(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 433 889 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
28.03.2012 Bulletin 2012/13

(21) Application number: **10777533.0**

(22) Date of filing: **12.05.2010**

(51) Int Cl.:
B65H 63/00 *(2006.01)* ***B65H 54/46*** *(2006.01)*

(86) International application number:
PCT/JP2010/003219

(87) International publication number:
WO 2010/134294 (25.11.2010 Gazette 2010/47)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **22.05.2009 JP 2009124663**

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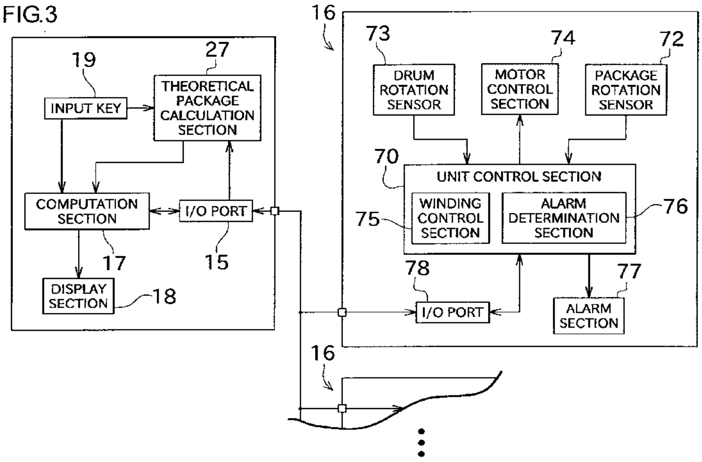
(54) YARN WINDING DEVICE AND ALARM THRESHOLD VALUE DETERMINATION METHOD FOR DETECTION OF ROTATIONAL FAULTS IN A PACKAGE

(57) A yarn winding device capable of automatically detecting an abnormal package rotation with a high accuracy is provided.

An automatic winder includes a winding unit (16) and a machine control device (11). The winding unit (16) performs a yarn winding operation. The machine control device (11) controls the winding unit (16). The machine control device (11) includes a theoretical package calculation section (27) and a computation section (17). The theoretical package calculation section (27) calculates the theoretical number of package rotations. The computation section (17) determines an alarm threshold value for determining an abnormal package rotation, based on the theoretical number of package rotations. The alarm threshold value is inputted to the winding unit (16). An alarm determination section (76) included in the winding unit (16) compares the actual number of package rotations with the alarm threshold value, and performs an alarm determination.

FIG.3



EP 2 433 889 A1

Printed by Jouve, 75001 PARIS (FR)

Description

TECHNICAL FIELD

[0001] The present invention relates mainly to a yarn winding device which winds a yarn to form a package.

BACKGROUND ART

[0002] In a yarn winding device such as an automatic winder, a configuration has been conventionally known in which a package is rotatably supported via a bearing and the package is driven in rotation while being in contact with a traverse drum to thereby rotate the package and thus wind a yarn.

[0003] In such a yarn winding device, Patent Document 1 discloses a method for calculating a wound-yarn volume and the like during formation of a package. According to a configuration of the Patent Document 1, a wound-yarn volume δ, a package diameter d_{sp}, and the like, are calculated based on a measured value of a rotation speed of the package, a measured value of a rotation speed of a traverse drum, a drum diameter of the traverse drum, and the like. A progress of the wound-yarn volume δ over the package diameter d_{sp} is recorded in a memory, or displayed on a display. The Patent Document 1 also discloses a configuration in which a control for returning a winding density to a normal value by, for example, decreasing a drive motor speed is performed when an actual value of the wound-yarn volume δ calculated is less than a target value because it means that a traverse-wound package is formed at an extremely high winding density.

PRIOR-ART DOCUMENTS

PATENT DOCUMENTS

[0004] Patent Document 1: Japanese Patent Application Laid-Open No. 10-72168 (1998)

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] Here, in a yarn winding device configured to rotatably support a package by a bearing as described above, if the package cannot smoothly rotate due to a failure of the bearing or the like, an outer circumferential surface of the package is frictioned with a rotating traverse drum, which may cause damage or heat generation. Therefore, in a case where such an abnormal package rotation occurs, it is preferred to find the abnormal package rotation at an early stage and take some measures.

[0006] Thus, as a method for detecting an abnormal package rotation, it is conceivable to set a lower limit value (threshold value) of an allowable rotation speed of a package in consideration of an appropriate margin and examine whether or not a measured value of a current rotation speed of the package is less than the threshold value.

[0007] However, a determination of the threshold value is not easy. In the yarn winding device, a yarn is often wound while winding conditions (such as a diameter of a yarn and a shape of the package) are variously changed as need arises. However, calculating and re-setting the threshold value at the operator side each time the yarn winding conditions are changed requires a lot of time and effort. On the other hand, equally applying a common threshold value under any yarn winding conditions inevitably requires a large margin to make determination conditions very lenient, which causes a deterioration of the accuracy of detection of an abnormal package rotation.

[0008] In the configuration of the Patent Document 1 described above, the wound-yarn volume δ is calculated in relation to the package diameter d_{sp}, not for the detection of an abnormal rotation, but because the progress of the actual value of the wound-yarn volume δ is related to the yarn winding density which is an important characteristic value of the traverse-wound package. Additionally, in the Patent Document 1, since the package diameter d_{sp} is set based on the measured value of the rotation speed of the package and the measured value of the rotation speed of the traverse drum (not set based on a diameter of the yarn, a shape of the package, and the like), if an abnormal package rotation occurs, the value of the package diameter d_{sp} calculated is deviated from an actual value. Therefore, the configuration of the Patent Document 1 cannot appropriately detect the above-described abnormal package rotation and cannot inform a person nearby of the abnormal package rotation.

[0009] The present invention is made in view of the circumstances described above, and an object of the present invention is to provide a yarn winding device capable of automatically detecting an abnormal package rotation with a high accuracy.

MEANS FOR SOLVING THE PROBLEMS AND EFFECTS THEREOF

[0010] The problem to be solved by the present invention is as described above, and next, means for solving the problem and effects thereof will be described.

[0011] According to an aspect of the present invention, a yarn winding device having the following configuration is provided. The yarn winding device includes a winding unit and a control section. A rotatable drum is provided in the winding unit. The winding unit performs a yarn winding operation by causing a package to be rotated by the drum. The control section controls the winding unit. The control section includes a theoretical package calculation section and a computation section. The theoretical package calculation section calculates the theoretical number of package rotations. The computation section determines an alarm threshold value for determining an abnormal package rotation, based on the theoretical number of package rotations.

[0012] Thereby, the alarm threshold value can be set automatically, and therefore a yarn winding device can be operated with an appropriate alarm threshold value being flexibly set.

[0013] In the yarn winding device, it is preferable that the theoretical package calculation section calculates a theoretical package diameter based on a yarn winding condition, and calculates the theoretical number of package rotations based on the theoretical package diameter and a yarn winding speed,

[0014] Thereby, an appropriate alarm threshold value in accordance with the yarn winding condition can be set. Additionally, a change of the yarn winding condition can be easily responded to.

[0015] In the yarn winding device, it is preferable that the theoretical package diameter is the theoretical package diameter at a time of full-winding.

[0016] Thereby, an alarm threshold value applicable under the same yarn winding condition can be obtained merely by obtaining, only once, the theoretical number of package rotations based on this theoretical package diameter. This can simplify a process performed by the theoretical package calculation section and the computation section.

[0017] In the yarn winding device, it is preferable that the yarn winding condition includes a kind of a yarn to be wound and a shape of a package to be formed.

[0018] This enables the theoretical package diameter to be accurately calculated,

[0019] It is preferable that the yarn winding device is configured as follows. The winding unit further includes a winding length measurement section and a winding length output section. The winding length measurement section measures a winding length which is a length of a wound part of a yarn. The winding length output section outputs the winding length measured by the winding length measurement section. The control section includes a winding length input section. The winding length outputted by the winding length output section is inputted to the winding length input section. The theoretical package calculation section calculates a theoretical package diameter based on a yarn winding condition and the winding length, and calculates the theoretical number of package rotations at a time when the winding length is measured based on the theoretical package diameter and a yarn winding speed.

[0020] Thereby, the theoretical package diameter at a time point in the middle of the winding can be obtained based on the winding length. Therefore, even in a case where the package diameter and the number of package rotations are changed in a time period from a start to an end of the winding, an appropriate alarm threshold value can be obtained.

[0021] In the yarn winding device, it is preferable that the alarm threshold value is updated each time the theoretical number of package rotations changes,

[0022] That is, although the number of package rotations can be changing every moment in the middle of the yarn winding, adoption of the above-described configuration enables an abnormal package rotation to be detected at any time point with a good accuracy.

[0023] Here, in the yarn winding device, it is also acceptable that the alarm threshold value is switched in stages in accordance with a change of the theoretical number of package rotations.

[0024] Thereby, the yarn winding device can be operated while the alarm threshold value is switched in accordance with a state of progress of the yarn winding, without considerably increasing a load on the theoretical package calculation section and the computation section.

