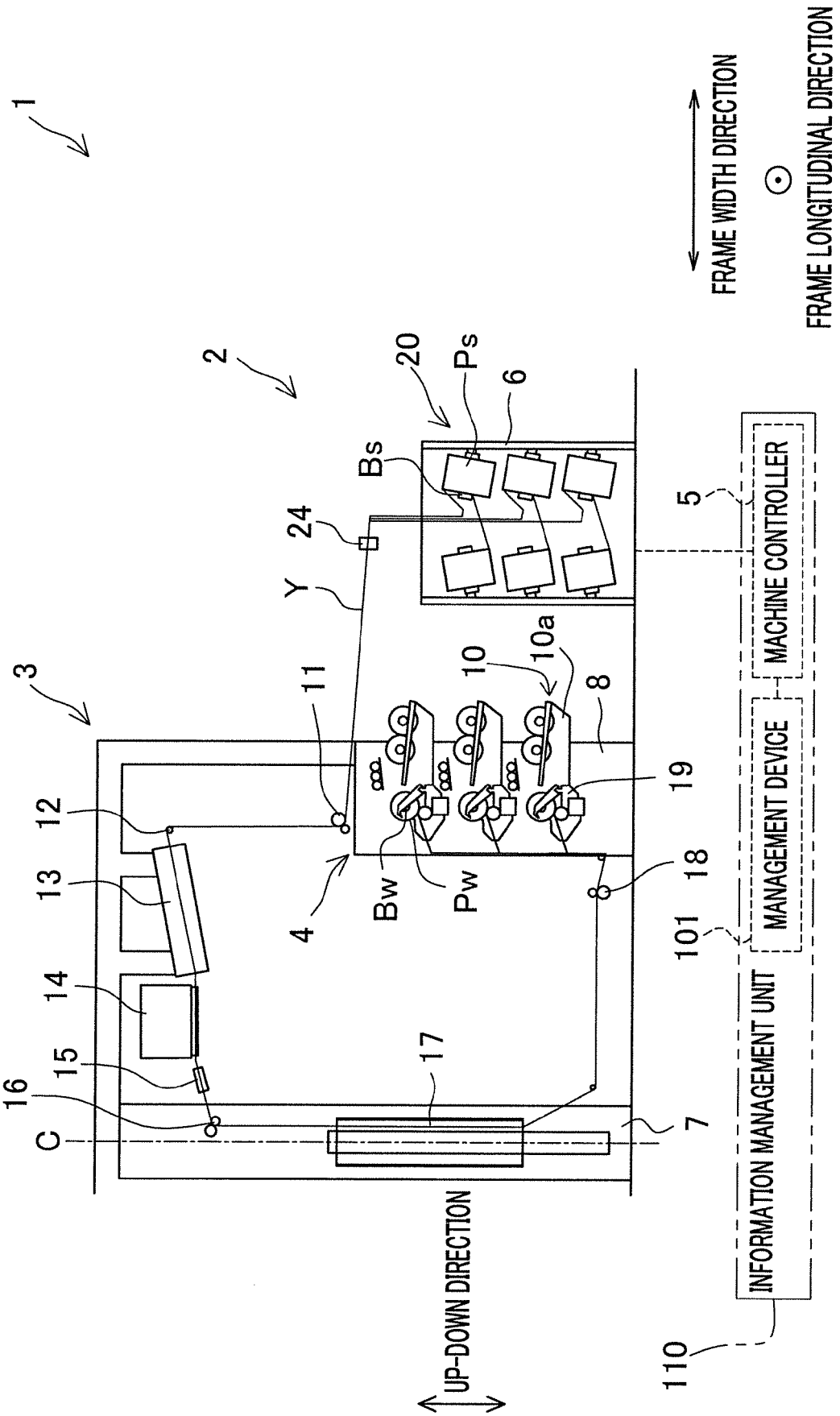

1
2
3
4
5
6
7
8
10
10a
11
12
13
14
15
16
17
18
19
20
24
Bs
Ps
Bw
Pw
Y
C
FRAME WIDTH DIRECTION
FRAME LONGITUDINAL DIRECTION
UP-DOWN DIRECTION
MACHINE CONTROLLER
MANAGEMENT DEVICE
INFORMATION MANAGEMENT UNIT
101
110

