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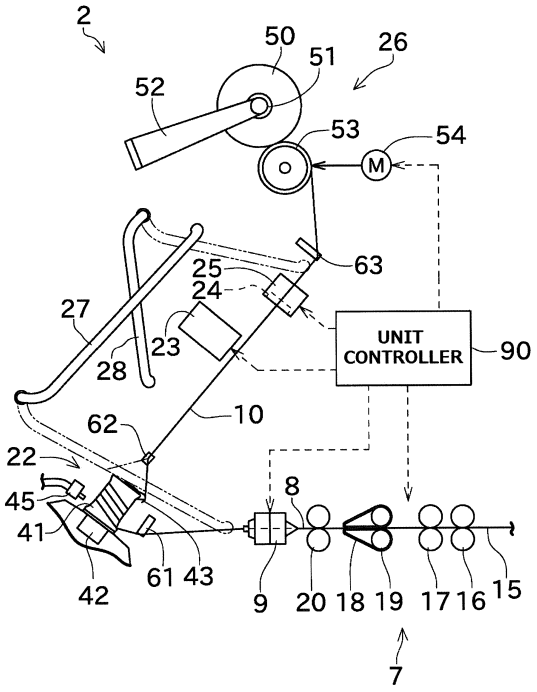
(54) YARN WINDING MACHINE AND YARN WINDING METHOD

(57) A spinning machine includes an air-jet spinning device (9), a yarn pooling device (22) and a winding section (26). The air-jet spinning device (9) supplies a spun yarn (10). The yarn pooling device (22) pools the spun yarn (10) supplied by the air-jet spinning device (9). The winding section (26) winds the spun yarn (10) from the yarn pooling device (22) to form a package (50). The winding section (26) includes a winding drum driving motor (54) that rotates the package (50). The winding section causes the winding drum driving motor to stop the rotation of the package (50) before the yarn is disconnected or after the yarn is disconnected but before a yarn end is wound onto the package (50).

FIG.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention principally relates to processes performed by a yarn winding machine when suspending winding of a yarn.

2. Description of the Related Art

[0002] Yarn winding machines equipped with a yarn monitoring device, a yarn cutting device, and a yarn joining device are known in the art. The yarn monitoring device is an optical sensor or the like, and monitors a state of a traveling yarn. The yarn cutting device cuts the yarn when the yarn monitoring device detects a yarn defect. The yarn joining device performs yarn joining to join the yarn from a yarn supplying section and the yarn from a winding section after the yarn cutting device cuts the yarn.

[0003] Japanese Patent Application Laid-open No. 2010-180007 (Patent Document 1) discloses such a yarn winding machine. The yarn winding machine (spinning machine) disclosed in Patent Document 1 suspends a spinning process when the yarn monitoring device (yarn clearer) detects a yarn defect. The suspension of the spinning process includes stopping the operations of a drafting device, an air-jet spinning device, and a winding section.

[0004] In Patent Document 1, the yarn is disconnected by suspension of the spinning process, and a yarn end downstream of the disconnected point (point where the yarn is disconnected) is wound onto a package.

[0005] In the yarn winding machine disclosed in Patent Document 1, the catching and guiding device at times fails to catch the yarn end from the package. When this happens, it is necessary to once again perform the processes required for yarn joining. Consequently, productivity decreases.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a yarn winding machine and a yarn winding method in which a yarn end is prevented from being wound onto a package when suspending winding of a yarn.

[0007] According to an aspect of the present invention, a yarn winding machine includes a yarn supplying section, a yarn pooling device, and a winding section. The yarn supplying section supplies a yarn. The yarn pooling device pools the yarn supplied by the yarn supplying section. The winding section winds the yarn from the yarn pooling device to form a package. The winding section includes a rotation driving unit that rotates the package. The winding section causes the rotation driving unit to stop the rotation of the package before the yarn is disconnected or after the yarn is disconnected but before a yarn end is wound onto the package.

[0008] According to another aspect of the present invention, a yarn winding method includes a winding step and a stopping step. At the winding step, the yarn is wound onto the package while the yarn is pooled in the yarn pooling device. At the stopping step, the rotation of the package is stopped before the yarn is disconnected or after the yarn is disconnected but before the yarn end is wound onto the package.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a side view of a spinning unit arranged in 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 flowchart of a process procedure performed by the spinning unit upon detection of a yarn defect in the first embodiment.

FIG. 4 is a side view of the spinning unit immediately before the detection of the yarn defect.

FIG. 5 is a side view of the spinning unit immediately after a spun yarn is cut on both sides of the yarn pooling device.

FIG. 6 is a side view of the spinning unit when ends of a first yarn and a second yarn are caught.

FIG. 7 is a side view of the spinning unit when yarn joining is performed to join the first yarn and the second yarn.

FIG. 8 is a flowchart of a process procedure performed by the spinning unit upon detection of the yarn defect in a second embodiment of the present invention.

FIG. 9 is a side view of the spinning unit when the ends of the second yarn and a residual yarn are caught.

FIG. 10 is a side view of the spinning unit when yarn joining is performed to join the second yarn and the residual yarn.

FIG. 11 is a side view of the spinning unit when the ends of the first yarn and the second yarn are caught.

FIG. 12 is a side view of the spinning unit when yarn joining is performed to join the first yarn and the second yarn.

FIG. 13 is a flowchart of a process procedure performed by the spinning unit upon detection of the yarn defect in a third embodiment of the present invention.

FIG. 14 is a side view of the spinning unit immediately after the spun yarn is cut upstream of the yarn pooling device.

FIG. 15 is a side view of the spinning unit when the ends of the first yarn and the second yarn are caught.

DETAILED DESCRIPTION

[0010] 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.

[0011] 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.

[0012] 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 25, and the winding section 26. All the parts of the spinning unit 2 are controlled by a unit controller (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 (controller).

[0013] 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 plural opposing rollers arranged respectively facing the draft rollers.

[0014] 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 the fiber bundle 8 by stretching (drafting) the sliver 15 until a predetermined fiber amount (or thickness) is obtained.

[0015] 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.

[0016] 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.

[0017] 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, a yarn hooking member 43, and a residual yarn sucking device 45. The spun yarn 10 is temporarily pooled by being wound around the outer circumferential surface of the yarn pooling roller 41.

[0018] 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.

[0019] 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.

[0020] The residual yarn sucking device 45 is arranged in an upstream end area of the yarn pooling roller 41. The residual yarn sucking device 45 is connected to a not shown blower and can generate a suction airflow. The spun yarn 10 remaining on the yarn pooling roller 41 after cutting or the like of the spun yarn 10 can be removed by causing the yarn pooling roller 41 to rotate in the reverse direction while causing the residual yarn sucking device 45 to generate the suction airflow.

[0021] 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.

[0022] 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 yarn 10 to the yarn joining device 23.

[0023] 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. 6). 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.

[0024] 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. 6). 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.

[0025] 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.

[0026] 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 not shown optical transmission type sensor. Upon detecting a yarn defect (a portion of the spun yarn 10 where the thickness or the like is abnormal) in the spun yarn 10, the yearn monitoring device 25 transmits a yarn defect detection signal to the unit controller 90. On receiving the yarn defect detection signal, the unit controller 90 drives a cutter (first yarn cutting device) 24 equipped in 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 an optical transmission type sensor, and can, for example, be a capacitance type sensor. A foreign matter included in the spun yarn 10 can be monitored as the yarn defect. The cutter 24 can be arranged between the yarn pooling device 22 and the winding section 26. Moreover, the cutter 24 can even be arranged as a separate unit from the yarn monitoring device 25.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] A process procedure performed by the spinning unit 2 when a yarn defect is detected by the yarn monitoring device 25 is explained below with reference to FIGS. 3 to 7. The process procedure shown in the flowchart of FIG. 3 is merely an example; the sequence of the processes can be changed, and two processes can be performed simultaneously.

[0031] FIG. 4 shows a situation where the spun yarn 10 is being wound. In FIG. 4, a defect of the spun yarn 10 is schematically denoted with the reference numeral 11. When the yarn defect 11 is detected by the yarn monitoring device 25 (Step S101), the rotation of the package 50 is stopped using a package brake or the like (Step S102). After stopping the rotation of the package 50, the spinning unit 2 stops the drafting of the fiber bundle 8 by stopping the drafting device 7 and stops the spinning by stopping the air-jet spinning device 9 (Step S103). In this manner, in the present embodiment, the drafting device 7 and the like are stopped after stopping the rotation of the package 50. That is, the rotation of the package 50 is stopped while the spun yarn 10 is continuous from the yarn pooling device 22 to the winding section 26. The yarn defect 11 is wound onto the package 50 because of the time lag between the detection of the yarn defect 11 by the yarn monitoring device 25 and stopping of the rotation of the package 50.

[0032] The spun yarn 10 downstream of the air-jet spinning device 9 is cut due to stopping of the spinning by the air-jet spinning device 9 (see FIG. 5). The spinning unit 2 uses the cutter 24 to cut the spun yarn 10 between the yarn pooling device 22 and the winding section 26 (Step S104). In the following explanation, the spun yarn 10 from the winding section 26 shall be referred to as a

second yarn 10b and the spun yarn 10 formed by cutting at two ends thereof shall be referred to as a residual yarn 10c. The spun yarn 10 that is freshly spun by the air-jet spinning device 9 shall be referred to as a first yarn 10a.

[0033] The spinning unit 2 then performs a process of removing the residual yarn 10c (Step S105). Specifically, after the spun yarn 10 is cut between the air-jet spinning device 9 and the yarn pooling device 22, the upstream yarn end of the residual yarn 10c is wound on the yarn pooling roller 41 by continuing the rotation of the yarn pooling roller 41. The spinning unit 2 then causes the yarn pooling roller 41 to rotate in the reverse direction while causing the residual yarn sucking device 45 to suck the upstream yarn end of the residual yarn 10c. By this action, the residual yarn 10c wound on the yarn pooling roller 41 is gradually unwound and sucked by the residual yarn sucking device 45, and is thereby removed from the yarn pooling roller 41. Some other method can be adopted for removing the residual yarn 10c; for example, the residual yarn 10c can be removed by rotating the yarn pooling roller 41 in the winding direction with the residual yarn 10c removed from the yarn hooking member 43.

[0034] An operation of catching and guiding the cut yarn end to the yarn joining device 23 is performed next. Specifically, as shown in FIG. 6, the second catching and guiding device 28 pivots upward to suck and catch the second yarn 10b (Step S106). In the present embodiment, because the spun yarn 10 is cut after stopping the rotation of the package 50, the yarn end is not wound onto the package 50. Hence, as shown in FIG. 6, the second catching and guiding device 28 catches the yarn end at a more upstream location than the package 50. The catching position of the second yarn 10b by the second catching and guiding device 28 can be set as desired. For example, the second catching and guiding device 28 can catch the second yarn 10b at any position upstream of or downstream of the position shown in FIG. 6.

[0035] Failure of catching the yarn end can be prevented by having the second catching and guiding device 28 catch the yarn end that is not wound onto the package 50. After sucking and catching the second yarn 10b, the second catching and guiding device 28 pivots downward, as shown in FIG. 7. By this action, the second yarn 10b is guided to a position where yarn joining can be performed by the yarn joining device 23 (Step S106). At this time, the package 50 is rotated in the reverse direction (in the direction opposite to the winding direction) (Step S106). After the package 50 is rotated in the reverse direction at least till the yarn defect 11 can be removed, the spinning unit 2 stops the rotation of the package 50 (Step S107). The amount of the reverse rotation of the package 50 can be a fixed amount. Alternatively, the amount of rotation of the package 50 between a time period from a time point when the yarn defect is detected to a time point when the package 50 stops rotating can be detected and this amount can be set as the amount of the reverse rotation of the package 50.

