



(11) **EP 2 345 611 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.07.2011 Bulletin 2011/29

(51) Int Cl.:
B65H 54/71 (2006.01) **B65H 54/74 (2006.01)**
B65H 67/02 (2006.01) **B65H 67/08 (2006.01)**

(21) Application number: **10193241.6**

(22) Date of filing: **01.12.2010**

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

(72) Inventor: **Nakagawa, Takashi**
Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Vogeser, Werner et al**
Hansmann & Vogeser
Patent- und Rechtsanwälte
Maximilianstrasse 4b
82319 Starnberg (DE)

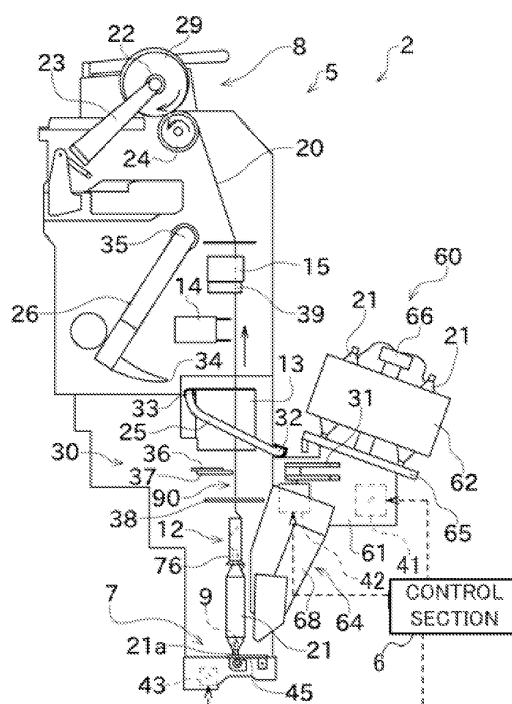
(30) Priority: **15.01.2010 JP 2010007453**

(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi, Kyoto 601-8326 (JP)

(54) **Yarn winding machine and yarn guiding method**

(57) An automatic winder includes a bobbin supporting section 7, a lower yarn guiding pipe 25, a bobbin supplying device 60, a bobbin-supplying-device driving motor 41, a bobbin-supporting-section driving motor 43, a yarn end holding opening 66, a yarn handling lever 31, and a control section 6. The bobbin supporting section 7 supports a yarn supplying bobbin 21. The bobbin-supplying-device driving motor 41 drives the bobbin supplying device 60. The bobbin-supporting-section driving motor 43 drives the bobbin supporting section 7. The control section 6 controls driving of the yarn handling lever 31. The yarn handling lever 31 is driven by a yarn-handling-lever driving motor 42 which is a dedicated driving means provided separately from the bobbin-supplying-device driving motor 41 and the bobbin-supporting-section driving motor 43.

FIG. 2



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a yarn winding machine. In particular, the present invention relates to a structure to appropriately pull out a yarn from a new yarn supplying bobbin in the yarn winding machine.

2. Description of the Related Art

[0002] A yarn winding machine that unwinds a yarn from a yarn supplying bobbin, rewinds the yarn around a winding tube, and forms a winding package has been conventionally known. In general, this type of yarn winding machine includes a bobbin supporting section that supports a yarn supplying bobbin and a bobbin supplying mechanism in which when the yarn supplying bobbin becomes empty, a new yarn supplying bobbin is supplied. For example, Japanese Unexamined Patent Application Publication No. 2009-18930 and Japanese Unexamined Patent Application Publication No. H09-183571 disclose a yarn winding machine provided with a magazine-typed bobbin supplying device.

[0003] When a new yarn supplying bobbin is supplied to the bobbin supporting section from the bobbin supplying device, a yarn (a lower yarn) from the new yarn supplying bobbin is sucked and held by a relay pipe (a lower yarn guiding pipe), and then the lower yarn is guided to a yarn splicing device. The yarn splicing device splices the lower yarn with an upper yarn from a package. Then, after completion of such a splicing operation, the yarn winding machine restarts a winding operation to wind a yarn from the new yarn supplying bobbin around the surface of the package.

[0004] Meanwhile, in the yarn winding machine provided with the magazine-typed bobbin supplying device, a new yarn supplying bobbin is supplied while the bobbin supplying device is hooking a yarn from the new yarn supplying bobbin. The yarn winding machine provided with the magazine-typed bobbin supplying device includes a yarn handling lever (a yarn guiding member) that hooks and pulls the yarn in order to guide the yarn to a position at which the yarn can be sucked through the relay pipe.

[0005] Further, the yarn handling lever also takes on the function to slacken the yarn such that the yarn can be sucked through the relay pipe. That is, by moving the yarn handling lever in a way that the yarn handling lever is hooking a lower yarn, the yarn handling lever pulls out the lower yarn from a yarn supplying bobbin, which makes it possible to slacken the lower yarn. Accordingly, in the yarn winding machine, it is possible to obtain at least a certain length of a yarn end which is sucked through the relay pipe; therefore, the yarn end can be reliably caught through the relay pipe.

[0006] Meanwhile, Japanese Unexamined Patent Application Publication No. 2009-18930 discloses a bobbin holding peg that drives a yarn supplying bobbin, which has been supplied from a magazine-typed bobbin supplying section in an oblique direction, until the position of the yarn supplying bobbin is turned upright. When changing the position of the yarn supplying bobbin as described in Japanese Unexamined Patent Application Publication No. 2009-18930, unless a yarn is appropriately guided in accordance with change of the position of the yarn supplying bobbin, a problem that is a breakage of a lower yarn occurs. Therefore, in the conventionally-known yarn winding machine, when changing the position of a yarn supplying bobbin, the yarn handling lever guided a lower yarn. The yarn handling lever guided the lower yarn, which prevented the lower yarn from breaking.

[0007] Movement of the yarn handling lever is required to be synchronized with change of the position of a yarn supplying bobbin such that the yarn handling lever guides a lower yarn while preventing the lower yarn from breaking. However, timing or a speed required for changing the position of the yarn supplying bobbin differs according to the shape of the core tube of the yarn supplying bobbin or the like. In the conventionally-known yarn winding machine, the yarn handling lever was driven by a driving source shared by the other components of the yarn winding machine. Accordingly, it has been impossible to separately change timing for starting to move the yarn handling lever, a speed of moving the yarn handling lever, or the like. Therefore, the conventionally-known yarn winding machine was incapable of dealing with cases in which movement of the yarn handling lever is not synchronized with the change of the position of the yarn supplying bobbin, which frequently caused a yarn breakage.

[0008] Further, in order to attempt to maintain an amount of yarn to be slackened constant under a state in which the yarn winding machine is configured such that a yarn is pulled out and slackened by the yarn handling lever, the yarn handling lever is required to be moved further when a more highly stretchable yarn is supplied. That is, a moving distance of the yarn handling lever is required to be changed in accordance with the type of a yarn. Therefore, in a conventional structure, several types of stoppers for restricting the movement of the yarn handling lever were prepared, and the moving distance of the yarn handling lever was changed by replacing a stopper in accordance with the type of a yarn. However, in the conventional structure, the stopper was required to be always replaced when replacing a type of yarn; therefore, there were problems that a heavy burden is put on an operator.

SUMMARY OF THE INVENTION

[0009] The present invention has been made to solve the above-described problems. It is a main object of the present invention to provide a yarn winding machine in which a yarn can be appropriately guided by a yarn han-

dling lever (a yarn guiding member) when the yarn is pulled out from a newly-supplied yarn supplying bobbin.

[0010] Problems to be solved by the present invention are as described above. Next, means for solving the problems and the effects thereof will be described.

[0011] According to a first aspect of the present invention, a yarn winding machine provided with the following structure is provided. That is, the yarn winding machine includes a bobbin supporting section, a yarn catching and guiding section, a bobbin supplying section, driving sources, a yarn end holding section, a yarn guiding member, and a control section. The bobbin supporting section supports the yarn supplying bobbin. The yarn catching and guiding section catches a yarn from the yarn supplying bobbin. The bobbin supplying section supplies the yarn supplying bobbin to the bobbin supporting section. The driving sources drive both the bobbin supporting section and the bobbin supplying section, or drive one of the bobbin supporting section and the bobbin supplying section. The yarn end holding section is located in the bobbin supplying section and holds a yarn end of the yarn from the yarn supplying bobbin. The yarn guiding member hooks a yarn placed between the yarn supplying bobbin supported by the bobbin supporting section and the yarn end holding section in order to guide the yarn to a position at which the yarn can be caught by the yarn catching and guiding section. The control section controls driving of the yarn guiding member. Further, the yarn guiding member is driven by a dedicated driving means provided separately from the driving sources.

[0012] That is, in a conventionally-known yarn winding machine, the yarn guiding member was driven by a driving means shared by the other components; therefore, it was difficult to control driving of the yarn guiding member separately and flexibly. Meanwhile, by driving the yarn guiding member by the dedicated driving means as described above, the driving of the yarn guiding member can be separately controlled; therefore, an amount of the driving of the yarn guiding member, a speed of the driving of the yarn guiding member, or the like can be flexibly changed as required. Accordingly, a yarn can be appropriately guided, which allows the yarn catching and guiding section to reliably catch a yarn end while preventing a yarn breakage.

[0013] It is preferable that the yarn winding machine includes a guiding member that slackens a yarn while interacting with the yarn guiding member.

[0014] By slackening the yarn as described above, a yarn end can be easily caught by the yarn catching and guiding section.

[0015] It is preferable that in the yarn winding machine, a stepping motor is used as the dedicated driving means.

[0016] That is, the stepping motor, which is capable of controlling a position or a speed of the yarn guiding member by a simple circuit structure, is especially preferred as a driving source of the yarn guiding member. Particularly, by using the stepping motor as the driving source, a position of the yarn guiding member can be easily de-

cided. Consequently, a stopper or the like for deciding a position of the yarn guiding member is unnecessary.

[0017] It is preferable that the yarn winding machine is configured as follows. That is, the yarn winding machine includes an operation input section capable of inputting a setting value. The control section can change at least one of timing for starting driving of the yarn guiding member and a speed of the driving of the yarn guiding member in accordance with a setting value set in the operation input section.

[0018] For example, when changing the position of a yarn supplying bobbin, a speed and timing required for changing the position differ according to the size or shape of a core tube. Accordingly, the yarn winding machine is configured capable of changing a speed and timing required for the driving of the yarn guiding member in accordance with the setting value as described above, which makes it possible to drive the yarn guiding member in accordance with change of the position of the yarn supplying bobbin. Consequently, a yarn breakage can be prevented.

[0019] The yarn winding machine can be also configured as follows. That is, the yarn winding machine includes an operation input section capable of inputting a setting value. The control section can change an amount of driving of the yarn guiding member in accordance with a setting value set in the operation input section.

[0020] For example, under a state in which each of yarns is provided with different stretch properties, even when the yarn guiding member is controlled so as to constantly move a certain fixed distance, the actual length of the each of yarns to be pulled out from the yarn supplying bobbin is different. Accordingly, the yarn winding machine is configured capable of changing the amount of driving of the yarn guiding member in accordance with the setting value as described above, which makes it possible to maintain the length of a yarn to be pulled out from the yarn supplying bobbin constant, regardless of the type of a yarn.

