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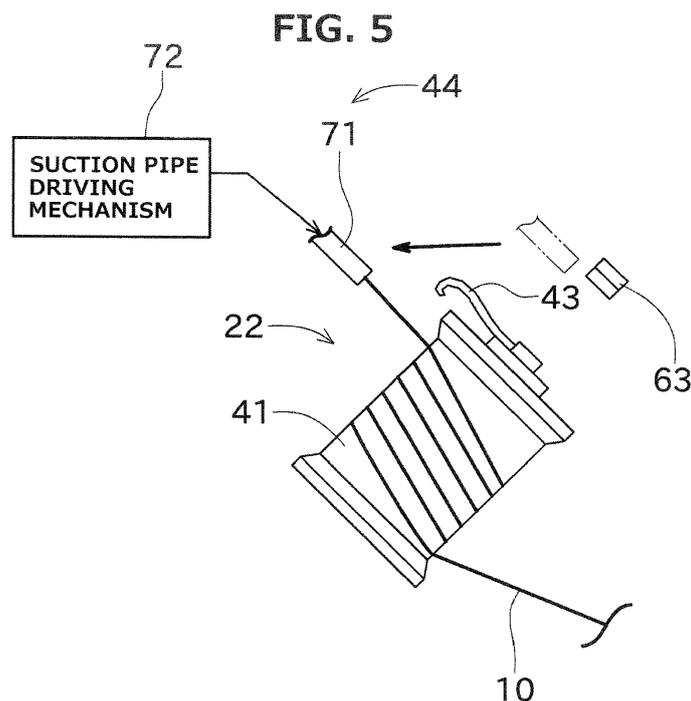
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(54) **Yarn pooling device and spinning unit**

(57) A yarn pooling device (22) includes a yarn pooling roller (41) and a yarn suction device (44). The yarn pooling roller (41) temporarily pools the spun yarn (10) by winding it on its outer circumferential surface. The yarn suction device (44) generates a suction air current at a suction port, which is arranged downstream of the yarn pooling roller (41) in the yarn running direction, to

suck and dispose of the spun yarn (10) remaining on the yarn pooling roller (41). When disposing of the spun yarn (10) remaining on the yarn pooling roller (41), the yarn suction device (44) unhooks the spun yarn (10) that is hooked on a yarn hooking member (43) by using a suction pipe (71) and the like.



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn pooling device that removes (disposes of) a yarn remaining on a yarn pooling roller after a yarn breakage has occurred.

2. Description of the Related Art

[0002] A spinning machine including a spinning device, a yarn pooling device, and a winding device is known in the art. The spinning device produces a spun yarn by spinning a fiber bundle drafted by a drafting device. The yarn pooling device temporarily pools the spun yarn produced by the spinning device. The winding device unwinds the spun yarn from the yarn pooling device and rewinds it into a package. The yarn pooling device includes a yarn pooling roller that winds the spun yarn on a peripheral surface thereof. By pooling the spun yarn, the yarn pooling device prevents occurrence of a slack in the spun yarn even when the spinning speed does not match with the winding speed of the spun yarn.

[0003] How the spun yarn on the yarn pooling roller is removed by suction when a yarn breakage occurs downstream of the yarn pooling device is explained below. Usually, when winding a package, the spun yarn temporarily pooled on the yarn pooling roller is unwound in a downstream direction by the winding device by application of tension and rewound into a package by the winding device.

[0004] However, when a yarn breakage occurs downstream of the yarn pooling device (i.e., between the yarn pooling device and the winding device), because the winding device cannot apply a tension on the spun yarn that has been pooled on the yarn pooling roller, the spun yarn remains on the yarn pooling roller. Accordingly, when this situation occurs, first, the spinning machine stops the operation of the spinning device to disconnect the spun yarn upstream of the yarn pooling device. Then, the spinning machine removes the spun yarn remaining on the yarn pooling roller. A suction airflow, for example, can be used to remove the spun yarn remaining on the yarn pooling roller. Japanese Patent Application Laid-open No. 2010-174421 (Patent Document 1) discloses a spinning machine of this type.

[0005] As shown in FIG. 7A, a spinning machine disclosed in Patent Document 1 includes a yarn suction device 92 that removes by suction the spun yarn remaining on a yarn pooling roller 91. The spinning machine includes a regulating guide 94 arranged downstream of the yarn pooling roller 91 to guide the spun yarn. A suction port 93 of the yarn suction device 92 is arranged near an upstream end of the yarn pooling roller 91 in a yarn running direction. The suction port 93 sucks an upstream end of the spun yarn remaining on the yarn pooling roller

91. When the suction port 93 has sucked the upstream end of the spun yarn, the spinning machine rotates the yarn pooling roller 91 in the reverse direction. Accordingly, the spun yarn remaining on the yarn pooling roller 91 can be removed.

[0006] In recent years, as disclosed in Japanese Patent Application Laid-open No. 2012-31523 (Patent Document 2), a spinning machine in which a direction of a yarn path is greatly different between the upstream and the downstream of the yarn pooling device has been proposed. In the spinning machine disclosed in Patent Document 2, the yarn path on the upstream of the yarn pooling device is headed for the rear upper direction (see FIG. 1 of Patent Document 2). On the other hand, the yarn path on the downstream of the yarn pooling device is headed for the front upper direction. That is, the yarn path changes by about 90 degrees before and after the yarn pooling device.

[0007] The following issues occur when removing the spun yarn remaining on the yarn pooling roller with the method disclosed in Patent Document 1.

[0008] First, what issues occur in the layout similar to that of Patent Document 1 will be explained. When a yarn breakage occurs downstream of the yarn pooling roller 91, as explained above, the spun yarn remaining on the yarn pooling roller 91 can be removed by sucking the upstream end of the spun yarn while rotating the yarn pooling roller 91 in the reverse direction.

[0009] However, as shown in FIG. 7B, because no spun yarn has been wound on the yarn pooling roller 91 immediately before completion of the removal of the spun yarn, there are times when the spun yarn between the regulating guide 94 and the suction port 93 gets hooked on a yarn hook 95. If the spun yarn gets caught in the yarn hook 95, because the yarn pooling roller 91 is rotating, there are times when the removed spun yarn is rewound on the yarn pooling roller 91 leading to spun yarn removal failure. In addition, before beginning the reverse rotation, the rotation of the yarn pooling roller 91 needs to be completely stopped once. Accordingly, the spun yarn removal takes longer time.

[0010] Next, what issues occur in the layout similar to that of Patent Document 2 will be explained with reference to FIGS. 8A and 8B. When a yarn breakage occurs downstream of the yarn pooling roller 91, the spun yarn hangs down due to the action of gravity. There are times when the hanging down spun yarn gets entangled with the spun yarn on the yarn pooling roller 91 or with the spun yarn upstream of the yarn pooling roller 91 leading to spun yarn removal failure.

[0011] Thus, in the conventional art, the spun yarn removal could take longer time, and/or the spun yarn may not be reliably removed.

SUMMARY OF THE INVENTION

[0012] It is an object of the present invention to provide a yarn pooling device that can reliably remove (dispose

of) a yarn remaining on a yarn pooling roller in a shorter time.

[0013] This object is achieved by yarn pooling device as claimed in Claim 1, and by a spinning unit as claimed in Claim 9.

[0014] According to an aspect of the present invention, a yarn pooling device includes a yarn pooling roller that pools a yarn on an outer circumferential surface thereof; and a yarn suction device having a suction port that is arranged downstream of the yarn pooling roller in a yarn running direction. When it becomes necessary to dispose of the yarn that has been pooled on the yarn pooling roller, the yarn suction device sucks the yarn from the yarn pooling roller and disposes of the yarn.

[0015] According to another aspect of the present invention, a spinning unit includes a spinning device that forms a yarn by twisting a fiber bundle; a yarn pooling roller that is arranged downstream of the spinning device in a yarn running direction and that pools a yarn on an outer circumferential surface thereof; a winding section that is arranged downstream of the yarn pooling roller in the yarn running direction and that forms a package by winding a yarn on a winding tube; a transporting device that transports the yarn from the spinning device when the yarn that extends from the spinning device to the package is disconnected; and a yarn suction device having a suction port that is arranged downstream of the yarn pooling roller in the yarn running direction and that sucks the yarn from the yarn pooling roller by generating a suction air current at the suction port and disposes of the yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a side view of a spinning unit including a yarn pooling device according to an embodiment of the present invention;

FIG. 2 is a perspective view of a structure of the yarn pooling device shown in FIG. 1;

FIG. 3 is a side view of a state of the yarn pooling device when a yarn breakage has occurred;

FIG. 4 is a side view of a state of a yarn suction device immediately after an end of a spun yarn is caught by the yarn suction device;

FIG. 5 is a side view of a state of a suction pipe after it is moved;

FIG. 6 is a side view of a state in which the spun yarn is unhooked from a yarn hooking member by a pressing member;

FIGS. 7A and 7B are side views illustrating how a spun yarn running from an upper side to a lower side may be hooked on a yarn hooking member; and

FIGS. 8A and 8B are side views illustrating how a spun yarn may get entangled when running from a lower side to an upper side.

