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

(11) EP 2 966 023 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.01.2016 Bulletin 2016/02

(21) Application number: **15167294.6**

(22) Date of filing: **12.05.2015**

(51) Int Cl.:
B65H 63/00 *(2006.01)* ***B65H 63/06*** *(2006.01)*
B65H 67/08 *(2006.01)* ***B65H 69/06*** *(2006.01)*

(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
Designated Validation States:
MA

(30) Priority: **10.07.2014 JP 2014142088**

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

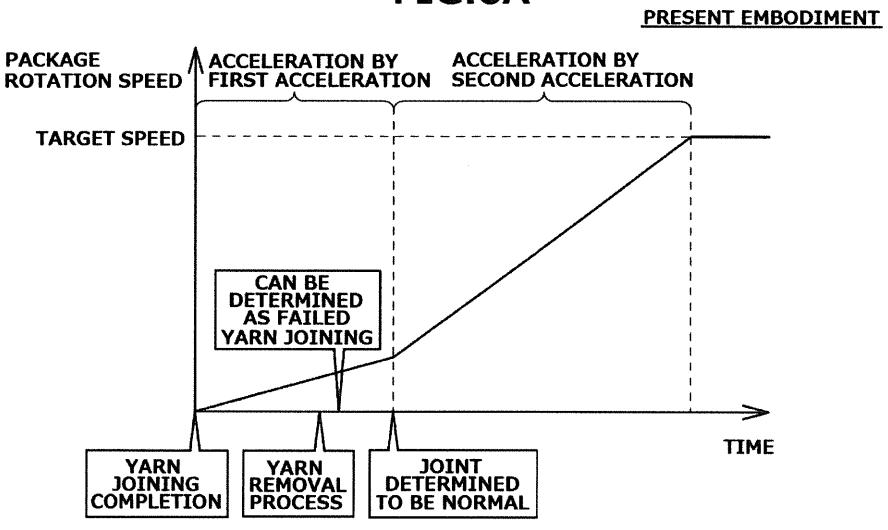
(72) Inventors:
- **Nakayama, Noboru**
  Kyoto, 612-8686 (JP)
- **Nakamura, Yuta**
  Kyoto, 612-8686 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) YARN WINDING MACHINE AND YARN WINDING METHOD

(57) A yarn winding machine includes a yarn supplying section (9), a winding section (26), a yarn joining device (23), a detecting section (25), and a determining section (90). The yarn supplying section (9) supplies a yarn (10). The winding section (26) winds the yarn (10) supplied by the yarn supplying section (9) onto the package (50). The yarn joining device (23) joins the yarn (10) from the yarn supplying section (9) and the yarn (10) from the winding section (26). The detecting section (25) detects a joint formed by the yarn joining device (23). The determining section (90) determines, based on a detection result of the detecting section (25), whether the joint is normal. The winding section (26) performs winding of the package (50) by increasing acceleration of a rotation speed of the package (50) after the determining section (90) determines that the joint is normal.

FIG.6A



EP 2 966 023 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention principally relates to a yarn winding machine having a function to inspect a joint formed by a yarn joining device.

2. Description of the Related Art

[0002] Yarn winding machines equipped with a yarn supplying section, a winding section, and a yarn joining device are known in the art. The winding section winds a yarn by rotating a package. When the yarn becomes discontinuous between the yarn supplying section and the winding section, the yarn joining device joins the yarn from the yarn supplying section and the yarn from the winding section. Yarn winding machines equipped with such a yarn joining device are disclosed, for example, in Japanese Patent Application Laid-open No. 2013-67892 (Patent Document 1), Japanese Patent Application Laid-open No. 2013-230908 (Patent Document 2), and Japanese Patent Application Laid-open No. H2-215662 (Patent Document 3).

[0003] The yarn winding machine disclosed in Patent Document 1 includes plural spinning units. All the spinning units are driven by a common driving source, and therefore, a rotation speed of a winding drum that rotates a package is the same in all the spinning units. Each spinning unit includes a joint monitor that monitors a thickness of a joint formed by the yarn joining device. Each spinning unit cuts the yarn and joins the yarn again if the joint monitor determines that the joint is not normal.

[0004] The yarn winding machine disclosed in Patent Document 2 has a yarn monitoring device arranged upstream of a yarn joining device. The yarn monitoring device is an optical-type sensor or the like, and monitors the quality of the yarn by detecting the thickness of the yarn passing through a yarn passage. The yarn monitoring device includes a blowing member that blows compressed air in the yarn passage. By this action, yarn waste adhering to the yarn passage is blown off, and thereby, the monitoring accuracy of the yarn monitoring device can be maintained.

[0005] A method of inspection of a yarn joining device (splicer) is disclosed in Patent Document 3. The yarn winding machine has a mode in which an inspection of the yarn joining device is performed. When the yarn winding machine is in this mode, the package is rotated at a lower speed after yarn joining has been performed, and a predetermined tension is applied on the yarn supplied from a yarn supplying section to detect presence of a yarn breakage. If a yarn breakage occurs, the yarn winding machine notifies an operator that the yarn joining is incomplete. If yarn breakage does not occur, the yarn winding machine cuts the yarn and performs the yarn joining again.

[0006] In the conventional yarn winding machine, when the yarn joining by the yarn joining device fails, the yarn from the package winds onto the package once. Thereafter, the yarn end is caught by applying a suction force or the like on the surface of the package, and the yarn joining device performs the yarn joining again. However, at times the attempt to catch the yarn end from the package fails and at times a part of the yarn from the surface of the package is unnecessarily caught.

[0007] In the yarn winding machine disclosed in Patent Document 1, because the rotation speed of the winding drum that rotates the package is the same in all the spinning units, the packages rotate swiftly even after the yarn joining operation. Consequently, the winding of the yarn is also performed swiftly after the yarn joining operation. Hence, even if the package is stopped after detection of a failed yarn joining, there is a high possibility of the yarn end being wound onto the package, resulting in a remarkable occurrence of the above problem. The yarn winding machine disclosed in Patent Document 2, however, does not have a configuration to address the above problem.

[0008] Patent Document 3 teaches control for rotating the package at a lower speed after the yarn joining has been completed when in the mode in which the inspection of the yarn joining device is performed. However, there is no mention of whether this control is performed even during normal winding. In the mode in which the inspection of the yarn joining device is performed, because the yarn is cut once after the package is rotated at lower speed following the yarn joining, the rotation speed of the package is not increased.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a yarn winding machine in which a yarn end is not wound onto a package when yarn joining fails.

[0010] A yarn winding machine according to an aspect of the present invention includes a yarn supplying section that supplies a yarn; a winding section that winds the yarn supplied by the yarn supplying section to form a package and includes a rotation driving unit that rotates the package; a yarn joining device that joins the yarn from the yarn supplying section and the yarn from the winding section; a detecting section that detects a joint that is a portion where yarn joining is performed by the yarn joining device; and a determining section that determines whether the joint is normal based on a detection result obtained by the detecting section, wherein the winding section performs winding of the package by increasing acceleration of a rotation speed of the package after the determining section determines that the joint is normal.

[0011] A yarn winding method according to another aspect of the present invention includes joining a yarn from a yarn supplying section that supplies the yarn and a yarn from a winding section that winds the yarn supplied by the yarn supplying section to form a package; detecting

a joint that is a portion where yarn joining is performed at the joining; determining whether the joint is normal based on a detection result obtained at the detecting; and winding the package by increasing acceleration of a rotation speed of the package after the joint is determined to be normal at the determining.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a side view of a spinning unit of a spinning machine according to an embodiment of the present invention.

FIG. 2 is an enlarged perspective view of a yarn pooling device and a first guide.

FIG. 3 is a perspective view of a yarn joining device.

FIG. 4 is a perspective view of a yarn monitoring device.

FIG. 5 is a flowchart of a process procedure performed by the spinning unit when a yarn breakage or yarn disconnection occurs.

FIG. 6A is a graph for explaining a change in a rotation speed of a package in the event of a successful yarn joining according to the present embodiment.

FIG. 6B is a graph for explaining a change in the rotation speed of the package in the event of a successful yarn joining according to conventional technology.

FIG. 7 is a side view of the spinning unit during the yarn joining.

FIG. 8 is a side view of the spinning unit in the event of a successful yarn joining.

FIG. 9 is a side view of the spinning unit in a situation of a failed yarn joining and when an end of a second yarn is removed by a yarn removing device.

FIG. 10 is a side view of the spinning unit in the situation of a failed yarn joining and when the end of the second yarn is caught by a second catching and guiding device.

FIG. 11 is a graph for explaining the change in the rotation speed of the package in the event of a successful yarn joining according to a modification.

DETAILED DESCRIPTION

[0013] Exemplary embodiments of a spinning frame (yarn winding machine) according to the present invention are explained in detail below with reference to the accompanying drawings. In this specification, the terms "upstream" and "downstream" refer to upstream and downstream in a traveling direction of a fiber bundle and a spun yarn during spinning.

[0014] The spinning machine includes plural spinning units 2 arranged side by side and a not shown main control device that performs centralized management of the spinning units 2. In each spinning unit 2, an air-jet spinning device (yarn supplying section) 9 spins a fiber bundle 8 conveyed from a drafting device 7 to form a spun yarn 10, and a winding section 26 winds the spun yarn 10 to form a package 50.

[0015] As shown in FIG. 1, each spinning unit 2 includes, sequentially from upstream to downstream, the drafting device 7, the air-jet spinning device 9, a yarn pooling device 22, a yarn joining device 23, a yarn monitoring device (detecting section) 25, and the winding section 26. All the parts of the spinning unit 2 are controlled by a unit controller 90 arranged in the spinning unit 2. All the parts of the spinning unit 2 can instead be controlled by the main control device.

[0016] The drafting device 7 includes, sequentially from the upstream, four draft rollers, namely, a back roller 16, a third roller 17, a middle roller 19 with a rubber apron belt 18, and a front roller 20. Each of the draft rollers is driven to rotate at a predetermined rotation speed. The drafting device 7 includes opposing rollers arranged respectively facing the draft rollers.

