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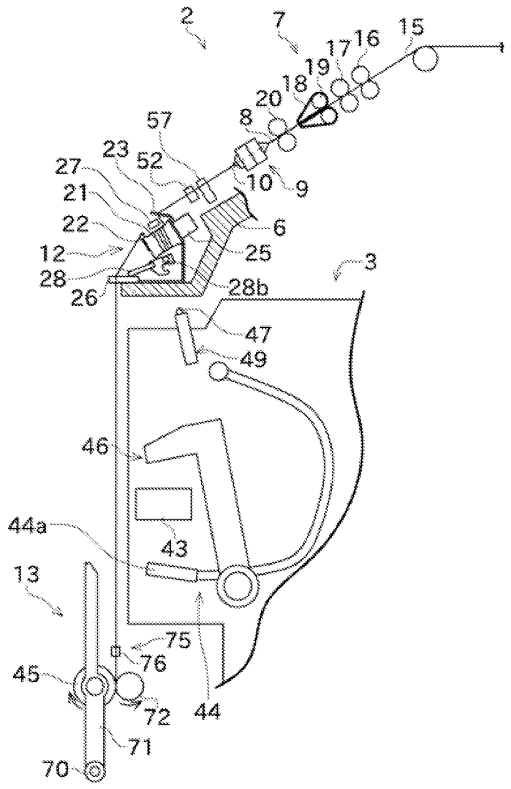
(54) Spinning machine

(57) A spinning frame includes a yarn accumulating roller (21), a yarn hooking member (22), a yarn removing lever (28), a suction pipe (44), and a unit controller (60). The hooking member (22) can wind a spun yarn (10) around the yarn accumulating roller (21). The yarn removing lever (28) can remove the spun yarn (10) from the yarn hooking member. The suction pipe (44) can catch a yarn end of the spun yarn (10) and includes a twisting nozzle (67) capable of applying twists to the caught spun yarn (10). The unit controller (60) controls the twisting nozzle (67) to operate while the spun yarn (10) caught by the suction pipe (44) is being wound around the yarn accumulating roller (21), and controls the twisting nozzle (67) to stop before the yarn removing lever (28) removes the spun yarn (10) from the yarn hooking member (22).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine including a yarn end catching device.

2. Description of the Related Art

[0002] Patent Document 1 discloses such kind of spinning machine. A spinning machine disclosed in Patent Document 1 includes a spinning device, a yarn feeding device, a winding device, a yarn splicing cart as main components.

[0003] The yarn feeding device includes a delivery roller and a nip roller. The delivery roller is driven and rotated under a state in which yarn fed from the spinning device (spun yarn) is caught between the delivery roller and the nip roller, so that the yarn feeding device can feed the spun yarn to a winding device side.

[0004] The yarn splicing cart includes a yarn splicing device and a suction pipe. For a yarn splicing operation in the yarn splicing device, the suction pipe can suck and catch a yarn end which is discharged from the spinning device, and then can guide the yarn end to the yarn splicing device.

[0005] In a structure of Patent Document 1, in the yarn splicing operation which is performed when a spinning operation is started or a yarn breakage occurs, the yarn end is injected from the spinning device, and then is controlled to nip at a roller of the yarn feeding device. After the above-described operation, since the yarn can be pulled downstream while tension is being applied to the yarn by driving of the yarn feeding device, the spinning device can generate truly-twisted yarn. A leading end of the suction pipe is controlled so as to be arranged immediately downstream of the yarn feeding device, and the yarn fed downstream by such a yarn feeding device is sucked and caught through such a suction pipe. Then, the suction pipe guides the caught yarn to the yarn splicing device, and then the yarn splicing operation is performed.

[0006] Such kind of spinning machine is also disclosed in Patent Document 2. In a same manner as the spinning machine disclosed in Patent Document 1, a spinning machine disclosed in such Patent Document 2 includes a yarn feeding device, which can feed the yarn downstream under a state in which the yarn is caught and held by a nip roller and a delivery roller.

[0007] Further, in the spinning machine described in Patent Document 2, a yarn slack eliminating device (a yarn accumulating device) is arranged downstream of the yarn feeding device. The yarn slack eliminating device includes a yarn slack eliminating roller (a yarn accumulating roller) capable of winding yarn around an outer peripheral surface thereof. While the yarn slack eliminating roller is being driven and rotated, by winding yarn, which is fed continuously from a spinning device, around the outer peripheral surface thereof, the yarn slack eliminating roller temporarily accumulates the yarn. Accordingly, a yarn slackening which is generated during a yarn splicing operation can be prevented.

[0008]

[Patent Document 1] Japanese Unexamined Patent Application Publication No. 2005-220483
[Patent Document 2] Japanese Unexamined Patent Application Publication No. 2004-124333

[0009] To improve yarn quality in a spinning machine, it is important that while tension is being stably applied to yarn which is fed from a yarn spinning device, the yarn is pulled out from the yarn spinning device. However, the yarn feeding device disclosed in Patent Document 1 pulls out the yarn from the spinning device by nipping the yarn while rotating. Accordingly, a yarn slipping was generated by a lack of nip force, which caused spinning quality of yarn to lower.

[0010] The yarn slack eliminating roller disclosed in Patent Document 2 can stably pull yarn downstream by rotating while winding the yarn fully around the outer peripheral surface thereof. However, even in such a spinning machine, when a sufficient length of yarn is not wound around the yarn slack eliminating roller, a yarn slipping is generated between the yarn slack eliminating roller and the yarn, and then yarn tension at an upstream side of the yarn slack eliminating device decreases. Accordingly, it is preferable that such a yarn slack eliminating roller is driven and rotated under a state in which at least a specific amount of yarn is constantly accumulated on the yarn slack eliminating roller. However, since the yarn is wound around the yarn slack eliminating roller with no yarn during the yarn splicing operation, a state in which a residual amount of yarn is not sufficient cannot be avoided. The yarn pulled out under such a state, which has unstable yarn quality, causes package quality to lower when such unstable yarn is wound into a package.

[0011] In the spinning machine including the yarn slack eliminating roller disclosed in Patent Document 2, a structure, in which the yarn feeding device is not used, is also known. During the yarn splicing operation, such a spinning machine cannot generate truly-twisted yarn while the yarn fed from the spinning device nips at the yarn feeding device (as described in Patent Document 1). Accordingly, since yarn, which is injected from the spinning device so that a suction pipe catches the yarn, is not truly twisted, yarn strength of the yarn considerably decreases. Consequently, when the suction pipe catches a yarn end of the yarn and guides the yarn end to a yarn splicing device, a yarn breakage occurs easily. Accordingly, it is recognized that such a splicing error causes operation efficiency in the spinning device to lower significantly.

SUMMARY OF THE INVENTION

[0012] The present invention has been made in view of the above-described circumstances. It is an object of the present invention to be capable of preventing unstable-quality yarn from being mixed into a package during a yarn splicing operation and to provide a spinning machine capable of preventing a yarn breakage appropriately when a yarn end is caught.

[0013] According to an aspect of the present invention, the spinning machine includes a spinning device, a yarn accumulating roller, a yarn hooking section, a yarn removing section, a yarn end catching device, and a control section. The spinning device generates spun yarn by applying twists to a fiber bundle. The yarn accumulating roller is arranged downstream of the spinning device and temporarily accumulates the spun yarn by winding the spun yarn around an outer peripheral surface thereof while rotating. The yarn hooking section can make contact with the spun yarn. A yarn hooking member winds the spun yarn around the outer peripheral surface of the yarn accumulating roller by rotating integrally with the yarn accumulating roller while making contact with the spun yarn. The yarn removing section can remove the spun yarn from the yarn hooking section. The yarn end catching device is a device for sucking and catching a yarn end of the spun yarn. The yarn end catching device includes a twisting section that can apply twists to the caught spun yarn. The control section controls the twisting section to operate while the spun yarn caught by the yarn end catching device is being wound around the yarn accumulating roller by the yarn hooking section, and controls the twisting section to stop a twisting operating before the yarn removing section removes the spun yarn from the yarn hooking section.

[0014] That is, since the spun yarn immediately after the spinning device starts a spinning operation is discharged under a uncompleted yarn state, yarn strength of the spun yarn is weaker than normal spun yarn. However, according to the above-described structure, even when such spun yarn with the weak yarn strength is sucked, the spun yarn can be sucked while twists are being further applied to the spun yarn so as to increase the yarn strength. Accordingly, the yarn can be continuously caught and sucked while a yarn breakage is prevented appropriately. If the twisting section is operating when the spun yarn is removed from the yarn hooking section, the yarn breakage may occur from being influenced by force generated by the twisting section and resistance force generated at a portion making contact with the yarn removing section. However, by using the above-described structure, a twisting operation of the twisting section is stopped before the spun yarn starts being unwound from the yarn accumulating roller. Consequently, the yarn end catching device can be prevented from catching the spun yarn excessively and the yarn breakage can be prevented. Further, when an amount of spun yarn on the yarn accumulating roller is not sufficient, the yarn cannot be stably pulled out from the spinning device, so that yarn quality may become unstable. However, according to the above-described structure, by accumulating the spun yarn on the yarn accumulating roller first, removing the spun yarn from the yarn hooking section, and then unwinding and sucking the spun yarn, such a yarn portion with unstable yarn quality can be removed.

[0015] In the spinning machine, the yarn end catching device includes a sucking section that can generate suction airflow directed towards a downstream side in a sucking direction. The sucking section is provided near the twisting section. When the yarn end catching device catches the spun yarn, the control section controls the sucking section to generate the suction airflow.

[0016] Accordingly, even when a suction opening of the yarn end catching device is away from the spun yarn that should be sucked, by using the suction airflow generated in the sucking section, the yarn end catching device can catch and suck the spun yarn easily.

[0017] In the spinning machine, it is preferable that while the spun yarn is being removed from the yarn hooking member by the yarn removing section, the control section controls the sucking section to generate the suction airflow.

[0018] That is, when the sucking section keep stopping generation of the suction airflow while the yarn is being removed, a speed at which the spun yarn is sucked decreases. Accordingly, when a speed at which the spun yarn is unwound is fast, the speed at which the spun yarn is sucked does not catch up with the speed the spun yarn is unwound. Consequently, the spun yarn unwound from the yarn accumulating roller may slacken and be entangled with each portion of the yarn accumulating roller. However, in the above-described structure, by using the suction airflow generated in the sucking section, the yarn end catching device catches the spun yarn before the spun yarn slackens; therefore, entanglement of the spun yarn can be prevented.

[0019] It is preferable that the spinning machine includes a yarn splicing device for splicing a yarn end of an upstream spun yarn with a yarn end of a downstream spun yarn. The yarn end catching device catches the yarn end of the spun yarn and guides the yarn end to the yarn splicing device.

[0020] Accordingly, errors caused by the yarn breakage during the yarn splicing operation in the yarn splicing device can be decreased, and operation efficiency in the spinning machine can be improved.

[0021] In the above-described spinning machine, it is preferable that the control section stops the twisting operation of the twisting section before the yarn splicing device starts a splicing operation.

