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

(11) **EP 2 484 620 A1**

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

(43) Date of publication:
08.08.2012 Bulletin 2012/32

(21) Application number: **10820660.8**

(22) Date of filing: **30.09.2010**

(51) Int Cl.:
B65H 51/22 *(2006.01)*

(86) International application number:
PCT/JP2010/067116

(87) International publication number:
WO 2011/040545 (07.04.2011 Gazette 2011/14)

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

(30) Priority: **30.09.2009 JP 2009228888**

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

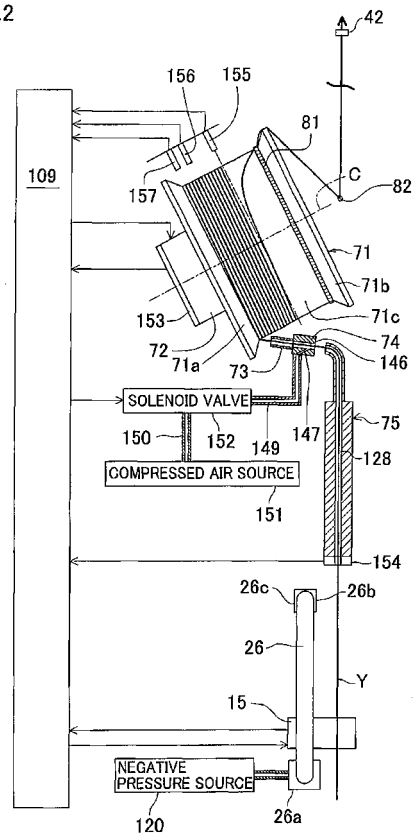
(72) Inventors:
- **IMAMURA Yuji**
  Kyoto-shi
  Kyoto 612-8686 (JP)
- **HIRAO, Osamu**
  Kyoto-shi
  Kyoto 612-8686 (JP)

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

(54) YARN WINDER

(57) A yarn is continuously wound by a yarn winder without interruption. When a yarn guiding member 73 guides a yarn Y to a tapered portion 71a which is the lower left end portion of a rotational storage drum 71, the yarn Y is wound onto the tapered portion 71a as the rotational storage drum 71 rotates and moves rightward and upward along the surface of the tapered portion 71a, with the result that the yarn Y is stored in the rotational storage drum 71. The yarn Y unwound from the rotational storage drum 71 passes through a gap between a rubber-made annular component 81 wrapping up the rotational storage drum 71 and the surface of the rotational storage drum 71 and runs toward a winding section 6. Furthermore, an airflow flowing from the rotational storage drum 71 side to the upper yarn guide pipe 26 side is generated by a blowdown nozzle 74 in the yarn guiding member 73 and the rotational storage drum 71 is rotated in a direction opposite to the direction at the time of winding the yarn, so that the yarn end of the yarn Y on the rotational storage drum 71 is sucked and drawn out to the upper yarn guide pipe 26.

FIG.2



EP 2 484 620 A1

Description

Technical Field

[0001] The present invention relates to a yarn winder (yarn winding device) which winds spun yarn unwound from a yarn supplying bobbin so as to form a package.

Background Art

[0002] A yarn produced by using a spinning machine or the like is wound onto a yarn supplying bobbin and transported to a yarn winder. The yarn winder joints, by using a predetermined yarn jointing device, yarns of a plurality of transported yarn supplying bobbins with one another, so as to form a package with a predetermined length. A known yarn winder having such a yarn jointing device is typically arranged to include a suction arm which catches the yarn end on the winding bobbin side and guides the yarn to the yarn jointing device and a relay pipe which catches the yarn end on the yarn supplying bobbin side and guides the yarn to the yarn jointing device.

[0003] When yarn breakage, yarn cutting or the like occurs in this yarn winder during a winding operation, the upper yarn is wound onto the winding bobbin rotating by inertia whereas the lower yarn is retained by a suitable trapping means. Then a yarn jointing operation is carried out as below. That is, the winding bobbin having stopped the rotation is reverse-rotated, the yarn end of the upper yarn to be unwound is sucked and caught by the leading end of the suction arm, and this yarn is guided to the yarn jointing device. Almost at the same time, the yarn end of the lower yarn retained by the trapping means is sucked and caught by the leading end of the relay pipe, with the result that the lower yarn is unwound from the yarn supplying bobbin and guided to the yarn jointing device. Thereafter, the yarn ends of the upper yarn and the lower yarn are jointed with each other by the yarn jointing device, and the winding operation starts.

[0004] On the other hand, when the yarn of the yarn supplying bobbin is completely wound onto the winding bobbin and a new yarn supplying bobbin is supplied, the winding bobbin having stopped the rotation is reverse-rotated, the yarn end of the upper yarn to be unwound is sucked and caught by the leading end of the suction arm, and the yarn is guided to the yarn jointing device. Almost at the same time, the yarn end of the yarn (lower yarn) on the new yarn supplying bobbin is blown up by an airflow and is sucked and caught by the leading end of the relay pipe, and then the lower yarn is unwound and guided to the yarn jointing device. Thereafter, the yarn ends of the upper yarn and the lower yarn are jointed with each other by the yarn jointing device, and the winding operation is resumed.

[0005] It is noted that the winding bobbin is stopped as above by a lift-up mechanism and a package braking mechanism of the yarn winder. The lift-up mechanism moves up a cradle so as to move the winding bobbin away from a winding driving unit. The package braking mechanism stops the rotation of the winding bobbin supported by the cradle, at the same time as the cradle is moved up by the lift-up mechanism. The rotation of the winding bobbin is stopped in this way, and the winding operation is discontinued.

[0006] In the meantime, even though an object is different from the yarn winder above, a winder for generating a single package from packages of a plurality of colors is recited in Patent Literature 1. The winder recited in Patent Literature 1 is arranged so that a wound yarn package is formed by serially winding different types or colors of yarns while measuring a predetermined length in each yarn in the longitudinal direction of the yarns. More specifically, the winder selects, by a selection device, at least one yarn from packages of different colors or of different yarn types, joints yarns by the yarn jointing device, and continuously forms a package by a yarn storage device which measures and stores the yarns at the same time.

[0007] In addition to the above, Patent Literature 2 recites a yarn winding method and device that make it possible to continue winding without interruption even at the time of yarn breakage. The device recited in Patent Literature 2 is arranged so that a yarn unwound from a bobbin is stored, and the winding is continued at the time of yarn breakage by using the stored yarn until the yarn jointing operation is completed.

Citation List

Patent Literatures

[0008]

Patent Literature 1: Japanese Unexamined Patent Publication No. 2004-156186
Patent Literature 2: Specification of U.S. Patent No. 3314621

Summary of Invention

Technical Problem

[0009] Increase in the winding speed for forming a package has been demanded to improve the production efficiency. Such increase in the winding speed, however, overtaxes the running yarn, with the result that yarn breakage frequently occurs. At the time of yarn breakage, it is necessary to pull out the yarn from the package and joint the same with the yarn on the yarn supplying bobbin side. In this regard, when reverse-rotating the package and catching the yarn on the package side in the yarn jointing operation, the sucking force of the suction arm may pull the surface of the package and disrupt the alignment of the wound yarn. Furthermore, because the winding is interrupted by the reverse rotation of the package in the yarn jointing operation, simply increasing the wind-

ing speed does not always result in the improvement in the production efficiency. Furthermore, since a routine of abruptly stopping the package rotating at a high speed and regaining the same high rotation speed after the yarn jointing operation is carried out each time the winding operation is discontinued, the power consumption is high.

[0010] In this regard, the wound yarn package of Patent Literature 1 is arranged so that yarn winding without interruption is achieved on account of a storage section of the yarn. The winder of Patent Literature 1, however, is arranged to form a package from a plurality of packages formed by a yarn winder having a yarn defect removal mechanism. The latter packages are the target of the present invention, and hence the winder of Patent Document 1 does not have any mechanism of removing yarn defects. For this reason, a yarn defect is wound from a yarn supplying bobbin onto a package. Furthermore, the structure of the yarn jointing device makes it difficult to remove such a yarn defect.

[0011] In the meanwhile, the yarn winding method and device recited in Patent Literature 2 are arranged so that the formation of a package is continued even if yarn breakage occurs, thanks to a storage container for storing a yarn. It is important in this yarn winding method and device to efficiently remove a defect and joint yarns before the yarn stored for continuing the formation of the package runs out, when yarn breakage occurs or defect removal is needed. In this regard, Patent Literature 2 does not include any specific descriptions concerning the yarn jointing and defect removal while continuing package formation. Furthermore, since no mechanism for aligning and storing a yarn is included, yarn entanglement may occur.

[0012] The present invention was done to solve the problems above, and an object of the present invention is to provide a yarn winder which can wind a yarn without interruption from the start to the end of the formation of a package.

Solution to Problem

[0013] According to the first aspect of the invention, a yarn winder includes: a yarn supplying portion for unwinding a spun yarn from a yarn supplying bobbin; a yarn winding section for winding the spun yarn to form a package; a yarn storage section which is provided between the yarn supplying portion and the yarn winding section to store the spun yarn; and a yarn jointing section for performing a yarn jointing operation of jointing a yarn end of the spun yarn on the yarn supplying portion side with a yarn end of the spun yarn on the yarn storage section side, the yarn storage section including: a rotational storage drum that rotates for winding and storing the spun yarn unwound from the yarn supplying bobbin; and a motor for rotating the rotational storage drum in both directions.

[0014] According to this arrangement, since the yarn storage section is provided between the yarn supplying portion and the yarn winding section, it is possible to carry out the yarn jointing while the yarn winding section winds the spun yarn stored in the yarn storage section, and hence the yarn winding operation is continuously done without interruption.

[0015] Furthermore, at the time of yarn jointing, the spun yarn wound on the rotational storage drum is drawn out to the yarn supplying portion side as the rotational storage drum is rotated in the direction opposite to the direction at the time of winding the yarn.

[0016] According to the second aspect of the invention, the yarn winder of the first aspect further includes a controller for controlling a winding operation of the winding section and driving of the motor, the controller having a control mode with which, in a normal winding operation of unwinding the spun yarn from the yarn supplying bobbin and forming a package, the winding operation by the yarn winding section and a storing operation of storing the yarn by rotating the rotational storage drum in a winding direction by the motor are executed, and when yarn jointing is carried out by the yarn jointing section, a drawing operation of rotating the rotational storage drum in a direction opposite to the winding direction by the motor to draw out the spun yarn to the yarn jointing section side is executed.

[0017] According to this arrangement, when the yarn jointing is performed by the yarn jointing section, the motor drives the rotational storage drum in the direction opposite to the winding direction so that the spun yarn is drawn out to the yarn jointing section side. The yarn is therefore certainly drawn out to the yarn jointing section.

[0018] According to the third aspect of the invention, the yarn winder of the second aspect is arranged so that, in the control mode, the controller simultaneously executes the winding operation by the yarn winding section and the drawing operation of drawing the spun yarn to the yarn jointing section side by rotating the rotational storage drum in the direction opposite to the winding direction by the motor, when the yarn jointing section carries out the yarn jointing.

[0019] According to this arrangement, because the winding operation by the yarn winding section and the drawing operation of drawing the spun yarn to the yarn jointing section side by rotating the rotational storage drum in the direction opposite to the winding direction by the motor are simultaneously done, the winding operation and the yarn jointing are simultaneously done.

[0020] According to the fourth aspect of the invention, the yarn winder of any one of the first to third aspects is arranged so that the rotational storage drum is further provided with a guide member for guiding the spun yarn unwound from the yarn supplying portion.

[0021] This arrangement makes it possible to easily adjust at which position on the rotational storage drum the spun yarn is wound, by the guide member.

[0022] According to th fifth aspect of the invention, the yarn winder of the fourth aspect is arranged so that the rotational storage drum has a tapered portion at a part

where the spun yarn is guided by the guide member, the tapered portion narrowing in diameter in a direction in which the spun yarn moves to be stored, and the guide member guides the spun yarn to the tapered portion so as to store the spun yarn in such a way that parts of the spun yarn are aligned on the surface of the rotational storage drum in the order in which the parts are wound on the surface.

