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(54) YARN PROCESSOR

GARNVERARBEITUNGSVORRICHTUNG

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn processor.

[0002] Patent Literature 1 (JP 2003 526584 A) discloses an apparatus (yarn processor) configured to form a winding assembly (wound package) in such a way that a yarn is unwound from a yarn supply package (a supplying bobbin in Patent Literature 1) formed by winding the yarn onto a yarn supplying bobbin and the processed yarn is wound onto a winding bobbin.

SUMMARY OF THE INVENTION

[0003] Among yarn layers formed by the yarn in the above-described yarn supply package, those on the inner side in the radial direction of the yarn supply package (i.e., those in the vicinity of the yarn supplying bobbin, which will be referred to as an inner layer part) may be lower in quality than a part on the outer side in the radial direction of the inner layer part. As described below, there are several reasons for this. The yarn supply package is typically formed by winding a yarn onto a yarn supplying bobbin having a circumferential surface in which slits are formed. When winding of a yarn onto such a yarn supplying bobbin starts, the yarn is treated in such a way that the tension of the yarn is higher than when the yarn is wound, in order to cause the yarn to be reliably held at a part of the yarn supplying bobbin, where the slits are formed. Furthermore, at the start of winding of a yarn onto a yarn supplying bobbin that is typically harder than the yarn, the yarn tends to be damaged due to, for example, contact with the yarn supplying bobbin. When a wound package which is to be sold as a product is contaminated with such a low-quality yarn in the inner layer part, the grade of the wound package may be decreased.

[0004] An object of the present invention is to avoid a wound package sold as a product from being contaminated with a low-quality yarn.

[0005] According to a first aspect of the invention, a yarn processor capable of processing a yarn unwound from a yarn supply package and winding the yarn onto a winding bobbin comprises: a yarn supply package retaining portion which is configured to retain the yarn supply package; a winding device which is capable of forming a wound package by winding the yarn onto the winding bobbin; a cutting unit which is capable of cutting the yarn before the yarn is wound onto the winding bobbin; a bobbin replacement unit which is capable of replacing the wound package formed by the winding device with a new winding bobbin as the winding bobbin and which is capable of performing yarn threading to the new winding bobbin; and a controller which is capable of performing: a formation termination process of cutting the yarn by controlling the cutting unit and terminating formation of the wound package by controlling the winding device; and a replacement process of replacing the formed wound package with the new winding bobbin and threading a yarn to the new winding bobbin by controlling the bobbin replacement unit, the controller performing the formation termination process and the replacement process when determining that an amount of the yarn in the wound package in formation reaches a predetermined target wound amount, the control unit generating, by calculation, remaining amount-related information that is numerical information regarding a remaining amount of the yarn remaining in the yarn supply package which is retained by the yarn supply package retaining portion and from which the yarn is being unwound, and when determining in remaining amount reduction determination that a numerical value of the remaining amount-related information is not larger than a predetermined value, the control unit performing the formation termination process to cause the winding device to form a formation forcible termination wound package that is a wound package having a smaller amount of the yarn than the target wound amount.

[0006] According to this aspect, when the remaining amount of the yarn in the yarn supply package becomes not larger than the predetermined value, i.e., when unwinding of the yarn in the inner layer part from the yarn supply package starts, the formation of the formation forcible termination wound package is terminated. This makes it possible to avoid the inclusion of the low-quality yarn in the formation forcible termination wound package that is a product. It is therefore possible avoid the contamination of the low-quality yarn in the wound package that is a product.

[0007] According to a second aspect of the invention, the yarn processor of the first aspect is arranged so that the controller stores individual information of the formation forcible termination wound package and information regarding the remaining amount reduction determination, in association with each other.

[0008] According to this aspect, it is possible to discern the formation forcible termination wound package from the other wound packages by utilizing the information stored in the controller.

[0009] According to a third aspect of the invention, the yarn processor of the first or second aspect is arranged so that the yarn supply package retaining portion is capable of retaining, as the yarn supply package, a first yarn supply package and a second yarn supply package different from the first yarn supply package and is capable of uninterruptedly supplying the yarn when a yarn connecting portion is formed by connecting a start end portion of a yarn in the first yarn supply package with a terminal portion of a yarn in the second yarn supply package, a detection unit is provided to be able to detect

information indicating occurrence of yarn supply package switching in which unwinding of the yarn from the first yarn supply package finishes at the yarn supply package retaining portion, the yarn connecting portion starts to move, and unwinding of the yarn from the second yarn supply package starts, when the remaining amount reduction determination is performed while the yarn is being unwound from the first yarn supply package, the controller terminates formation of the formation forcible termination wound package by performing the formation termination process, the controller performs the replacement process after the formation of the formation forcible termination wound package, and the controller causes the winding device to form an inner-layer-part-inclusive wound package that is a wound package and includes the yarn unwound from the first yarn supply package after the remaining amount reduction determination, by winding the yarn unwound from the first yarn supply package and processed after the remaining amount reduction determination onto the new winding bobbin attached to the winding device in the replacement process that is performed after the formation of the formation forcible termination wound package, and when switching determination is performed based on a result of detection by the detection unit to determine whether the yarn supply package switching occurs while the inner-layer-part-inclusive wound package is being formed, the control unit terminates formation of the inner-layer-part-inclusive wound package by performing the formation termination process, the control unit performs the replacement process after the formation of the inner-layer-part-inclusive wound package, and the control unit performs the replacement process after the formation of the inner-layer-part-inclusive wound package to wind the yarn unwound from the second yarn supply package and processed after the switching determination onto the new winding bobbin attached to the winding device.

[0010] According to this aspect, the yarn can be uninterruptedly supplied because unwinding of the yarn from the second yarn supply package starts when unwinding of the yarn from the first yarn supply package ends. With this arrangement, however, the formation of the inner-layer-part-inclusive wound package may continue even after the end of the unwinding of the yarn in the inner layer part of the first yarn supply package from the first yarn supply package. In such a case, a large amount of the high-quality yarn in the outer layer part of the second yarn supply package may be disadvantageously wound onto the inner-layer-part-inclusive wound package, with the result that the high-quality yarn may be wasted. According to the aspect, at the execution of the switching determination, the inner-layer-part-inclusive wound package is replaced with a new winding bobbin. With this arrangement, it is possible to immediately wind the yarn in the second yarn supply package onto the new winding bobbin after the occurrence of the yarn supply package switching. It is therefore possible to suppress a large amount of the high-quality yarn in the second yarn supply package from being included in the inner-layer-part-inclusive wound package.

[0011] According to a fourth aspect of the invention, the yarn processor of the third aspect is arranged so that the controller stores individual information of the inner-layer-part-inclusive wound package and information regarding the switching determination, in association with each other.

[0012] According to this aspect, it is possible to discern the inner-layer-part-inclusive wound package from the other wound packages by utilizing the information stored in the controller.

[0013] According to a fifth aspect of the invention, the yarn processor of the third or fourth aspect is arranged to further comprise a marking unit which is capable of performing a marking operation of providing a mark on the wound package that is being formed by the winding device, when the switching determination is performed, the controller controlling and causing the marking unit to perform, as the marking operation, an inner layer part inclusive marking operation of providing a mark on the inner-layer-part-inclusive wound package.

[0014] According to this aspect, the inner layer part inclusive marking operation makes it possible to discern a wound package without a mark from the inner-layer-part-inclusive wound package by appearance.

[0015] According to a sixth aspect of the invention, the yarn processor of any one of the first to fourth aspects further comprises a marking unit which is capable of performing a marking operation of providing a mark on the wound package that is being formed by the winding device, when the remaining amount reduction determination is performed, the controller controlling and causing the marking unit to perform, as the marking operation, an inner layer part avoiding marking operation of providing a mark on the formation forcible termination wound package.

[0016] According to this aspect, the inner layer part avoiding marking operation makes it possible to discern a wound package without a mark from the formation forcible termination wound package by appearance.

[0017] According to a seventh aspect of the invention, the yarn processor of the fifth aspect is arranged so that, when the remaining amount reduction determination is performed, the controller controlling and causing the marking unit to perform, as the marking operation, an inner layer part avoiding marking operation of providing a mark on the formation forcible termination wound package.

[0018] According to this aspect, the inner layer part avoiding marking operation makes it possible to discern a wound package without a mark from the formation forcible termination wound package by appearance.

[0019] According to an eighth aspect of the invention, the yarn processor of the seventh aspect is arranged so that the marking unit is capable of performing the marking operation so that the formation forcible termination wound package is discerned from the inner-layer-part-inclusive wound package, and the controller controls and causes the marking unit to perform the inner layer part inclusive marking operation and the inner layer part avoiding marking operation so that the formation forcible termination wound package is discerned from the inner-layer-part-inclusive wound package.

[0020] According to this aspect, it is possible to easily discern the formation forcible termination wound package from the inner-layer-part-inclusive wound package by appearance. On this account, it is possible to discern the formation forcible termination wound package from the inner-layer-part-inclusive wound package even if they are unintentionally mixed.

[0021] According to a ninth aspect of the invention, the yarn processor of any one of the fifth to eighth aspects is arranged so that the marking unit includes the winding device, the winding device includes: a rotational driving unit which is configured to rotationally drive the wound package about a central axis of the wound package; and a traverse unit including a traverse guide configured to traverse the yarn and a guide driving unit configured to reciprocally drive the traverse guide along the axial direction of the wound package, and the controller causes the winding device to perform the marking operation in such a way that the controller controls the traverse unit to stop the traverse guide at a predetermined position in the axial direction while controlling the rotational driving unit to rotate the wound package.

[0022] According to this aspect, as the marking operation, it is possible to form a so-called straight winding on the wound package. This makes it possible to achieve the marking operation by a simple means.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a block diagram illustrating the electrical structure of a yarn processing facility including a false-twist texturing machine of an embodiment.
FIG. 2 is a side view of the false-twist texturing machine.
FIG. 3 is a schematic diagram of the false-twist texturing machine, expanded along paths of yarns.
FIG. 4 illustrates items such as a selection screen for selecting a processing mode of the false-twist texturing machine.
FIGs. 5(a) to 5(c) are graphs showing the relationship between a yarn amount and a time in a known processing mode.
FIG. 6 is a flowchart showing the steps of replacement of a winding bobbin, which is performed when the remaining amount of a yarn in a yarn supply package is decreased.
FIGs. 7(a) to 7(c) are graphs showing the relationship between a yarn amount and a time in a processing mode for forming an inner-layer-part-inclusive wound package.
FIGs. 8(a) and 8(b) are schematic diagrams of a wound package. FIG. 8(c) illustrates information regarding the rank of the wound package.
FIG. 9 is a schematic diagram of a false-twist texturing machine related to a modification.
FIG. 10 is a schematic diagram of a false-twist texturing machine related to another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Outline of Yarn Processing Facility)

[0024] The following will describe an embodiment of the present invention. The following will outline a yarn processing facility 100 including a false-twist texturing machine 1 (described later) of the present embodiment, with reference to the 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, for example, aligned along a predetermined base longitudinal direction (see e.g., FIG. 2). Each false-twist texturing machine 1 can perform false twisting of yarns Y (see e.g., FIG. 2) made of, for example, synthetic fibers such as polyester or nylon (polyamide fibers). Each yarn Y is, for example, a multi-filament yarn formed of filaments (not illustrated). As described below, each false-twist texturing machine 1 is configured to process yarns Y supplied from a yarn supplying unit 2 by a processing unit 3 and form wound packages Pw by winding the yarns Y onto winding bobbins 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 provided in each false-twist texturing machine 1.

[0025] The management device 101 is a host computer configured to integrally manage information obtained by the machine controllers 5. The management device 101 includes a management input unit 101a (e.g., a keyboard), a management output unit 101b (e.g., a display), and a management storage unit 101c (e.g., a hard disk). The information management unit 110 of the present embodiment is equivalent to a combination of the management device 101 and the machine controllers 5.

(Overall Structure of Draw Texturing Machine)

[0026] Now, the overall structure of a false-twist texturing machine 1 will be described with reference to FIG. 2 and FIG. 3. FIG. 2 is a profile of the false-twist texturing machine 1. FIG. 3 is a schematic diagram of the false-twist texturing machine 1, expanded along paths of yarns Y (yarn paths). Hereinafter, a vertical direction to the sheet of FIG. 2 is defined as the above-

described base longitudinal direction, and a left-right direction to the sheet is defined as a base width direction. The direction orthogonal to the base longitudinal direction and the base width direction is defined as the up-down direction (vertical direction) in which the gravity acts. A direction in which a yarn Y runs will be referred to as a yarn running direction. The false-twist texturing machine 1 includes a yarn supplying unit 2 for supplying the yarns Y, a processing unit 3 which processes (false-twists) the yarns Y supplied from the yarn supplying unit 2, a winding unit 4 which winds the yarns Y processed by the processing unit 3 onto a winding bobbins Bw, and the machine controller 5 (a controller of the present invention).

[0027] The yarn supplying unit 2 includes a creel stand 6 retaining yarn supply packages Ps, and supplies the yarns Y to the processing unit 3. The processing unit 3 is configured to unwind the yarns Y from the yarn supplying unit 2 and process the yarns Y. In the processing unit 3, the following members are provided in this order from the upstream in the yarn running direction: first feed rollers 11; a twist-stopping guide 12; a first heater 13; a cooler 14; a false-twisting device 15; second feed rollers 16; a second heater 17; and third feed rollers 18. These constituent features of the processing unit 3 are provided in, for example, each of later-described spindles 9 (see FIG. 3). The winding unit 4 includes plural winding devices 19. Each winding device 19 winds the yarn Y for which the false winding has been performed at the processing unit 3 onto the winding bobbin Bw, and forms a wound package Pw. The winding part 4 is further provided with automatic doffers 10 which correspond to the respective winding devices 19 and are configured to replace completed wound packages Pw with new empty winding bobbins Bw.

[0028] The machine controller 5 is configured to be able to control each constituent feature of the yarn supplying unit 2, the processing unit 3, and the winding unit 4. The machine controller 5 is, for example, a typical computer device. The machine controller 5 includes a machine input unit 5a, a machine output unit 5b, and a machine storage unit 5c (see FIG. 1). The machine input unit 5a includes, for example, an unillustrated touch panel and/or a keyboard that are not illustrated, and is arranged to be operable by an operator. The display machine output unit 5b includes, for example, an unillustrated display and is capable of outputting information. The machine storage unit 5c is configured to store various sets of information for controlling the constituent features of the yarn supplying unit 2, the processing unit 3, and the winding unit 4. The machine controller 5 is configured to control the constituent features of the yarn supplying unit 2, the processing unit 3, and the winding unit 4 based on the sets of information. Alternatively, the machine controller 5 may indirectly control the constituent features of the yarn supplying unit 2, the processing unit 3, and the winding unit 4 through controllers (not illustrated) for controlling these constituent features. The machine controller 5 is electrically connected to the management device 101 which is a host computer. The machine controller 5 is able to perform at least a formation termination process and a replacement process that will be described later.

[0029] The false-twist texturing machine 1 includes a main base 7 and a winding base 8 which are placed to be spaced apart from each other in the base width direction. The main base 7 and the winding base 8 are substantially identical in length in the base longitudinal direction. The main base 7 and the winding base 8 are arranged to face each other in the base width direction. The false-twist texturing machine 1 includes units which are termed spans each of which includes a pair of the main base 7 and the winding base 8. In one span, each device is placed so that the yarns Y running while being aligned in the base longitudinal direction can be subjected to false-twist texturing at the same time. In the false-twist texturing machine 1, the spans are placed in a left-right symmetrical manner to the sheet, with a center line C of the base width direction of the main base 7 as a symmetry axis (main base 7 is shared between the left span and the right span). The spans are aligned in the base longitudinal direction.

[0030] A group of constituent features through which a single yarn Y supplied from the yarn supplying unit 2 passes before reaching the winding unit 4 is termed a spindle. The false-twist texturing machine 1 includes spindles 9 (see FIG. 3) that are identical in number with the winding devices 19. Roughly speaking, the spindles 9 are aligned along the base longitudinal direction. The inclusion relation is as follows: the false-twist texturing machine 1 includes plural spans, and each span includes plural spindles 9. The false-twist texturing machine 1 is able to false-twist the yarn Y in the spindle 9 to which the yarn Y is threaded.

