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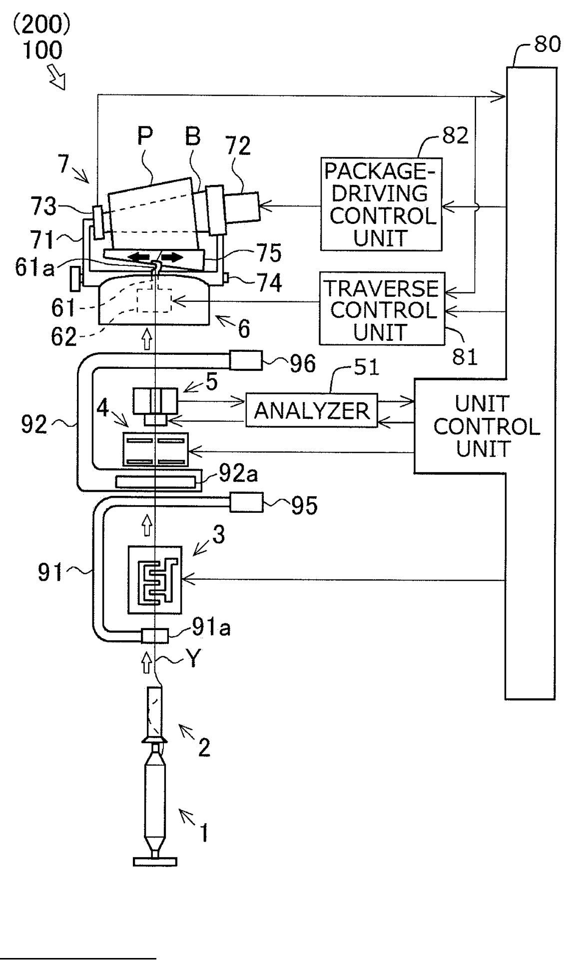
(54) Yarn winding device

(57) A yarn winding device (100) includes a package driving unit (72) that rotates a bobbin (B); a rotational-speed detecting unit (73) that detects a rotational speed of the bobbin (B); a traverse guide (61) that traverses a yarn to be wound around the bobbin (B); a traverse-guide driving unit (62) that drives the traverse guide (61); a traverse control unit (81) that controls driving of the traverse guide (61); and a target-position-command determining unit that determines a pre-correction target-position command (Pt) for the traverse-guide driving unit (62) from the rotational speed of the bobbin (B). The traverse control unit (81) calculates a post-correction target-position command (Ps) from a target-position correction amount (Cp), which is a feed-forward component depending on a detection delay time of the rotational-speed detecting unit (73) and a response delay time of the traverse-guide driving unit (62), and the pre-correction target-position command (Pt), and controls the driving of the traverse-guide driving unit (62) according to the post-correction target-position command (Ps).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding device that winds a yarn around a bobbin while traversing the yarn. More particularly, the present invention relates to a technique for controlling a traverse guide, of a yarn winding device, that winds a yarn around a bobbin while traversing the yarn.

2. Description of the Related Art

[0002] Yarn winding devices that rotate a bobbin to wind a yarn around the bobbin to thereby form a package on the bobbin have conventionally been known. When a defective portion is detected in the yarn that is being wound, that portion is cut and removed. Concretely, upon detecting the defective portion in a yarn, rotation of the bobbin is stopped to stop the yarn from winding on the bobbin, and the defective portion is cut and removed. Then, ends of the cut yarn are joined together, i.e., splicing is performed, and the winding of the yarn on the bobbin is resumed. Such removal of the defective portion leads to maintaining the quality of the yarn uniform.

[0003] In this process, a state of the bobbin changes from a stopped state to a rotating state, and a rotational speed of the bobbin gradually increases to a predetermined rotational speed. Accordingly, there has been a need for a technique for controlling a traverse guide that traverses the yarn depending on the rotational speed of the bobbin.

[0004] A yarn winding device that performs feed-forward control on a traverse-guide driving unit to minimize a disparity between an actual position of a traverse guide and an ideal position of the traverse guide is disclosed in Japanese published unexamined application No. 2007-238275. The feed-forward control described in Japanese published unexamined application No. 2007-238275 is performed in an acceleration winding period while taking a response delay time of the traverse-guide driving unit into account. The acceleration winding in this document denotes winding in a period, at a start of winding of yarn on a bobbin or a start of winding of yarn on the bobbin after resuming from a pause, over which a state of the bobbin changes from a stopped state to a rotating state and a rotational speed of the bobbin increases to a predetermined rotational speed.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a yarn winding device that reduces a deviation in an actual position of a traverse guide from its target position, or an ideal position, thereby preventing production of a defective package.

[0006] According to an aspect of the present invention, a yarn winding device includes a package driving unit adapted to rotation-drive a bobbin around which a yarn is to be wound to form a package; a rotational-speed detecting unit adapted to detect a rotational speed of the bobbin; a traverse guide adapted to traverse the yarn to be wound around the bobbin; a traverse-guide driving unit adapted to drive the traverse guide; a traverse control unit adapted to control driving of the traverse-guide driving unit; and a target-position-command determining unit adapted to determine a pre-correction target-position command of the traverse-guide driving unit in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit. The traverse control unit is adapted to calculate a post-correction target-position command in accordance with a target-position correction amount, which is a feed-forward component for the traverse control unit according to a detection delay time of the rotational-speed detecting unit and a response delay time of the traverse-guide driving unit, and the pre-correction target-position command, which has been determined by the target-position-command determining unit. The traverse control unit is adapted to control the driving of the traverse-guide driving unit in accordance with the post-correction target-position command.

[0007] According to another aspect of the present invention, a yarn winding device includes a package driving unit adapted to rotation-drive a bobbin around which a yarn is to be wound to form a package; a rotational-speed detecting unit adapted to detect a rotational speed of the bobbin; a traverse guide adapted to traverse the yarn to be wound around the bobbin; a traverse-guide driving unit adapted to drive the traverse guide; a traverse control unit adapted to control driving of the traverse-guide driving unit; and a target-speed-command determining unit adapted to determine a pre-correction target-speed command of the traverse-guide driving unit in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit. The traverse control unit is adapted to calculate a post-correction target-speed command in accordance with a target-speed correction amount, which is a feed-forward component for the traverse control unit according to a detection delay time of the rotational-speed detecting unit and a response delay time of the traverse-guide driving unit, and the pre-correction target-speed command, which has been determined by the target-speed-command determining unit. The traverse control unit is adapted to control the driving of the traverse-guide driving unit in accordance with the post-correction target-speed command.

[0008] The inventors recognized that performing only the feed-forward control on the traverse-guide driving unit is insufficient in some cases in preventing a deviation of an actual position of the traverse guide from an ideal position in an acceleration winding period of a package. In the yarn winding device disclosed in Japanese published unexamined application No. 2007-238275, a rotational-speed detecting unit detects a rotational speed of the bobbin and controls the traverse-guide driving unit based on a result of detection by the rotational-speed detecting unit. However, if the resolution of the rotational-speed detecting unit is low, the rotational-speed detecting unit may fail to obtain an accurate value of the rotational speed of the bobbin. As a result, in the yarn winding device disclosed in Japanese published unexamined application No. 2007-238275 the actual position of the traverse guide can deviate from its ideal position in the acceleration winding period of the package, resulting in production of a defective package. Embodiments of the invention deal with this problem.

[0009] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a schematic diagram illustrating an overall configuration of a yarn winding device according to a first embodiment of the present invention;

FIG. 2 shows a relationship between a pre-correction target-position command and a post-correction target-position command for a traverse guide, and a change in a rotational speed of a bobbin with time;

FIG. 3 shows a relationship between an actual position and a target position of the traverse guide in a conventional yarn winding device, and a change in the rotational speed of the bobbin with time;

FIG. 4 shows relationships among the pre-correction target-position command, the post-correction target-position command, and the actual position of the traverse guide in the yarn winding device according to the first embodiment, and a change in the rotational speed of the bobbin with time;

FIG. 5 shows a relationship between the actual position and the target position of the traverse guide in the yarn winding device according to the first embodiment, and a change in the rotational speed of the bobbin with time;

FIG. 6 shows relationships among a pre-correction target-speed command, a post-correction target-speed command, and an actual speed of the traverse guide in a yarn winding device according to a second embodiment of the present invention, and a change in the rotational speed of the bobbin with time;

FIG. 7 shows a relationship between the actual position and the target position of the traverse guide in the yarn winding device according to the second embodiment, and a change in the rotational speed of the bobbin with time.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Exemplary embodiments of the present invention are described below in detail with reference to the accompanying drawings.

[0012] A yarn winding device 100 according to a first embodiment of the present invention is described below first.