[0023] According to this arrangement, the spun yarn guided to the tapered portion is wound onto the tapered portion as the rotational storage drum rotates, and a yarn layer wound first is pushed by a yarn layer wound second and moves toward the yarn unwinding side along the inclined surface of the tapered portion. Because the parts of the spun yarn are serially stored on the rotational storage drum with the arrangement above, the guide member is only required to guide the spun yarn to a point on the tapered portion. It is therefore possible to relatively easily dispose the yarn guiding member irrespective of the position and orientation of the rotational storage drum. For this reason, the rotational storage drum can be disposed with relatively high design freedom in consideration of an unused space in the yarn winder. Furthermore, since the layers of the spun yarn are stored in an aligned manner, the interruption of the yarn winding due to yarn entanglement on the yarn storage section does not occur.

[0024] According to the sixth aspect of the invention, the yarn winder of the fifth aspect further includes yarn end capturing means for capturing a yarn end of the spun yarn on the rotational storage drum when the yarn storage section performs the yarn jointing operation.

[0025] According to this arrangement, the spun yarn guided to the tapered portion by the guide member moves from the yarn unwinding side to the yarn winding side of the rotational storage drum. That is to say, at the time of yarn breakage, the occurrence of yarn defect, or changing the yarn supplying bobbin, the yarn does not move from the yarn winding side to the yarn unwinding side of the rotational storage drum due to the inertia generated by the movement from the guide member to the storage drum. For this reason, the yarn end of the yarn is certainly placed at around the tapered portion at the yarn winding side of the rotational storage drum, with the result that the yarn end capturing means certainly captures the yarn end of the broken spun yarn.

[0026] According to the seventh aspect of the invention, the yarn winder of the sixth aspect is arranged so that the guide member is a pipe-shaped member, and the yarn end capturing means generates, in an internal space of the guide member, an airflow flowing from the rotational storage drum side to the yarn supplying portion side.

[0027] According to this arrangement, the generation of the airflow in the internal space of the pipe-shaped guide member by the yarn end capturing mean significantly lowers the air pressure in the internal space, and this makes it possible to powerfully suck the yarn end of the yarn and hence the yarn end of the yarn is certainly captured.

[0028] According to the eighth aspect of the invention, the yarn winder is arranged so that the yarn storage section further includes: storage amount detecting means for detecting an amount of the stored spun yarn; and rotation speed controlling means for controlling rotation speed of the motor, and the rotation speed controlling means controls the rotation speed of the motor so that the spun yarn is wound only onto a storage area of the rotational storage drum which area is on the tapered portion side of an intermediate position of the rotational storage drum, in accordance with the amount of the spun yarn detected by the storage amount detecting means.

[0029] According to this arrangement, because the spun yarn is not wound onto a part of the rotational storage drum which part is on the yarn unwinding side of the predetermined intermediate position (i.e., on the side where the yarn is drawn out and unwound by the yarn winding section), the spun yarn wound onto the rotational storage drum and running toward the yarn winding section rotates and runs on that part of the surface of the rotational storage drum, with the result that broken filaments of the spun yarn are laid down.

[0030] According to the ninth aspect of the invention, the yarn winder of any one of first to eighth aspects is arranged so that the yarn storage section further includes: resistance imparting means for imparting resistance to the spun yarn such that the spun yarn is sandwiched between the resistance imparting means and a surface of the rotational storage drum which surface is at an end portion from which the spun yarn is unwound by the yarn winding section.

[0031] According to this arrangement, a tension is imparted to the spun yarn as the resistance imparting means imparts resistance to the spun yarn, and this tension prevents the yarn running from the yarn storage section toward the yarn winding section from being bulged (i.e., prevents ballooning from occurring). Furthermore, because the spun yarn runs while being sandwiched between the resistance imparting means and the rotational storage drum, the broken filaments of the spun yarn are laid down.

[0032] According to the tenth aspect of the invention, the yarn winder of the ninth aspect is arranged so that the resistance imparting means rotates together with the rotational storage drum.

[0033] According to this arrangement, because the resistance imparting means does not move with respect to the rotational storage drum, it is possible to prevent the resistance imparting means from being worn away by the surface of the rotational storage drum.

[0034] According to the eleventh aspect of the invention, yarn winder of the tenth aspect is arranged so that the resistance imparting means is a rubber-made annular component attached to a yarn unwinding end portion of the rotational storage drum.

[0035] This arrangement simplifies the structure of the resistance imparting means.

[0036] According to the twelfth aspect of the invention, the yarn winder of any one of the second to eleventh aspects is arranged so that the yarn storage section is arranged to be able to store, when the control mode is executed, the spun yarn for an amount required for continuing the winding operation by the yarn winding section until the yarn jointing is performed at least once by the yarn jointing section.

[0037] According to this arrangement, the winding operation is continued until the yarn jointing is performed at least once.

[0038] According to the thirteenth aspect of the invention, the yarn winder of any one of the first to twelfth aspects is arranged so that the yarn supplying portion is provided with a yarn unwinding assisting device which assists unwinding of the spun yarn from the yarn supplying bobbin by lowering a regulator which covers a core of the yarn supplying bobbin in sync with the unwinding of the spun yarn from the yarn supplying bobbin.

[0039] According to this arrangement, since the transmission of the tension of the yarn is blocked by providing the yarn storage section between the yarn supplying bobbin and the winding section, it is possible to prevent a tension change due to the traversal of the winding section from being transferred to the unwinding tension part of the yarn supplying bobbin. Furthermore, since the yarn unwinding from the yarn supplying bobbin is stably performed because the unwinding assist unit is attached to the yarn supplying bobbin, it is possible to prevent yarn breakage and to increase the speed of unwinding from the yarn supplying bobbin. The efficiency in the unwinding from the yarn supplying bobbin is therefore improved.

Effects

[0040] According to the present invention, since the yarn storage section is provided between the yarn supplying portion and the yarn winding section, it is possible to carry out the yarn jointing while the yarn winding section winds the yarn stored in the yarn storage section, and hence the yarn winding operation is continuously done without interruption.

[0041] Furthermore, at the time of yarn jointing, the spun yarn wound on the rotational storage drum is drawn out to the yarn supplying portion side as the rotational storage drum is rotated in the direction opposite to the direction at the time of winding the yarn.

Brief Description of Drawings

[0042]

[FIG. 1] FIG. 1 is a schematic view of a winding unit according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a schematic view of the accumulator of FIG. 1.

[FIG. 3] FIG. 3 is a functional block diagram of the controller of FIG. 1.

[FIG. 4] FIG. 4 shows a control flow indicating the operation of the yarn winder.

[FIG. 5] FIG. 5 shows a control flow indicating the operation at the time of yarn breakage.

[FIG. 6] FIG. 6 shows a control flow indicating the operation at the time of the occurrence of yarn defect.

[FIG. 7] FIG. 7 shows a control flow indicating the operation at the time of bobbin change.

[FIG. 8] FIG. 8 relates to a modification of the present invention and corresponds to FIG. 2.

Description of Embodiments

[0043] The following will describe a preferred embodiment of the present invention.

[0044] FIG. 1 schematically shows winding units constituting an automatic winder of the present embodiment. The automatic winder is constituted by a plurality of winding units 2 (yarn winders) that are aligned in the crosswise directions of the plane of FIG. 1. Each winding unit 2 includes a yarn supplying portion 5, a winding section 6, a yarn defect detection section 7, a yarn jointing section 8, and a yarn storage section 9.

[0045] The yarn supplying portion 5 includes a yarn supplying bobbin supporter 60 that supports a yarn supplying bobbin 21, a yarn unwinding assisting device 12, and a first tensor 41. The yarn supplying portion 5 is further provided with an unillustrated bobbin supplier which supplies a new yarn supplying bobbin 21 to the yarn supplying bobbin supporter 60. Examples of the bobbin supplier include magazine-type suppliers and tray-type suppliers. When a spun yarn Y (hereinafter, yarn Y) is fully drawn out from a yarn supplying bobbin 21 set in the winding unit 10, the yarn supplying portion 5 ejects an empty bobbin supported by the yarn supplying bobbin supporter 60, and the bobbin supplier supplies a new yarn supplying bobbin 21 to the yarn supplying bobbin supporter 60 one by one.

[0046] The yarn unwinding assisting device 12 assists the unwinding of the yarn Y from the yarn supplying bobbin 21 by moving down a regulator 40 covering the core tube of the yarn supplying bobbin 21 in sync with the unwinding of the yarn Y from the yarn supplying bobbin 21. The regulator 40 contacts a balloon formed at an upper part of the yarn supplying bobbin 21 on account of the rotation of the yarn Y unwound from the yarn supplying bobbin 21 and a centrifugal force, so as to impart an appropriate tension to the balloon and assist the unwinding of the yarn Y. In an area below the regulator 40 is provided an unillustrated sensor for detecting a chase section of the yarn supplying bobbin 21. As the sensor detects that the chase section is moving down, the regulator 40 is accordingly moved down by, for example, an unillustrated air cylinder.

[0047] Around a yarn unwinding assisting device 12 is provided a yarn detector 37 that can detect the existence of a yarn Y. This yarn detector 37 is arranged to detect

that the yarn Y is no longer drawn out from the yarn supplying bobbin 21 and to send an empty bobbin signal to the controller 109.

[0048] The first tensor 41 imparts a predetermined tension to a running yarn Y. An example of this first tensor 41 is a gate-type tensor having fixed comb teeth and movable comb teeth. The movable comb teeth are rotatable by an unillustrated rotary solenoid so that the two sets of teeth are engaged or disengaged. The first tensor 41 imparts a constant tension to the yarn Y stored in the later-described accumulator 61, and hence the yarn Y is neatly wound and stored in the accumulator 61.

[0049] The winding section 6 includes an unillustrated cradle arranged to be able to retain the winding bobbin 22, a winding drum 24 which is used for allowing the yarn Y to conduct traversal and for rotating the winding bobbin 22, and a second tensor 42. The cradle is arranged to be able to swing in directions approaching and moving away from the winding drum 24. This allows the package 30 to contact or move away from the winding drum 24. Furthermore, as shown in FIG. 1, on the outer circumference of the winding drum 24 is formed a spiral traversing groove 27 to cause the yarn Y to perform traversal.

[0050] The winding drum 24 rotates to drive the winding bobbin 22 which is provided to oppose the winding drum 24. This winding drum 24 is connected to the output shaft of a winding drum motor 116 (see FIG. 3). This winding drum motor 116 is turned on or off by a drive signal supplied from the controller 109.

[0051] The second tensor 42 is provided for controlling the tension of the yarn Y when the yarn Y unwound from the later-described accumulator 61 of the yarn storage section 9 is wound onto the package. As a result, the yarn Y drawn out from the accumulator 61 is wound onto the winding bobbin 22 while a suitable tension is imparted thereto. An example of the second tensor 42 is, as in the case of the first tensor 41, a gate-type tensor having fixed comb teeth and movable comb teeth.

[0052] The yarn defect detection section 7 is provided with a yarn clearer 15 that detects a yarn defect. The yarn clearer 15 is arranged to detect a defect by monitoring the thickness of the yarn Y by an appropriate sensor. As a signal is supplied from the sensor of the yarn clearer 15, yarn defects such as slags and foreign matters are detected. In addition to this, the yarn clearer 15 is able to function as a sensor merely detecting the existence of the yarn Y. The yarn clearer 15 is provided with a cutter for cutting, when a yarn defect is detected, the yarn on the upstream of the yarn defect.

[0053] In addition to the above, on the downstream of the second tensor 42 is provided a waxing device 17 which waxes on a running yarn Y. On the downstream of the waxing device 17 is provided an unillustrated sucking section. This sucking section is connected to a suitable negative pressure source, and can suck and remove dregs of wax and yarn.

[0054] The yarn jointing section 8 includes a splicer 14 performing the yarn jointing operation, a lower yarn guide pipe 25, and an upper yarn guide pipe 26.

[0055] The splicer 14 joints the lower yarn on the yarn supplying bobbin 21 side with the upper yarn on the package 30 side, at the time of yarn breakage, the occurrence of a yarn defect, or bobbin change. Examples of the splicer 14 include a mechanical splicer and a splicer using a fluid such as compressed air.

