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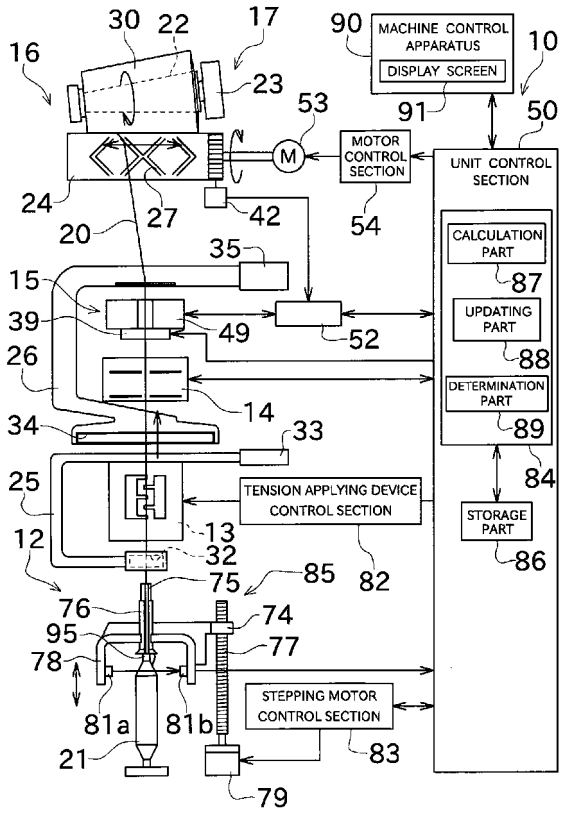
(54) BOBBIN WINDER

(57) Provided is a yarn winding machine configured to detect a core tube length of a yarn supply bobbin to thereby correctly obtain the amount of yam wound on the yam supply bobbin.

In a yam supply bobbin holder, a yam supply bobbin having a yam wound on a core tube thereof is set. A winding part winds, into a package, the yam drawn out from the yam supply bobbin. A core tube detection sensor detects a core tube length of the yam supply bobbin set in the yam supply bobbin holder. A stepping motor is configured to move the core tube detection sensor in a longitudinal direction of the core tube and to control the amount of movement thereof. A calculation part calculates the core tube length based on the amount of movement of the core tube detection sensor moved by the stepping motor.

Fig.2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a configuration for detecting a core tube length of a yam supply bobbin that is supplied to a yam winding machine.

BACKGROUND ART

[0002] Conventionally known is such a configuration of a yam winding machine that the amount of wound yam wound into a package by a winding part is subtracted from the amount of yam wound on a yam supply bobbin at a time of start of the winding, to thereby calculate the amount of remaining yam remaining on the yam supply bobbin and control each part in accordance with the amount of remaining yam. This type of the yam winding machine is disclosed in JP5078016(A) and JP2003002540(A). In a configuration disclosed in JP5078016(A), an unwinding assist device is controlled based on the amount of remaining yam remaining on a yam supply bobbin. In a configuration disclosed in JP2003002540(A), a tension applying device is controlled based on the amount of remaining yam remaining on a yam supply bobbin.

[0003] There can also be mentioned JP1231769(A), disclosing such a configuration that a sensor for detecting the amount of remaining yarn remaining on a yam supply bobbin is provided and the amount of remaining yam is calculated based on a detection signal of the sensor. In a configuration disclosed in JP1231769(A), a signal is generated when the amount of yam of the yarn supply bobbin falls below a predetermined amount.

SUMMARY OF THE INVENTION

[0004] In the configurations of JP5078016(A) and JP2003002540(A), it is necessary that the amount of yam at a time of start of the winding is preliminarily inputted to a yarn winding machine, in order to calculate the amount of remaining yam remaining on the yam supply bobbin. Here, the amount of yam wound on the yam supply bobbin varies depending on the length of a core tube on which the yam is wound. Accordingly, if a kind (the length of the core tube) of the yam supply bobbin to be subjected to a winding operation is different, a set value of the amount of wound yarn (the core tube length) has to be changed. Additionally, for example, in a case where yam supply bobbins in which the core tube lengths are variously different are supplied, or in a case where an operator incorrectly inputs the value of the amount of wound yam, a large difference may occur between the amount of wound yam set in the yam winding machine and the amount of yam actually wound on the yam supply bobbin. Controlling each part based on the amount of remaining yam calculated in such a state may adversely affect the quality of a package. In this respect, in the configuration of JP1231769(A), the actual amount of remaining yam is detected by the sensor, but the amount of remaining yarn (the amount of wound yam) at a time of start of the winding operation cannot be calculated, and therefore it is difficult to continuously perform a practical, detailed control.

[0005] The present invention is made in view of the circumstances described above, and an object of the present invention is to provide a yam winding machine configured to detect a core tube length of a yarn supply bobbin to thereby correctly obtain the amount of yam wound on the yarn supply bobbin.

[0006] 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.

[0007] An aspect of the present invention provides a yarn winding machine configured as follows. That is, a yam winding machine includes a bobbin set part, a winding part, and a core tube detection part. In the bobbin set part, a yam supply bobbin having a yam wound on a core tube thereof is set. The winding part winds, into a package, a yam drawn out from the yam supply bobbin. The core tube detection part detects a core tube length of the yam supply bobbin set in the bobbin set part.

[0008] Accordingly, the core tube length of the yam supply bobbin can be detected by the core tube detection part. This can save the trouble of inputting a set value of the core tube length to the yam winding machine, thus reducing a burden on an operator. Additionally, a value obtained by actual measurement of the core tube length is used for a control. This can avoid occurrence of an inappropriate control due to an input error, as compared with a conventional manual input.

[0009] The yam winding machine is preferably configured as follows. That is, the yam winding machine includes a storage part and an updating part. The storage part stores the core tube length detected by the core tube detection part. Upon setting of a yam supply bobbin in the bobbin set part, the updating part updates the core tube length stored in the storage part with a newly detected core tube length.

[0010] Accordingly, if the core tube length of the yarn supply bobbin set in the yam winding machine is once detected and stored in the storage part, then the core tube length can be easily obtained by referring to this storage content and can be used for various kinds of calculations. Even in a case where the core tube length set in the yam winding machine is not constant, the yam can be appropriately wound flexibly according to a change in the core tube length, because the updating part updates the content of the storage part each time the core tube is set.

[0011] The yarn winding machine is preferably configured as follows. That is, the yarn winding machine includes a driving part and a calculation part. The driving part is configured to move the core tube detection part in a longitudinal direction of the core tube and to control the amount of movement thereof. The calculation part

calculates the core tube length based on the amount of movement of the core tube detection part.

[0012] Accordingly, the core tube length can be easily and correctly calculated based on the amount of movement of the core tube detection part moved by the driving part.

[0013] The yam winding machine is preferably configured as follows. That is, the yarn winding machine includes an unwinding assist device for controlling a balloon that occurs when the yarn is drawn out from the yarn supply bobbin. The unwinding assist device includes a contact member configured to be in contact with the balloon, and a chase portion detection part for detecting a chase portion of the yam supply bobbin. The driving part moves the contact member in the longitudinal direction of the core tube, and thereby moves the core tube detection part integrally with the contact member.

[0014] Accordingly, a function for correctly detecting the core tube length can be achieved by a small number of parts, because the configuration of the unwinding assist device for controlling the balloon is utilized. Additionally, the amount of remaining yam of the yam supply bobbin can be easily calculated based on the position of the chase portion relative to the core tube length. Therefore, even in a case where the yam supply bobbin that is not full is set in the bobbin set part, the amount of remaining yam of this yam supply bobbin can be appropriately calculated.

[0015] The yam winding machine preferably includes a driving force conversion mechanism for converting rotation of a motor shaft included in a motor that serves as the driving part into linear movement of the core tube detection part.

[0016] Accordingly, by using the motor that can electrically control a rotation angle, the core tube detection part can be linearly moved. Therefore, the core tube length can be precisely measured.

[0017] The yam winding machine is preferably configured as follows. That is, the yam winding machine includes a tension applying device for applying a tension to the yam being wound into the package. The tension applying device performs a tension control in accordance with the core tube length detected by the core tube detection part.

[0018] Accordingly, the core tube length of the yarn supply bobbin set in the bobbin set part is actually measured and used for the control, and thereby the tension control more accurately reflecting a real status can be performed.

[0019] The yam winding machine is preferably includes a determination part for determining whether or not the yam supply bobbin is out of a set position in the bobbin set part based on a detection signal of the core tube detection part.

[0020] Accordingly, a function for determining whether or not the yarn supply bobbin is set in an appropriate position can be achieved by a simple configuration using the core tube detection part.

[0021] In the yam winding machine, it is preferable that in a case where the determination part determines that the yam supply bobbin is out of the set position in the bobbin set part, a winding operation of the winding part is suspended.

[0022] This can prevent a situation where the winding operation is performed while the yarn supply bobbin is out of the set position.

[0023] The yam winding machine preferably includes a notification section for notifying a deviation of the yam supply bobbin from the set position in the bobbin set part.

[0024] This enables the operator to quickly recognize the deviation of the yam supply bobbin from the set position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a side view of a winder unit provided in an automatic winder according to one embodiment of the present invention.

FIG. 2 is a front elevational view showing an outline configuration of the winder unit.

