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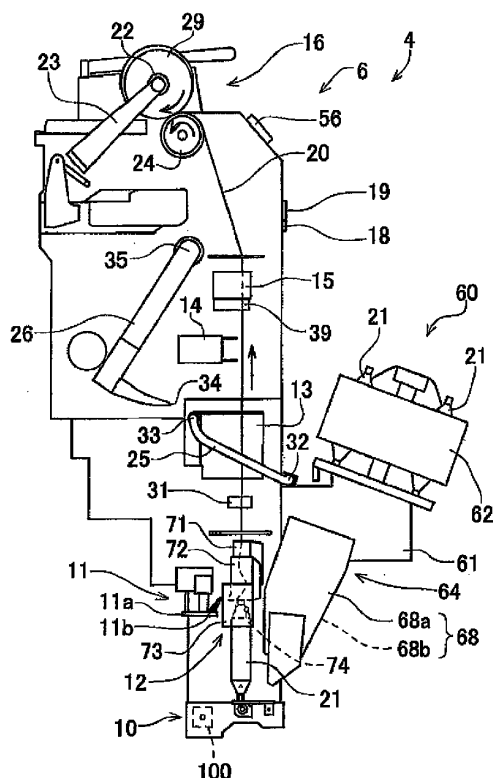
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(54) **Winding unit**

(57) The invention provides a winding unit (4) capable of performing a satisfactory winding operation by accurately aligning a position of an unwinding side end of a yarn feeding bobbin (21) with respect to a target position regardless of a diameter and/or a shape of the yarn feeding bobbin (21). A winder unit (winding unit) (4) includes a bobbin holding portion (110), a chase portion detection sensor (the yarn feeding bobbin detection unit) (74), a drive portion (200), and a stepping motor controller (102). The bobbin holding portion (110) holds the yarn feeding bobbin (21). The chase portion detection sensor (74) detects an unwinding side end of the yarn feeding bobbin (21) held by the bobbin holding portion (110). The drive portion (200) drives the bobbin holding portion (110) to adjust the position of the unwinding side end of the yarn feeding bobbin (21). The stepping motor controller (102) controls the drive portion (200) to align the position of the unwinding side end of the yarn feeding bobbin (21) with the target position set in advance based on a detection result of the chase portion detection sensor (74).

FIG. 2



Description

Technical Field

[0001] The present invention relates to a winding unit for unwinding a yarn from a yarn feeding bobbin and winding the unwound yarn around a winding bobbin.

Background Art

[0002] There is known a yarn winding machine in which a plurality of winding units for winding the yarn unwound from the yarn feeding bobbin around the winding bobbin to form a package are arranged in line. A positional relationship between the yarn feeding bobbin and a yarn guide arranged immediately above the yarn feeding bobbin is preferably constant in order for the winding unit to wind the yarn unwound from the yarn feeding bobbin into a satisfactory winding package. An unwinding assisting device for adjusting a balloon formed at an unwinding position, where the yarn of the yarn feeding bobbin is unwound, with a cylindrical balloon regulating unit is known as the yarn guide.

[0003] However, the yarn feeding bobbins of various shapes and inner diameters are supplied according to the yarn type, and the like. Thus, the positional relationship between the balloon regulating unit and the yarn feeding bobbin changes every time the type of yarn feeding bobbin that is supplied to the winding unit is changed. If the positional relationship of the balloon regulating unit and the yarn feeding bobbin changes, an unwinding tension generated on the yarn unwound from the yarn feeding bobbin becomes uneven. The operator thus needs to adjust the position upon unwinding of the yarn feeding bobbin so that an axis of the yarn feeding bobbin coincides with an axis of the balloon regulating unit every time the type of yarn feeding bobbin supplied to the winding unit is changed.

[0004] Japanese Unexamined Patent Publication Nos. H9-124230 and 2006-89284, on the other hand, describe a bobbin holding peg for supporting the inner periphery of the yarn feeding bobbin at a plurality of supporting points with a plurality of claw members (tightening claw group, gripping piece). According to such a configuration, the bobbin holding peg described in Japanese Unexamined Patent Publication Nos. H9-124230 and 2006-89284 can carry out a winding operation without changing the positional relationship of the yarn feeding bobbin and the winding device even with respect to the yarn feeding bobbin of different inner diameter. Therefore, the bobbin holding peg described in Japanese Unexamined Patent Publication Nos. H9-124230 and 2006-89284 can coincide the axis during unwinding of the yarn feeding bobbin with the axis of the balloon regulating unit.

[0005] In recent years, however, the type of yarn, a machine for winding up the yarn feeding bobbin in the previous process of the yarn winding machine, the type

and shape of the yarn feeding bobbin supplied to the winding unit are becoming diversified. The yarn feeding bobbin having a complicating shape such as a shape in which projections and depressions are formed inside the bobbin is sometimes supplied to the winding unit. The yarn feeding bobbin having a complicating shape may have its inner projections and depressions caught at the tip end of the claw member and held at a position tilted with respect to the claw member.

[0006] However, the winding unit including the bobbin holding peg described in Japanese Unexamined Patent Publication Nos. H9-124230 and 2006-89284 is not configured to check the position of the supplied yarn feeding bobbin. Thus, even if the yarn feeding bobbin is held with the axis center on the unwinding side of the yarn feeding bobbin deviated from the axis of the balloon regulating unit, the winding operation is advanced without checking a positional relationship of balloon regulating unit and yarn feeding bobbin.

[0007] There also exists a winding unit including a balloon regulating unit for regulating the balloon by being raised and lowered with respect to the yarn feeding bobbin. With such a winding unit, the balloon regulating unit may come into contact with the yarn feeding bobbin when being lowered if the shift between the yarn feeding bobbin and the raising and lowering type balloon regulating unit is significant. The contact between the balloon regulating unit and the yarn feeding bobbin becomes a cause of defective package such as stitching.

Disclosure of Invention

[0008] The present invention has been made in view of the above situations, and an object of the present invention is to provide a winding unit capable of performing a satisfactory winding operation by accurately aligning a position of an unwinding side end of a yarn feeding bobbin with respect to a target position regardless of a diameter and a shape of the yarn feeding bobbin.

[0009] According to the present invention, there is provided a winding unit for winding a yarn unwound from a yarn feeding bobbin to form a package with the following configuration. The winding unit includes a bobbin holding mechanism, a yarn feeding bobbin detection section, a drive portion, and a controller. The bobbin holding mechanism holds the yarn feeding bobbin. The yarn feeding bobbin detection section detects an unwinding side end of the yarn feeding bobbin held by the bobbin holding mechanism. The drive portion drives the bobbin holding mechanism to adjust a position of the unwinding side end of the yarn feeding bobbin. The controller controls the drive portion to align the position of the unwinding side end of the yarn feeding bobbin with a target position set in advance based on a detection result of the yarn feeding bobbin detection section.

[0010] Accordingly, in the winding unit of the present invention, the winding operation for forming the package from the yarn unwound from the yarn feeding bobbin can

be started after aligning the position of the unwinding side end of the yarn feeding bobbin with the target position. Thus, in the winding unit of the present invention, for example, a more appropriate winding operation can be performed since the winding operation can be started after aligning the position of the unwinding side end of the yarn feeding bobbin with the position at which the winding operation can be satisfactorily performed. Furthermore, since the adjustment of the position of the unwinding side end of the yarn feeding bobbin with respect to the target position can be automatically performed, a load of an operator can be alleviated compared to the configuration of manually adjusting the position of the unwinding side end of the yarn feeding bobbin.

[0011] The following configuration is preferably adopted in the winding unit described above. In other words, the winding unit further includes an unwinding assisting device for assisting the unwinding of the yarn of the yarn feeding bobbin. The target position set in advance is an unwinding standard position of the unwinding assisting device. The controller controls the drive portion to align the position of the unwinding side end of the yarn feeding bobbin with the unwinding standard position of the unwinding assisting device.

[0012] Accordingly, in the winding unit of the present invention, the position of the unwinding side end of the yarn feeding bobbin can be aligned with the unwinding standard position of the unwinding assisting device. Therefore, for example, the function of the unwinding assisting device can be appropriately exhibited in the winding unit of the present invention, and the operation efficiency of the winding operation can be improved by performing the winding operation while appropriately maintaining a tension of the yarn unwound from the yarn feeding bobbin.

[0013] The following configuration is preferably adopted in the winding unit described above. In other words, the winding unit includes a storage device for storing an adjustment distance for aligning the unwinding side end of the yarn feeding bobbin with the target position. The controller controls the drive portion so that the unwinding side end of the yarn feeding bobbin passes a detection region of the yarn feeding bobbin detection section, and controls the drive portion so as to move the position of the unwinding side end of the yarn feeding bobbin by the adjustment distance stored in the storage device from a position where the yarn feeding bobbin detection section detects the unwinding side end of the yarn feeding bobbin.

[0014] Accordingly, in the winding unit of the present invention, the unwinding side end of the yarn feeding bobbin can be moved to the target position based on the adjustment distance. Thus, the position of the unwinding side end of the yarn feeding bobbin can be more accurately aligned with the target position in the winding unit of the present invention.

[0015] The following configuration is preferably adopted in the winding unit described above. In other words,

the storage device stores a plurality of adjustment distances according to a type of the yarn feeding bobbin. Moreover, a setting section for setting one adjustment distance of the plurality of adjustment distances stored in the storage device is arranged. The drive portion is controlled based on the adjustment distance set by the setting section.

[0016] Accordingly, in the winding unit of the present invention, the position of the unwinding side end of the yarn feeding bobbin can be aligned with the target position based on the plurality of adjustment distances corresponding to the type of yarn feeding bobbin. Therefore, for example, the operator can set the type of the yarn feeding bobbin to perform the winding operation with respect to the winding unit and can more precisely align the position of the unwinding side end of the yarn feeding bobbin with the target position.

[0017] The following configuration is preferably adopted in the winding unit described above. In other words, the winding unit includes a storage device and a calculation section. The storage device stores an adjustment distance for aligning the unwinding side end of the yarn feeding bobbin with the target position. The calculation section calculates a first position which is a position where the unwinding side end of the yarn feeding bobbin enters the detection region of the yarn feeding bobbin detection section, a second position which is a position where the unwinding side end of the yarn feeding bobbin exits from the detection region of the yarn feeding bobbin detection section, and a third position which is an intermediate position between the first position and the second position, and calculates a final adjustment distance from the third position and the adjustment distance stored in the storage device. The controller controls the drive portion so as to move the position of the unwinding side end of the yarn feeding bobbin by the final adjustment distance calculated by the calculation section from the second position.

[0018] Accordingly, in the winding unit of the present invention, the diameter of the yarn feeding bobbin can be calculated by calculating the first position and the second position, and the position of an axis of the yarn feeding bobbin can be calculated by calculating the third position. Therefore, the position of the axis of the unwinding side end of the yarn feeding bobbin can be aligned with the target position in the winding unit of the present invention. Accordingly, the position of the unwinding side end of the yarn feeding bobbin can be aligned with a more appropriate position to perform the winding operation in the winding unit of the present invention.

[0019] The following configuration is preferably adopted in the winding unit described above. In other words, the yarn feeding bobbin detection section in the winding unit is arranged at the target position. The winding unit includes a controller and a calculation section. The controller drives the drive portion so that the unwinding side end of the yarn feeding bobbin passes the detection region of the yarn feeding bobbin detection section. The

calculation section calculates a first position which is a position where the unwinding side end of the yarn feeding bobbin enters the detection region of the yarn feeding bobbin detection section, a second position which is a position where the unwinding side end of the yarn feeding bobbin exits from the detection region of the yarn feeding bobbin detection section, and a third position which is an intermediate position between the first position and the second position. The controller controls the drive portion so as to move the position of the unwinding side end of the yarn feeding bobbin from the second position to the third position based on a calculation result of the calculation section.

[0020] Accordingly, in the winding unit of the present invention, the position of the unwinding side end of the yarn feeding bobbin can be easily and accurately aligned with the target position since the calculation of the position of the axis of the yarn feeding bobbin is performed by the yarn feeding bobbin detection section arranged at the target position.

[0021] The following configuration is preferably adopted in the winding unit described above. In other words, the unwinding assisting device assists the unwinding of the yarn of the yarn feeding bobbin by moving following change of a chase portion which is a yarn layer end of the yarn feeding bobbin involved in advancement of the winding operation. The yarn feeding bobbin detection section is a chase portion detection section capable of detecting the chase portion.

[0022] Accordingly, in the winding unit of the present invention, the detection section for detecting the unwinding side end of the yarn feeding bobbin and the detection section for detecting the chase portion can be commonly configured. The number of components thus can be reduced in the winding unit of the present invention. Therefore, the winding unit of the present invention can be configured small and manufactured at low cost.

[0023] The following configuration is preferably adopted in the winding unit described above. In other words, the unwinding assisting device includes an unwinding tubular member which is a tubular member for assisting the unwinding of the yarn of the yarn feeding bobbin by moving in a vertical direction. The unwinding standard position is positioned on an extended line of an axis center of the unwinding tubular member.

[0024] Accordingly, in the winding unit of the present invention, the unwinding side end of the yarn feeding bobbin can be aligned on the extended line of the axis of the unwinding tubular member, so that the winding operation can be performed while more appropriately maintaining the tension of the yarn unwound from the yarn feeding bobbin.

[0025] In the winding unit described above, the drive portion preferably includes a stepping motor including an origin sensor having a point where the position of the unwinding side end of the yarn feeding bobbin is positioned on the extended line of the axis center of the unwinding tubular member as an origin.

[0026] The winding unit of the present invention can adjust the position of the unwinding side end of the yarn feeding bobbin more easily and precisely by aligning the position of the unwinding side end of the yarn feeding bobbin with the target position using the number of steps of the motor.

[0027] The following configuration is preferably adopted in the winding unit described above. In other words, the winding unit further includes a yarn kink preventer for preventing the yarn unwound from the yarn feeding bobbin from kinking by coming into contact with the yarn feeding bobbin. The controller controls the yarn kink preventer to come into contact with the yarn feeding bobbin before the position of the unwinding side end of the yarn feeding bobbin is aligned with the target position.

[0028] The winding unit of the present invention can bring the yarn of the yarn feeding bobbin into contact with the yarn kink preventer before the position of the unwinding side end of the yarn feeding bobbin is aligned with the target position. Thus, for example, the winding unit of the present invention can prevent the yarn from kinking when the yarn of the yarn feeding bobbin is unwound during the operation of aligning the position of the unwinding side end of the yarn feeding bobbin with the target position.

[0029] The following configuration is preferably adopted in the winding unit described above. In other words, the bobbin holding mechanism includes a defining member and a holding member. The defining member defines the position of the yarn feeding bobbin. The holding member causes the defining member to hold the yarn feeding bobbin by changing the position with respect to the defining member. A direction of adjusting the position of the unwinding side end of the yarn feeding bobbin is a direction of changing the position of the holding member with respect to the defining member.

[0030] With the configuration in which the bobbin holding mechanism includes the defining member and the holding member, the winding unit of the present invention can align the position of the unwinding side end of the yarn feeding bobbin with the target position even if the position of the unwinding side end of the yarn feeding bobbin is shifted in the direction of changing the position of the holding member with respect to the defining member from the target position.