[0017] The drafting device 7 transports a sliver 15 supplied from a sliver case (not shown) via a sliver guide (not shown) by nipping the sliver 15 between the draft rollers and the opposing rollers, thus forming a fiber bundle 8 by stretching (drafting) the sliver 15 until a predetermined fiber amount (or thickness) is obtained.

[0018] The air-jet spinning device 9 is arranged immediately downstream of the front roller 20. The air-jet spinning device 9 forms the spun yarn 10 by twisting the fiber bundle 8 supplied from the drafting device 7. In the present embodiment, an air-jet spinning device that twists the fiber bundle 8 by using a swirling airflow has been employed.

[0019] A first guide 61 (see FIG. 2) that guides the spun yarn 10 is arranged downstream of the air-jet spinning device 9. The first guide 61 guides the spun yarn 10 to the yarn pooling device 22. The first guide 61 is movable so that it can pull the spun yarn 10 to the yarn pooling device 22 for performing yarn joining or the like.

[0020] The yarn pooling device 22 is arranged downstream of the first guide 61. The yarn pooling device 22 includes a yarn pooling roller 41, an electric motor 42 that drives the yarn pooling roller 41 to rotate, and a yarn hooking member 43. The spun yarn 10 is temporarily pooled by being wound around the outer circumferential surface of the yarn pooling roller 41.

[0021] The yarn hooking member 43 is mounted on a downstream end portion of the yarn pooling roller 41. The yarn hooking member 43 is supported in a rotatable manner relatively to the yarn pooling roller 41. A permanent magnet is attached to any one of the yarn hooking member 43 and the yarn pooling roller 41, and a magnetic hysteresis member is attached to the other of the yarn hooking member 43 and the yarn pooling roller 41. These magnetic means generate a torque against a relative rotation of the yarn hooking member 43 with respect to the yarn pooling roller 41. Therefore, only when a force overcoming the torque is applied (when a tension of a predetermined amount or larger is applied) on the yarn hooking

member 43, the yarn hooking member 43 is rotated relatively to the yarn pooling roller 41 so that the spun yarn 10 wound around the yarn pooling roller 41 can be unwound. On the other hand, when such a force is not applied to the yarn hooking member 43, the yarn pooling roller 41 and the yarn hooking member 43 are integrally rotated so that the spun yarn 10 is wound around the yarn pooling roller 41.

[0022] In this manner, the yarn pooling device 22 operates such that the spun yarn 10 is unwound when the yarn tension on the downstream is increased, and the spun yarn 10 is prevented from being unwound when the yarn tension is decreased (when the spun yarn 10 is about to have a slack). With this operation, the yarn pooling device 22 can remove the slack of the spun yarn 10 and apply an appropriate tension on the spun yarn 10. Furthermore, because the yarn hooking member 43 operates to absorb a variation of the tension applied on the spun yarn 10 between the yarn pooling device 22 and the winding section 26, the variation of the tension is prevented from affecting the spun yarn 10 between the air-jet spinning device 9 and the yarn pooling device 22.

[0023] A second guide 62 that regulates the spun yarn 10 unwound from the yarn pooling roller 41 is arranged downstream of the yarn pooling roller 41. The yarn joining device 23 is arranged downstream of the second guide 62. The yarn joining device 23 joins the spun yarn 10 from the air-jet spinning device 9 (first yarn) and the spun yarn 10 from the package 50 (second yarn) when the spun yarn 10 is disconnected between the air-jet spinning device 9 and the package 50 due to any reason. In the present embodiment, the yarn joining device 23 is a splicer device that twists and joins the yarn ends by the action of a swirling air current generated by compressed air. The yarn joining device 23, however, is not limited to the splicer device, and can be, for example, a mechanical knotter and the like.

[0024] The spinning unit 2 includes a first catching and guiding device 27 and a second catching and guiding device (catching and guiding device) 28 that guide the spun yearn 10 to the yarn joining device 23.

[0025] The first catching and guiding device 27 includes a base portion that is pivotably supported, and is able to pivot in a vertical direction around the base portion as a center. The first catching and guiding device 27 is hollow, connected to a not shown blower, and can generate a suction airflow. The first catching and guiding device 27 catches an end of the first yarn by pivoting downward (see FIG. 7). After catching the first yarn, the first catching and guiding device 27 guides the first yarn to the yarn joining device 23 by pivoting upward.

[0026] The second catching and guiding device 28 includes a base portion that is pivotably supported, and is able to pivot in the vertical direction around the base portion as a center. The second catching and guiding device 28 is also hollow, connected to a not shown blower, and can generate a suction airflow. The second catching and guiding device 28 catches an end of the second yarn by pivoting upward (see FIG. 7). After catching the second yarn, the second catching and guiding device 28 guides the second yarn to the yarn joining device 23 by pivoting downward.

[0027] By driving the yarn joining device 23 in a state in which the first yarn and the second yarn are guided in the yarn joining device 23, the first yarn and the second yarn are joined to bring the spun yarn 10 in a continuous state between the air-jet spinning device 9 and the package 50. Due to this, the winding of the spun yarn 10 on the package 50 can be resumed.

[0028] A concrete structure of the yarn joining device 23 and a yarn joining operation are explained below in detail with reference to FIG. 3. The yarn joining device 23 shown in FIG. 3 includes a yarn joining nozzle 71, a pair of yarn pulling levers (yarn pulling sections) 72, a pair of clamps (holding sections) 73, a pair of yarn holding-down levers 74, a pair of untwisting pipes 75, and a pair of cutters 76.

[0029] A yarn joining hole 70 is formed in the yarn joining nozzle 71. A not shown blowoff port is formed inside the yarn joining hole 70. The swirling airflow is generated inside the yarn joining hole 70 when compressed air is blown from the blowoff port.

[0030] Each of the pairs of the yarn pulling levers 72, the clamps 73, and the yarn holding-down levers 74 are arranged sandwiching the yarn joining nozzle 71. The yarn pulling levers 72 pull the first yarn and the second yarn guided to the yarn joining device 23 toward the yarn joining nozzle 71. The clamps 73 hold the first yarn and the second yarn that have been guided to the yarn joining nozzle 71 at predetermined places. The yarn holding-down levers 74 hold down and position the first yarn and the second yarn during yarn joining at the yarn joining nozzle 71.

[0031] One untwisting pipe 75 is arranged corresponding to the first yarn and another untwisting pipe 75 is arranged corresponding to the second yarn. Compressed air is blown inside each untwisting pipe 75 from a not shown compressed air passage.

[0032] The first yarn and the second yarn guided to the yarn joining device 23 are pulled toward the respective untwisting pipes 75 by the respective yarn pulling levers 72 and held by the clamps 73. The first yarn and the second yarn are cut to a predetermined length by the respective cutters 76.

[0033] After cutting the yarns, the fibers at the ends of the first yarn and the second yarn are untwisted inside the respective untwisting pipes 75 by the action of an airflow. On completion of untwisting of the yarn ends, the first yarn and the second yarn are pulled out from the respective untwisting pipes 75 and positioned overlapping each other inside the yarn joining hole 70 of the yarn joining nozzle 71 by the holding down action of the yarn holding-down levers 74. In this state, a swirling flow of compressed air is generated by blowing the compressed air into the yarn joining hole 70, and thereby the first yarn and the second yarn are twisted together to form a joint.

After the formation of the joint, the hold on the first yarn and the second yarn by the clamps 73 is released, and the operations of the yarn pulling levers 72 and the yarn holding-down levers 74 are released. In the present embodiment, if the yarn joining is performed normally, the portion where the joint is formed cannot be confirmed visually or at least will be difficult to confirm visually because the yarn joining is performed by the action of the swirling flow of the compressed air. In the present specification, for the sake of convenience, the term "joint" shall be used to refer to the yarn in the portion where the yarn joining has been performed.

[0034] The yarn monitoring device 25 is arranged downstream of the yarn joining device 23. The yarn monitoring device 25 monitors a thickness of the traveling spun yarn 10 with a capacitance type sensor. As shown in FIG. 4, the yarn monitoring device 25 includes a housing 80, a first air blowing member (yarn removing section, air blowing section) 82, a second air blowing member (yarn removing section, air blowing section) 83, and a cutter 85. In an alternative configuration, the cutter 85 can be arranged independently of the yarn monitoring device 25.

[0035] A slit-like concave portion 81 is formed in the housing 80. The spun yarn 10 travels inside the concave portion 81. The concave portion 81 is formed like a linear groove with one side open. The inside of the concave portion 81 forms a detection area for detecting the spun yarn 10. The cutter 85 is arranged further upstream than the detection area in a yarn traveling direction.

[0036] The first air blowing member 82 includes a first air blowoff port 82a formed on an inner wall on the interior side of the concave portion 81. By blowing air through the first air blowoff port 82a, the first air blowing member 82 generates airflow along the side walls of the groove-like concave portion 81 and blows air to the cutter 85, and the like.

[0037] A slit-like second blowoff port 83a is formed in the second air blowing member 83. The second air blowing member 83 blows air inside the concave portion 81 in a direction indicated by the arrow in FIG. 4, that is, obliquely relative to a width direction of the groove-like concave portion 81 and also obliquely relative to the yarn traveling direction. The air blown from the second blowoff port 83a of the second air blowing member 83 is blown into the concave portion 81 from the open side of the concave portion 81 and upstream side of yarn traveling direction, and hits the side wall on one side of the concave portion 81 slantingly. A helical airflow is thereby generated inside the concave portion 81.

[0038] With this configuration, even if a foreign matter, such as yarn waste and fibers or the like, enters into the concave portion 81, the air blown from the first air blowing member 82 and the second air blowing member 83 blow off the foreign matter to the outside of the concave portion 81.

[0039] The yarn monitoring device 25 transmits the quality information of the spun yarn 10 obtained as a result of monitoring to a unit controller (determining section, controller) 90. The unit controller 90 can thereby determine whether the joint formed by the yarn joining device 23 is normal and whether any defect (a place where the thickness of the spun yarn 10 or the like is abnormal) is present in the spun yarn 10 that is being wound. If abnormality in the joint or a yarn defect or the like is present, the unit controller 90 drives the cutter 85 (yarn cutting device) arranged near the yarn monitoring device 25 to cut the spun yarn 10. The sensor with which the yarn monitoring device 25 monitors the thickness of the spun yarn 10 is not limited to a capacitance type sensor, and can, for example, be an optical transmission type sensor. Moreover, a foreign matter included in the spun yarn 10 can be monitored as the yarn defect. Alternatively, the cutter 85 can be omitted, and the spun yarn 10 can be cut by suspending the formation of the spun yarn 10 by the air-jet spinning device 9.