[0025] It is preferable that the yarn winding device is configured as follows. The control section includes a threshold value output section. The threshold value output section outputs the alarm threshold value. The winding unit includes a threshold value input section, a number-of-package-rotations measurement section, an alarm determination section, and an alarm section. The alarm threshold value is inputted to the threshold value input section. The number-of-package-rotations measurement section measures the number of package rotations. The alarm determination section compares the alarm threshold value with the number of package rotations measured by the number-of-package-rotations measurement section, and performs an alarm determination. The alarm section generates an alarm in accordance with the determination performed by the alarm determination section,

[0026] Thereby, the alarm generated by the alarm section allows an operator to know occurrence of an abnormal package rotation at an early stage. Additionally, since the alarm section is provided in the winding unit, the operator can easily identify the winding unit in which the abnormal package rotation is occurring.

[0027] In the yarn winding device, it is preferable that the control section is a machine control device which controls a plurality of winding units.

[0028] Thereby, the same operation can be performed on a plurality of winding units by using the machine control device. Therefore, a working time can be shortened.

[0029] According to another aspect of the present invention, a method for determining an alarm threshold value for detecting an abnormal package rotation, which includes the following steps, is provided. In a theoretical package diameter calculation step, a theoretical package diameter is calculated based on a kind of a yarn to be wound, a shape of a package, and a yarn length required for forming the package. In a theoretical-number-of-package-rotations calculation step, the theoretical number of package rotations is calculated based on the theoretical package diameter. In an alarm threshold value determination step, an alarm threshold value is determined based on the theoretical number of package rotations.

[0030] This enables the alarm threshold value to be automatically set in accordance with a yarn winding condition, and therefore a yarn winding device can be operated with an appropriate alarm threshold value being flexibly set.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

FIG. 1 is a schematic elevation view of an automatic winder according to an embodiment of the present invention;
FIG. 2 is an elevation view schematically showing a winding unit included in the automatic winder;
FIG. 3 is a block diagram showing a main configuration of a machine control device and a winding unit;
FIG. 4 is a graph for conceptual explanation of a relationship between an alarm threshold value and a package diameter according to the embodiment of the present invention;
FIG. 5 is a graph for conceptual explanation of a relationship between an alarm threshold value and a package diameter according to a first modification;
FIG. 6 is a graph for conceptual explanation of a relationship between an alarm threshold value and a package diameter according to a second modification; and
FIG. 7 is an elevation view showing a winding unit configured such that a yarn speed is detected by a yarn speed sensor.

BEST MODE FOR CARRYING OUT THE INVENTION

[0032] Next, an embodiment of the present invention will be described with reference to the drawings. FIG. 1 is a schematic elevation view of an automatic winder 60 according to an embodiment of the present invention. FIG. 2 is an elevation view schematically showing a winding unit 16 included in the automatic winder 60. FIG. 3 is a block diagram showing a main configuration of a machine control device 11 and the winding unit 16.

[0033] As shown in FIG. 1, the automatic winder (yarn winding device) 60 includes a machine control device (control section) 11, a plurality of winding units 16 arranged side by side, and an automatic doffing device 51.

[0034] Each of the winding units 16 is configured such that a yarn 20 unwound from a yarn feed bobbin 21 is wound on a winding bobbin while being traversed by a traverse drum 41 so that a package 30 is formed. The winding unit 16 also has a clearer (yarn quality measuring instrument) 42 which monitors a diameter and the like of the running yarn 20, and when the clearer 42 detects a defect of the yarn 20, the defect can be removed.

[0035] When the package reaches full winding in each winding unit 16, the automatic doffing device 51 travels to a position of the winding unit 16, and picks up the full winding package while supplying an empty bobbin. This operation of the automatic doffing device 51 is controlled by the machine control device 11.

[0036] In the following, a specific configuration of the winding unit 16 will be described. As shown in FIG. 2, in the winding unit 16, in a yarn running path between the yarn feed bobbin 21 and the traverse drum 41, an unwinding assist device 12, a tension applying device 13, a splicing device 14, and the clearer 42 are arranged in the mentioned order from the yarn feed bobbin 21 side.

[0037] The unwinding assist device 12 assists unwinding of the yarn from the yarn feed bobbin 21 by moving down a restricting member 40 overlying a core tube of the yarn feed bobbin 21 in conjunction with the unwinding of the yarn 20 from the yarn feed bobbin 21. The restricting member 40 is brought into contact with a balloon, which is formed at an upper portion of the yarn feed bobbin 21, by the rotation and a centrifugal force of the yarn 20 unwound from the yarn feed bobbin 21, and appropriately controls the size of the balloon, to thereby assist the unwinding of the yarn 20. A not-shown sensor for detecting a chase portion of the yarn feed bobbin 21 is provided near the restricting member 40. When the sensor detects moving down of the chase portion, the restricting member 40 is controlled so as to be followingly moved down by an air cylinder (not shown), for example.

[0038] The tension applying device 13 applies a predetermined tension to the running yarn 20. As the tension applying device 13, for example, gate type one may be used in which movable comb-like teeth are arranged against fixed comb-like teeth. The comb-like teeth of the movable side can be rotated by, for example, a rotary type solenoid such that both of the comb-like teeth are brought into an engaged state or an open state.

[0039] A constant tension is applied to the yarn 20 which is being wound, by the tension applying device 13, and thus the quality of the package 30 can be increased, As the tension applying device 13, not only the above-mentioned gate type one but also disk type one may be adopted, for example.

[0040] The splicing device 14 splices a lower yarn at the yarn feed bobbin 21 side and an upper yarn at the package 30 side, when yarn cutting which is performed by the clearer 42 upon detection of a yarn defect is performed, when the yarn unwound from the yarn feed bobbin 21 is broken, or the like. As such a splicing device which splices the upper yarn and the lower yarn, one using a fluid such as compressed air or one of mechanical type may be adopted.

[0041] The clearer 42 has a clearer head 49 in which a not-shown sensor for detecting the diameter of the yarn 20 is disposed, and an analyzer 47 which processes a yarn thickness signal outputted from the sensor. The clearer 42 monitors the yarn thickness signal from the sensor, and thereby detects a yarn defect (yarn fault) such as a slab. A cutter 39 is provided near the clearer head 49, for immediately cutting the yarn 20 when the clearer 42 detects a yarn defect.

[0042] A lower yarn guide pipe 25 which captures the lower yarn at the yarn feed bobbin 21 side and guides the lower yarn to the splicing device 14, and an upper yarn guide pipe 26 which captures the upper yarn at the package 30 side and guides the upper yarn to the splicing device 14 are provided at the lower side and the upper side of the splicing device 14, respectively. The lower yarn guide pipe 25 and the upper yarn guide pipe 26 are rotatable about shafts 33 and 35, respectively. A suction port 32 is formed at a distal end of the lower yarn guide pipe 25, and a suction mouth 34 is provided at a distal end of the upper yarn guide pipe 26. An appropriate negative-pressure source is connected to each of the lower yarn guide pipe 25 and the upper yarn guide pipe 26, to cause suction flows in the suction port 32 and the suction mouth 34 so that yarn ends of the upper yarn and the lower yarn can be sucked and captured.

[0043] A cradle 23 has a pair of cradle arms 61 and 62. The cradle arms 61 and 62 are supported by a hinge shaft 48, and rotatable in directions moving toward and away from the traverse drum 41.

[0044] Rotating holders 63 and 64 are attached to distal ends of the pair of cradle arms 61 and 62. The rotating holders 63 and 64 are arranged so as to be opposed to each other, and each of the rotating holders 63 and 64 is rotatably supported via a not-shown bearing. In this configuration, a winding bobbin 22 is mounted so as to be interposed between the two rotating holders 63 and 64, and thereby the winding bobbin 22 can be rotatably supported on the cradle 23.

[0045] The cradle 23 has a package rotation sensor 72 for detecting the rotation of the package 30 (winding bobbin 22) mounted in the cradle 23. The package rotation sensor 72 is configured as a rotary encoder for example, and electrically connected to a unit control section 70. The package rotation sensor 72 outputs a pulse signal to the unit control section 70 each time the rotating holder 63 at one side is rotated at a predetermined angle.

[0046] The traverse drum 41 is arranged near the cradle 23, and rotatably supported. A spiral-shaped traverse groove for traversing the yarn 20 in a predetermined width is formed on an outer circumferential surface of the traverse drum 41. An output shaft of a drum drive motor 53 is coupled to the traverse drum 41, and the drum drive motor 53 is controlled by a motor control section 74. The motor control section 74 controls the rotation of the drum drive motor 53 based on a signal from the unit control section 70. When driven by the drum drive motor 53, the traverse drum 41 causes the winding bobbin 22 or the package 30 which is in contact with the outer circumferential surface of the traverse drum 41 to be rotated.

[0047] A drum rotation sensor 73 is arranged near the traverse drum 41, and the drum rotation sensor 73 is electrically connected to the unit control section 70, The drum rotation sensor 73 is configured as a rotary encoder for example, and outputs a rotation pulse signal to the unit control section 70 each time the traverse drum 41 rotates at a predetermined angle. The unit control section 70 measures the number of pulses per a predetermined time period, and thereby can obtain the number of rotations of the traverse drum 41.

[0048] Next, a control of each winding unit 16 will be described. As shown in FIGS. 2 and 3, the package rotation sensor (a number-of-package-rotations measurement section) 72, the drum rotation sensor (a winding length measurement section) 73, and the motor control section 74 are connected to the unit control section 70.

[0049] The unit control section 70 includes a CPU (Central Processing Unit), a ROM (Read Only Memory), and a RAM (Random Access Memory) which are not shown. The unit control section 70 also includes an I/O port (a threshold value input section, a winding length output section, and an input/output section) 78 capable of transmission and reception of data, as shown in FIG. 3.

