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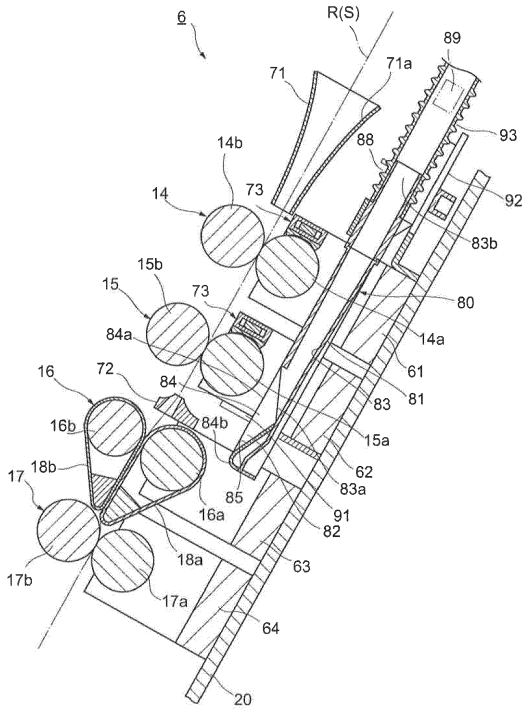
(54) FIBER COLLECTING DEVICE, DRAFTING DEVICE, AND SPINNING MACHINE

(57) A drafting device includes at least three roller pairs (15, 16, 17), each roller pair (15, 16, 17) including a bottom roller (15a, 16a, 17a) and a top roller (15b, 16b, 17b); and a fiber collecting device (80) having only one suction port (84) arranged facing a bottom roller (15a) of a third roller pair (15) from a downstream side in a drafting direction. When a distance between adjacent ones of the roller pairs (15, 16, 17) is a first distance, at least one of a shape and a position of the suction port (84) is in a first state. When the distance is a second distance, at least one of the shape and the position of the suction port (84) is in a second state. A downstream end portion (84b) of the suction port (84) in the drafting direction is positioned relatively on the downstream side in the drafting direction in the second state than in the first state.

FIG.5



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a fiber collecting device, a drafting device, and a spinning machine.

2. Description of the Related Art

[0002] Japanese Patent Application Laid Open-No. 2003-193339 discloses a drafting device that includes plural roller pairs that draft a fiber bundle and a fiber collecting device that collects fiber waste (so-called fly-waste and includes fiber waste of natural fibers such as cotton, chemical fibers, or other fibers, and this applies to the following explanation as well) generated by the plural roller pairs.

[0003] Depending on the type of the fibers, however, there may be a case where the fiber waste cannot be efficiently collected in the conventional drafting device.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a fiber collecting device, a drafting device, and a spinning machine capable of efficiently collecting fiber waste even if the type of the fibers is changed.

[0005] This object is achieved by a drafting device of claim 1.

[0006] A drafting device according to an aspect of the present invention includes at least three roller pairs that draft a fiber bundle, each roller pair including a bottom roller and a top roller; and a fiber collecting device having only one suction port arranged facing a bottom roller of a third roller pair from a downstream side in a drafting direction. When a distance between adjacent ones of the roller pairs is a first distance, at least one of a shape and a position of the suction port is in a first state, and when the distance between the adjacent ones of the roller pairs is a second distance, at least one of the shape and the position of the suction port is in a second state. An end portion of the suction port on the downstream side in the drafting direction is positioned relatively on the downstream side in the drafting direction in the second state than in the first state.

[0007] A drafting device according to another aspect of the present invention includes plural roller pairs and a fiber collecting device. The plural roller pairs draft a fiber bundle and each roller pair includes a bottom roller and a top roller. The fiber collecting device is arranged facing a bottom roller. The fiber collecting device includes a suction passage and a suction port. The suction passage performs suction in a direction that extends along a drafting direction. The suction port is connected to the suction passage and arranged facing the bottom roller.

[0008] A spinning machine according to still another aspect of the present invention includes the above drafting device; an air spinning device that forms a yarn by twisting the fiber bundle drafted in the drafting device; and a winding device that winds the yarn formed by the air spinning device into a package.

[0009] A fiber collecting device according to still another aspect of the present invention includes a main body and a suction-port forming member. The main body has a suction passage. The suction-port forming member forms a suction port that is connected to the suction passage. The suction-port forming member includes an end inclined surface with an end portion thereof inclined around the suction port going toward the end portion.

[0010] A drafting device according to still another aspect of the present invention includes the above fiber collecting device.

[0011] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a front view of a spinning machine according to an embodiment of the present invention.

FIG. 2 is a side view of a spinning unit of the spinning machine shown in FIG. 1.

FIG. 3 is a plan view of a drafting device included in the spinning unit shown in FIG. 2.

FIG. 4 is a side view of the drafting device included in the spinning unit shown in FIG. 2.

FIG. 5 is a cross-sectional view of a fiber collecting device included in the drafting device shown in FIG. 3.

FIG. 6 is a plan view of the fiber collecting device included in the drafting device shown in FIG. 3.

FIG. 7 is a cross-sectional view of the fiber collecting device included in the drafting device shown in FIG. 3.

FIG. 8 is a plan view of the fiber collecting device included in the drafting device shown in FIG. 3.

