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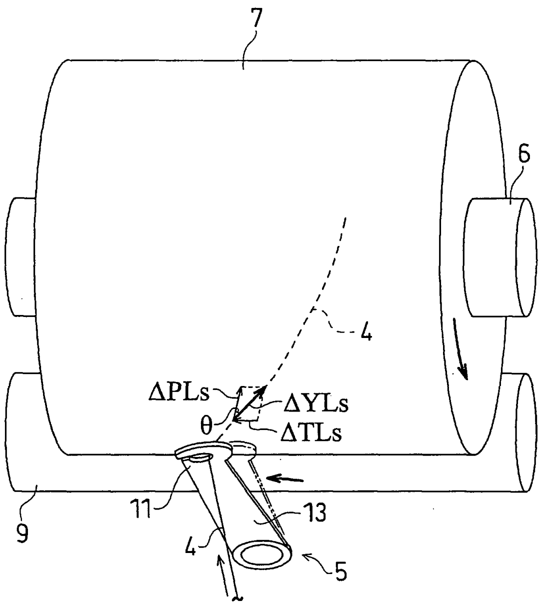
(54) **A yarn length measuring device for a yarn winding device**

(57) The yarn length measuring device includes: a means (73) that detects a yarn layer peripheral surface movement distance ΔPLs of a yarn layer formed by the winding yarn (4) around a winding tube (6) ; a means (74) that detects a traverse movement distance ΔTLs of the yarn; and a winding length computing means (75) that inputs the yarn layer peripheral surface movement distance ΔPLs, and the traverse movement distance ΔTLs, detected by the traverse movement distance computing means (74), calculates a winding length of the yarn (4) wound around the winding bobbin (6, 7) at each time (Ts) from the ΔTLs and the ΔPLs that have been input, and determines a winding length (YL) of the yarn (4) wound around the winding bobbin (6, 7) by summing up the winding lengths Δ YL calculated at each predetermined time (Ts).

FIG. 2



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Description

[0001] The present invention relates to a yarn length measuring device for a yarn winding device that winds a yarn around a winding bobbin while traversing the yarn.

[0002] In regard to this type of yarn length measuring device, Patent Document 1 (Japanese Published Unexamined Patent Application No. Hei 5-286646 (paragraph 0013, etc.)) discloses, in a traversing drum type yarn winding device (automatic winder), a yarn length measuring device of a constitution that measures a yarn length by counting detection pulses, generated by a drum rotation detector of a traversing drum, by a pulse counter.

[0003] Meanwhile, Patent Document 2 (Japanese Published Unexamined Patent Application No. 2000-247542 (paragraphs 0007, 0043, etc.)) discloses a yarn winding device (automatic winder), with which a winding bobbin rotative driving device and a traverse device are driven independently of each other. In this Patent Document 2, it is disclosed that by making the winding bobbin rotative driving device and the driving device for traversing independent of each other, traverse winding bobbins of a precision winding type, step precision winding type, and other forms canbemanufactured. Patent Document 2 also discloses a so-called winding bobbin direct drive constitution, in which a winding bobbin is coupled to a rotor of a winding bobbin rotative driving device in a manner in which relative rotation is disabled.

[0004] Though the constitution of Patent Document 2 provides the merit of being able to perform the above-mentioned various forms of winding because the winding bobbin and a traverse yarn guiding portion are driven by independent motors, the yarn length measuring device of Patent Document 1 cannot be applied to the winding device of Patent Document 2. That is, when just the rotation of a roller that contacts a yarn layer is detected as in Patent Document 1, yarn length measurement that takes into consideration influence of a traverse guide, which is traversed independently of the roller is not possible.

[0005] The present invention has been made in view of the above circumstances, and a principal object thereof is to provide a yarn length measuring device favorable for a yarn winding device of a type, with which a traverse device and a winding bobbin rotative driving device are driven independently.

[0006] The object of the present invention is as described above, and means for achieving this obj ect and effects thereof shall now be described.

[0007] A first aspect of the present invention provides, in a yarn winding device, having a winding bobbin rotative driving device that rotatively drives a winding bobbin for winding a yarn and a traverse device that is driven independently of the winding bobbin rotative driving device and traverses the yarn while the yarn is being wound around the winding bobbin, a yarn length measuring device that measures winding length of the yarn wound around the winding bobbin and has the following constitution. That is, the yarn length measuring device includes: a means that detects, at each predetermined sampling cycle time, a yarn peripheral surface movement distance in a peripheral direction of a peripheral surface of a yarn layer formed by winding the yarn around the winding bobbin; a means that detects, at each predetermined sampling cycle time, a traverse movement distance of the yarn in a width direction of the yarn layer; and a winding length computing means that inputs the yarn layer peripheral surface movement distance, detected at each predetermined sampling cycle time by the yarn layer peripheral surface movement distance detecting means, and the traverse movement distance, detected at each predetermined sampling cycle time by the traverse movement distance detecting means, and determines the winding length of the yarn wound around the winding bobbin based on the yarn layer peripheral surface movement distance and the traverse movement distance that have been input.

[0008] By this constitution, the winding length of the yarn can be measured precisely in a yarn winding device of type with which rotative drive of the winding bobbin and traverse drive are performed independently of each other.

[0009] With the above-described yarn length measuring device for the yarn winding device, the predetermined sampling cycle time is preferably an instantaneous period of time. Here, "instantaneous period of time" refers to an extremely short amount of time that is adequately shorter than a period of time when the yarn moves during one traverse stroke of the traverse device, and is specifically no more than 1 second.

