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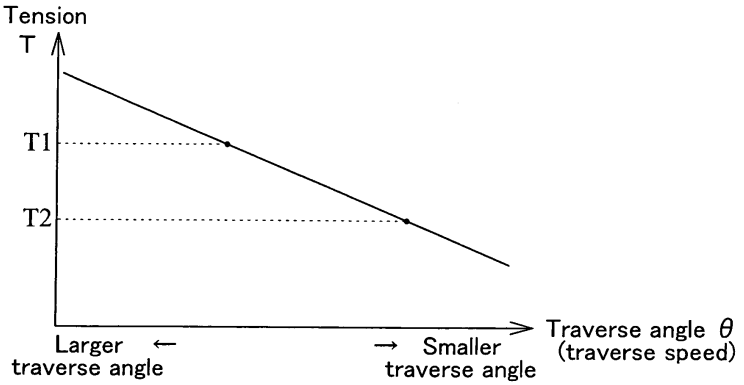
(54) Yarn winding device

(57) The present invention improves the quality of a package (7) by preventing wrinkles in a yarn winding device which forms the package (7) by winding a supplied yarn (4) around a winding tube (6) while applying a tension to the yarn (4) by a tensioning device (30) and traversing the yarn (4) by a traversing device (5).

Particularly, in precision winding with a fixed number of winds, in synchronism with an increase in diameter of a yarn layer (7) and a change in a traverse angle (θ), the tension to be applied by the tensioning device (30) is changed. In detail, according to reduction in the traverse angle (θ) calculated by traverse angle calculating means (75), tensioning control means (77) controls to reduce the tension to be applied.

FIG. 2



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Description

[0001] The present invention relates to a yarn winding device which winds a supplied yarn around a winding tube while applying tension to the yarn by a tensioning device and traversing the yarn by a traversing device.

[0002] Patent document 1 (Japanese Published Unexamined Patent Application No. H01-209280) discloses an automatic winder including a tension control device which applies a preset tension following a gradually reducing pattern according to a package diameter to a yarn via a tenser. According to this constitution, the pressure does not increase toward the inner side in a radial direction of the package accompanying an increase in the package diameter, a package inner diameter portion is not wrinkled, and so-called wrinkles can be avoided (refer to line 4 to 8 in the lower left column of page (2) and Fig. 1 of the patent document 1).

[0003] Patent document 2 (Japanese Published Unexamined Patent Application No. 2005-60039) discloses an automatic winder in which a plurality of traverse grooves with different numbers of winds are formed on a traversing drum and a switching device that switches the traverse groove to be engaged with a yarn is provided. In this automatic winder, normally, a yarn is wound by being engaged in a traverse groove with a number of winds of 2. 5W, and when the package diameter reaches a degree to cause ribboning, the switching device works to engage the yarn in a traverse groove with a number of winds of 2W to prevent ribboning (refer to paragraphs 0048 to 0051, Fig. 5, and Fig. 6 of the patent document 2).

[0004] However, the above-describedwrinkles and the like cannot be avoided only by determining a gradually reducing pattern according to a package diameter as described in the patent document 1.

[0005] For example, as one of the known methods for forming a package by winding a yarn around a winding tube, there is known precision winding in which a yarn is wound at a fixed number of winds. In this precision winding, a traverse angle becomes gradually smaller (traverse speed is reduced) as the package diameter increases, and as a result, the density of the yarn layer becomes high. That is, only by simply reducing the tension according to the package diameter as described in the patent document 1, due to the characteristics of precision winding in which the density of the yarn layer increases as the package diameter increases, the pressure toward the inner side in the radial direction of the package increases, and as a result, the inner diameter portion of the package is wrinkled and wrinkles cannot be prevented.

[0006] The constitution of the patent document 2 can reliably avoid ribboning, however, as a result of a change in a traverse angle (traverse speed) due to switching of the number of winds from 2.5W to 2W and to 2.5W, a substantial winding width changes accompanying a change in a winding tension, resulting in a step formed on a side surface of the package. The presence of such a step deteriorates the appearance of the package, and also causes stitching of the yarn depending on circumstances.

[0007] The problem to be solved by the present invention is as described above, and next, means for solving this problem and effects thereof will be described.

[0008] According to an aspect of the present invention, a yarn winding device constituted as described below is provided. The yarn winding device includes a tensioning device which applies a tension to a supplied yarn and can change and control the tension to be applied, and a traversing device which traverses the yarn. The yarn winding device forms a package by winding the yarn around a winding tube while applying tension to the yarn by the tensioning device and traversing the yarn by the traversing device. The yarn winding device also includes tensioning control means for controlling the tensioning device so as to change the tension to be applied in synchronism with a change in a traverse angle or a change in traverse speed.

[0009] Accordingly, tensioning can be controlled by the tensioning control means while considering fluctuations that influence a yarn layer density, etc., such as a change in a traverse angle and a change in traverse speed. Therefore, package quality lowering such as occurrence of wrinkles can be reliably prevented.

[0010] It is preferable that the yarn winding device is constituted as follows. That is, precision winding is per formed by reducing the traverse angle according to an increase in a diameter of the yarn layer formed by winding a yarn around the winding tube. The tensioning control means reduces the tension to be applied by the tensioning device in synchronism with the reduction in the traverse angle.

[0011] Accordingly, a precision-wound package with high quality can be formed while preventing the above-described wrinkles, etc.