FIG.4

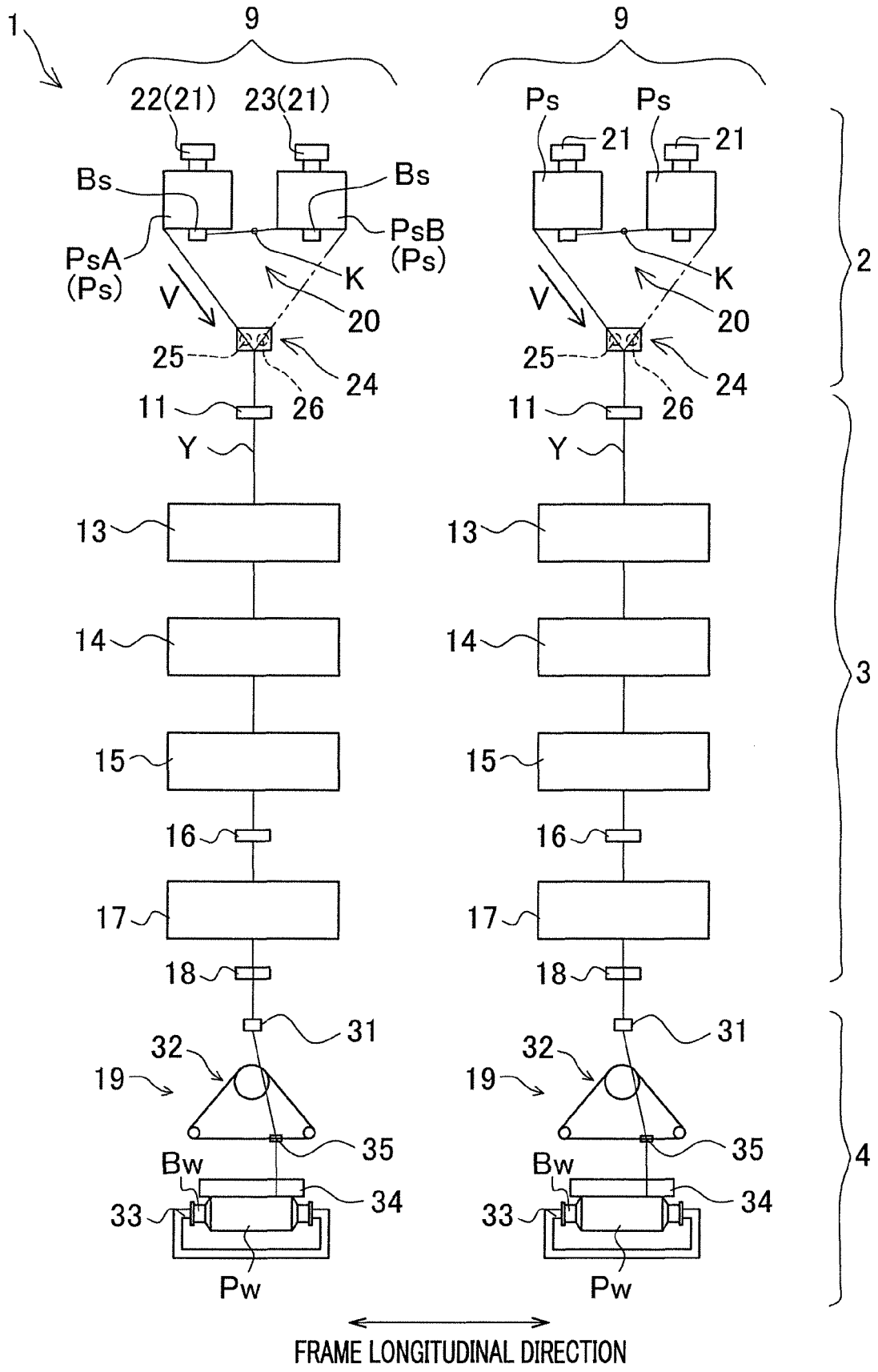