[0036] The first catching and guiding device 27 moves to a position where it can catch the first yarn 10a by pivoting downward, as shown in FIG. 6 (Step S108). The drafting of the fiber bundle 8 by the drafting device 7 and the spinning by the air-jet spinning device 9 are resumed, and the first catching and guiding device 27 sucks and catches the first yarn 10a (Step S108). With the first yarn 10a sucked and held, the first catching and guiding device 27 pivots upward, as shown in FIG. 7. By this action, the first yarn 10a is guided to a position where the yarn joining can be performed by the yarn joining device 23 (Step S108). The first guide 61 then moves so as to approach the yarn pooling device 22. By this action, the spun yarn 10 comes into contact with the yarn hooking member 43 of the yarn pooling device 22.

[0037] Thereafter, the yarn joining device 23 joins the first yarn 10a and the second yarn 10b (Step S109). After completion of the yarn joining, the winding section 26 resumes winding of the spun yarn 10 by rotating the package 50 (Step S110). With the above steps, the yarn end can be prevented from winding onto the package 50 with a simple control.

[0038] A second embodiment of the present invention is explained below with reference to FIGS. 8 to 12. The spinning machine according to the second embodiment includes the devices similar to the spinning machine according to the first embodiment. However, unlike the first embodiment in which the residual yarn 10c is removed, in the second embodiment, the residual yarn 10c is joined to the second yarn 10b and thereby also wound onto the package 50. The process procedure is explained in detail below. The processes at Steps S201 to S204 and Steps S205 and S206 are the same as the processes at Steps S101 to S104 and Steps S106 and S107, respectively, and therefore the description thereof is omitted.

[0039] After the second catching and guiding device 28 has caught and guided the second yarn 10b, the first catching and guiding device 27 pivots downward and sucks and catches the residual yarn 10c, as shown in FIG. 9 (Step S207). The position where the first catching and guiding device 27 catches the residual yarn 10c is not particularly limited and can be appropriately changed. A not shown guide member can be arranged and the residual yarn 10c can be caught near the guide member. With the residual yarn 10c sucked and held, the first catching and guiding device 27 pivots upward, as shown in FIG. 10. By this action, the residual yarn 10c is guided to a position where yarn joining can be performed by the yarn joining device 23 (Step S207). The yarn joining device 23 then joins the second yarn 10b and the residual yarn 10c (Step S208). The second yarn 10b with which the residual yarn 10c is joined shall be referred to as a second yarn 10b'.

[0040] After completion of the yarn joining, the winding section 26 rotates the package 50 and stops the rotation of the package 50 at a timing when the end of the second yarn 10b' reaches a predetermined position (Step S209). The predetermined position is not particularly limited and can be any position where the second catching and guid-

ing device 28 can easily catch the yarn end. By this action, the end of the second yarn 10b' is prevented from being wound onto the package 50. As shown in FIG. 11, the second catching and guiding device 28 pivots upward, and sucks and catches the end of the second yarn 10b' present at the predetermined position (Step S210). With the end of the second yarn 10b' sucked and held, the second catching and guiding device 28 pivots downward as shown in FIG. 12, and guides the second yarn 10b' to the yarn joining device 23 (Step S210).

[0041] In the same manner as at Step S108, the first catching and guiding device 27 catches and guides the first yarn 10a formed by the air-jet spinning device 9 to the yarn joining device 23 (Step S211, see FIGS. 10 and 11). Thereafter, the yarn joining device 23 joins the first yarn 10a and the second yarn 10b' (Step S212). After completion of the yarn joining, the winding section 26 resumes winding of the spun yarn 10 by rotating the package 50 (Step S213).

[0042] With the above process procedure, in the second embodiment, an amount of the spun yarn 10 that is discarded can be reduced as compared to the first embodiment. In the first embodiment, it is preferable to reduce an amount of the spun yarn 10 pooled in the yarn pooling device 22 because when a yarn defect is detected, the spun yarn 10 pooled in the yarn pooling device 22 is discarded. In the second embodiment, however, even if a yarn defect is detected, the spun yarn 10 pooled in the yarn pooling device 22 is not discarded; hence, the control to reduce the amount of the spun yarn 10 pooled in the yarn pooling device 22 need not be performed as strictly as in the first embodiment. In the second embodiment, the yarn pooling roller 41 need not be rotated in the reverse direction; hence, occurrence of malfunction (tangling or the like of the spun yarn 10) due to reverse rotation and a load on the electric motor 42 can be reduced.

[0043] In the first and second embodiments, the yarn monitoring device 25 is arranged not upstream of but downstream of the yarn pooling device 22. With this configuration, the quality of the spun yearn 10 can be monitored at a position near the package 50. Hence, yarn waste or the like that adhere to the spun yarn 10 when the spun yarn 10 travels past the yarn pooling device 22 or the like can be detected. Furthermore, there is no need to arrange a separate device for determining whether the joint formed is normal after the yarn joining (the portion where yarn joining has been performed) and/or whether the second catching and guiding device 28 has guided the spun yarn 10 successfully.

[0044] A third embodiment of the present invention is explained below with reference to FIGS. 13 to 15. In the spinning machine according to the first and second embodiments, the yarn monitoring device 25 is arranged between the yarn pooling device 22 and the winding section 26. On the other hand, in the spinning machine according to the third embodiment, a second yarn monitoring device 70 is arranged between the air-jet spinning device 9 and the yarn pooling device 22, and a first yarn monitoring device (yarn monitoring device) 25a is arranged between the yarn pooling device 22 and the winding section 26.

[0045] The process procedure performed by the spinning unit 2 when a yarn defect is detected by the second yarn monitoring device 70 is explained below. When the second yarn monitoring device 70 detects the yarn defect 11 (Step S301), the spinning unit 2 stops the drafting by the drafting device 7 and the spinning by the air-jet spinning device 9 (Step S302). By this action, the spun yarn 10 between the air-jet spinning device 9 (second yarn cutting device) and the yarn pooling device 22 is cut, as shown in FIG. 14.

[0046] Thereafter, at a timing when the end of the second yarn 10b reaches a predetermined position, the winding section 26 stops the rotation of the package 50 (Step S303). The predetermined position is not particularly limited and can be any position where the second catching and guiding device 28 can easily catch the yarn end. By this action, the end of the second yarn 10b is prevented from being wound onto the package 50.

[0047] The subsequent yarn guiding and yarn joining processes (Steps S304 to S308, see FIG. 15) are the same as in the first embodiment (Steps S106 to S110, respectively). However, in the third embodiment, because the spun yarn 10 is cut immediately upon detection of the yarn defect 11, the distance from the yarn end to the yarn defect 11 is shortened. Hence, at Step S305, the amount of reverse rotation of the package 50 can be smaller than the same in the second embodiment. Consequently, occurrence of malfunction due to reverse rotation of the package 50 can be reduced. Furthermore, the time required from the detection of the yarn defect 11 till the winding is resumed is shorter than that of the first and second embodiments.

[0048] In the third embodiment, the second yarn monitoring device 70 is arranged upstream of the yarn pooling device 22. With this configuration, yarn breakage due to malfunctioning of the air-jet spinning device 9 can be immediately detected. Hence, an amount of the sliver 15 that is discarded can be reduced and a load on the front roller 20 can be prevented. Furthermore, because any change in a traveling speed of the spun yarn 10 due to traversing is absorbed by the yarn pooling device 22, the spun yarn 10 can be monitored while traveling at a constant speed. Consequently, a monitoring accuracy of the second yarn monitoring device 70 can be enhanced. When the first yarn monitoring device 25a is not arranged, a fulcrum of traversing can be further separated from the winding drum 53, and thereby the traversing operation can be stabilized, and a variation in the tension on the spun yarn 10 can be reduced.

[0049] As explained above, the spinning machine includes the air-jet spinning device 9, the yarn pooling device 22, and the winding section 26. The air-jet spinning device 9 supplies the spun yarn 10. The yarn pooling device 22 pools the spun yarn 10 supplied by the air-jet

spinning device 9. The winding section 26 winds the spun yarn 10 from the yarn pooling device 22 to form the package 50. The winding section 26 includes the winding drum driving motor 54 that rotates the package 50, and stops the rotation of the package 50 before the spun yarn 10 is disconnected (first and second embodiments) or after the spun yarn 10 is disconnected but before the yarn end is wound onto the package 50 (third embodiment).

[0050] In the situations where the rotation of the package 50 is stopped before the spun yarn 10 is disconnected, as in the first and second embodiments, the yarn end can be positioned at the predetermined position because the spun yarn 10 is disconnected after the rotation of the package 50 is stopped. Furthermore, the spinning machine forms the package 50 while pooling the spun yarn 10, a length of the spun yarn 10 from the air-jet spinning device 9 to the winding section 26 increases. Hence, when the spun yarn 10 is disconnected upstream of the yarn pooling device 22, as in the third embodiment, the rotation of the package 50 can be easily stopped before the yarn end is wound onto the package 50.

[0051] In the spinning machine according to the first and second embodiments, when the yarn monitoring device 25 detects the yarn defect, the winding section 26 stops the rotation of the package 50 before the spun yarn 10 is disconnected.

[0052] By this action, because the spun yarn 10 is disconnected after the rotation of the package 50 is stopped, the yarn end can be reliably prevented from winding onto the package 50.

[0053] In the spinning machine according to the second embodiment, after the cutter 24 cuts the spun yarn 10, the yarn joining device 23 joins the residual yarn 10c from the yarn pooling device 22 and the second yarn 10b from the winding section 26, and thereafter joins the first yarn 10a from the air-jet spinning device 9 and the second yarn 10b' from the winding section 26.

[0054] By this action, the residual yarn 10c that is pooled in the yarn pooling device 22 when suspending winding of the package 50 is also wound onto the package 50. Consequently, the amount of the spun yarn 10 that is discarded can be drastically reduced.

[0055] In the spinning machine according to the second embodiment, after the yarn joining device 23 joins the residual yarn 10c from the yarn pooling device 22 and the second yarn 10b from the winding section 26, the winding section 26 winds the joined second yarn 10b' and stops the rotation of the package 50 such that the end of the spun yarn 10 is positioned at the predetermined position on the yarn traveling path.

[0056] By this action, the second catching and guiding device 28 can reliably catch the spun yarn 10 at the time of the second yarn joining. Furthermore, because the rotation of the package 50 is stopped once at the time of the first yarn joining, the package 50 is rotating at a relatively slower speed at the time of the second yarn joining. Hence, with a simple configuration the rotation of the package 50 can be stopped such that the yarn end is positioned at the predetermined position.

[0057] In the spinning machine according to the third embodiment, the second yarn monitoring device 70 is arranged between the air-jet spinning device 9 and the yarn pooling device 22, and monitors the status of the traveling spun yarn 10. When the second yarn monitoring device 70 detects the yarn defect, the air-jet spinning device 9 stops the spinning and cuts the spun yarn 10 upstream of the yarn pooling device 22. The yarn joining device 23 joins the spun yarn 10 from the air-jet spinning device 9 and the spun yarn 10 from the winding section 26. The second catching and guiding device 28 catches the spun yarn 10 from the winding section 26 and guides it to the yarn joining device 23. The winding section 26 stops the rotation of the package 50 so that the yarn end formed by cutting the yarn by the air-jet spinning device 9 is positioned at the predetermined position on the yarn traveling path.

[0058] Because the air-jet spinning device 9 cuts the spun yarn 10 at upstream of the yarn pooling device 22, the time period from the time point when the spun yarn 10 is cut to the time point when the rotation of the package 50 is stopped can be prolonged. Thereby, the yarn end can be precisely positioned at the predetermined position. Hence, the second catching and guiding device 28 can reliably catch the spun yarn 10 at the time of yarn joining.

[0059] Exemplary embodiments of the present invention are explained above. The above configuration can also be modified as explained below.

[0060] Even though in the above embodiments the yarn pooling device 22 is equipped with the yarn pooling roller 41, a yarn pooling device that pools the spun yarn 10 by temporarily sucking the spun yarn 10 can be used.

[0061] In the above embodiments, the unit controller 90 of the spinning unit 2 performs the determination based on the detection result of the yarn monitoring device 25. Alternatively, the determination can be performed by a controller that controls the yarn monitoring device 25 or by the main control device. The control of other structural components, such as the winding section 26 and the like, can be performed by the main control device or another control device instead of by the unit controller 90.

