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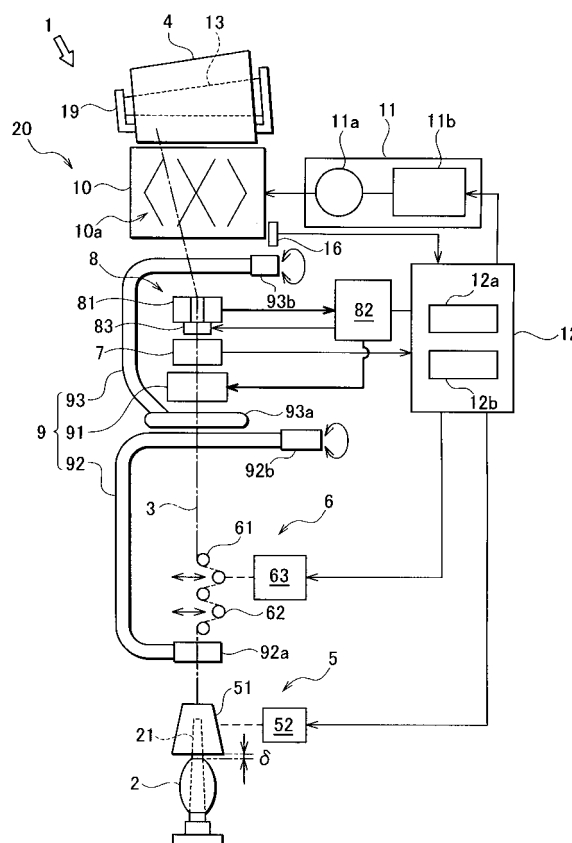
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(54) **Textile machine**

(57) With a textile machine including a large number of yarn processing units that produce packages, in spite of an attempt to make the yarn lengths of packages uniform on the basis of a yarn speed detected for each unit by a yarn speed sensor, the yarn length of an actually produced package varies among the units as a result of an inherent error in the yarn speed sensor. The present invention provides a winder 100 including a large number of winding units 1 each having a yarn speed sensor 7 that detects a yarn speed, a sequencer 12 that calculates the yarn length of a winding package 4 on the basis of the detected value from the yarn speed sensor 7, and a winding device 20 that forms a winding package 4. The winder 100 includes a setting member 41 that transmits correction information for each of the yarn speed sensors 7 to the corresponding sequencer 12. Each of the sequencers 12 corrects the detected value from a corresponding one of the yarn speed sensors 7 on the basis of the correction information to calculate a correction value for a corresponding yarn speed to calculate the yarn length of the corresponding winding package 4 on the basis of the correction value for the corresponding yarn speed (Fig. 2).

FIGURE 2



Description

Field of the Invention

[0001] The present invention relates to a textile machine comprising a large number of yarn processing units each including a yarn speed sensor that detects a yarn speed of a traveling yarn, a yarn length calculating device that calculates the yarn length of a package formed of the yarn on the basis of a detected value from the yarn speed sensor, and a winding device that winds the yarn to form a package.

Background of the Invention

[0002] There have been known textile machines such as spinning machines and winders which comprise a large number of yarn processing units each including a winding device for each unit so that packages can be simultaneously formed in a large number of units. Some of the known textile machines include a yarn speed sensor that allows the yarn length of a package to be detected (The Unexamined Japanese Patent Application Publication (Tokkai) No. 2005-194024). The yarn length can be calculated by integrating yarn speeds detected by the yarn speed sensor and yarn detecting time. For example, in the manufacture of woven cloths, where a large number of packages, which are materials, have nonuniform yarn lengths, the possible size of woven cloths is determined by a package with the shortest yarn length. Accordingly, where the packages have nonuniform yarn lengths, not only the size of woven cloths is limited but the extra part of a package with a longer yarn is wasted. Thus, a large number of packages with a uniform yarn length are desirable to be produced at the same time. The textile machine with the yarn speed sensor can form packages while detecting yarn speed (that is, yarn length). This meets the need for the simultaneous production of a large number of packages with a uniform yarn length.

[0003] However, the yarn speed sensor has its inherent detection characteristic and its detected value is more or less different from the true value. Further, the detection characteristic naturally varies among yarn speed sensors. When the same yarn speed is detected by a plurality of yarn speed sensors, different detected values are output from each of the yarn speed sensors. Then, even when a control system for the textile machine calculates the yarn lengths of packages on the basis of detected values of the yarn speed from the yarn speed sensors and determines that the yarn length is the same for all the units, the yarn length of the actually produced packages varies among the units. This is not limited to the configuration of the yarn speed sensor but also applies to optical or capacitance type sensors that detect the yarn speed while avoiding contact with a yarn and roller type sensors that detect the yarn speed (rotation speed) while making contact with the yarn.

[0004] The problems to be solved are that with a textile machine comprising a large number of yarn processing units that produce packages, in spite of an attempt to make the yarn lengths of packages uniform on the basis of a yarn speed detected for each unit by a yarn speed sensor, the yarn length of an actually produced packages varies among the units as a result of an inherent error in the yarn speed sensor.

Summary of the Invention

[0005] A description has been given of the problems to be solved by the present invention, and a description will be given of means for solving the problems.

