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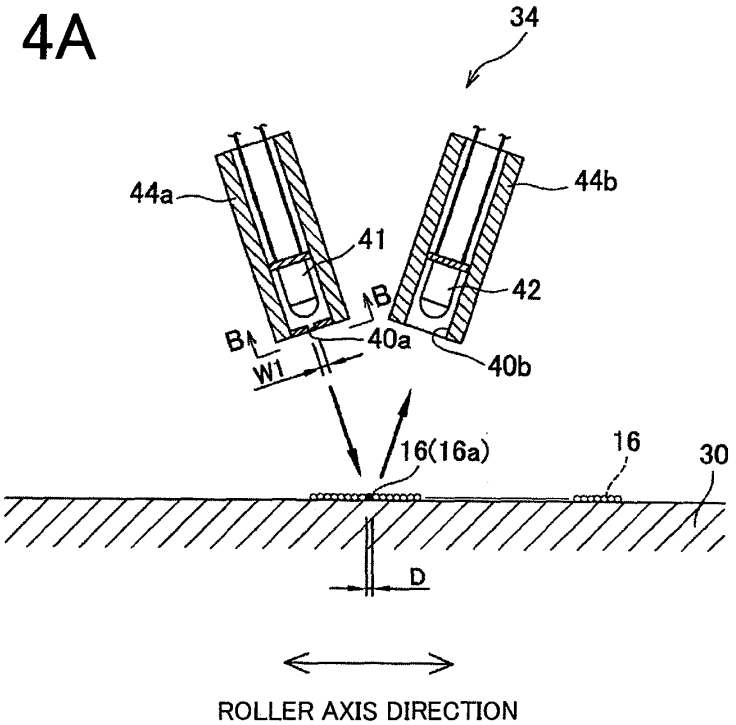
(54) Yarn winding machine

(57) A spinning machine (1) includes a winding device (12) and a slack eliminating device (8). The slack eliminating device (8) includes a slack eliminating roller (30) and a yarn detecting sensor (34). The yarn detecting sensor (34) is a reflective photo sensor having a light emitting element (41) and a light receiving element (42). An opening provided for the light emitting element (41) has a prescribed width such that a width of an irradiated range on the slack eliminating roller (30) is substantially equal to a thickness of the yarn (16).

FIG. 4A



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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 Japanese Unexamined Patent Publication No. 2009-242041 (FIG. 1, paragraph 0025) includes a spinning device, a winding device, a yarn clearer, a cutter, and a yarn accumulating device (yarn slack eliminating device). The winding device winds the yarn fed out from the spinning device into a package. The yarn clearer detects defects of the yarn before the yarn is wound into the package. When the yarn clearer detects a yarn defect, the cutter cuts the yarn. The yarn accumulating device is arranged between the winding device and the cutter. In other words, a yarn accumulating roller is arranged on a downstream side of the cutter.

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

[0004] When the yarn defect is detected by the yarn clearer and the yarn is cut with the cutter, the yarn on the package side wound on the yarn accumulating roller is unwound from the yarn accumulating roller and is normally wound to the package as is. However, the yarn defect is present at the yarn portion on the package side. The yarn strength of the relevant yarn portion is partially lowered at the yarn defect portion. Thus, the yarn breaks at the defect portion when the yarn portion is wound into the package, and one part of the yarn portion may remain on the yarn accumulating roller. If the winding of the yarn is resumed with such a yarn portion remaining at the yarn accumulating roller, such a yarn portion will be fed to the winding device along with the yarn fed from the upstream side and wound into the package. As a result, the quality of the package is lowered.

[0005] The yarn accumulating device of Japanese Unexamined Patent Publication No. 2009-242041 includes a sensor for detecting the wound amount of the yarn accumulating roller, but such a sensor merely detects whether or not the yarn of a certain amount or more is wound on the yarn accumulating roller. In other words, the sensor is not devised to detect a very small amount of yarn portion (e.g., small amount of yarn waste wound on the yarn accumulating roller by about one to two rounds) remaining on the yarn accumulating roller after yarn cutting.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a yarn winding machine capable of reliably detecting a small amount of yarn portion remaining on the yarn accumulating roller after yarn cutting.
This object is achieved by a yarn winding machine according to claim 1.

[0007] According to an aspect of the present invention, a yarn winding machine includes a winding device, a yarn defect detecting device, a cutting device, and a yarn accumulating device. The winding device forms a package by winding a traveling yarn. The yarn defect detecting device detects a yarn defect in the yarn wound by the winding device. The cutting device cuts the yarn when the yarn defect detecting device detects the yarn defect. The yarn accumulating device temporarily accumulates the yarn to be wound by the winding device. 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 is a reflective photo sensor having a light emitting element and a light receiving element. The yarn detecting sensor detects the yarn on the surface of the yarn accumulating roller. An opening (diaphragm) for restricting an irradiated range on the yarn accumulating roller is provided for the light emitting element of the yarn detecting sensor. The opening has a prescribed width such that a width of the irradiated range on the yarn accumulating roller is substantially equal to a thickness of the yarn.

[0008] The light emitted from the light emitting element of the yarn detecting sensor to the yarn accumulating roller is reflected at the surface of the yarn accumulating roller. The light receiving element of the yarn detecting sensor detects the change in the reflected amount of light. The yarn detecting sensor thereby detects whether or not a yarn is present on the surface of the yarn accumulating roller.

[0009] If the irradiated area of the light from the light emitting element to the yarn accumulating roller is large, the change in the reflected amount of light by the yarn portion is small even if a small amount of yarn portion is present on the surface of the yarn accumulating roller at the time of cutting the yarn. As a result, it is difficult to accurately detect such a small amount of yarn portion. In the first aspect of the invention, therefore, an opening for restricting the irradiated range on the yarn accumulating roller is provided for the light emitting element of the yarn detecting sensor. The width of the opening is set to the prescribed width such that the width of the

irradiated range on the yarn accumulating roller is substantially equal to the thickness of the yarn. Since the width of the irradiated range on the yarn accumulating roller is restricted to the extent of the thickness of the yarn, the change in the reflected amount of light received by the light receiving element becomes large even if the yarn portion remaining on the yarn accumulating roller is a small amount, whereby the small amount of yarn portion can be reliably detected.

[0010] In the above-described yarn winding machine, the opening is formed as a slit which is long in one direction. A width of the opening in a shorter direction is the prescribed width.

[0011] The shape of the opening provided on the light emitting element side may be a spot shape (circular shape). In this case, however, the opening area (i.e., irradiated range on the yarn accumulating roller) becomes very small, and high attachment precision is required for the yarn detecting sensor to be able to actually detect the yarn. There also arises a problem in that the yarn portion remaining on the surface of the yarn accumulating roller becomes difficult to fall within the irradiated range. In the present invention, the attachment precision as high as that for the spot-shaped opening is not necessary by adopting the slit-shaped opening having a length of a certain extent in one direction, and the yarn detecting sensor can be easily attached.

[0012] In the above-described yarn winding machine, a longitudinal direction of the opening formed as the slit is parallel to a peripheral direction of the yarn accumulating roller. During the winding of the package, the yarn wound on the yarn accumulating roller is substantially parallel to the peripheral direction of the yarn accumulating roller. Thus, if the yarn portion remains on the yarn accumulating roller after the yarn is cut by the cutting device, there is a high possibility such a yarn portion will remain along the peripheral direction of the yarn accumulating roller. In the present invention, the yarn portion remaining on the surface of the yarn accumulating roller is more reliably detected by arranging the longitudinal direction of the opening formed as the slit to be parallel to the peripheral direction of the yarn accumulating roller.

[0013] The above-described yarn winding machine includes a fluid blowing device. The fluid blowing device blows fluid on the surface of the yarn accumulating roller after the yarn is cut by the cutting device. According to such a configuration, the yarn portion remaining on the surface of the yarn accumulating roller can be removed by blowing fluid on the surface of the yarn accumulating roller from the fluid blowing device.