[0022] Accordingly, since the twisting operation of the twisting section is stopped and then the splicing operation is performed, an influence of twists applied by the twisting section does not affect a portion where a plurality of spun yarn is spliced together. Therefore, the yarn splicing de-

vice can easily remove the twists and splice the plurality of spun yarn together.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a front view illustrating an overall structure of a spinning frame according to an embodiment of the present invention.
Fig. 2 is a longitudinal sectional view of the spinning frame.
Fig. 3 is a block diagram illustrating a main structure of the spinning frame.
Fig. 4 is a longitudinal sectional view of a yarn accumulating device.
Fig. 5 is an external perspective view of the yarn accumulating device.
Fig. 6 is an enlarged sectional view illustrating a structure of a leading end portion of a suction pipe.
Fig. 7 is a flowchart describing the first half of a control in which a yarn portion with unstable yarn quality is unwound from a yarn accumulating roller.
Fig. 8 is a flowchart describing the last half of the control in which the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller.
Fig. 9 is a timing chart when the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller.
Fig. 10 is a longitudinal sectional view illustrating a state in which upper yarn and lower yarn are caught by the suction pipe and a suction mouth.
Fig. 11 is a longitudinal sectional view illustrating a state in which the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] Next, by referring to the drawings, a spinning frame (a spinning machine) 1 according to an embodiment of the present invention will be described. In this specification, "upstream" and "downstream" refer to an upstream side and a downstream side in a travelling direction of a yarn during a spinning operation, respectively. Fig. 1 is a front view illustrating an overall structure of the spinning frame 1. Fig. 2 is a longitudinal sectional view of the spinning frame 1. Fig. 3 is a block diagram illustrating a main structure of the spinning frame 1.

[0025] The spinning frame 1 as a spinning machine illustrated in Fig. 1 includes a plurality of units (spinning units 2) arranged next to one another. The spinning frame 1 includes a yarn splicing cart 3, a blower box 80, and a motor box 5.

[0026] As illustrated in Fig. 1, each spinning unit 2 includes a draft device 7, a spinning device 9, a yarn accumulating device 12, and a winding device 13 as main components, which are arranged in this order from upstream to downstream. The draft device 7 is arranged near an upper end of a frame 6 of the spinning frame 1. The spinning device 9 spins a fiber bundle 8 which is fed from the draft device 7. The spun yarn 10 fed from the spinning device 9 passes through a yarn clearer 52 which will be described later, is fed by the yarn accumulating device 12, and then is wound by the winding device 13 into a package 45.

[0027] The draft device 7 drafts a sliver 15 so as to produce the fiber bundle 8. As illustrated in Fig. 2, the draft device 7 includes four rollers, namely a back roller 16, a third roller 17, a middle roller 19 provided with an apron belt 18, and a front roller 20. As illustrated in Fig. 3, an electric motor driving such rollers(not illustrated in the drawings) is controlled by a unit controller (a control section) 60.

[0028] A detailed structure of the spinning device 9 is not illustrated in the drawings; however, the present embodiment adopts a pneumatic type of the spinning device 9 which applies twists to the fiber bundle 8 by whirling airflow and generates the spun yarn 10. Further, as illustrated in Fig. 3, the unit controller 60 controls generation and stoppage of the whirling airflow in the spinning device 9.

[0029] The yarn accumulating device 12 is located downstream of the spinning device 9. The yarn accumulating device 12 includes a yarn pulling function, a yarn slack preventing function, and a tension adjusting function. The yarn pulling function is a function in which the yarn accumulating device 12 applies predetermined tension to the spun yarn 10 and pulls out the spun yarn 10 from the spinning device 9. The yarn slack preventing function is a function to accumulate the spun yarn 10 which is fed from the spinning device 9 so as to prevent a yarn slackening during a yarn splicing operation performed by the yarn splicing cart 3 (which will be described later) or the like. The tension adjusting function is a function to adjust tension in order to prevent change in tension on a side of the winding device 13 (which will be described later) from propagating to a spinning device 9 side. As illustrated in Fig. 2, the yarn accumulating device 12 includes a yarn accumulating roller 21, a yarn hooking member (a yarn hooking section) 22, an upstream guide 23, an electric motor 25, a downstream guide 26, an accumulated amount detecting sensor 27, and a yarn removing lever (a yarn removing section) 28.

[0030] The yarn hooking member 22 is capable of being engaged with (hooking) the spun yarn 10. By rotating integrally with the yarn accumulating roller 21 under a state in which the yarn hooking member 22 is engaged with the spun yarn 10, the yarn hooking member 22 can guide the spun yarn 10 to an outer peripheral surface of the yarn accumulating roller 21.

[0031] The yarn accumulating roller 21 can accumulate the spun yarn 10 by winding the spun yarn 10 around the outer peripheral surface thereof. The yarn accumulating roller 21 is driven and rotated at a constant rotational speed by the electric motor 25 which is controlled

by the unit controller 60. In such a structure, the spun yarn 10 guided to the outer peripheral surface of the yarn accumulating roller 21 by the yarn hooking member 22 is wound around by rotation of the yarn accumulating roller 21 such that the yarn accumulating roller 21 is tightened, and pulls the spun yarn 10 located upstream of the yarn accumulating device 12. Accordingly, the spun yarn 10 can be continuously pulled out from the spinning device 9.

[0032] When the spun yarn 10 on the yarn accumulating roller 21 reach at least a specific amount, a contact area between the yarn accumulating roller 21 and the spun yarn 10 is increased, so that few slipping or the like is generated. Accordingly, by driving and rotating the yarn accumulating roller 21 under a state in which at least the specific amount of the spun yarn 10 is wound around the yarn accumulating roller 21, the spun yarn 10 can be pulled out from the spinning device 9 at a stable speed without generating the slipping or the like. In addition, in the following description, the specific amount of the spun yarn 10 (the yarn accumulated amount by which the slipping is no longer generated and force to pull the spun yarn 10 becomes stable) may be referred to as a minimum accumulated amount.

[0033] The accumulated amount sensor 27 detects an accumulated amount of the spun yarn 10 accumulated on the yarn accumulating roller 21 in a non-contact manner and transmits the detected accumulated amount of the spun yarn 10 to the unit controller 60.

[0034] The upstream guide 23 is located slightly upstream of the yarn accumulating roller 21. The upstream guide 23 is configured as a guiding member that appropriately guides the spun yarn 10 to the outer peripheral surface of the yarn accumulating roller 21. Further, the upstream guide 23 also functions as twist prevention which prevents twists of the spun yarn 10 propagated from the spinning device 9 from propagating downstream of the upstream guide 23.

[0035] The downstream guide 26 is located slightly downstream of the yarn accumulating roller 21. The downstream guide 26 restricts an orbit of the spun yarn 10 which is swung by the rotating yarn hooking member 22, and is configured as a guiding member that guides the spun yarn 10 by stabilizing a travelling route of the spun yarn 10 located downstream of the downstream guide 26.

[0036] The yarn removing lever 28 is arranged near an end portion of a downstream side of the yarn accumulating roller 21 and arranged upstream of the downstream guide 26. The yarn removing lever 28 is arranged so as to be capable of swinging around a swing shaft 28b.

[0037] The yarn clearer 52 is provided in front of the frame 6 of the spinning frame 1 and at a position between the spinning device 9 and the yarn accumulating device 12. The yarn clearer 52 monitors a thickness of the travelling spun yarn 10. When detecting a yarn defect in the spun yarn 10, the yarn clearer 52 transmits a yarn defect detection signal to the unit controller 60. A cutter 57 is arranged upstream of the yarn clearer 52. The unit controller 60 received the yarn defect detection signal, controls the cutter 57 to operate so as to cut off the spun yarn 10.

[0038] As illustrated in Fig. 1 and Fig. 2, the yarn splicing cart 3 includes a splicer (a yarn splicing device) 43, a suction pipe (a yarn end catching device) 44, a suction mouth 46, a pushing arm 47, and a pneumatic cylinder 49. When a yarn breakage or a yarn cut occurs in one spinning unit 2, the yarn splicing cart 3 travels on a rail 41 fixed to the frame 6 to such a spinning unit 2, stops in front of such a spinning unit 2, and performs the yarn splicing operation. The yarn splicing operation is an operation ranging from a process in which yarn ends generated by the yarn breakage or the yarn cut are caught to a process in which the yarn ends are spliced together. Such a series of processes may be referred to as a yarn splicing operation cycle.

[0039] The suction pipe 44 can swing around a shaft in a vertical direction. The suction pipe 44 can suck and catch a yarn end (an upper yarn) fed from the spinning device 9, and can guide the caught yarn end to the splicer 43. A nozzle member 44a is provided at a leading end portion of the suction pipe 44. A detailed description on the nozzle member 44a will be made later. The suction mouth 46 can swing around the shaft in a vertical direction. The suction mouth 46 can suck and catch a yarn end (a lower yarn) from the package 45 supported by the winding device 13, and can guide the caught yarn end to the splicer 43. Although a detailed structure on the splicer 43 is not described, by twisting both yarn ends together by whirling airflow after both yarn ends are untwisted, the splicer 43 is configured such that the upper yarn is spliced with the lower yarn.

[0040] The pushing arm 47 is arranged at a leading end portion of the pneumatic cylinder 49 provided as an actuator. By controlling the pushing arm 47 to move to an advanced position in an upward direction by driving of the pneumatic cylinder 49 so as to push the yarn removing lever 28, the pushing arm 47 is configured such that the yarn removing lever 28 can be driven to an elevated position. The driving of the pneumatic cylinder 49 is controlled by the unit controller 60.

[0041] The winding device 13 includes a cradle arm 71 which is supported so as to be capable of swinging around a supporting shaft 70. The cradle arm 71 can support a bobbin 48 for winding the spun yarn 10 in a manner that the bobbin 48 can be rotated.

[0042] The winding device 13 includes a winding drum 72 and a traverse device 75. The winding drum 72 can be driven by making contact with an outer peripheral surface of the bobbin 48 or an outer peripheral surface of the package 45 formed by winding the spun yarn 10 around the bobbin 48. The traverse device 75 includes a traverse guide 76 which can be engaged with the spun yarn 10. In such a structure, by driving the winding drum 72 by an electric motor (not illustrated in the drawings) while reciprocating the traverse guide 76 by a driving

means (not illustrated in the drawings), the package 45 making contact with the winging drum 72 is rotated, and the spun yarn 10 is wound into the package 45 while being traversed.

[0043] Next, a detailed structure of the yarn accumulating device 12 will be described by referring to Fig. 4 and Fig. 5. Fig. 4 is a longitudinal sectional view of the yarn accumulating device 12. Fig. 5 is an external perspective view of the yarn accumulating device 12.

[0044] The yarn accumulating roller 21 is a roller member formed of abrasion-resistant material. The yarn accumulating roller 21 is fixed to a motor shaft 25a of the electric motor 25. Further, in the yarn accumulating roller 21, a side where the yarn hooking member 22 is provided will be referred to as a leading end and a side where the electric motor 25 is provided will be referred to as a base end. The yarn accumulating roller 21 includes a base-end taper portion 21b, a cylindrical portion 21c, and a leading-end taper portion 21d arranged in this order from the base end to the leading end thereof.

[0045] The cylindrical portion 21c slightly tapers towards a leading end thereof, and also is flatly connected (without difference in level) with the base-end taper portion 21b and the leading-end taper portion 21d. A dimension of the cylindrical portion 21c is arbitrarily determined such that at least the minimum accumulated amount of the spun yarn 10 can be accumulated. The accumulated amount sensor 27 is arranged so as to face the cylindrical portion 21c. The accumulated amount sensor 27 detects the accumulated amount of the yarn 10 wound around the yarn accumulating roller 21, and then transmits the detected accumulated amount of the yarn 10 to the unit controller 60.

[0046] Each of the base-end taper portion 21b and the leading-end taper portion 21d is formed in a slightly tapered shape with a larger diameter at a corresponding end surface side. On an outer peripheral surface 21a of the yarn accumulating roller 21, the base-end taper portion 21b smoothly moves the supplied spun yarn 10 from a larger diameter portion to a smaller diameter portion towards the cylindrical portion 21c so as to orderly wind the spun yarn 10 around a surface of the cylindrical portion 21c. The leading-end taper portion 21d prevents a sloughing phenomenon in which the wound spun yarn 10 sloughs off all at once when unwinding the spun yarn 10 from the yarn accumulating roller 21. The leading-end taper portion 21d also has a function of sequentially rewinding the spun yarn 10 from the smaller diameter portion to the larger diameter portion at the end surface side so as to smoothly pull out the spun yarn 10.