[0012] It is preferable that the yarn winding device is constituted as follows. That is, when the number of winds approaches a dangerous number of winds accompanying progression of yarn winding, the traverse angle is changed so that the dangerous number of winds is avoided. The tensioning control means reduces the tension to be applied by the tensioning device when changing the traverse angle to be larger, and increases the tension to be applied by the tensioning device when changing the traverse angle to be smaller.

[0013] Accordingly, a package which has no ribboning that causes a yarn unwinding failure such as latching, and has no step on its side surface can be obtained.

[0014] It is preferable that the yarn winding device is constituted as follows. That is, the yarn tobe supplied is a yarn unwound from a supplying bobbin. The tensioning control means controls the tension to be applied by the tensioning device based on a tension pattern according to a yarn remaining amount on the supplying bobbin.

[0015] Accordingly, a yarn can be wound while considering a change in winding tension due to a remaining

yarn amount in the supplying bobbin.

[0016] It is preferable that the yarn winding device is constituted as follows. That is, the yarn winding device includes a winding bobbin support member which detachably supports the winding tube, and a winding bobbin rotative driving device which is provided on the winding bobbin support member and rotatively drives the winding tube in a state that a motor shaft is connected to the winding tube in a manner that the motor shaft does not rotate relatively with respect to the winding tube.

[0017] Fig. 1 is a schematic front view and a block diagram showing a yarn winding unit of an automatic winder according to an embodiment of the present invention.

[0018] Fig. 2 is a graph showing a relationship between a traverse angle and a value of tension to be applied by the tensioning device.

[0019] Fig. 3 is a graph showing a tension pattern for one supplying bobbin and correction according to a change in a traverse angle.

[0020] Fig. 4 is a graph showing another example of correction of the tension pattern accompanying a change in a traverse angle.

[0021] Next, embodiments of the present invention will be described.

[0022] First, based on Fig. 1, a yarn winding unit (yarn winding device) 2 of an automatic winder 1 will be described. This yarn winding unit 2 forms a yarn layer by winding a yarn 4 unwound and supplied from a supplying bobbin 3 around a winding tube 6 while traversing the yarn 4 by a traversing device 5 to form a package 7 having a predetermined length and a predetermined shape. Fig. 1 illustrates only one yarn winding unit 2, however, the automatic winder 1 is constituted by aligning a large number of such yarn winding units 2 on a frame that is not shown.

[0023] In this specification, a winding bobbin is used as a general term of the winding tube 6 and the package 7. A winding bobbin on which no yarn layer is formed is the winding tube 6, and a winding bobbin on which a yarn layer has been formed is the package 7.

[0024] The yarn winding unit 2 includes a cradle (winding bobbin support member) 8 that detachably supports the winding tube 6, and a contact roller 9 which can rotate following the package 7 by making contact with a peripheral surface of the package 7. The cradle 8 is formed so as to grip both ends of the winding tube 6 and support the winding tube 6 rotatably. In addition, this cradle 8 is formed so as to freely tilt around a swing shaft 10 and swings to suction wind thickening (an increase in yarn layer diameter) accompanying winding of the yarn 4 around the winding tube 6.

[0025] To a portion of the cradle 8 gripping the winding tube 6, a package drive motor (winding bobbin rotative driving device) 41 is attached, and the winding tube 6 is driven to rotate by this package drive motor 41 to wind the yarn 4. A motor shaft of the package drive motor 41 is connected to the winding tube 6 so as not to relatively rotate when the winding tube 6 is held by the cradle 8 (a so-called direct drive system). Operations of this package drive motor 41 are controlled by a package drive controller 42, and this package drive controller 42 is constituted so as to control driving/stop of the package drive motor 41 in response to a signal from a unit controller 50.

[0026] A package rotating speed sensor 43 is attached to the cradle 8, and this package rotating speed sensor 43 is constituted to detect a rotating speed of a winding bobbin (winding tube 6, package 7) attached to the cradle 8 (rotating speed of the yarn layer 7 formed on the winding tube 6). A rotating speed detection signal of the winding bobbin 6, 7 is transmitted from the package rotating speed sensor 43 to the package drive controller 42 and the unit controller 50. Furthermore, the rotating speed detection signal is also inputted into a traverse controller 46 that will be described later.

[0027] A package diameter sensor 44 consisting of a rotary encoder, etc., is attached to the cradle 8, and this package diameter sensor 44 is constituted to detect a diameter of a yarn layer (package 7) that is formed by winding the yarn 4 around the winding tube 6 attached to the cradle 8 by detecting a swing angle of the cradle 8. The diameter of the yarn layer detected by the package diameter sensor 44 is transmitted to the unit controller 50.

[0028] The traversing device 5 is provided near the contact roller 9, and the yarn 4 is wound into the package 7 while the yarn 4 is traversed by this traversing device 5. This traversing device 5 includes a traverse guide (yarn guide) 11 provided to reciprocate in the traverse direction, and a traverse drive motor 45 that reciprocates this traverse guide 11.

[0029] The traversing device 5 is constituted so that the hook-shaped traverse guide 11 is provided on the tip end of a thin and long arm member 13 that is formed to turn around a support shaft. The traversing device 5 rotatively reciprocates this arm member 13 as shown by an arrow in Fig. 1 by the traverse drive motor 45. In this embodiment, the traverse drive motor 45 consists of a voice coil motor.

[0030] Operations of this traverse drive motor 45 are controlled by the traverse controller 46, and this traverse controller 46 controls driving/stop of the traverse drive motor 45 in response to a signal from the unit controller 50. The traversing device 5 includes a traverse guide position sensor 47 consisting of a rotary encoder, etc., and is constituted to detect a turning position of the arm-member 13 (consequently, a position of the traverse guide 11) and transmit a position signal to the traverse controller 46.

