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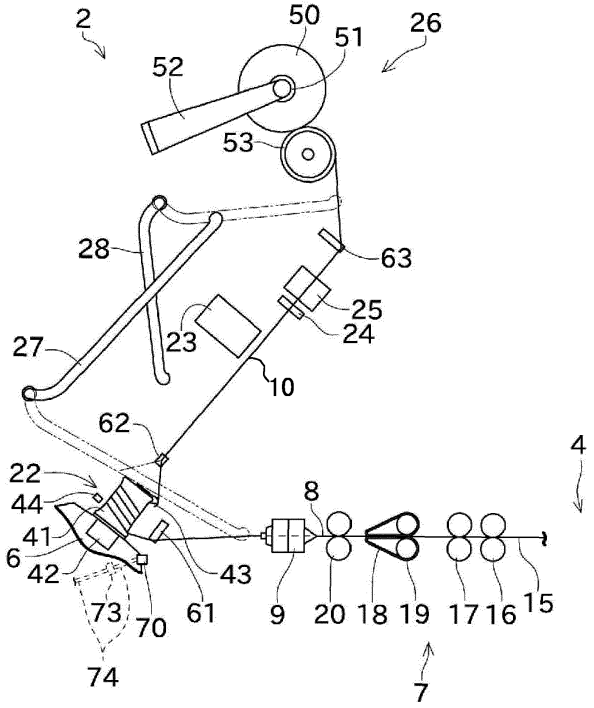
(54) AIR SPINNING MACHINE

(57) An air spinning machine includes a drafting device (7), an air spinning device (9), a yarn accumulating device (22), a suction part (70), a winding device (26), a yarn joining device (23), a first guiding device (27), and a second guiding device (28). The suction part (70) has a suction port (71) that is arranged opposing a fiber traveling path present between the air spinning device (9) and the yarn accumulating device (22). The winding device (26) is arranged at a higher position than an upstream end of the fiber traveling path of the drafting device (7).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to an air spinning machine that includes a suction part that removes yarn waste and / or fly waste and the like discharged from an air spinning device.

2. Description of the Related Art

[0002] Conventionally, spinning machines that have a configuration to remove yarn waste generated in an air spinning device are known in the art. Japanese Patent Application Laid-Open No. 2012-57274 (Patent Document 1) and Japanese Patent Application Laid-Open No. 2013-253358 (Patent Document 2) disclose such type of spinning machines.

[0003] The spinning machine disclosed in Patent Document 1 includes a spinning section, a yarn slack removing section, a winding device, and a yarn trap. The spinning section forms a spun yarn. The yarn slack removing section includes a buffer function that prevents variations in the tension of the spun yarn present on the winding device side from being conveyed to the spun yarn present on the spinning section side. The yarn trap is arranged above the yarn slack removing section. By generating a suction current in a suction port, the yarn trap sucks and removes the yarn waste that is generated when the spun yarn is cut.

[0004] The spinning machine disclosed in Patent Document 2 includes a spinning device, a defect detecting device, and a cutter. The defect detecting device is arranged downstream of the spinning device and is operative to detect a defective portion of the spun yarn. When a defect is detected by the defect detecting device, the spun yarn is cut by the cutter. In Patent Document 2, it is disclosed that a not-shown suction port is provided to remove a cut spun yarn.

[0005] However, in the spinning machines disclosed in Patent Documents 1 and 2, only the method of removing yarn waste in a layout in which the winding device is arranged at a lower position than the upstream end of the drafting device has been disclosed, and a configuration in which the yarn waste is removed in a layout in which the winding device is arranged at a higher position than the upstream end of the drafting device is not explained nor suggested.

SUMMARY OF THE INVENTION

[0006] One object of the present invention is to provide an air spinning machine that is capable of appropriately removing yarn waste and / or fly waste and the like in a layout in which a winding device is arranged at a higher position than an upstream end of a drafting device.

[0007] An air spinning machine according to one aspect of the present invention includes a drafting device; an air spinning device; a yarn withdrawing device; a suction part; a winding device; a yarn joining device; a first guiding device; and a second guiding device. The drafting device drafts a fiber bundle. The air spinning device performs a normal spinning in which the fiber bundle drafted by the drafting device is twisted by action of a swirling air current and forms a spun yarn. The yarn withdrawing device withdraws the spun yarn formed by the air spinning device. In the suction part, a suction port that is arranged opposing a fiber traveling path between the air spinning device and the yarn withdrawing device is formed. The winding device is arranged at a higher position than an upstream end of the fiber traveling path of the drafting device and winds the spun yarn withdrawn by the yarn withdrawing device to form a package. The yarn joining device performs yarn joining. The first guiding device catches a yarn end from the air spinning device and guides the yarn end to the yarn joining device. The second guiding device catches a yarn end from the package and guides the yarn end to the yarn joining device.

[0008] An air spinning machine according to one aspect of the present invention includes a drafting device; an air spinning device; a yarn withdrawing device; a suction part; a winding device; a yarn joining device; a first guiding device; and a second guiding device. The drafting device drafts a fiber bundle. The air spinning device performs a normal spinning in which the fiber bundle drafted by the drafting device is twisted by action of a swirling air current and forms a spun yarn. The yarn withdrawing device withdraws the spun yarn formed by the air spinning device. In the suction part, a suction port that is arranged opposing a fiber traveling path between the air spinning device and the yarn withdrawing device is formed. The winding device is arranged at a higher position than an upstream end of the fiber traveling path of the drafting device and winds the spun yarn withdrawn by the yarn withdrawing device to form a package. The yarn joining device performs yarn joining. The first guiding device catches a yarn end from the air spinning device and guides the yarn end to the yarn joining device. The second guiding device catches a yarn end from the package and guides the yarn end to the yarn joining device.

[0009] With this configuration, the yarn waste generated when the first guiding device fails to catch the yarn end and / or the fly waste and the like generated by the air spinning device at the time of yarn discharge spinning (hereinafter, "fiber waste") can be removed by the suction part. Therefore, occurrence of yarn defects due to entangling of the fiber waste with the spun yarn can be prevented.

[0010] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The first guiding device includes a hollow member that includes a catching member and a pivoting center. When the first guiding device is positioned at a catching position at which the first guiding device

catches the yarn end from the air spinning device, the air spinning device, the catching member, and the suction port are sequentially arranged along the fiber traveling path. With this configuration, for example, when the first guiding device fails to catch the spun yarn, the spun yarn can be sucked by the suction part.

[0011] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The air spinning device includes a fiber guide; a nozzle block; and a hollow guiding shaft. The fiber guide guides the fiber bundle. The fiber bundle is guided by the fiber guide to the nozzle block. In the nozzle block, a spinning chamber and a first nozzle through which air passes to generate the swirling air current in the spinning chamber are formed. The fiber bundle passed through the nozzle block is guided to the hollow guiding shaft. In the hollow guiding shaft, a yarn passage and a second nozzle through which air to be injected at least at the time of yarn discharge spinning passes are formed. The drafting device is driven in a drafting direction and air is injected from at least the second nozzle at the time of the yarn discharge spinning.

[0012] Even in the air spinning machine that performs the yarn discharge spinning by using a nozzle member explained above, the fiber waste can be effectively removed by the suction part.

[0013] In the above air spinning machine, it is preferable that the suction part sucks fiber waste that is generated when the air spinning device performs the yarn discharge spinning. With this configuration, entangling of the fiber waste with the spun yarn can be prevented.

[0014] In the above air spinning machine, it is preferable that, when the winding of the package performed by the winding device is interrupted, the yarn end of the package is positioned downstream of the suction port in a fiber traveling direction. With this configuration, the yarn end of the package can be caught by the second guiding device.

[0015] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The suction part includes an opening / closing section that is arranged on the suction port or on a removal passage through which a suction current flows. The opening / closing section is switchable between an open state in which the suction port or the removal passage is open and the suction current is generated in the suction port, and a closed state in which the suction port or the removal passage is closed and the suction current is not generated in the suction port.

[0016] With this configuration, because the generation of the suction current and stopping thereof can be controlled, energy consumption can be reduced and the fiber waste can be removed at a required timing.

[0017] In the above air spinning machine, it is preferable that the opening / closing section is set to the open state at least once during a period after the normal spinning performed by the air spinning device has stopped and before the yarn discharge spinning starts.

[0018] With this configuration, the fiber waste generated during the period from the stopping of the normal spinning and before the starting of the yarn discharge spinning can be removed by the suction part.

[0019] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. In the air spinning device, the nozzle block and the hollow guiding shaft are separable from each other. A cleaning operation in which air is injected from the first nozzle is performed while the nozzle block and the hollow guiding shaft are separated from each other at least once during a period after the spun yarn has become discontinuous and before the yarn discharge spinning starts, and the opening / closing section is set to the open state at least once during the cleaning operation.

[0020] With this configuration, the fiber waste generated during the cleaning operation of the air spinning device can be removed by the suction part.

[0021] In the above air spinning machine, it is preferable that the opening / closing section is switched to the closed state during a period from the completion of the cleaning operation till starting of the yarn discharge spinning.

[0022] With this configuration, effect of the suction current generated by the suction part on the yarn discharge spinning can be prevented, thereby making it possible to accurately perform the yarn discharge spinning.

[0023] In the above air spinning machine, it is preferable that the opening / closing section is in the closed state at the time of starting the yarn discharge spinning.

[0024] With this configuration, hindrance caused by the suction current generated by the suction part to the catching operation of the first guiding device can be prevented, and the first guiding device can reliably perform the catching operation.

[0025] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The drafting device performs drafting under start drafting conditions at the time of performing the yarn discharge spinning, and, then performs drafting under normal drafting conditions. The opening / closing section is switched from the open state to the closed state after the drafting conditions have changed from the start drafting conditions to the normal drafting conditions.

[0026] With this configuration, even when a yarn breakage occurs at the time of changing the drafting conditions, the broken spun yarn can be removed by the suction part.

[0027] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The upstream end of the fiber traveling path of the drafting device is arranged closer to an operator's passage than a downstream end of the fiber traveling path of the air spinning device. The yarn withdrawing device is arranged on an opposite side of the operator's passage with the air spinning device arranged therebetween.

[0028] With this configuration, even when the air spin-

ning device and the yarn withdrawing device are arranged at positions away from the operator's passage and it is difficult for the operator to visually check the accumulation status of the fiber waste, the fiber waste can be automatically removed by the suction part.

[0029] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The air spinning machine further includes a yarn monitoring device arranged between the air spinning device and the yarn withdrawing device on the fiber traveling path for monitoring the spun yarn. The suction port is arranged below the fiber traveling path that is present between the yarn monitoring device and the yarn withdrawing device.

[0030] With this configuration, poor monitoring that occurs when the yarn monitoring device detects the fiber waste can be prevented. Moreover, because the suction port is arranged below the fiber traveling path, the suction port can be arranged such that interference thereof to the fiber traveling path can be prevented. Furthermore, the spun yarn (yarn waste) that is not caught by the first guiding device and falls downward because of the gravitational force can be easily sucked by the suction part.

[0031] In the above air spinning machine, it is preferable that the air spinning machine has a configuration explained below. The air spinning machine further includes a yarn monitoring device arranged between the yarn withdrawing device and the winding device on the fiber traveling path for monitoring the spun yarn. The suction port is arranged below the fiber traveling path that is present between the air spinning device and the yarn withdrawing device.

[0032] With this configuration, because the suction part removes the fiber waste, and it becomes difficult for the yarn waste and the like to get entangled with the spun yarn, the number of yarn defects detected by the yarn monitoring device can be reduced. As a result, the number of times the package forming is interrupted for removing the yarn defects can be reduced, and the operational efficiency of the air spinning machine can be improved. Moreover, because the suction port is arranged below the fiber traveling path, the suction port can be arranged such that interference thereof to the fiber traveling path can be prevented. Furthermore, the spun yarn (yarn waste) that is not caught by the first guiding device and falls downward because of the gravitational force can be easily sucked by the suction part.

