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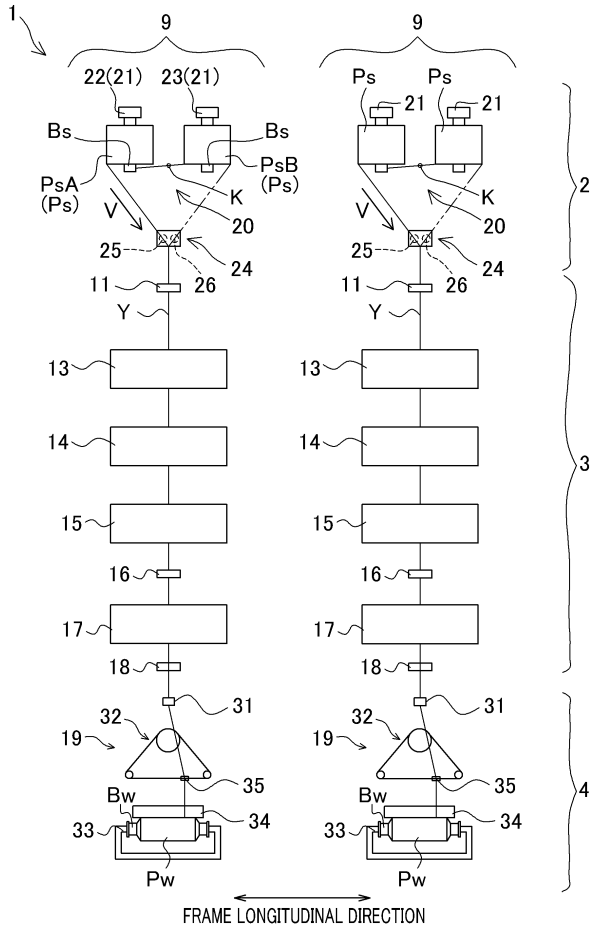
(54) YARN PROCESSING FACILITY

(57) An object of the present invention is to solve a problem occurring when a yarn supply package from which a yarn is unwound is suddenly replaced with a new yarn supply package. An information management unit 110 of a yarn processing facility 100 is configured to acquire at least one of the following sets of information by means of a calculation at a desired reference time point: remaining amount information regarding a remaining amount of a yarn Y in one of yarn supply packages Ps, the yarn Y being unwound from the one of the yarn supply packages Ps; and remaining time information regarding a remaining time in which the yarn Y can be supplied from the one of the yarn supply packages Ps at the reference time point. When sudden replacement information indicating execution of sudden replacement in which unwinding of a yarn Y from one of the yarn supply packages Ps has started and has not ended yet and the one of the yarn supply packages Ps is replaced with another of the yarn supply packages Ps is acquired, the information management unit 110 performs a reset process of resetting the at least one of the remaining amount information and the remaining time information to a predetermined initial value.

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 a yarn supplying bobbin, and 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 supply of the yarn from the one of the two yarn supply packages, (i) a node of the two yarns (i.e., yarn connecting portion) is pulled and (ii) 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 have 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. For example, the present inventors have discussed an idea of significantly improving production management by estimating a timing of running out of a yarn in a yarn supply package from which the yarn is unwound. In this regard, it is required to properly estimate the above-described timing even when the yarn supply package from which the yarn is unwound is suddenly replaced by a new yarn supply package because of, e.g., a yarn quality defect.

[0004] An object of the present invention is to solve a problem occurring when a yarn supply package from which a yarn is unwound is suddenly replaced by a new yarn supply package.

[0005] According to a first aspect of the invention, a yarn processing facility includes: a yarn processor including: a yarn supplying unit 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 configured to manage information regarding the yarn processor, the yarn supplying unit including at least one yarn supply package retaining portion to and from which yarn supply packages each including a yarn are attachable and detachable, and the at least one yarn supply package retaining portion being able to uninterruptedly supply at least one yarn when a terminal portion of a yarn in one yarn supply package among the yarn supply packages is connected to a start end portion of a yarn in another yarn supply package among the yarn supply packages from which the yarn is to be unwound next to the one yarn supply package. In this yarn processing facility, when a yarn is unwound from one of the yarn supply packages, the information management unit acquires, at a given reference time point and by means of a calculation, at least one of (i) remaining amount information regarding a remaining amount of the yarn in the one of the yarn supply packages and (ii) remaining time information regarding a remaining time in which the yarn can be supplied from the one of the yarn supply packages at the reference time point. Furthermore, in this yarn processing facility, when sudden replacement information indicating execution of sudden replacement in which unwinding of a yarn from one of the yarn supply packages has started and has not ended yet and the one of the yarn supply packages is replaced with new one of the yarn supply packages is acquired, the information management unit performs a reset process of resetting the at least one of the remaining amount information and the remaining time information to a predetermined initial value.

[0006] According to this aspect, at a desired time point, at least one of the remaining amount information and the remaining time information is acquired in regard to the at least one yarn supply package retaining portion. This arrangement makes it possible to predict, in the at least one yarn supply package retaining portion, when a yarn is run out at one yarn supply package from which the yarn is unwound. It is therefore possible to significantly improve production management. In this regard, one yarn supply package in which unwinding of a yarn has started and has not ended yet may be replaced with a new yarn supply package because of, e.g., a yarn quality defect. In this case, when at least one of the remaining amount information and the remaining time information is not updated, a calculated result/calculated results of the remaining amount and/or the remaining time is/are different from an actual value/actual values. Therefore, a timing of running out of the yarn at the one yarn supply package is not correctly predicted. According to this aspect, the reset process is performed when the information management unit acquires the sudden replacement information. This suppresses a calculated result/calculated results of the remaining amount and/or the remaining time from being different from an actual value/values. It is therefore possible to solve a problem occurring when one yarn supply package from which a yarn is unwound is suddenly replaced with a new yarn supply package.

[0007] According to a second aspect of the invention, the yarn processing facility of the first aspect is arranged such that the at least one yarn supply package retaining portion includes attachment units to which the yarn supply packages are respectively attached, the yarn supplying unit further includes a switching detector capable of detecting yarn supply package switching in which unwinding of a yarn from one of the yarn supply packages ends and unwinding of a yarn from another of the yarn supply packages starts, the one of the yarn supply packages being attached to one attachment unit among the attachment units, and the another of the yarn supply packages being attached to another attachment unit among the attachment units which is different from the one attachment unit, and when the switching detector detects the yarn supply package switching, the information management unit performs the reset process for the another attachment unit.

[0008] According to this aspect, in the yarn processing facility, when one yarn supply package retained by the at least one yarn supply package retaining portion becomes empty, unwinding of a yarn from the next yarn supply package starts as a normal operation. At this time, the yarn supply package switching is detected, and the reset process is performed. However, when (i) one yarn supply package in which unwinding of a yarn has started and has not ended yet is replaced with a new yarn supply package and then (ii) unwinding of a yarn from the new yarn supply package starts, the yarn supply package switching is not detected. According to this aspect, the reset process is similarly performed also in this case when the information management unit acquires the sudden replacement information. It is therefore possible to effectively suppress a calculated result/calculated results of the remaining amount and/or the remaining time from being different from an actual value/actual values while suppressing a program from being complex.

[0009] A third aspect of the invention, the yarn processing facility of the first or second aspect is arranged such that the information management unit is able to acquire: initial amount information regarding an initial amount of a yarn in each of the yarn supply packages as information of the predetermined initial value; unwinding unit amount information regarding an amount of a yarn which is unwound from each of the yarn supply packages per unit time; and cumulative time information regarding a cumulative time in which a yarn is unwound from one of the yarn supply packages, the yarn being unwound from the one of the yarn supply packages at the reference time point, the information management unit is configured to acquire the at least one of the remaining time information and the remaining amount information by means of a calculation based on at least the initial amount information, the unwinding unit amount information, and the cumulative time information, and the information management unit is configured to reset, as the reset process, the at least one of the remaining amount information and the remaining time information to the predetermined initial value by resetting the cumulative time to a predetermined initial time.

[0010] When the initial amount information, the unwinding unit amount information, and the cumulative time information are acquired, the remaining amount information and/or the remaining time information can be easily acquired at a desired time point by means of the calculation based on the initial amount information, the unwinding unit amount information, and the cumulative time information. According to this aspect, when the sudden replacement information is acquired, the cumulative time information is reset so as to indicate the predetermined initial time. It is therefore possible to easily suppress a calculated result/calculated results of the remaining amount information and/or the remaining time information from being different from an actual value/actual values while at least one of the remaining amount information and the remaining time information is easily acquired.

[0011] According to a fourth aspect of the invention, the yarn processing facility of the first or second aspect is arranged such that the information management unit is able to acquire: initial amount information regarding an initial amount of a yarn in each of the yarn supply packages as information of the predetermined initial value; unwinding unit amount information regarding an amount of a yarn which is unwound from each of the yarn supply packages per unit time; and unwinding start time point information regarding an unwinding start time point at which unwinding of a yarn from one of the yarn supply packages starts, the yarn being unwound from the one of the yarn supply packages at the reference time point, the information management unit is configured to acquire the at least one of the remaining time information and the remaining amount information in regard to each of the yarn supply packages by means of a calculation based on at least the initial amount information, the unwinding unit amount information, and the unwinding start time point information, and the information management unit is configured to reset, as the reset process, the at least one of the remaining amount information and the remaining time information to the predetermined initial value by acquiring the unwinding start time point information in regard to the new one of the yarn supply packages.

[0012] According to this aspect, it is possible to easily suppress a calculated result/calculated results of the remaining amount information and/or the remaining time information from being different from an actual value/actual values while at least one of the remaining amount information and the remaining time information is easily acquired in the same manner as the third aspect.

[0013] According to a fifth aspect of the invention, the yarn processing facility of the third or fourth aspect is arranged such that the information management unit is configured to acquire: information of initial weight and fineness of a yarn in each of the yarn supply packages as the initial amount information; and information of an unwinding speed indicating length of a yarn which is unwound from each of the yarn supply packages per the unit time as the unwinding unit amount information.

[0014] Typically, because information of the initial weight of each yarn supply package can be easily acquired in advance, such information is easily dealt with as the initial amount information. Similarly, because information of the unwinding speed can be easily acquired in advance, such information is easily dealt with as the 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 the remaining amount information and/or the remaining time information cannot be performed based only on the initial weight, the unwinding speed, and the cumulative time (or unwinding start time point) because the units cannot be unified. According to this aspect, information of the fineness (weight per unit length) that can be acquired in advance is also acquired as the initial amount information. This arrangement makes it easy to unify the units in the calculations of the remaining amount information and/or the remaining time information.

[0015] According to a sixth aspect of the invention, the yarn processing facility of any one of the first to fifth aspects is arranged such that the yarn processor is structured so that a yarn is unwound from one of the yarn supply packages in at least part of yarn threading time in which yarn threading is performed for the yarn processor after the sudden replacement is performed, and the yarn supplying unit further includes an unwinding detector capable of detecting whether the yarn is unwound from the one of the yarn supply packages. In this yarn processing facility, in order to acquire the at least one of the remaining amount information and the remaining time information, the information management unit is configured to use information of detection time in which unwinding of the yarn from the one of the yarn supply packages is detected by the unwinding detector. Furthermore, in this yarn processing facility, the at least part of the yarn threading time is included in the detection time.

[0016] For example, the yarn threading time may be excluded from the detection time. In this case, however, a process performed by the information management unit may be complex because information regarding completion of the yarn threading is required. According to this aspect, the at least part of the yarn threading time is included in the detection time. Therefore, the remaining amount information and/or the remaining time information can be acquired by an easy process.

[0017] According to a seventh aspect of the invention, the yarn processing facility of any one of the first to sixth aspects is arranged such that the information management unit is able to acquire a common initial value which is a common value regarding the yarn supply packages as the predetermined initial value.

[0018] According to this aspect, on the premise that an amount of a yarn in each yarn supply package is substantially the same between all yarn supply packages, it is possible to perform the reset process by using a simple program as compared to a case where all yarn supply packages have different initial values regarding the amount of the yarn.

[0019] According to an eighth aspect of the invention, the yarn processing facility of the seventh aspect is arranged such that the yarn processor is able to simultaneously process yarns, the yarn supplying unit includes yarn supply package retaining portions, and the common initial value is set as a common value regarding the yarn supply package retaining portions.

[0020] According to this aspect, even when the plural yarn supply package retaining portions are provided, the reset process can be performed with a simple program.

[0021] According to a ninth aspect of the invention, the yarn processing facility of any one of the first to sixth aspects is arranged such that the information management unit is able to acquire the predetermined initial value corresponding each of the yarn supply packages.

[0022] According to this aspect, even when the initial amount of a yarn in each yarn supply package is different between the yarn supply packages, the reset process can be properly performed.

[0023] According to a tenth aspect of the invention, the yarn processing facility of the ninth aspect is arranged such that the yarn processor is able to simultaneously process yarns, and the yarn supplying unit includes yarn supply package retaining portions.

[0024] According to this aspect, even when the plural yarn supply package retaining portions are provided, the reset process can be properly performed for each yarn supply package retaining portion.

[0025] According to an eleventh aspect of the invention, the yarn processing facility of any one of the first to tenth aspects is arranged such that the information management unit further includes an operation unit which is operable by an operator and, when a predetermined reset operation is performed for the operation unit, the information management unit generates the sudden replacement information.

[0026] According to this aspect, it is possible to manually perform the reset process when the operator replaces one yarn supply package in at least one yarn supply package retaining portion.

[0027] According to a twelfth aspect of the invention, the yarn processing facility of any one of the first to eleventh aspects further includes a yarn supply package replacement device capable of executing the sudden replacement. In this yarn processing facility, the yarn supply package replacement device is able to transmit the sudden replacement information to the information management unit.

[0028] According to this aspect, when at least one yarn supply package is replaced by the yarn supply package replacement device, the reset process can be performed without needing human workforce.