[0047] As illustrated in Fig. 3 and Fig. 5, the yarn hooking member 22 located on a leading end of the yarn accumulating roller 21 is arranged coaxially with the yarn accumulating roller 21. The yarn hooking member 22 includes a flyer axis 33 and a flyer 38 fixed to a leading end of the flyer axis 33.

[0048] The flyer axis 33 is supported to be relatively rotatable with respect to the yarn accumulating roller 21. Meanwhile, a permanent magnet is mounted on one of the flyer axis 33 and the yarn accumulating roller 21, and a magnetic hysteresis member is mounted on the other thereof. A resistance torque is generated against rotation of the yarn hooking member 22 relative to the yarn accumulating roller 21 by such magnetic mechanisms. The yarn hooking member 22 rotates accompanying rotation of the yarn accumulating roller 21 by the resistance torque. Accordingly, the yarn hooking member 22 and the yarn accumulating roller 21 can rotate integrally. Meanwhile, when force that surpasses the resistance torque is applied to the yarn hooking member 22, the yarn hooking member 22 rotates relatively with respect to the yarn accumulating roller 21.

[0049] The flyer 38 is curved arbitrarily towards the outer peripheral surface 21a of the yarn accumulating roller 21, and is formed in a shape in which the flyer 38 can be engaged with the spun yarn 10 (can hook the spun yarn 10). Under a state in which the spun yarn 10 is not wound around on the yarn accumulating roller 21, when the flyer 38 rotates integrally with the yarn accumulating roller 21, the flyer 38 is engaged with the spun yarn 10. The spun yarn 10 engaged with the rotating flyer 38 is swung around by such a flyer 38, and then is guided to and wound around the outer peripheral surface of the rotating yarn accumulating roller 21.

[0050] A state of the spun yarn 10 wound around the yarn accumulating roller 21 will be described as follows. That is, the spun yarn 10 passed through the upstream guide 23 is guided from a base end of the yarn accumulating roller 21 to the outer peripheral surface 21a, and then is wound around the cylindrical portion 21c a plurality of times. The spun yarn 10 pulled out from a leading end of the outer peripheral surface 21a, passes through the flyer 38, and then is fed downstream via the downstream guide 26.

[0051] As illustrated in Fig. 5, under a state in which the spun yarn 10 is wound around the yarn accumulating roller 21, when force to pull the spun yarn 10 engaged with the flyer 38 downstream is applied, force to attempt to rotate the yarn hooking member 22 so as to unwind the spun yarn 10 from a leading end portion of the yarn accumulating roller 21 is applied to the flyer 38. Accordingly, if yarn tension at a downstream side of the yarn accumulating device 12 (yarn tension between the yarn accumulating device 12 and the winding device 13) is high enough to surpass the resistance torque (that is, at least a predetermined value of yarn tension is applied to the spun yarn 10 engaged with the flyer 38), the yarn hooking member 22 rotates independently from the yarn accumulating roller 21. Consequently, the spun yarn 10 is gradually unwound from the leading end of the yarn accumulating roller 21 via the flyer 38.

[0052] Meanwhile, when the yarn tension at the downstream side of the yarn accumulating device 12 is not strong enough to surpass the resistance torque, the yarn hooking member 22 rotates integrally with the yarn accumulating roller 21. In such a case, the yarn hooking

member 22 operates so as to prevent the spun yarn 10 from being unwound from the leading end of the rotating yarn accumulating roller 21.

[0053] As described above, when downstream tension of the spun yarn 10 increases, the yarn accumulating device 12 operates to unwind the spun yarn 10. When the downstream tension of the spun yarn 10 decreases (when the spun yarn 10 is likely to slacken), the yarn accumulating device 12 operates to stop unwinding of the spun yarn 10. Accordingly, the yarn accumulating device 12 can eliminate slackening of the spun yarn 10 and apply appropriate tension to the spun yarn 10. Further, the yarn hooking member 22 operates so as to absorb change in tension applied to the spun yarn 10 between the yarn accumulating device 12 and the winding device 13 as described above. Consequently, such change in tension can be prevented from influencing the spun yarn 10 between the spinning device 9 and the yarn accumulating device 12. The spun yarn 10 can be pulled out from the spinning device 9 at a further steady speed by the yarn accumulating device 12 having the above-described structure.

[0054] Further, since the yarn accumulating roller 21 is driven and rotated at a predetermined speed, the spun yarn 10 is wound around at the base end of the yarn accumulating roller 21 at a predetermined speed. Accordingly, when a speed at which the spun yarn 10 is unwound from the leading end of the yarn accumulating roller 21 is faster than a speed at which the spun yarn 10 is wound around at the base end of the yarn accumulating roller 21, an accumulated amount of yarn decreases. When the spun yarn 10 is not unwound from the leading end of the yarn accumulating roller 21, the accumulated amount of yarn gradually increases.

[0055] Further, as described above, the yarn accumulating device 12 includes the yarn removing lever 28. As illustrated in Fig. 5, the yarn removing lever 28 is formed as a substantially L-shaped member having an elongate portion (an operating section 28a) arranged horizontally. A basal portion of the yarn removing lever 28 is supported by the swing shaft 28b. The yarn removing lever 28 is arranged so as to be capable of swinging vertically around the swing shaft 28b at a position between the elevated position and a lowered position. When the yarn removing lever 28 is at the lowered position, the yarn removing lever 28 does not make contact with a yarn passage of the spun yarn 10. When the yarn removing lever 28 is at the elevated position, the operating section 28a pushes up the yarn passage of the spun yarn 10 so as to remove the spun yarn 10 from the flyer 38. The yarn removing lever 28 is normally kept at the lowered position by being urged by a spring member (not illustrated in the drawings). The pneumatic cylinder 49 provided in the yarn splicing cart 3 is driven so that the yarn removing lever 28 is pushed by the pushing arm 47 and is moved up to the elevated position.

[0056] In the above-described structure, by moving the yarn removing lever 28 up to the elevated position, the spun yarn 10 can be removed from the yarn hooking member 22. Accordingly, since resistance force generated when the spun yarn 10 is unwound from the leading end of the yarn accumulating roller 21 (resistance torque acting on the yarn hooking member 22) stops acting on the spun yarn 10, even when yarn tension at the downstream side of the yarn accumulating roller 21 is weak, the spun yarn 10 can be unwound from the yarn accumulating roller 21. Controlling the yarn removing lever 28 to be kept at the elevated position under a state in which the spun yarn 10 is not wound around the yarn accumulating roller 21 can prevent the flyer 38 from being engaged with the spun yarn 10. Consequently, the spun yarn 10 can be prevented from being wound by the yarn accumulating roller 21.

[0057] Next, a detailed structure of the leading end portion of the suction pipe 44 provided in the yarn splicing cart 3 will be described. Fig. 6 is an enlarged sectional view illustrating the structure of the leading end portion of the suction pipe 44. Further, Fig. 6 illustrates a state in which the suction pipe 44 is swung and a leading end of the suction pipe 44 is located downstream of the spinning device 9.

[0058] As illustrated in Fig. 6, the elongate nozzle member 44a is fixed to the leading end portion of the suction pipe 44. The nozzle member 44a is formed in a pipe shape. A suction passage 62 formed in a cross-sectional round shape, is formed in the nozzle member 44a. One end of the suction passage 62 is connected to a suction opening 63 formed on a leading end surface of the nozzle member 44a.

[0059] The suction passage 62 is configured as a passage with steps which has a smaller diameter portion 64 formed in a portion near the suction opening 63 and a larger diameter portion 65 connected to the smaller diameter portion 64. Accordingly, a flow passage sectional area of the larger diameter portion 65 is larger than a flow passage sectional area of the smaller diameter portion 64. In the nozzle member 44a, a first air chamber 68 and a second air chamber 69, which are formed in a circular shape, are formed such that the suction passage 62 is surrounded by both air chambers. The first air chamber 68 and the second air chamber 69 are connected to a compressed air pipe 55, and a compressed air source (not illustrated in the drawings) can supply compressed air to the first air chamber 68 and the second air chamber 69.

[0060] An ejector nozzle (a sucking section) 66 for injecting compressed air to the suction passage 62 is connected to the first air chamber 68. The ejector nozzle 66 is formed as a ring-shaped nozzle formed in a cross-sectional triangular shape. A cross-sectional outline of the ejector nozzle 66 tapers towards the suction passage 62 arranged inside. A leading end of the ejector nozzle 66 forms an injection opening on an inner wall of the suction passage 62, and can inject air from the injection opening to the suction passage 62.

[0061] The injection opening of the ejector nozzle 66

is formed in a ring shape such that air is injected from the entire perimeter of the injection opening. The ejector nozzle 66 is arranged to slant arbitrarily so that oblique airflow directed towards a base end of the suction pipe 44 can be formed. In such a structure, by injecting air to the suction passage 62 from the first air chamber 68 through the ejector nozzle 66 at a high speed, a publicly known venture effect causes pressure drop (an eject effect) to be generated. Consequently, suction airflow directed towards a basal portion of the suction pipe 44 can be controlled to act on the suction opening 63. Generation and stoppage of such suction airflow are controlled by the unit controller 60.

[0062] The suction pipe 44 is connected to the blower box 80 via a blower duct (not illustrated in the drawings). By such a structure, different suction airflow from the suction airflow generated through the ejector nozzle 66 can be generated through the suction pipe 44.

[0063] A plurality of twisting nozzles (twisting sections) 67 for injecting compressed air to the suction passage 62 are connected to the second air chamber 69. The twisting nozzles 67 are placed at equally spaced intervals in the vicinity of the suction passage 62. Each twisting nozzle 67 forms an injection opening on the inner wall of the suction passage 62. Further, although for convenience in being described by the sectional view, Fig. 6 illustrates the twisting nozzle 67 such that the twisting nozzle 67 extends in a radial direction, an actual direction of the twisting nozzle 67 is a tangential direction of the round-shaped suction passage 62.

[0064] In such a structure, by injecting the compressed air to the suction passage 62 from the second air chamber 69 through the twisting nozzle 67, airflow is generated in the suction passage 62. Accordingly, while twists are applied to the spun yarn 10 introduced into the suction passage 62 by action of whirling airflow which is generated at the twisting nozzle 67, the spun yarn 10 is pulled into the basal portion of the suction pipe 44. Generation and stoppage of such whirling airflow are controlled by the unit controller 60.

[0065] Next, by referring to Fig. 7 through Fig. 11, a yarn processing method during the yarn splicing operation in the spinning frame 1 according to the present embodiment will be described. Fig. 7 is a flowchart describing the first half of a control in which a yarn portion with unstable yarn quality is unwound from the yarn accumulating roller 21. Fig. 8 is a flowchart describing the last half of the control in which the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller 21. Fig. 9 is a timing chart when the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller 21. Fig. 10 is a longitudinal sectional view illustrating a state in which the upper yarn and the lower yarn are caught by the suction pipe 44 and the suction mouth 46. Fig. 11 is a longitudinal sectional view illustrating a state in which the yarn portion with unstable yarn quality is unwound from the yarn accumulating roller 21.

[0066] Further, in Fig. 9, a state in which airflow is generated through the twisting nozzle 67, the ejector nozzle 66, and the suction pipe 44, is referred to as "ON", and a state in which generation of the airflow is stopped, is referred to as "OFF". Meanwhile, a state in which the yarn removing lever 28 is elevated, is referred to as "ON", and a state in which the yarn removing lever 28 is lowered, is referred to as "OFF".