[0014] In the above-described yarn winding machine, the fluid blowing device blows the fluid on the yarn accumulating roller such that the fluid flows from a position, which is located away from an irradiating position on the surface of the yarn accumulating roller irradiated by the light emitting element, towards the irradiating position. Even if the yarn portion remains at a position, which is located away from an irradiating position on the surface of the yarn accumulating roller irradiated by the light emitting element (i.e., detecting position of yarn detecting sensor), the yarn portion moves to the detecting position of the yarn detecting sensor by the fluid blown from the fluid blowing device. The yarn portion remaining on the surface of the yarn accumulating roller is thus reliably detected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a front view of a spinning machine according to an embodiment of the present invention;
FIG. 2 is a side view of one spinning unit of the spinning machine of FIG. 1;
FIG. 3 is an enlarged view of a slack eliminating device (yarn accumulating device);
FIGS. 4A and 4B are views illustrating a yarn detecting sensor, where FIG. 4A is a cross-sectional view of the yarn detection sensor and FIG. 4B is a view taken along line B-B of FIG. 4A;
FIGS. 5A and 5B are views illustrating a relationship of a yarn portion on a surface of a slack eliminating roller and an irradiated range of the yarn detecting sensor; where FIG. 5A illustrates a case where an opening width is large, and FIG. 5B illustrates a case where the opening width is small;
FIG. 6 is a block diagram illustrating a control configuration of the spinning machine;
FIG. 7 is a flowchart illustrating a process of stopping spinning when a yarn defect is detected;
FIG. 8 is a flowchart of a yarn splicing process;
FIGS. 9A and 9B are views illustrating a yarn detecting sensor according to another embodiment, where FIG. 9A is a view corresponding to FIG. 4B and FIG. 9B is a view corresponding to FIG. 5.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] Embodiments of the present invention will now be described. As illustrated in FIG. 1, a spinning machine 1 (yarn winding machine) includes a plurality of spinning units 2 arranged in line, a yarn splicing cart 3, a blower box 4, and a motor box 5.

[0017] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a spinning device 7, a cutter 10 (cutting device), a yarn clearer 11 (yarn defect detecting device), a slack eliminating device 8 (yarn accumulating device), a winding device 12, and the like. In the following description, "upstream" and "downstream" mean upstream and downstream in the traveling direction of the yarn at the time of spinning.

[0018] The draft device 6 is arranged near an upper end of a casing 13 of the main body of the spinning machine 1. A sliver 14 fed to the draft device 6 is drafted by the draft device into a fiber bundle 15. The fiber bundle

15 is spun by the spinning device 7, and a spun yarn 16 is formed. The spun yarn 16 is wound by the winding device 12 on the downstream side, and a package 17 is formed.

[0019] The draft device 6 is configured by four rollers of 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 in the traveling direction of the sliver 14 (fiber bundle 15) . The apron belt 24 is provided around the middle roller 25 and a tensor bar 27. A prescribed tension is applied to the apron belt 24 when the tensor bar 27 is biased in a direction of separating away from the middle roller 25.

[0020] Although the detailed configuration is not illustrated for the spinning device 7, an air type spinning device in which the spun yarn 16 is generated by twisting the fiber bundle 15 using a whirling airflow is adopted in the present embodiment.

[0021] The cutter 10 and the yarn clearer 11 are arranged on the downstream side of the spinning device 7. The yarn clearer 11 is configured to monitor the thickness of the traveling spun yarn 16 and detect a thin yarn portion or a thick yarn portion (yarn defect) of the spun yarn 16. When detecting a yarn defect, the yarn clearer 11 transmits a yarn defect detection signal to a unit controller 21 (see FIG. 6). Upon receiving the yarn defect detection signal, the unit controller 21 immediately operates the cutter 10 and cuts the spun yarn 16.

[0022] The slack eliminating device (yarn accumulating device) 8 is arranged between the cutter 10 and the winding device 12. The slack eliminating device 8 includes a slack eliminating roller 30 (yarn accumulating roller). The slack eliminating device 8 temporarily accumulates the spun yarn 16 and adjusts the yarn tension by winding the spun yarn 16 generated by the spinning device 7 around the slack eliminating roller 30 by a prescribed amount. The slack eliminating device 8 also has a function of pulling out the spun yarn 16 towards the downstream side from the spinning device 7 by actively rotating and driving the slack eliminating roller 30, on which the spun yarn 16 is wound. The details of the slack eliminating device 8 will be described later.

[0023] As illustrated in FIG. 1, the winding device 12 includes a winding drum 18 and a cradle 19 for supporting a bobbin in a freely rotating manner. The winding drum 18 rotates while making contact with the surface of the bobbin (or yarn layer wound on the bobbin) to thereby rotate the bobbin and wind the traveling spun yarn 16 to the bobbin, and form the package 17.

[0024] As illustrated in FIGS. 1 and 2, the yarn slicing cart 3 includes 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 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 cutting occurs in a certain spinning unit 2, the yarn splicing cart 3 travels up to the relevant spinning unit 2 and then stops. The suction pipe 93 captures the yarn end of the spun yarn 16 discharged from the spinning machine 7 and guides such yarn end to the yarn splicing device 92 while pivoting vertically with the axis as the center. The suction mouth 94 captures the yarn end of the spun yarn 16 from the package 17 supported in a freely rotating manner by the winding device 12 and guides such yarn end to the yarn splicing device 92 while pivoting vertically with the axis as the center. The yarn splicing device 92 splices the guided yarn ends. The suction pipe 93 and the suction mouth 94 are connected to a negative pressure source accommodated in the blower box 4, and obtain the suction force for sucking the yarn end from the negative pressure source.

[0025] The blower box 4 is arranged on one end side in the direction in which the plurality of the spinning units 2 are arranged. The blower box 4 accommodates the negative pressure source configured by a blower, a filter, and the like. A cleaning suction pipe (not illustrated) for sucking and removing yarn waste and cotton waste generated in the draft device 6 and the slack eliminating device 8, the suction pipe 93 and the suction mouth 94 of the yarn splicing cart 3 described above, and the like are connected to the negative pressure source.

[0026] The motor box 5 is arranged on the side opposite to the blower box 4 with respect to the plurality of spinning units 2. The motor box 5 accommodates motors for driving each of front rollers 26 and middle rollers 25 of the draft devices 6 of the plurality of spinning units 2. The motor box 5 includes a main control section 96 including a control panel 151. The main control section 96 transmits and receives signals with the unit controller 21 of the spinning unit 2, and performs operation control and state monitoring of each spinning unit 2.

[0027] The slack eliminating device 8 will now be described in detail below. As illustrated in FIG. 3, the slack eliminating device 8 includes the slack eliminating roller 30 (yarn accumulating roller), a yarn hooking member 31, an upstream guide 32, a downstream guide 33, and a yarn detecting sensor 34.

[0028] The slack eliminating roller 30 is a tubular roller made of metal. The slack eliminating roller 30 is rotatably supported by a bracket 35 fixed to the casing 13 of the spinning machine 1, and is rotatably driven by a motor 36. The yarn hooking member 31 has a distal end shape capable of engaging with (hooking) the spun yarn 16. The yarn hooking member 31 is attached to the downstream end of the slack eliminating roller 30. The yarn hooking member 31 integrally rotates with the slack eliminating roller 30 to wind the spun yarn 16 on the outer peripheral surface of the slack eliminating roller 30.

[0029] As illustrated in FIG. 3, both ends in the axial direction of the slack eliminating roller 30 are formed in a tapered shape in which the diameter continuously becomes larger from the central side towards the end face side. When the spun yarn 16 is wound from the upstream end with a large diameter of the slack eliminating roller 30, the wound spun yarn 16 is fed to the downstream end side of the yarn accumulating roller 30 by the tapered

shape of the upstream end. The spun yarn 16 is then temporarily accumulated at the central part of the yarn accumulating roller 30. Thereafter, the spun yarn 16 is unwound from the tapered downstream end of the yarn accumulating roller 30 and fed to the winding device 12.

[0030] The upstream guide 32 is arranged on the bracket 35 that supports the slack eliminating roller 30, and is arranged at a position slightly on the upstream side than 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. Furthermore, the upstream guide 32 also serves to stop the twist by preventing the twist of the spun yarn 16 propagated from the spinning device 7 from being transmitted to the downstream side than the upstream guide 32.

[0031] The downstream guide 33 is also arranged on the bracket 35, similar to the upstream guide 32. The downstream guide 33 is arranged at a position on the downstream side than 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.