[0050] A control program for controlling each configuration (for example, the motor control section 74 and the like) of the winding unit 16 is stored in the ROM. The CPU reads the control program stored in the ROM out into the RAM, and executes the control program, to thereby control each configuration so that winding of the yarn can be appropriately performed. In other words, the above-described hardware and software cooperate with each other to build a winding control section 75 for controlling winding of the yarn in the unit control section 70.

[0051] The unit control section 70 includes, in addition to the above-mentioned winding control section 75, an alarm determination section 76 which determines whether or not the package is in abnormal rotation. Details of this determination will be described later.

[0052] The winding unit 16 includes an alarm section 77 capable of generating an alarm by a light, a sound, or the like. Examples of a specific configuration of the alarm section 77 include a lamp, a buzzer, and the like. The alarm section 77 is electrically connected to the unit control section 70. In this configuration, when the alarm determination section 76 determines that there is an abnormal rotation of the package, the unit control section 70 outputs an alarm signal to the alarm section 77 to generate an alarm, thus alerting an operator.

[0053] As shown in FIGS. 1 and 3, the machine control device 11 includes a theoretical package calculation section 27, a computation section 17, a display section 18, and an input key 19. Similarly to the unit control section 70, the machine control device 11 also includes a CPU, a ROM, a RAM, and an I/O port (a threshold value output section, a winding length input section, and an input/output section) 15.

[0054] The I/O port 15 of the machine control device 11 is connected via an appropriate communication line to the I/O port 78 of the unit control section 70 provided in each winding unit 16. This configuration enables the machine control device 11 to transmit various yarn winding conditions to the unit control section 70 of each winding unit 16, to set the yarn winding conditions. The machine control device 11 can also receive, from the unit control section 70 of each winding unit 16, information (yarn winding status information) concerning a current yarn winding status in the winding unit 16.

[0055] This configuration allows the machine control device 11 to collectively manage the plurality of winding units 16 included in the automatic winder 60. To be specific, the machine control device 11 can transmit various yarn winding conditions to the unit control section 70 of each winding unit 16, to set the yarn winding conditions. Additionally, the machine control device 11 can also receive, from the unit control section 70 of each winding unit 16, the information concerning the current yarn winding status in the winding unit 16.

[0056] Examples of the yarn winding conditions set in the winding unit 16 include items concerning a kind of the yarn to be wound, a winding speed, a count, a winding tension, a shape of the package, a yarn length required for forming the package, a weight of the package, a yarn defect, and the like. Examples of the yarn winding status information transmitted from the winding unit 16 to the machine control device 11 include the current number of rotations of the package 30, the current number of rotations of the traverse drum 41, a current length wound on the package 30, a status of occurrence of a yarn breakage, a status of detection of a yarn defect, and the like,

[0057] Specifically, the operator can set the yarn winding conditions by displaying a yarn winding condition setting menu on the display section 18 of the machine control device 11 by an appropriate operation and inputting a numerical value through the input key 19. Set values concerning the yarn winding conditions may be individually transmitted to a designated winding unit 16, or may be collectively transmitted to all the winding units 16.

[0058] Next, a configuration for detecting occurrence of an abnormal rotation of the package will be described.

[0059] Before starting to wind the yarn, the operator inputs necessary ones of the items of the yarn winding conditions, to the machine control device 11. Then, the theoretical package calculation section 27 of the machine control device 11 obtains, by calculation, a relationship between a yarn winding length and a theoretical package diameter, based on necessary information (for example, the kind (count) of the yarn to be wound, the shape of the package, the density (specific gravity) of the package) among the set items. That is, when the theoretical package diameter is defined as D and the yarn winding length is defined as L, the theoretical package diameter D can be represented as D=F(L) using a function F. The theoretical package calculation section 27 determines the function F by calculation.

[0060] In this embodiment, the relationship between the theoretical package diameter and the winding length is theoretically obtained based on information of the yarn winding conditions, not based on a measured value. In a case where a cone-shaped package is formed as in this embodiment, the diameter differs between one end side and the other end side. The theoretical package diameter may be either a diameter at the larger diameter side or a diameter at the smaller diameter side, or the theoretical package diameter may be a diameter at a central portion in a shaft direction.

[0061] As represented by the aforementioned equation, the theoretical package diameter D can be expressed as a function having the winding length L as a parameter. Accordingly, once the aforementioned function F is obtained by calculation, then the theoretical package diameter D at a time point of a winding length L can be obtained by obtaining a function value of the function F with respect to this winding length L.

[0062] Next, an exemplary method for obtaining a relationship (that is, the aforementioned function F) between the yarn winding length and the theoretical package diameter will be described. In this example, information of the kind of the yarn, the shape of the package, and the density (specific gravity) of the package is used in the calculation.

[0063] Hereinafter, an idea will be described. Firstly, since a weight per unit length can be obtained from the kind of the yarn, this is multiplied by the winding length L, so that the weight of the wound yarn can be obtained. Then, this is divided by the density (specific gravity) of the package, so that the volume occupied by the wound yarn can be obtained. Then, using the diameter and a traverse width of the winding bobbin 22 which are known, the thickness of a yarn layer in a diameter direction required for realizing the above-mentioned volume is calculated based on a geometric relationship, to thereby obtain the theoretical package diameter. At a time point when the yarn winding conditions are inputted by the operator, the theoretical package calculation section 27 of the machine control device 11 calculates the relationship (function F) between the yarn winding length and the theoretical package diameter in the above-described manner, and stores an obtained result in a storage device such as the RAM.

[0064] The operator sets various conditions to the machine control device 11 and then instructs a start of winding, and thereby winding in each winding unit 16 is started. In this yarn winding, the drum rotation sensor 73 of each winding unit 16 outputs a pulse signal (drum pulse) to the unit control section 70 each time the traverse drum 41 rotates at the predetermined angle. The unit control section 70 counts the drum pulse from a time point when the yarn winding is started, to thereby obtain the accumulated number of rotations of the traverse drum 41 since the yarn is started to be wound on an empty bobbin.

[0065] Then, the unit control section 70 calculates the winding length (the length of the yarn wound from a start of the package formation to the current time) by multiplying the accumulated number mentioned above by the length of the yarn wound per one rotation of the traverse drum 41. The length of the yarn per one rotation of the traverse drum 41 is a constant which is specific to the traverse drum 41, and is preset in the unit control section 70. In this manner, in this embodiment, since the drum rotation sensor 73 detects the rotation of the traverse drum 41 to thereby obtain the yarn winding length, it can be considered that the drum rotation sensor 73 substantially functions as the winding length measurement section.

[0066] Then, the unit control section 70 outputs the obtained winding length (as the yarn winding status information) from the I/O port 78 of the winding unit 16 to the I/O port 15 of the machine control device 11. Since this process of outputting the winding length is repeatedly performed at short time intervals, the most recent winding length in each winding unit 16 is inputted to the machine control device 11 substantially in real time.

[0067] The machine control device 11 applies the winding length L received by the I/O port 15 to the aforementioned equation, to thereby obtain the theoretical package diameter D with respect to the winding length L at the time of the measurement.

[0068] Information inputted to the machine control device 11 by the operator before the yarn winding is started includes a winding speed (a length of the yarn wound per unit time). The machine control device 11 stores the inputted winding speed in a storage device such as the RAM, and also transmits this winding speed to each winding unit 16 (unit control section 70). The unit control section 70 of each winding unit 16 controls the drum drive motor 53 through the winding control section 75 and the motor control section 74, in order that the yarn can be wound at the received winding speed.

[0069] The theoretical package calculation section 27 provided in the machine control device 11 calculates the theoretical number of package rotations based on this winding speed and the theoretical package diameter. The theoretical number of package rotations is the number of rotations of the package which is theoretically obtained based on the theoretical package diameter and the winding speed.

[0070] An exemplified method for obtaining the theoretical number of package rotations will be shown. Firstly, the number of rotations of the traverse drum 41 which is required for realizing the aforementioned winding speed is obtained using a yarn length per one rotation of the traverse drum 41. Then, calculation is performed using the number of rotations of the traverse drum 41 thus obtained, the diameter of the traverse drum 41, and the theoretical package diameter D with respect to the winding length L at the time of the measurement, and thereby the theoretical number of package rotations can be obtained.

[0071] As described above, in the machine control device 11, the most recent winding length L in each winding unit 16 is obtained one after another. Each time the value of the winding length L is updated in each winding unit 16, the theoretical package calculation section 27 of the machine control device 11 re-calculates the theoretical package diameter and the theoretical number of package rotations in the winding unit 16.

[0072] FIG. 4 shows a relationship between the theoretical number of package rotations and the package diameter. FIG. 4 is a graph conceptually explaining a relationship between an alarm threshold value and the package diameter. In FIG. 4, the horizontal axis represents the package diameter, and the vertical axis represents the number of rotations.

[0073] When the yarn is wound at a constant winding speed (when the traverse drum 41 is driven with a constant number of rotations), the theoretical number of package rotations moderately and monotonically decreases as the package diameter increases, as shown in FIG. 4. That is, at an initial stage of the yarn winding, the package diameter is small and an angle of rotation of the package 30 per one rotation of the traverse drum 41 is large, and consequently the number of package rotations shows a high value. On the other hand, at a terminal stage of the yarn winding, the package diameter becomes large and the angle of rotation of the package 30 per one rotation of the traverse drum 41 becomes small, and therefore the number of package rotations shows a low value.