[0062] The spinning machine according to the above embodiments does not include a delivery roller and a nip roller for pulling out the spun yarn 10 formed by the air-jet spinning device 9. As an alternative configuration, the spinning machine can include the delivery roller and the nip roller.

[0063] In the first and second embodiments, the yarn monitoring device 25 is arranged only downstream of the yarn pooling device 22. The yarn monitoring device 25 can, however, be arranged only upstream of the yarn pooling device 22 or both upstream and downstream of the yarn pooling device 22 and still the same process procedure (for example, the process of stopping the rotation of the package 50 before cutting the spun yarn 10

when a yarn defect is detected) can be performed.

[0064] In the spinning machine according to the above embodiments, the various devices are arranged such that the package 50 is formed at a position that is above the spinning unit 2. The various devices can, however, be arranged such that the package 50 is formed at a position that is below the spinning unit 2. The yarn winding machine can be an automatic winder or the like. In the automatic winder, the structure that unwinds a yarn from a yarn supplying bobbin will correspond to the yarn supplying section.

[0065] According to an aspect of the present invention, a yarn winding machine includes a yarn supplying section, a yarn pooling device, and a winding section. The yarn supplying section supplies a yarn. The yarn pooling device pools the yarn supplied by the yarn supplying section. The winding section winds the yarn from the yarn pooling device to form a package. The winding section includes a rotation driving unit that rotates the package. The winding section causes the rotation driving unit to stop the rotation of the package before the yarn is disconnected or after the yarn is disconnected but before a yarn end is wound onto the package.

[0066] When the rotation of the package is stopped before the yarn is disconnected, the yarn end can be positioned at a predetermined position because the yarn is disconnected after the rotation of the package is stopped. Furthermore, because the yarn winding machine forms the package by winding the yarn from the yarn pooling device (that is, forms the package while pooling the yarn), a length of the yarn from the yarn supplying section to the winding section is long. Hence, when the yarn is disconnected upstream of the yarn pooling device, the rotation of the package can be easily stopped before the yarn end is wound onto the package.

[0067] The yarn winding machine includes a yarn monitoring device that monitors a state of the yarn. When the yarn monitoring device detects a yarn defect, the winding section stops the rotation of the package before the yarn is disconnected.

[0068] With this configuration, because the yarn is disconnected after the rotation of the package is stopped, the yarn end can be reliably prevented from being wound onto the package.

[0069] It is preferable that in the yarn winding machine, the yarn pooling device includes a yarn pooling roller that pools the yarn by winding it on an outer circumferential surface thereof.

[0070] If the yarn pooled in the yarn pooling device that pools the yarn by sucking the yarn is long, there are chances that the yarn can become tangled inside the yarn pooling device. By using the yarn pooling roller that pools the yarn by winding it on the outer circumferential surface thereof, the yarn can be prevented from becoming tangled even if the pooled yarn is long.

[0071] It is preferable that in the yarn winding machine, a first yarn cutting device is arranged that cuts the yarn downstream of the yarn pooling device and upstream of the winding section when the yarn monitoring device detects the yarn defect.

[0072] With this configuration, because the yarn can be cut near the winding section, the length of the yarn from the winding section can be shortened. Hence, when catching the yarn, the yarn from the winding section can be prevented from becoming tangled.

[0073] The yarn winding machine includes a yarn joining device and a catching and guiding device. The yarn joining device joins the yarn from the yarn supplying section and the yarn from the winding section. The catching and guiding device catches the yarn from the winding section and guides the yarn to the yarn joining device.

[0074] Because the catching and guiding device catches the yarn end that is located away from a surface of the package, the probability of catching the yarn successfully in the yarn winding machine can be increased. Hence, the yarn joining can be performed efficiently.

[0075] It is preferable that in the yarn winding machine, after the first yarn cutting device cuts the yarn, the yarn joining device joins the yarn from the yarn pooling device and the yarn from the winding section, and thereafter joins the yarn from the yarn supplying section and the yarn from the winding section.

[0076] By this action, because the yarn that is pooled in the yarn pooling device at suspension of winding is also wound onto the package, an amount of yarn that is discarded can be drastically reduced.

[0077] It is preferable that in the yarn winding machine, after the yarn joining machine joins the yarn from the yarn pooling device and the yarn from the winding section, the winding section causes the rotation driving unit to rotate the package to wind the joined yarn onto the package, and thereafter stop the rotation of the package such that the end of the yarn is positioned at the predetermined position on the yarn traveling path.

[0078] By this action, the catching and guiding device can reliably catch the yarn at the time of the second yarn joining. Furthermore, because the rotation of the package is stopped once when performing the first yarn joining, the package is rotating at a relatively slower speed at the time of the second yarn joining. Hence, with a simple configuration the rotation of the package can be stopped such that the yarn end is arranged at the predetermined position.

[0079] The yarn winding machine includes a second yarn monitoring device, a second yarn cutting device, the yarn joining device, and the catching and guiding device. The second yarn monitoring device is arranged between the yarn supplying section and the yarn pooling device and monitors the state of the yarn. The second yarn cutting device cuts the yarn upstream of the yarn pooling device when the second yarn monitoring device detects the yarn defect. The yarn joining device joins the yarn from the yarn supplying section and the yarn from the winding section. The catching and guiding device catches the yarn from the winding section and guides the yarn to the yarn joining device. The winding section stops the

rotation of the package such that the yarn end formed by the cutting of the yarn by the second yarn cutting device is positioned at the predetermined position on the yarn traveling path.

[0080] Because the second yarn cutting device cuts the yarn upstream of the yarn pooling device, a longer time can be secured from the time point when the yarn is cut to the time point when the rotation of the package is stopped. Consequently, the yarn end can be precisely positioned at the predetermined position. Hence, the catching and guiding device can reliably catch the yarn for yarn joining.

[0081] It is preferable that the yarn winding machine includes a controller that controls at least the yarn pooling device and the winding section.

[0082] With this configuration, because plural structural components are controlled with a single controller, control operations can be performed smoothly.

[0083] According to another aspect of the present invention, a yarn winding method includes a winding step and a stopping step. At the winding step, the yarn is wound onto the package while the yarn is pooled in the yarn pooling device. At the stopping step, the rotation of the package is stopped before the yarn is disconnected or after the yarn is disconnected but before the yarn end is wound onto the package.

[0084] When the rotation of the package is stopped before the yarn is disconnected, the yarn end can be positioned at the predetermined position because the yarn is disconnected after the rotation of the package is stopped. Furthermore, because the yarn winding machine winds the package while pooling the yarn, a length of the yarn from the yarn supplying section to the winding section is long. Hence, when the yarn is disconnected occurs upstream of the yarn pooling device, the rotation of the package can be easily stopped before the yarn end is wound onto the package.

Claims

1. A yarn winding machine comprising:

a yarn supplying section (9) adapted to supply a yarn (10);
a yarn pooling device (22) adapted to pool the yarn (10) supplied by the yarn supplying section (9); and
a winding section (26) adapted to wind the yarn (10) from the yarn pooling device (22) to form a package (50) and includes a rotation driving unit (54) adapted to rotate the package (50), wherein the winding section (26) is adapted to cause the rotation driving unit (54) to stop rotation of the package (50) before the yarn (10) is disconnected or after the yarn (10) is disconnected but before a yarn end is wound onto the package (50).

2. The yarn winding machine as claimed in Claim 1, further comprising a yarn monitoring device (25a) adapted to monitor a state of the yarn (10),
wherein the winding section (26) is adapted to cause, when the yarn monitoring device (25a) detects a yarn defect, the rotation driving unit (54) to stop the rotation of the package (50) before the yarn (10) is disconnected.

3. The yarn winding machine as claimed in Claim 1 or Claim 2, wherein the yarn pooling device (22) includes a yarn pooling roller (41) adapted to pool the yarn (10) by winding the yarn (10) on an outer circumferential surface thereof.

4. The yarn winding machine as claimed in Claim 2 or 3, further comprising a first yarn, cutting device (24) adapted to cut the yarn (10) downstream of the yarn pooling device (22) and upstream of the winding section (26) when the yarn monitoring device (25a) detects the yarn defect.

5. The yarn winding machine as claimed in any one of Claims 1 to 4, further comprising:

a yarn joining device (23) adapted to join the yarn (10a) from the yarn supplying section (9) and the yarn (10b) from the winding section (26); and
a catching and guiding device (28) adapted to catch the yarn (10b) from the winding section (26) and to guide the yarn (10b) to the yarn joining device (23).

6. The yarn winding machine as claimed in Claim 5, wherein the yarn joining device (23) is adapted to join, after the first yarn cutting device (24) cuts the yarn (10), the yarn (10c) from the yarn pooling device (22) and the yarn (10b) from the winding section (26), and thereafter to join the yarn (10a) from the yarn supplying section (9) and the yarn (10b) from the winding section (26).

7. The yarn winding machine as claimed in Claim 5 or Claim 6, wherein the winding section (26) is adapted to cause, after the yarn joining device (23) joins the yarn (10c) from the yarn pooling device (22) and the yarn (10b) from the winding section (26), the rotation driving unit (54) to rotate the package (50) to wind the joined yarn (10) onto the package (50) and to stop the rotation of the package (50) such that the end of the yarn (10) is positioned at a predetermined position on a yarn traveling path.

8. The yarn winding machine as claimed in Claim 1, further comprising:

a second yarn monitoring device (70) arranged

between the yarn supplying section (9) and the yarn pooling device (22) and adapted to monitor a state of the yarn (10);
a second yarn cutting device (9) adapted to cut the yarn (10) upstream of the yarn pooling device (22) when the second yarn monitoring device (70) detects a yarn defect;
a yarn joining device (23) adapted to join the yarn (10a) from the yarn supplying section (9) and the yarn (10b) from the winding section (26); and
a catching and guiding device (28) adapted to catch the yarn (10b) from the winding section (26) and to guide the yarn (10b) to the yarn joining device(23),
wherein the winding section (26) is adapted to stop the rotation of the package (50) such that a yarn end formed by the cutting of the yarn (10) by the second yarn cutting device (9) is positioned at a predetermined position on a yarn traveling path.

9. The yarn winding machine as claimed in any one of Claims 1 to 8, further comprising a controller (90) adapted to control at least the yarn pooling device (22) and the winding section (26).

10. A yarn winding method comprising:

winding a yarn (10) onto a package (50) while pooling the yarn (10) in a yarn pooling device (22); and
stopping rotation of the package (50) before the yarn (10) is disconnected or after the yarn (10) is disconnected but before a yarn end is wound onto the package (50).

