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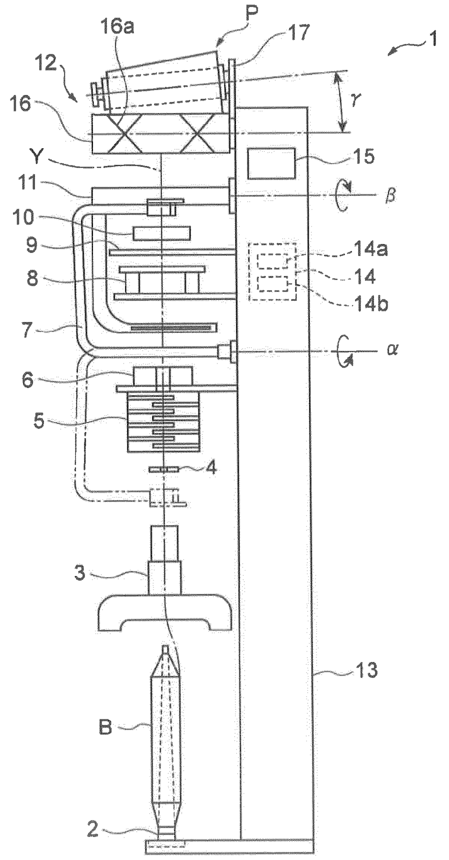
(54) Yarn winding device

(57) A yarn winding unit (1) includes a yarn supplying section (2) that supplies a yarn (Y), a winding section (12) that winds the yarn (Y) into a package (2), the winding section including a winding drum that makes contact with an outer peripheral surface of the package (P) and rotates, a yarn running speed detecting section (10) that detects a speed of the yarn (Y) running between the yarn supplying section (2) and the winding section (12), and an error detecting section (14a) that calculates a speed ratio by dividing the yarn running speed by a circumferential speed of the winding drum (16), and detects presence/absence of a winding error based on the speed ratio.

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 into a package.

2. Description of the Related Art

[0002] Yarn winding apparatuses that wind yarns into packages are known in the art. For example, a yarn winding device that includes a slub catcher that detects yarn irregularities is disclosed in Japanese Patent Application Laid-open No. H1-127566. In order to prevent a cut yarn from being disadvantageously wound around the winding drum, this document also discloses a method for judging whether a yarn is cut between the winding drum and the package. Concretely, when the detection values of the slub catcher show a minute variation, it is judged that the yarn has been cut.

[0003] However, the slub catcher sometimes fails to detect the minute variations in the detection values. If such a detection failure occurs, the cut yarn is likely to get wound around the winding drum. Once the cut yarn gets wound around the winding drum, no more minute variations occur in the detection values, and therefore, the yarn actually wound around the winding drum actually goes undetected.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a yarn winding device that can detect a yarn winding error.

[0005] A yarn winding device according to an aspect of the present invention includes a yarn supplying section that supplies a yarn; a winding section that winds the yarn into a package, the winding section including a winding drum that makes contact with an outer peripheral surface of the package and rotates; a yarn running speed detecting section that detects a yarn running speed of the yarn running between the yarn supplying section and the winding section; and an error detecting section that calculates a speed ratio by dividing the yarn running speed by a circumferential speed of the winding drum, and detects presence/absence of a winding error based on the speed ratio.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 is a front elevational view of a yarn winding unit, which is a yarn winding device according to an embodiment of the present invention;
FIG. 2 is a front elevational view of a cone package and a winding drum shown in FIG. 1;
FIG. 3 is a graph showing how yarn running speeds vary with time depending on the position of a driving point of the cone package;
FIG. 4 is a flowchart of a detection operation of the yarn wound around the winding drum during formation of the cone package;
FIG. 5 is a graph showing how the yarn running speed and the circumferential drum speed of the cone package vary with time in an accelerated winding phase;
FIG. 6 is a graph showing how the yarn running speed and the circumferential drum speed of the cone package vary with time in a constant winding speed phase;
FIG. 7 is a graph showing how the yarn running speed and the circumferential drum speed of the cone package vary with a winding length of the yarn when the phase changes from the accelerated winding phase to the constant winding speed phase;
FIG. 8 is a graph showing how the ratio of the yarn running speed and the circumferential drum speed shown in FIG. 7 vary with a winding length of the yarn; and
FIG. 9 is a front elevational view of a cheese package and the winding drum.

DETAILED DESCRIPTION

[0007] Exemplary embodiments of the present invention are explained below in detail with reference to the accompanying drawings. In the drawings, the parts that are identical or equivalent have been assigned the same reference numerals, and the description thereof is not repeated. Among the drawings, the graphs have been simplified for easy explanation.

[0008] As shown in FIG. 1, a yarn winding unit 1 winds a yarn Y into a package P. A plurality of yarn winding units 1 are arranged side by side to form an automatic winder. The yarn winding unit 1 includes a bobbin holding section 2 that functions as a yarn supplying section, a yarn unwinding assisting device 3, a pre-clearer 4, a gate-type tension applying device 5, a tension sensor 6, a lower yarn catching device 7, a splicer (yarn joining device) 8, a cutter 9, a yarn clearer 10 that functions as a yarn running speed detecting section, an upper yarn catching device 11, and a winding section 12. The above components are arranged in the mentioned order from an upstream side (from the bottom of FIG. 1) along a running path (yarn path) of the yarn Y, and mounted on a machine base 13. The yarn winding unit 1 also includes a controller 14 and a display 15 that functions as a notification section.

[0009] The bobbin holding section 2 holds a supply bobbin B upright. The supply bobbin B is formed by a spinning machine at a previous stage, and is transported on a tray from the spinning machine to the automatic winder. The yarn unwinding assisting device 3 controls, by use of a tube-shaped member arranged above the supply bobbin B, a balloon of the yarn Y that is unwound from the supply bobbin B. The gate-type tension applying device 5 applies a predetermined tension on the running yarn Y with a pair of comb teeth-like gates, one of which is fixed and the other of which is movable. The tension sensor 6 measures the tension of the yarn Y running along the yarn path. The controller 14 performs feedback control of the gate-type tension applying device 5 so that a predetermined tension is applied on the running yarn Y based on the tension of the yarn Y measured by the tension sensor 6.

[0010] The pre-clearer 4 pre-regulates a passage of a yarn defect that is bigger than a prescribed size with a pair of regulating members arranged on two sides of the yarn path with a predetermined gap between them. The yarn clearer 10 detects the yarn defect such as abnormal thickness of the yarn Y and/or a foreign substance included in the yarn Y during the winding operation of the yarn Y. The yarn clearer 10 detects a speed of the yarn Y running between the bobbin holding section 2 and the winding section 12.

[0011] The cutter 9 cuts the yarn Y when the passage of the yarn defect is regulated by the pre-clearer 4 or when a yarn defect is detected by the yarn clearer 10. The splicer 8 joins a yarn end from the supply bobbin B and a yarn end from the package P when the yarn Y is cut by the cutter 9 or when the yarn Y runs out.

[0012] The lower yarn catching device 7 is supported in a manner to pivot upward and downward about an axial line α. The lower yarn catching device 7 has a suction mouth at its end. The upper yarn catching device 11 is supported in a manner to pivot upward and downward about an axial line β. The upper yarn catching device 11 also has a suction mouth at its end. The lower yarn catching device 7 pivots downward, sucks the yarn end from the supply bobbin B with the suction mouth, and thereafter pivots upward to guide the yarn end from the supply bobbin B to the splicer 8. The upper yarn catching device 11 pivots upward, sucks the yarn end from the package P with the suction mouth, and thereafter pivots downward to guide the yarn end from the package P to the splicer 8.

[0013] The winding section 12 winds the yarn Y that is unwound from the supply bobbin B around a winding tube to form the package P, while traversing the yarn Y to and fro in an axial direction of a winding drum 16 (in a winding width direction of the package P). The winding section 12 includes the winding drum 16 and a cradle 17 that functions as a supporting structure.

[0014] The winding drum 16 rotates the package P while making contact with an outer peripheral surface of the package P. The winding drum 16 has a drum groove 16a formed over, along which the traversing is performed.

