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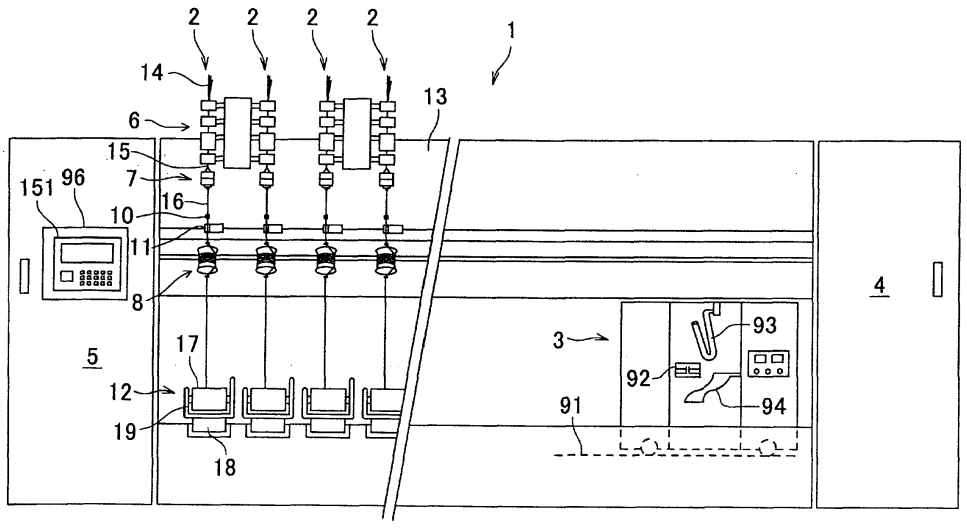
(54) Yarn winding machine

(57) A spinning machine (1) includes a winding device (12), a yarn clearer (11), a cutter (10), a slack eliminating device (8), a yarn splicing device (92), and a main control section (21). The slack eliminating device (8) includes a slack eliminating roller (30) and a yarn detecting sensor (34) for detecting a yarn on the surface of the slack eliminating roller (30). If a yarn defect is detected by the yarn clearer (11) and a yarn is cut by the cutter (10), the main control section (21) determines whether or not to control the yarn splicing device (92) to carry out yarn splicing in accordance with a detection result of the yarn detecting sensor (34).

FIG. 1



EP 2 361 867 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding machine for forming a wound package by winding a traveling yarn.

2. Description of the Related Art

[0002] One type of conventionally-known yarn winding machine includes a winding device for forming a package by winding a traveling yarn, and a yarn accumulating device for temporarily accumulating the yarn to be wound by the winding device. For example, a spinning machine described in Patent Document 1 includes a spinning device, a winding device, a yarn clearer, a cutter, a yarn splicing device, and a yarn accumulating device (a yarn slack eliminating device) . The winding device winds the yarn fed out from the spinning device. The yarn clearer detects a yarn defect. When the yarn clearer detects a yarn defect, the cutter cuts the yarn. After the yarn cut by the cutter, the yarn splicing device splices an upstream yarn end (a yarn end at a spinning machine side) and a downstream yarn end (a yarn end at a winding device side) together. The yarn accumulating device is arranged between the winding device and the cutter.

[0003] The yarn accumulating device includes a yarn accumulating roller (a slack eliminating roller), around which a yarn is wound, and a sensor (a wound amount sensor) for detecting an amount of yarn wound around the yarn accumulating roller. When a prescribed amount of yarn is wound around the yarn accumulating roller, yarn slack is eliminated and yarn tension stabilizes. A high quality package thus can be formed by the winding device.

[0004] [Patent Document 1] Japanese Unexamined Patent Application Publication No. 2009-242041 (FIG. 1, Paragraph [0025])

[0005] When a yarn defect is detected by the yarn clearer and the yarn is cut by the cutter, the yarn wound around the yarn accumulating roller at the package side is unwound from the yarn accumulating roller and is usually wound into the package. However, the yarn defect is present in a yarn portion at the package side. Yarn strength of the yarn portion is partially lowered at such a yarn defect portion. Therefore, the yarn may break at the yarn defect portion when the yarn portion is wound into the package, and a portion of the yarn portion may remain on the yarn accumulating roller. Under a state in which such a yarn portion is remaining on the yarn accumulating roller, if a yarn end located upstream of the cutter and a yarn end located downstream of the cutter are spliced together and then the winding of the yarn is resumed, such a yarn portion is fed to the winding device along with the yarn fed from an upstream side and wound into the package. As a result, the quality of the package is lowered.

[0006] The yarn accumulating device described in Patent Document 1 includes a sensor for detecting the amount of yarn wound around the yarn accumulating roller during winding of the package. However, Patent Document 1 neither discloses nor suggests a problem that a small amount of yarn portion remaining on the yarn accumulating roller may be wound into the package when a yarn defect is detected and the yarn is cut, and a means for solving such a problem.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a yarn winding machine capable of preventing a yarn portion remaining on a yarn accumulating roller after yarn cut from being wound into a package when resuming winding of a yarn after yarn splicing.

This object is achieved by a yarn winding machine according to claim 1.

[0008] According to an aspect of the present invention, the yarn winding machine includes a winding device, a yarn defect detecting device, a cutting device, a yarn splicing device, a yarn accumulating device, and a control device. The winding device forms a package by winding a traveling yarn. The yarn defect detecting device detects a defect in the yarn to be wound by the winding device. The cutting device cuts the yarn when the yarn defect detecting device detects a yarn defect. The yarn splicing device splices an upstream yarn end and a downstream yarn end together after the yarn cut by the cutting device. The yarn accumulating device is arranged between the winging device and the cutting device and temporarily accumulates the yarn to be wound by the winding device. The control device controls the yarn winding machine. The yarn accumulating device includes a yarn accumulating roller and a yarn detecting sensor. The yarn accumulating roller is provided rotatable and winds the yarn around a surface thereof. The yarn detecting sensor detects the yarn on the surface of the yarn accumulating roller. When the yarn is cut by the cutting device, the control device determines whether or not to control the yarn splicing device to carry out yarn splicing in accordance with a detection result of the yarn detecting sensor.

[0009] When the yarn defect detecting device detects a yarn defect and the yarn is cut by the cutting device, if the yarn detecting sensor detects that a small amount of yarn portion is remaining on the surface of the yarn accumulating roller, the control device prevents the yarn splicing device from carrying out yarn splicing. Accordingly, when resuming the winding of the package, the remaining yarn portion can be prevented from being wound into the package.

[0010] The yarn winding machine includes a fluid blowing device which blows fluid to the surface of the yarn accumulating roller after the yarn cut by the cutting device. According to such a configuration, even if a yarn

portion is remaining at a position located away from a yarn detecting position of the yarn detecting sensor, the yarn portion can be moved to the yarn detecting position of the yarn detecting sensor by flow of the fluid blown from the fluid blowing device. Alternatively, by blowing the fluid by the fluid blowing device to the surface of the yarn accumulating roller, the yarn portion remaining on the surface of the yarn accumulating roller can be removed.

[0011] The yarn winding machine includes a yarn splicing cart equipped with the yarn splicing device and the fluid blowing device. When the yarn is cut by the cutting device, if the yarn detecting sensor does not detect the yarn on the surface of the yarn accumulating roller, the control device controls the yarn splicing cart to travel closer to the yarn accumulating roller and controls the fluid blowing device to blow the fluid to the surface of the yarn accumulating roller. After the fluid blowing device blows the fluid to the surface of the yarn accumulating roller, if the yarn detecting sensor does not detect a yarn on the surface of the yarn accumulating roller, the control device controls the yarn splicing device to carry out yarn splicing.

[0012] Accordingly, when the yarn is cut by the cutting device, if the yarn detecting sensor detects a yarn on the surface of the yarn accumulating roller, the control device determines that yarn splicing should not be carried out, and prevents the yarn splicing cart from travelling. Only if the yarn is not detected, the control device controls the yarn splicing cart to travel closer to the yarn accumulating roller. However, at the time of the yarn detection made before the travelling of the yarn splicing cart, there may be a case in which the yarn was not detected by the yarn detecting sensor due to the yarn remaining at the position located away from the yarn detecting position of the yarn detecting sensor. Accordingly, when the fluid is blown from the fluid blowing device of the yarn splicing cart to the yarn accumulating roller, only if the yarn is not detected by the yarn detecting sensor, the yarn splicing device is controlled to carry out yarn splicing.

[0013] The fluid blowing device blows the fluid to the yarn accumulating roller such that the fluid flows from a position, which is located away from the yarn detecting position of the yarn detecting sensor on the surface of the yarn accumulating roller, towards the yarn detecting position. Accordingly, even if a yarn portion is remaining at the position located away from the yarn detecting position of the yarn detecting sensor on the surface of the yarn accumulating roller, the fluid blown from the fluid blowing device moves the yarn portion to the yarn detecting position of the yarn detecting sensor. Consequently, the yarn portion remaining on the surface of the yarn accumulating roller can be reliably detected by the yarn detecting sensor.

[0014] The fluid blowing device includes a first nozzle and a second nozzle. The first nozzle blows the fluid to a first end portion of the yarn accumulating roller in a rotational axis direction thereof. The second nozzle blows the fluid to a second end portion of the yarn accumulating roller in the rotational axis direction thereof. In a peripheral direction of the yarn accumulating roller, a position of a fluid injecting section of the first nozzle is displaced from a position of a fluid injecting section of the second nozzle.

[0015] When the first nozzle and the second nozzle blow the fluid to the yarn accumulating roller from both ends of the yarn accumulating roller, if the position of the fluid injecting section of the first nozzle and the position of the fluid injecting section of the second nozzle are same in the peripheral direction of the yarn accumulating roller, the fluid blown from the first nozzle and the fluid blown from the second nozzle collide with each other on the surface of the yarn accumulating roller. Consequently, the yarn remaining on the surface of the yarn accumulating roller cannot move. In the present invention, the position of the fluid injecting section of the first nozzle is displaced from the position of the fluid injecting section of the second nozzle in the peripheral direction of the yarn accumulating roller, which allows the yarn remaining on the surface of the yarn accumulating roller to move to the yarn detecting position of the yarn detecting sensor.