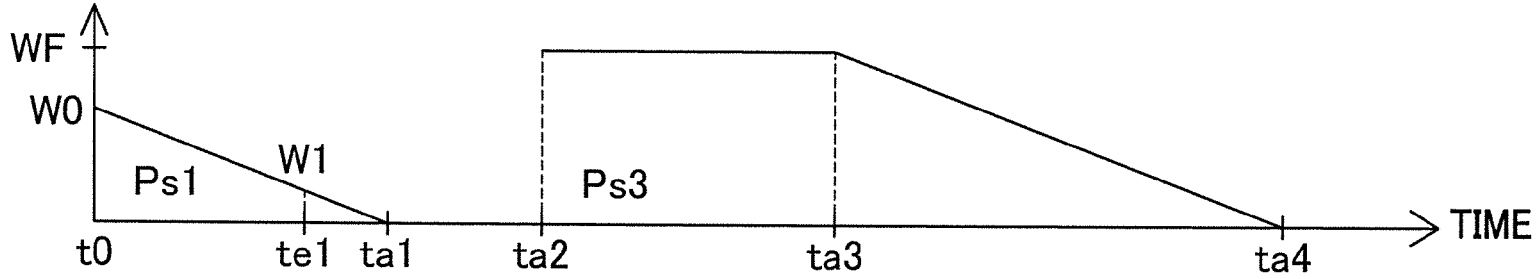
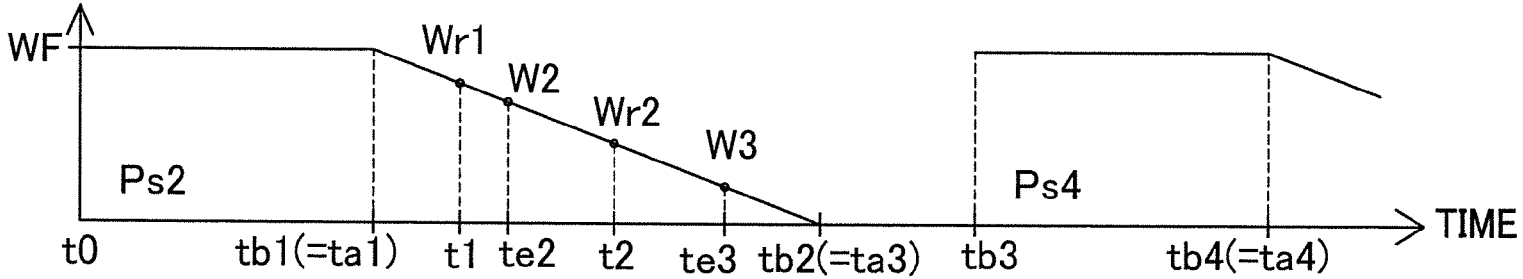

