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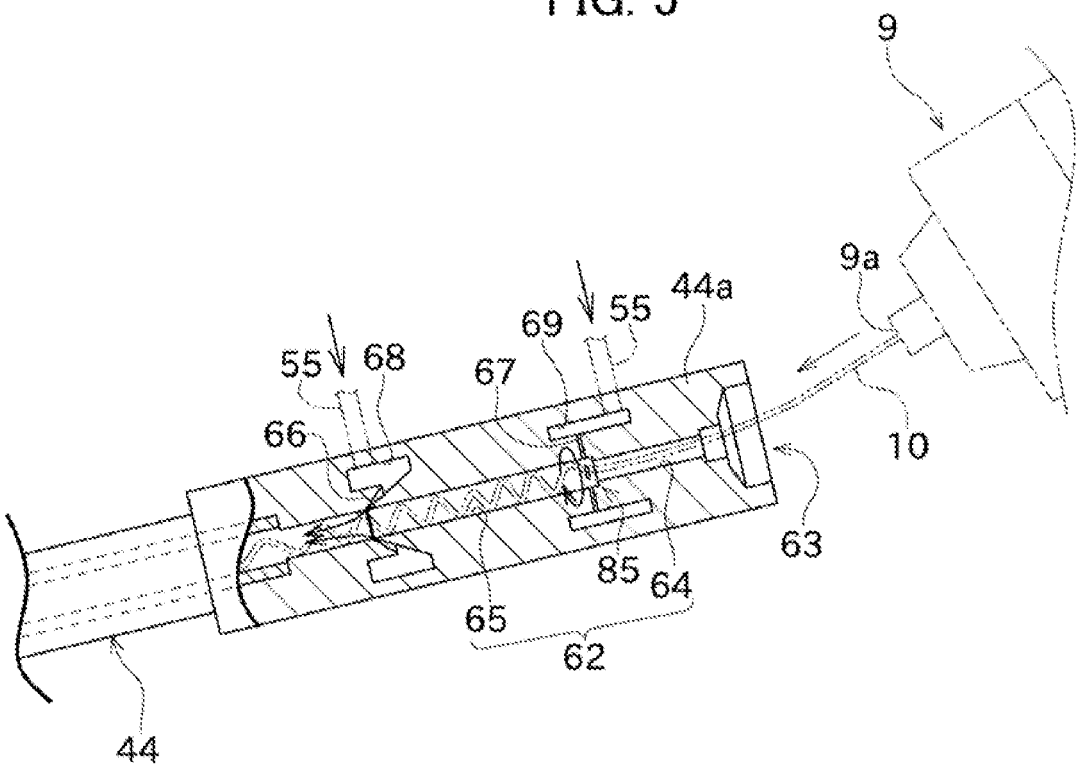
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(54) Yarn end catching device and spinning machine including the same

(57) A spinning machine includes a suction pipe (44) for sucking and catching a yarn end of spun yarn 10 and for guiding the yarn end to a yarn splicing device. The suction pipe 44 includes a suction passage 62 for sucking the yarn end and a twist applying nozzle 67. The twist applying nozzle 67 injects compressed air to generate whirling airflow in the suction passage 62, and thus, the twist applying nozzle 67 can apply twists to the spun yarn 10 sucked in the suction passage 62 (Fig. 5).

FIG. 5



EP 2 213 773 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention primarily relates to a yarn end catching device for catching and guiding yarn in a spinning machine.

2. Description of the Related Art

[0002] Japanese Unexamined Patent Application Publication No. 2005-220483 (Patent Document 1) discloses a spinning machine including a yarn end catching and guiding device of this type. The spinning machine of Patent Document 1 primarily includes a spinning device, a yarn feeding device, a winding device, and a yarn splicing cart.

[0003] The yarn feeding device includes a delivery roller and a nip roller. While a spun yarn discharged from the spinning device is nipped between the delivery roller and the nip roller, the delivery roller is driven and rotated, and thus, the spun yarn is fed to the winding device.

[0004] The yarn splicing cart includes a yarn splicing device and a suction pipe. In order to perform a yarn splicing operation by the yarn splicing device, the suction pipe sucks and catches a yarn end discharged from the spinning device and then guides the yarn end to the yarn splicing device.

[0005] In a structure of Patent Document 1, in the yarn splicing operation that is performed when the spinning device is activated or when a yarn breakage generates, the yarn end is ejected from the spinning device and nipped by the rollers of the yarn feeding device. Then, while being applied with tension, the yarn is pulled downstream by driving the yarn feeding device. Thus, true-twist yarn can be produced by the spinning device. A tip end of the suction pipe is controlled to be located immediately downstream of the yarn feeding device, and the yarn fed downstream by the yarn feeding device is sucked and caught by the suction pipe. Then, the suction pipe guides the caught yarn to the yarn splicing device, where the yarn splicing operation is performed.

[0006] The spinning machine of this type is also disclosed in Patent Document 2 (Japanese Unexamined Patent Application Publication No. 2004-124333). Similarly to Patent Document 1, the spinning machine of Patent Document 2 includes a yarn feeding device (a yarn feeding section), and nips yarn between a nip roller and a delivery roller to feed the yarn downstream.

[0007] The spinning machine of Patent Document 2 includes a yarn accumulating device arranged downstream of the yarn feeding device. The yarn accumulating device includes a yarn accumulating roller (a yarn slack eliminating roller) that can wind the yarn around an outer peripheral surface thereof. The yarn accumulating roller is driven and rotated, and temporarily accumulates the spun yarn, which is sequentially fed from the spinning device, around the outer peripheral surface thereof. Thus, the spinning machine of Patent Document 2 can prevent yarn slackening generated during a yarn splicing operation.

[0008] In order to improve spinning quality of the spinning machine disclosed in Patent Documents 1 and 2, it is important to pull the yarn from the spinning device while steadily applying tension to the yarn. However, the yarn feeding device disclosed in Patent Documents 1 and 2 rotates while nipping the yarn so as to pull the spun yarn from the spinning device. As a result, the spun yarn can slip at times due to an insufficient nipping force, which thereby causes a decrease in the spinning quality of the yarn.

[0009] The yarn accumulating roller disclosed in Patent Document 2 rotates under a state in which the spun yarn is sufficiently wound around the outer peripheral surface, and thus can stably pull the spun yarn downstream. Based on this point, the yarn feeding device may be omitted from a structure of Patent Document 2, and the yarn may be directly pulled from the spinning device by the yarn accumulating device. In the description, such a spinning machine including the above-described features may be referred to as a spinning machine without a delivery roller.

[0010] Such a spinning machine, which pulls the yarn directly by the yarn accumulating device, can pull the spun yarn with more stable tension as compared to the structure of Patent Document 2. Therefore, packages can be formed with consistent quality.

[0011] However, since the yarn feeding device is omitted from the spinning machine without the delivery roller, unlike Patent Document 1, true-twist yarn cannot be produced by nipping the yarn fed from the spinning machine by the yarn feeding device during the yarn splicing operation. Accordingly, true twists are not applied to the spun yarn that is ejected from the spinning device so as to be caught by the suction pipe, which thereby causes a substantial decrease in yarn strength as compared to that of Patent Document 1. As a result, when catching the yarn end of the spun yarn and guiding the yarn end to the yarn splicing device by the suction pipe, yarn breakage tends to occur, and efficiency may be extremely decreased due to an error in the yarn splicing operation.

[0012] The suction pipe of Patent Documents 1 and 2 catches the yarn end by sucking, which consumes a substantial amount of air. Therefore, such a structure requires improvement from a viewpoint of energy saving.