[0016] When the fluid is blown from the first nozzle and the second nozzle towards the yarn accumulating roller, the control device controls the yarn accumulating roller to rotate. By rotating the yarn accumulating roller while the fluid is being blown from the first nozzle and the second nozzle arranged as described above, a position where the fluid collides with the yarn portion remaining on the yarn accumulating roller (i.e., a position where the fluid acts) is continuously changed accompanying the rotation of the yarn accumulating roller. As a result, the yarn portion vibrates in the rotational axis direction of the yarn accumulating roller, and the yarn portion is easily detected by the yarn detecting sensor.

[0017] The yarn detecting sensor is a reflective photo sensor including a light emitting element and a light receiving element. The light emitting element is arranged to irradiate light to a prescribed position on the yarn accumulating roller that is located in a middle portion of the yarn accumulating roller in its rotational axis direction. The yarn detecting sensor can detect whether or not the yarn is wound to the prescribed position on the yarn accumulating roller during winding of the package by the winding device.

[0018] According to the such a configuration, the photo sensor for detecting whether or not the yarn is wound to the prescribed position on the yarn accumulating roller (i.e., whether or not at least a prescribed amount of yarn is wound) during winding of the package by the winding device is also used as the yarn detecting sensor for detecting the yarn remaining on the yarn accumulating roller after yarn cut by the cutting device. Accordingly, without increasing the number of sensors, the yarn portion remaining on the yarn accumulating roller can be detected at the time of yarn cut.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is a front view of a spinning machine according to an embodiment.

FIG. 2 is a side view of a spinning unit of the spinning machine illustrated in FIG.1.

FIG. 3 is an enlarged view of a slack eliminating device (a yarn accumulating device).

FIGS. 4A and 4B are views illustrating a yarn detecting sensor.

FIG. 4A is a cross-sectional view of the yarn detecting sensor. FIG. 4B is a view taken along the line B-B of FIG. 4A.

FIG. 5 is a view illustrating a relation between a yarn portion on a surface of a slack eliminating roller and an irradiated range of the yarn detecting sensor.

FIG. 6 is a view schematically illustrating a positional relation among the slack eliminating roller and respective air injecting sections of two nozzles.

FIG. 7 is a block diagram illustrating a control configuration of the spinning machine.

FIG. 8 is a flowchart illustrating a process to stop spinning when a yarn defect is detected.

FIG. 9 is a flowchart of a yarn splicing process.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] Next, an embodiment of the present invention will be described. As illustrated in FIG. 1, a spinning machine 1 (a yarn winding machine) includes a plurality of spinning units 2 which are arranged next to one another, a yarn splicing cart 3, a blower box 4, and a motor box 5. The yarn splicing cart 3 is arranged capable of travelling along a direction in which the spinning units 2 are arranged next to one another.

[0021] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a spinning device 7, a cutter 10 (a cutting device) , a yarn clearer 11 (a yarn defect detecting device) , a slack eliminating device 8 (a yarn accumulating device) , a winding device 12, and the like. Further, in the followings, "upstream" and "downstream" refer to an upstream side and a downstream side in a travelling direction of a yarn at the time of spinning, respectively.

[0022] The draft device 6 is arranged close to an upper end portion of a casing 13 of a main body of the spinning machine 1. A sliver 14 fed to the draft device 6 is drafted into a fiber bundle 15 by the draft device 6. The fiber bundle 15 is spun by the spinning device 7, thereby producing a spun yarn 16. The spun yarn 16 is wound by the winding device 12 at a downstream side, thereby forming a package 17.

[0023] The draft device 6 includes four rollers i.e. a back roller 22, a third roller 23, a middle roller 25 provided with an apron belt 24, and a front roller 26, which are arranged in this order along a travelling direction of the sliver 14 (the fiber bundle 15). The apron belt 24 is wound around the middle roller 25 and a tensor bar 27. The tensor bar 27 is urged in a direction departing away from the middle roller 25, thereby applying a prescribed tension to the apron belt 24.

[0024] A detailed configuration of the spinning device 7 will not be illustrated in the drawings; however, the present embodiment adopts a pneumatic type spinning device that use whirling airflow to apply twists to the fiber bundle 15 in order to produce the spun yarn 16.

[0025] The cutter 10 and the yarn clearer 11 are arranged downstream of the spinning device 7. The yarn clearer 11 is configured so as to monitor thickness of the travelling spun yarn 16 and detect a thin yarn portion or a thick yarn portion of the spun yarn 16 (i.e., a yarn defect in the spun yarn 16). If the yarn clearer 11 detects a yarn defect, the yarn clearer 11 transmits a yarn defect detection signal to a unit controller 21 (refer to FIG. 6). When the unit controller 21 receives the yarn defect detection signal, the unit controller 21 immediately activates the cutter 10, and controls the cutter 10 to cut the spun yarn 16.

[0026] The slack eliminating device 8 is arranged between the cutter 10 and the winding device 12. The slack eliminating device 8 includes a slack eliminating roller 30 (a yarn accumulating roller). By winding a prescribed amount of spun yarn 16 produced by the spinning device 7 around the slack eliminating roller 30, the slack eliminating device 8 temporarily accumulates the spun yarn 16 and adjusts yarn tension. Further, the slack eliminating device 8 also has a function to pull out the spun yarn 16 to a downstream side from the spinning device 7 by actively driving and rotating the slack eliminating roller 30 around which the spun yarn 16 is wound. A detailed description on the slack eliminating device 8 will be made later. A travelling yarn detecting sensor 28 for detecting the spun yarn 16 travelling towards the winding device 12 is arranged downstream of the slack eliminating device 8.

[0027] As illustrated in FIG. 1, the winding device 12 includes a winding drum 18 and a cradle 19 for rotatably supporting a bobbin. The winding drum 18 rotates while making contact with a surface of the bobbin (or a surface of a yarn layer wound around the bobbin) to thereby rotate the bobbin such that the traveling spun yarn 16 is wound around the bobbin to form the package 17.

[0028] As illustrated in FIGS. 1 and 2, the yarn splicing cart 3 is equipped with a yarn splicing device 92, a suction pipe 93, and a suction mouth 94. As illustrated in FIG. 1, the yarn splicing cart 3 is arranged so as to travel on a rail 91 arranged on the casing 13 of the main body of the spinning machine 1. When yarn breakage or yarn cut occurs in a certain spinning unit 2, the yarn splicing cart 3 travels to such spinning unit 2 and then stops. While swinging around a shaft in a vertical direction, the suction pipe 93 sucks and catches a yarn end of the spun yarn 16 discharged from the spinning device 7 (a yarn end on an upstream side), and guides the yarn end to the yarn

splicing device 92. While swinging around a shaft in a vertical direction, the suction mouth 94 sucks and catches a yarn end of the spun yarn 16 from the package 17 supported rotatable by the winding device 12 (a yarn end on a downstream side) , and guides the yarn end to the yarn splicing device 92. The yarn splicing device 92 splices the guided yarn ends together. Further, the suction pipe 93 and suction mouth 94 are connected to a negative-pressure source accommodated in the blower box 4 and obtain suction force to suck a yarn end from the negative-pressure source.

[0029] The blower box 4 is arranged in one end of the arrangement of the plurality of spinning units 2. The negative-pressure source including a blower, a filter, and the like is accommodated in the blower box 4. The negative-pressure source is connected to a cleaning suction pipe (not illustrated in the drawings) for sucking and removing yarn waste and fiber waste generated by the draft device 6 or the slack eliminating device 8. The negative-pressure source is also connected to the suction pipe 93 and the suction mouth 94 of the yarn splicing cart 3, and the like.

[0030] The motor box 5 is arranged in the other end of the arrangement of the plurality of spinning units 2 that is opposite from the side where the blower box 4 is arranged. A motor for respectively driving the front roller 26 and the middle roller 25 of the draft device 6 of each of the plurality of spinning unit 2 is accommodated in the motor box 5. The motor box 5 has a main control section 96 provided with a control panel 151. The main control section 96 transmits and receives signals with the unit controller 21 of each spinning unit 2 and the yarn splicing cart 3, and performs operation control and state monitoring of the each spinning unit 2 and the yarn splicing cart 3.

[0031] Next, a detailed description on the slack eliminating device 8 will be made. As illustrated in FIG. 3, the slack eliminating device 8 includes the slack eliminating roller 30 (the yarn accumulating roller), a yarn hooking member 31, an upstream guide 32, a downstream guide 33, and a yarn detecting sensor 34.

[0032] The slack eliminating roller 30 is a metallic cylindrical roller. The slack eliminating roller 30, which is supported rotatable by a bracket 35 fixed to the casing 13 of the spinning machine 1, is driven and rotated by a motor 36. The yarn hooking member 31 has a tip end formed capable of being engaged with the spun yarn 16 (i.e., a tip end formed capable of hooking the spun yarn 16). The yarn hooking member 31 is mounted on a downstream end portion of the slack eliminating roller 30. The yarn hooking member 31 rotates integrally with the slack eliminating roller 30, which makes it possible to wind the spun yarn 16 around an outer peripheral surface of the slack eliminating roller 30.

[0033] As illustrated in FIG. 3, both end portions of the slack eliminating roller 30 in an axial direction thereof are formed in a tapered shape in which the diameter continuously increases from a center side of the slack eliminating roller 30 towards an end side thereof. If the spun yarn 16 is wound from an upstream end portion of the slack eliminating roller 30 with a larger diameter, the wound spun yarn 16 is fed to the downstream end portion of the slack eliminating roller 30 by the taper-shaped upstream end portion. Accordingly, a prescribed amount of spun yarn 16 is temporarily accumulated on the slack eliminating roller 30. As described above, the spun yarn 16 is wound around the slack eliminating roller 30, thereby restricting fluctuation of yarn tension at upstream of the slack eliminating roller 30. The slack eliminating roller 30 is driven and actively rotated by the motor 36, whereby the wound spun yarn 16 is unwound from the downstream end portion of the slack eliminating roller 30, and fed to the winding device 12. That is, the slack eliminating roller 30 also functions as a feed roller for feeding the spun yarn 16 fed from the spinning device 7 to the winding device 12.