[0031] The traverse controller 46 is constituted as a microcomputer, and includes a Central Processing Unit (CPU) (computing means), a Read Only Memory (ROM), and Random Access Memory (RAM) (storage means), etc. The RAM stores programs for operating the above-described hardware as a traverse speed detecting means 71 and the like. This traverse speed detecting means 71 calculates and acquires a traverse speed based on the position signal from the traverse guide po-

sition sensor 47.

[0032] In this embodiment, as shown in Fig. 1, the package drive motor 41 for driving the winding bobbin 6, 7 and the traverse drive motor 45 for driving the traverse guide 11 are separately provided, and the winding bobbin 6, 7 and the traverse guide 11 are constituted so as to be driven (controlled) independently from each other. Accordingly, when winding the yarn 4 around the winding bobbin 6, 7, various winding methods such as precision winding can be realized, and traverse jumping that will be described later can also be carried out as appropriate.

[0033] Next, an unwinding assist device 26, a tensioning device 30, a yarn splicing device 14, and a yarn clearer 15 will be described. In the yarn winding unit 2, in order from the supplying bobbin 3 side, the unwinding assist device 2 6, the tensioning device 30, the yarn splicing device 14, and the yarn clearer (yarn defect detector) 15 are arranged in a yarn running path between the supplying bobbin 3 and the contact roller 9.

[0034] The unwinding assist device 26 has a tubular body 27 that can move in the vertical direction. This tubular body 27 can be driven in the vertical direction by a cylinder (actuator) 28. The unwinding assist device 26 has a chase portion detection sensor 29. This chase portion detection sensor 29 is constituted so as to be moved in the vertical direction together with the tubular body 27 by the cylinder 28. A detection signal of this chase portion detection sensor 29 is inputted into the unit controller 50.

[0035] In this constitution, the unit controller 50 controls the cylinder 28 so that the tubular body 27 is positioned at an upper position when a new supplying bobbin 3 is set. When an upper end (chase portion) of the yarn layer wound around a core is not detected by the chase portion detection sensor 29 accompanying unwinding of the yarn 4 from the supplying bobbin 3, the unit controller 50 transmits a signal to the cylinder 28 and lowers the tubular body 27 and the chase portion detection sensor 29 until a chase portion is detected again by the chase portion detection sensor 29.

[0036] In the above-described constitution, accompanying yarn unwinding from the supplying bobbin 3, by lowering the tubular body 27 covering the core of the bobbin, a so-called balloon resistance is reduced, and fluctuations of the unwinding tension of the yarn 4 from the supplying bobbin 3 can be reduced. In addition, a presence or an absence of a chase portion on the core is always monitored by the chase portion detection sensor 29, and the tubular body 27 is lowered until the chase portion detection sensor 29 detects a chase portion. Therefore, the unit controller 50 can recognize a yarn remaining amount on the supplying bobbin 3 based on the current position (lowered distance) of the tubular body 27 (remaining yarn amount detecting means 76 described later).

[0037] The tensioning device 30 applies a predetermined tension to the running yarn 4. The tensioning device 30 illustrated in this embodiment is a gate-type tenser in which movable comb-like teeth 32 are arranged with respect to fixed comb-like teeth 31. A solenoid 33 is connected to the movable comb-like teeth 32, and this solenoid 33 operates in response to a signal from the unit controller 50 to change the tension to be applied to the yarn 4.

[0038] The yarn splicing device 14 splices a yarn end (lower yarn) on the supplying bobbin 3 side and a yarn end (upper yarn) on the package 7 side together when the yarn clearer 15 detects a yarn defect and cuts the yarn or when the yarn is cut during unwinding from the supplying bobbin 3.

[0039] The yarn clearer 15 detects a defect in a thickness of the yarn 4, and detects a yarn defect such as slub or the like by detecting the thickness of the yarn 4 passing through the portion of the yarn clearer 15 by an appropriate sensor and analyzing a signal from this sensor by an analyzer 23. This yarn clearer 15 is provided with a cutter 16 for cutting the yarn 4 immediately when a yarn defect is detected.

[0040] A lower yarn catching and guiding means 17 for suctioning, catching, and guiding the lower yarn on the supplying bobbin 3 side is provided below the yarn splicing device 14. An upper yarn catching and guiding means 20 for suctioning, catching, and guiding the upper yarn on the package 7 side is provided above the yarn splicing device 14. The upper yarn catching and guiding means 20 is formed into a pipe shape, and provided so as to swing up and down around a shaft 21, and has a mouth 22 on its tip end side. The lower yarn catching and guiding means 17 is also formed into a pipe shape, and provided so as to swing up and down around a shaft 18, and has a suctioning port 19 on its tip end side. To the upper yarn catching and guiding means 20 and the lower yarn catching and guiding means 17, an appropriate negative pressure source is connected to cause suctioning into the mouth 22 and the suctioning port 19 at respective ends.

[0041] The constitution of the yarn winding unit 2 of the automatic winder 1 is as described above. In this yarn winding unit 2, a yarn tension control device 65 includes at least the tensioning device 30 and tensioning control means 77 described later of the unit controller 50.