[0013] FIG. 1 is a schematic diagram illustrating an overall configuration of the yarn winding device 100. Outline arrows in FIG. 1 indicate a feed direction of a yarn Y.

[0014] The yarn winding device 100 includes a yarn unwinding assisting device 2, a tension applying device 3, a yarn joining device 4, a yarn clearer 5, a traverse device 6, and a bobbin support device 7 that are arranged along the feed direction of the yarn Y unwound from a yarn feeding bobbin 1.

[0015] The yarn unwinding assisting device 2 assists unwinding of the yarn Y from the yarn feeding bobbin 1. The yarn unwinding assisting device 2 limits the degree, by which the yarn Y unwound from the yarn feeding bobbin 1 is moved outward due to its centrifugal force, and adjusts a tension applied to the yarn Y appropriately, thereby assisting the unwinding.

[0016] The tension applying device 3 applies a predetermined tension to the running yarn Y. As the tension applying device 3, for example, a tensioning device of a gate type, in which movable comb teeth are provided in combination with fixed comb teeth, can be used. The tension applying device 3 is desirable because it can improve a quality of a package P by applying a constant tension to the yarn Y being wound on a bobbin B. Meanwhile, the tension applying device 3 is not limited to the gate type, i.e., a disk type tension applying device can be employed.

[0017] The yarn joining device 4 joins yarn ends of the yarn Y, which has been cut or the like, together. For example, when the yarn Y has been cut to remove a defective portion from the yarn Y, the yarn joining device 4 joins the yarn ends of the yarn Y, which has been cut into two yarns, together. The yarn joining device 4 provided in the yarn winding device 100 functions as an air splicer device that splices yarn ends by utilizing a swirling airflow. The yarn joining device 4 can alternatively be a mechanical yarn joining device of, e.g., a disk type.

[0018] A lower-yarn guiding pipe 91 that catches and guides a lower yarn coming from the yarn feeding bobbin 1 into the yarn joining device 4 is arranged below the yarn joining device 4. The lower-yarn guiding pipe 91 is pivotable about a rod 95. An upper-yarn guiding pipe 92 that catches and guides an upper yarn coming from the package P into the yarn joining device 4 is arranged above the yarn joining device 4. The upper-yarn guiding pipe 92 is pivotable about a rod 96. A suction port 91a is formed at an end of the lower-yarn guiding pipe 91. A suction mouth 92a is provided at an end of the upper-yarn guiding pipe 92. Appropriate negative pressure sources are individually connected to the lower-yarn guiding pipe 91 and the upper-yarn guiding pipe 92 to generate a suction airflow at each of the suction port 91a and the suction mouth 92a so that an end of the upper yarn and an end of the lower yarn are caught in the suction port 91a and the suction mouth 92a, respectively, by suction. Accordingly, when a yarn breakage or a yarn cut occurs, the upper-yarn guiding pipe 92 guides the yarn end of the upper yarn coming from the package P into the yarn joining device 4 while the lower-yarn guiding pipe 91 guides the yarn end of the lower yarn coming from the yarn feeding bobbin 1 into the yarn joining device 4 so that the yarn joining device 4 can join the yarn ends of the upper yarn and the lower yarn together.

[0019] The yarn clearer 5 checks whether the yarn Y has a defective portion. The yarn clearer 5 includes a light source, such as a light-emitting diode, that illuminates the yarn Y and determines whether the yarn Y has a defective portion by measuring an amount of light reflected from the yarn Y. A cutter (not shown) that cuts the yarn Y when the yarn clearer 5 has detected the defective portion in the yarn Y is provided near the yarn clearer 5.

[0020] A configuration of the traverse device 6 is described in detail below.

[0021] As illustrated in FIG. 1, the traverse device 6 includes a traverse guide 61 that catches the yarn Y and reciprocates along an axial direction of the bobbin B. The traverse device 6 includes a traverse-guide driving unit 62 that drives the traverse guide 61. A traverse control unit 81 that controls the traverse-guide driving unit 62 will be described later.

[0022] The traverse guide 61 is an arm member that includes, at one end, a hook portion 61a for catching the yarn Y thereon. A motor shaft of a servo motor included in the traverse-guide driving unit 62 is coupled to the other end of the traverse guide 61. The traverse-guide driving unit 62 causes reciprocating movements of the motor shaft of the servo motor, thereby causing the traverse guide 61 to reciprocate (see solid arrows in FIG. 1).

[0023] The traverse guide 61 is swung about the motor shaft of the servo motor included in the traverse-guide driving unit 62. The traverse device 6 traverses the yarn Y relative to the package P by causing the hook portion 61a, on which the yarn Y is caught, to reciprocate.

[0024] As illustrated in FIG. 1, the traverse guide 61 of the traverse device 6 according to the first embodiment is tilted such that a longitudinal surface of the traverse guide 61 is substantially parallel to an installation surface of the yarn winding device 100, or an end portion, on the side of the hook portion 61a, of the traverse guide 61 is oriented upward by a larger degree than an end portion on the side of the traverse-guide driving unit 62 is. Hence, the traverse device 6 of the first embodiment traverses the yarn Y to be wound on the package P without involving sharp bending of a yarn path even at traverse end portions. The configuration of the traverse device 6 is not limited to the configuration according to the first embodiment discussed above. For example, the longitudinal surface of the traverse guide 61 can be situated substantially perpendicular to the installation surface of the yarn winding device 100.

[0025] In the first embodiment, the servo motor is used as a power source for causing the traverse guide 61 to swing; however, the power source is not limited thereto, and can alternatively be a step motor, a voice coil motor, or the like. The yarn winding device 100 according to the first embodiment employs a so-called arm-type traverse device that causes the yarn Y caught on the hook portion 61a at one end of the arm member to traverse relative to the package P. The same advantage as that produced by the yarn winding device 100 according to the first embodiment of the present invention can be obtained even when a so-called belt-type traverse device that causes the yarn Y caught on a yarn guiding unit arranged on a belt member to traverse relative to the package P is employed in lieu of the arm-type traverse device.

[0026] The configuration of the bobbin support device 7 is described in detail below.

[0027] As illustrated in FIG. 1, the bobbin support device 7 includes a cradle 71 that supports the bobbin B in a detachable manner. The bobbin support device 7 includes a package driving unit 72 that rotates the bobbin B (package P) based on a control signal received from a package-driving control unit 82, which will be described later, and a rotational-speed detecting unit 73 that measures a rotational speed Bv of the bobbin B (package P). Although the package P illustrated in FIG. 1 is a conical package, the yarn winding device 100 according to the first embodiment is capable of forming a cheese package as well.

[0028] The cradle 71 presses the package P against a contact roller 75 at a predetermined contact pressure. The cradle 71 can cause the package P to move toward or away from the contact roller 75. Accordingly, even when more and more yarn layers are stacked on the package P and the thickness of the package P gradually increases, the movement of the cradle 71 away from the contact roller 75 can accommodate an increase in a thickness of the yarn layers, thereby bringing an outer circumferential surface of the package P into contact with the contact roller 75 without fail.

[0029] The package driving unit 72 includes an electric motor as a power source and it is mounted on an end of the cradle 71. The package driving unit 72 rotates the bobbin B (package P) by rotating a motor shaft of the electric motor. The rotational-speed detecting unit 73 including a pulse disk and an electromagnetic pick-up sensor is attached to the other end of the cradle 71. The rotational-speed detecting unit 73 transmits, as a detection signal, an electromotive force that is responsive to pits and projections in the pulse disk to a unit control section 80, and to the traverse control unit 81. The rotational-speed detecting unit 73 can alternatively be mounted on the same end of the cradle where the electric motor is mounted.

[0030] In the first embodiment, the configuration where the electric motor included in the package driving unit 72 directly drives the bobbin B is employed. Alternatively, a configuration where the bobbin B (package P) is rotated by rotating the contact roller 75 that is in contact with the circumferential surface of the bobbin B (package P) can be employed.

[0031] As illustrated in FIG. 1, the contact roller 75 according to the first embodiment is a conical roller, the diameter of which is smaller at one end than the diameter at the other end. More specifically, the contact roller 75 is arranged such that a smaller-diameter end portion of the contact roller 75 corresponds to a smaller-diameter end portion of the package P while a larger-diameter end portion of the contact roller 75 corresponds to a larger-diameter end portion of the package P. This arrangement accommodates a difference in speed between a smaller-diameter portion and a larger-diameter portion of the package P that occurs during winding for forming the conical package P. Accordingly, stitching, which is likely to occur on the larger-diameter portion during the winding for forming the conical package P, can be prevented, and hence the package P of high quality can be produced. The shape of the contact roller 75 is not limited to the shape explained above; the contact roller 75 can alternatively be a cylindrical roller with equal diameters at both the ends.

[0032] The unit control section 80, the traverse control unit 81, and the package-driving control unit 82 are described below.