FIG. 3 is an enlarged perspective view showing configurations of an unwinding assist device and a core tube detection sensor.

FIG. 4 is a side cross-sectional view schematically showing the positional relationship between a yam supply bobbin and a movable member at a time when the yam supply bobbin is set in a yam supply bobbin holder.

FIG. 5 is a side cross-sectional view schematically showing a situation where the core tube detection sensor detects the length of a core tube.

FIG. 6 is a side cross-sectional view schematically showing a situation where a chase portion detection sensor detects a chase portion of the yam supply bobbin.

FIG. 7 is a side cross-sectional view schematically showing a situation where the core tube detection sensor detects a deviation of the yam supply bobbin from a set position.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0026] Next, an embodiment of the invention will be described.

[0027] In a winder unit 10 shown in FIGS. 1 and 2, a yam 20 unwound from a yarn supply bobbin 21 is, while being traversed, wound on a winding bobbin 22, to form a package 30 having a predetermined length and a predetermined shape. An automatic winder (yarn winding machine) of this embodiment includes a plurality of winder units 10 arranged side by side, and a machine control apparatus 90 arranged at one end in a direction in which the winder units 10 are arranged side by side. The machine control apparatus 90 includes a display screen (no-

tification section) 91 configured to display a status of a winding operation of each winder unit 10.

[0028] Each of the winder units 10 includes a unit frame 11 (FIG. 1) provided at one of left and right sides in a front view, and a winding unit main body 16 provided lateral to the unit frame 11. The winder unit 10 also includes a unit control section 50 for controlling each part of the winding unit main body 16.

[0029] The winding unit main body 16 includes a winding part 17 composed of a cradle 23 that is configured to have the winding bobbin 22 mounted thereon and a traverse drum 24 that traverses the yam 20 and drives the winding bobbin 22. The winding unit main body 16 also includes various devices provided in a yam travel path between the yam supply bobbin 21 and the traverse drum 24. To be specific, in the yam travel path, an unwinding assist device 12, a tension applying device 13, a yam joining device (yam joining part) 14, and a clearer head 49 of a clearer (yam quality measuring instrument) 15 are provided in this order from the yam supply bobbin 21 side to the traverse drum 24 side.

[0030] As shown in FIG. 1, a magazine type feeder 60 to which an operator feeds the yam supply bobbin 21 is arranged at the front side of the winding unit main body 16. The magazine type feeder 60 includes a magazine holder 61 that obliquely extends out from a lower portion of the winder unit 10 upward and frontward, and a bobbin storage 62 that is mounted at the distal end of the magazine holder 61.

[0031] The bobbin storage 62 includes a magazine can 63. In the magazine can 63, a plurality of storage holes are formed in a circular arrangement. In each of the storage holes, a feed bobbin 70 can be set in an inclined posture. The magazine can 63 is configured to intermittently perform rotational feed driving by means of a motor not shown. By the intermittent driving of the magazine can 63 and an opening-closing operation of a control valve, not shown, provided in the magazine can 63, the feed bobbin 70 can be dropped one by one onto a bobbin supply path, not shown, provided in the magazine holder 61. The feed bobbin 70 supplied to the bobbin supply path is guided to a yam supply bobbin holder (bobbin set part) 71 while being kept in the inclined posture.

[0032] The yam supply bobbin holder 71 includes turning means not shown for, after the feed bobbin 70 is received from the bobbin supply path, turning so as to raise the feed bobbin 70 from the inclined posture to an upright posture. This enables the feed bobbin 70 to be appropriately supplied, as the yarn supply bobbin 21, to a set position (position shown in FIGS. 1 and 2) located in a lower portion of the winding unit main body 16, so that the winder unit 10 performs the winding operation.

[0033] The automatic winder of this embodiment is configured to form the package 30 while performing yam joining on yarns of a plurality of yam supply bobbins 21. Here, the shape of the yam supply bobbin 21 used is not necessarily exactly constant. That is, the size of a core tube of the yarn supply bobbin 21 is set so as to satisfy a predetermined condition (for example, that the length of the core tube is within a predetermined range), but it may slightly vary depending on a manufacturer or the like. In this respect, in this embodiment, even in a case where the yarn supply bobbins 21 in which the lengths of the core tubes are variously different are set in the magazine can 63 and used, an appropriate control can be performed to wind the yam, as detailed later.

[0034] The unwinding assist device 12 assists unwinding of the yarn 20 by bringing a movable member 76 into contact with a balloon formed above the yam supply bobbin 21 by means of rotation and centrifugal force of the yam unwound from the yam supply bobbin 21 to thereby appropriately control the size of the balloon. In the unwinding assist device 12, a core tube detection sensor 81 for detecting the length of a core tube 95 of the yam supply bobbin 21 is mounted.

[0035] The unit control section 50 is configured to calculate a core tube length of the yam supply bobbin 21 set in the yam supply bobbin holder 71, based on a detection signal from the core tube detection sensor 81, and to set the amount of wound yarn wound on the yarn supply bobbin 21 based on the core tube length thus calculated. Configurations of the unwinding assist device 12 and the core tube detection sensor 81 and a detailed process of the unit control section 50 will be described later.

[0036] The tension applying device 13 applies a predetermined tension to the traveling yam 20. In this embodiment, the tension applying device 13 is configured as gate type one in which movable comb teeth are arranged relative to fixed comb teeth. The movable comb teeth are configured to be rotated by a rotary solenoid such that the comb teeth can be brought into engagement with or disengagement from each other. The tension of the yam being wound is controlled by the tension applying device 13, and thereby the quality of the package 30 can be improved.

[0037] The tension applying device 13 is electrically connected to a tension applying device control section 82. By an electrical control signal generated by the tension applying device control section 82, the strength of the tension applied to the yam 20 by the tension applying device 13 is controlled (tension control).

[0038] The tension applying device control section 82 performs the tension control in accordance with the amount of remaining yam remaining on the yam supply bobbin 21. More specifically, the tension applying device control section 82 controls the tension applying device 13 such that an increased force is applied to the yam 20, in an initial stage of an unwinding operation of the yam supply bobbin 21 in a full wound state (when a large amount of yam remains). On the other hand, the tension applying device control section 82 controls the tension applying device 13 such that an weakened tension is applied to the yam 20, in a late stage of the unwinding operation of the yam supply bobbin 21 (when a small amount of yam remains). This can suppress a tension

increase which would occur when the amount of yam remaining on the yam supply bobbin 21 decreases, and thus the tension of the yam 20 is stabilized.

[0039] For example, at a time of yam cutting that is performed by the clearer 15 upon detection of a yam defect, or at a time of yam breakage during unwinding from the yam supply bobbin 21, the yam joining device 14 joins a lower yam of the yam supply bobbin 21 to an upper yam of the package 30. As the yam joining device 14, one using a fluid such as a compressed air, or mechanical one, may be used.

[0040] The clearer 15 includes the clearer head 49 in which a sensor for detecting the diameter of the yam 20 is arranged, and an analyzer 52 for processing a yam diameter signal outputted by the sensor. The clearer 15 monitors the yam diameter signal supplied from the sensor, to thereby detect a yam defect (yam fault) such as a slub. A cutter 39 is arranged near the clearer head 49, for cutting the yam 20 when the clearer 15 detects a yam defect.

[0041] A lower yam guide pipe 25 for catching and guiding the lower yam of the yam supply bobbin 21 and an upper yam guide pipe (yam end catching part) 26 for catching and guiding the upper yam of the package 30 are provided at the lower and upper sides of the yam joining device 14, respectively. A suction port 32 is formed at the distal end of the lower yam guide pipe 25, and a suction mouth 34 is provided at the distal end of the upper yam guide pipe 26. An appropriate negative pressure source is connected to each of the lower yam guide pipe 25 and the upper yarn guide pipe 26, thus applying a suction flow to the suction port 32 and the suction mouth 34.

[0042] In this configuration, at a time of yam breakage or yam cutting, the suction port 32 of the lower yam guide pipe 25 catches the lower yarn at a position shown in FIGS. 1 and 2, and then rotates upward around a shaft 33 to thereby guide the lower yam to the yam joining device 14. Substantially simultaneously with this, the upper yam guide pipe 26 rotates upward around a shaft 35 from a position shown in FIGS. 1 and 2, thus catching, by the suction mouth 34, the upper yam unwound from the package 30 that is reversed by a drum driving motor 53. Subsequently, the upper yam guide pipe 26 rotates downward around the shaft 35, to thereby guide the upper yam to the yam joining device 14. Then, the yam joining device 14 joins the lower yam and the upper yam to each other.

[0043] As shown in FIG. 2, the yam unwound from the yam supply bobbin 21 is wound on the winding bobbin 22 that is arranged at the downstream side of the yam joining device 14. The winding bobbin 22 is driven in rotation by rotational driving of the traverse drum 24 that is opposed to the winding bobbin 22. A traverse groove 27 is formed in an outer peripheral surface of the traverse drum 24, and this traverse groove 27 enables the yam 20 to be traversed across a predetermined width. As shown in FIG. 2, the traverse drum 24 is coupled to a motor shaft of the drum driving motor (drum rotational driving section) 53, and an operation of the drum driving motor 53 is controlled by a motor control section 54. The motor control section 54 is configured to perform a control for operating and stopping the drum driving motor 53 based on a signal supplied from the unit control section 50.