[0032] As illustrated in FIG. 3 and FIGS. 4A and 4B, the yarn detecting sensor 34 is a reflective photo sensor (photo interruptor) including a light emitting element 41 and a light receiving element 42 accommodated in a case 44a and a case 44b, respectively. An opening (diaphragm) 40a for passing the light of the light emitting element 41 is formed at the surface (light emitting surface) of the case 44a on the slack eliminating roller 30 side. An opening 40b for passing the light reflected from the slack eliminating roller 30 and entering the light receiving element 42 is formed on the surface (light receiving surface) facing the case 44b on the slack eliminating roller 30 side. Thus, the light emitted to the outside through the opening 40a from the light emitting element 41 is reflected at the surface of the slack eliminating roller 30, and the reflected light passes through the opening 40b and is received by the light receiving element 42.

[0033] If the spun yarn 16 is present at a prescribed position at the central part of the slack eliminating roller 30 irradiated with light from the light emitting element 41 as in FIGS. 4A and 4B, the light hits the spun yarn 16 and is reflected. In such a case, the reflectivity lowers and the amount of light received by the light receiving element 42 decreases compared to a case where the spun yarn 16 is not present and the light is directly reflected at the surface of the metal slack eliminating roller 30. The yarn detecting sensor 34 thus can detect whether or not the spun yarn 16 is wound to the prescribed position (yarn detecting position) on the outer peripheral surface of the central part of the slack eliminating roller 30 and the spun yarn 16 of a prescribed amount or more is accumulated from the change in the amount of light received by the light receiving element 42.

[0034] When the yarn defect is detected in the spun yarn 16 by the yarn clearer 11 and the spun yarn 16 is cut by the cutter 10, a situation where a very small amount of yarn portion remains on the slack eliminating roller 30 occurs as will be described below. After the spun yarn 16 is cut by the cutter 10, the spun yarn 16 on the package 17 side is usually unwound from the slack eliminating roller 30 and wound into the package 17. However, if the yarn defect is present in the yarn portion on 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 relevant yarn defect portion, and the yarn portion of one part that is not wound into the package 17 may remain on the slack eliminating roller 30.

[0035] Therefore, if a 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 may be wound into the package 17 along with the spun yarn 16 fed after the resumption. The yarn waste thus may be mixed in the package 17, thereby lowering the quality of the package 17.

[0036] Problems do not arise if a relatively large amount of spun yarn 16 is closely wound on the surface of the slack eliminating roller 30 as illustrated in FIG. 4A. However, if only the yarn portion 16a (portion colored in black in FIG. 4A) of a very small amount (e.g., wound on the slack eliminating roller 30 by about one to two rounds) is present on the surface of the slack eliminating roller 30, it is difficult to reliably detect such a small amount of yarn portion 16a if a width W1 of the opening 40a is large. As illustrated in FIG. 5A, an irradiated range A is an irradiated range of the light from the opening 40a of the light emitting element 41 to the surface of the slack eliminating roller 30. A width W2 of the irradiated range A becomes large if the width W1 of the opening 40a is large. As a result, the proportion occupied by the yarn portion 16a becomes very small with respect to the irradiated range A. In such a case, the fluctuation of the receiving amount of light by the light receiving element 42 due to the presence of the yarn portion 16a is very small compared to the total receiving amount of light. Thus, it is difficult to reliably detect the small amount of yarn portion 16a when the width W1 of the opening 40a is large.

[0037] In the present embodiment, therefore, the size of the opening 40a of the light emitting element 41 is defined such that the yarn portion 16a can be detected even if the yarn portion 16a present on the surface of the slack eliminating roller 30 is a small amount of yarn wound around the slack eliminating roller 30 by one to two rounds. Specifically, as illustrated in FIGS. 4A and 4B, the opening 40a is formed as a slit which is long in one direction. Furthermore, as illustrated in FIG. 5B, the width W1 in the shorter direction of the opening 40a is set such that the width W2 of the irradiated range A on the slack eliminating roller 30 restricted by the opening 40 is substantially equal to a thickness D of the spun yarn 16. Therefore, as illustrated in FIG. 5B, even if the yarn portion 16a remaining on the slack eliminating roller 30

is a small amount, the portion occupied by the yarn portion 16a with respect to the irradiated range A of the light from the opening 40a becomes large, and the yarn detecting sensor 34 can reliably detect even such a 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 relationship of the width W1 of the opening 40, the width W2 of the irradiated range A, and the thickness D of the spun yarn 16 is $W1 < W2 \approx D$.

[0038] If the longitudinal direction of the slit-shaped opening 40a and the yarn portion 16a of the spun yarn 16 to be detected are substantially parallel, the yarn amount that falls within the irradiated range A increases and the detection accuracy of the yarn detecting sensor 34 enhances. As illustrated in FIG. 3, the spun yarn 16 is substantially parallel to the peripheral direction of the slack eliminating roller 30 when the spun yarn 16 is wound around the slack eliminating roller 30 during the winding of the package 17. If the spun yarn 16 on the package 17 side is further cut at the yarn defect portion after the spun yarn 16 is cut by the cutter 10, there is a sufficient possibility that the spun yarn 16 will remain on the slack eliminating roller 30 while being substantially parallel to the peripheral direction of the slack eliminating roller 30. The longitudinal direction of the slit-shaped opening 40a is thus preferably parallel to the peripheral direction of the slack eliminating roller 30 to more reliably detect the remaining yarn portion 16a.

[0039] After the spun yarn 16 is cut by the cutter 10, the yarn splicing cart 3 equipped with the yarn splicing device 92 moves to the position on the lower side of the slack eliminating roller 30 of the spinning unit 2, and the draft of the sliver 14 by the draft device 6 (generation of fiber bundle 15) and the spinning by the spinning device 7 are resumed. The yarn end on the package 17 side and the yarn end of the spun yarn 16 newly fed from the spinning device 7 are spliced by the yarn splicing device 92, and then the winding by the winding device 12 is resumed.

[0040] The yarn splicing cart 3 includes two nozzles 45 and 46 (fluid blowing device) for blowing air towards the slack eliminating roller 30. The nozzles 45 and 46 are respectively connected to an air supply source (not illustrated) through a supply valve 47 (see FIG. 6) arranged in the yarn splicing cart 3. The air is blown from the nozzles 45 and 46 towards the outer peripheral surface of the slack eliminating roller 30. The nozzle 45 blows the air towards the tapered upstream end of the slack eliminating roller 30. The blowing direction of the nozzle 45 is the radial direction of the slack eliminating roller 30. The nozzle 46 blows the air towards the tapered downstream end of the slack eliminating roller 30. The nozzle 46 is inclined towards the center in the rotational axis direction of the slack eliminating roller 30 with respect to the radial direction of the slack eliminating roller 30.

[0041] The yarn portion 16a of the spun yarn 16 remaining on the outer peripheral surface of the slack eliminating roller 30 is removed when air is blown from the nozzles 45 and 46 onto the outer peripheral surface of the slack eliminating roller 30. The yarn portion 16a removed from the slack eliminating roller 30 by the air blown from the nozzles 45 and 46 is sucked and discharged by the cleaning suction pipe (not illustrated) arranged in the vicinity of the slack eliminating roller 30.

[0042] As illustrated in FIG. 3, the nozzles 45 and 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 nozzles 45 and 46 to both ends of the slack eliminating roller 30 flows over the outer peripheral surface of the slack eliminating roller 30 in the rotational axis direction of the slack eliminating roller 30, and reaches the central part of the slack eliminating roller 30, which is the 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, which is located away from the irradiating position on the surface of the slack eliminating roller 30 irradiated by the light emitting element 41 (i.e., yarn detecting position of yarn detecting sensor 34), the yarn portion 16a is transferred to the detecting position of the yarn detecting sensor 34 by the air blown from the nozzle 45 or the nozzle 46. Therefore, the yarn portion 16a remaining on the surface of the slack eliminating roller 30 is reliably detected by the yarn detecting sensor 34.