[0033] Each of the unit control section 80, the traverse control unit 81, and the package-driving control unit 82 includes a central processing unit (CPU), which is an arithmetic unit, and a read only memory (ROM), which is a storage unit.

[0034] The unit control section 80 is electrically connected to an analyzer 50 for the yarn clearer 5, the rotational-speed detecting unit 73, and the like. The unit control section 80 generates a control signal based on a detection signal received from the analyzer 50, the rotational-speed detecting unit 73, and the like, and transmits the control signal to the traverse control unit 81 and/or the package-driving control unit 82.

[0035] The traverse control unit 81 adds a target-position correction amount Cp to a pre-correction target-position command Pt, which has been determined in advance in the form of a relationship with the rotational speed Bv of the bobbin B, thereby obtaining a post-correction target-position command Ps for the traverse guide 61. The traverse control unit 81 controls the traverse-guide driving unit 62 according to the thus-obtained post-correction target-position command Ps for the traverse guide 61.

[0036] Control software for causing the traverse guide 61 to traverse the yarn Y is stored in the ROM of the traverse control unit 81. The control software stored in the ROM of the traverse control unit 81 determines the target-position correction amount Cp, or, a feed-forward component, for use in calculation of the post-correction target-position command Ps for the traverse guide 61 and calculates the post-correction target-position command Ps based on the target-position correction amount Cp.

[0037] The package-driving control unit 82 controls the package driving unit 72 to thereby rotate or stop rotation of the bobbin B. For example, when the yarn clearer 5 detects a defective portion in the yarn Y, the unit control section 80 transmits a control signal for causing the package-driving control unit 82 to stop rotation of the bobbin B. For example, after completion of splicing of the yarn Y, which has been cut or the like into two yarns, by the yarn joining device 4, the unit control section 80 transmits a control signal for causing the package-driving control unit 82 to resume rotation of the bobbin B.

[0038] In the first embodiment, the configuration where the unit control section 80, the traverse control unit 81, and the package-driving control unit 82 are provided as separate units is employed. Alternatively, for example, the traverse control unit 81 and the package-driving control unit 82 can be provided inside the unit control section 80.

[0039] The pre-correction target-position command Pt, which is a command for a not-yet-corrected position of the traverse guide 61, and the post-correction target-position command Ps, which is a command for a corrected position of the traverse guide 61, are described in further detail below. Factors that cause an actual position Pr of the traverse guide 61 to deviate by a relatively large degree from a target position Pi, which is an ideal position of the traverse guide 61, in conventional yarn winding devices are described below.

[0040] FIG. 2, in (a), shows a relationship between the pre-correction target-position command Pt and the post-correction target-position command Ps for the traverse guide 61, and in (b), shows a change in the rotational speed Bv of the bobbin B with time. FIG. 3, in (a), shows a relationship between the actual position Pr and the target position Pi of the traverse guide 61 in the conventional yarn winding device, and in (b), shows a change in the rotational speed Bv of a bobbin in the conventional yarn winding device with time.

[0041] The pre-correction target-position command Pt for the traverse guide 61 specifies how the position of the reciprocating traverse guide 61 should change with time. The pre-correction target-position command Pt for the traverse guide 61 has been determined in advance in the form of the relationship with the rotational speed Bv of the bobbin B. The pre-correction target-position command Pt for the traverse guide 61 is updated by the traverse control unit 81, serving as a target-position-command determining unit, on a per-position-control-cycle basis of the traverse guide 61 to the pre-correction target-position command Pt that corresponds to the rotational speed Bv of the bobbin B.

[0042] As illustrated in (a) in FIG. 2, the pre-correction target-position command Pt for the traverse guide 61 is configured such that a traverse rate of the traverse guide 61 increases as the rotational speed Bv of the bobbin B increases. The pre-correction target-position command Pt for the traverse guide 61 is configured such that the traverse guide 61 reciprocates along a substantially sinusoidal path, of which center is at the origin O, between one end Be and the other end Be of the bobbin B (package P).

[0043] Consequently, when the rotational speed Bv of the bobbin B is increasing as illustrated in (a) and (b) in FIG. 2, the traverse rate increases with every to-and-fro motion of the traverse guide 61. When the rotational speed Bv of the bobbin B is constant, the traverse guide 61 is driven at a predetermined constant traverse rate.

[0044] The post-correction target-position command Ps for the traverse guide 61, which is obtained from the pre-correction target-position command Pt for the traverse guide 61 and the target-position correction amount Cp, specifies how the position of the reciprocating traverse guide 61 should change with time. In other words, the post-correction target-position command Ps for the traverse guide 61 is a command obtained by correcting the pre-correction target-position command Pt for the traverse guide 61 with the target-position correction amount Cp.

[0045] As illustrated in (a) in FIG. 2, the post-correction target-position command Ps for the traverse guide 61 has a phase shift relative to the pre-correction target-position command Pt for the traverse guide 61. This causes the traverse guide 61 to follow a target path specified by the post-correction target-position command Ps, thereby canceling a response delay time and the like of the traverse-guide driving unit 62.

[0046] However, even in the above-mentioned configuration, there can be a situation where the actual position Pr deviates from the target position Pi of the traverse guide 61 by a relatively large degree as illustrated in (a) and (b) in FIG. 3.

[0047] The factors that cause the actual position Pr to deviate from the target position Pi of the traverse guide 61 are described below.

[0048] A first factor is that immediately after the state of the bobbin B has changed from the stopped state to the rotating state, the rotational speed Bv of the bobbin B is low, which makes it difficult to obtain an accurate value of the rotational speed Bv. More specifically, the rotational-speed detecting unit 73 obtains detection signals in response to the pits and projections of the pulse disk. Hence, when the rotational speed Bv of the bobbin B is low, or, in other words, when the rotational speed of the pulse disk is low, a cycle period of the detection signals is undesirably long. Accordingly, in an acceleration winding period of the package P, even when the rotational speed Bv of the bobbin B is increasing, time intervals between detection signals output from the rotational-speed detecting unit 73 to the unit control section 80 and the traverse control unit 81 are long. This causes the unit control section 80 and/or the like to fail to detect that the rotational speed Bv of the bobbin B is increasing. That is, in the acceleration winding period of the package P, a calculated value of the rotational speed Bv of the bobbin B calculated by the unit control section 80 and the like is lower than an actual value of the rotational speed Bv of the bobbin B in some cases. In such a case, the traverse control unit 81 controls the traverse-guide driving unit 62 according to the pre-correction target-position command Pt that corresponds to the calculated value, which differs from the actual value, of the rotational speed Bv of the bobbin B. This results in a deviation of the actual position Pr of the traverse guide 61 from the target position Pi.

[0049] A second factor is the response delay time of the traverse-guide driving unit 62 related to supply of electric power, which is generated based on a calculation result and supplied by the traverse control unit 81. More specifically, the traverse control unit 81 supplies, to the traverse-guide driving unit 62, electric power that depends on the pre-correction target-position command Pt that corresponds to the rotational speed Bv of the bobbin B. When the traverse rate is changed in response to a change in control signals for the pre-correction target-position command Pt and the like, the response delay time of the traverse-guide driving unit 62 also changes. Accordingly, when the traverse rate increases in conjunction with an increase in the rotational speed Bv of the bobbin B, the response delay time of the traverse-guide driving unit 62 increases, resulting in a deviation of the actual position Pr of the traverse guide 61 from the target position Pi in some cases.

[0050] The reason why the yarn winding device 100 according to the first embodiment of the present invention is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi in the acceleration winding period of the package P is specifically described below.

[0051] FIG. 4, in (a), shows relationships among the pre-correction target-position command Pt, the post-correction target-position command Ps, and the actual position Pr of the traverse guide 61, and in (b), shows a change in the rotational speed Bv of the bobbin B with time. FIG. 5, in (a), shows a relationship between the actual position Pr and the target position Pi of the traverse guide 61 in the yarn winding device 100, and in (b), shows a change in the rotational speed Bv of the bobbin B with time.

[0052] The traverse control unit 81, serving as the target-position-command determining unit, obtains the rotational speed Bv of the bobbin B based on the detection signal fed from the rotational-speed detecting unit 73. More specifically, the traverse control unit 81 obtains the rotational speed Bv of the bobbin B on a per-position-control-cycle (Δt in (b) in FIG. 4) basis for the traverse guide 61 (see (b) in FIG. 4).

[0053] The traverse control unit 81 determines the target-position correction amount Cp by predicting a detection delay time of the rotational speed Bv of the bobbin B and a response delay time of the traverse-guide driving unit 62, and calculates the post-correction target-position command Ps based on the target-position correction amount Cp. The traverse control unit 81 controls the traverse-guide driving unit 62 according to the post-correction target-position command Ps on the per-position-control-cycle (Δt in (b) in FIG. 4) basis.