(Yarn Supplying Unit)

[0031] 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 correspond to the respective spindles 9. Each of the yarn supply package retaining portions 20 is arranged so that two yarn supply packages Ps are attached and detached to and from the portion. In other words, each 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, whereas the other is termed a second attachment unit 23. To and from each of the first attachment unit 22 and the second attachment unit 23, a single yarn supply package Ps can be attached and detached. The attachment and detachment of the yarn supply packages Ps to and from the package attachment unit 21 are performed, by, for example, an operator.

[0032] Each yarn supply package retaining portion 20 of the yarn supplying unit 2 is arranged to be able to unin-

terruptedly supply the yarn Y by the arrangement described below. For example, as shown in FIG. 3, a yarn supply package Ps1 that is one of the yarn supply packages Ps is attached to the first attachment unit 22. On the other hand, another yarn supply package Ps2 different from the yarn supply package Ps1 is attached to the second attachment unit 23. The yarn Y is unwound from the yarn supply package Ps1. A terminal portion of the yarn Y in the yarn supply package Ps1 is joined with (connected to) a start end portion of the yarn Y in the yarn supply package Ps2. Due to this, a node K (yarn connecting portion) is formed between the two yarns Y. This arrangement makes it possible to uninterruptedly supply the yarn Y from the yarn supply package Ps2 after the yarn supply package Ps1 becomes empty. To be more specific, immediately after the supply of the yarn Y from the yarn supply package Ps1 ends and the yarn supply package Ps1 becomes empty, the node K is pulled to the downstream side in the yarn running direction (i.e., to the winding device 19 side), with the result that the yarn Y is unwound from the yarn supply package Ps2. In other words, after the unwinding of the yarn Y from the yarn supply package Ps attached to one package attachment unit 21 finishes, unwinding of the yarn Y from the next yarn supply package Ps attached to the other package attachment unit 21 starts. For the sake of convenience, this action will be referred to as yarn supply package switching. Because of this, the yarn Y is uninterruptedly supplied. Thereafter, the yarn supply packages Ps (yarn supplying bobbin Bs) having become empty is replaced with a new yarn supply package Ps by, for example, the operator. Furthermore, a start end portion of the yarn supply package Ps2 is joined with a terminal portion of the new yarn supply package Ps by, for example, the operator. As these steps are repeated, the yarn Y is uninterruptedly supplied from the yarn supplying unit 2.

[0033] On the downstream side in the yarn running direction of each yarn supply package retaining portion 20, a yarn detection sensor 24 (a detection unit of the present invention) is provided. The yarn detection sensor 24 is configured to be able to detect from which one of the attachment units, the first attachment unit 22 and the second attachment unit 23, the yarn Y is being supplied. 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 configured to be able to detect whether the yarn Y is being supplied from the first attachment unit 22. The second detection unit 26 is configured to be able to detect whether the yarn Y is being supplied from the second attachment unit 23. Each of the first detection unit 25 and the second detection unit 26 is, for example, an optical sensor configured to optically detect the yarn Y. For further details of the yarn detection sensor 24, see e.g., Japanese Patent No. 5873105. Alternatively, the first detection unit 25 and the second detection unit 26 may be contact sensors, for example.

[0034] In the yarn running direction, on the downstream of each yarn supply package retaining portion 20 and on the upstream of the first feed roller 11, a cutter 27 capable of cutting the running yarn Y is provided. The cutter 27 is electrically connected to the machine controller 5.

(Processing Part)

[0035] The structure of the processing unit 3 will be described with reference to FIG. 2 and FIG. 3. For the sake of convenience, the following will describe only portions of the processing unit 3, which correspond to one spindle 9.

[0036] The first feed rollers 11 are arranged to unwind a yarn Y from a yarn supply package Ps attached to the yarn supplying unit 2 and feed the yarn Y to the first heater 13. The first feed rollers 11 are provided on the upstream side in the yarn running direction of the twist-stopping guide 12. The conveyance speed of conveying the yarn Y by the first feed rollers 11 is substantially identical with unwinding speed V (see FIG. 3) at which the yarn Y is unwound from the yarn supply package Ps. Information of a set value of the conveyance speed of the yarn Y by the first feed rollers 11 is stored in, for example, the machine controller 5 in advance. On the upstream side in the yarn running direction of the first feed rollers 11, the above-described cutter 27 is provided. When yarn breakage occurs, unfavorable winding of the yarn Y onto a rotationally-driven member such as the first feed rollers 11 can be prevented by cutting the yarn Y by the cutter 27.

[0037] The twist-stopping guide 12 is provided to prevent twist of the yarn Y formed by the false-twisting device 15 from being propagated to the upstream in the yarn running direction of the twist-stopping guide 12. The twist-stopping guides 12 are placed downstream of the first feed rollers 11 in the yarn running direction, and placed upstream of the first heater 13 in the yarn running direction.

[0038] The first heater 13 heats the yarns Y sent from the first feed rollers 11. The first heater 13 is placed downstream of the twist-stopping guide 12 in the yarn running direction and upstream of the cooler 14 in the yarn running direction. In the present embodiment, the first heater 13 is arranged to heat a single yarn Y for the sake of simplicity. 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.

[0039] The cooler 14 is configured to cool the yarn Y heated at the first heater 13. The coolers 14 are placed downstream of each first heater 13 in the yarn running direction, and placed upstream of the false-twisting devices 15 in the yarn running direction. In the present embodiment, the cooler 14 is arranged to cool a single yarn Y for the sake of simplicity. The disclosure, however, is not limited to this arrangement. The cooler 14 may be arranged to be able to simultaneously cool plural yarns Y.

[0040] The false-twisting device 15 is configured to twist the yarn Y. The false-twisting device 15 is a so-called disc-

friction-type false-twisting device, for example. The disclosure, however, is not limited to this arrangement. The false-twisting device 15 is placed downstream of the cooler 14 in the yarn running direction and upstream of the second feed rollers 16 in the yarn running direction.

[0041] The second feed rollers 16 are configured to send the yarns Y processed by the false-twisting device 15 to the second heater 17. The conveyance speed of conveying the yarn Y by the second feed rollers 16 is higher than the conveyance speed of conveying the yarn Y by the first feed rollers 11. The yarn Y is therefore drawn between the first feed rollers 11 and the second feed rollers 16. Information of a set value of the conveyance speed of the yarn Y by the second feed rollers 16 is stored in, for example, the machine controller 5 in advance.

[0042] The second heater 17 heats the yarn Y sent from the second feed rollers 16. The second heater 17 extends along the vertical direction. The second heater 17 is arranged to heat a single yarn Y for the sake of simplicity. 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.

[0043] The third feed rollers 18 send the yarn Y heated by the second heater 17 to the winding device 19. The conveyance speed of conveying the yarn Y by the third feed rollers 18 is lower than the conveyance speed of conveying the yarn Y by the second feed rollers 16. The yarn Y is therefore relaxed between the second feed rollers 16 and the third feed rollers 18. Information of a set value of the conveyance speed of the yarn Y by the third feed rollers 18 is stored in, for example, the machine controller 5 in advance.

[0044] In the processing unit 3 arranged as described above, the yarn Y drawn between the first feed rollers 11 and the second feed rollers 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. After being false-twisted by the false-twisting device 15, the yarn Y is thermally treated at the second heater 17 while being relaxed between the second feed rollers 16 and the third feed rollers 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 rollers 18 is wound onto the winding bobbin Bw by the winding device 19. Accordingly, the wound package Pw is formed.

(Winding Unit)

[0045] The structure of the winding unit 4 will be described with reference to FIG. 2 and FIG. 3. The winding unit 4 includes winding devices 19 (marking units of the present invention) and automatic doffers 10 (see FIG. 2; bobbin replacement units of the present invention) that are provided to correspond to the respective winding devices 19. The winding devices 19 belong to the respective spindles 9 (see FIG. 3). Each winding device 19 is configured to wind the yarn Y onto the winding bobbin Bw. Each winding device 19 includes, for example, a fulcrum guide 31, a traverse device 32 (traverse unit of the present invention), a cradle 33, and a winding roller 34. The fulcrum guide 31 is a guide which functions as a fulcrum when the yarn Y is traversed. For example, the traverse device 32 can traverse the yarn Y by a traverse guide 35 which is attached to an endless belt driven in a reciprocating manner by a motor 36 (a guide driving unit of the present invention). That is to say, the traverse device 32 is configured to reciprocate the traverse guide 35 along the axial direction (hereinafter, a winding bobbin axial direction) of the winding bobbin Bw (wound package Pw). The cradle 33 is arranged to be able to support the winding bobbin Bw (wound package Pw) to be rotatable about the central axis of the wound package Pw. The winding roller 34 is arranged to rotate the wound package Pw about the central axis and to apply contact pressure to the surface of the wound package Pw. The winding roller 34 is rotationally driven by the motor 37 (a rotational driving unit of the present invention) while being in contact with the surface of the wound package Pw, for example. With this arrangement, the wound package Pw is passively rotated 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 rotationally driven by an unillustrated motor.

[0046] The automatic doffer 10 is arranged to detach the wound package Pw from the winding device 19 and attach an empty winding bobbin Bw to the winding device 19. To put it differently, the automatic doffer 10 is arranged to be able to replace the completed wound package Pw with an empty winding bobbin Bw in the winding unit 4. The automatic doffer 10 is provided with an unillustrated cutter which is able to cut the yarn Y at around the wound package Pw. As the running yarn Y is cut by the cutter, the formation of the wound package Pw is completed. Even after the yarn is cut by the cutter, the yarn Y is unwound from the yarn supply package Ps at substantially the same speed as the winding onto the winding bobbin Bw, and is kept supplied to the winding device 19 side. The automatic doffer 10 includes an unillustrated suction which is able to suck, capture, and hold the running yarn Y supplied to the winding device 19, after the finish of the formation of a wound package Pw and until the start of the winding of the yarn Y onto the next winding bobbin Bw. Before the yarn Y is threaded to the winding bobbin Bw to which the yarn Y is to be wound next, a part of the yarn Y sucked by the suction is removed. The automatic doffer 10 is configured to thread the yarn Y to an empty winding bobbin Bw attached to the winding device 19. For

details of the structure of the automatic doffer 10, see Japanese Laid-Open Patent Publication No. H6-212521, for example.

[0047] In the winding unit 4 structured as above, the yarn Y which is sent from the third feed rollers 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 yarn Y is cut by the cutter of the automatic doffer 10 and the winding device 19 is stopped, the winding process of winding the yarn Y onto the winding bobbin Bw (i.e., formation of the wound package Pw) 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 having been formed is detached from the cradle 33 by the automatic doffer 10. Immediately after this, a new empty winding bobbin Bw is attached to the cradle 33 by the automatic doffer 10, and a yarn Y is threaded to the new winding bobbin Bw. As a result, it becomes possible to start winding of the yarn Y onto the new winding bobbin Bw. Hereinafter, for the sake of convenience, a process in which the machine controller 5 cuts the yarn Y by controlling the cutter of the automatic doffer 10 and terminates the formation of the wound package Pw by controlling the winding device 19 will be referred to as a formation termination process. For the sake of convenience, a process in which the machine controller 5 controls the automatic doffer 10 to replace the finished wound package Pw with a new winding bobbin Bw and to thread the yarn Y onto the new winding bobbin Bw will be referred to as a replacement process.

[0048] Among yarn layers formed by the yarn Y in the above-described yarn supply package Ps, those on the inner side in the radial direction of the yarn supply package Ps (i.e., those in the vicinity of the yarn supplying bobbin Bs, which will be referred to as an inner layer part) may be lower in quality than a part on the outer side in the radial direction of the inner layer part. As described below, there are several reasons for this. A yarn supply package Ps is typically formed by winding a yarn onto a yarn supplying bobbin Bs having a circumferential surface in which slits (not illustrated) are formed. When winding of a yarn onto such a yarn supplying bobbin Bs starts, the yarn Y is treated in such a way that the tension of the yarn Y is higher than when the yarn Y is wound, in order to cause the yarn Y to be reliably held at a part of the yarn supplying bobbin Bs, where the slits are formed. Furthermore, at the start of winding of the yarn Y onto the yarn supplying bobbin Bs that is typically harder than the yarn Y, the yarn Y tends to be damaged due to, for example, contact with the yarn supplying bobbin Bs. When such a low-quality yarn Y in the inner layer part is contaminated in a wound package Pw which is to be sold as a product, the grade of the wound package Pw may be decreased.

[0049] In the present embodiment, in order to avoid a wound package Pw which is to be sold as a product from being contaminated with a low-quality yarn Y, the machine controller 5 performs processes described below. Hereinafter, unless otherwise specified, the explanation deals with one specific spindle 9 among the spindles 9.

[0050] As a premise, the machine controller 5 is configured to be able to calculate the remaining amount of a yarn Y in a yarn supply package Ps from which the yarn Y is being unwound (hereinafter, an unwinding-in-progress package) at a predetermined reference time. (Hereinafter, this will be referred to as remaining amount calculation.) In the present embodiment, the reference time is a time at which the remaining amount calculation starts. Furthermore, the machine controller 5 is configured to be able to set in advance the content of a process performed when the remaining amount of the yarn Y in the yarn supply package Ps is reduced. (Hereinafter, this process will be referred to as an at-reduction process.) The remaining amount calculation and the at-reduction process will be specifically described below.

(Remaining Amount Calculation)

[0051] The following will describe the remaining amount calculation. The machine controller 5 is configured to be able to calculate (i.e., estimate) the remaining amount of the yarn Y included in the unwinding-in-progress package at the reference time, based on initial amount information, unwinding unit amount information, and cumulative time information that are described below. For convenience, the initial amount information, the unwinding unit amount information, and the cumulative time information may be collectively termed basic information.

[0052] The initial amount information is information related to an initial amount (initial weight or initial length) of a yarn Y in a yarn supply package Ps before unwinding of the yarn Y starts. The initial amount information is, for example, set in advance in the machine controller 5 as information in common between all yarn supply packages Ps of all spindles 9 of a single false-twist texturing machine 1. As more specific information, in the present embodiment, information of the above-described initial weight WF and information of fineness (i.e., 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, for example, kilogram. The fineness of the yarn Y is represented as F. The unit of the fineness is, for example, decitex. Decitex indicates the weight (gram) of the yarn Y per 10000 meters.

[0053] The unwinding unit amount information is information regarding the amount of a yarn Y unwound from a yarn supply package Ps per unit time. The unwinding unit amount information is, for example, information of the above-described unwinding speed V. In the present embodiment, for the sake of convenience, the unwinding speed V is substantially constant during a winding process. The unit of the unwinding speed is, for example, meter per minute. The unwinding unit amount information is, for example, set in advance in the machine controller 5 as information in common between all spindles 9 of a single false-twist texturing machine 1. The machine controller 5 obtains information of the

unwinding speed V based on, for example, the information of a set value of the rotation number of the first feed rollers 11.

[0054] The cumulative time information is information regarding the total time of unwinding of a yarn Y from a yarn supply package Ps (cumulative time). For the sake of convenience, the cumulative time of a yarn supply package Ps from which a yarn Y is unwound is represented as tin. The cumulative time information is obtained in the following manner. To begin with, when, for example, unwinding of the yarn Y from the above-described yarn supply package Ps1 (see FIG. 3) starts, the start of the unwinding of the yarn Y at the first attachment unit 22 is detected by the yarn detection sensor 24. At this stage, the machine controller 5 sets tin at a predetermined initial time (reset process). The initial time is zero, for example. Thereafter, the machine controller 5 increases tin over time (updates tin) while the yarn Y is being unwound from the yarn supply package Ps. When the unwinding of the yarn Y from the yarn supply package Ps is temporarily stopped due to, for example, yarn breakage (i.e., when a stop time is generated), the machine controller 5 temporarily stops the update of tin. In this way, the machine controller 5 obtains only the time (detection time) during which the unwinding of the yarn Y from the yarn supply package Ps is detected by the yarn detection sensor 24, as the cumulative time (tin). When a yarn Y is being unwound from a yarn supply package Ps, the machine controller 5 is able to obtain cumulative time information of that yarn supply package Ps.

[0055] During the winding process, the machine controller 5 determines whether yarn supply package switching with which the yarn supply package Ps supplying the yarn Y is switched has occurred, based on a detection result of the yarn detection sensor 24. For example, in FIG. 3, the yarn supply package switching is a matter in which unwinding of the yarn Y from the yarn supply package Ps1 ends (end of unwinding) and unwinding of the yarn Y from the yarn supply package Ps2 starts. When the state of the yarn detection sensor 24 is switched from a state in which the yarn Y is detected by one of the first detection unit 25 and the second detection unit 26 to a state in which the yarn Y is detected by the other of the first detection unit 25 and the second detection unit 26, the machine controller 5 determines that the yarn supply package switching has occurred. When it is determined that the yarn supply package switching has occurred, the machine controller 5 sets tin at the predetermined initial time by performing the above-described reset process.