[0033] In the above air spinning machine, it is preferable that the air spinning machine further includes a suction guide member that is formed so as to extend from the suction port to an upstream side in a suction current direction. The suction guide member is formed such that an upper part thereof is open, wall surfaces are formed on parts other than the upper part, and space between the side wall surfaces becomes narrower towards the suction port. With this configuration, the fiber waste can be guided to the suction port by the suction guide member.

[0034] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is a side view showing a configuration of a spinning unit that is included in a spinning frame according to an embodiment of the present invention.

FIG. 2 is a cross-sectional view showing an internal configuration of an air spinning device.

FIG. 3 is an enlarged perspective view showing shapes of a yarn accumulating device and a suction part.

FIG. 4 is a timing chart showing timings at which an opening / closing section opens / closes a suction port.

FIG. 5 is a side view showing a state of various structural components when a cleaning operation is being performed.

FIG. 6 is a side view showing a state of various structural components when a guiding device has caught a spun yarn.

FIG. 7 is a side view showing a state of various structural components when the guiding device guides the spun yarn to a yarn joining device.

FIG. 8 is a side view showing a state in which a first guiding device fails to catch the spun yarn and the suction part sucks the spun yarn.

FIG. 9 is a side view showing a configuration of a spinning unit according to a modification.

DETAILED DESCRIPTION

[0036] Exemplary embodiments of a spinning frame (air spinning machine) according to an embodiment of the present invention are explained below with reference to the accompanying drawings. In the present description, terms "upstream" and "downstream" refer to upstream and downstream in a traveling direction of a fiber (specifically, sliver 15, fiber bundle 8, and spun yarn 10). Moreover, in the explanation of the positional relationship of devices arranged along a fiber traveling path, devices that are arranged between A and B on the fiber traveling path are simply explained as arranged between A and B, and the like.

[0037] The spinning frame includes a plurality of spinning units 2 arranged side by side, and a not-shown machine-frame controlling device that centrally controls the spinning units 2. In each spinning unit 2, the fiber bundle 8 supplied from a drafting device 7 is spun by an air spinning device 9 to form the spun yarn 10, and the spun yarn 10 is wound by a winding device 26 to form a package 50. Moreover, an operator's passage 4 through which an operator passes is formed on an opposite side of a yarn accumulating device 22 (an end portion of a side near the drafting device 7, right side in FIG. 1) with

the air spinning device 9 arranged therebetween.

[0038] As shown in FIG. 1, each spinning unit 2 includes, sequentially from the upstream to the downstream, the drafting device 7, the air spinning device 9, the yarn accumulating device 22, a yarn joining device 23, a yarn monitoring device 25, and the winding device 26. All structural components of the spinning unit 2 are controlled by a not-shown unit controller provided in the spinning unit 2. However, all structural components of the spinning unit 2 can be controlled by the machine-frame controlling device. Alternatively, one unit controller can be provided for a predetermined number of the spinning units 2.

[0039] The drafting device 7 drafts the sliver (fiber bundle) 15. Specifically, the drafting device 7 transports the sliver 15 by sandwiching it between a plurality of drafting rollers (bottom rollers) and a plurality of opposing rollers (top rollers), and draws (drafts) the sliver 15 so that the sliver 15 has a predetermined fiber amount (or thickness) thereby forming the fiber bundle 8. The drafting device 7 includes, sequentially from the upstream, four drafting rollers, namely, a back roller 16, a third roller 17, a middle roller 19, and a front roller 20. An apron belt 18 made of rubber is wound on the middle roller 19. Each of the drafting rollers is driven to rotate at a predetermined rotational speed. The drafting device 7 includes the opposing rollers arranged respectively facing the drafting rollers.

[0040] In the present embodiment, each drafting roller arranged in the spinning unit 2 is driven by a separate driving section, and the rotational speed of each drafting roller can be separately changed. Accordingly, drafting conditions (specifically, drafting ratio, drafting speed, and the like) can be changed. The drafting conditions of the drafting device 7 are set differently, for example, at the time of later-explained yarn discharge spinning and at the time of normal spinning. Instead of the configuration in which one driving section is provided for each drafting roller of the spinning unit 2, at least two drafting rollers among the drafting rollers arranged in the spinning unit 2 can be driven by the same driving section. For example, the back roller 16 and the third roller 17 can be driven by the same driving section. Moreover, in the present embodiment, the driving sections of the drafting rollers are provided for each spinning unit 2. However, a common driving section can be provided for a plurality of the spinning units 2.

[0041] The air spinning device 9 is arranged immediately downstream of the front roller 20. The air spinning device 9 forms the spun yarn 10 by twisting the fiber bundle 8 supplied from the drafting device 7. In the present embodiment, an air spinning device that twists the fiber bundle 8 by using a swirling air current has been employed. As shown in FIG. 2, the air spinning device 9 includes a nozzle block 30, and a hollow guiding shaft 34. The nozzle block 30 includes a fiber guide 31, a spinning chamber 32, and a first nozzle 33. The hollow guiding shaft 34 includes a yarn passage 35 and a second nozzle 36. All structural components of the air spinning device 9 are controlled by the unit controller.

[0042] The fiber guide 31 is a member that guides the fiber bundle 8 drafted by the drafting device 7 towards an inside of the air spinning device 9. A fiber introducing port 31a and a guide needle 31b are formed in the fiber guide 31. The fiber bundle 8 drafted by the drafting device 7 is introduced from the fiber introducing port 31a and guided into the spinning chamber 32 via the guide needle 31b. The air spinning device 9 injects air from the first nozzle 33 into the spinning chamber 32 and applies the swirling air current on the fiber bundle 8 present in the spinning chamber 32. Alternatively, the guide needle 31b can be omitted, and a downstream end of the fiber guide 31 can be configured to function as the guide needle 31b.

[0043] The hollow guiding shaft 34 is a cylindrical member with the yarn passage 35 formed therein. By injecting air from the second nozzle 36 into the yarn passage 35, the air spinning device 9 generates the swirling air current in the yarn passage 35. The swirling air current generated in the yarn passage 35 flows in a direction opposite to that of the swirling air current generated in the spinning chamber 32.

[0044] The air spinning device 9 configured as explained above can perform the yarn discharge spinning, and the normal spinning. The yarn discharge spinning is a spinning operation performed when the air spinning device 9 starts or resumes the formation of the spun yarn 10. The normal spinning is a spinning operation in which, after the yarn discharge spinning operation, the spun yarn 10 to be wound by the winding device 26 is continuously formed.

[0045] When the yarn discharge spinning is performed, at first, the air is not injected from the first nozzle 33, but the air is injected from the second nozzle 36 to generate the swirling air current. The fiber bundle 8 drafted by the drafting device 7 is guided into the air spinning device 9 by the fiber guide 31. The guided fiber bundle 8 is supplied to the hollow guiding shaft 34.

[0046] Because the yarn passage 35 is formed such that the cross-sectional area thereof on the downstream side is larger than the cross-sectional area thereof on the upstream side, inside the yarn passage 35, the swirling air current flows toward the downstream side. Accordingly, the fiber bundle 8 can be supplied to the downstream side of the yarn passage 35. By the action of the air injected from the first nozzle 33 and the second nozzle 36, the fiber bundle 8 is spun into a fasciated yarn and discharged from the hollow guiding shaft 34.

[0047] After the yarn discharge spinning operation, the normal spinning is performed. In the normal spinning, the air is injected from the first nozzle 33, and the air is not injected from the second nozzle 36. Therefore, a rear fiber end of the fiber bundle 8 supplied from the drafting device 7 is caused to swing around a tip end of the hollow guiding shaft 34 by the action of the swirling air current generated in the spinning chamber 32 by the first nozzle 33. Accordingly, the fiber bundle 8 is twisted, and the spun yarn 10 is formed. The spun yarn 10 is passed

through the yarn passage 35 of the hollow guiding shaft 34, and then discharged to the outside of the air spinning device 9 from a not-shown yarn outlet arranged downstream.

[0048] As explained above, the air spinning device 9 can form the spun yarn 10 by twisting the fiber bundle 8 during the yarn discharge spinning and the normal spinning.

[0049] A first guide 61 that guides the spun yarn 10 is arranged downstream of the air spinning device 9. The first guide 61 guides the spun yarn 10 toward the yarn accumulating device 22. The first guide 61 is movable so as to guide the spun yarn 10 towards the yarn accumulating device 22 at the time of yarn joining and the like. Moreover, a sensor that detects a tension of the spun yarn 10 can be arranged between the air spinning device 9 and the yarn accumulating device 22. Alternatively, a sensor that detects the tension can be omitted.

[0050] The yarn accumulating device 22 is arranged downstream of the first guide 61. The yarn accumulating device 22 is supported by a frame 6. The yarn accumulating device 22 withdraws the spun yarn 10 from the air spinning device 9. The yarn accumulating device 22 includes a yarn accumulating roller 41, an electric motor 42 that rotationally drives the yarn accumulating roller 41, and a yarn hooking member 43. By winding the spun yarn 10 on an outer peripheral surface of the yarn accumulating roller 41, the spun yarn 10 is temporarily accumulated.

[0051] The yarn hooking member 43 is attached to the downstream end of the yarn accumulating roller 41. The yarn hooking member 43 is supported so as to relatively rotate with respect to the yarn accumulating roller 41. A permanent magnet is attached to one of the yarn hooking member 43 and the yarn accumulating roller 41, and a magnetic hysteresis material is attached to the other one of the two. By using such magnetic means, a torque that resists the relative rotation of the yarn hooking member 43 with respect to the yarn accumulating roller 41 is generated. Accordingly, only when a force that can overcome such torque is applied to the yarn hooking member 43 (when a yarn tension that is equal to or more than a predetermined value is applied), the yarn hooking member 43 can relatively rotate with respect to the yarn accumulating roller 41, and thus can unwind the spun yarn 10 wound on the yarn accumulating roller 41. Moreover, when a force that can overcome the torque is not applied to the yarn hooking member 43, the yarn accumulating roller 41 and the yarn hooking member 43 rotate integrally, and thus the spun yarn 10 is accumulated on the yarn accumulating roller 41.

[0052] In this manner, the yarn accumulating device 22 unwinds the spun yarn 10 when the yarn tension on the downstream side increases, and the yarn accumulating device 22 is operated to stop the unwinding of the spun yarn 10 when the yarn tension decreases (when slacking is likely to occur in the spun yarn 10). Accordingly, the yarn accumulating device 22 can remove slacking of the spun yarn 10 and apply an appropriate tension to the spun yarn 10. Moreover, by operating the yarn hooking member 43 to absorb the variations in the tension applied to the spun yarn 10 that is positioned between the yarn accumulating device 22 and the winding device 26 as explained above, the tension variations can be prevented from affecting the spun yarn 10 that is positioned between the air spinning device 9 and the yarn accumulating device 22.

[0053] A yarn amount detecting sensor 44 and a suction part 70 are arranged near the yarn accumulating device 22. The yarn amount detecting sensor 44 is an optical sensor, and detects the amount of the spun yarn 10 accumulated in the yarn accumulating device 22.

[0054] Similar to the yarn accumulating device 22, the suction part 70 is supported by the frame 6. As shown in FIG. 3, a suction port 71 is formed in the suction part 70. The suction part 70 is fixedly attached to the frame 6. The position of the suction port 71, too, is fixed. The suction port 71 is connected to a not-shown blower, and a suction current can be generated in the suction port 71. Accordingly, fiber waste (specifically, yarn waste that is the spun yarn 10 of which a yarn end is not caught by a first guiding device 27, fly waste discharged from the air spinning device 9 at the time of the yarn discharge spinning, and the like) that is present near the suction port 71 can be sucked. The fiber waste sucked by the suction port 71 is removed via a removal passage 74. The removal passage 74 is connected to the blower via a main duct that is arranged parallel to the arrangement direction of the spinning units 2. The removal passage 74 and the main duct can be connected via an auxiliary duct provided for a predetermined number of the removal passages 74. One auxiliary blower can be provided for each auxiliary duct. The removed fiber waste is collected in a collecting section arranged downstream of the main duct.