Brief Description of Figures in the Drawings

[0031] FIG. 1 is an outer appearance perspective view illustrating an overall configuration of an automatic winder according to one embodiment of the present invention;

[0032] FIG. 2 is a schematic side view of the winder unit;

[0033] FIG. 3 is a block diagram illustrating a main configuration of the winder unit;

[0034] FIG. 4 is an enlarged perspective view illustrating a configuration of an unwinding assisting device;

[0035] FIG. 5 is a perspective view illustrating a con-

figuration of a bobbin setting section;

[0036] FIGS. 6A to 6C are side views each illustrating a shape of a cam arranged in a power transmission unit;

[0037] FIG. 7 is a side view illustrating a configuration of an adjustment unit when a main axis member is in a receiving position;

[0038] FIG. 8 is a side view illustrating the configuration of the adjustment unit when the main axis member is in an unwinding position;

[0039] FIG. 9 is a side view illustrating the configuration of the adjustment unit when the main axis member is in a discharging position;

[0040] FIG. 10 is a flowchart illustrating a process performed by the winder unit when yarn cut or the like occurs;

[0041] FIGS. 11A and 11B are side views illustrating a first half of a state in which a position of an unwinding side end of the yarn feeding bobbin is adjusted;

[0042] FIGS. 12A and 12B are side views illustrating a last half of the state in which the position of the unwinding side end of the yarn feeding bobbin is adjusted;

[0043] FIG. 13 is a block diagram illustrating a modified example of a machine control device;

[0044] FIG. 14 is a flowchart illustrating the process of adjusting the position of the unwinding side end of the yarn feeding bobbin;

[0045] FIG. 15 is a block diagram illustrating the main configuration of the winder unit according to a first variant and a second variant;

[0046] FIG. 16 is a flowchart illustrating a process of adjusting the position of the unwinding side end of the yarn feeding bobbin according to the first variant;

[0047] FIGS. 17A and 17B are side views illustrating the first half of the state in which the position of the unwinding side end of the yarn feeding bobbin is adjusted according to the first variant;

[0048] FIGS. 18A and 18B are side views illustrating the last half of the state in which the position of the unwinding side end of the yarn feeding bobbin is adjusted according to the first variant;

[0049] FIG. 19 is a flowchart illustrating a process of adjusting the position of the unwinding side end of the yarn feeding bobbin according to the second variant;

[0050] FIGS. 20A and 20B are side views illustrating the first half of the state in which the position of the unwinding side end of the yarn feeding bobbin is adjusted according to the second variant; and

[0051] FIGS. 21A and 21B are side views illustrating the last half of the state in which the position of the unwinding side end of the yarn feeding bobbin is adjusted according to the second variant.

Best Mode for Carrying Out the Invention

[0052] An embodiment of the present invention will be described with reference to the drawings. First, an outline of an automatic winder 1 of the present embodiment will be described with reference to FIG. 1. In the following description, a front side of a winder unit 4 is simply re-

ferred to as the "front side", and a rear side of the winder unit 4 is simply referred to as the "rear side".

[0053] An automatic winder (yarn winding machine) 1 of the present embodiment includes a plurality of winder units (winding units) 4 arranged in line, and a machine control device 7 arranged at one end in a direction in which the plurality of winder units 4 are arranged in line.

[0054] Each of the winder units 4 includes a unit frame 5 arranged on one side on the left and the right when seen from the front surface, and a winding unit main body 6 arranged at the side of the unit frame 5. A unit controller 50 (see FIG. 3) for controlling each unit of the winding unit main body 6 is arranged inside the unit frame 5. The unit controller 50 includes a determination unit 51, a storage device 52, and a calculation section 53. The detailed function of each of the configurations of the unit controller 50 will be described later. The unit frame 5 also includes a unit input section (setting section) 18 capable of inputting the setting or the like of the winding unit main body 6, and a unit display section 19 capable of displaying the state or the like of the winding operation. The unit input section 18 may be configured as a key or a button, for example.

[0055] The machine control device 7 is configured to be communicable with the unit controller 50. The machine control device 7 thus can manage the operation of the plurality of winder units 4 in a concentrated manner. The machine control device 7 includes a machine input section (setting section) 8 for performing various settings on each winder unit 4, and a machine display section 9 capable of displaying the state or the like of the winding operation of each winder unit 4. The setting the machine control device 7 performs on each winder unit 4 includes the input of the type of yarn feeding bobbin 21 used in the winding operation of each winder unit 4.

[0056] The winder unit 4 will now be described in detail with reference to FIG. 2 and FIG. 3. The winder unit 4 winds a yarn from the yarn feeding bobbin 21 around a winding bobbin 22 to form a package 29. Each portion of the winder unit 4 will be described below.

[0057] As illustrated in FIG. 1 and FIG. 2, a bobbin supply device 60 is arranged on the front side of the winder unit 4 and an operator supplies the yarn feeding bobbin 21 to this bobbin supply device 60. The bobbin supply device 60 includes a magazine holding portion 61 installed towards the upward direction of the front surface from the lower part of the winder unit 4, a magazine can 62 attached to the upper end side of the magazine holding portion 61, a yarn feeding bobbin guiding unit 64 installed at the lower side of the magazine can 62, and an open/close unit 68.

[0058] A plurality of accommodation holes is formed lined in a circular form in the magazine can 62, so that the yarn feeding bobbin 21 can be set in an inclined position in each accommodation hole. The magazine can 62 is configured to be intermittently driven by a motor (not illustrated). When intermittently driven, the magazine can 62 moves a plurality of yarn feeding bobbins 21

set in the magazine can 62 to the yarn feeding bobbin guiding unit 64 one at a time. The moved yarn feeding bobbin 21 is then dropped to a diagonally lower side from the magazine can 62.

[0059] The yarn feeding bobbin guiding unit 64 is configured to diagonally slide and drop the yarn feeding bobbin 21 dropped from the magazine can 62, and guide the same to a bobbin holding portion (bobbin holding mechanism) 110 of a bobbin setting section 10. As illustrated in FIG. 5, the bobbin setting section 10 includes a discharge plate 40 for discharging the yarn feeding bobbin 21 (core tube 21 a), from which unwinding of the yarn is completed, and a drive portion 200 for operating the bobbin holding portion 110 and the discharge plate 40, in addition to the bobbin holding portion 110. The details of the bobbin setting section 10 will be described later.

[0060] The open/close unit 68 is configured by a pair of open/close members 68a, 68b that can oscillate between a near side in FIG. 2 and a far side in FIG. 2. The pair of open/close members 68a, 68b can switch between a closed state (state illustrated in FIG. 2) and an open state. When the open/close unit 68 is closed, the inner surface of the open/close unit 68 configures one portion of the yarn feeding bobbin guiding unit 64. That is, when the open/close unit 68 is closed, the inner surface of the open/close unit 68 comes into contact with the yarn feeding bobbin 21 dropped from the magazine can 62, and guides the yarn feeding bobbin 21 to the bobbin setting section 10 at the diagonally lower side. When the open/close unit 68 is opened, on the other hand, the winder unit 4 can discharge the yarn feeding bobbin 21, in which the winding is completed and the yarn is not wound, to the front side. A conveyor 3 (see FIG. 1) is installed on the front side of the open/close unit 68. Thus, the automatic winder 1 can convey the yarn feeding bobbin 21 discharged from the open/close unit 68 to a yarn feeding bobbin collecting box (not illustrated) arranged at the end in the conveying direction of the conveyor 3.

[0061] The bobbin holding portion 110 is configured to oscillate to the front side and the rear side when a stepping motor 100 illustrated in FIG. 2 and FIG. 3 is driven. As illustrated in FIG. 3, the stepping motor 100 is controlled by a stepping motor controller (control section) 102. An origin sensor 101 is attached at an appropriate position of the bobbin setting section 10, where the rotational control of the stepping motor 100 is carried out with the rotation state of the stepping motor 100 detected by the origin sensor 101 as a reference. A location and a member for attaching the origin sensor 101 will be described later.

[0062] The bobbin holding portion 110 is configured to oscillate between the rear side and the front side. A yarn feeding bobbin supporting unit 80 oscillates from the rear side to the front side to receive the yarn feeding bobbin 21 guided by the yarn feeding bobbin guiding unit 64. The bobbin holding portion 110 can set the received yarn feeding bobbin 21 in a substantially upright state by oscillating to the rear side. The details on the mechanism

for oscillating the bobbin holding portion 110 by the drive of the stepping motor 100 and the control performed by the stepping motor controller 102 will be described later.

[0063] As described above, the yarn 20 of the yarn feeding bobbin 21 set in the bobbin holding portion 110 of the bobbin setting section 10 is wound by a winding unit 16. As illustrated in FIG. 2, the winding unit 16 includes a cradle 23 configured to be able to attach the winding bobbin 22, and a traverse drum for traversing the yarn 20 and driving the winding bobbin 22.

[0064] The winding unit main body 6 includes various types of devices on a yarn traveling path between the bobbin setting section 10 and the traverse drum 24. The main devices of the winding unit main body 6 arranged on the yarn traveling path include a yarn kink preventer 11, an unwinding assisting device 12, a tension applying device 13, a yarn slicing device 14, and a clearer (yarn quality measuring device) 15 in this order from the bobbin setting section 10 to the traverse drum 24.

[0065] As illustrated in FIG. 4, the unwinding assisting device 12 includes a fixed member 71, a movable member (unwinding tubular member) 72, a raising/lowering member 73, and a chase portion detection sensor (yarn feeding bobbin detection section, chase portion detection section) 74. FIG. 4 is an enlarged perspective view illustrating the configuration of the unwinding assisting device 12.

[0066] The fixed member 71 is fixed to the unit frame 5 by way of an appropriate member. A throttle (not illustrated) for controlling the balloon is formed at the lower part of the fixed member 71. The movable member 72 is formed to a tubular shape, and is arranged to cover the outer side of the fixed member 71. In the following description, a center axis line of the movable member 72 configured to a tubular shape and a line extended from the center axis line are referred to as a virtual line L1.

[0067] The raising/lowering member 73 is integrally formed with the movable member 72. The raising/lowering member 73 and the movable member 72 are configured to be movable in the vertical direction. Furthermore, the raising/lowering member 73 includes a chase portion detection sensor 74 for detecting a chase portion 21b (see FIG. 4) of the yarn feeding bobbin 21. The chase portion 21 b is a yarn layer end of the yarn feeding bobbin 21 that lowers with advancement of the winding operation. The chase portion detection sensor 74 is a transmissive type photosensor including a light projecting portion 74a and a light receiving portion 74b. As illustrated in FIG. 3, a detection signal detected by the chase portion detection sensor 74 is inputted to the unit controller 50.

[0068] According to such a configuration, the winder unit 4 operates the raising/lowering member 73 based on the detection signal of the chase portion detection sensor 74. The winder unit 4 thus can position the movable member 72 at a predetermined distance from the chase portion 21b. The winder unit 4 can also cause the chase portion 21 b that lowers with advancement in the unwinding of the yarn feeding bobbin 21 to follow the

raising/lowering member 73. Therefore, the winder unit 4 can always keep the distance between the chase portion 21 b and the movable member 72 constant. According to such operations, the winder unit 4 can appropriately regulate the magnitude of the balloon generated at the position the yarn is disengaged from the chase portion 21b when the yarn feeding bobbin 21 is being unwound. Furthermore, according to the above operations, the winder unit 4 can carry out the winding operation while maintaining the tension of the yarn unwound from the yarn feeding bobbin 21 constant. The unwinding side end of the yarn feeding bobbin 21 needs to be aligned with the position (unwinding standard position) on the virtual line L1 in order for the winder unit 4 to perform such an appropriate unwinding assisting operation. The details on the control and the like for adjusting the position of the unwinding side end of the yarn feeding bobbin 21 will be described later.

[0069] The yarn kink preventer 11 for preventing the yarn kink is arranged on the rear side of the unwinding assisting device 12. The kink of the yarn is a state in which the yarn curls and entangles in a spiral shape, which is one drawback that occurs in the yarn. The yarn kink preventer 11 includes a brush arm 11a, and a brush portion 11b formed at the tip end of the brush arm 11a. The brush arm 11a is configured to be turnable. The winder unit 4 can bring the brush portion 11 b into contact with the upper end portion of the yarn feeding bobbin 21 by turning the brush arm 11a. The winder unit 4 thus can apply an appropriate tension on the yarn 20 at the time of the yarn splicing operation and the like to prevent the occurrence of yarn kinking.

[0070] The tension applying device 13 applies a predetermined tension on the traveling yarn 20. The tension applying device 13 of the present embodiment is configured to a gate form in which a movable comb tooth is arranged with respect to a fixed comb tooth. The comb tooth on the movable side is configured to be turnable by a rotary type solenoid. The fixed comb tooth and the movable comb tooth are switched to the closed state or the opened state by turning the comb tooth on the movable side.

[0071] A lower yarn detection sensor 31 is arranged between the unwinding assisting device 12 and the tension applying device 13. The lower yarn detection sensor 31 is configured to detect whether the yarn is traveling between the unwinding assisting device 12 and the tension applying device.

[0072] The clearer 15 monitors the yarn thickness of the yarn 20 to detect a yarn defect (yarn flaw) such as slub. A cutter 39 for immediately cutting the yarn 20 when the clearer 15 detects the yarn defect is arranged on the upstream side (lower side) of the clearer 15 in the yarn path.

[0073] The yarn splicing device 14 splices the lower yarn from the yarn feeding bobbin 21 and the upper yarn from the package 29 after the clearer 15 detects the yarn defect and cuts the yarn by the cutter 39, after yarn cut

of the yarn is unwound from the yarn feeding bobbin 21, or after replacing the yarn feeding bobbin 21. The yarn splicing device 14 may be a type that uses fluid such as compressed air or may be a mechanical type.

[0074] A lower yarn guiding pipe 25 for catching and guiding the lower yarn from the yarn feeding bobbin 21 is arranged on the lower side of the yarn splicing device 14. An upper yarn guiding pipe 26 for catching and guiding the upper yarn from the package 29 is arranged on the upper side of the yarn splicing device 14. A suction hole 32 is formed at the tip end of the lower yarn guiding pipe 25 and a suction mouse 34 is arranged at the tip end of the upper yarn guiding pipe 26. The lower yarn guiding pipe 25 and the upper yarn guiding pipe 26 are respectively connected to an appropriate negative pressure source to cause the suction hole 32 and the suction mouse 34 to generate a suction force.

[0075] With such a configuration, the suction hole 32 of the lower yarn guiding pipe 25 is turned to the lower side to suck and catch the lower yarn, and thereafter, is turned to the upper side with a shaft 33 as the center to guide the lower yarn to the yarn splicing device 14 when replacing the yarn feeding bobbin 21, or the like. Almost at the same time, the winder unit 4 turns the upper yarn guiding pipe 26 to the upper side with a shaft 35 as the center from the position of FIG. 2 and also reversely rotates the package 29 to catch the upper yarn unwound from the package 29 with the suction mouse 34. Subsequently, the winder unit 4 guides the upper yarn to the yarn splicing device 14 by turning the upper yarn guiding pipe 26 to the lower side with the shaft 35 as the center. The yarn splicing operation is then carried out on the lower yarn and the upper yarn in the yarn splicing device 14.

[0076] As illustrated in FIG. 2 and FIG. 3, the unit frame 5 includes a notification lamp 56. The notification lamp 56 is connected to the unit controller 50 as illustrated in FIG. 3 to notify the abnormality that occurred in each unit of the winding unit main body 6 to the operator. The notification lamp 56 is configured to notify the occurrence of abnormality to the operator by using light, but instead of such a configuration, the notification lamp 56 may be configured to notify with buzzer and the like.