[0029] According to a thirteenth aspect of the invention, the yarn processing facility of any one of the first to twelfth

aspects is arranged such that the information management unit is configured to acquire information of a predicted raw yarn disappearance time point which is acquired for each of at least one yarn supply package retaining portion and at which all of the yarn supply packages become empty, based on the remaining time information regarding the all of the yarn supply packages attached to the at least one yarn supply package retaining portion.

[0030] By utilizing the information of the predicted raw yarn disappearance time point acquired by this aspect, advanced control regarding operations such as replacement of yarn supply packages or advanced facility operation management is realized. Performing the reset process properly is especially effective to achieve such management.

[0031] According to a fourteenth aspect of the invention, the yarn processing facility of the thirteenth aspect further includes: a first output unit capable of outputting information; and a first output controller configured to control the first output unit. In this yarn processing facility, at a replacement notification time point which is earlier than the predicted raw yarn disappearance time point by a predetermined time, the first output controller causes the first output unit to output information prompting an operator to replace one of the yarn supply packages in at least one yarn supply package retaining portion.

[0032] This aspect of the invention makes it possible to prompt the operator to perform yarn supply package replacement at a suitable timing. It is therefore possible to prevent shortage of yarn supply packages attached to at least one yarn supply package retaining portion. Performing the reset process properly is especially effective to achieve such management. The first output controller may be included in the information management unit or may be provided to be independent from the information management unit.

[0033] According to a fifteenth aspect of the invention, the yarn processing facility of any one of the first to fourteenth aspects further includes: a connection information acquisition unit capable of acquiring information regarding whether a terminal portion of a yarn which is included in a predetermined yarn supply package among the yarn supply packages is connected to a start end portion of a yarn which is included in a reserve yarn supply package among the yarn supply packages from which the yarn is to be unwound next to the predetermined yarn supply package; a second output unit capable of outputting information; and a second output controller configured to control the second output unit. In this yarn processing facility, when the remaining time regarding the predetermined yarn supply package decreases to be equal to or less than a predetermined limit time while the start end portion is not connected to the terminal portion, the second output controller causes the second output unit to output information requesting a connecting operation of connecting the start end portion to the terminal portion based on information acquired by the connection information acquisition unit.

[0034] This aspect of the invention makes it possible to prevent the operator, etc. from forgetting to perform the connection. Performing the reset process properly is especially effective to achieve such management. 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is a block diagram of an electric configuration of a yarn processing facility of the present embodiment.
FIG. 2 is a profile of a false-twist texturing machine.
FIG. 3 is a schematic diagram of the false-twist texturing machine, expanded along paths of yarns.
FIG. 4(a) and FIG. 4(b) are graphs each of which shows the relationship between a remaining amount of each yarn in a yarn supply package and time points. FIG. 4(c) is a graph showing the relationship between an amount of each yarn wound onto a winding bobbin and time points.
FIG. 5 is a flowchart showing processes of replacing the yarn supply package which is being used.
FIG. 6 is a block diagram of an electric configuration of a yarn processing facility of a modification.
FIG. 7 is a schematic diagram of a false-twist texturing machine of another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Outline of Yarn Processing Facility)

[0036] 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 block diagram of FIG. 1. As shown in FIG. 1, the yarn processing facility 100 includes false-twist texturing machines 1 (yarn processors of the present invention) and a management device 101. The false-twist texturing machines 1 are aligned along, e.g., a predetermined frame longitudinal direction (see FIG. 2,

etc.). Each false-twist texturing machine 1 is arranged to be able to perform false twisting of each yarn Y (see FIG. 2, etc.) made of synthetic fibers such as polyester and nylon (polyamide fibers). Each yarn Y is, e.g., a multi-filament yarn formed of filaments (not illustrated). As described below, each false-twist texturing machine 1 is configured to form a wound package Pw by processing each yarn Y supplied from a yarn supplying unit 2 with use of a processing unit 3 and winding each 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.

[0037] 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). A combination of the management device 101 and the machine controllers 5 is an information management unit 110 of the present embodiment. The information handled by the information management unit 110 will be detailed later.

(Overall Structure of False-Twist Texturing Machine)

[0038] The overall structure of the false-twist texturing machine 1 will be described with reference to FIG. 2 and FIG. 3. FIG. 2 is a profile of each false-twist texturing machine 1. FIG. 3 is a schematic diagram of the false-twist texturing machine 1, expanded along paths of yarns Y (i.e., yarn paths). A direction vertical to the sheet of FIG. 2 is defined as the above-described frame longitudinal direction, and a left-right direction in the sheet is defined as a frame width direction. The direction orthogonal to both the frame longitudinal direction and the frame width direction is defined as an up-down direction (vertical direction) in which the gravity acts. A direction in which each yarn Y runs is defined as a yarn running direction. The false-twist texturing machine 1 includes the yarn supplying unit 2 provided for supplying yarns Y, the processing unit 3 configured to perform processing (false twisting) of the yarns Y supplied from the supplying unit 2, the winding unit 4 configured to wind the yarns Y processed by the processing unit 3 onto winding bobbins Bw, and a corresponding machine controller 5.

[0039] The yarn supplying unit 2 includes a creel stand 6 retaining yarn supply packages Ps, and is configured to supply the yarns Y to the processing unit 3. The processing unit 3 is configured to unwind the yarns Y from the yarn supplying unit 2 and to process the yarns Y. In the processing unit 3, the following members are placed in this order from the upstream side 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 components of the processing unit 3 is provided for, e.g., each of later-described spindles 9 (see FIG. 3). The winding unit 4 includes a plurality of winding devices 19. Each winding device 19 is configured to wind a yarn Y for which the false twisting has been performed at the processing unit 3 onto a winding bobbin Bw and to form a wound package Pw. The winding unit 4 is provided with automatic doffers 10 which correspond to the respective winding devices 19 and which are configured to replace formed wound packages Pw with empty winding bobbins Bw.

[0040] The machine controller 5 is configured to control each component of the yarn supplying unit 2, processing unit 3, and winding unit 4. The machine controller 5 is, e.g., a typical computer device. The machine controller 5 includes a machine input unit 5a (operation unit of the present invention), a machine output unit 5b, and a machine storage unit 5c (see FIG. 1). The machine input unit 5a is, e.g., an unillustrated touch panel and/or keyboard, and is arranged to be operable by an operator. The machine output unit 5b includes, e.g., an unillustrated display, and is arranged to be able to output information. The machine storage unit 5c is arranged to store sets of information used for controlling each component of the yarn supplying unit 2, processing unit 3, and winding unit 4. Based on the sets of information, the machine controller 5 controls each component of the yarn supplying unit 2, processing unit 3, and winding unit 4. Alternatively, the machine controller 5 may indirectly control each component of the yarn supplying unit 2, processing unit 3, and winding unit 4 through unillustrated controllers (not illustrated) configured to control these components. 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.

[0041] 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 false twisting is simultaneously performable for the yarns Y running while being aligned in the frame longitudinal direction. 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 base longitudinal direction.

[0042] A group of components 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. 3), 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. The false-twist texturing machine 1 is able to false-twist the yarns Y at the spindles 9 to which the yarns Y are threaded. In other words, the false-twist texturing machine 1 needs to thread the yarns Y to one or more spindles 9 (i.e., yarn threading is required) in order to false-twist the yarns Y.

(Yarn Supplying Unit)

[0043] The structure of the yarn supplying unit 2 will be described with reference to FIG. 2 and FIG. 3. The creel stand 6 of the yarn supplying unit 2 includes yarn supply package retaining portions 20 (see FIG. 3) 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 (one attachment unit of the present invention), and the other of the units is termed as a second attachment unit 23 (another attachment unit of the present invention). 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 each yarn supply package Ps to and from a corresponding package attachment unit 21 are performed by, e.g., the operator.

[0044] 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. 3, a first yarn supply package PsA (one 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. A terminal portion of the yarn Y in the first yarn supply package PsA is tied (connected) to a start end portion of a 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 (i) the supply of the yarn Y from the first yarn supply package PsA ends and (ii) 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, unwinding of a yarn Y from one yarn supply package Ps attached to one of the package attachment units 21 ends. Subsequently, unwinding of a yarn Y from another yarn supply package Ps attached to another of the package attachment units 21 starts. The another of the package attachment units 21 is different from the one of the package attachment units 21. Hereinafter, for the sake of convenience, such a matter is referred to as 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, e.g., the operator.

[0045] On the downstream side in the yarn running direction of each yarn supply package retaining portion 20, a yarn detection sensor 24 (switching detector and unwinding detector of the present invention) 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. 3, 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, e.g., 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 may be, e.g., a contact sensor.

(Processing Unit)

[0046] The structure of the processing unit 3 will be described with reference to FIG. 2 and FIG. 3. The following will describe a part of the processing unit 3, which corresponds to one spindle 9.

[0047] Each first feed roller 11 is configured to unwind one yarn Y from one yarn supply package Ps attached to the yarn supplying unit 2, and to feed the yarn Y to one first heater 13. The first feed roller 11 is provided upstream of one twist-stopping guide 12 in the yarn running direction. The conveyance speed of conveying the yarn Y by the first feed roller 11 is substantially identical with an unwinding speed V (see FIG. 3) at which the yarn Y is unwound from the yarn supply package Ps. The information regarding the conveyance speed of conveying the yarn Y by the first feed roller 11 is preliminarily stored in, e.g., the machine controller 5.

[0048] Each twist-stopping guide 12 is provided to prevent twist of the yarn Y from being propagated to the upstream side of the twist-stopping guide 12 in the yarn running direction. The twist of the yarn Y is formed by one false-twisting device 15. The twist-stopping guide 12 is provided downstream of the first feed roller 11 and upstream of one first heater 13 in the yarn running direction.

[0049] Each first heater 13 is configured to heat the yarn Y fed from the first feed roller 11. The first heater 13 is provided downstream of the twist-stopping guide 12 and upstream of one 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 arranged to be able to simultaneously heat plural yarns Y.

[0050] Each cooler 14 is configured to cool one yarn Y heated by the first heater 13. The cooler 14 is provided downstream of the first heater 13 and upstream of one 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 arranged to be able to simultaneously cool plural yarns Y.

[0051] Each false-twisting device 15 is configured to twist one yarn Y. The false-twisting device 15 is, e.g., a so-called disc-friction false-twisting device, but the disclosure is not limited to this arrangement. The false-twisting device 15 is provided downstream of the cooler 14 and upstream of one second feed roller 16 in the yarn running direction.

[0052] Each second feed roller 16 is configured to feed the yarn Y processed at the false-twisting device 15 to one second heater 17. The conveyance speed of conveying the yarn Y by the second feed roller 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 11 and the second feed roller 16. The information regarding the conveyance speed of conveying the yarn Y by the second feed roller 16 is preliminarily stored in, e.g., the machine controller 5.

[0053] In the yarn running direction, for example, a quality detection unit 27 (see FIG. 2) for detecting information regarding the quality of the yarn Y is provided downstream of the false-twisting device 15 and upstream of the second feed roller 16. For example, the quality detection unit 27 may include a tension sensor which is arranged to be able to detect the tension of the yarn Y. The quality detection unit 27 is configured to transmit a detection result to the machine controller 5.

[0054] Each 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 arranged to be able to simultaneously heat plural yarns Y.

[0055] The third feed roller 18 is arranged to feed the yarn Y heated by the second heater 17 to one 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. The information regarding the conveyance speed of conveying the yarn Y by the third feed roller 18 is preliminarily stored in, e.g., the machine controller 5.

[0056] In the processing unit 3 arranged as described above, the yarn Y drawn between the first feed roller 11 and the second feed roller 16 is twisted by the false-twisting device 15. The twist formed by the false-twisting devices 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, one wound package Pw is formed.

(Winding Unit)

[0057] The structure of the winding unit 4 will be described with reference to FIG. 2 and FIG. 3. 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. 2) which are provided to correspond to the respective winding devices 19. One winding device 19 belongs to one spindle 9 (see FIG. 3). Each winding device 19 includes, e.g., 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 is arranged to be able to traverse the yarn Y by means of a traverse guide 35 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 to apply contact pressure to the surface of the wound package Pw. The winding roller 34 is, e.g., 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.

[0058] Each automatic doffer 10 is configured to detach the wound package Pw from the winding device 19 and to attach an empty winding bobbin Bw to the winding device 19. To put it differently, at the winding unit 4, the automatic doffer 10 is arranged to be able to replace a wound package Pw having been formed with an empty winding bobbin Bw. The automatic doffer 10 is provided with an 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, 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 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, e.g., the operator. For details of the structure of the automatic doffer 10, etc., for example, see Japanese Laid-Open Patent Publication No. H6-212521.

[0059] For example, an unillustrated yarn threading device is provided in the vicinity of the winding device 19. The yarn threading device is configured to thread the yarn Y onto the empty winding bobbin Bw attached to the winding device 19.

[0060] 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). Subsequently, the yarn threading device threads the yarn Y to the new winding bobbin Bw. Thereafter, it becomes possible to start winding of the yarn Y onto the new winding bobbin Bw.

[0061] In this regard, during the winding process, the machine controller 5 is configured to determine the quality of the yarn Y included in each yarn supply package Ps based on a detection result of the above-described quality detection unit 27 (see FIG. 2). When the quality of the yarn Y in one yarn supply package Ps does not have a predetermined reference quality (e.g., when dispersion of tension over time is large), the machine controller 5 causes the machine output unit 5b to output information indicating that the quality of this yarn supply package Ps is not enough. For example, as the operator performs a predetermined stop operation for the machine input unit 5a, the machine controller 5 stops the winding process at one spindle 9 during or at the end of formation of the wound package Pw at this spindle 9. To be more specific, after the yarn Y is cut by the cutter of the automatic doffer 10 included in this spindle 9, the machine controller 5 stops the operation of each unit included in this spindle 9. Alternatively, a cutter for cutting the yarn Y when the stop operation is performed may be provided to be independent from the cutter of the automatic doffer 10.