[0055] An opening / closing section 73 is arranged on the removal passage 74. The opening / closing section 73 includes a shutter member that can be switched between an open state in which the removal passage 74 is open and the suction current is generated in the suction port 71 and a closed state in which the removal passage 74 is closed and no suction current is generated in the suction port 71. Specifically, when the shutter member is moved by a driving section such as an electric motor or a cylinder, the opening / closing section 73 is switched between the open state and the closed state. The opening / closing section 73 is not arranged in the suction port 71 but arranged on the removal passage 74 arranged downstream thereof. Accordingly, the fiber waste present near the suction port 71 can be prevented from getting caught between the opening / closing section 73 and the removal passage 74 when the opening / closing section 73 is switched from the open state to the closed state. Timings of switching between the open state and the closed state of the opening / closing section 73 will be explained in detail later.

[0056] The fiber waste that is a main removal target of

the suction part 70 is the yarn waste, the fly waste, and the like that is discharged from the air spinning device 9. More specifically, the spun yarn 10 supplied from the air spinning device 9 is caught by the later-explained first guiding device 27, is guided to the yarn joining device 23, and is then joined by the yarn joining device 23 with a spun yarn 10 from the package 50. However, when the first guiding device 27 fails to catch the spun yarn 10, the spun yarn 10 becomes the yarn waste. Moreover, the fly waste generated during the spinning remains in the air spinning device 9, and is discharged from the downstream end (outlet) of the air spinning device 9. The suction part 70 also removes other fiber wastes (for example, fly waste that falls from above, yarn waste introduced to the suction port 71 by the operator, and the like).

[0057] A suction guide member 72 that guides the fiber waste to the suction port 71 is arranged near the suction port 71. The suction guide member 72 is a part that extends from the suction port 71 toward the upstream side in a suction current direction (toward the air spinning device 9 side). In the suction guide member 72, an upper part thereof is open and wall surfaces are formed on parts other than the upper part. The suction guide member 72 is formed such that the space between the side wall surfaces becomes narrower (the cross-sectional area of the space becomes smaller) towards the suction port 71 (towards downstream of the suction current).

[0058] As shown in FIG. 1, the suction port 71 is arranged at a lower level than the downstream end (outlet) of the air spinning device 9. In other words, the suction port 71 is positioned below the fiber traveling path (yarn path) between the air spinning device 9 and the yarn accumulating device 22. Consequently, the fiber waste travels toward the suction port 71 from above (to be precise, from obliquely above). Because the suction guide member 72 is formed such that the upper part thereof is open, the fiber waste falling from an obliquely above position can be appropriately guided to the suction port 71.

[0059] The suction port 71 is arranged such that the axial direction thereof is along the fiber traveling path. Specifically, the axial direction of the suction port 71 and the fiber traveling path are substantially parallel to each other. In other words, the axial direction of the suction port 71 is almost parallel, rather than perpendicular, to the fiber traveling path. Instead of sucking the spun yarn 10 from the radial direction, the suction port 71 is configured to suck the spun yarn 10 from the longitudinal direction. The suction port 71 sucks the yarn waste that falls after hitting the suction guide member 72, the frame 6, and the like.

[0060] The fiber traveling path arranged upstream of the yarn accumulating device 22 (in detail, upstream of the first guide 61) is substantially horizontal to an installation surface of the spinning frame. The fiber traveling path arranged downstream of the yarn accumulating device 22 (in detail, downstream of a second guide 62) is formed so as to face obliquely upward. Accordingly, during winding of the spun yarn 10, the fiber traveling path is largely bent (by 90 degrees or more) by the yarn accumulating device 22.

[0061] The suction part 70 is arranged between the air spinning device 9 and the yarn accumulating device 22. Furthermore, the suction part 70 is arranged nearer to the yarn accumulating device 22 than a central position between the air spinning device 9 and the yarn accumulating device 22. That is, the suction part 70 is arranged near a position at which the fiber traveling path is largely bent.

[0062] In such a layout, among the drafting device 7, the air spinning device 9, the yarn accumulating device 22, the yarn monitoring device 25, and the winding device 26, in a plane view, the yarn accumulating device 22 is arranged farthest from the operator's passage 4. Therefore, because it is difficult for the operator to visually check the area near the yarn accumulating device 22, it becomes difficult for the operator to check an accumulation status of the fiber waste. In the present embodiment, because the suction part 70 is arranged near the yarn accumulating device 22, the fiber waste, which is difficult for the operator to check visually, can be removed automatically.

[0063] The substantially horizontal fiber traveling path that goes from the drafting device 7 toward the yarn accumulating device 22, and the oblique fiber traveling path that goes from the yarn accumulating device 22 toward the winding device 26 are both positioned above the suction part 70. Therefore, the amount of fiber waste falling from above tends to be large. By arranging the suction part 70 at such a position, it is possible to remove the fiber waste discharged from the air spinning device 9 and the fiber waste generated in other structural components of the spinning unit 2.

[0064] The second guide 62 that regulates the movement of the spun yarn 10 that is unwound from the yarn accumulating roller 41 is arranged downstream of the yarn accumulating roller 41. The yarn joining device 23 is arranged downstream of the second guide 62. When the spun yarn 10 positioned between the air spinning device 9 and the package 50 is disconnected due to some reason, the yarn joining device 23 joins the spun yarn 10 from the air spinning device 9 (first yarn) and the spun yarn 10 from the package 50 (second yarn). In the present embodiment, the yarn joining device 23 is a splicer device that twists together the yarn ends by the action of the swirling air current generated by the compressed air. The yarn joining device 23 is not limited to the splicer device explained above, and, for example, a mechanical knotter and the like can be employed. The yarn joining device 23 is configured such that the yarn joining device 23 is independent of the air spinning device 9. Therefore, the yarn joining device 23 differs from a configuration in which a fiber bundle on the upstream side and a yarn end on the downstream side are guided to a spinning device and the yarn joining is performed inside the spinning device.

[0065] The spinning unit 2 includes a guiding device that guides the spun yarn 10 to the yarn joining device

23. The guiding device is constituted by the first guiding device 27 that guides the first yarn to the yarn joining device 23 and a second guiding device 28 that guides the second yarn to the yarn joining device 23.

[0066] A base portion of the first guiding device 27 is pivotably supported, and the first guiding device 27 is pivotable in the vertical direction around the base portion as a pivoting center. The first guiding device 27 is a hollow member that is connected to a not-shown blower and can generate the suction air current. By pivoting downward, the first guiding device 27 can catch a yarn end of the first yarn (see FIG. 6, catching position). After catching the first yarn, by pivoting upward, the first guiding device 27 can guide the first yarn to the yarn joining device 23. The first guiding device 27 may include a twisting function or may not be provided with a twisting function.

[0067] A base portion of the second guiding device 28 is pivotably supported, and the second guiding device 28 is pivotable in the vertical direction around the base portion as a pivoting center. The second guiding device 28, too, is a hollow member that is connected to a not-shown blower and can generate the suction air current. By pivoting upward, the second guiding device 28 can catch a yarn end of the second yarn (see a portion shown by a dotted line in FIG. 1). After catching the second yarn, by pivoting downward, the second guiding device 28 can guide the second yarn to the yarn joining device 23.

[0068] By driving the yarn joining device 23 in a state in which the first yarn and the second yarn has been guided to the yarn joining device 23, the first yarn (spun yarn 10 formed by performing the normal spinning) and the second yarn are joined such that the spun yarn 10 travels continuously between the air spinning device 9 and the package 50. Accordingly, the winding of the spun yarn 10 onto the package 50 can be resumed.

[0069] The yarn monitoring device 25 is arranged downstream of the yarn joining device 23. The yarn monitoring device 25 monitors the thickness of the traveling spun yarn 10 by using a not-shown optical transmission-type sensor. Upon detecting a yarn defect on the spun yarn 10 (part of the spun yarn 10 having abnormal thickness and the like), the yarn monitoring device 25 transmits to the unit controller a yarn defect detection signal. Upon receiving the yarn defect detection signal, the unit controller drives a cutter 24 (yarn cutting device) arranged near the yarn monitoring device 25 to cut the spun yarn 10. The sensor used by the yarn monitoring device 25 for monitoring the thickness of the spun yarn 10 is not limited to the optical transmission-type sensor, and can be, for example, an electrostatic capacitance-type sensor. The yarn monitoring device 25 can monitor as the yarn defect a foreign substance contained in the spun yarn 10. The yarn monitoring device 25 can monitor the occurrence of yarn breakage. The cutter 24 can be arranged inside the yarn monitoring device 25. The cutter 24 can be omitted, and the spun yarn 10 can be cut by stopping the spinning performed by the air spinning device 9. When the spinning is interrupted due to the yarn breakage and / or cutting of the yarn and the like, after the spinning in the air spinning device 9 has stopped, the rotation of the yarn accumulating roller 41 is slowed down and eventually stopped. The drafting performed in the drafting device 7 is also stopped.

[0070] The winding device 26 is arranged downstream of the yarn accumulating device 22. The winding device 26 is arranged at a higher level than the upstream end of the drafting device 7. The winding device 26 includes a cradle arm 52 and a winding drum 53. The fiber traveling path that goes from the yarn accumulating device 22 to the winding device 26 is bent and guided by a downstream guide 63.

[0071] The cradle arm 52 can rotatably support a winding tube 51 on which the spun yarn 10 is wound. The cradle arm 52 is pivotable around a base portion thereof as a pivoting center. Accordingly, even when a diameter of the package 50 increases upon winding the spun yarn 10 around the winding tube 51, the winding of the spun yarn 10 can be appropriately continued.

[0072] When a driving force of a not-shown winding drum driving motor is transmitted, the winding drum 53 rotates while being in contact with an outer peripheral surface of the winding tube 51 or the package 50. A not-shown traversing groove is formed on the outer peripheral surface of the winding drum 53, and the spun yarn 10 can be traversed at a predetermined width by the traversing groove. Accordingly, the winding device 26 can wind the spun yarn 10 on the winding tube 51 while traversing the spun yarn 10 to form the package 50.

[0073] Instead of the winding drum 53, the winding device 26 can include a contact roller in which a traversing groove is not formed, and a traversing device that is provided independently of the contact roller. An arm-type traversing device, a belt-type traversing device, a rotary-type traversing device, and the like are the examples of the traversing device. In such a configuration, the winding tube 51 can be rotated by the winding drum driving motor, and the contact roller can rotate following the rotation of the winding tube 51.

[0074] Next, a flow of the yarn joining operation will be explained along with the timings at which the opening / closing section 73 is switched between the open state and the closed state. Note that, the same process is performed when the joining operation is not performed, and the spinning is started to start winding of the spun yarn 10 onto a new winding tube 51. The process explained below is performed by the unit controller, however, at least a part of the process can be performed by another device (for example, machine-frame controlling device).

[0075] FIG. 4 explains whether the first nozzle 33 injects the air (ON or OFF), whether the second nozzle 36 injects the air (ON or OFF), whether the drafting conditions are set to normal drafting conditions or start drafting conditions (drafting conditions at the time of the yarn discharge spinning), and whether the opening / closing section 73 is in the open state or the closed state during various processes performed by the spinning unit 2. The

horizontal axis in FIG. 4 denotes time. FIG. 4 shows a flow of processes performed from when the spinning and the like is stopped due to the spun yarn 10 becoming discontinuous during a winding operation, the cleaning operation and the yarn joining and the like are performed, till the winding operation is resumed.

[0076] Because the normal spinning is performed during the winding operation, the air is injected from the first nozzle 33 as explained above, and no air is injected from the second nozzle 36. Because the normal spinning is being performed, drafting is performed under the normal drafting conditions. Because the possibility of the main removal target of the suction part 70 being present near the suction port 71 is low, the opening / closing section 73 is in the closed state. In the present embodiment, the opening / closing section 73 is in the closed state during the winding operation to save the energy required to generate the suction current. However, the fiber waste can be removed by setting the opening / closing section 73 to the open state during the winding operation.