[0006] According to Claim 1, a textile machine comprises a large number of yarn processing units each including a winding device that winds a yarn to form a package, a yarn speed sensor that detects a yarn speed of the traveling yarn, and a yarn length calculating device that calculates the yarn length of the package formed of the yarn on the basis of the detected value from the yarn speed sensor.

The textile machine comprises a setting member that transmits correction information for each of the yarn speed sensors to a corresponding one of the yarn length calculating devices, and each of the yarn length calculating devices corrects the detected value from a corresponding one of the yarn speed sensors on the basis of the correction information to calculate a correction value for a corresponding yarn speed to calculate the yarn length of a corresponding one of the packages on the basis of the correction value for the corresponding yarn speed.

[0007] This configuration operates as follows. The adverse effect of an inherent error in each yarn speed sensor is eliminated from the correction value obtained by correcting the yarn speed detected by the yarn speed sensor. The adverse effect of the inherent error in each yarn speed sensor is thus also eliminated from the yarn length of the package calculated based on the correction value.

[0008] A textile machine according to Claim 2 is the textile machine according to Claim 1 wherein each piece of the correction information is set in accordance with a detection characteristic of the corresponding one of the yarn speed sensors which is detected during shipment inspections.

[0009] This configuration operates as follows. The detection characteristic itself of each yarn speed sensor is detected to determine the error between the detected value from the yarn speed sensor and the true value.

[0010] A textile machine according to Claim 3 is the textile machine according to Claim 1 wherein each piece of the correction information is set in each corresponding one of the yarn processing units by comparing an actual average yarn speed calculated on the basis of a yarn length obtained by unwinding a yarn from an experimentally produced sample package and time required to form

the sample package, with a detection-based average yarn speed obtained by averaging, over the winding time, detected values of the yarn speed obtained by the yarn speed sensor during formation of the sample package, followed by deriving a correspondence between the actual average yarn speed and the detection-based average yarn speed.

[0011] This configuration operates as follows. The error between the detected value from each yarn speed sensor and the true value is determined by deriving the correspondence between the actual average yarn speed and the detection-based average yarn speed.

[0012] The present invention exerts the effects described below.

[0013] According to Claim 1, the adverse effect of the inherent error in the yarn speed sensor is eliminated from the calculation of the yarn length of the package. Packages actually produced by all the yarn processing units thus have a uniform yarn length.

[0014] Claim 2 not only exerts the effects of Claim 1 but can also make the yarn length detected by the yarn length detecting device equal to that of the actually produced package. This improves the accuracy of yarn length detection.

[0015] Claim 3 not only exerts the effects of Claim 1 but can also make the yarn length detected by the yarn length detecting device equal to that of the actually produced package. This improves the accuracy of yarn length detection.

[0016] 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

[0017]

Figure 1 is a schematic diagram showing the configuration of a winder.

Figure 2 is a schematic diagram showing the configuration of a winding unit.

Figure 3 is a block diagram showing a mechanism that corrects an output signal from a yarn speed sensor.

Detailed Description of the Preferred Embodiments

[0018] An embodiment of the present invention will be described. A textile machine according to the present invention comprises a large number of yarn processing units that wind yarns. The present embodiment relates to a winder 100 as a textile machine which comprises rewinding units that rewind yarns, as yarn processing units. The yarn processing unit has only to be a device (or a set of devices) having a yarn winding function. For example, where the textile machine is a spinning ma-

chine, the yarn processing unit is a spinning unit that spins and winds a yarn.

[0019] The configuration of the winder 100 will be described with reference to Figure 1. The winder 100 rewinds a yarn from a supplying package 2 produced by a spinning machine or the like to form a winding package 4 with a predetermined shape. The winder 100 comprises a large number of winding units 1 each of which carries out rewinding in one unit. The winder 100 also comprises a work carriage 30 shared by the winding units 1, a driving device 40 that drives some of the devices provided in each winding unit 1, and a control device 50 that controls driving of each winding unit 1 and the work carriage 30. The devices in the winding unit 1 are basically driven on the unit basis by a driving source (motor) provided in this unit 1. The work carriage 30 is a device that collects full winding packages 4 from the winding units 1 and that instead supplies empty bobbins to the winding units 1.

[0020] The winding unit 1 will be described with reference to Figure 2. The winding unit 1 has the supplying package 2 placed at its lower part and the winding package 4 placed at its upper part. The winding unit 1 has an unwinding supporting device 5, a variable tension device 6, a yarn splicing device 9, a yarn speed sensor 7, a yarn defect detecting device 8, and a traversing drum 10 arranged along a route for a yarn 3 which extends from the supplying package 2 to the winding package 4. The winding unit 1 also comprises a drum driver 11 that rotationally drives the traversing drum 10, an encoder 16 that detects the rotation speed of the traversing drum 10, and a sequencer 12 that instructs the drum driver 11 to control rotational driving of the traversing drum 10.

[0021] The unwinding supporting device 5 controls an unwinding balloon that occurs when the yarn 3 is unwound from the supplying package 2 in its axial direction. The unwinding supporting device 5 comprises an umbrella-shaped cylindrical member 51 that covers a bobbin 21 for the supplying package 2, and a driving mechanism 52 that lowers the cylindrical member 51 so as to maintain a substantially fixed spacing $f\Delta$ between the cylindrical member 51 and a chess part of the supplying package 2. The cylindrical member 51 performs control such that the balloon diameter remains substantially constant during unwinding, with increase of unwinding tension prevented even when unwinding progresses.