[0062] 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 an idea of providing a means for knowing (i) a remaining amount of the yarn Y (yarn remaining amount; hereinafter, this may be referred to as just the remaining amount) after a part of the yarn Y is unwound from the yarn supply package Ps and/or (ii) a time (remaining time; hereinafter, this may be referred to as just the remaining time) in which the yarn Y can be supplied from the yarn supply package Ps, at a desired timing. For example, as such information is known, a timing of running out of the yarn Y in the yarn supply package Ps from which the yarn Y is unwound can be estimated. In this regard, it is required to properly estimate the above-described timing even when the yarn supply package Ps from which the yarn Y is unwound is suddenly replaced by a new yarn supply package Ps because of, e.g., a yarn quality defect. In the present embodiment, the information management unit 110 is configured to perform information processing as described below, in order to solve a problem occurring when the yarn supply package Ps from which the yarn Y is unwound is suddenly replaced with a new yarn supply package Ps. In a specific example, the information management unit 110 acquires and manages sets of information regarding matters shown in graphs of FIG. 4(a) to FIG. 4(c). Unless otherwise stated, the following explanation deals with only a predetermined spindle 9.

(Specific Example of Matters)

[0063] Before specifically explaining the information acquired by the information management unit 110, matters shown in the graphs of FIG. 4(a) to FIG. 4(c) as examples and time points at which the respective matters occur will be described

first in order to assist the understanding of the explanation given later. The information management unit 110 is configured to acquire information of at least one of the matters shown in the graphs of FIG. 4(a) to FIG. 4(c).

(The details will be given later.)

[0064] FIG. 4(a) is a graph showing the relationship between a remaining amount (vertical axis) of the yarn Y in a yarn supply package Ps (to be more specific, the yarn supply package Ps1, Ps3) attached to the first attachment unit 22 and time points (horizontal axis). FIG. 4(b) is a graph showing the relationship between a remaining amount (vertical axis) of the yarn Y in a yarn supply package Ps (to be more specific, the yarn supply package Ps2, Ps4) attached to the second attachment unit 23 and time points (horizontal axis). FIG. 4(c) is a graph showing the relationship between a wound amount (vertical axis) of the yarn Y onto a winding bobbin Bw (to be more specific, the winding bobbin Bw1, Bw2, Bw3, Bw4, Bw5) and time points (horizontal axis). In all of the graphs of FIG. 4(a) to FIG. 4(c), a time point t0 at which winding of the yarn Y onto a winding bobbin Bw1 starts is the origin. In the present embodiment, the weight (initial weight; hereinafter, this may be referred to as just the 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.

[0065] To begin with, at a time point t0, a yarn supply package Ps1 has been attached to the first attachment unit 22. The weight of a remaining yarn Y in the yarn supply package Ps1 is W0 (which is smaller than the above-described initial weight WF). At the time point t0, for example, an empty yarn supplying bobbin Bs has been attached to the second attachment unit 23.

[0066] At the time point t0 (time point ts1), attachment of the winding bobbin Bw1 to the cradle 33 by the automatic doffer 10 is completed and winding of the yarn onto the winding bobbin Bw1 starts. Therefore, the time point ts1 is a winding start time point 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.

[0067] At a time point tb1 that is later than the time point t0, the operator detaches the empty yarn supplying bobbin Bs from the second attachment unit 23 and attaches a new yarn supply package Ps2 to the second attachment unit 23. Thereafter, at a suitable timing, a terminal portion of the yarn Y in the yarn supply package Ps1 is tied with (connected to) a start end portion of a yarn Y in the yarn supply package Ps2 by the operator so that a node K (see FIG. 3) is formed. The operator may manually perform a tying operation (connecting operation). Alternatively, for example, the operator may perform the tying operation by operating an unillustrated portable tying device.

[0068] The remaining amount (remaining weight) of the yarn Y 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 point 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 point te1 is a winding end time point 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 time 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 point ts2 immediately after the time point te1, the attachment of a winding bobbin Bw2 to the cradle 33 by the automatic doffer 10 is completed and 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. 4) between the winding end time point (time point te1) of the winding bobbin Bw1 and the winding start time point (time point ts2) of the winding bobbin Bw2 onto which the yarn Y is wound next to the winding bobbin Bw1.

[0069] At a time point ta1 that is later than the time point ts2, the yarn supply package Ps1 attached to the first attachment unit 22 becomes empty. Therefore, the time point ta1 is an unwinding end time point 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 point tb2 (=time point ta1), the 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 side. 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 point tb2 is an unwinding start time point at which 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 point 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 time 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 point ts3, the winding process of winding the yarn Y onto a winding bobbin Bw3 starts. When at a time point 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.

[0070] At a time which is later the time point ta1 and is before the yarn supply package Ps2 becomes empty (e.g., at

the time point ta2), the operator detaches the empty yarn supply package Ps1 from the first attachment unit 22 and attaches 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 time is WF. Thereafter, at a suitable timing, a terminal portion of the yarn Y in the yarn supply package Ps2 is tied with a start end portion of a yarn Y in the yarn supply package Ps3 and a node K is formed.

[0071] At this time, for example, when the machine controller 5 determines that the quality of the yarn supply package Ps2 is not enough during the formation of the wound package Pw3, the machine output unit 5b outputs information indicating that the quality of the yarn supply package Ps2 is not enough. As the operator performs the stop operation for the machine input unit 5a based on the output of the machine output unit 5b, the winding process is stopped. At this time, for example, the winding process is stopped at the end of the formation of the wound package Pw3 (i.e., at the time point te3).

[0072] At a time point tb3 (substantially at the same time as the time point te3) after the winding process is stopped, the operator detaches the yarn supply package Ps2 from the second attachment unit 23 and attaches a new yarn supply package Ps4 to the second attachment unit 23. As such, a process of replacing one yarn supply package Ps which does not become empty yet with another yarn supply package Ps is referred to as "sudden replacement" for the sake of convenience. The remaining weight of the yarn supply package Ps4 at this time is WF. As such sudden replacement is performed, the remaining weight of each yarn supply package Ps attached to the second attachment unit 23 changes to WF from W3 at the time point tb3. Thereafter, for example, a terminal portion of a yarn Y in the yarn supply package Ps4 is tied with a start end portion of the yarn Y in the yarn supply package Ps3 and a node K is formed. In this case, the yarn Y is uninterruptedly supplied from the second attachment unit 23.

[0073] Thereafter, yarn threading is performed at the predetermined spindle 9. For example, the yarn Y is threaded to the yarn supplying unit 2, the processing unit 3, and the winding unit 4 in this order. When the yarn threading is performed for the winding unit 4, the yarn Y is sucked and retained by the suction of the automatic doffer 10 while being unwound from the yarn supply package Ps (e.g., yarn supply package Ps4) before the yarn Y is threaded to the next winding bobbin Bw (winding bobbin Bw4). In other words, before the winding process is restarted, unwinding of the yarn Y from the yarn supply package Ps4 starts at, e.g., a time point tb4. Thereafter, an unillustrated yarn threading device finishes the yarn threading to the winding bobbin Bw4 at a time point ts4, and the winding process is restarted. The difference between the time point ts4 and the time point tb4 is, e.g., tL1.

[0074] Thereafter, the yarn Y is wound onto the winding bobbin Bw4 from the time point ts4 to a time point te4 (i.e., a wound package Pw4 is formed). Furthermore, the yarn Y is wound onto a winding bobbin Bw5 from a time point ts5 to a time point te5 (i.e., a wound package Pw5 is formed).

(Outline of Basic Information Acquired by Information Management Unit)

[0075] 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, for example, the information management unit 110 is configured to acquire initial amount information, unwinding unit amount information, and cumulative time information of each yarn supply package Ps. The initial amount information, the unwinding unit amount information, and the cumulative time information are used for acquiring information regarding a remaining amount and/or remaining time (detailed later) used for performing various managements regarding the yarn processing facility 100. The information management unit 110 may be configured to further acquire sets of information (information regarding a start time point and end time point of the winding process, etc.) regarding each wound package Pw. However, the details of acquisition of these sets of information are omitted.

[0076] 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 unwinding of the yarn Y starts. For example, the initial amount information is preliminarily stored in the machine controller 5 as information shared between all yarn supply packages Ps of each spindle 9 in one false-twist texturing machine 1. To be more specific, in the present embodiment, information regarding the above-described initial weight WF and information regarding the fineness (weight per unit length) of the yarn Y are stored in the machine controller 5 as the initial amount information. The unit of the weight of the yarn supply package Ps is kilogram, for example. The fineness of the yarn Y is F. The unit of the fineness is dtex (decitex), for example. Decitex indicates the weight (gram) of a yarn Y per 10000 meters. A value of the initial weight WF is equivalent to a common initial value of the present invention.

[0077] The unwinding unit amount information is information regarding an amount of the yarn Y unwound from the yarn supply package Ps per unit time. The unwinding unit amount information is, e.g., information regarding the above-described unwinding speed V. For the sake of convenience, the unwinding speed V during the winding process is assumed to be substantially constant in the present embodiment. The unit of an unwinding speed is m/min, for example. For example, the unwinding unit amount information is preliminarily stored in the machine controller 5 as information shared between all spindles 9 in one false-twist texturing machine 1. For example, the machine controller 5 acquires

information of the unwinding speed V based on information of the rotation number of the first feed roller 11.

[0078] The cumulative time information is information regarding the total time (cumulative time: hereinafter, this may be referred to as just the cumulative time) of unwinding of the yarn Y from the yarn supply package Ps. For the sake of convenience, a cumulative time regarding the yarn supply package Ps attached to the first attachment unit 22 is referred to as a tin1. Furthermore, a cumulative time regarding the yarn supply package Ps attached to the second attachment unit 23 is referred to as a tin2. The machine controller 5 updates the tin1 when the yarn Y is unwound from the yarn supply package Ps (e.g., yarn supply package Ps1) attached to the first attachment unit 22. Meanwhile, the machine controller 5 updates the tin2 when the yarn Y is unwound from the yarn supply package Ps (e.g., yarn supply package Ps2) attached to the second attachment unit 23. For example, the cumulative time information regarding the yarn supply package Ps2 attached to the second attachment unit 23 is acquired as described below. 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 during the winding process. For example, in FIG. 4(a) and FIG. 4(b), a matter that (i) the yarn supply package Ps1 becomes empty and (ii) 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 the first detection unit 25 to (ii) a state of detecting the yarn Y by the second detection unit 26. When determining that the yarn supply package switching has occurred, the machine controller 5 resets the tin2 to a predetermined initial time (reset process). The predetermined initial time is, e.g., 0. Information of a time point (time point tb2) at which the yarn supply package switching has occurred may be acquired and stored by the machine controller 5 as unwinding start time point information regarding the unwinding start time point at which the unwinding of the yarn Y from the yarn supply package Ps2 starts.

[0079] Thereafter, the machine controller 5 increases the tin2 (updates the tin2) over time during the unwinding of the yarn Y from the yarn supply package Ps2. For example, when the yarn Y is detected by the second detection unit 26 and is sent to the downstream side in the yarn running direction by the first feed roller 11, the machine controller 5 updates the tin2. At this time, because the yarn Y is not detected by the first detection unit 25, the tin1 is not updated. For example, when the unwinding of the yarn Y from the yarn supply package Ps2 is stopped for any reason, the machine controller 5 stops updating of the tin2. In this way, the machine controller 5 acquires, as the cumulative time (tin2) regarding the second attachment unit 23, the time (detection time) in which the unwinding of the yarn Y from the yarn supply package Ps2 after the yarn supply package switching is detected by the second detection unit 26. The machine controller 5 is able to acquire the cumulative time information regarding one of yarn supply packages Ps including the yarn supply package Ps2 when the yarn Y is unwound from the one of the yarn supply packages Ps.

[0080] As described above, the information management unit 110 is configured to acquire the initial amount information, the unwinding unit amount information, and the cumulative time information as the basic information.

(Information Regarding Replacement of Yarn Supply Package and Node)

[0081] As the explanation regarding the above-described yarn supply package switching, the following will describe information acquired by the information management unit 110 when one empty yarn supply package Ps is replaced with a new yarn supply package Ps during the winding process. When the yarn supply package Ps attached to one package attachment unit 21 is empty, the operator detaches the empty yarn supply package Ps from the one package attachment unit 21 and attaches a new yarn supply package Ps to the one package attachment unit 21. At this time, the operator associates (inputs attachment information) individual information of the new yarn supply package Ps with individual information of the one package attachment unit 21. Thereafter, the operator connects a start end portion of the yarn Y included in the new yarn supply package Ps to a terminal portion of the yarn Y included in a yarn supply package Ps attached to the other package attachment unit 21, so that a node K is formed. The operator then provides the node K at a predetermined position. Subsequently, the operator inputs, into the machine controller 5, information (this information will be referred to as position information for the sake of convenience) indicating that the node K has been provided at the predetermined position. When such an input is made, the machine controller 5 stores the position information. After that, when the yarn supply package switching has occurred, the machine controller 5 performs the above-described reset process and stores information (this information will be referred to as movement information for the sake of convenience) indicating that the node K has been moved from the predetermined position.

(Remaining Amount Information and Remaining Time Information)

[0082] 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 cumulative time information). The information management unit 110 is configured to acquire at least one of remaining amount information and remaining time information by means of a calculation using the initial amount information, the unwinding unit amount information,

and the cumulative time information.

[0083] In the present specification, the remaining amount indicates the remaining amount of a yarn Y in each yarn supply package Ps attached to each package attachment unit 21 at a given reference time point. In the present specification, the remaining time indicates the length of time during which a yarn Y can be unwound from each yarn supply package Ps attached to each package attachment unit 21 at the given reference time point. A timing of end of unwinding of the yarn Y from each yarn supply package Ps can be estimated by using at least one of these sets of information.