[0042] In this constitution, the unit controller 50 is constituted as a microcomputer, and includes a CPU (computing means), a ROM and RAM (storage means), etc. The RAM stores programs for operating the hardware as a package rotating speed detecting means 72, a package diameter detecting means 73, a precision winding control means 74, a traverse angle calculating means 75, a yarn remaining amount detecting means 76, and a tensioning control means 77, etc.. This RAM can also store preset appropriate parameters (for example, a preset number of winds of precision winding) and control graphs of Fig. 2 and Fig. 3, etc..

[0043] In this embodiment, the package diameter sensor 44 outputs a detection signal corresponding to a diameter of the package 7, and this detection signal is transmitted to the unit controller 50. The package diam-

eter detecting means 73 calculates a package diameter from the detection signal and acquires information on the diameter of the package 7 (yarn layer). The package rotating speed sensor 43 outputs a detection signal corresponding to a rotating speed of the winding bobbin 6, 7, and this detection signal is transmitted to the unit controller 50. The package rotating speed detecting means 72 calculates a rotating speed of the package 7 from the detection signal and acquires a rotating speed of the package 7.

[0044] The precision winding control means 74 of the unit controller 50 calculates a speed of the traverse guide 11 so that the number of winds becomes constant at a preset number of winds based on a preset speed of the peripheral surface (winding speed) of the package 7 and the information on the diameter of the package 7 acquired by the package diameter detecting means 73. The result of this calculation is transmitted to the traverse controller 46 as a traverse speed instruction. The traverse controller 46 controls the driving of the traverse drive motor 45 so that the traverse speed detected by the traverse speed detecting means 71 coincides with the speed of the traverse speed instruction, and as a result, the above-described precision winding is realized.

[0045] Furthermore, the traverse angle calculating means 75 of the unit controller 50 calculates a traverse angle θ of the yarn 4 from the above-described information (the winding speed and the traverse speed) . Then, based on information on the calculated traverse angle θ, the tensioning control means 77 controls the tension to be applied by the tensioning device 30 according to the graph of Fig. 2. The graph of Fig. 2 shows controlling for gradually reducing tension T to be applied as the traverse angle θ becomes smaller. As a result, accompanying the reduction in traverse angle θ accompanied by increase in the winding diameter of the package 7 during precision winding, the tension T to be applied by the tensioning device 30 becomes smaller from T1 to T2 accompanying the reduction in the traverse angle θ. Thus, a yarn layer density change according to the winding diameter can be reduced, and wrinkles (bulge) can be effectively avoided.

[0046] A basic idea of control by the yarn tension control device 65 is shown in Fig. 2. However, in actuality, the control is not performed in the manner shown in Fig. 2, and tension control according to the traverse angle is combined with tension control according to an unwinding state of the supplying bobbin 3. That is, to form one package 7 in the automatic winder 1 of this embodiment, one supplying bobbin 3 is not enough, and yarns 4 of a plurality of supplying bobbins 3 are successively spliced by the yarn splicing device 14 and wound around the winding tube 6. Then, the yarn remaining amount detecting means 76 of the unit controller 50 aquires yarn remaining amounts on each of the supplying bobbins 3 from the position of the tubular body 27 for each of the supplying bobbins 3. Then, the tensioning control means 77 controls the tension to be applied by the tensioning device 30 according to, for example, the tension pattern as shown by the solid line of Fig. 3 based on the yarn remaining amount detected by the yarn remaining amount detecting means 76.

[0047] The basic form of the tension pattern of Fig. 3 will be described. When starting to unwind the yarn 4 from a new supplying bobbin 3, it is during acceleration of the rotation of the package 7. Therefore, tension is difficult to be applied to the yarn 4. In the control of this embodiment, considering this, the tensioning device 30 is controlled so as to apply a tension higher than normal to the yarn 4 at the beginning of unwinding. Then, after the yarn 4 is unwound to some degree from the supplying bobbin 3, the tension to be applied by the tensioning device 30 is made constant at a normal tension (basic tension) (T1 in the case of an actual waveform shown by the solid line). Then, immediately before the supplying bobbin 3 becomes empty, the tensioning device 30 applies a tension lower than normal to the yarn 4. When the supplying bobbin 3 becomes empty, a new supplying bobbin 3 is supplied and the tension pattern described above is repeated again. When the yarn 4 is cut during winding, a high tension at beginning of unwinding is applied, and then a tension according to a yarn remaining amount is applied.

[0048] The unit controller 50 recognizes the yarn remaining amount on the supplying bobbin 3 from the position of the tubular body 27 of the unwinding assist device 26 shown in Fig. 1 as described above. According to the yarn remaining amount, the unit controller 50 controls the tension to be applied by the tensioning device 30 as shown in Fig. 3. Accordingly, from the beginning of unwinding to the end of unwinding of the yarn 4 from the supplying bobbin 3, the winding tension can be maintained substantially constant.

[0049] When winding progresses and the traverse angle θ becomes smaller than in the case of control using the tension pattern shown by the solid line of Fig. 3, the pattern shown by the solid line of Fig. 3 is corrected to the dashed line to reduce the overall tension pattern. In detail, the pattern is corrected by offsetting in parallel the tension pattern of the solid line by a tension Δt to the tension reducing side. According to a resultant corrected pattern (dashed line of Fig. 3), the tension is controlled from the beginning of unwinding to the end of the unwinding from the supplying bobbin 3. Tension control is performed according to the traverse angle θ and the yarn remaining amount on the supplying bobbin 3 as described above.

[0050] The tension pattern may be corrected by multiplying the tension by a predetermined ratio k less than 1 (pattern transformation) as shown in Fig. 4, instead of subtraction of the predetermined tension Δt (that is, parallel offsetting of the pattern) as shown in Fig. 3.