[0034] The upstream guide 32 is arranged on the bracket 35, which supports the slack eliminating roller 30, and arranged slightly upstream of the slack eliminating roller 30. The upstream guide 32 appropriately guides the spun yarn 16 to the outer peripheral surface of the slack eliminating roller 30. Further, the upstream guide 32 also functions as twist prevention for preventing twists of the spun yarn 16 transmitted from the spinning device 7 from propagating to a downstream side of the upstream guide 32.

[0035] The downstream guide 33 is also arranged on the bracket 35. The downstream guide 33 is arranged downstream of the slack eliminating roller 30. The downstream guide 33 guides the spun yarn 16 unwound from the slack eliminating roller 30 to the winding device 12.

[0036] As illustrated in FIG. 3 and FIGS. 4A and 4B, the yarn detecting sensor 34 is a reflective photo sensor (a photo interrupter) including a light emitting element 41 and a light receiving element 42 which are accommodated in a case 44a and a case 44b, respectively. An opening 40a through which light of the light emitting element 41 passes is formed on a surface (a light emitting surface) of the case 44a at a slack eliminating roller 30 side. An opening 40b through which incoming light reflected from the slack eliminating roller 30 passes to the light receiving element 42 is formed on a surface (a light receiving surface) of the case 44b at the slack eliminating roller 30 side. Accordingly, light emitted to the outside from the light emitting element 41 through the opening 40a is reflected from the surface of the slack eliminating roller 30, and then the reflected light is received by the light receiving element 42 through the opening 40b.

[0037] As illustrated in FIGS. 4A and 4B, the light emitting element 41 is arranged to irradiate light to a prescribed position on the yarn accumulating roller 30 that is located in a middle portion of the yarn accumulating roller 30 in its rotational axis direction. If the spun yarn 16 is present at the prescribed position, the irradiated light from the light emitting element 41 hits the spun yarn 16, and is reflected from the spun yarn 16. A reflection rate in such a case is lower than a reflection rate in a

case in which the spun yarn 16 is not present and light is directly reflected from the surface of the metallic slack eliminating roller 30. Therefore, an amount of light received by the light receiving element 42 decreases. Accordingly, the yarn detecting sensor 34 can detect from changes in the amount of light received by the receiving element 42, whether or not the spun yarn 16 is wound to the prescribed position (a yarn detecting position) on the outer peripheral surface of the slack eliminating roller 30 that is located in a middle portion of the yarn accumulating roller 30 and whether or not at least a prescribed amount of spun yarn 16 is accumulated.

[0038] If the yarn clearer 11 detects a yarn defect in the spun yarn 16 and the spun yarn 16 is cut by the cutter 10, a very small amount of yarn portion may remain on the slack eliminating roller 30 as will be described below. After the spun yarn 16 is cut by the cutter 10, the spun yarn 16 at the package 17 side is normally unwound from the slack eliminating roller 30 and wound into the package 17. However, if a yarn defect is present at a yarn portion at the package 17 side, the strength of the spun yarn 16 is partially lowered at such a yarn defect portion. As a result, the spun yarn 16 may break at the yarn defect portion, and one yarn portion that is not wound into the package 17 may remain on the slack eliminating roller 30.

[0039] As described above, if very small amount of yarn portion (yarn waste) is present on the slack eliminating roller 30, when yarn splicing is carried out by the yarn splicing device 92 and the winding of the package 17 is resumed, the yarn portion remaining on the slack eliminating roller 30 moves towards the package 17 along with the spun yarn 16 fed after the resumption of the winding. The yarn portion thus may be mixed in the package 17, thereby lowering the quality of the package 17.

[0040] In the present embodiment, after the spun yarn 16 is cut by the cutter 10, the yarn detecting sensor 34 detects whether or not a small amount of yarn portion 16a is remaining on the surface of the slack eliminating roller 30. A determination as to whether or not to carry out yarn splicing by the yarn splicing device 92 (i.e., whether or not to resume the winding of the package 17) is carried out according to a detection result of the yarn detecting sensor 34. A detailed description will be made later on such a determination on whether or not to carry out yarn splicing.

[0041] There are cases where the yarn portion 16a that is present on the surface of the slack eliminating roller 30 is a small amount of spun yarn 16 wound on the slack eliminating roller 30 by about one to two times. It is preferable that the size of the opening 40a of the light emitting element 41 is determined such that the yarn portion 16a can be detected. Specifically, as illustrated in FIGS. 4A and 4B and FIG. 5, an irradiated range A on the slack eliminating roller 30 is defined by the opening 40a. The opening 40a is formed in a slit shape that is long in one direction. A width W1 in the shorter direction of the slit-shaped opening 40a is set such that a width W2 of the irradiated range A is substantially equal to a thickness D of the spun yarn 16.

[0042] Due to such a structure, even if the amount of the remaining yarn portion 16a is small as illustrated in FIG. 5, the size of a portion occupied by the yarn portion 16a with respect to the irradiated range A of the light from the opening 40a becomes large. Consequently, the yarn detecting sensor 34 can reliably detect a very small amount of yarn portion 16a. The light of the light emitting element 41 passes through the opening 40a, and reaches the surface of the slack eliminating roller 30 while slightly spreading, thereby forming the irradiated range A. Therefore, the width W1 of the opening 40a needs to be slightly smaller than the thickness D of the spun yarn 16. In other words, the relation of the width W1 of the opening 40a, the width W2 of the irradiated range A, and the thickness D of the spun yarn 16 is $W1<W2=D$.

[0043] If a longitudinal direction of the slit-shaped opening 40a and the yarn portion 16a of the spun yarn 16 to be detected are substantially parallel, an amount of yarn that falls within the irradiated range A increases and the detection accuracy of the yarn detecting sensor 34 is improved. As illustrated in FIG. 3, when the spun yarn 16 is wound around the slack eliminating roller 30 during winding of the package 17 by the winding device 12, the spun yarn 16 is substantially parallel to a peripheral direction of the slack eliminating roller 30. After the spun yarn 16 is cut by the cutter 10, if the spun yarn 16 at the package 17 side is further cut at the yarn defect portion, there is a sufficient possibility in which the spun yarn 16 is remaining on the slack eliminating roller 30 while being substantially parallel to the peripheral direction of the slack eliminating roller 30. In order to more reliably detect such remaining yarn portion 16a, the longitudinal direction of the slit-shaped opening 40a is preferably parallel to the peripheral direction of the slack eliminating roller 30.

[0044] Further, in the present embodiment, the yarn detecting sensor 34 for detecting whether or not at least a prescribed amount of spun yarn 16 is wound around the slack eliminating roller 30 during winding of the package 17 is also used as a sensor for detecting the spun yarn 16 remaining on the surface of the slack eliminating roller 30 at the time of yarn cut. Accordingly, without increasing the number of sensors, the yarn portion 16a remaining on the slack eliminating roller 30 can be detected at the time of yarn cut.

[0045] After the spun yarn 16 is cut by the cutter 10, the yarn splicing cart 3 equipped with the yarn splicing device 92 travels to a position in a lower side of the slack eliminating roller 30 of the spinning unit 2. Further, the drafting of the sliver 14 (the production of fiber bundle 15) by the draft device 6 and the spinning by the spinning device 7 are resumed. The yarn end at the package 17 side and the yarn end of the spun yarn 16 newly fed from the spinning device 7 are spliced together by the yarn splicing device 92, and then the winding by the winding device 12 is resumed.

[0046] The yarn splicing cart 3 is provided with a first

nozzle 45 and a second nozzle 46 (i.e., a fluid blowing device) for blowing air towards the slack eliminating roller 30. The first nozzle 45 and the second nozzle 46 are respectively connected to an air supply source (not illustrated in the drawings) via a supply valve 47 (refer to FIG. 7) arranged on the yarn splicing cart 3. Both the first nozzle 45 and the second nozzle 46 blow air towards the outer peripheral surface of the slack eliminating roller 30. Further, the first nozzle 45 blows air towards the tapered upstream end portion of the slack eliminating roller 30. Such a blowing direction of the first nozzle 45 is a radial direction of the slack eliminating roller 30. The second nozzle 46 blows air towards the tapered downstream end portion of the slack eliminating roller 30. A tip end portion (an air injecting section) of the second nozzle 46 is arranged to face to a middle portion of the slack eliminating roller 30 in the rotational axis direction thereof and arranged to be inclined with respect to the radial direction of the slack eliminating roller 30.

[0047] The first nozzle 45 and the second nozzle 46 blow air towards the outer peripheral surface of the slack eliminating roller 30 from both end portions of the slack eliminating roller 30 in the axial direction thereof, thereby removing the yarn portion 16a of the spun yarn 16 remaining on the outer peripheral surface of the slack eliminating roller 30. Further, the yarn portion 16a removed from the slack eliminating roller 30 by the air blown from the first nozzle 45 and the second nozzle 46 is sucked and discharged by a cleaning suction pipe (not illustrated in the drawings) arranged in the vicinity of the slack eliminating roller 30.

[0048] As illustrated in FIG. 3, the first nozzle 45 and the second nozzle 46 are arranged to sandwich the yarn detecting sensor 34 with respect to the rotational axis direction of the slack eliminating roller 30. The air blown from the first nozzle 45 and the second nozzle 46 to both end portions of the slack eliminating roller 30 flows over the outer peripheral surface of the slack eliminating roller 30 in the rotational axis direction thereof, and reaches a middle portion of the slack eliminating roller 30, which is an irradiating position of the light emitting element 41 of the yarn detecting sensor 34. Therefore, even if the yarn portion 16a remains at a position located away from the irradiating position of the light emitting element 41 on the surface of the slack eliminating roller 30 (i.e., the yarn detecting position of the yarn detecting sensor 34), the yarn portion 16a is transferred to the yarn detecting position of the yarn detecting sensor 34 by the air blown from the first nozzle 45 and the second nozzle 46. Consequently, the yarn portion 16a remaining on the surface of the slack eliminating roller 30 is reliably detected by the yarn detecting sensor 34.