[0056] As described above, the machine controller 5 generates (i.e., obtains), by calculation, the initial amount information, the unwinding unit amount information, and the cumulative time information as the basic information.

[0057] When the remaining amount of the yarn Y in the unwinding-in-progress package at the reference time is WR, the machine controller 5 performs the remaining amount calculation by using the basic information and based on the equation below. In the equation, "1000" and "10000" are coefficients for converting the units of the numbers on the respective sides of the equation to kilogram.

[0058]

$$WR=WF-(V \times F/10000) \times tin/1000$$

[0059] When the ratio of the remaining amount of the yarn Y in the unwinding-in-progress package to the initial amount (hereinafter, this ratio will be referred to as a remaining amount ratio) is R, the machine controller 5 is able to calculate the remaining amount ratio based on the equation below. The machine controller 5 may calculate the remaining amount ratio as a percentage of WR to WF (i.e., a remaining amount percentage).

$$R=WR/WF$$

[0060] Alternatively, a machine controller 5 may calculate the remaining amount ratio by utilizing only the basic information, without utilizing WR.

[0061] When the remaining time during which the yarn Y can be supplied from the unwinding-in-progress package is tR, the machine controller 5 may estimate tR based on, for example, the equation below. The unit of tR is minute.

$$tR=WF \times 1000/(V \times F/10000)-tin$$

(Arrangement for At-Reduction Process)

[0062] The following will describe an arrangement for the at-reduction process with reference to FIG. 4. FIG. 4 illustrates items such as a selection screen for selecting a processing mode of the false-twist texturing machine 1. For the sake of convenience, a display is provided as the machine output unit 5b and a touch panel is provided as the machine input unit 5a to overlap the display (see FIG. 4). It is noted that the machine input unit 5a and the machine output unit 5b may be arranged differently.

[0063] The machine controller 5 stores information of plural options of the at-reduction process in the machine storage unit 5c. The machine controller 5 is, for example, configured to be able to display the options of the at-reduction process on

the machine output unit 5b (see a screen S1 in FIG. 4). The machine controller 5 is configured to be able to set in advance the content of the at-reduction process in accordance with an input to the machine input unit 5a by the operator. For example, options "Nothing" and "Formation of Inner-Layer-Part-Inclusive Wound Package" are displayed in an upper part of the screen S1. "Nothing" indicates that no particular process is performed when the remaining amount of the unwinding-in-progress package is reduced. "Formation of Inner-Layer-Part-Inclusive Wound Package" indicates that, when the remaining amount of the unwinding-in-progress package is reduced, a later-described inner-layer-part-inclusive wound package is formed. Furthermore, for example, an entry field for inputting a processing condition is displayed in a lower part of the screen S1. The processing condition indicates what condition must be satisfied to start the execution of the at-reduction process. In the example shown in FIG. 4, the machine controller 5 is arranged to execute the at-reduction process when the above-described remaining amount ratio (R) becomes equal to or less than 5 %. As the at-reduction process, the machine controller 5 executes a process of forming a later-described inner-layer-part-inclusive wound package when the "Formation of Inner-Layer-Part-Inclusive Wound Package" is selected in advance and a predetermined processing condition is satisfied.

(When At-Reduction Process Is Not Executed)

[0064] For facilitating the understanding of the explanation below, with reference to FIG. 5(a) to FIG. 5(c), the following will describe unwinding of the yarn Y from each yarn supply package Ps and formation of each wound package Pw when the at-reduction process is not performed (i.e., when the above-described option "Nothing" is selected). FIG. 5(a) to FIG. 5(c) are graphs showing the relationship between a yarn amount in a known processing mode in which the at-reduction process is not performed and a time. To be more specific, FIG. 5(a) is a graph showing the relationship between the remaining amount (vertical axis) of a yarn Y in a yarn supply package Ps (specifically, a yarn supply package Ps1, Ps3) attached to the first attachment unit 22 and a time (horizontal axis). FIG. 5(b) is a graph showing the relationship between the remaining amount (vertical axis) of a yarn Y in a yarn supply package Ps (specifically, a yarn supply package Ps2) attached to the second attachment unit 23 and a time (horizontal axis). FIG. 5(c) is a graph showing the relationship between the wound amount (vertical axis) of a yarn Y on a winding bobbin Bw (specifically, a winding bobbin Bw1, Bw2, Bw3, Bw4, Bw5) and a time (horizontal axis). In all of the graphs in FIG. 5(a) to FIG. 5(c), a time t0 at which unwinding of the yarn Y from the yarn supply package Ps1 starts is the origin. In the present embodiment, in a state in which the yarn Y has not been unwound from each yarn supply package Ps at all (i.e., each package is fully wound), the weight (initial weight) of each yarn supply package Ps is WF.

[0065] To begin with, prior to the time t0, a fully-wound yarn supply package Ps1 is attached to the first attachment unit 22. The initial weight of the yarn Y in the yarn supply package Ps1 is WF. Prior to the time t0, a fully-would yarn supply package Ps2 is attached to the second attachment unit 23, too. A terminal portion of the yarn Y in the yarn supply package Ps1 is joined with a start end portion of the yarn Y in the yarn supply package Ps2 so that a node K is formed. At the time t0, yarn threading to the sections of a predetermined spindle 9 starts. In accordance with this, at the time t0, unwinding of the yarn Y from the fully-wound yarn supply package Ps1 starts. Thereafter, at a time ts1 immediately after the time t0, the yarn threading to the winding bobbin Bw1 attached to the winding device 19 finishes, and winding of the yarn Y onto the winding bobbin Bw1 starts (i.e., formation of the wound package Pw1 starts). Between the start of unwinding of the yarn Y from the yarn supply package Ps1 to the finish of yarn threading to the winding bobbin Bw1, the yarn Y is sucked and captured by the suction of the automatic doffer 10. In the present embodiment, the unwinding speed of the yarn Y when the yarn threading is performed is substantially identical with the unwinding speed (V described above) when the yarn Y is wound onto the winding bobbin Bw.

[0066] As time passes, the remaining amount (remaining weight) of the yarn Y in the yarn supply package Ps1 decreases whereas the wound amount (wound weight) of the yarn Y wound onto the winding bobbin Bw1 increases. In other words, the amount of the yarn Y in the wound package Pw1 increases over time. The machine controller 5 counts the time elapsed from the start of the formation of the wound package Pw1. By utilizing this information of the time, the machine controller 5 calculates the amount of the yarn Y in the wound package Pw1. When determining that the amount of the yarn Y in the wound package Pw1 reaches a predetermined target wound amount, the machine controller 5 terminates the formation of the wound package Pw1 (i.e., executes the formation termination process). To be more specific, for example, at a time te1, as the machine controller 5 causes the cutter of the automatic doffer 10 to cut the yarn Y, the winding process of winding the yarn Y onto the winding bobbin Bw1 is terminated. On this account, the time te1 is the winding end time at which winding of the yarn Y onto the winding bobbin Bw1 ends (i.e., formation of the wound package Pw1 is terminated). Onto the winding bobbin Bw1, only the yarn Y supplied from the yarn supply package Ps1 has been wound. Cutting of the yarn Y by the cutter and suction and capture of the yarn Y by the suction (i.e., start of sucking and removal of the yarn Y) are almost simultaneously performed. Furthermore, the machine controller 5 executes a replacement process by controlling the automatic doffer 10. In other words, the machine controller 5 controls the automatic doffer 10 to detach the winding bobbin Bw1 (wound package Pw1) from the cradle 33, to attach the winding bobbin Bw2 to the cradle 33, and to perform yarn threading to the winding bobbin Bw2. As a result, at a time ts2 immediately after the time te1, attachment of the winding

bobbin Bw2 to the cradle 33 by the automatic doffer 10 is completed and a winding process of winding the yarn Y onto the winding bobbin Bw2 starts. There is a slight time lag tL (see FIG. 5(c)) between the winding end time (te1) of the winding bobbin Bw1 and the winding start time (ts2) of the winding bobbin Bw2 onto which the yarn Y is to be wound next to the winding bobbin Bw1. As described above, even when the winding bobbin Bw is being replaced, the yarn Y is unwound from the yarn supply package Ps at a substantially same speed as the yarn Y wound onto the winding bobbin Bw. At a time te2, the winding process of winding the yarn Y onto the winding bobbin Bw2 ends (formation of the wound package Pw2 finishes) and a winding process of winding the yarn Y onto a winding bobbin Bw3 starts at a time ts3.

[0067] At a time ta1 (see FIG. 5(a)) after the time ts3, the yarn supply package Ps1 attached to the first attachment unit 22 becomes empty. Therefore the time ta1 is the unwinding end time at which 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 a time tb1 (= the time ta1), the node K formed by joining the yarn Y in the yarn supply package Ps1 with the yarn Y in the yarn supply package Ps2 is pulled toward the winding device 19 side. As a result, unwinding of the yarn Y from the yarn supply package Ps2 attached to the second attachment unit 23 starts. Therefore the time tb1 is the unwinding start time at which the yarn Y is unwound from the yarn supply package Ps2 for the first time (i.e., unwinding of the yarn Y from the yarn supply package Ps2 starts). Thereafter, at a time te3, the winding process of winding the yarn Y onto the winding bobbin Bw3 ends (formation of the wound package Pw3 finishes). On a winding bobbin Bw3, 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 Pw3 includes a node K. Thereafter, at a time ts4, a winding process of winding the yarn Y onto a winding bobbin Bw4 starts. At a time te4, the winding process of winding the yarn Y onto the winding bobbin Bw4 ends (formation of the wound package Pw4 finishes). Onto the winding bobbin Bw4, only the yarn Y unwound from the yarn supply package Ps2 has been wound.

[0068] After the time ta1 and before the yarn supply package Ps2 becomes empty (e.g., at the time ta2), the operator detaches the empty yarn supply package Ps1 from the first attachment unit 22 and attaches a new fully-wound yarn supply package Ps3 to the first attachment unit 22 (yarn supply package replacement). The remaining weight of the yarn supply package Ps3 at this stage is WF. Thereafter, at an appropriate timing, a terminal portion of the yarn Y in the yarn supply package Ps2 is joined (connected) by the operator with a start end portion of the yarn Y in the yarn supply package Ps3 so that a node K (see FIG. 3) is formed. The operator may manually join (connect) the end portions. Alternatively, the operator may join the end portions by operating an unillustrated portable joining device, for example.

[0069] Thereafter, from a time ts5 to a time te5, the yarn Y is wound onto a winding bobbin Bw5 (a wound package Pw5 is formed). At a time tb2 between the time ts5 and the time te5, the yarn supply package Ps2 attached to the second attachment unit 23 becomes empty. At the same time when the yarn supply package Ps2 becomes empty, at a time ta3 (= the time tb2), unwinding of the yarn Y from the yarn supply package Ps3 attached to the first attachment unit 22 starts.

[0070] When the at-reduction process is not performed, the yarn Y is unwound from each yarn supply package Ps as described above and each wound package Pw is formed.

(Steps of Formation of Inner-Layer-Part-Inclusive Wound Package)

[0071] With reference to FIG. 6 to FIG. 8(c), the following will describe the steps of the formation of an inner-layer-part-inclusive wound package when the "Formation of Inner-Layer-Part-Inclusive Wound Package" is selected as the mode in the at-reduction process. FIG. 6 is a flowchart showing the steps of replacement of a winding bobbin Bw, which is performed when the remaining amount of a yarn Y in a yarn supply package Ps is reduced. FIGs. 7(a) to 7(c) are graphs showing the relationship between a yarn amount and a time in a processing mode for forming an inner-layer-part-inclusive wound package. Being similar to FIG. 5(a), FIG. 7(a) is a graph showing the relationship between the remaining amount (vertical axis) of a yarn Y in a yarn supply package Ps attached to the first attachment unit 22 and a time (horizontal axis). Being similar to FIG. 5(b), FIG. 7(b) is a graph showing the relationship between the remaining amount (vertical axis) of a yarn Y in a yarn supply package Ps attached to the second attachment unit 23 and a time (horizontal axis). Being similar to FIG. 5(c), FIG. 7(c) is a graph showing the relationship between the wound amount (vertical axis) of a yarn Y on a winding bobbin Bw and a time (horizontal axis). Each of FIG. 8(a) and FIG. 8(b) is a schematic diagram of a wound package Pw. FIG. 8(c) illustrates information regarding the rank of a wound package Pw. FIG. 8(c) shows a screen S2 regarding information of a wound package Pw displayed on the machine output unit 5b, for example.

[0072] In an initial state, being similar to the above-described case where the at-reduction process is not performed, a yarn supply package Ps1 is attached to the first attachment unit 22 and a yarn supply package Ps2 is attached to the second attachment unit 23, for example. Furthermore, the yarn Y unwound from the yarn supply package Ps1 is processed by the processing unit 3 and is wound onto a winding bobbin Bw1. The yarn supply package Ps1 is equivalent to a first yarn supply package of the present invention. The yarn supply package Ps2 is equivalent to a second yarn supply package of the present invention.

[0073] Each time a predetermined time elapses, the machine controller 5 calculates the remaining amount ratio of the yarn Y remaining in the yarn supply package Ps1, for example. Hereinafter, for the sake of convenience, information of a value of a remaining amount ratio will be referred to as remaining amount-related information. To put it differently, the

machine controller 5 generates (obtains) the remaining amount-related information by calculation, each time the predetermined time elapses. The machine controller 5 determines whether the remaining amount ratio is not smaller than a predetermined value (S101). The predetermined value is a value that was set at the time of setting the above-described processing condition (see "5% or less" in FIG. 4). Until the remaining amount ratio becomes equal to or smaller than the predetermined value (No in S101), the machine controller 5 forms a wound package Pw at a predetermined spindle 9, in the same manner as in the case where the at-reduction process is not performed. In this example, the wound packages Pw1 and Pw2 are formed in order in the same manner as in the case where the at-reduction process is not performed. The machine controller 5 evaluates the wound packages Pw1 and Pw2 as wound packages Pw with the highest rank (e.g., "A1" in FIG. 8(c)). The machine controller 5 stores the individual information (see "ID" in FIG. 8(c)) and the rank of each wound package Pw in association with each other.

[0074] When it is determined that the remaining amount ratio becomes not larger than the predetermined value (remaining amount reduction determination; Yes in S101), the machine controller 5 controls and causes the winding device 19 to perform, for a wound package Pw in production, inner layer part avoiding marking operation that is described below (S102). For example, a time at which the remaining amount of the yarn Y in the yarn supply package Ps1 becomes W1 (see the time t1 in FIG. 7(a)) is a time at which the remaining amount ratio reaches the predetermined value. When the remaining amount ratio reaches the predetermined value, for example, the yarn Y is being wound onto a winding bobbin Bw3 and a wound package Pw3s is being formed (see FIG. 7(c)). When the remaining amount reduction determination is performed while the yarn Y is being unwound from the yarn supply package Ps1, the machine controller 5 performs an inner layer part avoiding marking operation in such a way that a motor 37 (see FIG. 3) is controlled to passively rotate a wound package Pw3s and a motor 36 is controlled to stop the traverse guide 35 at a predetermined first position in the winding bobbin axial direction. As a result, so-called straight winding is formed on the wound package Pw3s, i.e., a mark M1 (see FIG. 8(a)) is formed on the wound package Pw3s. To put it differently, the wound package Pw3s is marked. The inner layer part avoiding marking operation is encompassed in a marking operation of the present invention.

[0075] The machine controller 5 controls the automatic doffer 10 to cut the running yarn Y and terminates the formation of the wound package Pw3s (formation termination process). Thereafter, the machine controller 5 controls the automatic doffer 10 to replace the wound package Pw3s with a new winding bobbin Bw4 at the winding device 19 (S103; replacement process) Furthermore, the machine controller 5 controls the automatic doffer 10 to perform yarn threading to the new winding bobbin Bw4 (new winding bobbin of the present invention). This makes it possible to avoid the contamination of the yarn Y in the inner layer part of the yarn supply package Ps1 into the wound package Pw3s. The wound package Pw3s is smaller than the wound packages Pw1 and Pw2 (see FIG. 7(c)). To put it differently, the formation of the wound package Pw3s is terminated in a state in which the amount of the yarn Y in this package is smaller than the above-described target wound amount. The wound package Pw3s is equivalent to a formation forcible termination wound package of the present invention.