[0077] With such a configuration, each winder unit 4 of the automatic winder 1 can wind the yarn 20 unwound from the yarn feeding bobbin 21 around the winding bobbin 22 to form the package 29 of a predetermined length.

[0078] The bobbin setting section 10 will now be described in detail with reference to FIG. 5 to FIG. 9.

[0079] As described above, the bobbin setting section 10 includes the bobbin holding portion 110 for holding the supplied yarn feeding bobbin 21, the discharge plate 40 for discharging the yarn feeding bobbin 21 (core tube 21 a) which unwinding of the yarn is completed, and a drive portion 200 for operating the bobbin holding portion 110 and the discharge plate 40. The drive portion 200 is configured by a stepping motor 100, and a power transmission unit 120 for transmitting the power of the stepping

motor 100 to the discharge plate 40 and the bobbin holding portion 110.

[0080] The bobbin holding portion 110 oscillates as illustrated in FIG. 7 to FIG. 9 to change the position of the unwinding side end of the yarn feeding bobbin 21. The bobbin holding portion 110 is configured by a main axis member (defining member) 80 and an auxiliary main axis member (holding member) 90. As illustrated in FIG. 7, the main axis member 80 and the auxiliary main axis member 90 are closed when the yarn feeding bobbin 21 is supplied so as to enter the interior of the core tube 21 a. The bobbin holding portion 110 holds the yarn feeding bobbin 21 (see FIG. 8) when the auxiliary main axis member 90 oscillates in this state in the direction of moving away from the main axis member 80. The winder unit 4 oscillates the discharge plate 40 with the holding of the yarn feeding bobbin 21 by the bobbin holding portion 110 released. The winder unit 4 pushes out the bottom of the core tube 21 to take out the main axis member 80 and the auxiliary main axis member 90 by such oscillation. This operation enables the winder unit 4 to discharge the yarn feeding bobbin 21 (see FIG. 9).

[0081] The power transmission unit 120 will now be described. As illustrated in FIG. 5, the power transmission unit 120 includes a main axis member drive cam 81, a bearing 82, an oscillation arm 83, a positioning arm 84a, a contact arm 84b, a transmission shaft 85, and a pushing spring 86, as a configuration for oscillating the main axis member 80. The power transmission unit 120 further includes a transmission belt 103, a pulley 104, and a cam shaft 105 as a configuration for transmitting the power of the stepping motor 100 to the main axis member drive cam 81 and the like.

[0082] The pulley 104 is fixed to the cam shaft 105, and is coupled to the output shaft of the stepping motor 100 through the transmission belt 103. The transmission belt 103 is simply illustrated in FIG. 5, but is configured as a timing belt with teeth. The transmission belt 103 thus can transmit the rotation of the output shaft of the stepping motor 100 to the cam shaft 105 without slipping.

[0083] The origin sensor 101 (not illustrated in FIG. 5) is attached to the pulley 104. The origin sensor 101 is configured to send a detection signal when the pulley 104 or the cam shaft 105 is at a predetermined rotation phase. The rotation state when the origin sensor 101 transmits the detection signal becomes the origin of the stepping motor 100. The rotation control of the stepping motor 100 is carried out with such an origin as the reference.

[0084] The main axis member drive cam 81 is fixed to the cam shaft 105 to integrally rotate with the cam shaft 105. The oscillation arm 83 is arranged on the rear side than the main axis member drive cam 81. The rotatable bearing 82 is attached to the middle part of the oscillation arm 83. The bearing 82 is configured to appropriately rotate while coming into contact with the outer peripheral surface of the main axis member drive cam 81.

[0085] The tip end of the oscillation arm 83 is coupled

to one end of the positioning arm 84a supported in an oscillating manner at the appropriate position of the power transmission unit 120 through a rod shaped link. The rotatable rotation member 87 is supported at the other end of the positioning arm 84a.

[0086] The contact arm 84b is arranged on the front side than the positioning arm 84a. The tip end of the contact arm 84b is configured to come into contact with the rotation member 87 attached to the positioning arm 84a. One end of the transmission shaft 85 is fixed to the base of the contact arm 84b, and the other end of the transmission shaft 85 is fixed to the main axis member 80. That is, the transmission shaft 85 and the main axis member 80 are configured to cooperatively operate with each other. Therefore, the main axis member 80 integrally oscillates with the contact arm 84b. The torsion coil spring shaped pushing spring 86 is attached to the contact arm 84b. The pushing spring 86 biases the contact arm 84b in the direction of the arrow in FIG. 5.

[0087] The elastic force of the pushing spring 86 acts on the contact arm 84b according to the above configuration. This elastic force causes the contact arm 86b to come into contact with the rotation member 87 and push the positioning arm 84a. Furthermore, the bearing 82 of the oscillation arm 83 is pushed against the main axis member drive cam 81 since one end of the positioning arm 84a pulls the oscillation arm 83 through the link. Therefore, the pushing spring 86 generates a spring force for bringing the main axis member drive cam 81 in contact with the bearing 82, and for bringing the contact arm 84b in contact with the positioning arm 84a.

[0088] When the main axis member drive cam 81 rotates in such a state and the edge (bulged portion to be described later) of the main axis member drive cam 81 pushes the bearing 82, the oscillation arm 83 turns in the direction of moving away from the cam shaft 105, and the tip end of the oscillation arm 83 pulls the lower end of the positioning arm 84a through the link. As a result, the rotation member 87 at the upper end of the positioning arm 84a pushes the contact arm 84b, so that the power transmission unit 120 can oscillate the main axis member 80 towards the front side along with the contact arm 84b (see FIG. 8).

[0089] The power transmission unit 120 includes an auxiliary main axis member drive cam 91, a bearing 92, an oscillation arm 93, a transmission arm 94, a transmission shaft 95, and a holding spring 96 as a configuration for transmitting the power of the stepping motor 100 to the auxiliary main axis member 90.

[0090] The auxiliary main axis member drive cam 91 is fixed to the cam shaft 105, similar to the main axis member drive cam 81. The oscillation arm 93 is arranged on the rear side than the auxiliary main axis member drive cam 91. The rotatable bearing 92 is attached to the middle part of the oscillation arm 93. The bearing 92 is configured to appropriately rotate while making contact with the outer peripheral surface of the auxiliary main axis member drive cam 91.

[0091] One end of the oscillation arm 93 is coupled to the end of the transmission arm 94 supported in an oscillating manner at the appropriate position of the power transmission unit 120 through a rod shaped link. One end of the transmission shaft 95 is attached to the base of the transmission arm 94, and the other end of the transmission shaft 95 is fixed to the auxiliary main axis member 90. That is, the transmission shaft 95 and the auxiliary main axis member 90 are configured to cooperate with each other. Therefore, the auxiliary main axis member 90 integrally oscillates with the transmission arm 94. A torsion coil spring shaped holding spring 96 is attached to the transmission arm 94. The holding spring 96 biases the transmission arm 94 in the direction of the dotted line arrow of FIG. 5.

[0092] With such a configuration, the holding spring 96 acts the spring force in the direction the auxiliary main axis member 90 oscillates towards the rear side (direction of moving away from the main axis member 80) on the auxiliary main axis member 90 through the transmission arm 94 and the transmission shaft 95. Furthermore, the bearing 92 of the oscillation arm 93 is pushed against the auxiliary main axis member drive cam 91 since the tip end of the transmission arm 94, on which the elastic force of the holding spring 96 acts, pulls the oscillation arm 93 through the link. Therefore, the holding spring 96 generates the spring force for bringing the auxiliary main axis member drive cam 91 into contact with the bearing 92.

[0093] When the auxiliary main axis member drive cam 91 rotates in this state and the edge (bulged portion to be described later) of the auxiliary cam member drive cam 91 pushes the bearing 92, the oscillation arm 93 oscillates in the direction of moving away from the cam shaft 105. The oscillation arm 93 pulls the end of the transmission arm 94 through the link. As a result, the power transmission unit 120 can oscillate the auxiliary main axis member 90 towards the front side (direction of moving closer to the main axis member 80).

[0094] When the auxiliary main axis member 90 is oscillated towards the front side exceeding a predetermined angle, the auxiliary main axis member 90 comes into contact with a portion (not illustrated) of the main axis member 80, and thereafter, the auxiliary main axis member 90 and the main axis member 80 integrally oscillate as the auxiliary main axis member 90 pushes the main axis member 80. In this case, the tip end of the contact arm 84b and the rotation member 87 are appropriately spaced apart. In other words, the main axis member 80 is driven by the auxiliary main axis member drive cam 91 rather than by the main axis member drive cam 81 when the auxiliary main axis member 90 is oscillated towards the front side exceeding a predetermined angle.

[0095] The configuration for driving the discharge plate 40 will now be described. The power transmission unit 120 includes a discharge plate drive cam 41, a bearing 42, an oscillation arm 43, a transmission arm 44, a transmission shaft 45, and a return spring 46 as a configuration

for transmitting the power of the stepping motor 100 to the discharge plate 40.

[0096] The discharge plate drive cam 41 is fixed to the cam shaft 105, similar to the auxiliary main axis member drive cam 91 and the main axis member drive cam 81. The oscillation arm 43 is arranged on the rear side than the discharge plate drive cam 41. The rotatable bearing 42 is attached to the middle part of the oscillation arm 43. The bearing 42 is configured to appropriately rotate while making contact with the outer peripheral surface of the discharge plate drive cam 41.

[0097] One end of the oscillation arm 43 is coupled to the end of the transmission arm 44 supported in an oscillating manner at the appropriate position of the power transmission unit 120 through a rod shaped link. One end of the transmission shaft 45 is attached to the base of the transmission arm 44, and the other end of the transmission shaft 45 is fixed to the discharge plate 40. That is, the transmission shaft 45 and the discharge plate 40 are configured to cooperate with each other. Therefore, the discharge plate 40 integrally oscillates with the transmission arm 44. The torsion coil spring shaped return spring 46 is attached to the transmission arm 44. The return spring 46 biases the transmission arm 44 in the direction of the dotted line arrow of FIG. 5.

[0098] With such a configuration, the bearing 42 of the oscillation arm 43 is pushed against the discharge plate drive cam 41 since the tip end of the transmission arm 44, on which the elastic force of the return spring 46 acts, pulls the oscillation arm 43 through the link. Therefore, the return spring 46 generates the spring force for bringing the discharge plate drive cam 41 into contact with the bearing 42.

[0099] When the discharge plate drive cam 41 rotates in this state and the edge (bulged portion to be described later) of the discharge plate drive cam 41 pushes the bearing 42, the oscillation arm 43 moves in the direction of moving away from the cam shaft 105 and the tip end of the oscillation arm 43 pulls the end of the transmission arm 44 through the link. As a result, the power transmission unit 120 can flip up the discharge plate 40 towards the front side (see FIG. 9).

[0100] Next, a configuration will be described in which the winder unit 4 receives the yarn feeding bobbin 21, holds the yarn feeding bobbin 21 at a predetermined position where the yarn 20 of the yarn feeding bobbin 21 is unwound, and discharges the same. As described above, in the present embodiment, the discharge plate drive cam 41, the main axis member drive cam 81, and the auxiliary main axis member drive cam 91 are configured as a cam coupling mechanism 130 fixed to the common cam shaft 105. That is, the discharge plate drive cam 41, the main axis member drive cam 81, and the auxiliary main axis member drive cam 91 are integrally driven. Furthermore, as illustrated in FIGS. 6A to 6C, the discharge plate drive cam 41, the main axis member drive cam 81, and the auxiliary main axis member drive cam 91 each includes a bulged portion, where the position of the discharge plate

40, the main axis member 80, and the auxiliary main axis member 90 changes by this bulged portion. The bulged portion (holding cam operation region) of the auxiliary main axis member drive cam 91 and the bulged portion (discharge cam operation region) of the discharge plate drive cam 41 are formed to be gradual, but the bulged portion (defined cam operation region) of the main axis member drive cam 81 is formed to be slightly sharp. The bulged portion of the auxiliary main axis member drive cam 91 and the bulged portion of the discharge plate drive cam 41 are formed at substantially the same phase. The bulged portion of the main axis member drive cam 81, on the other hand, is formed at a phase different by substantially 180° with the bulged portion of the auxiliary main axis member drive cam 91 and the bulged portion of the discharge plate drive cam 41.

[0101] In the above configuration, the winder unit 4 appropriately drives the stepping motor 100 so that the bearing 92 of the oscillation arm 93 is in contact with the area slightly passed the peak of the bulged portion of the auxiliary main axis member drive cam 91 when receiving the yarn feeding bobbin 21. If the winder unit 4 stops the drive of the stepping motor 100 in this state, the auxiliary main axis member 90 is in a position slightly collapsed towards the front side from the upright state, as illustrated in FIG. 7.

[0102] In this state, the main axis member 80 also oscillates to the front side in a form of being pushed by the auxiliary main axis member 90 since the auxiliary main axis member 90 oscillates exceeding a predetermined angle. The position of the main axis member 80 in this state is slightly collapsed towards the front side from the upright state, similar to the auxiliary main axis member 90. When the yarn feeding bobbin 21 is supplied from the magazine holding portion 61 in this state, the bobbin holding portion 110 (main axis member 80 and auxiliary main axis member 90) enters inside the core tube 21a. In the present specification, the position (position of FIG. 7) of the main axis member 80 when receiving the yarn feeding bobbin 21 is referred to as a receiving position.

[0103] When unwinding the yarn with respect to the received yarn feeding bobbin 21, the stepping motor 100 is again driven to rotate the cam shaft 105 in the direction indicated with the arrow in FIG. 7. The bearings 42, 92 of the oscillation arms 43, 93 thereby completely pass the bulged portion of the discharge plate drive cam 41 and the auxiliary main axis member drive cam 91 and comes into contact with the non-bulged portion. The bearing 82 of the oscillation arm 83 comes into contact with the bulged portion of the main axis member drive cam 81.

[0104] Accompanied therewith, as illustrated in FIG. 8, the discharge plate 40 oscillates towards the rear side from the state of FIG. 7 and becomes horizontal, and the auxiliary main axis member 90 oscillates to slightly collapse towards the rear side. The main axis member 80 pushed towards the front side by the auxiliary main axis member 90 also similarly oscillates towards the rear side

with the oscillation of the auxiliary main axis member 90 towards the rear side, but the oscillation of the main axis member 80 stops as the contact arm 84b eventually comes into contact with the rotation member 87 of the positioning arm 84a, and thereafter, only the auxiliary main axis member 90 oscillates towards the rear side by the spring force of the holding spring 96. In other words, the core tube 21 a of the yarn feeding bobbin 21 can be held from the inner side by the bobbin holding portion 110 since the auxiliary main axis member 90 is displaced so as to relatively move away from the main axis member 80.

[0105] In this case, the position at which the oscillation of the main axis member 80 is stopped is defined by the position of the rotation member 87 of the positioning arm 84a. Since the positioning arm 84a is coupled to the oscillation arm 83 by way of the link, the position of the main axis member 80 can be changed depending on which part of the bulged portion of the main axis member drive cam 81 the bearing 82 of the oscillation arm 83 is in contact with (whether in contact with the rising part of the bulged portion or in contact with the peak). In other words, the position of the main axis member 80 can be adjusted by changing the rotation phase of the main axis member drive cam 81. Even if the position of the main axis member 80 is changed as described above, the auxiliary main axis member 90 can maintain the holding state of the yarn feeding bobbin 21 without any problems by the elastic force of the holding spring 96.