SUMMARY OF THE INVENTION

[0013] In order to overcome the problems described above, preferred embodiments of the present invention provide a yarn end catching device that can stably reduce yarn breakage even when catching yarn having weak yarn strength, and that can also reduce consumption of air.

[0014] According to a first aspect of the present invention, a yarn end catching device, which sucks and catches a yarn end of yarn through a suction opening, includes a suction passage and a twist applying member. The suction passage sucks the yarn end. The twist applying member can apply twists to the yarn sucked in the suction passage. Thus, while applying twists to the yarn sucked in the suction passage, the yarn can be caught and guided. Accordingly, even when catching yarn having weak yarn strength, yarn breakage can be effectively avoided, which thereby can stably prevent errors in catching the yarn end.

[0015] In the yarn end catching device, the twist applying member preferably is a twist applying nozzle that injects compressed air to form whirling airflow in the suction passage. By generating the whirling airflow, twists can be swiftly and effectively applied to the yarn. Moreover, since the spun yarn spirals accompanying the whirling airflow in the suction passage, suction airflow in the suction passage twines around the yarn in good condition, and a suction force can effectively act. As a result, consumption of the air for suction can be saved, and a running cost can be reduced.

[0016] In the yarn end catching device, the suction passage includes a first section connected to the suction opening and a second section connected to a downstream side end of the first section in a suction direction. A cross-sectional area of flow channel of the second section is greater than that of the first section. An injection hole of the twist applying nozzle is formed in the second section. Accordingly, the whirling airflow generated by the injection of the compressed air from the twist applying nozzle smoothly and spirally flows towards a downstream side in the suction direction in the second section. Therefore, the yarn can be smoothly sucked, and the yarn can be caught and guided more reliably.

[0017] The yarn end catching device includes a pulling nozzle that injects compressed air towards the downstream side in the suction direction in the suction passage. The pulling nozzle is disposed away from the suction opening than the twist applying nozzle. Accordingly, the yarn is spirally fed towards the downstream side by the whirling airflow of the twist applying nozzle, and the airflow from the pulling nozzle acts on the spiral portion of the yarn. As a result, a great pulling action can be achieved, further reducing the consumption of the air for suction.

[0018] According to a second aspect of the present invention, the spinning machine includes the above-described yarn end catching device, a spinning device, and a winding device. The spinning device can generate spun yarn by air-jet spinning and feed the spun yarn from a spinning outlet. The winding device forms a package by winding around a bobbin the spun yarn that has been spun in the spinning device. The yarn end catching device can directly suck the spun yarn fed from the spinning outlet into the suction passage.

[0019] That is, because twists are not stopped at the downstream side, the spun yarn produced immediately after the start of the spinning operation of the spinning device is not applied with true-twists, and yarn strength is reduced as compared to that of a normal operation. On this point, in the above-described structure, even when directly sucking the spun yarn having such weak yarn strength, the spun yarn can be sucked while increasing the yarn strength by additional twists, and the yarn can be reliably caught and guided while appropriately preventing yarn breakage.

[0020] The spinning machine includes a yarn splicing device for splicing yarn at the spinning device and yarn at the package. The yarn end catching device catches a yarn end of the spun yarn and guides the yarn end to the yarn splicing device. Thus, errors resulted from yarn breakage in a yarn splicing operation by the yarn splicing device can be reduced, and operation efficiency of the spinning machine can be improved.

[0021] The spinning machine includes a doffing device that removes a fully-wound package from the winding device and replaces with an empty bobbin so that the yarn can be wound around the empty bobbin. The yarn end catching device catches the yarn end of the spun yarn and guides the yarn end to the empty bobbin. Thus, errors resulted from yarn breakage in a doffing operation of the doffing device can be reduced, and the operation efficiency of the spinning machine can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Fig. 1 is a front view of an entire structure of a spinning machine according to an embodiment of the present invention.

[0023] Fig. 2 is a longitudinal cross-sectional view of the spinning machine.

[0024] Fig. 3 is a longitudinal cross-sectional view of a yarn accumulating device.

[0025] Fig. 4 is a longitudinal cross-sectional view illustrating a state in which an upper yarn and a lower yarn are caught by a suction pipe and a suction mouth.

[0026] Fig. 5 is an enlarged cross-sectional view of a tip-end portion of the suction pipe.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0027] A spinning machine according to an embodiment of the present invention will be described with reference to the drawings. In the description, "upstream" and "downstream" respectively refer to upstream and downstream in a direction in which a yarn travels during a spinning operation.

[0028] A spinning machine 1 illustrated in Fig. 1 includes a plurality of aligned units (spinning units) 2. The spinning machine 1 includes a yarn splicing cart 3, a doffing cart 4, a blower box 80, and a motor box 5.

[0029] As illustrated in Fig. 1, each of the spinning units 2 primarily includes a draft device 7, a spinning device

9, a yarn accumulating device 12, and a winding device 13, which are arranged in this order from the upstream to the downstream. The draft device 7 is provided near an upper end of a frame 6 of the spinning machine 1. The spinning device 9 spins a fiber bundle 8 fed from the draft device 7. After a spun yarn 10 fed from the spinning device 9 passes through a later-described yarn clearer 52 and further through the yarn accumulating device 12, the spun yarn 10 is wound by the winding device 13 into a package 45.

[0030] The draft device 7 drafts a sliver 15 into the fiber bundle 8. As illustrated in Fig. 2, the draft device 7 includes a back roller 16, a third roller 17, a middle roller 19, and a front roller 20. Further, an apron belt 18 is wound around the middle roller 19.

[0031] Although a detailed structure of the spinning device 9 is not illustrated in the drawings, the spinning device 9 according to the present embodiment is a pneumatic type which uses a whirling airflow to apply twists to the fiber bundle 8 and forms the spun yarn 10.

[0032] The yarn accumulating device 12 is provided downstream of the spinning device 9. The yarn accumulating device 12 includes a function of applying prescribed tension to the spun yarn 10 and pulling out the spun yarn 10 from the spinning device 9. The yarn accumulating device 12 also includes a function of preventing yarn slackening by accumulating the spun yarn 10 fed from the spinning device 9 during a yarn splicing operation or the like performed by the yarn splicing cart 3. The yarn accumulating device 12 further includes a function of adjusting the tension in such a manner that a change in the tension at the winding device 13 is not transmitted to the spinning device 9. As illustrated in Fig. 2, the yarn accumulating device 12 includes a yarn accumulating roller 21, a yarn hooking member 22, an upstream guide 23, an air cylinder 24, an electric motor 25, and a downstream guide 26.

[0033] The yarn hooking member 22 can be engaged with (can hook) the spun yarn 10. By integrally rotating 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.

[0034] The yarn accumulating roller 21 can wind and accumulate the spun yarn 10 around the outer peripheral surface thereof. The yarn accumulating roller 21 is rotationally driven at a constant rotation speed by the electric motor 25. When the yarn accumulating roller 21 is rotated, the spun yarn 10 guided to the outer peripheral surface of the yarn accumulating roller 21 by the yarn hooking member 22 is wound as if to tighten the yarn accumulating roller 21, and the spun yarn 10 located upstream of the yarn accumulating device 12 is pulled. Thus, the yarn accumulating device 12 can sequentially pull the spun yarn 10 from the spinning device 9.

[0035] The upstream guide 23 is arranged slightly upstream of the yarn accumulating roller 21. The upstream guide 23 is a guide 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 includes a twist stopping function that prevents the twists of the spun yarn 10 from being transmitted from the spinning device 9 towards the downstream of the upstream guide 23. The upstream guide 23 is attached to the air cylinder 24, and can be appropriately moved by driving the air cylinder 24.