[0051] As described above, the yarn winding unit 2 of the automatic winder 1 of this embodiment includes the tensioning device 30 which applies a tension to the supplied yarn 4 and can change and control the tension to

be applied, and the traversing device 5 which traverses the yarn 4. In addition, this yarn winding unit 2 forms a package 7 by winding the yarn 4 around the winding tube 6 while applying a tension to the yarn 4 by the tensioning device 30 and traversing the yarn 4 by the traversing device 5. The yarn tension control device 65 of this yarn winding unit 2 includes the tensioning control means 77 which controls and changes the tension to be applied by the tensioning device 30 in synchronism with a change in the traverse angle θ as shown in Fig. 2.

[0052] Therefore, tension control that takes into account a density change of the yarn layer 7 according to a change in the traverse angle θ can be performed. As a result, package quality lowering such as wrinkles can be reliably prevented.

[0053] The yarn winding unit 2 of this embodiment includes the package rotating speed detecting means 72 which recognizes a diameter of the yarn layer 7 formed by winding the yarn 4 around the winding tube 6 by the package diameter sensor 44, and precision winding control means 74 for performing precision winding by reducing the traverse angle θ according to an increase in the diameter. Then, when precision winding is performed by the precision winding control means 74, the tensioning control means 77 controls to reduce the tension to be applied by the tensioning device 30 in synchronism with the reduction in traverse angle θ.

[0054] Therefore, a precision-wound package 7 with high quality (in excellent shape) can be formed by preventing the above-described wrinkles. In addition, by performing correction by subtraction of a predetermined value (Fig. 3) or multiplication by a predetermined ratio (Fig. 4), the control becomes easy and the electrical configuration of the yarn tension control device 65 can be simplified.

[0055] The yarn winding unit 2 of this embodiment is constituted so that the supplying bobbin 3 for supplying the yarn 4 can be set, and when the yarn 4 of the supplying bobbin 3 is exhausted, the supplying bobbin 3 is replaced with a new supplying bobbin 3 and winding is restarted. Furthermore, the yarn winding unit 2 includes the yarn remaining amount detecting means 76 for detecting a yarn remaining amount on the supplying bobbin 3. The tensioning control means 77 controls the tension to be applied by the tensioning device 30 based on a tension pattern (Fig. 3) according to the detected yarn remaining amount. When the traverse angle θ changes, the tensioning control means 77 corrects the tension by subtracting a predetermined tension Δt from the tension pattern, and controls the tension to be supplied by the tensioning device 30 based on the corrected tension pattern (dashed line of Fig. 3). Alternatively, the tensioning control means 77 corrects the tension by multiplying the tension pattern by a predetermined ratio k, and controls the tension to be applied by the tensioning device 30 based on the corrected tension pattern (dashed line of Fig. 4).

[0056] Therefore, when winding according to a method in which yarns 4 of a plurality of supplying bobbins 3 are spliced by the yarn splicing device 14 and wound into a single package 7, the winding tension can be accurately controlled and a package 7 with high quality can be formed.

[0057] Instead of the tension control by the tensioning control means 77 according to a change in the traverse angle θ calculated by the traverse angle calculating means 75, the tension control can be performed according to a change in speed (traverse speed) of the traverse guide 11 detected by the traverse speed detecting means 71 of the traverse controller 46.

[0058] Instead of the tension control by the tensioning control means 77 according to the reduction in the traverse angle θ accompanying an increase in the winding diameter in precision winding, for example, the tension control can be performed according to the reduction/increase in the traverse angle θ in response to traverse jumping for avoiding, for example, a dangerous number of winds. Hereinafter, this modification will be described. When performing so-called random winding (at a constant winding speed and at a constant traverse speed) and not the presicion winding, since the number of winds changes according to a change in package diameter, the number of winds may reach a dangerous number of winds. To avoid this, the current number of winds is calculated and monitored as needed by the traverse controller 46 or the unit controller 50. When it is judged that the calculated number of winds has become close to the predetermined dangerous number of winds, traverse jumping is performed to discontinuously change (skip) the traverse angle to change the number of winds.

[0059] Then, to increase the traverse angle, the tension to be applied by the tensioning device 30 is reduced, and to reduce the traverse angle, the tension to be applied by the tensioning device 30 is increased. This control can prevent formation of a step on the package side surface that has been described above with reference to the patent document 2.

[0060] The substantial winding tension is controlled to be uniform by reducing the winding tension when the traverse angle increases and the winding tension increases and by increasing the winding tension when the traverse angle is reduced and the winding tension is reduced. Accordingly, a step on the side surface of the package 7 can be improved. As a result, a package 7 with good appearance can be formed, and stitching of the yarn 4 can also be prevented.

[0061] As a method for reducing the tension to be applied by the tensioning device 30, for example, as shown in Fig. 3, the pattern may be corrected by uniformly subtracting the predetermined value Δt from the original tension pattern, or as shown in Fig. 4, the pattern may be corrected by multiplying the tension by the predetermined ratio k (k<1). A method for increasing the tension to be applied is not illustrated, however, conversely with the case of Fig. 3, the pattern may be corrected by uniformly adding the predetermined value Δt to the original pattern, or setting the ratio k of Fig. 4 to be larger than 1 and

multiplying the original pattern by such ratio k.