[0106] In the present specification, the position of the main axis member 80 when unwinding the yarn feeding bobbin 21 is referred to as an unwinding position. The origin sensor 101 detects the rotation phase of the pulley 104 in a state the main axis member 80 is in a substantially upright position as in FIG. 8, and is set so that such a state becomes the origin in the rotation control of the stepping motor 100. The unwinding position of the main axis member 80 changes by the type of yarn feeding bobbin 21, and the like, and hence the origin detected by the origin sensor 101 and the unwinding position do not necessarily coincide.

[0107] The stepping motor 100 is then appropriately driven to rotate the three cams 41, 81, 91 when discharging the yarn feeding bobbin 21. The bearings 42, 92 of the oscillation arms 43, 93 thereby come into contact with the bulged portion of the discharge plate drive cam 41 and the auxiliary main axis member drive cam 91. Therefore, the discharge plate 40 greatly oscillates towards the front side, as illustrated in FIG. 9. The auxiliary main axis member 90 oscillates towards the front side in cooperation therewith thereby releasing the holding of the yarn feeding bobbin 21, and the auxiliary main axis member 90 greatly oscillates towards the front side while pushing the main axis member 80. Accordingly, the discharge plate 40 pushes up the lower end of the core tube 21 a of the yarn feeding bobbin 21 so that the yarn feeding bobbin 21 can be discharged. In the present specification, the position of the main axis member 80 when dis-

charging the yarn feeding bobbin 21 is referred to as a discharging position.

[0108] As described above, in the present embodiment, the receiving of the yarn feeding bobbin 21, the holding of the yarn feeding bobbin 21 in the unwinding position (and adjustment of the unwinding position), and the discharging of the yarn feeding bobbin 21 can be carried out by simply driving the stepping motor 100 which is the single drive source.

[0109] A series of flow when the automatic winder 1 performs winding while replacing the yarn feeding bobbin 21 will now be described with reference to FIG. 10 to FIG. 12B. FIG. 10 is a flowchart illustrating the process performed by the winder unit 4 when yarn cut or the like occurs. FIGS. 11A and 11B are side views illustrating a first half of a state in which the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted. FIGS. 12A and 12B are side views illustrating a last half of a state in which the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted. The flowchart and the process illustrated in the flowchart described below are examples, and the effects of the present invention may be obtained by changing the processing content or changing the processing order.

[0110] During the winding operation by the winder unit 4, the clearer 15 may detect the yarn defect and the yarn may be cut with the cutter 39, the yarn cut of the yarn being unwound from the yarn feeding bobbin 21 may occur, or the unwinding of the yarn from the yarn feeding bobbin 21 may be completed and the yarn 20 may run out. The winder unit 4 monitors such yarn cut or the like (S101), and stops the winding operation when the yarn cut or the like occurs.

[0111] When the winding operation is stopped, the suction hole 32 of the lower yarn guiding pipe 25 positioned on the lower side sucks and catches the lower yarn and the upper yarn guiding pipe 26 sucks and catches the upper yarn, and yarn splicing starts (S102). Thereafter, the unit controller 50 determines whether or not the lower yarn exists after the yarn splicing based on the detection result of the lower yarn detection sensor 31 (S103).

[0112] In the case where the cutting of the yarn by the cutter 39 or the yarn breakage of the yarn 20 being unwound occurs, the yarn splicing is completed if a yarn is remained on the yarn feeding bobbin 21 and if a mechanical error or the like does not occur. Therefore, the lower yarn is detected by the lower yarn detection sensor 31. In this case, the unit controller 50 resumes the winding of the yarn by controlling each unit of the winding unit main body 6.

[0113] If the unwinding of all the yarn of the yarn feeding bobbin 21 is finished and the yarn 20 is no longer present, the lower yarn is not detected by the lower yarn detection sensor 31 since the yarn splicing cannot be carried out. In this case, the unit controller 50 determines that the unwinding of the yarn of the yarn feeding bobbin 21 is completed, and operates the bobbin holding portion 110 and the discharge plate 40 to perform the discharging

process of the core tube 21a (S104). Thereafter, the unit controller 50 causes the bobbin supply device 60 to newly supply the yarn feeding bobbin 21 (S105). In this case, the stepping motor controller 102 drives the stepping motor 100 and moves the main axis member 80 to the receiving position in advance.

[0114] As illustrated in FIG. 11A, the newly supplied yarn feeding bobbin 21 is guided to the bobbin setting section 10. The stepping motor controller 102 oscillates the bobbin holding portion 110 to the rear side.

[0115] In the winder unit 4 of the present embodiment, the layout of the bobbin holding portion 110 is taken into consideration such that the yarn feeding bobbin 21 can traverse the detection range of the chase portion detection sensor 74 when oscillating the bobbin holding portion 110 to the rear side. The determination unit 51 of the unit controller 50 determines whether or not the yarn feeding bobbin 21 is newly supplied based on the detection result of the chase portion detection sensor 74 (S106). Specifically, if the yarn feeding unit 21 is detected by the chase portion detection sensor 74 after the unit controller 50 instructs to newly supply the yarn feeding bobbin 21, the determination unit 51 determines that the yarn feeding bobbin 21 is newly supplied. If the yarn feeding bobbin 21 is not detected by the chase portion detection sensor 74 within a predetermined time, the determination unit 51 determines that the yarn feeding bobbin 21 is not newly supplied.

[0116] If determined by the determination unit 51 that the yarn feeding bobbin 21 is newly supplied, the unit controller 50 stores such a determination result in the storage device 52. The unit controller 50 then have the yarn end of the newly supplied yarn feeding bobbin 21 and the yarn end on the package side caught to start the yarn splicing (S110).

[0117] If determined by the determination unit 51 that the yarn feeding bobbin 21 is not newly supplied, the unit controller 50 stores such a determination result in the storage device 52. The unit controller 50 is configured to transmit an appropriate signal to the notification lamp 56 without starting the yarn splicing operation. The notification lamp 56 that received the signal notifies the operator that the yarn feeding bobbin 21 is not newly supplied using a display color and the like set in advance (S107).

[0118] If determined that the yarn feeding bobbin 21 is not newly supplied and the appropriate signal is transmitted to the notification lamp 56, the unit controller 50 of the present embodiment does not perform the catching operation of the lower yarn, the catching operation of the upper yarn, and the yarn splicing until this problem is resolved. The operator can know that the yarn feeding bobbin 21 is not supplied to the bobbin supply device 60 by the notification of the notification lamp 56. The operator can stop the notification of the notification lamp 56 by supplying the yarn feeding bobbin 21 to the bobbin supply device 60 (S108) and operating the error release button (S109). Thereafter, the bobbin supply device 60 newly performs the supply of the yarn feeding bobbin 21

by the instruction of the unit controller 50 (S105). When determined by the determination unit 51 that the yarn feeding bobbin 21 is supplied, the unit controller 50 catches the yarn end of the newly supplied yarn feeding bobbin 21 and the yarn end from the package to start the yarn splicing (S110). The determination result of the determination unit 51 here is not stored in the storage device 52.

[0119] In the conventional configuration, whether or not to perform yarn splicing is determined based on the detection result of the lower yarn detection sensor since the sensor for detecting the presence of the yarn feeding bobbin 21 is not arranged, but such a configuration has the following problems when the supply of the yarn feeding bobbin 21 fails. In other words, in the conventional configuration, although it is apparent that the catching of the lower yarn is not possible at the time point the yarn feeding bobbin is not supplied, the yarn splicing operation is attempted and an error occurs for the first time at the time point the lower yarn is not detected with the lower yarn detection sensor at the end of the yarn splicing operation. Therefore, in the conventional yarn winding machine, the catching of the upper yarn is also carried out when the catching of the lower yarn is attempted, and the caught upper yarn is ultimately discarded due to occurrence of error, thereby wastefully consuming the yarn. In the configuration of causing error if the lower yarn is not detected with the lower yarn detection sensor, whether the cause of occurrence of error is due to catching mistake at a lower yarn catching unit (mechanical error) or because the yarn feeding bobbin 21 is not supplied (human error) cannot be determined on the device side.

[0120] With regards to such an aspect, in the present embodiment, the catching operation of the lower yarn can be stopped at the time point the absence of the yarn feeding bobbin 21 is detected by the chase portion detection sensor 74. Therefore, the wasting of the upper yarn can be prevented. Since the presence of the yarn feeding bobbin 21 is detected with the chase portion detection sensor 74, the cause of occurrence of error can be definitely isolated.

[0121] Furthermore, in the present embodiment, the time at which the mechanical error occurred, the time at which the human error occurred and the like are stored in the storage device 52 each time, so that the calculation section 53 of the unit controller 50 can calculate the number of human errors in a predetermined time band, the number of mechanical errors in a predetermined time band, and the like based on the storage content. The calculation result can be displayed on the unit display section 19.

[0122] Therefore, a more appropriate process can be carried out with respect to the error in the present embodiment. Specifically, if a great number of errors occurs due to the yarn feeding bobbin 21 not being supplied, the problems in the operation of supplying the yarn feeding bobbin 21 to the magazine can 62 by the operator are suspected, and thus appropriate countermeasures such as instructing the operator may be carried out. Further-

more, the pure mechanical error can be detected and an accurate maintenance operation can be carried out since the human error is not counted as the mechanical error.

[0123] The functions of the storage device 52 and the calculation section 53 may be provided to the machine control device 7 as illustrated in FIG. 13 in place of or in addition to providing the functions to the winder unit 4. FIG. 13 is a block diagram illustrating a modified example of the machine control device 7. In this configuration, the unit controller 50 outputs the time at which the mechanical error occurred, the time at which the human error occurred, and the like to the machine control device 7. The outputted times are then stored in a storage device 252 of the machine control device 7. When the operator operates the machine input section 8 to specify an appropriate time band, the calculation section 253 of the machine control device 7 calculates the number of human errors and mechanical errors in the relevant time band. The calculation result can be displayed on the machine display section 9.

[0124] The unit controller 50 then adjusts the position of the unwinding side end of the yarn feeding bobbin 21 in parallel to the yarn splicing (S111). Hereinafter, the adjustment of the position of the unwinding side end of the yarn feeding bobbin 21 will be described in detail with reference to FIGS. 11A and 11B, FIGS. 12A and 12B, and FIG. 14. FIG. 14 is a flowchart illustrating the process of adjusting the position of the unwinding side end of the yarn feeding bobbin 21.

[0125] In other words, in the present embodiment, the yarn feeding bobbin 21 is covered when the movable member 72 of the unwinding assisting device 12 moves. The winder unit 4 of the present embodiment adjusts the position of the yarn feeding bobbin 21 using the chase portion detection sensor 74 of the unwinding assisting device 12.

[0126] More detailed description will be made below. The stepping motor controller 102 controls the stepping motor 100 to turn the main axis member 80 in the receiving position towards the rear side and once makes the yarn feeding bobbin 21 upright (FIG. 11A). In this case, the unit controller 50 brings the brush portion 11 b of the yarn kink preventer 11 into contact with the upper end portion of the yarn feeding bobbin 21 (applies appropriate tension on the yarn 20) to prevent the yarn from kinking (S201, FIG. 11 B). Thereafter, the stepping motor controller 102 oscillates the bobbin holding portion 110 so as to again slightly collapse the yarn feeding bobbin 21 towards the front side (S202). The unit controller 50 then stops the oscillation of the bobbin holding portion 110 when the yarn feeding bobbin 21 is detected by the chase portion detection sensor 74 (S203, FIG. 12A).

[0127] The storage device 52 of the unit controller 50 stores, in correspondence with the type of the yarn feeding bobbin 21 to use, that how much pulse the stepping motor 100 is to be driven from the position where the yarn feeding bobbin 21 started to be detected by the chase portion detection sensor 74 to have the yarn feed-

ing bobbin 21 at the appropriate position (adjustment distance). The operator inputs the type of yarn feeding bobbin 21 to use to the unit input section 18 before starting the winding operation. The adjustment distance to be used in the current winding operation is thereby set in the unit controller 50. The unit controller 50 outputs a predetermined number of pulses to the stepping motor 100 based on the set adjustment distance, and oscillates the bobbin holding portion 100 towards the rear side (S204, FIG. 12B).

[0128] The unwinding side end of the yarn feeding bobbin 21 thus can be aligned with the unwinding standard position. Therefore, the contact of the movable member 72 and the yarn feeding bobbin 21 can be prevented while appropriately exhibiting the function of the unwinding assisting device 12.

[0129] If the type of yarn feeding bobbin 21 to use is changed, the appropriate adjustment distance can be set in the unit controller 50 by performing an appropriate input to the unit input section 18. Such input may be made to the machine input section 8 instead of to the unit input section 18. In this case, the machine control device 7 transmits the content inputted to the machine input section 8 to each winder unit 4. Thus, the appropriate adjustment distance can be collectively set with respect to the unit controller 50 of each winder unit 4.

[0130] As described above, the winder unit 4 of the present embodiment includes the bobbin holding portion 110, the chase portion detection sensor 74, the drive portion 200, and the stepping motor controller 102. The bobbin holding portion 110 holds the yarn feeding bobbin 21. The chase portion detection sensor 74 detects the unwinding side end of the yarn feeding bobbin 21 held by the bobbin holding portion 110. The drive portion 200 drives the bobbin holding portion 110 to adjust the position of the unwinding side end of the yarn feeding bobbin 21. The stepping motor controller 102 controls the drive portion 200 to align the position of the unwinding side end of the yarn feeding bobbin 21 to the target position set in advance based on the detection result of the chase portion detection sensor 74.

[0131] Therefore, in the winder unit 4 of the present embodiment, the winding operation of forming a package from the yarn unwound from the yarn feeding bobbin 21 can be started after aligning the position of the unwinding side end of the yarn feeding bobbin 21 to the target position. As the operation can be started after aligning the position of the unwinding side end of the yarn feeding bobbin 21 to the position where the winding operation can be satisfactorily performed, a more appropriate winding operation can be performed. Furthermore, since the adjustment of the position of the unwinding side end of the yarn feeding bobbin 21 with respect to the target position can be automatically performed, the load of the operator can also be reduced compared to the configuration of manually adjusting the position of the unwinding side end of the yarn feeding bobbin 21.

[0132] The winder unit 4 of the present embodiment

also includes the unwinding assisting device 12 for assisting the unwinding of the yarn of the yarn feeding bobbin 21. The target position set in advance is the unwinding standard position of the unwinding assisting device 12. The stepping motor controller 102 controls the drive portion 200 to align the position of the unwinding side end of the yarn feeding bobbin 21 to the unwinding standard position of the unwinding assisting device 12.

[0133] Therefore, in the winder unit 4 of the present embodiment, the position of the unwinding side end of the yarn feeding bobbin 21 can be aligned with the unwinding standard position of the unwinding assisting device 12. As the function of the unwinding assisting device 12 can be appropriately exhibited in the winder unit 4 of the present embodiment, the operation efficiency of the winding operation can be improved by performing the winding operation while appropriately maintaining the tension of the yarn unwound from the yarn feeding bobbin 21.

[0134] In the winder unit 4 of the present embodiment, the storage device 52 for storing the adjustment distance for aligning the unwinding side end of the yarn feeding bobbin 21 to the unwinding standard position is arranged. The stepping motor controller 102 controls the drive portion 200 so that the unwinding side end of the yarn feeding bobbin 21 passes the detection region of the chase portion detection sensor 74, and controls the drive portion 200 so as to move the position of the unwinding side end of the yarn feeding bobbin 21 by the adjustment distance stored in the storage device 52 from the position where the chase portion detection sensor 74 detected the unwinding side end of the yarn feeding bobbin 21.