[0084] 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 point. For example, the current time point at which the remaining amount information is acquired is dealt with as a reference time point. When the current time point is the time point t1 (see FIG. 4(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. Furthermore, the information management unit 110 acquires information of the initial weight WF, information of the fineness (the above-described F), information of the unwinding speed V, and information of the cumulative time regarding the yarn supply package Ps2. At the time point t1, the cumulative time (tin2) regarding the yarn supply package Ps2 is equal to the difference between the time point t1 and the time point tb2.

[0085] When the remaining amount (remaining weight) of the yarn supply package Ps2 at the time point t1 is Wr1 (see FIG. 4(b)), the remaining weight Wr1 is calculated based on an equation below. A is a coefficient by which the unit of a result of a calculation is converted to kilogram.

$$Wr1 = WF - A \times V \times F \times tin2$$

[0086] 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. In this way, by using the initial amount information, the unwinding unit amount information, and the cumulative time information, the information management unit 110 acquires information (remaining amount information) of the remaining weight of the yarn supply package Ps2 at the time point t1 (reference time point). Furthermore, the information management unit 110 may calculate the remaining amount regarding a yarn supply package Ps (yarn supply package Ps1) attached to the other package attachment unit 21 (first attachment unit 22), too. At the time point t1, an empty yarn supply package Ps1 is still attached to the first attachment unit 22. At the time point t1, because the above-described tin1 is not updated, the calculated remaining amount regarding the yarn supply package Ps1 is substantially zero at the time point t1.

[0087] For example, when the current time point is the time point t2 (see FIG. 4(b)), the remaining weight Wr2 of the yarn supply package Ps2 at the time point t2 can also be calculated in a similar manner.

[0088] The unit of the remaining amount may not be weight. For example, information of the length of the yarn Y remaining in the yarn supply package Ps may be acquired as the remaining amount information. 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.

[0089] 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 point t1 is tr1, information (remaining time information) of the remaining time tr1 is calculatable by an equation below with the use of information of the remaining weight Wr1.

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

[0090] Alternatively, tr1 may be calculated by an equation below without using Wr1.

$$tr1 = (WF - A \times V \times F \times tin2) / (A \times V \times F)$$

[0091] The remaining time in which the yarn Y can be supplied from the yarn supply package Ps1 is substantially zero at the time point t1. This is because the remaining amount in the yarn supply package Ps1 is substantially zero at the time point t1, as described above.

[0092] Furthermore, for example, when the remaining time regarding the yarn supply package Ps2 at the time point

t2 is tr2 (see FIG. 4(b)), the remaining time tr2 is calculatable based on the remaining weight Wr2 in a similar manner.

[0093] The information management unit 110 is able to estimate, by using the remaining time information, a time point (predicted unwinding end time point) at which unwinding of the yarn Y from a yarn supply package Ps from which the yarn Y is being unwound at the reference time point ends. For example, at the time point t1, the yarn Y is being unwound from the yarn supply package Ps2. The information management unit 110 may acquire information of a time point acquired by adding the remaining time tr1 to the time point t1, as information of the predicted unwinding end time point at which the unwinding of the yarn Y from the yarn supply package Ps2 ends.

[0094] In this way, at a desired time point, at least one of the remaining amount information and remaining time information regarding each yarn supply package retaining portion 20 is acquired. When the above-described reset process is performed, each of the remaining amount and the remaining time regarding the yarn supply package Ps in which unwinding of the yarn Y starts is reset to a value when the cumulative time is zero (i.e., initial value). For example, a timing of end of unwinding of the yarn Y from the yarn supply package Ps can be estimated based on information acquired by such a process.

(Processes Executed When Sudden Replacement is Performed)

[0095] The following will describe steps of a process performed when the above-described sudden replacement (as a specific example, replacement of the yarn supply package Ps2 with the yarn supply package Ps4) is performed, with reference to a flowchart of FIG. 5.

[0096] To begin with, for example, when the machine output unit 5b outputs information indicating that the quality of a yarn supply package Ps2 is not enough during the winding process, an operator performs the output operation for the machine input unit 5a in order to stop the winding process at one spindle 9 corresponding to this yarn supply package Ps2. The machine controller 5 determines whether the output operation has been performed (S101). In this regard, the winding process is being executed until the stop operation is performed (NO in S101). When the stop operation has been performed by the operator (YES in S101), the machine controller 5 stops the winding process by controlling each component of the spindle 9 (S102). Subsequently, the operator replaces the yarn supply package Ps2 in which unwinding of a yarn Y has started and has not ended yet with a new yarn supply package Ps4 (S103; sudden replacement). In the sudden replacement, when a terminal portion of the yarn Y in the yarn supply package Ps2 is tied with a start end portion of a yarn Y in a yarn supply package Ps3, the operator cuts the yarn Y in the vicinity of a node K with use of, e.g., an unillustrated cutter and removes the node K.

[0097] Subsequently, the operator inputs the attachment information regarding the yarn supply package Ps4 into the machine input unit 5a and performs a predetermined reset operation to indicate that the sudden replacement has been performed, for the machine input unit 5a (S104). The reset operation may be, e.g., an input of a predetermined command or an operation of selecting a predetermined button displayed on a display. Alternatively, a button (not illustrated) dedicated to the reset operation may be provided. When the reset operation has been performed, the machine controller 5 generates (acquires) sudden replacement information indicating the execution of the sudden replacement. The machine controller 5 resets the tin2 to be a predetermined initial time (e.g., zero) in accordance with the sudden replacement information. Because of this, each of the remaining amount and remaining time regarding the second attachment unit 23 is reset to a value when the tin2 is zero (i.e., initial value). In this way, the same steps as in the above-described reset process are performed by the reset operation (S105). With this arrangement, the remaining amount information and the remaining time information can be properly acquired even when the sudden replacement is performed.

[0098] Subsequently, the operator ties a terminal portion of a yarn Y in the yarn supply package Ps4 with a start end portion of the yarn Y in the yarn supply package Ps3 so as to form a node K (tying process; S106). The operator then provides the node K at a predetermined position. The operator then inputs the above-described position information into the machine controller 5. The machine controller 5 stores the above-described position information when such an input is made.

[0099] Subsequently, the operator pulls the yarn Y in the yarn supply package Ps4 out from the yarn supply package Ps4 and performs the yarn threading (S107). As described above, before the winding process is restarted, unwinding of the yarn Y from the yarn supply package Ps4 starts at, e.g., the time point tb4. Typically, an unwinding speed of the yarn Y before the restart of the winding process is lower than the unwinding speed V of the yarn Y at the time of the winding process. While, e.g., the first feed roller 11 is in operation, the machine controller 5 determines that the unwinding of the yarn Y starts when the yarn Y is detected by the second detection unit 26 (the above-described time point tb4). The machine controller 5 starts updating the cumulative time (i.e., detection time) at the time point tb4. In other words, part of the time (yarn threading time) in which the yarn threading is performed is included in the detection time. The machine controller 5 may acquire information of the time point tb4 as the unwinding start time point information regarding the yarn supply package Ps4. After that, the yarn threading to the winding bobbin Bw4 is completed and the winding process is restarted (S108) As such, the processes from the execution of the stop operation to the restart of the winding process are executed.

[0100] As described above, the reset process is performed when the information management unit 110 acquires the sudden replacement information. This suppresses a calculated result/calculated results of the remaining amount and/or the remaining time from being different from an actual value/values. It is therefore possible to solve a problem occurring when one yarn supply package Ps from which the yarn Y is unwound is suddenly replaced with a new yarn supply package Ps.

[0101] As a normal operation, when a yarn supply package Ps retained by one yarn supply package retaining portion 20 becomes empty, unwinding of the yarn Y from the next yarn supply package Ps starts. At this time, the yarn supply package switching is detected, and the reset process is performed. In this regard, the reset process is similarly performed when the information management unit 110 acquires the sudden replacement information. It is therefore possible to effectively suppress a calculated result/calculated results of the remaining amount and/or the remaining time from being different from an actual value/actual values while suppressing a program from being complex.

[0102] When the initial amount information, the unwinding unit amount information, and the cumulative time information are acquired, the remaining amount information and/or the remaining time information can be easily acquired at a desired time point by performing a calculation using the initial amount information, the unwinding unit amount information, and the cumulative time information. In the present embodiment, when the sudden replacement information is acquired, the cumulative time information is reset so as to indicate the initial time. It is therefore possible to easily suppress a calculated result/calculated results of the remaining amount information and/or the remaining time information from being different from an actual value/actual values while at least one of the remaining amount information and the remaining time information is easily acquired.

[0103] Typically, because information of the initial weight of the yarn supply package Ps can be easily acquired in advance, such information is easily dealt with as the initial amount information. Similarly, because information of the unwinding speed V can be easily acquired in advance, such information is easily dealt with as the unwinding unit amount information. However, while the initial weight has a dimension of mass, the unwinding speed V has a dimension of length. In this case, calculations regarding the remaining amount information and/or the remaining time information cannot be performed based only on the initial weight, an unwinding speed, and the cumulative 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 also acquired as the initial amount information. This makes it easy to unify the units in calculations of the remaining amount information and/or the remaining time information.

[0104] At least part of the yarn threading time is included in the detection time. For example, the yarn threading time may be excluded from the detection time. In this case, however, a process performed by the information management unit 110 may be complex because information regarding completion of the yarn threading is required. In the present embodiment, the remaining amount information and/or the remaining time information can be acquired by a relatively easy process.

[0105] Typically, the yarn threading time is much shorter than a time in which the wound package Pw is formed. Therefore, even when an unwinding speed during the yarn threading is lower than an unwinding speed during the formation of the wound package, an error of at least one of the remaining amount information and the remaining time information is sufficiently small. When the yarn threading time is excluded from the detection time, a calculation result/calculation results of the remaining amount information and/or the remaining time information may be larger than an actual value/actual values. When at least one of the calculation results is larger than at least one of the actual values, an actual timing of running out of the yarn Y is disadvantageously sooner than an estimated timing of running out of the yarn Y in the yarn supply package Ps. To avoid such a problem, part of the yarn threading time is preferably included in the detection time.

[0106] The information management unit 110 is arranged to be able to acquire the common initial value regarding yarn supply packages Ps. On the premise that the amount of the yarn Y included in each yarn supply package Ps is substantially the same between all yarn supply packages Ps, it is therefore possible to perform the reset process by using a simple program as compared to a case where the yarn supply packages Ps have different initial values regarding the amount of the yarn Y.

[0107] The common initial value is set as a common value regarding the yarn supply package retaining portions 20. Therefore, even when the yarn supply package retaining portions 20 are provided, the reset process is performed with a simple program.

[0108] The machine controller 5 generates the sudden replacement information when the predetermined reset operation is performed for the machine input unit 5a. It is therefore possible to manually perform the reset process when the operator replaces the yarn supply package Ps at each yarn supply package retaining portion 20.

[0109] 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, the cumulative time is reset to zero as the initial time in the reset process. However,

the disclosure is not limited to this. A value of the initial time may be a number different from zero. For example, when the accuracy of estimation is increased by setting the initial time to be a predetermined value different from zero, a value of the cumulative time may be reset to such a predetermined value in the reset process.

(2) In the embodiment above, the machine controller 5 stores a value of the initial weight WF as the common initial value of the present invention. However, the disclosure is not limited to this. In addition to or instead of the initial weight WF, the machine controller 5 may store an initial value of the remaining time as the common initial value. The initial value of the remaining time may be input into the machine controller 5 by, e.g., the operator. The remaining time and/or the remaining amount at a reference time point may be calculated based on the initial value of the remaining time.

(3) In the embodiment above, at least one of the remaining amount information and the remaining time information is acquired by using the initial amount information, the unwinding unit amount information, and the cumulative time information. However, the disclosure is not limited to this. The remaining amount information and/or the remaining time information may be calculated by using the unwinding start time point information, instead of the cumulative time information. For example, when a value of the above-described remaining weight Wr1 of the yarn supply package Ps2 is calculated at the time point t1 (reference time point), Wr1 may be calculated by using the unwinding start time point (time point tb2) based on an equation below. Also in this arrangement, a calculation result/calculation results of the remaining amount information and/or the remaining time information is easily suppressed from being different from an actual value/actual values while at least one of the remaining amount information and the remaining time information is easily acquired. For simplifying the explanation, the equation below assumes that the yarn Y is uninterruptedly unwound from the unwinding start time point to the reference time point.

$$Wr1 = WF - A \times V \times F \times (t1 - tb2)$$

[0110] A value of the remaining time tr1 may be calculated based on an equation below.

$$tr1 = [WF - \{A \times V \times F \times (t1 - tb2)\}] / (A \times V \times F)$$

[0111] In this case, when the reset process is performed, the information management unit 110 deals with, based on a detection result of the yarn detection sensor 24, a time point at which unwinding of the yarn Y from a new yarn supply package Ps4 starts as the unwinding start time point regarding the new yarn supply package Ps. In this regard, when the unwinding of the yarn Y is temporarily stopped for any reason, how long the unwinding of the yarn Y is temporarily stopped (stop time) is required to be taken into consideration. Therefore, to be more specific, a variable indicating the stop time may be included in the equation above.

[0112] (4) The tying process (see S106 in FIG. 5) performed after the sudden replacement may not be necessarily performed between the reset operation and the yarn threading. The tying process may be performed, e.g., before the reset operation. Alternatively, the tying process may be performed during the yarn threading or after the restart of the winding process.