[0036] The downstream guide 26 is arranged slightly downstream of the yarn accumulating roller 21. The downstream guide 26 is a guide member for guiding the spun yarn 10 by regulating a path of the spun yarn 10 swung around by the rotating yarn hooking member 22 and thus stabilizing the yarn travel path located downstream thereof.

[0037] The yarn clearer 52 is arranged at a position that is located on a front side of the frame 6 of the spinning machine 1 and between the spinning device 9 and the yarn accumulating device 12. The spun yarn 10, which is spun by the spinning device 9, passes through the yarn clearer 52 before being wound by the yarn accumulating device 12. The yarn clearer 52 monitors a thickness of the traveling spun yarn 10. When a yarn defect of the spun yarn 10 is detected, the yarn clearer 52 transmits a yarn defect detection signal to a not-illustrated unit controller.

[0038] As illustrated in Figs. 1 and 2, the yarn splicing cart 3 includes a splicer (yarn splicing device) 43, a suction pipe (yarn end catching device) 44, and a suction mouth 46. When a yarn cut or a yarn breakage generates in a certain spinning unit 2, the yarn splicing cart 3 travels on a rail 41, which is fixed on the frame 6, to such spinning unit 2 and stops to perform a yarn splicing operation.

[0039] The suction pipe 44 can vertically swing around a shaft.

The suction pipe 44 sucks and catches a yarn end (upper yarn) fed from the spinning device 9, and then guides the yarn end to the splicer 43. The suction mouth 46 can vertically swing around a shaft. The suction mouth 46 sucks and catches a yarn end (lower yarn) from the package 45, which is supported by the winding device 13, and then guides the yarn end to the splicer 43. Although a detailed description of the splicer 43 is omitted, the splicer 43 splices the upper yarn and the lower yarn by twisting the yarn ends by whirling airflow.

[0040] The winding device 13 includes a cradle arm 71 that is supported on a supporting shaft 70 in a manner that the cradle arm 71 can swing around the supporting shaft 70. The cradle arm 71 can support a bobbin 48, around which the spun yarn 10 is wound, in a manner that the bobbin 48 can be rotated.

[0041] The winding device 13 includes a winding drum 72 and a traverse device 75. The winding drum 72 can be driven in contact with an outer peripheral surface of the bobbin 48 or the package 45, which is formed by winding the spun yarn 10 around the bobbin 48. The traverse device 75 includes a traverse guide 76 that can

be engaged with the spun yarn 10. By driving the winding drum 72 by a not-illustrated electric motor while reciprocating the traverse guide 76 by a not-illustrated drive mechanism, the package 45 that is in contact with the winding drum 72 is rotated, and the spun yarn 10 is wound while being traversed.

[0042] The doffing cart 4 includes a doffing device 61. The doffing device 61 includes a cradle operating arm 90, a suction pipe 88, and a bunch-winding arm 91. When the package 45 is fully wound in a certain spinning unit 2, the doffing cart 4 travels on a travel path 86 formed on the frame 6 and stops at such a spinning unit 2.

[0043] The cradle operating arm 90 can operate the cradle arm 71 of the winding device 13. The suction pipe 88 is telescopic, and can suck and catch the yarn end discharged from the spinning device 9 to guide the yarn end to an empty bobbin 48 set in the winding device 13. The bunch-winding arm 91 can fix the spun yarn 10 on the bobbin 48 by forming a straight-winding of spun yarn 10 around the bobbin 48.

[0044] With reference to Figs. 2 and 3, a detailed structure of the yarn accumulating device 12 will be described. The yarn accumulating roller 21 is a roller member made from abrasion-resistant material, and is fixed on a motor shaft 25a of the electric motor 25. A side of an outer peripheral surface 21a of the yarn accumulating roller 21 where the yarn hooking member 22 is provided will be referred to as a tip end of the outer peripheral surface 21a of the yarn accumulating roller 21. A side of the outer peripheral surface 21a of the yarn accumulating roller 21 where the electric motor 25 is provided will be referred to as a base end of the outer peripheral surface 21a of the yarn accumulating roller 21. The outer peripheral surface 21a of the yarn accumulating roller 21 includes a base-end taper section 21b, a cylindrical section 21c, and a tip-end taper section 21d in this order from the base end to the tip end.

[0045] The cylindrical section 21c slightly tapers toward the tip end, and is flatly connected (without difference in level) with the taper sections 21b and 21d.

[0046] Each of the base-end taper section 21b and the tip-end taper section 21d has a moderate tapered-shape with a larger diameter at a respective end surface side. On the outer peripheral surface 21a of the yarn accumulating roller 21, the base-end taper section 21b smoothly moves the supplied spun yarn 10 from a larger diameter portion to a smaller diameter portion towards the cylindrical section 21c so as to orderly wind the spun yarn 10 around the surface of the cylindrical section 21c. The tip-end taper section 21d has a function of preventing a sloughing phenomenon in which the wound spun yarn 10 sloughs all at once when unwinding the spun yarn 10. The tip-end taper section 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 that the spun yarn 10 can be smoothly pulled out.

[0047] As illustrated in Fig. 3, the yarn hooking member 22 on the tip 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 on a tip end of the flyer axis 33.

[0048] The flyer axis 33 is supported in a manner that the flyer axis 33 can be rotated relative to the yarn accumulating roller 21. A permanent magnet is attached to either one of the flyer axis 33 and the yarn accumulating roller 21, and a magnetic hysteresis member is attached to another one of the flyer axis 33 and the yarn accumulating roller 21. A resistance torque is generated by such a magnetic mechanism against the rotation of the yarn hooking member 22 relative to the yarn accumulating roller 21. The yarn hooking member 22 is rotated accompanying the rotation of the yarn accumulating roller 21 by the resistance torque, and as a result, the yarn hooking member 22 and the yarn accumulating roller 21 can be integrally rotated. When a force surpassing the resistance torque is applied to the yarn hooking member 22, the yarn hooking member 22 is rotated relative to the yarn accumulating roller 21.

[0049] The flyer 38 is formed to appropriately curve towards the outer peripheral surface 21a of the yarn accumulating roller 21. Accordingly, the flyer 38 can be engaged with (can hook) the spun yarn 10. When the flyer 38 is rotated integrally with the yarn accumulating roller 21 under a state in which the spun yarn 10 is not wound around the yarn accumulating roller 21, the flyer 38 becomes engaged with the spun yarn 10. The spun yarn 10 engaged with the rotating flyer 38 is swung around by the flyer 38, and guided to and wound around the outer peripheral surface 21a of the rotating yarn accumulating roller 21.

[0050] The spun yarn 10 wound around the yarn accumulating roller 21 will be described. After passing through the upstream guide 23, the spun yarn 10 is guided from the base end to the outer peripheral surface 21a, and then wound around the cylindrical section 21c several times. After passing through the flyer 38, the spun yarn 10 pulled out from the tip end of the outer peripheral surface 21a is fed downstream through the downstream guide 26.

[0051] Under a state in which the spun yarn 10 is wound around the yarn accumulating roller 21 as illustrated in Fig. 2, when a force is applied to pull the spun yarn 10 engaged with the flyer 38 towards the downstream side, a force is applied to the flyer 38 such that the yarn hooking member 22 is rotated to unwind the spun yarn 10 from the tip end of the yarn accumulating roller 21. Therefore, when the yarn tension at the downstream side of the yarn accumulating device 12 (i.e., the yarn tension between the yarn accumulating device 12 and the winding device 13) is great enough to surpass the resistance torque, the yarn hooking member 22 is rotated independently from the yarn accumulating roller 21, and thus, the spun yarn 10 is gradually unwound from the tip end of the yarn accumulating roller 21 via the flyer 38.