FIG.1

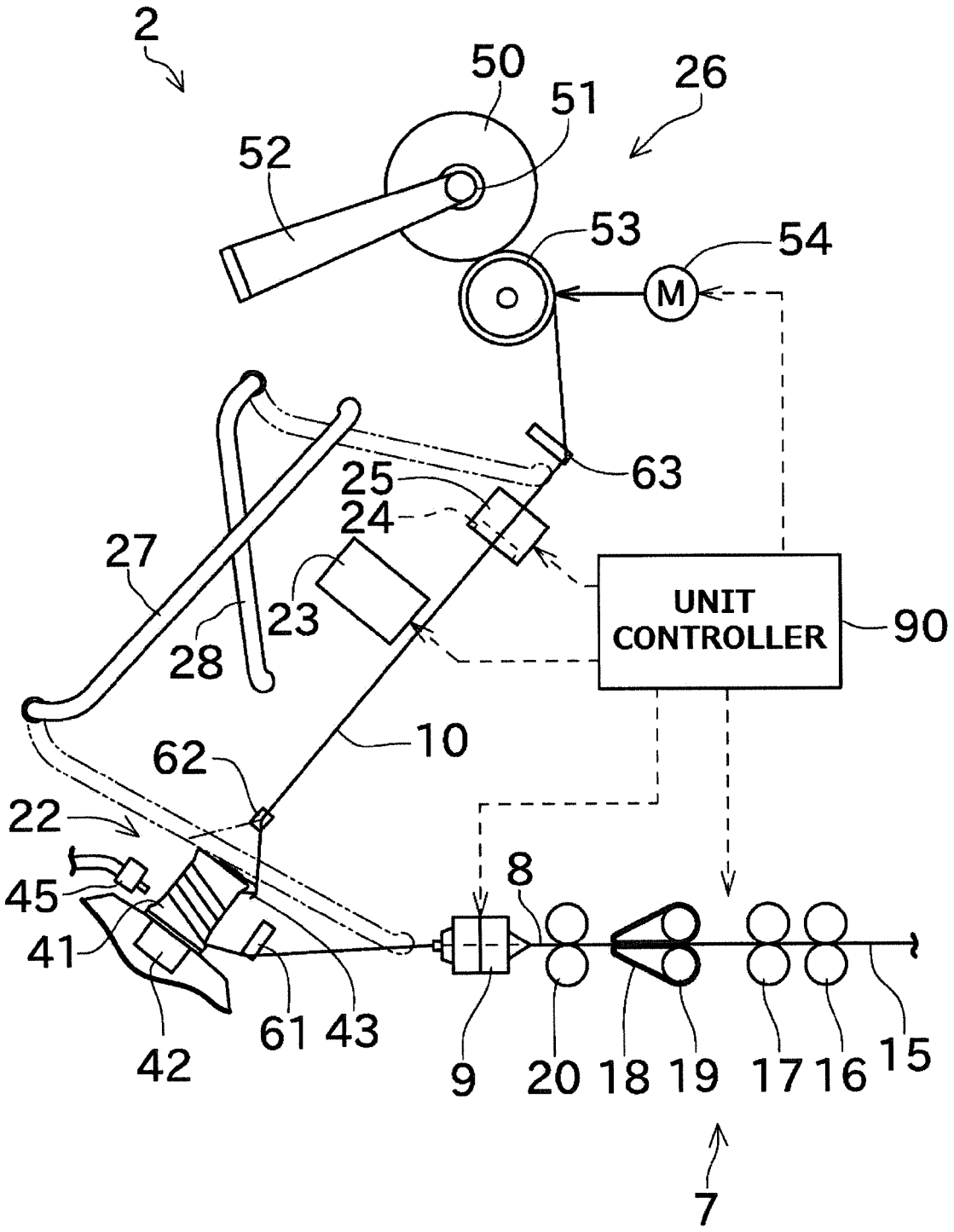

2
50
51
26
52
53
54
M
63
25
24
27
23
28
UNIT CONTROLLER
90
10
62
22
8
45
41
42
61
43
9
20
18
19
17
16
15
7

FIG.2

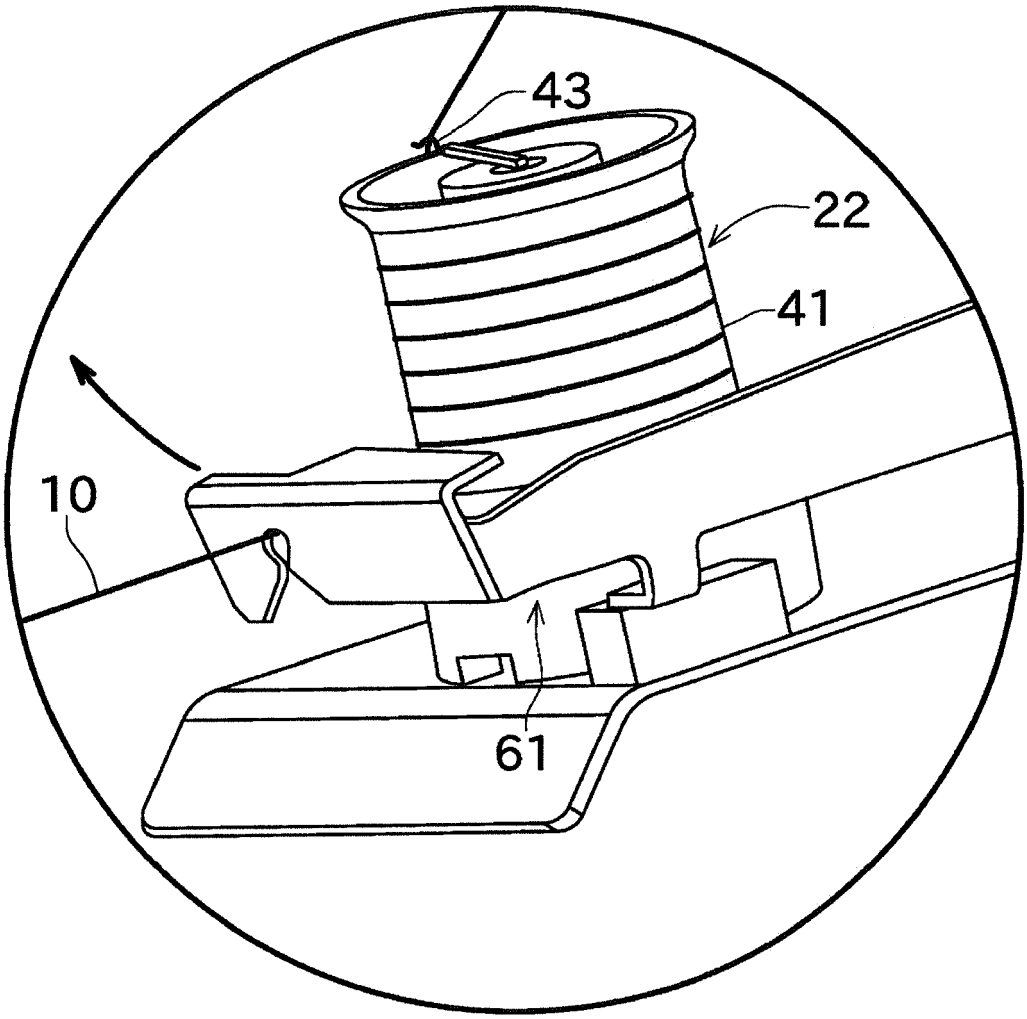


FIG.3

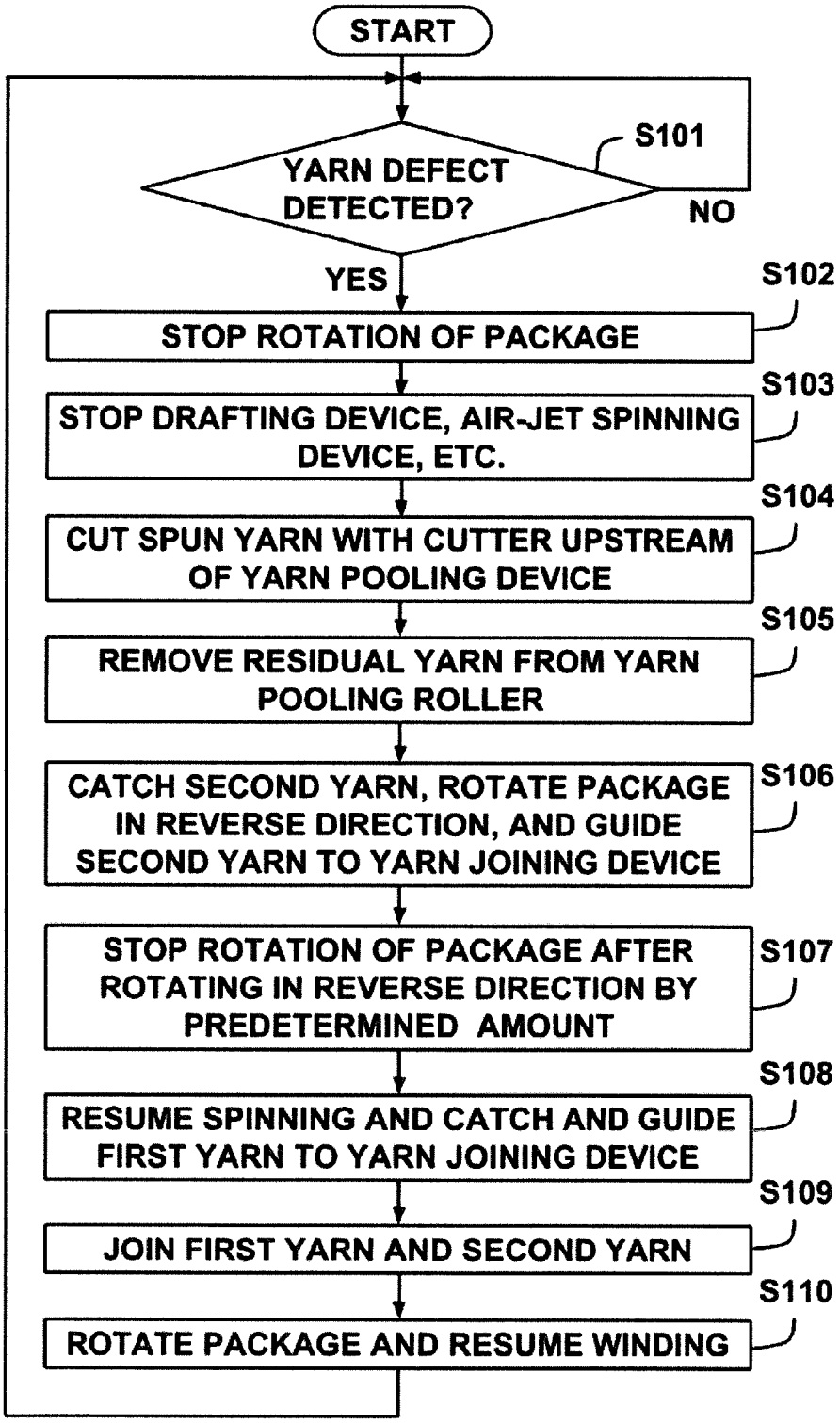

START
S101
YARN DEFECT DETECTED?
NO
YES
S102
STOP ROTATION OF PACKAGE
S103
STOP DRAFTING DEVICE, AIR-JET SPINNING DEVICE, ETC.
S104
CUT SPUN YARN WITH CUTTER UPSTREAM OF YARN POOLING DEVICE
S105
REMOVE RESIDUAL YARN FROM YARN POOLING ROLLER
S106
CATCH SECOND YARN, ROTATE PACKAGE IN REVERSE DIRECTION, AND GUIDE SECOND YARN TO YARN JOINING DEVICE
S107
STOP ROTATION OF PACKAGE AFTER ROTATING IN REVERSE DIRECTION BY PREDETERMINED AMOUNT
S108
RESUME SPINNING AND CATCH AND GUIDE FIRST YARN TO YARN JOINING DEVICE
S109
JOIN FIRST YARN AND SECOND YARN
S110
ROTATE PACKAGE AND RESUME WINDING