[0040] The winding section 26 is arranged downstream of the yarn pooling device 22. The winding section 26 includes a cradle arm 52, a winding drum 53, and a winding-drum driving motor (rotation driving unit) 54. A direction of a yarn path from the yarn pooling device 22 to the winding section 26 is bent and guided by a downstream guide 63. A restraining guide (restraining section) 64 is arranged near the downstream guide 63.

[0041] The cradle arm 52 rotatably supports a winding tube 51 on which the spun yarn 10 is to be wound. The cradle arm 52 is pivotable around a base portion as a center of pivoting. With this configuration, even when a diameter of the package 50 increases with the winding of the spun yarn 10 around the winding tube 51, the winding of the spun yarn 10 can be continued properly.

[0042] The winding drum 53 rotates while being in contact with an outer circumferential surface of the winding tube 51 or the package 50 by a driving force transmitted from the winding-drum driving motor 54. A not shown traverse groove is formed on an outer circumferential surface of the winding drum 53 and the spun yarn 10 can be traversed to a predetermined width using this traverse groove. With this configuration, the winding section 26 can form the package 50 by winding the spun yarn 10 around the winding tube 51 while traversing the spun yarn 10. In this manner, because a separate winding-drum driving motor 54 is arranged for every spinning unit 2 in the present embodiment, the winding drum 53 of every spinning unit 2 can be rotated at a different speed.

[0043] A process procedure performed by the spinning unit 2 when a yarn breakage or yarn cutting occurs is explained below with reference to FIGS. 5 to 10. The process procedure shown in the flowchart in FIG. 5 is merely an example; the sequence of the process procedure can be changed, and two processes can even be performed simultaneously.

[0044] When a yarn breakage occurs or the cutter 85 cuts the spun yarn 10 while the package 50 is being wound, the spun yarn 10 is disconnected. Upon detecting a yarn breakage or a cut yarn (Step S101), the spinning

unit 2 stops the rotation of the parkage 50 using a package brake or the like (Step S102), and also stops the drafting by the drafting device 7 and the spinning by the air-jet spinning device 9. The first guide 61 moves to a position that is located away from the yarn pooling device 22.

[0045] Next, an operation of catching the disconnected yarn ends and guiding the yarn ends to the yarn joining device 23 is performed (Step S103). Specifically, as shown in FIG. 7, the second catching and guiding device 28 pivots upward and catches the second yarn. Thereafter, the second catching and guiding device 28 pivots downward while the winding section 26 rotates the package 50 backward. By these actions, the second yarn is guided to a position where the yarn joining can be performed by the yarn joining device 23. The first catching and guiding device 27 pivots downward and moves to a position where the first yarn can be caught. The drafting by the drafting device 7 and the spinning by the air-jet spinning device 9 are then resumed, and thereby, the first yarn is sucked and caught by the first catching and guiding device 27. The first catching and guiding device 27 then pivots upward, with the first yarn sucked and held. By this action, the first yarn is guided to a position where the yarn joining can be performed by the yarn joining device 23. The first guide 61 then moves so as to approach the yarn pooling device 22. By this action, the spun yarn 10 is pulled to the yarn hooking member 43 of the yarn pooling device 22.

[0046] The yarn joining device 23 then performs a yarn joining operation to form a joint between the first yarn and the second yarn (Step S104). Thereafter, the winding section 26 rotates the package 50 and winds the spun yarn 10. While rotating the package 50, as shown in FIG. 6A, the winding section 26 accelerates the package 50 by a first acceleration (Step S105). The first acceleration is lower than both a second acceleration shown in FIG. 6A and the acceleration in a conventional case shown in FIG. 6B.

[0047] Thereafter, the spinning unit 2 performs a yarn removal process (Step S106). The yarn removal process is a process of applying a force on the spun yarn 10 so as to remove the spun yarn 10 from the detection area of the yarn monitoring device 25. In the present embodiment, the yarn removal process is performed by blowing air by at least one of the first air blowing member 82 and the second air blowing member 83.

[0048] Upon successful yarn joining, the spun yarn 10 is continuous and has a tension applied thereon, as shown in FIG. 8, and therefore is not affected by the yarn removal process. In contrast, when the yarn joining fails, as shown in FIG. 9, the second yarn comes off from the yarn monitoring device 25 in the yarn removal process. The second yarn that has come off from the yarn monitoring device 25 is guided to the restraining guide 64. The movement of the second yarn is thereby restrained, enabling the position of the end of the second yarn to be easily specified.

[0049] Failed yarn joining can be determined at an early timing by performing the yarn removal process early. Hence, it is preferable that the yarn removal process is performed, for example, after the looseness of the spun yarn 10 that occurs when the spun yarn 10 is released is lost following the joint formation process performed by the yarn joining device 23. Alternatively, the yarn removal process can be performed after the clamps 73 release the spun yarn 10 and before the yarn pulling levers 72 release the first yarn and the second yarn.

[0050] After the yarn removal process, the unit controller 90 determines whether the joint formed in the spun yarn 10 is normal (Step S107). The unit controller 90 determines that the joint is normal when the joint of the spun yarn 10 detected by the yarn monitoring device 25 satisfies a predetermined condition (thickness or the like). Alternatively, the unit controller 90 can be configured to determine the joint to be a normal joint when the spun yarn 10 is detected continuously for a predetermined time period. When the joint detected by the yarn monitoring device 25 does not satisfy the predetermined condition or when the yarn monitoring device 25 is unable to detect the spun yarn 10, the unit controller 90 determines that yarn joining has failed (Step S108).

[0051] If it is determined that the yarn joining has failed, the unit controller 90 determines whether the yarn joining has failed successively for a predetermined number of times (Step S109). If the yarn joining has failed successively for the predetermined number of times, the spinning unit 2 notifies the failure to an operator by lighting a not shown lamp or by sounding an alarm or the like (Step S110).

[0052] If the number of successive failure of yarn joining has not reached the predetermined value, the winding section 26 stops the rotation of the package 50 (Step S102). In the present embodiment, because the package 50 is rotated at a lower first acceleration as explained above, a rotation speed of the package 50 at the time of determination of a failed yarn joining is low. Consequently, the package 50 can be stopped before the end of the second yarn is wound onto the package 50. Hence, as shown in FIG. 10, the second catching and guiding device 28 can suck and catch the end of the second yarn under a state in which the yarn end is located away from the package 50. Consequently, the probability of occurrence of an error when catching the yarn end can be reduced. Furthermore, because whether the yarn joining has been successful can be determined at an early timing, a pooled amount of the spun yarn 10 in the yarn pooling device 22 in the time period in which the unit controller 90 performs the determination can be reduced. Hence, an amount of the spun yarn 10 that needs to be discarded can be reduced, and thereby a winding efficiency can be increased. Thereafter, the spinning unit 2 performs the processes from Step S102 onward as explained above.

[0053] If the unit controller 90 determines that the joint is normal (Yes at Step S107), the winding section 26 increases the rotation speed of the package 50 by the

second acceleration (see Step S111 and FIG. 6A). The second acceleration is higher than the first acceleration and the conventional acceleration.

[0054] The winding section 26 then determines whether the rotation speed of the package 50 has reached a target speed (Step S112), and ends the acceleration of the package 50 (Step S113) at a time point when the package 50 reaches the target speed. By increasing the acceleration of the package 50 as explained above, the target speed can be reached in a shorter time.

[0055] A modification of the present embodiment is explained below with reference to FIG. 11. In this modification, the configuration of the spinning unit 2 is similar to that of the above embodiment. However, this modification differs from the above embodiment in that, after yarn joining, the yarn removal process is performed before the package 50 is rotated.

[0056] As explained above, the package 50 can be stopped while it is rotating at a lower speed if failed yarn joining can be detected early, and thereby the end of the second yarn can be restrained from getting wound onto the package 50. Hence, in this modification, the yarn removal process is performed after the joint formation but before the rotation of the package 50. Because the spun yarn 10 is loose after the joint formation, even if the yarn joining is successful, the spun yarn 10 can potentially be removed from the yarn monitoring device 25 by the yarn removal process. Therefore, tension needs to be applied on the spun yarn 10 with a tension applying device or the like.

[0057] When the yarn monitoring device 25 fails to detect the spun yarn 10 because of the yarn removal process, this is determined as failed yarn joining. In this case, because unnecessary rotation of the package 50 is not performed, the yarn joining can be performed once again and at an early timing.

[0058] As explained above, the spinning machine includes the air-jet spinning device 9, the winding section 26, the yarn joining device 23, the yarn monitoring device 25, and the unit controller 90. The air-jet spinning device 9 supplies the spun yarn 10. The winding section 26 includes the winding drum driving motor 54 that rotates the package 50, and winds the spun yarn 10 supplied by the air-jet spinning device 9 to form the package 50. The yarn joining device 23 joins the first yarn from the air-jet spinning device 9 and the second yarn from the winding section 26. The yarn monitoring device 25 detects the joint that is the portion where the yarn joining is performed by the yarn joining device 23. The unit controller 90 determines whether the joint is normal based on the detection result of the yarn monitoring device 25. The winding section 26 performs winding of the package 50 by increasing the acceleration of the rotation speed of the package 50 after the unit controller 90 determines that the joint is normal.

[0059] With this configuration, the acceleration of the package 50 is increased to accelerate the rotation speed of the package 50 to the target speed after it is determined that the joint is normal. The rotation speed of the package 50 is restrained until the determination is performed. Hence, in the event of a failed yarn joining, the yarn end is not wound onto the package 50. Consequently, for example, the yarn end of the package 50 can be reliably caught.