[0049] If a position of a tip end portion (an air injecting section) of the first nozzle 45 and a position of the tip end portion (the air injecting section) of the second nozzle 46 are the same with respect to the peripheral direction of the slack eliminating roller 30, air which is blown from the first nozzle 45 and the second nozzle 46 to the slack eliminating roller 30 and flows in the axial direction of the slack eliminating roller 30 collides with each other on the surface of the slack eliminating roller 30. Accordingly, there are cases where the yarn portion 16a remaining on the surface of the slack eliminating roller 30 cannot move in the axial direction of the slack eliminating roller 30. Consequently, there is a possibility that the spun yarn 16 may be stopped at the position located away from the yarn detecting position of the yarn detecting sensor 34. As illustrated in FIG. 6, the position of the tip end portion of the first nozzle 45 is thus arranged to be displaced from the position of the tip end portion of the second nozzle 46 in the peripheral direction of the slack eliminating roller 30. According to such a configuration, the yarn portion 16a is pressed at two portions thereof by force of the air injected from the first nozzle 45 and the second nozzle 46. Accordingly, the yarn portion 16a can move in the rotational axis direction of the slack eliminating roller 30.

[0050] The following is another reason that the first nozzle 45 and the second nozzle 46 blow air in the spinning machine 1 according to the present embodiment. As is obvious from FIG. 2, a feed roller for feeding the spun yarn 16 to the winding device 12 is not provided at the downstream of the spinning device 7 in the spinning machine 1 according to the present embodiment. In place of the feed roller, the actively-rotating slack eliminating roller 30 functions to pull out the spun yarn 16 from the spinning device 7 to a downstream side.

[0051] If the spun yarn 16 is excessively wound at high density around the slack eliminating roller 30, yarn tension of the spun yarn 16 at an upstream side of the slack eliminating roller 30 is extremely increased, which causes a defective yarn to be produced. Further, the yarn detecting sensor 34 detects whether or not the spun yarn 16 is wound to a middle portion of the slack eliminating roller 30. However, the yarn detecting sensor 34 is not configured capable of monitoring the excessive winding of the spun yarn 16 on the slack eliminating roller 30. Accordingly, in order to increase an acceptable amount of spun yarn 16 to be wound around the slack eliminating roller 30, the diameter of the slack eliminating roller 30 is set to be larger than the diameter of a conventional slack eliminating roller. However, if the diameter of the slack eliminating roller 30 is set to be large, the area of the outer peripheral surface of the slack eliminating roller 30 also becomes large. When a small amount of yarn portion 16a is remaining on the slack eliminating roller 30 after yarn cut by the cutter 10, it is difficult to reliably detect the yarn portion 16a remaining somewhere on the large surface of the slack eliminating roller 30 by a single yarn detecting sensor 34 having a fixed irradiating position. Therefore, the first nozzle 45 and the second nozzle 46 blow air to the surface of the slack eliminating roller 30. Accordingly, the yarn portion 16a is moved on the surface of the slack eliminating roller 30 so as to fall within the yarn detecting position of the yarn detecting sensor 34.

[0052] Next, an electrical configuration of the spinning machine 1 will be described with reference to a block diagram of FIG. 7. As illustrated in FIG. 7, the main control section 96 (a control device) controls the entire spinning machine 1. The main control section 96 is connected to unit controllers 21 of the plurality of spinning units 2 and a controller 50 of the yarn splicing cart 3. The main control section 96 performs control and state monitoring of the plurality of spinning units 2 and the yarn splicing cart 3.

[0053] The unit controller 21 of the spinning unit 2 includes a Central Processing Unit (CPU) that is an arithmetic processing unit, a Read-Only Memory (ROM), a Random Access Memory (RAM), an input/output interface, and the like. The ROM stores programs to be executed by the CPU, and data used for the programs. The RAM temporarily stores data at the time of program execution. The input/output interface carries out input and output of data with the outside. The main control section 96, the unit controllers 21 of the plurality of spinning units 2, and the controller 50 of the yarn splicing cart 3 perform the following processes in addition to the package winding process realized by the control of the spinning device 7 and the winding device 12.

[0054] During spinning by the spinning device 7, the yarn detecting sensor 34 detects whether or not the spun yarn 16 is present at the prescribed yarn detecting position on the outer peripheral surface of the slack eliminating roller 30 that is located in the middle portion of the slack eliminating roller 30 (i.e., whether or not the prescribed amount of spun yarn 16 is wound from the upstream end portion to the middle portion of the slack eliminating roller 30). If a determination is made that an amount of the spun yarn 16 wound around the slack eliminating roller 30 has become small, the unit controller 21 controls winding speed of the winding device 12 to be reduced, for example, in order to maintain a state in which at least a prescribed amount of the spun yarn 16 is always wound around the slack eliminating roller 30.

[0055] If a yarn defect is detected in the spun yarn 16 by the yarn clearer 11 and a yarn defect detection signal is received from the yarn clearer 11, the unit controller 21 controls the cutter 10 to cut the spun yarn 16. The controller 50 of the yarn splicing cart 3, which carries out yarn splicing after the yarn cut, controls the supply valve 47 to blow air from the first nozzle 45 and the second nozzle 46 towards the slack eliminating roller 30. At this point of time, if the yarn portion 16a is remaining on the surface of the slack eliminating roller 30, the yarn portion 16a is detected by the yarn detecting sensor 34. A detection result of the yarn detecting sensor 34 is transmitted from the unit controller 21 to the main control section 96. The main control section 96 determines whether or not to control the yarn splicing device 92 to carry out yarn splicing in accordance with the detection result of the yarn detecting sensor 34 (in accordance with the presence or absence of the yarn portion 16a).

[0056] A series of processes performed in the spinning unit 2 and the yarn splicing cart 3 at the time of the above-described yarn defect detection will be described with reference to flowcharts of FIGS. 8 and 9. In FIGS. 8 and 9, Si (i=10, 11, ...) indicates the step number.

[0057] If a yarn defect is detected in the spun yarn 16 by the yarn clearer 11 (step S10: Yes), the unit controller 21 controls the cutter 10 to cut the spun yarn 16 (step S11) . At the same time, the main control section 96 stops feeding and drafting of the sliver 14 by the draft device 6 (i.e., driving of the front roller 26 and the middle roller 25). Then, the main control section 96 stops the spinning by the spinning device 7 (i.e., supplying of air to the pneumatic spinning device 7) (step S12) . Further, in accordance with a yarn defect detection signal transmitted from the yarn clearer 11, there are cases where the main control section 96 determines that the detected yarn defect is not a temporarily-occurring defect, but a major defect (e.g., a very long-lasting yarn defect) caused by a trouble occurring in the spinning unit 2 (step S13: Yes). In this case, the main control section 96 controls the unit controller 21 to light an abnormal display lamp and the like in order to notify an operator of such an abnormal state, and urges the operator to check and/or replace components such as various rollers (operator call: step S14) . Then, if the abnormal state is solved by the operator, the main control section 96 determines that yarn splicing can be carried out. Then, the main control section 96 transmits a signal to the controller 50 of the yarn splicing cart 3, and controls the yarn splicing cart 3 to travel to a position located close to the slack eliminating roller 30 (a position at a lower side of the slack eliminating roller 30) of the spinning unit 2 in which the yarn defect was detected and the yarn cut was carried out (yarn splicing cart call: step S17).

[0058] Meanwhile, if the main control section 96 determines that the detected yarn detect is a minor temporarily-occurring defect (step S13: No), the yarn detecting sensor 34 detects whether or not a small amount of the spun yarn 16 is remaining on the slack eliminating roller 30 due to the spun yarn 16 at the package 17 side being cut at the yarn defect portion at the time of yarn cut (step S15). If the yarn portion 16a is detected by the yarn detecting sensor 34 (step S15: Yes), the main control section 96 notifies the operator of such an abnormal state by lighting the abnormal display lamp, and the like, and urges the operator to remove the remaining yarn portion 16a (operator call: step S16). Then, when the operator removes the yarn portion 16a and the abnormal state is solved, a determination is made again as to whether or not the yarn portion 16a is surely removed in step S15. If the yarn portion 16a is not detected by the yarn detecting sensor 34 (step S15: No), the main control section 96 transmits a signal to the controller 50 of the yarn splicing cart 3, controls the yarn splicing cart 3 to travel to the position located close to the slack eliminating roller 30 (the position in the lower side of the slack eliminating roller 30) of the spinning unit 2 in which the yarn defect was detected and the yarn cut was carried out (yarn splicing cart call: step S17), and then controls a yarn splicing

process described below to be performed (step S20).

[0059] In the present embodiment, after the cutting of the spun yarn 16 by the cutter 10 and before the travelling of the yarn splicing cart 3, the main control section 96 determines whether or not to control the yarn splicing cart 3 to travel in accordance with a detection result of the yarn detecting sensor 34, thereby minimizing unnecessary travelling of the yarn splicing cart 3 under a state in which yarn splicing is prohibited.

[0060] Next, the flow of the yarn splicing process will be described with reference to FIG. 9. When the yarn splicing cart 3 arrives at the spinning unit 2 in which the spun yarn 16 has been cut by the cutter 10, the controller 50 of the yarn splicing cart 3 controls the supply valve 47 to blow air from the first nozzle 45 and the second nozzle 46 towards the slack eliminating roller 30 (step S21) . The air blown from the first nozzle 45 and the second nozzle 46 to the both end portions of the slack eliminating roller 30 flows along the outer peripheral surface of the slack eliminating roller 30 and reaches the middle portion of the slack eliminating roller 30 that is the yarn detecting position of the yarn detecting sensor 34. Therefore, even if the yarn portion 16a is remaining at the position located away from the yarn detecting position of the slack eliminating roller 30, the yarn portion 16a is transferred to the yarn detecting position.

[0061] As illustrated in FIG. 6, with respect to the peripheral direction of the slack eliminating roller 30, the position of the tip end portion of the first nozzle 45 is displaced from the position of the tip end portion of the second nozzle 46. It is preferable that the slack eliminating roller 30 is rotated under such a state in which air is blown from the first nozzle 45 and the second nozzle 46. A position in which the air collides with the yarn portion 16a remaining on the surface of the slack eliminating roller 30 (i.e., a position on which the air acts) is continuously changed by the above-described rotation of the slack eliminating roller 30, thereby greatly vibrating the yarn portion 16a in the rotational axis direction of the slack eliminating roller 30 (i.e., a horizontal direction in FIG. 6) . Consequently, even if an initial position of the yarn portion 16a is located away from the yarn detecting position of the yarn detecting sensor 34 in the rotational axis direction of the slack eliminating roller 30, the yarn portion 16a can be easily detected by the yarn detecting sensor 34.