[0074] Then, based on this theoretical number of package rotations, the machine control device 11 of this embodiment determines the alarm threshold value which is a criterion for determining whether or not an abnormal package rotation is occurring. As this alarm threshold value, conceivable is a value obtained by multiplying the theoretical number of package rotations by a predetermined ratio (X %) which is less than 1, for example. It is preferable that this ratio (the value of X) can be changed by the operator operating the input key 19 of the machine control device 11, for example.

[0075] Each time the winding progresses and the theoretical number of package rotations changes in each winding unit 16, the machine control device 11 re-calculates the alarm threshold value as needed. FIG. 4 also shows a transition of the alarm threshold value in a case where the alarm threshold value is determined by multiplying the theoretical number of package rotations by a constant ratio as described above. The alarm threshold value smoothly varies, following the change of the theoretical number of package rotations. Accordingly, at any time point in the winding, whether or not an abnormal package rotation is occurring can be accurately determined using an appropriate alarm threshold value.

[0076] The calculated alarm threshold value is inputted from the I/O port 15 of the machine control device 11 through the I/O port 78 of the winding unit 16 to the unit control section 70. The unit control section 70 stores the inputted alarm threshold value in a storage device such as the RAM.

[0077] On the other hand, during the yarn winding, each time the package 30 is rotated at a predetermined angle, the package rotation sensor 72 outputs a rotation detection signal (pulse signal) to the unit control section 70. The unit control section 70 counts the pulse signal in a predetermined time zone, to thereby obtain the number of package rotations. In the following description, the number of package rotations obtained in this manner will sometimes be referred to as the actual number of package rotations.

[0078] FIG. 4 shows two examples of the actual number of package rotations. As shown in this graph, normally, the actual number of package rotations obtained based on the measured value is substantially coincident with the theoretical number of package rotations. However, if, for example, a failure occurs in the bearing supporting the rotating holders 63 and 64, the package 30 cannot be properly rotated. In this case, the actual number of package rotations drastically decreases, and falls below the alarm threshold value.

[0079] The alarm determination section 76 included in the unit control section 70 compares the actual number of package rotations with the alarm threshold value during the yarn winding. When the actual number of package rotations is equal to or greater than the alarm threshold value, it means that the package is rotating in a good manner, and therefore the alarm determination section 76 continues the aforesaid comparison process. On the other hand, when the actual number of package rotations is smaller than the alarm threshold value, the alarm determination section 76 outputs the alarm signal to the alarm section 77. When the alarm signal is inputted, the alarm section 77 actually generates an alarm to inform the operator of occurrence of abnormality. This allows the operator to find occurrence of an abnormal package rotation at an early stage and take appropriate measures.

[0080] In a case where the alarm determination section 76 generates the alarm signal (that is, in a case where occurrence of an abnormal package rotation is detected), the winding control section 75 immediately stops the drum drive motor 53 through the motor control section 74. Immediately stopping the winding in this manner can avoid the traverse drum 41 forcibly driving in rotation the package 30 which cannot be properly rotated. Thus, damage to the package 30 and overload of the drum drive motor 53 can be prevented.

[0081] In this embodiment, the time zone in which the pulse signal of the package rotation sensor 72 is counted in order to obtain the actual number of package rotations described above is set in consideration of a disturb control performed by the unit control section 70.

[0082] In the following, the disturb control will be briefly described. When the number of rotations of the traverse drum 41 and the number of rotations of the package becomes integer multiples of each other during the yarn winding, a traverse cycle and a winding cycle of the package are synchronized with each other, to cause a so-called ribbon winding in which the wound yarn is gathered and stacked at the same position. In a package in which such a ribbon winding occurs, ribbon-wound yarns are tangled with each other, which causes a problem that a yarn breakage occurs when the yarn of the package is unwound in a subsequent step, and the like, Therefore, to break this ribbon winding, a method is known in which the speed of rotation of the traverse drum 41 is rapidly increased and decreased at a position near a diameter at which the ribbon winding is occurring, to thereby cause a slip between the package and the traverse drum 41, so that winding is performed while distributing yarn paths of the traversing yarn. This is the disturb control.

[0083] Since the package 30 is slipped on the traverse drum 41 in the disturb control as described above, the actual number of package rotations may become smaller than normal in the course of the disturb process. Thus, if the speed at that moment is measured as the actual number of package rotations, a reduction of the number of package rotations which is caused simply by the disturb control may be erroneously determined to be an abnormal package rotation.

[0084] Therefore, in this embodiment, the time zone in which the pulse signal of the package rotation sensor 72 is counted in order to obtain the actual number of package rotations is set to be a time period in accordance with a cycle of a speed-change caused by the disturb control, By sufficiently ensuring a count time in this manner, an influence of a phenomenon in which the number of package rotations is instantaneously reduced by the disturb control is suppressed, and an erroneous determination of an abnormal package rotation can be avoided.

[0085] The above description states that the alarm determination section 76 compares the actual number of package rotations with the alarm threshold value, but in a precise sense, the alarm determination section 76 compares the number of pulses, which corresponds to the amount of rotations obtained by multiplying the number of rotations obtained as the alarm threshold value by the length of the aforesaid time zone, with a counted value of a pulse of the package rotation sensor 72 which is actually measured in the aforesaid time zone. Thereby, the alarm determination section 76 determines whether or not an abnormal package rotation is occurring. However, it can be substantially considered that the above-described process eventually compares the numbers of rotations with each other.

[0086] As described above, the automatic winder 60 of this embodiment includes the winding units 16 and the machine control device 11. The traverse drum 41 is provided in each of the winding units 16. In the winding unit 16, the package 30 is rotated by the traverse drum 41 to perform winding of the yarn. The machine control device 11 controls the winding units 16. The machine control device 11 includes the theoretical package calculation section 27 and the computation section 17. The theoretical package calculation section 27 calculates the theoretical number of package rotations. The computation section 17 determines the alarm threshold value for determining an abnormal package rotation, based on the aforesaid theoretical number of package rotations.

[0087] Thereby, the alarm threshold value can be set automatically, and therefore the automatic winder 60 can be operated with an appropriate alarm threshold value being flexibly set.

[0088] In the automatic winder 60 of this embodiment, the theoretical package calculation section 27 calculates the theoretical package diameter based on the yarn winding conditions, and calculates the theoretical number of package rotations based on the aforesaid theoretical package diameter and the yarn winding speed.

[0089] Thereby, the theoretical number of package rotations in accordance with the yarn winding conditions can be calculated. Additionally, for example, if the yarn winding conditions are changed due to a change in a lot of the package, such a change can be easily responded to.

[0090] In the automatic winder 60 of this embodiment, the yarn winding conditions include the kind of the yarn to be wound and the shape of the package to be formed.

[0091] This enables an accurate calculation of the theoretical package diameter.

[0092] In the automatic winder 60 of this embodiment, the winding unit 16 further includes the drum rotation sensor 73 and the I/O port 78. The drum rotation sensor 73 measures the winding length which is the length of a wound part of the yarn. The I/O port 78 outputs the winding length measured by the drum rotation sensor 73, to the computation section 17 of the machine control device 11. The machine control device 11 includes the I/O port 15. The winding length outputted by the I/O port 78 is inputted to the I/O port 15. The theoretical package calculation section 27 of the machine control device 11 calculates the theoretical package diameter based on the yarn winding conditions and the winding length, and calculates the theoretical number of package rotations at the time when the winding length is measured, based on this theoretical package diameter and the yarn winding speed.

[0093] Thereby, the alarm threshold value can be changed in accordance with an increase of the winding length, during a time period from the start to the end of the yarn winding. This enables an abnormal package rotation to be detected using a more appropriate alarm threshold value.

[0094] In the automatic winder 60 of this embodiment, each time the theoretical number of package rotations changes, the alarm threshold value is updated.

[0095] That is, although the number of package rotations can be changing every moment in the middle of the yarn winding, adoption of the above-described configuration enables an abnormal rotation of the package 30 to be accurately detected at any time point.

[0096] The automatic winder 60 of this embodiment is configured as follows. That is, the I/O port 15 of the machine control device 1 outputs the alarm threshold value. The winding unit 16 includes the I/O port 78, the package rotation sensor 72, the alarm determination section 76, and the alarm section 77. The alarm threshold value is inputted to the I/O port 78. The package rotation sensor 72 measures the number of package rotations. The alarm determination section 76 compares the alarm threshold value with the number of package rotations measured by the package rotation sensor 72, and performs an alarm determination. The alarm section 77 generates an alarm based on the determination performed by the alarm determination section 76.

[0097] Thus, the alarm generated by the alarm section 77 allows the operator to know occurrence of an abnormal package rotation at an early stage. Additionally, since the alarm section 77 is provided in the winding unit 16, the operator can easily identify the winding unit 16 in which the abnormal package rotation is occurring.

[0098] In the automatic winder 60 of this embodiment, the machine control device 11 controls the plurality of winding units 16.

[0099] This allows the machine control device 11 to perform the same operation collectively on the plurality of winding units 16, which can shorten a working time.

[0100] Next, a first modification of the above-described embodiment will be described. FIG. 5 is a graph conceptually explaining a relationship between an alarm threshold value and a package diameter according to the first modification.