FIG.4

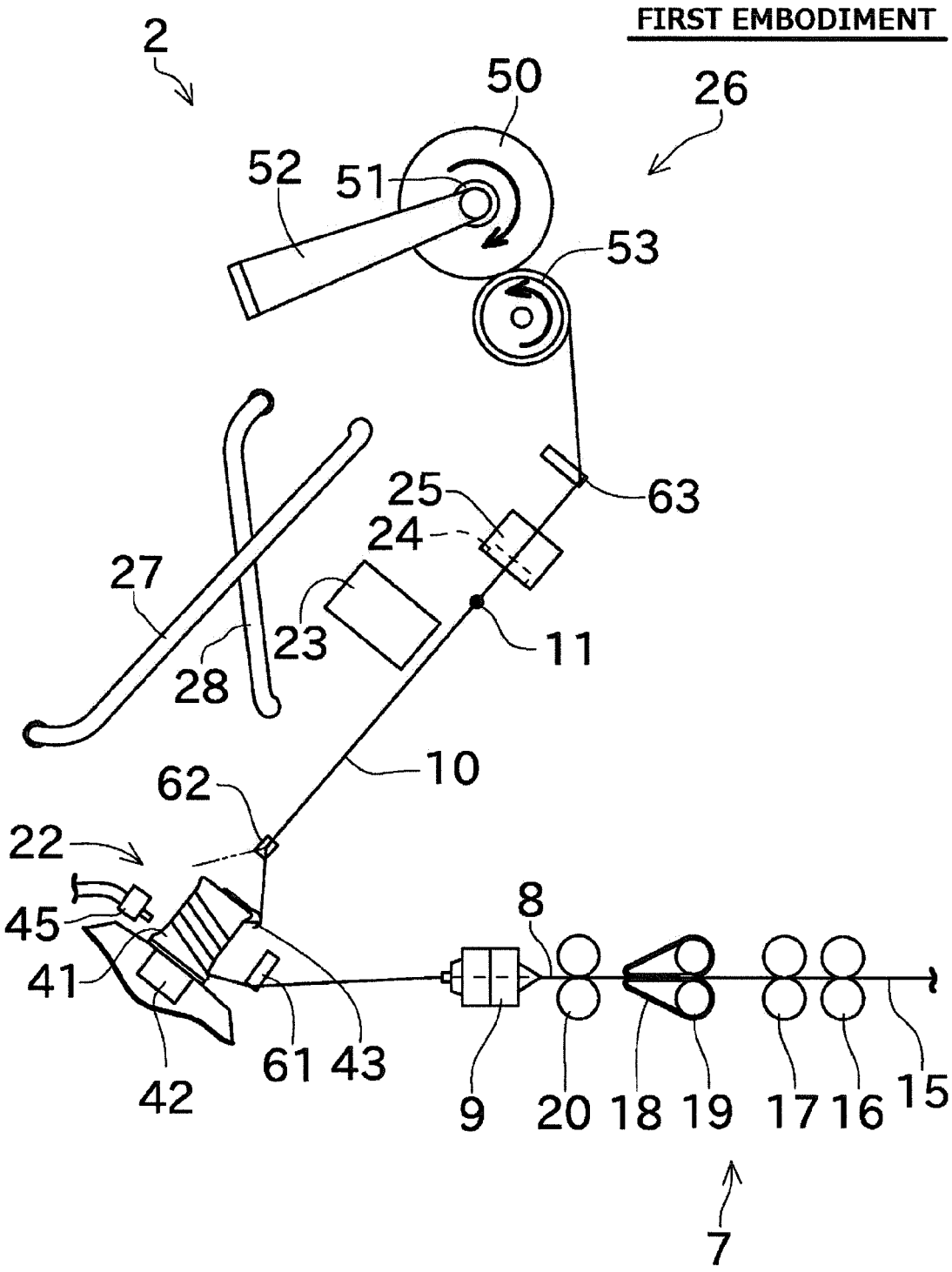

FIRST EMBODIMENT
2
50
26
52
51
53
63
25
24
27
23
11
28
10
62
22
45
8
41
42
61
43
9
20
18
19
17
16
15
7

FIG.5

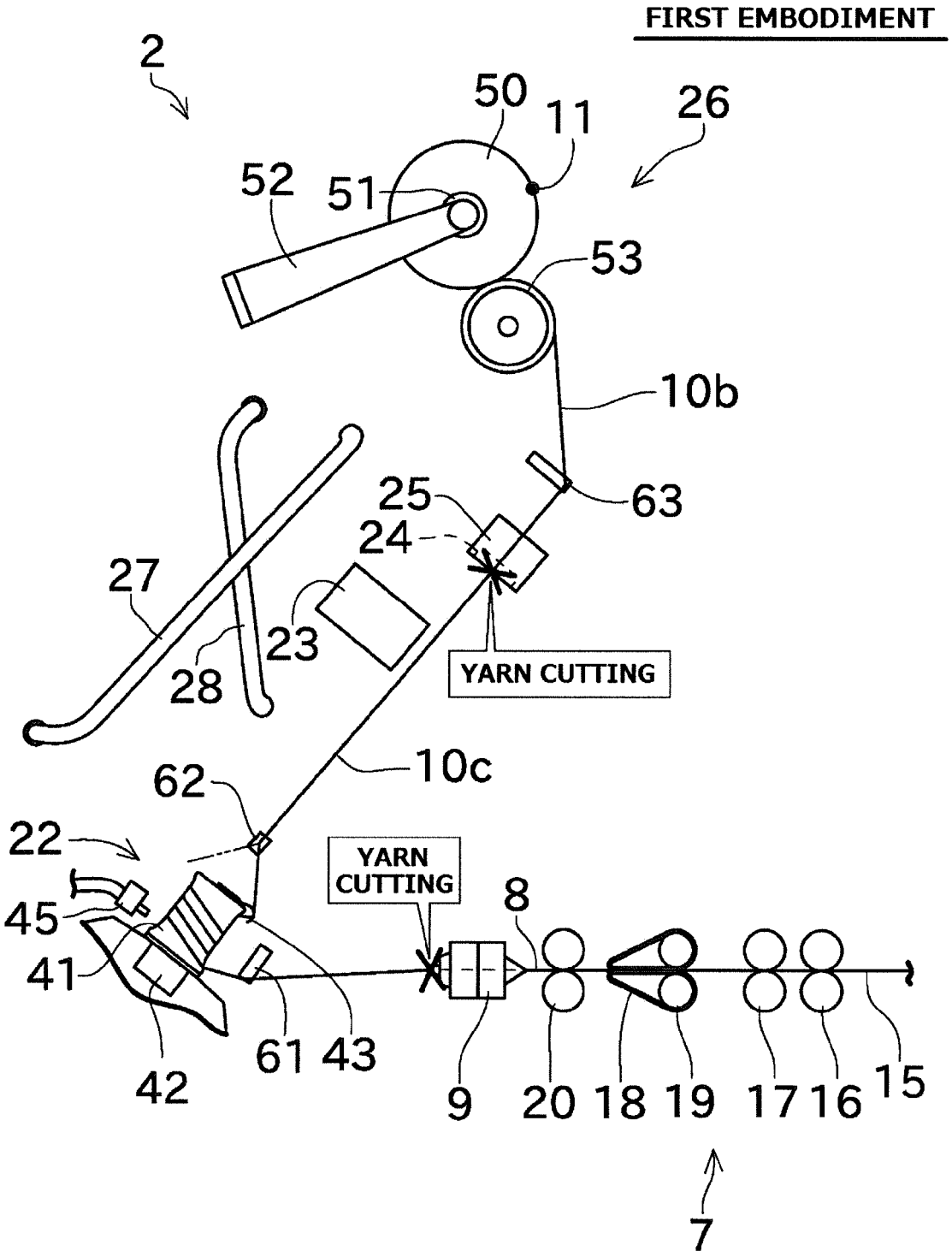

FIRST EMBODIMENT
2
50
11
26
52
51
53
10b
63
25
24
27
23
28
YARN CUTTING
10c
62
22
YARN CUTTING
8
45
41
42
61
43
9
20
18
19
17
16
15
7