[0062] After the air is blown from the first nozzle 45 and the second nozzle 46, if the yarn portion 16a is detected by the yarn detecting sensor 34 (step S22: Yes), the main control section 96 notifies the operator of such a state and urges the operator to remove the remaining yarn portion 16a from the slack eliminating roller 30 (operator call: step S23) . Then, when the operator removes the yarn portion 16a from the slack eliminating roller 30 and the abnormal state is solved, air is blown again from the first nozzle 45 and the second nozzle 46 (step S21) . Furthermore, in step S22, a determination is carried out as to whether or not the yarn portion 16a is surely removed from the slack eliminating roller 30.

[0063] Meanwhile, when the yarn portion 16a is not detected by the yarn detecting sensor 34 even if air is blown from the first nozzle 45 and the second nozzle 46 (step S22: No), a determination is made that no yarn portion 16a is present on the surface of the slack eliminating roller 30. Then, the main control section 96 controls to start feeding and drafting of the sliver 14 by the draft device 6 and spinning by spinning device 7. A yarn end of the spun yarn 16 newly fed from the spinning device 7 and a yarn end at the package 17 side are spliced together by the yarn splicing device 92 (yarn splicing operation: step S24).

[0064] A determination as to whether or not such a yarn splicing operation has succeeded is carried out in accordance with detection results of the yarn detecting sensor 34 and the travelling yarn detecting sensor 28 (refer to FIG. 2) (step S25) . If the spun yarn 16 is detected by both the yarn detecting sensor 34 and the travelling yarn detecting sensor 28, a determination is made that the yarn splicing operation has succeeded. If the spun yarn 16 is not detected by either the yarn detecting sensor 34 or the travelling yarn detecting sensor 28, a determination is made that the yarn splicing operation has failed. If a determination is made that the yarn splicing operation has succeeded (step S25 : Yes), the winding operation of the package 17 by the winding device 12 is resumed.

[0065] If a determination is made that the yarn splicing operation has failed (step S25: No) , the abnormal state is notified to the operator, and the operator is urged to check components that are used during the yarn splicing operation by the yarn splicing device 92 and the like (operator call: step S26) . After the check by the operator is completed and the abnormal state is solved, the process proceeds onto step S21. Then, air is blown again from the first nozzle 45 and the second nozzle 46 to the slack eliminating roller 30. At this point of time, a detection is carried out as to whether or not a small amount of yarn portion 16a, which may have been generated due to failure of the yarn splicing operation, is remaining on the surface of the slack eliminating roller 30. If the yarn portion 16a is not remaining on the slack eliminating roller 30, the yarn splicing operation is performed again (step S24).

[0066] Even when the yarn portion 16a, which has been generated due to failure of the yarn splicing operation, is remaining on the surface of the slack eliminating roller 30, if the yarn portion 16a can be reliably removed from the slack eliminating roller 30 at the time of the check by the operator, the yarn splicing operation (step S24) may be performed immediately without blowing air from the first nozzle 45 and the second nozzle 46 (step S21) and detecting the yarn portion 16a by the yarn detecting sensor 34 (step S22) . However, since there is a possibility in which the operator overlooks the yarn portion 16a, there is no guarantee that the remaining yarn portion 16a is always removed. Accordingly, as described above, in order to carry out the yarn splicing operation under a

state in which the yarn portion 16a is not present on the slack eliminating roller 30, the detection of the yarn portion 16a is carried out again by the yarn detecting sensor 34 (step S22), and then the yarn splicing operation is carried out(step S24).

[0067] A determination as to whether or not the main control section 96 controls the yarn splicing device 92 to perform a yarn splicing operation in accordance with a detection result of the yarn detecting sensor 34 may be made such that the yarn splicing operation is prohibited immediately after the yarn detecting sensor 34 detects the yarn portion 16a for even a second. Alternatively, after the yarn detecting sensor 34 instantaneously detects the yarn portion 16a, if a state in which the yarn portion 16a is not detected lasts for a certain period of time, a determination may be made that although the yarn portion 16a initially remained on the slack eliminating roller 30, the yarn portion 16a has been removed from the slack eliminating roller 30 by blowing air from the first nozzle 45 and the second nozzle 46, and the yarn splicing operation may be permitted.

[0068] Next, alternative embodiments in which various modifications are added to the above-described embodiment will be described. The same reference numerals are denoted for the configurations similar to those of the above-described embodiment, and the description thereof will be appropriately omitted.

[0069] 1) In the above-described embodiment, the first nozzle 45 and the second nozzle 46 for blowing air to the surface of the slack eliminating roller 30 are arranged on the yarn splicing cart 3 equipped with the yarn splicing device 92. However, the first nozzle 45 and the second nozzle 46 may be arranged separately from the yarn splicing cart 3 (e.g., the first nozzle 45 and the second nozzle 46 may be arranged on the casing 13 of the spinning machine 1). In this case, after the spun yarn 16 is cut by the cutter 10, air is blown from the first nozzle 45 and the second nozzle 46 towards the slack eliminating roller 30. Only when the yarn portion 16a is not detected by the yarn detecting sensor 34 at this point of time, it is preferable to control the yarn splicing cart 3 travel. By blowing air from the first nozzle 45 and the second nozzle 46 before the travelling of the yarn splicing cart 3, even if the yarn portion 16a is remaining at a position located away from the yarn detecting position of the yarn detecting sensor 34, the yarn detecting sensor 34 can reliably detect the yarn portion 16a. Consequently, after the travelling of the yarn splicing cart 3, detection of the yarn portion 16a by the yarn detecting sensor 34 and a determination as to whether or not a yarn splicing operation is performed are not required to be carried out again.

[0070] 2) Only one nozzle may be provided for blowing air to the surface of the slack eliminating roller 30. In this case, the yarn portion 16a remaining on the surface of the slack eliminating roller 30 is moved in one direction by the air blown from the single nozzle and reaches the yarn detecting position of the yarn detecting sensor 34. If the air is to be blown from the nozzle in order to remove the yarn portion 16a from the slack eliminating roller 30 rather than transferring the remaining yarn portion 16a to the yarn detecting position of the yarn detecting sensor 34, blowing air from a single nozzle in one direction of the yarn eliminating roller 30 is preferable than blowing air from both the first nozzle 45 and the second nozzle 46 as in the above-described embodiment. Further, three or more nozzles may be provided according to a purpose of blowing air.

[0071] Further, the yarn detecting sensor 34 may be configured capable of detecting the yarn portion 16a over a wide range of the surface of the slack eliminating roller 30. For example, a plurality of yarn detecting sensors 34 may be arranged in the rotational axis direction of the slack eliminating roller 30. Alternatively, a single yarn detecting sensor may be arranged capable of scanning in the rotational axis direction of the slack eliminating roller 30. In this case, since the yarn portion 16a is not required to be moved on the surface of the slack eliminating roller 30, a nozzle for blowing air may be omitted.

[0072] 3) In the above-described embodiment, a single yarn detecting sensor 34 functions as both the sensor for detecting the spun yarn 16 wound around the slack eliminating roller 30 during winding of a package by the winding device 12 and the sensor for detecting the yarn portion 16a remaining on the slack eliminating roller 30 at the time of yarn cut by the cutter 10. However, separate sensors may be provided.

[0073] 4) The yarn detecting sensor 34 for detecting the spun yarn 16 on the surface of the slack eliminating roller 30 is not limited to the reflective photo sensor described in the above-described embodiment. Sensors with other various detection methods can be adopted as the yarn detecting sensor 34.

[0074] 5) The above-described embodiment is an example in which the present invention is applied to a spinning machine, but the application target of the present invention is not limited to the spinning machine, and the present invention can also be applied to a yarn winding machine of textile machinery other than the spinning machine.

Claims

1. A yarn winding machine comprising:

a winding device (12) which is adapted to wind a travelling yarn and to form a package,

a yarn defect detecting device (11) which is adapted to detect a defect in the yarn wound by the winding device (12),

a cutting device (10) which is adapted to cut the yarn when the yarn defect detecting device (11) detects a defect in the yarn,

a yarn splicing device (92) which is adapted to carry out a splicing operation to splice an upstream yarn end and a downstream yarn end

after the yarn is cut by the cutting device (10),
a yarn accumulating device (8) which is arranged between the winding device (12) and the cutting device (10) and adapted to temporality accumulate the yarn to be wound by the winding device (12), and
a control device (21),
wherein the yarn accumulating device (8) includes:

a yarn accumulating roller (30) which is provided rotatable and adapted to wind the yarn around a surface thereof, and
a yarn detecting sensor (34) which is adapted to detect the yarn on the surface of the yarn accumulating roller (30),

wherein when the yarn is cut by the cutting device (10), the control device (21) is adapted to determine whether or not to control the yarn splicing device (92) to perform the splicing operation in accordance with a detection result of the yarn detecting sensor (34) .

2. The yarn winding machine according to claim 1, further comprising a fluid blowing device (45, 46) which is adapted to blow fluid to the surface of the yarn accumulating roller (30),
wherein after the fluid blowing device (45, 46) blows the fluid to the surface of the yarn accumulating roller (30), the control device (21) is adapted to determine whether or not to control the yarn splicing device (92) to perform the yarn splicing operation.

3. The yarn winding machine according to claim 2, further comprising:

a plurality of spinning units (2), each spinning unit (2) including the winding device (12) , the yarn defect detecting device (11), the cutting device (10), and the yarn accumulating device (8), and
a yarn splicing cart (3) including the yarn splicing device (92) and the fluid blowing device (45, 46),
wherein when the yarn is cut by the cutting device (10) and the yarn detecting sensor (34) does not detect the yarn on the surface of the yarn accumulating roller (30), the control device (21) is adapted to control the yarn splicing cart (3) to travel to the yarn spinning unit (2) including said yarn accumulating roller (30) and to control the fluid blowing device (45, 46) to blow the fluid to the surface of the yarn accumulating roller (30), and
after the fluid blowing device (45, 46) blows the fluid to the surface of the yarn accumulating roller (30), when the yarn detecting sensor (34) does not detect a yarn on the surface of the yarn accumulating roller (30), the control device (21) is adapted to control the yarn splicing device (92) to perform the yarn splicing operation.