[0044] A rotation sensor 42 is mounted to the traverse drum 24, and the rotation sensor 42 is electrically connected to the analyzer 52 provided in the clearer 15. The rotation sensor 42 is configured as, for example, a rotary encoder, and configured to transmit a rotation pulse signal to the analyzer 52 each time the traverse drum 24 is rotated through a predetermined angle. The analyzer 52 obtains a yarn winding speed based on the number of rotation pulse signals inputted per unit time, and uses it for the determination of a yam defect. The unit control section 50 calculates the amount of wound yam based on the rotation pulse signal that is obtained via the analyzer 52. The amount of wound yam is also used for the calculation of the amount of remaining yam remaining on the yarn supply bobbin 21.

[0045] In the above-described configuration, a bobbin is supplied from the magazine type feeder 60 to the yam supply bobbin holder 71, and then the winding bobbin 22 is driven to wind, on the winding bobbin 22, the yarn 20 unwound from the yam supply bobbin 21, so that the package 30 having a predetermined length is formed.

[0046] Next, configurations of the unwinding assist device 12 and the core tube detection sensor 81 will be described with reference to FIGS. 3 to 6.

[0047] As shown in FIGS. 1 and 2, the unwinding assist device 12 of this embodiment includes, as a main configuration, a fixed member 75, a driving force conversion mechanism 85, a movable member 76, a stepping motor (driving part) 79, and a chase portion detection sensor 80. As mentioned above, the core tube detection sensor 81 is provided in the unwinding assist device 12.

[0048] The fixed member 75 is fixed to the unit frame 11. A restriction part (not shown) for controlling the balloon is formed below the fixed member 75. The yam drawn out from the yam supply bobbin 21 is guided through the restriction part to the tension applying device 13.

[0049] The driving force conversion mechanism 85 is for converting a rotation-direction force of the stepping motor 79 into a line-direction force, and includes an elevator part 78 and a screw shaft 77. The screw shaft 77 is arranged in the vertical direction (that is, a direction parallel to a longitudinal direction of the yam supply bobbin 21 being set), and supported in a rotatable manner. The elevator part 78 has a substantially inverted-U shape in a front view. The elevator part 78 can hold the movable member (contact member) 76 having a cylindrical shape.

[0050] The elevator part 78 is supported on a mounting member 74. The mounting member 74 is cut to form a screw hole therein, and the screw shaft 77 is screwed into the screw hole so that the elevator part 78 is mounted

to the screw shaft 77. A motor shaft of the stepping motor 79 is coupled to one end portion of the screw shaft 77. Movement of the elevator part 78 in a rotation direction is restricted by appropriate means, in order to prevent the elevator part 78 from rotating integrally with the screw shaft 77.

[0051] In this configuration, the stepping motor 79 is driven to rotate the screw shaft 77, and thereby the elevator part 78 moves upward or downward along the axial direction of the screw shaft 77. At a time of setting a new yam supply bobbin 21 or at a time of performing a yam joining operation, the stepping motor 79 is appropriately controlled to cause the movable member 76 (elevator part 78) to wait in a waiting position located above the yam supply bobbin 21. In a case where the setting of the yam supply bobbin 21 is completed or in a case where the yam joining operation is completed, the stepping motor 79 is controlled to cause the movable member 76 to move down from the waiting position and estabilish a predetermined positional relationship relative to the chase portion of the yam supply bobbin 21. Here, the chase portion means an inclined part of a yam layer formed on the yam supply bobbin 21 that is positioned at the unwinding side of the yam 20.

[0052] The stepping motor 79 is electrically connected to the stepping motor control section 83. The stepping motor control section 83 controls the stepping motor 79 by means of a drive pulse signal. The stepping motor control section 83 is connected to the unit control section 50, and the unit control section 50 can perform the control of the respective parts such as the yam joining device 14 and the clearer 15 in conjunction with the control of the unwinding assist device 12.

[0053] The chase portion detection sensor (chase portion detection part) 80 is for detecting the chase portion of the yam supply bobbin 21. In this embodiment, the chase portion detection sensor 80 is configured as a transmission type photosensor including a light emitting part 80a and a light receiving part 80b. A detection signal of detection by the chase portion detection sensor 80 is inputted to the unit control section 50.

[0054] The core tube detection sensor 81 (core tube detection part) is for detecting the length of the core tube 95 of the yarn supply bobbin 21. In this embodiment, the core tube detection sensor 81 is, similarly to the chase portion detection sensor 80, configured as a transmission type photosensor including a light emitting part 81a and a light receiving part 81b. In a side view, the core tube detection sensor 81 is arranged at the center of the elevator part 78, in order to detect the center of the core tube 95. Both the core tube detection sensor 81 and the chase portion detection sensor 80 are arranged in the elevator part 78, and the two sensors move up and down simultaneously with the upward and downward movement of the elevator part 78. A detection signal of detection by the core tube detection sensor 81 is inputted to the unit control section 50.

[0055] As shown in FIG. 2, the unit control section 50 includes a processing part 84 for performing various processes based on the detection signal of the core tube detection sensor 81. The processing part 84 includes a calculation part 87, an updating part 88, and a determination part 89. The unit control section 50 also includes a storage part 86 for storing the core tube length that is calculated based on the detection signal of the core tube detection sensor 81.

[0056] The calculation part 87 performs a process of calculating the core tube length based on the driving amount of the stepping motor 79 (the amount of movement of the core tube detection sensor 81 moved by the stepping motor 79). More specifically, the unit control section 50 firstly controls the stepping motor 79, to move the elevator part 78 to the waiting position. Then, while monitoring a state of the core tube detection sensor 81, the unit control section 50 rotates the stepping motor 79 to move down the elevator part 78 at a predetermined speed. At this time, the number of drive pulses transmitted to the stepping motor 79 is counted by an appropriate counter.

[0057] Then, at a time point when the elevator part 78 moves down through a certain distance from the waiting position, the core tube detection sensor 81 detects the core tube, and then the calculation part 87 calculates a downward movement distance (distance moved) of the core tube detection sensor 81 based on a drive pulse count value of the stepping motor 79 (that is, a rotation angle of the screw shaft 77) and the pitch of the screw shaft 77. Then, the calculation part 87 subtracts the obtained downward movement distance from a predetermined distance, and thereby obtains the core tube length of the yam supply bobbin 21.

[0058] The unit control section 50 controls the stepping motor 79 so as to continuously move down the elevator part 78 even after the core tube detection sensor 81 detects the core tube. Then, at a time point when the elevator part 78 moves down through a certain distance from the waiting position, the chase portion detection sensor 80 detects the chase portion, and thus the calculation part 87 obtains the position of the chase portion in substantially the same manner as the case of the core tube detection sensor 81 described above.

[0059] In the above-described manner, the calculation part 87 obtains the core tube length and the position of the chase portion, and then calculates the amount of wound yam (the amount of remaining yam) of the yam supply bobbin 21 at a time of start of the winding. The amount of remaining yam can be obtained by applying an appropriate function based on the position of the chase portion relative to the core tube length.

[0060] After the calculation part 87 obtains the core tube length, the updating part 88 performs a process of overwriting (updating) the core tube length stored in the storage part 86 with the calculated core tube length. Thereby, each time the yam supply bobbin 21 is supplied to the winding unit main body 16, the core tube length of this yam supply bobbin 21 can be stored again in the

storage part 86.

[0061] The determination part 89 performs a determination process of determining whether or not the yam supply bobbin 21 is out of the set position. Details of the determination process performed by the determination part 89 will be described later.

[0062] Next, a process performed by the unit control section 50 in a case where the yam supply bobbin 21 is set in the yam supply bobbin holder 71 will be described. As shown in FIG. 4, at a time point immediately after the yam supply bobbin 21 is supplied from the magazine type feeder 60 and set in the yam supply bobbin holder 71, the movable member 76 is withdrawn in the waiting position located above the yam supply bobbin 21. Then, after the setting of the yam supply bobbin 21 in the yam supply bobbin holder 71 is completed, the stepping motor 79 is driven to thereby move down the elevator part 78.

[0063] Then, at a time point when the elevator part 78 moves down through a certain distance, as shown in FIG. 5, a light emitted from the light emitting part 81a to the light receiving part 81b of the core tube detection sensor 81 is blocked by an upper end portion of the core tube 95, so that the upper end portion of the core tube 95 is detected. The core tube detection sensor 81 transmits to the unit control section 50 a detection signal indicating the detection of the core tube 95. The unit control section 50 receives this detection signal, and then the calculation part 87 calculates the core tube length based on this detection signal. Then, the updating part 88 stores, in the storage part 86, the core tube length thus calculated.

[0064] Thereafter, the elevator part 78 continuously moves down, and in turn, the chase portion of the yarn supply bobbin 21 is detected by the chase portion detection sensor 80. The unit control section 50 receives the detection signal of the chase portion detection sensor 80, and then the calculation part 87 calculates the position of the chase portion and additionally calculates the amount of wound yam wound on the yam supply bobbin 21 based on the position of the chase portion thus obtained and the core tube length stored in the storage part 86.