[0135] Therefore, the unwinding side end of the yarn feeding bobbin 21 can be moved to the target position based on the adjustment distance in the winder unit 4 of the present embodiment. The position of the unwinding side end of the yarn feeding bobbin 21 thus can be accurately aligned with the unwinding standard position in the winder unit 4 of the present embodiment.

[0136] In the winder unit 4 of the present embodiment, the storage device 52 stores a plurality of adjustment distances in correspondence with the type of yarn feeding bobbin 21. The unit input section 18 (or machine input section 8) for setting one adjustment distance of the plurality of adjustment distances stored in the storage device 52 is also arranged. The stepping motor controller 102 drives the drive portion 200 based on the adjustment distance set by the unit input section 18.

[0137] Therefore, in the winder unit 4 of the present embodiment, the position of the unwinding side end of the yarn feeding bobbin 21 can be aligned with the target position based on the plurality of adjustment distances corresponding to the type of yarn feeding bobbin 21. The operator thus can align the position of the unwinding side end of the yarn feeding bobbin 21 with the target position more precisely by setting the type of yarn feeding bobbin 21 to perform the winding operation with respect to the winder unit 4.

[0138] In the winder unit 4 of the present embodiment, the unwinding assisting device 12 assists the unwinding of the yarn of the yarn feeding bobbin 21 by moving following the change of the chase portion which is the end of the yarn layer of the yarn feeding bobbin 21 involved in the advancement of the winding operation. The chase portion detection sensor 74 is a chase portion detection section capable of detecting the chase portion and detects the position of the unwinding side end of the yarn feeding bobbin 21.

[0139] Therefore, in the winder unit 4 of the present embodiment, the detection section for detecting the unwinding side end of the yarn feeding bobbin 21 and the detection section for detecting the chase portion are commonly configured. Thus, the number of components is reduced in the winder unit 4 of the present embodiment. Therefore, the winder unit 4 of the present embodiment can be configured small and can be manufactured at low cost.

[0140] In the winder unit 4 of the present embodiment, the unwinding assisting device 12 includes the movable member 72 which is a tubular member for assisting the unwinding of the yarn of the yarn feeding bobbin 21 by moving in the vertical direction. The unwinding standard position is the position on the extended line of the center of the movable member 72.

[0141] Therefore, in the winder unit 4 of the present embodiment, since the unwinding side end of the yarn feeding bobbin 21 can be aligned on the extended line of the axis of the movable member 72 of the unwinding assisting device 12, the winding operation can be performed while more appropriately maintaining the tension of the yarn unwound from the yarn feeding bobbin 21.

[0142] In the winder unit 4 of the present embodiment, the drive portion 200 includes the stepping motor 100 including the origin sensor 101 having the point where the position of the unwinding side end of the yarn feeding bobbin 21 is positioned on the extended line of the center of the movable member 72 as the origin.

[0143] Therefore, the winder unit 4 of the present embodiment can adjust the position of the unwinding side end of the yarn feeding bobbin 21 more easily and precisely by aligning the position of the unwinding side end of the yarn feeding bobbin 21 with the unwinding standard position using the number of steps of the motor.

[0144] The winder unit 4 of the present embodiment includes the yarn kink preventer 11 for preventing the yarn unwound from the yarn feeding bobbin 21 from kinking by coming into contact with the yarn feeding bobbin 21. The stepping motor controller 102 controls to bring the yarn kink preventer 11 into contact with the yarn feeding bobbin 21 before the position of the unwinding side end of the yarn feeding bobbin 21 is aligned with the unwinding standard position.

[0145] The winder unit 4 of the present embodiment can bring the yarn of the yarn feeding bobbin 21 into contact with the yarn kink preventer 11 before the position of the unwinding side end of the yarn feeding bobbin 21

is aligned with the unwinding standard position. Thus, the winder unit 4 of the present embodiment can prevent the yarn from kinking by unwinding the yarn of the yarn feeding bobbin 21 during the operation of aligning the position of the unwinding side end of the yarn feeding bobbin 21 with the unwinding standard position.

[0146] The winder unit 4 of the present embodiment includes the bobbin holding portion 110, the main axis member 80, and the auxiliary main axis member 90. The main axis member 80 defines the position of the yarn feeding bobbin 21. The auxiliary main axis member 90 causes the main axis member 80 to hold the yarn feeding bobbin 21 by changing the position with respect to the main axis member 80. The direction of adjusting the position of the unwinding side end of the yarn feeding bobbin 21 is the direction of changing the position of the auxiliary main axis member 90 with respect to the main axis member 80.

[0147] When configured such that the bobbin holding portion 110 includes the main axis member 80 and the auxiliary main axis member 90, the winder unit 4 of the present embodiment can align the position of the unwinding side end of the yarn feeding bobbin 21 with the unwinding standard position even if the position of the unwinding side end of the yarn feeding bobbin 21 is shifted in the direction of changing the position of the auxiliary main axis member 90 with respect to the main axis member 80 from the unwinding standard position.

[0148] A first variant of the above embodiment will now be described with reference to FIG. 15 to FIG. 18B. FIG. 15 is a block diagram illustrating the main configuration of the winder unit 4 according to the first variant and a second variant. FIG. 16 is a flowchart illustrating the process of adjusting the position of the unwinding side end of the yarn feeding bobbin 21 according to the first variant. FIGS. 17A and 17B are side views illustrating the first half of the state in which the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted according to the first variant. FIGS. 18A and 18B are side views illustrating the last half of the state in which the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted according to the first variant.

[0149] In the present variant, the same reference numerals are denoted for the members same as or similar to the embodiment described above, and the description thereof may be omitted. In the present variant, the illustration of the yarn kink preventer 11 and the chase portion detection sensor 74 is omitted to simplify the surrounding of the yarn feeding bobbin 21.

[0150] In the embodiment described above, whether the yarn feeding bobbin 21 is newly supplied is detected by the chase portion detection sensor 74 of the unwinding assisting device 12, but the detection of the yarn feeding bobbin 21 is carried out by a bobbin detection sensor 58 arranged on the inner side of the open/close unit 68 in the present variant. Furthermore, the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted based on the detection result of not the chase portion

detection sensor 74 but of the position detection sensor (yarn feeding bobbin detection section) 59 in the present variant. Furthermore, the unit controller 50 of the winder unit 4 of the present example has a configuration including a calculation section 54 as illustrated in FIG. 15. The process of adjusting the unwinding side end of the yarn feeding bobbin 21 will be specifically described below.

[0151] Since the bobbin detection sensor 58 is arranged on the inner side of the open/close unit 68, the yarn feeding bobbin 21 enters the detection range of the bobbin detection sensor 58 (see FIG. 17A) when the yarn feeding bobbin 21 is newly supplied (S301). The determination unit 51 of the unit controller 50 determines whether or not the yarn feeding bobbin 21 is newly supplied based on the detection result of the bobbin detection sensor 58 (S302). The method of determining whether or not the yarn feeding bobbin 21 is newly supplied and the control performed by the unit controller 50 after the presence or absence of the yarn feeding bobbin 21 is determined are carried out similar to the embodiment described above.

[0152] The unit controller 50 drives the stepping motor 100 to oscillate the bobbin holding portion 110 towards the rear side before and after the determination by the determination unit 51 on whether or not the yarn feeding bobbin 21 is newly supplied (S303). When the yarn feeding bobbin 21 is raised on the rear side, the unwinding side end of the yarn feeding bobbin 21 is detected by the position detection sensor 59 (see FIG. 17B). The position detection sensor 59 has a linear detection range, which detection range is arranged to intersect the virtual line L1 described above. The calculation section 54 of the unit controller 50 calculates the number of pulses from the origin at the position (first position) of the moment the unwinding side end of the yarn feeding bobbin 21 is detected by the position detection sensor 59 (S304).

[0153] When the bobbin holding portion 110 is further oscillated towards the rear side, the unwinding side end of the yarn feeding bobbin 21 is no longer detected by the position detection sensor 59 (see FIG. 18A). In this case, the calculation section 54 calculates the number of pulses from the origin at the position (second position) of the moment the unwinding side end of the yarn feeding bobbin 21 is no longer detected by the position detection sensor 59 (S305). Thereafter, the calculation section 54 calculates the number of pulses from the origin at a third position which is an intermediate position between the first position and the second position (S306).

[0154] The stepping motor controller 102 then drives the stepping motor 100 based on the calculated number of pulses at the third position, and oscillates the bobbin holding portion 110 towards the front side (S307, FIG. 18B).

[0155] The unwinding side end of the yarn feeding bobbin 21 thus can be aligned with the unwinding standard position. Therefore, the contact of the movable member 72 and the yarn feeding bobbin 21 can be prevented while appropriately exhibiting the function of the unwinding as-

sisting device 12.

[0156] The intermediate position can be considered as a position that divides the space between the first position and the second position in half, but the present invention is not limited thereto, and various positions can be adopted according to the layout. Furthermore, the count of the number of pulses can be obtained by counting the pulses that the stepping motor controller 102 outputs to the stepping motor 100.

[0157] The first position, the second position, and the third position are calculated in the first variant, but the following method may be used instead. That is, the first position is calculated, and the pulse that the stepping motor controller 102 outputs to the stepping motor 100 is counted until the moment the unwinding side end of the yarn feeding bobbin 21 is no longer detected from the first position. The bobbin holding portion 110 is returned (turned towards the front side) by the distance corresponding to half of the counted number of pulses to perform alignment.

[0158] As described above, the position detection sensor 59 is arranged at the unwinding standard position in the winder unit 4 of the first variant. The winder unit 4 of the first variant includes the stepping motor controller 102 and the calculation section 54. The stepping motor controller 102 drives the drive portion 200 so that the unwinding side end of the yarn feeding bobbin 21 passes the detection region of the position detection sensor 59. The calculation section 54 calculates the first position which is the position where the unwinding side end of the yarn feeding bobbin 21 enters the detection region of the position detection sensor 59, the second position which is the position where the unwinding side end of the yarn feeding bobbin 21 exits the detection region of the position detection sensor 59, and the third position which is the intermediate position between the first position and the second position. The stepping motor controller 102 controls the drive portion 200 to move the position of the unwinding side end of the yarn feeding bobbin 21 from the second position to the third position based on the calculation result of the calculation section 54.

[0159] Thus, in the winder unit 4 of the first variant, the calculation of the position of the axis of the yarn feeding bobbin 21 is performed by the position detection sensor 59 arranged at the unwinding standard position, and hence the position of the unwinding side end of the yarn feeding bobbin 21 can be easily and accurately aligned with the unwinding standard position.

[0160] A second variant of the above embodiment will be described with reference to FIG. 19 to FIG. 21B. FIG. 19 is a flowchart illustrating the process of adjusting the position of the unwinding side end of the yarn feeding bobbin 21 according to the second variant. FIGS. 20A and 20B are side views illustrating the first half of the state in which the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted according to the second variant. FIGS. 21A and 21B are side views illustrating the last half of the state in which the position of

the unwinding side end of the yarn feeding bobbin 21 is adjusted according to the second variant.

[0161] In the present variant, the same reference numerals are denoted for the members same as or similar to the embodiment described above, and the description thereof may be omitted. In the present variant, the illustration of the yarn kink preventer 11 is omitted to simplify the surrounding of the yarn feeding bobbin 21. The winder unit 4 of the present variant also includes the calculation section 54 as illustrated in FIG. 15. In the present variant, the position of the unwinding side end of the yarn feeding bobbin 21 is adjusted using the chase portion detection sensor 74. The process of adjusting the position of the unwinding side end of the yarn feeding bobbin 21 will be specifically described below.

[0162] When the yarn feeding bobbin 21 is newly supplied (S401, FIG. 20A), the unit controller 50 oscillates the bobbin holding portion 110 towards the rear side (S402). In this case, the calculation section 54 calculates the number of pulses from the origin at the position (first position, FIG. 20B) where the unwinding side end of the yarn feeding bobbin 21 starts to be detected by the chase portion detection sensor 74 (S403). The yarn feeding bobbin 21 is then further oscillated towards the rear side, and the number of pulses from the origin at the position (second position, FIG. 21A) where the yarn feeding bobbin 21 is no longer detected by the chase portion detection sensor 74 is calculated (S404).

[0163] The calculation section 54 then calculates the number of pulses from the origin at the third position which is the intermediate position between the first position and the second position (S405). The stepping motor controller 102 thereafter calculates the final adjustment distance based on the third position and the adjustment distance set based on the storage content of the storage device 52 (S406). The number of pulses to output to the stepping motor 100 is then determined based on the final adjustment distance.

[0164] The stepping motor controller 102 drives the stepping motor 100 by the determined number of pulses, thereby rotating the bobbin holding portion 110 towards the rear side (S407, FIG. 21 B).

[0165] In this manner, the winder unit 4 of the second variant can align the unwinding side end of the yarn feeding bobbin 21 with the unwinding standard position. Therefore, the contact of the movable member 72 and the yarn feeding bobbin 21 can be prevented while appropriately exhibiting the function of the unwinding assisting device 12.

[0166] As described above, the winder unit 4 of the second variant includes the storage device 52 and the calculation section 54. The storage device 52 stores the adjustment distance for aligning the unwinding side end of the yarn feeding bobbin 21 with the unwinding standard position. The calculation section 54 calculates the first position which is the position where the unwinding side end of the yarn feeding bobbin 21 enters the detection region of the chase portion detection sensor 74, the sec-

ond position which is the position where the unwinding side end of the yarn feeding bobbin 21 exits from the detection region of the chase portion detection sensor 74, and the third position which is the intermediate position between the first position and the second position, and also calculates the final adjustment distance from the third position and the adjustment distance stored in the storage device 52. The stepping motor controller 102 controls the drive portion 200 to move the position of the unwinding side end of the yarn feeding bobbin 21 by the final adjustment distance calculated in the calculation section 54 from the second position.

[0167] Thus, the diameter of the yarn feeding bobbin 21 can be calculated by calculating the first position and the second position, and the position of the axis of the yarn feeding bobbin 21 can be calculated by calculating the third position. The position of the axis of the unwinding side end of the yarn feeding bobbin 21 then can be aligned with the target position. Therefore, the position of the unwinding side end of the yarn feeding bobbin 21 can be aligned at a more appropriate position to perform the winding operation.

[0168] The preferred embodiment and the variants of the present invention have been described above, but the above-described configuration may be modified as below.

[0169] In the embodiment and the variants described above, the configuration in which other processes are not carried out until error is resolved when determined that the yarn feeding bobbin 21 is not supplied is adopted, but instead, a configuration of resupplying the yarn feeding bobbin 21 by a predetermined number of times may be adopted.

[0170] In the embodiment and the variants described above, the tubular movable member 72 is used in the unwinding assisting device 12, but instead, the movable member 72 of various shapes such as a linear guide member or a polygonal column member molded with a plate member having a guide hole, a wire, and the like may be used.

[0171] In the embodiment and the variant described above, the unwinding standard position is set with the unwinding assisting device 12 as the basis, but the unwinding standard position merely needs to be a target position set in advance, and the member that becomes the basis in the setting of the unwinding standard position is not limited to the unwinding assisting device 12. For example, consideration is made in setting the unwinding standard position in the winder unit 4 of a type in which the unwinding assisting device 12 is not arranged. Other than being set with the unwinding assisting device 12 as the basis, the unwinding standard position may be a position on the extended line of the center position where the yarn 20 is traversed with respect to the winding bobbin 22, or a position on the vertical line of the guide member for guiding the yarn unwound from the yarn feeding bobbin 21.