[0052] In contrast, if the yarn tension at the downstream side of the yarn accumulating device 12 is not great enough to surpass the resistance torque, the yarn hooking member 22 is rotated integrally with the yarn accumulating roller 21. In such a case, the yarn hooking member 22 operates to prevent the spun yarn 10 from being unwound from the tip end of the rotating yarn accumulating roller 21.

[0053] When the yarn tension at the downstream side increases, the yarn accumulating device 12 unwinds the yarn. When the yarn tension decreases (i.e., when the yarn is likely to slacken), the yarn accumulating device 12 stops the unwinding of the yarn. Thus, the yarn accumulating device 12 can eliminate the yarn slackening and apply appropriate tension to the yarn. Moreover, since the yarn hooking member 22 operates to absorb changes in the tension applied to the spun yarn 10 located between the yarn accumulating device 12 and the winding device 13, such tension changes can be prevented from influencing the spun yarn 10 located between the spinning device 9 and the yarn accumulating device 12. Thus, the spun yarn 10 can be pulled out at a more stable speed from the spinning device 9 by the above-described yarn accumulating device 12.

[0054] Since the yarn accumulating roller 21 is driven and rotated at a prescribed speed, the spun yarn 10 is wound around the base end of the yarn accumulating roller 21 at the prescribed speed. Accordingly, when the speed at which the spun yarn 10 is unwound from the tip end of the yarn accumulating roller 21 is greater than the speed at which the spun yarn 10 is wound around the base end, an amount of the accumulated yarn decreases, and when the spun yarn 10 is not unwound from the tip end, the amount of the accumulated yarn gradually increases.

[0055] As described above, the upstream guide 23 can be moved between an advanced position and a receded position by the air cylinder 24. When the upstream guide 23 is located at the advanced position (indicated by the solid line of Fig. 3), the yarn path is held by the upstream guide 23 such that the spun yarn 10 is disengaged from the yarn hooking member 22 of the yarn accumulating device 12. When the upstream guide 23 is moved to the receded position (indicated by the dashed line of Fig. 3), the yarn path is moved to a position where the spun yarn 10 becomes engaged with the yarn hooking member 22 and wound around the yarn accumulating roller 21.

[0056] Next, with reference to Fig. 4, a yarn splicing operation by the spinning machine 1 according to the present embodiment will be described. When the yarn clearer 52 detects a yarn defect during the winding operation of the spun yarn 10, the yarn clearer 52 transmits a yarn defect detection signal to the unit controller. When receiving the yarn defect detection signal, the unit controller immediately cuts the spun yarn 10 by a cutter 57, and stops the draft device 7 and the spinning device 9 or the like. At this time, the yarn at the downstream side of such a cutting position is once wound around the package 45 by the winding device 13. Thus, the spun yarn 10 that was wound around the yarn accumulating roller 21 is also wound around the package 45, and the yarn accumulating roller 21 resultantly has no yarn thereon. A portion including the yarn defect is also wound around the package 45.

[0057] Next, the unit controller transmits a control signal to the yarn splicing cart 3, and controls the yarn splicing cart 3 to travel to the front of the spinning unit 2 and to start a yarn splicing operation. The unit controller controls to swing the suction mouth 46 to the vicinity of the surface of the package 45 (refer to Fig. 4) and to generate suction airflow, and also controls to rotate the package 45 reversely by the winding device 13. Thus, the yarn end (lower yarn) is pulled out from the outer peripheral surface of the package 45, and sucked and caught by the suction mouth 46. At this time, the yarn including the yarn defect is pulled out from the package 45 and sucked by the suction mouth 46, which thereby can remove the yarn including the yarn defect from the package 45.

[0058] Then, while reversely rotating the package 45, the unit controller controls the suction mouth 46 with the lower yarn sucked therein to swing upward so as to guide the lower yarn to the splicer 43. When the lower yarn is guided to the splicer 43, the unit controller stops the rotation of the package 45.

[0059] At approximately the same time as the swinging operation of the suction mouth 46, the unit controller controls to swing the suction pipe 44 to the vicinity of the downstream of the spinning device 9. The unit controller controls to re-drive the spinning device 9 or the like to resume a spinning operation, and controls the suction pipe 44 to generate suction airflow and to catch the yarn end (upper yarn) at the spinning device 9. A detailed structure of the suction pipe 44 will be described later.

[0060] Then, while continuing the suction operation, the unit controller controls the suction pipe 44 to swing downward from the state illustrated in Fig. 4 in order to pull out the spun yarn 10 from the spinning device 9 and guide the spun yarn 10 to the splicer 43. At this time, the unit controller drives the air cylinder 24 to move the upstream guide 23 to the advanced position (indicated by the solid line of Fig. 3). Thus, while maintaining the state in which the spun yarn 10 is disengaged from the rotating flyer 38, the yarn end can be guided to the splicer 43.

[0061] The upstream guide 23 is moved to the advanced position for the following reasons. That is, the suction force of the suction pipe 44 is not great enough to surpass the resistance torque of the yarn hooking member 22. Accordingly, the spun yarn 10 cannot be unwound from the yarn accumulating roller 21 via the yarn hooking member 22 by the suction force of the suction pipe 44. Therefore, if the operation of winding the yarn around the yarn accumulating roller 21 is started before the yarn end is guided to the splicer 43, the suction pipe 44 cannot pull out the upper yarn any further. As a result, the upper yarn cannot be guided to the splicer 43, causing a failure of the yarn splicing operation. Accord-

ingly, by placing the upstream guide 23 at the advanced position until the suction pipe 44 completes the guiding of the upper yarn to the splicer 43, the start of the operation of winding the spun yarn 10 around the yarn accumulating roller 21 can be avoided.

[0062] Although it is illustrated in Fig. 4 that the suction pipe 44 and the suction mouth 46 simultaneously perform the swinging movement, the timing of such swinging movement may be flexible.

[0063] When the upper yarn is guided to the splicer 43, the upper guide 23 is controlled to immediately move to the receded position. Accordingly, the flyer 38 becomes engaged with the spun yarn 10, and the operation of winding the spun yarn 10 around the yarn accumulating roller 21 is started. That is, during the yarn splicing operation, although the winding operation of the winding device 13 is stopped, the spun yarn 10 is continuously fed from the spinning device 9. As a result, the yarn slackens if the spun yarn 10 is kept being fed. In the present embodiment, by winding the spun yarn 10 around the yarn accumulating roller 21 by the yarn accumulating device 12, the slackening of the spun yarn 10 can be prevented. Accordingly, the yarn accumulating device 12 serves as a yarn slack eliminating device during the yarn splicing operation.

[0064] When the yarn end is guided to the splicer 43 by the suction pipe 44, the splicer 43 immediately starts splicing the yarn ends. When the yarn splicing operation is completed, the unit controller controls to resume the winding operation of the spun yarn 10 by the winding device 13.

[0065] Next, a detailed structure of a tip end of the suction pipe 44 of the yarn splicing cart 3 will be described. Fig. 5 is an enlarged cross-sectional view of the structure of the tip end of the suction pipe 44. It is illustrated in Fig. 5 that the suction pipe 44 has swung as illustrated in Fig. 4 so that the tip end thereof is located downstream of the spinning device 9. The spinning device 9 includes a spinning outlet 9a for feeding out the spun yarn 10 towards the downstream side. When the suction pipe 44 is swung upward as illustrated in Fig. 4, the tip end thereof is located to substantially face the spinning outlet 9a.

[0066] As illustrated in Fig. 5, an elongate nozzle member 44a is attached to the tip end of the suction pipe 44. The nozzle member 44a has a tubular shape, and a suction passage 62 having a circular shape in cross-section is formed in the nozzle member 44a. One end of the suction passage 62 is connected with a suction opening 63, which is formed on a tip-end surface of the nozzle member 44a.