[0010] The precision of yarn length measurement can thereby be improved. That is, even if the speed of traverse movement changes within one traverse stroke, the yarn length can be measured precisely. The yarn length can also be measured accurately even under various variations of the bobbin rotation speed and the traverse movement speed.

[0011] Preferably with the above-described yarn measuring device for the yarn winding device, the traverse device has a traverse guide that is driven to move the yarn in the traverse direction and a driving motor that drives the traverse guide, and a rotation angle of a rotor of the driving motor and a movement distance of the traverse guide are maintained in a predetermined relationship and the traverse movement distance detecting means detects the rotation angle of the rotor of the driving motor.

[0012] The traverse movement distance can thereby be detected precisely with a simple constitution.

[0013] Preferably with the above-described yarn measuring device for the yarn winding device, the yarn layer peripheral surface movement distance detecting means has a yarn layer diameter sensor that detects a diameter of the yarn layer and a winding bobbin rotation angle sensor that detects a rotation angle of the winding bobbin, and determines the yarn layer peripheral surface movement speed from detection results of the yarn layer diameter sensor and the winding bobbin rotation angle sensor.

[0014] The yarn length can thereby be measured accurately. That is, with a constitution as in Patent Document 1, in which the rotation angle of a roller that contacts a yarn layer is detected, because slipping may occur between the yarn layer and the roller, the yarn length measurement value tends to be inaccurate. In regard to this point, by forming the yarn layer peripheral surface movement distance detecting means from the yarn layer diameter sensor and the winding bobbin rotation angle sensor as in the constitution of the present invention, the yarn length can be measured accurately.

[0015] Preferably with the above-described yarn length measuring device for the yarn winding device, the yarn layer diameter sensor can detect the yarn layer diameter in a state in which the winding of the yarn is stopped.

[0016] Because the yarn length measurement can thereby be performed immediately after the start of winding of the yarn, the winding length of the yarn can be measured accurately. Also, with a constitution in which a yarn layer diameter sensor includes a winding bobbin rotation angle sensor and a roller rotation angle sensor and a yarn layer diameter is computed from signals from the two sensors, when the rotation speeds of the winding bobbin and the roller are low after the start of yarn winding, the numbers of signals (numbers of pulses) from the two sensors per unit time are low and a computing process by a computing means is difficult. However, with the constitution according to the present invention, the yarn layer diameter sensor can detect the yarn layer diameter in a state in which the winding of the yarn is stopped and can thus also detect the yarn layer diameter when the rotation speed of the winding bobbin is low. Such a constitution is especially effective in a yarn winding device of a constitution, which has a yarn defect removing device (yarn defect detector, yarn piecing device, etc.,) and the detection of a yarn defect, stoppage of yarn winding, removal of the yarn defect, yarn piecing, and restarting of yarn winding are repeated during yarn winding.

[0017] FIG. 1 shows a schematic front view and a block diagram of a yarn winding station of an automatic winder according to an embodiment of the present invention.

[0018] FIG. 2 is a perspective view of principal portions for describing a computation of a winding length ΔYLs of a yarn in a sampling cycle time Ts.

[0019] FIG. 3 shows a schematic front view and a block diagram of a modification example of a traverse device.

First Embodiment

[0020] Embodiments of the present invention will now be described.

[0021] First, based on FIG. 1, a yarn winding station (yarn winding device) 2 of an automatic winder 1 will be described. This yarn winding station 2 forms a yarn layer by winding a yarn 4, from a supplying bobbin 3, around a winding tube 6 while traversing the yarn 4 by a traversing device 5, and thereby forms a package 7 of predetermined length and predetermined shape. Though only one yarn winding station 2 is shown in FIG. 1, the automatic winder 1 is formed by disposing a plurality of rows of such yarn winding stations 2 on an unillustrated frame. In the this specification, the winding tube 6 and the package 7 shall be referred to collectively as the "winding bobbin." That is, the winding tube 6 is the winding bobbin on which a yarn layer is not formed, and the package 7 is the winding bobbin on which the yarn layer has been formed.

[0022] The yarn winding station 2 has a cradle (winding bobbin supporting member) 8 that detachably supports the winding tube 6 and a contact roller 9 that can be driven and rotated by making contact with a peripheral surface of the yarn layer of the package 7. The cradle 8 is arranged to clamp opposite ends of the winding tube 6 and rotatably support the winding tube 6. The cradle 8 is also arranged to be swingable about a swinging shaft 10 so that an increase in the package diameter accompanying the winding of the yarn 4 around the winding tube 6 can be absorbed by the swinging of the cradle 8.

[0023] A package driving motor (winding bobbin rotative driving device) 41 is mounted on a portion of the cradle 8 that clamps the winding tube 6, and the winding tube 6 is actively driven to rotate by this package driving motor 41 to wind the yarn 4. A motor shaft of the package driving motor 41 is connected to the winding tube 6 in a manner disabling relative rotation when the winding tube 6 is clamped by the cradle 8 (so-called direct drive arrangement). The actuation of the package driving motor 41 is controlled by a package drive control unit 42, and the package drive control unit 42 is provided to control operation/stoppage of the package driving motor 41 upon receiving signals from a winding station control unit 50.

[0024] A package rotation sensor (winding bobbin rotation angle sensor) 43 is mounted on the cradle 8, and the package rotation sensor 43 is provided to detect a rotation angle (how many times the winding bobbin has rotated) of the winding bobbin (winding tube 6 or package 7) mounted on the cradle 8. A rotation angle detection signal of the winding bobbin 6 or 7 is transmitted from the package rotation sensor 43 to the package drive control unit 42 and the winding station control unit 50. The rotation angle detection signal is also input into a traverse control unit 46 to be described later.