DETAILED DESCRIPTION

[0013] Exemplary embodiments of the present invention will be explained below with reference to the accompanying drawings. Identical elements will be indicated by like reference symbols in the drawings and duplicate explanation thereof will be omitted.

[0014] As shown in FIG. 1, a spinning machine 1 includes plural spinning units 2, a yarn joining carrier 3, a not-shown doffing carrier, a first end frame 4, and a second end frame 5. The plural spinning units 2 are arranged in a line. Each spinning unit 2 forms a yarn Y and winds

the yarn Y into a package P. When the yarn Y is disconnected or when yarn breakage occurs due to any reason in any spinning unit 2, the yarn joining carrier 3 performs a yarn joining operation in the specific spinning unit 2. If a package P is fully wound in any spinning unit 2, the doffing carrier removes the fully-wound package P and supplies a new bobbin B to the specific spinning unit 2.

[0015] A collecting device that collects fiber waste, yarn waste, and the like, generated in the spinning unit 2, and the like are arranged in the first end frame 4. An air supplying section that adjusts air pressure of compressed air (air) to be supplied to the spinning machine 1 and supplies the compressed air to each component of the spinning machine 1 is arranged in the second end frame 5. A driving motor and the like that supply driving power to each component of the spinning unit 2 are arranged in the second end frame 5. A main controlling device 41, a display screen 42, and one or more input keys 43 are arranged in the second end frame 5. The main controlling device 41 controls and manages each component of the spinning machine 1 in a centralized manner. The display screen 42 can display information and the like pertaining to settings and/or states of the spinning units 2. An operator can appropriately operate the input keys 43 to perform various settings on the spinning units 2.

[0016] As shown in FIGS. 1 and 2, each spinning unit 2 includes a drafting device 6, an air spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn pooling device 11, a waxing device 12, and a winding device 13. These devices are arranged in the above-stated order from an upstream side in a running direction of the yarn Y. One unit controller 10 is arranged for each predetermined number of the spinning units 2 and controls the operations of those spinning units 2.

[0017] The drafting device 6 drafts a sliver (fiber bundle) S. The drafting device 6 includes a back roller pairs 14, a third roller pair 15, a middle roller pair 16, and a front roller pair 17. These roller pairs are arranged in the above-stated order from an upstream side in a running direction of the sliver S. Each roller pair 14, 15, 16, and 17 includes a bottom roller and a top roller. The bottom roller is driven to be rotated by a driving motor arranged in the second end frame 5, or by a driving motor arranged in each spinning unit 2. An apron belt 18a is stretched over the bottom roller of the middle roller pair 16 and an apron belt 18b is stretched over the top roller of the middle roller pair 16.

[0018] The air spinning device 7 forms the yarn Y by twisting with a swirling air current a fiber bundle F that was drafted in the drafting device 6. For this purpose, although not specifically shown in the drawings, the air spinning device 7 includes a spinning chamber, a fiber guiding member, a swirling air current generating nozzle, and a hollow guiding member. The fiber guiding member guides to the spinning chamber the fiber bundle F supplied from the upstream drafting device 6. One or more swirling air-current generating nozzles are arranged around a running path of the fiber bundle F and generate a swirling air current inside the spinning chamber. The fiber ends of the fibers constituting the fiber bundle F are reversed and swirled by this swirling air current. The hollow guiding member guides the yarn Y from the inside of the spinning chamber to the outside of the air spinning device 7.

[0019] The yarn monitoring device 8 is arranged between the air spinning device 7 and the yarn pooling device 11. The yarn monitoring device 8 monitors information about the running yarn Y and detects presence or absence of a yarn defect in the yarn Y based on the monitored information. Upon detecting a yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects, as the yarn defect, for example, abnormality in the thickness of the yarn Y and/or foreign material contained in the yarn Y. The yarn monitoring device 8 also detects yarn breakage and the like. The tension sensor 9 is arranged between the air spinning device 7 and the yarn pooling device 11 and it measures a tension level of the running yarn Y and transmits a tension measurement signal to the unit controller 10. When the unit controller 10 determines that there is an abnormality based on the detection result received from the yarn monitoring device 8 and/or the tension sensor 9, the unit controller 10 causes the yarn Y to be disconnected in the specific spinning unit 2. More specifically, the yarn Y is disconnected by stopping the air supply to the air spinning device 7 thereby discontinuing the formation of the yarn Y. Alternatively, the yarn Y can be cut with a separate cutter.

[0020] The waxing device 12 applies wax to the yarn Y at a position between the yarn pooling device 11 and the winding device 13.

[0021] The yarn pooling device 11 eliminates slack in the yarn Y at a position between the air spinning device 7 and the winding device 13. The yarn pooling device 11 has a function of stably pulling the yarn Y from the air spinning device 7, a function of preventing slackening of the yarn Y by pooling the yarn Y supplied from the air spinning device 7 while, for example, the yarn joining carrier 3 is performing a yarn joining operation, and a function of preventing a fluctuation in the tension level of the yarn Y positioned on the downstream side of the yarn pooling device 11 from being conveyed to the air spinning device 7.