[0015] The cradle 17 rotatably supports the package P. The yarn winding unit 1 can form a cone package or a cheese package (which are explained in detail later). An angle γ of the cradle 17 that is formed by an axial line of the winding drum 16 and an axial line of the package P can be adjusted. By adjusting the angle γ, a position of a contact point between the winding drum 16 and the package P (hereinafter, "driving point") can be adjusted. The cradle 17 brings the outer peripheral surface of the package P into contact with an outer peripheral surface of the winding drum 16 at an appropriate contact pressure. With a motor driving the winding drum 16 and thereby rotating the package P together with the winding drum 16, the winding section 12 winds the yarn Y into the package P while traversing the yarn Y within a predetermined width.

[0016] The controller 14 controls the components of the yarn winding unit 1. The controller 14 is an electronic control unit that includes, for example, a central processing unit (CPU), a read-only memory (ROM), a random access memory (RAM), and such-like. The controller 14 receives information necessary for performing a control operation from the components forming the yarn winding unit 1. The controller 14 includes at least an error detecting section 14a and a suspend command issuing section 14b as processing sections. The processing sections of the controller 14 are in the form of computer programs, that is, software, stored in the ROM from which they are loaded to the RAM and executed by the CPU. Needless to say, the processing sections can be implemented as hardware. In an automatic winder that includes two or more yarn winding units 1, the controller 14 exchanges various types of information with a control device that is shared by the yarn winding units 1 and that performs overall control of the automatic winder.

[0017] The error detecting section 14a detects the presence/absence of a winding error of the yarn Y in the winding section 12. Specifically, the error detecting section 14a detects the presence/absence of a winding error based on the yarn running speed detected by the yarn clearer 10 (explained in detail later). Winding errors include at least either one of an error of the yarn Y wound around a driving section (winding drum 16) that drives the package P to rotate and an error, that is, deviation, of the driving point at which the package P is driven. The suspend command issuing section 14b issues a command to the winding section 12, etc., to suspend the winding operation of the yarn Y when a winding error is detected by the error detecting section 14a.

[0018] The display 15 displays an operation status and such-like of the yarn winding unit 1. When a winding error is detected by the error detecting section 14a, the display 15 notifies detection of the winding error and/or details pertaining to the winding error.

[0019] Next, how the yarn Y is wound into a cone package P1 is explained below.

[0020] In FIG. 3, the horizontal axis represents time, while the vertical axis represents speed (yarn running speed and circumferential drum speed (a circumferential speed of the winding drum 16)). As shown in FIG. 2, the cone package P1 is formed by winding the yarn Y around a conical winding tube. A traverse guide 10a is arranged above the yarn clearer 10.

[0021] A diameter of the cone package P1 varies in an axial direction. Therefore, a length of the yarn Y wound in one rotation of the cone package P1 varies according to a winding position (traverse position) of the yarn Y on the cone package P1 in the axial direction of the cone package P1. Consequently, as shown in FIG. 3, even at a constant number of rotations of the cone package P1, the yarn running speed varies periodically as the traverse position changes due to traversing of the yarn Y.

[0022] If the yarn Y is cut between the winding drum 16 and the cone package P1, causing the yarn Y on the upstream side in a yarn running direction to wind around the winding drum 16, the traversing of the yarn Y stops. This means that the periodic variations in the yarn running speed, which have been produced by the change in the traverse position, no longer occurs. Periodic variations in the running speed can occur due to the drum groove 16a; however, the effect of this kind of periodic variations can be reduced by determining a moving average of the yarn running speed (this is explained in detail later).

[0023] An operation for detecting the yarn Y wound around the winding drum 16 during the winding of the yarn Y into the cone package P1 is explained below.

[0024] As shown in FIG. 4, first the error detecting section 14a samples speed data (the yarn running speed and the circumferential drum speed) (Step S1).

[0025] Thereafter, the error detecting section 14a counts the number of periodic variations of the yarn running speed in a predetermined range (Step S2). The error detecting section 14a can count the number of periodic variations by the following method.

[0026] In FIGS. 5 and 6, the horizontal axis represents time, and the vertical axis represents speed (yarn running speed and circumferential drum speed).

[0027] As shown in FIG. 5, in an accelerated winding phase, the circumferential drum speed increases, and the yarn running speed increases while varying periodically with the circumferential drum speed substantially as its center. As the winding advances, the period $\lambda 1$ of the periodic variations in the yarn running speed becomes shorter, while the amplitude A1 becomes larger. The amplitude A1 can be defined as a total amount of increase/decrease with the circumferential drum speed as the center (total of a speed difference A1a and a speed difference A1b). As shown in FIG. 6, in a constant winding speed phase, the circumferential drum speed is substantially constant, and the yarn running speed varies periodically with the circumferential drum speed substantially as its center. The period $\lambda 1$ and the amplitude A1 are substantially constant in the constant winding speed phase. Therefore, when counting the number of periodic variations of the yarn running speed based on the speed data within a certain time period, different methods need to be adopted for the accelerated winding phase and the constant winding speed phase.

[0028] In FIG. 7, the horizontal axis represents winding length of the yarn Y, and the vertical axis represents speed. As shown in FIG. 7, the error detecting section 14a converts the speed data determined per unit time period (see FIGS. 5 and 6) into speed data determined per unit winding length of the yarn Y. In the speed data determined per unit winding length of the yarn Y, a period $\lambda 2$ is substantially constant both in the accelerated winding phase and the constant winding speed phase. The winding length of the yarn Y can be measured by, for example, the yarn clearer 10.

[0029] In FIG. 8, the horizontal axis represents winding length of the yarn Y, and the vertical axis represents speed ratio (the yarn running speed divided by the circumferential drum speed). As shown in FIG. 8, the error detecting section 14a calculates the speed ratio by dividing the yarn running speed by the circumferential drum speed, thereby converting the speed data into the speed ratio. The speed ratio varies periodically about 1 in both the accelerated winding phase and the constant winding speed phase. The amplitude A2 of the speed ratio is substantially constant in both the accelerated winding phase and the constant winding speed phase.

[0030] Thus, as explained above, by converting the speed data relative to the time period into the speed data relative to the winding length of yarn Y, and also converting the speed data into the speed ratio, the number of periodic variations can be counted by the same method, regardless of the accelerated winding phase or the constant winding speed phase. The order of conversion of the speed data relative to the time period into the speed data relative to the winding length of the yarn Y and the conversion of the speed data into the speed ratio can be reversed.

[0031] The yarn running speed determined by the yarn clearer 10 and the speed ratio calculated based on the yarn running speed can include various types of periodic variation components. Among these, in the periodic variations of the yarn running speed accompanying a change in the traverse position, wavelengths (winding lengths) λ1 and λ2 per periodic variation cycle are equivalent to the winding length of the yarn Y being traversed to and fro in one trip for a winding width. If there is a periodic variation having a wavelength smaller than the wavelength λ1 or λ2, this is produced not due to the change in the traverse position but is produced due to, for example, the drum groove 16a. Such a periodic variation becomes a noise when counting the number of periodic variations. To remove this noise, for example, a moving average is determined for the yarn running speed and/or the speed ratio to average out values at a plurality of sampling points, and thereby data with reduced noise as shown in FIG. 3 can be obtained.

[0032] As a method of counting the number of periodic variations, for example, a predetermined threshold value n1 can be preset corresponding to the speed ratio. Among the speed ratios in a predetermined range, those peak values larger than the threshold value n1 on the high speed side can be counted, and the number of such peak values can be determined as the number of periodic variations.

[0033] The predetermined range for counting the number of periodic variations should be a multiple of the winding length of the yarn Y in one trip of being traversed to and fro between a smaller diameter end and a larger diameter end of the cone package P1 (i.e., the winding width). By setting a range for counting the number of periodic variations that is a multiple of the winding length of the yarn Y in one trip of being traversed for the winding width to and fro, the number of periodic variations being counted can be stabilized.

[0034] Returning to FIG. 4, the error detecting section 14a judges whether the calculated number of periodic variations is within a normal range (Step S3). For example, the error detecting section 14a judges that the number of periodic variations counted at Step S2 is within the normal range if the count is greater than a predetermined value n2 and not within the normal range if the count is less than or equal to the predetermined value n2.