FIG.6

FIRST EMBODIMENT

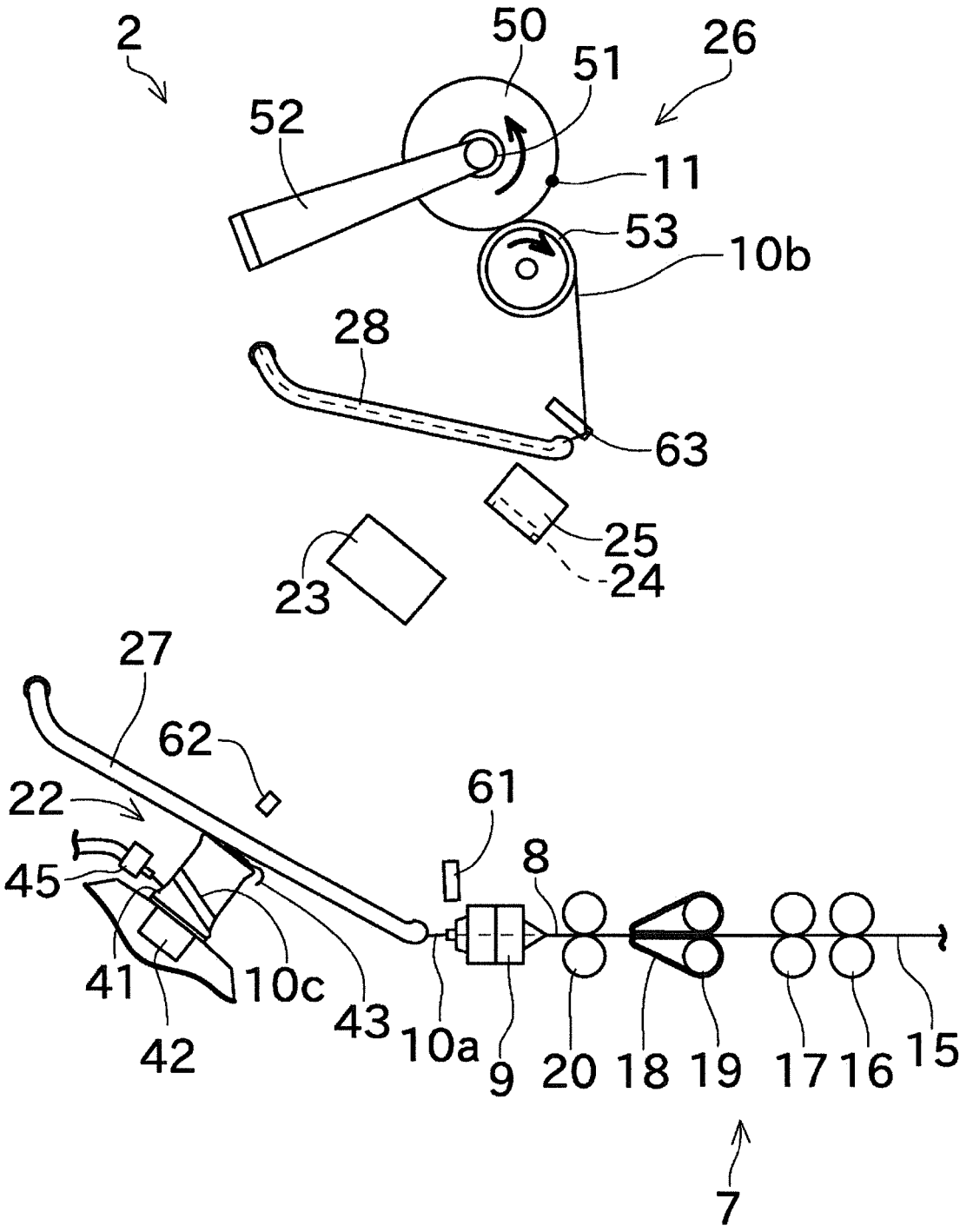


FIG.7

FIRST EMBODIMENT

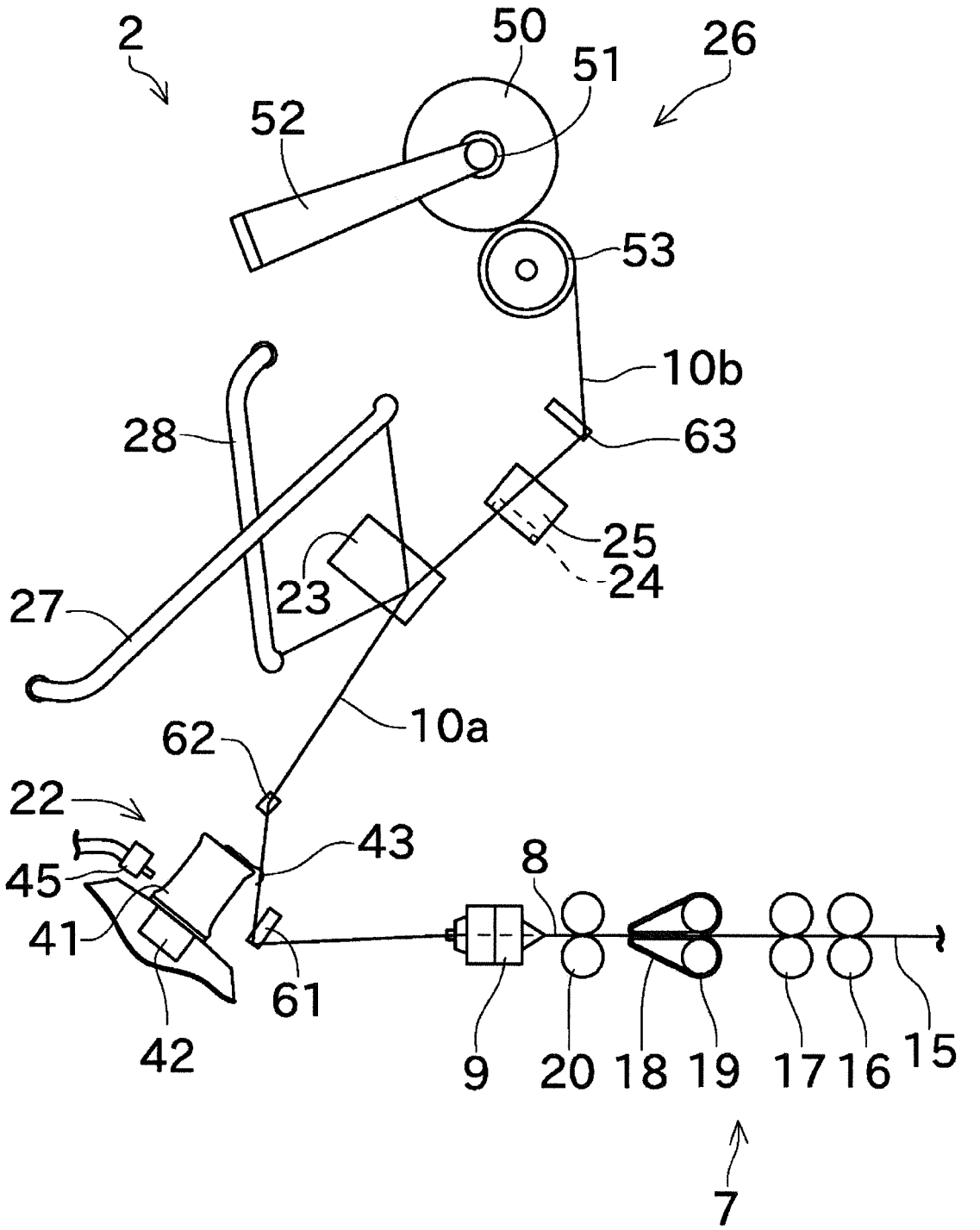


FIG.8

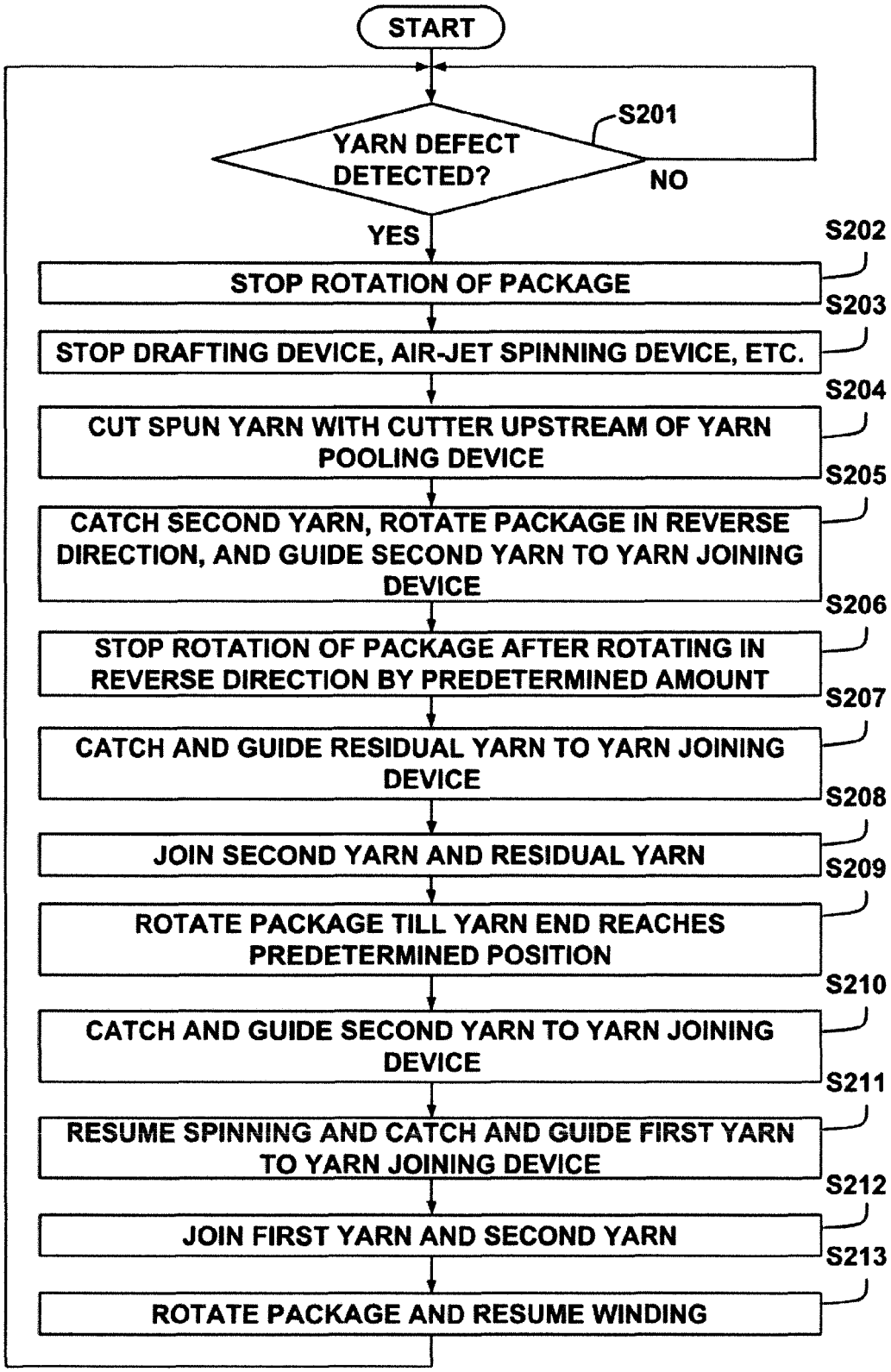

START
S201
YARN DEFECT DETECTED?
NO
YES
S202
STOP ROTATION OF PACKAGE
S203
STOP DRAFTING DEVICE, AIR-JET SPINNING DEVICE, ETC.
S204
CUT SPUN YARN WITH CUTTER UPSTREAM OF YARN POOLING DEVICE
S205
CATCH SECOND YARN, ROTATE PACKAGE IN REVERSE DIRECTION, AND GUIDE SECOND YARN TO YARN JOINING DEVICE
S206
STOP ROTATION OF PACKAGE AFTER ROTATING IN REVERSE DIRECTION BY PREDETERMINED AMOUNT
S207
CATCH AND GUIDE RESIDUAL YARN TO YARN JOINING DEVICE
S208
JOIN SECOND YARN AND RESIDUAL YARN
S209
ROTATE PACKAGE TILL YARN END REACHES PREDETERMINED POSITION
S210
CATCH AND GUIDE SECOND YARN TO YARN JOINING DEVICE
S211
RESUME SPINNING AND CATCH AND GUIDE FIRST YARN TO YARN JOINING DEVICE
S212
JOIN FIRST YARN AND SECOND YARN
S213
ROTATE PACKAGE AND RESUME WINDING