[0060] In the spinning machine according to the present embodiment, in the time period after the yarn joining is performed by the yarn joining device 23, the average acceleration in the time period between the time point when the rotation of the package 50 is started by the winding section 26 and the time point when it is determined whether the joint is normal by the unit controller 90 is regarded as the first acceleration and the average acceleration in the time period between the time point when the joint is determined to be normal by the unit controller 90 and the time point when the rotation speed of the package 50 reaches the target speed is regarded as the second acceleration. The winding section 26 changes the rotation speed of the package 50 such that the second acceleration is higher than the first acceleration.

[0061] With the above acceleration control, because the acceleration of the package 50 is lower until the unit controller 90 determines whether the joint is normal, the rotation speed of the package 50 after failed yarn joining can be restrained.

[0062] In the spinning machine according to the present embodiment, if the unit controller 90 determines that the joint has not been formed or the joint is abnormal, the winding section 26 stops the winding of the package 50 before the yarn end is wound onto the package 50.

[0063] With the above action, the yarn end of the package 50 can be reliably caught.

[0064] The spinning machine according to the present embodiment includes the first air blowing member 82 and the second air blowing member 83 that apply a force on the yarn in the direction in which the yarn is removed from the yarn monitoring device 25 after the yarn joining is performed by the yarn joining device 23.

[0065] On receiving the force from the first air blowing member 82 or the like, the yarn is removed from the yarn monitoring device 25 in the event of a failed yarn joining but not removed from the yarn monitoring device 25 in the event of a successful yarn joining. Hence, whether the yarn joining is successful can be determined at an early timing by performing the yarn removal process.

[0066] Exemplary embodiments of the present invention and the modifications thereof are explained above; the above configurations, however, can be modified, for example, as follows.

[0067] In the present embodiment, the first air blowing member 82 and the second air blowing member 83 equipped in the yarn monitoring device 25 are explained as the yarn removing members. The air blowing members can, however, be arranged in other part. Instead of a fluid, such as air or the like, a solid body can be caused to come into contact with the spun yarn 10, if the structure

is such that the solid body applies just enough force on the spun yarn 10 so as not to affect the yarn quality when used in the event of a successful yarn joining.

[0068] If the yarn monitoring device 25 does not detect the spun yarn 10 for a predetermined duration or longer after the yarn joining and during normal winding, the unit controller 90 determines that the spun yarn 10 is not present. This determination criterion can be changed depending on whether it is immediately after the yarn joining or it is during normal winding. The determination can be performed early by reducing the predetermined duration immediately after the yarn joining. Consequently, in the event of a failed yarn joining, the rotation speed of the package 50 can be set to a still lower value.

[0069] As an alternative configuration, separate devices can be arranged for determining whether the joint is normal and for monitoring the quality of the traveling spun yarn 10.

[0070] In the above embodiment, the first acceleration and the second acceleration are constant. Alternatively, one or both of the first acceleration and the second acceleration can be made variable. In this case also it is preferable that the average acceleration between the time point when the yarn joining is completed and the time point when the joint is determined to be normal is lower than the average acceleration between the time point when the joint is determined to be normal and the time point when the target speed is reached.

[0071] In the present embodiment, the unit controller 90 of the spinning unit 2 has been given the function to determine whether the joint is normal based on the detection result of the yarn monitoring device 25. Alternatively, this function can be given to a controller that controls the yarn monitoring device 25 or to a main control device.

[0072] In the above embodiment, the present invention is adapted to a spinning machine in which the package 50 is formed at a position that is above the spinning unit 2. The present invention can also be adapted to a spinning machine in which the package 50 is formed at a position that is below the spinning unit 2 (for example, as in Japanese Patent Application Laid-open No. 2013-67892). The present invention can also be adapted to a yarn winding machine, such as an automatic winder or the like. In this case, a structure that unwinds the yarn from a yarn supplying bobbin will correspond to the yarn supplying member.

[0073] A yarn winding machine according to an aspect of the present invention includes a yarn supplying section that supplies a yarn; a winding section that winds the yarn supplied by the yarn supplying section to form a package and includes a rotation driving unit that rotates the package; a yarn joining device that joins the yarn from the yarn supplying section and the yarn from the winding section; a detecting section that detects a joint that is a portion where yarn joining is performed by the yarn joining device; and a determining section that determines whether the joint is normal based on a detection result obtained by the detecting section, wherein the winding section performs winding of the package by increasing acceleration of a rotation speed of the package after the determining section determines that the joint is normal.

[0074] With this configuration, the acceleration of the package is increased to accelerate the rotation speed of the package to the target speed after it is determined that the joint is normal. The rotation speed of the package is restrained until the determination of the joint is completed. Hence, in the event of a failed yarn joining, the yarn end is not wound onto the package. Consequently, for example, the yarn end of the package can be reliably caught.

[0075] In the above yarn winding machine, if, in a time period after the yarn joining is performed by the yarn joining device, an average acceleration in a first time period, the first time period being a period of time between a time point when the rotation of the package is started by the winding section and a time point when it is determined whether the joint is normal by the determining section, is regarded as a first acceleration, and an average acceleration in a second time period, the second time period being a period of time between a time point when the joint is determined to be normal by the determining section and a time point when the rotation speed of the package reaches a target speed, is regarded as a second acceleration, the winding section changes the rotation speed of the package such that the second acceleration is higher than the first acceleration.

[0076] With the above acceleration control, because the acceleration of the package is low until the determining section determines whether the joint is normal, the rotation speed of the package after failed yarn joining can be restrained.

[0077] In the above yarn winding machine, the winding section stops the winding of the package when the determining section determines that the joint has not been formed or the joint is abnormal.

[0078] With this configuration, the winding operation can be stopped in the event of a failed yarn joining.

[0079] In the above yarn winding machine, the winding section stops the winding of the package before a yarn end is wound onto the package when the determining section determines that the joint has not been formed or the joint is abnormal.

[0080] With the above action, the yarn end of the package can be reliably caught.

[0081] The above yarn winding machine further includes a yarn removing section that performs a yarn removal process in which a force is applied on the yarn in a direction in which the yarn is removed from the detecting section after the yarn joining is performed by the yarn joining device.

[0082] On receiving the force from the yarn removing section, the yarn is removed from the detecting section in the event of a failed yarn joining but not removed from the detecting section in the event of a successful yarn joining. Hence, whether the yarn joining is successful can

be determined at an early timing by performing the yarn removal process.

[0083] In the above yarn winding machine, the yarn removing section is an air blowing section that blows air in a yearn path of the yarn that is wound to form the package.

[0084] With this configuration, in the event of a successful yarn joining, excessive tension can be prevented from being applied on the yarn, and in the event of a failed yarn joining, the yarn can be substantially reliably removed from the detecting section.

[0085] In the above yarn winding machine, the yarn removing section performs the yarn removal process after looseness of the yarn that occurs when the yarn is released by the yarn joining device is lost following resumption of the winding of the package by the winding section.

[0086] With this action, because the yarn removing section can be caused to perform the yarn removal process at a relatively early timing, whether the yarn joining has been successful can be determined at a relatively early timing.

[0087] In the above yarn winding machine, the yarn joining device includes a holding section that holds the yarn being joined and a yarn pulling section that pulls the yarn that is held by the holding section, and the yarn removing section performs the yarn removal process after the holding section releases the yarn and before the yarn pulling section releases the yarn.

[0088] With this action, because the yarn removing section can be caused to perform the yarn removal process at a very early timing, whether the yarn joining has been successful can be determined at a very early timing.

[0089] The above yarn winding machine further includes a restraining section that restrains movement of the yarn that has been subjected to the yarn removal process by the yarn removing section; and a catching and guiding device that catches the yarn from the package restrained by the restraining section and guides the yarn to the yarn joining device.

[0090] With this action, when the yarn joining is performed again following a failed yarn joining, the catching and guiding device can catch the yarn more reliably.

[0091] The above yarn winding machine further includes a yarn pooling device that pools the yarn at a position between the yarn supplying section and the winding section.

[0092] Even if the yarn winding machine includes the yarn pooling device, because whether the yarn joining has been successful can be determined at an early timing, a pooled amount of the yarn in the yarn pooling device in the time period in which the determining section performs the determination can be reduced. Hence, in the event of a failed yarn joining, an amount of the yarn that is discarded and the time required for discarding the waste yarn can be reduced.

[0093] The above yarn winding machine further includes a controller that controls at least the winding section, the yarn joining device, and the detecting section.

[0094] With this configuration, smooth control can be performed because several sections can be controlled with a single controller.

[0095] A yarn winding method according to another aspect of the present invention includes joining a yarn from a yarn supplying section that supplies the yarn and a yarn from a winding section that winds the yarn supplied by the yarn supplying section to form a package; detecting a joint that is a portion where yarn joining is performed at the joining; determining whether the joint is normal based on a detection result obtained at the detecting; and winding the package by increasing acceleration of a rotation speed of the package after the joint is determined to be normal at the determining.

[0096] With this configuration, the acceleration of the package is increased to accelerate the rotation speed of the package to the target speed after it is determined that the joint is normal. The rotation speed of the package is restrained until the determination of the joint is performed. Hence, in the event of a failed yarn joining, the yarn end is not wound onto the package. Consequently, for example, the yarn end of the package can be reliably caught.

Claims

1. A yarn winding machine comprising:

a yarn supplying section (9) adapted to supply a yarn (10);
a winding section (26) adapted to wind the yarn (10) supplied by the yarn supplying section (9) to form a package (50) and includes a rotation driving unit (54) adapted to rotate the package (50);
a yarn joining device (23) adapted to join the yarn (10) from the yarn supplying section (9) and the yarn (10) from the winding section (26);
a detecting section (25) adapted to detect a joint that is a portion where yarn joining is performed by the yarn joining device (23); and
a determining section (90) adapted to determine whether the joint is normal based on a detection result obtained by the detecting section (25),
wherein the winding section (26) is adapted to perform winding of the package (50) by increasing acceleration of a rotation speed of the package (50) after the determining section (90) determines that the joint is normal.

2. The yarn winding machine as claimed in Claim 1, wherein
if, in a time period after the yarn joining is performed by the yarn joining device (23), an average acceleration in a first time period, the first time period being a period of time between a time point when the ro-

tation of the package (50) is started by the winding section (26) and a time point when it is determined whether the joint is normal by the determining section (90), is regarded as a first acceleration, and an average acceleration in a second time period, the second time period being a period of time between a time point when the joint is determined to be normal by the determining section (90) and a time point when the rotation speed of the package (50) reaches a target speed, is regarded as a second acceleration, the winding section (26) changes the rotation speed of the package (50) such that the second acceleration is higher than the first acceleration.