[0065] Here, the amount of yam of the yam supply bobbin 21 supplied to the yam supply bobbin holder 71 is not always constant (full amount). For example, it is conceivable that the yam supply bobbin 21 that is not full is supplied to the winding unit main body 16 for the following reasons. That is, in a possible case, for example, a yam supply bobbin 21 that is full is supplied to the winding unit main body 16 and the winding operation is smoothly performed up to a certain time point, but from the middle of the operation, an error in the yam joining frequently occurs and therefore the yam supply bobbin 21 is discharged from the winding unit main body 16 even before the yam is wholly unwound. In this case, an operator takes measures for, for example, eliminating a cause of the error in the yam joining with respect to the discharged yam supply bobbin 21 (the yam supply bobbin that is not full), and then puts this yam supply bobbin 21 into the magazine can 63 again. Thus, this yam supply bobbin 21 that is not full is supplied to the winding unit main body 16. However, in the configuration of this embodiment, even for such a yam supply bobbin that is not full, the amount of wound yam (the amount of remaining yam) can be appropriately calculated because the core tube length and the position of the chase portion are actually measured.

[0066] After the amount of wound yam is calculated in the above-described manner, the yam joining device 14 joins the yam of the package 30 and the yam of the yam supply bobbin 21 to each other, and then the winding is started. In this winding operation, the unit control section 50 performs a control for moving the elevator part 78 of the unwinding assist device 12 based on the detection signal inputted from the chase portion detection sensor 80. More specifically, the chase portion detection sensor 80 detects the downward movement of the chase portion that occurs along with the unwinding of the yarn from the yam supply bobbin 21, and in accordance with it, the stepping motor 79 is driven to move down the movable member 76. Thereby, the size of the balloon occurring when the yam is unwound from the yarn supply bobbin 21 can be appropriately controlled.

[0067] The unit control section 50 calculates the amount of currently remaining yarn based on the amount of wound yarn of the yam supply bobbin 21 calculated by the calculation part 87 and the amount of yam (the amount of wound yam) wound from this yam supply bobbin 21 into the package 30, and controls the tension applying device 13 based on the amount of remaining yam thus obtained. As a result, a control for suppressing a tension increase can be correctly performed when the amount of remaining yarn of the yam supply bobbin 21 decreases. Thus, the quality of the package 30 can be improved.

[0068] After the unwinding of the yam wound on the yam supply bobbin 21 is fully completed, the yam supply bobbin 21 that is now an empty bobbin is discharged from the yarn supply bobbin holder 71 into an appropriate place. Then, a new yam supply bobbin 21 is introduced from the magazine type feeder 60. Thus, in the same manner as described above, the unit control section 50 performs the process of measuring the core tube length and obtains the core tube length of the newly supplied yam supply bobbin 21, to start the winding operation. To the tension control performed at this time, the value of the newly obtained core tube length is applied.

[0069] Next, an erroneous setting determination process for determining an erroneous setting at a time of start of the winding, which is performed by the determination part 89, will be described. In the automatic winder of this embodiment, a shortest core tube length (a lower limit value of the core tube length) that allows the winder unit 10 to appropriately perform the winding operation is preliminarily set. In the erroneous setting determination process, whether or not the yarn supply bobbin 21 is appropriately set in the set position is determined based on

this shortest core tube length.

[0070] In the following, a detailed description will be given. In the unit control section 50, a driving amount of the stepping motor 79 necessary for moving the core tube detection sensor 81 from the above-mentioned waiting position to a position corresponding to the shortest core tube length is preliminarily stored. In a case where the core tube detection sensor 81 does not detect the core tube 95 even though the stepping motor 79 is driven by the driving amount (that is, even though the core tube detection sensor 81 reaches a detection position corresponding to the shortest core tube length), the determination part 89 determines that an erroneous setting is occurring.

[0071] Accordingly, in a case where a yam supply bobbin 21 having a core tube length shorter than the shortest core tube length is set, it can be detected as abnormality. Also in a case where the yarn supply bobbin 21 is not set in the correct position because the magazine type feeder 60 erroneously shoots the yam supply bobbin 21, it can be detected by this erroneous setting determination process.

[0072] If the determination part 89 determines that the erroneous setting is occurring, the unit control section 50 displays it on the display screen 91 of the machine control apparatus 90, and stops the winding operation of the winding part 17.

[0073] Here, it is conceivable that the yarn supply bobbin 21 is normally set in the yam supply bobbin holder 71 in the beginning but the yarn supply bobbin 21 falls out of the set position in the yam supply bobbin holder 71 during the winding operation. For example, during the winding operation, the yam is pulled upward while being unwound from the yam supply bobbin 21, and accordingly the yam supply bobbin 21 itself is pulled upward so that the yarn supply bobbin 21 escapes and rises from the yarn supply bobbin holder 71.

[0074] If the winding operation continues in a state where the yam supply bobbin 21 is not in place as described above, a large amount of yam may be wasted. Therefore, in this embodiment, to prevent such a situation, the determination part 89 is configured to have a function for checking whether or not the yam supply bobbin 21 is set in an appropriate position in the yam supply bobbin holder 71.

[0075] Next, a checking process in the winding operation, which is performed by the determination part 89, will be described with reference to FIG. 7.

[0076] A set position checking process performed by the determination part 89 is conducted by using the movement of the movable member 76 caused in the yam joining operation. To be specific, for example, when the yam is broken while being unwound from the yam supply bobbin 21, when the clearer 15 finds a yam defect and cuts the yam by the cutter, and when the yam supply bobbin 21 is newly supplied, the unit control section 50 moves up the movable member 76 to the waiting position, in order to perform the yam joining operation described above. Then, to restart the winding after the yam joining operation is completed, the movable member 76 is moved down to the original position, in order to return the balloon to a controllable state again at a time of the yam unwinding. Then, the set position checking process for checking the set position of the yam supply bobbin 21 is performed based on the detection signal of the core tube detection sensor 81 detected at a time when this downward movement occurs. In the following, this determination process will be described.

[0077] When the yam joining operation involved in a yam breakage or the like is completed and then the movable member 76 is moved down, the determination part 89 measures the core tube length in the same procedure as when the yam supply bobbin 21 is newly set. Then, the obtained core tube length is compared with the core tube length (the core tube length stored in the storage part 86) measured at a time when the yarn supply bobbin 21 is newly set. Since the core tube length of the same yam supply bobbin 21 is measured, the two measurement values should be coincident. However, for example, if the yarn supply bobbin 21 is rising as mentioned above, the measurement values of the core tube length are not coincident. If the two measurement values of the core tube length are not coincident as a result of the comparison (to be exact, if a difference between the two core tube lengths is equal to or greater than a predetermined difference), the determination part 89 determines that the yam supply bobbin 21 is out of the set position.

[0078] For example, as shown in FIG. 7, if the yam supply bobbin 21 falls out of a regular set position (the position illustrated with the dot-dash line) in the yam supply bobbin holder 71 during the winding operation, the detected core tube length is different from the original value. Accordingly, in a case as shown in FIG. 7, it is determined that the yam supply bobbin 21 is out of the set position.

[0079] If the determination part 89 determines that the yam supply bobbin 21 is out of the set position, the unit control section 50 displays it on the display screen 91 of the machine control apparatus 90, and stops the winding operation of the winding part 17. Thereby, the operator can promptly perform an operation necessary for recovery and restart the winding.

[0080] As shown above, the automatic winder of this embodiment includes the yam supply bobbin holder 71, the winding part 17, and the core tube detection sensor 81. In the yam supply bobbin holder 71, the yam supply bobbin 21 having the yam wound on the core tube 95 is set. The winding part 17 winds, into the package, the yarn drawn out from the yam supply bobbin 21. The core tube detection sensor 81 detects the core tube length of the yam supply bobbin 21 set in the yam supply bobbin holder 71.

[0081] Accordingly, the core tube length of the yarn supply bobbin 21 can be detected by the core tube detection sensor 81. This can save the trouble of inputting the set value of the core tube length to the automatic

winder, thus reducing a burden on the operator. Additionally, the value obtained by actual measurement of the core tube length is used for the control. This can avoid occurrence of an inappropriate control due to an input error, as compared with a conventional manual input.

[0082] The automatic winder of this embodiment is configured as follows. That is, the automatic winder includes the storage part 86 and the updating part 88. The storage part 86 stores the core tube length detected by the core tube detection sensor 81. When the yam supply bobbin 21 is set in the yam supply bobbin holder 71, the updating part 88 updates the core tube length stored in the storage part 86 with a newly detected core tube length.

[0083] Accordingly, if the core tube length of the yam supply bobbin 21 set in the automatic winder is once detected and stored in the storage part 86, then the core tube length can be easily obtained by referring to this storage content and can be used for various kinds of calculations. Even in a case where the core tube length set in the automatic winder is not constant, the yam can be appropriately wound flexibly according to a change in the core tube length, because the updating part 88 updates the content of the storage part 86 each time the core tube is set.

[0084] The automatic winder of this embodiment is configured as follows. That is, the automatic winder includes the stepping motor 79 and the calculation part 87. The stepping motor 79 is configured to move the core tube detection sensor 81 in a longitudinal direction of the core tube 95, and to control the amount of movement of the core tube detection sensor 81. The calculation part 87 calculates the core tube length based on the amount of movement of the core tube detection sensor 81.