[0025] A package diameter sensor (yarn layer diameter sensor) 44 that includes a rotary encoder, etc., is also mounted on the cradle 8. This package diameter sensor 44 is enabled to detect a diameter of the yarn layer (package 7), formed by winding the yarn 4 around the winding tube 6 mounted on the cradle 8, by detecting a swinging angle of the cradle 8. The package diameter sensor 44 can detect the diameter of the yarn layer both when the yarn 4 is being wound and when the winding of the yarn 4 is stopped. The diameter of the yarn layer that is acquired by the package diameter sensor 44 is transmitted to the winding station control unit 50. The package rotation sensor 43 and the package diameter sensor 44 are components of a yarn layer peripheral surface movement distance measuring means that detects a yarn layer peripheral surface movement distance in a peripheral direction of a peripheral surface of the yarn layer formed by winding the yarn 4 around the winding tube 6.

[0026] The traverse device 5 is disposed near the contact roller 9, and by this traverse device 5, the yarn 4 is wound around the package 7 while being traversed. This traverse device 5 has a traverse guide (yarn guide 11), disposed capable of reciprocating in a traverse direction, and a traverse driving motor 45 that reciprocatingly drives the traverse guide 11.

[0027] The traverse device 5 has the hook-shaped traverse guide 11, which is provided at a tip of an elongate arm member 13, and which is enabled to pivot about a supporting axis, and reciprocatingly and pivotingly drives the arm member 13 as shown by an arrow in FIG. 1 by means of the traverse driving motor 45. In the present embodiment, the traverse driving motor 45 is formed of a voice coil motor.

[0028] The actuation of the traverse driving motor 45 is controlled by the traverse control unit 46. The traverse control unit 46 is constituted to control the operation/stoppage of the traverse driving motor 45 upon receiving operation signals from the winding station control unit 50. The traverse device 5 has a traverse guide position sensor 47 that includes a rotary encoder, etc., and is provided to detect a pivoting position of the arm member 13 (and thus the position of the traverse guide 11) and transmit a position signal to the traverse control unit 46. The traverse guide position sensor 47 is a component of a traverse movement distance detecting means.

[0029] As shown in FIG. 1, according to the present embodiment, the package driving motor 41 that drives the winding bobbin 6 or 7 and the traverse drivingmotor 45 that drives the traverse guide 11 are disposed separately, and the winding bobbin 6 or 7 and the traverse guide 11 are driven (controlled) independently of each other. Various forms of winding, such as precision winding, step precision winding, random winding, etc., can thereby be realized in the process of winding the yarn 4 around the winding bobbin 6 or 7.

[0030] The yarn winding station 2 has a yarn piecing device 14 and a yarn clearer (yarn monitor) 15 disposed in this order from the supplying bobbin 3 side in a yarn running path between the supplying bobbin 3 and the contact roller 9.

[0031] The yarn piecing device 14 is provided to piece together a bobbin yarn at the supplying bobbin side 3 and an upper yarn at the package 7 side when the yarn is cut upon detection of a yarn defect by the yarn clearer 15 or when the yarn is cut during unwinding of the yarn from the yarn supplying bobbin 3.

[0032] The yarn clearer 15 detects defects in thickness of the yarn 4 and is provided to detect the thickness of the yarn 4, passing through a portion of the yarn clearer 15, by an appropriate sensor and detect slabs and other yarn defects by analyzing a signal from the sensor by an analyzer 23. The yarn clearer 15 is provided with a cutter 16 that cuts the yarn 4 immediately upon detecting a yarn defect.

[0033] At a lower side of the yarn piecing device 14 a bobbin yarn capturing and guiding means 17 that captures the bobbin yarn at the supplying bobbin 3 side by suction and guides the yarn is disposed. At an upper side of the yarn piecing device14 an upper yarn capturing and guiding means 20 that captures the upper yarn at the package 7 side by suction and guides the yarn is disposed. The upper yarn capturing and guiding means 20 is formed in a form of a pipe, is disposed in a manner capable of swinging upward and downward about a shaft 21, and has a mouth 22 at its tip. The bobbin yarn capturing and guiding means 17 is also formed in a form of a pipe, is disposed in a manner capable of swinging upward and downward about a shaft 18, and has a suction inlet 19 at its tip. An appropriate negative pressure source is connected to the upper yarn capturing and guiding means 20 and the bobbin yarn capturing and guiding means 17 such that the yarn can be sucked by the mouth 22 and the suction inlet 19.

[0034] The automatic winder 1 is configured as described above, and a yarn length measuring device 60 that measures a winding length YL of the yarn 4 from the start of winding in the yarn winding station 2 of the automatic winder 1 includes at least the package rotation sensor 43, the package diameter sensor 44, the traverse guide position sensor 47, and the traverse control unit 46, etc.