[0022] The variable tension device 6 applies a variable winding tension to the yarn 3 unwound from the supplying package 2. The variable tension device 6 comprises fixed comb teeth 61 and movable comb teeth 62 which are staggeredly located opposite each other across the route for the yarn 3, and a driving mechanism 63 such as a solenoid which increases and reduces the amount by which the fixed comb teeth 61 and the movable comb teeth 62 engage with each other. The variable tension device 6 operates on a control signal from the sequencer 12 to control the amount by which the movable comb teeth 62 engages with the fixed comb teeth 61, that is, the degree at which the yarn route is bent zigzag. This

enables sequential control of the winding tension applied to the yarn 3.

[0023] The yarn speed sensor 7 detects the traveling speed (yarn speed) of the yarn 3 in a non-contact manner. In the present embodiment, the yarn speed sensor 7 utilizes a variation in thickness of yarn to detect the moving speed of varying portions of the yarn by a space filter method, and outputs a detected value for the speed. More specifically, the yarn speed sensor 7 comprises a plurality of optical yarn thickness detecting devices along the yarn traveling direction, and the yarn speed sensor 7 thus uses the space filter method to detect the traveling speed of the yarn 3 on the basis of output signals from the yarn thickness detecting devices located at different positions in the yarn traveling direction. The optical yarn thickness detecting device comprises a light receiving element and a light source. The quantity of light received by the light receiving element varies depending on the thickness of the yarn 3 passing by the detection position of the yarn thickness detecting device. The yarn thickness detecting device outputs an electric signal corresponding to the yarn thickness.

[0024] In the present embodiment, the yarn 3 is a spun yarn. Thus, fluffs vary the yarn thickness along the length of the yarn 3. A lengthwisely fluffed portion of the yarn 3 has an apparently increased thickness. Moreover, the yarn thickness varies from "average" through "thick" to "average" in this area. The moving speed of the thickness varying portions is detected by the space filter method. This means detection of the yarn speed because the moving speed is equal to the yarn speed.

[0025] To indirectly detect the yarn speed of the yarn 3, a roller (rotating member) is placed to contact with the yarn 3 and rotationally driven by the travelling yarn so that the rotation speed of the roller is detected to detect the yarn speed. Since the yarn speed is proportional to the peripheral speed of the roller, the yarn speed can be calculated from the rotation speed of the roller. In particular, the roller rotates in conjunction with traveling of the yarn 3 and rotates at a speed directly proportional to the yarn speed. Consequently, the rotation speed of the roller accurately reflects information on the yarn speed. To indirectly detect the yarn speed using the roller that is contacted with the yarn 3, it is necessary to prevent the slippage between the roller and the yarn 3. Thus, the indirect yarn speed detecting roller is placed on the route for the yarn 3 upstream of a waxing device (which applies wax) or an oiling device (which applies oil) in the yarn traveling direction.

[0026] Upon detecting a yarn defect such as a slab on the yarn 3, the yarn defect detecting device 8 cuts the yarn 3. The yarn defect detecting device 8 comprises a yarn thickness detecting device 81 that detects the thickness of the passing yarn 3, a yarn defect determining device 82 that determines whether or not the yarn thickness indicates a yarn defect, and a yarn cutting device 83 that cuts the yarn 3 determined to be a yarn defect. The yarn thickness detecting device 81 and the yarn de-

fect determining device 82 will be described below in detail.

During winding, the yarn defect determining device 82 determines whether or not the yarn 3 is defective on the basis of information on the thickness of the yarn 3 detected by the yarn thickness detecting device 81, and when any yarn defect is detected, the yarn defect determining device 82 immediately instructs the yarn cutting device 83 to cut the yarn 3. The yarn cutting device 83 is then actuated to forcibly cut the yarn 3. Simultaneously with the yarn cutting, a yarn traveling signal from the yarn thickness detecting device 81 is turned off, and the yarn defect determining device 82 senses the yarn breakage and transmits a signal for stopping the traversing drum 10 to the drum driver 11 via the sequencer 12. The rotation of the traversing drum 10 is thus stopped. The yarn thickness detecting device 81, provided in the yarn defect detecting device 8, is essentially similar to a yarn thickness detecting device provided in the yarn speed sensor 7, and the yarn thickness detecting device 81 also comprises a light receiving element and a light source. The yarn thickness detecting device 81 outputs an electric signal corresponding to the yarn thickness.

[0027] The yarn splicing device 9 splices a lower yarn located at the supplying package 2 side with an upper yarn located at the winding package 4 side. When yarn breakage results from yarn cutting carried out by the yarn defect detecting device 8 or from other reason, the yarn 3 is divided into the upper yarn and the lower yarn. The yarn splicing device 9 then splices the upper yarn and the lower yarn together to restart rewinding the yarn 3 into the winding package 4. Then, when the yarn traveling signal from the yarn thickness detecting device 81 is turned off, the yarn defect determining device 82 transmits a yarn splicing instruction signal to the yarn splicing device 9 via the sequencer 12 so as to actuate the yarn splicing device 9 after the actuation of the yarn cutting device 82.