[0067] First, when detecting a yarn defect during a winding operation of the spun yarn 10, the yarn clearer 52 transmits the yarn defect detection signal to the unit controller 60. Immediately after receiving the yarn defect detection signal (step S101), the unit controller 60 controls the cutter 57 to cut off the spun yarn 10 and also stops operations of the draft device 7, the spinning device 9, or the like (step S102). Meanwhile, the winding device 13 still continues performing the winding operation, and the spun yarn 10 located downstream of a position at which the spun yarn 10 was cut off, is temporarily wound into the package 45. Accordingly, the spun yarn 10 wound around the yarn accumulating roller 21 is also wound into the package 45, which cause the spun yarn 10 on the yarn accumulating roller 21 to run out. Further, a yarn portion including the yarn defect is also wound into the package 45 temporarily.

[0068] Next, the unit controller 60 transmits a control signal to the yarn splicing cart 3, and then controls the yarn splicing cart 3 to travel to the front of such a spinning unit 2 (step S103) .

[0069] Then, the yarn splicing operation cycle starts. Specifically, the unit controller 60 controls the suction mouth 46 to swing to the vicinity of a surface of the package 45 (refer to Fig. 10) and controls the winding device 13 to rotate the package 45 backward (step S104 of Fig. 7). Accordingly, a yarn end of the lower yarn is pulled out from the outer peripheral surface of the package 45, and then the yarn end is caught by the suction mouth 46 (step S104). Further, at this point of time, by pulling out the spun yarn 10 including the yarn defect from the package 45 and sucking the spun yarn 10 including the yarn defect by suction airflow generated through the suction mouth 46, the spun yarn 10 including the yarn defect can be removed from the package 45.

[0070] Next, while rotating the package 45 backward, the unit controller 60 swings the suction mouth 46 upward under a state in which the suction mouth 46 is sucking the lower yarn so as to guide the lower yarn to the splicer 43 (step S105). Then, when the lower yarn is guided to the splicer 43, the unit controller 60 also stops rotation of the package 45 (step S105).

[0071] Before or after swinging movement of the suction mouth 46, the unit controller 60 controls the suction pipe 44 to swing to the vicinity of a downstream side of the spinning device 9 (refer to Fig. 10). Before or after the swinging movement, the unit controller 60 controls suction airflow to be generated through the suction pipe 44 (step S106 of Fig. 7). Then, the unit controller 60 controls whirling airflow to be generated through the twisting nozzle 67 (step S107) and controls suction airflow to be

generated through the ejector nozzle 66 (step S108) (refer to Fig. 9). The unit controller 60 controls the above-described airflow to be generated, and also re-drive the spinning device 9 or the like such that the spun yarn 10 is generated.

[0072] The spun yarn 10 fed herein from the spinning device 9, has been less sufficiently twisted than the spun yarn 10 in a normal state, and yarn strength of such spun yarn 10 has been decreased. Accordingly, when the spun yarn 10 is just sucked by the suction airflow generated through the ejector nozzle 66 and the suction pipe 44, friction or the like which is generated between the spun yarn 10 and the suction opening 63 of the suction pipe 44 or between the spun yarn 10 and the inner wall of the suction passage 62 causes the spun yarn 10 to break easily, for example.

[0073] However, in a structure of the present embodiment, the whirling airflow generated through the twisting nozzle 67 acts such that another twists are applied to the spun yarn 10. By such another twists, the yarn strength of the spun yarn 10 can be increased and the spun yarn 10 can be sucked in the suction pipe 44. Accordingly, a yarn breakage can be prevented effectively.

[0074] Further, by controlling the airflow to be generated in the above-described order, the spun yarn 10 can be sucked while twists are being applied sufficiently to the spun yarn 10 in an early stage, which has been generated by the spinning device 9, by the whirling airflow. Accordingly, the spun yarn 10 is caught without fail.

[0075] When the suction pipe 44 catches the upper yarn, by swinging the suction pipe 44 downward while continuing sucking the spun yarn 10, the unit controller 60 pulls out the spun yarn 10 from the spinning device 9 and guides the spun yarn 10 to the splicer 43 (step S109). Further, although in a flowchart of Fig. 7, a process in which the lower yarn is caught (step S104 and step S105) is first carried out and then a process in which the upper yarn is caught (step S106 through step S109) is carried out, the flowchart just illustrates an example of operations. That is, it is possible to catch the upper yarn first and then to catch the lower yarn, or to catch the upper yarn and the lower yarn at the same time.

[0076] When the spun yarn 10 is guided to the splicer 43 is completed, the spun yarn 10 between the spinning device 9 and the suction pipe 44 is engaged with the flyer 38, and then starts being wound around the yarn accumulating roller 21. Meanwhile, although the winding operation performed by the winding device 13 is stopped during the yarn splicing operation, since the spun yarn 10 is fed continuously from the spinning device 9 even in such a stopped state, slackening of the spun yarn 10 is generated if the spun yarn 10 is left untouched. However, by winding the spun yarn 10 around the yarn accumulating roller 21, the slackening of the spun yarn 10 is prevented. As described above, the yarn accumulating device 12 functions as a yarn slack eliminating device during the yarn splicing operation. After this time, as an accumulated amount of yarn on the yarn accumulating roller 21 increases, force to pull the spun yarn 10 from the spinning device 9 also increases.

[0077] Meanwhile, as described above, until at least the minimum accumulated amount of the spun yarn 10 is accumulated on the yarn accumulating roller 21, slipping is likely to be generated between the yarn accumulating roller 21 and the spun yarn 10, and the force to pull the spun yarn 10 is unstable. Accordingly, the spun yarn 10, which has been pulled out from the spinning device 9 until a sufficient amount of the spun yarn 10 (the minimum accumulated amount of the spun yarn 10) is accumulated on the yarn accumulating roller 21, includes many portions where yarn strength is low; namely, there are many yarn portions with unstable yarn quality.

[0078] Further, in a conventional spinning machine, immediately after the suction pipe 44 guided a yarn end to the splicer 43, a splicing operation performed by the splicer 43 started. The splicing operation is an operation, in which the upper yarn and the lower yarn located at a predetermined position are cut off, untwisted, and twisted, and a plurality of the spun yarn 10 is actually twisted and spliced together. When the splicing operation is performed at the above-described timing, since there are the unstable yarn portions on the yarn accumulating roller 21 as described above, such unstable yarn portions are wound into the package 45.

[0079] Then, for preventing such unstable yarn portions from being mixed into the package 45, the spinning frame 1 according to the present embodiment is configured as follows.

[0080] First, even after the upper yarn is guided to the splicer 43 by the suction pipe 44, the unit controller 60 does not start performing the splicing operation immediately. By monitoring the accumulated amount of yarn on the yarn accumulating roller 21 by the accumulated amount sensor 27, the unit controller 60 determines whether or not the accumulated amount of yarn on the yarn accumulating roller 21 reaches the minimum accumulated amount based on a monitoring result of the accumulated amount sensor 27 (step S110). When the accumulated amount of yarn does not reach the minimum accumulated amount, by keeping the yarn removing lever 28 located at the lowered position, the spun yarn 10 is wound by the yarn accumulating roller 21. Accordingly, the accumulated amount of yarn increases. Meanwhile, when the accumulated amount sensor 27 detects that the accumulated amount of yarn reaches at least the minimum accumulated amount, the unit controller 60 stops the whirling airflow generated through the twisting nozzle 67 (step S111). Then, the unit controller 60 controls the pneumatic cylinder 49 to be elevated so as to move the yarn removing lever 28 up to the elevated position (step S112), and removes the spun yarn 10 from the flyer 38.

[0081] At this point of time, since the spun yarn 10 is subjected to drag force upward in a substantially vertical direction (in an upper side in Fig. 11) by making contact with the yarn removing lever 28, friction is generated at such a contact portion. The stronger the force to pull the

spun yarn 10 is, the larger such drag force is and also the higher a possibility of occurrence of a yarn breakage is. Further, when whirling airflow is generated through the suction pipe 44, since the spun yarn 10 follows such whirling airflow, suction airflow acts on the spun yarn 10 effectively. Accordingly, the force to pull the spun yarn 10 becomes strong. As described above, the yarn breakage may occur by elevating the yarn removing lever 28. However, in the present embodiment, by stopping the whirling airflow generated through the suction pipe 44 before the spun yarn 10 makes contact with the yarn removing lever 28, drag force of the whirling airflow and friction force accompanying such drag force are reduced and the yarn breakage is prevented.

[0082] When the spun yarn 10 is removed from the flyer 38 under a state in which the yarn accumulating roller 21 rotates, the resistance force which acts so as to prevent the spun yarn 10 from unwinding from the leading end portion of the yarn accumulating roller 21, disappears. Consequently, the spun yarn 10 can be unwound from the yarn accumulating roller 21 even by weak suction force of the suction pipe 44 or the like. Accordingly, under the state illustrated in Fig. 11, the spun yarn 10 on the yarn accumulating roller 21 is unwound, and is sucked in the suction pipe 44. Therefore, the unstable spun yarn 10 on the yarn accumulating roller 21 can be removed through the suction pipe 44.

[0083] Further, when the yarn removing lever 28 is elevated, depending on how far the yarn accumulating roller 21 rotates, the slackening of the spun yarn 10 is generated at the leading end portion of the yarn accumulating roller 21. Then, when a portion with the slackening of the spun yarn 10 becomes long, the spun yarn 10 may be entangled with the flyer 38 or the like. Accordingly, it is necessary to eliminate the portion with the slackening of the spun yarn 10 immediately. However, in the present embodiment, the suction airflow is generated through the ejector nozzle 66, as well as the normal suction airflow is generated through the suction pipe 44. Consequently, strong suction action is generated. Therefore, the spun yarn 10 is sucked through the suction pipe 44 without slackening (before slackening). Meanwhile, at the base end of the yarn accumulating roller 21, the spun yarn 10 is newly wound around by rotation of the yarn accumulating roller 21. That is, since the spun yarn 10 is newly wound by the yarn accumulating roller 21 depending on how much of the spun yarn 10 the suction pipe 44 sucks, the accumulated amount of yarn is kept substantially constant.

[0084] Accordingly, while a state in which at least the minimum accumulated amount of the spun yarn 10 is accumulated on the yarn accumulated roller 21 is being kept, the spun yarn 10 is pulled out from the spinning device 9. Consequently, it is possible to say that the spun yarn 10 which is newly wound around at the base end of the yarn accumulating roller 21 is stable in quality. Then, while the stable spun yarn 10 is being wound around from the base end of the yarn accumulating roller 21, since the unstable spun yarn 10 is unwound from the leading end of the yarn accumulating roller 21, the spun yarn 10 on the yarn accumulating roller 21 is sequentially replaced with the stable-quality spun yarn 10.

[0085] In the unit controller 60, a prescribed period of time, which is required to replace all of the spun yarn 10 on the yarn accumulating roller 21 with the stable-quality spun yarn 10 after the unstable spun yarn 10 starts being unwound by elevating the yarn removing lever 28 (i.e., a period of time which is required to remove all of the unstable-quality spun yarn 10 from the yarn accumulating roller 21), is input in advance. The unit controller 60 determines whether or not the prescribed period of time has elapsed (step S113). When the prescribed period of time has elapsed, the unit controller 60 stops the suction airflow generated through the ejector nozzle 66 (step S114). The unit controller 60 controls the pneumatic cylinder 49 to lower so as to control the yarn removing lever 28 to lower (step S114). Then, the splicing operation performed by the splicer 43 starts (step S115).

[0086] Further, since the flyer 38 is engaged with the spun yarn 10 by lowering the yarn removing lever 28, the spun yarn 10 is not unwound from the leading end of the yarn accumulating roller 21. Consequently, the spun yarn 10 can be prevented from slackening. Furthermore, as described above, a yarn end of the upper yarn and a yarn end of the lower yarn are untwisted, and then are spliced by twisting both yarn ends together. In the present embodiment at this point of time, the whirling airflow generated through the twisting nozzles 67 is stopped before the upper yarn is guided to the splice 43 (more specifically, before a yarn removing operation is performed). Accordingly, since so many twists have not been applied to the spun yarn 10 which is guided to the splicer 43, such an untwisting operation can be performed easily.