[0056] The lower yarn guide pipe 25 is supported to be rotatable about an axis 25a below the splicer 14, and is rotated by a lower pipe motor 122 (see FIG. 3). At the leading end of the lower yarn guide pipe 25 is provided a suction port 25b, and this suction port 25b is provided with an unillustrated clamping section. Furthermore, the lower yarn guide pipe 25 receives a negative pressure from an unillustrated negative pressure source, with the result that a suction flow for sucking the yarn Y is generated at the suction port 25b.

[0057] The upper yarn guide pipe 26 is supported to be rotatable about an axis 26a above the splicer 14, and is rotated by an upper pipe motor 121 (see FIG. 3). At the leading end of the upper yarn guide pipe 26 is provided a suction port 26b, and this suction port 26b is provided with a clamping section 26c (see FIG. 2). Furthermore, the upper yarn guide pipe 26 receives a negative pressure from a negative pressure source 120 (see FIG. 2), and hence a suction flow for sucking the yarn Y is generated at the suction port 26b.

[0058] The yarn storage section 9 is provided with the accumulator 61 which stores the yarn Y before being wound onto the package 30. FIG. 2 is a schematic view of the accumulator 61.

[0059] As shown in FIG. 2, the accumulator 61 includes components such as a rotational storage drum 71, a rotational storage drum motor 72, a yarn guiding member 73, a blowdown nozzle 74, and a yarn passage forming member 75.

[0060] The rotational storage drum 71 is a drum rotatable about an axis C, and the yarn Y is stored such that the yarn Y is wound onto the rotational storage drum 71 as described later. The respective end portions of the rotational storage drum 71 are tapered portions 71a and 71b each of which narrows toward the other end portion, and a part of the drum 71 between the tapered portion 71a and the tapered portion 71b is a linear portion 71c having a substantially constant diameter.

[0061] In addition to the above, the upper right end portion (yarn unwinding end portion) of the rotational storage drum 71 in FIG. 2, strictly speaking, the upper right end portion of the linear portion 71c is wrapped up by an annular component 81 (resistance imparting means) made of rubber, such as a rubber band or an O-ring. With this, the annular component 81 rotates in sync with the rotation of the rotational storage drum 71. Furthermore, as described above, because the upper right end portion of the rotational storage drum 71 is formed as the tapered portion 71b, the annular component 81 does not drop off from the rotational storage drum 71 rightward and upward.

[0062] The rotational storage drum motor 72 is a position-controllable motor such as a servo motor, a DC brushless motor, and a stepping motor, and rotates the rotational storage drum 71 in both directions. The rotational storage drum motor 72 is provided with a rotary encoder 153 that sends an angle signal indicating the rotation angle of the rotational storage drum motor 72 to the controller 109.

[0063] The yarn guiding member 73 is a linear pipe (pipe-shaped component) and is disposed so that the upper left end portion' shown in FIG. 2 opposes the tapered portion 71a. With this, the yarn Y having reached the yarn guiding member 73 from the yarn supplying portion 5 side is guided to the tapered portion 71a by the yarn guiding member 73. As such, because in the present embodiment the yarn Y is guided to the tapered portion 71a by the yarn guiding member 73, it is possible to easily adjust on which part of the rotational storage drum 71 the yarn Y is wound.

[0064] The blowdown nozzle 74 (yarn end capturing means) is provided at the right side of the yarn guiding member 73 in the figure, and includes a yarn path 146 which is connected to the internal space of the yarn guiding member 73 and a blowdown path 147 which is connected to the yarn path 146 and inclined with respect to the yarn path 146.

[0065] The blowdown path 147 is connected to a compressed air source 151 via a connection pipe 149 and a connection pipe 150, and a solenoid valve 152 electrically connected to the controller 109 is provided between the connection pipe 149 and the connection pipe 150.

[0066] The yarn passage forming member 75 forms a yarn passage 128 and is provided between the suction port 26b of the upper yarn guide pipe 26 and the blowdown nozzle 74. The yarn passage 128 extends substantially vertically upward from its lower end which is immediately above the suction port 26b of the upper yarn guide pipe 26. The yarn passage 128 bends toward the upper left of FIG. 2 at its upper end portion, so that the upper end of the yarn passage 128 opposes the lower right end portion of the yarn path 146 of the blowdown nozzle 74.

[0067] Because the yarn guiding member 73, the blowdown nozzle 74, and the yarn passage forming member 75 are structured as above, when the controller 109 opens the solenoid valve 152 so that the compressed air from the compressed air source 151 is ejected to the yarn path 146 after passing through the connection pipe 150, the connection pipe 149, and the blowdown path 147 in this order, an airflow flowing from the rotational storage drum 71 side to the upper yarn guide pipe 26 side is generated in the internal space of the yarn guiding member 73, the yarn path 146, and the yarn passage 128. Thanks to this airflow, the yarn end of the yarn Y wound onto the rotational storage drum 71 is sucked and captured and is drawn out to the yarn jointing section 8 side.

[0068] In regard to the above, because the yarn guiding member 73 is a pipe having an internal space which is open only at the respective ends, the generation of the airflow in the internal space of the yarn guiding member 73 by the blowdown nozzle 74 significantly lowers the air pressure in the internal space of the yarn guiding member 73, as the internal air is sucked. This makes it possible to powerfully suck the yarn end of the yarn Y, and hence the yarn end of the yarn Y is certainly captured.

[0069] At the lower end of the yarn passage forming member 75 is provided a drawing sensor 154 capable of detecting whether the yarn end of the yarn Y wound by the accumulator 61 has actually been drawn to the yarn jointing section 8 side. This drawing sensor 154 is electrically connected to the controller 109, and transmits a drawing detection signal to the controller 109 upon detecting that the yarn end of the yarn Y has been drawn to the yarn jointing section 8 side.

[0070] The accumulator 61 is further provided with a storage upper limit sensor 155, a storage lower limit sensor 156, and a storage lowest limit sensor 157 for detecting the storage amount of the yarn Y. The storage upper limit sensor 155, the storage lower limit sensor 156, and the storage lowest limit sensor 157 are positioned to oppose the upper end of the yarn Y wound on the outer circumferences of the rotational storage drum 71 when the storage amount of the yarn Y in the accumulator 61 reaches 300m, 200m, and 40m, respectively.

[0071] This length, 300m, indicates the length longer than the length of the spun yarn Y wound by the winding section 5 while later-described yarn jointing is repeated for, for example, three times (at least once). With this, as described later, a shortage of spun yarn Y is less likely to occur in the accumulator 7 even if the winding of the spun yarn Y by the winding section 5 is continued while the yarn jointing is carried out.

[0072] With the arrangement above, the storage upper limit sensor 155, the storage lower limit sensor 156, and the storage lowest limit sensor 157 transmit, to the controller 109, a storage amount upper limit signal, a storage amount lower limit signal, and a storage amount lowest limit signal, respectively, when detecting that the yarn Y opposes each sensor.

[0073] It is noted that when 300 meters of the yarn Y is wound onto the rotational storage drum 71, the upper right end of the yarn Y opposing the storage upper limit sensor 155 is not at the upper right end portion of the rotational storage drum 71 but at a predetermined intermediate position on the rotational storage drum 71, e.g., at a substantial center of the rotational storage drum 71.

[0074] Now, the structure of the controller 109 of the winding unit 2 will be described. That is to say, the controller 109 shown in FIG. 3 includes a CPU (Central Processing Unit) which is a processor, a ROM (Read Only Memory) which stores a control program executed by the CPU and data used by the control program, and a RAM (Random Access Memory) which temporarily stores data at the time of the execution of a program. As the control program stored in the ROM is read and executed by the CPU, the control program causes the hardware such as the CPU to function as a winding drum

motor controller 160, a rotational storage drum motor controller 161, a drawn yarn length calculation unit 163, and an upper pipe controller 164.

[0075] The winding drum motor controller 160 controls the rotation speed of the winding drum motor 116, and reduces the winding speed Va with which the winding section 6 winds the yarn Y, when the storage amount detected by the storage amount detector falls below a predetermined value.

[0076] More specifically, when the storage amount lower limit signal is no longer transmitted from the storage lower limit sensor 156, the winding drum motor controller 160 gently reduces the winding speed Va to the extent that yarn layers of the package 30 are not disturbed. Furthermore, when the storage amount lowest limit signal is no longer transmitted from the storage lowest limit sensor 157, the winding drum motor controller 160 quickly reduces the winding speed Va and eventually stops the winding by the winding section 6.

[0077] As such, the winding drum motor controller 160 reduces the winding speed Va when the storage amount of the yarn Y in the accumulator 61 becomes low, and stops the winding by the winding section 6 when the storage amount of the yarn Y of the accumulator 61 becomes extremely low. A shortage of the yarn Y in the accumulator 61 is therefore prevented.

[0078] The rotational storage drum motor controller 161 is provided for controlling the rotational direction of the rotational storage drum motor 72. When winding the yarn Y onto the rotational storage drum 71, the controller 161 controls the rotational storage drum motor 72 so that the rotational storage drum 71 rotates in one direction. When the yarn end of the yarn Y on the rotational storage drum 71 is drawn out to the yarn jointing section 8 side, the controller 161 controls the rotational storage drum motor 72 so that the rotational storage drum 71 rotates in the direction opposite to the direction at the time of winding the yarn. Furthermore, the rotational storage drum motor controller 161 (rotation speed controlling means) controls the rotation speed of the rotational storage drum motor 72, as described later.

[0079] The drawn yarn length calculation unit 163 calculates the drawn yarn length which indicates the length of the yarn Y drawn out from the accumulator 61 to the yarn jointing section 8 side, based on the rotation angle of the rotational storage drum motor 72 detected by the rotary encoder 153 since the drawing sensor 154 detects the yarn Y.

[0080] The upper pipe controller 164 compares the yarn defect length obtained from a yarn defect detection signal with the drawn yarn length calculated by the drawn yarn length calculation unit 163, and rotates the upper yarn guide pipe 26 while keeping the clamping state so as to guide the yarn Y which is on the winding section 6 side to the splicer 14 and places the yarn Y, when it is determined that the drawn yarn length reaches the yarn defect length.

[0081] Now, the operation of the winding unit 2 will be described with reference to FIG. 4 to FIG. 7.

[0082] An operator of the automatic winder (winding unit 2) unwinds the yarn Y from the yarn supplying bobbin 21, places this yarn Y on the yarn unwinding assisting device 12, the yarn detector 37, the first tensor 41, the yarn clearer 15, the accumulator 61, the second tensor 42, and the waxing device 17, and fixes the yarn Y to the winding bobbin 22. The yarn path of the yarn Y in the accumulator 61 is arranged as shown in FIG. 2. That is to say, the operator causes the yarn Y to pass through the drawing sensor 154, the yarn passage 128 of the yarn passage forming member 75, the yarn path 146 of the blowdown nozzle 74, and the internal path of the yarn guiding member 73 in this order. After this operation, the operator draws out the yarn Y from the opening of the yarn guiding member 73 which opening opposes the rotational storage drum 71, winds the yarn Y onto the rotational storage drum 71 for about 5 to 20 times, causes the yarn Y to pass through the gap between the rotational storage drum 71 and the annular component 81, and places the yarn Y onto the yarn guide 82 which is above and to the right of the rotational storage drum 71 and then places the yarn Y onto the second tensor 42. Although the yarn shown in FIG. 2 is thick and an interval between neighboring yarn parts is long for convenience of explanation, The rotational storage drum 71 in reality always stores the yarn Y wound for about 600 times with very short intervals.

(Normal Winding)

[0083] When the winding unit 2 is powered on as shown in FIG. 4 while the state above is maintained (S300), the controller 109 (rotational storage drum motor controller 161) starts the rotation of the winding drum 24 so that the winding speed Va of the yarn Y wound by the winding section 6 is, for example, 1200m/min and starts the driving of the rotational storage drum motor 72 so that the winding speed Vb of the yarn Y wound onto the rotational storage drum motor 71 is, for example, 1500m/min (S310).

[0084] With this, the yarn Y wound onto the rotational storage drum 71 is serially unwound by the winding section 6 from the upper right end portion side, and the yarn Y is wound onto the package 30 while being traversed by the winding drum 24.