[0054] In the yarn winding device 100 according to the first embodiment, the detection delay time of the rotational speed Bv of the bobbin B gradually decreases as the rotational speed Bv of the bobbin B increases. As illustrated in (a) and (b) in FIG. 3, if the traverse control unit 81 has obtained information in advance about a period of time tr, over which the bobbin B proceeds from the stopped state to the rotating state and the rotational speed of the bobbin B increases to a predetermined rotational speed Bvr, the traverse control unit 81 can predict the detection delay time. More specifically, as illustrated in (b) in FIG. 4, when the detection delay time of a rotational speed Bv1 of the bobbin B is denoted as R1, and detection delay times detected at subsequent rotational-speed detection times are denoted as R2, R3, and R4, the detection delay times satisfy the following relation:

$$R1>R2>R3>R4.$$

[0055] Thus, as expressed with R1, R2, R3, and R4, the detection delay time of the rotational speed Bv of the bobbin B gradually decreases as the rotational speed Bv of the bobbin B increases. By utilizing this characteristic, the traverse control unit 81 can optimally calculate the post-correction target-position command Ps for the traverse guide 61 and control the driving of the traverse-guide driving unit 62 according to the post-correction target-position command Ps. Thus, the yarn winding device 100 according to the first embodiment is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0056] In the yarn winding device 100 according to the first embodiment, the response delay time of the traverse-guide driving unit 62 gradually increases as the rotational speed Bv of the bobbin B increases. As illustrated in (a) and (b) in FIG. 3, if the traverse control unit 81 has obtained information in advance about the period of time tr, over which the state of the bobbin B changes from the stopped state to the rotating state and the rotational speed of the bobbin B increases to the predetermined rotational speed Bvr, the traverse control unit 81 can predict the response delay time. More specifically, as illustrated in (a) in FIG. 4, when the response delay time of the traverse-guide driving unit 62 corresponding to the rotational speed Bv1 of the bobbin B is denoted as r1, and subsequent response delay times are denoted as r2, r3, and r4, the response delay times satisfy the following relation:

$$r1<r2<r3<r4.$$

[0057] Thus, as expressed with r1, r2, r3, and r4, the response delay time of the traverse-guide driving unit 62 gradually increases as the rotational speed Bv of the bobbin B increases. By utilizing this characteristic, the traverse control unit 81 can optimally calculate the post-correction target-position command Ps for the traverse guide 61 and control the driving of the traverse-guide driving unit 62 according to the post-correction target-position command Ps. More specifically, the traverse control unit 81 can control the driving of the traverse-guide driving unit 62 in a manner that the response delay time r1 of the traverse-guide driving unit 62 is the same as each of r2, r3, and r4. Accordingly, the yarn winding device 100 according to the first embodiment is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0058] As discussed above, even when the rotational speed Bv of the bobbin B varies as illustrated in (a) and (b) in FIG. 5, the yarn winding device 100 according to the first embodiment can prevent a deviation of the actual position Pr of the traverse guide 61 from the target position Pi by a large degree.

[0059] The yarn winding device 100 according to the first embodiment calculates the post-correction target-position command Ps for the traverse guide 61 and controls the driving of the traverse-guide driving unit 62 according to the post-correction target-position command Ps only when the rotational speed Bv of the bobbin B is increasing. This is because, when the rotational speed Bv of the bobbin B is increasing, the deviation of the actual position Pr of the traverse guide 61 from the target position Pi is likely to increase. Hence, the yarn winding device 100 according to the first embodiment can reduce the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0060] The yarn winding device 100 according to the first embodiment does not calculate the post-correction target-position command Ps for the traverse guide 61, but controls the driving of the traverse-guide driving unit 62 according to the pre-correction target-position command Pt when the rotational speed Bv of the bobbin B is constant or decreasing. This is because, when the rotational speed Bv of the bobbin B is constant or decreasing, the deviation of the actual position Pr of the traverse guide 61 from the target position Pi is less likely to increase. Hence, the configuration of the yarn winding device 100 related to control can be simplified.

[0061] The reason why a yarn winding device 200 according to a second embodiment of the present invention is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi is specifically described below. The yarn winding device 200 according to the second embodiment differs from the yarn winding device 100 according to the first embodiment in specifying the traverse rate rather than specifying how the position of the traverse guide 61 changes with time. Constituent elements that are the same or similar in configuration with those of the yarn winding device 100 discussed above are denoted by like reference numerals and constituent elements that differ from those of the yarn winding device 100 are mainly discussed below.

[0062] FIG. 6, in (a), shows relationships among a pre-correction target-speed command Vt, a post-correction target-speed command Vs, and an actual speed Vr of the traverse guide 61, and in (b), shows a change in the rotational speed Bv of the bobbin B with time. FIG. 7, in (a), shows a relationship between the actual position Pr and the target position Pi of the traverse guide 61 in the yarn winding device 200, and in (b), shows a change in the rotational speed Bv of the bobbin B with time. The pre-correction target-position command Pt and the post-correction target-position command Ps are presented in (a) in FIG. 6 for reference purpose.

[0063] The traverse control unit 81, serving as a target-speed-command determining unit, obtains the rotational speed Bv of the bobbin B based on the detection signals received from the rotational-speed detecting unit 73. More specifically, the traverse control unit 81 obtains the rotational speed Bv of the bobbin B on a per-speed-control-cycle (Δt in (b) in FIG. 6) basis for the traverse guide 61 (see (b) in FIG. 6).

[0064] The traverse control unit 81 determines a target-speed correction amount Cv by predicting a detection delay time of the rotational speed Bv of the bobbin B and a response delay time of the traverse-guide driving unit 62, and calculates the post-correction target-speed command Vs based on the target-speed correction amount Cv. The traverse control unit 81 controls the traverse-guide driving unit 62 according to the post-correction target-speed command Vs on the per-speed-control-cycle (Δt in (b) in FIG. 6) basis.

[0065] In the yarn winding device 200 according to the second embodiment, the detection delay time of the rotational speed Bv of the bobbin B gradually decreases as the rotational speed Bv of the bobbin B increases. As illustrated in (a) and (b) in FIG. 3, if the traverse control unit 81 has obtained information in advance about the period of time tr, over which the state of the bobbin B changes from the stopped state to the rotating state and the rotational speed of the bobbin B increases to the predetermined rotational speed Bvr, the traverse control unit 81 can predict the detection delay time. More specifically, as illustrated in (b) in FIG. 6, when the detection delay time of the rotational speed Bv1 of the bobbin B is denoted as R1, and subsequent detection delay times are denoted as R2, R3, and R4, the detection delay times satisfy the following relation:

$$R1>R2>R3>R4.$$

[0066] Thus, as expressed with R1, R2, R3, and R4, the detection delay time of the rotational speed Bv of the bobbin B gradually decreases as the rotational speed Bv of the bobbin B increases. By utilizing this characteristic, the traverse control unit 81 can optimally calculate the post-correction target-speed command Vs for the traverse guide 61 and control the driving of the traverse-guide driving unit 62 according to the post-correction target-speed command Vs. Thus, the yarn winding device 200 according to the second embodiment is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0067] In the yarn winding device 200 according to the second embodiment, the response delay time of the traverse-guide driving unit 62 gradually increases as the rotational speed Bv of the bobbin B increases. As illustrated in (a) and (b) in FIG. 3, if the traverse control unit 81 has obtained information in advance about the period of time tr, over which the state of the bobbin B changes from the stopped state to the rotating state and the rotational speed of the bobbin B increases to the predetermined rotational speed Bvr, the traverse control unit 81 can predict the response delay time. More specifically, as illustrated in (a) in FIG. 6, when the response delay time of the traverse-guide driving unit 62 corresponding to the rotational speed Bv1 of the bobbin B is denoted as r1, and subsequent response delay times are denoted as r2, r3, and r4, the response delay times satisfy the following relation:

$$r1<r2<r3<r4.$$

[0068] Thus, as expressed with r1, r2, r3, and r4, the response delay time of the traverse-guide driving unit 62 gradually increases as the rotational speed Bv of the bobbin B increases. By utilizing this characteristic, the traverse control unit 81 can optimally calculate the post-correction target-speed command Vs for the traverse guide 61 and control the driving of the traverse-guide driving unit 62 according to the post-correction target-speed command Vs. More specifically, the traverse control unit 81 can control the driving of the traverse-guide driving unit 62 such that the response delay times r1, r2, r3, and r4 of the traverse-guide driving unit 62 are equal to one another. Thus, the yarn winding device 200 according to the second embodiment is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0069] Hence, as illustrated in (a) and (b) in FIG. 7, even when the rotational speed Bv of the bobbin B varies, the yarn winding device 200 according to the second embodiment can prevent the actual position Pr of the traverse guide 61 from deviating from the target position Pi by a large degree.