3. The yarn winding machine as claimed in Claim 1 or 2, wherein the winding section (26) is adapted to stop the winding of the package (50) when the determining section (90) determines that the joint has not been formed or the joint is abnormal.

4. The yarn winding machine as claimed in Claim 3, wherein the winding section (26) is adapted to stop the winding of the package (50) before a yarn end is wound onto the package (50) when the determining section (90) determines that the joint has not been formed or the joint is abnormal.

5. The yarn winding machine as claimed in any one of Claims 1 to 4, further comprising a yarn removing section (82;83) adapted to perform a yarn removal process in which a force is applied on the yarn (10) in a direction in which the yarn (10) is removed from the detecting section (25) after the yarn joining is performed by the yarn joining device (23).

6. The yarn winding machine as claimed in Claim 5, wherein the yarn removing section (82; 83) is an air blowing section adapted to blow air in a yarn path of the yarn (10) that is wound to form the package (50).

7. The yarn winding machine as claimed in Claim 5 or 6, wherein the yarn removing section (82; 83) is adapted to perform the yarn removal process after looseness of the yarn (10) that occurs when the yarn (10) is released by the yarn joining device (23) is lost following resumption of the winding of the package (50) by the winding section (26).

8. The yarn winding machine as claimed in Claim 5 or 6, wherein
the yarn joining device (23) includes a holding section (73) adapted to hold the yarn (10) being joined and a yarn pulling section (72) adapted to pull the yarn (10) that is held by the holding section (73), and the yarn removing section (82; 83) is adapted to perform the yarn removal process after the holding section (73) releases the yarn (10) and before the yarn pulling section (72) releases the yarn (10).

9. The yarn winding machine as claimed in any one of Claims 5 to 8, further comprising:

a restraining section (64) adapted to restrain movement of the yarn (10) that has been subjected to the yarn removal process by the yarn removing section (82; 83); and
a catching and guiding device (28) adapted to catch the yarn (10) from the package (50) restrained by the restraining section (64) and to guide the yarn (10) to the yarn joining device (23).

10. The yarn winding machine as claimed in any one of Claims 1 to 9, further comprising a yarn pooling device (22) adapted to pool the yarn (10) at a position between the yarn supplying section (9) and the winding section (26).

11. The yarn winding machine as claimed in any one of Claims 1 to 10, further comprising a controller (90) adapted to control at least the winding section (26), the yarn joining device (23), and the detecting section (25).

12. A yarn winding method comprising:

joining a yarn (10) from a yarn supplying section (9) adapted to supply the yarn (10) and a yarn (10) from a winding section (26) adapted to wind the yarn (10) supplied by the yarn supplying section (9) to form a package (50);
detecting a joint that is a portion where yarn joining is performed at the joining;
determining whether the joint is normal based on a detection result obtained at the detecting; and
winding the package (50) by increasing acceleration of a rotation speed of the package (50) after the joint is determined to be normal at the determining.