[0172] In the embodiment and the variants described

above, the configuration in which the discharge plate 40, the bobbin holding portion 110, and the like are driven using the stepping motor 100 is adopted, but instead, a configuration in which the power transmission unit 120 is driven using a servo motor, a linear motor, a voice coil motor, or the like may be adopted.

[0173] In the embodiment and the variants described above, a transmissive type photosensor is used for the chase portion detection sensor 74, the position detection sensor 59, and the bobbin detection sensor 58, but instead, a reflection type photosensor and the like may be used. Furthermore, instead of the configuration of detecting the yarn feeding bobbin 21 with the sensor, a configuration of detecting the movement or the state of the chase portion of the yarn feeding bobbin 21 by detecting the yarn feeding bobbin 21 as an image by means of a camera may be adopted.

[0174] In the embodiment and the variants described above, a gate type tension applying device is used for the tension applying device 13, but instead, a configuration in which a predetermined tension is applied on the traveling yarn using the known disc type tension applying device may be adopted.

[0175] In the embodiment and the variants described above, a pulse for controlling the stepping motor 100 is used in the position detection of the bobbin holding portion 110, but the position detection may be carried out by feedback controlling the servo motor. The angle of the bobbin holding portion 110 may be detected using an angular sensor.

[0176] In the embodiment and the variants described above, the bobbin supply device 60 including the magazine can 62 is described, but the bobbin supply device 60 is not limited to such a configuration as long as it supplies the yarn feeding bobbin 21 to a predetermined position where the yarn 20 is unwound. For example, a configuration including a columnar accommodation member capable of accommodating a plurality of yarn feeding bobbins 21 in a stacked manner to supply the yarn feeding bobbin 21 from the accommodation member may be adopted.

[0177] In the embodiment and the variants described above, the bobbin supply device 60 including the magazine can 62 is described, but the configuration of the bobbin supply device 60 is not limited thereto. For example, the bobbin supply device 60 may be a yarn feeding bobbin supply device 60 of a tray type that transports the tray on which the yarn feeding bobbin 21 is stacked with a conveyor belt to supply to the unwinding position. In the winder unit 4 including the tray type yarn feeding bobbin supply device 60, the position of the unwinding side end of the yarn feeding bobbin 21 may be moved in the front and back direction by switching the transporting direction of the conveyor to align the position of the unwinding side end of the yarn feeding bobbin 21 with the target position. Furthermore, an oscillation member for oscillating the tray may be arranged at the unwinding position, and the yarn feeding bobbin 21 may be oscillated at the unwind-

ing position to align the position of the unwinding side end of the yarn feeding bobbin 21 with the target position.

5 Claims

1. A winding unit (4) for winding a yarn (20) unwound from a yarn feeding bobbin (21) to form a package (29); the winding unit (4) **characterized by** comprising: a bobbin holding mechanism (110) for holding the yarn feeding bobbin (21); a yarn feeding bobbin detection section (74) for detecting an unwinding side end of the yarn feeding bobbin (21) held by the bobbin holding mechanism (110); a drive portion (200) for driving the bobbin holding mechanism (110) to adjust a position of the unwinding side end of the yarn feeding bobbin (21); and a controller (102) for controlling the drive portion (200) to align the position of the unwinding side end of the yarn feeding bobbin (21) with a target position set in advance based on a detection result of the yarn feeding bobbin detection section (74).

2. The winding unit (4) according to claim 1, further **characterized by** comprising:

an unwinding assisting device (12) for assisting the unwinding of the yarn (20) of the yarn feeding bobbin (21), wherein the target position set in advance is an unwinding standard position of the unwinding assisting device (12), and the controller (102) controls the drive portion (200) to align the position of the unwinding side end of the yarn feeding bobbin (21) with the unwinding standard position of the unwinding assisting device (12).

3. The winding unit (4) according to claim 1, further **characterized by** comprising:

a storage device (52) for storing an adjustment distance for aligning the unwinding side end of the yarn feeding bobbin (21) with the target position,

wherein the controller (102) controls the drive portion (200) so that the unwinding side end of the yarn feeding bobbin (21) passes a detection region of the yarn feeding bobbin detection section (59), and controls the drive portion (200) so as to move the position of the unwinding side end of the yarn feeding bobbin (21) by the adjustment distance stored in the storage device (52) from a position where the yarn feeding bobbin detection section (59) detects the unwinding side end of the yarn feeding bobbin (21).

4. The winding unit (4) according to claim 3, **characterized in that** the storage device (52) stores a plu-

ality of adjustment distances according to a type of the yarn feeding bobbin (21), a setting section (18) for setting one adjustment distance of the plurality of adjustment distances stored in the storage device (52) is arranged, and the drive portion (200) is controlled based on the adjustment distance set by the setting section (18).

5. The winding unit (4) according to any one of claims 1 to 3, **characterized by** further comprising: a storage device (52) for storing an adjustment distance for aligning the unwinding side end of the yarn feeding bobbin (21) with the target position; and a calculation section (54) for calculating a first position which is a position where the unwinding side end of the yarn feeding bobbin (21) enters the detection region of the yarn feeding bobbin detection section (59), a second position which is a position where the unwinding side end of the yarn feeding bobbin (21) exits from the detection region of the yarn feeding bobbin detection section (59), and a third position which is an intermediate position between the first position and the second position, and calculating a final adjustment distance from the third position and the adjustment distance stored in the storage device (52), wherein the controller (102) controls the drive portion (200) so as to move the position of the unwinding side end of the yarn feeding bobbin (21) by the final adjustment distance calculated by the calculation section from the second position.
6. The winding unit (4) according to claim 1, **characterized in that** the yarn feeding bobbin detection section (59) is arranged at the target position, the controller (102) drives the drive portion (200) so that the unwinding side end of the yarn feeding bobbin (21) passes the detection region of the yarn feeding bobbin detection section (59), a calculation section (54) for calculating a first position which is a position where the unwinding side end of the yarn feeding bobbin (21) enters the detection region of the yarn feeding bobbin detection section (59), a second position which is a position where the unwinding side end of the yarn feeding bobbin (21) exits from the detection region of the yarn feeding bobbin detection section (59), and a third position which is an intermediate position between the first position and the second position is arranged, and the controller (102) controls the drive portion (200) so as to move the position of the unwinding side end of the yarn feeding bobbin (21) from the second position to the third position based on a calculation result of the calculation section (54).
7. The winding unit (4) according to claim 2, **characterized in that** the unwinding assisting device (12) assists the unwinding of the yarn of the yarn feeding bobbin by moving following change of a chase por-

tion (21 b) which is a yarn layer end of the yarn feeding bobbin (21) involved in advancement of the winding operation, and the yarn feeding bobbin detection section (59) is a chase portion detection section (74) for detecting the chase portion (21 b).

8. The winding unit according to claim 2 or 7, **characterized in that** the unwinding assisting device (12) includes an unwinding tubular member (72) which is a tubular member for assisting the unwinding of the yarn (20) of the yarn feeding bobbin (21) by moving in a vertical direction; and the unwinding standard position is positioned on an extended line of an axis center of the unwinding tubular member (72).
9. The winding unit (4) according to claim 8, **characterized in that** the drive portion (200) includes a stepping motor (100) including an origin sensor (101) having a point where the position of the unwinding side end of the yarn feeding bobbin (21) is positioned on the extended line of the axis center of the unwinding tubular member (72) as an origin.
10. The winding unit (4) according to claim 9, further **characterized by** comprising:
a yarn kink preventer (11) for preventing the yarn (20) unwound from the yarn feeding bobbin (21) from kinking by coming into contact with the yarn feeding bobbin (21); wherein the controller (102) controls the yarn kink preventer (11) to come into contact with the yarn feeding bobbin (21) before the position of the unwinding side end of the yarn feeding bobbin (21) is aligned with the target position.
11. The winding unit (4) according to any one of claims 1 to 10, **characterized in that** the bobbin holding mechanism (110) includes: a defining member (80) for defining a position of the yarn feeding bobbin (21); and a holding member (90) for causing the defining member (80) to hold the yarn feeding bobbin (21) by changing the position with respect to the defining member (80); and a direction of adjusting the position of the unwinding side end of the yarn feeding bobbin (21) is a direction of changing the position of the holding member (90) with respect to the defining member (80).