[0035] A yarn length measuring function of the yarn length measuring device 60 will now be described. The traverse control unit 46 that constitutes the yarn length measuring device 60 is constituted in the form of a microcomputer, and has a Central Processing Unit (CPU) 70 as a computing means, a RandomAccess Memory (RAM) 71 as a storage means, a timer circuit 72, etc. The CPU 70 has a yarn layer peripheral surface movement distance computing means 73, a traverse movement distance computing means 74, and a winding length computing means 75. The yarn layer peripheral surface movement distance computing means 73 is a component of the yarn layer peripheral surface movement distance detecting means and computes a movement distance ΔPLs of the yarn layer peripheral surface at each predetermined sampling cycle time Ts from the detection result of the package rotation sensor 43 and the detection result of the package diameter sensor 44. The traverse movement distance computing means 74 is a component of the traverse movement distance detecting means and computes a traverse movement distance ΔTLs at each predetermined sampling cycle time Ts from the detection result of the traverse guide position sensor 47. The winding length computing means 75 inputs the yarn layer peripheral surface movement distance ΔPLs detected at each predetermined sampling cycle time Ts by the yarn layer peripheral surface movement distance computing means 73 and the traverse movement distance ΔTLs detected at each predetermined sampling cycle time Ts by the traverse movement distance computing means 74, calculates the winding length of the yarn 4 wound around the winding bobbin 6 or 7 at each predetermined cycle time Ts from the yarn layer peripheral surface movement distance ΔPLs and the traverse movement distance ΔTLs that have been input, and sums up the winding length calculated for each cycle time Ts from the start of winding to determine the winding length of the yarn 4 wound around the winding bobbin 6 or 7. The CPU 70 of the traverse control unit 46 thus computes the movement distance ΔPLs of the peripheral surface of the yarn layer wound around the winding bobbin 6 or 7 and the movement distance ΔTLs of the traverse guide 11 at each predetermined sampling cycle time Ts. The sampling cycle time Ts is an extremely short amount of time that is adequately shorter than a period of time when the yarn moves during one traverse stroke of the traverse guide 11, and though the shorter the better, the sampling cycle time Ts is set, for example, to no more than 1 second (approximately a few hundred μs).

[0036] Specifically, according to the present embodiment, the package diameter sensor 44 detects the diameter of the package 7 at each appropriate time interval, and the detected diameter is transmitted to the winding station control unit 50. Upon receiving the signal of the diameter of the package 7, the winding station control unit 50 transfers the signal to the traverse control unit 46. The package rotation sensor 43 detects the rotation angle of the winding bobbin 6 or 7 (rotation speed of the winding bobbin 6 or 7) at each appropriate time interval, and the detected rotation angle is transmitted to the traverse control unit 46.

[0037] Accordingly, the traverse control unit 46 can acquire the diameter of the package (yarn layer) and the rotation speed of the winding bobbin 6 or 7, and based on the detected diameter and the rotation speed, the yarn peripheral surface movement distance computing means 73 of the traverse control unit 46 computes the movement distance ΔPLs of the peripheral surface of the yarn layer at the sampling cycle time Ts according to the following formula. That is, if the diameter of the package 7 is D (meters), the rotation speed of the winding bobbin 6 or 7 is B (rpm), and the cycle time is Ts (s), $\Delta PLs = (\pi \times D \times B \times Ts)/60$.

[0038] At the same time, the traverse guide position sensor 47 is provided to transmit, as the position signal, pulse signals of a number that is in accordance with the movement distance of the traverse guide 11 to the traverse control unit 46 at each appropriate time interval. The traverse movement distance computing means 74 of the traverse control unit 46 computes and acquires the movement distance ΔTLs at the sampling cycle time Ts by determining the difference between the number of the pulse signals that are input currently and the number of the pulse signals that were input just the sampling cycle time Ts before and multiplying the difference by the distance per pulse. That is, if the number of pulses in the current sampling is Cc (pulses), the number of pulses in the previous sampling is Cp (pulses), and the distance per pulse is ΔLp (meters), $\Delta TLs = |Cc - Cp| \times \Delta Lp$.

[0039] The winding length computing means 75 of the traverse control unit 46 then sums up the respective values of the ΔPLs and the ΔTLs, obtained by the above computation, for a predetermined cycle time (calculation cycle time) Tc. The cumulative values ΔPL and ΔTL that are thus obtained are such that $\Delta PL = \Sigma \Delta PLs$ and $\Delta TL = \Sigma \Delta TLs$, respectively. The calculation cycle time Tc is set longer than the sampling cycle time Ts.

[0040] When the calculation cycle time Tc elapses, the winding length computing means 75 of the traverse control unit 46 calculates a length ΔYL of the yarn 4 wound within the calculation cycle time Tc based on the cumulative values ΔPL and ΔTL and in accordance with the Pythagorean formula. That is, if the length of the yarn wound within the calculation cycle time Tc is ΔYL (meters), $\Delta YL = \sqrt{(\Delta PL^2 + \Delta TL^2)}$.

[0041] That is, as shown in FIG. 2, a vector(ΔYL) that expresses the winding length of the yarn in an adequately short time Tc is expressed as a vector sum of a vector (ΔPL) of a component in the direction in which the peripheral surface of the yarn layer moves and a traverse movement component vector (ΔTL) that is perpendicular to the peripheral surface movement vector (ΔPL). The relationship, $\Delta YL = \sqrt{(\Delta PL^2 + \Delta TL^2)}$, thus holds. An angle θ in FIG. 2 is a traverse angle.

[0042] Because in the present embodiment, the traverse guide 11 is disposed at the tip of the arm member 13 that is driven to pivot, in a strict sense, the traverse guide 11 moves not along a rectilinear locus but along an arcuate locus. In regard to this point, according to the present embodiment, it is deemed that the length of the arm member 13 is sufficiently long and that the motion of the traverse guide 11 approximates a rectilinear motion and thus the above calculation formula is applied. However, the present invention is not restricted to making such an approximation, and a component ΔTL' of the movement distance ΔTL of the traverse guide 11 in the width direction of the yarn layer (the component distance that practically contributes to the traversing motion of the yarn 4) may be computed using trigonometric functions and the ΔYL may be calculated from the above Pythagorean formula using the distance ΔTL' obtained as descrived above.