[0085] Accordingly, the core tube length can be easily and correctly calculated based on the amount of movement of the core tube detection sensor 81 moved by the stepping motor 79.

[0086] The automatic winder of this embodiment is configured as follows. That is, the automatic winder includes the unwinding assist device 12 for controlling the balloon that occurs when the yam is drawn out from the yam supply bobbin 21. The unwinding assist device 12 includes the movable member 76 configured to be in contact with the balloon and the chase portion detection sensor 80 configured to detect the chase portion of the yam supply bobbin 21. The stepping motor 79 moves the movable member 76 in the longitudinal direction of the core tube 95, and thereby moves the core tube detection sensor 81 integrally with the movable member 76.

[0087] Accordingly, a function for correctly detecting the core tube length can be achieved by a small number of parts, because the configuration of the unwinding assist device 12 for controlling the balloon is utilized. Additionally, the amount of remaining yam of the yarn supply bobbin 21 can be easily calculated based on the position of the chase portion relative to the core tube length. Therefore, even in a case where the yam supply bobbin 21 that is not full is set in the yarn supply bobbin holder 71, the amount of remaining yam of this yarn supply bobbin can be appropriately calculated.

[0088] The automatic winder of this embodiment includes the driving force conversion mechanism 85 for converting the rotation of the motor shaft included in the stepping motor 79 that serves as the driving part into linear movement of the core tube detection sensor 81.

[0089] Accordingly, by using the stepping motor 79 that can electrically control the rotation angle, the core tube detection sensor 81 can be linearly moved. Therefore, the core tube length can be precisely measured.

[0090] The automatic winder of this embodiment is configured as follows. That is, the automatic winder includes the tension applying device 13 that applies a tension to the yam 20 being wound into the package 30. The tension applying device 13 performs the tension control in accordance with the core tube length detected by the core tube detection sensor 81.

[0091] Accordingly, the core tube length of the yam supply bobbin 21 set in the yam supply bobbin holder 71 is actually measured and used for the control, and thereby the tension control more accurately reflecting a real status can be performed.

[0092] The automatic winder of this embodiment includes the determination part 89 for determining whether or not the yam supply bobbin 21 is out of the set position in the yam supply bobbin holder 71 based on the detection signal of the core tube detection sensor 81.

[0093] Accordingly, a function for determining whether or not the yam supply bobbin 21 is set in an appropriate position can be achieved by a simple configuration using the core tube detection sensor 81.

[0094] In the automatic winder of this embodiment, if the determination part 89 determines that the yam supply bobbin 21 is out of the set position in the yam supply bobbin holder 71, the winding operation of the winding part 17 is suspended.

[0095] This can prevent a situation where the winding operation is performed while the yarn supply bobbin 21 is out of the set position.

[0096] The automatic winder of this embodiment includes the display screen 91 for notifying the deviation of the yarn supply bobbin 21 from the set position in the yam supply bobbin holder 71.

[0097] This enables the operator to quickly recognize the deviation of the yam supply bobbin 21 from the set position.

[0098] Although an embodiment of the present invention has been described above, the above-described configuration may be further modified as follows.

[0099] In the embodiment described above, the core tube detection sensor 81 is arranged in the elevator part 78 of the unwinding assist device 12. This configuration may be appropriately modified. For example, in a possible modified configuration, the core tube detection sensor 81 is arranged in a member different from the elevator part 78.

[0100] Although transmission type photosensors are adopted as the chase portion detection sensor 80 and the core tube detection sensor 81, this configuration may be appropriately modified. For example, reflection type photosensors may be adopted as the chase portion detection sensor 80 and the core tube detection sensor 81.

[0101] Instead of the chase portion detection sensor 80 and the core tube detection sensor 81, a distance sensor capable of measuring a distance to a detection object may be adopted. For example, in order to detect the upper end portion of the core tube 95 of the yam supply bobbin 21, one distance sensor is arranged at the center of the elevator part 78. Based on distance information obtained by the distance sensor, the unit control section 50 obtains position information of the core tube 95 and the position information of the chase portion of the yam supply bobbin 21. In this manner, such a configuration is also possible that one core tube detection part detects the core tube length and the position of the chase portion.

[0102] The driving force conversion mechanism 85 may be appropriately modified, as long as it is configured to convert the rotation of the motor shaft into the linear movement of the core tube detection sensor 81. For example, in a possible modified configuration, the elevator part 78 is moved in the vertical direction by means of belt driving. Alternatively, in a possible modified configuration, the elevator part 78 is moved in the vertical direction by means of a worm gear and a pinion. Moreover, instead of the stepping motor 79, a servomotor may be adopted as the motor for driving the elevator part 78. Furthermore, something other than the motor may be adopted as the driving part. For example, a cylinder may be adopted as the driving part so that the winder unit is configured as follows. That is, the winder unit includes a cylinder for driving the core tube detection sensor 81, and a movement amount detection part for detecting the amount of movement of the core tube detection sensor 81 moved by the cylinder. The calculation part 87 of the unit control section 50 calculates the core tube length based on the amount of movement of the core tube detection sensor 81 detected by the movement amount detection part.

[0103] Although gate type one is adopted as the tension applying device 13, the configuration thereof may be appropriately modified as long as the tension control can be performed. For example, disc type one may be adopted as the tension applying device.

[0104] In a possible modified configuration, a warning lamp is arranged for each winder unit 10, and if the yam supply bobbin 21 is out of the yam supply bobbin holder 71, this warning lamp is actuated so that the operator is notified of a state of the yam supply bobbin 21.

[0105] Although the winding part 17 is configured to traverse the yam by means of the traverse drum 24, a configuration for traversing the yam may be appropriately modified. For example, a traverse device configured to rotate a traverse arm having a yam guide attached to the distal end thereof, a traverse device configured to reciprocate a yarn guide by means of belt driving, a rotary type traverse device using a rotating blade, or the like, may be adopted.

[0106] Instead of the magazine type feeder 60 shown in FIG. 1, such a configuration may be possible that a transport conveyor not shown is provided below the automatic winder and the yam supply bobbin 21 is supplied from a yarn supply bobbin feed part not shown to the yam supply bobbin holder 71 of each winder unit 10.

Claims

1. A yam winding machine comprising:

a bobbin set part for setting therein a yam supply bobbin having a yam wound on a core tube thereof;
a winding part for winding, into a package, a yam drawn out from the yam supply bobbin; and
a core tube detection part for detecting a core tube length of the yam supply bobbin set in the bobbin set part.

2. The yam winding machine according to claim 1, comprising:

a storage part for storing the core tube length detected by the core tube detection part; and
an updating part for, upon setting of a yam supply bobbin in the bobbin set part, updating the core tube length stored in the storage part with a newly detected core tube length.

3. The yam winding machine according to claim 1 or 2, comprising:

a driving part configured to move the core tube detection part in a longitudinal direction of the core tube and to control the amount of movement thereof; and
a calculation part for calculating the core tube length based on the amount of movement of the core tube detection part.

4. The yam winding machine according to claim 3, comprising
an unwinding assist device for controlling a balloon that occurs when the yam is drawn out from the yam supply bobbin, wherein
the unwinding assist device includes:

a contact member configured to be in contact with the balloon; and
a chase portion detection part for detecting a chase portion of the yam supply bobbin,

the driving part moves the contact member in the

longitudinal direction of the core tube, and thereby moves the core tube detection part integrally with the contact member.

5. The yam winding machine according to claim 3 or 4, comprising
a driving force conversion mechanism for converting rotation of a motor shaft included in a motor that serves as the driving part into linear movement of the core tube detection part.

6. The yam winding machine according to any one of claims 1 to 5, comprising
a tension applying device for applying a tension to the yam being wound into the package, wherein
the tension applying device performs a tension control in accordance with the core tube length detected by the core tube detection part.

7. The yam winding machine according to any one of claims 1 to 6, comprising
a determination part for determining whether or not the yam supply bobbin is out of a set position in the bobbin set part based on a detection signal of the core tube detection part.

8. The yam winding machine according to claim 7, wherein
in a case where the determination part determines that the yam supply bobbin is out of the set position in the bobbin set part, a winding operation of the winding part is suspended.

9. The yam winding machine according to claim 7 or 8, comprising
a notification section for notifying a deviation of the yam supply bobbin from the set position in the bobbin set part.