[0035] If it is judged at Step S3 that the number of periodic variations is within the normal range, the error detecting section 14a judges that the yarn Y is being wound normally, and allows the winding operation of the yarn Y to be continued while concurrently detecting the presence/absence of a winding error. On the other hand, if it is judged at Step S3 that the number of periodic variations is not within the normal range, the error detecting section 14a judges that a winding error, such as the yarn Y wound around the winding drum 16, has occurred. In this event, the suspend command issuing section 14b issues a command to the winding section 12 to suspend the winding operation of the yarn Y. The controller 14 issues a command to the display 15 to notify detection of a winding error and/or details pertaining to the winding error (Step S4). An operator can read the content on the display 15 and take necessary steps to remove the cause of the winding error. After the cause of the winding error is removed, the yarn winding unit 1 is caused to resume the winding operation of the yarn Y while concurrently detecting the presence/absence of a winding error.

[0036] As explained above, in the yarn winding unit 1 according to the present embodiment, the speed of the yarn Y running between the bobbin holding section 2 and the winding section 12 is detected, and a winding error is detected based on this yarn running speed. Specifically, when the winding section 12 is winding the yarn Y into a cone package P1, the error detecting section 14a detects a winding error by judging whether the number of periodic variations in the yarn running speed detected in the predetermined range by the yarn clearer 10 is less than or equal to the predetermined value.

[0037] The error detecting section 14a calculates the speed ratio by dividing the yarn running speed by the circumferential speed of the winding drum 16, and detects a winding error based on the speed ratio. Consequently, the same detection method can be adopted regardless of whether the cone package P1 is being wound in the accelerated winding phase or the constant winding speed phase (that is, regardless of whether the winding drum 16 is being rotated in an accelerated rotation phase or a constant rotation speed phase).

[0038] The yarn winding unit 1 further includes the display 15 that notifies the winding error detected by the error detecting section 14a. Consequently, the operator can be notified in the event of a winding error.

[0039] The yarn winding unit 1 further includes the suspend command issuing section 14b that issues a command to the winding section 12 to suspend the winding operation of the yarn Y when a winding error is detected by the error detecting section 14a. Consequently, the winding error can be kept from escalating.

[0040] In the above embodiment, the number of periodic variations in the yarn running speed can be counted based on the speed data relative to the time period in a predetermined time range.

[0041] A method by which the yarn winding unit 1 detects whether the driving point is shifting toward the smaller diameter end or toward the larger diameter end during the winding of the yarn Y into the cone package P1 is explained below.

[0042] As shown in FIG. 2, when the position of the driving point is too far toward a larger diameter end L3 or toward a smaller diameter end L1 of the cone package P1, it is likely that the yarn Y is wound around a portion L4 or a portion L5 that extends outside the ends of the cone package P1 in the axial direction. In addition, when the position of the driving point is too far toward the larger diameter end L3 or toward the smaller diameter end L1, a density of the yarn Y tends to be uneven in the axial direction of the cone package P1.

[0043] When the driving point is located at the smaller diameter end L1 of the cone package P1, a circumference of the cone package P1 that is in contact with the winding drum 16 is shorter than a circumference of the cone package P1 when the driving point is located at the center L2. This increases the number of rotations of the cone package P1 per rotation of the winding drum 16. Accordingly, as shown in FIG. 3, when the driving point is located toward the smaller diameter end L1, a region in which the periodic variations have occurred in the yarn running speed shifts toward a higher speed side compared to the case where the driving point is located at the center L2.

[0044] When the driving point is at the larger diameter end L3, the circumference of the cone package P1 that is in contact with the winding drum 16 is longer than the circumference of the cone package P1 when the driving point is located at the center L2. This reduces the number of rotations of the cone package P1 per rotation of the winding drum 16. Accordingly, when the driving point is located at the larger diameter end L3, the region in which the periodic variations have occurred in the yarn running speed shifts toward a lower speed side compared to the case where the driving point is located at the center L2.

[0045] An operation for detecting whether the driving point is shifting toward the smaller diameter end or toward the larger diameter end during the winding of the yarn Y into a cone package P1 is explained below.

[0046] The error detecting section 14a first samples the speed data (the yarn running speed and the circumferential drum speed). Thereafter, as explained above, the error detecting section 14a converts the speed data relative to the time period into the speed data relative to the winding length, also converts the speed data into the speed ratio, and reduces the noise by determining the moving average.

[0047] The error detecting section 14a then judges whether the region of the speed ratio in a predetermined range is shifted too far toward the higher speed side or toward the lower speed side. The predetermined range is determined as a multiple of (for example, twice) the winding length of the yarn Y traversed to and fro in one trip for the winding width. For example, if a minimum value of the speed ratio in the predetermined range is greater than a given threshold value x, the error detecting section 14a judges that the region of the speed ratio is shifted toward the higher speed side (that is, the driving point is located toward the smaller diameter end L1). If a maximum value of the speed ratio of the predetermined range is smaller than a given threshold value y, the error detecting section 14a judges that the region of the speed ratio is shifted toward the lower speed side (that is, the driving point is located toward the larger diameter end L3).

[0048] When the error detecting section 14a judges that the region of the speed ratio is shifted too far toward the higher speed side or toward the lower speed side, the suspend command issuing section 14b issues a command to the winding section 12 to suspend the winding operation of the yarn Y. The controller 14 issues a command to the display 15 to notify detection of a winding error and/or details pertaining to the winding error, thereby enabling the operator to read the content on the display 15 and take necessary steps to remove the cause of the winding error. After the cause of the winding error is removed, the yarn winding unit 1 is caused to resume the winding operation of the yarn Y while concurrently detecting the presence/absence of a winding error. If the region of the speed ratio is not shifted too far toward the higher speed side or toward the lower speed side, the error detecting section 14a judges that the yarn Y is being wound normally, allowing the winding operation of the yarn Y to be continued while concurrently detecting the presence/absence of a winding error.

[0049] As explained above, in the yarn winding unit 1 according to the present embodiment, when the winding section 12 winds the yarn Y into a cone package P1, the error detecting section 14a judges whether the region in which the periodic variations have occurred in the yarn running speed detected by the yarn clearer 10 is shifted toward the higher speed side or toward the lower speed side with respect to the predetermined region. Accordingly, the error detecting section 14a suitably detects the winding error, thereby preventing stitching, etc.

[0050] The error detecting section 14a calculates the speed ratio by dividing the yarn running speed by the circumferential speed of the winding drum 16, and detects the winding error based on the speed ratio. Consequently, the same detection method can be adopted regardless of the accelerated winding phase or the constant winding speed phase of the cone package P1 (that is, regardless of the accelerated rotation phase or the constant rotation speed phase of the winding drum 16).

[0051] In the above embodiment, whether the region in which the periodic variations have occurred in the yarn running speed is shifted toward one end can be judged in a predetermined time range based on the speed data relative to the time period.

[0052] How the yarn Y is wound into a cheese package P2 is explained below.

[0053] As shown in FIG. 9, the cheese package P2 is formed by winding the yarn Y around a winding tube whose outer circumferential surface is substantially cylindrical. The yarn Y is wound into the cheese package P2 by being traversed. The yarn Y forms a predetermined traverse angle θ (where $\theta>0$) relative to a circumferential direction of the cheese package P2. Consequently, a running speed V of the yarn Y is greater than a circumferential drum speed V_0, as shown by the following expression:

$$V=V_0/\cos\theta>V_0 \quad (1)$$

[0054] When, for example, the yarn Y is cut between the winding drum 16 and the cheese package P2, and the cut yarn Y becomes wound around the winding drum 16, the yarn running speed substantially equals the circumferential speed of the winding drum 16. More specifically, because the winding drum 16 has a small outer diameter at the drum groove 16a, when the yarn Y becomes wound around the drum groove 16a, the yarn running speed becomes lower than the circumferential drum speed. That is, a running speed V_d of the yarn Y when the yarn Y is wound around the winding drum 16 satisfies following relationship:

$$V_d \leq V_0 \quad (2)$$

[0055] An operation of detecting the yarn Y wound around the winding drum 16 during the winding of the yarn Y into a cheese package P2 is explained below.