[0077] When the spun yarn 10 becomes discontinuous during winding of the package 50 (specifically, when the yarn breakage occurs, when the spun yarn 10 is cut by the cutter 24, or when the spinning of the air spinning device 9 is stopped and the spun yarn 10 is cut), the winding device 26 stops the winding of the package 50, the drafting device 7 stops the drafting of the fiber bundle 8, and the air spinning device 9 stops the spinning. The first guide 61 moves to a position away from the yarn accumulating device 22.

[0078] Subsequently, as shown in FIG. 5, after the nozzle block 30 and the hollow guiding shaft 34 of the air spinning device 9 are separated from each other, the cleaning operation of the air spinning device 9 is performed by injecting the air from the first nozzle 33. By performing the cleaning operation, the fly waste may be discharged from the air spinning device 9. To remove the fly waste, the opening / closing section 73 is switched from the closed state to the open state. In the present embodiment, the opening / closing section 73 is switched from the closed state to the open state at the same time as when the yarn breakage is detected and / or the spun yarn 10 is cut. Alternately, the opening / closing section 73 may be switched to the open state by the start of the cleaning operation. Even in a configuration in which the cleaning operation is not performed, by setting the opening / closing section 73 to the open state at least once during a period after the spinning has stopped and before the yarn discharge spinning starts, the fly waste and the like generated at this timing can be removed.

[0079] After the cleaning operation is completed (injection of air from the first nozzle 33 is stopped), the nozzle block 30 and the hollow guiding shaft 34 of the air spinning device 9 are brought closer and returned to the original position thereof. Subsequently, the yarn discharge spinning is started. Accordingly, the second nozzle 36 is caused to start injecting the air. Furthermore, the drafting device 7 resumes the drafting under the start drafting conditions. To prevent the effect of the suction current generated by the suction part 70 on the yarn discharge spinning, the opening / closing section 73 is switched from the open state to the closed state before the yarn discharge spinning starts.

[0080] By pivoting upward before or after the yarn discharge spinning starts, the second guiding device 28 catches the second yarn as shown in FIG. 6. Subsequently, by pivoting downward with the caught second yarn, the second guiding device 28 guides the second yarn to a position at which the yarn joining device 23 can perform the yarn joining. The second guiding device 28 can directly catch the second yarn from the package 50, or another device can be arranged between the package 50 and the second guiding device 28 for catching the second yarn.

[0081] Before the yarn discharge spinning starts, by pivoting downward, the first guiding device 27 moves to a position at which the first yarn can be caught (catching position). When the air spinning device 9 forms the first yarn by performing the yarn discharge spinning, the first yarn is sucked and caught by the first guiding device 27 as shown in FIG. 6. When the first guiding device 27 attempts to catch the first yarn, there may be a situation in which, even if the first guiding device 27 fails to catch the yarn end of the first yarn supplied from the air spinning device 9, by catching the middle part of the first yarn, the first guiding device 27 can catch the yarn end of the first yarn.

[0082] Suppose that the opening / closing section 73 is always in the open state and the first guiding device 27 fails to catch the yarn end of the first yarn, there is a possibility that the yarn end gets sucked by the suction part 70, and the first guiding device 27 cannot catch the yarn even if the middle part of the first yarn is sucked. In other words, always keeping the opening / closing section 73 in the open state lowers the probability of the first guiding device 27 succeeding in catching the first yarn. In the present embodiment, at the start of the yarn discharge spinning, the opening / closing section 73 is in the closed state, and after a predetermined time has elapsed (for example, before the first guiding device 27 pivots upward), the opening / closing section 73 is switched to the open state. Accordingly, decrease in the success probability of the first yarn being caught by the first guiding device 27 can be prevented. The starting point of the yarn discharge spinning is, for example, a time point at which the air starts being injected from the second nozzle 36 or a time point at which the back roller 16 starts being driven in a drafting direction.

[0083] Subsequently, after the air is injected from the first nozzle 33, the first guiding device 27 pivots upward along with the sucked first yarn and guides the first yarn to a position at which the yarn joining device 23 can perform the yarn joining. Accordingly, as shown in FIG. 7, the first yarn and the second yarn are guided to the yarn joining device 23. Furthermore, when the first guiding device 27 fails to catch the first yarn, the drafting of the

drafting device 7 and the spinning of the air spinning device 9 stop, and as shown in FIG. 8, the first yarn supplied from the air spinning device 9 is sucked and removed by the suction part 70.

[0084] After the first yarn and the second yarn are guided to the yarn joining device 23, by moving toward the yarn accumulating device 22, the first guide 61 catches the spun yarn 10 and guides the caught spun yarn 10 to vicinity of the yarn accumulating device 22. Then, the normal spinning is started. Specifically, after the yarn ends are guided by the first guiding device 27 and the second guiding device 28, the normal spinning starts. That is, the injection of air from the second nozzle 36 stops, and the drafting conditions change from the start drafting conditions to the normal drafting conditions. At the time of changing the drafting conditions, the yarn breakage may occur. Therefore, the opening / closing section 73 is in the open state when the drafting conditions change so as to enable the sucking of the spun yarn 10 if the yarn breakage occurs. After the drafting conditions are changed, the opening / closing section 73 is switched from the open state to the closed state. Subsequently, the winding operation is resumed when the yarn joining performed by the yarn joining device 23 is completed.

[0085] Next, a modification of the embodiment explained above will be explained. In the explanation of the present modification, structural elements having the same or similar configuration as those explained in the embodiment explained above are indicated by the same reference numerals and explanation thereof may be omitted.

[0086] In the present modification, arrangement of the cutter 24 and the yarn monitoring device 25 differs from that of explained in the above embodiment. Specifically, in the spinning unit 2 according to the embodiment explained above, the cutter 24 and the yarn monitoring device 25 are arranged between the yarn accumulating device 22 and the winding device 26 (specifically, between the yarn joining device 23 and the winding device 26). In a spinning unit 2 according to the present modification, however, the cutter 24 and the yarn monitoring device 25 are arranged between the air spinning device 9 and the yarn accumulating device 22.

[0087] Even in the present modification, the cutter 24 can be omitted, and the spun yarn 10 can be cut by stopping the spinning performed by the air spinning device 9.

[0088] In the present modification, the suction port 71 is arranged opposing the fiber traveling path between the yarn monitoring device 25 and the yarn accumulating device 22.

[0089] In the present modification, the fiber waste discharged from the air spinning device 9 may enter a monitoring space of the yarn monitoring device 25. In such a case, yarn defects and the like of the spun yarn 10 cannot be accurately detected. However, because the suction part 70 is provided, the yarn monitoring device 25 can appropriately monitor the spun yarn 10.

[0090] Separate yarn monitoring devices can be arranged at the position explained in the above embodiment and at the position explained in the present modification. In such a configuration, the yarn defect of the spun yarn 10 can be detected by the yarn monitoring device arranged between the air spinning device 9 and the yarn accumulating device 22 (first yarn monitoring device), and the quality of the yarn joined by the yarn joining device 23 can be inspected by the yarn monitoring device arranged between the yarn joining device 23 and the winding device 26 (second yarn monitoring device).

[0091] As explained above, the air spinning machine according to the present embodiment includes the drafting device 7, the air spinning device 9, the yarn accumulating device 22, the suction part 70, the winding device 26, the yarn joining device 23, the first guiding device 27, and the second guiding device 28. The drafting device 7 drafts the sliver (fiber bundle) 15 into the fiber bundle 8. The air spinning device 9 forms the spun yarn 10 by performing the normal spinning in which the fiber bundle 8 drafted by the drafting device 7 is twisted by the action of the swirling air current. The yarn accumulating device 22 withdraws the spun yarn 10 formed by the air spinning device 9. The suction part 70 includes the suction port 71 formed thereon that is arranged opposing the fiber traveling path between the air spinning device 9 and the yarn accumulating device 22. The winding device 26 is arranged at a higher position than the upstream end of the fiber traveling path of the drafting device 7, and winds the spun yarn 10 withdrawn by the yarn accumulating device 22 to form the package 50. The yarn joining device 23 performs the yarn joining. The first guiding device 27 catches the yarn end from the air spinning device 9 and guides the yarn end to the yarn joining device 23. The second guiding device 28 catches the yarn end from the package 50 and guides the yarn end to the yarn joining device 23.

[0092] With such a configuration, the fiber waste present near the suction port 71 can be removed by the suction part 70. Accordingly, occurrence of the yarn defects due to the entangling of the fiber waste with the spun yarn 10 can be prevented, thereby improving the quality of the package 50. Moreover, because the yarn joining that needs to be performed due to such yarn defect is not performed, the operational efficiency of the spinning unit 2 does not decrease.

[0093] The first guiding device 27 includes a hollow member that includes a catching member and a pivoting center. When the first guiding device 27 is positioned at the catching position at which the first guiding device 27 catches the yarn end from the air spinning device 9, the air spinning device 9, the catching member, and the suction port 71 are sequentially arranged along the fiber traveling path. The catching member is arranged at a tip end of the hollow member. The pivoting center is arranged on an opposite side of the catching member and is a center around which the hollow member pivots when the catching member moves to the catching position or

a standby position. Accordingly, for example, when the first guiding device 27 fails to catch the spun yarn 10, the spun yarn 10 can be sucked by the suction part 70.

[0094] In the air spinning machine according to the present embodiment, the air spinning device 9 includes the fiber guide 31, the nozzle block 30, and the hollow guiding shaft 34. The fiber guide 31 guides the fiber bundle 8. The fiber bundle 8 guided by the fiber guide 31 is introduced into the nozzle block 30. The spinning chamber 32 and the first nozzle 33 through which the air to generate the swirling air current in the spinning chamber 32 passes are formed in the nozzle block 30. The fiber bundle 8 passed through the nozzle block 30 is introduced into the hollow guiding shaft 34. The yarn passage 35 and the second nozzle 36 through which the air to be injected at least at the time of the yarn discharge spinning passes are formed in the hollow guiding shaft 34. At the time of the yarn discharge spinning, when the drafting device 7 is driven in the drafting direction and the air is injected from at least the second nozzle 36, the fiber bundle 8 drafted by the drafting device 7 is taken inside the air spinning device 9 from the fiber guide 31.

[0095] Even in the air spinning machine that performs the yarn discharge spinning by using the nozzle member explained above, the fiber waste can be effectively removed by the suction part 70.

[0096] When the winding of the package 50 performed by the winding device 26 is interrupted, the yarn end of the package 50 is positioned on the downstream side of the suction port 71 in the fiber traveling direction. Accordingly, the yarn end of the package 50 can be caught by the second guiding device 28.

[0097] In the air spinning machine according to the present embodiment, the suction part 70 includes the opening / closing section 73 that is arranged on the suction port 71 or on the removal passage 74 via which the suction current flows. The opening / closing section 73 is switchable between the open state in which the suction port 71 or the removal passage 74 is open and the suction current is generated in the suction port 71, and the closed state in which the suction port 71 or the removal passage 74 is closed and no suction current is generated in the suction port 71.

[0098] Accordingly, because the generation of the suction current and stopping thereof can be controlled, energy consumption can be reduced and the fiber waste can be removed at a required timing.

[0099] In the air spinning machine according to the present embodiment, at least once during a period after the normal spinning by the air spinning device 9 is stopped and before the yarn discharge spinning starts, the opening / closing section 73 is set in the open state.

[0100] Accordingly, the fiber waste generated during the period from the stopping of the normal spinning and before the starting of the yarn discharge spinning can be removed by the suction part 70.

[0101] In the air spinning machine according to the present embodiment, the nozzle block 30 and the hollow guiding shaft 34 of the air spinning device 9 are separable from each other. At least once during a period after the spun yarn 10 has become discontinuous and before the yarn discharge spinning starts, the cleaning operation in which the air is injected from the first nozzle 33 in a state in which the nozzle block 30 and the hollow guiding shaft 34 are separated from each other is performed, and at least once during the cleaning operation, the opening / closing section 73 is set to the open state.