[0070] The yarn winding device 200 according to the second embodiment calculates the post-correction target-speed command Vs for the traverse guide 61 and controls the driving of the traverse-guide driving unit 62 according to the post-correction target-speed command Vs only when the rotational speed Bv of the bobbin B is increasing. This is because, when the rotational speed Bv of the bobbin B is increasing, the deviation of the actual position Pr of the traverse guide 61 from the target position Pi is likely to increase. Hence, the yarn winding device 200 according to the second embodiment is capable of reducing the deviation of the actual position Pr of the traverse guide 61 from the target position Pi, thereby preventing the package P from becoming defective.

[0071] When the rotational speed Bv of the bobbin B is constant or decreasing, the yarn winding device 200 according to the second embodiment does not calculate the post-correction target-speed command Vs for the traverse guide 61, but controls the driving of the traverse-guide driving unit 62 according to the pre-correction target-speed command Vt. This is because, when the rotational speed Bv of the bobbin B is constant or decreasing, the deviation of the actual position Pr of the traverse guide 61 from the target position Pi is less likely to increase. Accordingly, the configuration of the yarn winding device 200 related to control can be simplified.

[0072] A yarn winding device according to an aspect of the present invention includes a package driving unit, a rotational-speed detecting unit, a traverse guide, a traverse-guide driving unit, and a target-position-command determining unit. The package driving unit rotation-drives a bobbin around which a yarn is to be wound to form a package. The rotational-speed detecting unit detects a rotational speed of the bobbin. The traverse guide traverses the yarn to be wound around the bobbin. The traverse-guide driving unit drives the traverse guide. The traverse control unit controls driving of the traverse-guide driving unit. The target-position-command determining unit determines a pre-correction target-position command of the traverse-guide driving unit in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit. The traverse control unit calculates a post-correction target-position command in accordance with a target-position correction amount, which is a feed-forward component for the traverse control unit according to a detection delay time of the rotational-speed detecting unit and a response delay time of the traverse-guide driving unit, and the pre-correction target-position command, which has been determined by the target-position-command determining unit, and controls the driving of the traverse-guide driving unit in accordance with the post-correction target-position command.

[0073] In a yarn winding device according to another aspect of the present invention, when a state of the bobbin changes from a stopped state to a rotating state and the rotational speed of the bobbin is increasing, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the post-correction target-position command.

[0074] In a yarn winding device according to still another aspect of the present invention, the traverse control unit adapts a gradually decreasing predicted value as the target position-correction amount in accordance with a detection delay time of the rotational speed of the bobbin that decreases as the rotational speed of the bobbin increases.

[0075] In a yarn winding device according to still another aspect of the present invention, the traverse control unit adapts a gradually decreasing predicted value as the target position-correction amount according to an increase in the rotational speed of the bobbin such that the response delay time of the traverse-guide driving unit becomes constant while the rotational speed of the bobbin is increasing.

[0076] In a yarn winding device according to still another aspect of the present invention, when the rotational speed of the bobbin is constant, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the pre-correction target-position command of the traverse guide that is preset in association with the rotational speed of the bobbin.

[0077] In a yarn winding device according to still another aspect of the present invention, when the rotational speed of the bobbin is decreasing, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the pre-correction target-position command of the traverse guide that is preset in association with the rotational speed of the bobbin.

[0078] A yarn winding device according to still another aspect of the present invention includes a package driving unit, a rotational-speed detecting unit, a traverse guide, a traverse-guide driving unit, a traverse control unit, and a target-speed-command determining unit. The package driving unit rotation-drives a bobbin around which a yarn is to be wound to form a package. The rotational-speed detecting unit detects a rotational speed of the bobbin. The traverse guide traverses the yarn to be wound around the bobbin. The traverse-guide driving unit drives the traverse guide. The traverse control unit controls driving of the traverse-guide driving unit. The target-speed-command determining unit determines a pre-correction target-speed command of the traverse-guide driving unit in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit. The traverse control unit calculates a post-correction target-speed command in accordance with a target-speed correction amount, which is a feed-forward component for the traverse control unit according to a detection delay time of the rotational-speed detecting unit and a response delay time of the traverse-guide driving unit, and the pre-correction target-speed command, which has been determined by the target-speed-command determining unit, and controls the driving of the traverse-guide driving unit in accordance with the post-correction target-speed command.

[0079] In a yarn winding device according to still another aspect of the present invention, when a state of the bobbin changes from a stopped state to a rotating state and the rotational speed of the bobbin is increasing, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the post-correction target-speed command.

[0080] In a yarn winding device according to still another aspect of the present invention, the traverse control unit adapts a gradually decreasing predicted value as the target-speed correction amount in accordance with a detection delay time of the rotational speed of the bobbin that decreases as the rotational speed of the bobbin increases.

[0081] In a yarn winding device according to still another aspect of the present invention, the traverse control unit adapts a gradually decreasing predicted value as the target-speed correction amount according to an increase in the rotational speed of the bobbin such that the response delay time of the traverse-guide driving unit becomes constant while the rotational speed of the bobbin is increasing.

[0082] In a yarn winding device according to still another aspect of the present invention, when the rotational speed of the bobbin is constant, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the pre-correction target-speed command of the traverse guide that is preset in association with the rotational speed of the bobbin.

[0083] In a yarn winding device according to still another aspect of the present invention, when the rotational speed of the bobbin is decreasing, the traverse control unit controls the driving of the traverse-guide driving unit in accordance with the pre-correction target-speed command of the traverse guide that is preset in association with the rotational speed of the bobbin.

[0084] The present invention yields the following advantages.

[0085] According to an aspect of the present invention, the traverse control unit controls driving of the traverse-guide driving unit based on the detection delay time of the rotational-speed detecting unit and the response delay time of the traverse-guide driving unit. Accordingly, a deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0086] According to another aspect of the invention, when the state of the bobbin changes from a stopped state to a rotating state and the rotational speed of the bobbin is increasing, the traverse control unit controls the driving of the traverse-guide driving unit according to a post-correction target-position command. In a situation where the state of the bobbin changes from the stopped state to the rotating state and the rotational speed of the bobbin is increasing, a deviation of the actual position of the traverse guide from the target position gradually accumulates; accordingly, the deviation is increasing. Hence, by causing the traverse control unit to control the driving of the traverse-guide driving unit as discussed above, the deviation of the actual position of the traverse guide from the target position in the acceleration winding period can be reduced, and hence production of a defective package can be prevented.

[0087] According to still another aspect of the present invention, a characteristic that the detection delay time of the rotational-speed detecting unit gradually decreases as the rotational speed of the bobbin increases has been utilized. Accordingly, by calculating the post-correction target-position command, where the feed-forward component is taken into account, and causing the traverse control unit to control the driving of the traverse-guide driving unit according to the post-correction target-position command, the deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0088] According to still another aspect of the present invention, a characteristic that the response delay time of the traverse-guide driving unit gradually increases as the rotational speed of the bobbin increases has been utilized. Accordingly, by calculating the post-correction target-position command, where the feed-forward component is taken into account, and causing the traverse control unit to control the driving of the traverse-guide driving unit according to the post-correction target-position command, the deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0089] When the bobbin rotates at a constant rotational speed, the deviation of the actual position of the traverse guide from the target position is less likely to increase. According to still another aspect of the present invention, therefore, by causing the traverse control unit to control the driving of the traverse-guide driving unit according to the pre-correction target-position command determined by the target-position-command determining unit rather than according to the post-correction target-position command, the configuration of the yarn winding device related to control can be simplified.

[0090] When the rotational speed of the bobbin is decreasing, the detection delay time of the rotational-speed detecting unit is short and a change in the rotational speed of the bobbin is also small; hence, the deviation of the actual position of the traverse guide from the target position is less likely to increase. According to still another aspect of the present invention, therefore, by causing the traverse control unit to control the driving of the traverse-guide driving unit according to the pre-correction target-position command determined by the target-position-command determining unit rather than according to the post-correction target-position command, the configuration of the yarn winding device related to control can be simplified.

[0091] According to still another aspect of the present invention, the traverse control unit controls the driving of the traverse-guide driving unit depending on the detection delay time of the rotational-speed detecting unit and the response delay time of the traverse-guide driving unit. Accordingly, the deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0092] According to still another aspect of the present invention, when the state of the bobbin changes from the stopped state to the rotating state and the rotational speed of the bobbin is increasing, the driving of the traverse-guide driving unit is controlled according to the post-correction target-speed command. When the state of the bobbin changes from the stopped state to the rotating state and the rotational speed of the bobbin is increasing, the deviation of the actual position of the traverse guide from the target position gradually accumulates, causing the deviation to increase. Hence, by causing the traverse control unit to control the driving of the traverse-guide driving unit as discussed above, the deviation of the actual position of the traverse guide from the target position in the acceleration winding period can be reduced, and hence production of a defective package can be prevented.