DETAILED DESCRIPTION

[0017] Exemplary embodiments of a spinning machine according to the present invention are explained in detail below with reference to the accompanying drawings. In this specification, the terms "upstream" and "downstream", respectively, mean the upstream and the downstream in a running direction of a fiber bundle and a spun yarn at the time of spinning.

[0018] A spinning machine includes a plurality of spinning units 2 arranged in parallel and a not shown main control device that manages the spinning units 2 in a centralized manner. Each spinning unit 2 forms a spun yarn 10 by spinning a fiber bundle 8 supplied from a drafting device 7 using a spinning device 9, and forms a package 50 by winding the spun yarn 10 using a winding section 26.

[0019] As shown in FIG. 1, each spinning unit 2 includes the drafting device 7, the spinning device 9, a yarn pooling device 22, a yarn joining device 23, a yarn monitoring device 25, and the winding section 26, arranged sequentially from the upstream to the downstream. The structural components included in the spinning unit 2 are controlled by a not shown unit controller arranged in the spinning unit 2.

[0020] The drafting device 7 includes, sequentially from the upstream, four draft rollers, namely, a back roller 16, a third roller 17, a middle roller 19 with a rubber apron belt 18, and a front roller 20. Each of the draft rollers is driven to rotate at a predetermined rotation speed. The drafting device 7 further includes opposing rollers arranged respectively facing the draft rollers.

[0021] The drafting device 7 transports a sliver 15 supplied from a not shown sliver case via a sliver guide by nipping the sliver 15 between the rotating draft rollers and the opposing rollers respectively facing the draft rollers, thus forming a fiber bundle 8 by stretching (drafting) the sliver 15 until a predetermined fiber amount (or thickness) is obtained.

[0022] The spinning device 9 is arranged immediately downstream of the front roller 20. The fiber bundle 8 drafted by the drafting device 7 is supplied to the spinning device 9. The spinning device 9 forms the spun yarn 10 by twisting the fiber bundle 8 supplied from the drafting device 7. According to the present embodiment, an air spinning device is employed, which twists the fiber bundle 8 by using a swirling airflow. Specifically, the spinning device 9 includes a fiber guiding section, a swirling airflow generating nozzle, and a hollow guide shaft, although a detailed description and drawing thereof are omitted. The fiber guiding section guides the fiber bundle 8 supplied from the drafting device 7 to a spinning chamber inside the spinning device 9. The swirling airflow generating nozzle is arranged around a path of the fiber bundle 8, and generates a swirling airflow inside the spinning chamber. Ends of fibers of the fiber bundle 8 inside the spinning chamber are reversed and swirled by the swirling airflow. The hollow guide shaft guides the spun yarn

10 that is spun in the above manner from the spinning chamber to outside the spinning device 9.

[0023] A delivery roller 21 and a nip roller, which can be brought into contact with or separated from the delivery roller, are arranged downstream of the spinning device 9. By nipping the spun yarn 10, which is discharged from the spinning device 9, between the delivery roller 21 and the nip roller and driving the delivery roller 21 to rotate, the spun yarn 10 is sent toward the winding section 26.

[0024] The yarn pooling device 22 is arranged downstream of the delivery roller 21. A first guide 61 that guides the spun yarn 10 is arranged between the yarn pooling device 22 and the delivery roller 21. The yarn pooling device 22 includes a yarn pooling roller 41, an electric motor 42 that drives the yarn pooling roller 41 to rotate, a yarn hooking member 43, a yarn suction device 44, and a yarn detecting sensor 45. A certain amount of the spun yarn 10 can be pooled by being wound around the outer circumferential surface of the yarn pooling roller 41.

[0025] The yarn hooking member 43 is mounted on a downstream end portion of the yarn pooling roller 41. The yarn hooking member 43 is supported in a rotatable manner relative to the yarn pooling roller 41. A permanent magnet is attached to any one of the yarn hooking member 43 and the yarn pooling roller 41, and a magnetic hysteresis member is attached to the other of the yarn hooking member 43 and the yarn pooling roller 41. These magnetic means generate a torque against a relative rotation of the yarn hooking member 43 with respect to the yarn pooling roller 41. Therefore, only when a force overcoming the torque is applied (when a tension of a predetermined amount or larger is applied) on the yarn hooking member 43, the yarn hooking member 43 is rotated relative to the yarn pooling roller 41 so that the spun yarn 10 remaining on the yarn pooling roller 41 can be unwound. On the other hand, when such a force is not applied to the yarn hooking member 43, the yarn pooling roller 41 and the yarn hooking member 43 are integrally rotated so that the spun yarn 10 is wound around the yarn pooling roller 41.

[0026] In this manner, the yarn pooling device 22 operates such that the spun yarn 10 is unwound when the tension on the spun yarn 10 on the downstream is increased, and the spun yarn 10 is prevented from being unwound when the tension on the spun yarn 10 is decreased (when the spun yarn 10 is about to have a slack). With this operation, the slack of the spun yarn 10 can be removed and an appropriate tension can be applied on the spun yarn 10. Furthermore, because the yarn hooking member 43 operates to absorb a variation of the tension applied on the spun yarn 10 between the yarn pooling device 22 and the winding section 26, the variation of the tension is prevented from affecting the spun yarn 10 between the spinning device 9 and the yarn pooling device 22.

[0027] A second guide 62 that guides the spun yarn 10 being unwound from the yarn pooling roller 41 is ar-

ranged downstream of the yarn pooling roller 41. A regulating guide 63 that regulates the yarn path of the spun yarn 10 is arranged downstream of the second guide 62. In the present embodiment, the regulating guide 63 includes two members (see FIG. 2); however, the regulating guide 63 can include a single member.

[0028] When a yarn breakage and the like occurs downstream of the yarn pooling device 22, the yarn suction device 44 removes (disposes of) the spun yarn 10 remaining on the yarn pooling device 22. As shown in FIG. 2, the yarn suction device 44 includes a suction pipe 71 and a suction pipe driving mechanism 72.

[0029] The suction pipe 71 is a hollow cylindrical member having one or more bends. One end of the suction pipe 71 is cut obliquely to form a suction port 71a. The suction pipe 71 is connected to a not shown blower via a tube 75. As a result, the suction pipe 71 generates a suction air current near the suction port 71a and directly sucks the spun yarn 10 from the suction port 71a.

[0030] The suction port 71a is arranged downstream of the yarn pooling device 22. To clarify further, the suction pipe 71 is arranged between the second guide 62 and the regulating guide 63 at a suction start position, and it faces the yarn path regulated by the regulating guide 63. The reason for arranging the suction port 71a near the regulating guide 63 is that the spun yarn 10 does not make substantial movement near the regulating guide 63. As long as the suction port 71a is arranged near the regulating guide 63, it is optional to arrange the suction port 71a downstream of the regulating guide 63.

[0031] The suction pipe driving mechanism 72 is a mechanism for moving the suction pipe 71. The suction pipe driving mechanism 72 includes a rotatable arm 73 and an air cylinder (yarn unhooking member) 74.

[0032] The suction pipe 71 has two bends where it is bent substantially at right angles. An end of a base portion (the end on the other side of the suction port 71a) of the suction pipe 71 is firmly attached to the rotatable arm 73. The suction pipe 71 and the tube 75 are coupled with a rotary joint, for example.

[0033] The other end of the rotatable arm 73 is coupled to a cylinder rod of the air cylinder 74. The rotatable arm 73 can be rotated by causing expansion and contraction of the cylinder rod of the air cylinder 74. Because the suction pipe 71 is firmly attached to the rotatable arm 73, the suction pipe 71 can be rotated to move further upstream of the yarn hooking member 43 of the yarn pooling device 22. The timing at which the suction pipe 71 is rotated will be explained later.

[0034] The yarn detecting sensor 45 is a sensor that detects a pooled amount of the spun yarn 10 on the yarn pooling roller 41. The yarn detecting sensor 45 is arranged at a predetermined position with respect to the yarn pooling roller 41, and detects presence/absence of the spun yarn 10 at this predetermined position to determine whether the pooled amount of the spun yarn 10 is greater than a predetermined amount. When forming the package 50, the spinning unit 2 controls the rotation

speed of a winding drum 53 based on the result of detection obtained at the yarn detecting sensor 45 such that the pooled amount of the spun yarn 10 on the yarn pooling roller 41 is within a predetermined range.

[0035] During a disposal operation of disposing of the spun yarn 10 on the yarn pooling roller 41, if the yarn detecting sensor 45 does not detect the spun yarn 10, the unit controller determines that the spun yarn 10 on the yarn pooling roller 41 has been completely disposed of and completes the disposal operation. During the disposal operation, if the yarn detecting sensor 45 keeps on detecting the spun yarn 10 even after elapse of a predetermined time from the start of the disposal operation, the unit controller can be caused to determine that the disposal operation has failed. If the disposal operation has failed, the operation of the spinning unit 2 is stopped and an error message is displayed on a not shown display device.