[0022] The winding device 13 forms the package P by winding the yarn Y around a bobbin B. The winding device 13 includes a cradle arm 21, a winding drum 22, and a traverse guide 23. The cradle arm 21 rotatably supports the bobbin B. The cradle arm 21 is swingably supported by a support shaft 24. The cradle arm 21 can bring the surface of the bobbin B or the surface of the package P into contact with the surface of the winding drum 22 with an appropriate pressure. A not-shown driving motor arranged in the second end frame 5 drives all the winding drums 22 of plural spinning units 2 at the same time. As a result, the bobbins B or the packages P in those spin-

ning units 2 are rotated in the winding direction. The traverse guides 23 of plural spinning units 2 are arranged on a support shaft 25 that is shared among those spinning units 2. Each traverse guide 23 traverses the yarn Y within a predetermined width with respect to the rotating bobbin B or the package P, as a result of a not-shown driving motor arranged in the second end frame 5 driving the support shaft 25 to reciprocate in the rotation axis direction of the winding drum 22.

[0023] When the yarn Y is disconnected or when yarn breakage occurs due to any reason in any spinning unit 2, the yarn joining carrier 3 travels to the specific spinning unit 2 and performs the yarn joining operation. The yarn joining carrier 3 includes a yarn joining device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a support shaft 31. The suction pipe 27 catches the yarn Y from the air spinning device 7 and guides the yarn Y to the yarn joining device 26. The suction mouth 28 is swingably supported by a support shaft 32. The suction mouth 28 catches the yarn Y from the winding device 13 and guides the yarn Y to the yarn joining device 26. The yarn joining device 26 joins the yarns Y that were guided thereto. The yarn joining device 26 can be a splicer that uses compressed air, a knotter that mechanically joins the yarns Y, and the like. For the yarn joining, instead of using the yarn joining device 26 that is a splicer, a knotter, and the like, a piecer that performs piecing yarn joining by using seed yarn can be used.

[0024] While performing the yarn joining operation, the yarn joining carrier 3 rotates the package P in a direction that is opposite to the winding direction (reverse rotation). When doing so, the cradle arm 21 is moved by a not-shown air cylinder in such a manner that the package P is separated from the winding drum 22, and then the package P is reversely rotated by a not-shown reverse rotating roller arranged in the yarn joining carrier 3.

[0025] The drafting device 6 will be explained in detail below. As shown in FIGS. 3 and 4, the back roller pair 14 includes a back bottom roller 14a and a back top roller 14b opposing each other across a running path R of the sliver S. The third roller pair 15 includes a third bottom roller 15a and a third top roller 15b opposing each other across the running path R. The middle roller pair 16 includes a middle bottom roller 16a and a middle top roller 16b opposing each other across the running path R. The apron belt 18a is stretched over the middle bottom roller 16a of the middle roller pair 16. The apron belt 18b is stretched over the middle top roller 16b of the middle roller pair 16. The front roller pair 17 includes a front bottom roller 17a and a front top roller 17b opposing each other across the running path R.

[0026] The drafting roller pairs 14, 15, 16, and 17 send the sliver S supplied from a not-shown can from the upstream side to the downstream side while drafting the sliver S, and supply the fiber bundle F to the air spinning device 7. In the following explanation, a direction that extends along the running path R is called "drafting direction". An upstream side in the drafting direction is called "upstream side" and a downstream side in the drafting direction is called "downstream side".

[0027] The back bottom roller 14a is rotatably supported in a back roller housing 61. The third bottom roller 15a is rotatably supported in a third roller housing 62. The middle bottom roller 16a is rotatably supported in a middle roller housing 63. The front bottom roller 17a is rotatably supported in a front roller housing 64. The bottom rollers 14a, 15a, 16a, and 17a are rotated at mutually different rotational speeds such that the rollers positioned on the downstream side are rotated at relatively higher rotational speeds.

[0028] Each roller housing 61, 62, 63, and 64 is installed in a machine frame 20. Positions of the back roller housing 61, the third roller housing 62, and the middle roller housing 63 are respectively adjustable along the running path R. As a result, a distance between the front bottom roller 17a and the middle bottom roller 16a, a distance between the middle bottom roller 16a and the third bottom roller 15a, and a distance between the third bottom roller 15a and the back bottom roller 14a can be respectively adjusted.

[0029] Each top roller 14b, 15b, 16b, and 17b is rotatably supported by a drafting cradle 65. Each top roller 14b, 15b, 16b, and 17b respectively contacts with each bottom roller 14a, 15a, 16a, and 17a at a predetermined pressure and is driven following the rotation of each bottom roller 14a, 15a, 16a, and 17a.

[0030] A side guide 66 is attached to a side surface of the drafting cradle 65. The side guide 66 regulates a distance between the front top roller 17b and the middle top roller 16b, a distance between the middle top roller 16b and the third top roller 15b, and a distance between the third top roller 15b and the back top roller 14b. Plural types of the side guides 66 are prepared in advance and an appropriate one of the side guides 66 is used depending on a distance between the front bottom roller 17a and the middle bottom roller 16a, a distance between the middle bottom roller 16a and the third bottom roller 15a, and a distance between the third bottom roller 15a and the back bottom roller 14a.

[0031] The drafting cradle 65 is rotatable about a support axis 67 as a center to a position at which each top roller 14b, 15b, 16b, and 17b respectively contacts with each bottom roller 14a, 15a, 16a, and 17a at a predetermined pressure and to a position at which each top roller 14b, 15b, 16b, and 17b is respectively separated from each bottom roller 14a, 15a, 16a, and 17a. The drafting cradle 65 rotatably supports the top rollers 14b, 15b, 16b, and 17b of the drafting devices 6 of a pair of adjacent spinning units 2.