FIG.9

SECOND EMBODIMENT

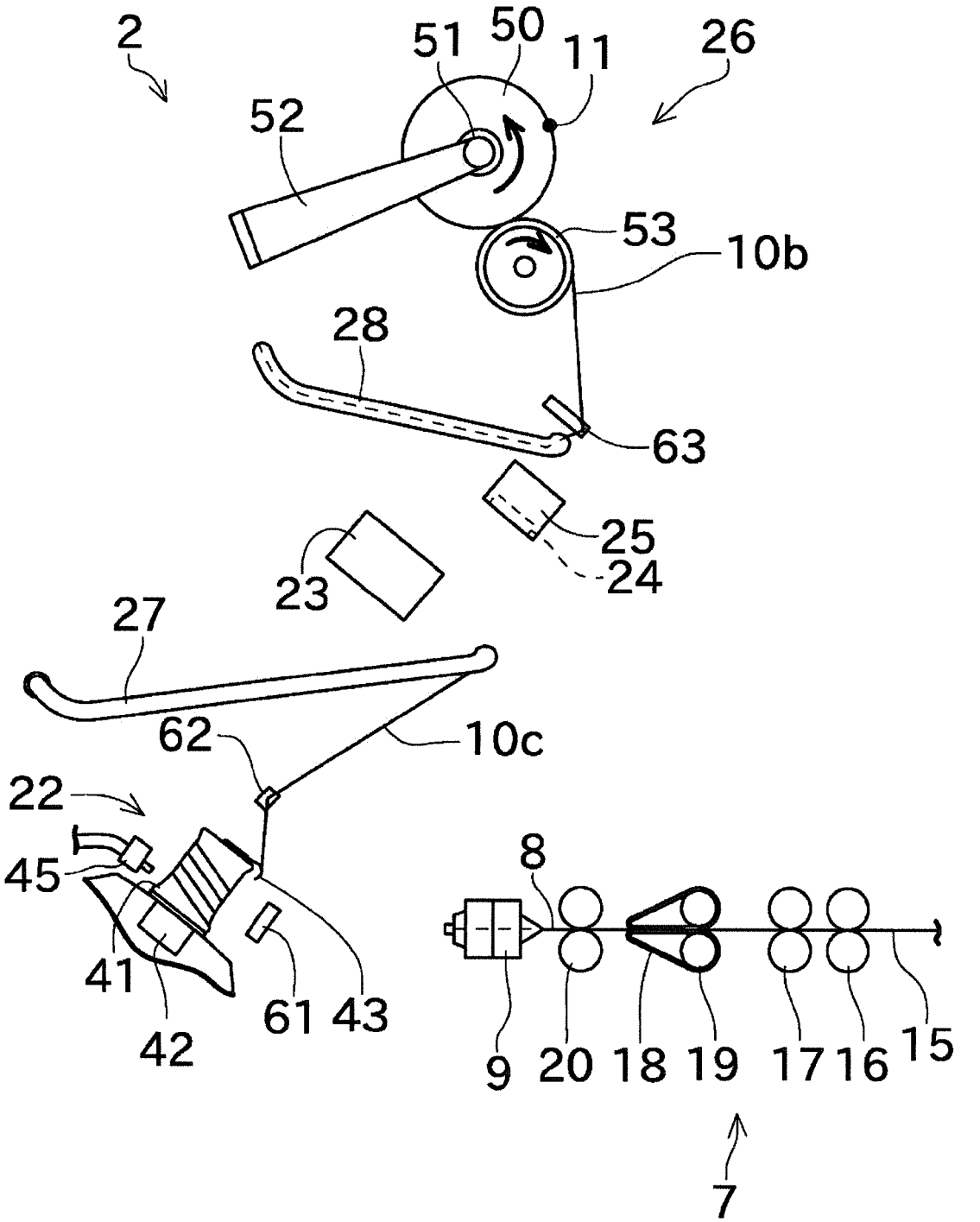


FIG.10

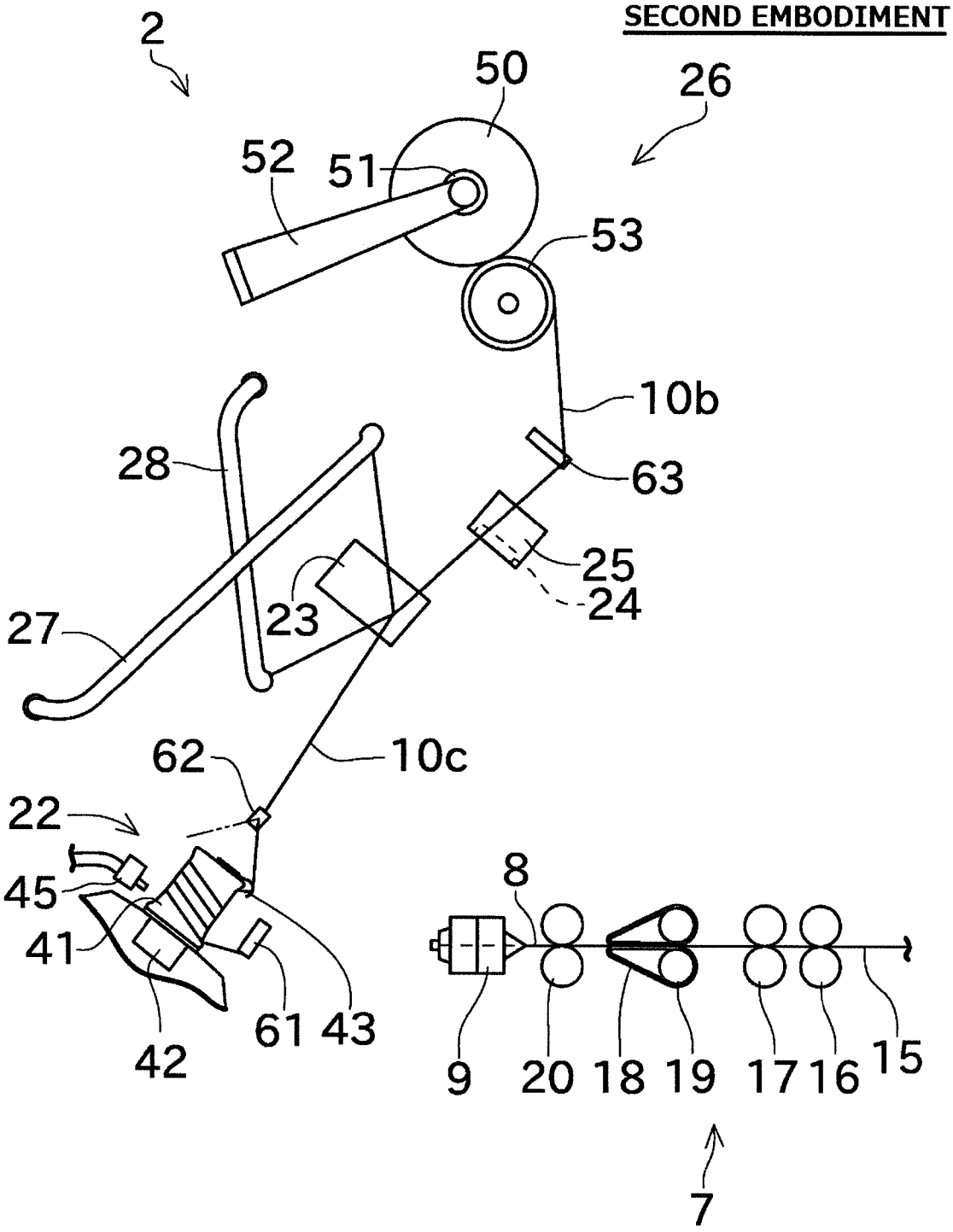

SECOND EMBODIMENT
2
50
26
52
51
53
10b
28
63
25
24
23
27
62
10c
22
45
41
42
61
43
8
9
20
18
19
17
16
15
7

FIG.11

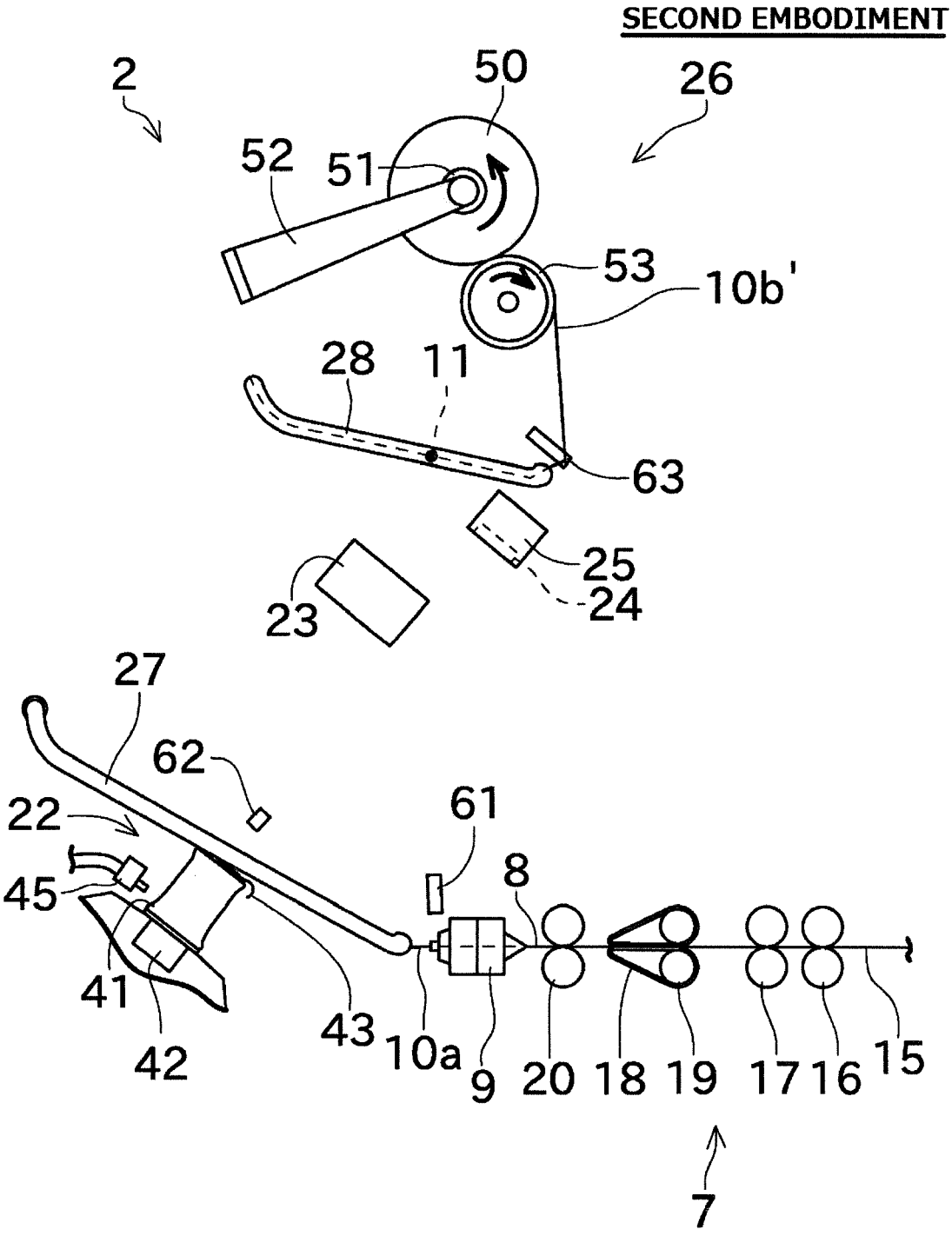
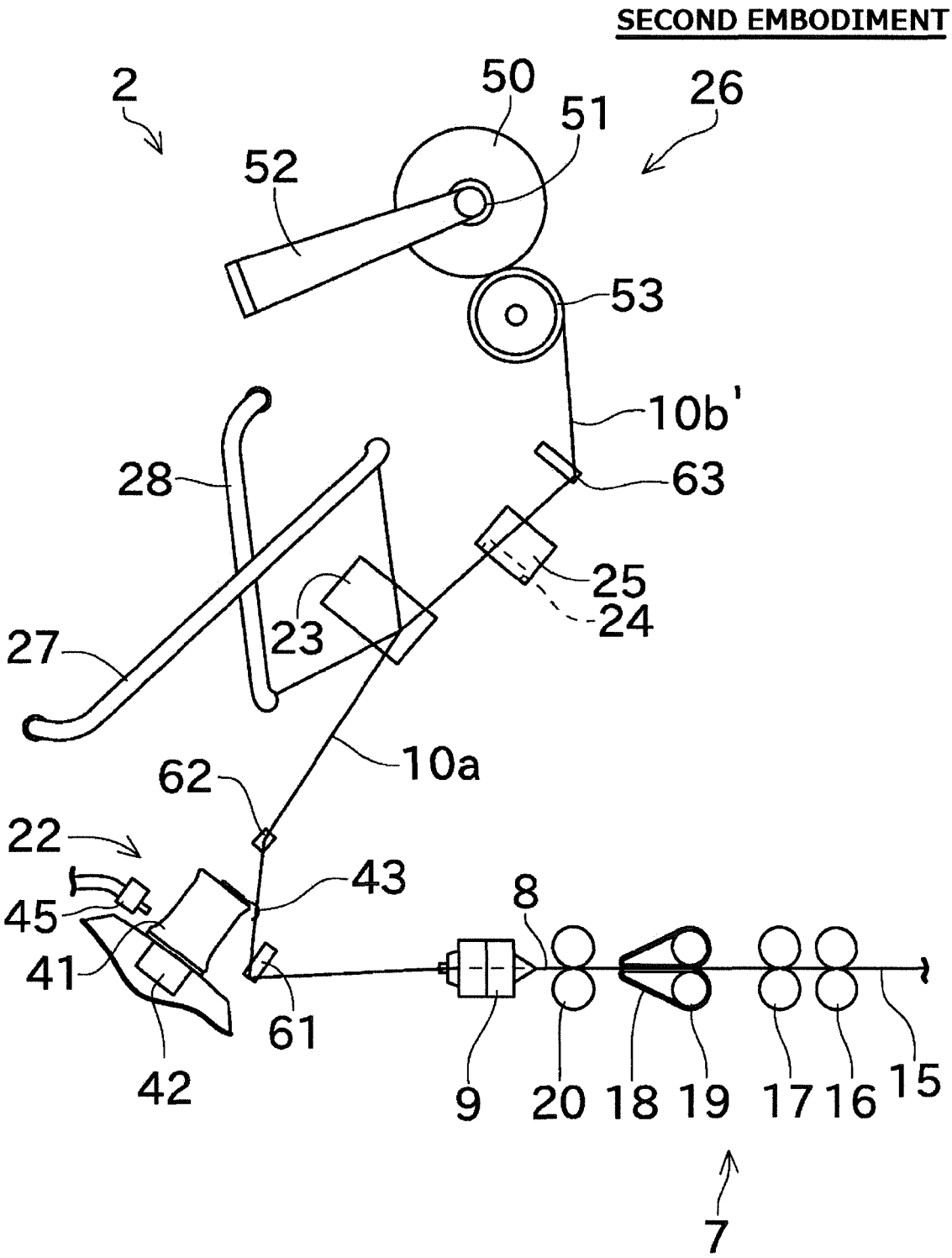

SECOND EMBODIMENT
2
50
26
52
51
53
10b'
28
11
63
25
24
23
27
62
22
61
8
45
41
42
43
10a
9
20
18
19
17
16
15
7

FIG.12


SECOND EMBODIMENT
2
50
51
26
52
53
10b'
28
63
25
24
23
27
10a
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22
43
8
45
41
61
42
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20
18
19
17
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15
7