[0028] The yarn splicing device 9 comprises a pneumatic nozzle device 91 that splices the upper yarn and the lower yarn together by using an air current to entangle the fibers of the yarns, a lower yarn sucking device 92 that sucks, catches, and guides the lower yarn to the pneumatic nozzle device 91, and an upper yarn sucking device 93 that sucks, catches, and guides the upper yarn to the pneumatic nozzle device 91. The lower yarn sucking device 92 has a suction pipe that sucks and catches the yarn 3, as a main body, and a suction opening 92a at a leading end of the suction pipe is pivotable around a shaft 92b at a trailing end of the suction pipe. Vertical pivotal motion of the suction pipe moves the suction opening 92a between the pneumatic nozzle device 91 and a position below the unwinding supporting device 5. The upper yarn sucking device 93 is similarly configured. The upper yarn sucking device 93 has a suction pipe that sucks and catches the yarn 3, as a main body. A suction opening 93a at a leading end of the suction pipe is pivotable around a shaft 93b at a trailing end of the suction

pipe. Vertical pivotal motion of the suction pipe moves the suction opening 93a between the pneumatic nozzle device 91 and a peripheral surface of the winding package 4.

[0029] When the yarn defect detecting device 8 forcibly cuts the yarn 3 on the basis of detection of a yarn defect, the upper yarn is wound into the winding package 4, and on the basis of the yarn splicing instruction signal, the lower yarn is caught by the lower yarn sucking device 92 with its suction opening 92a standing by at the position below the unwinding supporting device 5. Then, on the basis of the yarn splicing instruction signal, the upper yarn is caught by the upper yarn sucking device 93 with its suction opening 93a standing by at the peripheral surface of the winding package 4. The lower yarn sucking device 92 subsequently moves the suction opening 92a upward to guide the lower yarn to the pneumatic nozzle device 91, and the upper yarn sucking device 93 moves the suction opening 93a downward to guide the upper yarn to the pneumatic nozzle device 91. The pneumatic nozzle device 91 then splices the upper yarn and the lower yarn together. After the yarn splicing operation, the rotational driving of the traversing drum 10 is restarted in response to an instruction from the sequencer 12. Winding is thus carried out again.

[0030] The traversing drum 10 is a device that traverses and winds the yarn 3 into the winding package 4. More specifically, the traversing drum 10 has a function (traverse means) for deflecting the yarn 3 along the axis of the winding package 4, and a function (winding means) for winding the yarn 3 on the winding package 4 by rotating the winding package 4. The function as the winding means is implemented by forming the traversing drum 10 into a columnar rotating member. The traversing drum 10 is arranged so that its outer peripheral surface is in contact with the outer peripheral surface of the winding package 4. Under these conditions, rotation of the traversing drum 10 rotates the winding package 4 in conjunction with the traversing drum 10. The function as the traverse means is implemented by a groove 10a which is formed on an outer peripheral surface of the traversing drum 10 and through which the yarn 3 is guided. The groove 10a is formed along the circumference of the traversing drum 10 and changes its angle against the axis of the traversing drum 10. The yarn 3 being guided through the groove 10a is deflected along the axis of the traversing drum 10 as the traversing drum 10 rotates.

[0031] The device that traverses and winds the yarn 3 into the winding package 4 is not limited to the traversing drum 10 integrally comprising the traverse means and winding means. The device may comprise separate devices serving as the traverse means and the winding means. For example, the traverse means may be a device that deflects a yarn guide along the axis of the winding package 4, and the winding means may be a simple cylindrical rotating member (drum) without any yarn guiding groove.

[0032] The winding device 20 winds the yarn 3 on a

bobbin to form a winding package 4. The winding device 20 comprises a cradle arm 19 that supports the bobbin, which is a core of the winding package 4, and the traversing drum 10 that rotates the winding package 4 while deflecting the yarn 3 along the axis of the winding package 4. The yarn guiding groove 10a is formed on the traversing drum 10 to allow the yarn to be deflected along the axis. The traversing drum 10 comprises both the function for traversing the yarn 3 and the function for winding the yarn 3.

[0033] The drum driver 11 is a device that rotationally drives the traversing drum 10 which is provided in the winding device 20. The drum driver 11 comprises a driving motor 11 a that rotationally drives the traversing drum 10, and an inverter 11 b that varies an output from the driving motor 11 a.

[0034] The rotation speed detecting sensor 16 is a device that detects the rotation speed of the traversing drum 10 which is provided in the winding device 20.

[0035] The sequencer 12 is a device that instructs the drum driver 11 to control the rotation speed of the traversing drum 10. The sequencer 12 is a computer device comprising a calculating device 12a that processes data on the basis of a program and a storage device 12b in which data and the program are stored. To make the rotation speed of the traversing drum 10 equal to a predetermined target value, the sequencer 12 transmits an instruction value to the drum driver 11 to control the rotation speed of the traversing drum 10, while comparing the rotation speed of the traversing drum 10 with the rotation speed value detected by the rotation speed detecting sensor 16. The predetermined target value is set in the form of a curve that varies as the time elapses (as the winding diameter of the winding package 4 varies). Specifically, the curve is shaped like, for example, a trapezoid that varies in three stages, a winding start stage (acceleration), an intermediate stage (constant speed), and a winding end stage (deceleration) of the winding package 4. Data on such a predetermined target value is pre-stored in the storage device 12b.