[0085] Because the yarn Y at this stage runs while being sandwiched between the surface of the rotational storage drum 71 and the annular component 81, broken filaments of the yarn Y are laid down. Furthermore, because the yarn Y is sandwiched between the surface of the rotational storage drum 71 and the annular component 81 (i.e., resistance is imparted to the yarn Y), a tension is imparted to the yarn Y. This tension prevents the yarn Y unwound from the rotational storage drum 71 and running toward the winding section 6 from being bulged (i.e., prevents ballooning from occurring). Furthermore, because at this stage the annular component 81 wrap-

ping up the rotational storage drum 71 rotates together with the rotational storage drum 71, the annular component 81 does not move with respect to the rotational storage drum 71, with the result that the annular component 81 is not worn away by the rotational storage drum 71.

[0086] At the same time, the yarn Y on the yarn supplying portion 5 side is, as shown in FIG. 2, guided to the tapered portion 71a of the rotational storage drum 71 by the yarn guiding member 73, and the guided yarn Y is wound onto the tapered portion 71a as the rotational storage drum 71 rotates in one direction about the axis C.

[0087] Furthermore, parts of the yarn Y wound onto the tapered portion 71a serially move upward and rightward along the surface of the tapered portion 71a, in a direction more or less in parallel to the axis C. As a result, the yarn Y is stored in the rotational storage drum 71.

[0088] As such, according to the present embodiment, the yarn Y guided to the tapered portion 71a is wound onto the tapered portion 71a by the rotation of the rotational storage drum 71 and slides rightward and upward along the surface of the tapered portion 71a, and a previously wound part of the yarn Y is pushed up by a newly wound part of the yarn Y and therefore parts of the yarn Y are serially stored in the rotational storage drum 71. For this reason, the yarn guiding member 73 is merely required to guide the yarn Y to a single point on the tapered portion 71a. It is therefore possible to relatively easily dispose the yarn guiding member 73 irrespective of the position and orientation of the rotational storage drum 71. For this reason, the rotational storage drum 71 can be disposed with relatively high design freedom in consideration of an unused space in the winding unit 2.

[0089] In addition to the above, provided that, being different from the present embodiment, a fixed storage drum is provided in place of the rotational storage drum 71 and a mechanism for winding the yarn Y onto the storage drum is additionally provided, the mechanism is required to have a part rotating around the storage drum to cause the yarn Y to be wound onto the storage drum. In this regard, it is unavoidable that the yarn path formed in this part bends many times. As a result, because the yarn Y passing through this path also bends many times, the quality of the yarn Y may be deteriorated.

[0090] In this regard, the present embodiment is arranged so that the yarn Y is wound onto the rotational storage drum 71 by the rotation of the rotational storage drum 71. Therefore the above-described mechanism for winding the yarn Y is not provided and the path on which the yarn Y is guided to the rotational storage drum 71 does not frequently bend, as exemplified by the path constituted by the yarn passage 128, the yarn path 146 of the blowdown nozzle 74, and the internal space of the yarn guiding member 73. It is therefore possible to prevent the quality of the yarn Y from being deteriorated.

[0091] In the normal winding in which the yarn Y is wound onto the package 30 while the yarn Y is undisrupted from the yarn supplying portion 5 to the winding section 6, the controller 109 checks, as shown in FIG. 4, whether a yarn breakage signal has been supplied (S320), whether a yarn defect detection signal has been supplied (S330), whether an empty bobbin signal has been supplied (S340), and whether a storage amount upper limit signal has been supplied (S350).

[0092] When it is determined that the yarn breakage signal has been supplied (S320: YES), the yarn defect detection signal has been supplied (S330: YES), or the empty bobbin signal has been supplied (S340, the control flows shown in FIG. 5, FIG. 6, and FIG. 7 are executed, respectively, (S325, S335, S345), and the process returns to the control flow shown in FIG. 4.

[0093] Since the winding speed Vb is higher than the winding speed Va for a while after the start of the winding, the storage amount of the yarn Y in the accumulator 61 increases. When the storage amount of the yarn Y reaches 300m, the storage upper limit sensor 155 sends a storage amount upper limit signal to the controller 109. Upon receiving the storage amount upper limit signal from the storage upper limit sensor 155 as shown in FIG. 4 (S350: YES), the controller 109 (rotational storage drum motor controller 161) changes the rotation speed of the rotational storage drum motor 72 so as to change the winding speed Vb from 1500m/min to 1200m/min, for example (S360) . The winding speed Va becomes identical with the winding speed Vb as a result, and the storage amount of the accumulator 61 is kept constant.

[0094] In this regard, because the storage upper limit sensor 155 opposes an intermediate part of the rotational storage drum 71 as described above, on the rotational storage drum 71 the yarn Y is wound only onto a part on the lower left end side (yarn winding side) of a part opposing the storage upper limit sensor 155, and the yarn Y is not wound onto a part on the upper right end side (yarn unwinding side) of the opposing part.

[0095] With this, the yarn Y unwound from the rotational storage drum 71 and running toward the winding section 6 rotates and runs on a part of the surface of the rotational storage drum 71 which part is on the upper right end side of a part opposing the storage upper limit sensor 155, with the result that broken filaments of the yarn Y are laid down.

(Yarn Breakage)

[0096] Now, the control flow shown in FIG. 5 at the time of yarn breakage will be described. As yarn breakage occurs and the controller 109 receives a yarn breakage signal from the yarn clearer 15 (S320: YES), the controller 109 stops the rotation of the rotational storage drum 71 in the first place (S410).

[0097] Subsequently, the controller 109 switches the solenoid valve 152 to the open state so that an airflow from the rotational storage drum 71 side to the upper yarn guide pipe 26 side is generated in the internal space of the yarn guiding member 73, the yarn passage 128, or the like (S420).

[0098] At the same time, the controller 109 switches

the suction port 26b of the upper yarn guide pipe 26 from the closed state to the open state, so as to generate an airflow from the suction port 26b side to the negative pressure source 120 side in the upper yarn guide pipe 26 (S420).

[0099] Thereafter, the winding arm motor controller 161 controls the rotational storage drum motor 72 to drive at a slow speed in the direction opposite to the winding of the yarn Y by the rotational storage drum 71 (S430), and a drawing detection signal from the drawing sensor 154 is waited for (S440: NO).

[0100] As a result, the yarn end of the yarn Y on the rotational storage drum 71 is sucked into the opening of the yarn guiding member 73 and drawn out to the suction port 26b of the upper yarn guide pipe 26 via the yarn passage 128 or the like. In this regard, since the rotational storage drum motor 72 is a position-controllable motor, a part of the rotational storage drum 71 where the yarn end of the yarn Y locates is precisely moved to a position opposing the opening of the yarn guiding member 73. It is therefore possible to certainly suck the yarn end of the yarn Y from the opening of the yarn guiding member 73.

[0101] Furthermore, as described above, because the yarn guiding member 73 guides the yarn Y to the tapered portion 71a, the yarn Y guided from the yarn guiding member 73 to the rotational storage drum 71 moves from the upper right end side which is the yarn unwinding end portion toward the lower left end side which is the tapered portion 71a side, with respect to the axial directions of the rotational storage drum 71 (i.e., directions in parallel to the axis C).

[0102] This arrangement prevents the yarn Y guided to the tapered portion 71a from moving to the upper right end side of the rotational storage drum 71 due to the inertia generated by the movement from the yarn guiding member 73 to the rotational storage drum 71. For this reason, the yarn end of the yarn Y is certainly placed at around the tapered portion 71a of the rotational storage drum 71, strictly speaking, above the lower left end portion of the linear portion 71c. The yarn Y is therefore certainly sucked from the opening of the yarn guiding member 73.

[0103] The yarn guiding member 73 is arranged so that the opening at the upper left end is positioned across the tapered portion 71a and the lower left end portion of the linear portion 71c to allow the yarn guiding member 73 not only to guide the yarn Y to the tapered portion 71a but also to suck the yarn end of the yarn Y on the lower left end portion of the linear portion 71c.

[0104] As the yarn Y passes through the drawing sensor 154, the drawing sensor 154 sends a drawing detection signal to the controller 109. Receiving the drawing detection signal from the drawing sensor 154 (S440: YES), the controller 109 switches the suction port 26b from the open state to the closed state while maintaining the low speed driving of the rotational storage drum 71, clamps the yarn Y by the clamping section 26c, and rotates the upper yarn guide pipe 26 about the axis 26a downward. In this way, the controller 109 guides the yarn Y drawn out from the accumulator 61 to the splicer 14 of the yarn jointing section 8 (S450).

[0105] At this stage, the length of a newly drawn part of the yarn Y drawn out from the accumulator 61 by the rotation of the upper yarn guide pipe 26 is about 60cm. To prevent the yarn breakage of the yarn Y between the clamping section 26c and the rotational storage drum 71 at this time, the controller 109 synchronizes the rotation of the upper yarn guide pipe 26 with the rotation of the rotational storage drum 71. After the completion of the guide of the yarn Y to the splicer 14 by the upper yarn guide pipe 26 (S450), the controller 109 stops the rotation of the rotational storage drum 71 (S460).

[0106] In the meanwhile, the lower yarn guide pipe 25 sucks and captures the yarn end of the yarn Y around the yarn detector 37 and guides this yarn Y to the splicer 14, in the same manner as the upper yarn guide pipe 26. When a part of the yarn Y on the accumulator 61 side and a part of the yarn Y on the yarn supplying portion 5 side are placed on the splicer 14, the controller 109 causes the splicer 14 to conduct the yarn jointing operation (S470).

[0107] Thereafter, the controller 109 starts, as shown in FIG. 2, to rotate the rotational storage drum 71 in one direction (S480), and hence the normal winding state is resumed (S490). The number of rotations of the rotational storage drum 71 at this time is arranged so that the winding speed Vb is 1500m/min (S480).

(When Yarn Defect Is Detected)

[0108] Now, the control flow shown in FIG. 6 at the time of the detection of a yarn defect will be described. It is noted that some steps in this process are identical with those in the yarn breakage, and hence such identical steps will not be detailed below.

[0109] When a yarn defect is detected and the controller 109 receives a yarn defect detection signal and a yarn cutting signal from the yarn clearer 15, the controller 109 conducts the steps S410 to S440 above in this order, in the same manner as in the case of yarn breakage. Receiving the drawing detection signal from the drawing sensor 154 (S440: YES), the drawn yarn length calculation unit 163 obtains the rotation angle of the rotational storage drum 71 detected by the rotary encoder 153, which indicates how many angles the rotational storage drum 71 rotates after the detection of the yarn Y by the drawing sensor 154 (S570), and the drawn yarn length is calculated based on this rotation angle (S580).

[0110] The upper pipe controller 164 then compares the length of the yarn defect obtained from the yarn defect detection signal with the drawn yarn length calculated by the drawn yarn length calculation unit 163 (S590) . The upper pipe controller 164 then waits for the drawn yarn length to reach the yarn defect length (S590: NO). When reaching the yarn defect length (S590: YES), the steps S450 to S480 are conducted in this order in the same

manner as in the case of yarn breakage, with the result that the yarn jointing is conducted and the normal winding operation is resumed.

(When Bobbin Is Changed)

[0111] Now, the following will describe the operation indicated by the control flow shown in FIG. 7, which is performed when the yarn supplying bobbin 21 becomes empty. It is noted that some steps in this operation are identical with those in the case of yarn breakage, and such identical steps will not be detailed below.

[0112] When the yarn supplying bobbin 21 becomes empty and the controller 109 receives an empty bobbin signal from the yarn detector 37 (S340: YES) , the currently attached yarn supplying bobbin 21 is discharged and a new yarn supplying bobbin 21 is attached to the yarn supplying bobbin supporter 60, and the yarn Y of this yarn supplying bobbin 21 is guided so that the lower yarn guide pipe 25 is able to capture and suck the yarn Y (S710). Thereafter, in the same manner as in the case of yarn breakage, the yarn jointing is conducted and the normal winding operation is resumed by the steps S410 to S480.

[0113] Because of the steps above conducted in the winding unit 2, the winding of the yarn Y onto the package P in the winding section 5 is continued at least until the yarn jointing operation is conducted once, as the spun yarn Y stored in the yarn storage drum 27 is unwound during the yarn jointing in the yarn jointing section 6. To put it differently, it is possible to conduct the yarn jointing by the yarn jointing section 6 without interrupting the winding of the yarn Y onto the package P in the winding section 5.