FIG.13

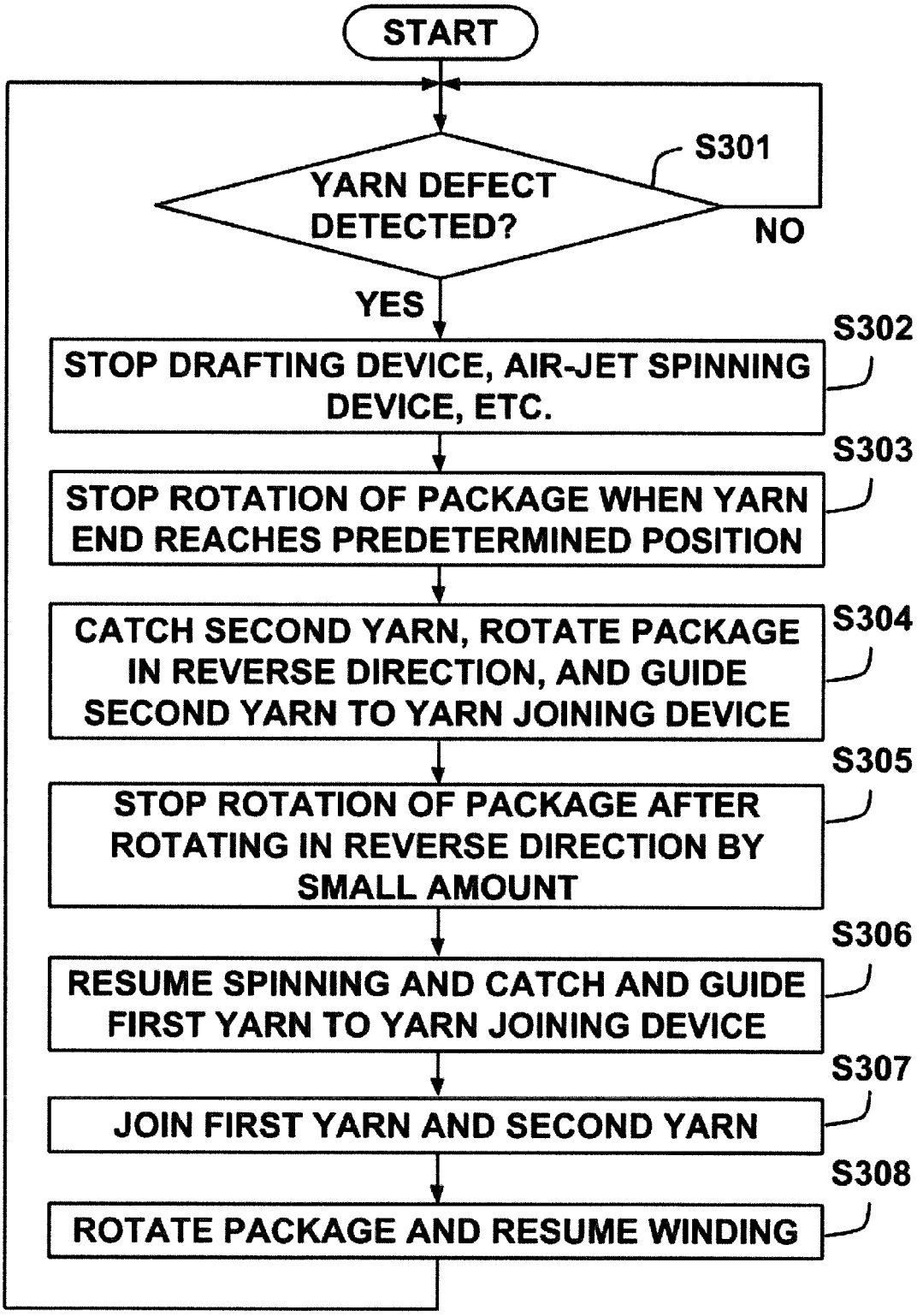

START
S301
YARN DEFECT DETECTED?
NO
YES
S302
STOP DRAFTING DEVICE, AIR-JET SPINNING DEVICE, ETC.
S303
STOP ROTATION OF PACKAGE WHEN YARN END REACHES PREDETERMINED POSITION
S304
CATCH SECOND YARN, ROTATE PACKAGE IN REVERSE DIRECTION, AND GUIDE SECOND YARN TO YARN JOINING DEVICE
S305
STOP ROTATION OF PACKAGE AFTER ROTATING IN REVERSE DIRECTION BY SMALL AMOUNT
S306
RESUME SPINNING AND CATCH AND GUIDE FIRST YARN TO YARN JOINING DEVICE
S307
JOIN FIRST YARN AND SECOND YARN
S308
ROTATE PACKAGE AND RESUME WINDING

FIG.14

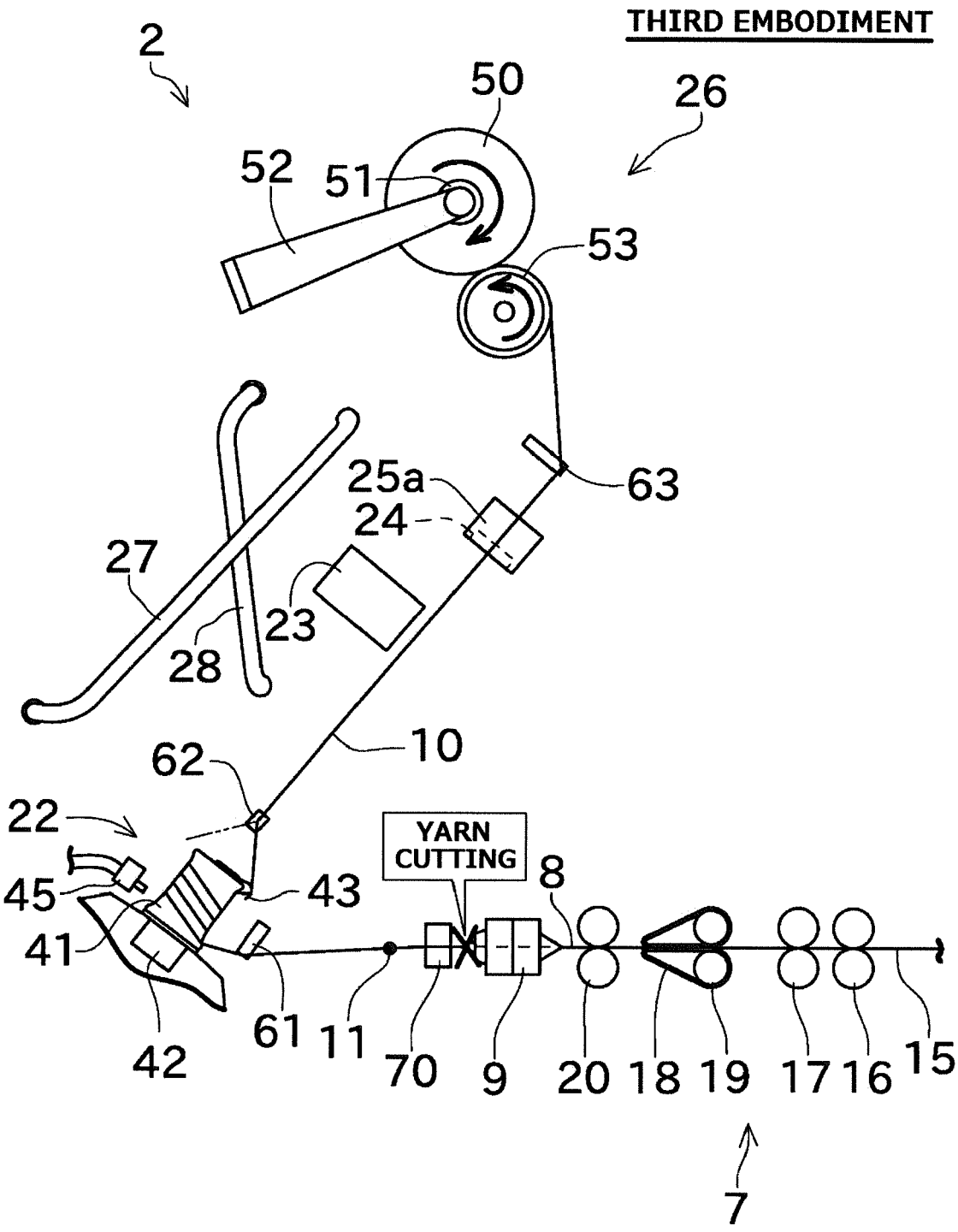
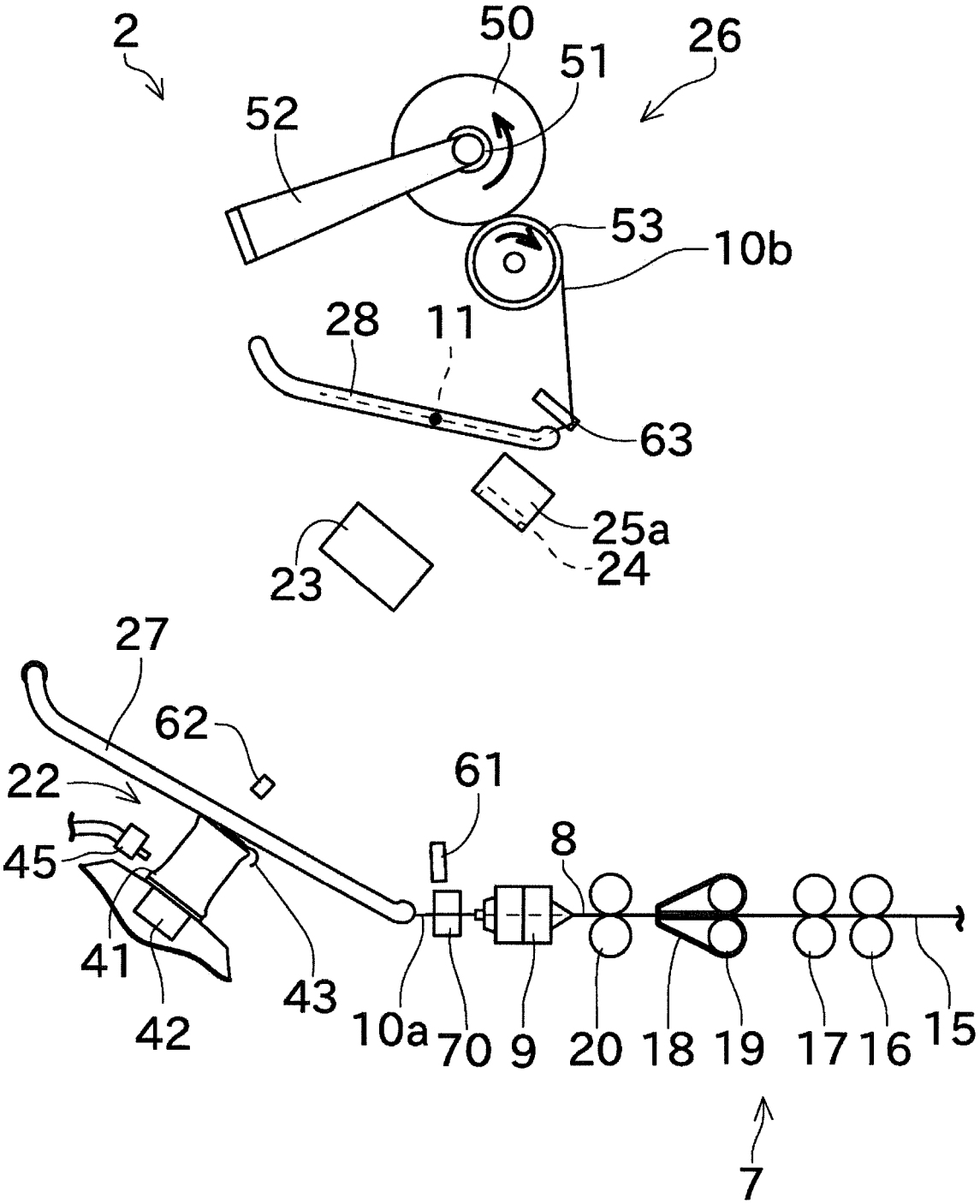

THIRD EMBODIMENT
2
50
26
52
51
53
63
25a
24
27
23
28
10
62
22
YARN CUTTING
8
45
43
41
42
61
11
70
9
20
18
19
17
16
15
7

FIG.15

THIRD EMBODIMENT



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 0253

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	DE 10 2012 102695 A1 (RIETER AG MASCHF [CH]) 2 October 2013 (2013-10-02) * paragraphs [0040], [0041]; figures 2,3,5 *	1-5,9,10 6-8	INV. B65H51/22 B65H63/06 B65H67/08 B65H69/06
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X	EP 2 664 572 A2 (MURATA MACHINERY LTD [JP]) 20 November 2013 (2013-11-20) * claim 1 *	1,3,5,9, 10	
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X	EP 2 573 237 A2 (RIETER INGOLSTADT GMBH [DE]) 27 March 2013 (2013-03-27) * paragraphs [0035], [0036] *	1,9,10	

TECHNICAL FIELDS SEARCHED (IPC)
B65H
D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 November 2015	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

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26-11-2015

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

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