[0076] Furthermore, the machine controller 5 evaluates the wound package Pw3s as a wound package Pw which is, for example, lower in rank than the wound packages Pw1 and Pw2 (see e.g., A2 in FIG. 8(c)), and stores the individual information and the rank of the wound package Pw3s in association with each other. In S103, the machine controller 5 stores the individual information of the wound package Pw3s and information indicating that the remaining amount reduction determination has been done during the formation of the wound package Pw3s (see e.g., inner layer part contamination avoidance in FIG. 8(c)), in association with each other.

[0077] Subsequently, the machine controller 5 controls the winding device 19 to start winding of the yarn Y onto a winding bobbin Bw4, i.e., to start formation of a wound package Pw4r. The machine controller 5 determines whether the above-described yarn supply package switching has occurred during the formation of the wound package Pw4r, based on a detection result of the yarn detection sensor 24 (S104). The machine controller 5 continues the formation of the wound package Pw4r until the occurrence of the yarn supply package switching (No in S104). When the yarn supply package switching occurs, the unwinding of the yarn Y from the yarn supply package Ps1 finishes, a node K is pulled, and unwinding of the yarn Y from the yarn supply package Ps2 starts (see FIGs. 7(a) and 7(b)). When determining that the yarn supply package switching has occurred (switching determination; Yes in S104), the machine controller 5 executes a below-described inner layer part inclusive marking operation for the wound package Pw4r (S105). When the switching determination is performed while the yarn Y is being wound onto the winding bobbin Bw4, as the inner layer part inclusive marking operation, the machine controller 5 controls the motor 37 to passively rotate the wound package Pw4r and controls the motor 36 to stop the traverse guide 35 at a predetermined second position in the winding bobbin axial direction. As a result, straight winding is formed on the wound package Pw4r, i.e., a mark M2 (see FIG. 8(b)) is formed on the wound package Pw4r. To put it differently, the wound package Pw4r is marked. The inner layer part inclusive marking operation is encompassed in the marking operation of the present invention.

[0078] The machine controller 5 preferably controls the motor 36 so that the position of the mark M1 in the winding bobbin axial direction is different from the position of the mark M2 in the winding bobbin axial direction. For example, in the winding bobbin axial direction, the mark M1 may be positioned at around an equidistant position between an end face of the wound package Pw3s and the center of the wound package Pw3s. The mark M2 may be provided at around the center in the

winding bobbin axial direction of the wound package Pw4r. This makes it easy to discern the wound package Pw3s from the wound package Pw4r by appearance.

[0079] In addition to the above, the machine controller 5 controls the cutter of the automatic doffer 10 at a predetermined timing to cut the running yarn Y so that, for example, the node K is included in the wound package Pw4r, and terminates the formation of the wound package Pw4r (formation termination process). As a result, the yarn Y in the inner layer part of the yarn supply package Ps1 and the node K are wound into the winding bobbin Bw4, and the wound package Pw4r is formed. Alternatively, the machine controller 5 may cause the cutter of the automatic doffer 10 to cut the running yarn Y at a timing at which the node K is not included in the wound package Pw4r and is sucked and removed by the suction of the automatic doffer 10.

[0080] Thereafter, the machine controller 5 controls the automatic doffer 10 to replace the wound package Pw4r with a new winding bobbin Bw5 (a new winding bobbin of the present invention) at the winding device 19 (S106; replacement process). In the same manner as the wound package Pw3s, the wound package Pw4r is smaller than the wound packages Pw1 and Pw2 (see FIG. 7(c)). The wound package Pw4r is intentionally formed as a wound package Pw that is inferior to the other wound packages Pw in quality, in order to remove the yarn Y in the inner layer part of the yarn supply package Ps1. The wound package Pw4r may be discarded. Alternatively, the wound package Pw4r may be treated as a low-ranked wound package Pw. The wound package Pw4r formed by winding the yarn Y onto the winding bobbin Bw4 is equivalent to the inner-layer-part-inclusive wound package of the present invention. Furthermore, the machine controller 5 controls the automatic doffer 10 to perform yarn threading to a new winding bobbin Bw5. The machine controller 5 controls the winding device 19 to start winding of the yarn Y onto the winding bobbin Bw5.

[0081] Furthermore, the machine controller 5 evaluates the wound package Pw4r as a wound package Pw which is, for example, lower in rank than the wound packages Pw1, Pw2, and Pw3r (see e.g., B in FIG. 8(c)). The machine controller 5 stores the individual information and the rank of the wound package Pw4r in association with each other. In S106, the machine controller 5 stores the individual information of the wound package Pw4r and information indicating that the switching determination has been done during the formation of the wound package Pw4r (see e.g., "including inner layer part" in FIG. 8(c)), in association with each other.

[0082] Furthermore, the yarn Y is wound onto a winding bobbin Bw5 and a wound package Pw5 is formed. Being similar to the wound packages Pw1 and Pw2, the wound package Pw5 is formed as a high-ranked wound package Pw (see FIG. 8(c)). Subsequent processes are not explained.

[0083] As described above, when the remaining amount of the yarn Y in the yarn supply package Ps1 becomes not larger than the predetermined value, i.e., when unwinding of the yarn Y in the inner layer part from the yarn supply package Ps1 starts, the formation of the wound package Pw3s is terminated (formation termination process). This makes it possible to avoid the inclusion of the low-quality yarn Y in the wound package Pw3s that is a product. It is therefore possible avoid the contamination of the low-quality yarn Y in the wound package Pw that is a product.

[0084] The machine controller 5 stores the individual information of the wound package Pw3s (formation forcible termination wound package) and information regarding the remaining amount reduction determination, in association with each other. It is possible to discern the wound package Pw3s from the other wound packages Pw by utilizing the information stored in the machine controller 5.

[0085] At the execution of the switching determination, the wound package Pw4r is replaced with a new winding bobbin Bw5. With this arrangement, it is possible to immediately wind the yarn Y in the yarn supply package Ps2 onto the new winding bobbin Bw5 after the occurrence of the yarn supply package switching. It is therefore possible to suppress a large amount of the high-quality yarn Y in the yarn supply package Ps2 from being included in the wound package Pw4r.

[0086] The machine controller 5 stores the individual information of the wound package Pw4r (inner-layer-part-inclusive wound package) and information regarding the switching determination, in association with each other. It is possible to discern the wound package Pw4r from the other wound packages Pw by utilizing the information stored in the machine controller 5.

[0087] The machine controller 5 causes the winding device 19 to perform the inner layer part inclusive marking operation. This makes it possible to discern the wound package Pw without the mark M2 from the wound package Pw4r by appearance.

[0088] The machine controller 5 causes the winding device 19 to perform the inner layer part avoiding marking operation. This makes it possible to discern the wound package Pw without the mark M1 from the wound package Pw3s by appearance.

[0089] The machine controller 5 causes the winding device 19 to perform the inner layer part avoiding marking operation and the inner layer part inclusive marking operation in order to make it possible to discern the wound package Pw3s from the wound package Pw4r. This makes it easy to discern the wound package Pw3s from the wound package Pw4r by appearance. On this account, it is possible to discern the wound package Pw3s from the wound package Pw4r even if they are unintentionally mixed.

[0090] In addition to the above, as the marking operation, it is possible to form a straight winding on the wound package Pw. This makes it possible to achieve the marking operation by a simple means.

[0091] 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.

[0092]

(1) In the embodiment above, the machine controller 5 stores the information of "Nothing" and "Formation of Inner-Layer-Part-Inclusive Wound Package" as options in the at-reduction process. In addition to them, as an option in the at-reduction process, the machine controller 5 may be able to select a process of cutting the yarn Y by the above-described cutter 27 in response to satisfaction of a predetermined condition. Such an option may be displayed as "Yarn Cutting" on the machine output unit 5b, for example. When the "Yarn Cutting" is selected as the processing mode, the machine controller 5 causes the cutter 27 to cut the yarn Y when the remaining amount reduction determination is performed and stops the operation of the spindle 9 where the yarn Y is running. With this, the formation of the wound package Pw (formation forcible termination wound package) at the spindle 9 is terminated (formation termination process). In this case, the cutter 27 is equivalent to the cutting unit of the present invention. Also when the "Yarn Cutting" is selected as the processing mode, the machine controller 5 may cause the winding device 19 to perform the inner layer part avoiding marking operation.

(2) In the embodiment above, the machine controller 5 stores the individual information of each wound package Pw and the information regarding the determination performed for each wound package Pw (i.e., the remaining amount reduction determination or the switching determination described above), in association with each other. However, the disclosure is not limited to this. The machine controller 5 may not store the information regarding the determination performed for each wound package Pw.

(3) In the embodiment above, the machine controller 5 causes the winding device 19 to perform the inner layer part avoiding marking operation and the inner layer part inclusive marking operation. However, the disclosure is not limited to this. In each spindle 9, for example, an unillustrated marking device (marking unit) may be provided to be able to color the yarn Y immediately before it is wound onto the rotating winding bobbin Bw. The marking device may be, for example, arranged to be able to discharge or spray liquid such as ink onto the yarn Y. The marking device may be arranged such that, for example, in order to make it possible to discern a formation forcible termination wound package from an inner-layer-part-inclusive wound package by appearance, the color of the ink applied to the yarn Y wound onto the formation forcible termination wound package is differentiated from the color of the ink applied to the yarn Y wound onto inner-layer-part-inclusive wound package.

(4) In the embodiment above, the machine controller 5 causes the winding device 19 or the marking device to perform both the inner layer part avoiding marking operation and the inner layer part inclusive marking operation. However, the disclosure is not limited to this. Only one of the inner layer part avoiding marking operation and the inner layer part inclusive marking operation may be performed. Alternatively, neither the inner layer part avoiding marking operation nor the inner layer part inclusive marking operation may be performed. Even in such cases, it is possible to avoid the contamination of a formation forcible termination wound package (e.g., the wound package Pw3s) that is a product with a low-quality yarn Y.

(5) In the embodiment above, the initial amount information is stored in the machine controller 5 as a common value for 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 divided into plural groups. The machine controller 5 may be arranged to be able to set initial amount information of each of the groups. Alternatively, the machine controller 5 may be arranged to be able to set initial amount information of each spindle 9. In this case, the machine controller 5 may be further arranged to be able to obtain initial amount information (or information of an initial value of the remaining time) of each of plural yarn supply packages Ps. To be more specific, each time a new yarn supply package Ps is attached to the yarn supply package retaining portion 20, information such as initial amount information of the new yarn supply package Ps may be individually obtained.

(6) In the embodiment above, the operator performs the replacement of the yarn supply package Ps. However, the disclosure is not limited to this. The replacement of the yarn supply package Ps may be performed by, for example, an unillustrated creel robot. The yarn processing facility 100 may include an unillustrated wound package conveyance device which is configured to collect a formed wound package Pw.

(7) In the embodiment above, the start and finish of unwinding of the yarn Y from the yarn supply package Ps are detected by 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. 9, a yarn supplying unit 2a of a false-twist texturing machine 1a may include, in each spindle 9a, a detection unit 41 that is structurally different from the yarn detection sensor 24. Being similar to the yarn detection sensor 24, the detection unit 41 is equivalent to the detection unit of the present invention. The detection unit 41 may include, for example, a supply sensor 42 and a node sensor 43. The supply sensor 42 is configured to be able to detect whether the yarn Y is being supplied from the first attachment unit 22 (i.e., whether unwinding has started). The node sensor 43 is configured to be able to detect a node K that is stationarily provided at a predetermined position. According to this arrangement, when the node K is moved from the

predetermined position and the node K is no longer detected by the node sensor 43, it is determined that the yarn supply package switching has occurred (i.e., the unwinding is terminated). From which one of the attachment units, the first attachment unit 22 and the second attachment unit 23, the yarn Y is being supplied at the time of the yarn supply package switching can be known based on a detection result of the supply sensor 42. In this way, even when a result of detection of the node K is used, it is possible to reliably know from which one of the attachment units, the first attachment unit 22 and the second attachment unit 23, the yarn Y is being supplied. The node sensor 43 may be arranged to be able to detect a moving node K.

(8) Each yarn supply package retaining portion 20 may be arranged to be able to retain three or more yarn supply packages Ps. In this case, end portions of the yarns Y in the three or more yarn supply packages Ps may be suitably connected to one another.

Alternatively, as shown in FIG. 10, in each spindle 9, a yarn supplying unit 2b of a false-twist texturing machine 1b may include a yarn supply package retaining portion 50 which is able to retain only one yarn supply package Ps, in place of the yarn supply package retaining portion 20. In this case, the yarn supply package retaining portion 50 includes only one package attachment unit 21. The yarn supplying unit 2b may include a supply sensor 42. Also in this arrangement, the machine controller 5 may store the information of "Nothing", "Formation of Inner-Layer-Part-Inclusive Wound Package", and "Yarn Cutting" as options in the at-reduction process. When the "Formation of Inner-Layer-Part-Inclusive Wound Package" is selected as the processing mode, the machine controller 5 may execute the formation termination process and the replacement process when the remaining amount reduction determination is performed. In this case, when the yarn supply package Ps retained by the yarn supply package retaining portion 50 runs out of the yarn Y, the operation of the spindle 9b having that yarn supply package retaining portion 50 is stopped. When the "Yarn Cutting" is selected as the processing mode, the machine controller 5 may cause the cutter 27 to cut the yarn when the remaining amount reduction determination is performed. In this case, the operation of the spindle 9b having that cutter 27 is stopped when the cutter 27 cuts the yarn.

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

(10) In the embodiment above, the machine controller 5 controls the sections of the false-twist texturing machine 1 and generates the remaining amount-related information. However, the disclosure is not limited to this. For example, the management device 101 may control the sections of the false-twist texturing machine 1 and/or may generate the remaining amount-related information. In this case, the management device 101 is included in the controller of the present invention.

(11) While in the embodiment above the information management unit 110 includes the machine controllers 5 and the management device 101, the disclosure is not limited to this arrangement. The information management unit 110 may include a computer device (not illustrated) that is neither the machine controller 5 nor the management device 101. Alternatively, the information management unit 110 may include only the machine controller 5 or the management device 101.

(12) While in the embodiment above the yarn processing facility 100 includes plural false-twist texturing machines 1, the disclosure is not limited to this arrangement. The yarn processing facility 100 may include only one false-twist texturing machine 1. In addition to this, the management device 101 may not be provided. Furthermore, while in the embodiment above the false-twist texturing machine 1 has plural spindles 9, the disclosure is not limited to this arrangement. The number of the spindles 9 in the false-twist texturing machine 1 may be one. To put it differently, the number of the yarn supply package retaining portions 20 in the yarn supplying unit 2 may be one.

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

Claims

1. A yarn processor (1) capable of processing a yarn (Y) unwound from a yarn supply package (Ps) and winding the yarn (Y) onto a winding bobbin (Bw), comprising:

a yarn supply package retaining portion (20) which is configured to retain the yarn supply package (Ps);
a winding device (19) which is capable of forming a wound package (Pw) by winding the yarn (Y) onto the winding bobbin (Bw);
a cutting unit (10) which is capable of cutting the yarn (Y) before the yarn (Y) is wound onto the winding bobbin (Bw) ;
a bobbin replacement unit (10) which is capable of replacing the wound package (Bw) formed by the winding device (19) with a new winding bobbin (Bw4, Bw5) as the winding bobbin (Bw) and which is capable of performing yarn threading to the new winding bobbin (Bw4, Bw5); and
a controller (5) which is capable of performing: a formation termination process of cutting the yarn (Y) by controlling the cutting unit (10) and terminating formation of the wound package (Pw) by controlling the winding device (19); and a replacement process of replacing the formed wound package (Pw) with the new winding bobbin (Bw4, Bw5) and threading a yarn (Y) to the new winding bobbin (Bw4, Bw5) by controlling the bobbin replacement unit (10),
the controller (5) performing the formation termination process and the replacement process when determining that an amount of the yarn (Y) in the wound package (Pw) in formation reaches a predetermined target wound amount,
the control unit (5) generating, by calculation, remaining amount-related information that is numerical information regarding a remaining amount of the yarn (Y) remaining in the yarn supply package (Ps) which is retained by the yarn supply package retaining portion (20) and from which the yarn (Y) is being unwound, and
when determining in remaining amount reduction determination that a numerical value of the remaining amount-related information is not larger than a predetermined value, the control unit (5) performing the formation termination process to cause the winding device (19) to form a formation forcible termination wound package (Pw3s) that is a wound package (Pw) having a smaller amount of the yarn (Y) than the target wound amount.