[0043] If the position of the distal end (air ejecting portion) of the nozzle 45 and the nozzle 46 with respect to the peripheral direction of the slack eliminating roller 30 are the same, the air blown on the slack eliminating roller 30 from the nozzle 45 and the nozzle 46 collide at the surface of the slack eliminating roller 30, and the yarn portion 16a remaining on the surface of the slack eliminating roller 30 may not be able to move in the rotational axis direction of the slack eliminating roller 30. The distal ends of the nozzle 45 and the nozzle 46 are thus arranged to be shifted from each other in the peripheral direction of the slack eliminating roller 30.

[0044] An electrical configuration of the spinning machine 1 will now be described with reference to the block diagram of FIG. 6. As illustrated in FIG. 6, the main control section 96 of the spinning machine 1 is connected to the unit controllers 21 of a plurality of spinning units 2, and the controller 50 of the yarn splicing cart 3. The main control section 96 performs control and state monitoring of the spinning units 2 and the yarn splicing cart 3.

[0045] 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 of the unit controller 21 with the outside. The unit controller 21 performs the following processes in addition to the package winding process realized by the control of the spinning device 7 and the winding device 12.

[0046] During spinning, the yarn detecting sensor 34 detects whether or not the spun yarn 16 is present at a prescribed detecting position on the outer peripheral surface of the central part of the slack eliminating roller 30 (i.e., whether or not a prescribed amount of spun yarn 16 is wound from the upstream end to the central part of the slack eliminating roller 30). If the yarn detecting sensor 34 determines that the wound amount of the spun yarn 16 on the slack eliminating roller 30 has become small, the winding speed of the winding device 12 is reduced, for example, to maintain a state in which a constant amount of spun yarn 16 is always wound around the slack eliminating roller 30.

[0047] When the yarn defect is detected in the spun yarn 16 by the yarn clearer 11 and the yarn defect detection signal from the yarn clearer 11 is received, the unit controller 21 controls the cutter 10 to cut the spun yarn 16. The controller 50 of the yarn splicing cart 3 for performing yarn splicing after yarn cutting controls the supply valve 47 to blow air from the nozzle 45 and the nozzle 46 towards the slack eliminating roller 30. In this case, if the yarn portion 16a is remaining on the surface of the slack eliminating roller 30, the remaining yarn portion 16a is detected by the yarn detecting sensor 34 and the detection result is sent to the unit controller 21.

[0048] A series of processes performed by the spinning unit 2 and the yarn splicing cart 3 at the time of yarn defect detection described above will be described with reference to the flowchart of FIGS. 7 and 8. In FIG. 7 and FIG. 8, Si (i = 10, 11, ...) indicates the step number.

[0049] FIG. 7 is a flowchart illustrating the process of stopping the spinning when the yarn defect is detected. If the yarn defect of the spun yarn 16 is detected by the yarn clearer 11 (step S10: Yes), the unit controller 21 controls the cutter 10 to cut the spun yarn 16 (step S11), and stops the spinning by the spinning device 7 (step S12). The yarn detecting sensor 34 detects whether or not the spun yarn 16 on the package 17 side is cut at the yarn defect portion at the time of yarn cutting and a small amount of yarn portion 16a is remaining on the slack eliminating roller 30 (step S13). If the yarn portion 16a is detected by the yarn detecting sensor 34 (step S13: Yes) , the unit controller 21 notifies such a state to the operator by lighting an abnormal display lamp of the spinning unit 2, and the like, and urges the operator to remove the yarn portion 16a remaining on the slack eliminating roller 30 (operator call: step S14). If the yarn portion 16a is not detected by the yarn detecting sensor 34 (step S13: No), the main control section 96 sends a signal to the controller 50 of the yarn splicing cart 3, and moves the yarn splicing cart 3 to the spinning unit 2 in which the yarn defect detection and the yarn cutting were carried out (yarn splicing cart call: step S15), to perform the yarn splicing process described below (step S20).

[0050] FIG. 8 is a flowchart of the yarn splicing process. When the yarn splicing cart 3 arrives at the spinning unit 2 in which yarn cutting was carried out, the controller 50 of the yarn splicing cart 3 controls the supply valve 47 to blow air from the nozzle 45 and the nozzle 46 towards the slack eliminating roller 30 (step S21). In this case, the air blown from the nozzle 45 and the nozzle 46 to both ends of the slack eliminating roller 30 flows along the outer peripheral surface of the slack eliminating roller 30 and reaches the central part of the slack eliminating roller 30 that is the detecting position of the yarn detecting sensor 34. Therefore, even if the yarn portion 16a remains at the position located away from the detecting position of the slack eliminating roller 30, such a yarn portion 16a will be transferred to the detecting position. If the yarn portion 16a is detected by the yarn detecting sensor 34 after the air is blown (step S22: Yes), the unit controller 21 notifies such a state to the operator by lighting the abnormal display lamp and the like, and urges the operator to remove the remaining yarn portion 16a (operator call: step S23). If the yarn portion 16a is not detected by the yarn detecting sensor 34 even when the air is blown (step S22: No), the spinning by the spinning device 7 is started and the yarn splicing operation by the yarn splicing device 92 is carried out (step S24), and the winding operation of the package 17 by the winding device 12 is resumed.

[0051] 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 that of the above-described embodiment, and the description thereof will be appropriately omitted.

[0052] 1) The slit-shaped opening 40a on the light emitting element 41 side formed in the case 44a as in FIGS. 4A and 4B does not necessarily need to have the longitudinal direction thereof parallel to the peripheral direction of the slack eliminating roller 30. For example, the longitudinal direction of the opening 40a may be parallel to the rotational axis direction of the slack eliminating roller 30.

[0053] 2) The opening 40a on the light emitting element 41 side is not limited to a slit-shape that is long in one direction. As illustrated in FIGS. 9A and 9B, the opening 40a may be a spot (circular) opening having a prescribed width (diameter) W1 such that the width (inner diameter) W2 of the circular irradiated range A on the slack eliminating roller 30 becomes substantially equal to the yarn thickness D. In this case, the irradiated range A is further narrowed compared to the slit-shaped opening, and thus is more advantageous than the slit-shaped opening in terms of detection accuracy of when detecting a small amount of yarn portion 16a. However, since the irradiated range A is very small, the yarn detecting sensor 34 actually needs to be accurately attached to be able to detect the yarn portion 16a. The spot-shaped opening is disadvantageous compared to the slit-shaped opening in

terms of attachment easiness. If the irradiated range A is too small, the transferred yarn portion 16a may not fall within the irradiated range A when air is blown from the nozzle 45 and the nozzle 46. Therefore, judging in a comprehensive manner, the slit-shaped opening 40a is preferable.

[0054] 3) The above-described embodiment is an example in which the present invention is applied to the spinning machine, but the application target of the present invention is not limited to the spinning machine, and the present invention can be applied to a yarn winding machine of textile machinery other than the spinning machine.

[0055] The spinning machine 1 includes the winding device 12 and the slack eliminating device 8. The winding device 12 forms a package by winding the traveling yarn. The slack eliminating device 8 temporarily accumulates the yarn to be wound by the winding device 12. The yarn accumulating device 8 includes the slack eliminating roller 30 and the yarn detecting sensor 34. The slack eliminating roller 30 is configured to be freely rotatable, where the yarn is wound on the surface thereof. The yarn detecting sensor 34 is a reflective photo sensor including the light emitting element 41 and the light receiving element 42. The yarn detecting sensor 34 detects the yarn on the surface of the slack eliminating roller 30. The diaphragm 40a is arranged with respect to the light emitting element 41 of the yarn detecting sensor 34. The diaphragm 40a restricts the irradiated range on the slack eliminating roller 30. The diaphragm 40a has a diaphragm width such that the width of the irradiated range on the slack eliminating roller 30 becomes substantially equal to the thickness of the yarn.

[0056] The spinning machine 1 further includes the yarn clearer 11 and the cutter 10. The yarn clearer 11 detects the defect of the yarn wound by the winding device 12. When the yarn clearer 11 detects the yarn defect, the cutter 10 cuts the yarn. The slack eliminating device 8 is arranged between the winding device 12 and the cutter 10.

[0057] The diaphragm 40a is formed as a slit that is long in one direction. The width in the shorter direction of the diaphragm 40a is the diaphragm width.