4. The yarn winding machine according to claim 2 or claim 3, wherein the fluid blowing device (45, 46) is adapted to blow the fluid to the yarn accumulating roller (30) such that the fluid flows from a position, which is located away from a yarn detecting position of the yarn detecting sensor (34) on the surface of the yarn accumulating roller (30) , towards the yarn detecting position.

5. The yarn winding machine according to any one of claim 2 through claim 4, wherein the fluid blowing device (45, 46) includes a first nozzle (45), which is adapted to blow fluid to a first end portion of the yarn accumulating roller (30) in a rotational axis direction thereof, and a second nozzle (46), which is adapted to blow fluid to a second end portion of the yarn accumulating roller (30) in the rotational axis direction thereof, the second end portion being arranged opposite to the first end portion, and
in a peripheral direction of the yarn accumulating roller (30) , a position of a fluid injecting section of the first nozzle (45) is displaced from a position of a fluid injecting section of the second nozzle (46).

6. The yarn winding machine according to any one of claim 2 through claim 5, wherein when the fluid blowing device (45, 46) is blowing the fluid towards the yarn accumulating roller (30), the control device (21) is adapted to control the yarn accumulating roller (30) to rotate.

7. The yarn winding machine according to any one of claim 1 through claim 6, wherein the yarn detecting sensor (34) is a reflective photo sensor including a light emitting element (41) and a light receiving element (42),
the light emitting element (41) is arranged to irradiate light to a prescribed position on the yarn accumulating roller (30) that is located in a middle portion of the yarn accumulating roller (30) in its rotational axis direction, and
the yarn detecting sensor (34) is adapted to detect whether or not the yarn is wound to the prescribed position on the yarn accumulating roller (30) during winding of the package by the winding device (12).