[0056] The error detecting section 14a first samples the speed data (the yarn running speed and the circumferential drum speed). The error detecting section 14a then judges whether the yarn running speed is lower than or equal to the set circumferential speed V_0 of the winding drum 16 over a predetermined time period (for example, a time period in which the yarn Y is traversed to and fro for the winding width in one or more trip). The circumferential speed V_0 of the winding drum 16 that is used in a judgment operation is set by the controller 14.

[0057] If the yarn running speed is lower than or equal to the set circumferential speed V_0 over the predetermined time period, the error detecting section 14a judges that a winding error, such as the yarn Y wound around the winding drum 16, has occurred. The suspend command issuing section 14b issues a command to the winding section 12 to suspend the winding operation of the yarn Y. The controller 14 issues a command to the display 15 to notify detection of a winding error and/or details pertaining to the winding error, thereby enabling the operator to read the content on the display 15 and take necessary steps to remove the cause of the winding error or such-like. After the cause of the winding error is removed, the yarn winding unit 1 is caused to resume the winding operation of the yarn Y while concurrently detecting the presence/absence of a winding error. On the other hand, if the yarn running speed is not lower than or equal to the set circumferential speed V_0 over the predetermined time period, the error detecting section 14a judges that the yarn Y is being wound normally, allowing the winding operation of the yarn Y to be continued while concurrently detecting the presence/absence of a winding error.

[0058] As explained above, in the yarn winding unit 1 according to the present embodiment, the error detecting section 14a judges whether the yarn running speed detected by the yarn clearer 10 is lower than or equal to the predetermined speed when the yarn Y is being wound into a cheese package P2 by the winding section 12. In this manner, a winding error can be suitably detected.

[0059] Because the error detecting section 14a detects that a winding error has occurred when the yarn running speed is lower than or equal to the set circumferential speed V_0 of the winding drum 16 over a predetermined time period, a threshold value can be easily set.

[0060] The error detecting section 14a can calculate the speed ratio, and judge, based on this speed ratio, whether the yarn running speed is lower than or equal to the set circumferential speed V_0 over the predetermined time period (that is, judge whether the speed ratio is less than or equal to 1). In this case, the same detection method can be adopted regardless of the accelerated winding phase or the constant winding speed phase of the cheese package P2 (that is, regardless of the accelerated rotation phase or the constant rotation speed phase of the winding drum 16).

[0061] An embodiment of the present invention has been explained above; however, the present invention is not limited thereto. For example, in the above embodiment, the yarn clearer 10 that detects a yarn defect also functions as the yarn running speed detecting section. However, a dedicated device that detects the yarn running speed can be arranged as the yarn running speed detecting section.

[0062] In the above embodiment, when a winding error is detected, the winding operation is first suspended and then occurrence of the winding error is displayed on the display 15. The suspension of the winding operation of the yarn Y and the display of the occurrence of the winding error can be performed simultaneously, or the display of the occurrence of the winding error can be performed before the suspension of the winding operation of the yarn Y.

[0063] In the above embodiment, when the yarn Y wound around the winding drum 16 is detected as a winding error, the yarn Y can be cut to suspend the winding operation of the yarn Y.

[0064] In the above embodiment, when the driving point that has shifted too far is detected as a winding error, detection of the winding error and/or details pertaining to the winding error can be displayed on the display 15 without suspending the winding operation of the yarn Y so that the winding operation can be continued.

[0065] In the present embodiment, the winding drum 16 having the drum groove 16a is used. However, a winding drum (contact roller) without a drum groove can also be used. In such a case, the winding section 12 can include an arm-type traverse device, a belt-type traverse device, a rod-type traverse device, or the like that can function as a traverse mechanism.

[0066] In the above embodiment, the yarn winding unit 1 that forms the automatic winder is adopted as the yarn winding device. However, any yarn winding unit (for example, air spinning machine) that has a winding drum can be adopted.

[0067] In the above embodiment, the display 15 is used as the notification section. A sound output device, such as a loudspeaker, can also be used as the notification section.

[0068] In the above embodiment, a driving device, such as a motor, can be provided on the cradle 17 so that the driving device can drive the cradle 17 to perform an adjustment of the angle γ. In this case, when the error detecting section 14a judges that the region of periodic variations in the yarn running speed is shifted toward the higher speed side or toward the lower speed side with respect to the predetermined region, it issues a command to the cradle 17 to adjust the angle γ formed by the axial line of the winding drum 16 and the axial line of the cone package P1 such that the region of the periodic variations can fit within the predetermined region. Consequently, the driving point shifted toward the smaller diameter end or toward the larger diameter end can be automatically resolved.

[0069] In the above embodiment, the yarn winding unit 1 is capable of forming any of the cone packages P1 and the cheese packages P2. However, the yarn winding unit 1 can be one that forms only the cone packages P1 or only the cheese packages P2.

[0070] In the above embodiment, the upstream side of the tension sensor 6 along the yarn path is at the bottom and the downstream side is at the top; however, this arrangement can be reversed. Instead of the gate-type tension applying device 5, any tension applying device, such as the so-called disc-type tension applying device, that can apply a predetermined tension on the yarn Y running along the yarn path can be employed.

[0071] In the above embodiment, the accelerated winding phase and the constant winding speed are used merely for explaining the sequence of the winding operation, and as such, there is no setting for an accelerated winding mode or a constant winding speed mode in the present embodiment.

[0072] A yarn winding device according to an aspect of the present invention includes a yarn supplying section that supplies a yarn; a winding section that winds the yarn into a package, the winding section including a winding drum that makes contact with an outer peripheral surface of the package and rotates; a yarn running speed detecting section that detects a yarn running speed of the yarn running between the yarn supplying section and the winding section; and an error detecting section that calculates a speed ratio by dividing the yarn running speed by a circumferential speed of the winding drum, and detects presence/absence of a winding error based on the speed ratio.

[0073] When a winding error, such as the yarn wound around the winding drum, occurs in the winding section, behavior of the yarn running speed is different from the behavior in the normal operation. By calculating the speed ratio based on the yarn running speed, a winding error can be detected by using the same detecting method regardless of whether the winding drum is in an accelerated rotation phase or a constant rotation speed phase.

[0074] In the yarn winding device according to another aspect of the present invention, the error detecting section detects, as the winding error, at least either one of an error that is winding of the yarn around the winding drum and an error that is deviation of a driving point at which the package is driven.

[0075] In the yarn winding device according to still another aspect of the present invention, when the winding section is winding the yarn into a cone package, the error detecting section detects that the winding error has occurred if the number of periodic variations in the speed ratio in a predetermined range is less than or equal to a predetermined value. When forming a cone package, the yarn running speed varies periodically during the winding due to the variation of a diameter of an outer peripheral surface of the package in an axial direction. If, for example, the yarn winds around the winding drum, the periodic variations of the yarn running speed will not occur. By calculating the speed ratio based on the yarn running speed and determining whether the number of periodic variations of the speed ratio in the predetermined range is less than or equal to the predetermined value, a winding error can be suitably detected.

[0076] In the yarn winding device according to still another aspect of the present invention, when the winding section is winding the yarn into the cone package, the error detecting section detects that the winding error has occurred if a region in which periodic variations have occurred in the speed ratio is shifted toward a higher speed side or toward a lower speed side with respect to a predetermined region. When forming a cone package, if a contact point between the package and the winding drum is shifted toward a smaller diameter end of the package, the region in which periodic variations have occurred in the yarn running speed shifts toward a higher speed side. Conversely, if the contact point is shifted toward the larger diameter end, the region in which periodic variations have occurred in the yarn running speed shifts toward a lower speed side. If the contact point moves too far with respect to the larger diameter end or the smaller diameter end, the yarn is likely to be wound around a portion outside the ends of the package in the axial direction, leading to stitching, etc. Consequently, by determining whether the region in which the periodic variations have occurred in the speed ratio is shifted toward the higher speed side than a predetermined region or toward the lower speed side than the predetermined region, a winding error can be suitably detected to prevent stitching, etc.