[0032] A guiding member 71 (not shown in FIGS. 1 and 2) is arranged in the upstream side of the back roller pair 14. The guiding member 71 has a through hole 71a for passing the sliver S. The guiding member 71 guides to the running path R the sliver S that was supplied from the not-shown can.

[0033] A regulating member 72 (not shown in FIGS. 1 and 2) is arranged between the third roller pair 15 and the middle roller pair 16. The regulating member 72 has a through hole 72a for passing the sliver S. The regulating member 72 regulates a width of the sliver S to a width of the through hole 72a.

[0034] A cleaning device 73 (not shown in FIGS. 1 and 2) is arranged with respect to the third bottom roller 15a. The cleaning device 73 includes a main body 73a, a contacting member 73b, and a magnet 73c. The main body 73a holds the contacting member 73b. The contacting member 73b has at least one convex part that touches the third bottom roller 15a. The main body 73a and the contacting member 73b are made from resin, for example. The magnet 73c is arranged in the main body 73a. Because the magnetic force of the magnet 73c acts on the third bottom roller 15a via the contacting member 73b, the cleaning device 73 is pressed against an outer circumferential surface of the third bottom roller 15a and it is forced to rotate following the rotation of the third bottom roller 15a. However, this rotation of the cleaning device 73 is prevented by a not-shown stopper. Accordingly, the contacting member 73b rubs the outer circumferential surface of the rotating third bottom roller 15a whereby fibers adhering to the peripheral surface of the third bottom roller 15a are removed. A cleaning device having the same configuration as the cleaning device 73 is also arranged with respect to the back bottom roller 14a.

[0035] A fiber collecting device 80 (not shown in FIGS. 1 and 2) is arranged on one side of the bottom rollers 14a, 15a, and 16a with the top rollers 14b, 15b, and 16b being arranged on the other side. The fiber collecting device 80 faces the bottom rollers 14a, 15a, and 16a. The fiber collecting device 80 is a thin and elongated member and a longitudinal axis thereof extends in the drafting direction. As shown is FIGS. 5 and 6, the fiber collecting device 80 includes a main body 81 and a suction-port adjusting member (suction-port forming member) 82. As shown in FIG. 5, the drafting device 6 is arranged, in a state in which the back roller pair 14 is positioned above and the front roller pair 17 is positioned below in the vertical direction, such that each bottom roller 14a, 15a, 16a, and 17a is arranged in an inclined manner whereby it is positioned at a lower level than each top roller 14b, 15b, 16b, and 17b respectively.

[0036] A suction passage 83 is arranged within the main body 81. The suction passage 83 extends parallel to the running path R. In other words, the direction in which suction is performed by the suction passage 83 is the same as the longitudinal direction of the fiber collecting device 80 and also extends along the drafting direction. The suction-port adjusting member 82 includes a suction port 84 that is connected to a connection opening 83a of the suction passage 83. Only one suction port 84 is arranged for each drafting device 6, and the suction port 84 faces the middle bottom roller 16a of the middle roller pair 16, which is the second roller pair from the downstream side, and the third bottom roller 15a of the third roller pair 15, which is the third roller pair from the downstream side. A suction-port inclined surface 85 that extends from the suction port 84 to the connection opening 83a of the suction passage 83 is arranged between the suction port 84 and the suction passage 83. The suction-port inclined surface 85 makes an acute angle with respect to an opening plane 84a (an imaginary plane formed by the open area of the suction port 84) of the suction port 84 and extends from a downstream end portion 84b of the suction port 84 to a bottom portion (a portion that opposes the opening plane 84a in the connection opening 83a) of the connection opening 83a.

[0037] A suction pipe 93 is connected to a connection opening 83b that is located on the opposite side of the suction port 84 in the suction passage 83. The suction pipe 93 is connected to a not-shown blower that generates a suction air current. With this arrangement, the fiber waste generated in the drafting device 6 is sucked from the suction port 84, passed through the suction passage 83 and the suction pipe 93, and collected in a not-shown fiber discharging device arranged near the blower. A cross-sectional surface area of the suction passage 83 that extends from the connection opening 83a to the connection opening 83b can be the same (constant) everywhere, can gradually increase, or can gradually decrease. In a configuration where the cross-sectional surface area gradually decreases, because a high-speed current is generated near the connection opening 83a, accumulation of the fiber waste may be suppressed.

[0038] The main body 81 is formed integrally with resin, for example. The suction-port adjusting member 82 is also formed integrally with resin, for example. The suction-port adjusting member 82 is attached to the main body 81 with a bolt 86, and the suction-port adjusting member 82 can be attached to and/or detached from the main body 81 by using a bolt attaching/detaching mechanism. Plural types of the suction-port adjusting members 82 are prepared in advance and an appropriate one of the suction-port adjusting members 82 is used depending on the type of the fibers of the sliver S. Accordingly, the suction-port adjusting member 82 adjusts at least one of a shape and a position of the suction port 84 (i.e., the shape and/or the position of the suction port 84).