FIG. 1

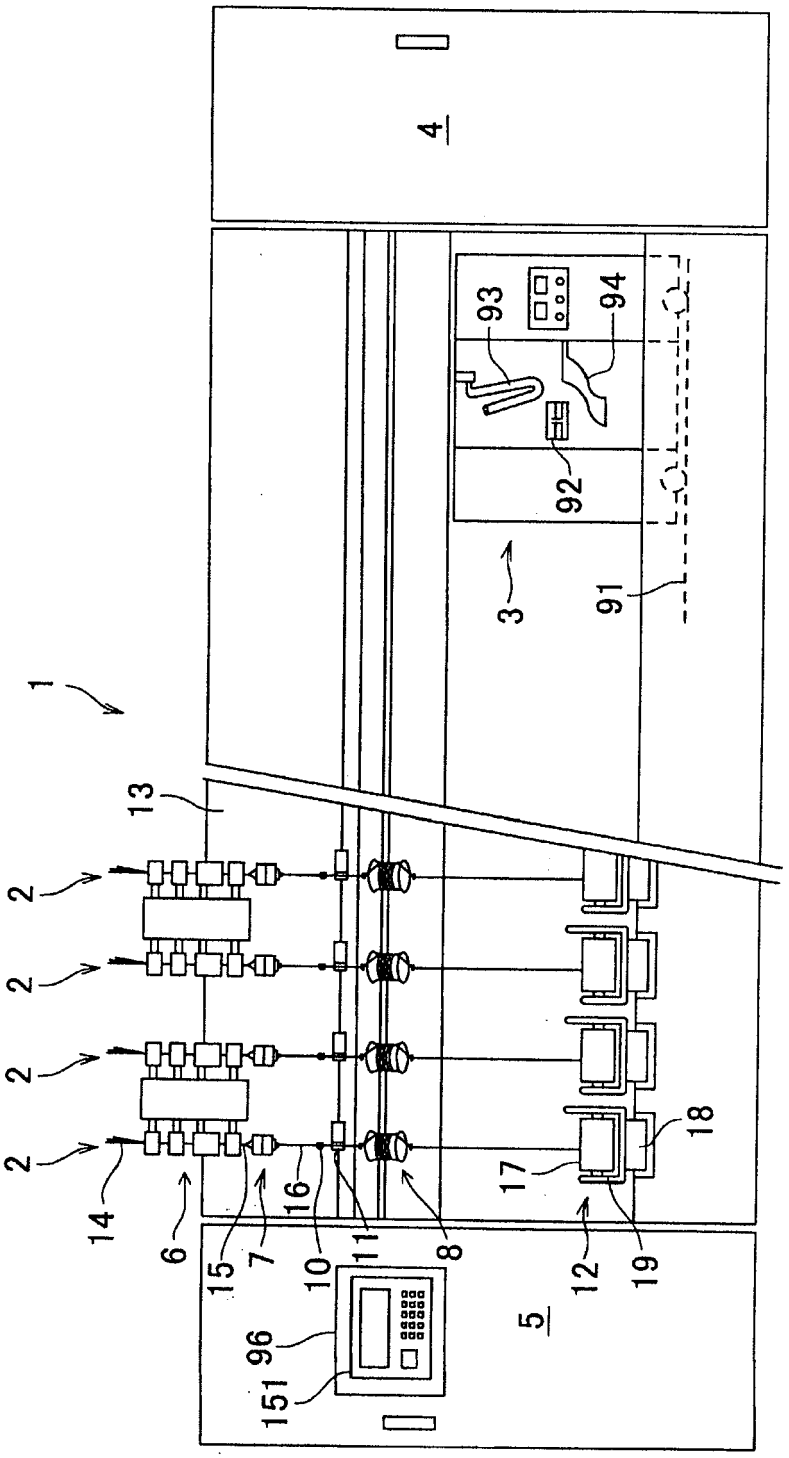


FIG. 2

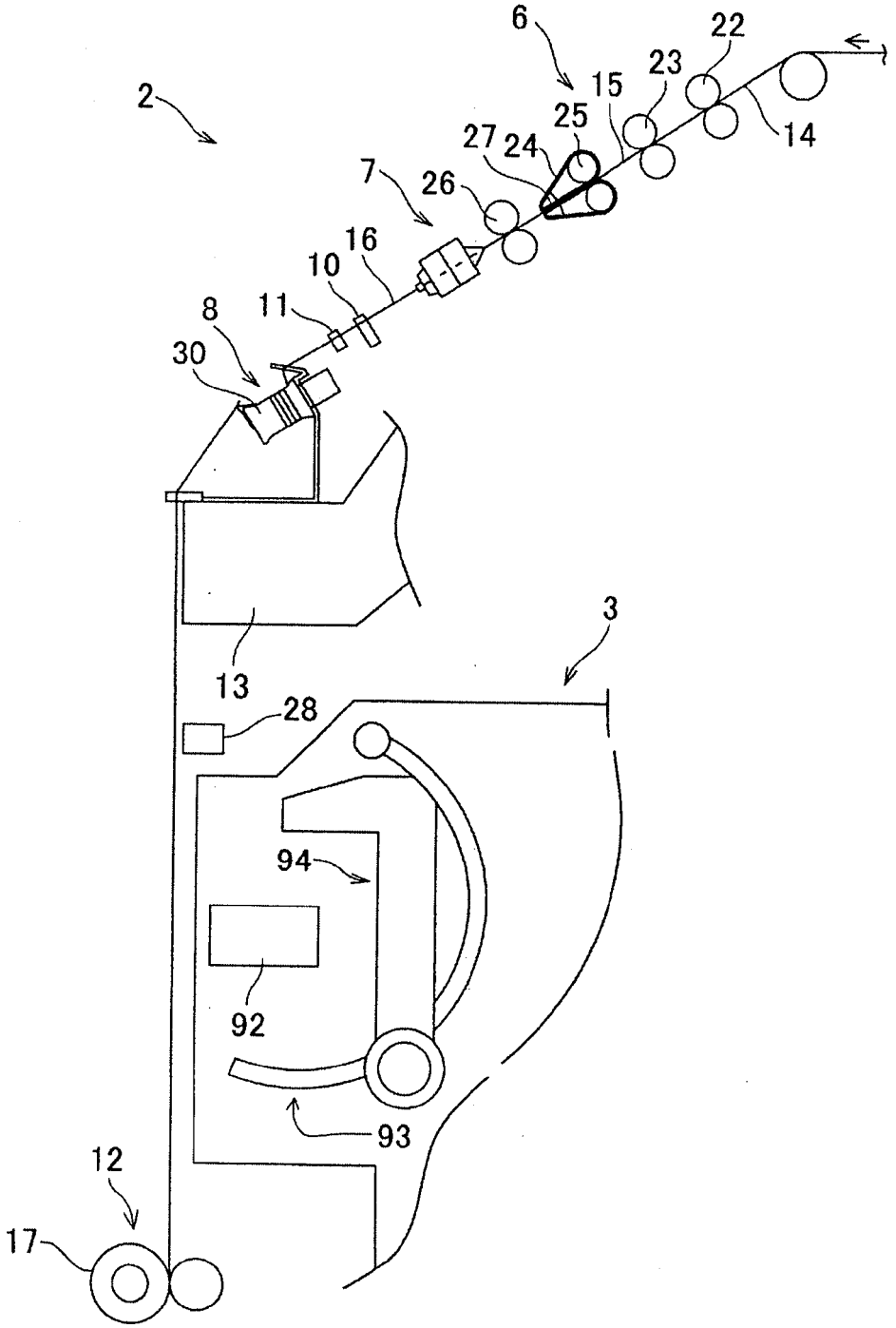


FIG. 3

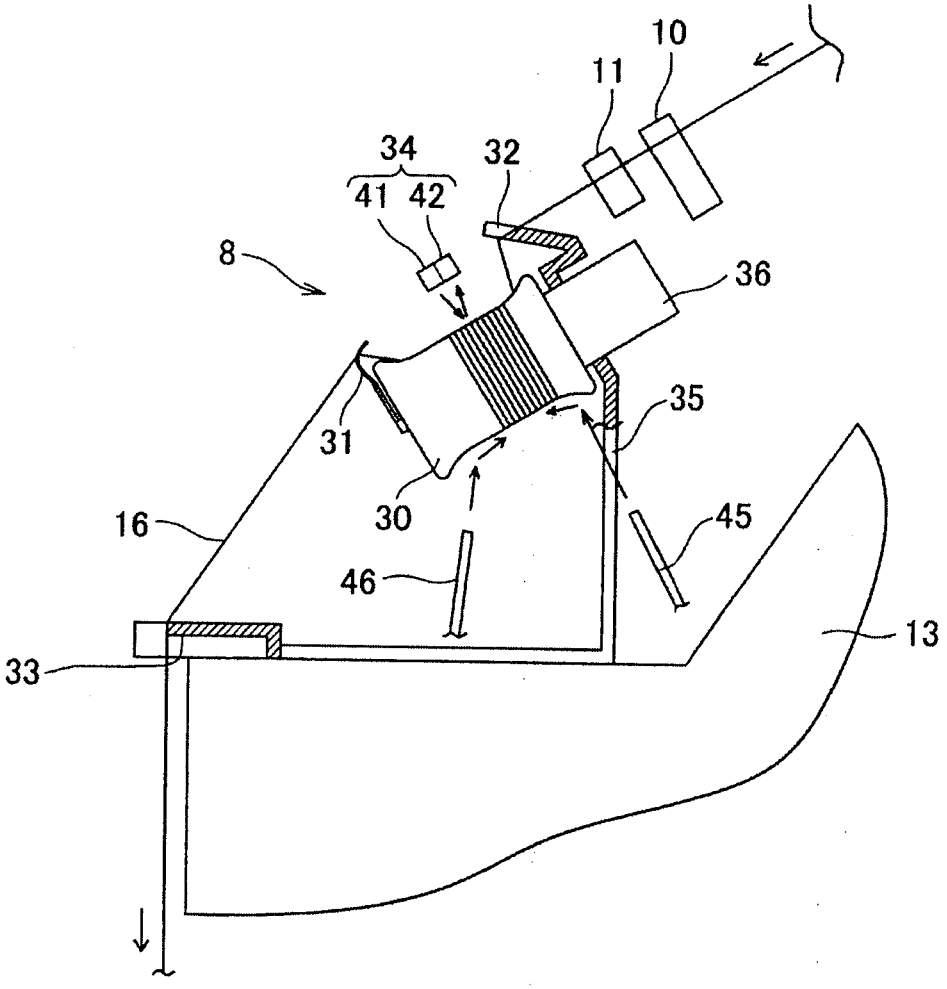


FIG. 4A

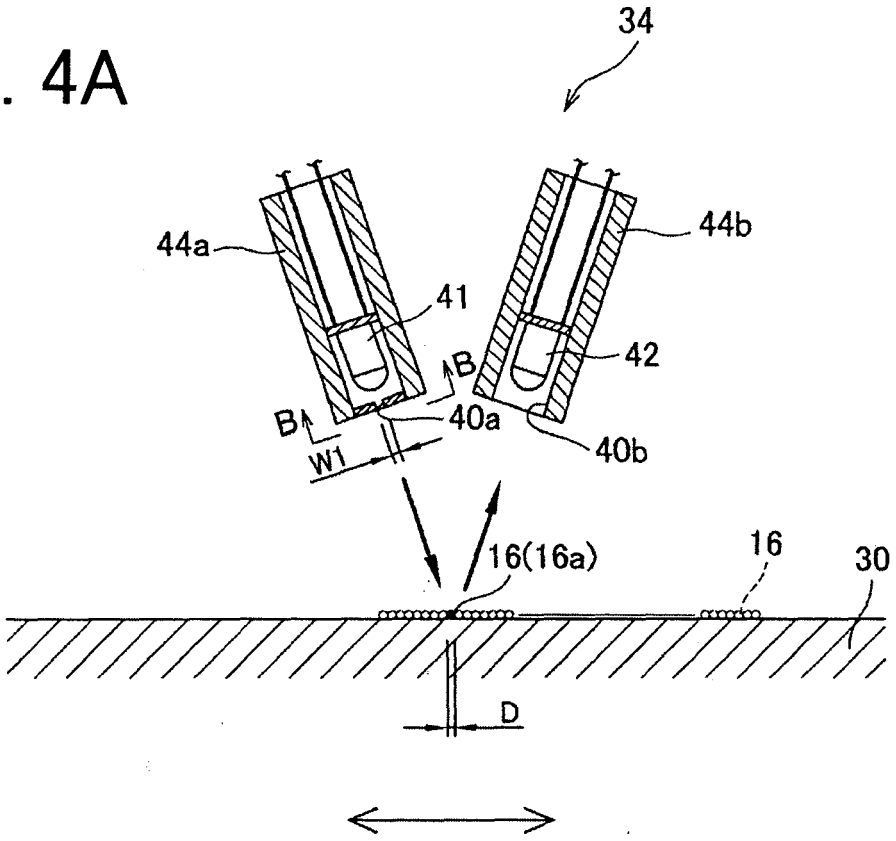

34
44a
44b
41
42
B
B
40a
40b
W1
16(16a)
16
30
D
ROLLER AXIS DIRECTION

FIG. 4B

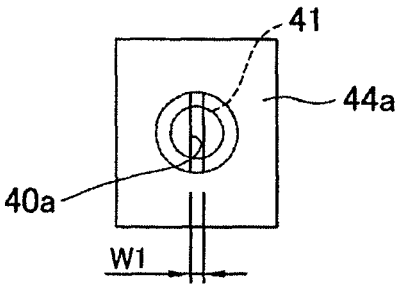

41
44a
40a
W1

FIG. 5

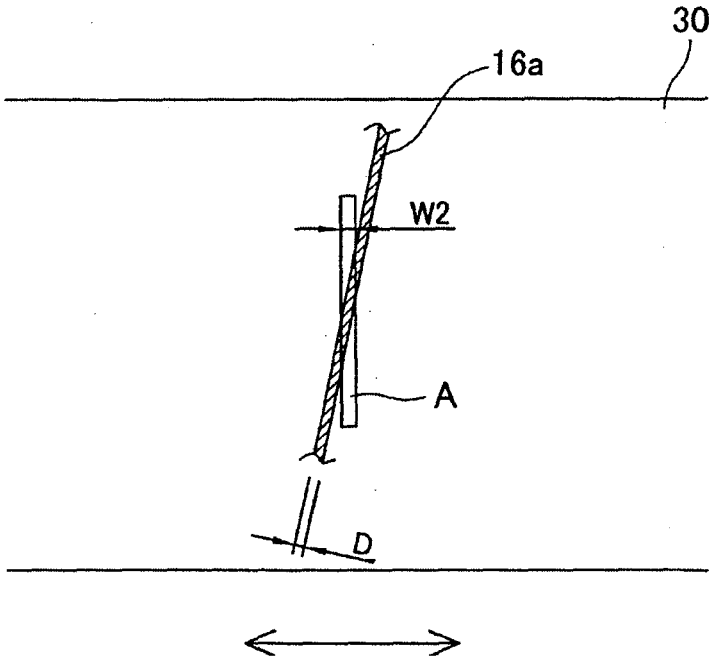


FIG. 6

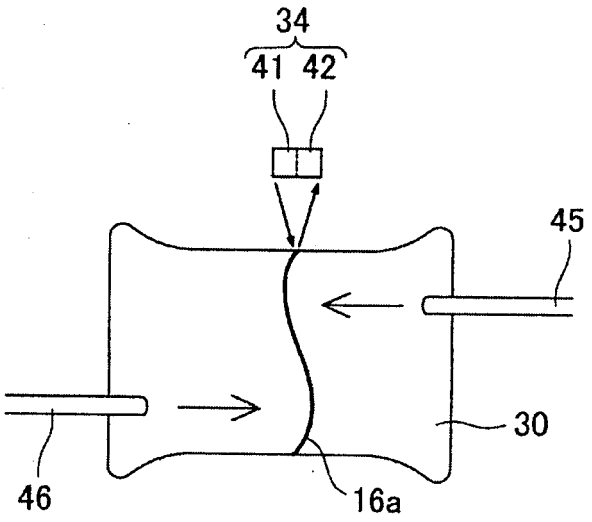


FIG. 7

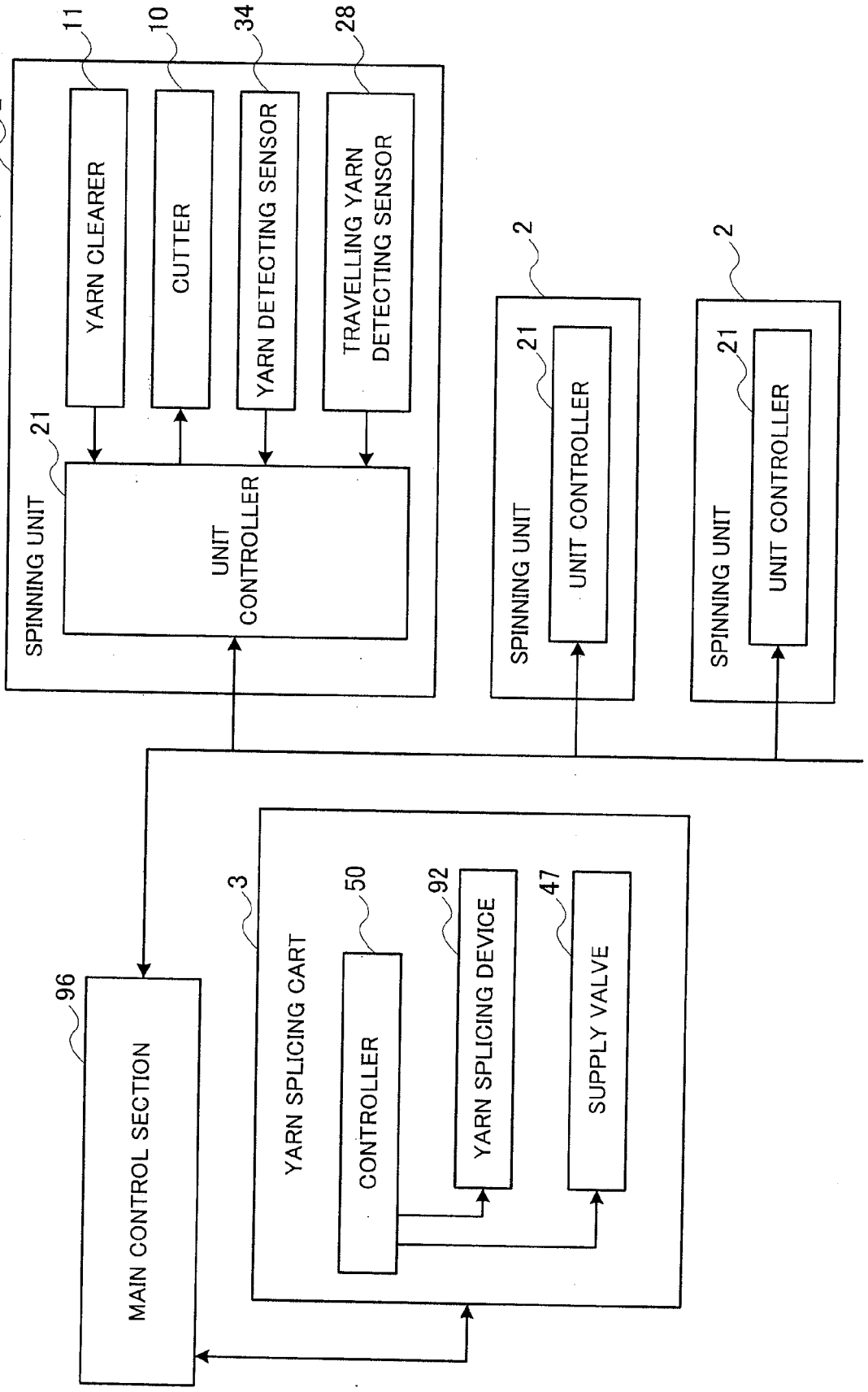

2
11
10
34
28
YARN CLEARER
CUTTER
YARN DETECTING SENSOR
TRAVELLING YARN DETECTING SENSOR
21
SPINNING UNIT
UNIT CONTROLLER
2
21
SPINNING UNIT
UNIT CONTROLLER
2
21
SPINNING UNIT
UNIT CONTROLLER
96
MAIN CONTROL SECTION
3