2. The yarn processor (1) according to claim 1, wherein, the controller (5) stores individual information of the formation forcible termination wound package (Pw3s) and information regarding the remaining amount reduction determination, in association with each other.

3. The yarn processor (1) according to claim 1 or 2, wherein,

the yarn supply package retaining portion (20) is capable of retaining, as the yarn supply package (Ps), a first yarn supply package (Ps1) and a second yarn supply package (Ps2) different from the first yarn supply package (Ps1) and is capable of uninterruptedly supplying the yarn (Y) when a yarn connecting portion (K) is formed by connecting a start end portion of a yarn (Y) in the first yarn supply package (Ps1) with a terminal portion of a yarn in the second yarn supply package (Ps2),
a detection unit (24) is provided to be able to detect information indicating occurrence of yarn supply package switching in which unwinding of the yarn (Y) from the first yarn supply package (Ps1) finishes at the yarn supply package retaining portion (20), the yarn connecting portion (K) starts to move, and unwinding of the yarn (Y) from the second yarn supply package (Ps2) starts,
when the remaining amount reduction determination is performed while the yarn (Y) is being unwound from the first yarn supply package (Ps1), the controller (5) terminates formation of the formation forcible termination wound package (Pw3s) by performing the formation termination process, the controller (5) performs the replacement process after the formation of the formation forcible termination wound package (Pw3s), and the controller (5) causes the winding device to form an inner-layer-part-inclusive wound package (Pw4r) that is a wound package (Pw) and includes the yarn (Y) unwound from the first yarn supply package (Ps1) after the remaining amount reduction determination, by winding the yarn (Y) unwound from the first yarn supply package (Ps1) and processed after the remaining amount reduction determination onto the new winding bobbin (Bw4) attached to the winding device (19) in the replacement process that is performed after the formation of the formation forcible termination wound package (Pw3s), and
when switching determination is performed based on a result of detection by the detection unit (24) to determine whether the yarn supply package switching occurs while the inner-layer-part-inclusive wound package (Pw4r) is being formed, the control unit (5) terminates formation of the inner-layer-part-inclusive wound package by performing the formation termination process, the control unit (5) performs the replacement process after the formation of the inner-layer-part-inclusive wound package (Pw4r), and the control unit (5) performs the replacement process after the formation of the inner-layer-part-inclusive wound package (Pw4r) to wind the yarn (Y) unwound from the second yarn supply package (Ps2) and processed after the switching determination onto the new winding bobbin (Bw5) attached to the winding device.

4. The yarn processor (1) according to claim 3, wherein, the controller (5) stores individual information of the inner-layer-part-inclusive wound package (Pw4r) and information regarding the switching determination, in association with each other.

5. The yarn processor (1) according to claim 3 or 4, further comprising

a marking unit (19) which is capable of performing a marking operation of providing a mark on the wound package (Pw) that is being formed by the winding device (19),
when the switching determination is performed, the controller (5) controlling and causing the marking unit (19) to perform, as the marking operation, an inner layer part inclusive marking operation of providing a mark on the inner-layer-part-inclusive wound package (Pw4r).

6. The yarn processor (1) according to any one of claims 1 to 4, further comprising

a marking unit (19) which is capable of performing a marking operation of providing a mark on the wound package (Pw) that is being formed by the winding device (19),
when the remaining amount reduction determination is performed, the controller (5) controlling and causing the marking unit (19) to perform, as the marking operation, an inner layer part avoiding marking operation of providing a mark on the formation forcible termination wound package (Pw3s).

7. The yarn processor (1) according to claim 5, wherein, when the remaining amount reduction determination is performed, the controller (5) controlling and causing the marking unit (19) to perform, as the marking operation, an inner layer part avoiding marking operation of providing a mark on the formation forcible termination wound package (Pw3s).

8. The yarn processor (1) according to claim 7, wherein,

the marking unit (19) is capable of performing the marking operation so that the formation forcible termination wound package (Pw3s) is discerned from the inner-layer-part-inclusive wound package (Pw4r), and
the controller (5) controls and causes the marking unit (19) to perform the inner layer part inclusive marking operation and the inner layer part avoiding marking operation so that the formation forcible termination wound package (Pw3s) is discerned from the inner-layer-part-inclusive wound package (Pw4r).

9. The yarn processor (1) according to any one of claims 5 to 8, wherein,

the marking unit (19) includes the winding device (19),
the winding device (19) includes:

a rotational driving unit (37) which is configured to rotationally drive the wound package (Pw) about a central axis of the wound package (Pw); and
a traverse unit (32) including a traverse guide (35) configured to traverse the yarn (Y) and a guide driving unit (36) configured to reciprocally drive the traverse guide (35) along the axial direction of the wound package (Pw), and
the controller (5) causes the winding device (19) to perform the marking operation in such a way that the controller (5) controls the traverse unit (32) to stop the traverse guide (35) at a predetermined position in the axial direction while controlling the rotational driving unit (37) to rotate the wound package (Pw).

Patentansprüche

1. Garnverarbeitungsvorrichtung (1), die in der Lage ist, ein von einer Garnzufuhrpackung (Ps) abgewickeltes Garn (Y) zu verarbeiten und das Garn (Y) auf eine Wickelspule (Bw) aufzuwickeln, umfassend:

einen Garnzufuhrpackung-Rückhalteabschnitt (20), der konfiguriert ist, um die Garnzufuhrpackung (Ps) zurückzuhalten;
eine Wickelvorrichtung (19), die in der Lage ist, eine Wickelpackung (Pw) durch Aufwickeln des Garns (Y) auf die Wickelspule (Bw) zu bilden;
eine Schneideeinheit (10), die in der Lage ist, das Garn (Y) zu schneiden, bevor das Garn (Y) auf die Wickelspule

(Bw) aufgewickelt wird;
eine Spulenersatzeinheit (10), die in der Lage ist, die von der Wickelvorrichtung (19) gebildete Wickelpackung (Bw) durch eine neue Wickelspule (Bw4, Bw5) als die Wickelspule (Bw) zu ersetzen und die in der Lage ist, Garneinfädeln auf die neue Wickelspule (Bw4, Bw5) durchzuführen; und
eine Steuereinheit (5), die in der Lage ist, Folgendes durchzuführen: einen Bildungsbeendigungsprozess des Schneidens des Garns (Y) durch Steuern der Schneideeinheit (10) und des Beendens der Bildung der Wickelpackung (Pw) durch Steuern der Wickelvorrichtung (19); und einen Ersatzprozess des Ersetzens der gebildeten Wickelpackung (Pw) durch die neue Wickelspule (Bw4, Bw5) und des Einfädelns eines Garns (Y) auf die neue Wickelspule (Bw4, Bw5) durch Steuern der Spulenersatzeinheit (10),
wobei die Steuereinheit (5) den Bildungsbeendungsprozess und den Ersatzprozess durchführt, wenn bestimmt wird, dass eine Menge des Garns (Y) in der Wickelpackung (Pw), die gebildet wird, eine vorbestimmte Zielwickelmenge erreicht,
wobei die Steuereinheit (5) durch Berechnen eine Information bezüglich der verbleibenden Menge erzeugt, die eine numerische Information in Bezug auf eine verbleibende Menge des Garns (Y) ist, das in der Garnzufuhrpackung (Ps) verbleibt, die von dem Garnzufuhrpackung-Rückhalteabschnitt (20) zurückgehalten wird und von dem das Garn (Y) abgewickelt wird, und
wenn bei der Bestimmung von Verringerung der verbleibenden Menge bestimmt wird, dass ein numerischer Wert der Informationen bezüglich der verbleibenden Menge nicht größer als ein vorbestimmter Wert ist, führt die Steuereinheit (5) den Bildungsbeendigungsprozess durch, um zu veranlassen, dass die Wickelvorrichtung (19) eine Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung bildet, die eine Wickelpackung (Pw) ist, die eine geringere Menge des Garns (Y) aufweist als die Zielwickelmenge.

2. Garnverarbeitungsvorrichtung (1) nach Anspruch 1, wobei die Steuereinheit (5) einzelne Informationen der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung und Informationen bezüglich der Bestimmung von Verringerung der verbleibenden Menge in Verbindung miteinander speichert.

3. Garnverarbeitungsvorrichtung (1) nach Anspruch 1 oder 2, wobei

der Garnzufuhrpackung-Rückhalteabschnitt (20) in der Lage ist, als die Garnzufuhrpackung (Ps) eine erste Garnzufuhrpackung (Ps1) und eine zweite Garnzufuhrpackung (Ps2), die sich von der ersten Garnzufuhrpackung (Ps1) unterscheidet, zurückzuhalten und in der Lage ist, das Garn (Y) ununterbrochen zuzuführen, wenn ein Garnverbindungsabschnitt (K) durch Verbinden eines Startendabschnitts eines Garns (Y) in der ersten Garnzufuhrpackung (Ps1) mit einem Beendigungsabschnitt eines Garns in der zweiten Garnzufuhrpackung (Ps2) gebildet wird,
eine Erfassungseinheit (24) so bereitgestellt ist, dass sie fähig ist, Informationen zu erfassen, die das Auftreten von Umschalten der Garnzufuhrpackung angeben, bei dem Abwickeln des Garns (Y) von der ersten Garnzufuhrpackung (Ps1) am Garnzufuhrpackung-Rückhalteabschnitt (20) beendet wird, der Garnverbindungsabschnitt (K) beginnt, sich zu bewegen, und Abwickeln des Garns (Y) von der zweiten Garnzufuhrpackung (Ps2) beginnt, wenn die Bestimmung von Verringerung der verbleibenden Menge durchgeführt wird, während das Garn (Y) von der ersten Garnzufuhrpackung (Ps1) abgewickelt wird, beendet die Steuereinheit (5) die Bildung der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung durch Durchführen des Bildungsbeendigungsprozesses, führt die Steuereinheit (5) den Ersatzprozess nach der Bildung der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung durch, und veranlasst die Steuereinheit (5) die Wickelvorrichtung, eine Innenschichtteil-einschließende Wickelpackung (Pw4r) zu bilden, die eine Wickelpackung (Pw) ist und das von der ersten Garnzufuhrpackung (Ps1) abgewickelte Garn (Y) nach der Bestimmung von Verringerung der verbleibenden Menge einschließt, indem das von der ersten Garnzufuhrpackung (Ps1) abgewickelte und nach der Bestimmung von Verringerung der verbleibenden Menge verarbeitete Garn (Y) auf die neue Wickelspule (Bw4) aufgewickelt wird, die an der Wickelvorrichtung (19) im Ersatzprozess befestigt wird, der nach der Bildung der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung durchgeführt wird; und
wenn Umschaltbestimmung basierend auf einem Erfassungsergebnis von der Erfassungseinheit (24) durchgeführt wird, um zu bestimmen, ob das Umschalten der Garnzufuhrpackung auftritt, während die Innenschichtteil-einschließende Wickelpackung (Pw4r) gebildet wird, beendet die Steuereinheit (5) die Bildung der Innenschichtteil-einschließenden Wickelpackung, indem sie den Bildungsbeendigungsprozess durchführt, führt die Steuereinheit (5) den Ersatzprozess nach der Bildung der Innenschichtteil-einschließenden Wickelpackung (Pw4r) durch und steuert die Steuereinheit (5) den Ersatzprozess nach der Bildung der Innenschichtteil-einschließenden Wickelpackung (Pw4r) durch, um das von der zweiten Garnzufuhrpackung (Ps2) abgewickelte und nach der Umschaltbestimmung verarbeitete Garn auf die neue Wickelspule (Bw5) aufzuwickeln, die an der Wickelvorrichtung befestigt ist.

4. Garnverarbeitungsvorrichtung (1) nach Anspruch 3, wobei die Steuereinheit (5) einzelne Informationen über die Innenschichtteil-einschließende Wickelpackung (Pw4r) und Informationen bezüglich der Umschaltbestimmung in Verbindung miteinander speichert.

5. Garnverarbeitungsvorrichtung (1) nach Anspruch 3 oder 4, weiter umfassend

eine Markierungseinheit (19), die in der Lage ist, einen Markierungsvorgang des Bereitstellens einer Markierung an der Wickelpackung (Pw), die von der Wickelvorrichtung (19) gebildet wird, durchzuführen,
wenn die Umschaltbestimmung durchgeführt wird, steuert die Steuereinheit (5) die Markierungseinheit (19) und veranlasst diese, als den Markierungsvorgang einen Innenschichtteil-einschließenden Markierungsvorgang des Bereitstellens einer Markierung an der Innenschichtteil-einschließenden Wickelpackung (Pw4r) durchzuführen.

6. Garnverarbeitungsvorrichtung (1) nach einem der Ansprüche 1 bis 4, weiter umfassend

eine Markierungseinheit (19), die in der Lage ist, einen Markierungsvorgang des Bereitstellens einer Markierung an der Wickelpackung (Pw), die von der Wickelvorrichtung (19) gebildet wird, durchzuführen,
wenn die Bestimmung von Verringerung der verbleibenden Menge durchgeführt wird, steuert die Steuereinheit (5) die Markierungseinheit (19) und veranlasst diese, als den Markierungsvorgang einen Innenschichtteil-vermeidenden Markierungsvorgang des Bereitstellens einer Markierung an der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung durchzuführen.

7. Garnverarbeitungsvorrichtung (1) nach Anspruch 5, wobei, wenn die Bestimmung von Verringerung der verbleibenden Menge durchgeführt wird, steuert die Steuereinheit (5) die Markierungseinheit (19) und veranlasst diese, als den Markierungsvorgang einen Innenschichtteil-vermeidenden Markierungsvorgang des Bereitstellens einer Markierung an der Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung durchzuführen.

8. Garnverarbeitungsvorrichtung (1) nach Anspruch 7, wobei

die Markierungseinheit (19) in der Lage ist, den Markierungsvorgang so durchzuführen, dass die Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung von der Innenschichtteil-einschließenden Wickelpackung (Pw4r) verschieden ist, und
die Steuereinheit (5) die Markierungseinheit (19) steuert und diese veranlasst, den Innenschichtteil-einschließenden Markierungsvorgang und den ein Innenschichtteil vermeidenden Markierungsvorgang so durchzuführen, dass die Wickelpackung (Pw3s) mit erzwungener Bildungsbeendigung von der Innenschichtteil-einschließenden Wickelpackung (Pw4r) verschieden ist.

9. Garnverarbeitungsvorrichtung (1) nach einem der Ansprüche 5 bis 8, wobei

die Markierungseinheit (19) die Wickelvorrichtung (19) einschließt,
die Wickelvorrichtung (19) Folgendes einschließt:

eine Drehantriebseinheit (37), die konfiguriert ist, um die Wickelpackung (Pw) drehend um eine mittlere Achse der Wickelpackung (Pw) anzutreiben; und
eine Chargiereinheit (32), die eine Chargierführung (35) einschließt, die konfiguriert ist, um das Garn (Y) zu chargieren, und eine Führungsantriebseinheit (36), die konfiguriert ist, um reziprok die Chargierführung (35) entlang der axialen Richtung der Wickelpackung (Pw) anzutreiben, und
die Steuereinheit (5) die Wickelvorrichtung (19) veranlasst, den Markierungsvorgang auf solche Weise durchzuführen, dass die Steuereinheit (5) die Chargiereinheit (32) steuert, um die Chargierführung (35) an einer vorbestimmten Position in der axialen Richtung zu stoppen, während sie die Drehantriebseinheit (37) steuert, um die Wickelpackung (Pw) zu drehen.