[0058] The longitudinal direction of the diaphragm 40a formed as the slit is parallel to the peripheral direction of the slack eliminating roller 30.

[0059] The spinning machine 1 includes the nozzles 45 and 46. The nozzles 45 and 46 blow fluid on the surface of the slack eliminating roller 30 after the yarn is cut by the cutter 10. The nozzles 45 and 46 blow fluid with respect to the slack eliminating roller 30 so that the fluid flows from the position, which is located away from the irradiating position on the surface of the slack eliminating roller 30 irradiated by the light emitting element 41 towards the irradiating position.

[0060] The light emitting element 41 is arranged to emit light on a prescribed position in a middle portion of the slack eliminating roller 30 in the rotational axis direction of the slack eliminating roller 30. The yarn detecting sensor 34 can detect whether or not the yarn is wound to the prescribed position on the slack eliminating roller 30 during the winding of the package by the winding device 12.

Claims

1. A yarn winding machine comprising:

a winding device (12) which is adapted to form a package by winding a traveling yarn, and
a yarn accumulating device (8) which is adapted to temporarily accumulate the yarn to be wound by the winding device (12),
wherein the yarn accumulating device (8) includes:

a yarn accumulating roller (30) which is provided rotatable and is adapted to wind the yarn around a surface thereof, and
a yarn detecting sensor (34) which is a reflective photo sensor having a light emitting element (41) and a light receiving element (42) and is adapted to detect the yarn on the surface of the yarn accumulating roller (30),

wherein an opening (40a) for restricting an irradiated range (A) on the yarn accumulating roller (30) is provided for the light emitting element (41) of the yarn detecting sensor (34), and
wherein the opening (40a) has a prescribed width such that a width (W2) of the irradiated range (A) on the yarn accumulating roller (30) is substantially equal to a thickness of the yarn.

2. The yarn winding machine according to claim 1, wherein the opening (40a) is formed as a slit which is long in one direction, and a width (W1) of the opening (40a) in a shorter direction is the prescribed width.

3. The yarn winding machine according to claim 1 or claim 2, wherein a longitudinal direction of the opening (40a) formed as the slit is parallel to a peripheral direction of the yarn accumulating roller (30).

4. The yarn winding machine according to claim 1, further comprising:

a yarn defect detecting device (11) which is adapted to detect a yarn defect in the yarn wound by the winding device (12), and
a cutting device (10) which is adapted to cut the yarn when the yarn defect detecting device (11) detects the yarn defect,
wherein the yarn accumulating device (8) is arranged between the winding device (12) and the

cutting device (10).

5. The yarn winding machine according to claim 4, wherein the opening (40a) is formed as a slit which is long in one direction, and a width (W1) of the opening (40a) in a shorter direction is the prescribed width.

6. The yarn winding machine according to claim 5, wherein a longitudinal direction of the opening (40a) formed as the slit is parallel to a peripheral direction of the yarn accumulating roller (30).

7. The yarn winding machine according to any one of claim 4 through claim 6, further comprising a fluid blowing device (45, 46) which is adapted to blow fluid on the surface of the yarn accumulating roller (30) after the yarn is cut by the cutting device (10).

8. The yarn winding machine according to claim 7, wherein the fluid blowing device (45, 46) is adapted to blow the fluid on the yarn accumulating roller (30) such that the fluid flows from a position, which is located away from an irradiating position on the surface of the yarn accumulating roller (30) irradiated by the light emitting element, (41) towards the irradiating position.

9. The yarn winding machine according to any one of claim 1 through claim 3, wherein the light emitting element (41) is arranged to emit light on a prescribed position in a middle portion of the yarn accumulating roller (30) in a rotational axis direction of the yarn accumulating roller (30), and
during winding of the package by the winding device (12), the yarn detecting sensor (34) is adapted to detect whether or not the yarn is being wound to the prescribed position on the yarn accumulating roller (30).

10. The yarn winding machine according to any one of claim 4 through claim 8, wherein the light emitting element (41) is arranged to emit light on a prescribed position in a middle portion of the yarn accumulating roller (30) in a rotational axis direction of the yarn accumulating roller (30), and
during winding of the package by the winding device (12), the yarn detecting sensor (34) is adapted to detect whether or not the yarn is being wound to the prescribed position on the yarn accumulating roller (30).