[0036] The yarn joining device 23 is arranged downstream of the yarn pooling device 22. When the spun yarn 10 gets disconnected between the spinning device 9 and the package 50, the yarn joining device 23 joins the spun yarn 10 (first yarn) from the spinning device 9 and a yarn (second yarn) from the package 50. In the present embodiment, the yarn joining device 23 is a splicer device that twists ends of the yarns together by a swirling airflow generated by a compressed air. However, the yarn joining device 23 is not limited to the above-mentioned splicer device, but can be a mechanical knotter or the like, for example.

[0037] The spinning unit 2 includes a first transporting device (transporting device) 27 that transports the first yarn to the yarn joining device 23, and a second transporting device 28 that transports the second yarn to the yarn joining device 23.

[0038] The first transporting device 27 includes a base portion that is pivotably supported, and can pivot in a vertical direction around the base portion as a center. The first transporting device 27 is hollow, connected to a not shown blower, and can generate a suction airflow. The first transporting device 27 catches an end of the first yarn sent by the delivery roller 21 by pivoting in the vertical direction (see a dashed double-dotted line in FIG. 1).

[0039] The second transporting device 28 includes a base portion that is pivotably supported, and can pivot in the vertical direction around the base portion as a center. The second transporting device 28 is also hollow, connected to a not shown blower, and can generate a suction airflow. The second transporting device 28 catches an end of the second yarn from the package 50 by pivoting in the vertical direction (see a dashed double-dotted line in FIG. 1). A yarn detection sensor can be arranged on at least one of the first transporting device 27 or the second transporting device 28 to determine whether the yarn has been successfully caught.

[0040] In a state where the first yarn and the second yarn have been guided by the first transporting device

27 and the second transporting device 28, respectively, to the yarn joining device 23, by driving the yarn joining device 23, the first yarn and the second yarn are joined to bring the spun yarn 10 in a continuous state between the spinning device 9 and the package 50. Once the yarns have been joined, the winding of the spun yarn 10 can be resumed to form the package 50.

[0041] The yarn monitoring device 25 is arranged downstream of the yarn joining device 23. The yarn monitoring device 25 monitors the thickness of the running spun yarn 10. When a yarn defect of the spun yarn 10 (a place where a thickness of the spun yarn 10 or the like is abnormal) is detected, the yarn monitoring device 25 transmits a yarn-defect detection signal to the unit controller. A cutter 24 (yarn cutting device) is arranged upstream of the yarn monitoring device 25. Upon receiving the yarn-defect detection signal, the unit controller operates the cutter 24 and cuts the spun yarn 10. A foreign matter included in the spun yarn 10 can also be monitored as the yarn defect. Moreover, the cutter 24 can be arranged downstream of the yarn monitoring device 25.

[0042] The winding section 26 is arranged downstream of the yarn pooling device 22 via a third guide 64. The winding section 26 includes a cradle arm 52 and a winding drum 53.

[0043] The cradle arm 52 rotatably supports a winding tube 51 on which the spun yarn 10 is to be wound. The cradle arm 52 is pivotable around a base portion as a center. With this configuration, even when a diameter of the package 50 is increased by winding the spun yarn 10 around the winding tube 51, the winding of the spun yarn 10 can be appropriately continued.

[0044] The winding drum 53 rotates while being in contact with an outer circumferential surface of the winding tube 51 or the package 50 by a driving force transmitted from a not shown winding-drum driving motor. A not shown traverse groove is formed on the outer circumferential surface of the winding drum 53 and the spun yarn 10 can be traversed to a predetermined width by this traverse groove. With this configuration, the winding section 26 can form the package 50 by winding the spun yarn 10 around the winding tube 51 while traversing the spun yarn 10.

[0045] A yarn guiding-out device 54 and a guide plate 55 are arranged near the winding drum 53. The yarn guiding-out device 54 guides out the yarn end on a surface of the package 50 when performing yarn joining or the like. Upon receiving an instruction for performing yarn joining or the like, the yarn guiding-out device 54 generates an airflow along the surface of the package 50. The yarn end on the surface of the package 50 is extracted and then guided in the downward direction. The yarn end guided out by the yarn guiding-out device 54 is guided along the guide plate 55, and hence catching of the spun yarn 10 by the second transporting device 28 can be reliably performed. Alternately, instead of arranging the yarn guiding-out device 54, the second transporting device 28 can be configured to perform the guiding out of

the yarn end.

[0046] In this manner, the spinning unit 2 winds the spun yarn 10 to form the package 50.

[0047] When a yarn breakage occurs downstream of the yarn pooling device 22, how the spun yarn 10 that has remained on the yarn pooling roller 41 is disposed of will be explained in the following paragraphs. FIGS. 3 to 5 are side views that explain how the spun yarn 10 remaining on the yarn pooling roller 41 is disposed of after a yarn breakage has occurred. The process explained here is simply an example, and the timing of performing each step of this process and the contents of the steps can be changed appropriately as desired.

[0048] As explained above, the suction port 71a of the suction pipe 71 is movable. The suction port 71a of the suction pipe 71 is arranged near the regulating guide 63 (the position shown in FIG. 2) when the spun yarn 10 is running and the package 50 is being formed. When the yarn monitoring device 25 or the like detects a yarn breakage (or when the cutter 24 cuts the spun yarn 10), the unit controller stops the rotation of the back roller 16 and the third roller 17, stops the supply of the fiber bundle 8 to the spinning device 9, and stops the output of air from the swirling airflow generating nozzle of the spinning device 9. With this operation, as spinning of the spun yarn 10 by the spinning device 9 comes to a halt, the strength of the spun yarn 10 drops, and the spun yarn 10 is cut by being pulled apart.

[0049] An end of the spun yarn 10 downstream of the yarn pooling roller 41 is caught by being sucked by the suction pipe 71 (see FIG. 4). In this state, since the spun yarn 10 is hooked on the yarn hooking member 43, the spun yarn 10 remaining on the yarn pooling roller 41 is not disposed of. There are times when the spinning unit 2 cannot predict the timing at which the spun yarn 10 will be cut downstream of the yarn pooling roller 41. To handle this issue, in the present embodiment, the suction airflow is flown through the suction pipe 71 without halt. It is not necessary to flow the suction airflow through the suction pipe 71 without halt, and the suction airflow can be appropriately halted.

[0050] Subsequently, the unit controller controls the suction pipe driving mechanism 72 (more particularly, the air cylinder 74) to move the suction port 71a of the suction pipe 71 (see FIG. 5). With this operation, the spun yarn 10 can be unhooked from the yarn hooking member 43. Accordingly, the spun yarn 10 remaining on the yarn pooling roller 41 is unwound, and the unwound spun yarn 10 is sucked by the suction pipe 71. As explained above, the unit controller can determine, based on the result of detection obtained at the yarn detecting sensor 45, whether disposing of the spun yarn 10 remaining on the yarn pooling roller 41 has been completed.

[0051] In the present embodiment, the rotation speed of the yarn pooling roller 41 is not changed during formation of the package 50 and during disposing of the spun yarn 10 remaining on the yarn pooling roller 41. However, the rotation speed of the yarn pooling roller 41 can be

made slower before and after stopping the spinning device 9, for example.

[0052] As explained above, the yarn pooling device 22 according to the present embodiment includes the yarn pooling roller 41 and the yarn suction device 44. The spun yarn 10 is pooled on the yarn pooling roller 41 by being wound on an outer circumferential surface of the yarn pooling roller 41. The yarn suction device 44 generates a suction air current at the suction port 71a arranged downstream of the yarn pooling roller 41 and disposes of the spun yarn 10 remaining on the yarn pooling roller 41 by suction. When it becomes necessary to dispose of the spun yarn 10 that has been pooled on the yarn pooling roller 41 (for example, when a yarn breakage occurs downstream of the yarn pooling device 22, and/or when the spun yarn 10 is cut based on the result of detection obtained at the yarn detecting sensor 45), the yarn suction device 22 sucks the spun yarn 10 from the yarn pooling roller 41 and disposes of the spun yarn 10.

[0053] Accordingly, the following cases can be prevented from occurring: the spun yarn 10 that should have been disposed of gets wound on the yarn pooling roller 41, or the spun yarn 10 that is being sucked for disposing of and the spun yarn 10 remaining on the yarn pooling roller 41 entangle with each other. In other words, the spun yarn 10 remaining on the yarn pooling roller 41 can be reliably disposed of.

[0054] When it becomes necessary to dispose of the spun yarn 10 because the spun yarn 10 is cut downstream of the yarn pooling roller 41 in the yarn running direction, the yarn suction device 44 sucks the downstream end of the spun yarn 10 remaining on the yarn pooling roller 41.