Revendications

1. Dispositif de traitement (1) de fil apte à traiter un fil (Y) déroulé à partir d'un paquet d'alimentation en fil (Ps) et à enrouler le fil (Y) sur une bobine d'enroulement (Bw), comprenant :

une partie de retenue (20) de paquet d'alimentation en fil qui est configurée pour retenir le paquet d'alimentation

en fil (Ps) ;
un dispositif d'enroulement (19) qui est apte à former un paquet enroulé (Pw) en enroulant le fil (Y) sur la bobine d'enroulement (Bw) ;
une unité de coupe (10) qui est apte à couper le fil (Y) avant que le fil (Y) ne soit enroulé sur la bobine d'enroulement (Bw) ;
une unité de remplacement de bobine (10) qui est apte à remplacer le paquet enroulé (Bw) formé par le dispositif d'enroulement (19) par une nouvelle bobine d'enroulement (Bw4, Bw5) en tant que bobine d'enroulement (Bw) et qui est apte à réaliser un enfilage de fil sur la nouvelle bobine d'enroulement (Bw4, Bw5) ; et
un dispositif de commande (5) qui est apte à réaliser :

un traitement de fin de formation consistant à couper le fil (Y) en commandant l'unité de coupe (10) et à mettre fin à la formation du paquet enroulé (Pw) en commandant le dispositif d'enroulement (19) ; et un traitement de remplacement consistant à remplacer le paquet enroulé formé (Pw) par la nouvelle bobine d'enroulement (Bw4, Bw5) et d'enfilage d'un fil (Y) sur la nouvelle bobine d'enroulement (Bw4, Bw5) en commandant l'unité de remplacement de bobine (10),
le dispositif de commande (5) réalisant le traitement de fin de formation et le traitement de remplacement lorsqu'il détermine qu'une quantité du fil (Y) dans le paquet enroulé (Pw) en formation atteint une quantité enroulée cible prédéterminée,
l'unité de commande (5) générant, par calcul, des informations relatives à la quantité restante qui sont des informations numériques concernant une quantité restante du fil (Y) restant dans le paquet d'alimentation en fil (Ps) qui est retenue par la partie de retenue de paquet d'alimentation en fil (20) et à partir de laquelle le fil (Y) est déroulé, et
lorsqu'il est déterminé dans la détermination de réduction de quantité restante qu'une valeur numérique des informations relatives à la quantité restante n'est pas supérieure à une valeur prédéterminée, l'unité de commande (5) réalisant le traitement de fin de formation pour amener le dispositif d'enroulement (19) à former un paquet enroulé à fin de formation forcée (Pw3s) qui est un paquet enroulé (Pw) présentant une quantité de fil (Y) inférieure à la quantité enroulée cible.

2. Dispositif de traitement (1) de fil selon la revendication 1, dans lequel le dispositif de commande (5) stocke des informations individuelles du paquet enroulé à fin de formation forcée (Pw3s) et des informations concernant la détermination de réduction de quantité restante, en association les unes avec les autres.

3. Dispositif de traitement (1) de fil selon la revendication 1 ou la revendication 2, dans lequel,

la partie de retenue (20) de paquet d'alimentation en fil est apte à retenir, en tant que paquet d'alimentation en fil (Ps), un premier paquet d'alimentation en fil (Ps1) et un second paquet d'alimentation en fil (Ps2) différent du premier paquet d'alimentation en fil (Ps1) et est apte à alimenter sans interruption le fil (Y) lorsqu'une partie de raccordement de fil (K) est formée en raccordant une partie d'extrémité de départ d'un fil (Y) dans le premier paquet d'alimentation en fil (Ps1) à une partie terminale d'un fil dans le second paquet d'alimentation en fil (Ps2),
une unité de détection (24) est fournie pour être apte à détecter des informations indiquant l'occurrence d'une commutation de paquet d'alimentation en fil dans laquelle le déroulement du fil (Y) à partir du premier paquet d'alimentation en fil (Ps1) se termine au niveau de la partie de retenue de paquet d'alimentation en fil (20), la partie de raccordement de fil (K) commence à se déplacer, et le déroulement du fil (Y) à partir du second paquet d'alimentation en fil (Ps2) commence,
lorsqu'il est déterminé que la réduction de quantité restante est réalisée pendant que le fil (Y) est déroulé du premier paquet d'alimentation en fil (Ps1), le dispositif de commande (5) met fin à la formation du paquet enroulé à fin de formation forcée (Pw3s) en réalisant le traitement de fin de formation, le dispositif de commande (5) réalise le traitement de remplacement après la formation du paquet enroulé à fin de formation forcée (Pw3s), et le dispositif de commande (5) amène le dispositif d'enroulement à former un paquet enroulé incluant la partie de couche interne (Pw4r) qui est un paquet enroulé (Pw) et inclut le fil (Y) déroulé du premier paquet d'alimentation en fil (Ps1) après la détermination de réduction de quantité restante, en enroulant le fil (Y) déroulé du premier paquet d'alimentation en fil (Ps1) et traité après la détermination de réduction de quantité restante sur la nouvelle bobine d'enroulement (Bw4) fixée au dispositif d'enroulement (19) dans le traitement de remplacement qui est réalisé après la formation du paquet enroulé à fin de formation forcée (Pw3s), et
lorsque la détermination de commutation est réalisée sur la base d'un résultat de détection par l'unité de détection (24) pour déterminer si oui ou non la commutation de paquet d'alimentation en fil se produit pendant la formation du paquet enroulé incluant la partie de couche interne (Pw4r), l'unité de commande (5) met fin à la formation du paquet enroulé incluant la partie de couche interne en réalisant le traitement de fin de formation, l'unité de

commande (5) réalise le traitement de remplacement après la formation du paquet enroulé incluant la partie de couche interne (Pw4r), et l'unité de commande (5) réalise le traitement de remplacement après la formation du paquet enroulé incluant la partie de couche interne (Pw4r) pour enrouler le fil (Y) déroulé à partir du second paquet d'alimentation en fil (Ps2) et traité après la détermination de commutation sur la nouvelle bobine d'enroulement (Bw5) fixée au dispositif d'enroulement.

4. Dispositif de traitement (1) de fil selon la revendication 3, dans lequel le dispositif de commande (5) stocke des informations individuelles du paquet enroulé incluant la partie de couche interne (Pw4r) et des informations concernant la détermination de commutation, en association les unes avec les autres.

5. Dispositif de traitement (1) de fil selon la revendication 3 ou la revendication 4, comprenant en outre

une unité de marquage (19) qui est apte à réaliser une opération de marquage consistant à fournir une marque sur le paquet enroulé (Pw) qui est formé par le dispositif d'enroulement (19),
lorsque la détermination de commutation est réalisée, le dispositif de commande (5) commandant et amenant l'unité de marquage (19) à réaliser, en tant qu'opération de marquage, une opération de marquage incluant la partie de couche interne consistant à fournir une marque sur le paquet enroulé incluant la partie de couche interne (Pw4r).

6. Dispositif de traitement (1) de fil selon l'une des revendications 1 à 4, comprenant en outre

une unité de marquage (19) qui est apte à réaliser une opération de marquage consistant à fournir une marque sur le paquet enroulé (Pw) qui est formé par le dispositif d'enroulement (19),
lorsque la détermination de réduction de quantité restante est réalisée, le dispositif de commande (5) commandant et amenant l'unité de marquage (19) à réaliser, en tant qu'opération de marquage, une opération de marquage évitant la partie de couche interne consistant à fournir une marque sur le paquet enroulé à fin de formation forcée (Pw3s).

7. Dispositif de traitement (1) de fil selon la revendication 5, dans lequel, lorsque la détermination de réduction de quantité restante est réalisée, le dispositif de commande (5) commandant et amenant l'unité de marquage (19) à réaliser, en tant qu'opération de marquage, une opération de marquage évitant la partie de couche interne consistant à fournir une marque sur le paquet enroulé à fin de formation forcée (Pw3s).

8. Dispositif de traitement (1) de fil selon la revendication 7, dans lequel,

l'unité de marquage (19) est apte à réaliser l'opération de marquage de sorte que le paquet enroulé à fin de formation forcée (Pw3s) soit distingué du paquet enroulé incluant la partie de couche interne (Pw4r), et
le dispositif de commande (5) commande et amène l'unité de marquage (19) à réaliser l'opération de marquage incluant la partie de couche interne et l'opération de marquage évitant la partie de couche interne de sorte que le paquet enroulé à fin de formation forcée (Pw3s) soit distingué du paquet enroulé incluant la partie de couche interne (Pw4r).

9. Dispositif de traitement (1) de fil selon l'une quelconque des revendications 5 à 8, dans lequel,

l'unité de marquage (19) inclut le dispositif d'enroulement (19),
le dispositif d'enroulement (19) inclut :

une unité d'entraînement en rotation (37) qui est configurée pour entraîner en rotation le paquet enroulé (Pw) autour d'un axe central du paquet enroulé (Pw) ; et
une unité de traverse (32) incluant un guide de traverse (35) configuré pour traverser le fil (Y) et une unité d'entraînement de guide (36) configurée pour entraîner selon un mouvement de va-et-vient le guide transversal (35) le long de la direction axiale du paquet enroulé (Pw), et
le dispositif de commande (5) amène le dispositif d'enroulement (19) à réaliser l'opération de marquage de sorte que le dispositif de commande (5) commande l'unité de traverse (32) pour arrêter le guide de traverse (35) au niveau d'une position prédéterminée dans la direction axiale tout en commandant l'unité d'entraînement en rotation (37) pour entraîner en rotation le paquet enroulé (Pw).

FIG.1

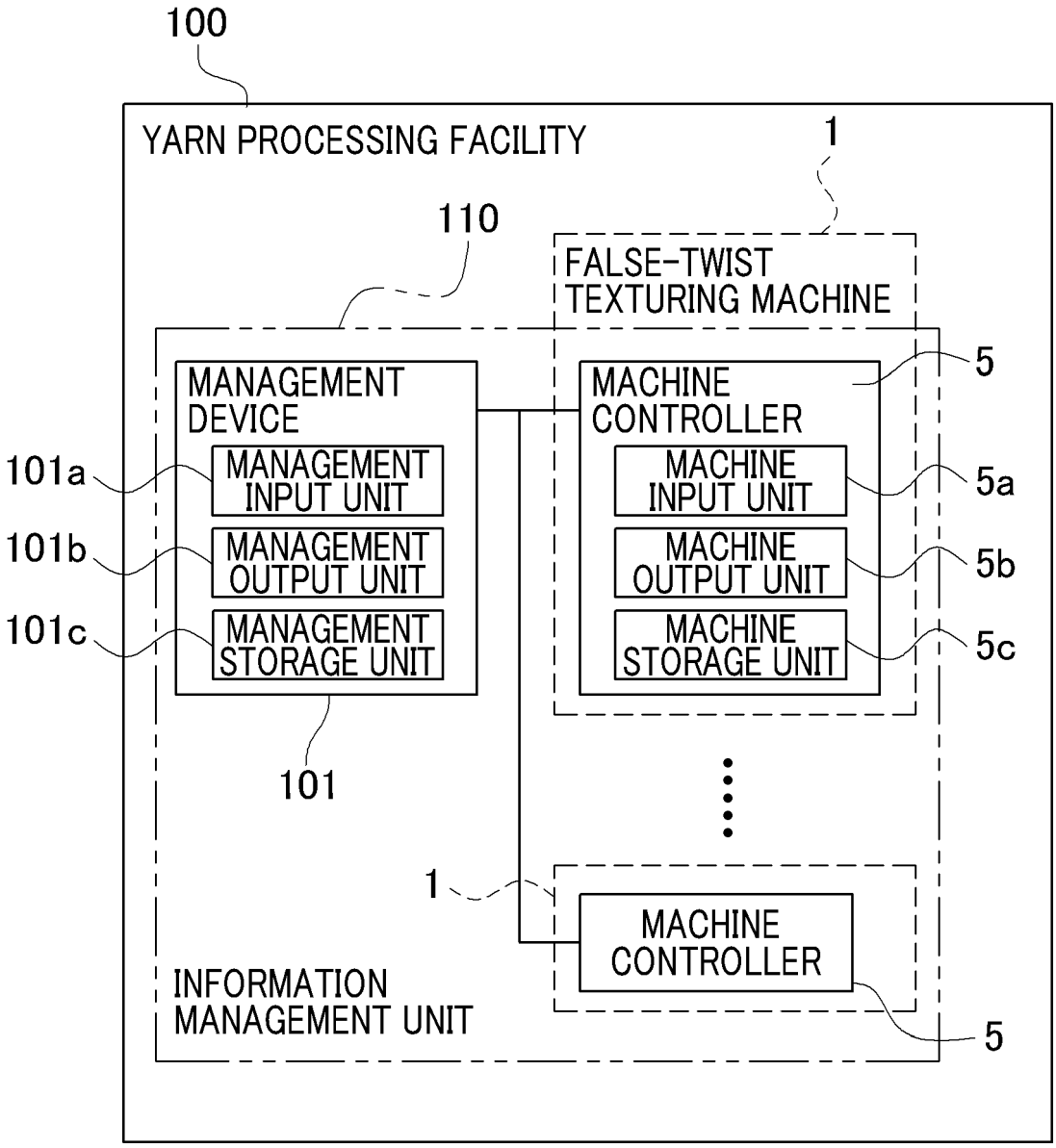

100
YARN PROCESSING FACILITY
1
110
FALSE-TWIST
TEXTURING MACHINE
MANAGEMENT
DEVICE
MACHINE
CONTROLLER
5
101a
MANAGEMENT
INPUT UNIT
MACHINE
INPUT UNIT
5a
101b
MANAGEMENT
OUTPUT UNIT
MACHINE
OUTPUT UNIT
5b
101c
MANAGEMENT
STORAGE UNIT
MACHINE
STORAGE UNIT
5c
101
1
MACHINE
CONTROLLER
INFORMATION
MANAGEMENT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

FIG.2

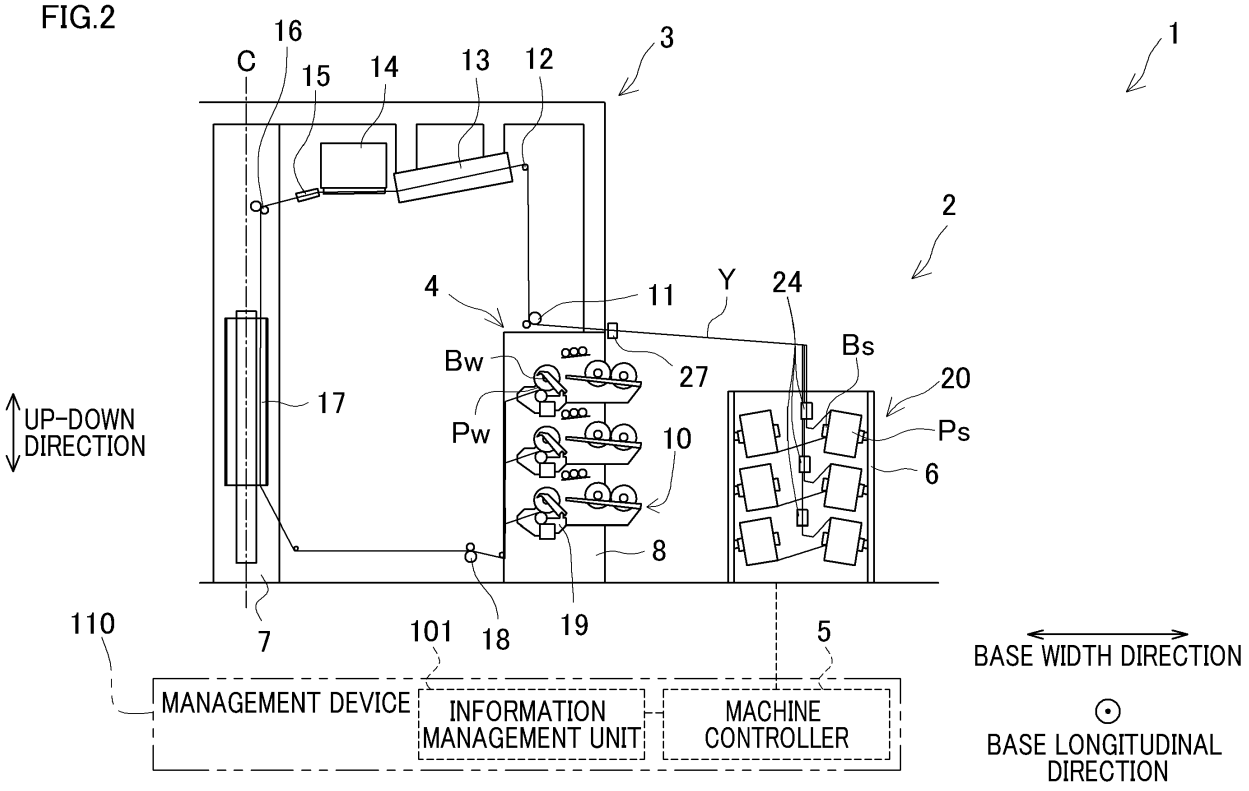

C
16
15
14
13
12
3
1
2
4
11
Y
24
Bs
20
Bw
27
17
Pw
10
Ps
6
UP-DOWN DIRECTION
8
8
110
7
101
18
19
5
MANAGEMENT DEVICE
INFORMATION MANAGEMENT UNIT
MACHINE CONTROLLER
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.3