[0077] In the yarn winding device according to still another aspect of the present invention, when the winding section is winding the yarn into a cheese package, the error detecting section detects that the winding error has occurred if the speed ratio is lower than or equal to a predetermined value. When forming a cheese package, the yarn is traversed so as to form a predetermined angle (traverse angle) relative to a circumferential direction of the package. Consequently, the yarn running speed is greater than the circumferential speed of the package. In contrast, when, for example, the yarn winds around the winding drum, the yarn running speed decreases. Thus, a winding error can be suitably detected by calculating the speed ratio based on the yarn running speed and determining whether the speed ratio is less than or equal to a predetermined value.

[0078] The yarn winding device according to still another aspect of the present invention further includes a notification section that notifies occurrence of the winding error detected by the error detecting section. An operator can be notified of the winding error.

[0079] The yarn winding device according to still another aspect of the present invention further includes a suspend command issuing section that issues a command to the winding section to suspend a winding operation of the yarn when the winding error is detected by the error detecting section. The winding error can thereby be kept from escalating.

Claims

1. A yarn winding device comprising:

   a yarn supplying section (2) adapted to supply a yarn (Y);
   a winding section (12) adapted to wind the yarn (Y) into a package (P), the winding section (12) including a winding drum (16) adapted to make contact with an outer peripheral surface of the package (p) and rotate;
   a yarn running speed detecting section (10) adapted to detect a yarn running speed of the yarn (Y) running between the yarn supplying section (2) and the winding section (12); and
   an error detecting section (14a) adapted to calculate a speed ratio by dividing the yarn running speed by a circumferential speed of the winding drum (16), and to detect presence/absence of a winding error based on the speed ratio.

2. The yarn winding device according to Claim 1, wherein the error detecting section (14a) is adapted to detect, as the winding error, at least either one of an error that is winding of the yarn (Y) around the winding drum (16) and an error that is deviation of a driving point at which the package (P) is driven.

3. The yarn winding device according to Claim 1, wherein, when the winding section (12) is winding the yarn (Y) into a cone package (P), the error detecting section (14a) is adapted to detect that the winding error has occurred if a number of periodic variations in the speed ratio in a predetermined range is less than or equal to a predetermined value.

4. The yarn winding device according to Claim 1 or 3, wherein, when the winding section is winding the yarn (Y) into the cone package (P), the error detecting section (14a) is adapted to detect that the winding error has occurred if a region in which periodic variations have occurred in the speed ratio is shifted toward a higher speed side or toward a lower speed side with respect to a predetermined region.

5. The yarn winding device according to Claim 1, wherein, when the winding section (12) is winding the yarn (Y) into a cheese package (P), the error detecting section (14a) is adapted to detect that the winding error has occurred if the speed ratio is lower than or equal to a predetermined value.

6. The yarn winding device according to any one of Claims 1 to 5, further comprising a notification section (15) adapted to notify occurrence of the winding error detected by the error detecting section (14a).

7. The yarn winding device according to any one of Claims 1 to 6, further comprising a suspend command issuing section (14b) adapted to issue a command to the winding section (12) to suspend a winding operation of the yarn (Y) when the winding error is detected by the error detecting section (14a).