[0055] The yarn pooling device 22 is arranged downstream of the yarn pooling roller 41 in the yarn running direction, and includes the regulating guide 63 that regulates the yarn path of the spun yarn 10 unwound from the yarn pooling roller 41. The suction port 71a of the yarn pooling device 22 is arranged at a suction start position so as to face the yarn path regulated by the regulating guide 63.

[0056] With this arrangement, since the yarn path does not change near the regulating guide 63, the spun yarn 10 can be reliably sucked.

[0057] The yarn pooling device 22 includes the electric motor 42 that drives the yarn pooling roller 41 in such a manner that the direction of rotation of the yarn pooling roller 41 when pooling the spun yarn 10 and the direction of rotation of the yarn pooling roller 41 when disposing of the spun yarn 10 by the yarn suction device 44 coincide.

[0058] With this arrangement, the number of components does not increase since there is no need to provide a mechanism for rotating the yarn pooling roller 41 in a reverse direction.

[0059] The electric motor 42 of the yarn pooling device 22 maintains the rotating state of the yarn pooling roller 41 when shifting from the operation of pooling the spun

yarn 10 on the yarn pooling roller 41 to the operation of disposing of the spun yarn 10 from the yarn pooling roller 41.

[0060] With this arrangement, the disposing of the spun yarn 10 can be performed in a shorter time since there is no need to halt the rotation of the yarn pooling roller 41.

[0061] It should be noted that, the electric motor 42 of the yarn pooling device 22 can change the rotation speed of the yarn pooling roller 41 when shifting from the operation of pooling the spun yarn 10 on the yarn pooling roller 41 to the operation of disposing of the spun yarn 10 from the yarn pooling roller 41.

[0062] With this arrangement, for example, even if the rotation speed of the yarn pooling roller 41 is extraordinarily high or extraordinarily low, by changing the rotation speed of the yarn pooling roller 41 to a speed that is suitable for the disposal operation of the spun yarn 10, the spun yarn 10 remaining on the yarn pooling roller 41 can be reliably disposed of.

[0063] The spinning unit 2 includes the yarn hooking member 43, the yarn monitoring device 25, and the air cylinder 74. The yarn hooking member 43 is coupled to the yarn pooling device 22. The yarn hooking member 43 rotates integrally with the yarn pooling roller 41 while being in contact with the spun yarn 10 to wind the spun yarn 10 on the outer circumferential surface of the yarn pooling roller 41. The yarn monitoring device 25 detects whether the yarn has been cut downstream of the yarn pooling roller 41. The air cylinder 74 unhooks the spun yarn 10 from the yarn hooking member 43 when the yarn monitoring device 25 detects that the yarn has been cut. The yarn hooking member 43 has a contact portion that makes a contact with the spun yarn 10 that is being unwound from the yarn pooling roller 41 and moves along a circumferential direction of a downstream end of the yarn pooling roller 41.

[0064] Since the spinning unit 2 includes the yarn monitoring device 25, the spinning unit 2 can determine an appropriate timing of disposing of the spun yarn 10 remaining on the yarn pooling roller 41. Accordingly, the spun yarn 10 can be unhooked from the yarn hooking member 43 by rotating the suction pipe 71 by the air cylinder 74 at an appropriate timing to dispose of the spun yarn 10 remaining on the yarn pooling roller 41.

[0065] A modification example of the above embodiment is explained below with reference to FIG. 6.

[0066] In the above embodiment, the spun yarn 10 is unhooked from the yarn hooking member 43 by movement (rotation) of the suction pipe 71. Alternatively, in the modification example, the spun yarn 10 is unhooked from the yarn hooking member 43 not by movement of the suction pipe 71 but by the action of a pressing member 78. The pressing member 78 is arranged separately from the suction pipe 71 (the yarn suction device 44).

[0067] The pressing member 78 is a thin and long cylindrical member and is movable so as to pass between the suction pipe 71 and the yarn hooking member 43.

The shape and the mechanism for moving the pressing member 78 are optional. With regard to the mechanism for moving the pressing member 78, for example, in the same manner as that of the suction pipe 71, an air cylinder (yarn unhooking section) and a suitable driving force conveying mechanism can be used.

[0068] When a yarn breakage occurs, after the suction pipe 71 has caught the spun yarn 10, the pressing member 78 moves so as to pass between the suction pipe 71 and the yarn hooking member 43. As a result, the spun yarn 10 is unhooked from the yarn hooking member 43 and the spun yarn 10 remaining on the yarn pooling roller 41 can be disposed of without causing the suction pipe 71 to move.

[0069] The exemplary embodiments of the present invention are explained above. However, the above-mentioned configuration can be modified, for example, as explained below.

[0070] In the above embodiments, a mechanism for rotating the yarn pooling roller 41 in a reverse direction is not provided; however, it is allowable to change to a configuration that includes a mechanism for rotating the yarn pooling roller 41 in a reverse direction.

[0071] Moreover, instead of the configuration in which one yarn joining device 23 is arranged for each spinning unit 2, a configuration can be adopted in which a work carrier that is movable among plural spinning units 2 is arranged and the work carrier performs the yarn joining.

[0072] The mechanism for moving the suction pipe 71 and the pressing member 78 are optional. For example, solenoids or motors can be used instead of air cylinders. The mechanism for conveying the driving force is also optional. For example, links can be used instead of cams.

[0073] In the above embodiments, the spun yarn 10 is unhooked from the yarn hooking member 43 by moving either the suction pipe 71 or the pressing member 78; however, a configuration can be adopted in which both the suction pipe 71 and the pressing member 78 are moved.

[0074] In the above embodiments, a layout is shown in which the downstream end of the yarn pooling device 22 is arranged at a higher level than its upstream end in the height direction of the spinning unit. However, the present invention can be applied to a layout (the layout disclosed in Patent Document 1) in which the downstream end of the yarn pooling device 22 is arranged at a lower level than its upstream end in the height direction of the spinning unit.

[0075] In the above embodiments, the delivery roller 21 is arranged downstream of the spinning device 9; however, the delivery roller 21 can be omitted from the configuration.

[0076] According to an aspect of the present invention, a yarn pooling device includes a yarn pooling roller and a yarn suction device. The yarn pooling roller pools a yarn on an outer circumferential surface thereof. The yarn suction device has a suction port that is arranged downstream of the yarn pooling roller in a yarn running direc-

tion. When it becomes necessary to dispose of the yarn that has been pooled on the yarn pooling roller, the yarn suction device sucks the yarn from the yarn pooling roller and disposes of the yarn.

[0077] With the above arrangement, since the suction port is arranged downstream in the yarn running direction, the following cases can be prevented from occurring: the yarn that should have been disposed of gets wound on the yarn pooling roller, or the yarn that is being sucked for disposing of and the yarn remaining on the yarn pooling roller entangle with each other. In other words, the yarn remaining on the yarn pooling roller can be reliably disposed of.

[0078] In the above yarn pooling device, it is preferable that the yarn suction device sucks a downstream end of the yarn remaining on the yarn pooling roller when the yarn is cut downstream of the yarn pooling roller in the yarn running direction.

[0079] It is preferable that the above yarn pooling device further includes a regulating guide that is arranged downstream of the yarn pooling roller in the yarn running direction and that regulates a yarn path of the yarn unwound from the yarn pooling roller. Furthermore, the suction port is arranged at a suction start position so as to face the yarn path regulated by the regulating guide.

[0080] With the above arrangement, since the yarn path does not change near the regulating guide, the yarn can be reliably sucked.

[0081] It is preferable that the above yarn pooling device further includes a driving section that drives the yarn pooling roller in such a manner that a direction of rotation of the yarn pooling roller when pooling the yarn and a direction of rotation of the yarn pooling roller when disposing of the yarn by the yarn suction device coincide.

[0082] With this arrangement, the number of components does not increase since there is no need to provide a mechanism for rotating the yarn pooling roller in a reverse direction.

[0083] In the above yarn pooling device, it is preferable that the driving section maintains a rotating state of the yarn pooling roller when shifting from an operation of pooling the yarn on the yarn pooling roller to an operation of disposing of the yarn from the yarn pooling roller.

[0084] With this arrangement, the yarn can be disposed of in a shorter time since there is no need to halt the rotation of the yarn pooling roller.

[0085] In the above yarn pooling device, it is preferable that the driving section changes a rotation speed of the yarn pooling roller when shifting from an operation of pooling the yarn on the yarn pooling roller to an operation of disposing of the yarn from the yarn pooling roller.

[0086] With this arrangement, for example, even if the rotation speed of the yarn pooling roller is extraordinarily high or extraordinarily low, by changing the rotation speed of the yarn pooling roller to a speed that is suitable for the disposal operation of the yarn, the yarn remaining on the yarn pooling roller can be reliably disposed of.

[0087] In the above yarn pooling device, it is preferable

that, in a height direction of the spinning unit, a downstream end of the yarn pooling roller in the yarn running direction is arranged at a higher level than an upstream end thereof in the yarn running direction.

[0088] With this arrangement, during disposal of the yarn remaining on the yarn pooling roller, the yarn being disposed of and the yarn remaining on the yarn pooling roller can be prevented from entangling with each other.