[0087] Further, even during the splicing operation performed by the splicer 43, the suction airflow is being generated through the suction mouth 46 and the suction pipe 44 and the spun yarn 10 is being sucked by the suction airflow. Then, in the middle of the splicing operation, the unnecessary spun yarn 10 is cut off by the splicer 43, and then is sucked and removed.

[0088] Then, when the splicing operation has been completed, the unit controller 60 restarts the winding operation of the spun yarn 10 performed by the winding device 13.

[0089] As described above, the spinning frame 1 according to the present embodiment includes the spinning device 9, the yarn accumulating roller 21, the yarn hooking member 22, the yarn removing lever 28, the suction pipe 44, and the unit controller 60. The spinning device 9 generates the spun yarn 10 by applying twists to the fiber bundle 8. The yarn accumulating roller 21 is arranged downstream of the spinning device 9 and temporarily accumulates the spun yarn 10 by winding the spun yarn 10 around the outer peripheral surface thereof while rotating. The yarn hooking member 22 can make contact with the spun yarn 10 and winds the spun yarn 10 around

the outer peripheral surface of the yarn accumulating roller 21 by rotating integrally with the yarn accumulating roller 21 while making contact with the spun yarn 10. The yarn removing lever 28 can remove the spun yarn 10 from the yarn hooking member 22. The suction pipe 44 is a device for sucking and catching a yarn end of the spun yarn 10. The suction pipe 44 includes the twisting nozzle 67 that can apply twists to the caught spun yarn 10. The unit controller 60 controls the twisting nozzle 67 to operate while the spun yarn 10 caught by the suction pipe 44 is being wound around the yarn accumulating roller 21 by the yarn hooking member 22, and controls the twisting nozzle 67 to stop a twisting operating before the yarn removing member 28 removes the spun yarn 10 from the yarn hooking member 22.

[0090] That is, the spun yarn 10 immediately after the spinning device 9 has started the spinning operation is not truly twisted since a process for preventing twists from being eliminated has not been carried out at a downstream side, and yarn strength of such spun yarn is weaker than yarn strength of normal spun yarn. However, by using the above-described structure, even when the spun yarn 10 with such weak yarn strength is sucked through the suction pipe 44, such weak yarn strength can be increased and the spun yarn 10 can be sucked by an another twists applying operation performed by the twisting nozzle 67. Consequently, the suction pipe 44 can keep catching and sucking the spun yarn 10 while preventing the yarn breakage appropriately. Further, if the twisting nozzle 67 is operating when the spun yarn 10 is removed from the yarn hooking member 22, the yarn breakage may occur since resistance force (friction force) at a portion making the yarn removing lever 28 into contact with the spun yarn 10 increases by force (suction force) generated by the twisting nozzle 67. However, according to the above-described structure, since a twisting operation of the twisting nozzle 67 is stopped before the spun yarn 10 starts being unwound from the yarn accumulating roller 21, the suction pipe 44 can be prevented from catching the spun yarn 10 excessively and the yarn breakage can be prevented. Further, when an amount of the spun yarn 10 on the yarn accumulating roller 21 is not sufficient, the spun yarn 10 cannot be stably pulled out from the spinning device 9 and quality of the spun yarn 10 may become unstable. However, according to the above-described structure, by accumulating the spun yarn 10 on the yarn accumulating roller 21 first, by removing the spun yarn 10 from the yarn hooking member 22, and then by sucking the spun yarn 10 in the suction pipe 44 while unwinding the spun yarn 10 from the yarn accumulating roller 21, such a unstable-quality yarn portion of the spun yarn 10 can be removed.

[0091] In the spinning frame 1 according to the present embodiment, the suction pipe 44 includes the ejector nozzle 66 that can generate suction airflow directed towards a downstream side in a sucking direction. The ejector nozzle 66 is provided near the twisting nozzle 67. When the suction pipe 44 catches the spun yarn 10, the unit controller 60 controls the suction airflow to be generated through the ejector nozzle 66.

[0092] Accordingly, even when the suction opening 63 of the suction pipe 44 is away from the spun yarn 10 that should be sucked, by using the suction airflow generated through the ejector nozzle 66, the spun yarn 10 can be easily caught and sucked through the suction pipe 44.

[0093] Further, in the spinning frame 1 according to the present embodiment, while the spun yarn 10 is being removed from the yarn hooking member 22 by the yarn removing lever 28, the control section 60 controls the suction airflow to be generated through the ejector nozzle 66.

[0094] That is, when the suction airflow generated through the ejector nozzle 66 stops while the spun yarn 10 is being removed from the yarn hooking member 22, a speed at which the spun yarn 10 is sucked decreases. Accordingly, when a speed at which the spun yarn 10 is unwound is fast, the speed at which the spun yarn 10 is sucked through the suction pipe 44 does not catch up with the speed the spun yarn 10 is unwound. Consequently, the spun yarn 10 unwound from the yarn accumulating roller 21 may slacken. In this case, the slackened spun yarn 10 is entangled with the flyer 38 or the like on the yarn accumulating roller 21. However, in the above-described structure, the spun yarn 10 is sucked through the suction pipe 44 before slackening by using the suction airflow generated through the ejector nozzle 66. Accordingly, entanglement of the spun yarn 10 can be prevented.

[0095] Further, the spinning frame 1 according to the present embodiment includes the splicer 43 that splices a yarn end of the spun yarn 10 at an upstream side with a yarn end of the spun yarn 10 at a downstream side. The suction pipe 44 catches a yarn end of the spun yarn 10 and guides the yarn end to the splicer 43.

[0096] Accordingly, errors caused by the yarn breakage during the yarn splicing operation in the splicer 43 can be decreased, and operation efficiency in the spinning frame 1 can be improved.

[0097] Further, in the spinning frame 1 according to the present embodiment, the control section 60 stops the twisting operation of the twisting nozzle 67 before the splicer 43 starts the splicing operation.

[0098] Accordingly, since the twisting operation of the twisting nozzle 67 is stopped and then the splicing operation is performed, an influence of twists applied by the twisting nozzle 67 does not affect a portion where the plurality of the spun yarn 10 is spliced together. Therefore, the splicer 43 can eliminate twists of the spun yarn 10 and splice the plurality of the spun yarn 10 together easily.

[0099] While a preferred embodiment of the present invention has been described as above, the above-described structure can also be modified as follows, for example.

[0100] Although in the above-described embodiment, the yarn processing method applied during the yarn splic-

ing operation when the yarn defect is detected has been described, a yarn processing method of the present invention can be applied not only when the yarn splicing operation is performed but also when the spun yarn 10 starts being wound around the yarn accumulating roller 21. For example, even when a doffing operation for changing the bobbin 48 is performed since the package 45 turns into a fully-wound package, the unstable spun yarn 10 can be discarded from the yarn accumulating roller 21 by the yarn processing method of the present invention.

[0101] Although the yarn removing lever 28 as a yarn removing section has a structure in which the yarn removing lever 28 swings around a shaft, a structure provided to the yarn removing lever 28 is not limited to the structure in which the yarn removing lever 28 swings around a shaft. For example, a structure in which the spun yarn 10 is removed from the yarn removing member 22 by controlling the yarn removing lever 28 to move back and forth in a parallel direction, may be provided.

[0102] Further, in place of a structure in which a dedicated member is provided as the yarn removing section, a structure in which the downstream guide 26 is arranged so as to be capable of moving forward and backward and the spun yarn 10 is removed from the yarn hooking member 22 by moving the downstream guide 26 forward, may be provided, for example.

[0103] In the above-described embodiment, although the yarn splicing cart 3, the pushing arm 47, and the pneumatic cylinder 49 are provided as a means that drives the yarn removing lever 28, a structure in which each spinning unit 2 drives the yarn removing lever 28 may be provided, for example. Further, in place of the pneumatic cylinder 49, for example, a structure in which an appropriate structure such as a rack and pinion mechanism or a cam mechanism moves the yarn removing lever 28, may be provided.

[0104] Further, in place of a structure in which the yarn splicing cart 3 performs the yarn splicing operation, each spinning unit 2 may include a structure for performing the yarn splicing operation.

[0105] A method of applying torque to between the yarn hooking member 22 and the yarn accumulating roller 21 is not limited to magnetic means as described above. For example, friction force or an electromagnetic means may be provided.

[0106] A structure in which one ejector nozzle 66 and one twisting nozzle 67 are arranged, can be changed into a structure in which at least two ejector nozzle 66 and at least two twisting nozzle 67 are arranged, for example.

[0107] A position of the ejector nozzle 66 can be changed such that the ejector nozzle 66 is arranged at a suction opening 63 side of the twisting nozzle 67 (at an upstream side in a sucking direction).

Claims

1. A spinning machine (2) comprising:

a spinning device (9) that generates spun yarn by applying twists to a fiber bundle;
a yarn accumulating roller (12) that is arranged downstream of the spinning device (9) and temporarily accumulates the spun yarn by winding the spun yarn around an outer peripheral surface (21a) thereof while rotating;
a yarn hooking member (22) that can make contact with the spun yarn and winds the spun yarn around the outer peripheral surface (21a) of the yarn accumulating roller (12) by rotating integrally with the yarn accumulating roller (12) while making contact with the spun yarn;
a yarn removing member (28) that can remove the spun yarn from the yarn hooking member (22);
a yarn end catching device (44) that is a device for sucking and catching a yarn end of the spun yarn, and that includes a twisting section (67) that can apply twists to the caught spun yarn; and
a control section that controls the twisting section (67) to operate while the spun yarn caught by the yarn end catching device (44) is being wound around the yarn accumulating roller (12) by the yarn hooking member (22), and controls the twisting section (67) to stop operating before the yarn removing member (28) removes the spun yarn from the yarn hooking member (22).

2. The spinning machine (2) according to claim 1, **characterized in that** the yarn end catching device (44) includes a sucking section (66) that can generate suction airflow directed towards a downstream side in a sucking direction, the sucking section (66) being provided near the twisting section (67), and
when the yarn end catching device (44) catches the spun yarn, the control section controls the sucking section (66) to generate the suction airflow.

3. The spinning machine (2) according to claim 2, **characterized in that** while the spun yarn is being removed from the yarn hooking member (22) by the yarn removing member (28), the control section (60) controls the sucking section (66) to generate the suction airflow.

4. The spinning machine (2) according to any one of claim 1 through claim 3, **characterized by** further comprising a yarn splicing device (43) that performs a yarn splicing operation to splice a yarn end of an upstream spun yarn and a yarn end of a downstream spun yarn,
characterized in that the yarn end catching device

(44) catches a yarn end of the spun yarn and guides the yarn end to the yarn splicing device (43).

5. The spinning machine (2) according to claim 4, **characterized in that** the control section (60) stops the operation of the twisting section (67) before the yarn splicing device (43) starts the yarn splicing operation.