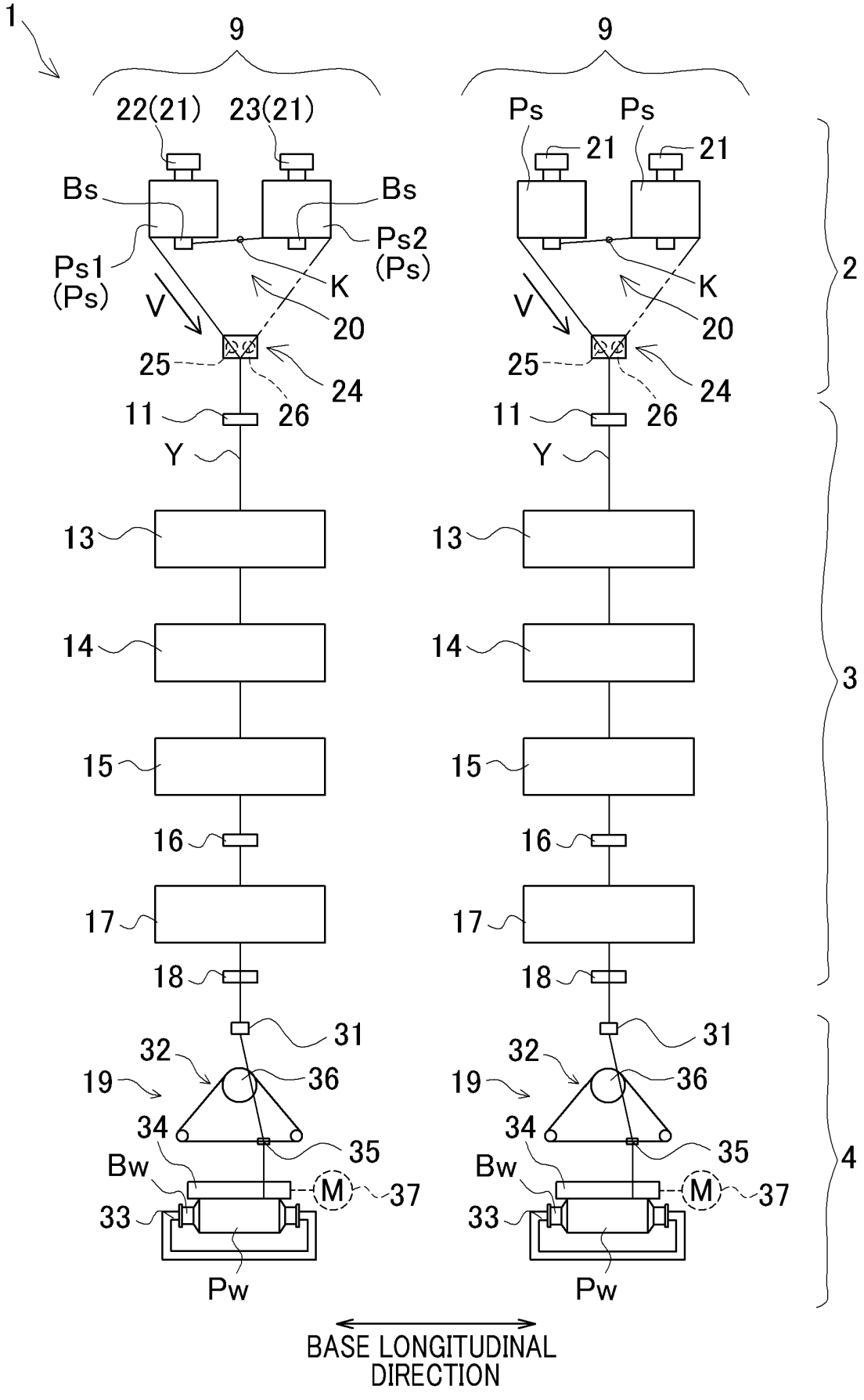

1
9
22(21)
23(21)
Bs
Bs
Ps1
(Ps)
Ps2
(Ps)
V
K
20
25
24
11
26
Y
13
14
15
16
17
18
31
32
19
36
34
35
Bw
M
37
33
Pw
9
Ps
Ps
21
21
2
3
4
BASE LONGITUDINAL
DIRECTION

FIG.4

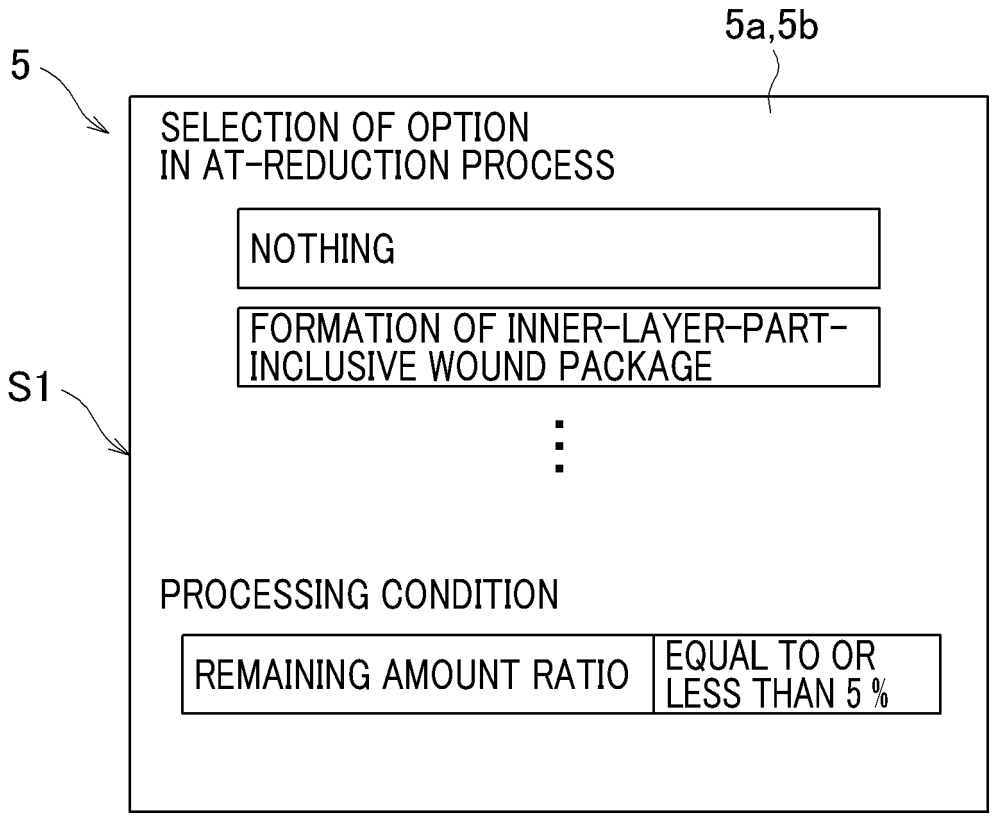

5a,5b
5
SELECTION OF OPTION
IN AT-REDUCTION PROCESS
NOTHING
FORMATION OF INNER-LAYER-PART-
INCLUSIVE WOUND PACKAGE
S1
PROCESSING CONDITION
REMAINING AMOUNT RATIO
EQUAL TO OR
LESS THAN 5 %

FIG.5(a) REMAINING AMOUNT OF YARN AT FIRST ATTACHMENT UNIT VS. TIME

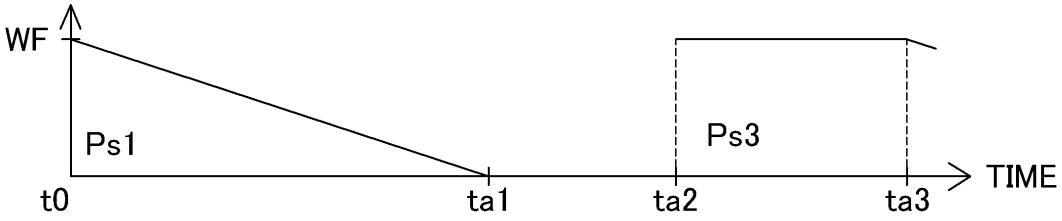


FIG.5(b) REMAINING AMOUNT OF YARN AT SECOND ATTACHMENT UNIT VS. TIME

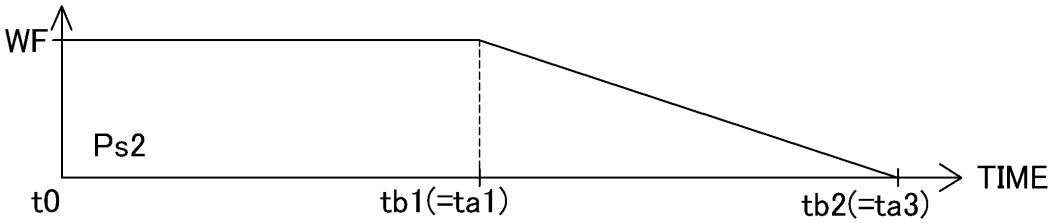


FIG.5(c) WOUND AMOUNT OF YARN ON WINDING BOBBIN VS. TIME

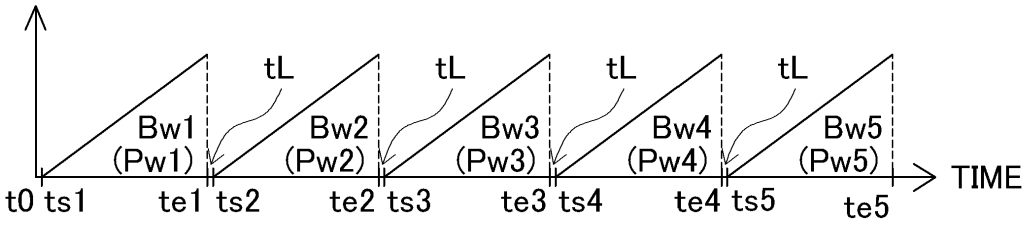


FIG.6

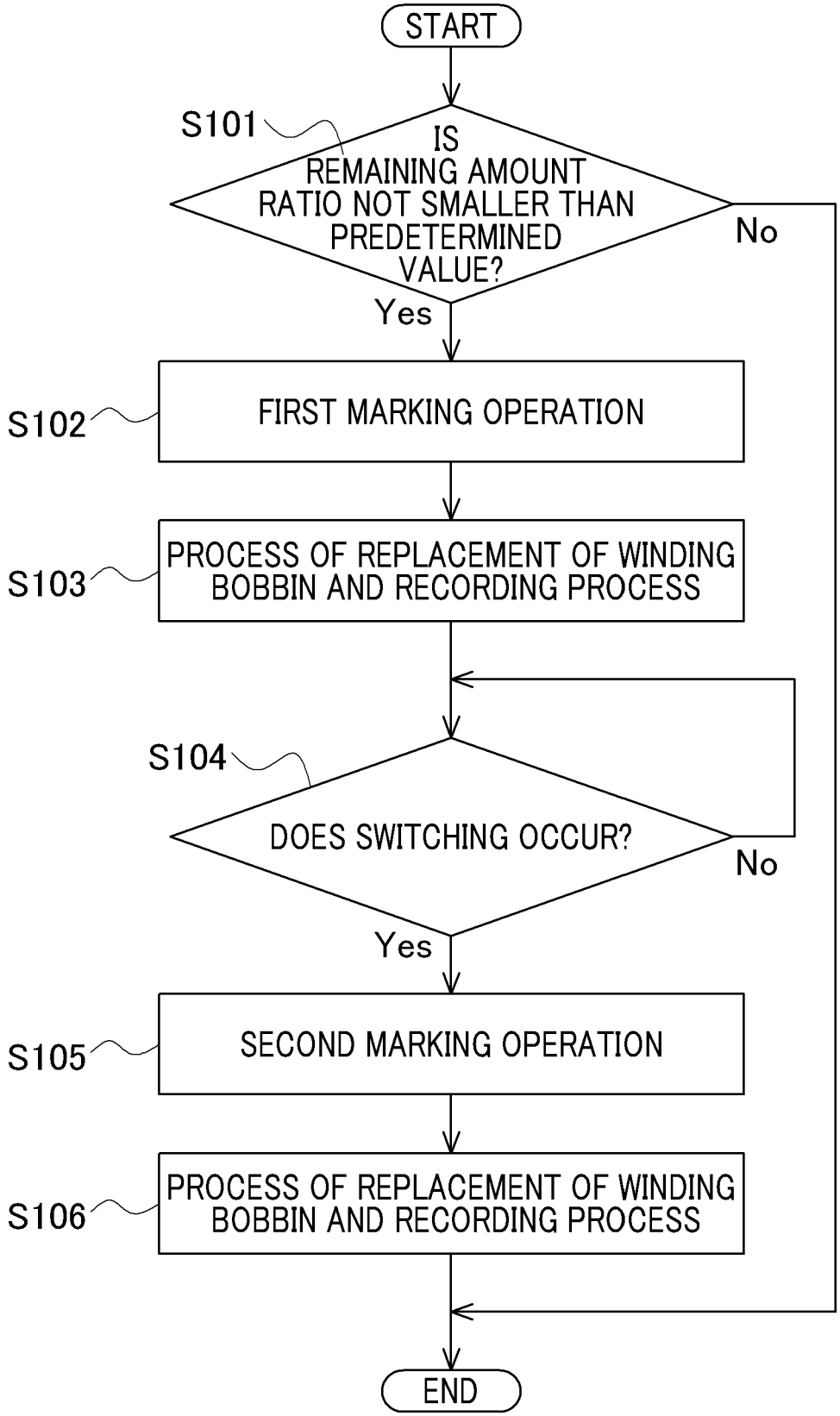

START
S101
IS REMAINING AMOUNT RATIO NOT SMALLER THAN PREDETERMINED VALUE?
No
Yes
S102
FIRST MARKING OPERATION
S103
PROCESS OF REPLACEMENT OF WINDING BOBBIN AND RECORDING PROCESS
S104
DOES SWITCHING OCCUR?
No
Yes
S105
SECOND MARKING OPERATION
S106
PROCESS OF REPLACEMENT OF WINDING BOBBIN AND RECORDING PROCESS
END