[0067] The suction passage 62 is a stepped passage including a small diameter section (first section) 64 arranged near the suction opening 63 and a large diameter section (second section) 65 connected to the small diameter section 64. Accordingly, a cross-sectional area of the flow channel of the large diameter section 65 is greater than a cross-sectional area of the flow channel of the small diameter section 64. A ring-shaped first air chamber 68 and a ring-shaped second air chamber 69 are formed in the nozzle member 44a as if to surround the suction passage 62. Compressed air pipes 55 are respectively connected to the two air chambers 68 and 69, and compressed air can be supplied from a not-illustrated compressed air source to the air chambers 68 and 69.

[0068] An ejector nozzle (pulling nozzle) 66 is connected to the first air chamber 68 for injecting the compressed air to the suction passage 62. The ejector nozzle 66 is a ring-shaped nozzle having a triangular shape in cross-section. A cross-sectional outline of the ejector nozzle 66 gradually tapers off towards the inner suction passage 62. A tip end of the ejector nozzle 66 forms an injection hole in an inner wall of the suction passage 62 (the large diameter section 65), and thus the air can be injected from the injection hole towards the suction passage 62.

[0069] The injection hole of the ejector nozzle 66 has a ring shape, and the air can be injected from the whole circumference of the injection hole. The ejector nozzle 66 is slightly slanted so that the airflow directed obliquely towards a base end of the suction pipe 44 can be formed. By injecting the air at high speed from the first air chamber 68 via the ejector nozzle 66 to the suction passage 62, pressure drop is generated (ejector effect) by the well-known Venturi effect, and suction airflow directed to the base end of the suction pipe 44 can act at the suction opening 63.

[0070] A plurality of twist applying nozzles 67 are connected to the second air chamber 69 for injecting the compressed air to the suction passage 62. The twist applying nozzles 67 are arranged at equal interval around the suction passage 62. Each of the twist applying nozzles 67 forms an injection hole in the inner wall of the suction passage 62. The twist applying nozzle 67 extends in a radial direction in Fig. 5 for convenience of the description according to the cross-sectional view, however, the actual twist applying nozzle 67 extends in a tangential direction of the circular suction passage 62.

[0071] By injecting the compressed air from the second air chamber 69 via the twist applying nozzles 67 to the suction passage 62, whirling airflow is generated in the suction passage 62. Accordingly, the spun yarn 10 sucked into the suction passage 62 is twisted by the action of the whirling airflow generated at portions of the twist applying nozzles 67, and pulled into the base end of the suction pipe 44.

[0072] In the yarn splicing operation, twists of the spun yarn 10 fed from the spinning device 9 are not sufficient as compared to that of a normal operation, and the yarn strength is decreased. Accordingly, even if the spun yarn 10 is simply sucked with a great force by the suction pipe 44, such a suction is not sufficient, and the spun yarn 10 easily breaks due to, for example, friction with the suction opening 63 or the inner wall of the suction passage 62. As a result, a yarn splicing error frequently occurs.

[0073] On this point, in the present embodiment, the whirling airflow generated in the suction passage 62 by

the twist applying nozzles 67 acts to further apply twists to the spun yarn 10. By this twist adding effect, the spun yarn 10 can be sucked into the suction pipe 44 while increasing the yarn strength of the spun yarn 10. Therefore, yarn breakage can be effectively prevented, and the yarn splicing operation can be smoothly performed.

[0074] The twist applying nozzles 67 are arranged along a virtual plane that is orthogonal to the longitudinal direction of the suction passage 62. An opening of each of the twist applying nozzles 67 is formed in the large diameter section 65 of the suction passage 62. A level-difference 85 where the large diameter section 65 and the small diameter section 64 are connected is formed on a tip end side of the opening of each of the twist applying nozzles 67. Accordingly, even if the compressed air injected from the twist applying nozzles 67 attempts to flow towards the tip end (suction opening 63) of the suction pipe 44, most of such flow is prevented by the level difference 85. As a result, the compressed air injected from the twist applying nozzles 67 flows to the base end of the suction pipe 44 while forming a whirling airflow.

[0075] The spun yarn 10 sucked into the suction passage 62 from the suction opening 63 of the nozzle member 44a is applied with additional twists by the whirling airflow from the twist applying nozzles 67 as described above, and also, the spun yarn 10 is spirally swung around by the spiral whirling airflow. Accordingly, the spun yarn 10 is spiraled, and the suction airflow generated by the air injection from the ejector nozzle 66 twines around the spun yarn 10. As a result, the spun yarn 10 can be efficiently sucked into the suction pipe 44. Therefore, even if the amount of the injected compressed air is reduced as compared to that of conventional art, a similar suction operation can be achieved. Thus, the consumption of the compressed air can be saved, and a running cost can be reduced. From a result of calculation by the inventor, according to the present embodiment, even if the consumption of the compressed air related to the suction pipe 44 is reduced by substantially 40 to 50 percent as compared to the conventional art, catching performance that is similar to or more than that of the conventional art can be achieved.

[0076] As described above, the suction pipe 44 of the yarn splicing cart 3 of the spinning machine 1 according to the present embodiment includes the suction passage 62 and the twist applying nozzles 67. The suction passage 62 sucks the yarn end of the spun yarn 10. The twist applying nozzles 67 can apply twists to the spun yarn 10 sucked into the suction passage 62. Thus, while improving the yarn strength by applying twists to the spun yarn 10 sucked into the suction passage 62, the spun yarn 10 can be caught and guided. Accordingly, even when catching yarn having weak yarn strength, yarn breakage can be effectively prevented, and thus errors in catching the yarn end can be effectively prevented.

[0077] In the suction pipe 44, the twist applying nozzles 67 inject the compressed air to form the whirling airflow in the suction passage 62. By generating the whirling airflow, twists can be applied to the spun yarn 10 swiftly and effectively. Since the spun yarn 10 spirals accompanying the whirling airflow in the suction passage 62, the suction airflow twines around the spun yarn 10 in the suction pipe 62 in good condition, and the suction force can be effectively utilized. As a result, the air consumption for suction can be saved, and the running cost can be reduced.

[0078] In the suction pipe 44, the suction passage 62 includes the small diameter section 64 connected to the suction opening 63 that is externally opened and the large diameter section 65 connected to a downstream side end of the small diameter section 64 in the suction direction. The large diameter section 65 has a cross-sectional area of the flow channel that is greater than that of the small diameter section 64. The injection hole of each of the twist applying nozzles 67 is formed in the large diameter section 65. Thus, the whirling airflow generated by the injection of the compressed air from the twist applying nozzles 67 smoothly and spirally flows towards the downstream side in the suction direction in the large diameter section 65. Since the spun yarn 10 can be smoothly sucked, the spun yarn 10 can be more reliably caught and guided.

[0079] The suction pipe 44 includes the ejector nozzle 66 that injects the compressed air towards the downstream side in the suction direction in the suction passage 62. The ejector nozzle 66 is located away from the suction opening 63 than the twist applying nozzles 67. Accordingly, while the spun yarn 10 spirals accompanying the whirling airflow generated by the twist applying nozzles 67, the spun yarn 10 is fed downstream in the suction passage 62, and the airflow from the ejector nozzle 66 acts on the spiral portion of the spun yarn 10. Thus, the suction operation with great force can be achieved, and the air consumption for such suction can be further reduced.