FIG. 1

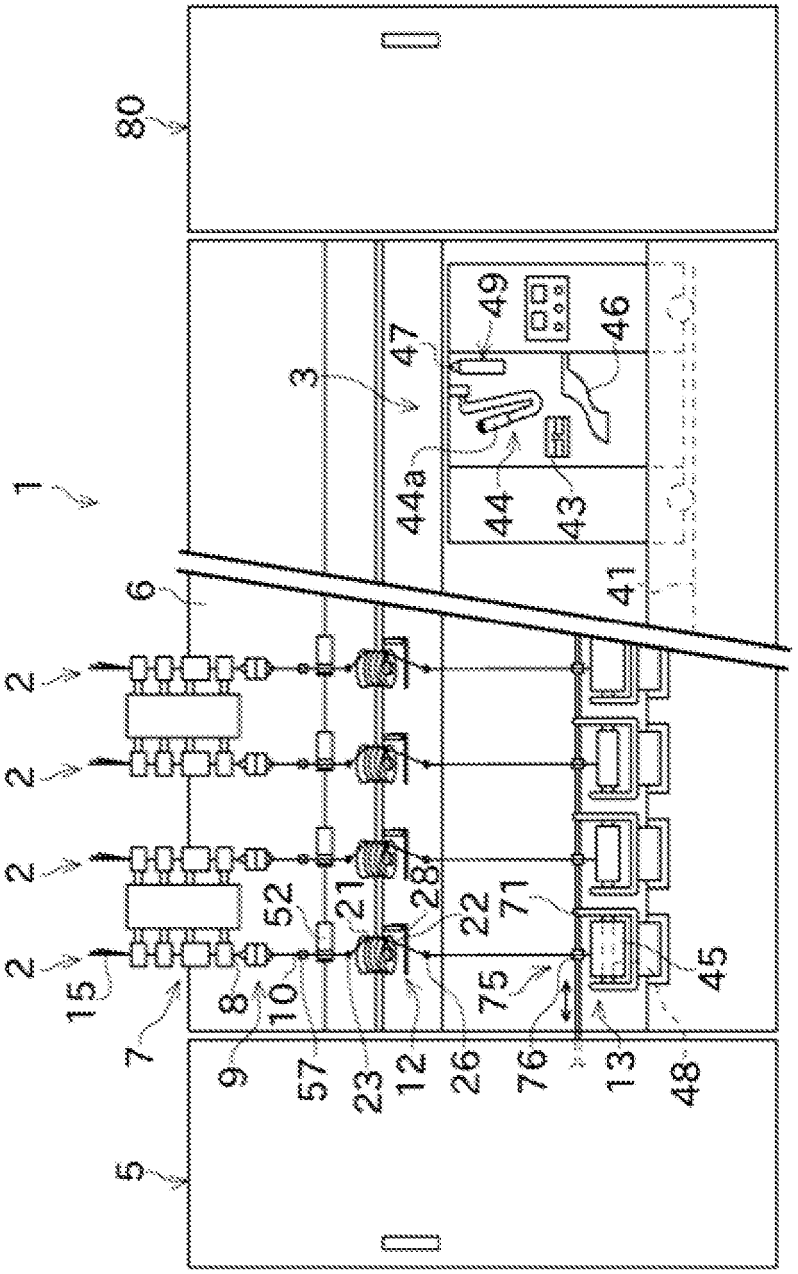
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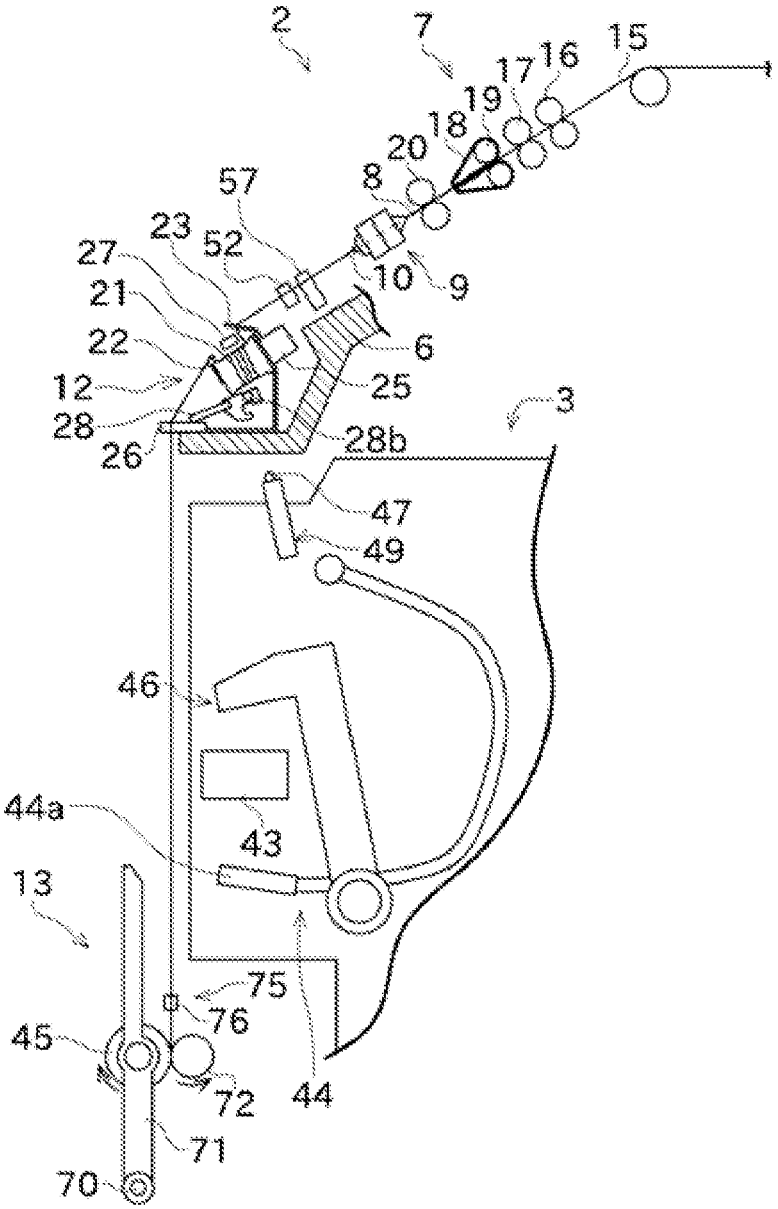
FIG. 2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76
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71
70

FIG. 3

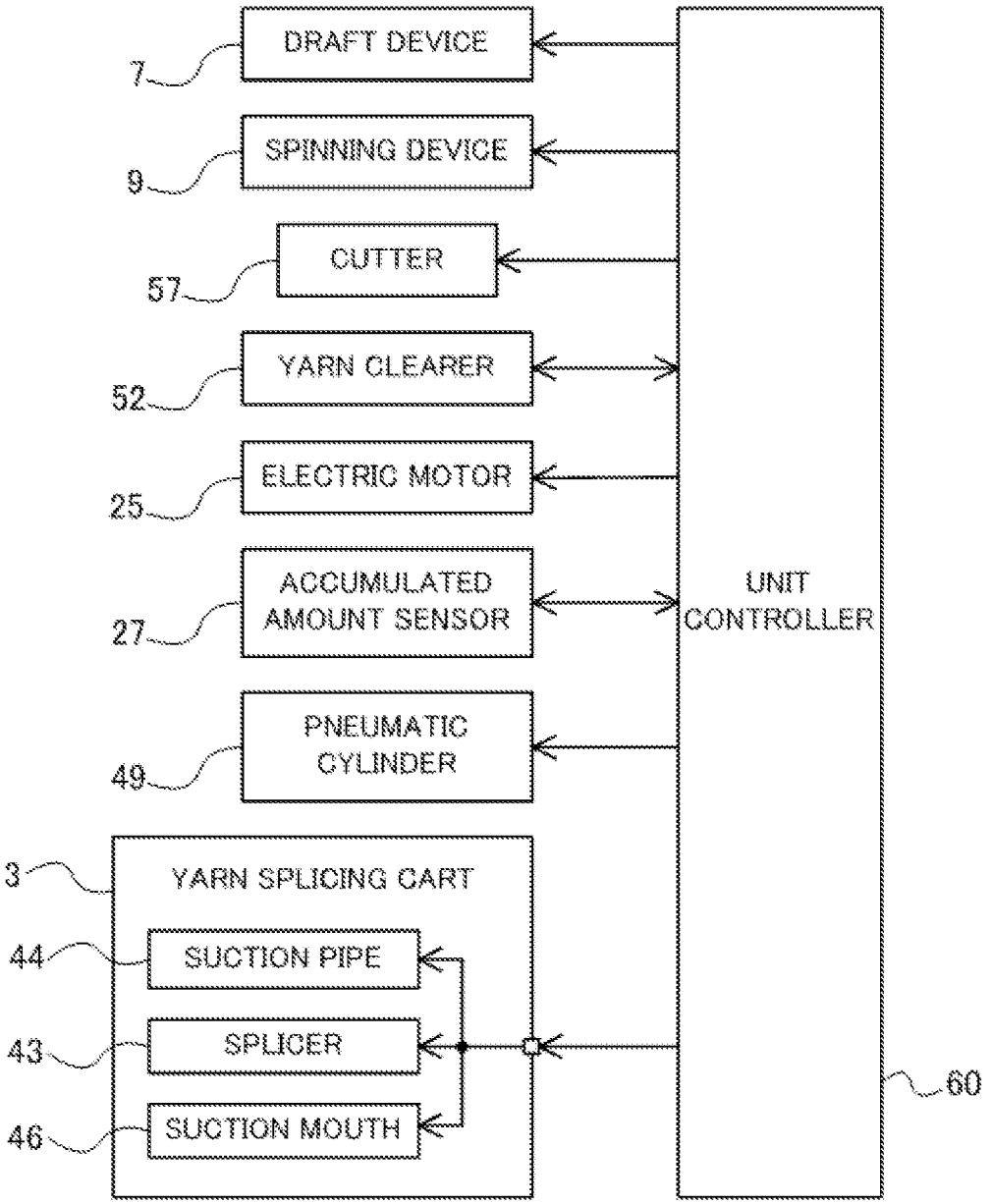

DRAFT DEVICE
7
SPINNING DEVICE
9
CUTTER
57
YARN CLEARER
52
ELECTRIC MOTOR
25
ACCUMULATED AMOUNT SENSOR
27
PNEUMATIC CYLINDER
49
UNIT CONTROLLER
60
3
YARN SPLICING CART
44
SUCTION PIPE
43
SPLICER
46
SUCTION MOUTH