Fig.1

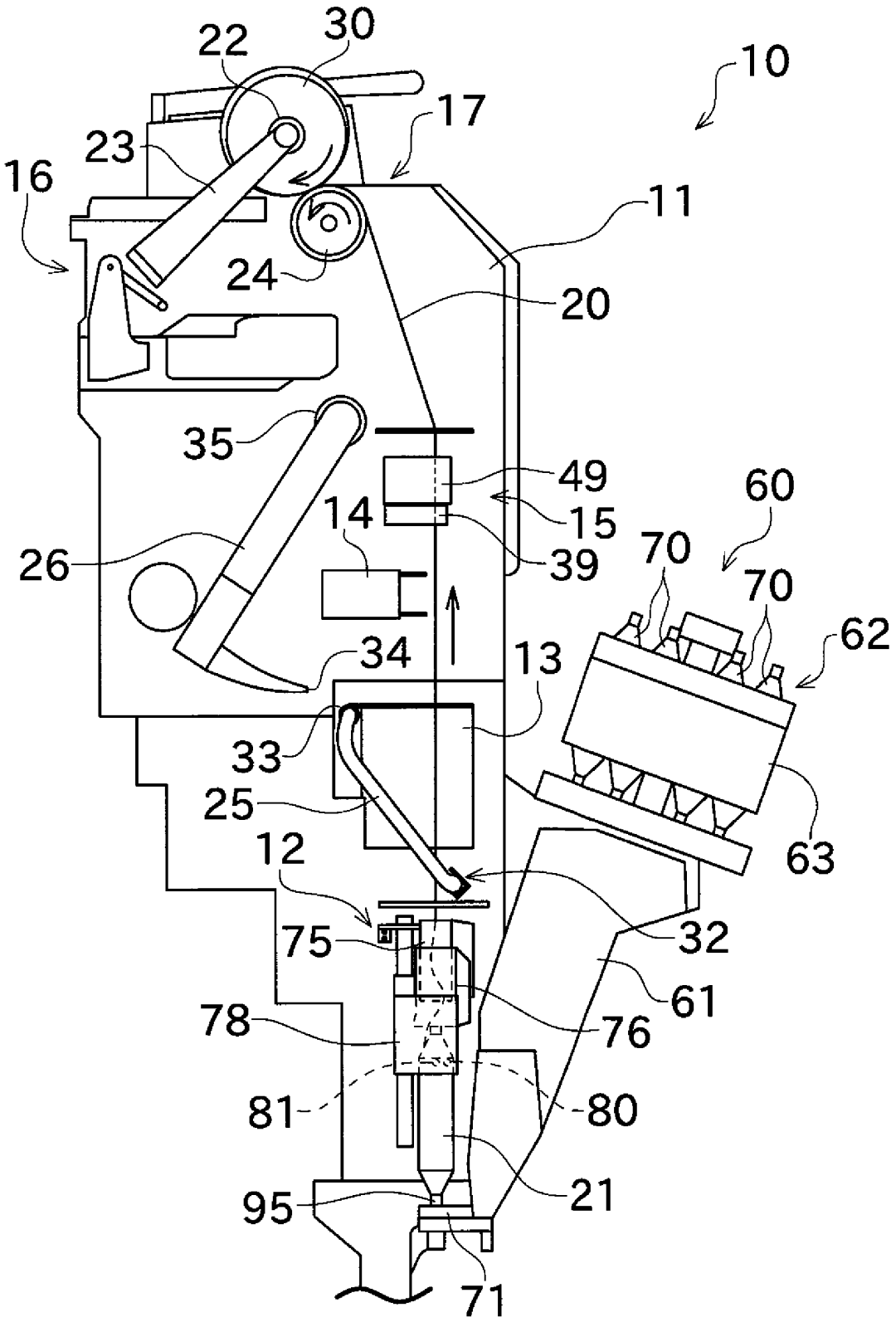
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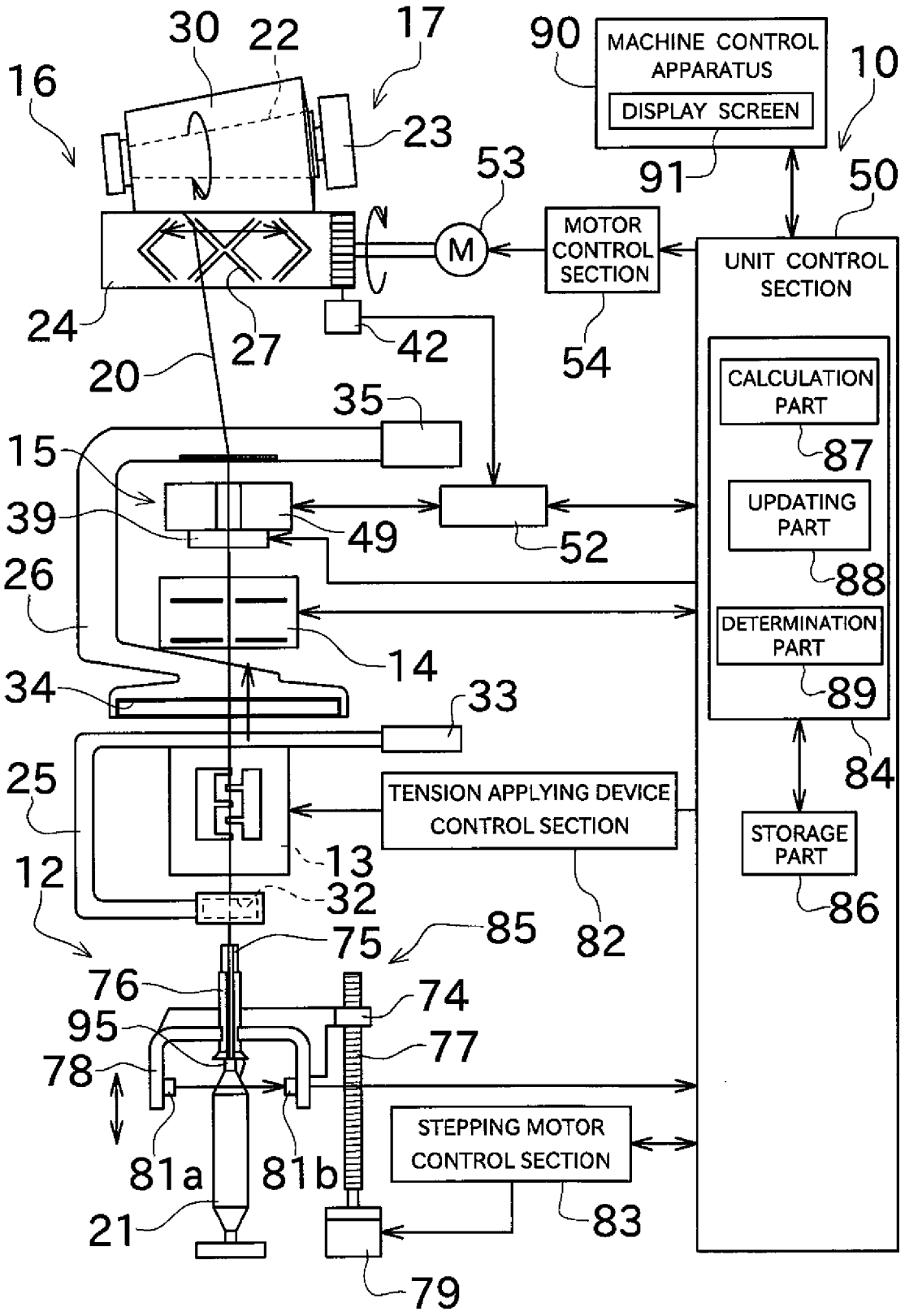
Fig.2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17
90
MACHINE CONTROL APPARATUS
DISPLAY SCREEN
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23
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91
50
M
MOTOR CONTROL SECTION
UNIT CONTROL SECTION
24
27
42
54
20
CALCULATION PART
35
87
15
UPDATING PART
39
49
52
88
26
DETERMINATION PART
14
89
34
33
84
25
TENSION APPLYING DEVICE CONTROL SECTION
STORAGE PART
13
12
32
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STEPPING MOTOR CONTROL SECTION
81a
81b
83
21
79