[0089] In the above yarn pooling device, it is preferable that, in a height direction of the spinning unit, a downstream end of the yarn pooling roller in the yarn running direction is arranged at a lower level than an upstream end thereof in the yarn running direction.

[0090] With this arrangement, during disposal of the yarn remaining on the yarn pooling roller, the yarn being disposed of can be prevented from getting wound on the yarn pooling roller.

[0091] According to another aspect of the present invention, a spinning unit includes a spinning device, a yarn pooling roller, a winding section, and a transporting device. The spinning device is arranged upstream of the yarn pooling roller in a yarn running direction and forms a yarn by twisting a fiber bundle. The winding section is arranged downstream of the yarn pooling roller in the yarn running direction and forms a package by winding a yarn on a winding tube. The transporting device transports the yarn from the spinning device when the yarn that extends from the spinning device to the package is disconnected. The spinning unit further includes a yarn suction device having a suction port that is arranged downstream of the yarn pooling roller in the yarn running direction and that sucks the yarn from the yarn pooling roller by generating a suction air current at the suction port and disposes of the yarn.

[0092] With this arrangement, since the spinning unit can reliably dispose of the yarn remaining on the yarn pooling roller, an interruption in the winding operation of the yarn can be shortened, and winding efficiency can be improved.

[0093] In the above spinning unit, it is preferable that the yarn suction device sucks a downstream end of the yarn remaining on the yarn pooling roller when the yarn is cut downstream of the yarn pooling roller in the yarn running direction.

[0094] It is preferable that the above spinning unit further includes a regulating guide that is arranged downstream of the yarn pooling roller in the yarn running direction and that regulates a yarn path of the yarn unwound from the yarn pooling roller. Furthermore, the suction port is arranged at a suction start position so as to face the yarn path regulated by the regulating guide.

[0095] It is preferable that the above spinning unit further includes a driving section that drives the yarn pooling roller in such a manner that a direction of rotation of the yarn pooling roller when pooling the yarn and a direction of rotation of the yarn pooling roller when disposing of the yarn by the yarn suction device coincide.

[0096] In the above spinning unit, it is preferable that

the driving section maintains a rotating state of the yarn pooling roller when shifting from an operation of pooling the yarn on the yarn pooling roller to an operation of disposing of the yarn from the yarn pooling roller.

[0097] In the above spinning unit, it is preferable that the driving section changes a rotation speed of the yarn pooling roller when shifting from an operation of pooling the yarn on the yarn pooling roller to an operation of disposing of the yarn from the yarn pooling roller.

[0098] In the above spinning unit, it is preferable that, in a height direction of the spinning unit, a downstream end of the yarn pooling roller in the yarn running direction is arranged at a higher level than an upstream end thereof in the yarn running direction.

[0099] In the above spinning unit, it is preferable that, in a height direction of the spinning unit, a downstream end of the yarn pooling roller in the yarn running direction is arranged at a lower level than an upstream end thereof in the yarn running direction.

[0100] It is preferable that the above spinning unit further includes a yarn cutting device that is arranged downstream of the yarn pooling roller in a yarn running direction and that cuts the yarn.

[0101] With this arrangement, an end of the yarn that is disconnected downstream of the yarn pooling device can be reliably sucked by the suction port arranged downstream of the yarn pooling device.

[0102] It is preferable that the above spinning unit further includes a yarn hooking member, a yarn monitoring device, and a yarn unhooking member. The yarn hooking member has a contact portion that makes a contact with the yarn that is being unwound from the yarn pooling roller and that moves along a circumferential direction of the yarn pooling roller. The yarn monitoring device detects whether the yarn has been cut downstream of the yarn pooling roller. The yarn unhooking member unhooks the yarn from the yarn hooking member when the yarn monitoring device detects that the yarn has been cut.

[0103] Since the spinning unit includes the yarn monitoring device, the spinning unit can determine the timing of disposing of the yarn remaining on the yarn pooling roller. Accordingly, the yarn unhooking member can unhook the yarn from the yarn hooking member at an appropriate timing to dispose of the yarn remaining on the yarn pooling roller.

[0104] In the above spinning unit, it is preferable that the yarn unhooking member unhooks the yarn from the yarn hooking member by moving the suction port.

[0105] With this arrangement, the number of components can be reduced as the yarn can be unhooked from the yarn hooking member by using the suction port (more particularly, a pipe or the like having the suction port).

[0106] It is preferable that the above spinning unit further includes a pressing member. Furthermore, the yarn unhooking member unhooks the yarn from the yarn hooking member by causing the pressing member to make a contact with the yarn extending between the suction port and the yarn hooking member and then moving the press-

ing member.

[0107] With this arrangement, since the pressing member is moved, there is no need to move the suction port. Accordingly, the yarn can be unhooked from the yarn hooking member even in a layout where it is not possible to adopt a configuration that includes a mechanism for moving the suction port due to presence of a duct or the like.

[0108] It is preferable that the above spinning unit further includes a yarn joining device that joins a yarn from the spinning device and a yarn from the package.

[0109] With this arrangement, since yarn joining can be started immediately after completion of disposal of the yarn remaining on the yarn pooling roller, package winding efficiency of the spinning unit can be improved.

Claims

1. A yarn pooling device (22) comprising:
 - a yarn pooling roller (41) adapted to pool a yarn (10) on an outer circumferential surface thereof; and
 - a yarn suction device (44) having a suction port (71a) that is arranged downstream of the yarn pooling roller (41) in a yarn running direction, wherein when a need arises to dispose of the yarn (10) that has been pooled on the yarn pooling roller (41), the yarn suction device (44) is adapted to suck the yarn (10) from the yarn pooling roller (41) and disposes of the yarn (10).
2. The yarn pooling device (22) as claimed in Claim 1, wherein the yarn suction device (44) is adapted to suck a downstream yarn end remaining on the yarn pooling roller (41) when the yarn (10) is cut downstream of the yarn pooling roller (41) in the yarn running direction.
3. The yarn pooling device (22) as claimed in Claim 1 or 2, further comprising a regulating guide (63) arranged downstream of the yarn pooling roller (41) in the yarn running direction and adapted to regulate a yarn path of the yarn (10) unwound from the yarn pooling roller (41), wherein the suction port (71a) is arranged at a suction start position so as to face the yarn path regulated by the regulating guide (63).
4. The yarn pooling device (22) as claimed in any one of Claims 1 to 3, further comprising a driving section (42) adapted to drive the yarn pooling roller (41) in such a manner that a direction of rotation of the yarn pooling roller (41) when pooling the yarn (10) and a direction of rotation of the yarn pooling roller (41) when disposing of the yarn (10) by the yarn suction device (44) coincide.

5. The yarn pooling device (22) as claimed in Claim 4, wherein the driving section (42) is adapted to maintain a rotating state of the yarn pooling roller (41) when shifting from an operation of pooling the yarn (10) on the yarn pooling roller (41) to an operation of disposing of the yarn (10) from the yarn pooling roller (41).
6. The yarn pooling device (22) as claimed in Claim 4 or 5, wherein the driving section (42) is adapted to change a rotation speed of the yarn pooling roller (41) when shifting from an operation of pooling the yarn (10) on the yarn pooling roller (41) to an operation of disposing of the yarn (10) from the yarn pooling roller (41).
7. The yarn pooling device (22) as claimed in any one of Claims 1 to 6, wherein, in a height direction of the yarn pooling device (22), a downstream end of the yarn pooling roller (41) in the yarn running direction is arranged at a higher level than an upstream end thereof in the yarn running direction.
8. The yarn pooling device (22) as claimed in any one of Claims 1 to 6, wherein, in a height direction of the yarn pooling device (22), a downstream end of the yarn pooling roller (41) in the yarn running direction is arranged at a lower level than an upstream end thereof in the yarn running direction.
9. A spinning unit (2) comprising:
- a spinning device (9) adapted to form a yarn (10) by twisting a fiber bundle (8);
 - a yarn pooling device (22) as claimed in any one of Claims 1 to 7, the yarn pooling device (22) having its yarn pooling roller (41) arranged downstream of the spinning device (9) in a yarn running direction;
 - a winding section (26) arranged downstream of the yarn pooling roller (41) in the yarn running direction and adapted to form a package (50) by winding the yarn (10) on a winding tube (51); and
 - a transporting device (27) adapted to transport the yarn (10) from the spinning device (9) when the yarn (10) that extends from the spinning device (9) to the package (50) is disconnected; wherein the yarn suction device (44) of the yarn pooling device (22) is adapted to suck the yarn (10) from the yarn pooling roller (41) by generating a suction air current at the suction port (71a).
10. The spinning unit (2) as claimed in Claim 9, wherein the driving section (42) is adapted to change a rotation speed of the yarn pooling roller (41) when shifting from an operation of pooling the yarn (10) on the yarn pooling roller (41) to an operation of disposing of the yarn (10) from the yarn pooling roller (41).
11. The spinning unit (2) as claimed in Claim 9 or 10, wherein, in a height direction of the spinning unit (2), a downstream end of the yarn pooling roller (41) in the yarn running direction is arranged at a higher level or at a lower level than an upstream end thereof in the yarn running direction.
12. The spinning unit (2) as claimed in any one of Claims 9 to 11, further comprising a yarn cutting device (24) arranged downstream of the yarn pooling roller (41) in the yarn running direction and adapted to cut the yarn (10).
13. The spinning unit (2) as claimed in any one of Claims 9 to 12, further comprising:
- a yarn hooking member (43) having a contact portion that makes a contact with the yarn (10) that is being unwound from the yarn pooling roller (41) and adapted to move along a circumferential direction of the yarn pooling roller (41);
 - a yarn monitoring device (25) adapted to detect whether the yarn (10) has been cut downstream of the yarn pooling roller (41); and
 - a yarn unhooking member (74) adapted to unhook the yarn (10) from the yarn hooking member (43) when the yarn monitoring device (25) detects that the yarn (10) has been cut.
14. The spinning unit (2) as claimed in Claim 13, wherein the yarn unhooking member (74) is adapted to unhook the yarn (10) from the yarn hooking member (43) by moving the suction port (71a).
15. The spinning unit (2) as claimed in Claim 13, further comprising a pressing member (78), wherein the yarn unhooking member (74) is adapted to unhook the yarn (10) from the yarn hooking member (43) by causing the pressing member (78) to make a contact with the yarn (10) extending between the suction port (71a) and the yarn hooking member (43) and then moving the pressing member (78).
16. The spinning unit (2) as claimed in any one of Claims 9 to 15, further comprising a yarn joining device (23) adapted to join the yarn (10) from the spinning device (9) and the yarn (10) from the package (50).