[0113] In this regard, when the sudden replacement is performed or when an empty yarn supplying bobbin Bs is replaced with a new yarn supply package Ps, the new yarn supply package Ps may be left (i.e., tying oversight may occur) without performing the tying process by the operator. Therefore, the information management unit 110 may determine the tying oversight as described below. The information management unit 110 determines whether a node K is formed in one spindle 9 during the winding process at the spindle 9. For example, after the yarn supply package switching has been performed latest at the spindle 9 (after the above-described movement information is stored), the information management unit 110 may perform this determination based on whether the above-described position information regarding the spindle 9 is stored. When it has been determined the node K is not formed in the spindle 9, the information management unit 110 further determines whether the remaining time regarding the yarn supply package Ps from which the yarn Y is unwound decreases to be equal to or less than a predetermined limit time at the spindle 9. When the information management unit 110 has determined that the remaining time is not longer than the limit 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 has been determined that a node K is formed in the spindle 9 or when it has been determined that the remaining time is longer than the limit time, the control for the machine output unit 5b is not performed. In this case, the new yarn supply package Ps is equivalent to a reserve yarn supply package of the present invention. Furthermore, the yarn supply package Ps from which the yarn Y is unwound is equivalent to a predetermined yarn supply package of the present invention. Furthermore, the information management

unit 110 is equivalent to a connection information acquisition unit of the present invention. Furthermore, the machine controller 5 is equivalent to a second output controller of the present invention. Furthermore, the machine output unit 5b is equivalent to a second output unit of the present invention. Alternatively, instead of the machine output unit 5b, the management output unit 101b of the management device 101 may output the information as described above. 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.

[0114] (5) In the embodiment above, one yarn supply package Ps (e.g., yarn supply package Ps2) used immediately before the sudden replacement and another yarn supply package Ps (e.g., yarn supply package Ps4) used immediately after the sudden replacement are attached to the same package attachment unit 21 and are uninterruptedly used. However, the disclosure is not limited to this. That is, the one yarn supply package Ps used immediately before the sudden replacement and the another yarn supply package Ps used immediately after the sudden replacement may be attached to different package attachment units 21 and the yarn Y may be unwound from these yarn supply packages Ps. For example, the yarn threading may be performed so that the yarn Y is unwound from the yarn supply package Ps3 attached to the first attachment unit 22 after (i) the yarn supply package Ps2 is detached from the second attachment unit 23 and (ii) the yarn supply package Ps4 is attached to the second attachment unit 23. In this case, when the reset process (S105) is executed, the cumulative time regarding the yarn supply package Ps4 attached to the second attachment unit 23 is reset to the initial time. However, when the start of the unwinding is detected (S107), the yarn supply package switching from the second attachment unit 23 to the first attachment unit 22 is detected and the reset process (reset process performed in the normal winding process subsequent to the sudden replacement) regarding the yarn supply package Ps3 attached to the first attachment unit 22 is performed. Therefore, even when (i) the one yarn supply package Ps used immediately before the sudden replacement and the another yarn supply package Ps used immediately after the sudden replacement are attached to the different package attachment units 21 and (ii) the yarn Y is unwound from these yarn supply packages Ps, the reset process is properly performed. As such, when unwinding of the yarn Y from the yarn supply package Ps3 starts after the sudden replacement, the reset operation of the step S104 may not be necessarily performed. The following will describe the reason. In this case, a terminal portion of the yarn Y in the yarn supply package Ps3 is tied with a start end portion of a yarn Y in the yarn supply package Ps4. Because of this, after the unwinding of the yarn Y from the yarn supply package Ps3 ends, unwinding of the yarn Y starts from the yarn supply package Ps4 starts (i.e., the yarn supply package switching occurs). At this time, the reset process is performed for the yarn supply package Ps4. Therefore, even if the reset operation is not performed in this case, no problem occurs in calculations of the remaining amount and/or remaining time regarding each yarn supply package Ps from which the yarn Y is unwound.

[0115] (6) In the embodiment above, at least the cumulative time (and/or the unwinding start time point) regarding one of the package attachment units 21 is calculatable at a reference time point. In this regard, one yarn supply package Ps from which the yarn Y is unwound is attached to the one of the package attachment units 21. Furthermore, by calculating the cumulative time (and/or the unwinding start time point) regarding the other of the package attachment units 21 at the same time as that regarding the one of the package attachment units 21, the remaining time may be calculated in regard to the two package attachment units 21 at the same time. To achieve this, the information management unit 110 may perform the following process. For example, when the operator performs the reset operation, the information management unit 110 may reset the cumulative time regarding each of the two package attachment units 21 to an initial time (e.g., zero). When the yarn supply package replacement is performed in the normal winding process, the information management unit 110 may perform the following process. For example, when the above-described attachment information is input in the machine input unit 5a, the information management unit 110 may reset the cumulative time regarding one package attachment unit 21 for which the yarn supply package replacement has been performed to an initial time. By doing this, the remaining time may be calculated in regard to each of the two package attachment units 21. In this case, the information management unit 110 may estimate a time point (predicted raw yarn disappearance time point) at which all yarn supply packages Ps retained by the yarn supply package retaining portion 20 at one spindle 9 become empty. The predicted raw yarn disappearance time point is calculated by adding the remaining time regarding the two package attachment units 21 to a reference time point, regardless of whether a node K is formed. By utilizing the information of the predicted raw yarn disappearance time point, further advanced control regarding operations such as replacement of the yarn supply packages Ps or advanced facility operation management is realized. Performing the reset process properly is especially effective to achieve such management.

[0116] For example, when the information management unit 110 acquires the predicted raw yarn disappearance time point as described above, the machine controller 5 may cause the machine output unit 5b to make an output for prompting the operator to replace the yarn supply package Ps at an appropriate timing. For example, the machine controller 5 may determine whether a replacement notification time point has come. The replacement notification time point is before the predicted raw yarn disappearance time point regarding the yarn supply package retaining portion 20 at one spindle 9, by a predetermined time. When the replacement notification time point has come, the machine controller 5 may cause the machine output unit 5b to output information indicating that the one spindle 9 requires the replacement of the yarn

supply package Ps. The proper execution of the reset process is especially effective to achieve such management. In this case, the machine controller 5 is equivalent to a first output controller of the present invention, and the machine output unit 5b is equivalent to a first output unit of the present invention. Alternatively, the above-described 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 second output unit of the present invention may be identical with each other or different from each other. The first output controller and second output controller of the present invention may be identical with each other or different from each other. The first output controller and 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.

[0117] (7) In the embodiment above, the cumulative time (tin1) regarding the first attachment unit 22 and the cumulative time (tin2) regarding the second attachment unit 23 are calculated independently from each other. However, the disclosure is not limited to this. For example, the information management unit 110 may be arranged to be able to calculate only the cumulative time (e.g., tin) regarding one yarn supply package Ps from which the yarn Y is unwound at a reference time point. Even when only such tin is calculated, the above-described predicted raw yarn disappearance time point is calculatable as described below. Among the two package attachment units 21, the remaining time regarding one package attachment unit 21 to which the one yarn supply package Ps from which the yarn Y is unwound is attached is calculatable by using this cumulative time. In this regard, when a new yarn supply package Ps is attached to the other of the two package attachment units 21, the remaining time regarding the other package attachment unit 21 can be acquired as a constant. When the new yarn supply package Ps is not attached to the other package attachment unit 21, the remaining time regarding the other package attachment unit 21 can be acquired as zero. The predicted raw yarn disappearance time point is calculated by adding the remaining time of the one package attachment unit 21 to the remaining time of the other package attachment unit 21.

[0118] (8) In the embodiment above, the machine controller 5 uses the cumulative time information or the unwinding start time point in order to acquire the remaining amount information and/or the remaining time information. However, the disclosure is not limited to this. As described below, the machine controller 5 may acquire the remaining amount information and/or the remaining time information in regard to one yarn supply package Ps from which the yarn Y is unwound, without utilizing the cumulative time information or the unwinding start time point. For example, when the remaining amount information is acquired, as the reset process, the machine controller 5 stores the initial weight WF of one yarn supply package Ps in which the unwinding of the yarn Y starts as the remaining amount. In this case, a value of WF is identical to an initial value of the present invention. After that, each time a predetermined unit time (e.g., dt) elapses, the machine controller 5 subtracts a predetermined unit amount acquired by utilizing the unwinding unit amount information from the remaining amount. This predetermined unit amount is acquired by multiplying the above-described A, V, F, and dt by one another. In this way, each time the predetermined unit time elapses, a value of the remaining amount is updated. When the remaining time information is acquired, as the reset process, the machine controller 5 stores, as the remaining time, the initial value (initial remaining time) of the remaining time in which the yarn Y can be supplied from one yarn supply package Ps in which the unwinding of the yarn Y starts. For example, a value of the initial remaining time is calculatable by dividing the initial weight WF by the above-described A, V, and F. After that, each time the predetermined unit time elapses, the machine controller 5 subtracts the predetermined unit time from the remaining time. Because of this, each time the predetermined unit time elapses, a value of the remaining time is updated. As such, at least one of the remaining amount information and the remaining time information may be acquired by a simple method. In this modification, the machine controller 5 may acquire the remaining amount information and/or the remaining time information in regard to both the first attachment unit 22 and the second attachment unit 23. Alternatively, the machine controller 5 may acquire the remaining amount information and/or the remaining time information in regard to only one yarn supply package Ps from which the yarn Y is unwound at a reference time point. In this modification, the machine controller 5 may not necessarily acquire the cumulative time information and the unwinding start time point.

[0119] (9) The information management unit 110 may be arranged to be able to store the individual information of one yarn supply package Ps and information of the unwinding start time point regarding the one yarn supply package Ps in association with each other. When the yarn supply package switching occurs, the information management unit 110 may store (i) the individual information of one yarn supply package Ps from which the yarn Y is unwound until immediately before the occurrence of the yarn supply package switching and (ii) information of an occurrence time point of the yarn supply package switching in association with each other. The occurrence time point may be dealt with as the unwinding end time point at which the unwinding of the yarn Y from the one yarn supply package Ps ends. Furthermore, the information management unit 110 may be arranged to be able to store (i) the individual information of one yarn supply package Ps detached from a corresponding package attachment unit 21 and (ii) information of a time point at which the sudden replacement is performed in association with each other, when the sudden replacement occurs. The time point at which the sudden replacement is performed may be dealt with as the unwinding end time point at which the unwinding of the yarn Y from the one yarn supply package Ps detached from the corresponding package attachment unit 21 ends.

[0120] (10) In the embodiment above, the information management unit 110 acquires information of the initial weight of the yarn Y in each yarn supply package Ps as the initial amount information. However, the disclosure is not limited to this. For example, the information management unit 110 may acquire information of the initial length of the yarn Y in the yarn supply package Ps as the 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.

[0121] (11) In the embodiment above, the initial amount information is stored in the information management unit 110 as a common value between all spindles 9 of the false-twist texturing machine 1. However, the disclosure is not limited to this. For example, the spindles 9 may be grouped into plural groups. The information management unit 110 may be arranged so that initial amount information is set for each of these groups.

[0122] Alternatively, the information management unit 110 may be arranged so that the initial amount information is settable for each spindle 9. In this case, the information management unit 110 may be further arranged to be able to acquire the initial amount information (or information of an initial value of the remaining time) corresponding to each of the yarn supply packages Ps. To be more specific, each time a new yarn supply package Ps is attached to one yarn supply package retaining portion 20, the information management unit 110 may be able to acquire the initial amount information, etc. regarding the new yarn supply package Ps. In this case, among the spindles 9, even when the initial amount of the yarn Y included in each yarn supply package Ps is different between the yarn supply packages Ps, the reset process can be properly performed. Furthermore, the reset process can be properly performed for each of the yarn supply package retaining portions 20.

[0123] (12) In the embodiment above, the operator performs the sudden replacement. However, the disclosure is not limited to this. The sudden replacement may be performed by, e.g., a later-described creel robot 102 (see FIG. 6; yarn supply package replacement device of the present invention) . As shown in FIG. 6, a yarn processing facility 100a may include the creel robot 102 which is arranged to be able to convey one or more yarn supply packages Ps. The creel robot 102 is arranged to be able to: attach each yarn supply package Ps to one package attachment unit 21; and detach the yarn supply package Ps from the one package attachment unit 21. The creel robot 102 may be controlled by a creel controller 102a which is electrically connected to the management device 101. The creel controller 102a may cause the creel robot 102 to perform (i) the yarn supply package replacement in the normal winding process and (ii) the sudden replacement. The creel controller 102a may generate the above-described sudden replacement information and, transmit this information to the machine controller 5 in the sudden replacement. The machine controller 5 may acquire the sudden replacement information in this way. In this case, the operator may be able to manually perform the reset operation. When a new yarn supply package Ps is attached to one package attachment unit 21, the creel controller 102a may transmit the above-described attachment information to the information management unit 110.

[0124] The yarn processing facility 100a may include a wound package conveyance device 103 (see FIG. 6) configured to collect and convey one fully-wound package Pw in which the winding process ends.

[0125] (13) The yarn processing facility 100 or 100a may be configured to perform the reset process as described below. In this regard, each package attachment unit 21 may include a replacement detection sensor (not illustrated) for detecting replacement of each yarn supply package Ps. For example, the replacement detection sensor may be a known transmissive optical sensor. Furthermore, the machine controller 5 may be configured to perform the reset process based on a detection result of the replacement detection sensor. When the operator or the above-described creel robot 102 replaces the yarn supply package Ps at one package attachment unit 21, the replacement detection sensor provided at the one package attachment unit 21 detects whether the yarn supply package exists as described below. That is, when the yarn supply package Ps which is not replaced yet is attached to the one package attachment unit 21, the replacement detection sensor detects the yarn supply package Ps existing. After that, when the yarn supply package Ps is detached from the one package attachment unit 21, the replacement detection sensor detects absence of the yarn supply package Ps. Subsequently, when a new yarn supply package Ps is attached to the one package attachment unit 21, the replacement detection sensor detects the yarn supply package Ps existing. As such, when information of changes (change information) indicating existence, absence, and existence in this order is detected, the machine controller 5 may perform the reset process for the one package attachment unit 21. That is, the machine controller 5 may perform the reset process when determining that the yarn supply package replacement has been performed.

[0126] In this modification, the machine controller 5 may be configured to perform the reset process only when the sudden replacement is performed (i.e., when the change information is detected while the winding process is stopped). In this case, the change information is equivalent to the sudden replacement information of the present invention. Also in the normal winding process, the machine controller 5 may be configured to perform the reset process when the change information is detected. In this case, the remaining amount and the remaining time are properly calculated by properly calculating the cumulative time regarding each package attachment unit 21.