[0043] When the winding lengths ΔYL for each calculation cycle time Tc are thus obtained by computation, the winding length computing means 75 of the traverse control unit 46 determines the winding length YL from the start of winding around the winding bobbin 6 or 7 as a cumulative value. That is, $YL = \Sigma \Delta YL$. The winding length computing means 75 of the traverse control unit 46 then resets the cumulative values ΔPL and ΔTL to zero, respectively, begins the process for the next calculation cycle time Tc, and repeats the same process as described above.

[0044] Because the winding length computing means 75 of the traverse control unit 46 repeats the above calculation at each calculation cycle time Tc and updates the value of the winding length YL from the start of winding, the winding length YL increases with time as the winding by the yarn winding station 2 progresses. When the value of the yarn winding length YL reaches a predetermined length that has been set in advance, the winding length computing means 75 judges that a fully wound state is reached and transmits a full wound signal to the winding station control unit 50. The winding station control unit 50 then transmits stop signals to the package drive control unit 42 and the traverse control unit 46 to stop the package driving motor 41 and the traverse driving motor 45 and thereby stops the winding of the yarn 4 around the winding bobbin 6 or 7 and also makes an unillustrated doffing device perform an appropriate doffing operation. Then, the operations of the package driving motor 41 and the traverse driving motor 45 are restarted via the package drive control unit 42 and the traverse control unit 46 and the winding of the yarn 4 around a new winding bobbin (winding tube) 6 is performed again. Needless to say, when winding the yarn 4 around the new winding bobbin 6, the measurement value of the yarn winding length YL is reset to zero.

[0045] As described above, the yarn length measuring device 60 has the yarn length computing means 75 that computes and determines the yarn length ΔYLs of the yarn 4 at each predetermined sampling cycle time Ts from the movement distance ΔPLs of the peripheral surface of the yarn layer wound around the winding bobbing 6 or 7 and the movement distance ΔTLs of the traverse guide 11 at the predetermined sampling cycle time Ts. The winding length computing means 75 is constituted to sum up the winding lengths ΔYLs, repeatedly determined at each sampling cycle time Ts, to determine the winding length YL of the yarn 4 from the start of winding.

[0046] In the yarn winding device in which the rotative driving of the winding bobbin 6 or 7 and the driving of the traverse guide 11 are performed independently of each other, yarn length measurement that takes into consideration the rotation direction component of the winding bobbin 6 or 7 and the traverse direction component respectively can be performed. As a result, presicion of the yarn length measurement is extremely high, and inadequacies of the yarn winding amount and wasting of yarn can be prevented reliably.

[0047] The cycle time Ts, at which the winding length computing means 75 of the traverse control unit 46 computes the winding length ΔYLs, is set adequately shorter than the period of time the yarn 4 to move during one traverse stroke of the traverse guide 11 (an adequately short, instantaneous time). The value of the winding length YL can thus be determined while finely reflecting effects of the reciprocating motion of the traverse guide 11 (in other words, variations of the ΔTLs), in which the traverse guide 11 decelerates as it approaches a traverse stroke end, stops for an instant at the end, and then accelerates toward the opposite traverse stroke end. The precision of the yarn length measurement can thus be improved greatly. Variations of the winding bobbin rotation speed and the traverse movement speed can also be accommodated readily.

[0048] The yarn winding station 2 of the automatic winder 1 according to the present embodiment has the package diameter sensor 44 that detects the diameter of the yarn layer and the package rotation sensor 43 that detects the rotation angle of the yarn layer. The yarn length computing means 75 of the traverse control unit 46 computes and determines the movement distance ΔPLs of the peripheral surface of the yarn layer at the sampling cycle time Ts from the detection value of the package diameter sensor 44 and the detection value of the package rotation sensor 43. Though the movement distance ΔPLs of the peripheral surface can also be determined by an arrangement in which a rotation sensor is mounted on the-contact roller 9, because slipping may occur between the yarn layer and the contact roller 9, the yarn length measurement value tends to be inaccurate with this constitution. In regard to this point, according to the present embodiment, because the yarn layer peripheral surface movement distance detecting means is formed of the package diameter sensor 44 and the package rotation sensor 43, the yarn length can be measured accurately.

[0049] According to the present embodiment, the traverse device 5 has the traverse guide 11 that is driven to move the yarn 4 in the traverse direction and the traverse driving motor 45 that drives the traverse guide 11, and the rotation angle of the rotor of the traverse driving motor 45 and the movement distance of the traverse guide 11 are in a proportional relationship. The traverse guide position sensor 47 is provided to detect the rotation angle of the rotor of the traverse driving motor 45. The movement distance ΔTLs of the traverse guide 11 can thus be detected precisely by a simple constitution.

[0050] According to the present embodiment, the package diameter sensor 44 is enabled to detect the yarn layer diameter even in the state in which the winding of the yarn 4 is stopped. Therefore, the yarn layer diameter can be measured by the package diameter sensor 44 even when the winding bobbin 6 or 7 is rotating at low speed, such as immediately after the start of winding of the yarn around an empty winding bobbin and immediately after the restarting of winding after yarn piecing, and the yarn length can thus be measured accurately.