[0114] In addition to the above, because the yarn Y is drawn out to the yarn jointing section 8 side by the rotation of the rotational storage drum 271 in the direction opposite to the direction at the time of winding the yarn Y, the yarn Y is certainly drawn out to the yarn jointing section 8.

[0115] In addition to the above, because the winding by the winding section 5 and the drawing of the yarn to the yarn jointing section 8 side by rotating the rotational storage drum 271 in the direction opposite to the direction at the time of winding the yarn Y are simultaneously done, the winding of the yarn Y and the yarn jointing are simultaneously done.

[0116] In addition to the above, in the yarn winding unit 2 having the above-described structure, because the transmission of the tension of the yarn Y is blocked by providing the yarn storage section 9 between the yarn supplying bobbin 21 and the winding section 6, it is possible to prevent a tension change due to the traversal of the winding section 6 from being transferred to the part of the yarn unwound from the yarn supplying bobbin 21. Furthermore, since the yarn unwinding from the yarn supplying bobbin 21 is stably performed because the unwinding assist unit 12 is attached to the yarn supplying bobbin 21, it is possible to prevent yarn breakage and to increase the speed of unwinding from the yarn supplying bobbin 21. The efficiency in the unwinding from the yarn supplying bobbin 21 is therefore improved.

[0117] Various modifications of the present embodiment will now be described. It is noted that the same components as in the embodiment are denoted by the same reference numerals as in the embodiment, respectively, and the description thereof will be omitted.

[0118] According to a modification, as shown in FIG. 8, the yarn passage forming member 75 (yarn passage 128) is shorter in height than the member 75 of the embodiment above. Furthermore, the rotational storage drum 71, the rotational storage drum motor 72, the yarn guiding member 73, and the blowdown nozzle 74 are provided at positions lower than those in the embodiment above and are significantly distanced leftward in the figure from the yarn passage forming member 75, as compared to the embodiment above. Furthermore, the yarn passage forming member 76 is attached to the lower right end portion of the blowdown nozzle 74, and the yarn path 146 of the blowdown nozzle 74 is connected to the yarn passage 128 via the yarn passage 129 formed inside the yarn passage forming member 76.

[0119] In this case, because the components such as the rotational storage drum 71 are provided at positions lower than those in the embodiment above, the winding unit 2 is provided at more or less the same height as the winding unit having no accumulator 61.

[0120] In addition to the above, while in the modification the positions of the components such as the rotational storage drum 71 are significantly different from those in the embodiment above, the yarn Y is guided to the tapered portion 71a in the same manner as the embodiment above, when only the height of the yarn passage forming member 75 (yarn passage 128) is changed and the yarn passage forming member 76 is attached to the lower right end portion of the blowdown nozzle 74 to connect the yarn path 146 with the yarn passage 128 via the yarn passage 129. Also for this reason, the rotational storage drum 71 can be disposed with relatively high design freedom in consideration of an unused space in the winding unit 2.

[0121] In addition to the above, while in the embodiment above the yarn guiding member 73 is a pipe-shaped component such as a pipe and the blowdown nozzle 74 generates an airflow from the rotational storage drum 71 side to the upper yarn guide pipe 26 side in the internal space of the yarn guiding member 73 so as to suck and capture the yarn end of the yarn Y of the rotational storage drum 71, the present invention is not limited to this arrangement. For example, a mechanism capable of capturing the yarn end of the yarn Y stored in the rotational storage drum 71 is provided instead of the blowdown nozzle 74. An example of such a mechanism is a mechanism that sucks the yarn end of the yarn Y on the rotational storage drum 71 and carries the sucked yarn Y to the suction port 26b of the upper yarn guide pipe 26. In the case above, furthermore, the yarn guiding member

73 is not necessarily pipe-shaped as long as the member is able to guide the yarn Y to the tapered portion 71a.

[0122] In addition to the above, while in the embodiment above the annular component 81 made of rubber wraps up, as resistance imparting means, the upper right end portion of the rotational storage drum 71, the annular component 81 may be made of a material other than rubber, e.g., a synthetic resin material.

[0123] Furthermore, the resistance imparting means may be not an annular component wrapping up of the rotational storage drum 71 but a component provided outside the rotational storage drum 71, on condition that the yarn Y is sandwiched between the means and the surface of the rotational storage drum 71. For preventing the resistance imparting means from being worn out by the rotational storage drum 71, the resistance imparting means preferably rotates together with the rotational storage drum 71. However, the resistance imparting means may not rotate together with the rotational storage drum 71, i.e., the means may be fixed to a component outside the rotational storage drum 71, on condition that the resistance imparting means is made of a material with high wearing resistance. Alternatively, the resistance imparting means may be a metal ring which is provided with a predetermined distance from the rotational storage drum 71.

[0124] Alternatively, the resistance imparting means, which is arranged to impart resistance to the yarn Y such that the resistance imparting means and the surface of the rotational storage drum 71 sandwich the yarn Y, may not be provided when sufficient resistance is imparted to the yarn Y because the yarn Y runs while contacting the upper right end portion of the rotational storage drum 71 or when a mechanism for imparting resistance to the yarn Y is additionally provided between the rotational storage drum 71 and the winding section 6.

[0125] In addition to the above, while in the embodiment above the storage upper limit sensor 155 opposes an intermediate part of the rotational storage drum 71 and the yarn Y is wound only onto a part on the lower left end side of that intermediate part, the storage upper limit sensor 155 may be provided to oppose the upper right end portion of the rotational storage drum 71 and the yarn Y may be wound onto the almost entirety of the rotational storage drum 71. In this case, while the above-described effect of laying down the broken filaments of the yarn Y is less prominent, an amount of the yarn Y stored in the rotational storage drum 71 is increased.

[0126] In addition to the above, while in the embodiment above the respective end portions of the rotational storage drum 71 are formed as tapered portions 71a and 71b each narrowing toward the other end portion, the upper right end portion shown in FIG. 2 may be more or less constant in diameter.

[0127] In addition to the above, while in the embodiment above a part of the rotational storage drum motor 72 protrudes from the rotational storage drum 71, the entirety of the rotational storage drum motor 72 may be contained in the rotational storage drum 71. The design freedom of the rotational storage drum 71 is further increased in this case, because the rotational storage drum motor 72 does not protrude from the rotational storage drum 71.

[0128] In addition to the above, the embodiment above is arranged so that the yarn Y on the downstream side is fully wound onto the rotational storage drum 71 when yarn breakage occurs, when a yarn defect is detected, or when bobbin change is conducted. Alternatively, when yarn breakage occurs, when a yarn defect is detected, or when bobbin change is conducted, the occurrence of such an incident may be detected in advance and the rotation of the rotational storage drum 71 may be stopped before the yarn Y on the downstream is fully wound onto the rotational storage drum 71. For example, when a yarn defect is detected, a cutter attached to the yarn clearer 15 cuts the yarn Y and at the same time as the driving of the rotational storage drum 71 is stopped. For the bobbin change, a sensor for detecting the remaining yarn amount on the yarn supplying bobbin 21 is attached to the yarn unwinding assisting device 12 to monitor the remaining yarn amount on the yarn supplying bobbin 21. With this, the occurrence of the empty state of the yarn supplying bobbin 21 is detected in advance and the driving of the rotational storage drum 71 is stopped before the spun yarn Y on the downstream side is fully wound onto the rotational storage drum 71.

[0129] As such, because the driving of the rotational storage drum 71 is stopped before the yarn Y is fully wound onto the rotational storage drum 71, the yarn end of the yarn Y is stopped while the yarn Y hangs down on the upstream of the blowdown nozzle 74 of the accumulator 61 or the yarn passage forming member 75.

[0130] Since this allows the upper yarn guide pipe 26 to capture the yarn end hanging down from the accumulator 61, the step of drawing out the yarn Y by the yarn end drawing mechanism is eliminated and hence the yarn jointing becomes more efficient. According to this arrangement, since the drawing sensor 154 is provided, it is possible to check whether the yarn end of the yarn Y stored in the accumulator 61 stops in the state of being receivable by the upper yarn guide pipe 26, i.e., whether the yarn end certainly stops in the state of hanging down on the upstream of the accumulator 61. This makes it possible to shorten the time required for drawing out the yarn end of the yarn Y from the yarn storage section to the yarn jointing section side.

[0131] As such, the drawing mechanism of the present invention is capable of not only drawing out the yarn Y having completely been enclosed inside the accumulator 61 but also drawing out the yarn Y stopping at the position below the accumulator 61 to the yarn jointing section 8 side. Furthermore, the rotation speeds described in the present embodiment are mere examples, and therefore the rotation speeds may be set differently or may be indicated by other units of velocity.

Reference Signs List

[0132]

2	WINDING UNIT
5	YARN SUPPLYING PORTION
6	WINDING SECTION
9	YARN STORAGE SECTION
21	YARN SUPPLYING BOBBIN
30	PACKAGE
71	ROTATIONAL STORAGE DRUM
71a	TAPERED PORTION
72	ROTATIONAL STORAGE DRUM MOTOR
73	YARN GUIDING MEMBER
74	YARN SUCKING MECHANISM
81	ANNULAR COMPONENT

Claims

1. A yarn winder comprising:

a yarn supplying portion for unwinding a spun yarn from a yarn supplying bobbin;
a yarn winding section for winding the spun yarn to form a package;
a yarn storage section which is provided between the yarn supplying portion and the yarn winding section to store the spun yarn; and
a yarn jointing section for performing a yarn jointing operation of jointing a yarn end of the spun yarn on the yarn supplying portion side with a yarn end of the spun yarn on the yarn storage section side,
the yarn storage section including:
a rotational storage drum that rotates for winding and storing the spun yarn unwound from the yarn supplying bobbin; and
a motor for rotating the rotational storage drum in both directions.

2. The yarn winder according to claim 1, further comprising:

a controller for controlling a winding operation of the winding section and driving of the motor, the controller having a control mode with which, in a normal winding operation of unwinding the spun yarn from the yarn supplying bobbin and forming a package, the winding operation by the yarn winding section and a storing operation of storing the yarn by rotating the rotational storage drum in a winding direction by the motor are executed, and when yarn jointing is carried out by the yarn jointing section, a drawing operation of rotating the rotational storage drum in a direction opposite to the winding direction by the motor to draw out the spun yarn to the yarn jointing section side is executed.

3. The yarn winder according to claim 2, wherein,
in the control mode, the controller simultaneously executes the winding operation by the yarn winding section and the drawing operation of drawing the spun yarn to the yarn jointing section side by rotating the rotational storage drum in the direction opposite to the winding direction by the motor, when the yarn jointing section carries out the yarn jointing.

4. The yarn winder according to any one of claims 1 to 3, wherein,
the rotational storage drum is further provided with a guide member for guiding the spun yarn unwound from the yarn supplying portion.

5. The yarn winder according to claim 4, wherein,
the rotational storage drum has a tapered portion at a part where the spun yarn is guided by the guide member, the tapered portion narrowing in diameter in a direction in which the spun yarn moves to be stored, and
the guide member guides the spun yarn to the tapered portion so as to store the spun yarn in such a way that parts of the spun yarn are aligned on the surface of the rotational storage drum in the order in which the parts are wound on the surface.

6. The yarn winder according to claim 5, further comprising:

yarn end capturing means for capturing a yarn end of the spun yarn on the rotational storage drum when the yarn storage section performs the yarn jointing operation.

7. The yarn winder according to claim 6, wherein,
the guide member is a pipe-shaped member, and
the yarn end capturing means generates, in an internal space of the guide member, an airflow flowing from the rotational storage drum side to the yarn supplying portion side.

8. The yarn winder according to any one of claims 5 to 7, wherein,
the yarn storage section further includes:

storage amount detecting means for detecting an amount of the stored spun yarn; and
rotation speed controlling means for controlling rotation speed of the motor, and
the rotation speed controlling means controls the rotation speed of the motor so that the spun yarn is wound only onto a storage area of the rotational storage drum which area is on the tapered portion side of an intermediate position of the rotational storage drum, in accordance with the amount of the spun yarn detected by the storage amount detecting means.