[0101] In the above-described embodiment, the alarm threshold value is updated to a new value as needed during the yarn winding, whereas in this modification, the alarm threshold value is updated only once in a time period of forming one package,

[0102] Hereinafter, a specific description will be given. Before the yarn winding is started, the theoretical package calculation section 27 of the machine control device 11 calculates the theoretical number of package rotations corresponding to half the winding length at a time of full-winding. The winding length (a yarn length required for forming the package) at the time of full-winding is inputted in the machine control device 11 in advance. The computation section 17 previously obtains an alarm threshold value (first alarm threshold value) corresponding to that theoretical number of package rotations, and outputs it to the unit control section 70 of the winding unit 16.

[0103] Then, the yarn winding is started in the winding unit 16, The alarm determination section 76 of the winding unit 16 detects an abnormal package rotation by using the aforesaid first alarm threshold value.

[0104] As the winding progresses, the winding length outputted through the I/O port 78 by the winding unit 16 increases. However, in this modification, the theoretical package calculation section 27 and the computation section 17 of the machine control device 11 does not recalculates the theoretical number of package rotations and the alarm threshold value, unless the winding length reaches a predetermined value (specifically, a value half the winding length at the time of full-winding). Accordingly, until the yarn winding progresses to a certain degree, the alarm determination section 76 of the winding unit 16 detects an abnormal package rotation by using a constant alarm threshold value (first alarm threshold value) as a criterion.

[0105] When the winding length outputted from the winding unit 16 to the machine control device 11 becomes equal to or larger than half the winding length at the time of full-winding, the theoretical package calculation section 27 of the machine control device 11 calculates the theoretical number of package rotations corresponding to the winding length at the time of full-winding. Then, the computation section 17 calculates an alarm threshold value (second alarm threshold value) corresponding to that theoretical number of package rotations, and outputs it to the unit control section 70 of the winding unit 16. However, the theoretical number of package rotations at the time of full-winding and the second alarm threshold value may be, together with the first alarm threshold value and the like, calculated in advance before the winding is started, and may be stored in the RAM or the like.

[0106] When the new alarm threshold value is inputted to the unit control section 70 of the winding unit 16, the alarm determination section 76 performs an alarm determination using the new threshold value. After outputting the second alarm threshold value, the machine control device 11 does not update the alarm threshold value until the package 30 of this winding unit reaches full winding. Accordingly, in the winding unit 16, an abnormal package rotation is detected by using a constant alarm threshold value (second alarm threshold value) as a criterion, until a predetermined length of the yarn is wound to bring the package 30 into the full winding.

[0107] A transition of the alarm threshold value according to this modification is shown in the graph of FIG. 5. In this modification, in accordance with the progress of the yarn winding, the alarm threshold value is switched in two stages, to be changed stepwise. In this modification in which the alarm threshold value is updated in stages in this manner, the frequency of re-calculation of the theoretical number of package rotations and the alarm threshold value can be considerably reduced as compared with in the above-described embodiment, and therefore this modification is advantageous in that a load on the theoretical package calculation section 27 and the computation section 17 can be suppressed, and additionally a communication traffic between the machine control device 11 and the winding unit 16 can be reduced. The number of times the alarm threshold value is updated is not limited to once, and the alarm threshold value may be (intermittently) updated at a frequency of twice or three times, or higher.

[0108] As indicated above, in the automatic winder 60 of this modification, the alarm threshold value is switched in stages in accordance with a change of the theoretical number of package rotations.

[0109] Thereby, the automatic winder 60 can be operated while the alarm threshold value is updated in accordance with a state of progress of the yarn winding, without considerably increasing the load on the theoretical package calculation section 27 and the computation section 17.

[0110] Next, a second modification of the above-described embodiment will be described. FIG. 6 is a graph conceptually explaining a relationship between an alarm threshold value and a package diameter according to the second modification.

[0111] In this modification, the theoretical package diameter is calculated using the winding length at the time of full-winding. The winding length (a yarn length required for forming the package) at the time of full-winding is inputted in the machine control device 11 in advance. The theoretical package calculation section 27 of the second modification applies this winding length L_F at the time of full-winding to the above-mentioned equation to obtain a theoretical package diameter D_F with respect to the winding length at the time of full-winding, and calculates the theoretical number of package rotations in the same manner as described in the above embodiment. Then, the alarm threshold value is determined by the computation section 17.

[0112] Therefore, in this modification, the alarm threshold value is a constant value throughout a period from the start to the end of the yarn winding, as shown in FIG. 6. In this configuration, it suffices that the theoretical number of package rotations and the alarm threshold value are calculated once, which can further reduce the load on the theoretical package calculation section 27 and the computation section 17. The theoretical number of package rotations at the time of full-winding has a constant value as long as a lot of the package 30 is the same. Therefore, in a case where the same lot of the package is formed by a plurality of winding units 16, it suffices that a single alarm threshold value obtained by a single calculation is outputted to the plurality of winding units 16. Therefore, in this respect as well, the load on the computation section 17 can be reduced.

[0113] As indicated above, in the automatic winder 60 of this modification, the theoretical package diameter is the theoretical package diameter at the time of full-winding.

[0114] Therefore, an alarm threshold value applicable under the same yarn winding conditions can be obtained merely by obtaining, only once, the theoretical number of package rotations based on this theoretical package diameter. This can simplify a process performed by the theoretical package calculation section 27 and the computation section 17.

[0115] Although the preferred embodiment and the modifications of the present invention have been described above, the configurations described above may be modified as follows, for example.

[0116] There is no problem in determining the alarm threshold value in an arbitrary method, as long as the determination is based on the theoretical number of package rotations. For example, instead of determining the alarm threshold value by multiplying the theoretical number of package rotations by a predetermined ratio, the alarm threshold value may be determined by subtracting (offsetting) a predetermined value, for example.

[0117] The above-described embodiment is applicable not only to a case where a cone-shaped package is formed, but also to a case where a cheese-shaped package is formed.

[0118] In the above-described embodiment, the winding unit 16 includes the alarm determination section 76 and the alarm section 77. However, instead, the machine control device 11 may include the alarm determination section and the alarm section. That is, a configuration may be acceptable in which: the number of package rotations measured by the package rotation sensor 72 is outputted to the machine control device 11; the machine control device 11 collectively performs an alarm determination; and the alarm section of the machine control device 11 is actuated when an abnormal package rotation is detected. In this case, a configuration of the winding unit can be simplified as compared with the configuration in which each winding unit 16 includes the alarm determination section 76 and the alarm section 77.

[0119] In the above-described embodiment, the winding length on the package is measured by the drum rotation sensor 73 counting the rotation of the traverse drum 41. However, instead, the winding length may be measured using a yarn speed sensor. This configuration is shown in FIG. 7. In the description of the configuration of FIG. 7, members identical or similar to those of the above-described embodiment are denoted by the same corresponding reference numerals on the drawing, and descriptions thereof may be omitted.

[0120] A yarn speed sensor 65 shown in FIG. 7 is a device which detects a yarn speed by, utilizing the fact that there is a fluctuation in the yarn thickness in the yarn, detecting a moving speed of a portion where the fluctuation of the yarn thickness exists. A signal of this yarn speed is inputted to the unit control section 70, and the yarn speed is subjected to integral processing in the unit control section 70, to thereby obtain a winding length. Accordingly, it can be considered that, similarly to the drum rotation sensor 73, the yarn speed sensor 65 substantially functions as the winding length measurement section which measure the yarn winding length. Here, a configuration may be also acceptable in which both the drum rotation sensor 73 and the yarn speed sensor 65 are provided so that the winding length is measured with an enhanced accuracy.

[0121] The alarm section 77 may be connected to an equipment which detects not only the abnormal package rotation mentioned above but also various abnormalities (a mistake in doffing by the automatic doffing device 51, a mistake in a splicing operation by the splicing device 14, an abnormality of a power supply, and the like), so that the alarm is generated also when such abnormalities are detected. In this case, a configuration for displaying contents of the abnormality using a numerical value or the like may be provided in the alarm section 77, so that the operator can easily recognize what kind of event is occurring.

[0122] In the above-described embodiment, the kind of the yarn to be wound and the shape of the package to be formed are adopted as the yarn winding conditions for obtaining the relationship (function F) between the yarn winding length and the theoretical package diameter. However, the theoretical package diameter may be obtained using other yarn winding conditions.

[0123] In the above-described embodiment, the theoretical package calculation section 27 and the computation section 17 of the machine control device 11 calculate the theoretical package diameter and the theoretical number of package rotations, to determine the alarm threshold value. However, instead, the unit control section 70 of each winding unit 16 may calculate the theoretical package diameter and the theoretical number of package rotations, to determine the alarm threshold value.

[0124] The application of the above-described embodiment is not limited to an automatic winder, but may be yarn winding devices such as spinning machine and twisting machines.

DESCRIPTION OF REFERENCE NUMERALS

[0125]

11 machine control device (control section)
12 computation section
16 winding unit
27 theoretical package calculation section
60 automatic winder (yarn winding device)
70 unit control section
72 package rotation sensor (number-of-package-rotations measurement section)
73 drum rotation sensor (winding length measurement section)
76 alarm determination section
77 alarm section

Claims

1. A yarn winding device comprising:

a winding unit in which a rotatable drum is provided and which performs a yarn winding operation by causing a package to be rotated by the drum; and
a control section which controls the winding unit, wherein the control section includes a theoretical package calculation section which calculates the theoretical number of package rotations, and a computation section which determines an alarm threshold value for determining an abnormal package rotation, based on the theoretical number of package rotations.