[0051] For example, it is possible to omit the package diameter sensor 44 and instead mount a rotation sensor on the contact roller 9 and use the CPU 70, etc., to compute the yarn layer diameter from the pulse signals from the rotation sensor and the pulse signals from the package rotation sensor 43. However, in the case of computing the yarn layer diameter from such a relationship of rotation speeds, when the winding bobbin is rotating at low speed immediately after the start of yarn winding, etc., the computation process at the CPU 70 is made difficult because the number of pulses per unit time is low in such instances. In regard to this point, according to the constitution of the present embodiment, because the yarn layer diameter can be obtained accurately by the package diameter sensor 44 even during low speed rotation of the winding bobbin, the yarn length can be measured accurately. Especially with the yarn winding station 2 of the automatic winder 1 according to the present embodiment, because each time the yarn clearer 15 detects a yarn defect, the operation, in which the rotation of the winding bobbin 6 or 7 is stopped, the yarn defect is removed, and the rotation of the winding bobbin 6 or 7 is restarted after yarn piecing has been performed by the yarn piecing device 14, is repeated, the employment of the package diameter sensor 44 that can detect the yarn layer diameter even when the winding bobbin is stopped as described above is of merit.

[0052] The yarn winding station 2 of the automatic winder 1 according to the present embodiment is provided to stop the winding around the winding bobbin 6 or 7 when the winding length YL from the start of winding that is measured by the yarn length measuring device 60 reaches the length set in advance. Fixed length winding can thus be performed while accurately measuring the winding length YL of the yarn 4, and the forming of a package 7 with an inadequate winding amount of the yarn 4, the wasting of the yarn 4 due to excessive winding of the yarn 4 around the package 7, etc., can thus be prevented.

[0053] The constitution disclosed above is one example, and modifications such as the following can be made.

[0054] In place of the constitution, in which the arm member 13 is driven to pivot reciprocatingly by the traverse drive motor 45 that is formed of a voice coil motor, the traverse device 5 can be changed to a constitution, in which, as shown in FIG. 3, an endless timing belt 31 is disposed near the contact roller 9, a traverse guide 11' is mounted on the timing belt 31, and the timing belt 31 is driven reciprocatingly by a traverse driving motor 45' that is, for example, a pulse motor. A change to a traverse device with a constitution, such as that in which a cam groove is formed in a spiraling manner on an outer peripheral surface of a drum-shaped traverse cam and a traverse guide is engaged with the cam groove, is also possible.

[0055] In place of the constitution, in which the signal of the diameter detected by the package diameter sensor 44 is transferred to the traverse control unit 46 via the winding station control unit 50, a change can be made to a constitution in which the diameter signal is input directly into the traverse control unit 46. The traverse control unit 46 and/or the package drive control unit 42 may be incorporated in the winding station control unit 50.

[0056] Instead of computing the winding lengths (ΔYLs, ΔYL, YL) of the yarn at the traverse control unit 46, a change, for example, to a constitution in which the yarn lengths are computed at the winding station control unit 50 is also possible.

Claims

1. A yarn length measuring device that measures a winding length of a yarn wound around a winding bobbin in a yarn winding device, having a winding bobbin rotative driving device that rotatively drives the winding bobbin for winding the yarn and a traverse device that is driven independently of the winding bobbin rotative driving device and traverses the yarn while the yarn is being wound around said winding bobbin, said yarn length measuring device comprising:

    a means that detects, at each predetermined sampling cycle time, a yarn layer peripheral surface movement distance in a peripheral direction of a peripheral surface of a yarn layer formed by the winding of the yarn around said winding bobbin;
    a means that detects, at each predetermined sampling cycle time, a traverse movement distance of the yarn in a width direction of said yarn layer; and
    a winding length computing means that inputs the yarn layer peripheral surface movement distance, detected at each predetermined sampling cycle time by said yarn layer peripheral surface movement distance detecting means, and the traverse movement distance, detected at each predetermined sampling cycle time by said traverse movement distance detecting means, and determines the winding length of the yarn wound around the winding bobbin from the yarn layer peripheral surface movement distance and the traverse movement distance that have been input.

2. The yarn length measuring device for the yarn winding device according to Claim 1, wherein said predetermined sampling cycle time is an instantaneous period of time.

3. The yarn length measuring device for the yarn winding device according to Claim 1 or Claim 2, wherein said traverse device comprises: a traverse guide that is driven to move the yarn in a traverse direction; and a driving motor that drives the traverse guide; and a rotation angle of a rotor of the driving motor and a movement distance of the traverse guide are maintained in a predetermined relationship, and said traverse movement distance detecting means detects the rotation angle of the rotor of said driving motor.

4. The yarn length measuring device for the yarn winding device according to any of Claims 1 to 3, wherein said yarn layer peripheral surface movement distance detecting means comprises: a yarn layer diameter sensor that detects a diameter of said yarn layer; and a winding bobbin rotation angle sensor that detects a rotation angle of said winding bobbin; and determines said yarn layer peripheral surface movement distance from detection results of said yarn layer diameter sensor and said winding bobbin rotation angle sensor.

5. The yarn length measuring device for the yarn winding device according to Claim 4, wherein said yarn layer diameter sensor can detect the yarn layer diameter in a state in which the winding of the yarn is stopped.