[0021] According to a second aspect of the present invention, a yarn guiding method of guiding a yarn from a yarn supplying bobbin to the yarn winding machine, which includes the following steps, is provided. That is, the yarn guiding method includes a bobbin supplying step, a bobbin position changing step, and a yarn guiding step. The bobbin supplying step supplies a yarn supplying bobbin to the bobbin supporting section. The bobbin position changing step changes the position of the yarn supplying bobbin supplied to the bobbin supporting section so that a yarn can be unwound from the yarn supplying bobbin. The yarn guiding step guides a yarn from the yarn supplying bobbin to a predetermined position by driving the yarn guiding member while hooking the yarn from the yarn supplying bobbin on the yarn guiding member. Further, the yarn guiding step is carried out simultaneously with the bobbin position changing step. Furthermore, the yarn guiding step controls driving of the yarn guiding member such that a portion in which the

yarn is hooked on the yarn guiding member is located above an extended line of an axis line of the yarn supplying bobbin.

[0022] As described above, the yarn guiding member guides the yarn when changing the position of the yarn supplying bobbin, which makes it possible to pull out the yarn in a direction of the axial line of the yarn supplying bobbin. Accordingly, occurrence of a yarn breakage of when changing the position of the yarn supplying bobbin can be prevented, which makes it possible to form a high-quality package.

[0023] It is preferable that the yarn guiding method is organized as follows. That is, the yarn guiding method includes a yarn slackening step of further driving the yarn guiding member to slacken a yarn after the yarn guiding step. The yarn slackening step controls driving of the yarn handling member so as to maintain the length of a yarn to be pulled out from the yarn supplying bobbin constant, regardless of the type of a yarn.

[0024] For example, under a state in which each of yarns is provided with different stretch properties, even when the yarn guiding member is controlled so as to constantly move a certain fixed distance, the actual length of the each of yarns to be pulled out from the yarn supplying bobbin is different. Accordingly, driving of the yarn guiding member is changed in accordance with the type of a yarn, which makes it possible to maintain the length of a yarn to be pulled out from the yarn supplying bobbin constant, regardless of the type of a yarn. Consequently, since a yarn end of the yarn from the yarn supplying bobbin can be reliably caught in the following steps, a package can be effectively produced.

[0025] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of a preferred embodiment of the present invention with reference to attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Fig. 1 is an external perspective view illustrating an overall structure of an automatic winder according to an embodiment of the present invention.

[0027] Fig. 2 is a side view schematically illustrating a winder unit.

[0028] Fig. 3 is an external perspective view illustrating a bobbin supplying device.

[0029] Fig. 4 is a side view illustrating a state of when a bobbin supporting section releases an empty bobbin.

[0030] Fig. 5 is a side view illustrating a state of when the bobbin supporting section receives a new yarn supplying bobbin.

[0031] Fig. 6 is a side view illustrating a state in which the bobbin supporting section holds a yarn supplying bobbin upright.

[0032] Fig. 7 is a partially sectioned side view illustrating a state of when the empty bobbin is discharged.

[0033] Fig. 8 is a partially sectioned side view illustrating

a state of when the new supplying bobbin is supplied.

[0034] Fig. 9 is a partially sectioned side view illustrating a state in the middle of changing the position of the yarn supplying bobbin.

[0035] Fig. 10 is a partially sectioned side view illustrating a state of when the yarn supplying bobbin is turned upright.

[0036] Fig. 11 is a partially sectioned side view illustrating a state in which a yarn is slackened.

[0037] Fig. 12 is a partially sectioned side view illustrating a state of when a lower yarn is caught through a lower yarn guiding pipe.

[0038] Fig. 13 is a partially sectioned side view illustrating a case in which the yarn supplying bobbin is turned upright without the yarn being guided by a yarn handling lever.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0039] Next, an embodiment of the present invention will be described. Fig. 1 is a schematic external perspective view of an automatic winder according to the embodiment of the present invention. The automatic winder (a yarn winding machine) 1 according to the present embodiment includes a plurality of winder units 2 arranged next to one another and a frame control device 3 arranged in an end of a direction in which the plurality of winding unit 2 are arranged next to one another.

[0040] Each of the winder units 2 includes a unit frame 4 located in either the right-hand side or the left side of the each of the winder units 2 when seen from a front side and a winding unit main body 5 located in a lateral side of the unit frame 4.

[0041] Fig. 2 is a side view schematically illustrating the winder unit 2. As illustrated in Fig. 2, the winder unit 2 includes the winding unit main body 5, a bobbin supporting section 7, and a winding section 8.

[0042] The bobbin supporting section 7 includes a bobbin holding peg 9. By being inserted in an axial direction with respect to a core tube 21a of a yarn supplying bobbin 21, the bobbin holding peg 9 can hold the yarn supplying bobbin 21 substantially-upright. The winding section 8 includes a cradle 23 capable of being attached to a winding bobbin 22 and a traverse drum 24 that traverses a yarn 20 and drives the winding bobbin 22.

[0043] The traverse drum 24, which has been arranged so as to face the winding bobbin 22, is driven and rotated in order to drive and rotate the winding bobbin 22. Accordingly, a yarn unwound from the yarn supplying bobbin 21 can be wound around the winding bobbin 22. Further, a traverse groove (not illustrated in the drawings) is formed on an outer peripheral surface of the traverse drum 24 and the yarn 20 can be traversed at a predetermined width through the traverse groove. By such a structure, by winding the yarn 20 wound from the yarn supplying bobbin 21 around the winding bobbin 22 while traversing the yarn 20, a package 29 can be formed at a

predetermined length and into a predetermined shape.

[0044] Further, the winding unit main body 5 includes various devices in a yarn travelling path between the bobbin supporting section 7 and the winding section 8. More specifically, an yarn unwinding assisting device 12, a yarn slackening section 30, a tension applying device 13, a yarn splicing device 14, and a clearer (a yarn quality measuring device) 15 are arranged along the yarn travelling path and in this order from a bobbin holding peg 9 side to a traverse drum 24 side.

[0045] The yarn unwinding assisting device 12 controls a movable member 76 to make contact with a balloon formed in an upper portion of the yarn supplying bobbin 21 by a yarn being unwound from the yarn supplying bobbin 21 and then being swung, and appropriately adjusts the size of the balloon in order to assist unwinding of the yarn 20.

[0046] The tension applying device 13 applies predetermined tension to the travelling yarn 20. The tension applying device 13 according to the present embodiment is formed into a gate-typed shape in which movable comb teeth are arranged with respect to fixed comb teeth. The movable comb teeth are formed capable of being swung by a rotary solenoid so that the movable comb teeth and the fixed comb teeth can be engaged with or disengaged from one another.

[0047] The clearer 15 monitors a yarn thickness of the yarn 20 in order to detect a yarn defect such as a slub (a yarn fault). Further, a cutter 39 for cutting the yarn 20 immediately after the clearer 15 detects a yarn defect is arranged in the vicinity of the clearer 15.

[0048] When a yarn cut occurs (i.e., when the cutter 39 cuts a yarn after the clearer 15 detects a yarn defect), when a yarn breakage occurs while the yarn is being unwound from the yarn supplying bobbin 21, or when the yarn supplying bobbin 21 is replaced, or the like, the yarn splicing device 14 splices a lower yarn from the yarn supplying bobbin 21 and an upper yarn from the package 29. As such a yarn splicing device 14, a device using fluid such as compressed air or a mechanical device can be used.

[0049] A lower yarn guiding pipe (a yarn catching and guiding section) 25 that catches and guides the lower yarn from the yarn supplying bobbin 21 and an upper yarn guiding pipe 26 that catches and guides the upper yarn from the package 29 are located at a lower side of the yarn splicing device 14 and at an upper side of the yarn splicing device 14, respectively. A suction opening 32 is formed at a tip end of the lower yarn guiding pipe 25. A suction mouth 34 is provided at a tip end of the upper yarn guiding pipe 26. Appropriate negative-pressure sources are connected to the lower yarn guiding pipe 25 and the upper yarn guiding pipe 26, respectively, so that suction airflow can act on the suction opening 32 and the suction mouth 34.

[0050] In such a structure, when a yarn cut occurs, when a yarn breakage occurs, when a yarn supplying bobbin 21 is replaced, or the like, the suction opening 32

of the lower yarn guiding pipe 25 swings to a lower yarn catching position 90 illustrated in Fig. 2 to suck and catch a lower yarn, and then swings upward around a shaft 33 to guide the lower yarn to the yarn splicing device 14. Further, at almost the same time as such an operation, the upper yarn guiding pipe 26 is swung upward from the position of the upper yarn guiding pipe 26 illustrated in Fig. 2 around a shaft 35 and the package 29 is rotated backward, so that the suction mouth 34 catches an upper yarn which is unwound from the package 29. Then, the upper yarn guiding pipe 26 swings downward around the shaft 35 to guide the upper yarn to the yarn splicing device 14. Consequently, the yarn splicing device 14 splices the lower yarn and the upper yarn.

[0051] The yarn slackening section 30 is located in the vicinity of the lower yarn catching position 90. The yarn slackening section 30 includes a lower yarn guide (a guiding member) 38 arranged immediately above the bobbin holding peg 9 and at a lower side of the lower yarn catching position 90, a cutter 36 arranged at an upper side of the lower yarn catching position 90, and a cutter introduction guide 37 arranged in the vicinity of the cutter 36. The lower yarn guide 38 (which will be described in detail later) is a member that guides a yarn such that the yarn is pulled out in an immediate upward direction from the yarn supplying bobbin 21 held upright by the bobbin supporting section 7 and that slackens the yarn while interacting with a yarn handling lever 31 (which will be described later). The cutter introduction guide 37 is a member that guides a lower yarn to a position at which the cutter 36 can cut the lower yarn when the lower yarn is moved closer to the lower yarn catching position 90 by the yarn handling lever 31 (which will be described later).

[0052] Further, a magazine-typed bobbin supplying device (a bobbin supplying section) 60 is arranged in the front side of the winding unit main body 5. When a yarn supplying bobbin 21 from which a yarn is being unwound in the bobbin supporting section 7 becomes empty, the bobbin supplying device 60 is configured so as to a new yarn supplying bobbin 21 can be supplied to the bobbin supporting section 7.

[0053] In the above-described structure, when a new yarn supplying bobbin 21 is supplied to the bobbin supporting section 7, a lower yarn from the new yarn supplying bobbin 21 and an upper yarn from the package 29 are spliced together. Then, after such a yarn splicing operation, by driving the package 29 by the traverse drum 24, a yarn is unwound from the yarn supplying bobbin 21 to be rewound around the surface of the package 29.

[0054] Further, a yarn supplying bobbin 21, which becomes empty after an unwinding operation, (i.e., a yarn supplying bobbin 21 around which no yarn is wound) is discharged as an empty bobbin from the bobbin supporting section 7 to the right-hand side of Fig. 2 (i.e., the front side of a winding unit 2). As illustrated in Fig. 1, a conveyer 81 is arranged at a lower part of the front side of the winding unit 2. The empty bobbin discharged from each of the winding units 2 is conveyed by the conveyer 81

and collected into a collection container (not illustrated in the drawings).