FIG. 1

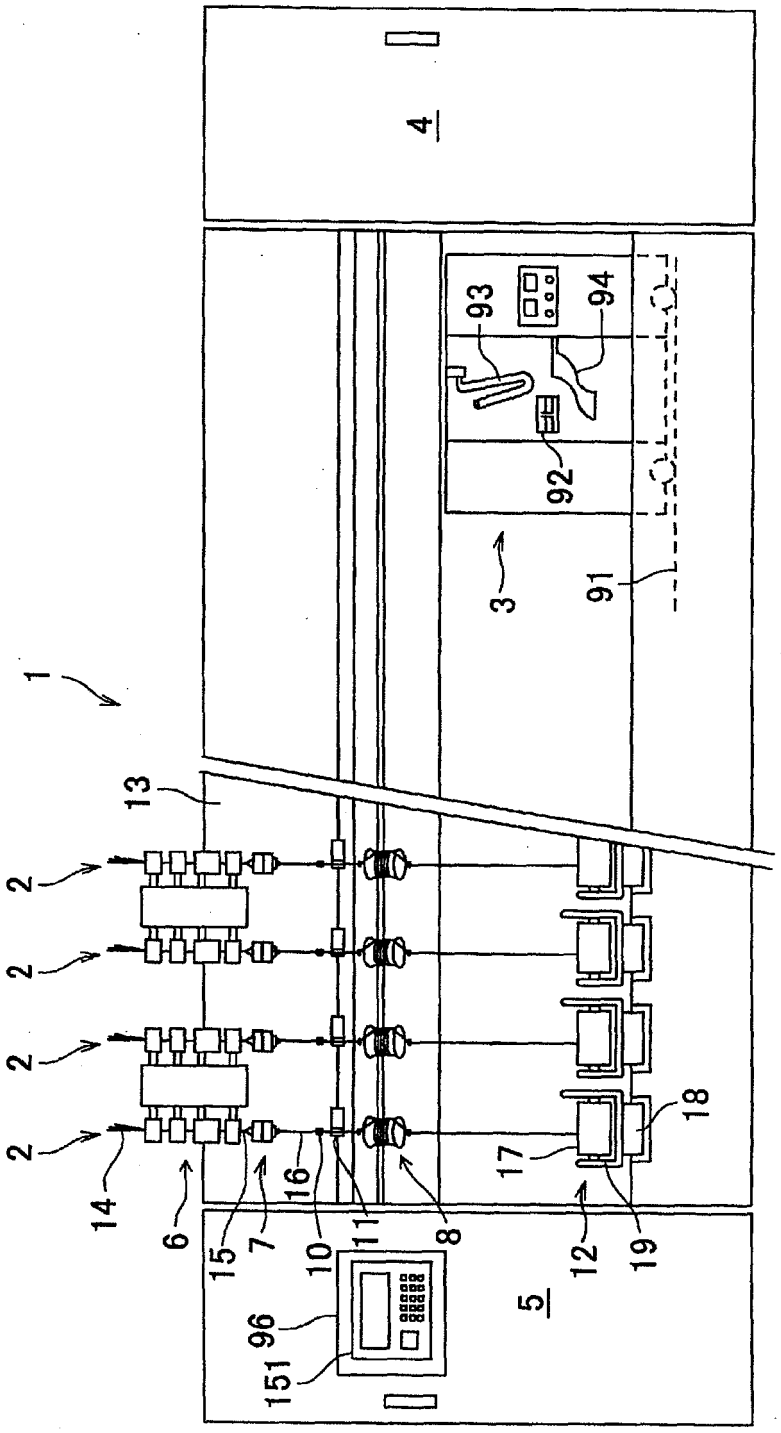


FIG. 2

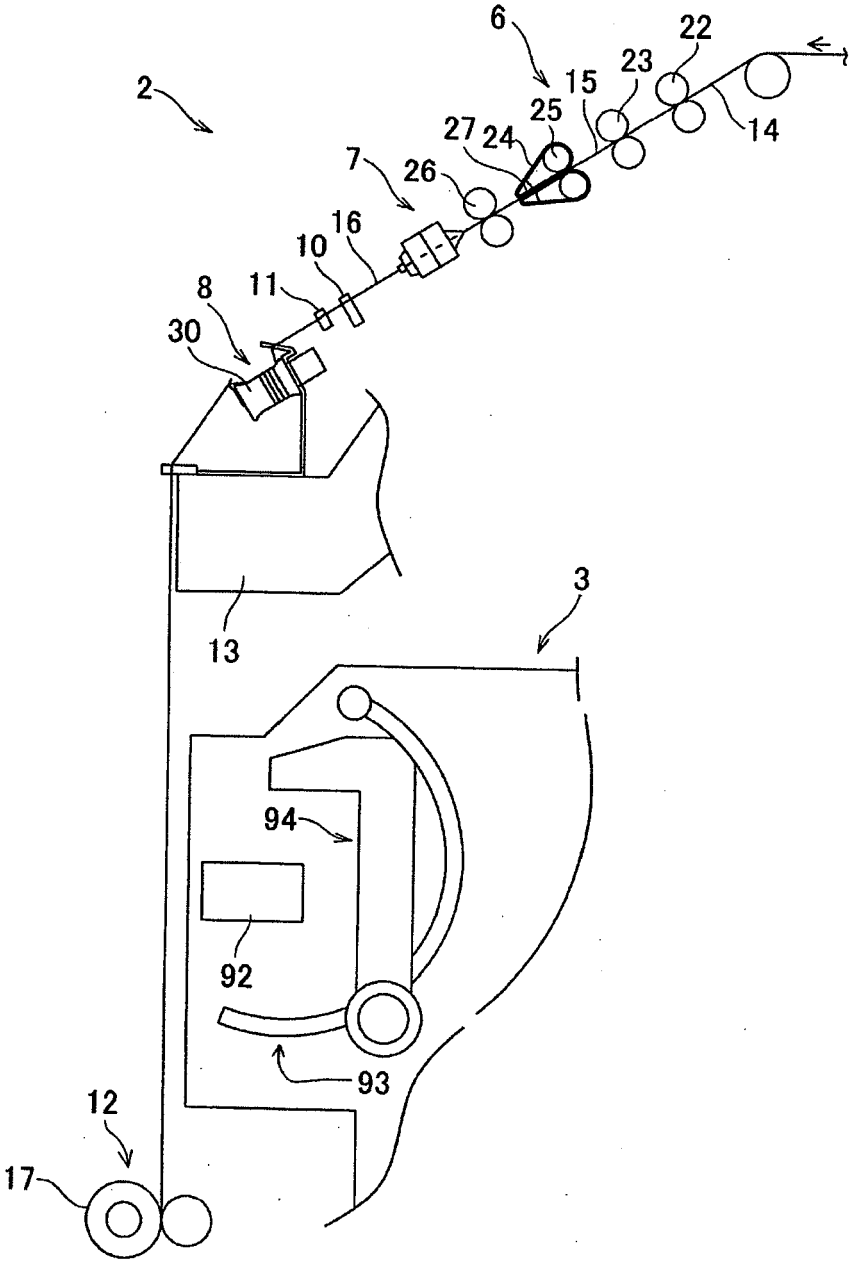


FIG. 3

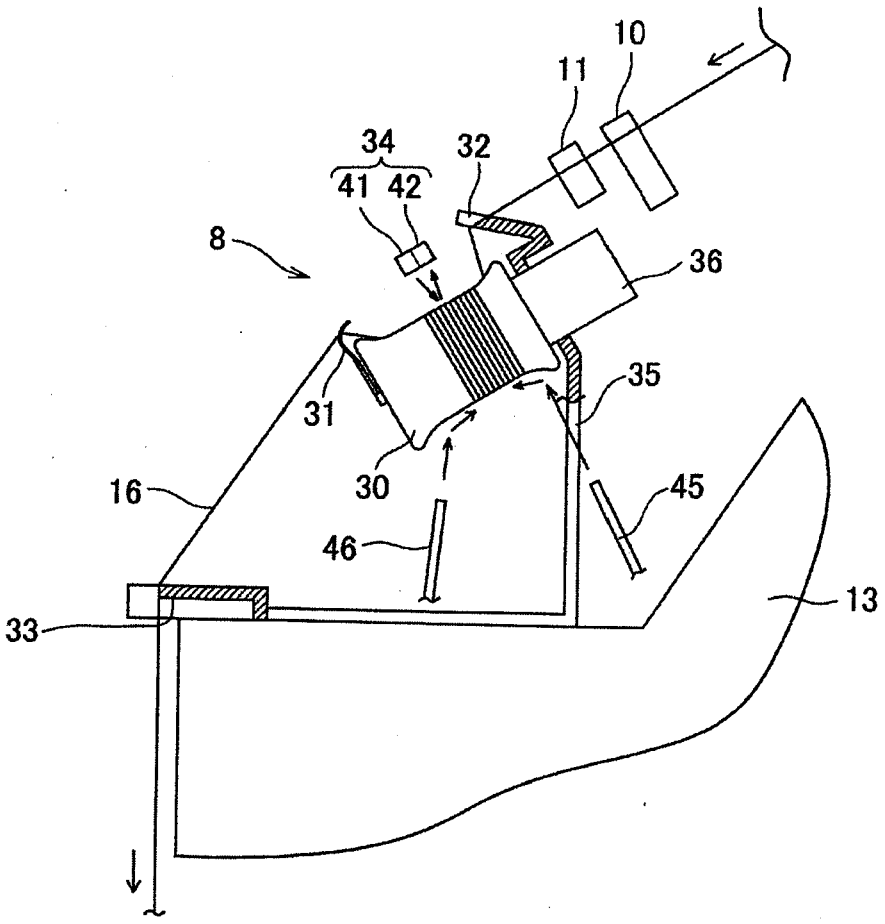


FIG. 4A

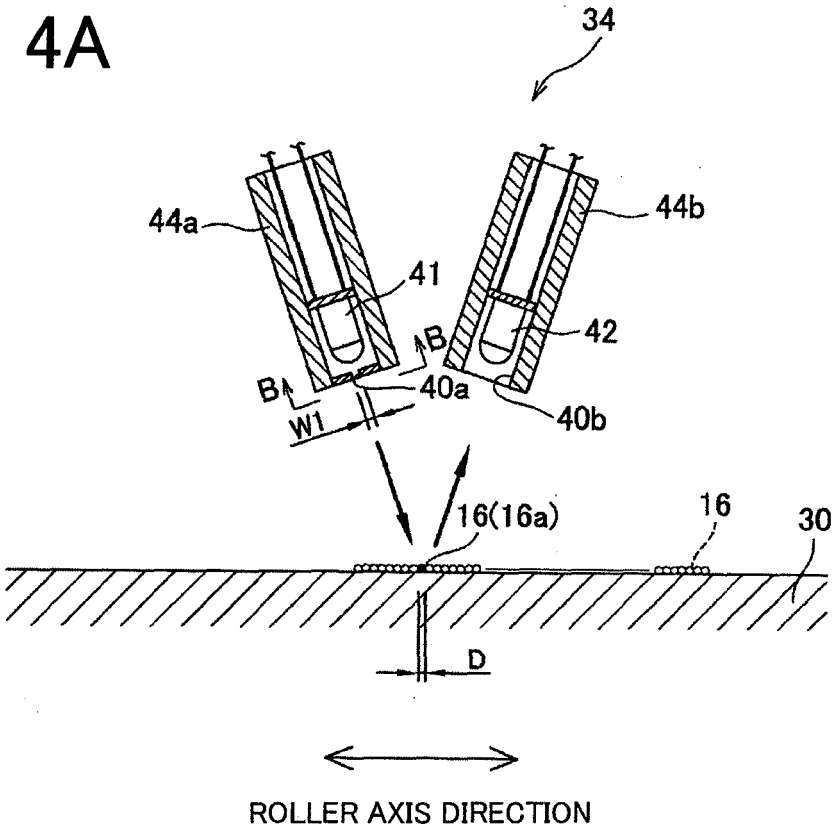

34
44a
44b
41
42
B
B
40a
40b
W1
16(16a)
16
30
D
ROLLER AXIS DIRECTION

FIG. 4B

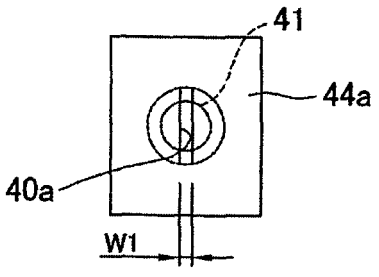

41
44a
40a
W1

FIG. 5A

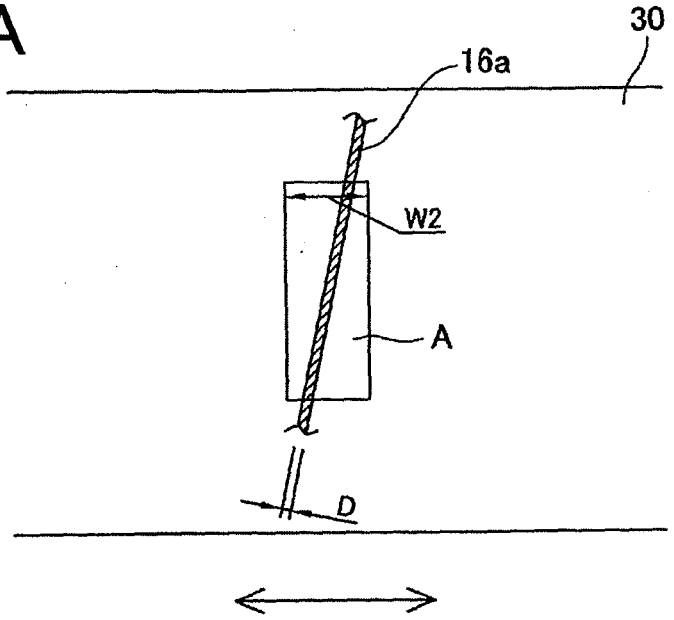

30
16a
W2
A
D