[0127] (14) In the embodiment above, whether the 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. However, the disclosure is not limited to this. For example, as shown in FIG. 7, 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. Being similar to the yarn detection sensor 24, the switching detector 41 is equivalent to the switching detector of the present invention. The switching detector 41 may include, e.g., a supply sensor 42 (unwinding detector of the present invention) and a node part sensor 43. The supply sensor 42 is arranged to be able to detect whether the yarn Y is being supplied from the first attachment unit 22. 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 the 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 in 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.

[0128] (15) In the embodiment 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 or the switching detector 41. However, the disclosure is not limited to this. The information management unit 110 may determine whether the yarn supply package switching has occurred by utilizing, e.g., the predicted unwinding end time point.

[0129] (16) While in the embodiment above the information management unit 110 is configured to acquire 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. 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 be configured to acquire the information of an unwinding speed based on these sets of information. Alternatively, as the unwinding unit amount information, the information management unit 110 may be configured to acquire information of the weight of the yarn Y which is 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, e.g., the operator.

[0130] (17) When the yarn Y is wound onto a winding bobbin Bw at one spindle 9, the information management unit 110 may acquire information (for the sake of convenience, this will be referred to as winding start information) of the winding start time point at which the winding of the yarn onto the winding bobbin Bw starts. The information management unit 110 may acquire information (for the sake of convenience, this will be referred to as winding end information) regarding at least one of a planned winding end time point, a planned wound amount, and a planned winding time which are described below. The planned winding end time point is a planned time point at which the winding of the yarn Y onto the winding bobbin Bw ends. The planned wound amount is a planned wound amount at the winding bobbin Bw. The planned winding time is a planned time from the current time point to the end of the winding of the yarn Y onto the winding bobbin Bw. For example, the management described below can be performed by acquiring the winding start information and the winding end information.

[0131] When the above-described predicted unwinding end time point is between the winding start time point and the planned winding end time point, the information management unit 110 may predict that a node K will be mixed in one wound package Pw formed by winding the yarn Y onto the winding bobbin Bw. Alternatively, when the remaining amount regarding one yarn supply package Ps from which the yarn Y is unwound is smaller than the planned wound amount at the winding start time point, the information management unit 110 may predict that a node K will be mixed in the one wound package Pw. Alternatively, when the remaining time regarding the one yarn supply package Ps from which the yarn Y is unwound is shorter than the planned winding time at the winding start time point, the information management unit 110 may predict that a node K will be mixed in the one wound package Pw. The information management unit 110 may perform at least one of these three prediction methods.

[0132] When determining that a node K will be mixed in the one wound package Pw, the information management unit 110 may output information indicating that the node K will be mixed in the one wound package Pw. For example, the machine controller 5 may control the machine output unit 5b to notify the operator that the node K will be mixed in the one wound package Pw.

[0133] (18) While in the embodiment above the information management unit 110 includes plural machine controllers 5 and the management device 101, the disclosure is not limited to this. The information management unit 110 may include a computer device (not illustrated) in addition to the machine controllers 5 and the management device 101. Alternatively, the information management unit 110 may include only the machine controllers 5 or the management device 101. In other words, only one of the machine controllers 5 and the management device 101 may be configured to acquire required information.

[0134] (19) While in the embodiment above the yarn processing facility 100 has plural false-twist texturing machines 1, the disclosure is not limited to this. 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 machine 1 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. 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.

[0135] (20) 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) 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) configured to manage information regarding the yarn processor (1),

the yarn supplying unit (2) including at least one yarn supply package retaining portion (20) to and from which yarn supply packages (Ps) each including a yarn (Y) are attachable and detachable,

the at least one yarn supply package retaining portion (20) being able to uninterruptedly supply at least one yarn (Y) when a terminal portion of a yarn (Y) in one yarn supply package (PsA) among the yarn supply packages (Ps) is connected to a start end portion of a yarn (Y) in another yarn supply package (PsB) among the yarn supply packages (Ps) from which the yarn (Y) is to be unwound next to the one yarn supply package (PsA),

when a yarn (Y) is unwound from one of the yarn supply packages (Ps), the information management unit (110) acquiring, at a given reference time point and by means of a calculation, at least one of (i) remaining amount information regarding a remaining amount of the yarn (Y) in the one of the yarn supply packages (Ps) and (ii) remaining time information regarding a remaining time in which the yarn (Y) can be supplied from the one of the yarn supply packages (Ps) at the reference time point, and

when sudden replacement information indicating execution of sudden replacement in which unwinding of a yarn (Y) from one of the yarn supply packages (Ps) has started and has not ended yet and the one of the yarn supply packages (Ps) is replaced with new one of the yarn supply packages (Ps) is acquired, the information management unit (110) performing a reset process of resetting the at least one of the remaining amount information and the remaining time information to a predetermined initial value.

2. The yarn processing facility (100) according to claim 1, wherein, the at least one yarn supply package retaining portion (20) includes attachment units (21) to which the yarn supply packages (Ps) are respectively attached,

the yarn supplying unit (2) further includes a switching detector (24, 41) capable of detecting yarn supply package switching in which unwinding of a yarn (Y) from one of the yarn supply packages (Ps) ends and unwinding of a yarn (Y) from another of the yarn supply packages (Ps) starts, the one of the yarn supply packages (Ps) being attached to one attachment unit (22) among the attachment units (21), and the another of the yarn supply packages (Ps) being attached to another attachment unit (23) among the attachment units (21) which is different from the one attachment unit (22), and

when the switching detector (24, 41) detects the yarn supply package switching, the information management unit (110) performs the reset process for the another attachment unit (23).

3. The yarn processing facility (100) according to claim 1 or 2, wherein, the information management unit (110) is able to acquire: initial amount information regarding an initial amount of a yarn (Y) in each of the yarn supply packages (Ps) as information of the predetermined initial value;

unwinding unit amount information regarding an amount of a yarn (Y) which is unwound from each of the yarn supply packages (Ps) per unit time; and

cumulative time information regarding a cumulative time in which a yarn (Y) is unwound from one of the yarn supply packages (Ps), the yarn (Y) being unwound from the one of the yarn supply packages (Ps) at the reference time point,

the information management unit (110) is configured to acquire the at least one of the remaining time information

and the remaining amount information by means of a calculation based on at least the initial amount information, the unwinding unit amount information, and the cumulative time information, and
the information management unit (110) is configured to reset, as the reset process, the at least one of the remaining amount information and the remaining time information to the predetermined initial value by resetting the cumulative time to a predetermined initial time.

4. The yarn processing facility (100) according to claim 1 or 2, wherein, the information management unit (110) is able to acquire: initial amount information regarding an initial amount of a yarn (Y) in each of the yarn supply packages (Ps) as information of the predetermined initial value;

unwinding unit amount information regarding an amount of a yarn (Y) which is unwound from each of the yarn supply packages (Ps) per unit time; and
unwinding start time point information regarding an unwinding start time point at which unwinding of a yarn (Y) from one of the yarn supply packages (Ps) starts, the yarn (Y) being unwound from the one of the yarn supply packages (Ps) at the reference time point,
the information management unit (110) is configured to acquire the at least one of the remaining time information and the remaining amount information in regard to each of the yarn supply packages (Ps) by means of a calculation based on at least the initial amount information, the unwinding unit amount information, and the unwinding start time point information, and
the information management unit (110) is configured to reset, as the reset process, the at least one of the remaining amount information and the remaining time information to the predetermined initial value by acquiring the unwinding start time point information in regard to the new one of the yarn supply packages (Ps).

5. The yarn processing facility (100) according to claim 3 or 4, wherein, the information management unit (110) is configured to acquire: information of initial weight and fineness of a yarn (Y) in each of the yarn supply packages (Ps) as the initial amount information; and
information of an unwinding speed (V) indicating length of a yarn (Y) which is unwound from each of the yarn supply packages (Ps) per the unit time as the unwinding unit amount information.

6. The yarn processing facility (100) according to any one of claims 1 to 5, wherein, the yarn processor (1) is structured so that a yarn (Y) is unwound from one of the yarn supply packages (Ps) in at least part of yarn threading time in which yarn threading is performed for the yarn processor (1) after the sudden replacement is performed,

the yarn supplying unit (2) further includes an unwinding detector (24, 42) capable of detecting whether the yarn (Y) is unwound from the one of the yarn supply packages (Ps),
in order to acquire the at least one of the remaining amount information and the remaining time information, the information management unit (110) is configured to use information of detection time in which unwinding of the yarn (Y) from the one of the yarn supply packages (Ps) is detected by the unwinding detector (24, 42), and
the at least part of the yarn threading time is included in the detection time.

7. The yarn processing facility (100) according to any one of claims 1 to 6, wherein, the information management unit (110) is able to acquire a common initial value which is a common value regarding the yarn supply packages (Ps) as the predetermined initial value.

8. The yarn processing facility (100) according to claim 7, wherein, the yarn processor (1) is able to simultaneously process yarns (Y),

the yarn supplying unit (2) includes yarn supply package retaining portions (20), and
the common initial value is set as a common value regarding the yarn supply package retaining portions (20).

9. The yarn processing facility (100) according to any one of claims 1 to 6, wherein, the information management unit (110) is able to acquire the predetermined initial value corresponding to each of the yarn supply packages (Ps).

10. The yarn processing facility (100) according to claim 9, wherein, the yarn processor (1) is able to simultaneously process yarns (Y), and
the yarn supplying unit (2) includes yarn supply package retaining portions (20).

11. The yarn processing facility (100) according to any one of claims 1 to 10, wherein, the information management unit

(110) further includes an operation unit (5a) which is operable by an operator and, when a predetermined reset operation is performed for the operation unit (5a), the information management unit (110) generates the sudden replacement information.

12. The yarn processing facility (100) according to any one of claims 1 to 11, further comprising a yarn supply package replacement device (102) capable of executing the sudden replacement, wherein,
the yarn supply package replacement device (102) is able to transmit the sudden replacement information to the information management unit (110).

13. The yarn processing facility (100) according to any one of claims 1 to 12, wherein, the information management unit (110) is configured to acquire information of a predicted raw yarn disappearance time point which is acquired for each of at least one yarn supply package retaining portion (20) at which all of the yarn supply packages (Ps) become empty, based on the remaining time information regarding the all of the yarn supply packages (Ps) attached to the at least one yarn supply package retaining portion (20).

14. The yarn processing facility (100) according to claim 13, further comprising: a first output unit (5b) capable of outputting information; and

a first output controller (5) configured to control the first output unit (5b), wherein,
at a replacement notification time point which is earlier than the predicted raw yarn disappearance time point by a predetermined time, the first output controller (5) causes the first output unit (5b) to output information prompting an operator to replace one of the yarn supply packages (Ps) in at least one yarn supply package retaining portion (20).

15. The yarn processing facility (100) according to any one of claims 1 to 14, further comprising: a connection information acquisition unit (110) capable of acquiring information regarding whether a terminal portion of a yarn (Y) which is included in a predetermined yarn supply package (Ps) among the yarn supply packages (Ps) is connected to a start end portion of a yarn (Y) which is included in a reserve yarn supply package (Ps) among the yarn supply packages (Ps) from which the yarn (Y) is to be unwound next to the predetermined yarn supply package (Ps);

a second output unit (5b) capable of outputting information; and
a second output controller (5) configured to control the second output unit (5b), wherein,
when the remaining time regarding the predetermined yarn supply package (Ps) decreases to be equal to or less than a predetermined limit time while the start end portion is not connected to the terminal portion, the second output controller (5) causes the second output unit (5b) to output information requesting a connecting operation of connecting the start end portion to the terminal portion based on information acquired by the connection information acquisition unit (110).

FIG.1

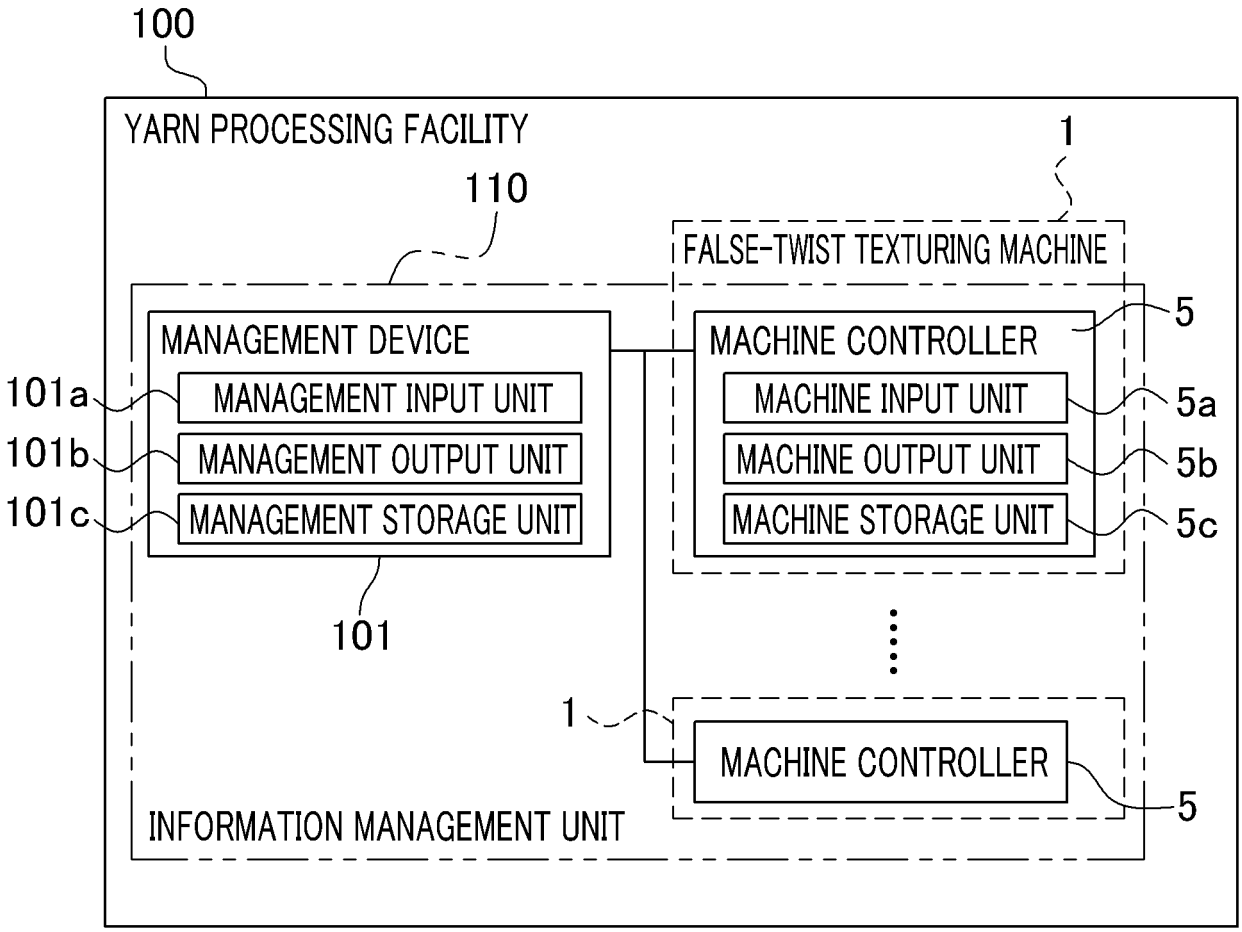

100
YARN PROCESSING FACILITY
1
110
FALSE-TWIST TEXTURING MACHINE
MANAGEMENT DEVICE
MACHINE CONTROLLER
5
101a
MANAGEMENT INPUT UNIT
MACHINE INPUT UNIT
5a
101b
MANAGEMENT OUTPUT UNIT
MACHINE OUTPUT UNIT
5b
101c
MANAGEMENT STORAGE UNIT
MACHINE STORAGE UNIT
5c
101
1
MACHINE CONTROLLER
5
INFORMATION MANAGEMENT UNIT