[0093] According to still another aspect of the present invention, a characteristic that the detection delay time of the rotational-speed detecting unit gradually decreases as the rotational speed of the bobbin increases has been utilized. By calculating the post-correction target-speed command, where the feed-forward component is taken into account, and causing the traverse control unit to control the driving of the traverse-guide driving unit according to the post-correction target-speed command, the deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0094] According to still another aspect of the present invention, a characteristic that the response delay time of the traverse-guide driving unit gradually increases as the rotational speed of the bobbin increases has been utilized. By calculating the post-correction target-speed command, where the feed-forward component is taken into account, and causing the traverse control unit to control the driving of the traverse-guide driving unit according to the post-correction target-speed command, the deviation of the actual position of the traverse guide from the target position can be reduced, and hence production of a defective package can be prevented.

[0095] When the rotational speed of the bobbin is constant, the deviation of the actual position of the traverse guide from the target position is less likely to increase. According to still another aspect of the present invention, therefore, by causing the traverse control unit to control the driving of the traverse-guide driving unit according to the pre-correction target-speed command determined by the target-speed-command determining unit rather than according to the post-correction target-speed command, the configuration of the yarn winding device related to control can be simplified.

[0096] When the rotational speed of the bobbin is decreasing, the detection delay time of the rotational-speed detecting unit is short and a change in the rotational speed of the bobbin is also small; hence, the deviation of the actual position of the traverse guide from the target position is less likely to increase. According to still another aspect of the present invention, therefore, by causing the traverse control unit to control the driving of the traverse-guide driving unit according to the pre-correction target-speed command determined by the target-speed-command determining unit rather than according to the post-correction target-speed command, the configuration of the yarn winding device related to control can be simplified.

[0097] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the present invention.

Claims

1. A yarn winding device comprising:

a package driving unit (72) adapted to rotation-drive a bobbin around which a yarn is to be wound to form a package;
a rotational-speed detecting unit (73) adapted to detect a rotational speed of the bobbin;
a traverse guide (61) adapted to traverse the yarn to be wound around the bobbin;
a traverse-guide driving unit (62) adapted to drive the traverse guide;
a traverse control unit (81) adapted to control driving of the traverse-guide driving unit (62); and
a target-position-command determining unit (81) adapted to determine a pre-correction target-position command of the traverse-guide driving unit (62) in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit (73), wherein
the traverse control unit (81) is adapted to calculate a post-correction target-position command in accordance with a target-position correction amount, which is a feed-forward component for the traverse control unit (81) according to a detection delay time of the rotational-speed detecting unit (73) and a response delay time of the traverse-guide driving unit (62), and the pre-correction target-position command, which has been determined by the target-position-command determining unit (81), and
the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the post-correction target-position command.

2. The yarn winding device according to Claim 1, wherein when a state of the bobbin changes from a stopped state to a rotating state and the rotational speed of the bobbin is increasing, the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the post-correction target-position command.

3. The yarn winding device according to Claim 1 or 2, wherein the traverse control unit (81) is adapted to adapt a gradually decreasing predicted value as the target position-correction amount in accordance with a detection delay time of the rotational speed of the bobbin that decreases as the rotational speed of the bobbin increases.

4. The yarn winding device according to any one of Claims 1 to 3, wherein the traverse control unit (81) is adapted to adapt a gradually decreasing predicted value as the target position-correction amount according to an increase in the rotational speed of the bobbin such that the response delay time of the traverse-guide driving unit (62) becomes constant while the rotational speed of the bobbin is increasing.

5. The yarn winding device according to any one of Claims 1 to 4, wherein when the rotational speed of the bobbin is constant, the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the pre-correction target-position command of the traverse guide (61) that is preset in association with the rotational speed of the bobbin.

6. The yarn winding device according to any one of Claims 1 to 5, wherein when the rotational speed of the bobbin is decreasing, the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the pre-correction target-position command of the traverse guide (61) that is preset in association with the rotational speed of the bobbin.

7. A yarn winding device comprising:

a package driving unit (72) adapted to rotation-drive a bobbin around which a yarn is to be wound to form a package;
a rotational-speed detecting unit (73) adapted to detect a rotational speed of the bobbin;
a traverse guide (61) adapted to traverse the yarn to be wound around the bobbin;
a traverse-guide driving unit (62) adapted to drive the traverse guide;
a traverse control unit (81) adapted to control driving of the traverse-guide driving unit (62); and
a target-speed-command determining unit (81) adapted to determine a pre-correction target-speed command of the traverse-guide driving unit (62) in accordance with the rotational speed of the bobbin detected by the rotational-speed detecting unit (73), wherein
the traverse control unit (81) is adapted to calculate a post-correction target-speed command in accordance with a target-speed correction amount, which is a feed-forward component for the traverse control unit (81) according to a detection delay time of the rotational-speed detecting unit (73) and a response delay time of the traverse-guide driving unit (62), and the pre-correction target-speed command, which has been determined by the target-speed-command determining unit (81), and
the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the post-correction target-speed command.

8. The yarn winding device according to Claim 7, wherein when a state of the bobbin changes from a stopped state to a rotating state and the rotational speed of the bobbin is increasing, the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the post-correction target-speed command.

9. The yarn winding device according to Claim 7 or 8, wherein the traverse control unit (81) is adapted to adapt a gradually decreasing predicted value as the target-speed correction amount in accordance with a detection delay time of the rotational speed of the bobbin that decreases as the rotational speed of the bobbin increases.

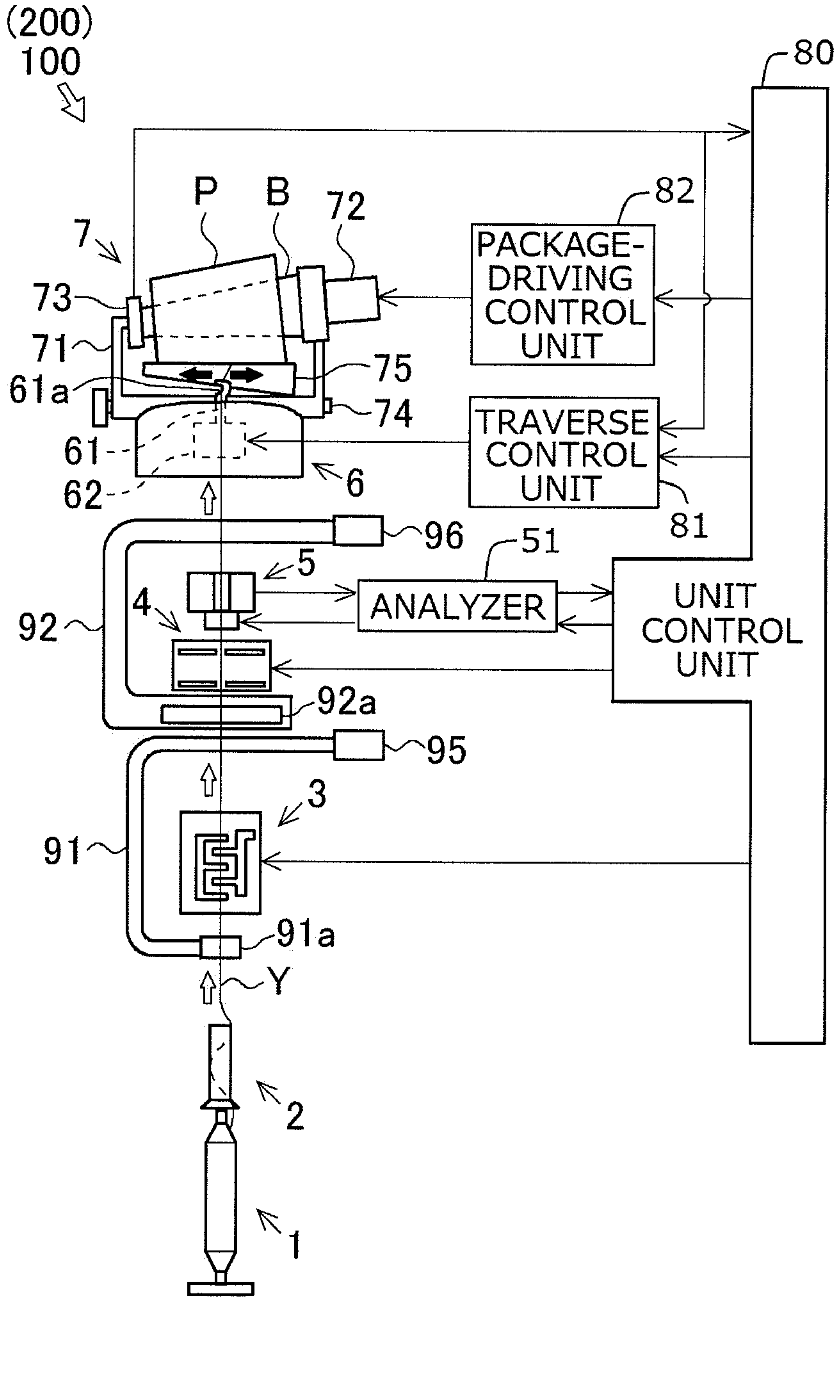
10. The yarn winding device according to any one of Claims 7 to 9, wherein the traverse control unit (81) is adapted to adapt a gradually decreasing predicted value as the target-speed correction amount according to an increase in the rotational speed of the bobbin such that the response delay time of the traverse-guide driving unit (62) becomes constant while the rotational speed of the bobbin is increasing.