2. The yarn winding device according to claim 1, wherein
the theoretical package calculation section calculates a theoretical package diameter based on a yarn winding condition, and calculates the theoretical number of package rotations based on the theoretical package diameter and a yarn winding speed.

3. The yarn winding device according to claim 2, where-

in
the theoretical package diameter is the theoretical package diameter at a time of full-winding,

4. The yarn winding device according to claim 2, wherein
the yarn winding condition includes a kind of a yarn to be wound, and a shape of a package to be formed.

5. The yarn winding device according to claim 1, wherein
the winding unit further comprises:

a winding length measurement section which measures a winding length which is a length of a wound part of a yarn; and
a winding length output section which outputs the winding length measured by the winding length measurement section,

the control section includes a winding length input section to which the winding length outputted by the winding length output section is inputted,
the theoretical package calculation section calculates a theoretical package diameter based on a yarn winding condition and the winding length, and calculates the theoretical number of package rotations at a time when the winding length is measured based on the theoretical package diameter and a yarn winding speed.

6. The yarn winding device according to claim 1, wherein
the alarm threshold value is updated each time the theoretical number of package rotations changes.

7. The yarn winding device according to claim 1, wherein
the alarm threshold value is switched in stages in accordance with a change of the theoretical number of package rotations.

8. The yarn winding device according to claim 1, wherein
the control section includes a threshold value output section which outputs the alarm threshold value,
the winding unit includes:

a threshold value input section to which the alarm threshold value is inputted;
a number-of-package-rotations measurement section which measures the number of package rotations;
an alarm determination section which compares the alarm threshold value with the number of package rotations measured by the number-of-package-rotations measurement section, and performs an alarm determination; and
an alarm section which generates an alarm in accordance with the determination performed by the alarm determination section.

9. The yarn winding device according to claim 1, wherein
the control section is a machine control device which controls a plurality of winding units.

10. A method for determining an alarm threshold value for detection of an abnormal package rotation, the method comprising:

a theoretical package diameter calculation step of calculating a theoretical package diameter based on a kind of a yarn to be wound, a shape of a package, and a yarn length required for forming the package;
a theoretical-number-of-package-rotations calculation step of calculating the theoretical number of package rotations based on the theoretical package diameter; and
an alarm threshold value determination step of determining an alarm threshold value based on the theoretical number of package rotations.

FIG.1

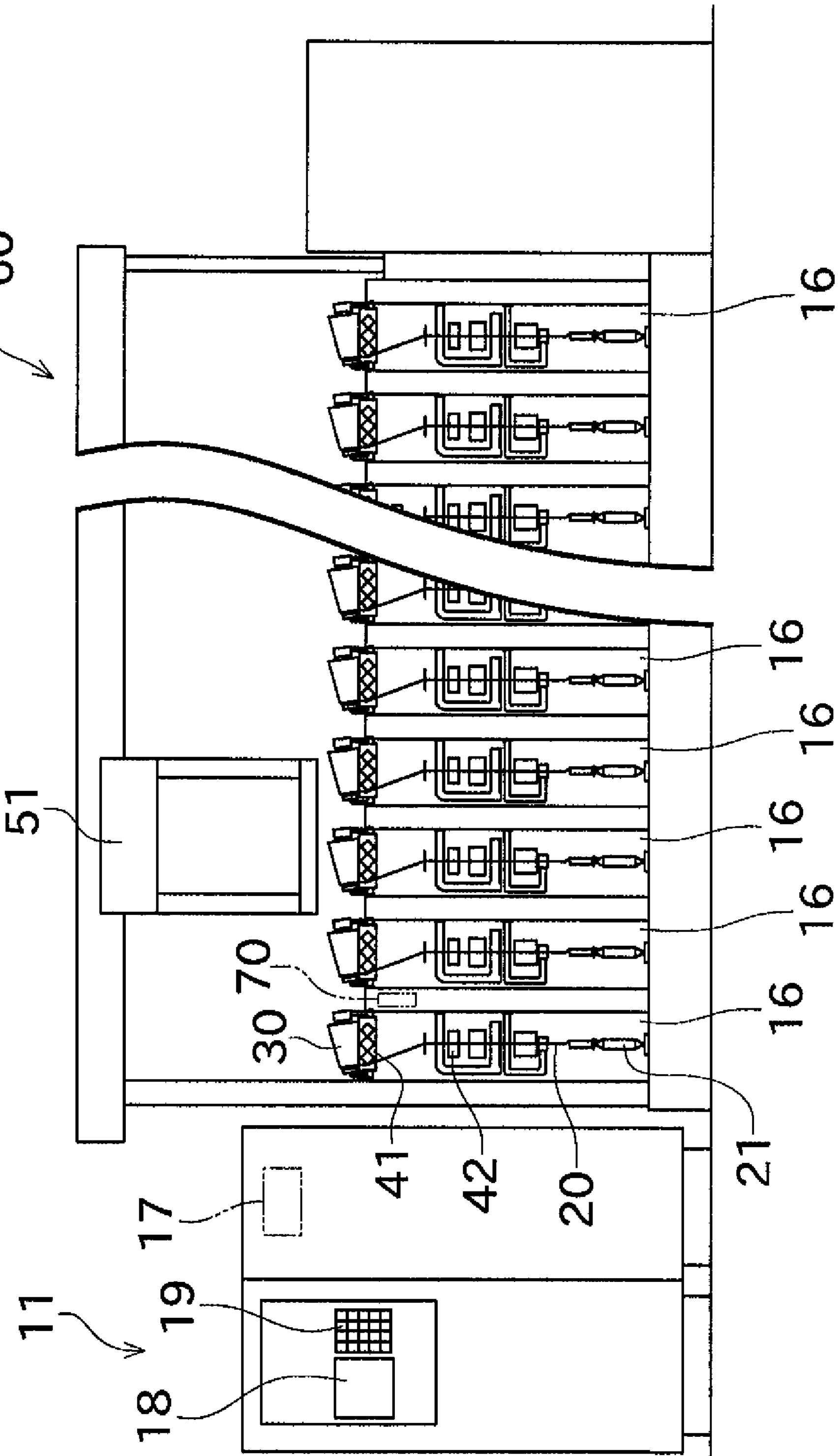
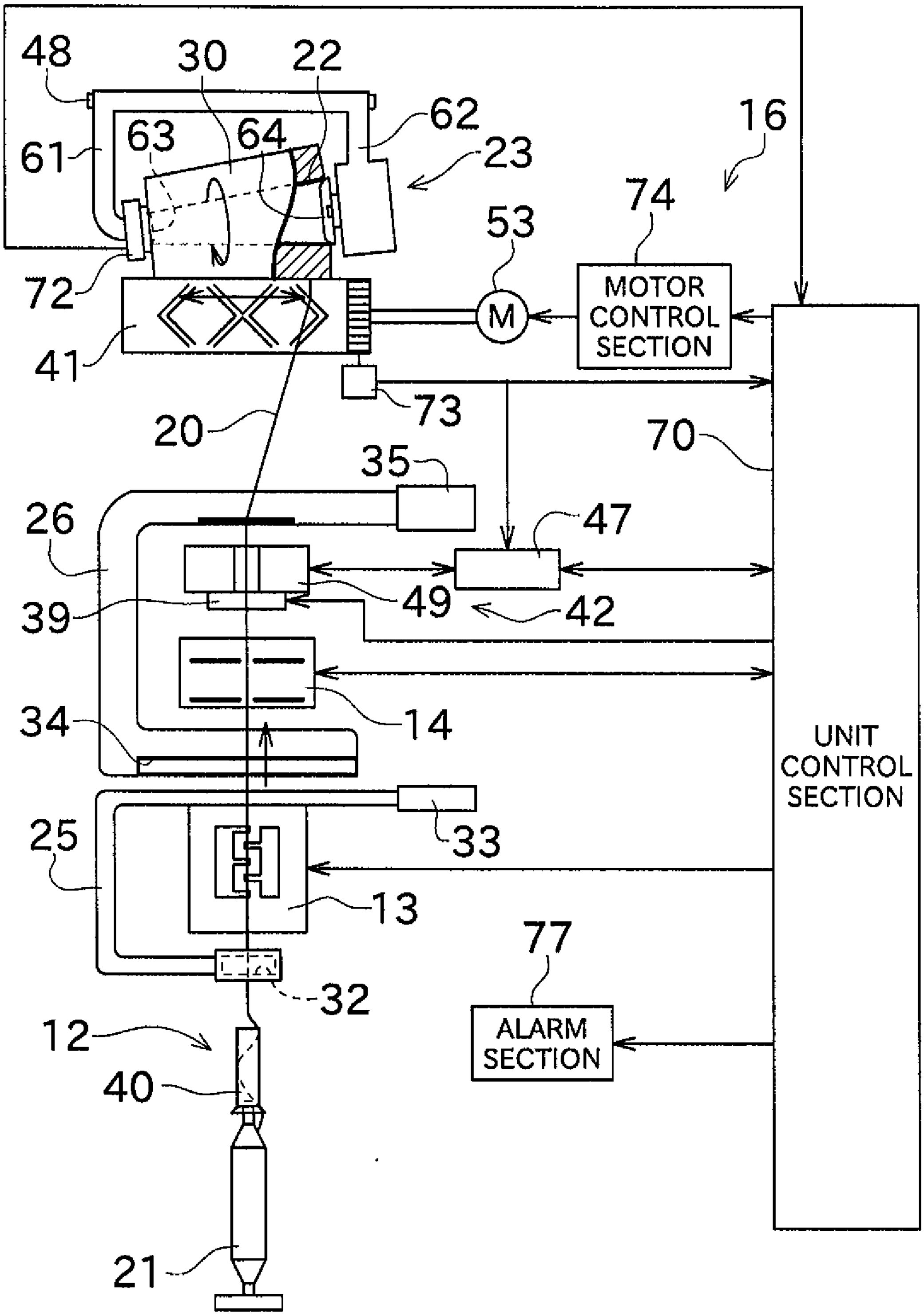