FIG. 4

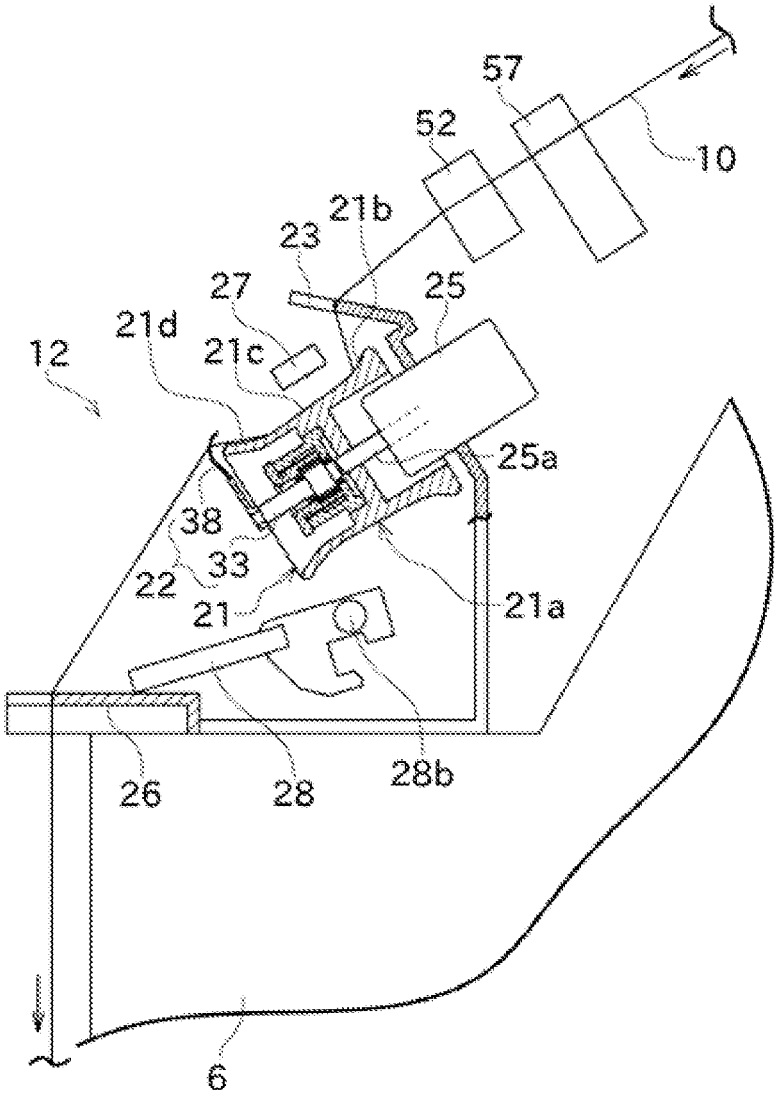


FIG. 5

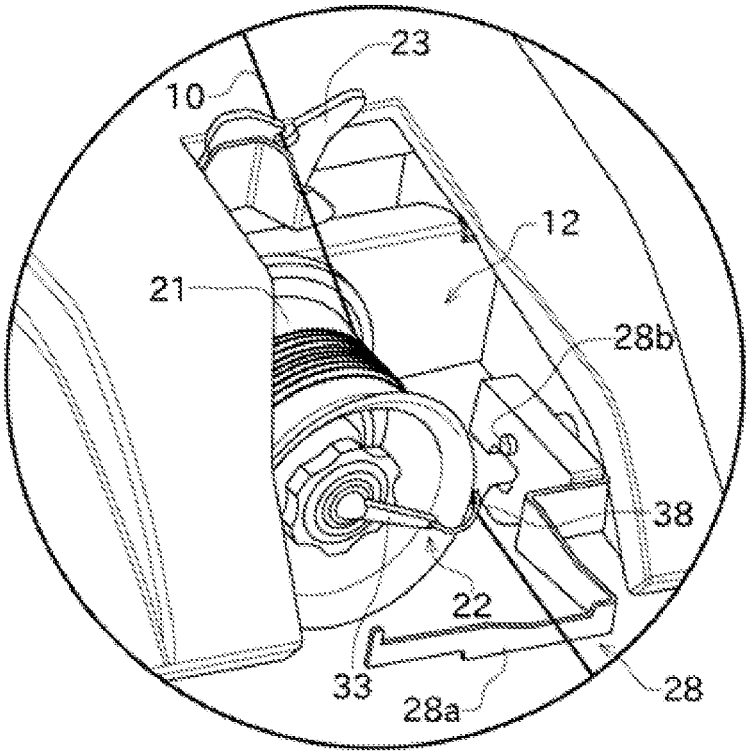


FIG. 6

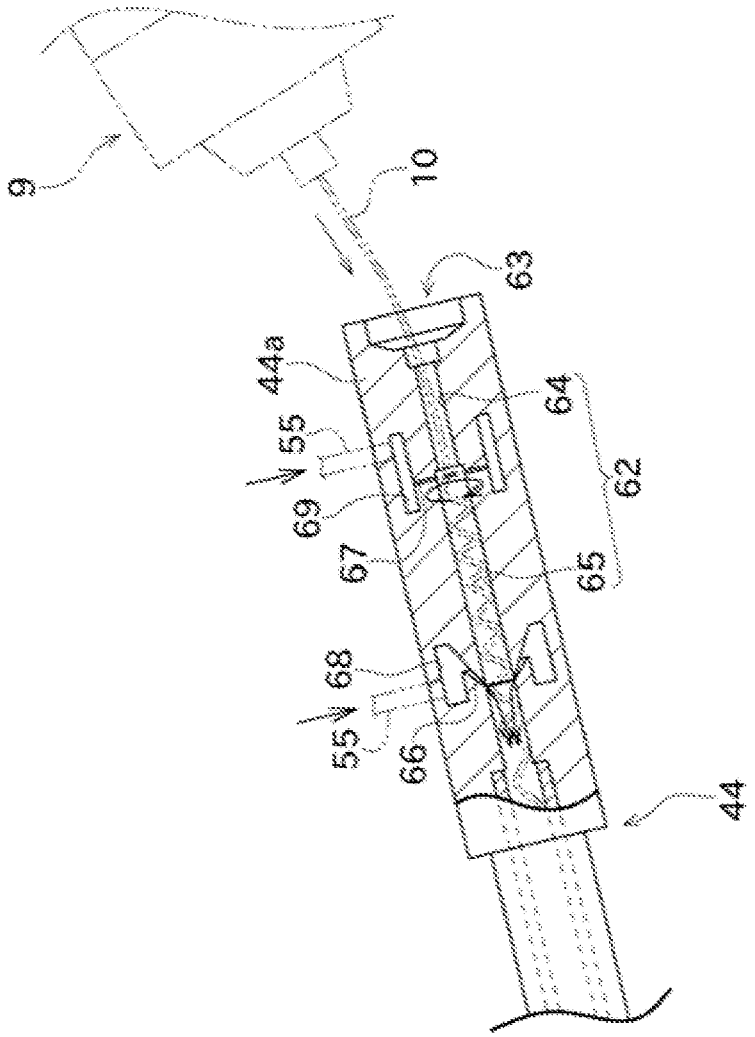


FIG. 7

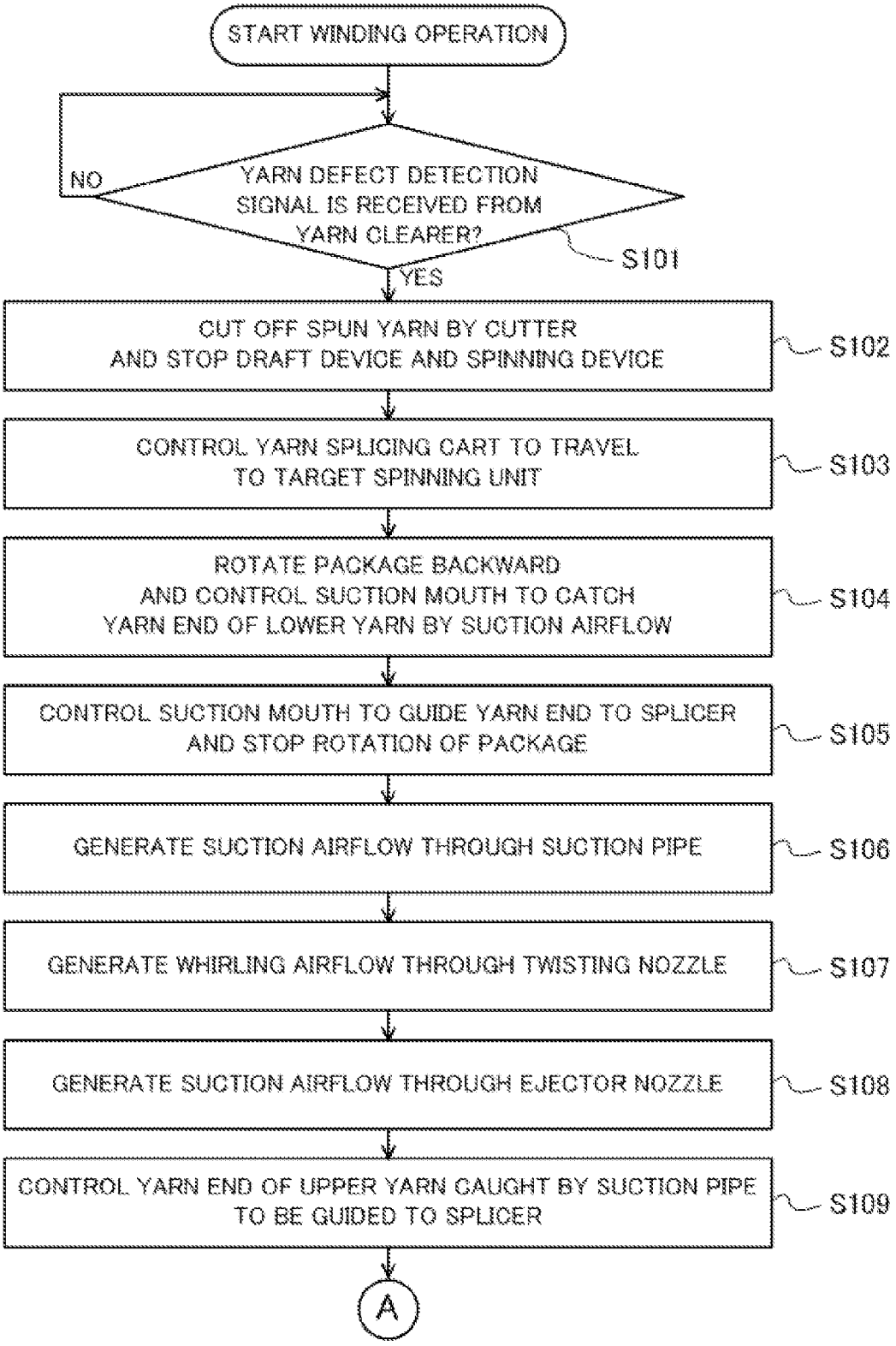

START WINDING OPERATION
YARN DEFECT DETECTION SIGNAL IS RECEIVED FROM YARN CLEARER?
NO
YES
S101
CUT OFF SPUN YARN BY CUTTER AND STOP DRAFT DEVICE AND SPINNING DEVICE
S102
CONTROL YARN SPLICING CART TO TRAVEL TO TARGET SPINNING UNIT
S103
ROTATE PACKAGE BACKWARD AND CONTROL SUCTION MOUTH TO CATCH YARN END OF LOWER YARN BY SUCTION AIRFLOW
S104
CONTROL SUCTION MOUTH TO GUIDE YARN END TO SPLICER AND STOP ROTATION OF PACKAGE
S105
GENERATE SUCTION AIRFLOW THROUGH SUCTION PIPE
S106
GENERATE WHIRLING AIRFLOW THROUGH TWISTING NOZZLE
S107
GENERATE SUCTION AIRFLOW THROUGH EJECTOR NOZZLE
S108
CONTROL YARN END OF UPPER YARN CAUGHT BY SUCTION PIPE TO BE GUIDED TO SPLICER
S109
A