9. The yarn winder according to any one of claims 1 to 8, wherein,
the yarn storage section further includes:
resistance imparting means for imparting resistance to the spun yarn such that the spun yarn is sandwiched between the resistance imparting means and a surface of the rotational storage drum which surface is at an end portion from which the spun yarn is unwound by the yarn winding section.

10. The yarn winder according to claim 9, wherein,
the resistance imparting means rotates together with the rotational storage drum.

11. The yarn winder according to claim 10, wherein,
the resistance imparting means is a rubber-made annular component attached to a yarn unwinding end portion of the rotational storage drum.

12. The yarn winder according to any one of claims 2 to 11, wherein,
the yarn storage section is arranged to be able to store, when the control mode is executed, the spun yarn for an amount required for continuing the winding operation by the yarn winding section until the yarn jointing is performed at least once by the yarn jointing section.

13. The yarn winder according to any one of claims 1 to 12, wherein,
the yarn supplying portion is provided with a yarn unwinding assisting device which assists unwinding of the spun yarn from the yarn supplying bobbin by lowering a regulator which covers a core of the yarn supplying bobbin in sync with the unwinding of the spun yarn from the yarn supplying bobbin.

FIG.1

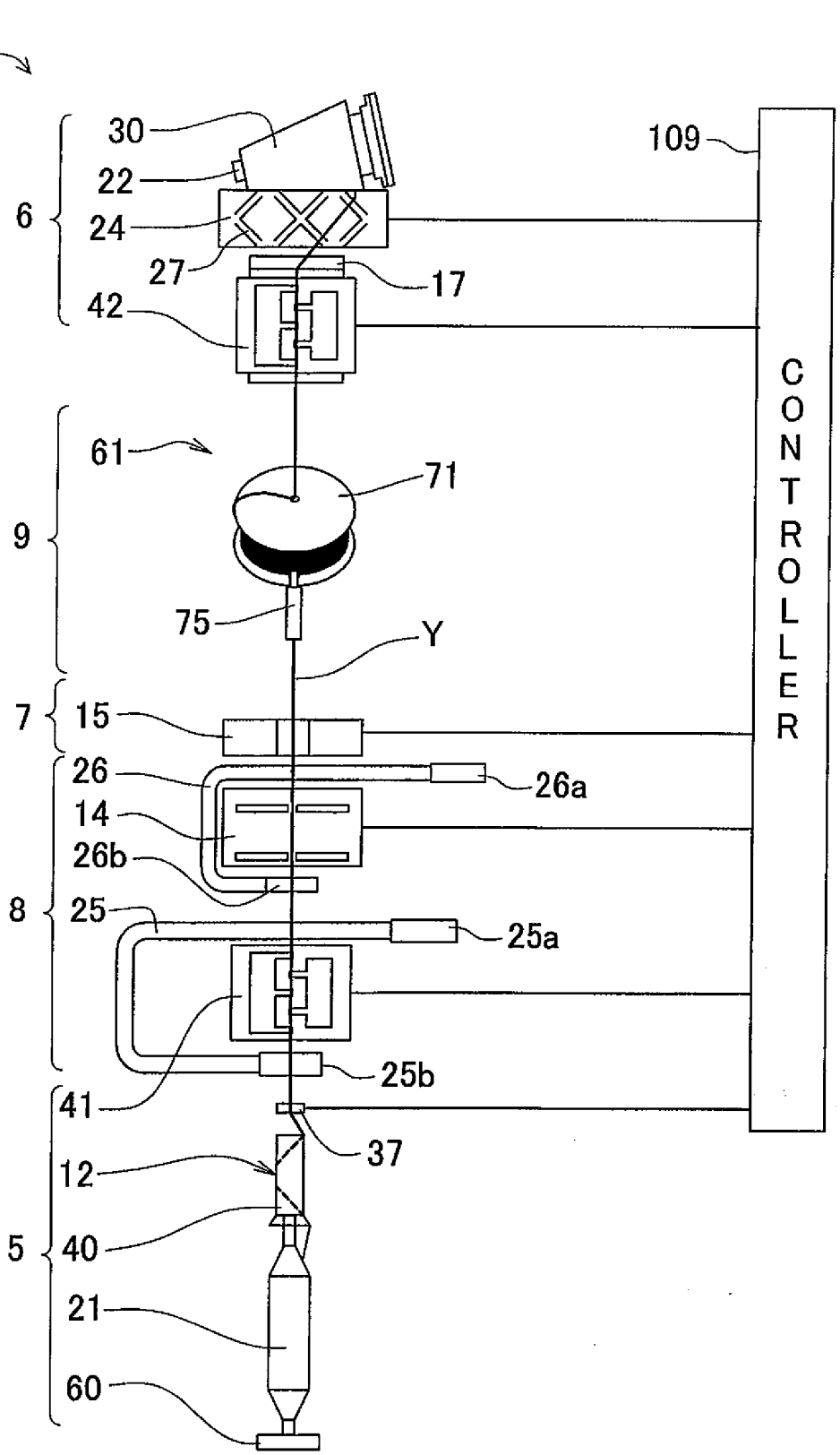

2
30
22
6
24
27
17
42
109
CONTROLLER
61
71
9
75
Y
7
15
26
26a
14
26b
8
25
25a
25b
41
37
12
5
40
21
60

FIG.2

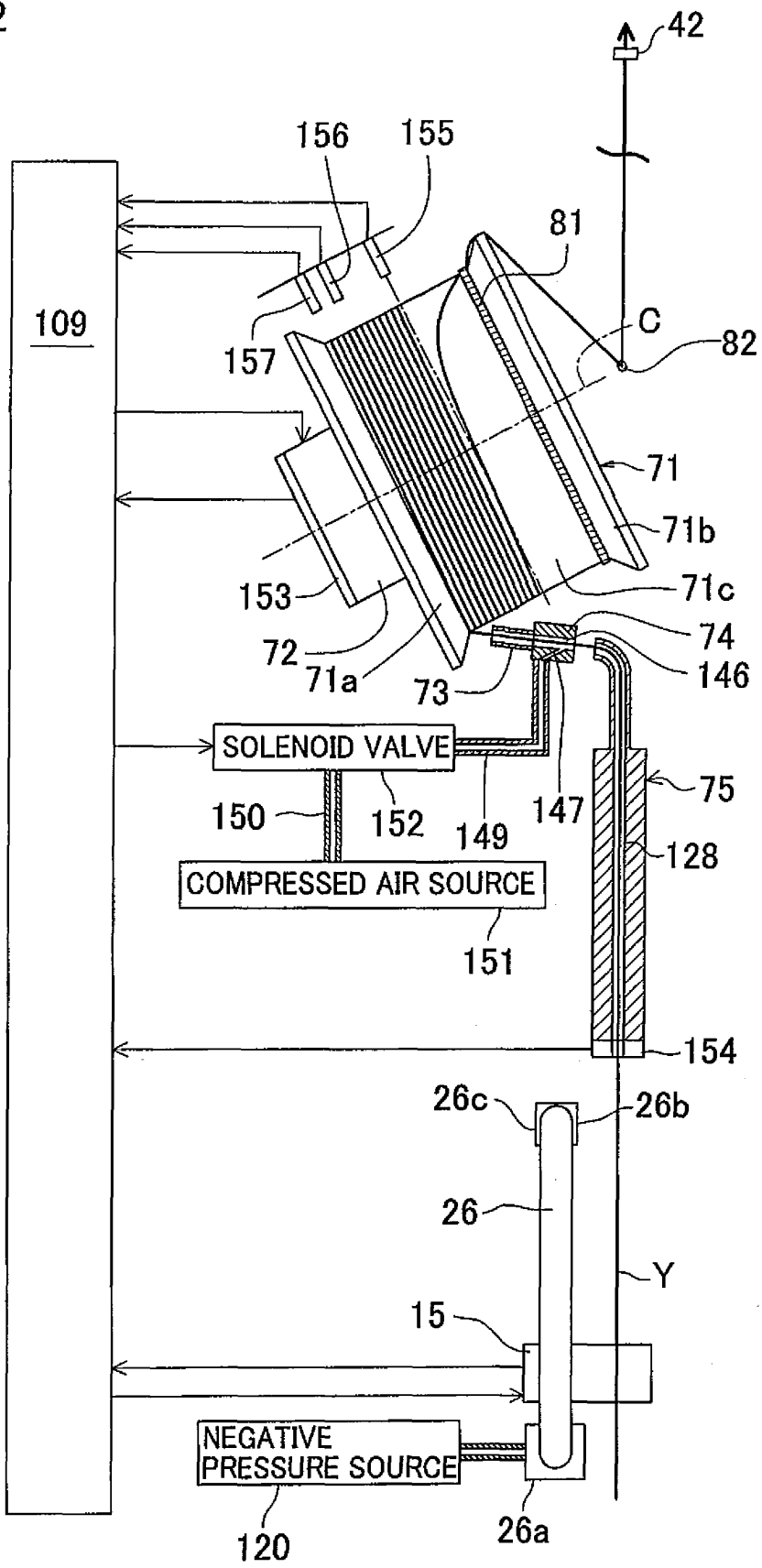

42
156
155
81
109
157
C
82
71
71b
153
71c
74
72
71a
73
146
SOLENOID VALVE
75
150
152
149
147
128
COMPRESSED AIR SOURCE
151
154
26c
26b
26
Y
15
NEGATIVE PRESSURE SOURCE
120
26a

FIG.3

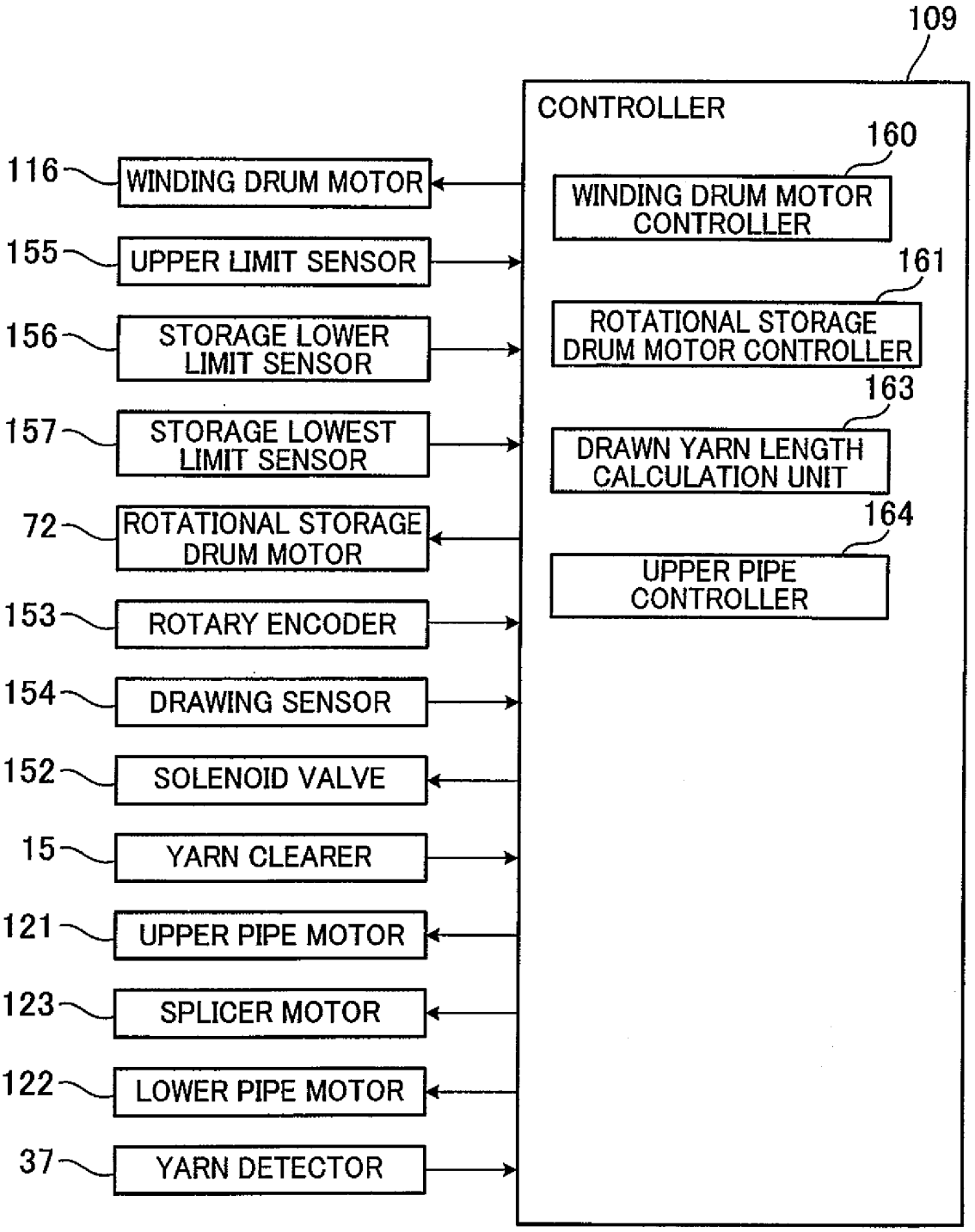

109
CONTROLLER
160
WINDING DRUM MOTOR CONTROLLER
161
ROTATIONAL STORAGE DRUM MOTOR CONTROLLER
163
DRAWN YARN LENGTH CALCULATION UNIT
164
UPPER PIPE CONTROLLER
116
WINDING DRUM MOTOR
155
UPPER LIMIT SENSOR
156
STORAGE LOWER LIMIT SENSOR
157
STORAGE LOWEST LIMIT SENSOR
72
ROTATIONAL STORAGE DRUM MOTOR
153
ROTARY ENCODER
154
DRAWING SENSOR
152
SOLENOID VALVE
15
YARN CLEARER
121
UPPER PIPE MOTOR
123
SPLICER MOTOR
122
LOWER PIPE MOTOR
37
YARN DETECTOR