[0039] A positioning member 87 is arranged in the main body 81. The positioning member 87 includes an end surface 87a positioned on both sides of the suction-port adjusting member 82. The positioning member 87 performs positioning of the main body 81 with respect to the third bottom roller 15a by causing the end surface 87a to make contact with a positioning plate 91 that is fixed to the third roller housing 62. The main body 81, in a state in which it has been positioned by the positioning member 87, is fixed with a bolt 88 to a supporting plate 92 that has been fixed to the back roller housing 61.

[0040] In the following explanation, a distance between adjacent roller pairs 17 and 16, a distance between adjacent roller pairs 16 and 15, and a distance between adjacent roller pairs 15 and 14 are simply called "roller

pair distance". In the fiber collecting device 80, as shown in FIGS. 5 and 6, when the roller pair distance is equal to a first distance suitable for drafting a sliver S that mainly contains chemical fibers, a suction-port adjusting member 82 appropriate for the chemical fibers (i.e., for the sliver S that mainly contains chemical fibers) is attached to the main body 81 and at least one of the shape and the position of the suction port 84 is in a first state specific for the chemical fibers. On the other hand, as shown in FIGS. 7 and 8, when the roller pair distance is equal to a second distance suitable for drafting a sliver S that mainly contains cotton fibers, a suction-port adjusting member 82 appropriate for the cotton fibers (i.e., for the sliver S that mainly contains cotton fibers) is attached to the main body 81 and at least one of the shape and the position of the suction port 84 is in a second state specific for the cotton fibers. The "sliver S that mainly contains cotton fibers" is a sliver S that contains 50% or more of 100% cotton. The "sliver S that mainly contains chemical fibers" is a sliver S that contains less than 50% of 100% cotton and an average fiber length of the chemical fibers is from 32 millimeters (mm) to 51 mm. The suction-port inclined surface 85 is constituted by the suction-port adjusting member 82 in the first state and constituted by the main body 81 in the second state.

[0041] When comparing a case (shown in FIGS. 5 and 6) in which the sliver S that mainly contains chemical fibers is drafted with a case (shown in FIGS. 7 and 8) in which the sliver S that mainly contains cotton fibers is drafted, the second distance is shorter than the first distance. The reason is because the cotton fibers contain more short fibers than the chemical fibers. The downstream end portion 84b of the suction port 84 is positioned relatively on the downstream side (near the front roller pair) in the second state than in the first state. The reason is because the fiber waste is easily generated near the middle bottom roller 16a of the middle roller pair 16 that is the second roller pair from the downstream side when drafting the sliver S that mainly contains cotton fibers than when drafting the sliver S that mainly contains chemical fibers.

[0042] In an example shown in FIGS. 7 and 8, an end inclined surface 94 that gradually inclines downward going toward an end portion thereof is arranged at the end portion (downstream end portion in the drafting direction) of the suction-port adjusting member 82. The end inclined surface 94 is formed on both lateral sides around the suction port 84. The both lateral sides here mean one side and the other side in an axial direction of the draft roller. The end inclined surface 94 is formed on an upper surface (surface facing the bottom roller) of the suction-port adjusting member 82. The shape (inclination angle and/or length of an inclined part) of the end inclined surface 94 is not limited to that shown in FIG. 7. For example, the inclined part can be longer (length along the drafting direction) than that shown in FIG. 7. Because the end portion of the suction-port adjusting member 82 extends to a position below the middle bottom roller 16a (to a position facing the middle bottom roller 16a) and because the suction-port adjusting member 82 includes the end inclined surface 94, a space that is fairly large can be secured between the middle bottom roller 16a (apron belt 18a) and the suction port 84. As a result, fiber waste can be prevented from accumulating in this space.

[0043] As explained above, the fiber collecting device 80 includes the main body 81 that has the suction passage 83, and the suction-port adjusting member 82 that adjusts at least one of the shape and the position of the suction port 84 connected to the suction passage 83. Accordingly, in the fiber collecting device 80, at least one of the shape and the position of the suction port 84 can be appropriately adjusted depending on the type of the fibers. Therefore, in the fiber collecting device 80, even if the type of the fibers is changed, the fiber waste can be collected efficiently.

[0044] In the fiber collecting device 80, the suction-port adjusting member 82 is attachable to and/or detachable from the main body 81. With this arrangement, at least one of the shape and the position of the suction port 84 can be adjusted with a simple structure. Moreover, because the structure is simple, the fiber waste does not accumulate easily as compared to a structure in which, for example, the suction port is arranged in the main body and a separate member such as a sliding member or a rotating member is arranged so as to function as the suction-port adjusting member.

[0045] The fiber collecting device 80 further includes the positioning member 87 that performs positioning of the third bottom roller 15a of the third roller pair 15, which is the third roller pair from the downstream side, with respect to the main body 81. With this arrangement, even when at least one of the shape and the position of the suction port 84 is adjusted, the position of the suction port 84 can be adjusted to a position near the third bottom roller 15a in which the fiber waste is easily generated due to curling-up of fibers and the like.

[0046] In the fiber collecting device 80, the suction-port inclined surface 85 that extends from the suction port 84 to the connection opening 83a of the suction passage 83 is arranged between the suction port 84 and the suction passage 83. With this arrangement, the fiber waste can be smoothly passed from the suction port 84 into the suction passage 83 because of the presence of the suction-port inclined surface 85. Accordingly, the fiber waste can be collected efficiently.

[0047] The fiber collecting device 80 can be attached to and/or detached from the drafting device 6 by attaching and/or detaching the bolt 88. Accordingly, maintenance can be performed easily.