[0036] A description will be given of the yarn length calculating device that calculates the yarn length of the winding package 4. The yarn length of the winding package 4 means the total length of the yarn 3 wound into the winding package 4. In the present embodiment, the sequencer 12 also serves as the yarn length calculating device. The sequencer 12 calculates the length of the yarn 3 wound into the winding package 4, on the basis of the detected yarn speed value output from the yarn speed sensor 7. More specifically, the yarn length can be calculated by multiplying the yarn speed by the time for which the yarn 3 has traveled. Accordingly, even with a change during winding in yarn speed, the yarn length of the winding package 4 can be calculated by temporally integrating the yarn speed from the winding start (empty bobbin) to the winding end (full package) of the winding package 4. In other words, the sequencer 12 temporally integrates the yarn speed values detected by the yarn

speed sensor 7 from the winding start to the winding end of the winding package 4, to calculate the yarn length of the winding package 4.

[0037] With reference to Figure 3, a description will be given of a mechanism for correcting an output signal from the yarn speed sensor 7. Individual yarn speed sensors 7 have inherent detection characteristics, and different yarn speed sensors 7 output respective detected values even if their actual detection target is the same yarn speed. The detection characteristic of the yarn speed sensor 7 configured according to the present embodiment may deviate from an ideal characteristic due to an output from the light source, the sensitivity of the light receiving element, or the like. When no action is taken for the difference in such a detection characteristic, the actual yarn length may differ from the yarn length calculated by the sequencer 12 on the basis of the yarn speed value detected by the yarn speed sensor 7. This makes the yarn lengths of the winding packages 4 in the winding units 1 nonuniform. Thus, in calculating the yarn length, the output signal (yarn speed information) from each yarn speed sensor 7 is corrected so as to eliminate the adverse effect of a variation in the inherent detection characteristic in each yarn speed sensor 7. This enables the yarn speed to be accurately calculated.

[0038] The correcting mechanism comprises a correction information setting member 41, and the yarn speed sensor 7 and sequencer 12, provided in each winding unit 1. The setting member 41 is provided in the control device 40. The setting member 41 transmits correction information required to correct the yarn speed value detected by each yarn speed sensor 7, to the sequencer 12 of the corresponding winding unit 1. The correction information is used to eliminate the adverse effect of a variation in the inherent detection characteristic in each yarn speed sensor 7 (an inherent error in each yarn speed sensor 7). When caused to detect the same yarn speed, the yarn speed sensors 7 may detect different yarn speed values due to the variation in the inherent detection characteristic in each yarn speed sensor 7. Thus, the detected yarn speed values are corrected on the basis of the correction information so that when the yarn speed sensors 7 are caused to detect the same yarn speed, each corrected yarn speed values are found to be uniform.

[0039] The sequencer 12 corrects the detected yarn speed value output by the corresponding yarn speed sensor 7, on the basis of the correction information transmitted by the setting member 41, to calculate a corrected yarn speed value. The sequencer 12 then calculates the yarn length of the winding package 4 on the basis of the corrected yarn speed value.

[0040] Specifically, the correction information is as described below. For example, when the detected yarn speed value accounts for 100.1 % of the true yarn speed value due to the detection characteristic of the yarn speed sensor 7, it is corrected by multiplying it by -0.1 % (100.0/100.1). In this case, the setting member 41 transmits the correction information -1 % to the sequencer 12

as information for correction. More specifically, the correction information contains meaning information represented as "%" indicating amplification or attenuation of the signal, and quantity information represented as "-1" and specifying the magnitude of the amplification or attenuation. Further, occurrence of the error between the true value and detected value for the yarn speed sensor 7 is not limited to a deviation in the form of amplification or attenuation (difference in %). The error occurrence may be a deviation of a fixed value regardless of the yarn speed or a variable depending on the yarn speed. For example, at a yarn speed of 1,000 m/min., the voltage value of the output signal deviates from the detected yarn speed value by +0.1 mV. At a yarn speed of 800 m/min., the voltage value of the output signal deviates from the detected yarn speed value by -0.05 mV. In this case, the setting member 41 transmits error information corresponding to the yarn speed, for example, a table composed of the yarn speed and the magnitude of the error, to the sequencer 12 as correction information.

[0041] A substitute for the true value of the yarn speed may be yarn speed obtained by, for example, experimentally winding a yarn to form a sample package and executing a back calculation from the yarn length of the sample package actually formed and the time required for the formation. Further, the yarn length of the sample package actually formed can be determined by measuring the length of the yarn unwound from the sample package. It is difficult to use the full winding package 4 for the back calculation because of the large amount of yarn in the full winding package 4. A yarn speed control pattern (temporal-variation curve for the yarn speed) for winding on the full winding package 4 is not always constant, and the yarn may also be cut when yarn defects are found. Consequently, accurate back calculation of the yarn speed is difficult.