FIG.1

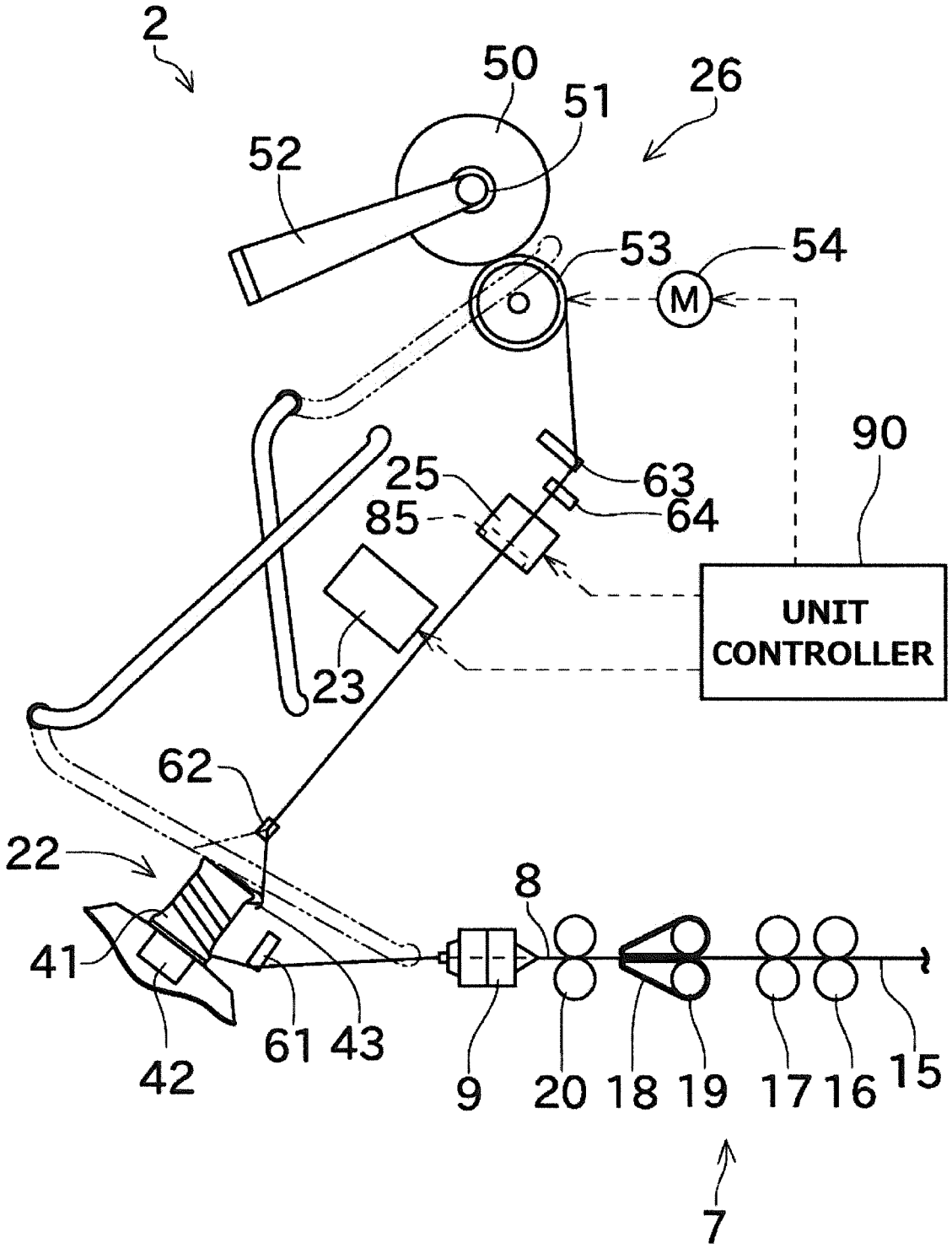

2
50
51
26
52
53
54
M
90
25
63
64
85
UNIT CONTROLLER
23
62
22
8
41
42
61
43
9
20
18
19
17
16
15
7

FIG.2

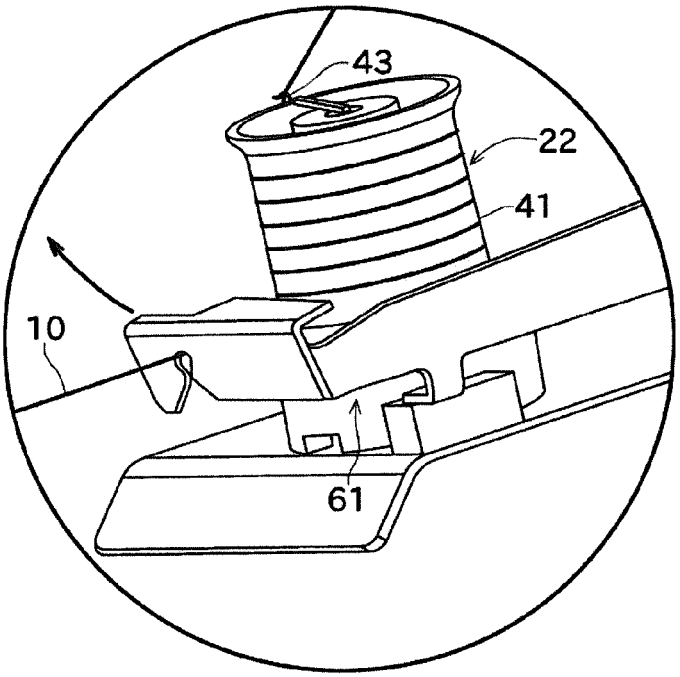


FIG.3

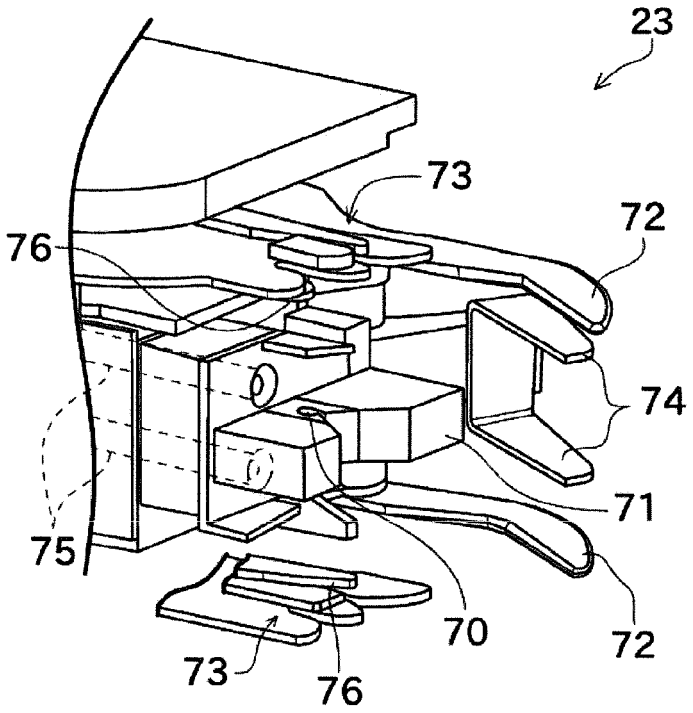


FIG.4

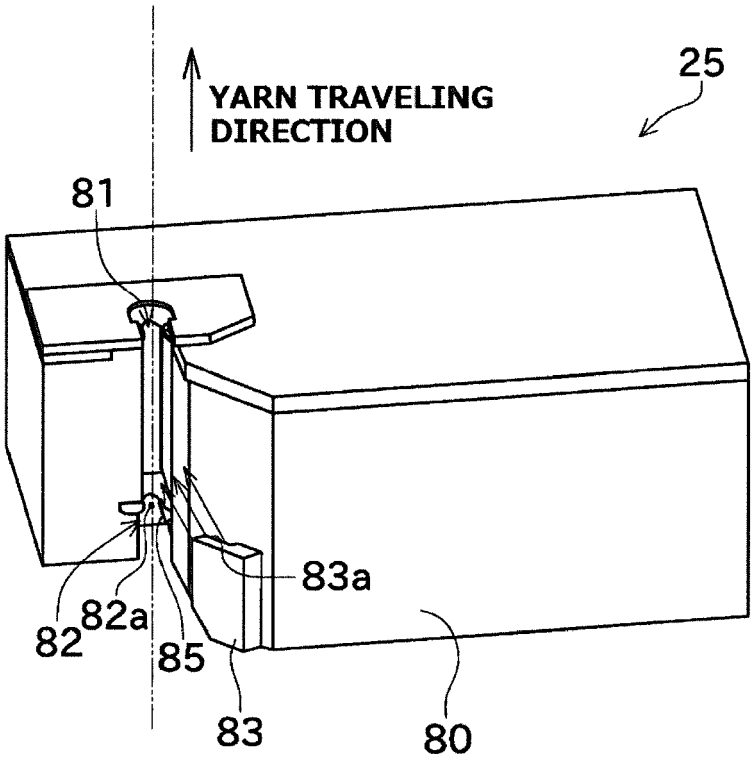


FIG.5

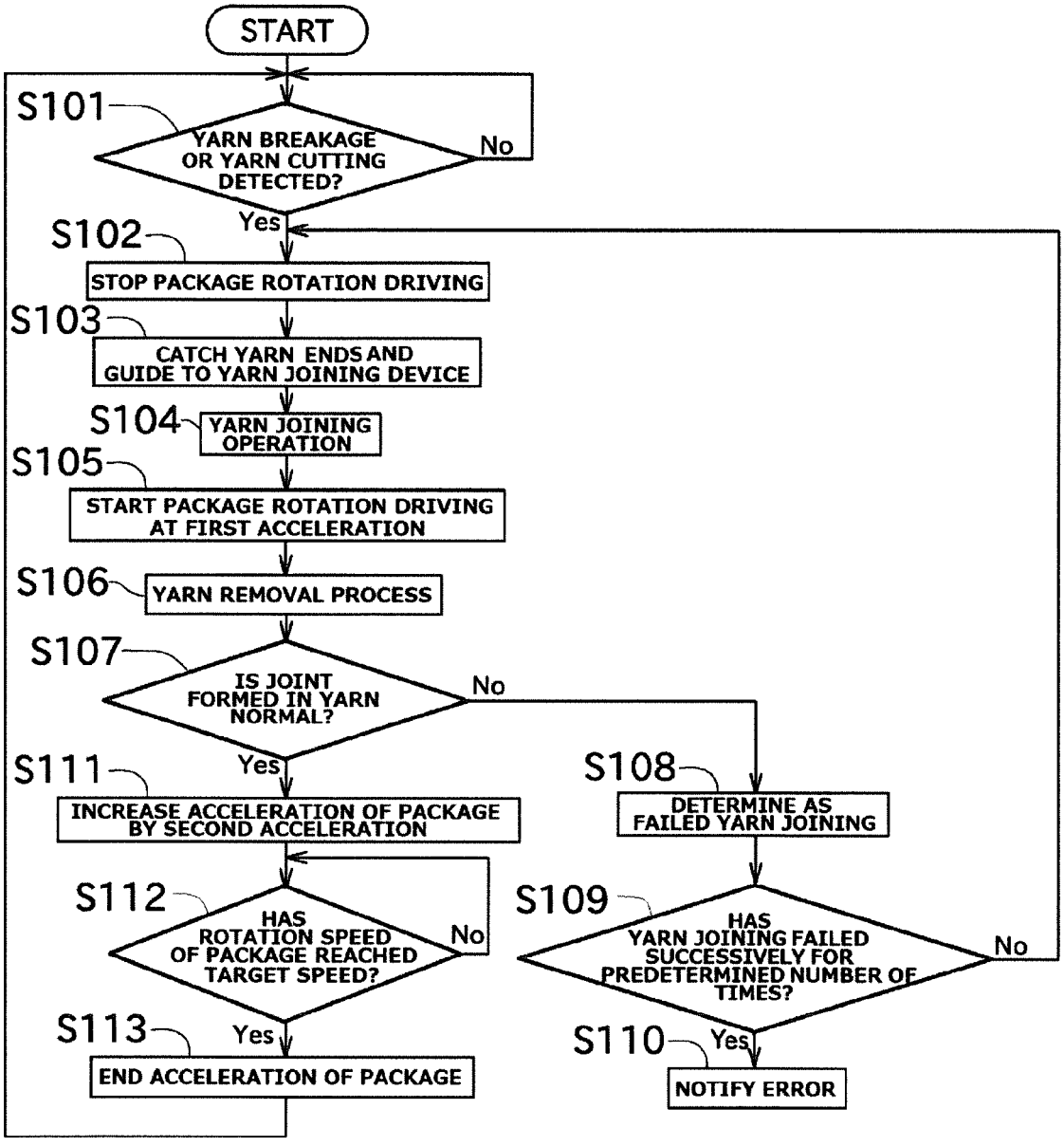

START
S101
YARN BREAKAGE OR YARN CUTTING DETECTED?
No
Yes
S102
STOP PACKAGE ROTATION DRIVING
S103
CATCH YARN ENDS AND GUIDE TO YARN JOINING DEVICE
S104
YARN JOINING OPERATION
S105
START PACKAGE ROTATION DRIVING AT FIRST ACCELERATION
S106
YARN REMOVAL PROCESS
S107
IS JOINT FORMED IN YARN NORMAL?
No
Yes
S111
INCREASE ACCELERATION OF PACKAGE BY SECOND ACCELERATION
S112
HAS ROTATION SPEED OF PACKAGE REACHED TARGET SPEED?
No
Yes
S113
END ACCELERATION OF PACKAGE
S108
DETERMINE AS FAILED YARN JOINING
S109
HAS YARN JOINING FAILED SUCCESSIVELY FOR PREDETERMINED NUMBER OF TIMES?
No
Yes
S110
NOTIFY ERROR