ROLLER AXIS DIRECTION

FIG. 5B

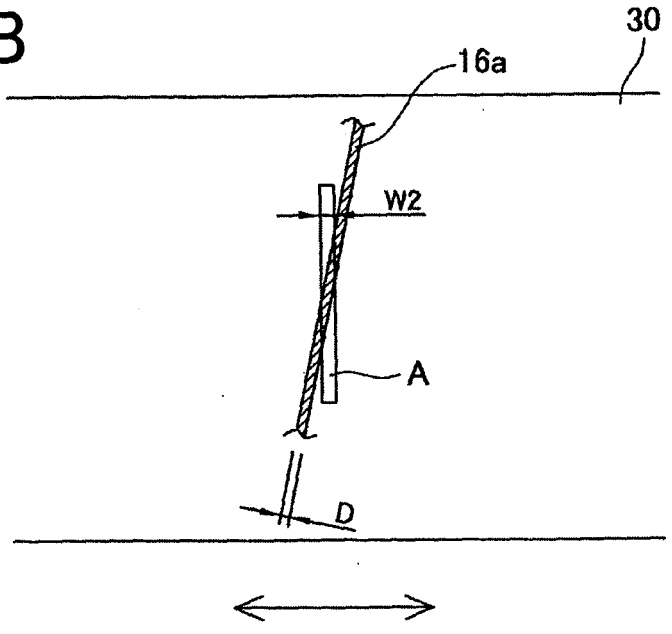

30
16a
W2
A
D
ROLLER AXIS DIRECTION

FIG. 6

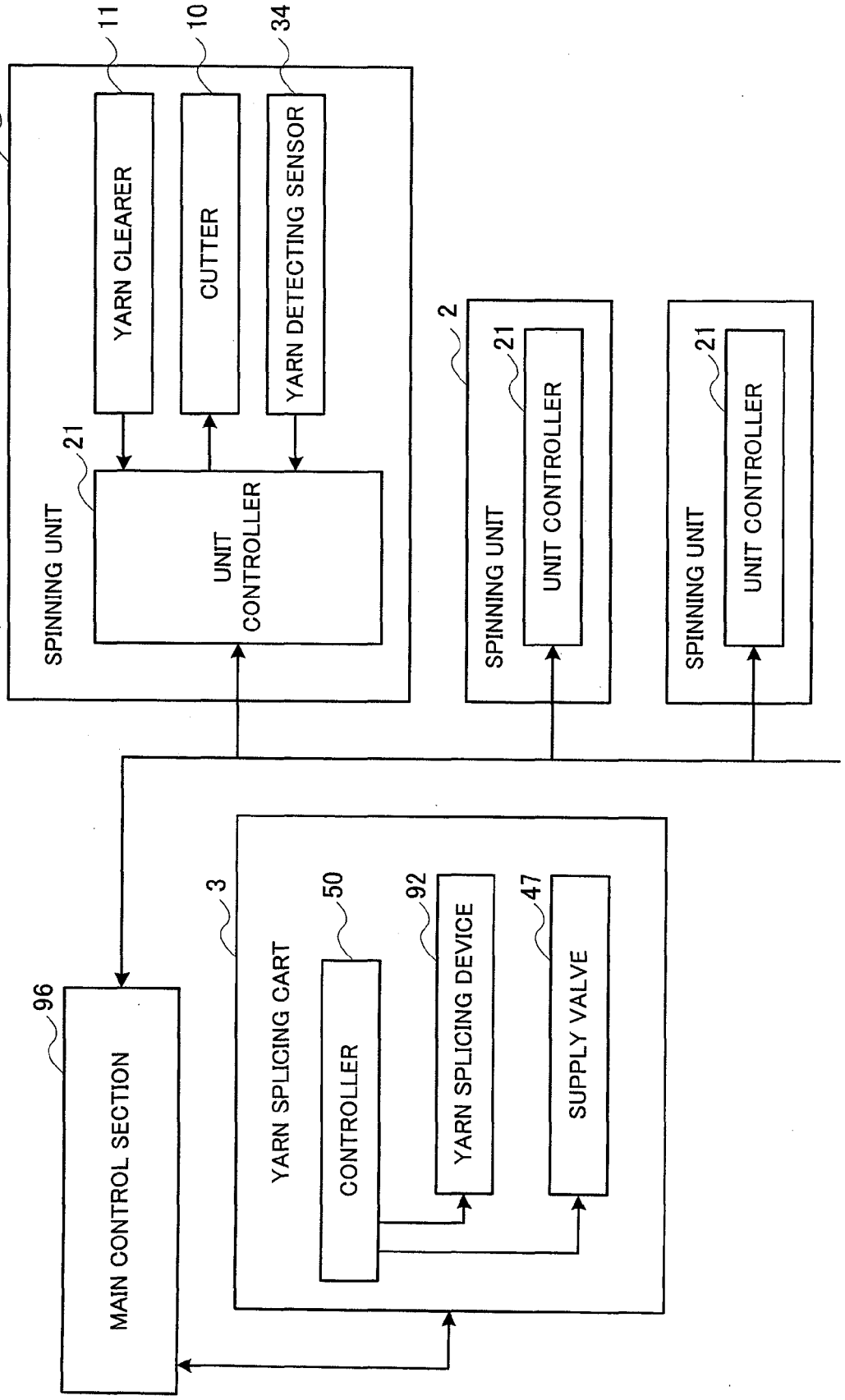

2
11
10
34
YARN CLEARER
CUTTER
YARN DETECTING SENSOR
21
SPINNING UNIT
UNIT CONTROLLER
2
21
SPINNING UNIT
UNIT CONTROLLER
21
SPINNING UNIT
UNIT CONTROLLER
3
50
92
47
YARN SPLICING CART
CONTROLLER
YARN SPLICING DEVICE
SUPPLY VALVE
96
MAIN CONTROL SECTION