FIG.4

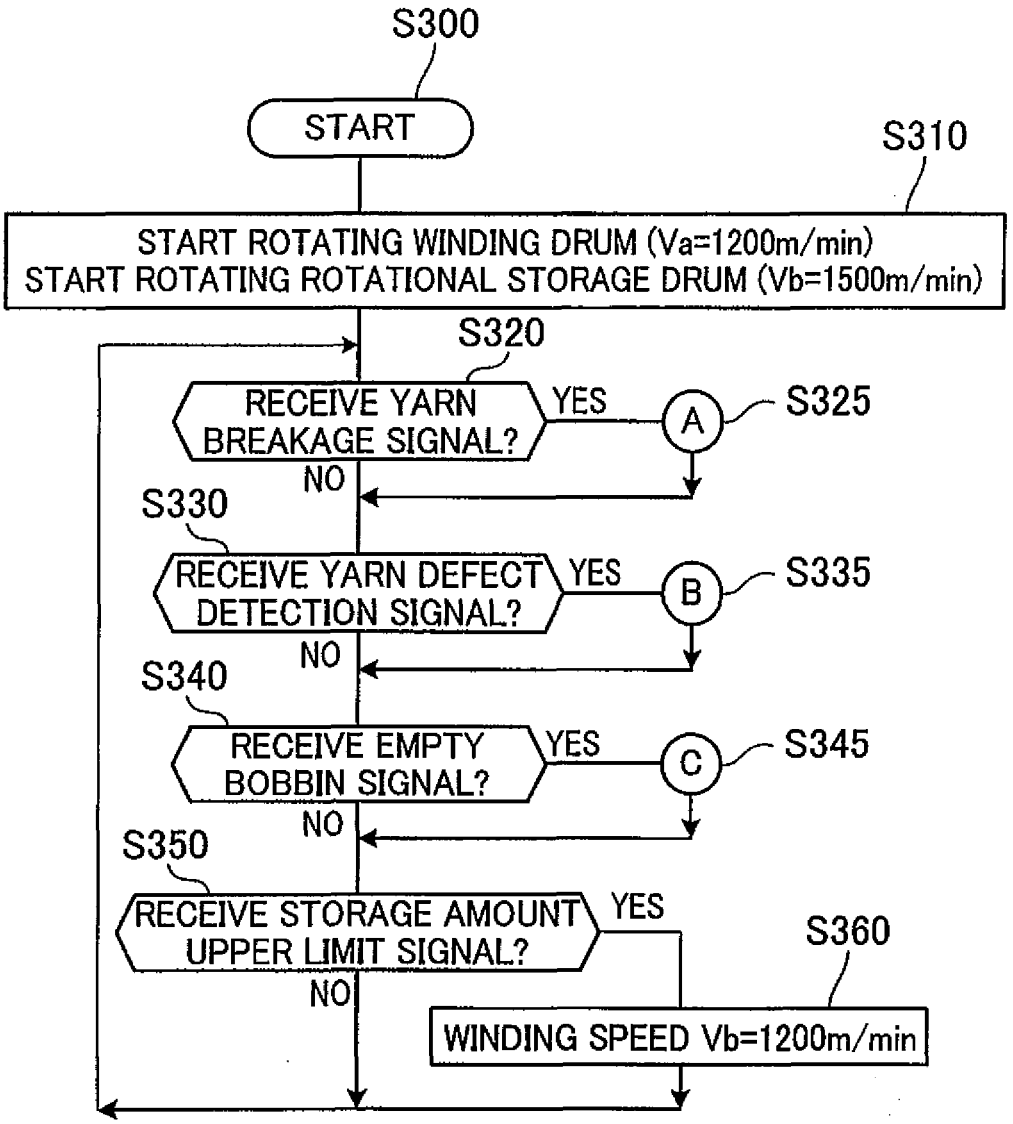

S300
START
S310
START ROTATING WINDING DRUM (Va=1200m/min)
START ROTATING ROTATIONAL STORAGE DRUM (Vb=1500m/min)
S320
RECEIVE YARN BREAKAGE SIGNAL?
YES
A
S325
NO
S330
RECEIVE YARN DEFECT DETECTION SIGNAL?
YES
B
S335
NO
S340
RECEIVE EMPTY BOBBIN SIGNAL?
YES
C
S345
NO
S350
RECEIVE STORAGE AMOUNT UPPER LIMIT SIGNAL?
YES
S360
NO
WINDING SPEED Vb=1200m/min

FIG.5

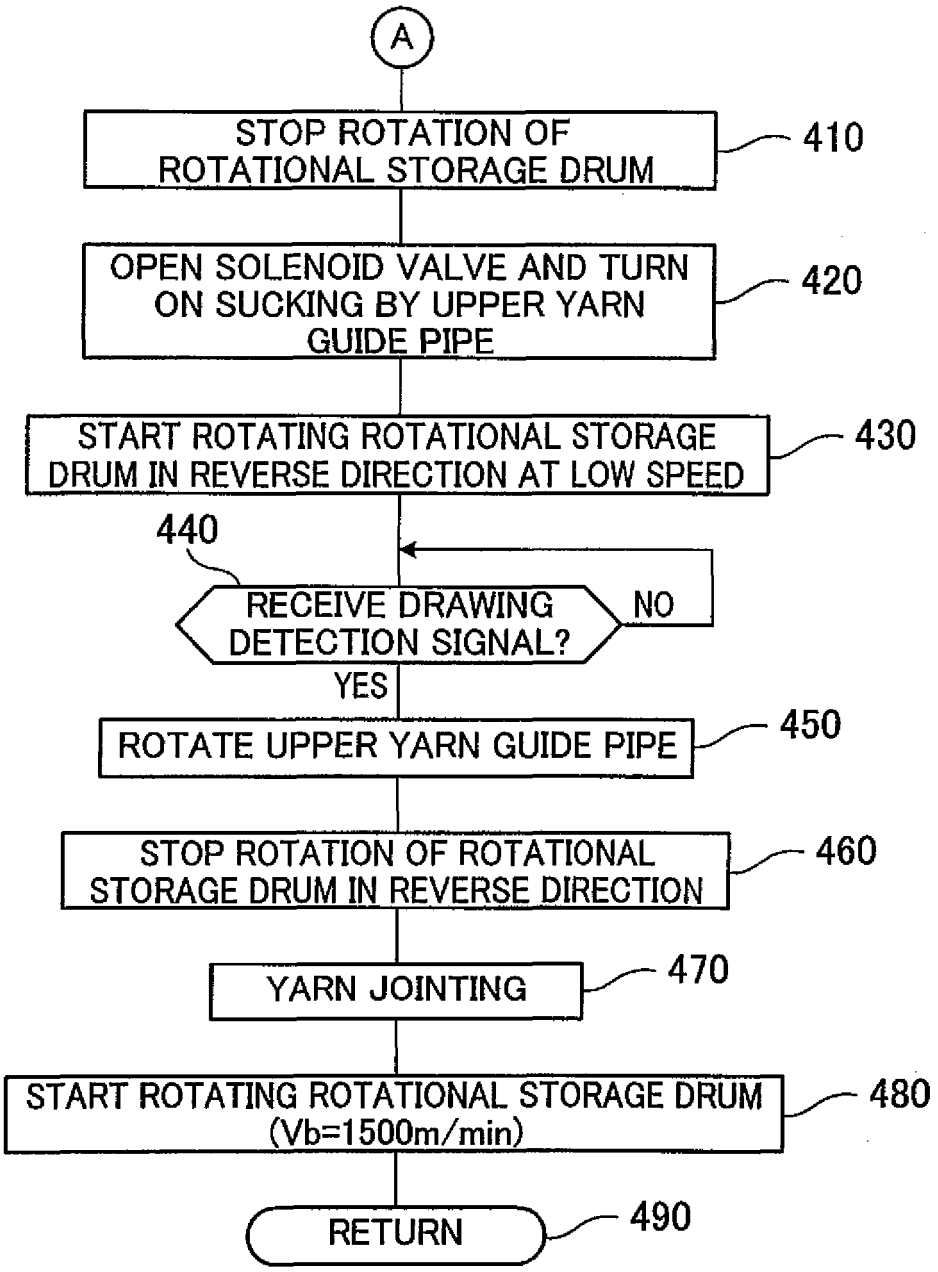

A
STOP ROTATION OF ROTATIONAL STORAGE DRUM
410
OPEN SOLENOID VALVE AND TURN ON SUCKING BY UPPER YARN GUIDE PIPE
420
START ROTATING ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION AT LOW SPEED
430
440
RECEIVE DRAWING DETECTION SIGNAL?
NO
YES
ROTATE UPPER YARN GUIDE PIPE
450
STOP ROTATION OF ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION
460
YARN JOINTING
470
START ROTATING ROTATIONAL STORAGE DRUM (Vb=1500m/min)
480
RETURN
490