FIG.6A

PRESENT EMBODIMENT

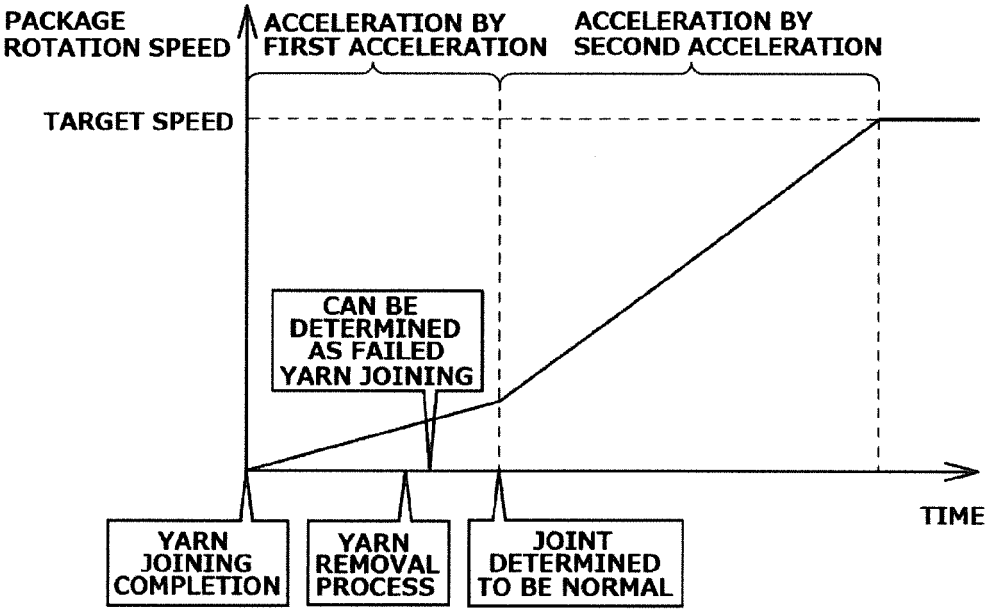


FIG.6B

CONVENTIONAL TECHNOLOGY

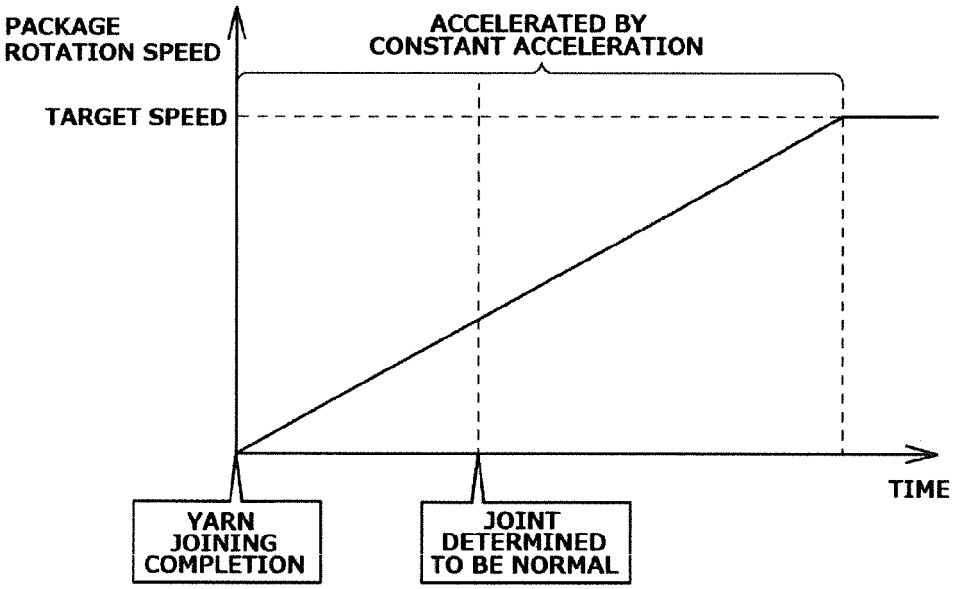


FIG.7

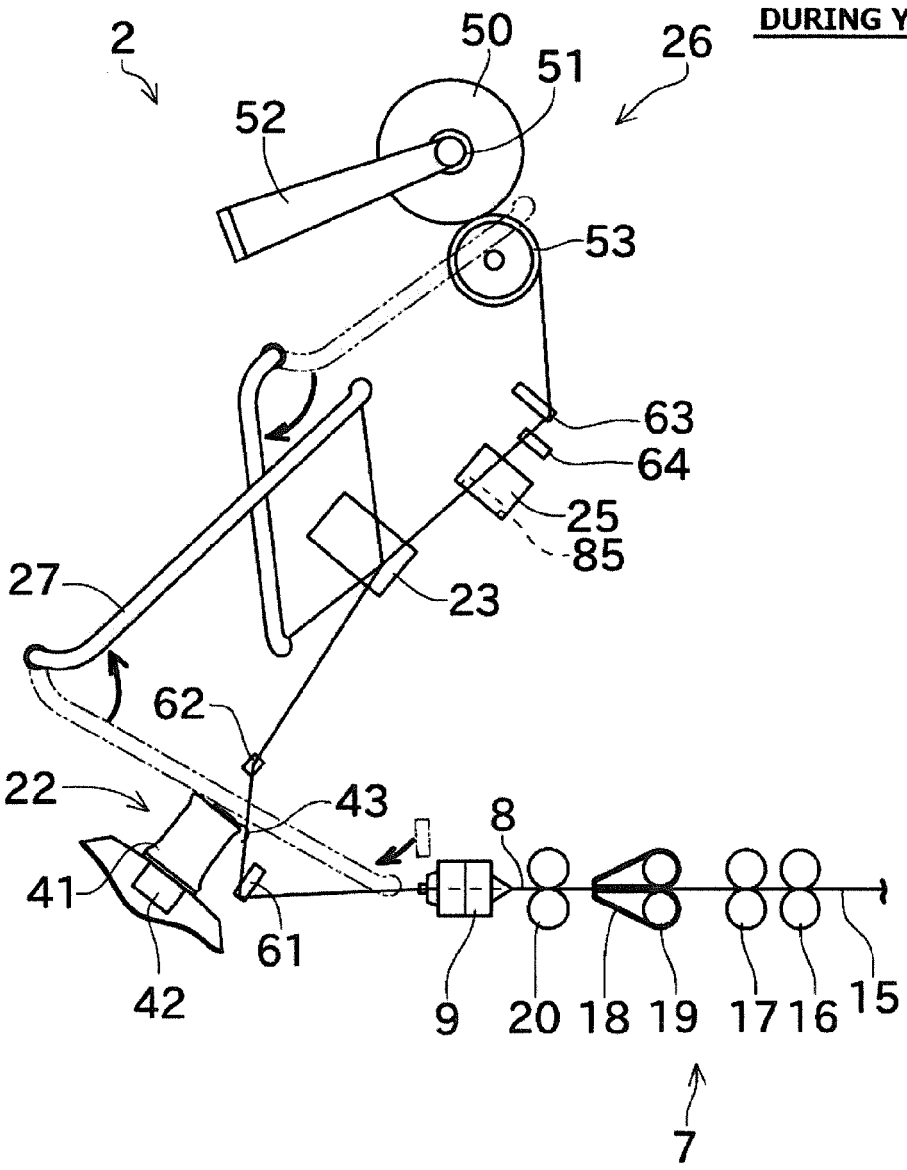

DURING YARN JOINING
2
50
51
26
52
53
63
64
25
85
27
23
62
22
43
8
41
61
42
9
20
18
19
17
16
15
7

FIG.8

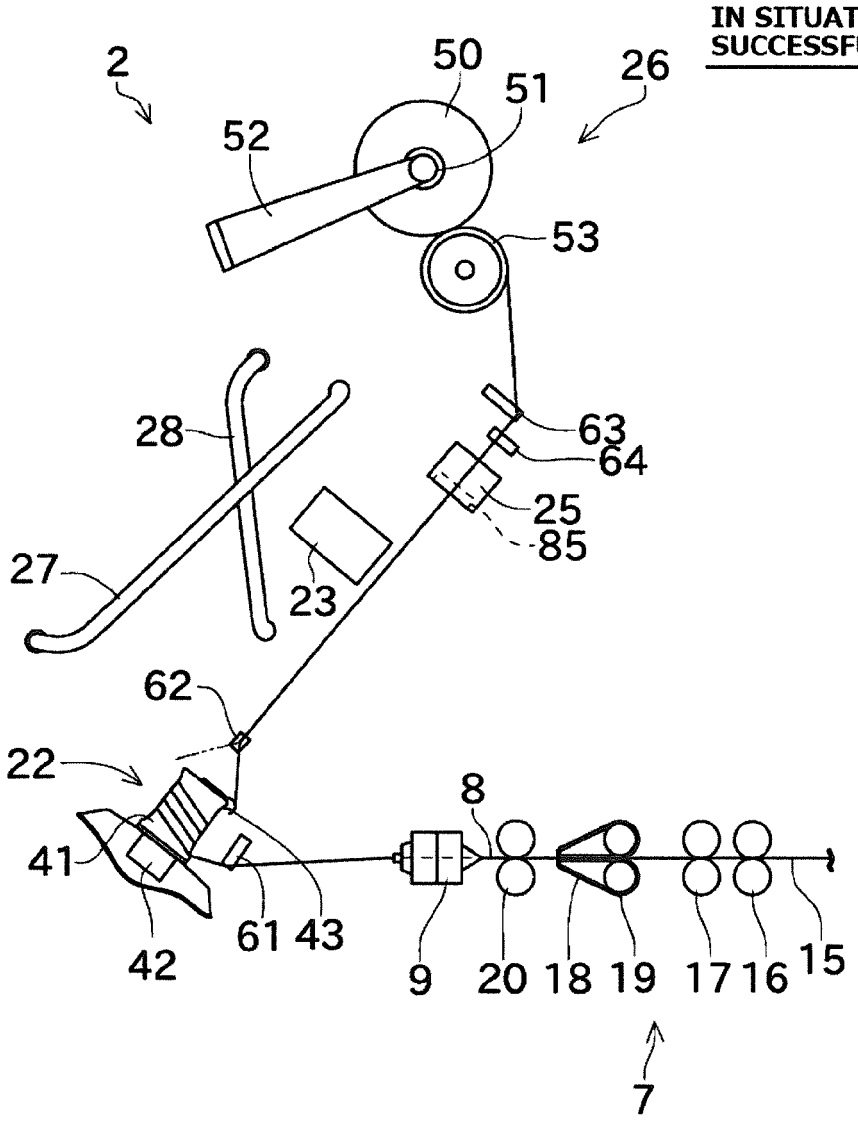

IN SITUATION OF SUCCESSFUL YARN JOINING
2
50
51
26
52
53
28
63
64
25
85
27
23
62
22
8
41
42
61
43
9
20
18
19
17
16
15
7

FIG.9

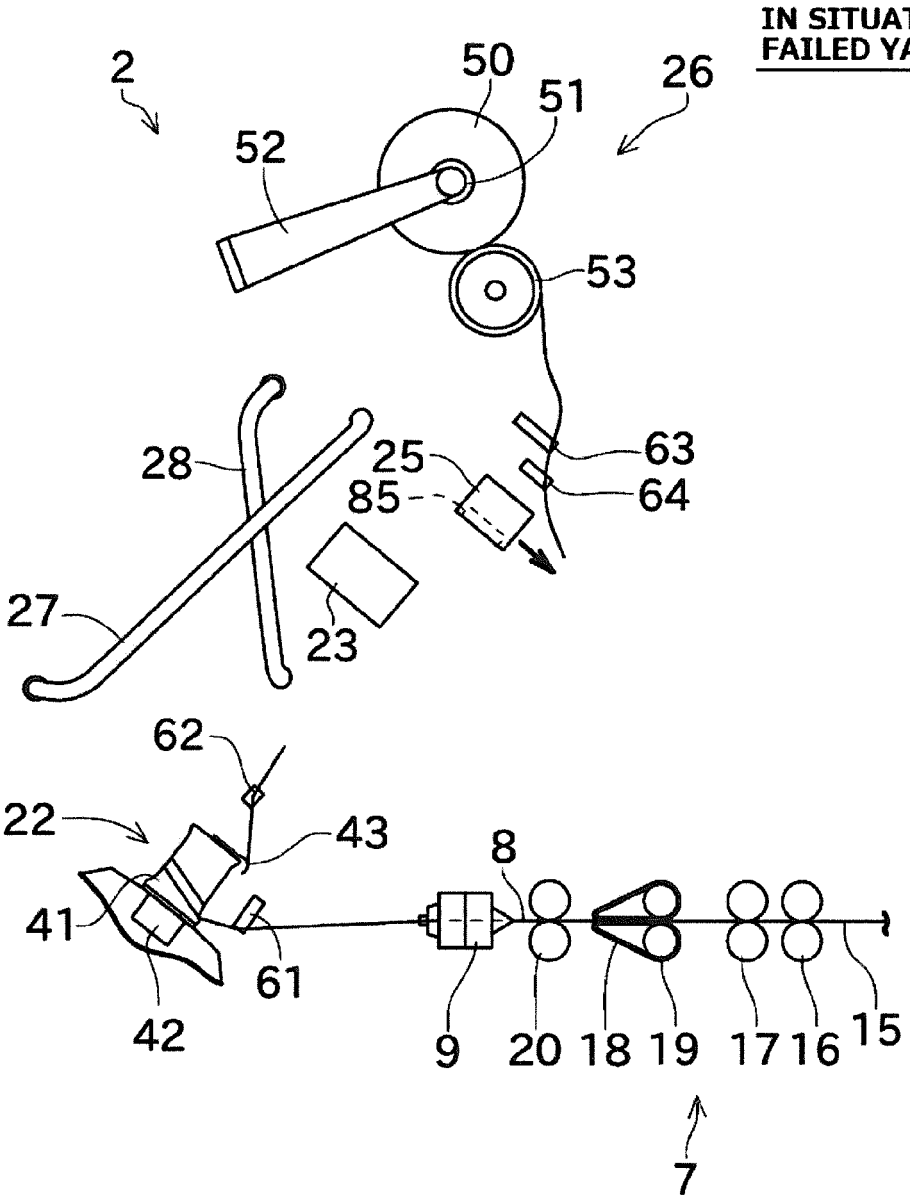

IN SITUATION OF FAILED YARN JOINING
2
50
51
26
52
53
28
25
63
85
64
27
23
62
22
43
8
41
61
42
9
20
18
19
17
16
15
7

FIG.10

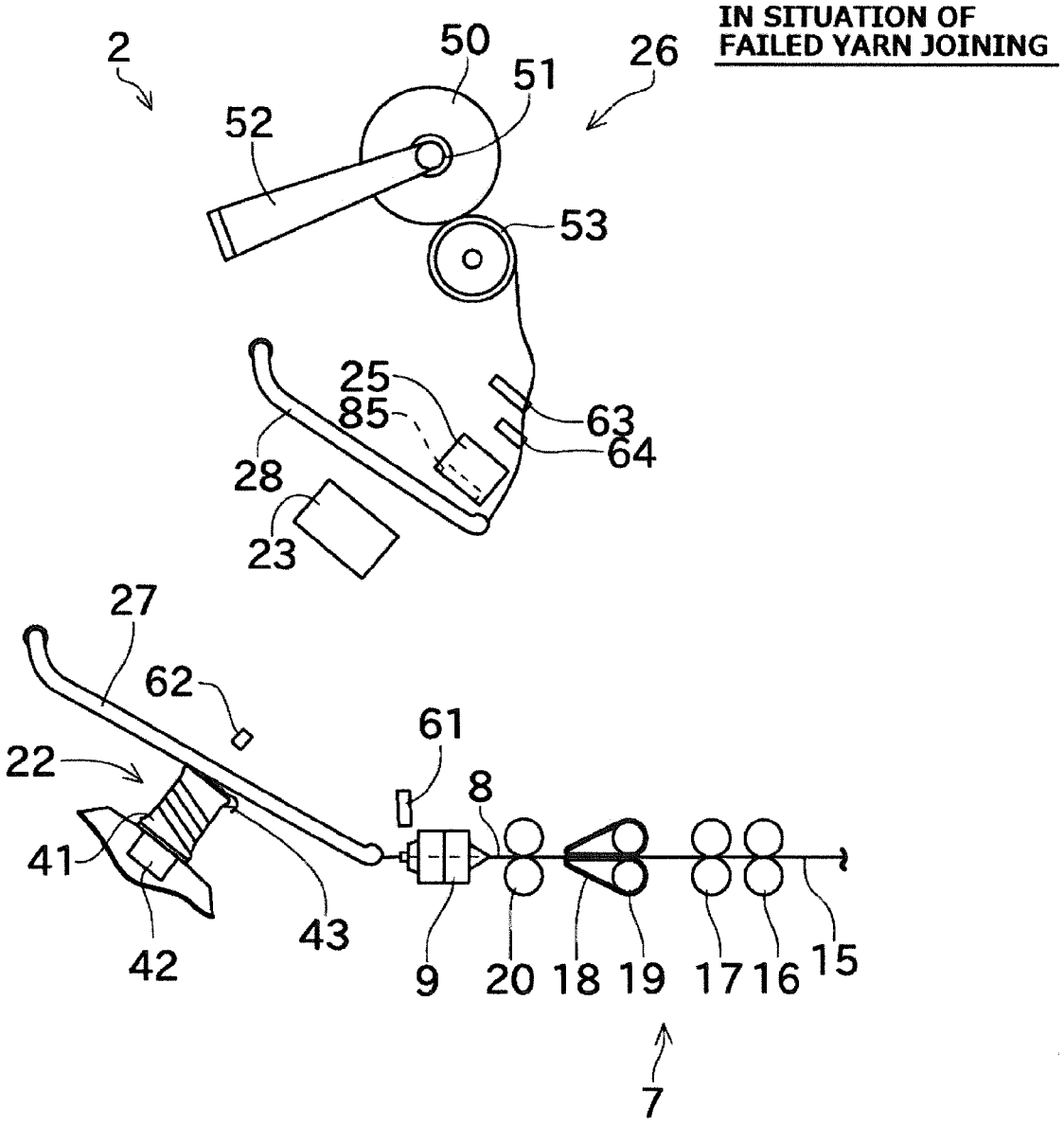
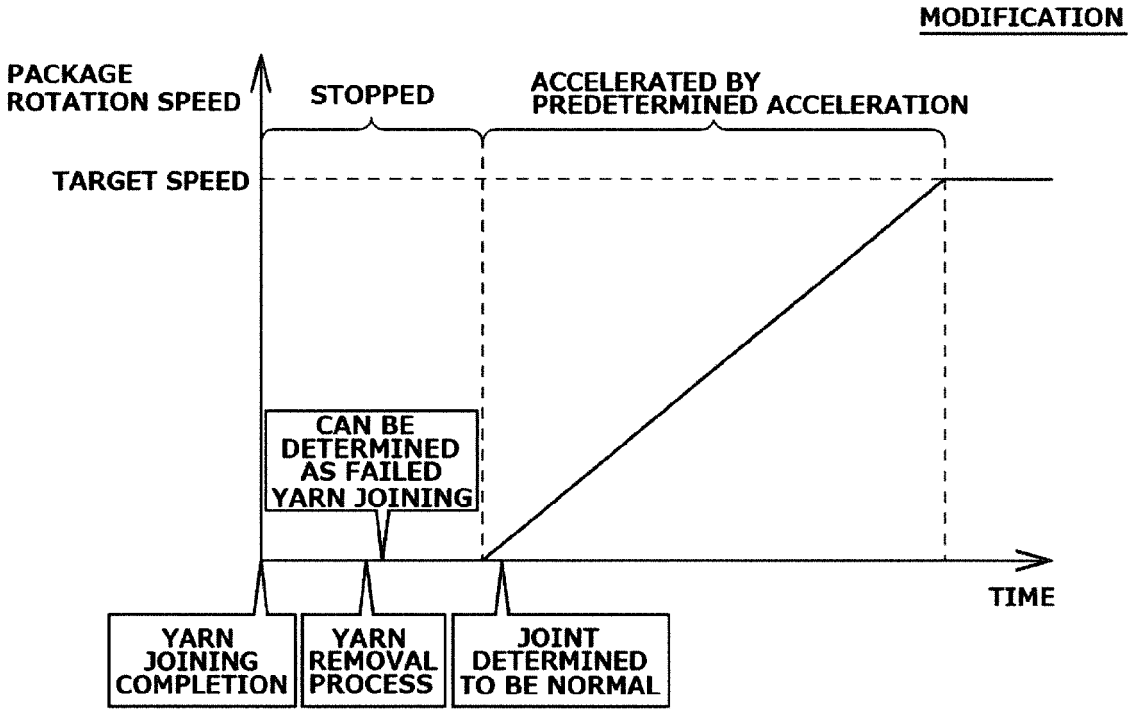

IN SITUATION OF FAILED YARN JOINING
2
50
51
26
52
53
25
85
63
64
28
23
27
62
61
22
8
41
43
42
9
20
18
19
17
16
15
7

FIG.11


MODIFICATION
PACKAGE ROTATION SPEED
STOPPED
ACCELERATED BY PREDETERMINED ACCELERATION
TARGET SPEED
CAN BE DETERMINED AS FAILED YARN JOINING
TIME
YARN JOINING COMPLETION
YARN REMOVAL PROCESS
JOINT DETERMINED TO BE NORMAL

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 16 7294

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 2 361 867 A2 (MURATA MACHINERY LTD [JP]) 31 August 2011 (2011-08-31) * paragraph [0064] *	1,3-12 2	INV. B65H63/00 B65H63/06 B65H67/08