FIG. 7

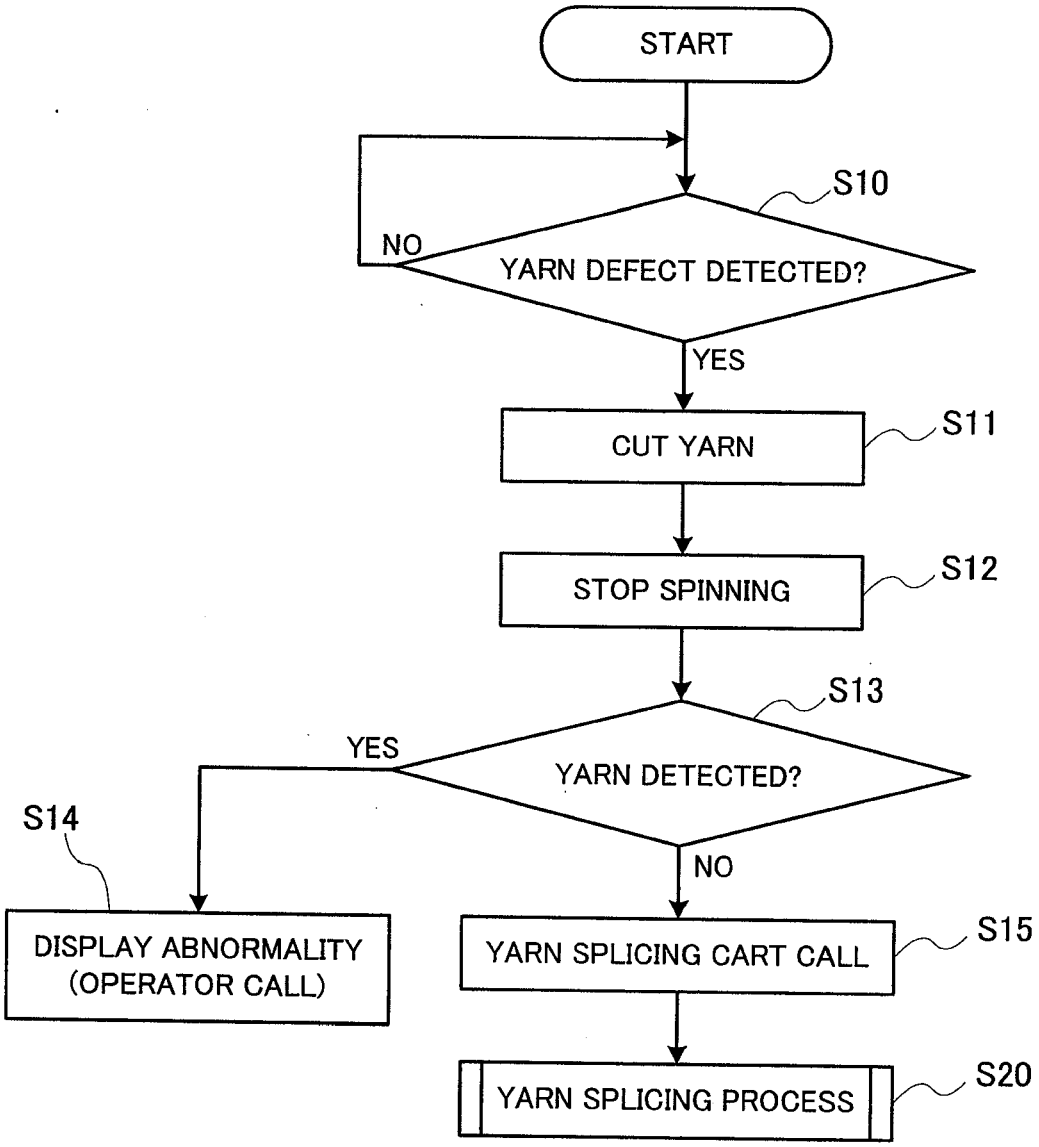

START
S10
NO
YARN DEFECT DETECTED?
YES
CUT YARN
S11
STOP SPINNING
S12
S13
YES
YARN DETECTED?
S14
NO
DISPLAY ABNORMALITY
(OPERATOR CALL)
YARN SPLICING CART CALL
S15
YARN SPLICING PROCESS
S20

FIG. 8

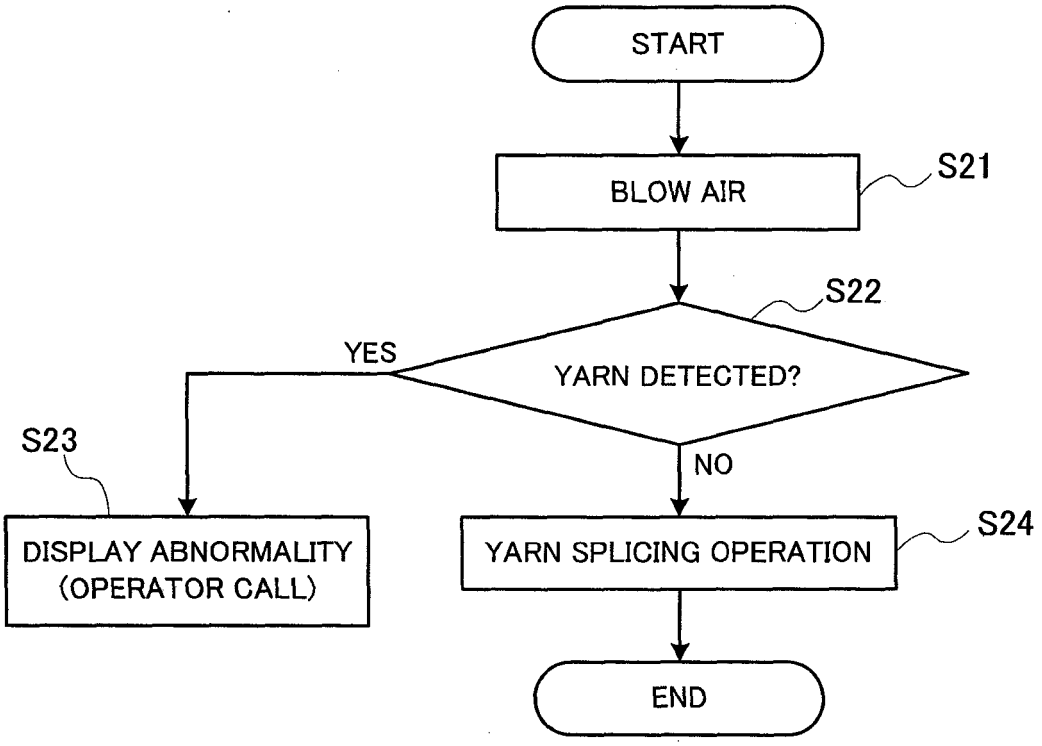

START
BLOW AIR
S21
S22
YES
YARN DETECTED?
NO
S23
DISPLAY ABNORMALITY
(OPERATOR CALL)
YARN SPLICING OPERATION
S24
END

FIG. 9A

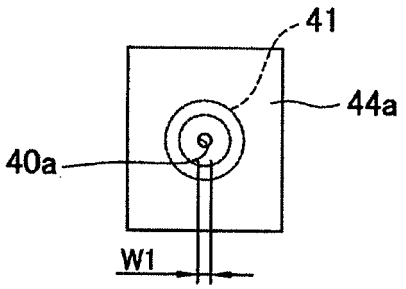
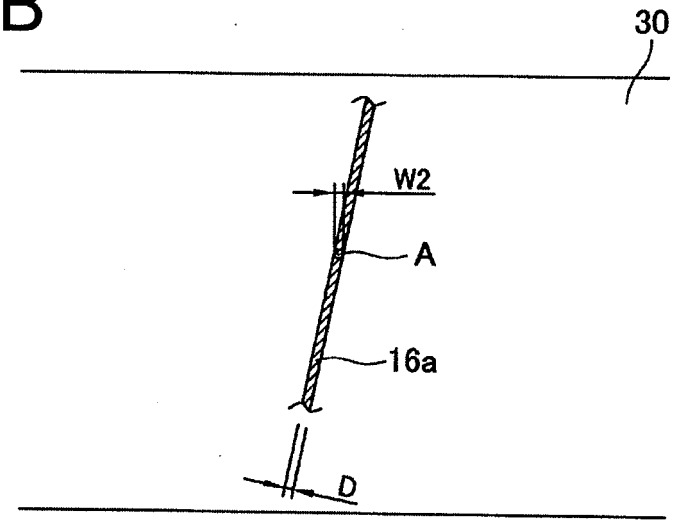


FIG. 9B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009242041 A **[0002] [0005]**