[0102] Accordingly, the fiber waste generated during the cleaning operation of the air spinning device 9 can be removed by the suction part 70.

[0103] In the air spinning machine according to the present embodiment, during a period from the completion of the cleaning operation and till the starting of the yarn discharge spinning, the opening / closing section 73 is switched to the closed state.

[0104] Accordingly, effect of the suction current generated by the suction part 70 on the yarn discharge spinning can be prevented, and the yarn discharge spinning can be performed accurately.

[0105] In the air spinning machine according to the present embodiment, at the time when the yarn discharge spinning starts, the opening / closing section 73 is in the closed state.

[0106] Accordingly, hindrance caused by the suction current generated by the suction part 70 to the catching operation performed by the first guiding device 27 can be prevented, and the first guiding device 27 can reliably perform the catching operation.

[0107] In the air spinning machine according to the present embodiment, the drafting device 7 performs the drafting under the start drafting conditions at the time of the yarn discharge spinning, and then performs the drafting under the normal drafting conditions. After the drafting conditions are changed from the start drafting conditions to the normal drafting conditions, the opening / closing section 73 is switched from the open state to the closed state.

[0108] Accordingly, even if a yarn breakage occurs at the time of changing the drafting conditions, the broken spun yarn 10 can be removed by the suction part 70.

[0109] In the air spinning machine according to the present embodiment, the upstream end of the fiber traveling path of the drafting device 7 is arranged closer to the operator's passage 4 than the downstream end of the fiber traveling path of the air spinning device 9. The yarn accumulating device 22 is arranged on the opposite side of the operator's passage 4 with the air spinning device 9 arranged therebetween.

[0110] Accordingly, even when the air spinning device 9 and the yarn accumulating device 22 are arranged at positions away from the operator's passage 4 and it is difficult for the operator to visually check the accumulation status of the fiber waste, the fiber waste can be automatically removed by the suction part 70.

[0111] The air spinning machine according to the present embodiment includes, on the fiber traveling path

and arranged between the air spinning device 9 and the yarn accumulating device 22, the yarn monitoring device 25 that monitors the spun yarn 10. The suction port 71 is arranged below the fiber traveling path present between the yarn monitoring device 25 and the yarn accumulating device 22.

[0112] Accordingly, poor monitoring that occurs when the yarn monitoring device 25 detects the fiber waste can be prevented. Because the suction port 71 is arranged below the fiber traveling path, the suction port 71 can be arranged such that interference thereof to the fiber traveling path can be prevented. Furthermore, the spun yarn 10 (yarn waste) that is not caught by the first guiding device 27 and falls downward because of the gravitational force can be easily sucked by the suction part 70.

[0113] The air spinning machine according to the modification includes, on the fiber traveling path and arranged between the yarn accumulating device 22 and the winding device 26, the yarn monitoring device 25 that monitors the spun yarn 10.

[0114] Accordingly, because the suction part 70 removes the fiber waste, and it becomes difficult for the yarn waste and the like to get entangled with the spun yarn 10, the number of the yarn defects is reduced. Hence, the number of the yarn defects detected by the yarn monitoring device 25 can be reduced. Because the suction port 71 is arranged below the fiber traveling path, the suction port 71 can be arranged such that interference thereof to the fiber traveling path can be prevented. Furthermore, the spun yarn 10 (yarn waste) that is not caught by the first guiding device 27 and falls downward because of the gravitational force can be easily sucked by the suction part 70.

[0115] The air spinning machine includes the suction guide member 72 formed so as to extend from the suction port 71 to an upstream side in the suction current direction. The upper part of the suction guide member 72 is open, the wall surfaces are formed on the parts other than the upper part, and it is preferable that the space between the side wall surfaces becomes narrower towards the suction port 71. Accordingly, the fiber waste can be guided to the suction port 71 by the suction guide member 72.

[0116] Exemplary embodiments and modifications of the present invention are explained above. The configurations explained above, however, can be modified as explained below. In any of the following modifications, the suction port 71 is arranged between the air spinning device 9 and a yarn withdrawing device. Moreover, the following modifications can be appropriately combined.

[0117] In the above embodiments, the suction port 71 is arranged nearer to the yarn accumulating device 22 than the air spinning device 9. However, the suction port 71 can be arranged near the air spinning device 9. Separate suction ports 71 can be arranged at a position nearer to the yarn accumulating device 22 than the air spinning device 9 and at a position near the air spinning device 9. The configuration of the suction part 70 is not limited to being supported by the same frame 6 as that of the yarn accumulating device 22 and can be supported by another member.

[0118] In the above embodiments, the opening / closing section 73 is arranged on the removal passage 74. However, the opening / closing section 73 can be arranged on the suction port 71.

[0119] In the above embodiments, the state in which the suction current is generated in the suction port 71 and the state in which the suction current is not generated in the suction port 71 are switched therebetween by using the opening / closing section 73. However, by configuring the suction part 70 so as to be movable from the suction position as shown in FIG. 1 and causing the suction part 70 to move between a position in which the fiber waste can be sucked and a position in which the fiber waste cannot be sucked (a position in which the suction part 70 is retracted from the fiber traveling path farther than the position shown in FIG. 1), the suction state of the suction part 70 can be switched.

[0120] In the above embodiments, the spun yarn 10 formed by the air spinning device 9 is withdrawn by the yarn accumulating device 22. However, instead of the yarn accumulating device 22, a delivery roller and a nip roller can be provided to withdraw the spun yarn 10. In such a configuration, the delivery roller and the nip roller are equivalent to the yarn withdrawing device. Alternatively, the delivery roller and the nip roller can be arranged between the air spinning device 9 and the yarn accumulating device 22. Even in such a configuration, the delivery roller and the nip roller are equivalent to the yarn withdrawing device. In such a configuration, instead of the yarn accumulating roller 41, an air-type slack tube and / or a mechanical compensator can be provided as the yarn accumulating device 22. In either of the configurations, the first guiding device 27 catches the yarn end from the air spinning device 9 at a position downstream of the air spinning device 9 and guides the yarn end to the yarn joining device 23. The position downstream of the air spinning device 9 can be a position between the air spinning device 9 and the delivery roller or a position downstream of the delivery roller.

[0121] In the above embodiments, the fiber traveling path is largely bent by the yarn accumulating device 22; however, various devices can be arranged such that the fiber traveling path from the upstream end portion of the drafting device 7 till the winding device 26 is not largely bent. In such a configuration, for example, the fiber traveling path of the drafting device 7 is arranged substantially perpendicular to the installation surface of the spinning unit 2.

[0122] In the above embodiments, the drafting device 7 drafts the fiber bundle by using a plurality of drafting rollers. However, the fiber bundle can be drafted by using a combing roller.

[0123] In the above embodiments, the fiber guide 31 and the nozzle block 30 are explained as separate members, however, the fiber guiding section 31 and the nozzle

block 30 can be formed as one member.

[0124] In the above embodiments, the first guiding device 27, the second guiding device 28, and the yarn joining device 23 are arranged in each spinning unit 2. Alternatively, the first guiding device 27, the second guiding device 28, and the yarn joining device 23 can be arranged on a movable cart so as to be commonly utilized by a predetermined number of the spinning units 2.

Claims

1. An air spinning machine comprising:

a drafting device (7) adapted to draft a fiber bundle (8);
an air spinning device (9) adapted to perform a normal spinning in which the fiber bundle (8) drafted by the drafting device (7) is twisted by action of a swirling air current to form a spun yarn (10);
a yarn withdrawing device (22) adapted to withdraw the spun yarn (10) formed by the air spinning device (9);
a winding device (26) that is arranged at a higher position than an upstream end of the fiber traveling path of the drafting device (7) and adapted to wind the spun yarn (10) withdrawn by the yarn withdrawing device (22) to form a package (50);
a yarn joining device (23) adapted to perform yarn joining;
a first guiding device (27) adapted to catch a yarn end from the air spinning device (9) and to guide the yarn end to the yarn joining device (23); and
a second guiding device (28) adapted to catch a yarn end from the package (50) and to guide the yarn end to the yarn joining device (23);**characterized by** a suction part (70) in which a suction port (71) that is arranged opposing a fiber traveling path between the air spinning device (9) and the yarn withdrawing device (22) is formed.

2. The air spinning machine as claimed in Claim 1, wherein
the first guiding device (27) includes a hollow member that includes a catching member and a pivoting center, and
when the first guiding device (27) is positioned at a catching position at which the first guiding device (27) catches the yarn end from the air spinning device (9), the air spinning device (9), the catching member, and the suction port (71) are sequentially arranged along the fiber traveling path.

3. The air spinning machine as claimed in Claim 1 or 2, wherein the air spinning device (9) includes
a fiber guide (31) adapted to guide the fiber bundle (8);
a nozzle block (30) to which the fiber guide (31) guides the fiber bundle (8), and in which a spinning chamber (32) and a first nozzle (33) through which air passes to generate a swirling air current in the spinning chamber (32) are formed; and
a hollow guiding shaft (34) to which the fiber bundle (8) passed through the nozzle block (30) is guided and in which a yarn passage (35) and a second nozzle (36) through which air to be injected at least at the time of yarn discharge spinning passes are formed, and
the drafting device (7) is driven in a drafting direction and air is injected from at least the second nozzle (36) at the time of the yarn discharge spinning.

4. The air spinning machine as claimed in Claim 3, wherein the suction part (70) is adapted to suck fiber waste that is generated when the air spinning device (9) performs the yarn discharge spinning.

5. The air spinning machine as claimed in Claim 3 or 4, wherein when the winding of the package (50) performed by the winding device (26) is interrupted, the yarn end of the package (50) is positioned downstream of the suction port (71) in a fiber traveling direction.

6. The air spinning machine as claimed in any one of Claims 1 to 5, wherein
the suction part (70) includes an opening / closing section (73) that is arranged on the suction port (71) or a removal passage (74) through which a suction current flows, and
the opening / closing section (73) is switchable between

an open state in which the suction port (71) or the removal passage (74) is open and the suction current is generated in the suction port (71), and
a closed state in which the suction port (71) or the removal passage (74) is closed and the suction current is not generated in the suction port (71).

7. The air spinning machine as claimed in Claim 6, wherein the opening / closing section (73) is set to the open state at least once during a period after the normal spinning performed by the air spinning device (9) has stopped and before the yarn discharge spinning starts.

8. The air spinning machine as claimed in Claim 7, wherein
in the air spinning device (9), the nozzle block (30)

and the hollow guiding shaft (34) are separable from each other, and
a cleaning operation in which air is injected from the first nozzle (33) is performed while the nozzle block (30) and the hollow guiding shaft (34) are separated from each other at least once during a period after the spun yarn (10) has become discontinuous and before the yarn discharge spinning starts, and
the opening / closing section (73) is set to the open state at least once during the cleaning operation.

9. The air spinning machine as claimed in Claim 8, wherein the opening / closing section (73) is switched to the closed state during a period from the completion of the cleaning operation till starting of the yarn discharge spinning.

10. The air spinning machine as claimed in any one of Claims 6 to 9, wherein the opening / closing section (73) is in the closed state at the time of starting the yarn discharge spinning.

11. The air spinning machine as claimed in any one of Claims 6 to 10, wherein the drafting device (7) is adapted to perform drafting under start drafting conditions at the time of performing the yarn discharge spinning, and then to perform drafting under normal drafting conditions, and
the opening / closing section (73) is switched from the open state to the closed state after the drafting conditions have changed from the start drafting conditions to the normal drafting conditions.

12. The air spinning machine as claimed in any one of Claims 1 to 11, wherein
the upstream end of the fiber traveling path of the drafting device (7) is arranged closer to an operator's passage (4) than a downstream end of the fiber traveling path of the air spinning device (9), and
the yarn withdrawing device (22) is arranged on an opposite side of the operator's passage (4) with the air spinning device (9) arranged therebetween.