[0080] The spinning machine 1 according to the present embodiment includes the suction pipe 44, the spinning device 9, and the winding device 13. The spinning device 9 can form the spun yarn by the air-jet spinning operation and feed such spun yarn 10 from the spinning outlet 9a. The winding device 13 winds the spun yarn, which has been spun in the spinning device 9, around the bobbin 48 into the package 45. As illustrated in Fig. 5, the suction pipe 44 can directly suck the spun yarn 10 fed from the spinning outlet 9a into the suction passage 62.

[0081] That is, since the twists are not stopped at the downstream side, the spun yarn 10 that has been formed immediately after the start of the spinning operation of the spinning device 9 following the yarn splicing operation or the like is not applied with true twists. Therefore, the yarn strength of such spun yarn is weak compared to that of a normal operation. On this point, according to the present embodiment, even when directly sucking the spun yarn 10 having such weak yarn strength as illus-

trated in Fig. 5, the spun yarn 10 can be sucked under the state in which the yarn strength is increased by the additional twists applied by the twist applying nozzles 67. Therefore, while appropriately preventing the yarn breakage, the spun yarn 10 can be reliably caught and guided.

[0082] The spinning machine 1 according to the present embodiment includes the splicer 43 for splicing the spun yarn 10 (upper yarn) at the spinning device 9 and the spun yarn 10 (lower yarn) at the package 45. The suction pipe 44 catches the yarn end of the spun yarn 10 and guides the yarn end to the splicer 43. Thus, errors resulted from the yarn breakage in the yarn splicing operation performed by the splicer 43 can be reduced, and an operation efficiency of the spinning machine 1 can be improved.

[0083] The structure for applying additional twists to the spun yarn 10 in the suction passage 62 is not limited to the suction pipe 44 of the yarn splicing cart 3, and may be applied to the suction pipe 88 of the doffing device 61 of the doffing cart 4. A doffing operation by the doffing cart 4 will be described below.

[0084] When a not-illustrated sensor detects that the package 45 in a certain spinning unit 2 is fully wound, the unit controller stops the spinning operation performed by the spinning device 9. At almost the same time, the unit controller controls the cradle arm 71 to swing towards the left in Fig. 2 in the winding device 13 so as to move the fully-wound package 45 away from the winding drum 72 to stop the rotation.

[0085] The doffing cart 4 appropriately operates the cradle arm 71 by the cradle operating arm 90 and removes the fully-wound package 45 from the cradle arm 71 by a not-illustrated package removing device. The removed fully-wound package 45 rolls on a sloped floor 94 formed in the doffing cart 4, drops and stops on a groove-shaped shelf 96. Then, an empty bobbin 48 is placed in the cradle arm 71 by a not-illustrated empty bobbin supplying mechanism of the doffing cart 4.

[0086] The unit controller of the spinning unit 2 re-starts the driving of the draft device 7 and the spinning device 9. At almost the same time, the suction pipe 88 extends upward. The suction pipe 88 sucks and catches the yarn end of the spun yarn 10 discharged from the spinning device 9, and then, guides the yarn end to the vicinity of the empty bobbin 48. The bunch-winding arm 91 performs a bunch winding operation, and thus, the yarn end is attached to the empty bobbin 48. After the series of the above-described operation, the spun yarn 10 fed from the spinning device 9 can be stared to be wound by the winding device 13.

[0087] After the re-start of the driving of the spinning device 9, the unit controller controls to move the upstream guide 23 to the receded position by the air cylinder 24. Thus, the spun yarn 10 is wound around the yarn accumulating roller 21, and yarn slackening during the doffing operation can be prevented.

[0088] When the bunch-winding operation is completed, the doffing cart 4 swings the cradle arm 71 towards the right in Fig. 2 by the cradle operating arm 90, and the bobbin 48 having the bunch-winding operation performed thereon is made into contact with the winding drum 72 to start the winding of the spun yarn 10. Thus, winding tension is applied to the spun yarn 10, and the spun yarn 10 is gradually unwound from the yarn accumulating roller 21.

[0089] As described above, the doffing device 61 removes the fully-wound package 45 from the winding device 13, replaces such fully-wound package 48 with the empty bobbin 48, and performs a doffing operation so that the spun yarn 10 can be wound around the empty bobbin 48. The above-described twist applying nozzles 67 etc. may be provided to the suction pipe 88, which catches the yarn end of the spun yarn 10 and guides the yarn end to the empty bobbin 48 in the doffing operation. In such a case, errors in the doffing operation of the doffing device 61 resulted from yarn breakage can be reduced, and the operation efficiency of the spinning machine 1 can be improved.

[0090] The preferred embodiment of the present invention has been described above, however, the above-described structure may be modified as follows.

[0091] In the above-described embodiment, the spinning machine without the delivery roller is used in which the yarn feeding device disclosed in Patent Documents 1 and 2 is omitted. However, the structure of the above-described suction pipe 44 may be applied to a spinning machine that includes the yarn feeding device as disclosed in Patent Documents 1 and 2.

[0092] It is disclosed in Patent Document 1 that the yarn end of the spun yarn ejected from the spinning device lands on the delivery roller of the yarn feeding device, and that the spun yarn is nipped between the delivery roller and the nip roller by the rotation of the delivery roller. However, in such a structure, the yarn may not be fed downstream in good condition, and the spun yarn may be wound around the nip roller or the delivery roller. Accordingly, in order to prevent such winding of the yarn around the yarn feeding device, a mechanism for moving the nip roller away from the delivery roller may be provided so that the yarn end of the spun yarn ejected from the spinning device is fed downstream and caught by the suction pipe without being nipped by the yarn feeding device. In such a case, since the spun yarn is not nipped by the yarn feeding device, true-twist spun yarn cannot be generated by the spinning device, however, by providing the suction pipe with the structure for applying additional twists as described above, the yarn having weak yarn strength may be caught in good condition.

[0093] Instead of providing one ejector nozzle 67 and one twist applying nozzle 67, for example, two or more ejector nozzles 66 and two or more twist applying nozzles 67 may be provided.

[0094] The ejector nozzle 66 may be arranged closer to the suction opening 63 (i.e., disposed upstream in the suction direction) than the twist applying nozzle 67.

[0095] The twist applying nozzle 67 may be slightly

slanted relative to the plane that is orthogonal to the suction passage 62, and thus, the twist applying nozzle 67 may serve as an ejector nozzle.

Claims

1. A yarn end catching device, which sucks and catches a yarn end of yarn through a suction opening (63), the yarn end catching device **characterized by** comprising:

   a suction passage (62) for sucking the yarn end; and
   a twist applying member (67) which applies twists to the yarn sucked in the suction passage (62).

2. The yarn end catching device according to claim 1, **characterized in that** the twist applying member (67) is a twist applying nozzle (67) that forms whirling airflow in the suction passage (62) by injecting compressed air.

3. The yarn end catching device according to claim 2, **characterized in that** the suction passage (62) includes a first section (64) connected to the suction opening (63) and a second section (65) connected to a downstream side end of the first section (64) in a suction direction,
   a cross-sectional area of a flow channel of the second section (65) is greater than a cross-sectional area of a flow channel of the first section (64), and
   an injection hole of the twist applying nozzle (67) is formed in the second section (65).

4. The yarn end catching device according to claim 2 or claim 3, **characterized by** further comprising a pulling nozzle (66) which injects compressed air towards a downstream side in the suction direction in the suction passage (62), and
   characterized in that in the suction direction, the twist applying nozzle (67) is arranged between the suction opening (63) and the pulling nozzle (66).

5. A spinning machine **characterized by** comprising:

   the yarn end catching device (44) according to any one of claim 1 through claim 4;
   a spinning device (9) that generates spun yarn by air-jet spinning and feeds the spun yarn from a spinning outlet (9a); and
   a winding device (13) that forms a package by winding the spun yarn spun by the spinning device (9) around a bobbin,

   characterized in that the yarn end catching device (44) can directly suck the spun yarn fed from the spinning outlet (9a) into the suction passage (62).