FIG. 1

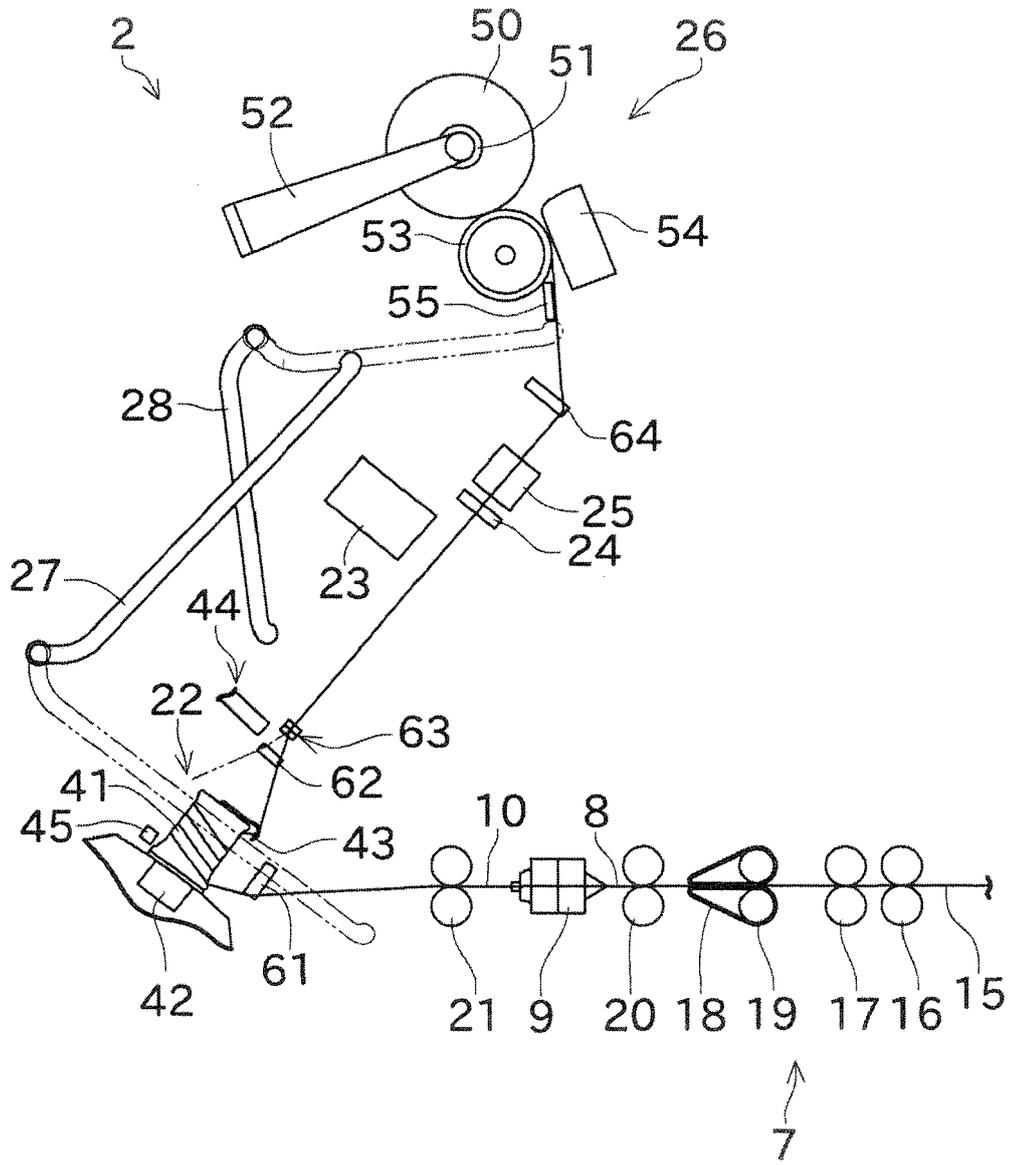


FIG. 2

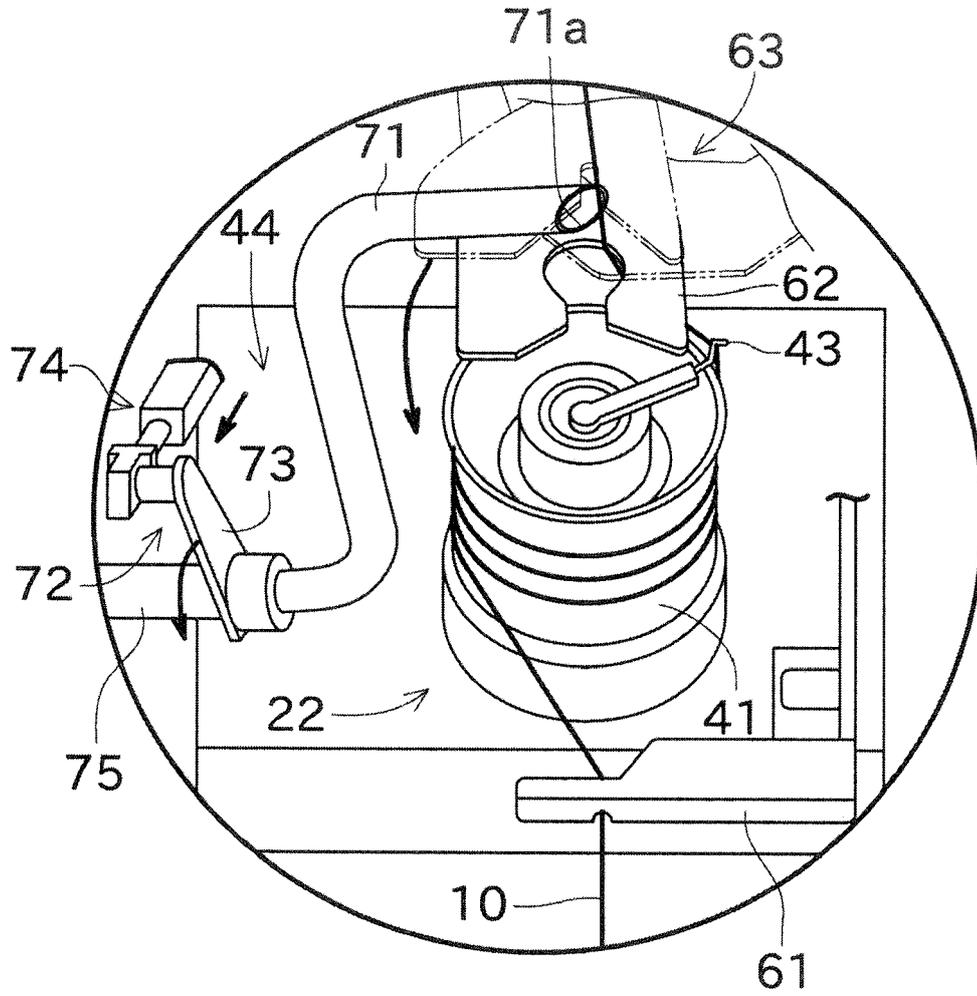


FIG. 3

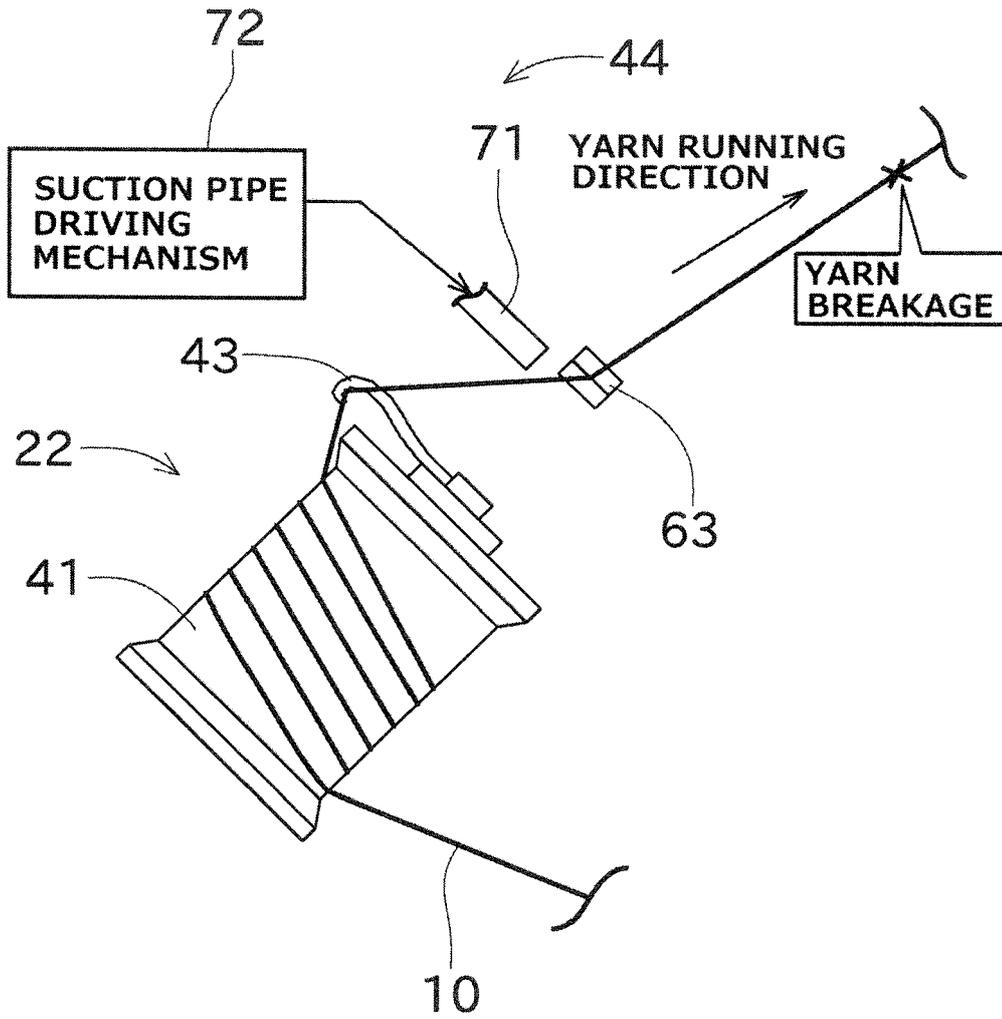


FIG. 4

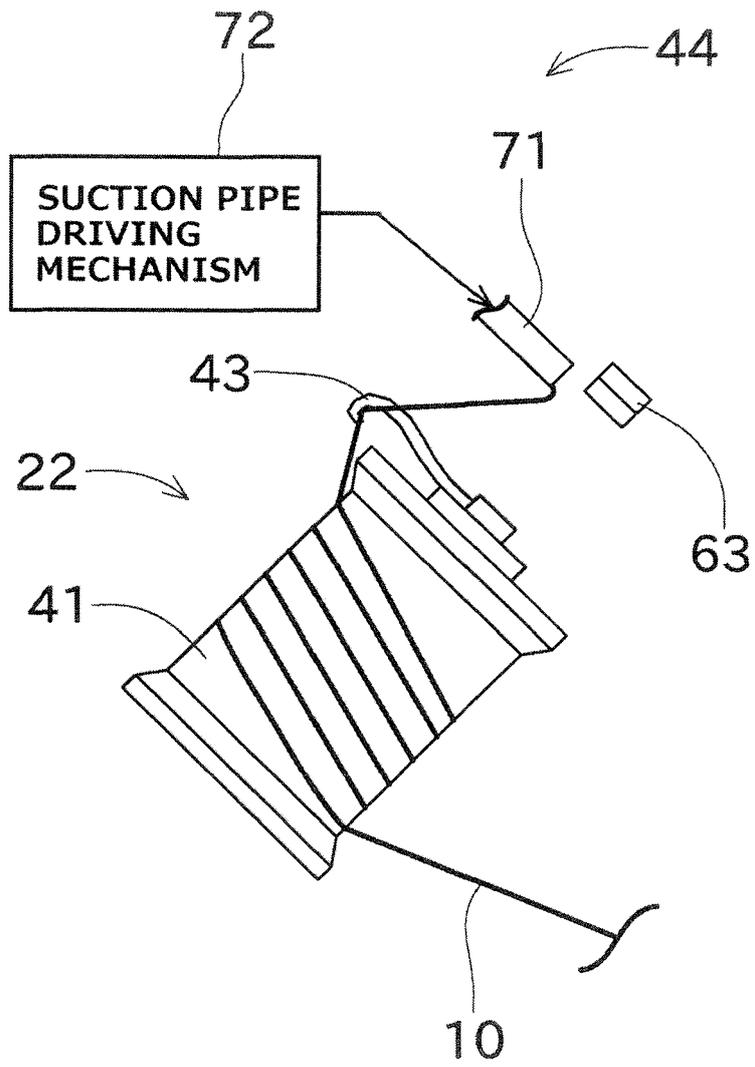