FIG.1

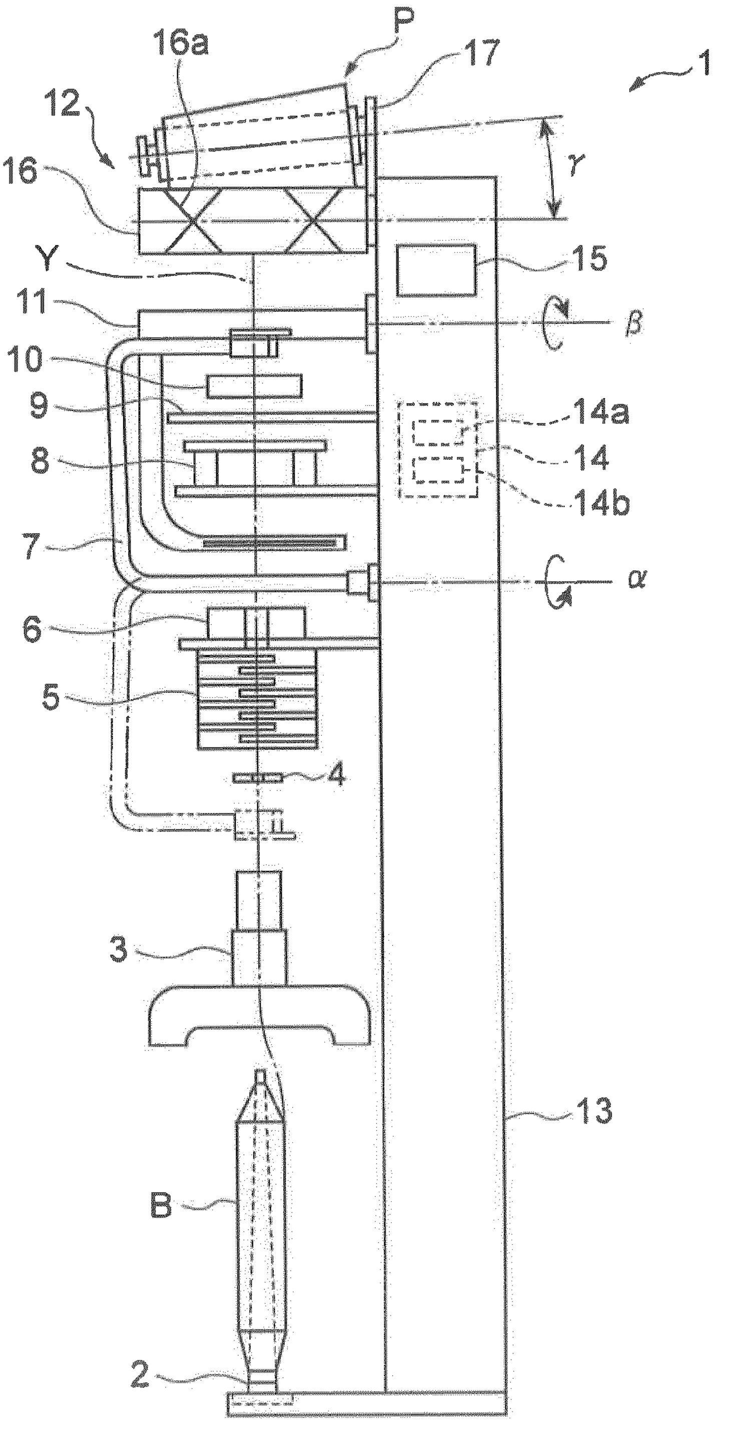


FIG.2

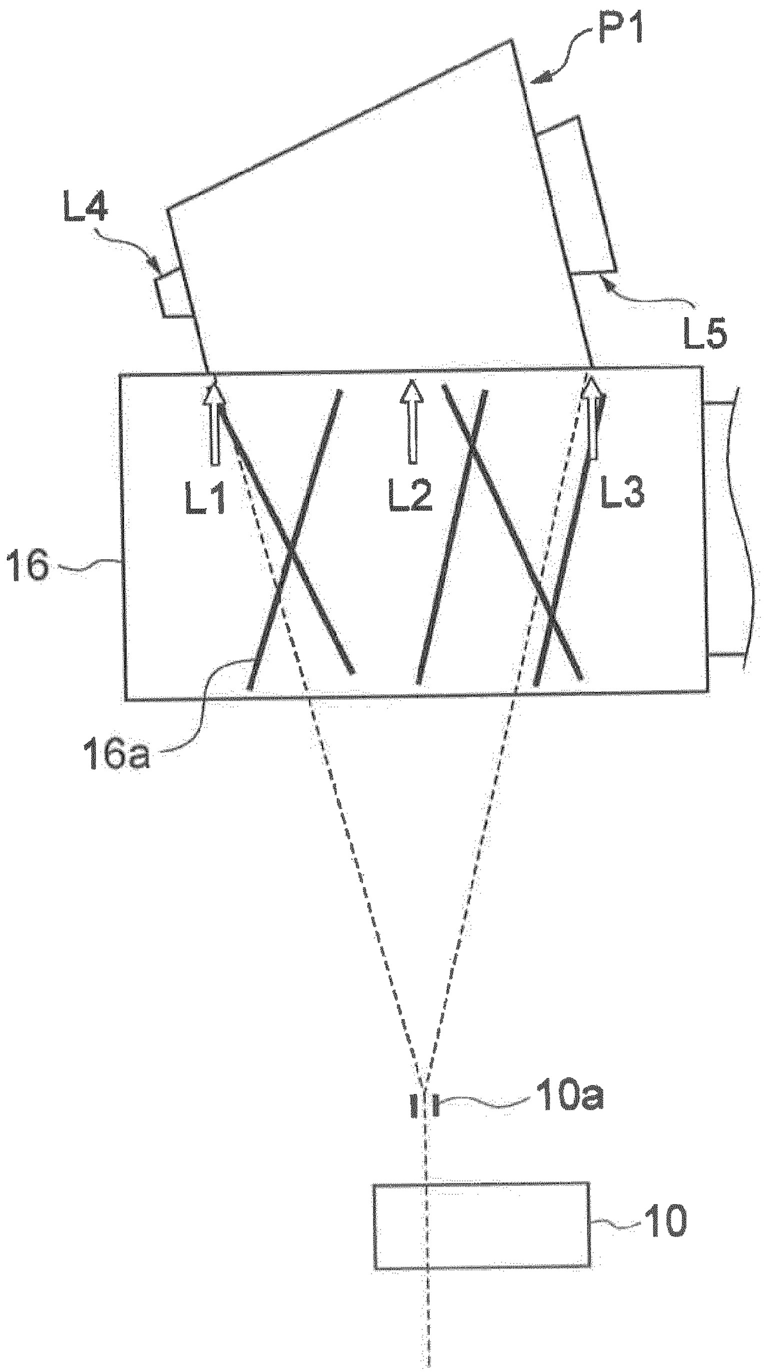


FIG.3

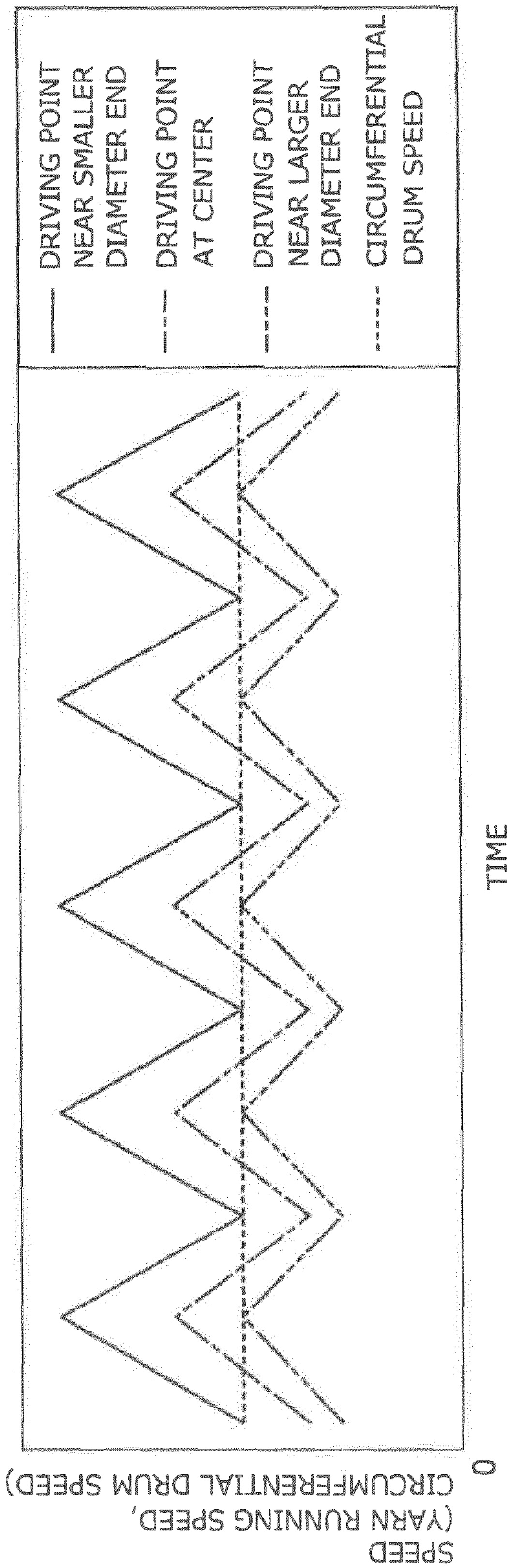

DRIVING POINT NEAR SMALLER DIAMETER END
DRIVING POINT AT CENTER
DRIVING POINT NEAR LARGER DIAMETER END
CIRCUMFERENTIAL DRUM SPEED
SPEED (YARN RUNNING SPEED, CIRCUMFERENTIAL DRUM SPEED)
0
TIME

FIG.4

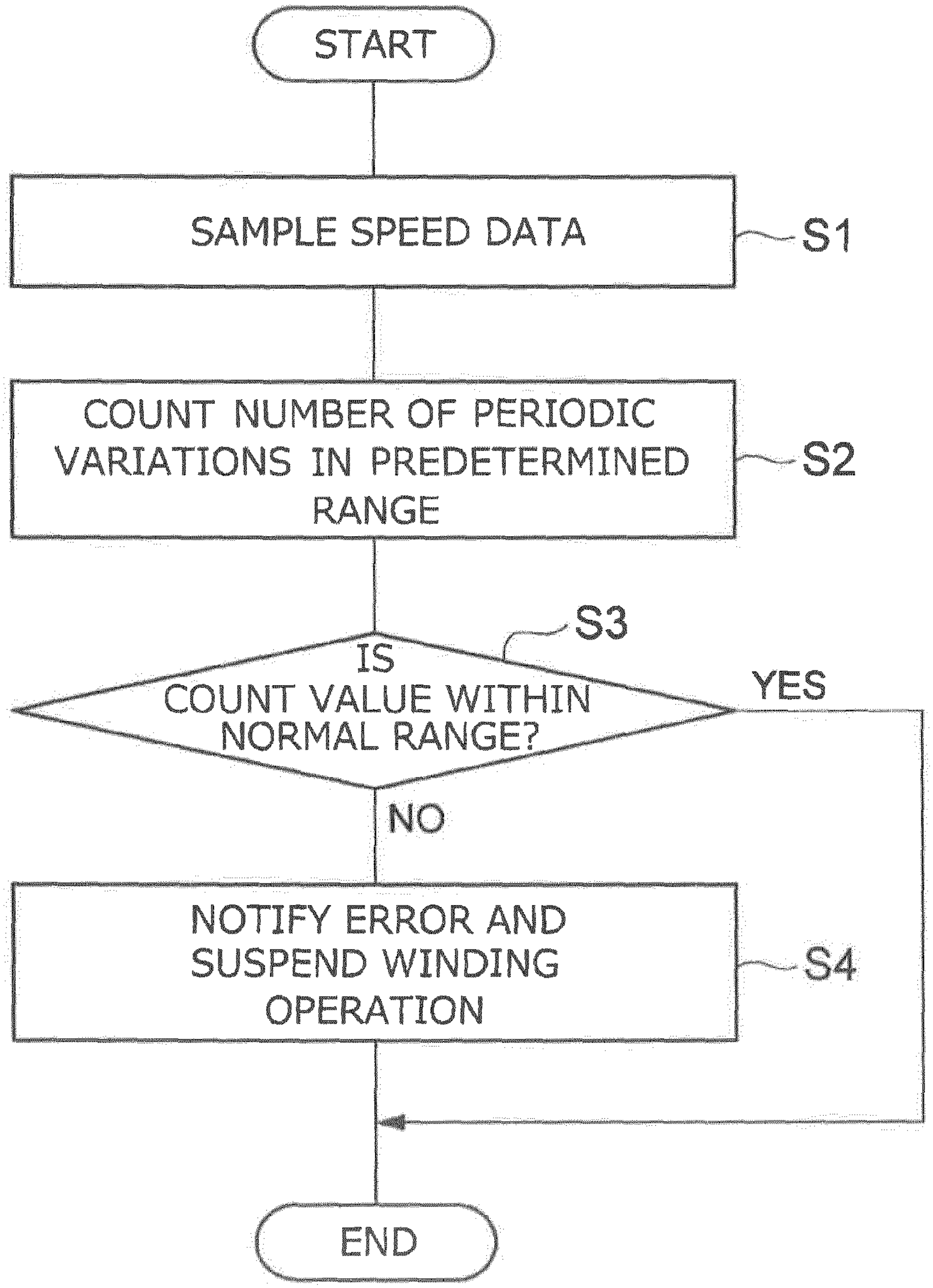

START
SAMPLE SPEED DATA
S1
COUNT NUMBER OF PERIODIC VARIATIONS IN PREDETERMINED RANGE
S2
S3
IS COUNT VALUE WITHIN NORMAL RANGE?
YES
NO
NOTIFY ERROR AND SUSPEND WINDING OPERATION
S4
END