6. The spinning machine according to claim 5, **characterized by** further comprising a yarn splicing device (43) which splices spun yarn at the spinning device (9) and spun yarn at the package,
   characterized in that the yarn end catching device (44) catches a yarn end of the spun yarn fed from the spinning device (9) and guides the yarn end to the yarn splicing device (43).

7. The spinning machine according to claim 5, **characterized by** further comprising a doffing device (61) which removes a fully-wound package from the winding device (13) and replaces with an empty bobbin so that the spun yarn can be wound around the empty bobbin,
   characterized in that the yarn end catching device (44) catches a yarn end of the spun yarn fed from the spinning device (9) and guides the yarn end to the empty bobbin.

FIG. 1

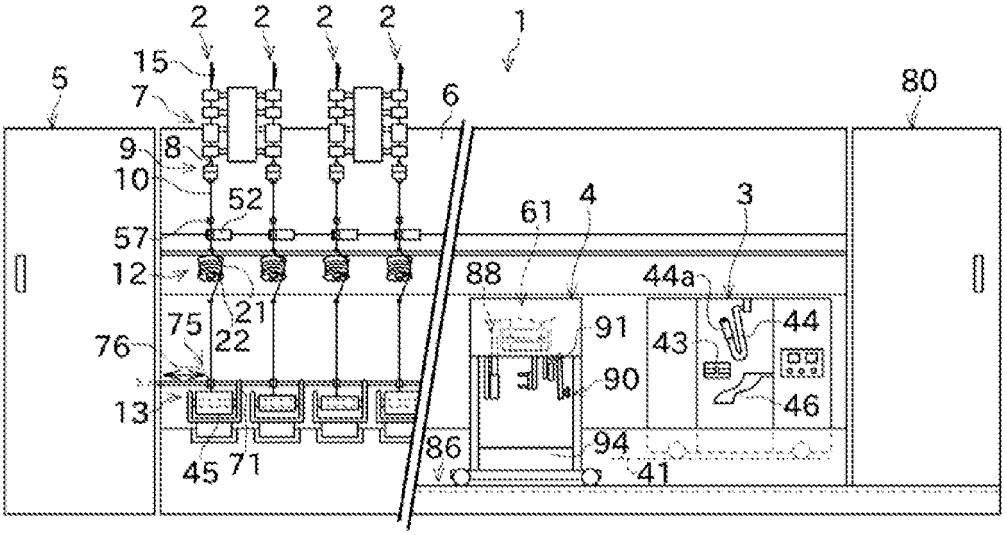

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FIG. 2

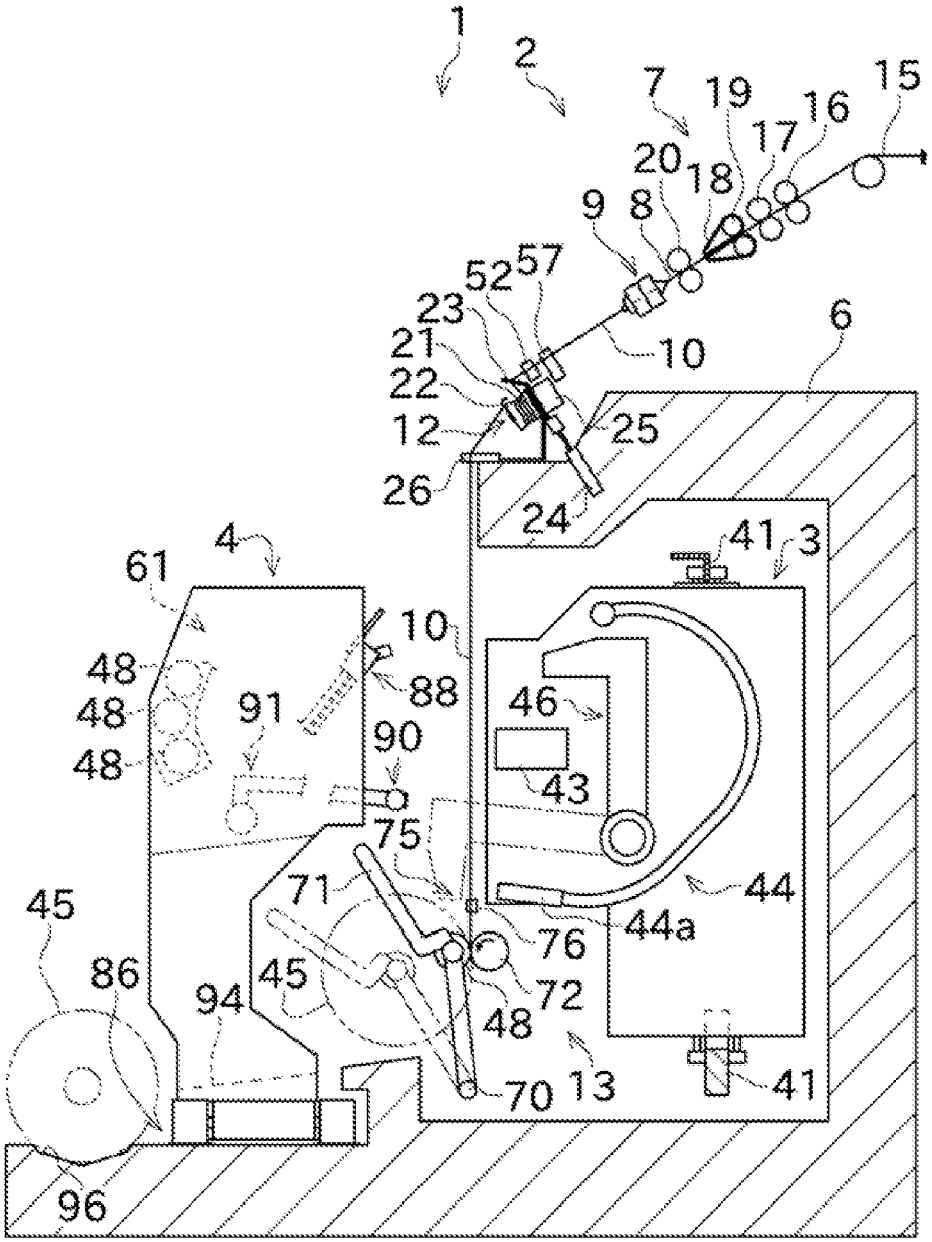

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FIG. 3

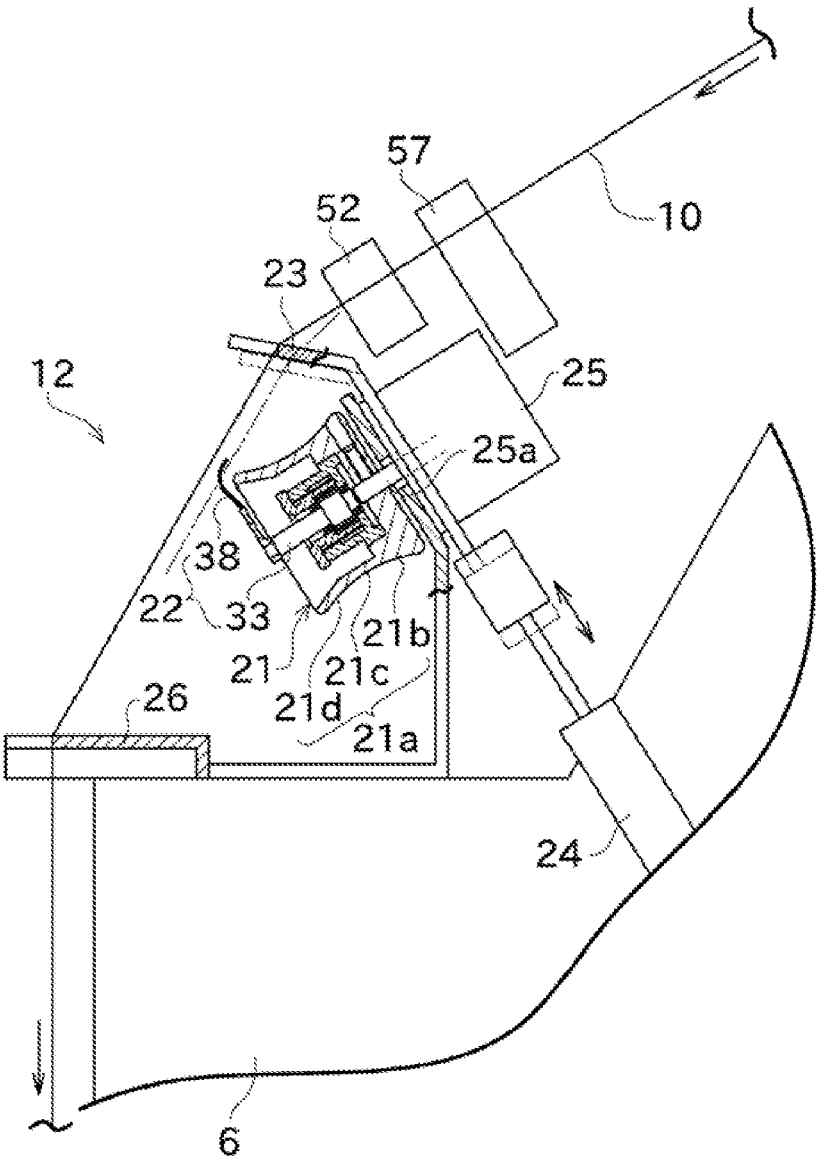


FIG. 4

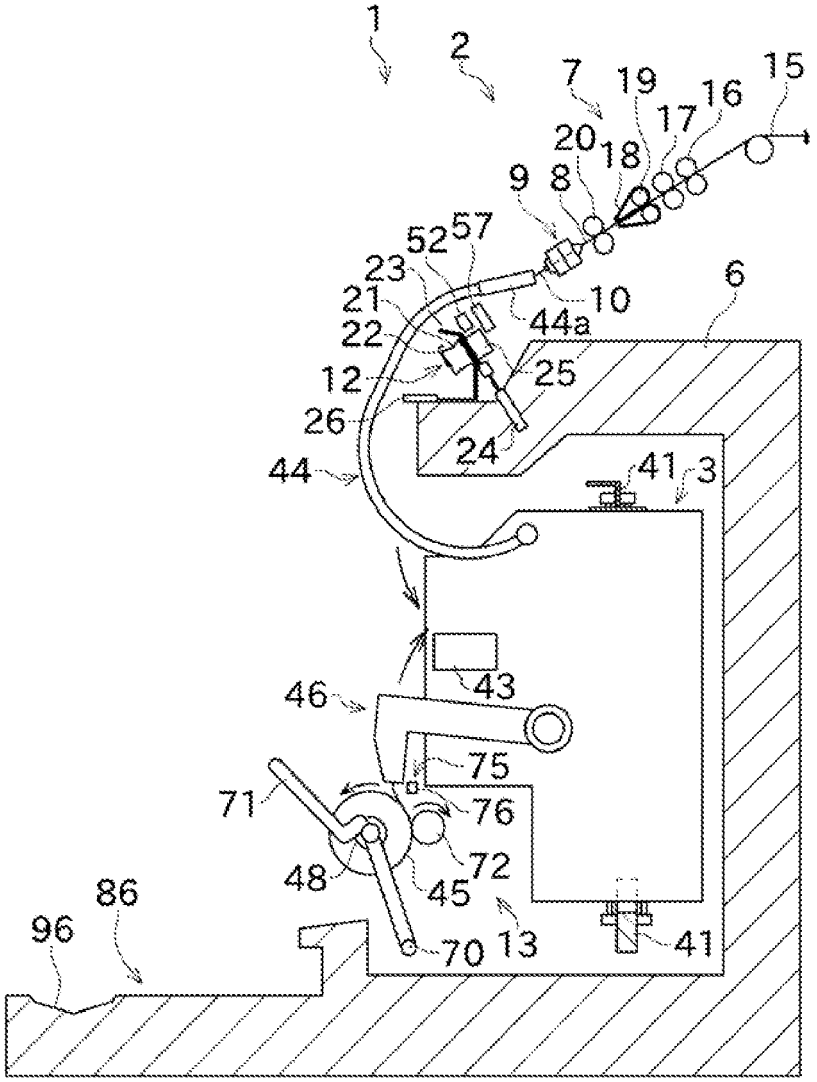
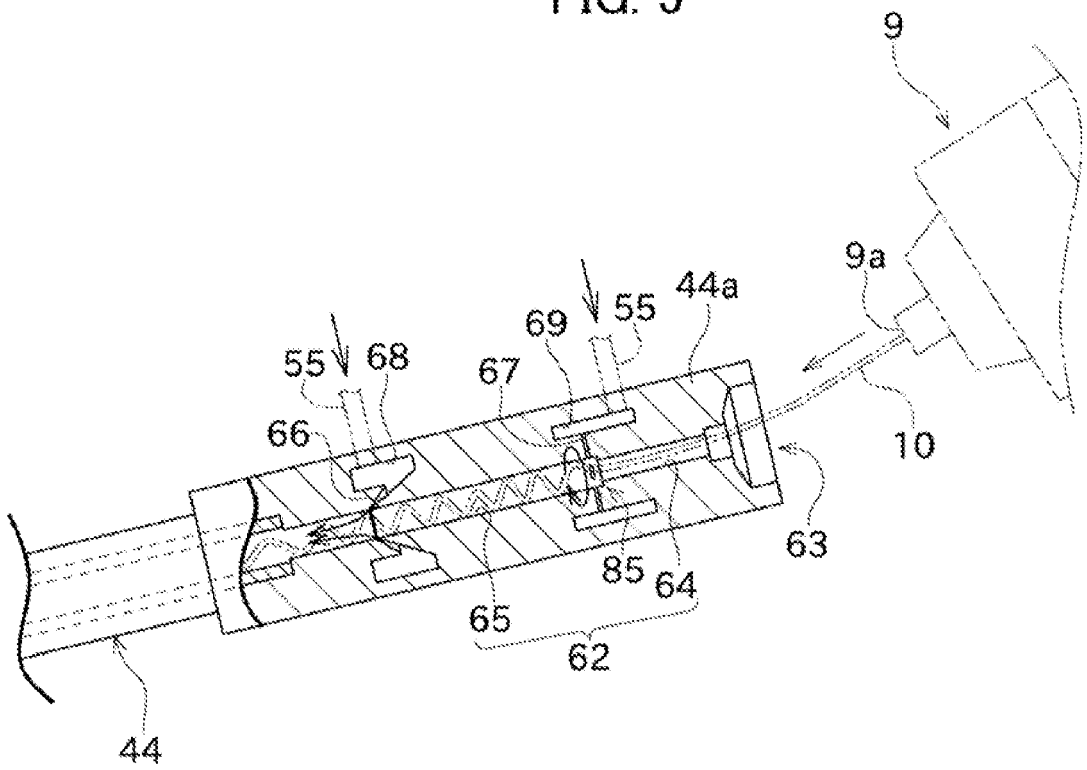

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FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 8273

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D01H
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 June 2010	Dreyer, Claude

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