FIG.2

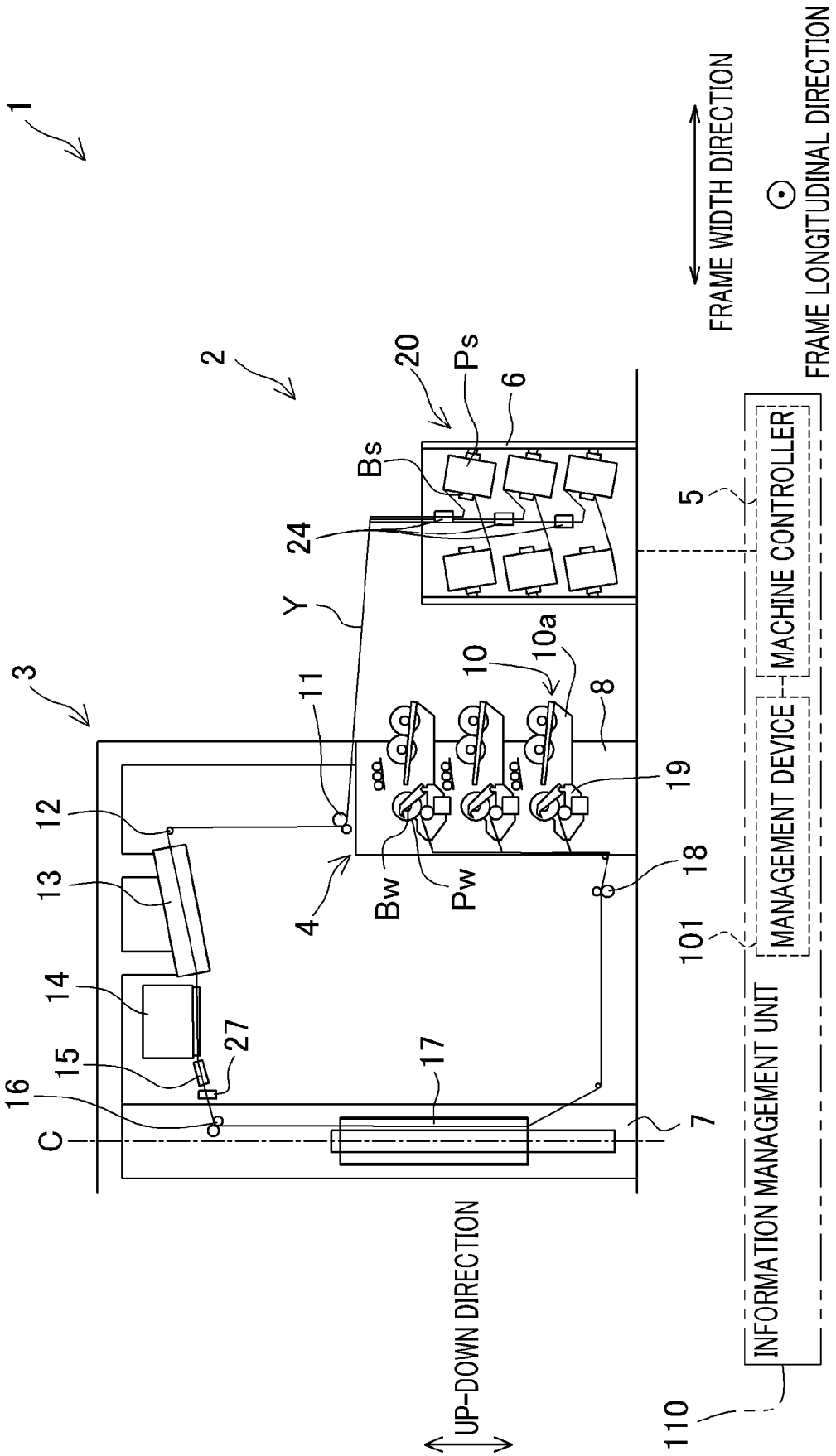

1
2
3
4
5
6
7
8
10
10a
11
12
13
14
15
16
17
18
19
20
24
27
Bs
Ps
Bw
Pw
Y
C
FRAME WIDTH DIRECTION
FRAME LONGITUDINAL DIRECTION
UP-DOWN DIRECTION
MACHINE CONTROLLER
MANAGEMENT DEVICE
INFORMATION MANAGEMENT UNIT
101
110

FIG.3

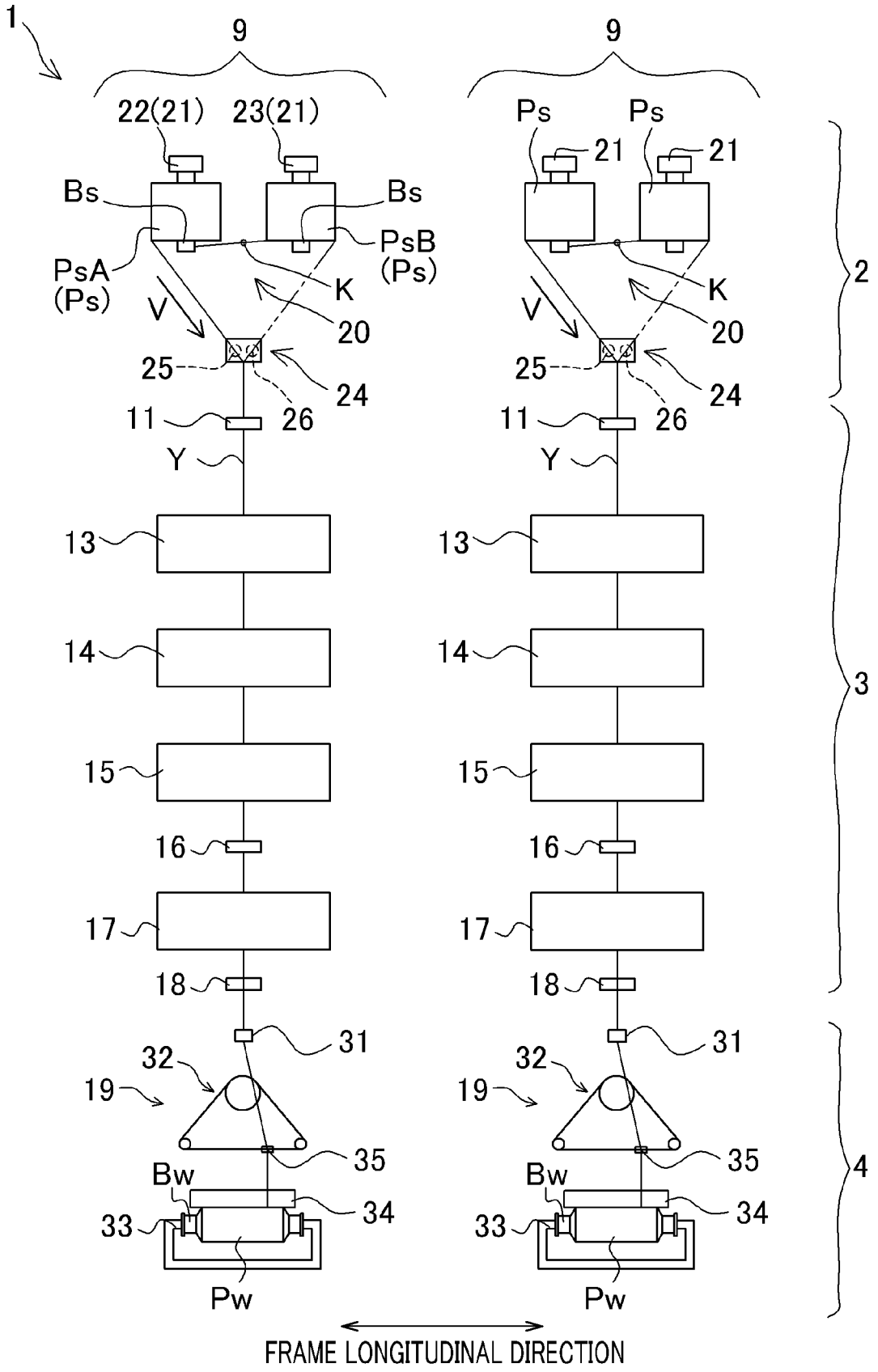

1
9
9
22(21)
23(21)
Ps
Ps
21
21
Bs
Bs
PsB
(Ps)
PsA
(Ps)
K
V
20
25
24
26
11
Y
2
13
14
15
16
17
18
3
31
32
19
35
Bw
34
33
Pw
4
FRAME LONGITUDINAL DIRECTION

FIG.4

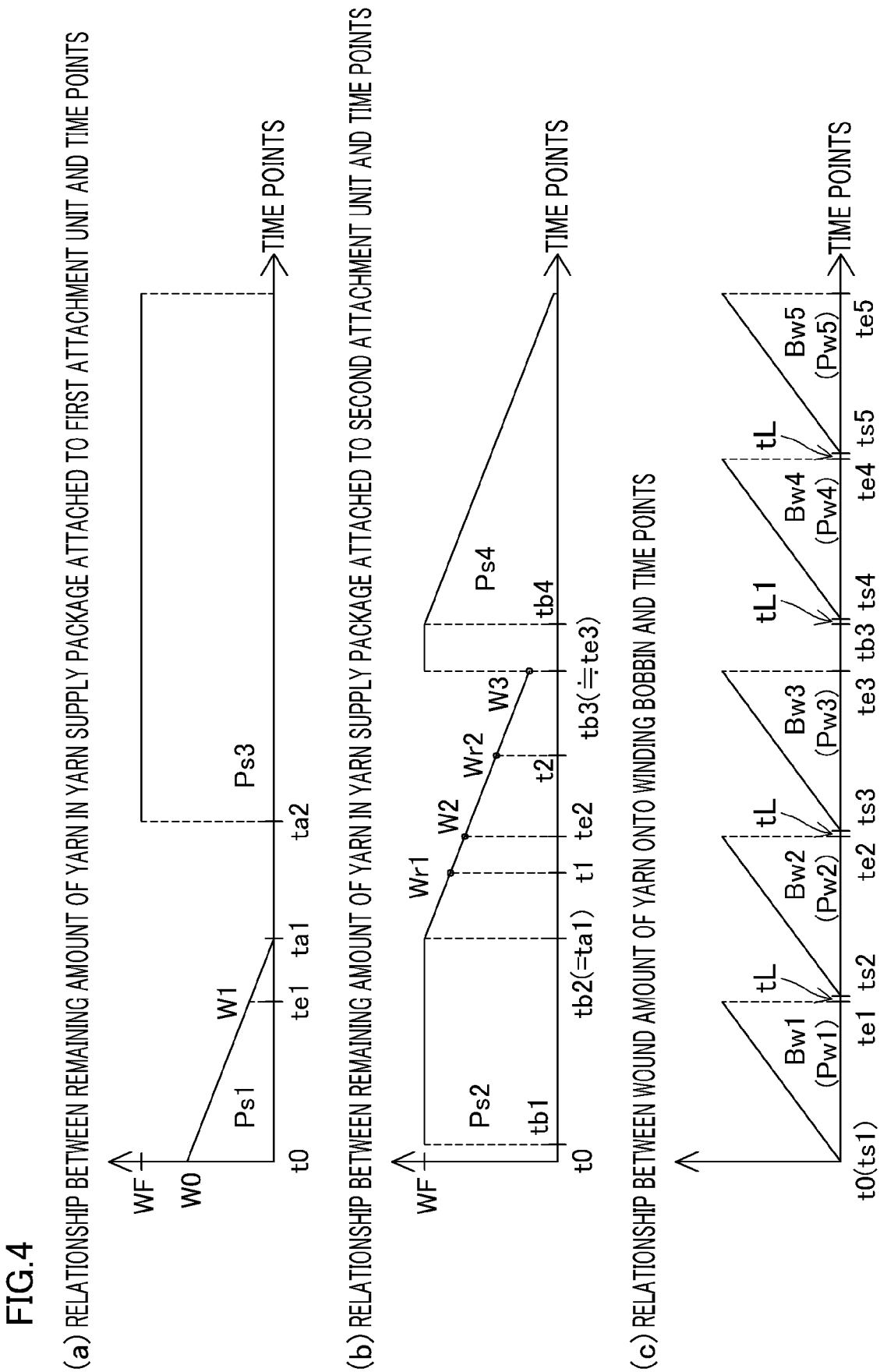

(a) RELATIONSHIP BETWEEN REMAINING AMOUNT OF YARN IN YARN SUPPLY PACKAGE ATTACHED TO FIRST ATTACHMENT UNIT AND TIME POINTS
WF
W0
W1
Ps1
Ps3
t0
te1
ta1
ta2
TIME POINTS
(b) RELATIONSHIP BETWEEN REMAINING AMOUNT OF YARN IN YARN SUPPLY PACKAGE ATTACHED TO SECOND ATTACHMENT UNIT AND TIME POINTS
WF
Wr1
W2
Wr2
W3
Ps2
Ps4
tb1
t0
t1
te2
t2
tb2(=ta1)
tb3(≒te3)
tb4
TIME POINTS
(c) RELATIONSHIP BETWEEN WOUND AMOUNT OF YARN ONTO WINDING BOBBIN AND TIME POINTS
t0(ts1)
te1
ts2
te2
ts3
te3
ts4
te4
ts5
te5
tL
tL1
Bw1
(Pw1)
Bw2
(Pw2)
Bw3
(Pw3)
Bw4
(Pw4)
Bw5
(Pw5)
TIME POINTS