FIG. 5

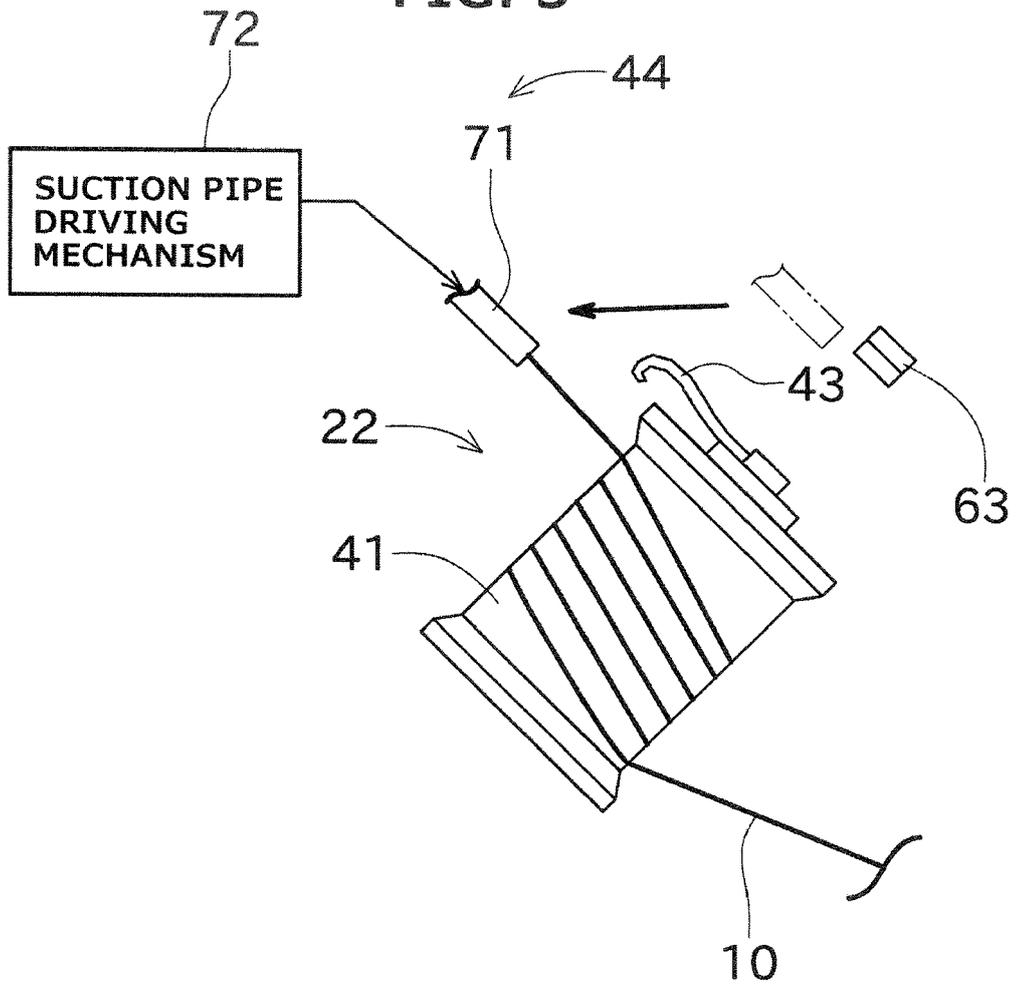


FIG. 6

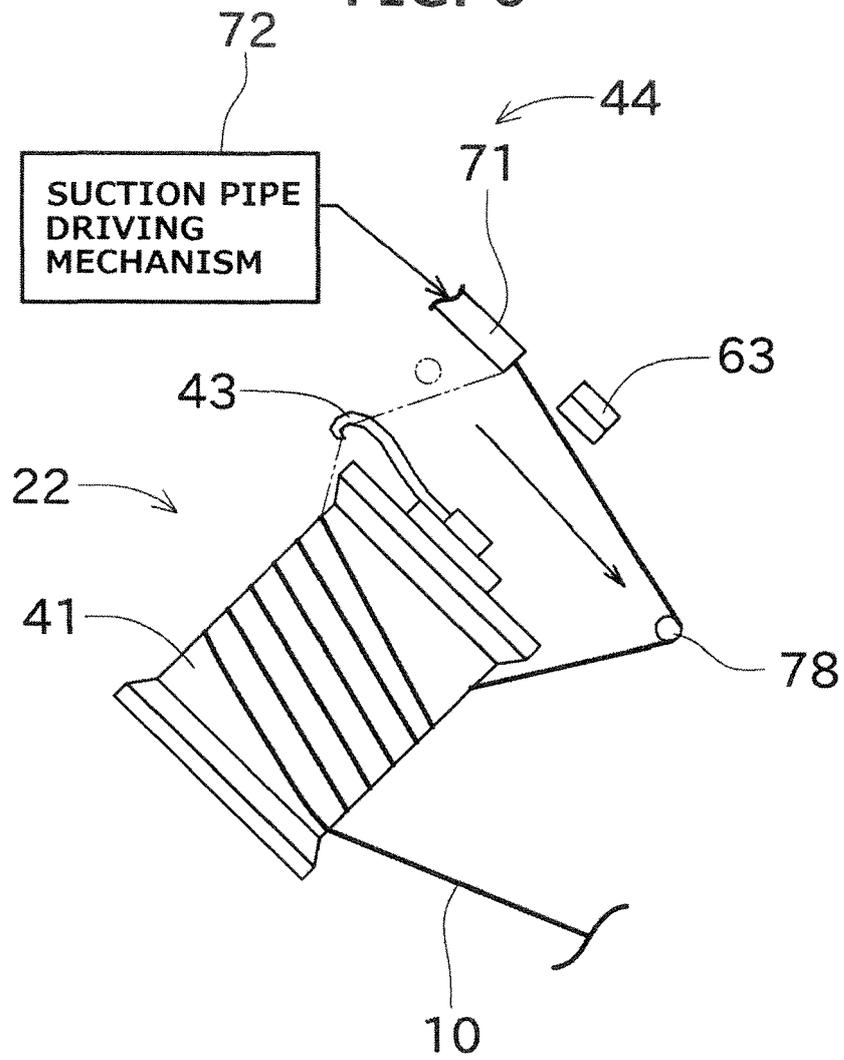


FIG. 7B

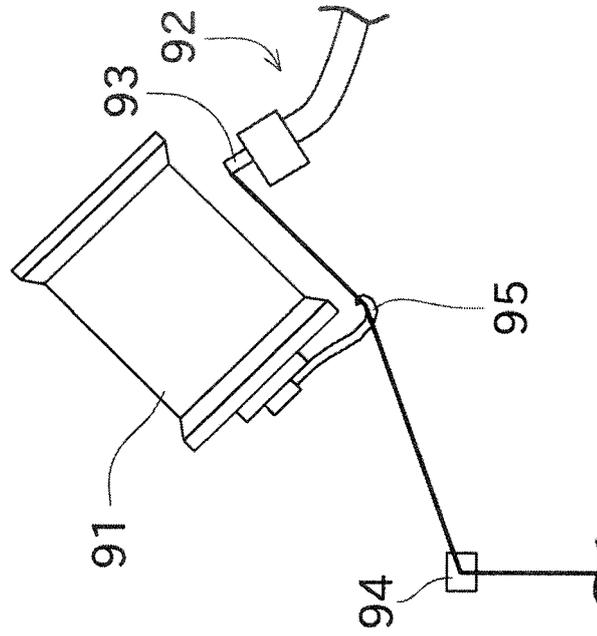


FIG. 7A

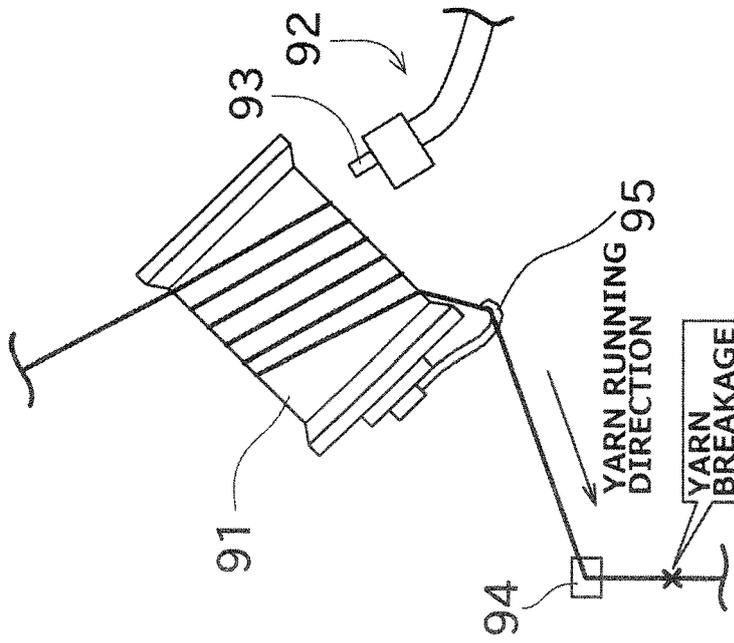