[0062] When the above-described control is performed, the yarn winding unit 2 of the automatic winder 1 can avoid ribboning by skipping the traverse angle θ to the increasing side so that the dangerous number of winds is skipped when approaching the package diameter in which the number of winds approaches near the dangerous number of winds. Then, when passing through a region of the package diameter in which the number of winds is near the dangerous number of winds, the traverse angle θ is restored to the original angle (reduction skipping). Accordingly, winding can be performed at a substantially constant traverse angle θ. In this case, when increasing the traverse angle θ, the yarn tension control device 65 accordingly reduces the tension to be applied by the tensioning device 30, and when reducing the traverse angle, the yarn tension control device 65 accordingly increases the tension to be applied by the tensioning device 30.

[0063] Accordingly, ribboning that causes a yarn unwinding failure such as latching can be reliably prevented, and a package wound by a constant traverse angle can be obtained. Furthermore, a step can be prevented from being formed on the side surfaces of the package 7, and stitching of the yarn 4 can also be prevented.

[0064] The constitution described above is an example and for example, following changes can be made.

[0065] The skipping of the traverse angle θ (traverse jumping) can be performed in any manner as long as performed for avoiding the dangerous number of winds. The traverse angle θ may skip to only the traverse angle increasing side or to only the traverse angle reducing side, or the traverse angle increasing skipping and the traverse angle reducing skipping may be combined.

[0066] The constitution of the tensioning device 30 is not limited to the illustrated gate type tenser, and may be changed to other various tensers such as a tenser which sandwiches a yarn by two disks.

[0067] The traversing device 5 can be changed so as to reciprocate the traverse guide by, for example, an endless flexible timing belt instead of rotatively reciprocating the arm member 13 by the traverse drive motor 45 formed as a voice coil motor. In addition, the traversing device can be changed to other constitutions such as a constitution in which a cam groove is formed obliquely on the outer peripheral surface of a drum-shaped traverse cam and the traverse guide is engaged in this cam groove. In the case of the modification in which the random winding is performed, the traversing device can be changed so that a yarn is traversed by a traversing drum having a plurality of traversing grooves with different traverse angles.

Claims

1. A yarn winding device which forms a package by winding a yarn around a winding tube while applying a tension to the yarn by a tensioning device and traversing the yarn by a traversing device, comprising:

the tensioning device which applies a tension to a yarn to be supplied and can control and change the tension to be applied; and
the traversing device which traverses the yarn,

wherein the yarn winding device includes tensioning control means for controlling the tensioning device so as to change the tension to be applied in synchronism with a change in a traverse angle or a change in traverse speed.

2. The yarn winding device according to Claim 1, wherein precision winding is carried out by reducing the traverse angle according to an increase in diameter of a yarn layer formed by winding the yarn around the winding tube, and
the tensioning control means reduces the tension to be applied by the tensioning device in synchronism with the reduction in the traverse angle.

3. The yarn winding device according to Claim 1, wherein the traverse angle is changed to avoid a dangerous number of winds when a number of winds approaches the dangerous number of winds accompanying a progression of yarn winding, and
when changing the traverse angle to an increasing side, the tensioning control means reduces the tension to be applied by the tensioning device according to the change in the traverse angle, and when the traverse angle is changed to a reducing side, the tensioning control means increases the tension to be applied by the tensioning device according to the change in the traverse angle.

4. The yarn winding device according to any one of Claims 1 through 3, wherein the yarn to be supplied is a yarn unwound from a supplying bobbin, and
the tensioning control means controls the tension to be applied by the tensioning device based on a tension pattern according to a yarn remaining amount on the supplying bobbin.

5. The yarn winding device according to any one of Claims 1 through 4, wherein the yarn winding device comprising:

a winding bobbin support member which detachably supports the winding tube; and
a winding bobbin rotative driving device which is provided on the winding bobbin support member and rotatively drives the winding tube in a state that a motor shaft is connected to the winding tube so as not to relatively rotate.