FIG.2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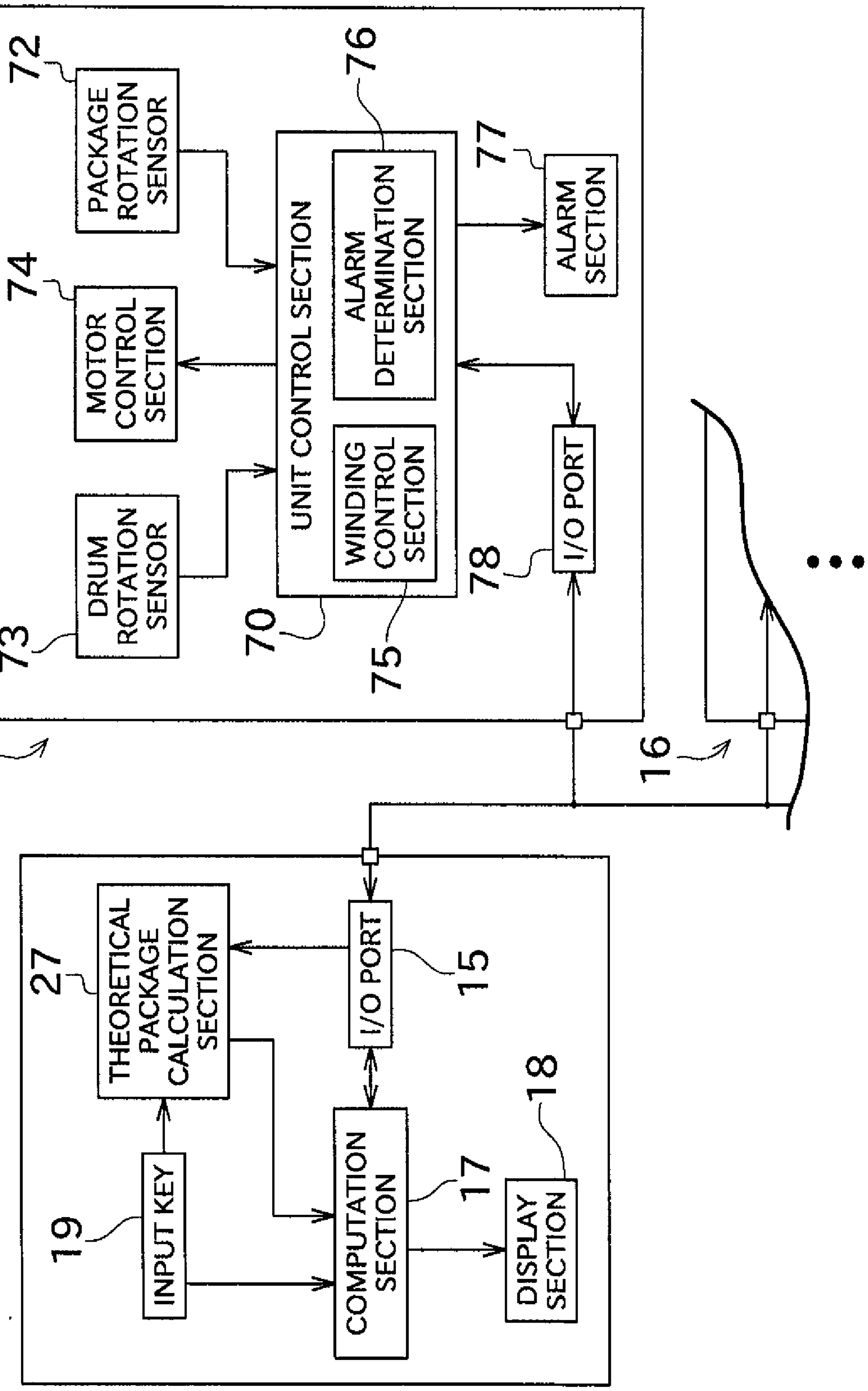
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ALARM SECTION
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I/O PORT
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16
THEORETICAL PACKAGE CALCULATION SECTION
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I/O PORT
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INPUT KEY
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COMPUTATION SECTION
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DISPLAY SECTION
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FIG.3

FIG.4

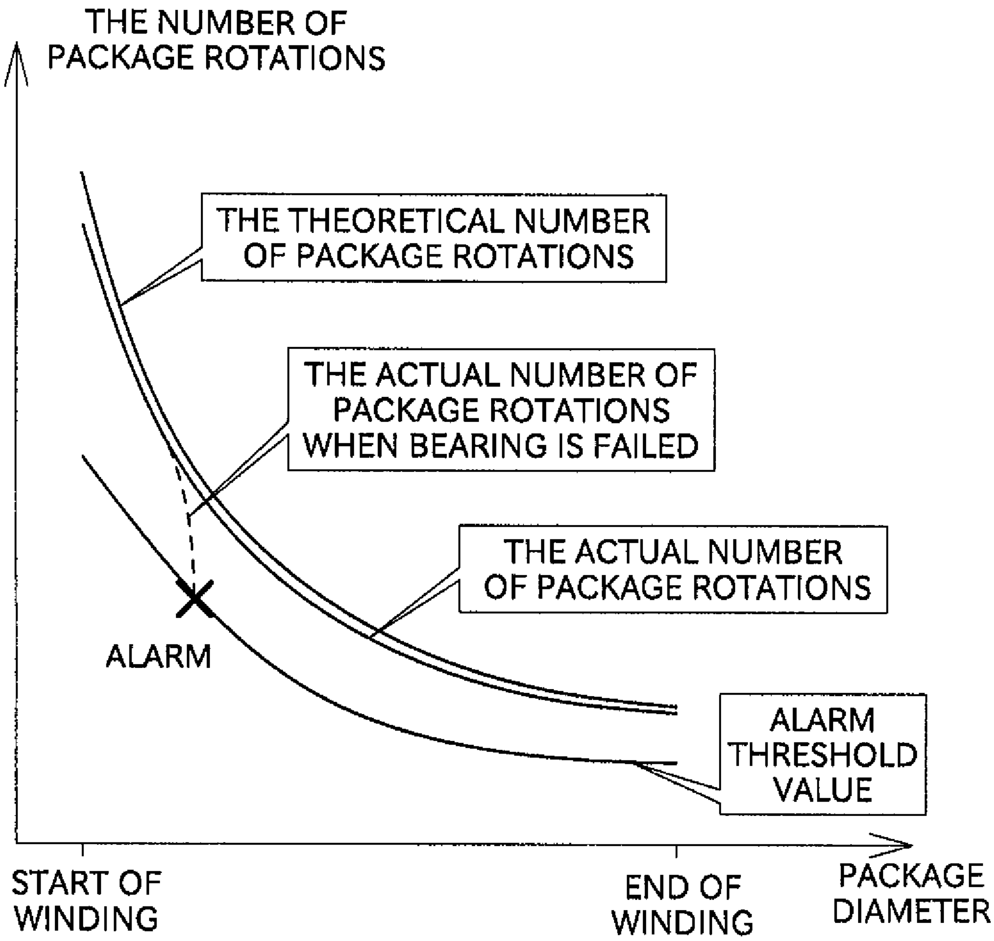
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FIG.5