[0048] In the drafting device 6, when the roller pair distance is equal to the first distance suitable for drafting the sliver S that mainly contains chemical fibers, at least one of the shape and the position of the suction port 84 is in the first state specific for the chemical fibers. On the other hand, when the roller pair distance is equal to the second distance suitable for drafting the sliver S that

mainly contains cotton fibers, at least one of the shape and the position of the suction port 84 is in the second state specific for the cotton fibers. The downstream end portion 84b of the suction port 84 is positioned relatively on the downstream side in the second state than in the first state.

[0049] The fiber waste is easily generated near the third bottom roller 15a due to curling-up of fibers and the like. As a solution, in the drafting device 6, only one suction port 84 of the fiber collecting device 80 is caused to face the third bottom roller 15a. Also, the fiber waste is easily generated even near the middle bottom roller 16a when drafting the sliver S that mainly contains cotton fibers. As a solution, in the drafting device 6, when drafting the sliver S that mainly contains cotton fibers, as compared to when drafting the sliver S that mainly contains chemical fibers, the downstream end portion 84b of the suction port 84 is positioned relatively on the downstream side (i.e., the downstream end portion 84b of the suction port 84 is located near the middle bottom roller 16a). Therefore, in the drafting device 6, even if the type of the fibers is changed, the fiber waste can be collected efficiently.

[0050] The position adjustment of the downstream end portion 84b of the suction port 84 toward the downstream side is effective not only when drafting a sliver S that contains 100% cotton, but also, for example, when drafting a sliver S made of blended material containing carded cotton, having a high short-fiber content, and chemical fiber material. In other words, the position adjustment of the downstream end portion 84b of the suction port 84 toward the downstream side is effective when drafting a sliver S that is made of material in which the fibers can get easily accumulated below the middle bottom roller 16a. Moreover, the collection rate of the fiber waste can be improved by adjusting at least one of the shape and the position of the suction port 84 based on environment and/or conditions. Temperature and/or humidity in the room in which the spinning machine 1 is operating can be taken as an example of the environment. The ease with which fibers are wound on each bottom roller 14a, 15a, 16a, and 17a varies depending on the temperature and/or the humidity in the room in which the spinning machine 1 is operating. For example, when the humidity is high, the fibers easily adhere to the apron belt 18a. A drafting rate (force with which the fibers are pulled) can be considered as an example of the conditions. When the drafting rate is high, the fibers are easily wound on the bottom rollers 14a, 15a, 16a, and 17a.

[0051] In the drafting device 6, the cleaning device 73 is arranged with respect to each of the third bottom roller 15a and the back bottom roller 14a. With this arrangement, the fibers can be removed from the third bottom roller 15a and the back bottom roller 14a in which the fibers easily curl-up. As explained above, the drafting device 6 is arranged, in a state in which the back roller pair 14 is positioned above and the front roller pair 17 is positioned below in the vertical direction, such that each bottom roller 14a, 15a, 16a, and 17a is arranged in an inclined manner whereby it is positioned at a lower level than each top roller 14b, 15b, 16b, and 17b respectively. Therefore, the fibers that were removed by the cleaning devices 73 fall with their own weight on the suction-port inclined surface 85 as the fiber waste and are sucked from the suction port 84.

[0052] In the drafting device 6, because only one suction port 84 is arranged, air consumption of the entire spinning machine 1 can be suppressed compared to the case in which plural suction ports, for example, one suction port with respect to each bottom roller 14a, 15a, 16a, and 17a, are arranged.

[0053] Embodiments of the present invention have been explained above; however, the present invention is not to be limitedly interpreted to the above-explained embodiments.

[0054] As shown in FIG. 5, the fiber collecting device 80 can include a flow-rate adjusting section 89 that adjusts a suction air flow rate of the suction port 84. An example of the flow-rate adjusting section 89 is an orifice. By arranging the flow-rate adjusting section 89 with respect to the suction passage 83 or the suction pipe 93, the fiber waste can be collected by setting a suction air flow rate that is appropriate for the type of the fibers and the like.

[0055] The fiber collecting device 80 can be installed in an installation target device (a device in which fiber waste is generated) other than the drafting device 6. In this case, the positioning member 87 performs positioning of the main body 81 with respect to the installation target device. Accordingly, the position of the suction port 84 can be adjusted to a desired position with respect to the installation target device even in a case in which the at least one of the shape and the position of the suction port 84 has been adjusted.

[0056] The suction-port adjusting member 82 needs not be attached to the main body 81 with the bolt 86 but can be attached by fitting. When attached by fitting, the number of parts can be reduced.

[0057] The suction port 84 can be arranged, not in the suction-port adjusting member 82, but in the main body 81. When arranged in the main body 81, a separate member such as the sliding member or the rotating member functions as the suction-port adjusting member.

[0058] The cleaning device 73 can include a scraper member made of resin and a pressing member that presses the scraper member with respect to the bottom roller.

[0059] The air spinning device 7 can include a needle that is held by the fiber guiding member so as to protrude in the spinning chamber to prevent the twist of the fiber bundle from being conveyed to the upstream side of the air spinning device 7. In the air spinning device 7, instead of arranging such a needle, the downstream end portion of the fiber guiding member can be used to prevent the twist of the fiber bundle F from being conveyed to the upstream side of the air spinning device 7. Furthermore,

in the air spinning device 7, instead of the above configuration, a pair of air jet nozzles that twist the fiber bundle F in mutually opposite directions can be arranged.