FIG. 1

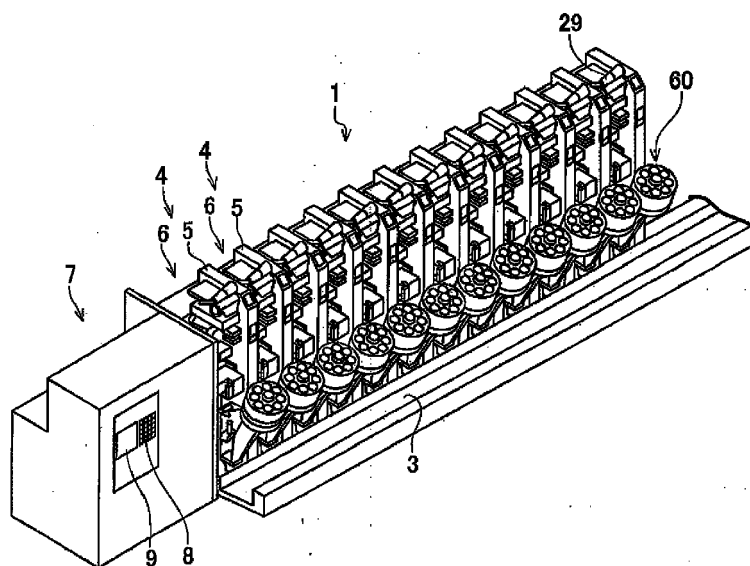


FIG. 2

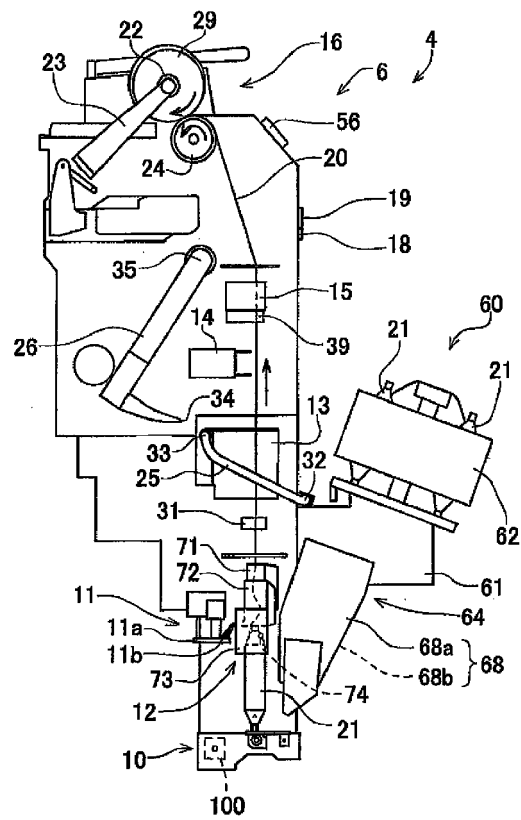


FIG. 3

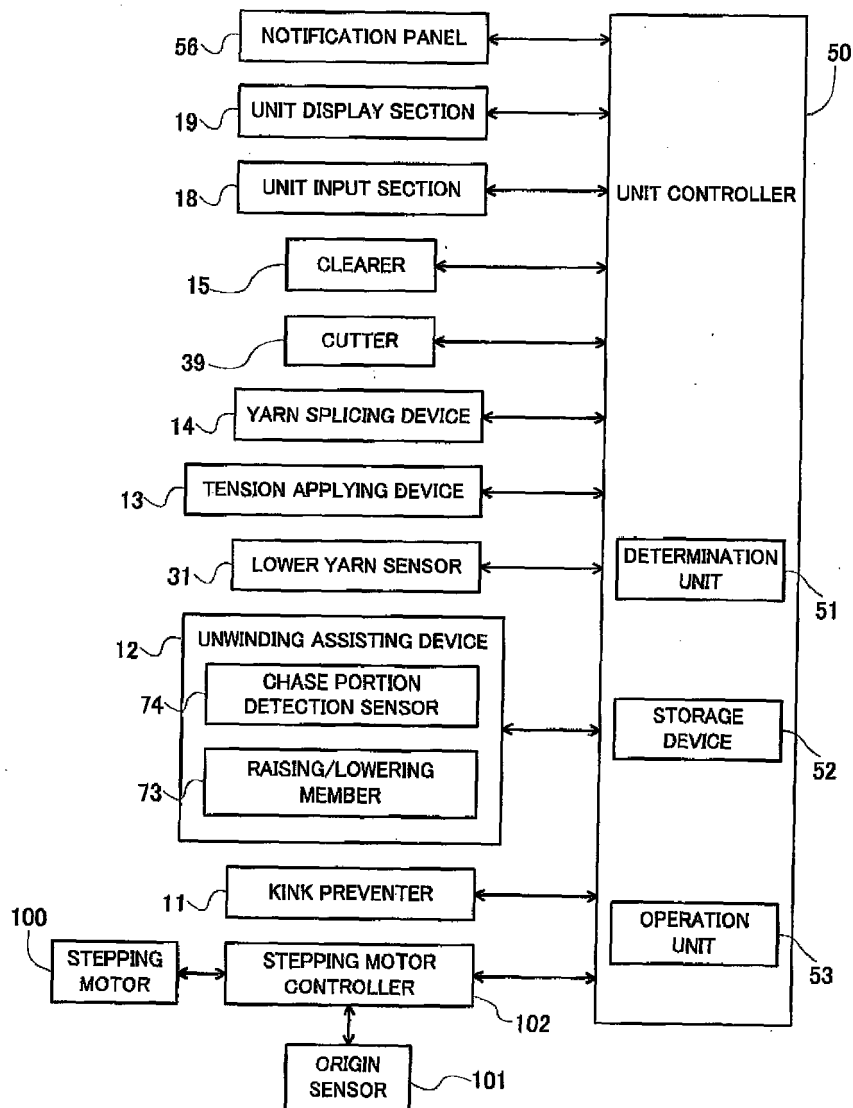


FIG. 4

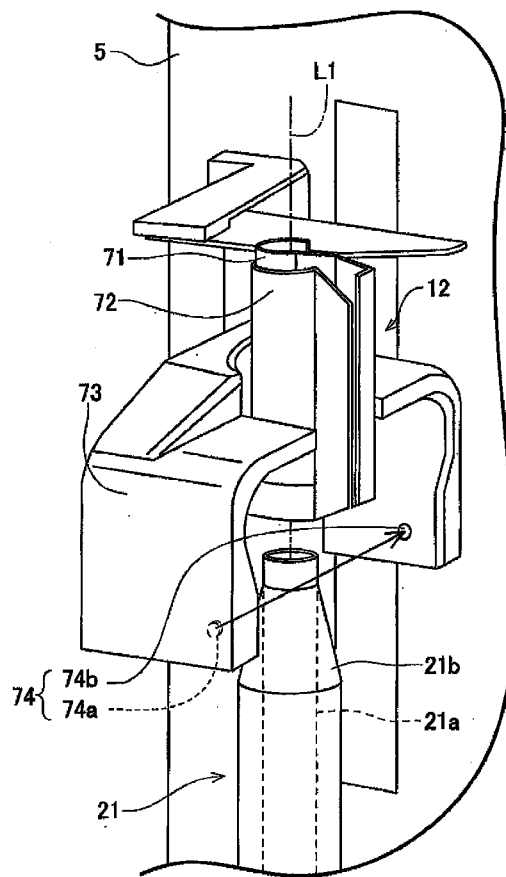


FIG. 5

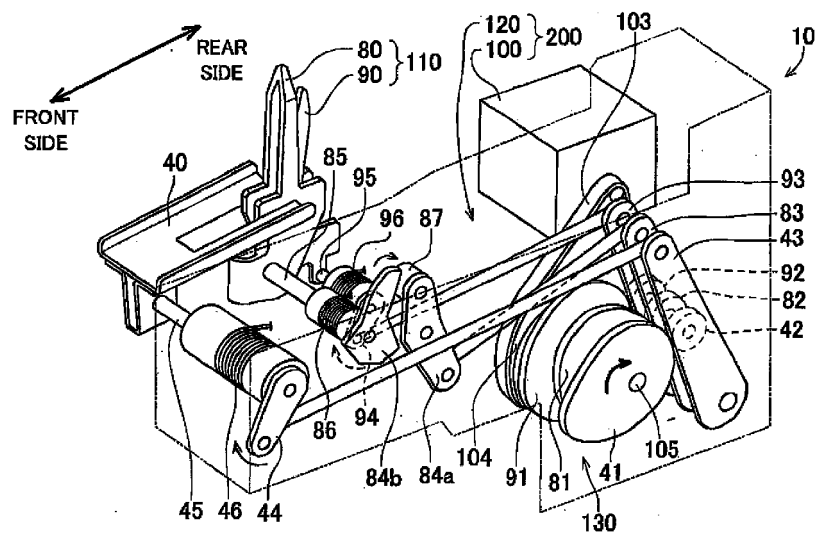


FIG. 6A

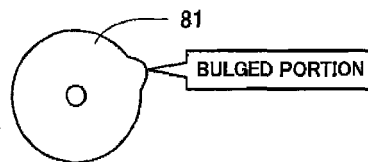


FIG. 6B

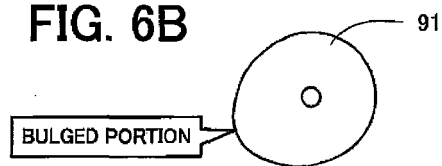


FIG. 6C

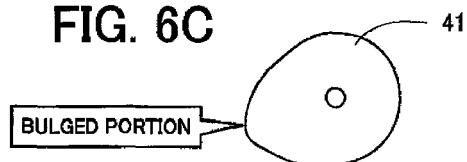


FIG. 7

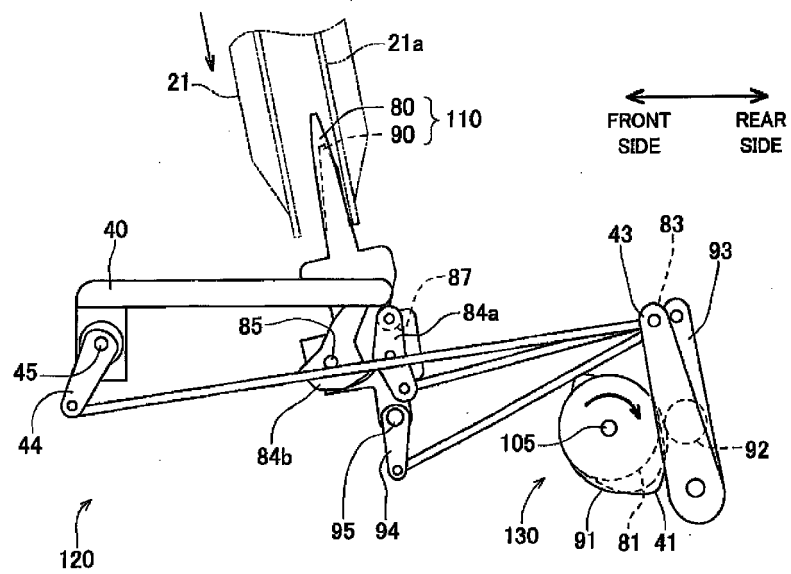


FIG. 8

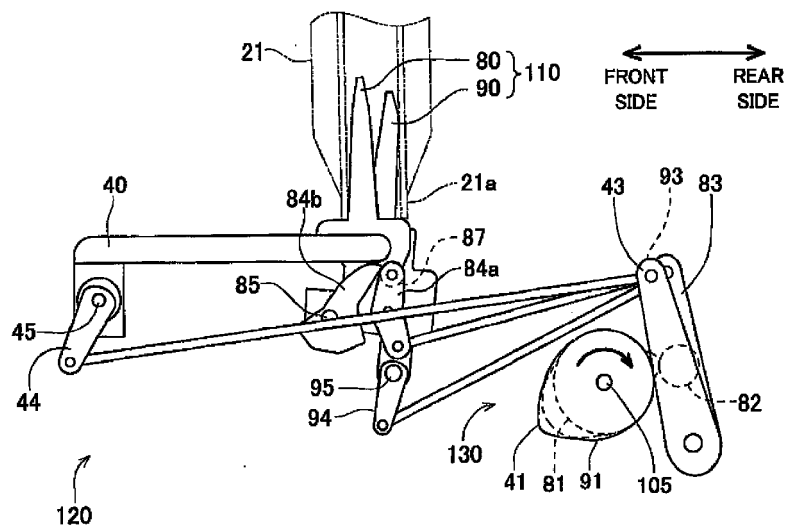


FIG. 9

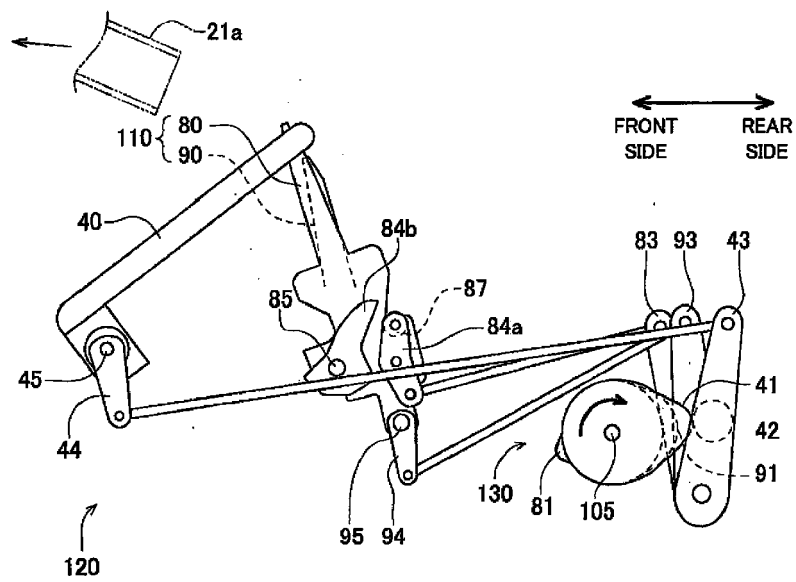


FIG. 10

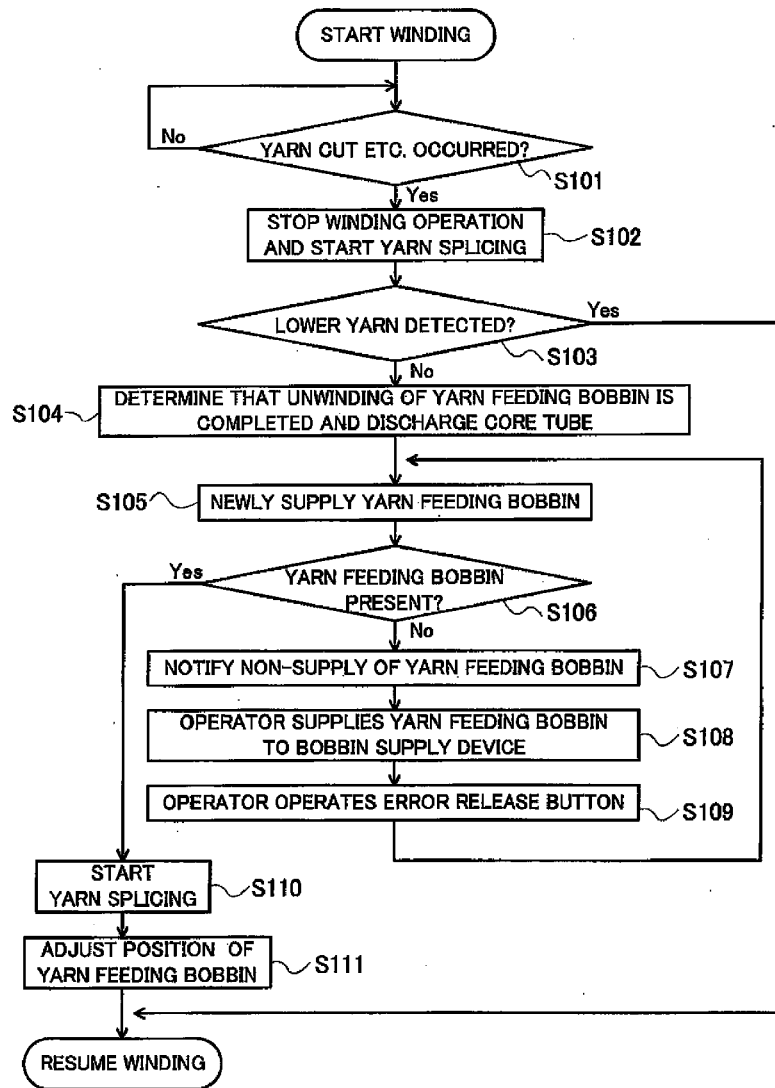


FIG. 11A

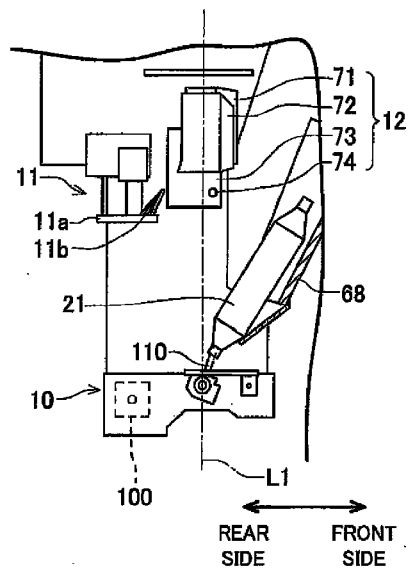


FIG. 11B

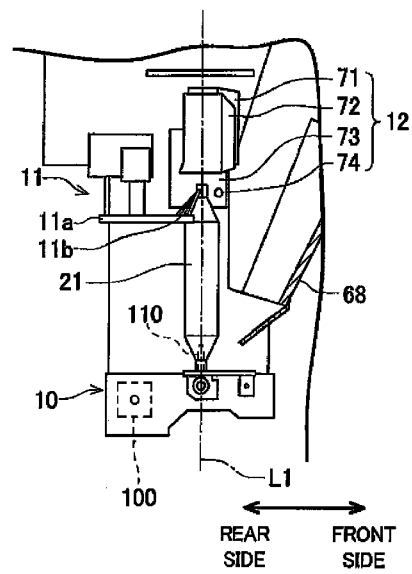


FIG. 12A

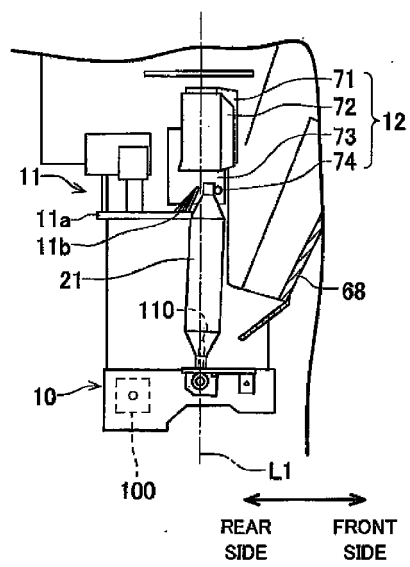


FIG. 12B