FIG.7(a) REMAINING AMOUNT OF YARN AT FIRST ATTACHMENT UNIT VS. TIME

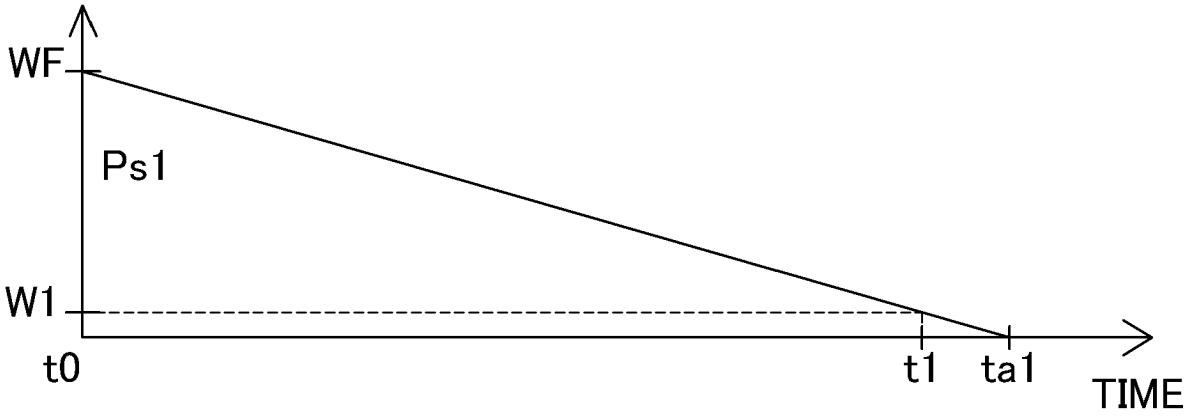


FIG.7(b) REMAINING AMOUNT OF YARN AT SECOND ATTACHMENT UNIT VS. TIME

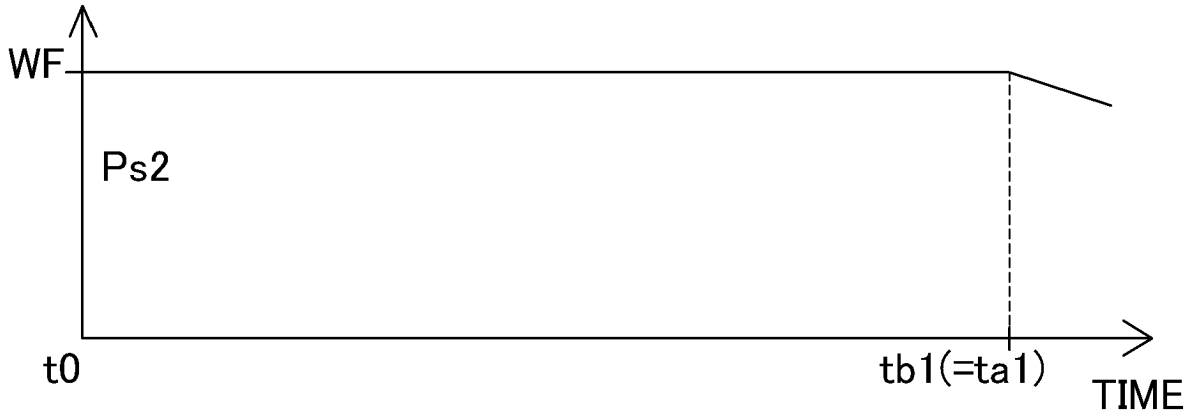


FIG.7(c) WOUND AMOUNT OF YARN ON WINDING BOBBIN VS. TIME

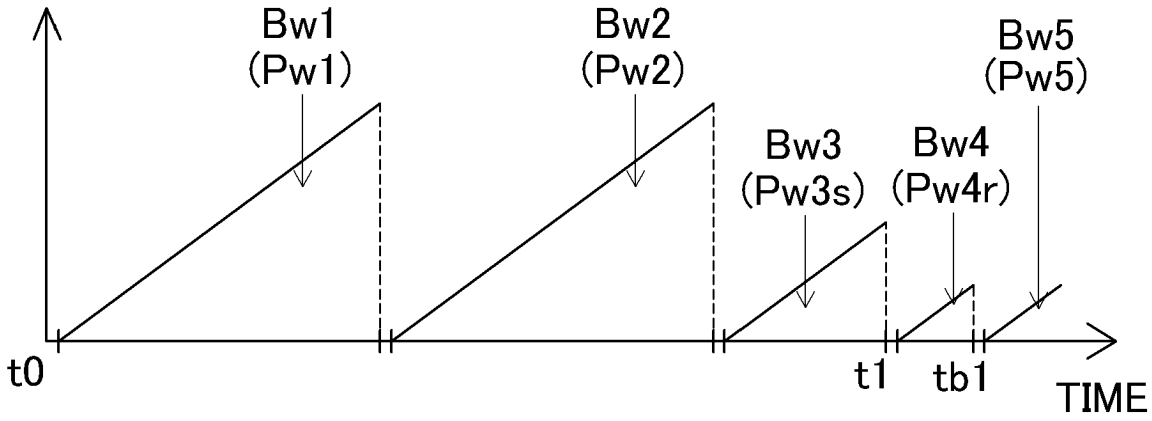


FIG.8(a)

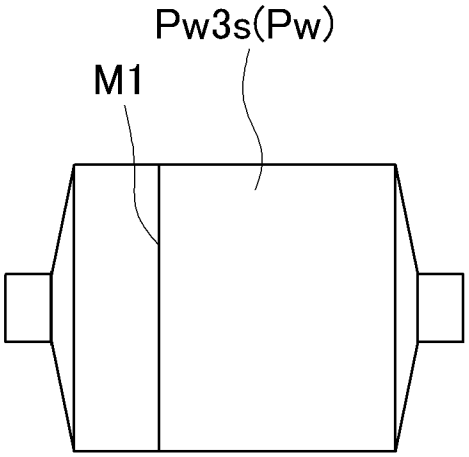


FIG.8(b)

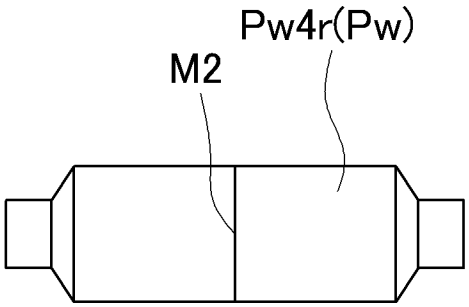


FIG.8(c)

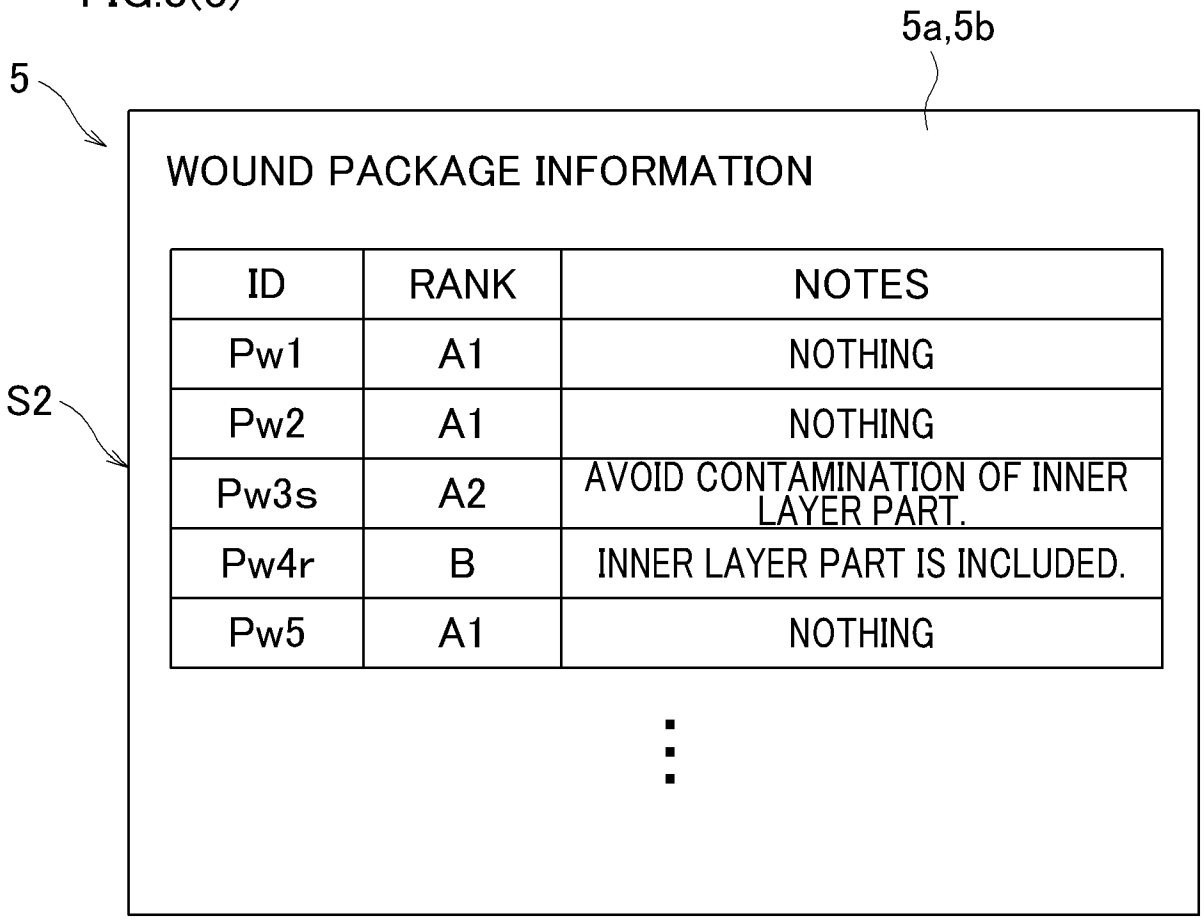


FIG.9

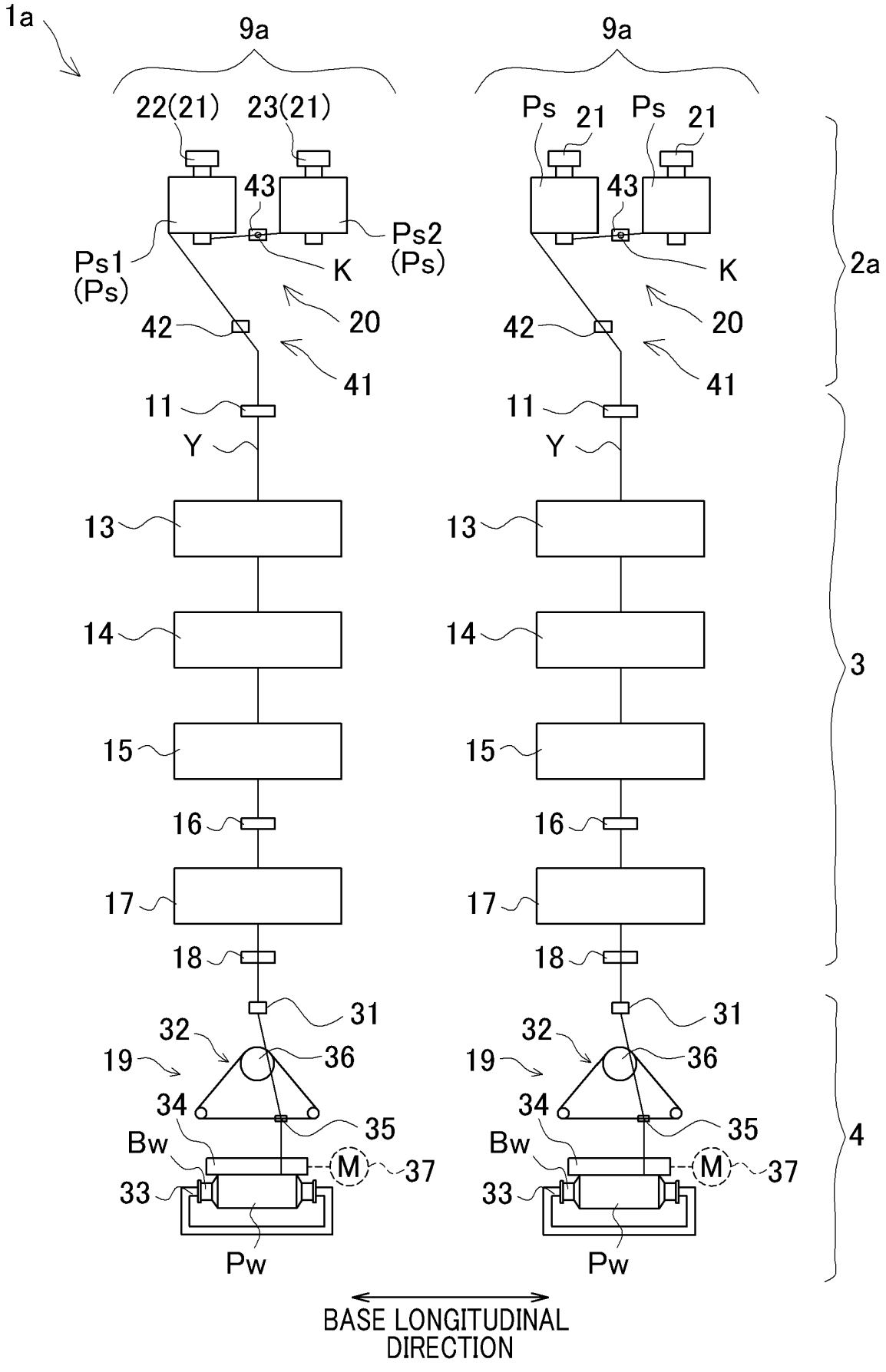
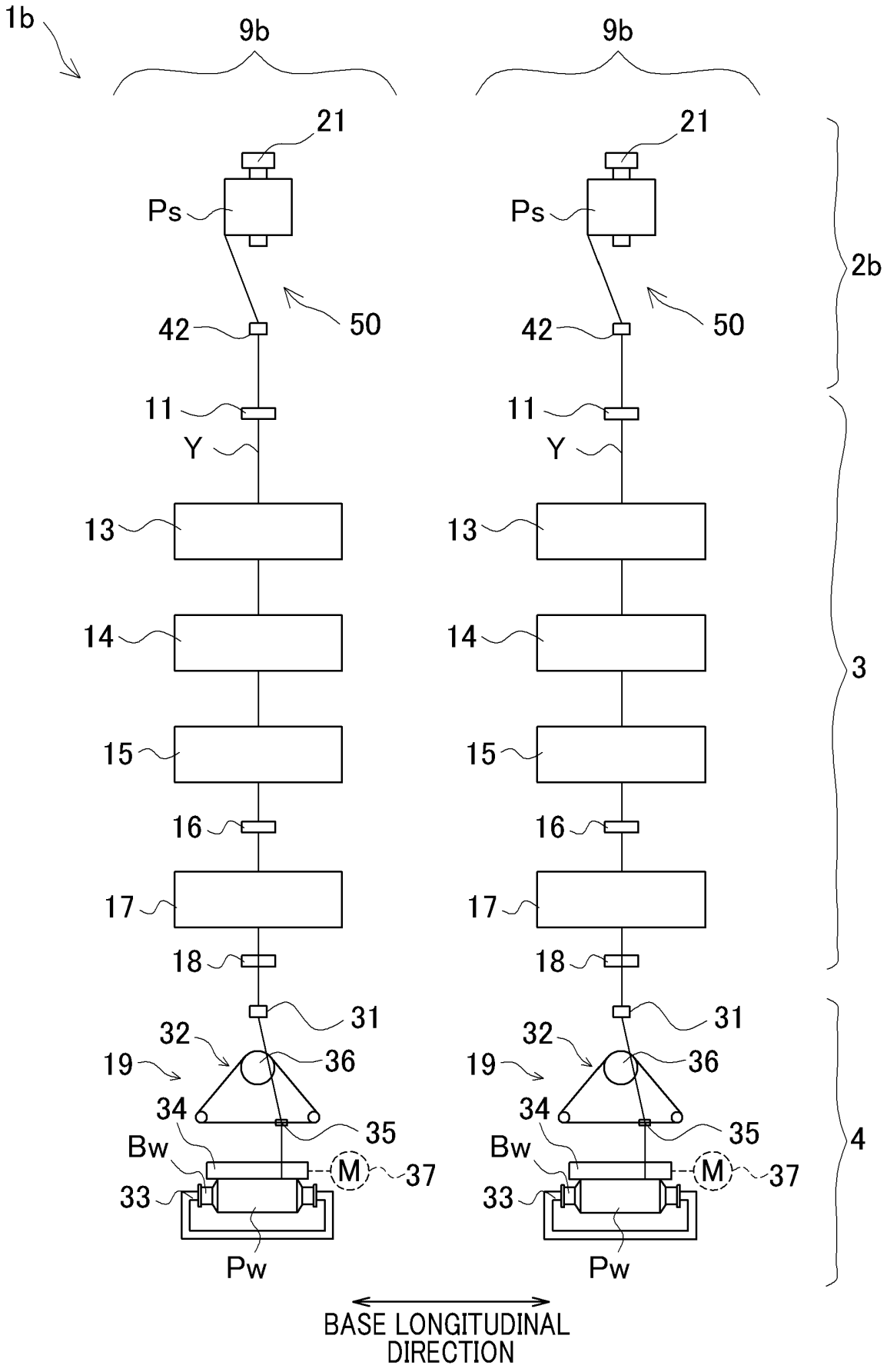

1a
9a
9a
22(21)
23(21)
Ps
21
Ps
21
43
43
Ps1
(Ps)
Ps2
(Ps)
K
K
2a
20
20
42
42
41
41
11
11
Y
Y
13
13
14
14
3
15
15
16
16
17
17
18
18
31
31
32
32
19
36
36
34
34
35
35
Bw
M
37
33
Pw
Pw
4
BASE LONGITUDINAL DIRECTION

FIG.10


1b
9b
9b
21
21
Ps
Ps
2b
42
50
42
50
11
11
Y
Y
13
13
14
14
3
15
15
16
16
17
17
18
18
31
31
32
32
19
19
36
36
34
34
35
35
Bw
Bw
M
M
37
37
33
33
4
Pw
Pw
BASE LONGITUDINAL DIRECTION

REFERENCES CITED IN THE DESCRIPTION

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- JP 2002088605 A **[0092]**