[0055] Further, the winding unit 2 includes a control unit 6 that controls each component of the winding unit 2. The control unit 6 includes hardware such as a CPU (not illustrated in the drawings), a RAM (not illustrated in the drawings), and a ROM (not illustrated in the drawings) and software such as a control program stored in the ROM. Then, the hardware is used with the software, which controls the each component of the winding unit 2. Further, the control unit 6 of each of the winding units 2 is configured capable of communicating with the frame control device 3. Accordingly, the operation of the plurality of winding units 2 of the automatic winder 1 can be managed in an integrated way by the frame control device 3.

[0056] Further, an operation input section 10 including a ten-key keypad or the like is located in the frame control device 3. Using the operation input section 10 allows an operator of the automatic winder 1 to give setting instructions for changing various winding conditions collectively to the plurality of winding units 2 of the automatic winder 1. Using the operation input section 10 also allows the operator of the automatic winder 1 to give setting instructions for changing a single winding condition separately to each of the winding units 2.

[0057] The magazine-typed bobbin supplying device 60 will be described in detail. The bobbin supplying device 60 includes a magazine holding section 61 slanted upward in a front direction from a bottom portion of the winder unit 2, a magazine can 62 attached at a tip end of the magazine holding section 61, and a guide chute 64 arranged at a lower side of the magazine can 62.

[0058] As illustrated in Fig. 3, the magazine can 62 is formed in a way that a plurality of holding holes 63 are circularly arranged on the magazine can 62. A yarn supplying bobbin 21 for being supplied to the bobbin supporting section 7 can be set in an oblique position to each of the holding holes 63. Further, the magazine can 62 is formed so as to be intermittently driven, rotated, and fed by a bobbin-supplying-device driving motor (a driving source) 41 (which will be described later).

[0059] Each of the holding holes 63 is formed so as to pass through the magazine can 62. Each yarn supplying bobbin 21 stored in a holding hole 63 is received by a bobbin receiving plate 65 arranged at a lower side of the magazine can 62 to prevent the each yarn supplying bobbin 21 from being dropped. The bobbin receiving plate 65 is fastened to the magazine holding section 61 (i.e., the bobbin receiving plate 65 does not rotate even when the magazine can 62 is driven and rotated.). Further, a single notch 65a, in which the size is equal to the size of a holding hole 63, is formed in the bobbin receiving plate 65 (refer to Fig. 7 etc.).

[0060] In such a structure, by driving and rotating the magazine can 62, the position of the notch 65a is relatively moved with respect to the magazine can 62. Then, the yarn supplying bobbin 21 which is stored in the mag-

azine can 62 and has not been supported by the bobbin receiving plate 65 at the position of the notch 65a is dropped. That is, by intermittently driving and rotating the magazine can 62, the each yarn supplying bobbin 21 can be separately supplied downward.

[0061] Further, a yarn end holding opening (a yarn end holding portion) 66 is formed at an upper end of the rotational axis of the magazine can 62. The yarn end holding opening 66 is connected to an appropriate negative-pressure source via a hose 67 illustrated in Fig. 3; therefore, suction airflow is generated at the yarn end holding opening 66. When newly setting a yarn supplying bobbin 21 in a holding hole 63, a yarn end of a yarn from such a yarn supplying bobbin 21 is required to be held such that the yarn end is sucked in the yarn end holding opening 66 as illustrated in Fig. 2 etc. As described above, by holding the yarn end in advance, since the yarn end is not required to be retrieved when replacing a yarn supplying bobbin 21, a yarn splicing operation can be easily performed.

[0062] The guide chute 64, which is arranged at a lower side of the notch 65a, is formed such that a yarn supplying bobbin 21 dropped from the magazine can 62 slides down to be guided to the bobbin supporting section 7. The guide chute 64 includes an opening and closing portion 68 formed into a double door-typed shape. The opening and closing portion 68 is formed capable of being opened in a downward direction.

[0063] While the opening and closing portion 68 is being closed, an upper surface of the opening and closing portion 68 makes contact with a yarn supplying bobbin 21 dropped from the magazine can 62, which guides the yarn supplying bobbin 21 to the bobbin supporting section 7 slanted downward. Meanwhile, while the opening and closing portion 68 is being opened, the yarn supplying bobbin 21 can be discharged in a downward direction without being guided to the bobbin supporting section 7. Further, the conveyer 81 is arranged at a lower side of the opening and closing portion 68; therefore, the yarn supplying bobbin 21 discharged from the opening and closing portion 68 can be conveyed to the collection container by the conveyer 81.

[0064] The bobbin-supplying-device driving motor 41 is controlled by the control section 6. The bobbin-supplying-device driving motor 41 is formed so as to drive both the magazine can 62 and the opening and closing portion 68, and will be specifically described as follows. The control section 6 controls the bobbin-supplying-device driving motor 41 to rotate forward and backward at a predetermined angle. Driving force of the bobbin-supplying-device driving motor 41 is transmitted to the rotational axis of the opening and closing portion 68 via a pulley (not illustrated in the drawings), a link mechanism (not illustrated in the drawings), or the like. In such a structure, by rotating the bobbin-supplying-device driving motor 41 in a one-way direction at a predetermined angle, the opening and closing portion 68 can be driven to be a closed state from an opened state. Further, by rotating

the bobbin-supplying-device driving motor 41 backward at a predetermined angle, the opening and closing portion 68 can be driven to a state in which the opening and closing portion 68 is opened from a state in which the opening and closing portion 68 is closed.

[0065] Meanwhile, a ratchet mechanism (not illustrated in the drawings) including a stop latch is located above the rotational axis of the magazine can 62. Rotary driving force of the bobbin-supplying-device driving motor 41 is transmitted to the ratchet mechanism via the pulley (not illustrated in the drawings) or the like. In such a structure, by rotating the bobbin-supplying-device driving motor 41 at a predetermined angle, the magazine can 62 can be rotated at a predetermined angle. Meanwhile, even when rotating the bobbin-supplying-device driving motor 41 backward, the ratchet mechanism blocks the magazine can 62 from being driven and rotated. That is, the magazine can 62 can be intermittently driven in a one-way direction at a predetermined angle.

[0066] Then, as described above, the opening and closing portion 68 and the magazine can 62 are driven by a shared driving source (the bobbin-supplying-device driving motor 41), which makes it possible to control rotation of the magazine can 62 to be performed with a opening and closing operation of the opening and closing portion 68. Specifically, when rotating the magazine can 62 (when supplying a yarn supplying bobbin 21 to the bobbin supporting section 7), the opening and closing portion 68 is kept closed; in other cases, the opening and closing portion 68 is kept open. Accordingly, when supplying a yarn supplying bobbin 21 from the magazine can 62, the yarn supplying bobbin 21 can be guided to the bobbin supporting section 7 by the opening and closing portion 68 which is kept closed. Further, the opening and closing portion 68 is kept open except when a yarn supplying bobbin 21 is not required to be supplied; therefore, even when the operator mistakenly drops a yarn supplying bobbin 21 into a holding hole 63 located at the position of the notch 65a, for example, the yarn supplying bobbin 21 can be discharged in a downward direction from the opening and closing portion 68 which is kept open without being guided to the bobbin supporting section 7.

[0067] Further, the yarn handling lever (a yarn guiding member) 31 and a yarn-handling-lever driving motor 42 that drives the yarn handling lever 31 are arranged in the magazine holding section 61. The yarn-handling-lever driving motor 42, which is formed as a stepping motor, is controlled by the control section 6.

[0068] The yarn handling lever 31, which has a yarn hooking portion 70 as illustrated in Fig. 3, can hook a yarn on the yarn hooking portion 70 bent into a V shape. Then, by swinging the yarn handling lever 31 in a way that the yarn is hooked on the yarn hooking portion 70, the yarn can be guided to the lower yarn catching position 90. Further, as illustrated in Fig. 3, the yarn hooking portion 70 of the yarn handling lever 31 is split into an upper part and a lower part and is formed into a bifurcated shape. When a distinction between the upper part and

the lower part of the yarn hooking portion 70 are definitely required to be made, the upper part and the lower part is referred to as an upper part yarn hooking portion and a lower part yarn hooking portion, respectively.

[0069] The yarn handling lever 31 can be swung between a lever standby position and a yarn slackening position. "The lever standby position" indicates a position at which the yarn hooking portion 70 is located across a trajectory, which is generated when the yarn supplying bobbin 21 is dropped from the magazine can 62 and then slides down to the bobbin supporting section 7, from the lower yarn catching position 90 when seen from a side direction (i.e., a position illustrated in Fig. 8). Meanwhile, "the yarn slackening position" indicates a position at which the cutter introduction guide 37 is nipped between the upper part yarn hooking portion and the lower part yarn hooking portion on the yarn handling lever 31 (i.e., a position illustrated in Fig. 11).

[0070] Next, a structure of the bobbin supporting section 7 will be described. Fig. 4 through Fig. 6 are enlarged side views illustrating the structure of the bobbin supporting section 7. As described in Fig. 4 through Fig. 6, the bobbin supporting section 7 includes the bobbin holding peg 9, a flip-up plate 45, and a bobbin-supporting-section driving motor (a driving source) 43.

[0071] The bobbin holding peg 9 includes a first holding portion 46 and a second holding portion 47. Then, the bobbin holding peg 9 is formed capable of switching between a state in which the first holding portion 46 and the second holding portion 47 are kept stuck and overlapped together (states illustrated in Fig. 4 and Fig. 5) and a state in which a tip end of the first holding portion 46 and a tip end of the second holding portion 47 are kept separated (a state illustrated in Fig. 6). As illustrated in Fig. 6, since a state in which the bobbin holding peg 9 is kept open causes the first holding portion 46 and the second holding portion 47 to make tight contact with the inside of the core tube 21a of a yarn supplying bobbin 21, the yarn supplying bobbin 21 is prevented from being dropped from the bobbin holding peg 9. Consequently, the yarn supplying bobbin 21 can be reliably held. Meanwhile, the bobbin holding peg 9 is formed capable of holding a yarn supplying bobbin 21 upright (the state illustrated in Fig. 6). Further, the state in which the tip end of the first holding portion 46 and the tip end of the second holding portion 47 are kept separated (the state illustrated in Fig. 6) will be hereinafter referred to as a bobbin holding state.

[0072] More specifically, the first holding portion 46 and the second holding portion 47 will be described as follows. The second holding portion 47 is fastened to a swing shaft 49. Driving force of the bobbin-supporting-section driving motor 43 is transmitted to the swing shaft 49 via a pulley, a link mechanism, or the like. The bobbin-supporting-section driving motor 43 is controlled by the control section 6. By driving the bobbin-supporting-section driving motor 43 forward and backward in order to drive and rotate the swing shaft 49, the control section 6 can switch the second holding portion 47 between a state

in which the second holding portion 47 is slanted with respect to the front side of the winding unit 2 (a state illustrated in Fig. 4) and a state in which the second holding portion 47 is held upright by being moved to the back side of the winding unit 2 (the state illustrated in Fig. 6; the bobbin holding state).