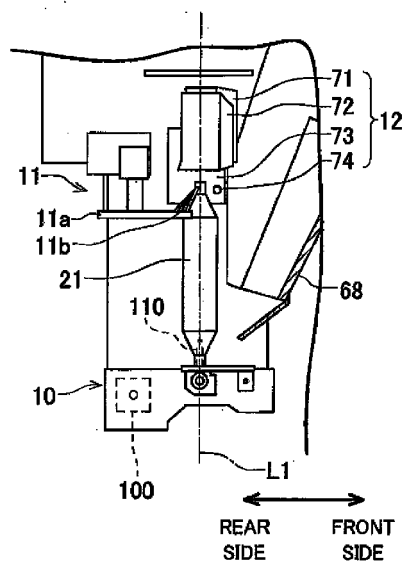


FIG. 13

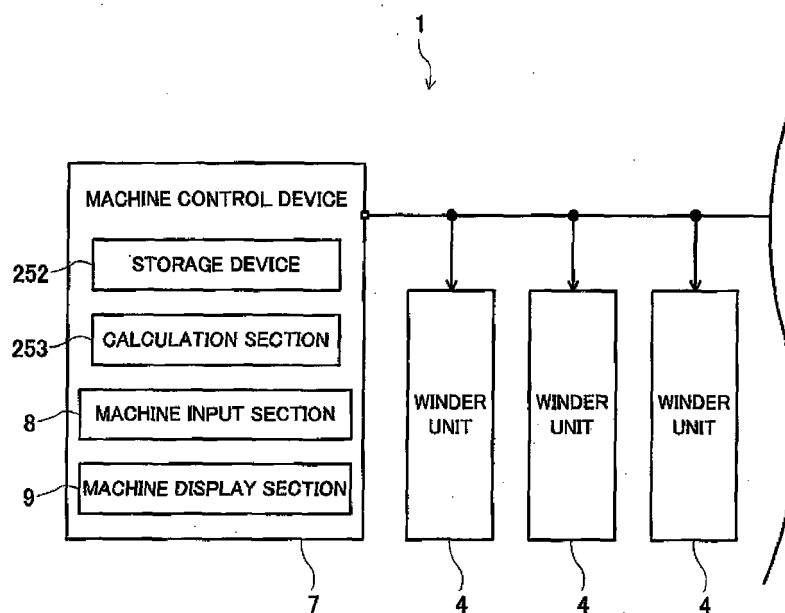


FIG. 14

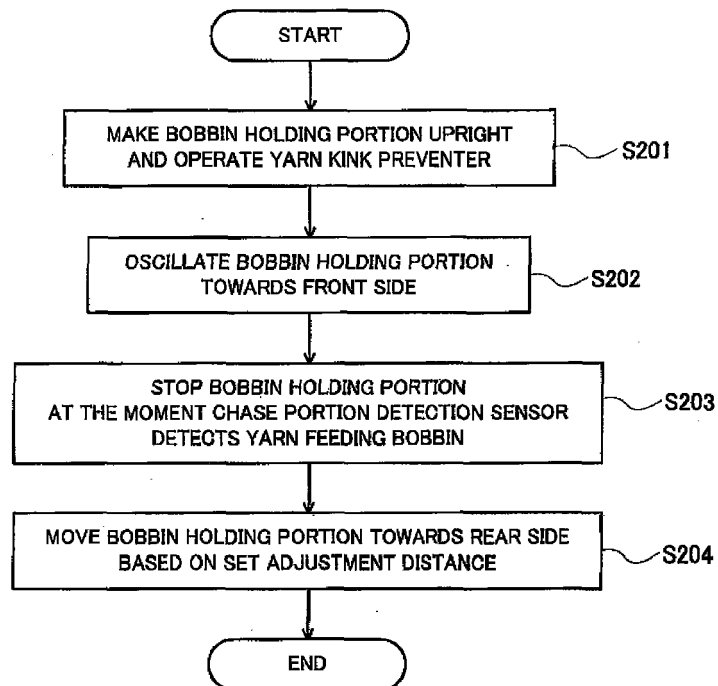


FIG. 15

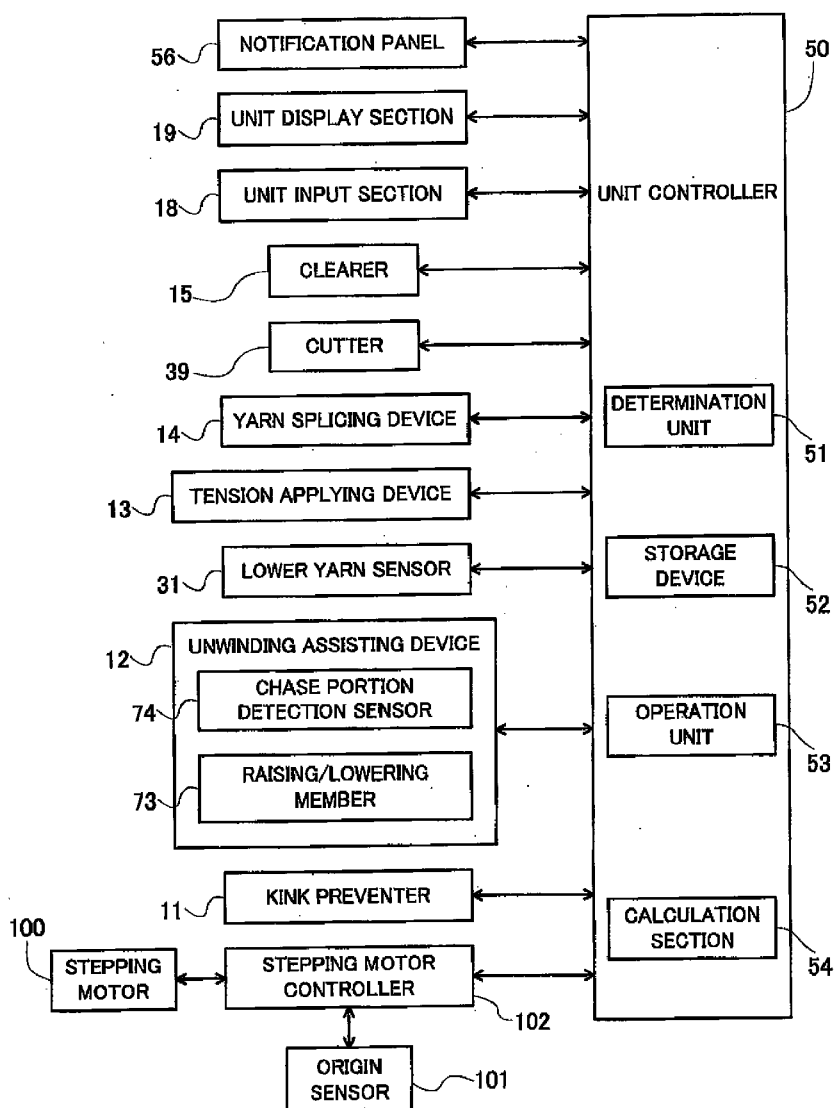


FIG. 16

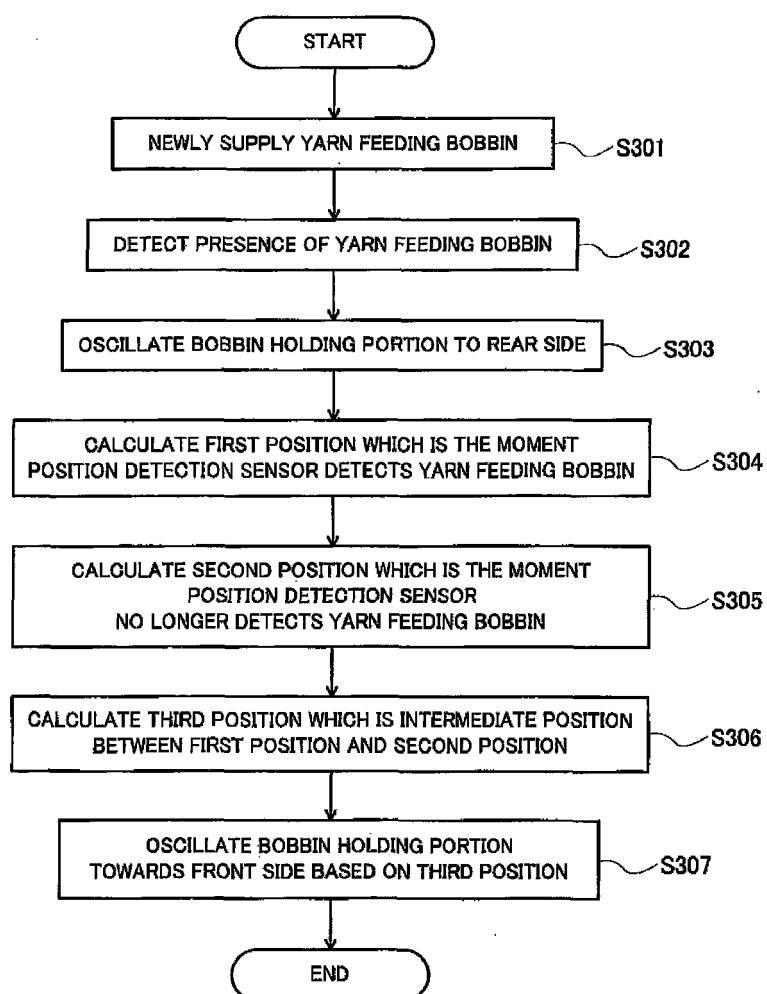


FIG. 17A

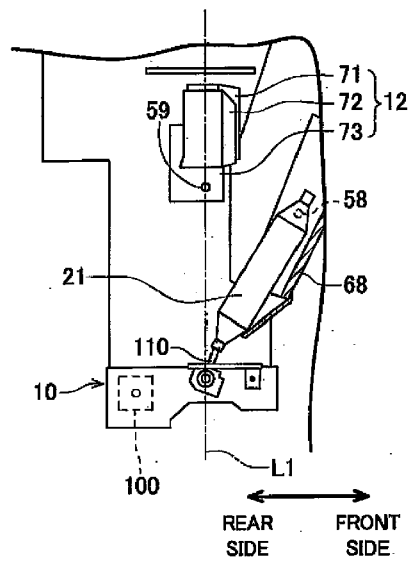


FIG. 17B

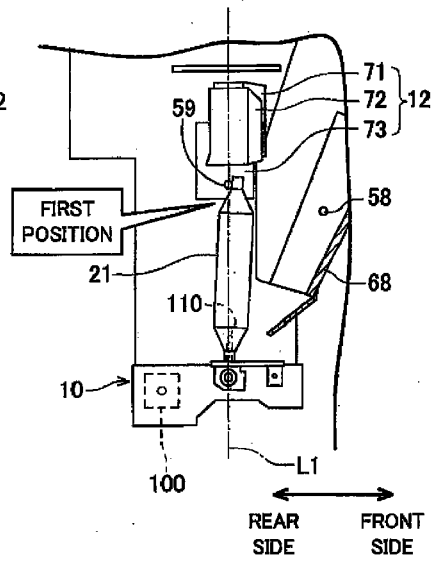


FIG. 18A

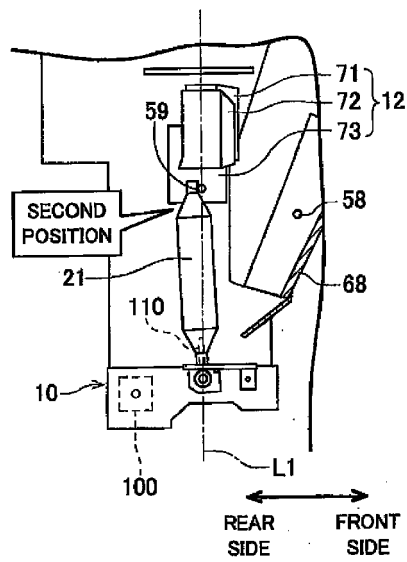


FIG. 18B

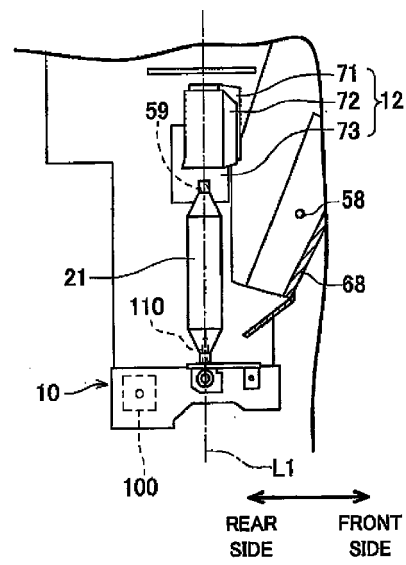


FIG. 19

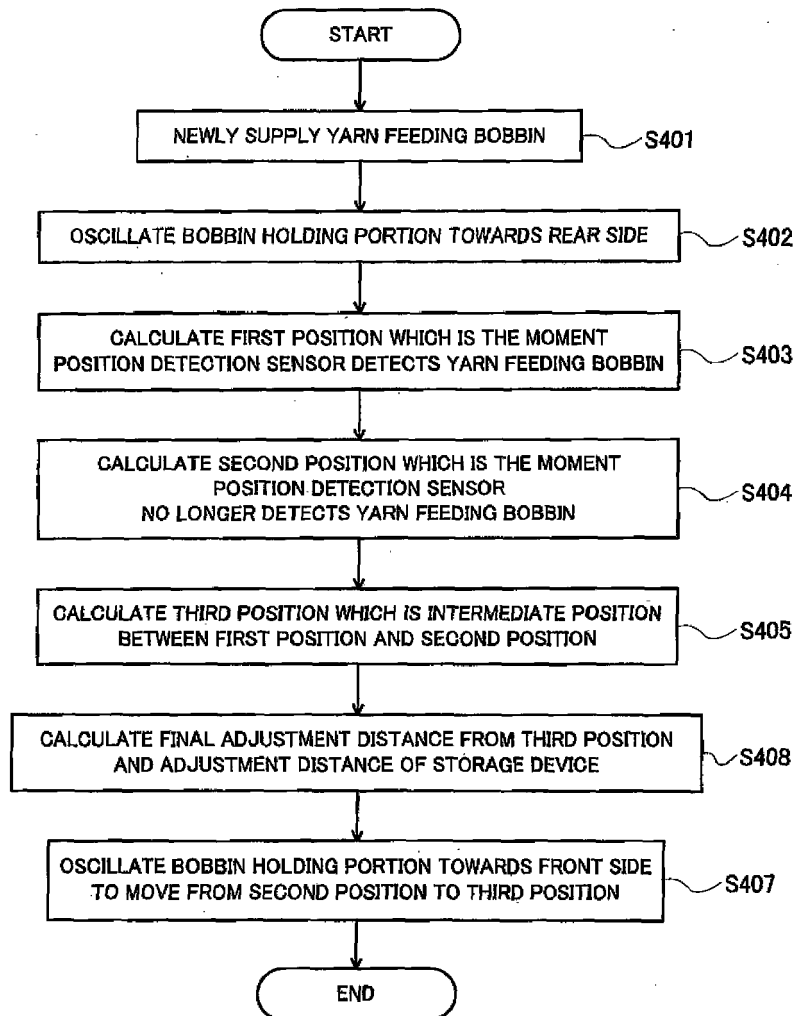


FIG. 20A

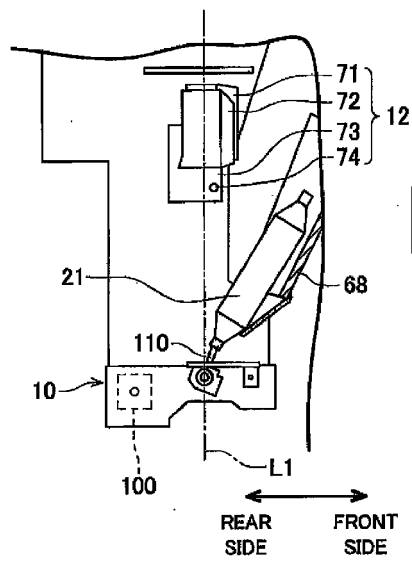


FIG. 20B

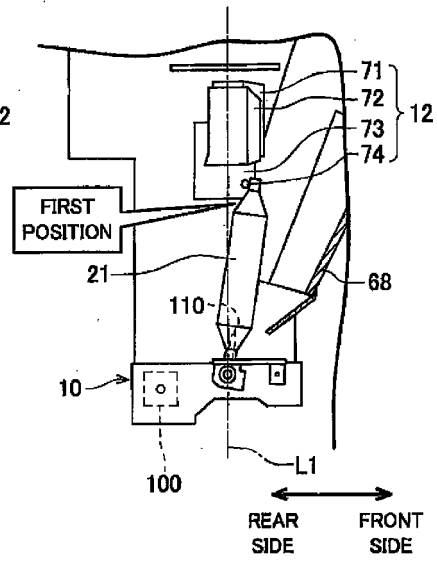


FIG. 21A

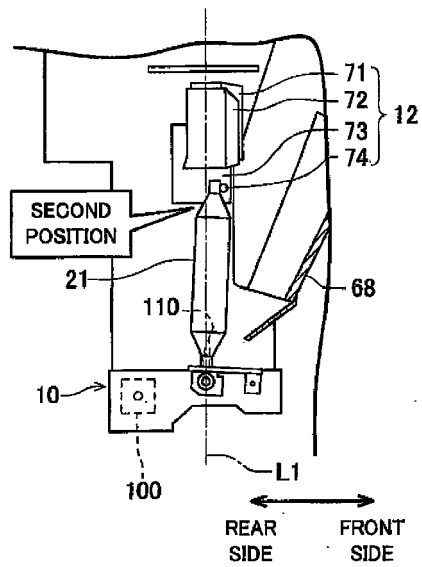
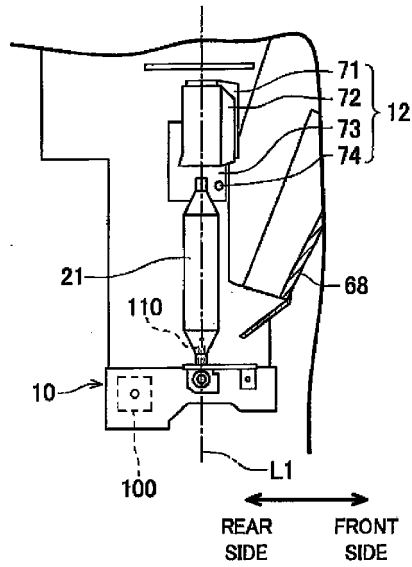


FIG. 21B



REFERENCES CITED IN THE DESCRIPTION

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