FIG.6

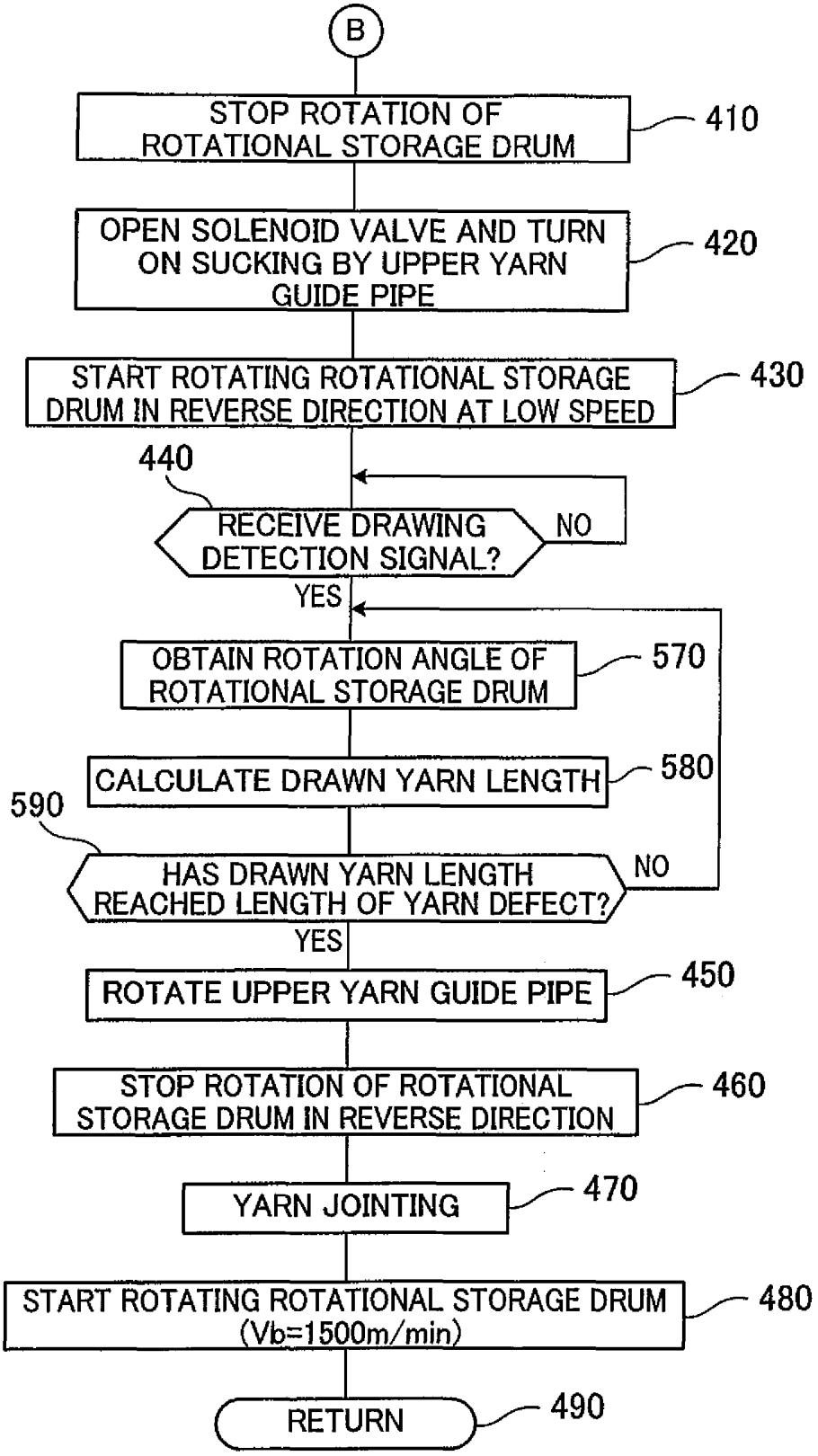

B
STOP ROTATION OF ROTATIONAL STORAGE DRUM
410
OPEN SOLENOID VALVE AND TURN ON SUCKING BY UPPER YARN GUIDE PIPE
420
START ROTATING ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION AT LOW SPEED
430
440
RECEIVE DRAWING DETECTION SIGNAL?
NO
YES
OBTAIN ROTATION ANGLE OF ROTATIONAL STORAGE DRUM
570
CALCULATE DRAWN YARN LENGTH
580
590
HAS DRAWN YARN LENGTH REACHED LENGTH OF YARN DEFECT?
NO
YES
ROTATE UPPER YARN GUIDE PIPE
450
STOP ROTATION OF ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION
460
YARN JOINTING
470
START ROTATING ROTATIONAL STORAGE DRUM (Vb=1500m/min)
480
RETURN
490

FIG.7

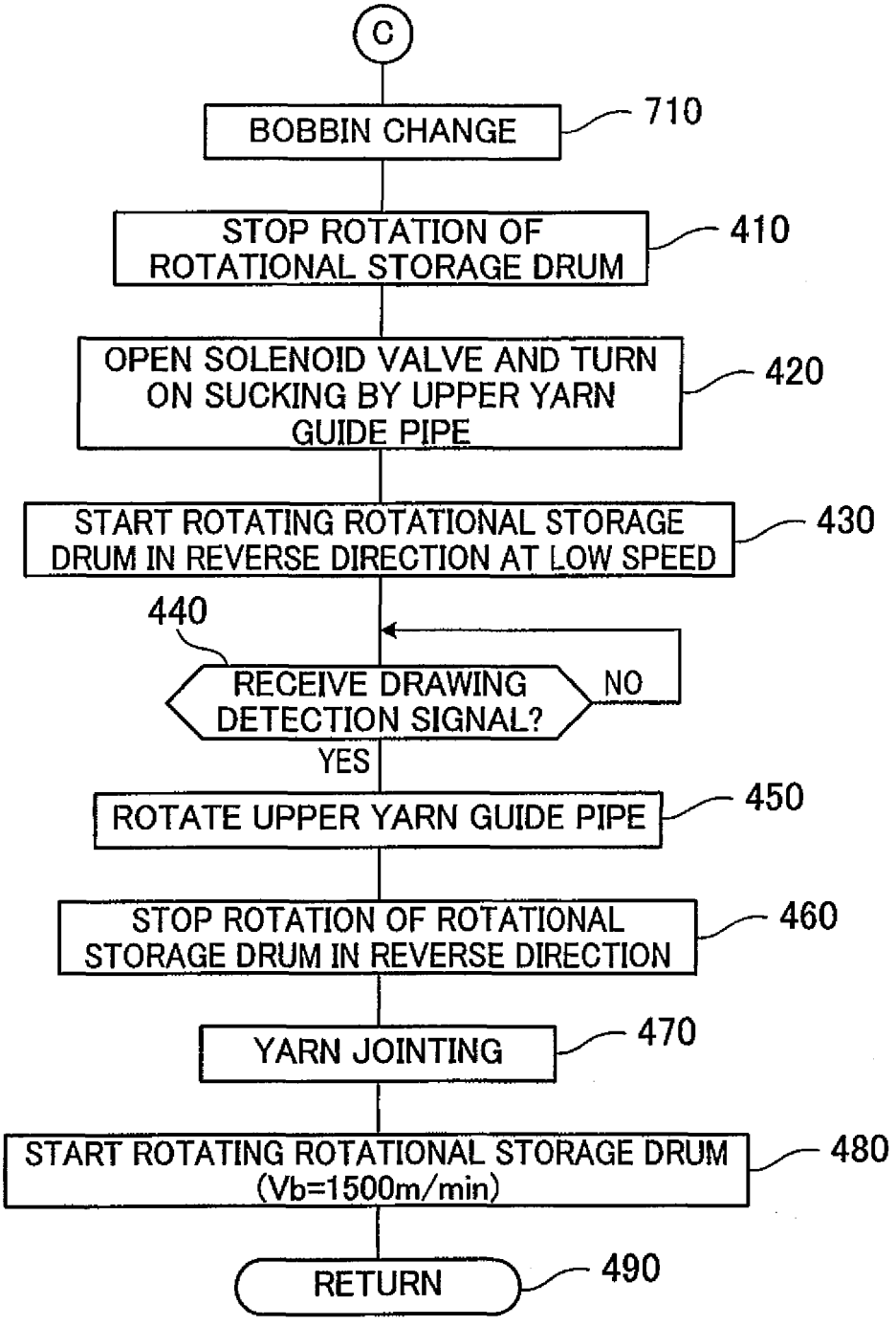
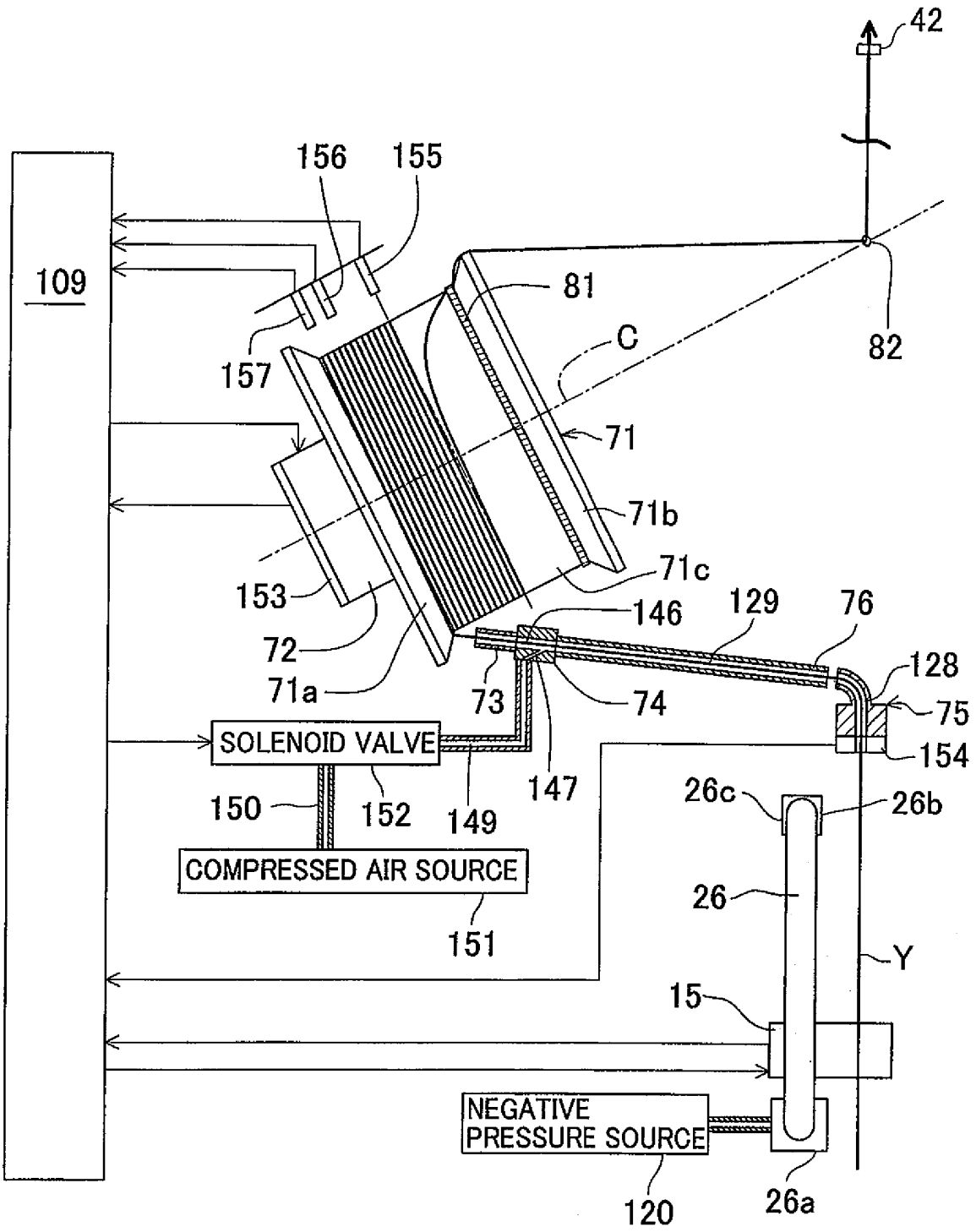

C
BOBBIN CHANGE
710
STOP ROTATION OF ROTATIONAL STORAGE DRUM
410
OPEN SOLENOID VALVE AND TURN ON SUCKING BY UPPER YARN GUIDE PIPE
420
START ROTATING ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION AT LOW SPEED
430
440
RECEIVE DRAWING DETECTION SIGNAL?
NO
YES
ROTATE UPPER YARN GUIDE PIPE
450
STOP ROTATION OF ROTATIONAL STORAGE DRUM IN REVERSE DIRECTION
460
YARN JOINTING
470
START ROTATING ROTATIONAL STORAGE DRUM (Vb=1500m/min)
480
RETURN
490

FIG.8


42
156
155
109
81
157
C
82
71
71b
71c
153
146
129
76
72
71a
73
74
128
75
SOLENOID VALVE
154
147
26c
26b
150
152
149
COMPRESSED AIR SOURCE
26
151
Y
15
NEGATIVE
PRESSURE SOURCE
120
26a

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/067116

A. CLASSIFICATION OF SUBJECT MATTER
B65H51/22(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H51/22

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-277947 A (Murata Machinery Ltd.), 07 October 2004 (07.10.2004), paragraphs [0029] to [0045]; fig. 14 to 15 (Family: none)	1-13
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 99743/1991(Laid-open No. 42262/1993) (Murata Machinery Ltd.), 08 June 1993 (08.06.1993), paragraphs [0010] to [0023]; fig. 1 to 2 & US 5377923 A & DE 4221559 A	1-13

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 26 November, 2010 (26.11.10)	Date of mailing of the international search report 07 December, 2010 (07.12.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

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 2004156186 A **[0008]**
- US 3314621 A **[0008]**