FIG. 8

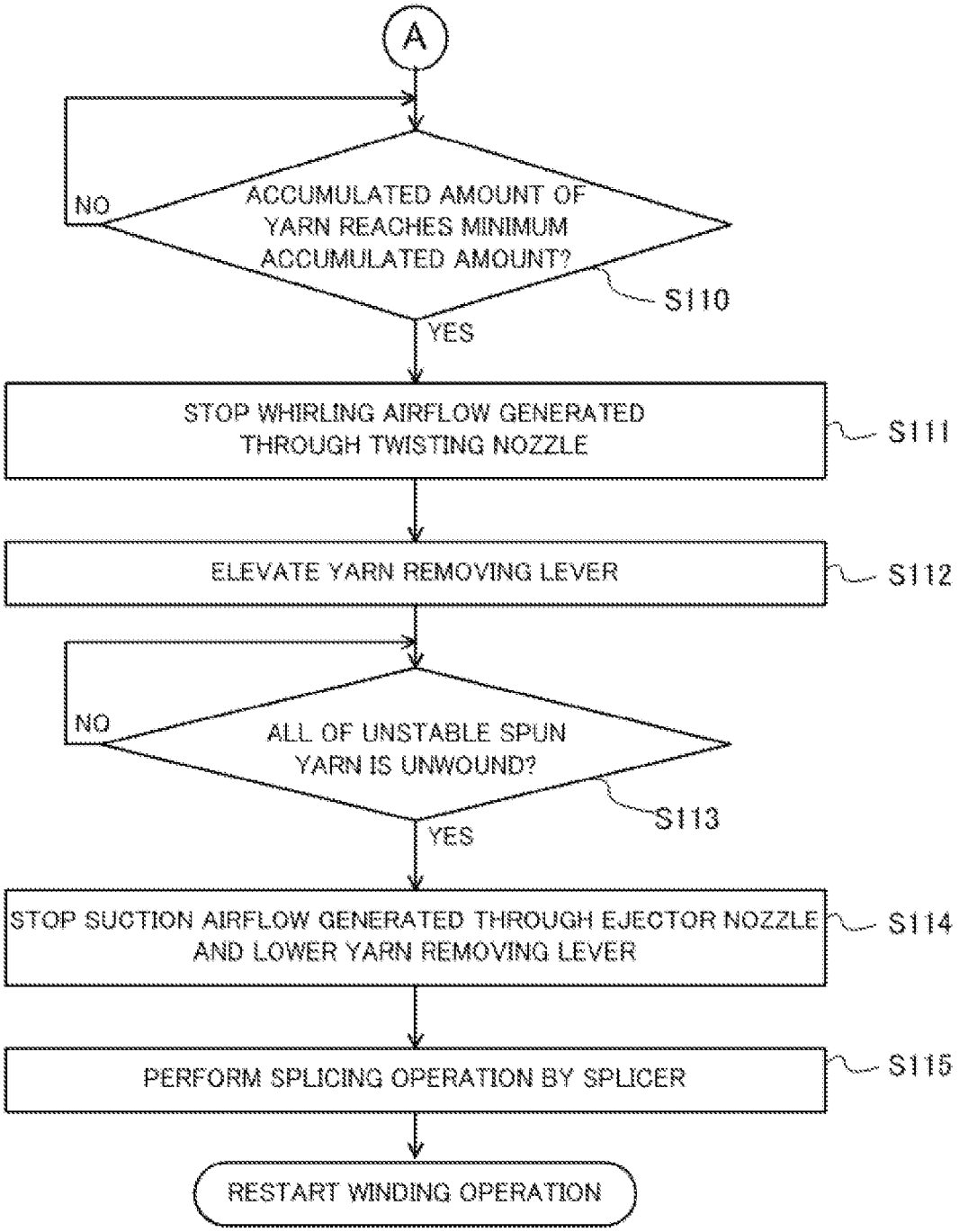

A
NO
ACCUMULATED AMOUNT OF YARN REACHES MINIMUM ACCUMULATED AMOUNT?
S110
YES
STOP WHIRLING AIRFLOW GENERATED THROUGH TWISTING NOZZLE
S111
ELEVATE YARN REMOVING LEVER
S112
NO
ALL OF UNSTABLE SPUN YARN IS UNWOUND?
S113
YES
STOP SUCTION AIRFLOW GENERATED THROUGH EJECTOR NOZZLE AND LOWER YARN REMOVING LEVER
S114
PERFORM SPLICING OPERATION BY SPLICER
S115
RESTART WINDING OPERATION

FIG. 9

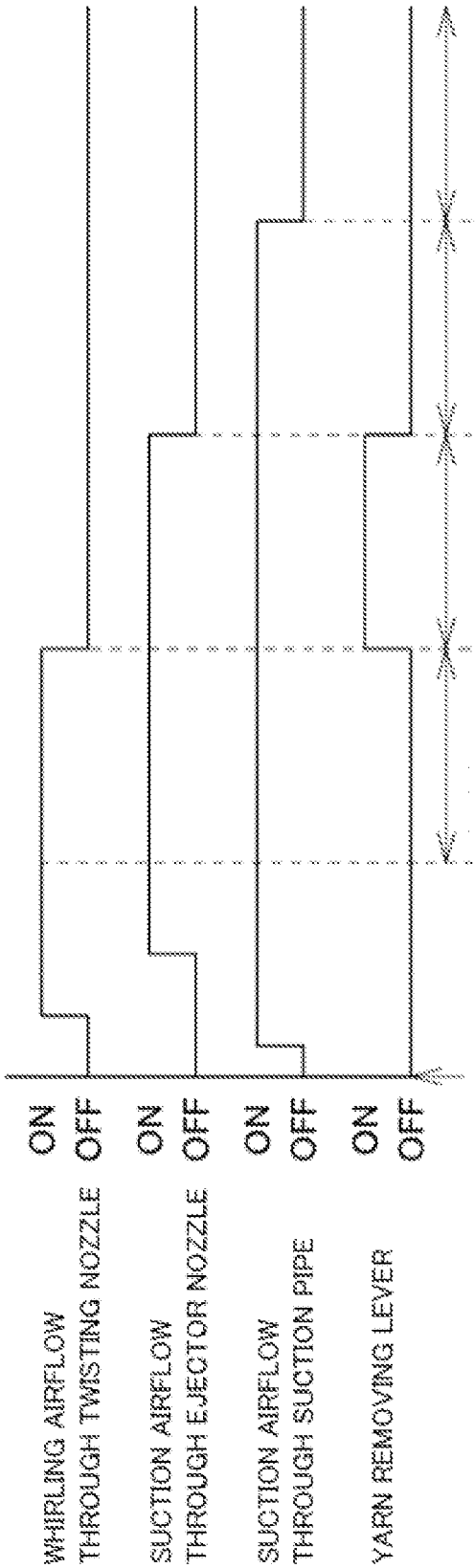
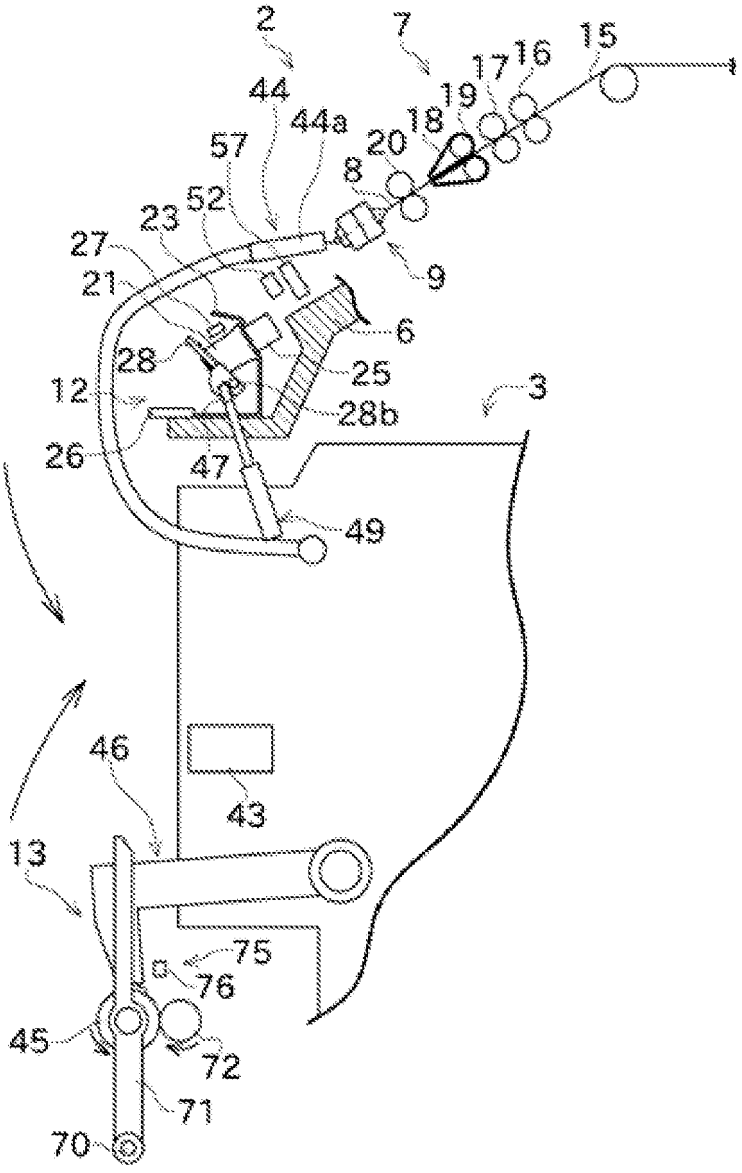

WHIRLING AIRFLOW THROUGH TWISTING NOZZLE
ON
OFF
SUCTION AIRFLOW THROUGH EJECTOR NOZZLE
ON
OFF
SUCTION AIRFLOW THROUGH SUCTION PIPE
ON
OFF
YARN REMOVING LEVER
ON
OFF
YARN SPLICING OPERATION CYCLE STARTS
S104
YARN IS WOUND AROUND YARN ACCUMULATING ROLLER
S110
UNNECESSARY YARN IS UNWOUND
S113
SPLICING OPERATION
S115
WINDING OPERATION

FIG. 10


2
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44a
57
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28b
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49
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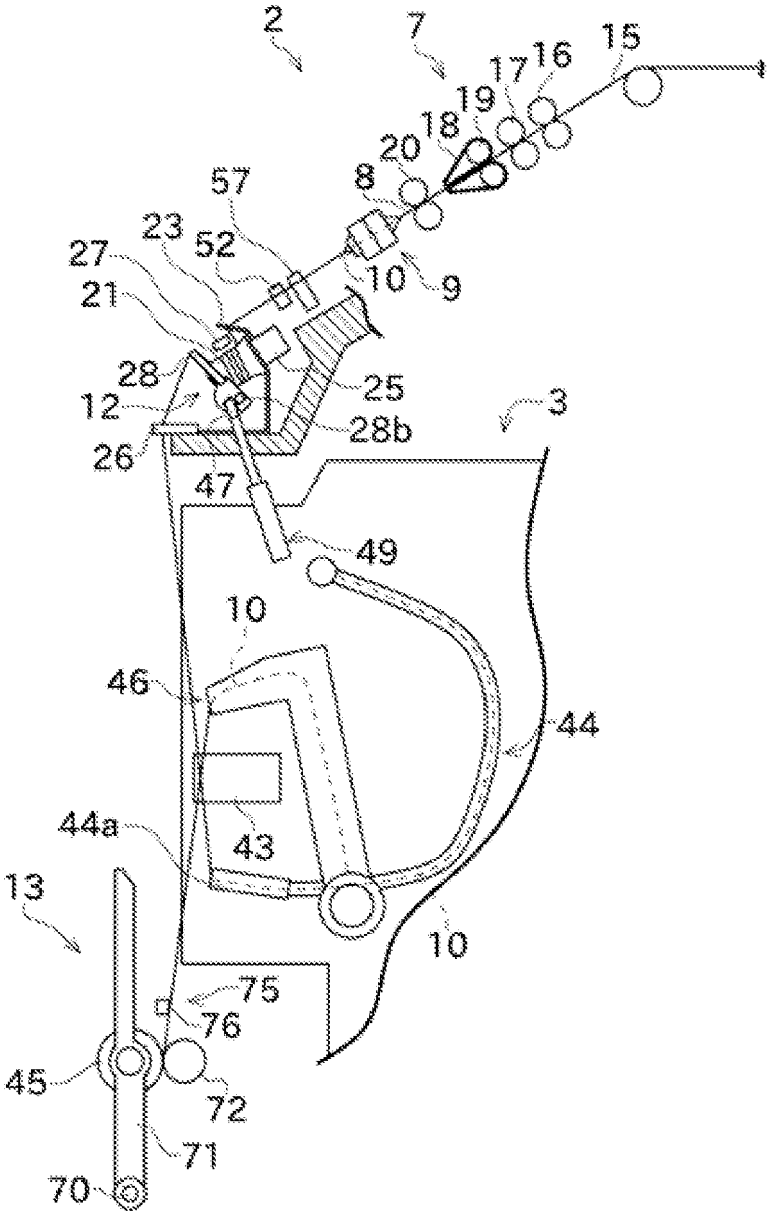
FIG. 11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28b
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47
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44a
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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 8860

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

D01H
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 February 2011	Dreyer, Claude

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