1
9
9
22(21)
23(21)
Ps
Ps
21
21
Bs
Bs
PsB
(Ps)
PsA
(Ps)
K
V
20
25
24
11
26
Y
2
13
14
15
16
17
18
3
31
32
19
35
Bw
34
33
Pw
4
FRAME LONGITUDINAL DIRECTION

FIG.5

(a) RELATIONSHIP BETWEEN REMAINING AMOUNT OF YARN IN YARN SUPPLY PACKAGE ATTACHED TO FIRST ATTACHMENT UNIT AND TIME



(b) RELATIONSHIP BETWEEN REMAINING AMOUNT OF YARN IN YARN SUPPLY PACKAGE ATTACHED TO SECOND ATTACHMENT UNIT AND TIME



(c) RELATIONSHIP BETWEEN AMOUNT OF YARN WOUND ON WINDING BOBBIN AND TIME

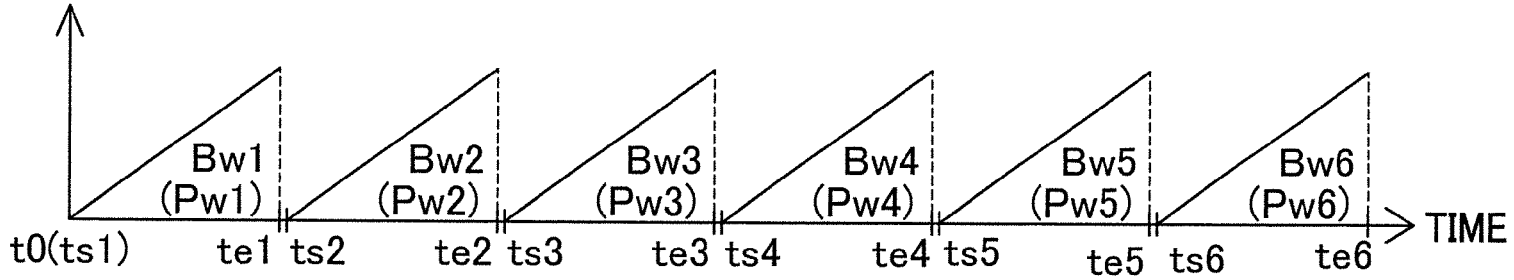


FIG.6

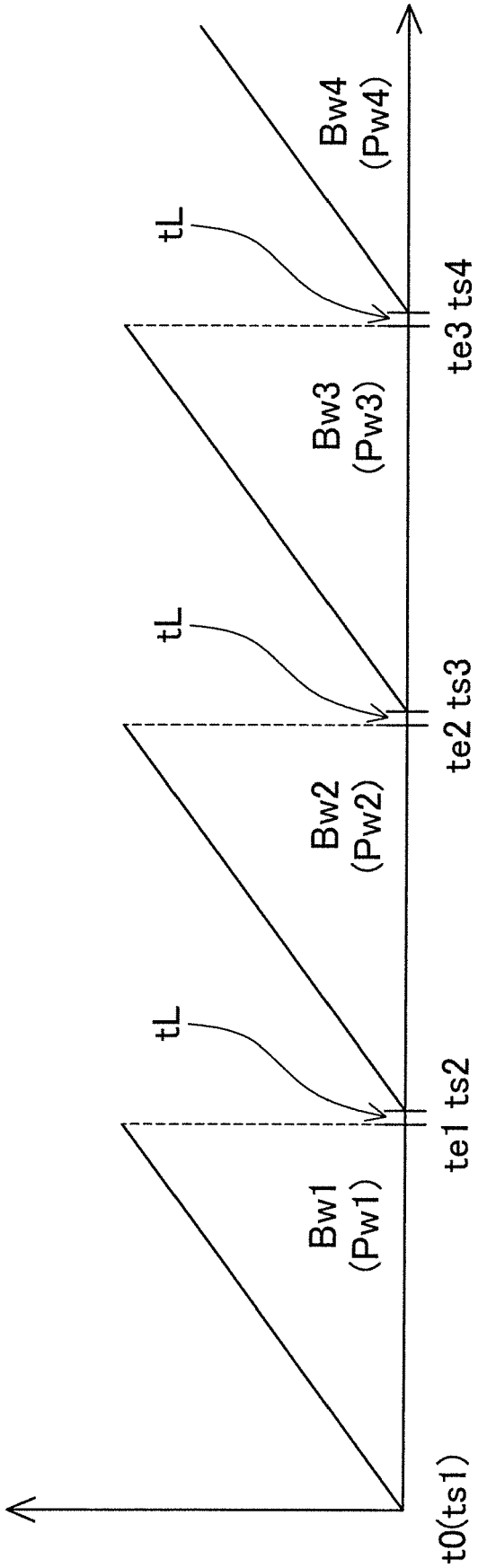

t0(ts1)
te1 ts2
te2 ts3
te3 ts4
tL
tL
tL
Bw1
(Pw1)
Bw2
(Pw2)
Bw3
(Pw3)
Bw4
(Pw4)

FIG.7

(a) ASSOCIATION BETWEEN YARN SUPPLY PACKAGE INDIVIDUAL INFORMATION, INDIVIDUAL INFORMATION OF PACKAGE ATTACHMENT UNIT, AND SETS OF INFORMATION

YARN SUPPLY PACKAGE INDIVIDUAL INFORMATION	PACKAGE ATTACHMENT UNIT	ATTACHMENT TIME	INITIAL WEIGHT	FINENESS
Ps1	FIRST ATTACHMENT UNIT	(OMITTED)	WF	F
Ps2	SECOND ATTACHMENT UNIT	(OMITTED)	WF	F
Ps3	FIRST ATTACHMENT UNIT	ta2	WF	F
Ps4	SECOND ATTACHMENT UNIT	tb3	WF	F

(b) ASSOCIATION BETWEEN INDIVIDUAL INFORMATION OF PACKAGE ATTACHMENT UNIT, UNWINDING START TIME INFORMATION, AND UNWINDING END TIME INFORMATION

PACKAGE ATTACHMENT UNIT	UNWINDING START TIME	UNWINDING END TIME
FIRST ATTACHMENT UNIT	(OMITTED)	ta1
SECOND ATTACHMENT UNIT	tb1	tb2
FIRST ATTACHMENT UNIT	ta3	ta4
SECOND ATTACHMENT UNIT	tb4	(OMITTED)