FIG. 1

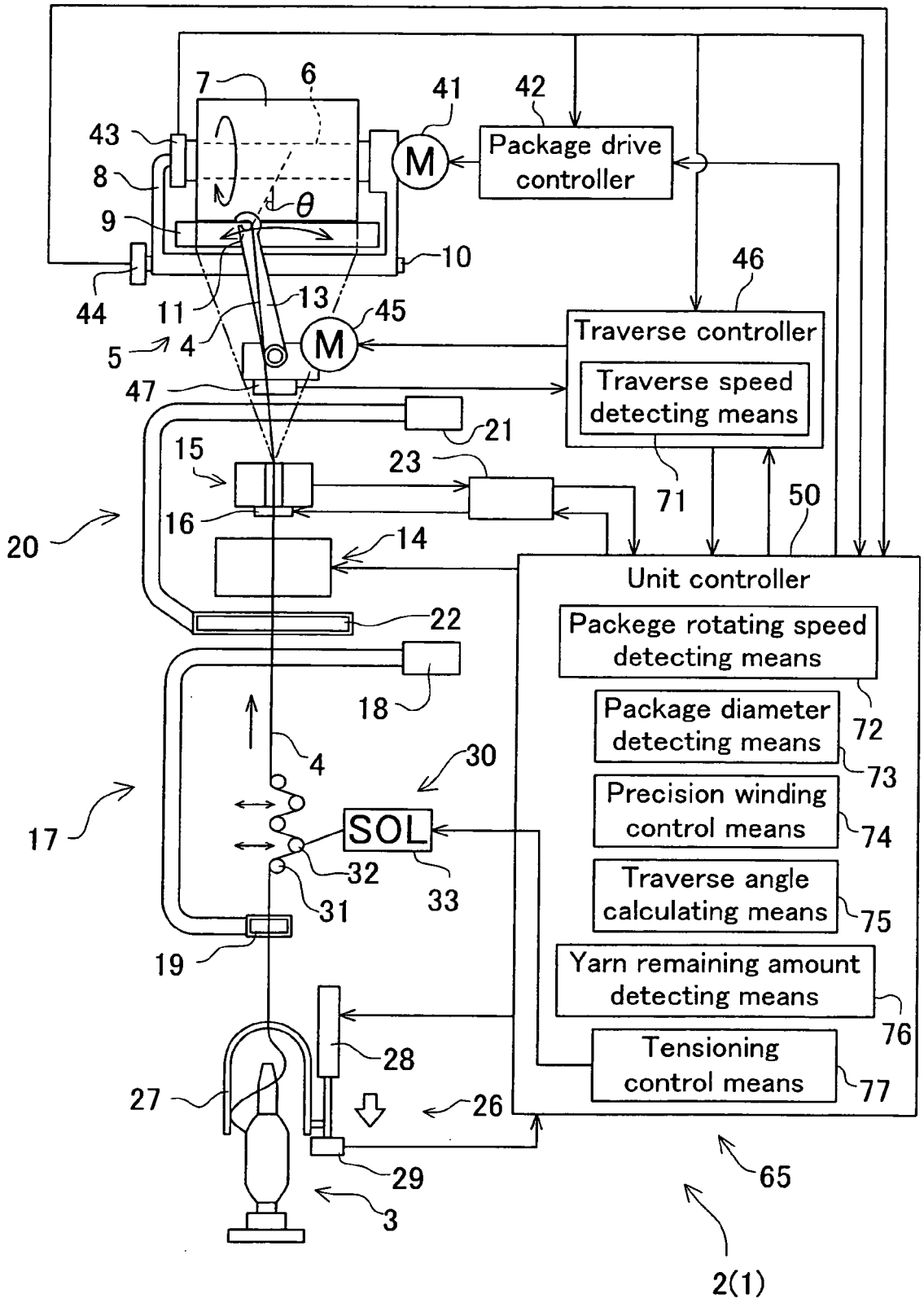

7
6
41
42
43
8
9
θ
10
46
44
11
13
45
5
4
47
21
15
23
71
50
20
16
14
Unit controller
22
Packege rotating speed detecting means
18
Package diameter detecting means
72
4
30
73
17
SOL
Precision winding control means
74
32
33
Traverse angle calculating means
31
75
19
Yarn remaining amount detecting means
76
28
Tensioning control means
27
26
77
29
65
3
2(1)
Package drive controller
Traverse controller
Traverse speed detecting means

FIG. 2

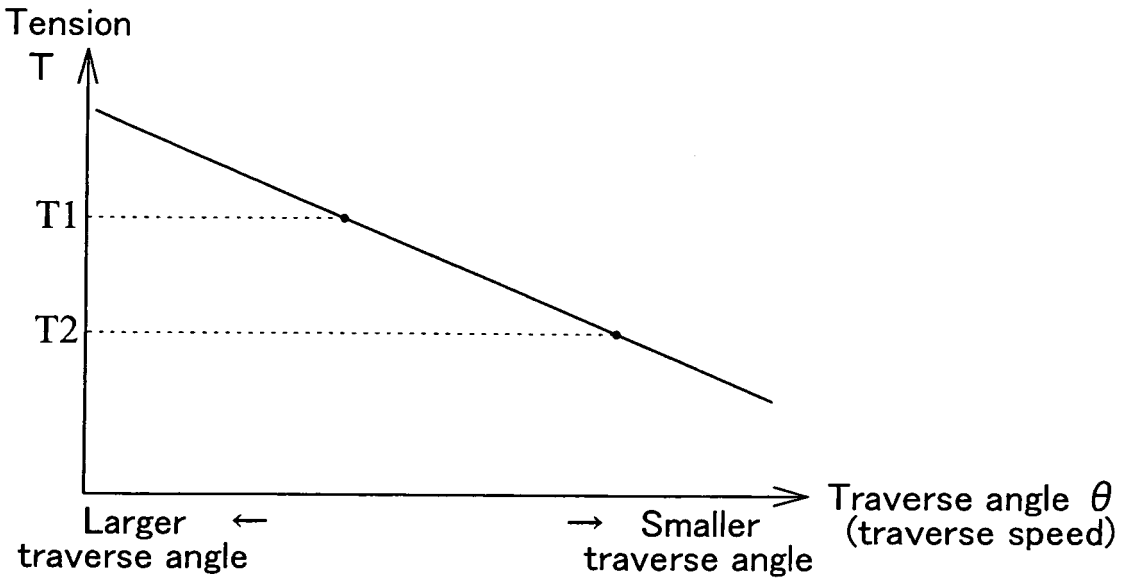

Tension
T
T1
T2
Traverse angle θ
(traverse speed)
Larger ←
traverse angle
→ Smaller
traverse angle