13. The air spinning machine as claimed in any one of Claims 1 to 12, further comprising a yarn monitoring device (25) arranged between the air spinning device (9) and the yarn withdrawing device (22) on the fiber traveling path and adapted to monitor the spun yarn (10),
wherein the suction port (71) is arranged below the fiber traveling path that is present between the yarn monitoring device (25) and the yarn withdrawing device (22).

14. The air spinning machine as claimed in any one of Claims 1 to 12, further comprising a yarn monitoring device (25) arranged between the yarn withdrawing device (22) and the winding device (26) on the fiber traveling path and adapted to monitor the spun yarn (10),
wherein the suction port (71) is arranged below the fiber traveling path that is present between the air spinning device (9) and the yarn withdrawing device (22).

15. The air spinning machine as claimed in Claim 13 or 14, further comprising a suction guide member (72) that is formed so as to extend from the suction port (71) to an upstream side in a suction current direction, wherein
the suction guide member (72) is formed such that an upper part thereof is open, wall surfaces are formed on parts other than the upper part, and space between the side wall surfaces becomes narrower towards the suction port.

FIG. 1

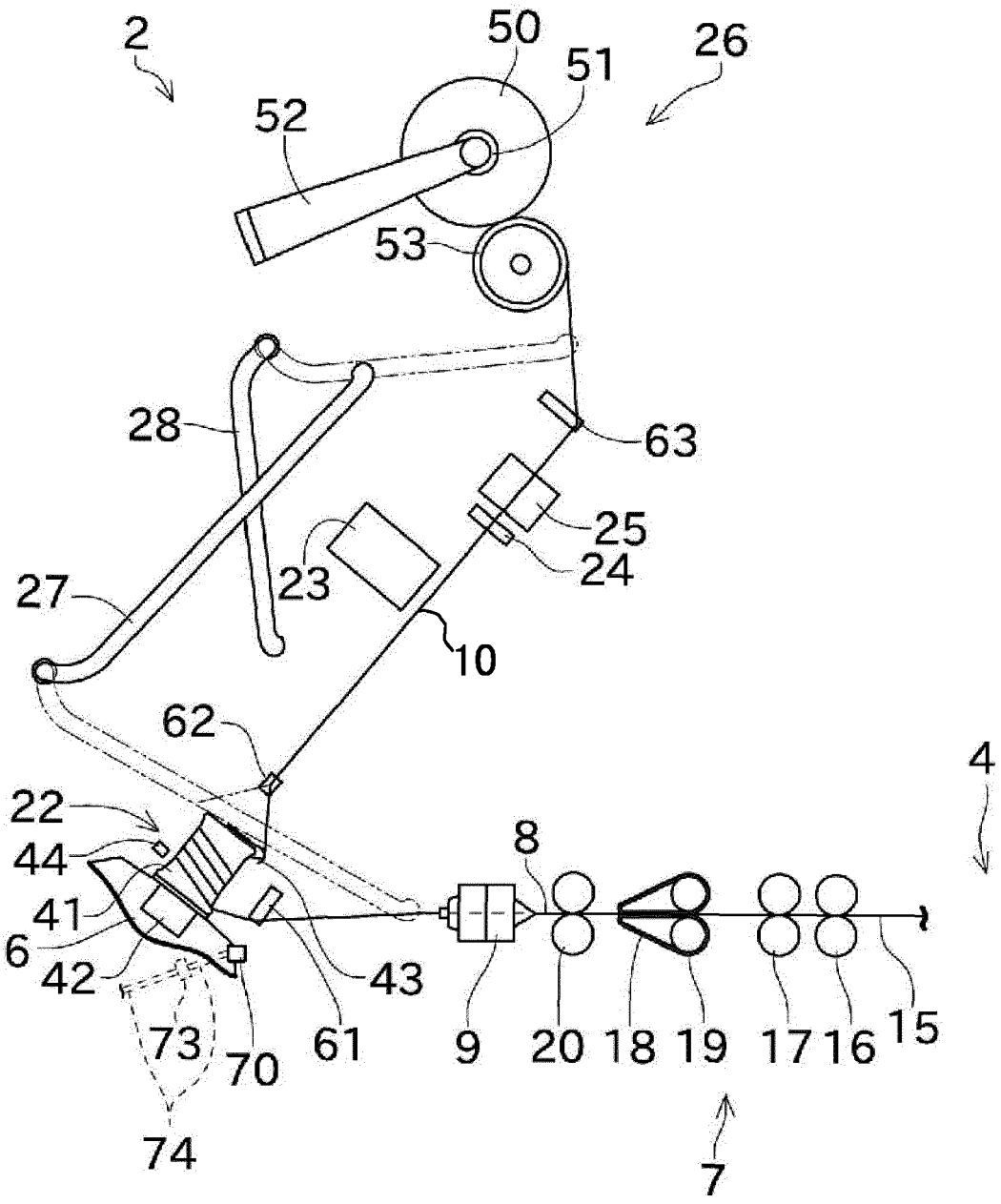
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FIG. 2