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FIG.8 (a) YARN SUPPLY PACKAGE INDIVIDUAL INFORMATION AND INFORMATION ASSOCIATED WITH YARN SUPPLY PACKAGE INDIVIDUAL INFORMATION

YARN SUPPLY PACKAGE INDIVIDUAL INFORMATION	UNWINDING START TIME	UNWINDING END TIME	INITIAL WEIGHT	FINENESS	UNWINDING SPEED
Ps1	(OMITTED)	ta1	WF	F	V
Ps2	tb1	tb2	WF	F	V
Ps3	ta3	ta4	WF	F	V
Ps4	tb4	(OMITTED)	WF	F	V

(b) WOUND PACKAGE INDIVIDUAL INFORMATION AND INFORMATION ASSOCIATED WITH WOUND PACKAGE INDIVIDUAL INFORMATION

WOUND PACKAGE INDIVIDUAL INFORMATION	WINDING START TIME	WINDING END TIME
Pw1	ts1	te1
Pw2	ts2	te2
Pw3	ts3	te3
Pw4	ts4	te4
Pw5	ts5	te5
Pw6	ts6	te6

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FIG.9

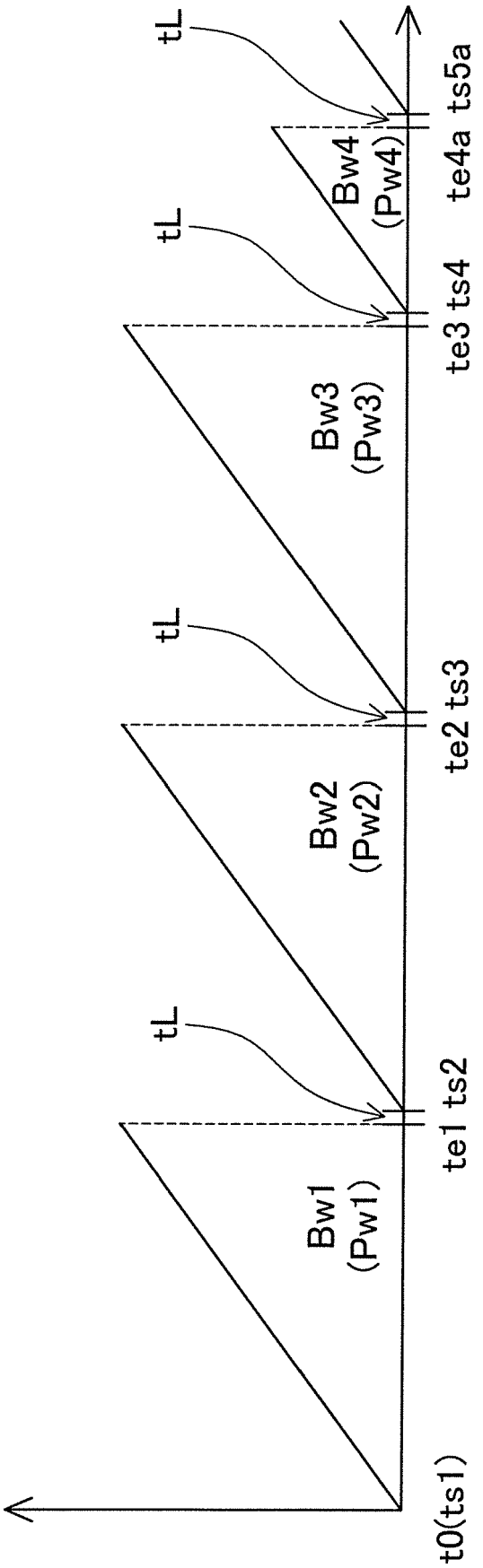
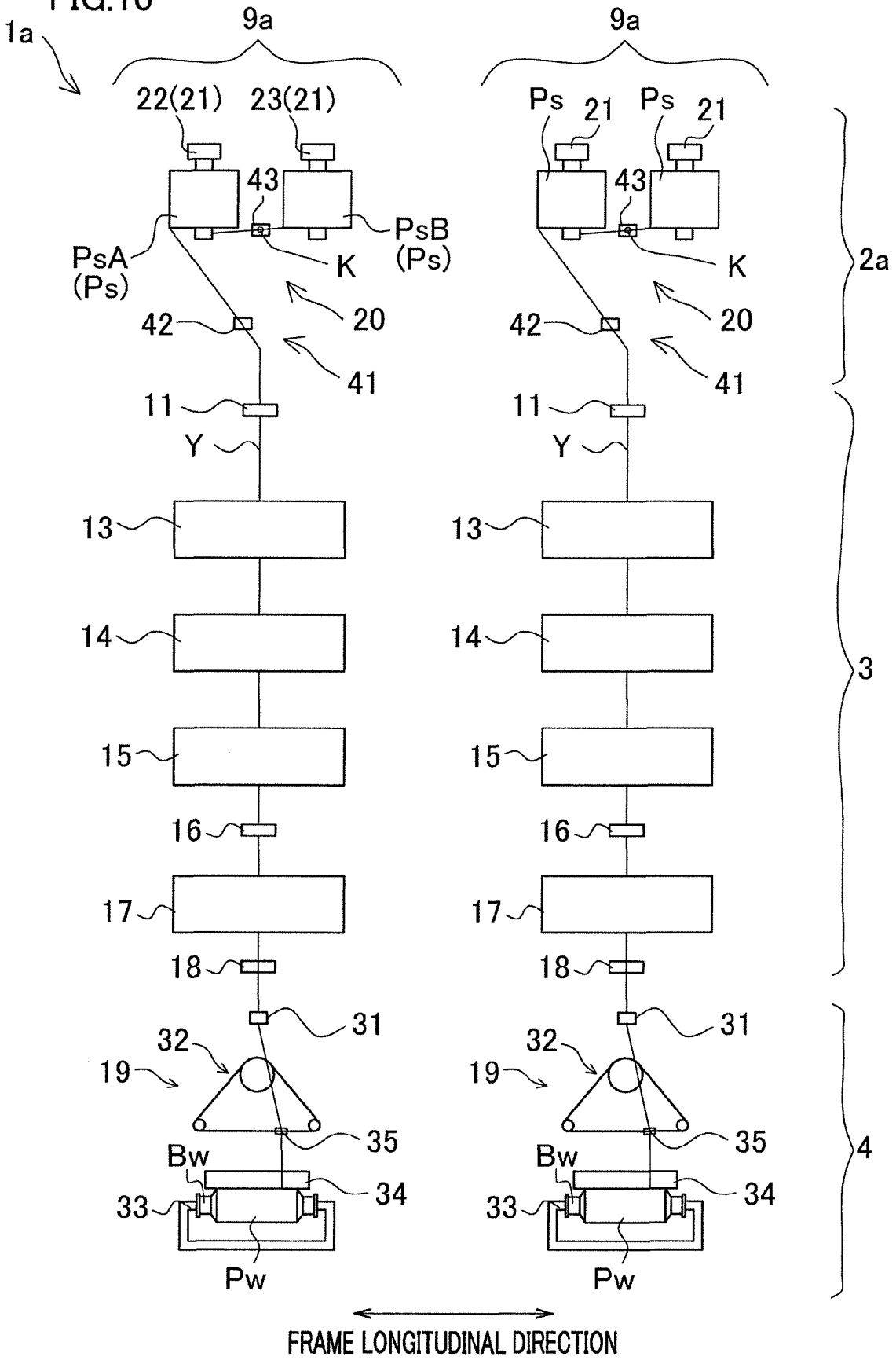

t0(ts1)
te1 ts2
te2 ts3
te3 ts4
te4a ts5a
tL
tL
tL
tL
Bw1
(Pw1)
Bw2
(Pw2)
Bw3
(Pw3)
Bw4
(Pw4)

FIG.10


1a
9a
9a
22(21)
23(21)
Ps
21
Ps
21
43
43
PsA
(Ps)
PsB
(Ps)
K
K
2a
20
20
42
42
41
41
11
11
Y
Y
13
13
14
14
3
15
15
16
16
17
17
18
18
31
31
32
32
19
19
35
35
Bw
Bw
34
34
33
33
4
Pw
Pw
FRAME LONGITUDINAL DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 0929

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X,D	WO 2020/127489 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 25 June 2020 (2020-06-25) * pages 9-12 *	1,2	
X A	US 2019/177108 A1 (CHARLES EATON DAVID [GB] ET AL) 13 June 2019 (2019-06-13) * paragraphs [0025] - [0028] *	1,2 3	

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B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 June 2022	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

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15-06-2022

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