FIG. 3

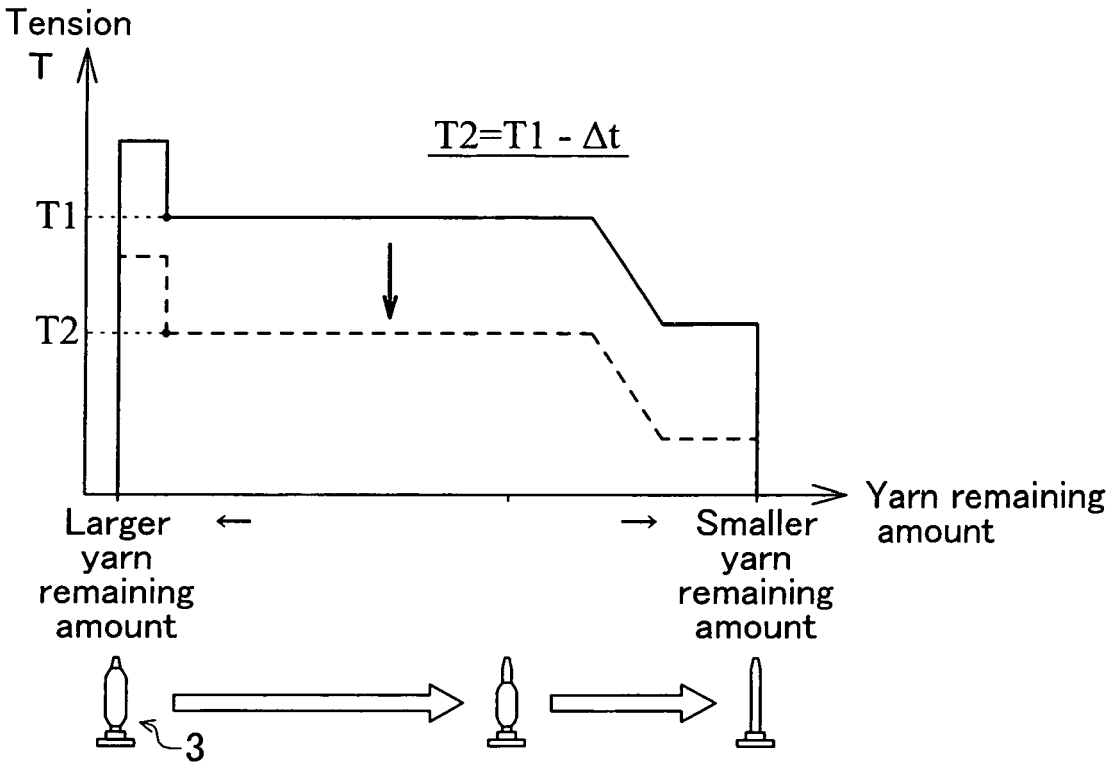
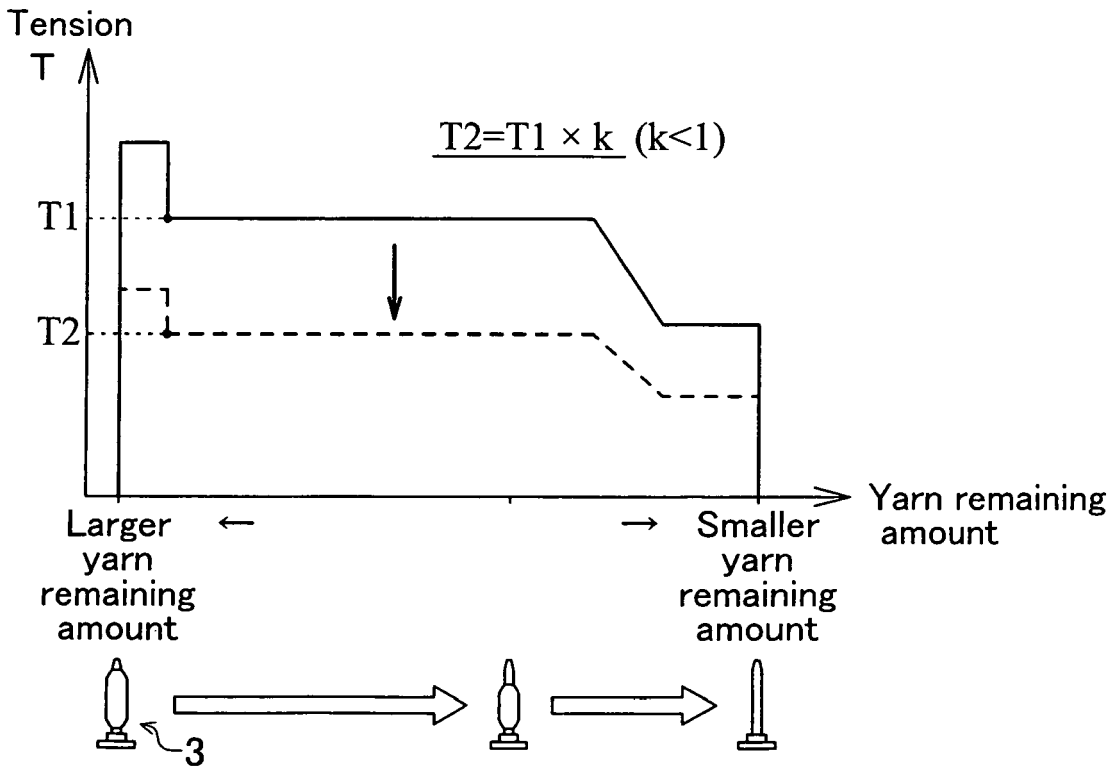

Tension
T
T2=T1 - Δt
T1
T2
Yarn remaining amount
Larger yarn remaining amount
Smaller yarn remaining amount
3

FIG. 4


Tension
T
T2=T1 × k (k<1)
T1
T2
Yarn remaining amount
Larger yarn remaining amount
Smaller yarn remaining amount
3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H01209280 A **[0002]**
- JP 2005060039 A **[0003]**