FIG.5

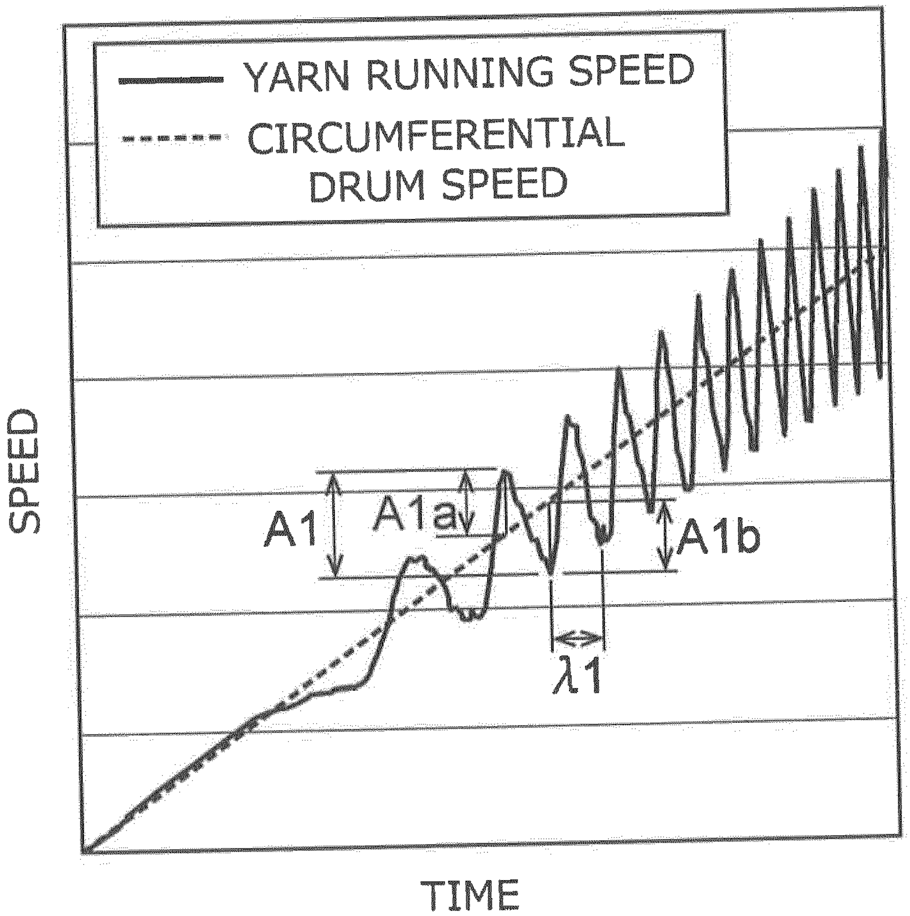

YARN RUNNING SPEED
CIRCUMFERENTIAL DRUM SPEED
SPEED
A1
A1a
A1b
λ1
TIME

FIG.6

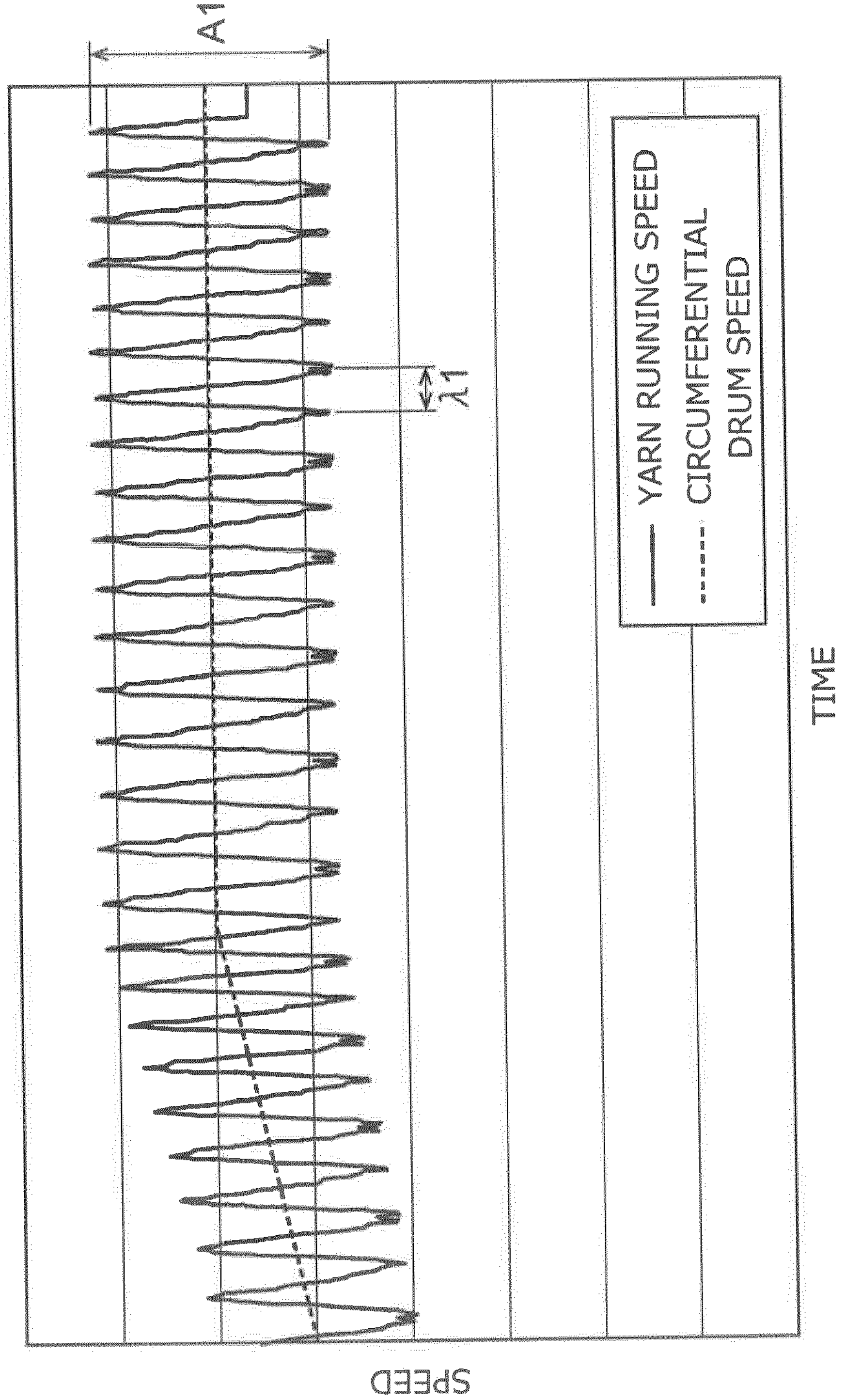

A1
λ1
YARN RUNNING SPEED
CIRCUMFERENTIAL DRUM SPEED
TIME
SPEED

FIG.7

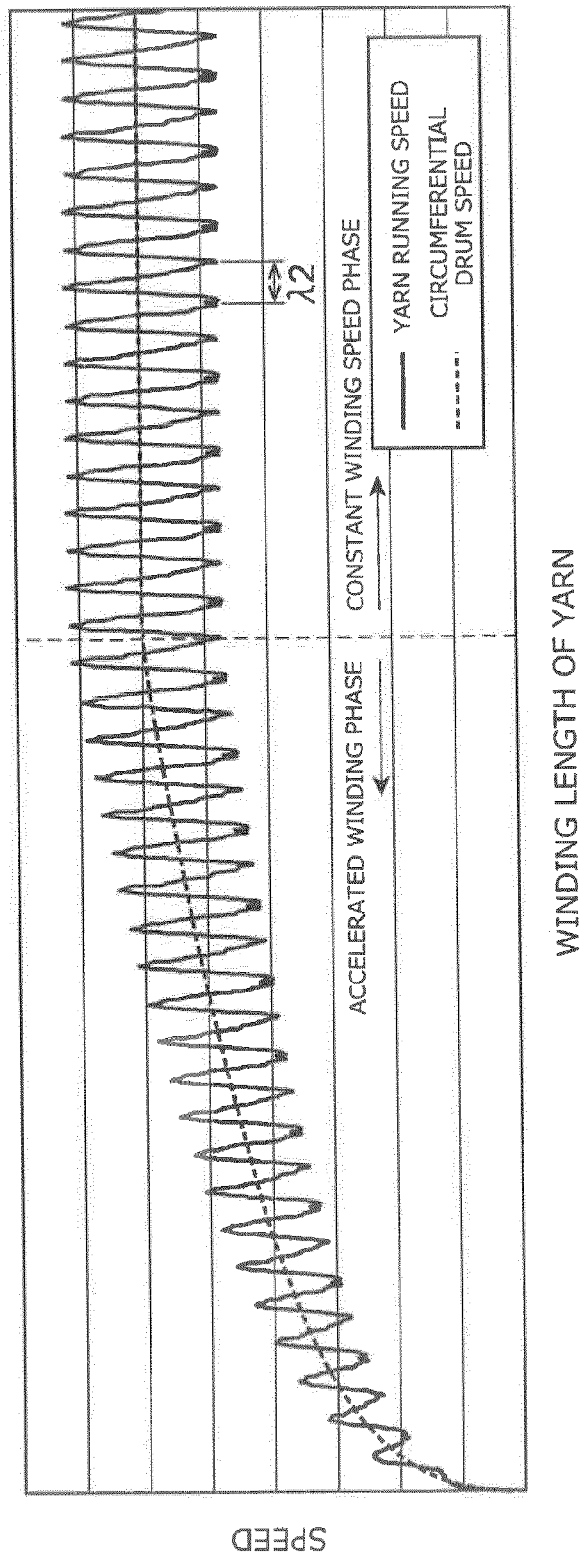

YARN RUNNING SPEED