[0073] The first holding portion 46 is supported relatively rotatable with respect to the swing shaft 49, and force to rotate the first holding portion 46 is applied in a counterclockwise direction as illustrated in Fig. 4 to the second holding portion 47. Such urging force allows the first holding portion 46 and the second holding portion 47 to be kept stuck and overlapped together. In such a state, the bobbin-supporting-section driving motor 43 drives and rotates the swing shaft 49, which causes the first holding portion 46 and the second holding portion 47 to swing integrally. However, movement to swing the first holding portion 46 is controlled by a stopper (not illustrated in the drawings) in order to prevent the first holding portion 46 from being slanted with respect to the back side of the winding unit 2.

[0074] That is, when the swing shaft 49 is driven from the state illustrated in Fig. 4 in a counterclockwise direction, the first holding portion 46 and the second holding portion 47, which are kept overlapped together, is swung integrally until the middle of such swinging movement; the first holding portion 46 is stopped in an upright position in the middle of such movement; and then, only the second holding portion 47 is swung in a counterclockwise direction. As a result, as illustrated in Fig. 6, the state is switched to a state in which the tip end of the first holding portion 46 and the tip end of the second holding portion 47 are kept separated (the bobbin holding state).

[0075] Further, as illustrated in Fig. 6, a lower end of the core tube 21a of the yarn supplying bobbin 21 into which the bobbin holding peg 9 is inserted makes contact with an upper surface of the flip-up plate 45. The flip-up plate 45 is formed capable of being swung from "a parallel position" illustrated in Fig. 6 to "a flip-up position". Driving force of the bobbin-supporting-section driving motor 43 is transmitted to the flip-up plate 45 via a pulley, a link mechanism, or the like. Accordingly, the flip-up plate 45 can be driven by being moved with the bobbin holding peg 9. Specifically, as illustrated in Fig. 6, when the bobbin holding peg 9 is in the bobbin holding state, the flip-up plate 45 is located at the parallel position. Then, as the bobbin holding peg 9 is further swung from the bobbin holding state in a counterclockwise direction, the flip-up plate 45 is flipped up higher.

[0076] Next, a description will be made specifically on a yarn guiding method of guiding a yarn from a newly-supplied yarn supplying bobbin 21 to a position at which the yarn can be caught through the lower yarn guiding pipe 25 in the automatic winder 1 configured as described above.

[0077] First, the operation for discharging a yarn supplying bobbin 21 which has become empty (i.e., a bobbin discharging step) will be described.

[0078] When recognizing that a yarn supplying bobbin 21 becomes empty, the control section 6 drives the bobbin-supporting-section driving motor 43 to swing the second holding portion 47 such as the second holding portion 47 is slanted with respect to the front side of the winding unit 2. Accordingly, the bobbin holding peg 9 is closed and the flip-up plate 45 is swung to the flip-up position (states illustrated in Fig. 4 and Fig. 7).

[0079] Then, a lower end of an empty yarn supplying bobbin 210 is pushed by the flip-up plate 45 in an obliquely upward direction, and then the empty yarn supplying bobbin 210 is dropped from the bobbin holding peg 9. At this point of time, the opening and closing portion 68 located at the front side of the bobbin supporting section 7 is kept opened; therefore, the empty yarn supplying bobbin 210 can be discharged to the front side of the winding unit 2 through the opening and closing portion 68 which is kept opened. Further, the discharged empty yarn supplying bobbin 210 is conveyed to the collection container by the conveyor 81.

[0080] Next, the operation for supplying a new yarn supplying bobbin 21 from the magazine can 62 (i.e., a bobbin supplying step) will be described.

[0081] After completion of the bobbin discharging step, by appropriately controlling the bobbin-supporting-section driving motor 43, the control section 6 swings the swing shaft 49 such that a tip end of the bobbin holding peg 9 faces to a direction in which the notch 65a is arranged (i.e., a direction in which a yarn supplying bobbin 21 is dropped) (a state illustrated in Fig. 5; the peg standby state). Further, in such a state, as illustrated in Fig. 5, the first holding portion 46 and the second holding portion 47 are kept stuck together. Then, by appropriately controlling the yarn-handling-lever driving motor 42, the control section 6 controls the yarn handling lever 31 to stand by at the lever standby position.

[0082] In such a state, the control section 6 drives the bobbin-supplying-device driving motor 41 in a one-way direction at a predetermined angle. Accordingly, the opening and closing portion 68 is closed and the magazine can 62 is driven and rotated, and then a yarn supplying bobbin 21 is dropped to the guide chute 64. The yarn supplying bobbin 21 dropped to the guide chute 64 is guided in an obliquely downward direction by the closed opening and closing portion 68 so as to reach the bobbin supporting section 7. In the bobbin supporting section 7, the yarn supplying bobbin 21 is guided in an oblique direction and then covers the bobbin holding peg 9 which stands by while being kept slanted, in a way that the bobbin holding peg 9 can be inserted into the inside of the core tube 21a of the yarn supplying bobbin 21 (states illustrated in Fig. 5 and Fig. 8).

[0083] Then, the operation for changing the position of a yarn supplying bobbin 21 from an oblique position as illustrated in Fig. 8 to an upright position as illustrated in Fig. 10 (i.e., a bobbin position changing step) will be described.

[0084] After completion of the bobbin supplying step,

by controlling the bobbin-supporting-section driving motor 43, the control section 6 drives the bobbin holding peg 9 to be in the bobbin holding state. Accordingly, a yarn supplying bobbin 21 which has been supplied while having been kept slanted can be turned upright as illustrated in Fig. 10. Consequently, a tip end of the first holding portion 46 and a tip end of the second holding portion 47 is separated, which makes it possible to hold the yarn supplying bobbin 21 tight.

[0085] Then, the operation for guiding a yarn from a newly-supplied yarn supplying bobbin 21 to the lower yarn catching position 90 (i.e., a yarn handling step) will be described.

[0086] When the yarn supplying bobbin 21 is supplied, as illustrated in Fig. 8, a yarn is placed between the yarn supplying bobbin 21 held by the bobbin holding peg 9 and the yarn end holding opening 66. In such a state, a yarn path is strayed far from the lower yarn catching position 90; therefore, the yarn cannot be sucked and caught in the suction opening 32 of the lower yarn guiding pipe 25. Accordingly, by swinging the yarn handling lever 31, the yarn placed between the yarn supplying bobbin 21 held by the bobbin holding peg 9 and the yarn end holding opening 66 is hooked on yarn hooking portion 70, which causes the yarn to be pulled to the lower yarn catching position 90. A state of when the yarn has been pulled to the lower yarn catching position 90 is illustrated in Fig. 10.

[0087] Further, when focusing only on guiding the yarn to the lower yarn catching position 90, the yarn handling step may be carried out after completion of the bobbin position changing step. However, when the bobbin position changing step is separately carried out, a yarn from a yarn supplying bobbin 21 is pulled in an oblique direction, which causes a problem that a yarn breakage frequently occurs.

[0088] In order to make such a description understandable easily, first, a relation between a direction in which a yarn is pulled out from a yarn supplying bobbin 21 and a tendency for occurrence of a yarn breakage will be briefly described. A yarn supplying bobbin 21 is provided with a core tube 21a around which a yarn is wound. Accordingly, when the yarn supplying bobbin 21 can be driven and swung around an axis line in a direction in which a yarn is unwound, the yarn can be easily pulled out from the yarn supplying bobbin 21. However, a yarn winding machine such as the automatic winder 1 according to the present embodiment does not drive and swing a yarn supplying bobbin 21 itself; therefore, directions in which a yarn to be pulled out from the yarn supplying bobbin 21 are limited.

[0089] That is, while a yarn supplying bobbin 21 is fastened, when attempting to pull out a yarn in a direction strayed from a direction of an axis line of the yarn supplying bobbin 21, the yarn is hooked on the yarn supplying bobbin 21; therefore, when forcibly pulling out the yarn, a yarn breakage occurs. Accordingly, this type of yarn winding machine is generally configured so as to pull out

a yarn in a direction of an axis line of a yarn supplying bobbin 21. Consequently, since the yarn is not hooked on the yarn supplying bobbin 21, the yarn can be easily unwound without rotating the yarn supplying bobbin 21 itself.

[0090] Next, a description will be made by referring to Fig. 13. Fig. 13 is a view illustrating a state in which the yarn supplying bobbin 21 is turned upright without a yarn being guided by the yarn handling lever 31 (guiding a yarn will be described later). Since switching the position of a yarn supplying bobbin 21 from an oblique position to an upright position causes a distance between the surface of the yarn supplying bobbin 21 and the yarn end holding opening 66 to change, a yarn from the yarn supplying bobbin 21 is pulled by the yarn end holding opening 66. At this point of time, when the yarn is not guided by the yarn handling lever 31, the yarn is slanted and stretched between the yarn supplying bobbin 21 supported upright by the bobbin supporting section 7 and the yarn end holding opening 66 as illustrated in Fig. 13. That is, standing a yarn supplying bobbin 21 upright without a yarn being guided causes the yarn to be pulled in a direction strayed from an extended line of an axis line of the yarn supplying bobbin 21; therefore, a yarn breakage is likely to occur.

[0091] By considering the above-described features, when a yarn supplying bobbin 21 is stood upright from an oblique position, the control section 6 according to the present embodiment is configured so as to perform a yarn handling operation by the yarn handling lever 31 in accordance with change of the position of the yarn supplying bobbin 21 (That is, the control section 6 according to the present embodiment is configured so as to carry out the bobbin position changing step and the yarn handling step simultaneously).

[0092] A more specific description will be made as follows. When the control section 6 starts the bobbin position changing step, the control section 6 starts the yarn handling operation (the yarn handling step) by the yarn handling lever 31 by driving the yarn-handling-lever driving motor 42 before or after the bobbin position changing step. Accordingly, while the yarn handling operation is performed by hooking a yarn on the yarn hooking portion 70 of the yarn handling lever 31, the position of a yarn supplying bobbin 21 is changed. In other words, during the operation for changing the position of the yarn supplying bobbin 21, the yarn is guided by the yarn handling lever 31.

[0093] Accordingly, as illustrated in Fig. 9, even during the operation for changing the position of the yarn supplying bobbin 21, the yarn can be pulled out in a direction of an axis line of the yarn supplying bobbin 21, which prevents a yarn breakage and makes it possible to pull out a length of the yarn corresponding to a pulled-out length of the yarn.

[0094] Next, drive control of the yarn handling lever 31 carried out by the control section 6 in the yarn handling step will be described.

[0095] The control section 6 is required to appropriately control timing for starting driving of the yarn handling lever 31, a speed of the driving of the yarn handling lever 31, or the like in accordance with change of the position of the yarn supplying bobbin 21. Further, the above-described "the control section 6 is required to appropriately controls timing for starting driving of the yarn handling lever 31, a speed of the driving of the yarn handling lever 31, or the like in accordance with change of the position of the yarn supplying bobbin 21" indicates that when the position of the yarn supplying bobbin 21 is changed, the control section 6 controls the yarn hooking portion 70 to be constantly located above an extended line of an axis line of the yarn supplying bobbin 21. By controlling the driving of the yarn handling lever 31 as described above, when the position of the yarn supplying bobbin 21 is changed, a yarn can be pulled out in a direction of the axis line of the yarn supplying bobbin 21; therefore, a yarn breakage can be prevented. Meanwhile, when the yarn hooking portion 70 is strayed from the extended line of the axis line of the yarn supplying bobbin 21, the yarn from the yarn supplying bobbin 21 is pulled in an oblique direction, which causes occurrence of a yarn breakage.