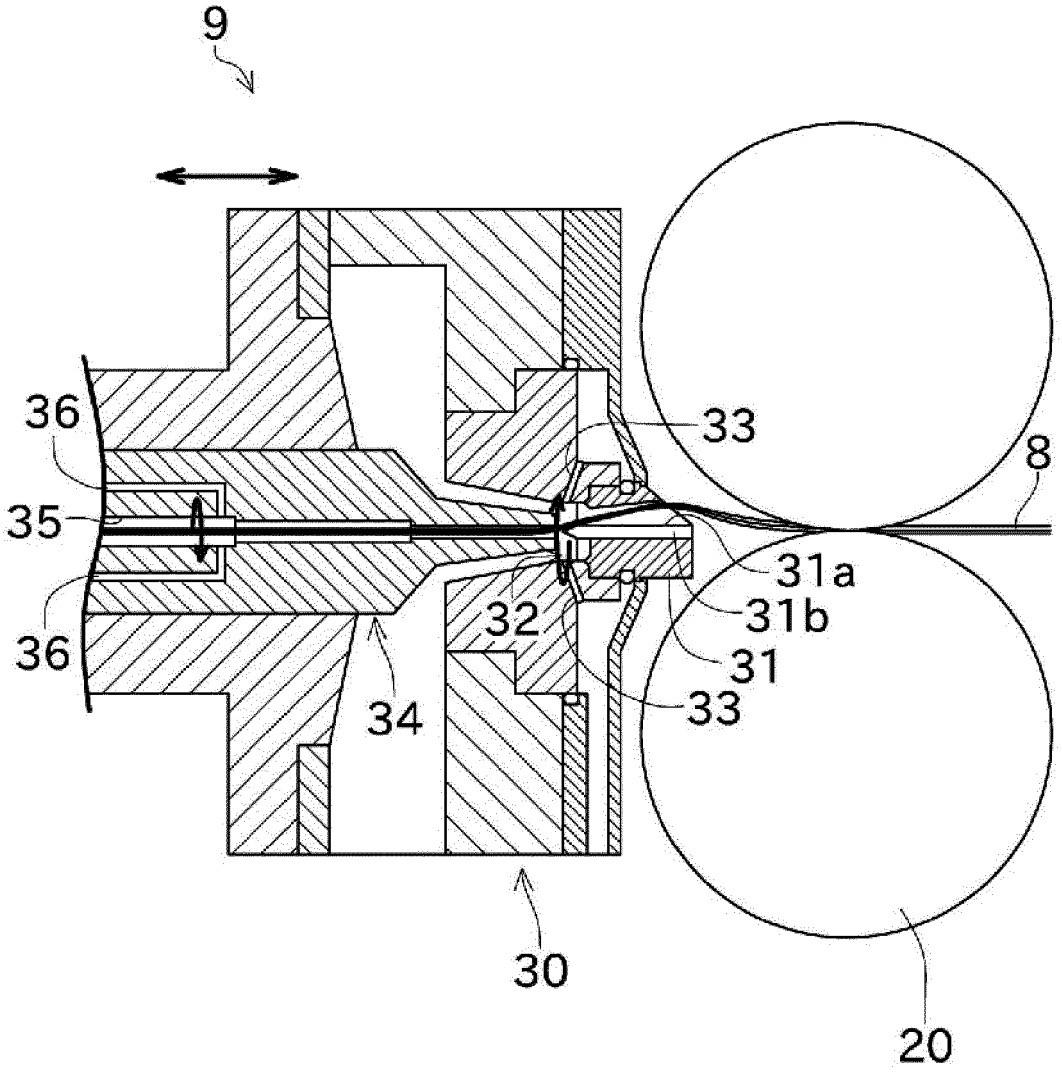


FIG. 3

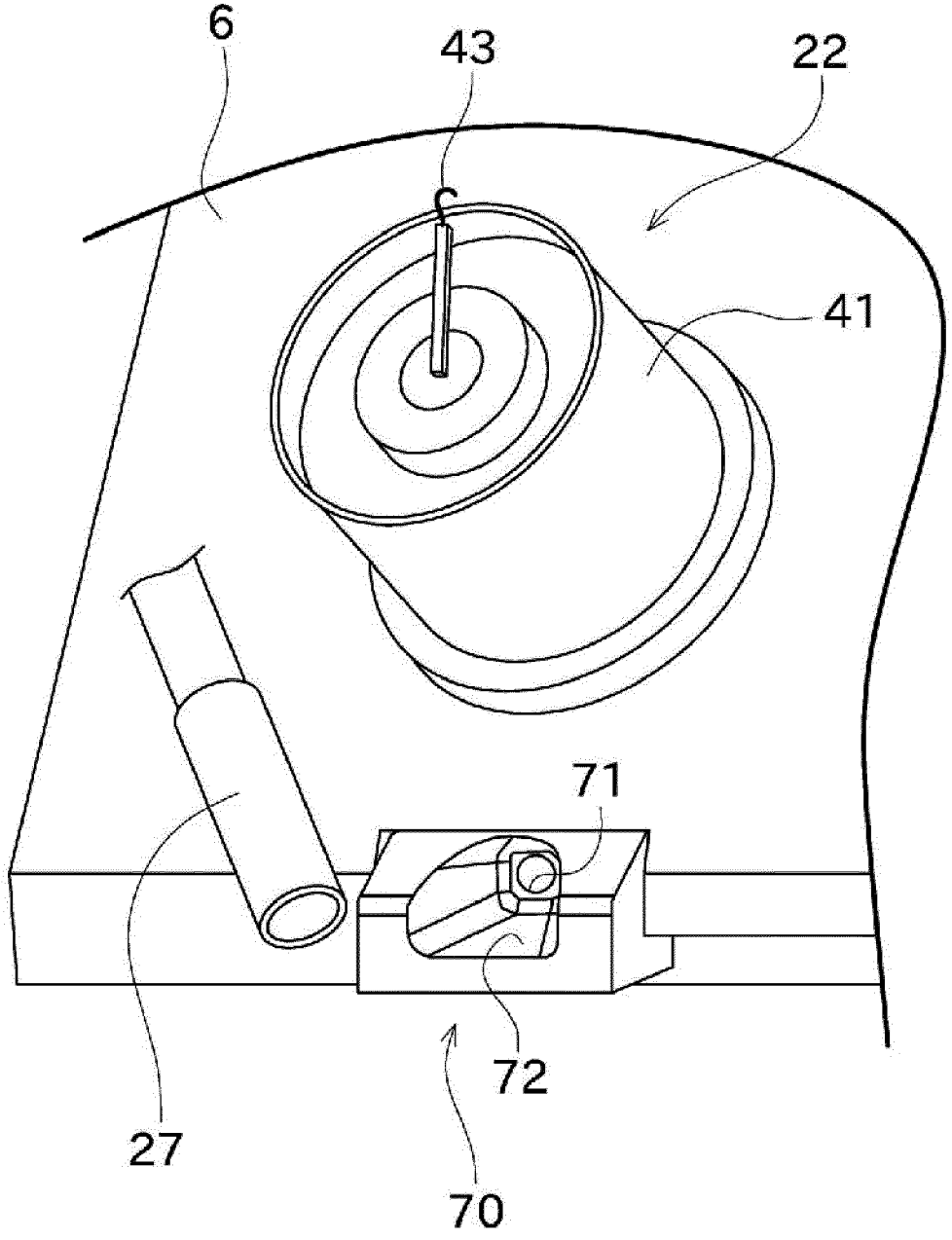
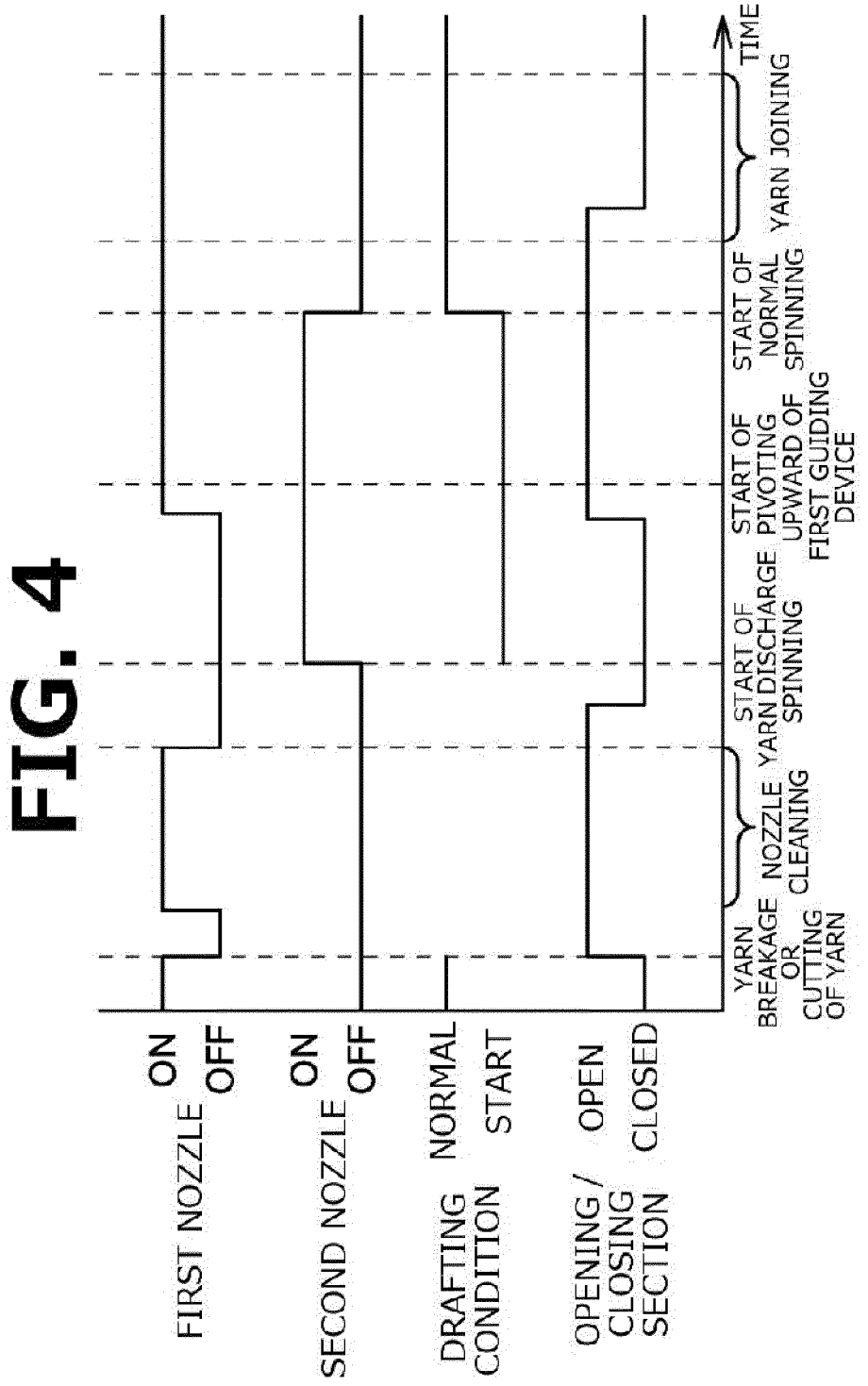


FIG. 4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SECOND NOZZLE
ON
OFF
DRAFTING CONDITION
NORMAL
START
OPENING / CLOSING SECTION
OPEN
CLOSED
YARN BREAKAGE OR CUTTING OF YARN
NOZZLE CLEANING
START OF YARN DISCHARGE SPINNING
START OF PIVOTING UPWARD OF FIRST GUIDING DEVICE
START OF NORMAL SPINNING
YARN JOINING
TIME

FIG. 5

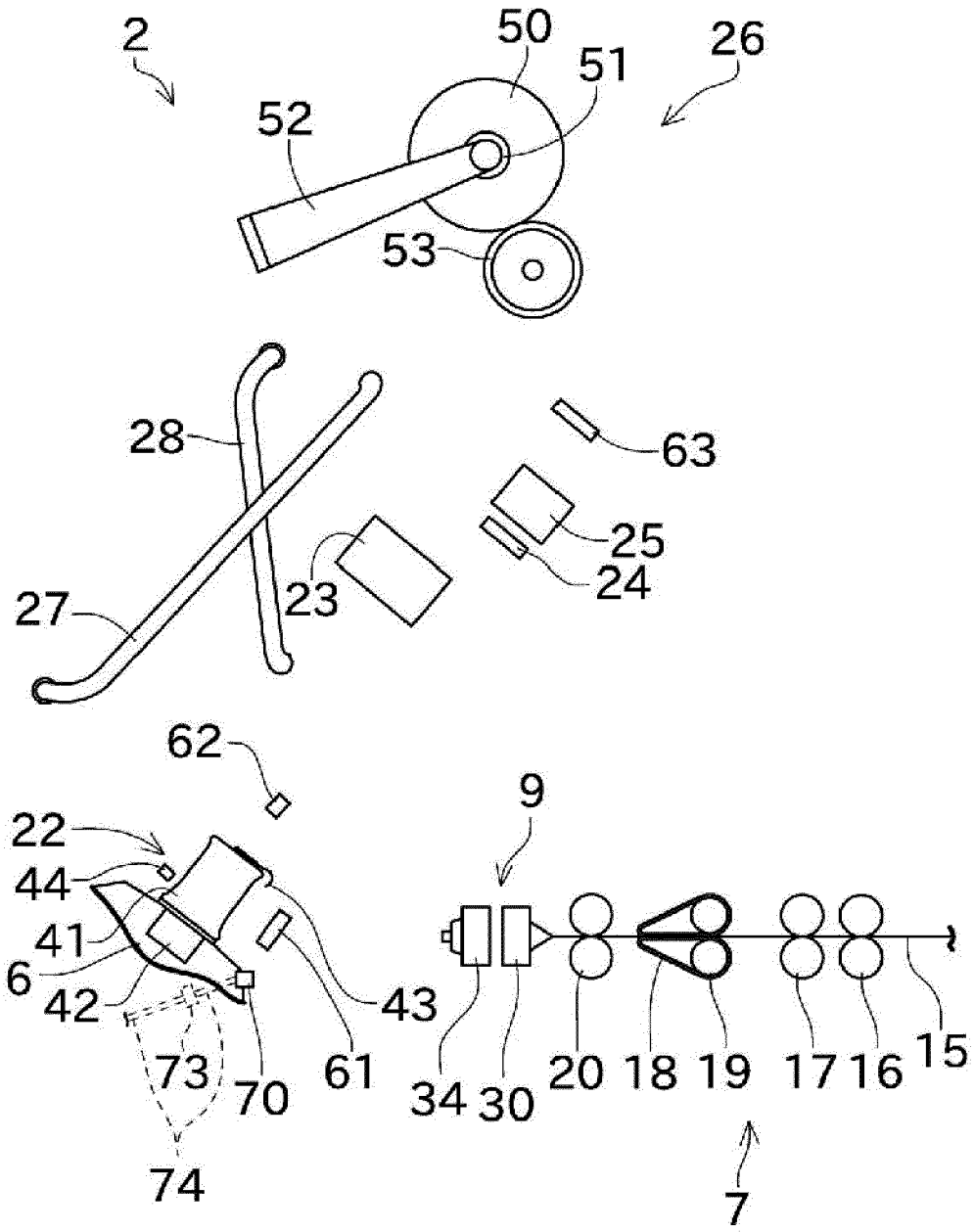
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FIG. 6

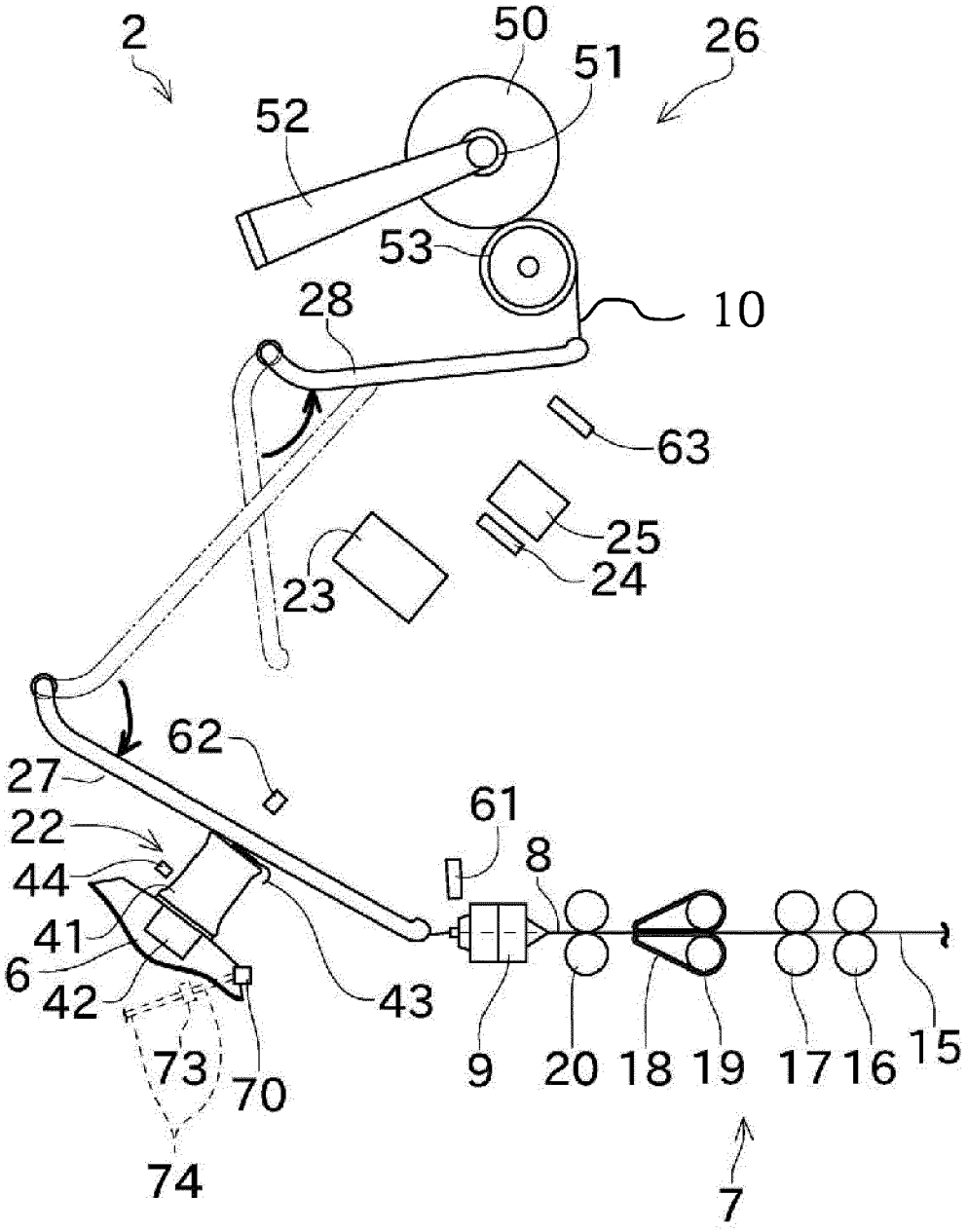
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FIG. 7