11. The yarn winding device according to any one of Claims 7 to 10, wherein when the rotational speed of the bobbin is constant, the traverse control unit (81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the pre-correction target-speed command of the traverse guide (61) that is preset in association with the rotational speed of the bobbin.

12. The yarn winding device according to any one of Claims 7 to 11, wherein when the rotational speed of the bobbin is decreasing, the traverse control unit

(81) is adapted to control the driving of the traverse-guide driving unit (62) in accordance with the pre-correction target-speed command of the traverse guide (61) that is preset in association with the rotational speed of the bobbin.

FIG. 1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TRAVERSE CONTROL UNIT
81
96
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ANALYZER
4
UNIT CONTROL UNIT
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Y
2
1

FIG. 2

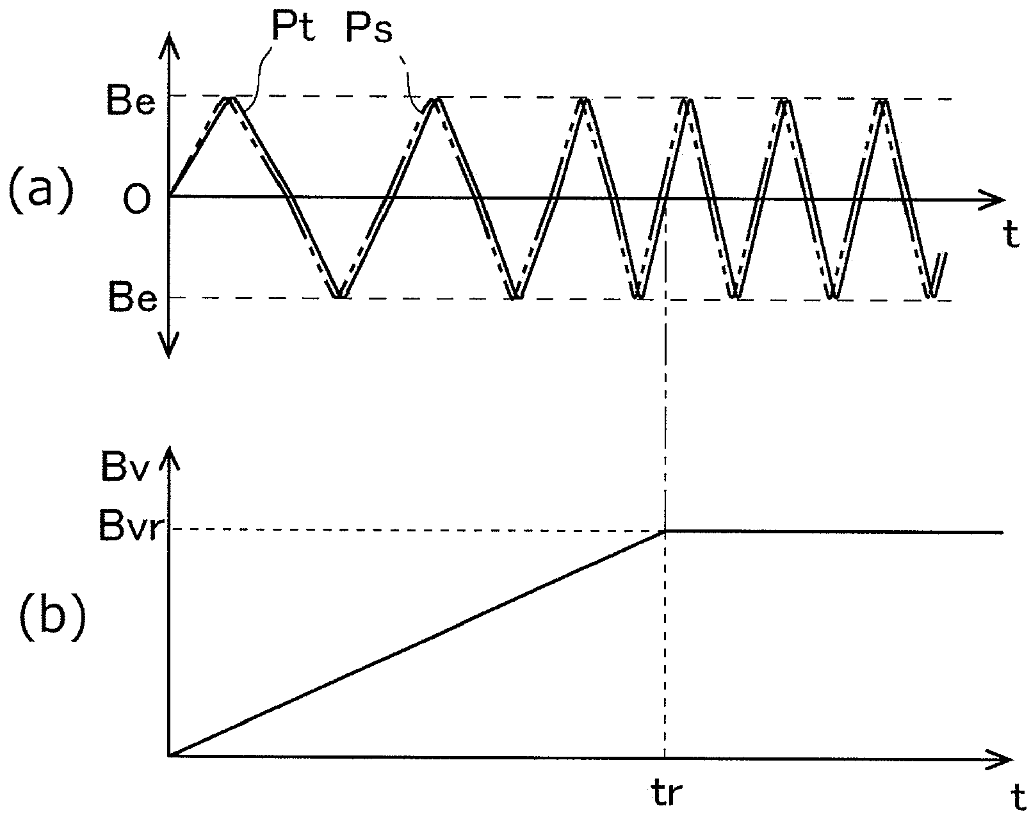


FIG. 3

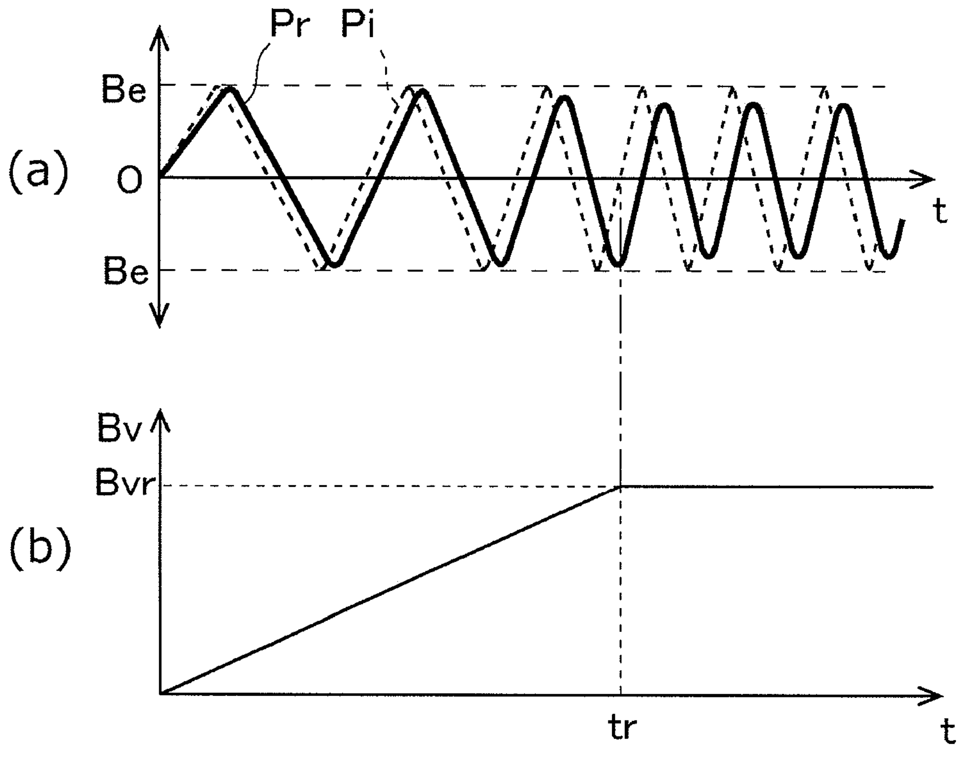


FIG. 4

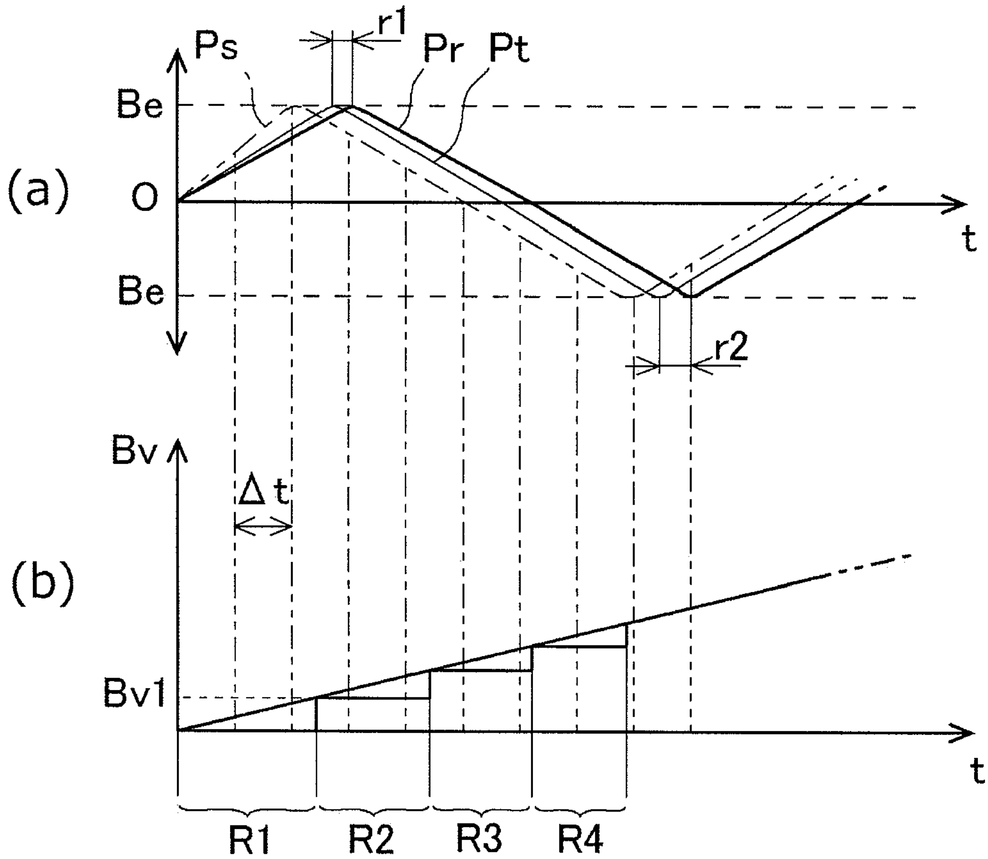


FIG. 5

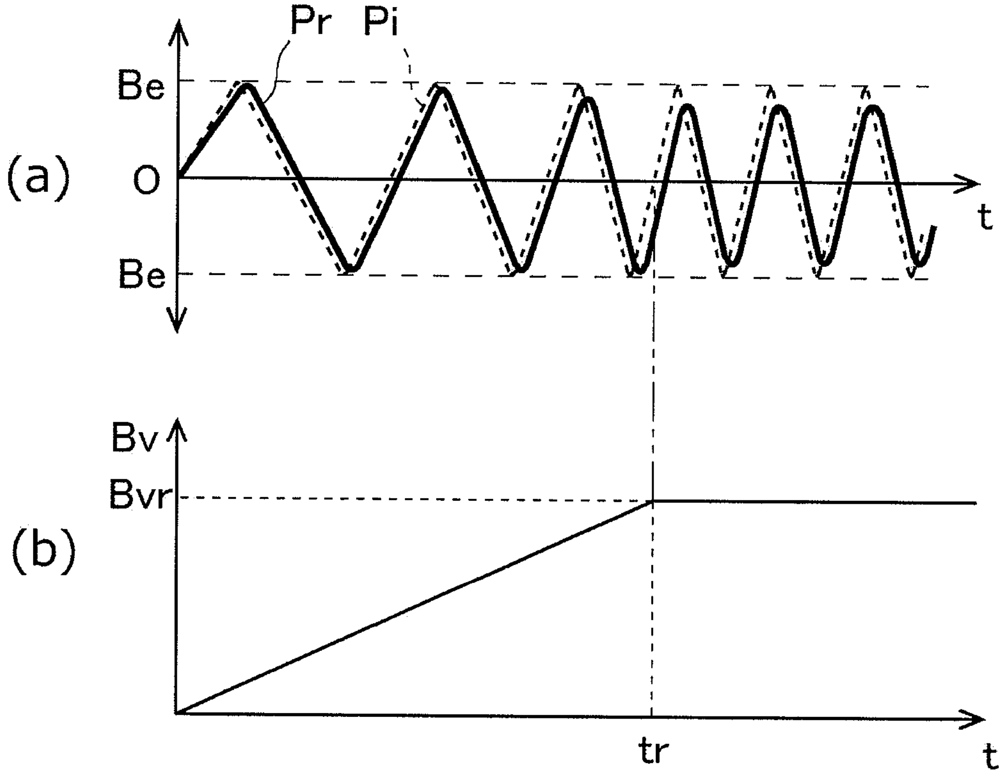


FIG. 6

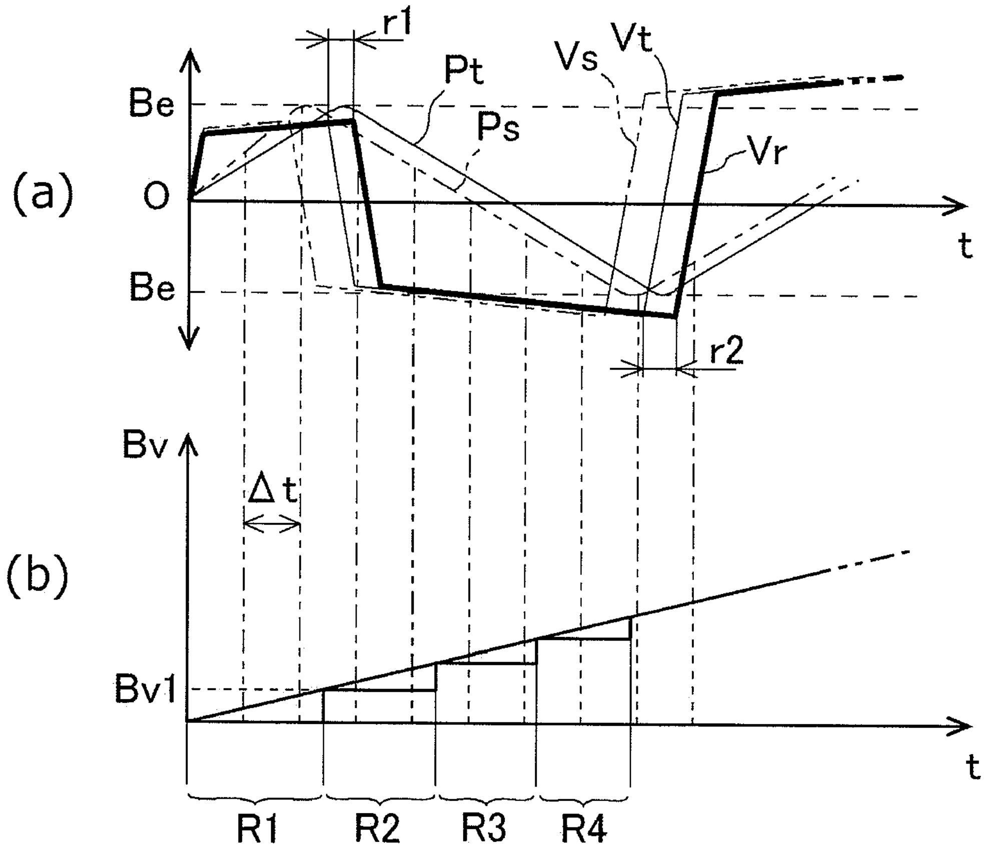
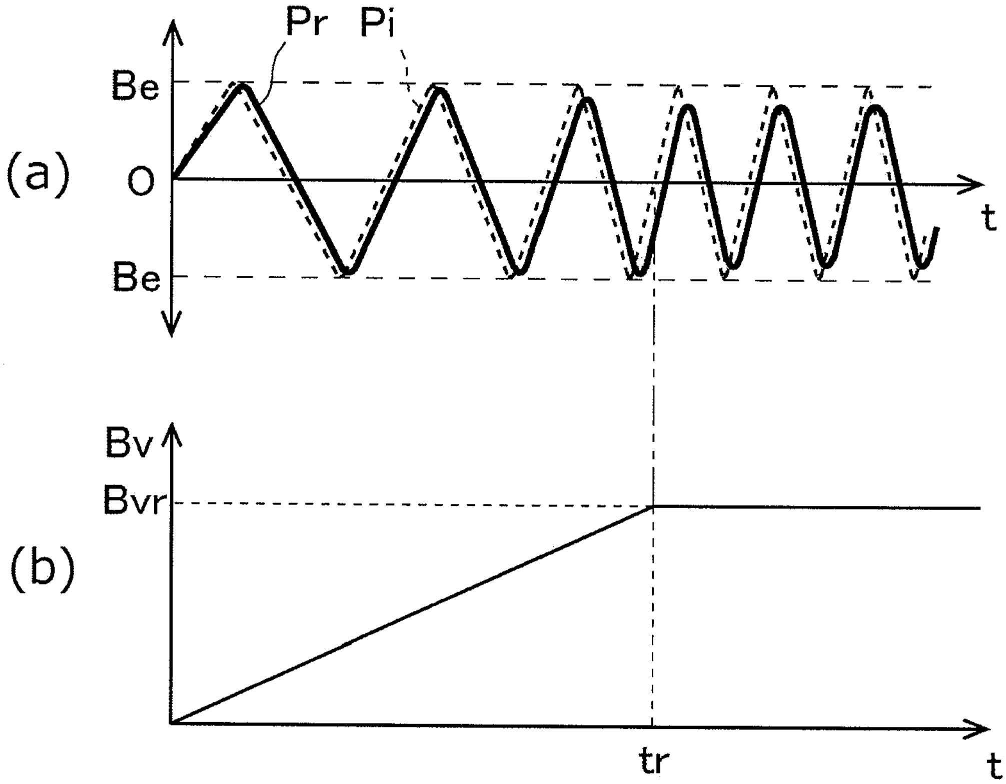


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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