[0096] Timing and a speed required for changing the position of the yarn supplying bobbin 21 differ according to the size or shape of a core tube 21a. Accordingly, the timing for starting the driving of the yarn handling lever 31, the speed of the driving of the yarn handling lever 31, or the like is also required to be changed in accordance with the type of a core tube 21a. In the following, a description will be made on how the speed and the timing required for changing the position of the yarn supplying bobbin 21 are changed in accordance with the type of a core tube 21a.

[0097] As illustrated in Fig. 5, while the first holding portion 46 and the second holding portion 47 are kept stuck together, a slit exists between the core tube 21a of a yarn supplying bobbin 21 and the bobbin holding peg 9. Accordingly, even when the control section 6 starts to swing the bobbin holding peg 9 from such a state, the position of the yarn supplying bobbin 21 does not change promptly. Timing for starting to change the position of a yarn supplying bobbin 21 differs according to the slit between the core tube 21a and the bobbin holding peg 9 (i.e., according to the size and shape of a core tube 21a). When the size or shape of a core tube 21a differs among yarn supplying bobbins 21, a distance, which is required to be put between the first holding portion 46 and the second holding portion 47 until the bobbin holding peg 9 makes tight contact with the inside of the core tube 21a, differs among the yarn supplying bobbins 21. That is, timing required for holding a yarn supplying bobbin 21 upright differs according to the size and shape of a core tube 21a. Accordingly, the timing or the speed required for changing the position of the yarn supplying bobbin 21 differs according to the type of a core tube 21a.

[0098] By considering the above-described features, the control section 6 of the automatic winder 1 according

to the present embodiment is configured capable of changing timing for starting driving of the yarn handling lever 31, a speed of the driving of the yarn handling lever 31, or the like in accordance with the type of a core tube 21a. For example, setting data for appropriately controlling the yarn handling lever 31 are required to be prepared in advance for each of types of a core tube 21a. The setting data include data required for settings such as timing for starting driving of the yarn-handling-lever driving motor 42 and a speed of the driving of the yarn-handling-lever driving motor 42.

[0099] When change of a winding state such as replacing a type of a core tube 21a occurs, the operator of the automatic winder 1 uses the operation input section 10 located in the frame control device 3 in order to input a setting value for specifying the type of a core tube 21a. Then in each of the winder units 2, setting data corresponding to the type of the core tube 21a are applied to the control section 6 in accordance with the input setting value. Accordingly, the yarn handling lever 31 can be appropriately driven in accordance with the type of a core tube 21a. That is, regardless of the type of a core tube 21a, when changing the position of a yarn supplying bobbin 21, a yarn can be pulled out in a direction of an axis line of the yarn supplying bobbin 21; therefore, a yarn breakage can be prevented when changing the position of the yarn supplying bobbin 21.

[0100] Further, since a conventionally-known yarn winding machine did not include a dedicated driving source for a yarn handling lever such as a yarn-handling-lever driving motor, a yarn handling lever was driven by driving force of a bobbin-supporting-section driving motor 43 taken by a link mechanism or the like, for example. That is, in the conventionally-known yarn winding machine, the yarn handling lever was driven by a driving source shared by the other components. Accordingly, in the conventionally-known yarn winding machine, it was difficult to separately and closely regulate driving of a yarn handling lever 31. Therefore, there were cases where the conventionally-known yarn winding machine cannot deal with differences among types of core tubes, which frequently caused a yarn breakage when changing the position of a yarn supplying bobbin.

[0101] Meanwhile, in the automatic winder 1 according to the present embodiment, a dedicated driving source for the yarn handling lever 31 (the yarn-handling-lever driving motor 42) is located separately from the bobbin-supplying-device driving motor 41 and the bobbin-supporting-section driving motor 43. The control section 6 can flexibly and closely control driving of the yarn handling lever 31. By such a structure, the yarn handling lever 31 can be driven and controlled in accordance with the type of a core tube 21a.

[0102] Next, the operation for reliably sucking and catching a lower yarn through the lower yarn guiding pipe 25 (i.e., a yarn slackening step) will be described.

[0103] When a yarn supplying bobbin 21 is turned upright (a state illustrated in Fig. 10) after completion of the

bobbin position changing step (and yarn handling step), the control section 6 stops driving of the bobbin holding peg 9 and swings the yarn handling lever 31 to the yarn slackening position. Accordingly, the yarn hooking portion 70 pulls a yarn from the yarn supplying bobbin 21, which causes the yarn to be further pulled out. Consequently, the yarn hooking portion 70 is strayed from an extended line of an axial line of the yarn supplying bobbin 21. The lower yarn guide 38, which is arranged immediately above the yarn supplying bobbin 21, can guide the yarn; therefore, the yarn can be pulled out in a direction of the axial line of the yarn supplying bobbin 21 (refer to Fig. 11). Accordingly, after holding the yarn supplying bobbin 21 upright (after completion of the bobbin position changing step), even when the yarn hooking portion 70 is strayed from the extended line of the axis line of the yarn supplying bobbin 21, the yarn is not cut off. As described above, the lower yarn guide 38 and the yarn handling lever 31 interact with each other, which makes it possible to pull out the yarn from the yarn supplying bobbin 21. Consequently, the yarn (a lower yarn) from the yarn supplying bobbin 21 can be slackened.

[0104] As illustrated in Fig. 11, the yarn handling lever 31 swings in a way that the cutter introduction guide 37 and the cutter 36 are nipped between the upper part yarn hooking portion and the lower part yarn hooking portion. Accordingly, a lower yarn hooked by the yarn hooking portion 70 is introduced in the cutter introduction guide 37, and the lower yarn is guided to a position at which the cutter 36 can cut the lower yarn. Further, in such a state, as illustrated in Fig. 11, a yarn path is bent by the yarn handling lever 31, the cutter introduction guide 37, and the lower yarn guide 38.

[0105] Next, the operation for sucking and catching a lower yarn from a yarn supplying bobbin 21 through the lower yarn guiding pipe 25 (i.e., a yarn end catching step) will be described.

[0106] After completion of the yarn slackening step, the control section 6 drives and rotates the lower yarn guiding pipe 25 around the shaft 33, and then moves the suction opening 32 to the vicinity of the lower yarn catching position 90. Then, the control section 6 controls the cutter 36 to cut a yarn off while performing a sucking operation by the suction opening 32. As described above, a yarn path is kept bent immediately before cutting the yarn. Accordingly, by controlling the cutter 36 to cut the yarn off in such a state (a state illustrated in Fig. 11), a yarn (a lower yarn) between the cutter 36 and a yarn supplying bobbin 21 can be slackened. Then, the slackened lower yarn is sucked and caught in the suction opening 32 arranged to suck a yarn at the lower yarn catching position 90 (a state illustrated in Fig. 12).

[0107] As described above, when the lower yarn is sucked and caught through the lower yarn guiding pipe 25, by slackening the lower yarn, a yarn end of the lower yarn can be reliably sucked and caught in the suction opening 32. At this point of time, when a small amount of yarn is slackened, the length of the yarn end which is

sucked through the lower yarn guiding pipe 25 is shorter, which may fail to catch the yarn end. Accordingly, in order to reliably catch the lower yarn, driving of the yarn handling lever 31 is required to be controlled so as to maintain at least a constant amount of yarn to be slackened.

[0108] The amount of yarn to be slackened can be regulated by controlling an amount of driving of the yarn handling lever 31. That is, as the yarn hooking portion 70 is moved closer to the left side of Fig. 11 (as a yarn is further pulled by the yarn handling lever 31), a lower yarn can be more slackened. However, even when a certain fixed amount of driving of the yarn handling lever 31 is applied to different types of yarns, an amount of yarn to be slackened differs among the different types of yarns. For example, a highly stretchable yarn is stretched just by being pulled by the yarn handling lever 31, which causes an actual amount of yarn which is slackened to be smaller.

[0109] By considering the above-described features, the control section 6 of the automatic winder 1 according to the present embodiment is configured capable of changing the amount of driving of the yarn handling lever 31 in accordance with the type of a yarn. For example, setting data for controlling an amount of driving of the yarn-handling-lever driving motor 42 are prepared in advance for each types of a yarn. The setting data are required to be set such that a more highly stretchable yarn can move the yarn handling lever 31 further.

[0110] When change of a winding state such as replacing a type of a yarn from a yarn supplying bobbin 21 occurs, the operator of the automatic winder 1 uses the operation input section 10 located in the frame control device 3 in order to input a setting value for specifying the type of a yarn from the yarn supplying bobbin 21. Then, in each of the winder units 2, setting data corresponding to the type of the yarn are applied to the control section 6 in accordance with the input setting value. Consequently, regardless of the type of a yarn, at least a constant amount of yarn to be slackened is maintained. Accordingly, a lower yarn can be reliably sucked and caught through the lower yarn guiding pipe 25.

[0111] Further, as described above, in the conventionally-known yarn winding machine, since the yarn handling lever was driven by the driving source shared by the other components, the yarn handling lever was incapable of being separately regulated. Therefore, in the conventionally-known winding machine, a stopper for restricting an amount of driving of the yarn handling lever was located, and an amount of yarn to be slackened was regulated by replacing the stopper with another stopper when replacing a type of a yarn. Meanwhile, the yarn handling lever 31 according to the present embodiment is driven by the yarn-handling-lever driving motor 42 which is a dedicated driving source, and a stepping motor is used as the yarn-handling-lever driving motor 42. The use of the stepping motor makes it possible to easily decide a position of a rotor without the user of a stopper or the like. Accordingly, such a structure of the present em-

bodiment makes it possible to eliminate the use of a stopper; therefore, a stopper is not required to be always replaced when replacing a type of a yarn, which makes it possible to reduce such a burden on the operator.

[0112] Furthermore, in a structure to control an amount of swinging movement of a yarn handling lever by a stopper, such as a structure of the conventionally-known yarn winding machine, a control section cannot recognize whether or not the yarn handling lever is swung to an appropriate position. Accordingly, in the conventionally-known yarn winding machine, the control section started a yarn end catching step after the elapse of an enough length of time required for swinging the yarn handling lever to a position which is restricted by the stopper. Meanwhile, in the present embodiment, the control section 6 decides a position of the yarn handling lever 31; therefore, swinging the yarn handling lever 31 to an appropriate position makes it possible to promptly switch to the yarn end catching step. Accordingly, by the structure of the present embodiment, a length of time required for the yarn handling step can be reduced and a package can be effectively produced.

[0113] After completion of the yarn end catching step, the control section 6 swings the lower yarn guiding pipe 25 to guide a lower yarn to the yarn splicing device 14. Then, in the yarn splicing device 14, the lower yarn is spliced with an upper yarn from a package 29. Consequently, the upper yarn from the package 29 and a yarn from a yarn supplying bobbin 21 are connected. Under such a state, by restarting to drive and rotate the package 29, the yarn can be unwound from the yarn supplying bobbin 21 to wind the yarn around the package 29.