X	DE 39 37 824 A1 (SCHLAFHORST & CO W [DE]) 16 May 1991 (1991-05-16) * column 4, lines 64-68 *	1,3,11, 12	B65H69/06
X	GB 2 100 310 A (MESDAN SPA) 22 December 1982 (1982-12-22) * page 3, lines 79-96 *	1,12	
X	DE 41 24 036 A1 (MURATA MACHINERY LTD [JP]) 23 January 1992 (1992-01-23) * column 4, lines 15-39 *	1,12	
A	WO 2007/000203 A1 (SAURER GMBH & CO KG [DE]; WASSENHOVEN HEINZ-GEORG [DE]) 4 January 2007 (2007-01-04) * claims 1,6 *	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 November 2015	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 16 7294

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-11-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2361867 A2	31-08-2011	CN 102161451 A	24-08-2011
		EP 2361867 A2	31-08-2011
		JP 2011173674 A	08-09-2011
DE 3937824 A1	16-05-1991	NONE	
GB 2100310 A	22-12-1982	DE 3222796 A1	10-02-1983
		GB 2100310 A	22-12-1982
		IT 1194072 B	14-09-1988
		JP S582164 A	07-01-1983
		SU 1255047 A3	30-08-1986
		US 4437299 A	20-03-1984
DE 4124036 A1	23-01-1992	DE 4124036 A1	23-01-1992
		IT 1249683 B	09-03-1995
		JP H0482928 A	16-03-1992
		JP H0545698 B2	09-07-1993
WO 2007000203 A1	04-01-2007	CN 101203753 A	18-06-2008
		DE 102005029937 A1	11-01-2007
		WO 2007000203 A1	04-01-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 2013067892 A **[0002] [0072]**
- JP 2013230908 A **[0002]**
- JP H2215662 B **[0002]**