[0042] That is to say, the correction information corresponds to a function that derives the corrected yarn speed value from the detected yarn speed value. The detected yarn speed value is defined as VD_i , and the corrected yarn speed value is defined as VC_i . The function corresponding to the correction information and using the detected yarn speed value as a variable is defined as $f(VC_i, Ci)$. Then, these items have the relationship expressed by Equation 1. i is any of the numbers from 1 to n where the winder 100 has n winding units 1. C_i denotes the coefficient of the function f and its value varies with the yarn speed sensor 7. The correspondence between the detected value and true value (corrected value) is similar among the yarn speed sensors 7. Consequently, the function has the same basic form for all of the correction information.

[Equation 1]

[0043] When the detected yarn speed value accounts for 100.1% of the true value of the yarn speed as described above, C_i equals 0.1 in the function $f = 100 / 100$

+ C_i which corresponds to the correction information. The value C_i varies with the yarn speed sensor 7.

[0044] In particular, the part corresponding to the function f is stored in the storage device 12b in the sequencer 12. The information transmitted from the setting member 41 to each sequencer 12 may have only to specify the coefficient C_i . In the above example (the detected yarn speed value accounts for 100.1% of the true value of the yarn speed), the setting member 41 transmits information such as -1, 0, or +2 which corresponds to the coefficient C_i to each sequencer 12.

[0045] The sequencer 12 further calculates the yarn length on the basis of the corrected yarn speed value. The relationship given by Equation 2 is established among the detection time T_i required to detect the yarn 3, the yarn length L_i over which the yarn travels during the detection time T_i , and the corrected value V_{Ci} . As is the case with Equation 1, i is any of the numbers from 1 to n where the winder 100 has n winding units 1.

[Equation 2]

[0046] With the above configuration, in spite of the variation in the detection characteristic among the yarn speed sensors 7, each sequencer 12 corrects the detected yarn speed value on the basis of the correction information to calculate the corrected yarn speed value free from the variation among the yarn speed sensors 7. The sequencer 12 thus appropriately calculates the yarn length of the winding package 4 formed by each winding unit 1. Therefore, the winder 100 can rewind the yarn 3 so that the full winding packages 4 formed by the winding units 1 offer a uniform yarn length.

[0047] Now, a description will be given of methods for setting the correction information. A first method sets the correction information in accordance with the detection characteristic of each yarn speed sensor 7 detected during shipment inspections. More specifically, the error between the true value and detected value for each yarn speed sensor 7 is determined, and the correction information is set so as to correct the error. A second setting method sets the correction information by comparing an actual average yarn speed calculated from the length of a yarn unwound from an experimentally produced a sample package with a detection-based average yarn speed calculated from a detected value from the yarn speed sensor 7 followed by deriving the correspondence between the average yarn speeds.

[0048] The first setting method will be described. When the yarn speed sensor 7 is shipped from a production factory, each yarn speed sensor 7 is inspected for its performance. This performance inspection allows the error between the detected yarn speed value and the true yarn speed value to be detected for each yarn speed sensor 7. Since the absolute difference (error) between the true value and the detected value is thus detected for each yarn speed sensor 7, the relative error between different yarn speed sensors 7 (a variation among the

yarn speed sensors 7) can also be determined. This makes it possible to set correction information that corrects the error between the true value and detected value obtained through the performance inspection. The first setting method stores the correction information thus obtained in the setting member 41, which then transmits the correction information to each sequencer 12.

[0049] The second setting method will be described. First, each winding unit 1 winds a yarn into an experimental sample package in order to obtain correction information on the yarn speed. Here, the time (winding time) required to form the sample package can be determined. The length of the yarn formed into the sample package can be measured by unwinding the yarn from the sample package. For easier measurements, less yarn is required to form a full sample package than to form a full normal winding package 4. The actual average yarn speed in the formation of the sample package is then calculated from the yarn length of the sample package and the sample package winding time. Meanwhile, the average yarn speed is obtained by averaging the yarn speed values detected by the yarn speed sensors 7 during the winding of the sample packages. The obtained average yarn speed corresponds to the average yarn speed value during the formation of the sample package but is a value fundamentally calculated on the basis of the detected values from the yarn speed sensors 7. Consequently, the detection-based average yarn speed differs from the actual average yarn speed due to the adverse effect of the error attributed to the detection characteristic. Then, the correspondence between the actual average yarn speed and the detection-based average yarn speed can be derived by comparison. This correspondence can be more accurately derived by executing winding of more sample packages followed by aforementioned comparison. Moreover, the correction information can be set on the basis of the derived correspondence. For example, for a certain winding unit 1, when the detection-based average yarn speed is higher than the actual average yarn speed by 0.1 %, the correction information transmitted to the sequencer 12 of this winding unit 1 is -1%. The second setting method stores the correction information thus obtained in the setting member 41, and transmits the correction information to each sequencer 12.

[0050] Setting the correction information by the above setting methods determines the error between the detected value from each yarn speed sensor 7 and the true value. Thus, the yarn length detected by each sequencer 12 can be made equal to the yarn length of the actually produced winding package 4, increasing detection accuracy of yarn length.

[0051] 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 invention.