[0114] As described above, the automatic winder 1 according to the present embodiment includes the bobbin supporting section 7, the lower yarn guiding pipe 25, the bobbin supplying device 60, the bobbin-supplying-device driving motor 41, the bobbin-supporting-section driving motor 43, the yarn end holding opening 66, the yarn handling lever 31, and the control section 6. The bobbin supporting section 7 supports a yarn supplying bobbin 21. The lower yarn guiding pipe 25 catches a yarn from the yarn supplying bobbin 21. The bobbin supplying device 60 supplies the yarn supplying bobbin 21 to the bobbin supporting section 7. The bobbin-supplying-device driving motor 41 drives the bobbin supplying device 60. The bobbin-supporting-section driving motor 43 drives the bobbin supporting section 7. The yarn end holding opening 66, which is located in the bobbin supplying device 60, holds a yarn end of the yarn from the yarn supplying bobbin 21. The yarn handling lever 31 hooks a yarn placed between the yarn supplying bobbin 21 supported by the bobbin supporting section 7 and the yarn end holding opening 66 in order to guide the yarn to a position at which the yarn can be caught through the lower yarn guiding pipe 25. The control section 6 controls driving of the yarn handling lever 31. Further, the yarn handling lever 31 is driven by the yarn-handling-lever driving motor 42 which is a dedicated driving means provided sepa-

ately from the bobbin-supplying-device driving motor 41 and the bobbin-supporting-section driving motor 43.

[0115] That is, in a conventionally-known yarn winding machine, a yarn handling member was driven by a driving means shared by the other components; therefore, it was difficult to control driving of the yarn handling member separately and flexibly. Meanwhile, by driving the yarn handling lever 31 by the dedicated driving means as described above, the driving of the yarn handling lever 31 can be separately controlled; therefore, an amount of the driving of the yarn handling lever 31, a speed of the driving of the yarn handling lever 31, or the like can be flexibly changed as required. Accordingly, a yarn can be appropriately guided, which makes it possible to reliably catch a yarn end through the lower yarn guiding pipe 25 while a yarn breakage is being prevented.

[0116] Further, the automatic winder 1 according to the present embodiment includes the lower yarn guide 38 that slackens a lower yarn while interacting with the yarn handling lever 31.

[0117] By slackening the lower yarn as described above, a yarn end can be easily caught through the lower yarn guiding pipe 25.

[0118] Further, in the automatic winder 1 according to the present embodiment, a stepping motor is used as the yarn-handling-lever driving motor 42.

[0119] That is, the stepping motor, which can control a position or a speed by a simple circuit structure, is especially preferred as a driving source of the yarn handling lever 31. Particularly, by using the stepping motor as the driving source, a position of the yarn handling lever 31 can be easily decided. Consequently, a stopper or the like for deciding a position of the yarn handling lever 31 is unnecessary.

[0120] Further, the automatic winder 1 according to the present embodiment includes an operation input section 10 capable of inputting a setting value. Then, the control section 6 can change timing for starting driving of the yarn handling lever 31 and a speed of the driving of the yarn handling lever 31 in accordance with a setting value set in the operation input section 10.

[0121] That is, when changing the position of a yarn supplying bobbin 21, a speed and timing required for changing the position differ according to the size or shape of a core tube 21a. Accordingly, the automatic winder 1 is configured capable of changing a speed and timing required for the driving of the yarn handling lever 31 in accordance with the setting value as described above, which makes it possible to drive the yarn handling lever 31 in accordance with change of the position of the yarn supplying bobbin 21. Consequently, a yarn breakage can be prevented.

[0122] Further, in the automatic winder 1 according to the present embodiment, the control section 6 can change an amount of driving of the yarn handling lever 31 in accordance with the setting value input in the operation input section 10.

[0123] For example, under a state in which each of

yarns is provided with different stretch properties, even when the yarn handling lever 31 is controlled to constantly move a certain fixed distance, the actual length of the each of the yarns to be pulled out from a yarn supplying bobbin 21 is different. Accordingly, the yarn winding machine is configured capable of changing an amount of driving of the yarn handling lever 31 in accordance with a setting value as described above, which makes it possible to maintain the length of a yarn to be pulled out from the yarn supplying bobbin 21 constant, regardless of the type of a yarn.

[0124] Further, a yarn guiding method according to the present embodiment includes the bobbin supplying step, the bobbin position changing step, and the yarn handling step. The bobbin supplying step supplies a yarn supplying bobbin 21 to the bobbin supporting section 7. The bobbin position changing step changes the position of the yarn supplying bobbin 21 supplied to the bobbin supporting section 7 so that a yarn can be unwound from the yarn supplying bobbin 21 (an upright position). The yarn handling step drives the yarn handling lever 31 while hooking a yarn from the yarn supplying bobbin 21 on the yarn handling lever 31. Accordingly, the yarn handling lever 31 guides the yarn to the lower yarn catching position 90. Further, the yarn handling step is carried out simultaneously with the bobbin position changing step. Furthermore, the yarn handling step controls driving of the yarn handling lever 31 such that a portion in which the yarn is hooked on the yarn handling lever 31 (i.e., the yarn hooking portion 70) is located above an extended line of an axis line of the yarn supplying bobbin 21.

[0125] As described above, the yarn handling lever 31 guides the yarn when changing the position of the yarn supplying bobbin 21; which makes it possible to pull out the yarn in a direction of the axial line of the yarn supplying bobbin 21. Accordingly, occurrence of a yarn breakage of when changing the position of the yarn supplying bobbin 21 can be prevented, which makes it possible to form a high-quality package.

[0126] Further, the yarn guiding method according to the present embodiment includes the yarn slackening step of further driving the yarn handling lever 31 to slacken a yarn after the yarn handling step. The yarn slackening step controls driving of the yarn handling lever 31 so as to maintain the length of a yarn to be pulled out from a yarn supplying bobbin 21 constant, regardless of the type of a yarn.

[0127] For example, under a state in which each of yarns is provided with different stretch properties, even when the yarn handling lever 31 is controlled so as to move a certain fixed distance, the actual length of the each of the yarns to be pulled out from the yarn supplying bobbin 21 is different. A more detailed description will be made as follows. That is, since a highly stretchable yarn is shrunk by being cut by the cutter 36, the length of such a yarn to be pulled out from a yarn supplying bobbin 21 is shorter than the length of a less stretchable yarn to be pulled out from a yarn supplying bobbin 21; therefore,

the highly stretchable yarn may be prevented from being caught through the lower yarn guiding pipe 25. Consequently, an amount of highly stretchable yarns to be slackened is required to be larger than an amount of less stretchable yarns to be slackened. Accordingly, by changing an amount of driving of the yarn handling lever 31 in accordance with the type of a yarn as described above, it becomes possible to keep the length of a yarn to be pulled out from a yarn supplying bobbin 21 constant, regardless of the type of a yarn. As a result, since a yarn end of the yarn from the yarn supplying bobbin 21 can be reliably caught in the following steps, a package can be produced effectively.

[0128] While a preferred embodiment of the present invention have been described, the above-described structures can be modified as follows.

[0129] The above-described embodiment is organized such that setting data for controlling the yarn-handling-lever driving motor 42 are prepared in advance for each type of core tube or each type of yarn, and then a setting value for specifying a type of core tube or a type of yarn is input. However, in place of such a structure or in addition to such a structure, an operation input section may be located such that the operator can manually adjust settings in accordance with a winding state such as a type of core tube or a type of yarn. In such a case, for example, it is preferable to use a structure in which the operator can input a setting value for relatively selecting settings such as "making a speed of driving of a yarn handling lever faster" or "making the speed of driving of the yarn handling lever slower". Under such a structure, even when replacing a yarn supplying bobbin causes a yarn breakage to occur frequently, the speed of driving of the yarn handling lever or the like can be intuitively adjusted. Needless to mention, such a structure may be replaced with a structure in which operator can directly input a numerical value which is a setting value indicating a speed of driving of the yarn handling lever, timing for starting driving of the yarn handling lever, an amount of driving of the yarn handling lever, or the like, for example.

[0130] Although the above-described embodiment is organized such that a stepping motor is used as the yarn-handling-lever driving motor 42, a servomotor other than the stepping motor also can be used. However, since the stepping motor is easily controlled and has a feature that its location can be easily decided, the stepping motor is especially preferred as a driving source of the yarn handling lever.

[0131] Further, although the above-described embodiment is organized such that a speed of driving of the yarn handling lever 31 and timing for starting the driving of the yarn handling lever 31 are changed in accordance with the type of a core tube 21a, such a structure may be replaced with a structure to change one of the speed of driving of the yarn handling lever 31 and the timing for starting the driving of the yarn handling lever 31. Furthermore, even the structure to change one of the speed of driving of the yarn handling lever 31 and the timing for

starting the driving of the yarn handling lever 31 can control a yarn breakage caused by change of the position of a yarn supplying bobbin 21 to occur less frequently than a structure in which the speed of driving of the yarn handling lever 31 and the timing for starting the driving of the yarn handling lever 31 are fixed. However, in an aspect in which the yarn handling lever 31 is appropriately controlled in accordance with the change of the position of a yarn supplying bobbin 21, it is preferable to use a structure to change both the speed of driving of the yarn handling lever 31 and the timing for starting the driving of the yarn handling lever 31 in accordance with the type of a core tube 21a.

[0132] The structures of the present invention can be applied not only to an automatic winder but also to other types of yarn winding machines.

[0133] While the present invention has been described with respect to a preferred embodiment thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the present invention.

Claims

1. A yarn winding machine comprising:

a bobbin supporting section (7) which supports a yarn supplying bobbin (21),
 a yarn catching and guiding section (25) which catches a yarn from the yarn supplying bobbin (21),
 a bobbin supplying section (60) which supplies the yarn supplying bobbin (21) to the bobbin supporting section (7),
 driving sources (41, 43) which drive both the bobbin supporting section (7) and the bobbin supplying section (60), or drives one of the bobbin supporting section (7) and the bobbin supplying section (60),
 a yarn end holding section (66) which is located in the bobbin supplying section (60) and holds a yarn end of the yarn from the yarn supplying bobbin (21),
 a yarn guiding member (31) which hooks a yarn placed between the yarn supplying bobbin (21) supported by the bobbin supporting section (7) and the yarn end holding section (66) in order to guide the yarn to a position at which the yarn can be caught by the yarn catching and guiding section (25), and
 a control section (6) which controls driving of the yarn guiding member (31),
characterized in that the yarn guiding member

(31) is driven by a dedicated driving means (42) provided separately from the driving sources (41, 43).