[0060] In the spinning unit 2, the yarn pooling device 11 is used to pull the yarn Y from the air spinning device 7; however, a delivery roller and a nip roller can be used to pull the yarn Y from the air spinning device 7. If the yarn Y is pulled from the air spinning device 7 by using the delivery roller and the nip roller, a slack tube that absorbs slack of the yarn Y by using a suction air current or a mechanical compensator and the like may be arranged instead of the yarn pooling device 11.

[0061] In the spinning machine 1, various devices are arranged such that the yarn Y supplied from the upper side is wound on the lower side in the height direction of the machine frame. However, those devices can be arranged such that the yarn Y supplied from the lower side is wound on the upper side.

[0062] In the spinning machine 1, the traverse guide 23 and at least one among the bottom rollers of the drafting device 6 are driven by a power source arranged in the second end frame 5 (i.e., the power source is shared among plural spinning units 2). However, each component (e.g., the drafting device 6, the air spinning device 7, the winding device 13 and the like) of each spinning unit 2 can be driven independently in each spinning unit 2.

[0063] The tension sensor 9 can be arranged upstream of the yarn monitoring device 8 in the running direction of the yarn Y. One unit controller 10 can be arranged for each spinning unit 2. Moreover, in the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 can be omitted.

[0064] In FIG. 1, the spinning machine 1 is shown to wind the yarn Y into a cheese-shaped package P; however, it is possible to wind the yarn Y into a cone-shaped package. The yarn may slacken when traversing the yarn for winding the cone-shaped package; however, such slack can be absorbed by the yarn pooling device 11.

[0065] A drafting device according to an aspect of the present invention includes at least three roller pairs that draft a fiber bundle, each roller pair including a bottom roller and a top roller; and a fiber collecting device having only one suction port arranged facing a bottom roller of a third roller pair from a downstream side in a drafting direction. When a distance between adjacent ones of the roller pairs is a first distance, at least one of a shape and a position of the suction port is in a first state, and when the distance between the adjacent ones of the roller pairs is a second distance, at least one of the shape and the position of the suction port is in a second state. An end portion of the suction port on the downstream side in the drafting direction is positioned relatively on the downstream side in the drafting direction in the second state than in the first state.

[0066] In the above drafting device, the suction port is arranged facing bottom rollers of a second roller pair and the third roller pair from the downstream side in the drafting direction. Moreover, the first distance is a distance for drafting a fiber bundle that mainly contains chemical fibers, and the second distance is a distance for drafting a fiber bundle that mainly contains cotton fibers.

[0067] Fiber waste is easily generated near the bottom roller of the third roller pair from the downstream side in the drafting direction due to curling-up of fibers and the like. As a solution, in the drafting device, only one suction port of the fiber collecting device is made to face the bottom roller of the third roller pair. Also, the fiber waste is easily generated near the bottom roller of the second roller pair from the downstream side in the drafting direction when drafting the fiber bundle that mainly contains cotton fibers. As a solution, in the drafting device, when drafting the fiber bundle that mainly contains cotton fibers, as compared to when drafting the fiber bundle that mainly contains chemical fibers, the end portion of the suction port is positioned relatively on the downstream side in the drafting direction. Therefore, in the above drafting device, even if the type of the fibers is changed, the fiber waste can be collected efficiently. The "fiber bundle that mainly contains cotton fibers" is a fiber bundle that contains 50% or more of 100% cotton. The "fiber bundle that mainly contains chemical fibers" is a fiber bundle that contains less than 50% of 100% cotton and an average fiber length of the chemical fibers is from 32 mm to 51 mm.

[0068] In the above drafting device, the fiber collecting device can include a main body having a suction passage; and a suction-port adjusting member that adjusts at least one of the shape and the position of the suction port that is connected to the suction passage. Accordingly, at least one of the shape and the position of the suction port can be appropriately adjusted depending on the type of the fibers.

[0069] In the above drafting device, the fiber collecting device can include a positioning member that performs positioning of the main body with respect to the bottom roller of the third roller pair. Accordingly, even when at least one of the shape and the position of the suction port is adjusted, the position of the suction port can be adjusted to a position near the bottom roller of the third roller pair in which the fiber waste is easily generated.

[0070] The above drafting device can include a cleaning device arranged with respect to at least one bottom roller of the roller pairs after the third roller pair from the downstream side in the drafting direction. Accordingly, the fibers can be removed from the bottom roller of the roller pair after the third roller pair in which the fibers easily curl-up. The removed fibers are collected by the fiber collecting device as the fiber waste.

[0071] A drafting device according to another aspect of the present invention includes plural roller pairs and a fiber collecting device. The plural roller pairs draft a fiber bundle and each roller pair includes a bottom roller and a top roller. The fiber collecting device is arranged facing a bottom roller. The fiber collecting device includes a suction passage and a suction port. The suction passage performs suction in a direction that extends along a draft-

ing direction. The suction port is connected to the suction passage and arranged facing the bottom roller.

[0072] A spinning machine according to still another aspect of the present invention includes the above drafting device; an air spinning device that forms a yarn by twisting the fiber bundle drafted in the drafting device; and a winding device that winds the yarn formed by the air spinning device into a package.