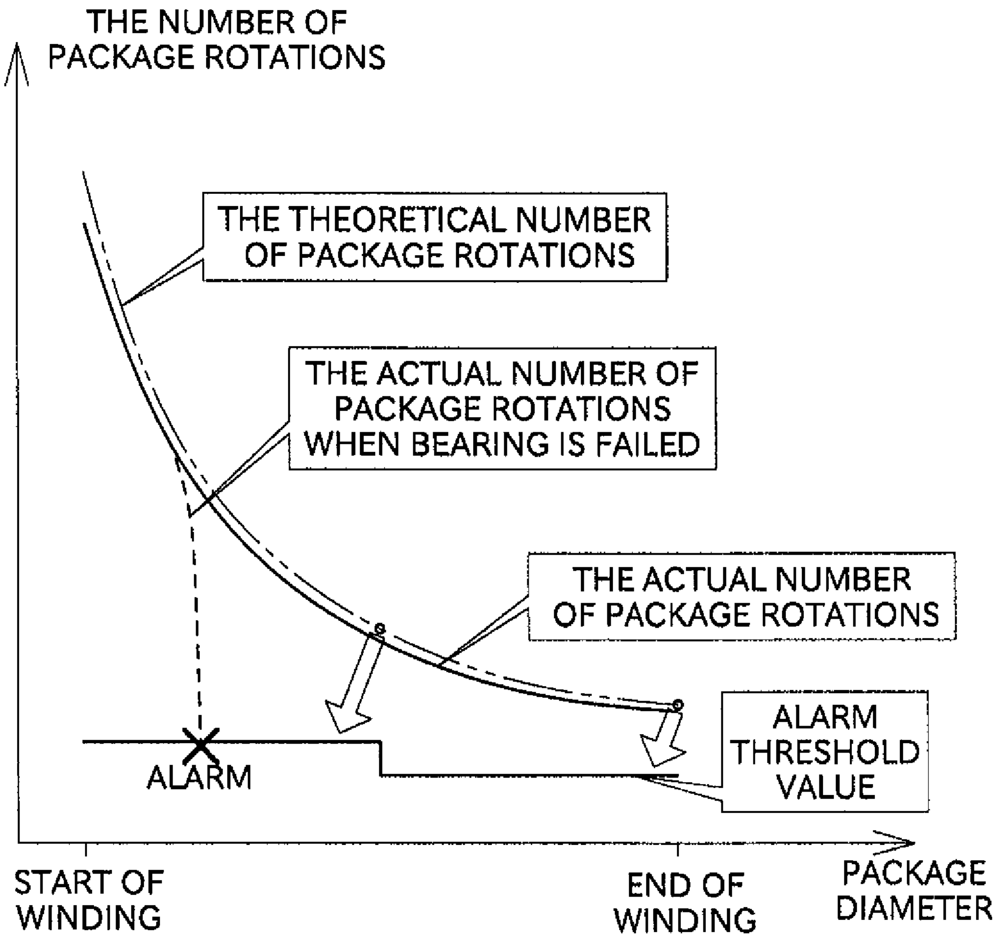
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FIG.6

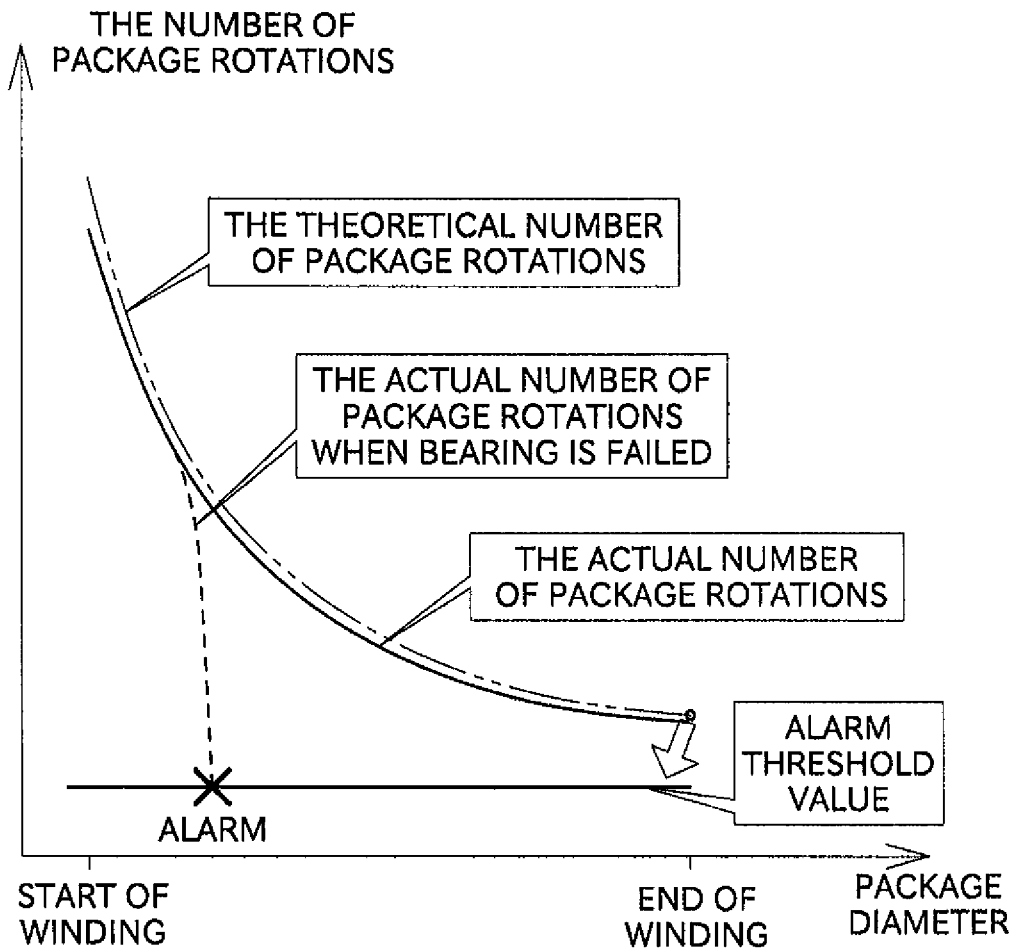
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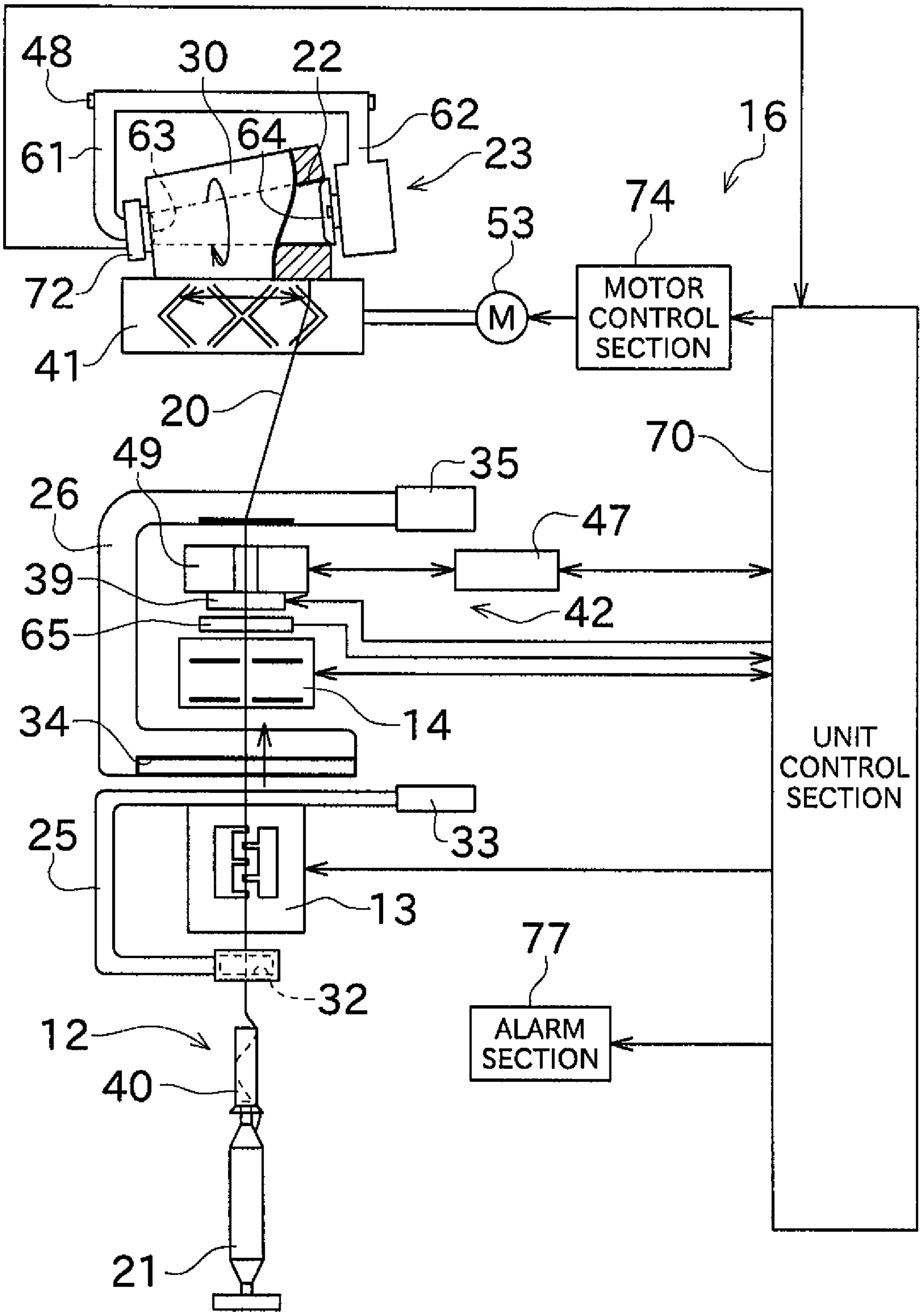
FIG.7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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/003219

A. CLASSIFICATION OF SUBJECT MATTER
B65H63/00(2006.01)i, *B65H54/46*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H63/00, B65H54/46

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-221060 A (Teijin Seiki Co., Ltd.), 01 October 1986 (01.10.1986), page 2, lower right column, line 6 to page 4, upper right column, line 14 & US 4685629 A & EP 196090 A2	1-10
A	JP 2006-89157 A (Murata Machinery Ltd.), 06 April 2006 (06.04.2006), paragraphs [0006] to [0014]; fig. 1 (Family: none)	1-10
A	JP 2006-188342 A (Murata Machinery Ltd.), 20 July 2006 (20.07.2006), paragraphs [0018] to [0021] (Family: none)	1-10

☐ Further documents are listed in the continuation of Box C.
☐ See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 July, 2010 (23.07.10)	03 August, 2010 (03.08.10)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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