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Claims

1. A textile machine **characterized by** comprising a large number of yarn processing units each including a winding device that winds a yarn to form a package, a yarn speed sensor that detects a yarn speed of the traveling yarn, and a yarn length calculating device that calculates a yarn length of the package formed of the yarn on the basis of the detected value from the yarn speed sensor, the textile machine being **characterized by** comprising a setting member that transmits correction information for each of the yarn speed sensors to a corresponding one of the yarn length calculating devices, and **characterized in that** each of the yarn length calculating devices corrects the detected value from a corresponding one of the yarn speed sensors on the basis of the correction information to calculate a correction value for a corresponding yarn speed to calculate the yarn length of a corresponding one of the packages on the basis of the correction value for the corresponding yarn speed.

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2. A textile machine according to Claim 1, **characterized in that** each piece of the correction information is set in accordance with a detection characteristic of a corresponding one of the yarn speed sensors which is detected during shipment inspections.

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3. A textile machine according to Claim 1, **characterized in that** each piece of the correction information is set in each corresponding one of the yarn processing units by comparing an actual average yarn speed calculated on the basis of a yarn length obtained by unwinding a yarn from an experimentally formed sample package and time required to form the sample package with a detection-based average yarn speed obtained by averaging, over the winding time, detected values of the yarn speed obtained by the yarn speed sensor during formation of the sample package, and then by deriving a correspondence between the actual average yarn speed and the detection-based average yarn speed.