2. The yarn winding machine according to claim 1, **characterized by** further comprising a guiding member that slackens a yarn while interacting with the yarn guiding member (31).
3. The yarn winding machine according to claim 1 or claim 2, **characterized in that** a stepping motor is used as the dedicated driving means (42).
4. The yarn winding machine according to any one of claim 1 through claim 3, **characterized by** further comprising an operation input section (10) capable of inputting a setting value, and **characterized in that** the control section (6) can change at least one of timing for starting driving of the yarn guiding member (31) and a speed of the driving of the yarn guiding member (31) in accordance with a setting value set in the operation input section (10).
5. The yarn winding machine according to any one of claim 1 through claim 3, **characterized by** further comprising an operation input section (10) capable of inputting a setting value, and **characterized in that** the control section (6) can change an amount of driving of the yarn guiding member (31) in accordance with a setting value set in the operation input section (10).
6. A yarn guiding method of guiding a yarn from a yarn supplying bobbin (21) to the yarn winding machine comprising:

a bobbin supplying step which supplies a yarn supplying bobbin (21) to the bobbin supporting section (7),
 a bobbin position changing step which changes the position of the yarn supplying bobbin (21) supplied to the bobbin supporting section (7) so that a yarn can be unwound from the yarn supplying bobbin (21), and
 a yarn guiding step which guides a yarn from the yarn supplying bobbin (21) to a predetermined position by driving the yarn guiding member (31) while hooking the yarn from the yarn supplying bobbin (21) on the yarn guiding member (31),
characterized in that the yarn guiding step is carried out simultaneously with the bobbin position changing step, and the yarn guiding step controls driving of the yarn guiding member (31) such that a portion in which the yarn is hooked on the yarn guiding member (31) is located above an extended line of an axis line of the yarn supplying bobbin (21).

7. The yarn guiding method according to claim 6, **characterized by** further comprising a yarn slackening step of further driving the yarn guiding member (31) to slacken a yarn after the yarn guiding step, and **characterized in that** the yarn slackening step controls driving of the yarn guiding member (31) so as to maintain the length of a yarn to be pulled out from the yarn supplying bobbin 21 constant, regardless of the type of a yarn.