FIG.5

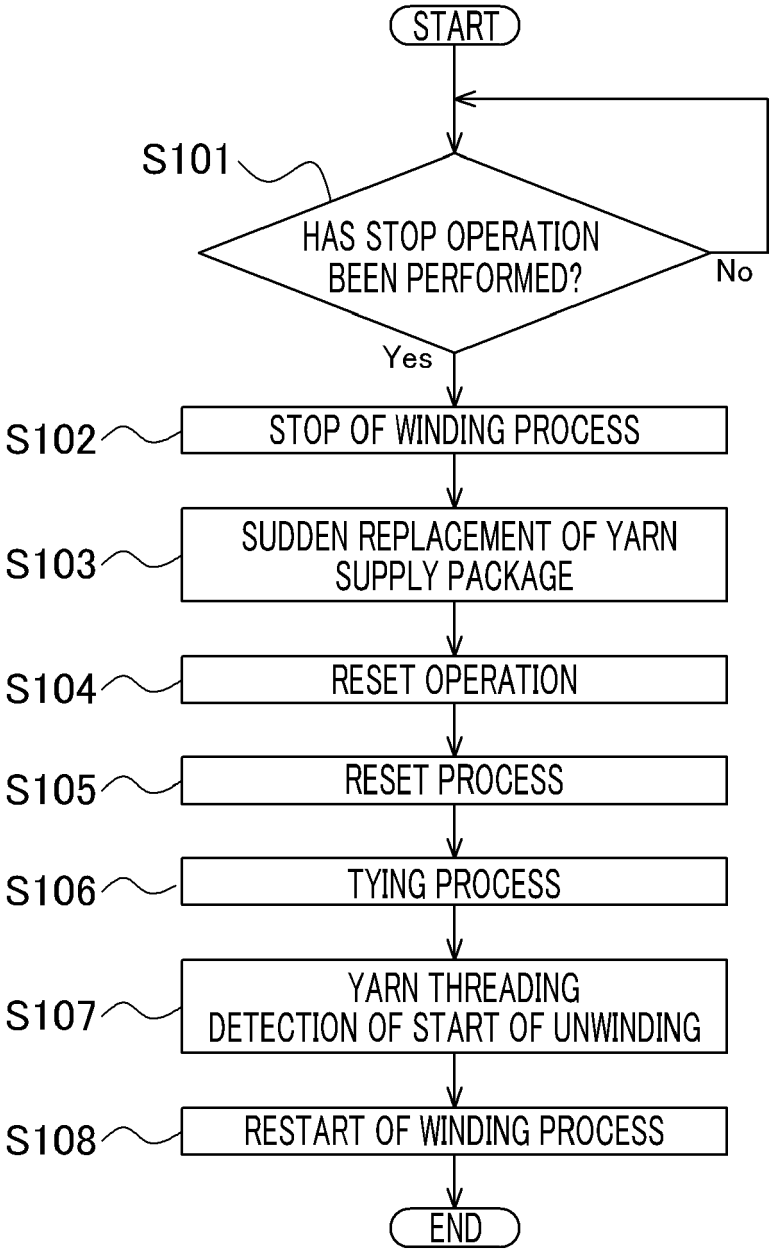

START
S101
HAS STOP OPERATION BEEN PERFORMED?
No
Yes
S102
STOP OF WINDING PROCESS
S103
SUDDEN REPLACEMENT OF YARN SUPPLY PACKAGE
S104
RESET OPERATION
S105
RESET PROCESS
S106
TYING PROCESS
S107
YARN THREADING
DETECTION OF START OF UNWINDING
S108
RESTART OF WINDING PROCESS
END

FIG.6

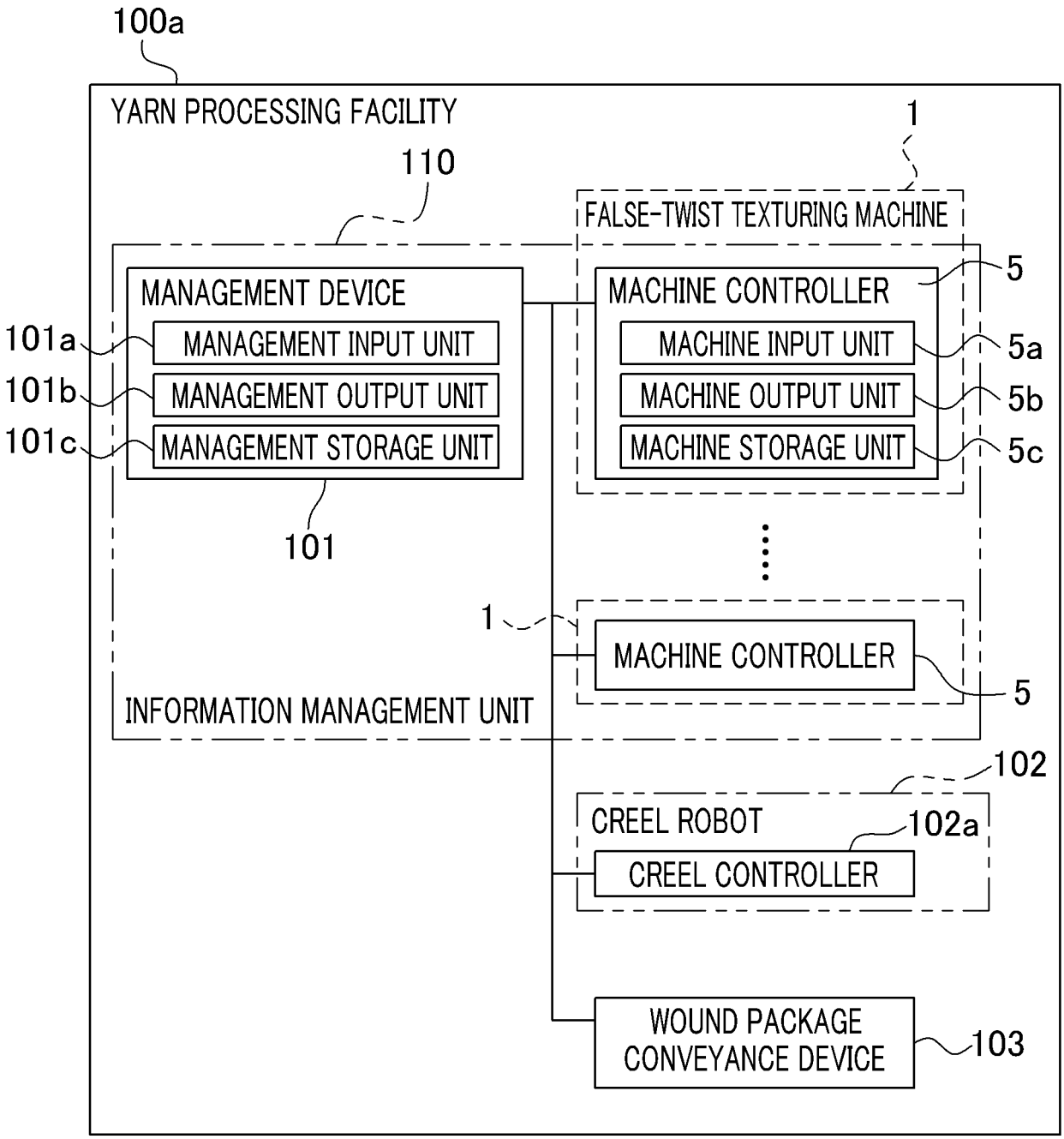
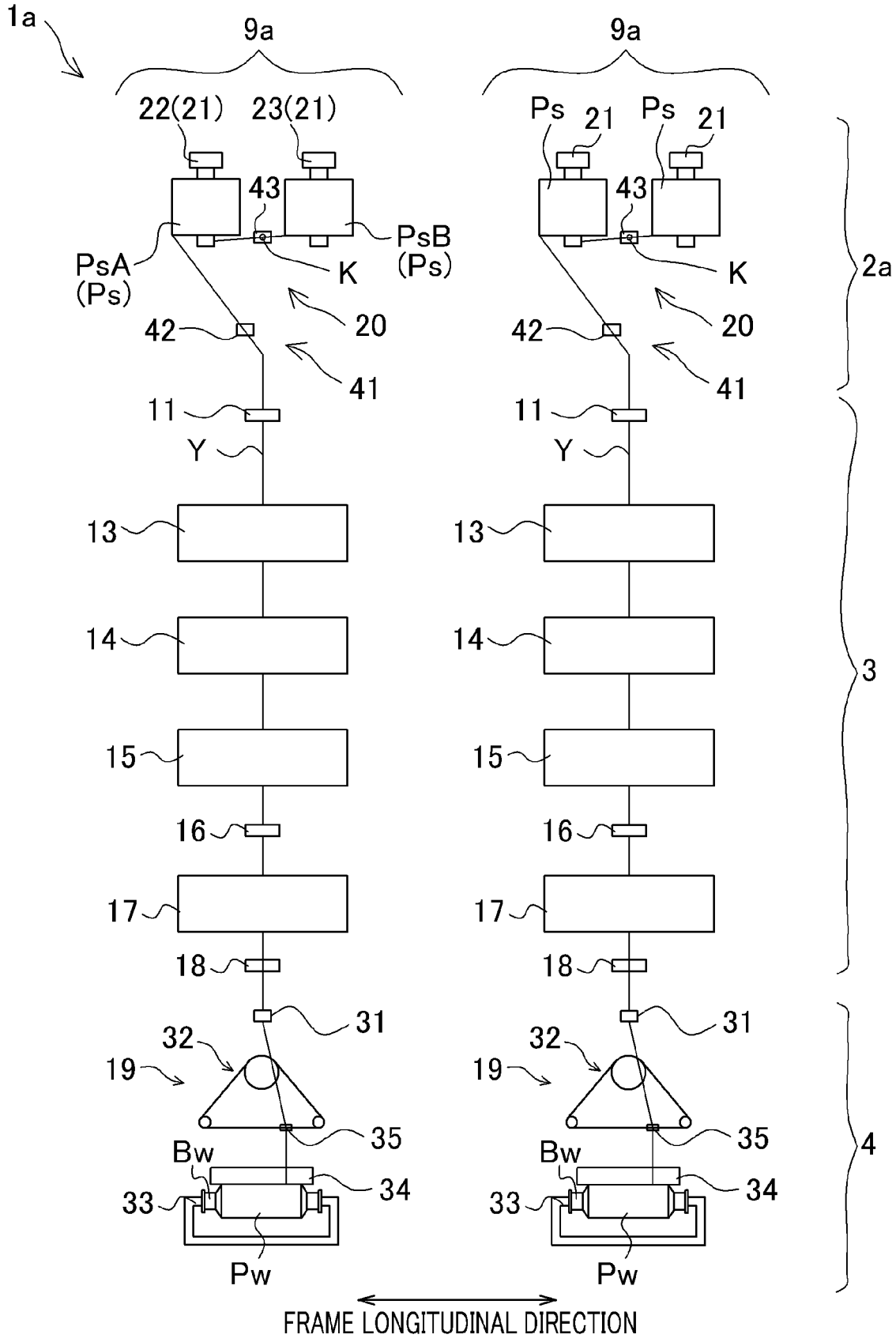

100a
YARN PROCESSING FACILITY
110
1
FALSE-TWIST TEXTURING MACHINE
MANAGEMENT DEVICE
MANAGEMENT INPUT UNIT
MANAGEMENT OUTPUT UNIT
MANAGEMENT STORAGE UNIT
101
101a
101b
101c
MACHINE CONTROLLER
5
MACHINE INPUT UNIT
MACHINE OUTPUT UNIT
MACHINE STORAGE UNIT
5a
5b
5c
1
MACHINE CONTROLLER
5
INFORMATION MANAGEMENT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

FIG.7


1a
9a
9a
22(21)
23(21)
Ps
21
Ps
21
43
43
PsA
(Ps)
PsB
(Ps)
K
K
2a
42
20
42
20
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 18 6945

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 771 677 A1 (TMT MACHINERY INC [JP]) 3 February 2021 (2021-02-03) * paragraphs [0006] - [0012], [0018] - [0028], [0064] - [0105] *	1-15	INV. B65H63/08 B65H67/02 B65H49/12
A	US 2019/177108 A1 (CHARLES EATON DAVID [GB] ET AL) 13 June 2019 (2019-06-13) * paragraphs [0027], [0028]; claims 1-4 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	5 January 2023	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

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05-01-2023

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- JP 2002088605 A **[0135]**