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FIGURE 1

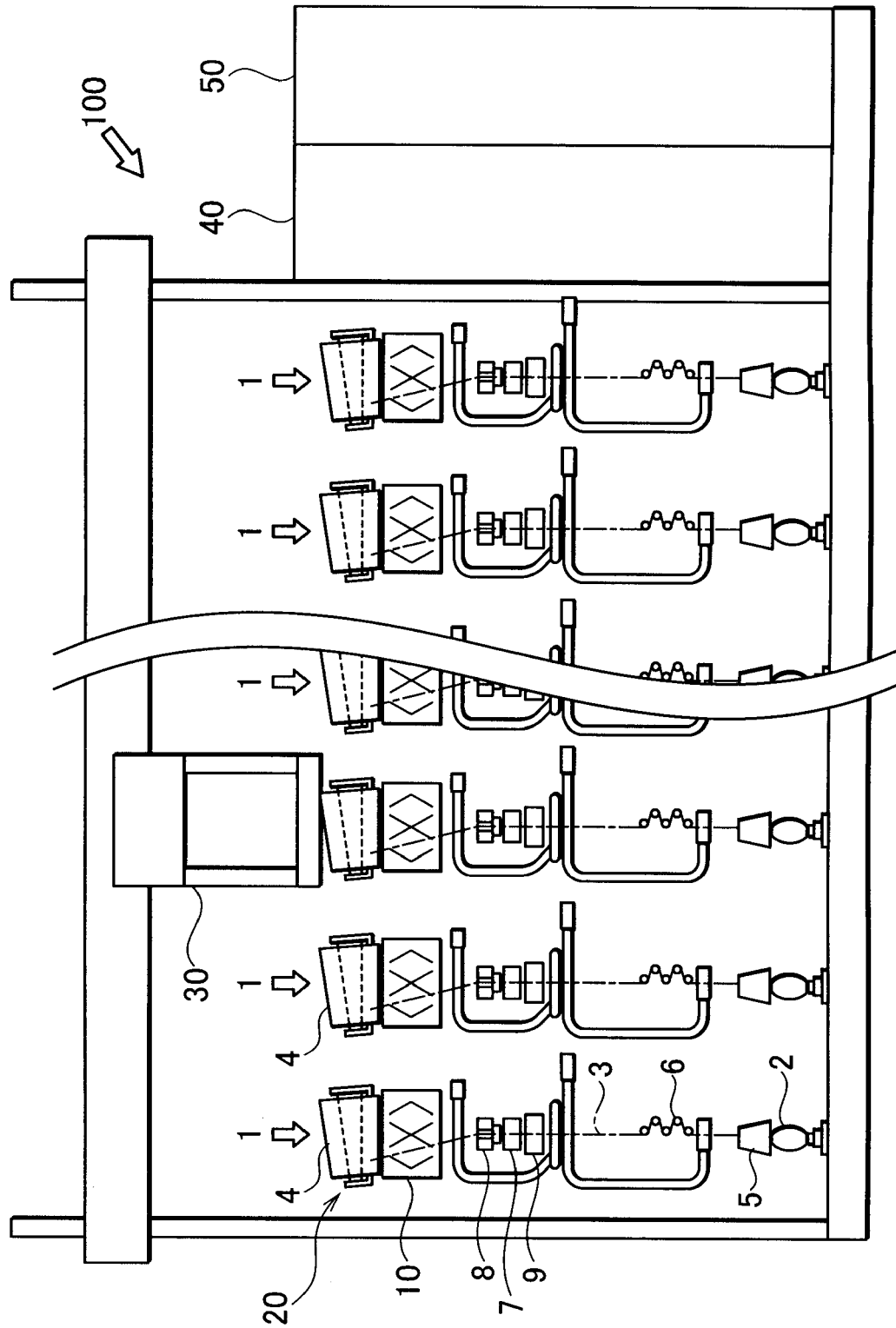


FIGURE 2

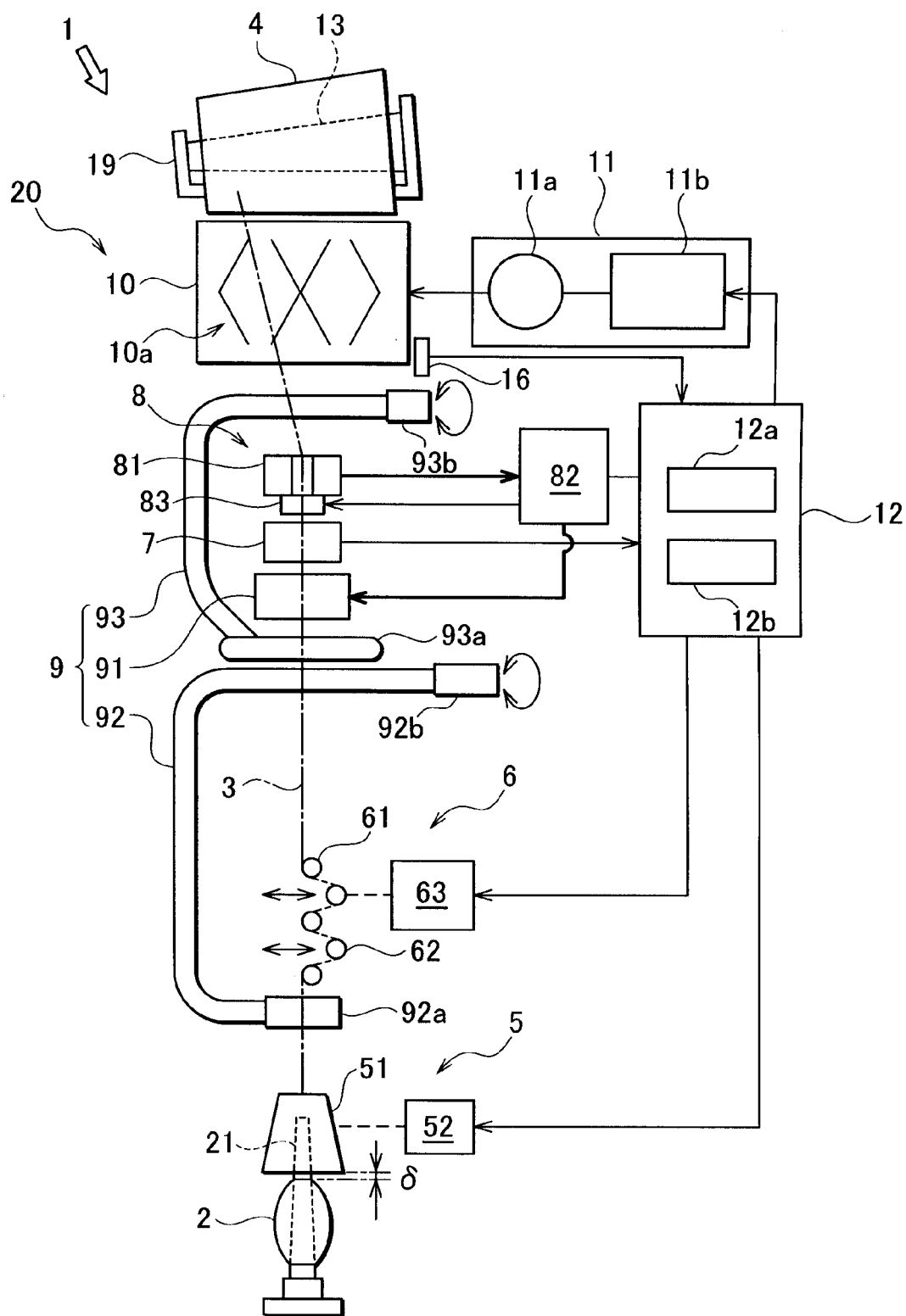
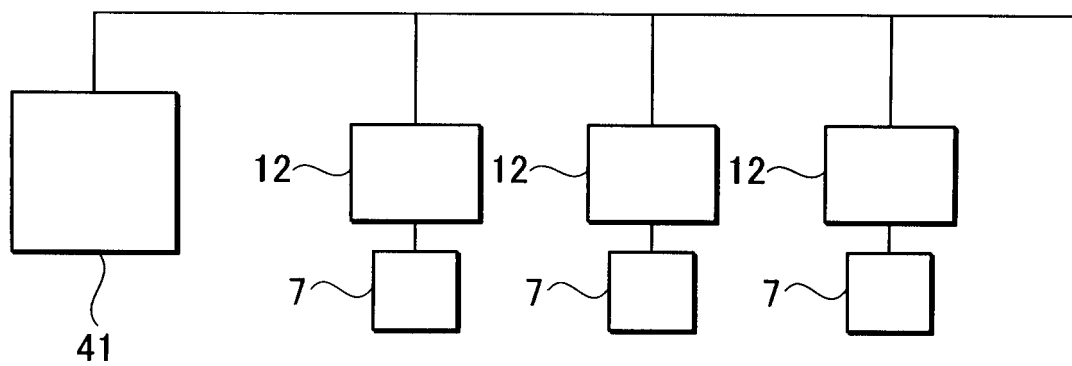


FIGURE 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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