5

10

15

20

25

30

35

40

45

50

55

FIG. 1

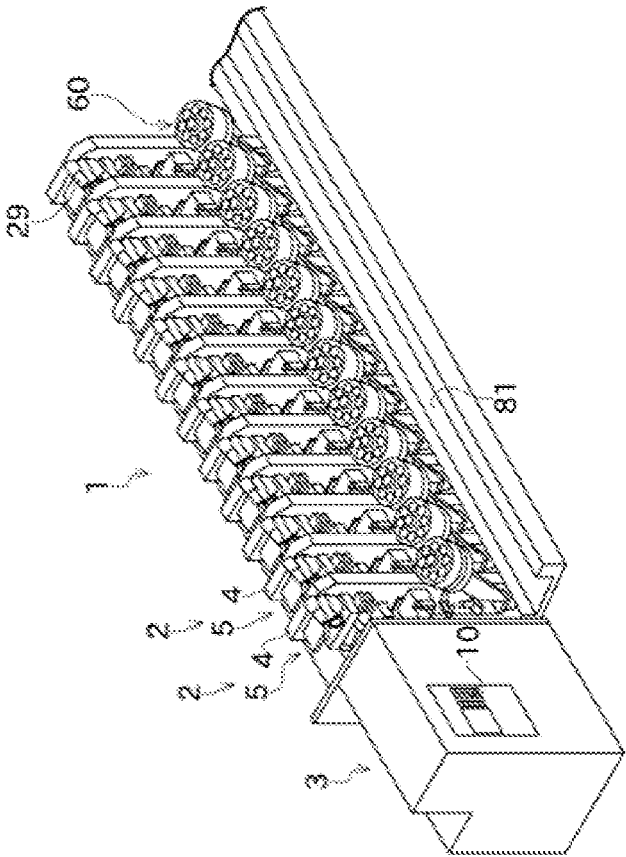


FIG. 2

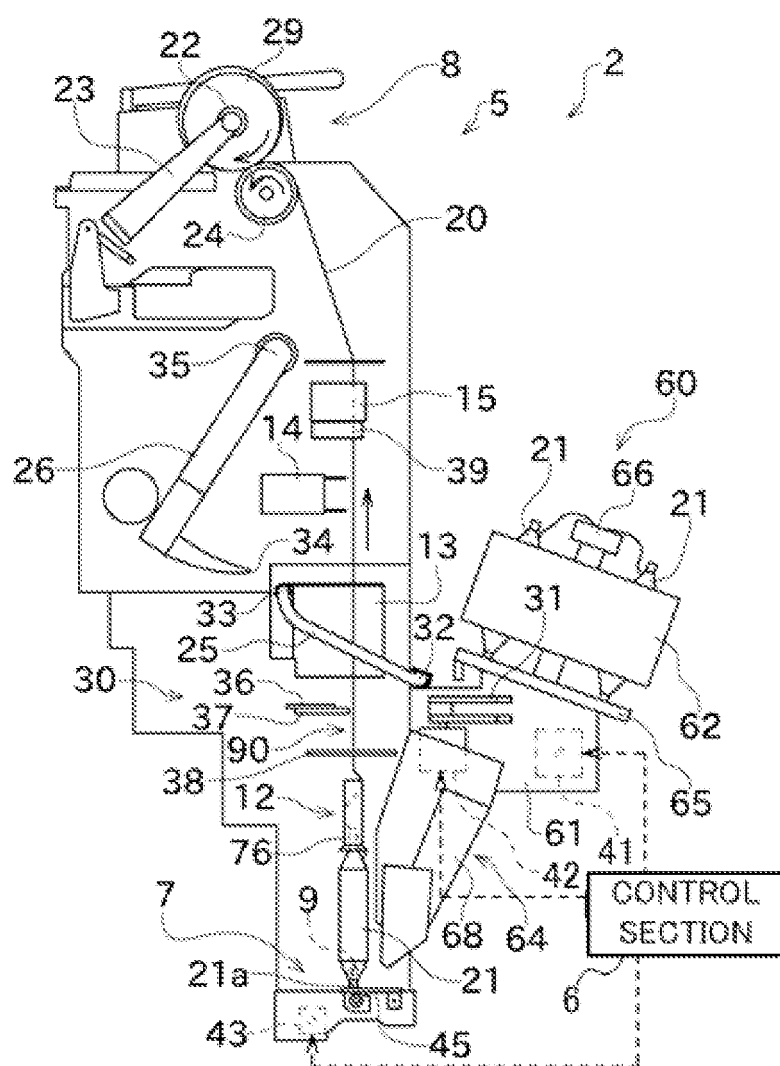


FIG. 3

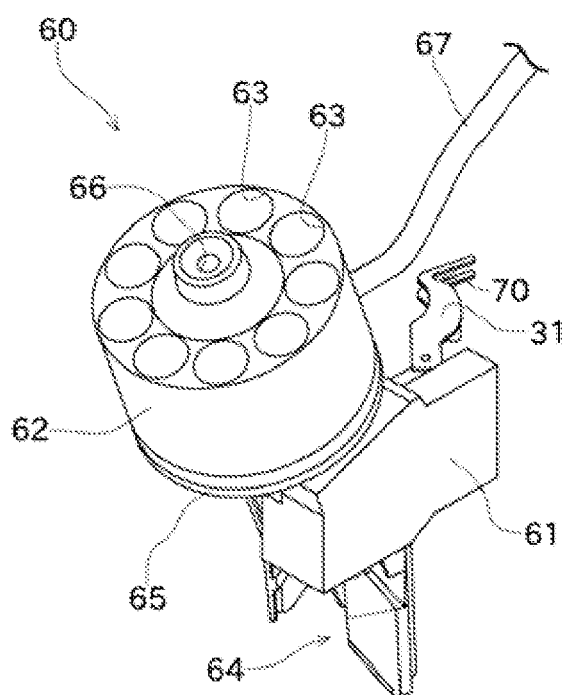


FIG. 4

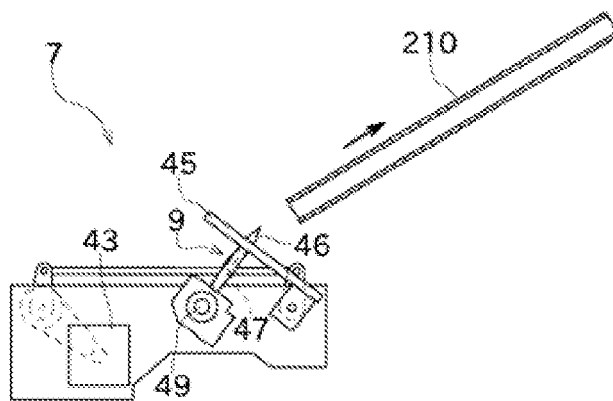


FIG. 5

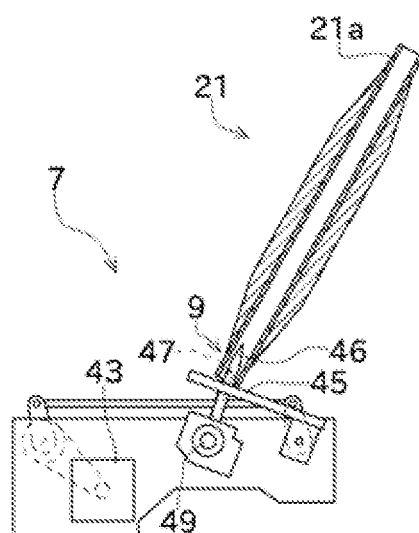


FIG. 6

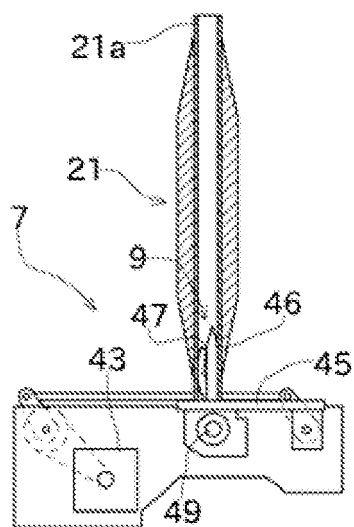


FIG. 7

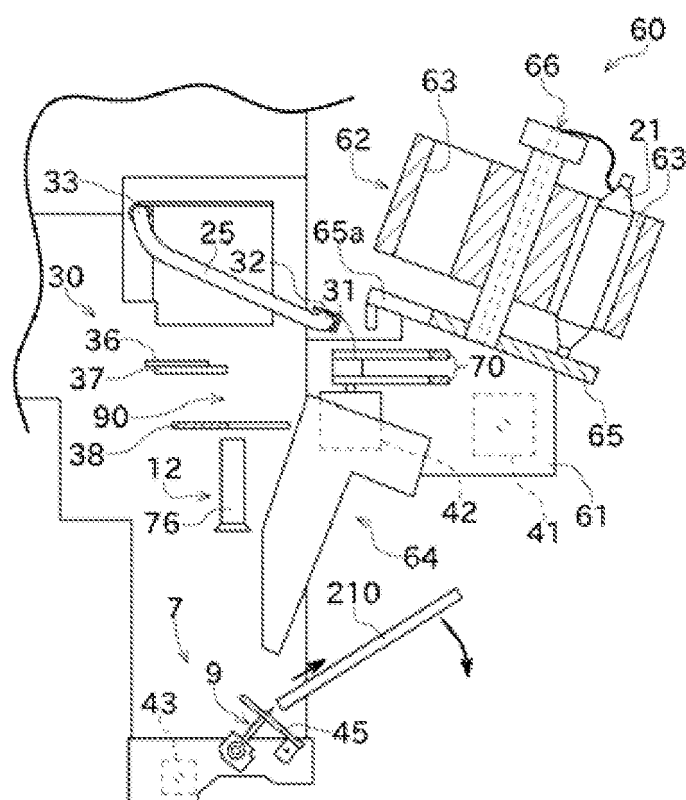


FIG. 8

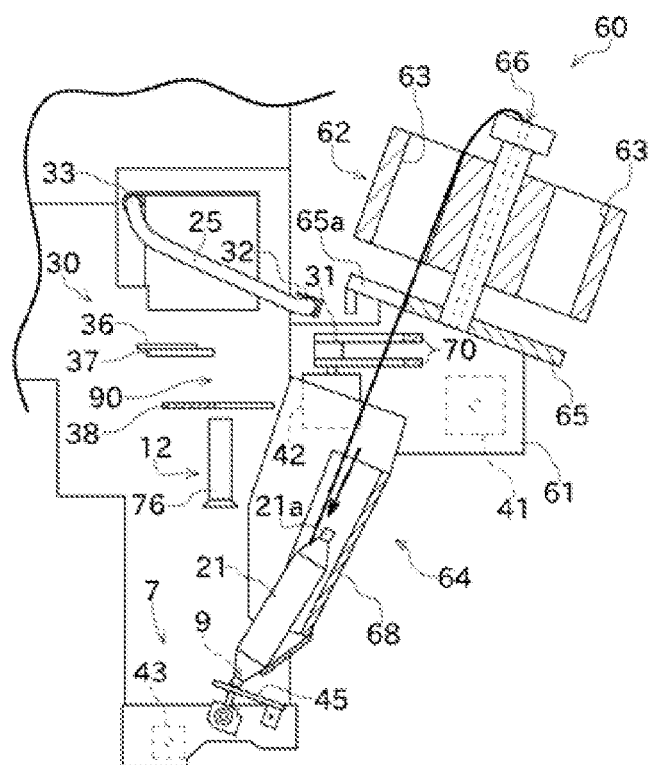


FIG. 9

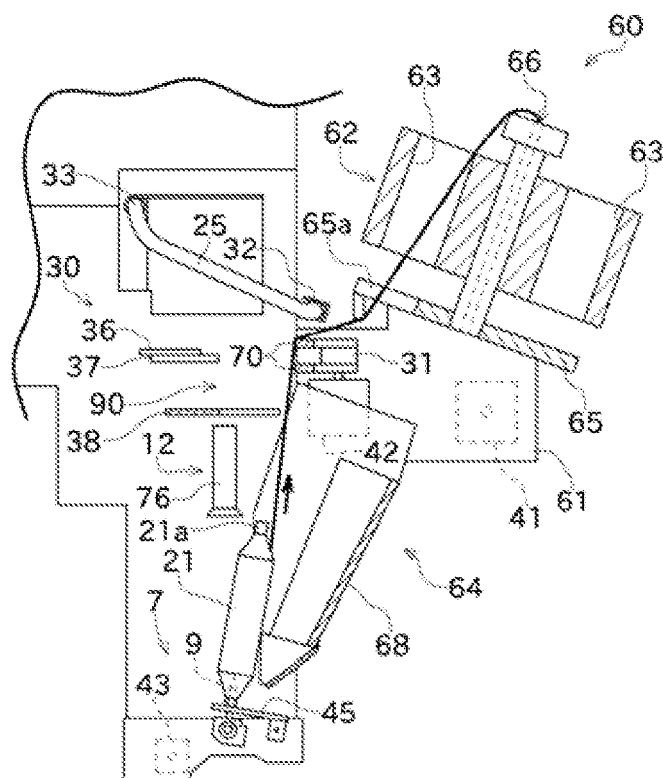


FIG. 10

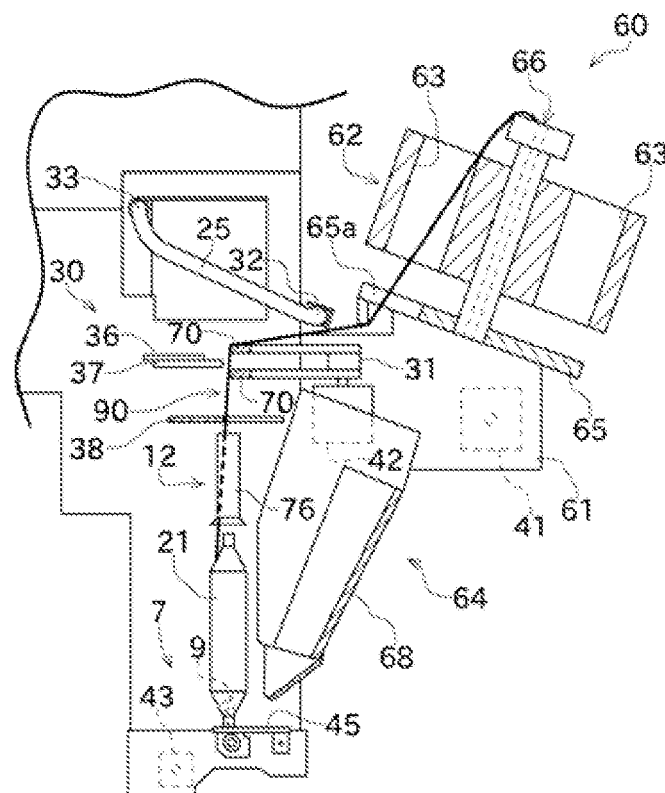


FIG. 11

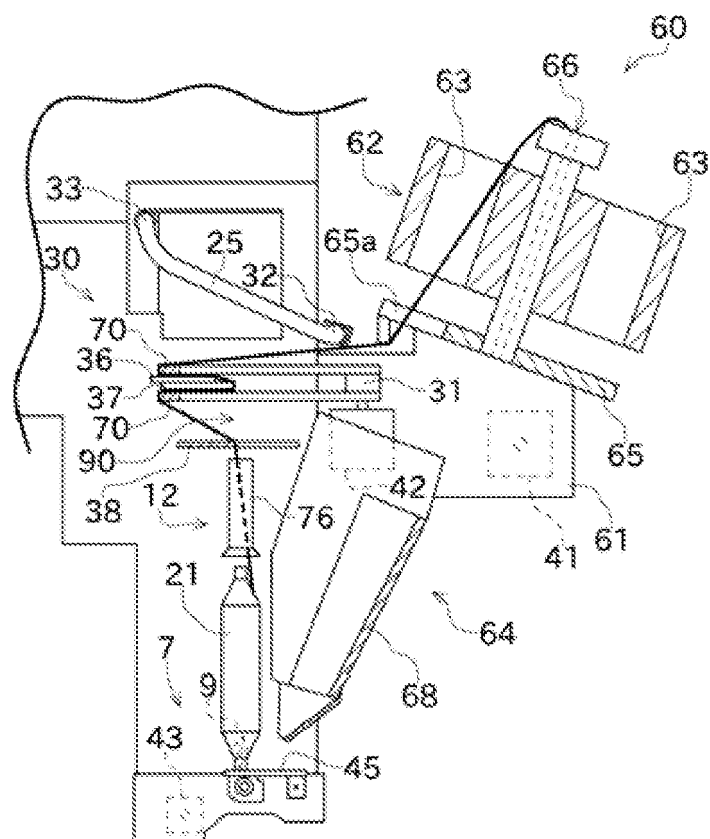


FIG. 12

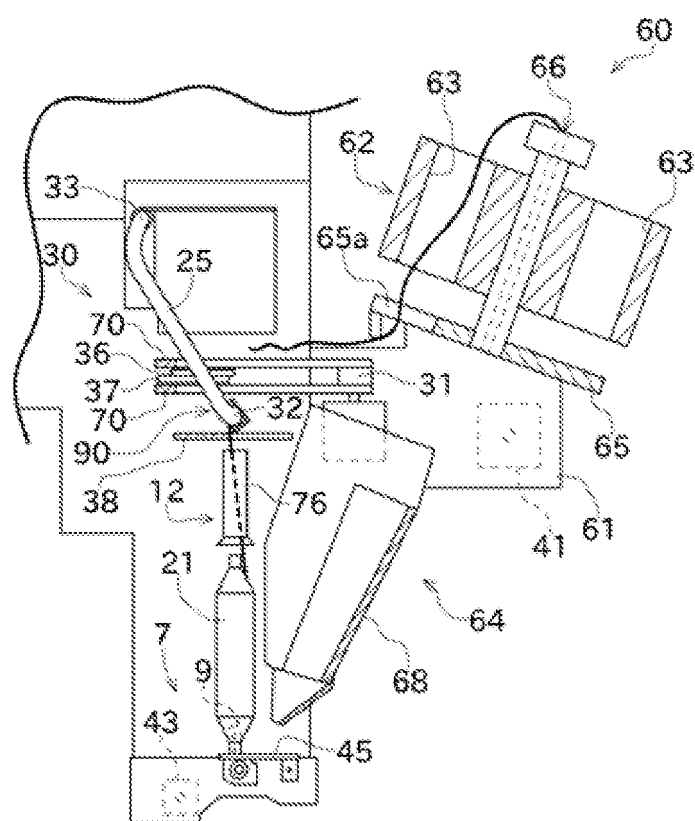
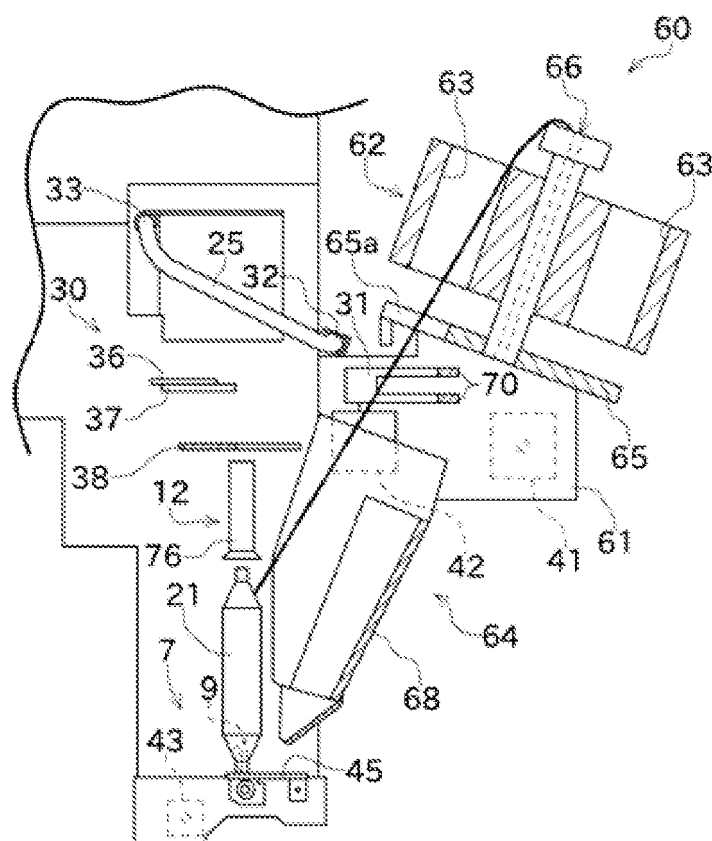


FIG. 13

COMPARATIVE EXAMPLE



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2009018930 A [0002] [0006]
- JP H09183571 B [0002]