YARN SPLICING CART
50
CONTROLLER
92
YARN SPLICING DEVICE
47
SUPPLY VALVE

FIG. 8

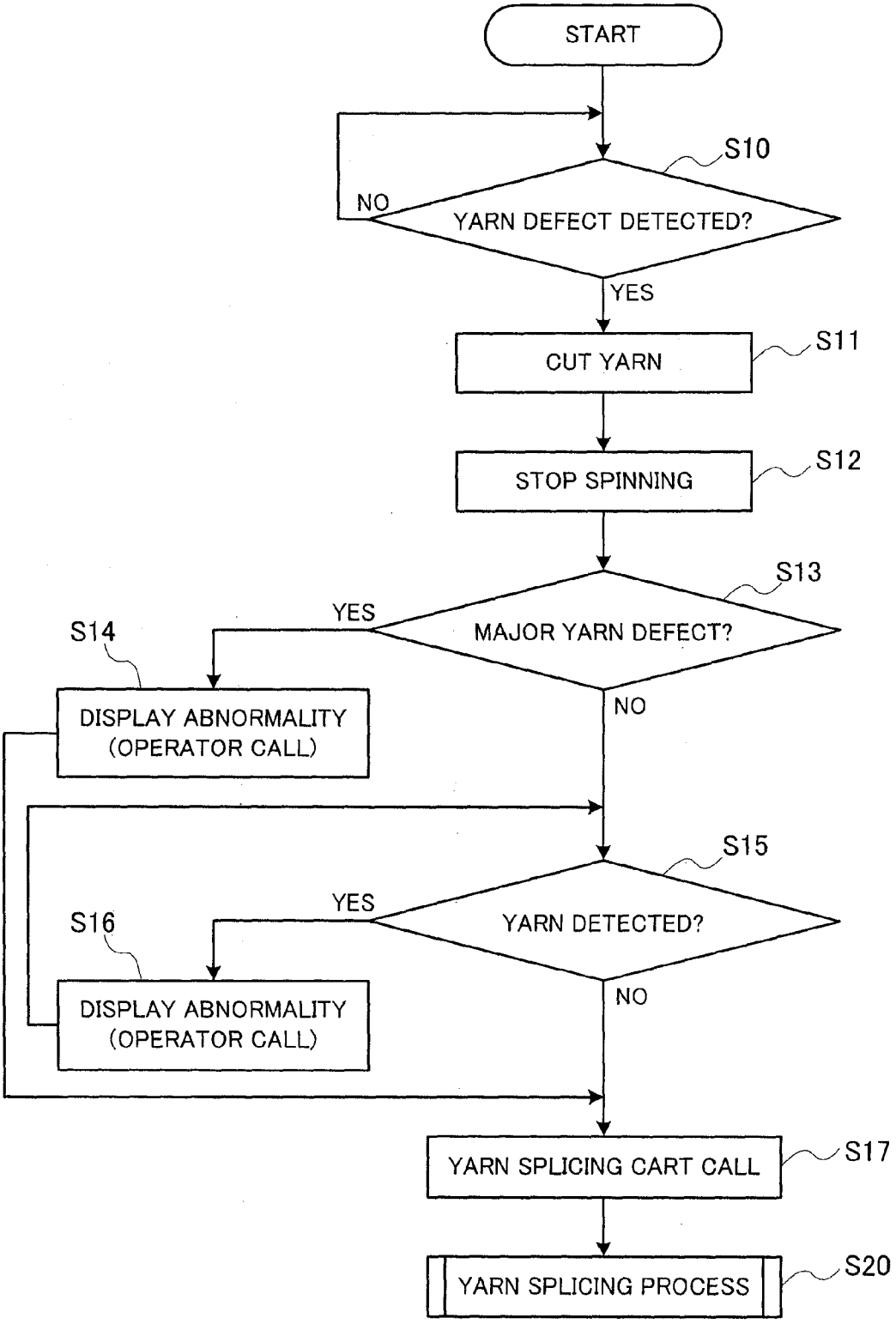
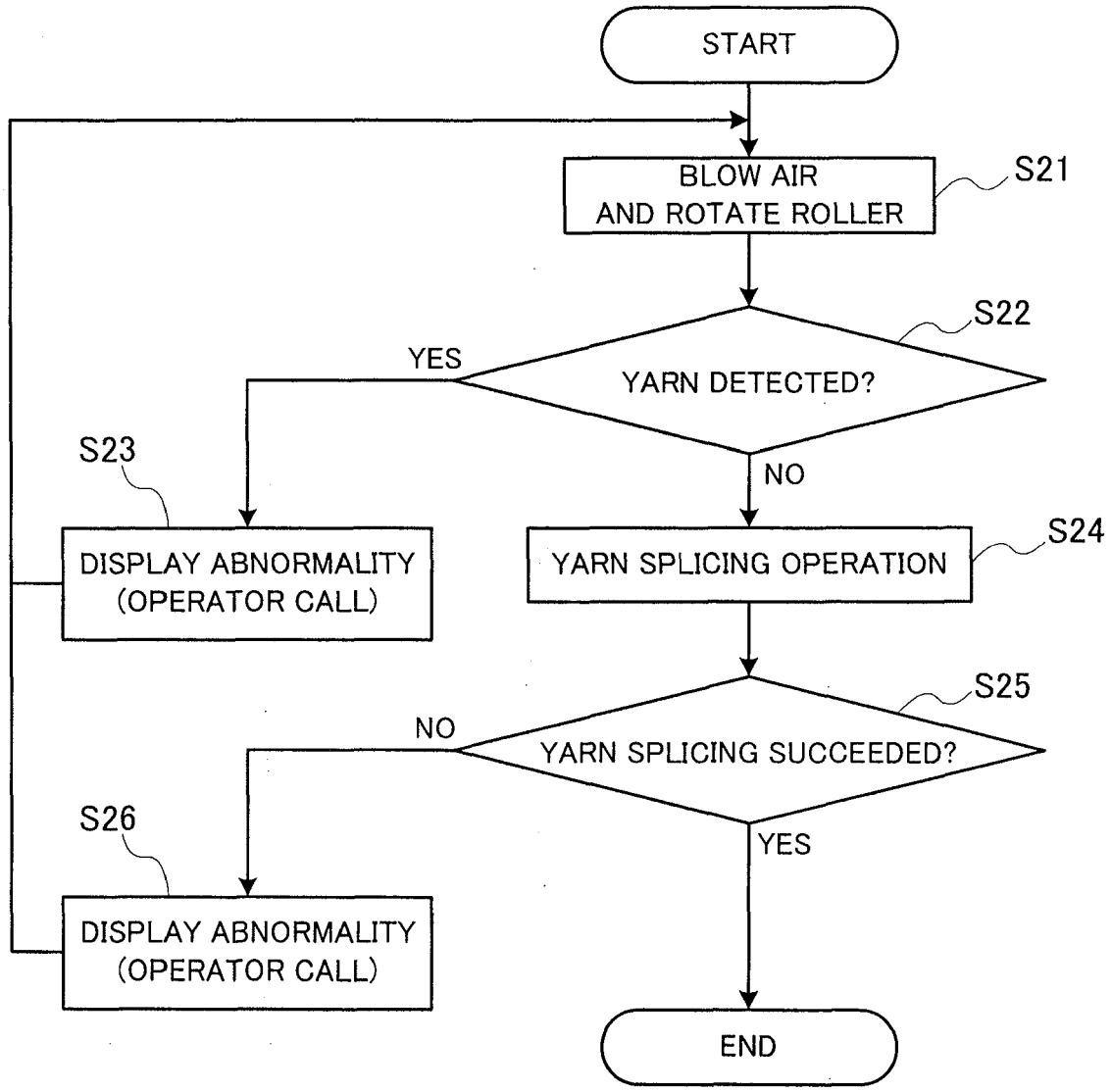

START
S10
NO
YARN DEFECT DETECTED?
YES
CUT YARN
S11
STOP SPINNING
S12
S13
YES
MAJOR YARN DEFECT?
S14
NO
DISPLAY ABNORMALITY
(OPERATOR CALL)
S15
YES
YARN DETECTED?
S16
NO
DISPLAY ABNORMALITY
(OPERATOR CALL)
YARN SPLICING CART CALL
S17
YARN SPLICING PROCESS
S20

FIG. 9


START
BLOW AIR AND ROTATE ROLLER
S21
S22
YARN DETECTED?
YES
NO
S23
DISPLAY ABNORMALITY (OPERATOR CALL)
YARN SPLICING OPERATION
S24
S25
YARN SPLICING SUCCEEDED?
NO
YES
S26
DISPLAY ABNORMALITY (OPERATOR CALL)
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009242041 A **[0004]**