FIG. 1

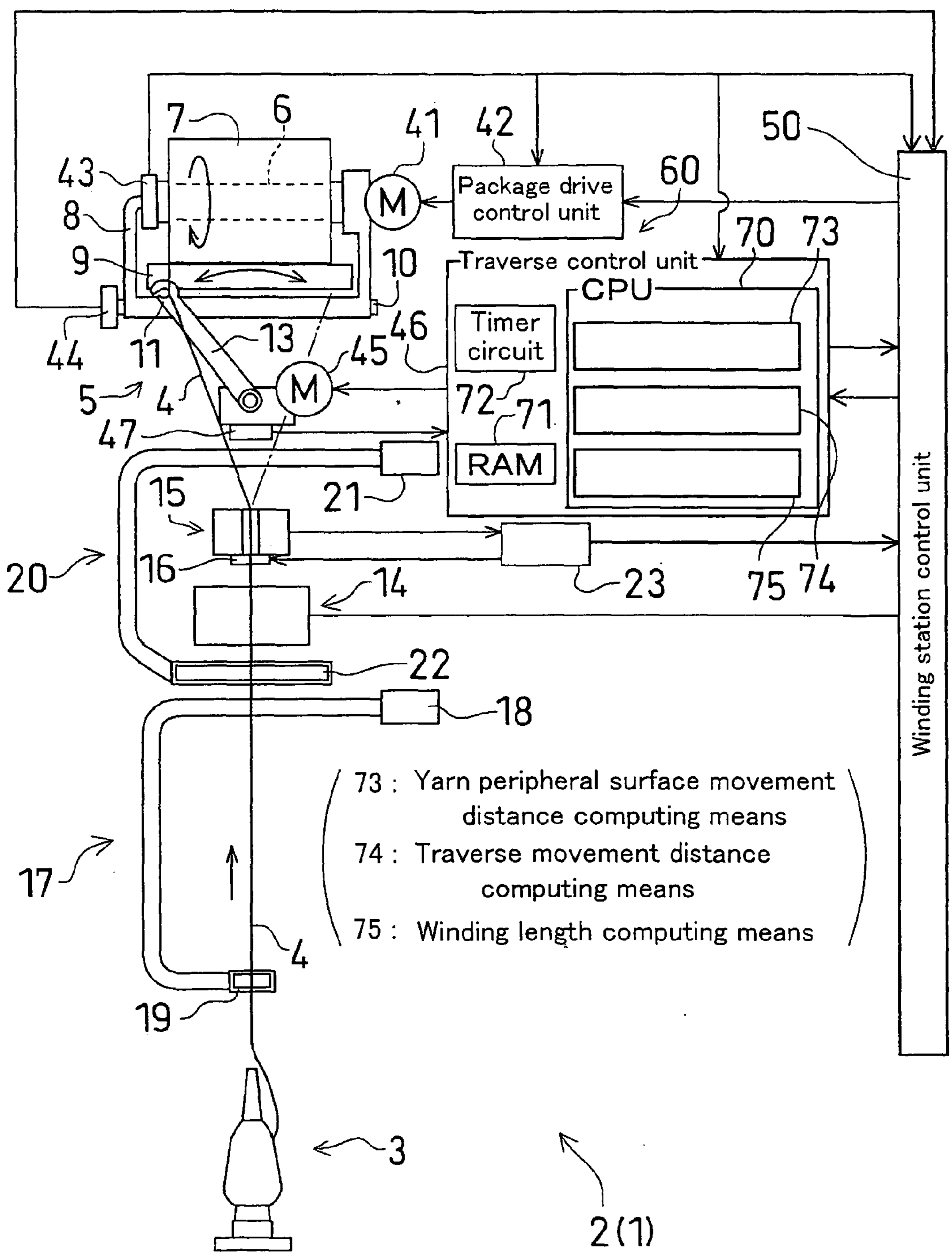

7
6
41
42
50
43
8
Package drive control unit
60
M
70
73
9
10
Traverse control unit
CPU
Timer circuit
46
44
11
13
45
M
5
4
72
71
47
RAM
15
21
20
16
23
75
74
14
22
18
Winding station control unit
73 : Yarn peripheral surface movement distance computing means
74 : Traverse movement distance computing means
75 : Winding length computing means
17
4
19
3
2(1)