FIG. 8B

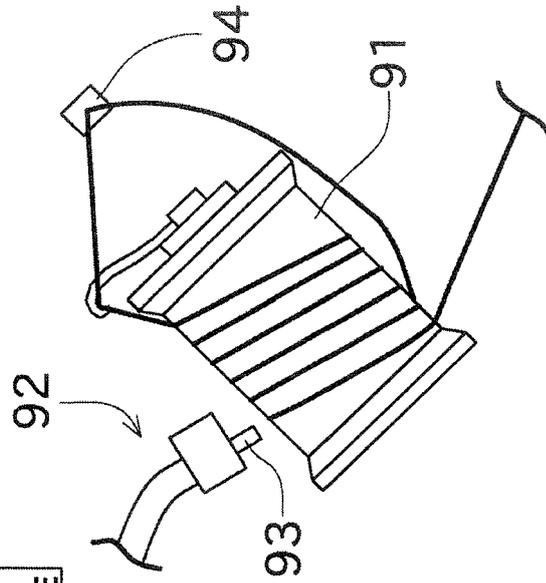
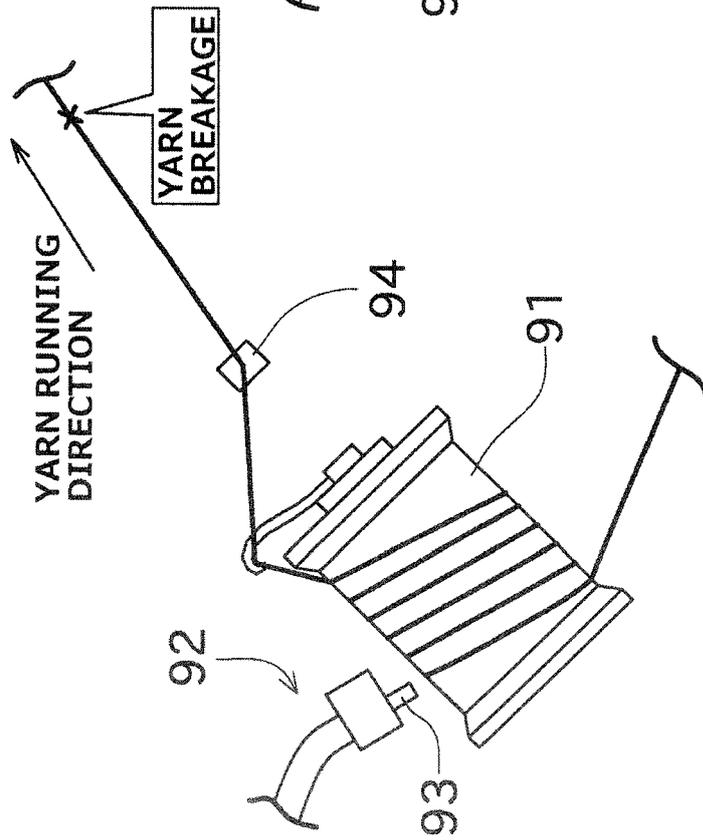


FIG. 8A



REFERENCES CITED IN THE DESCRIPTION

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