Fig.3

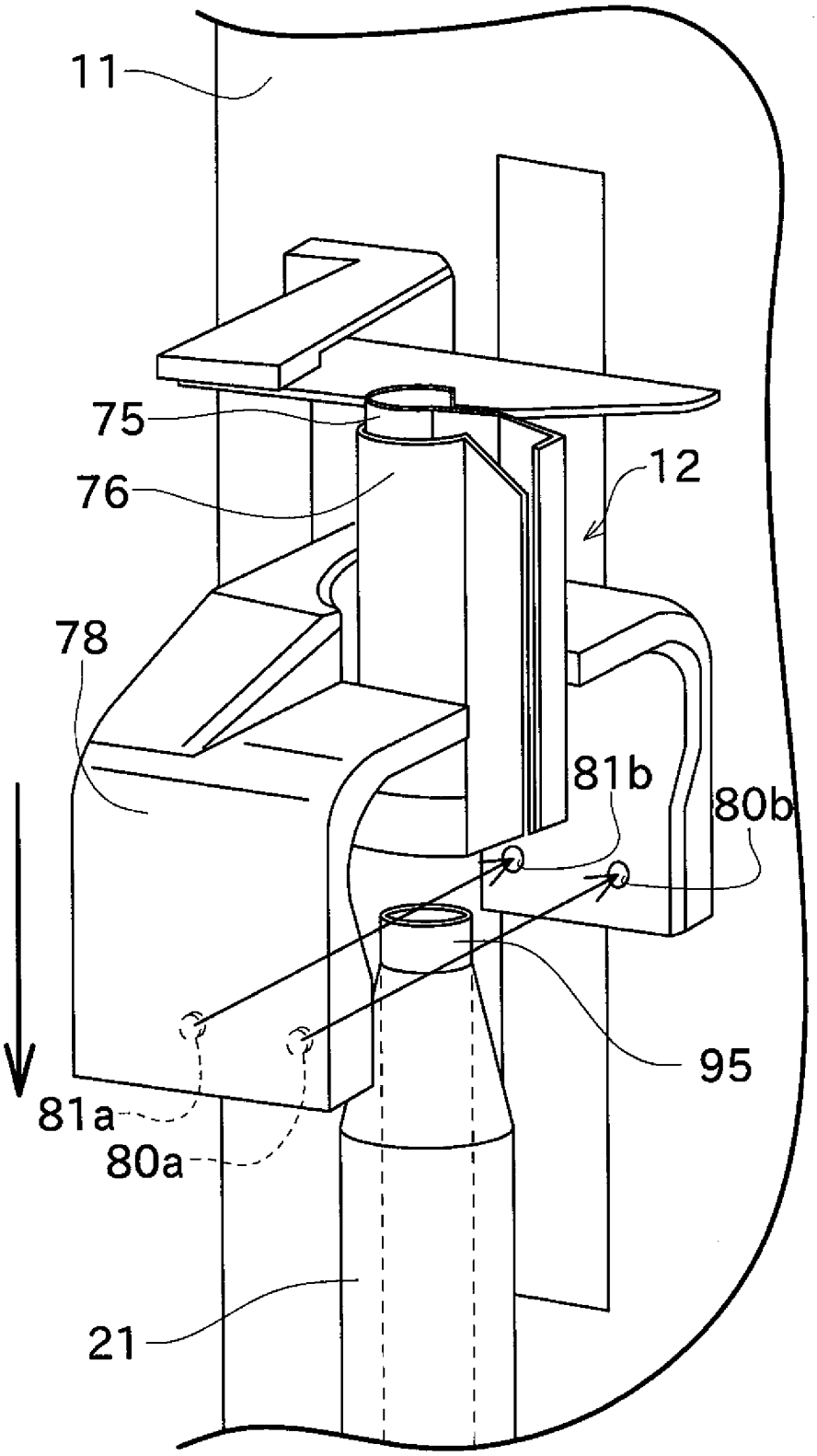


Fig.4

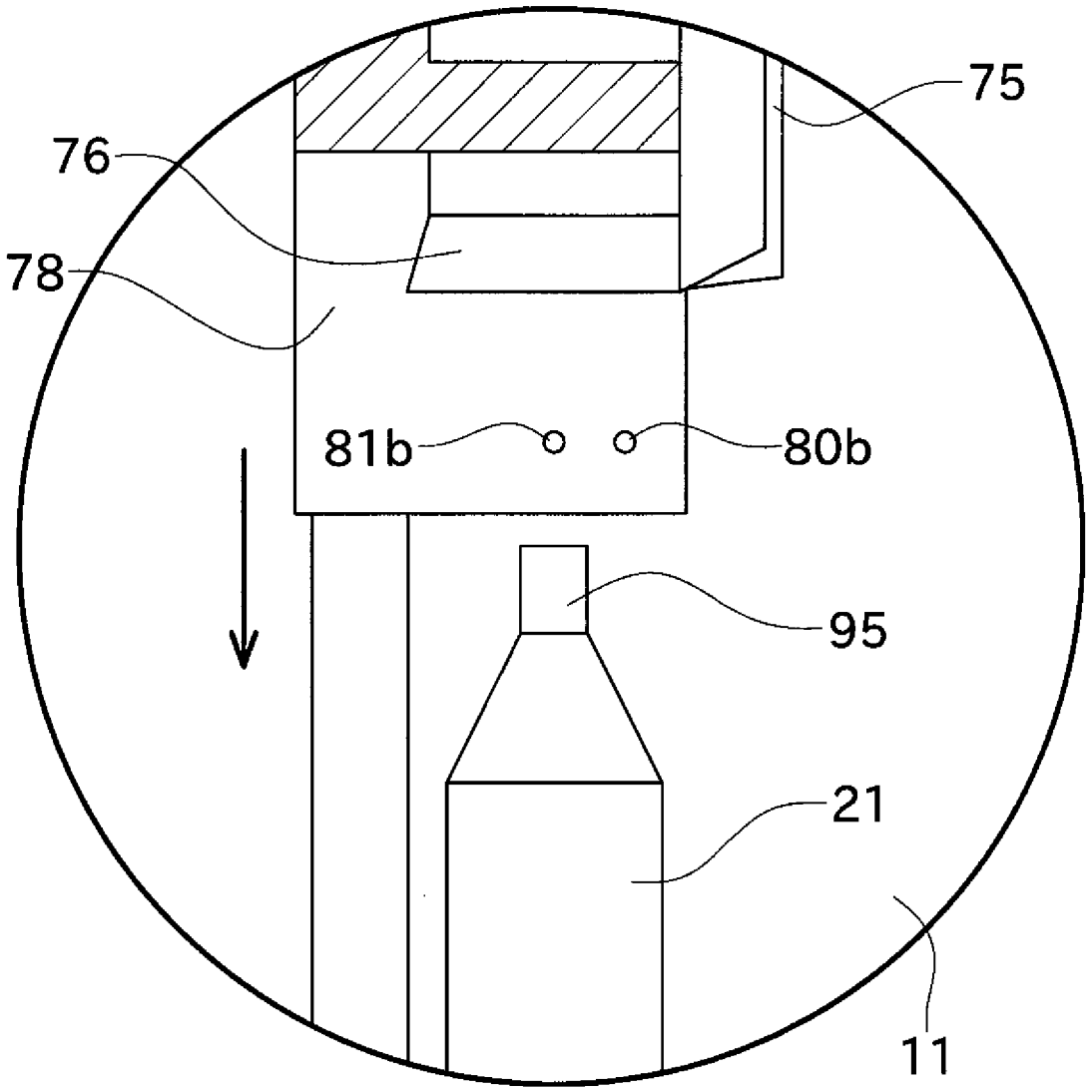


Fig.5

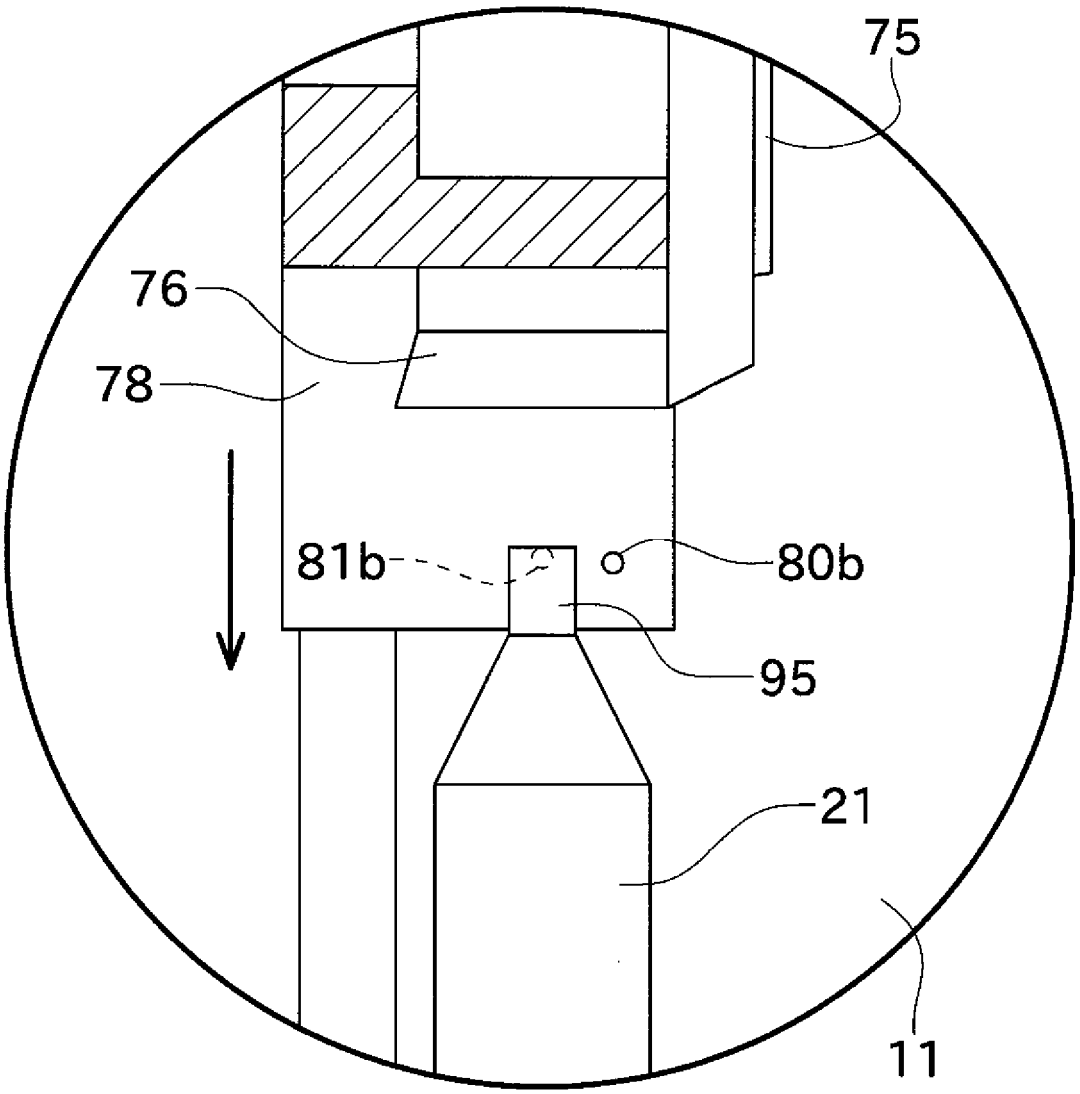


Fig.6

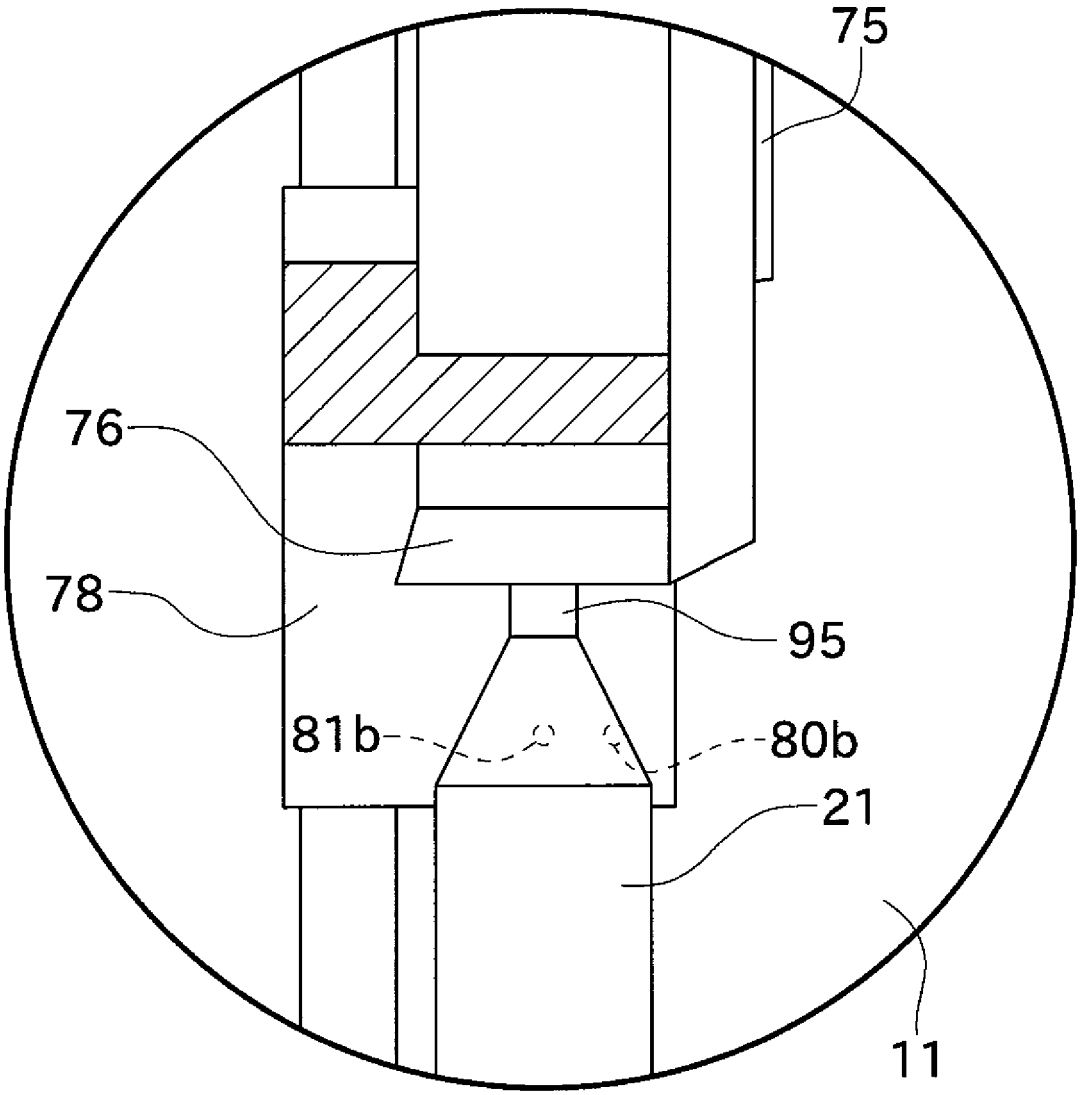
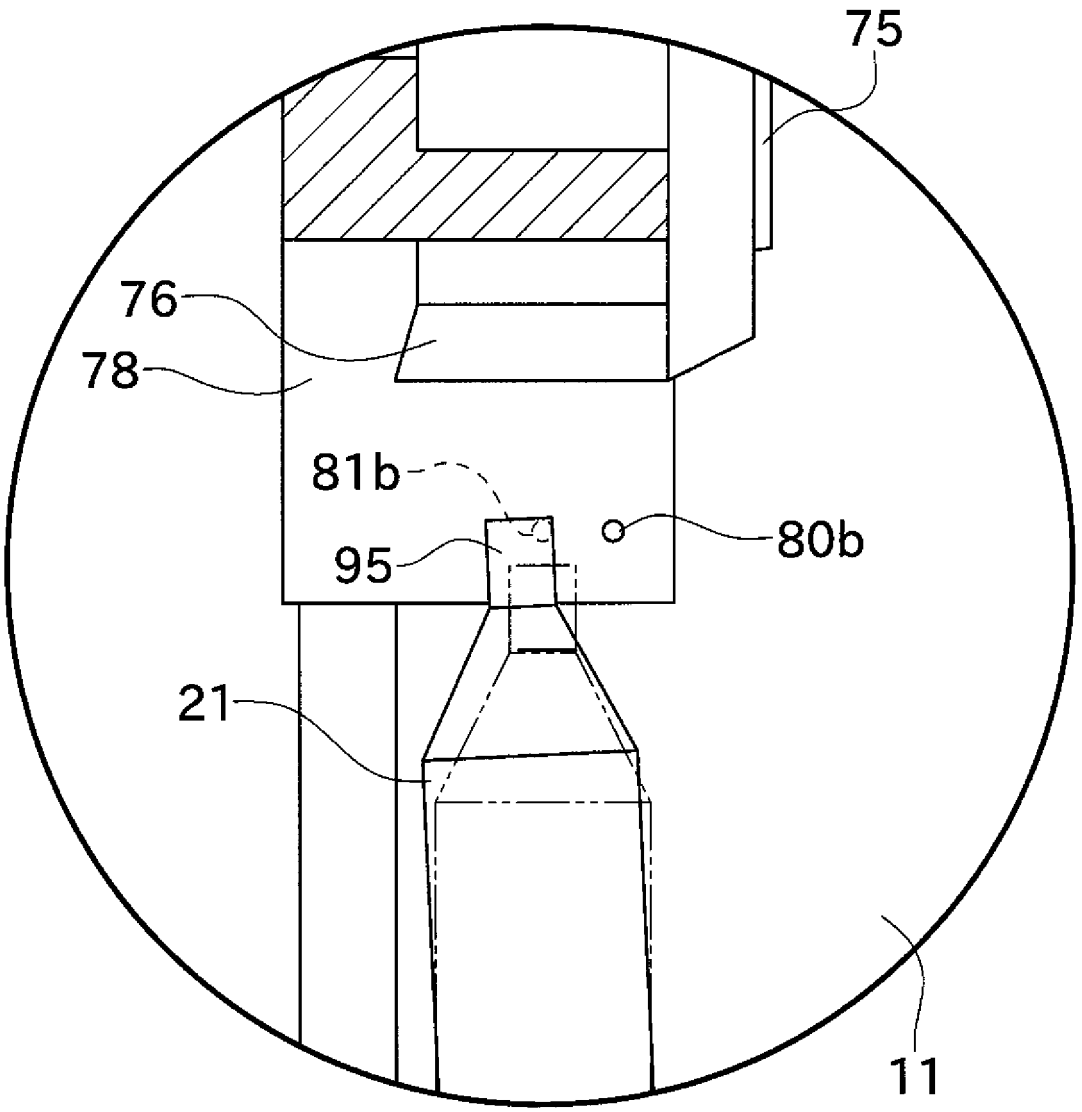


Fig.7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/006461

A. CLASSIFICATION OF SUBJECT MATTER
B65H63/00(2006.01)i, *B65H57/22*(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, B65H57/22

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.
X A	JP 5-78015 A (Murata Machinery Ltd.), 30 March 1993 (30.03.1993), paragraphs [0012] to [0024] (Family: none)	1-2 3-9
A	JP 2009-242028 A (Murata Machinery Ltd.), 22 October 2009 (22.10.2009), paragraphs [0006] to [0007], [0031] (Family: none)	1-9
A	JP 1-231769 A (Vue Rainerusu Fueruvuarutsungusu GmbH), 18 September 1989 (18.09.1989), page 1, left column, line 4 to page 6, upper left column, line 2 & US 5184786 A & EP 311815 A2	1-9

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

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"P" document published prior to the international filing date but later than the priority date claimed
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"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
20 December, 2010 (20.12.10)	28 December, 2010 (28.12.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/006461

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-303038 A (Toyota Industries Corp.), 22 November 2007 (22.11.2007), paragraph [0006] & EP 1857578 A2	1-9

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

REFERENCES CITED IN THE DESCRIPTION

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- JP 5078016 A **[0002] [0004]**
- JP 2003002540 A **[0002] [0004]**
- JP 1231769 A **[0003] [0004]**