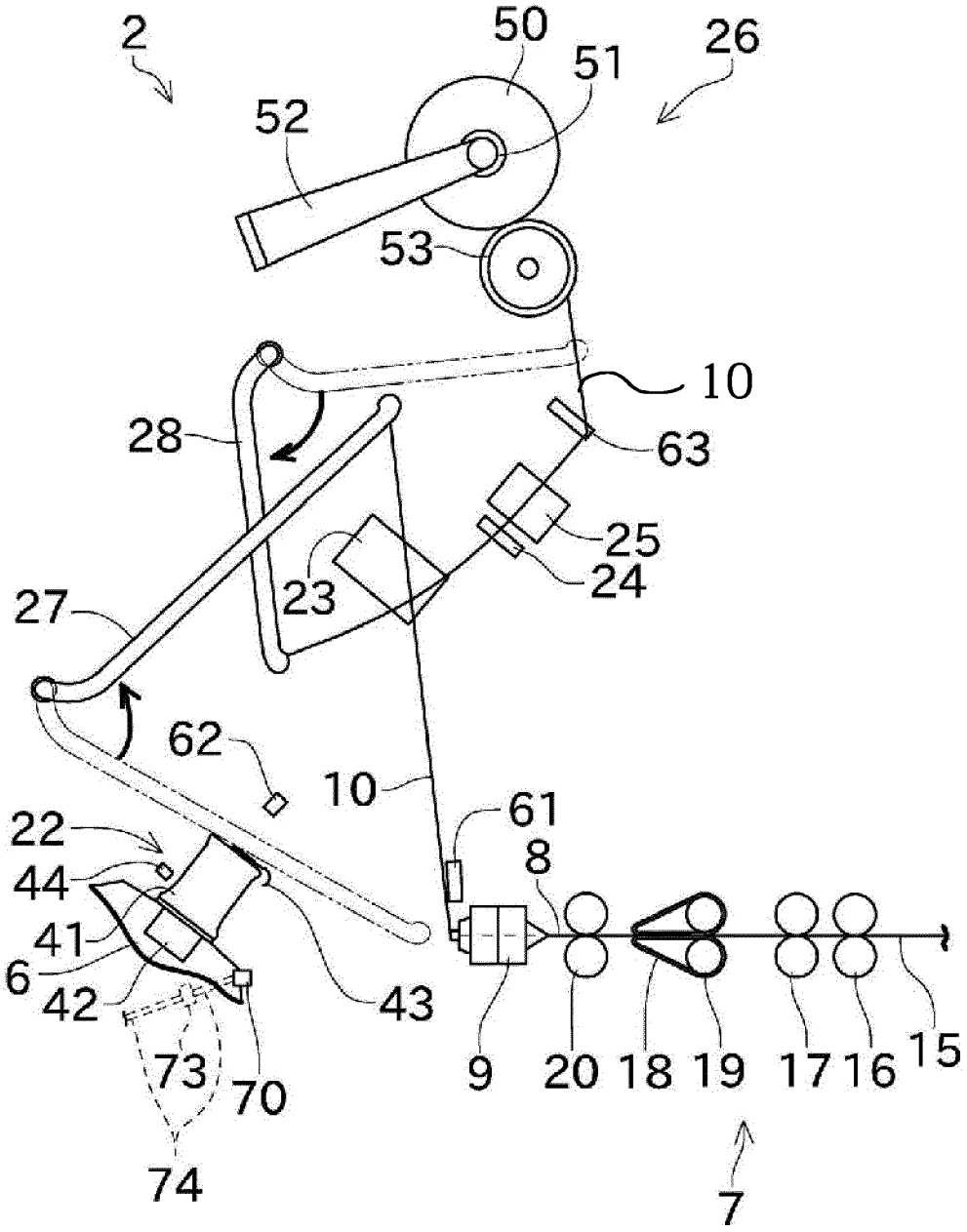
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FIG. 8

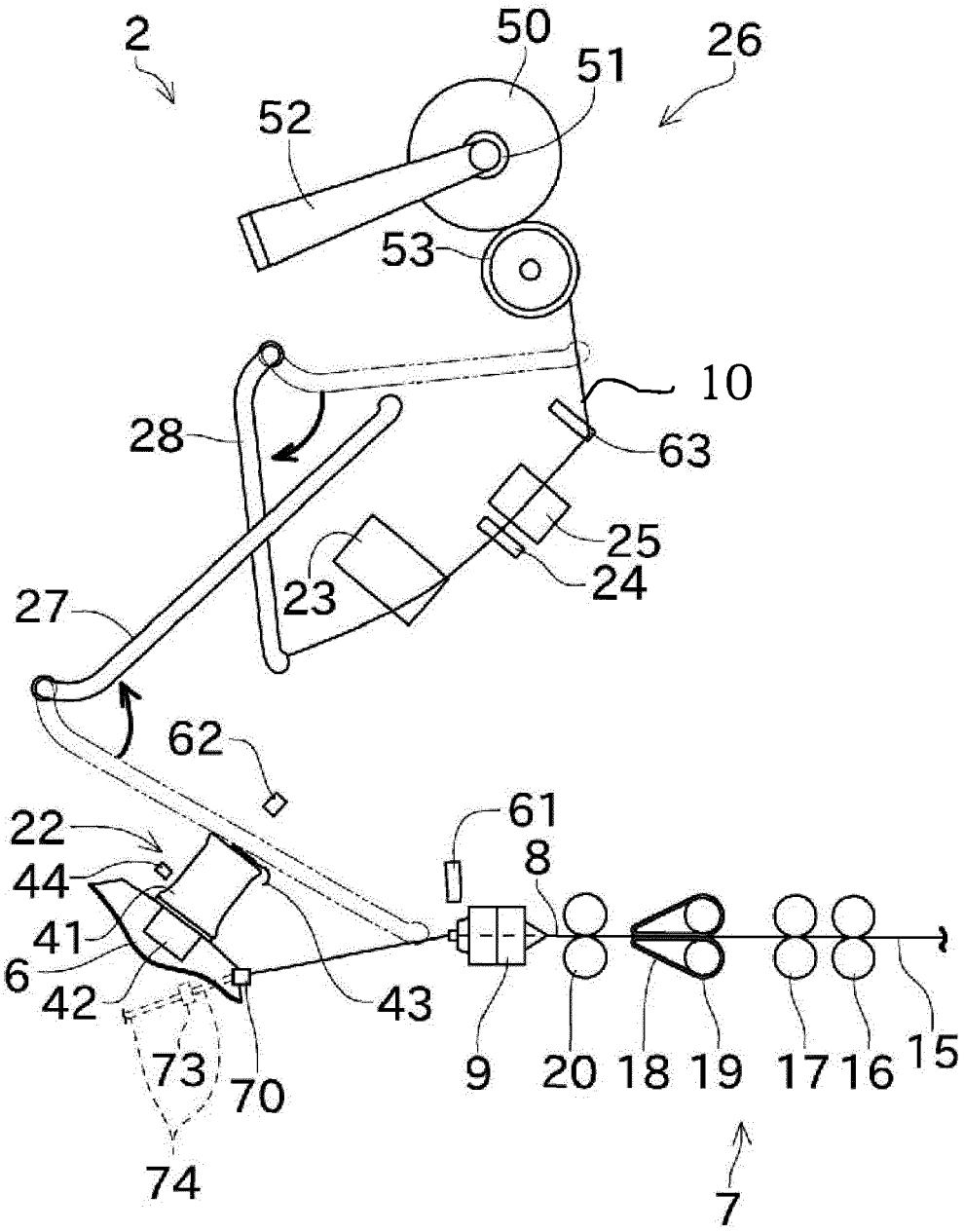
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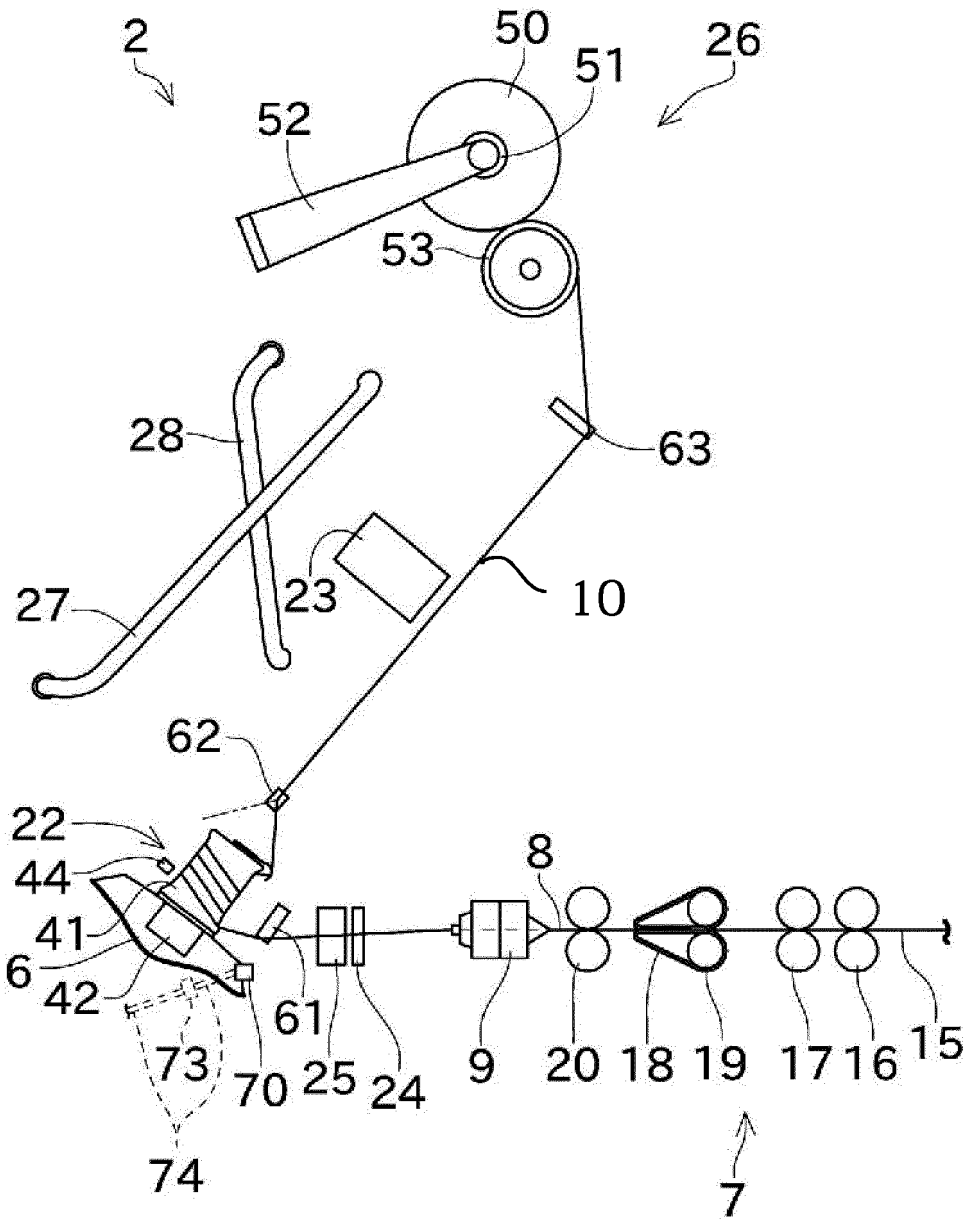
FIG. 9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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
Munich	14 December 2018	Todarello, Giovanni

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