FIG. 2

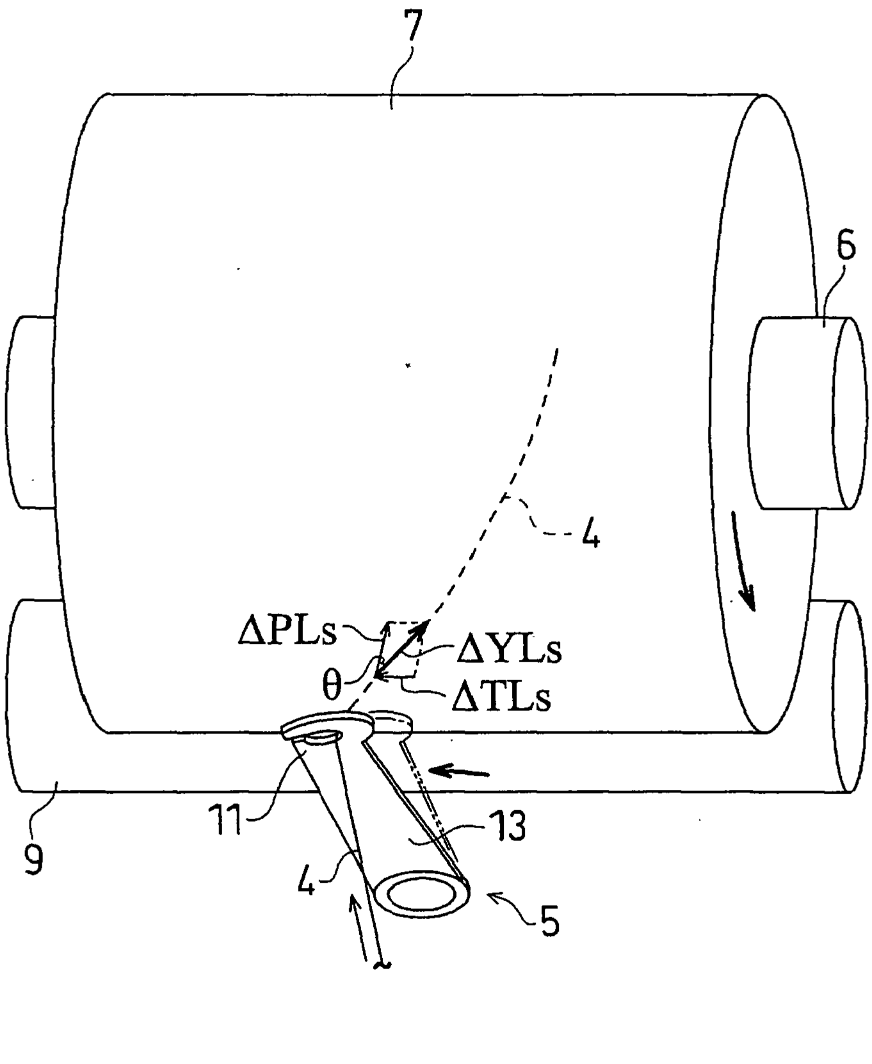
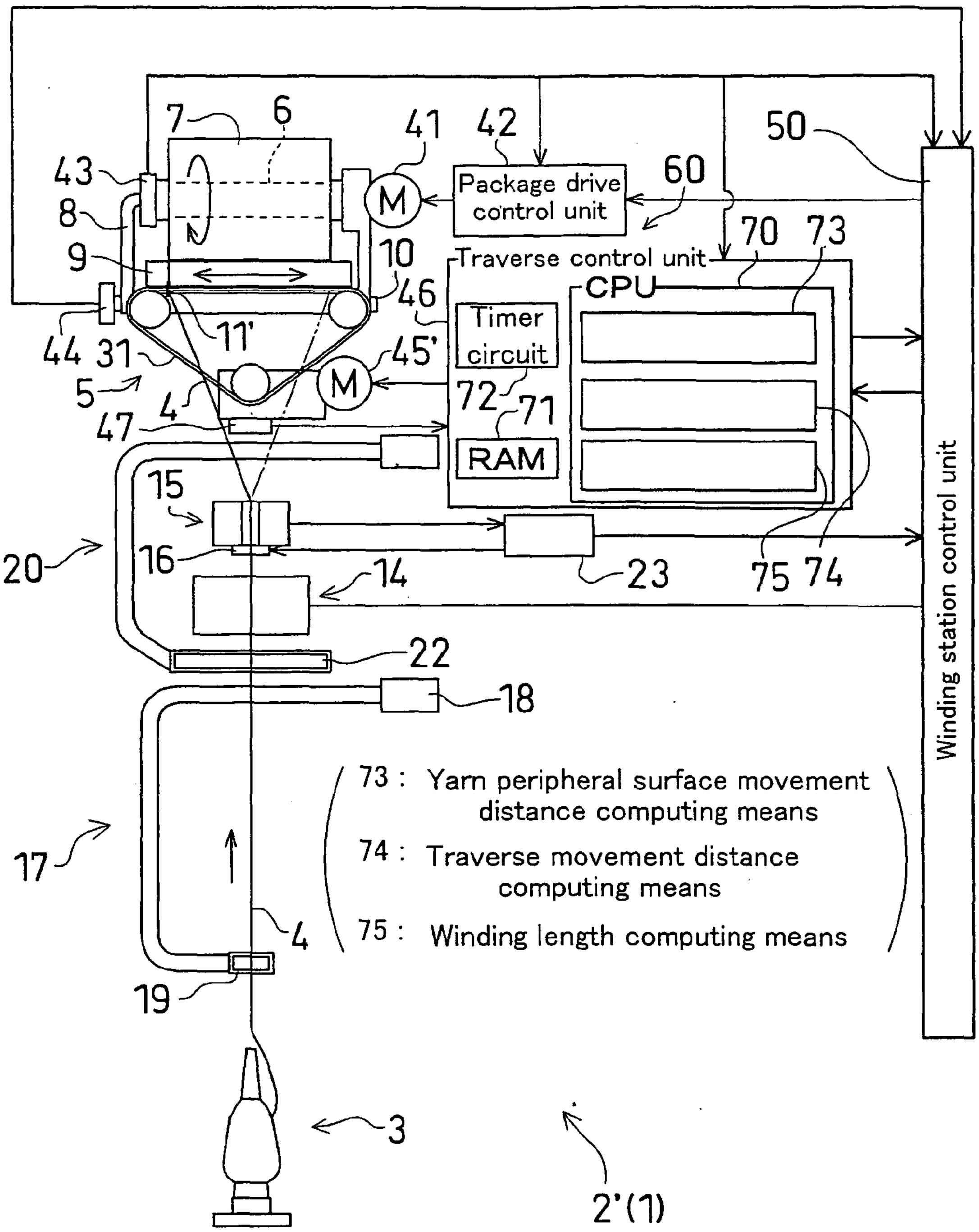


FIG. 3



Package drive control unit
Traverse control unit
CPU
Timer circuit
RAM
Winding station control unit
73 : Yarn peripheral surface movement distance computing means
74 : Traverse movement distance computing means
75 : Winding length computing means

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EUROPEAN SEARCH REPORT

Application Number
EP 06 02 4153

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