CIRCUMFERENTIAL DRUM SPEED
λ2
CONSTANT WINDING SPEED PHASE
ACCELERATED WINDING PHASE
WINDING LENGTH OF YARN
SPEED

FIG.8

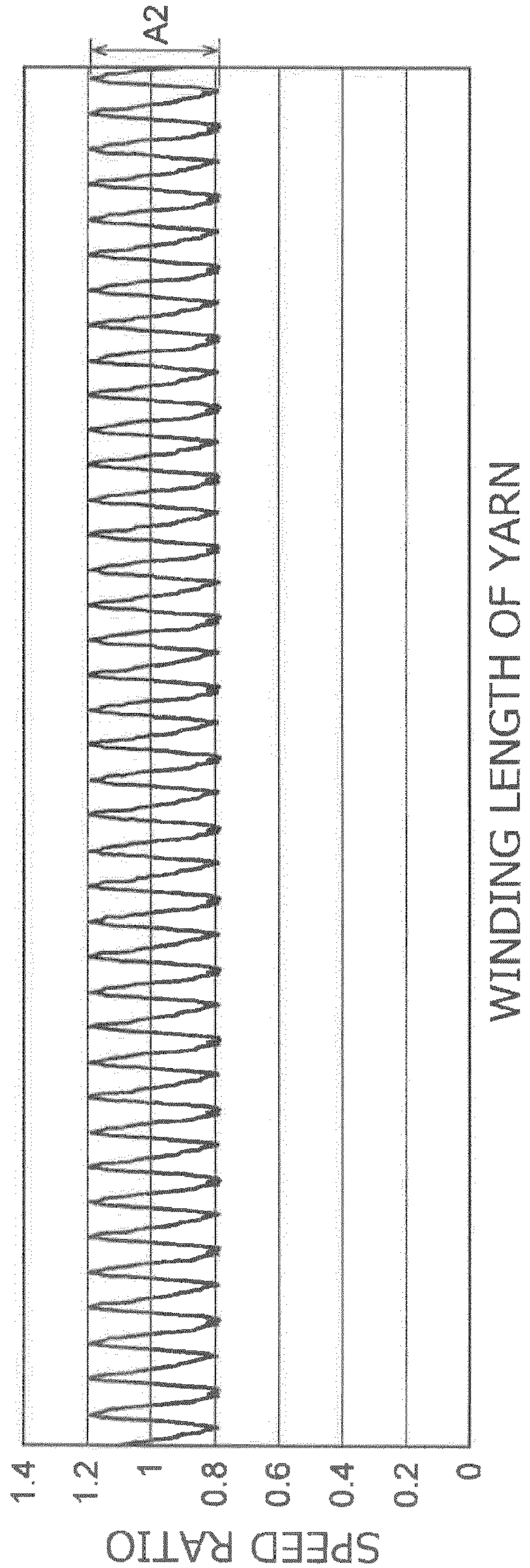
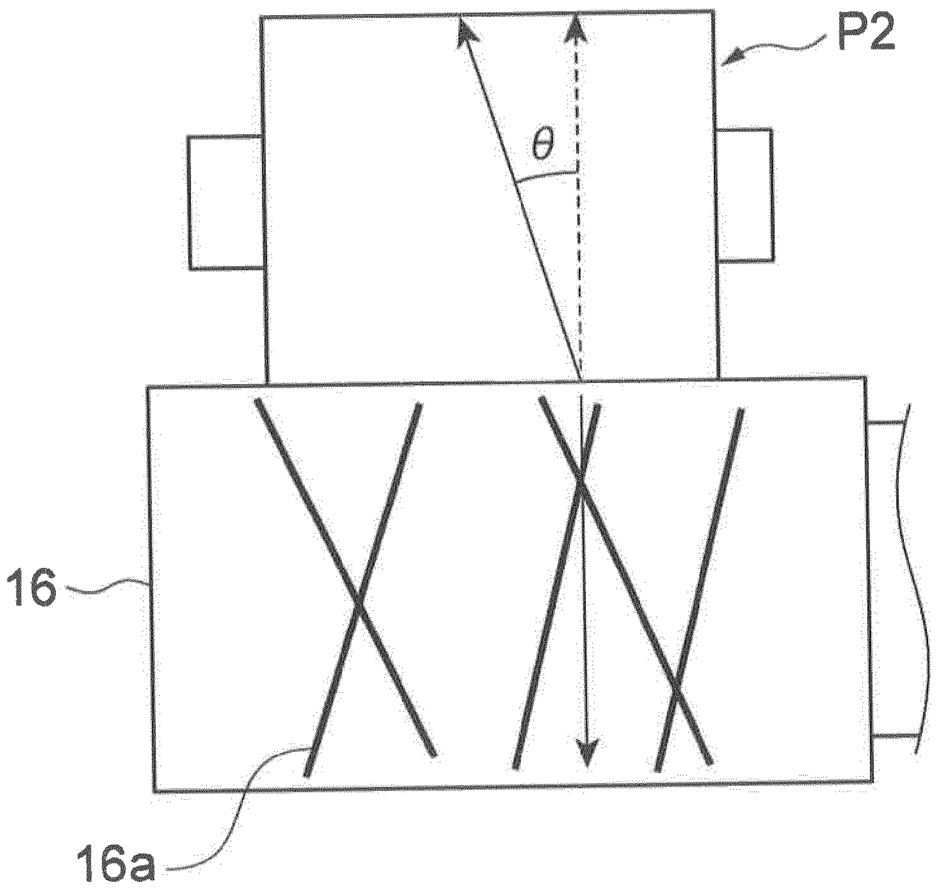


FIG.9



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H1127566 B **[0002]**