[0073] Because the above spinning machine includes the above drafting device, even if the type of the fibers is changed, the fiber waste can be collected efficiently.

[0074] A fiber collecting device according to still another aspect of the present invention includes a main body and a suction-port forming member. The main body has a suction passage. The suction-port forming member forms a suction port that is connected to the suction passage. The suction-port forming member includes an end inclined surface with an end portion thereof inclined around the suction port going toward the end portion.

[0075] According to the present invention, the fiber collecting device, the drafting device, and the spinning machine capable of efficiently collecting the fiber waste even if the type of the fibers is changed can be provided.

[0076] In the above explanation, the meaning of "plural" also includes "a predetermined number of".

[0077] Further embodiments will not be described.

[0078] A first embodiment provides a drafting device comprising at least three roller pairs that draft a fiber bundle, each roller pair including a bottom roller and a top roller, and a fiber collecting device having only one suction port arranged facing a bottom roller of a third roller pair from a downstream side in a drafting direction, wherein when a distance between adjacent ones of the roller pairs is a first distance, at least one of a shape and a position of the suction port is in a first state, wherein when the distance between the adjacent ones of the roller pairs is a second distance, at least one of the shape and the position of the suction port is in a second state, and wherein an end portion of the suction port on the downstream side in the drafting direction is positioned relatively on the downstream side in the drafting direction in the second state than in the first state.

[0079] A second embodiment provides a drafting device in accordance with the first embodiment wherein the suction port is arranged facing bottom rollers of a second roller pair and the third roller pair from the downstream side in the drafting direction.

[0080] A third embodiment provides a drafting device in accordance with the first or second embodiment wherein the first distance is a distance for drafting a fiber bundle that mainly contains chemical fibers, and wherein the second distance is a distance for drafting a fiber bundle that mainly contains cotton fibers.

[0081] A fourth embodiment provides a drafting device in accordance with any one of the first to third embodiments wherein the fiber collecting device includes a main body having a suction passage, and a suction-port adjusting member that adjusts at least one of the shape and the position of the suction port that is connected to the suction passage.

[0082] A fifth embodiment provides a drafting device in accordance with the fourth embodiment, wherein the fiber collecting device further includes a positioning member that performs positioning of the main body with respect to the bottom roller of the third roller pair.

[0083] A sixth embodiment provides a drafting device in accordance with any one of the first to fifth embodiments, further comprising a cleaning device arranged with respect to at least one bottom roller of the roller pairs after the third roller pair from the downstream side in the drafting direction.

[0084] A seventh embodiment provides a drafting device comprising plural roller pairs that draft a fiber bundle, each roller pair including a bottom roller and a top roller; and a fiber collecting device arranged facing a bottom roller, the fiber collecting device including a suction passage for performing suction in a direction that extends along a drafting direction; and a suction port that is connected to the suction passage and arranged facing the bottom roller.

[0085] An eighth embodiment provides a drafting device in accordance with the seventh embodiment wherein the fiber collecting device is arranged with a longitudinal direction thereof parallel to the drafting direction.

[0086] A ninth embodiment provides a spinning machine comprising the drafting device in accordance with any one of the first to eighth embodiments; an air spinning device that forms a yarn by twisting the fiber bundle drafted in the drafting device; and a winding device that winds the yarn formed by the air spinning device into a package.

[0087] A tenth embodiment provides a fiber collecting device comprising a main body having a suction passage; and a suction-port forming member that forms a suction port that is connected to the suction passage, wherein the suction-port forming member includes an end inclined surface with an end portion thereof inclined around the suction port going toward the end portion.

[0088] An eleventh embodiment provides a fiber collecting device in accordance with the tenth embodiment, wherein the end inclined surface is formed on an upper surface of the suction-port forming member and gradually inclines downward going toward the end portion.

[0089] A twelfth embodiment provides a fiber collecting device in accordance with the tenth or eleventh embodiment, wherein the suction-port forming member is detachable from and attachable to the main body.

[0090] A thirteenth embodiment provides a fiber collecting device in accordance with any one of the tenth to twelfth embodiments, further comprising a positioning member that performs positioning of the main body with respect to an installation target device.

[0091] A fourteenth embodiment provides a fiber collecting device in accordance with any one of the tenth to thirteenth embodiments, further comprising a suction-port inclined surface that is arranged between the suction port and the suction passage and extends from the suc-

tion port to a connection opening of the suction passage.

[0092] A fifteenth embodiment provides a drafting device comprising the fiber collecting device in accordance with any one of the tenth to fourteenth embodiments.

[0093] Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

Claims

1. A drafting device comprising:

plural roller pairs (14, 15, 16, 17) that draft a fiber bundle (F), each roller pair (14, 15, 16, 17) including a bottom roller (14a, 15a, 16a, 17a) and a top roller (14b, 15b, 16b, 17b) opposing each other across a running path (R) of a sliver (S); and

a fiber collecting device (80) including

a suction passage (83) extending parallel to the running path (R) for performing suction in a direction that extends along a drafting direction; and

a suction port (84) that is connected to the suction passage (83) and arranged facing one or more of the bottom rollers (14a, 15a, 16a, 17a).

2. the drafting device as claimed in Claim 1, wherein

the plural roller pairs comprise at least three roller pairs (15, 16, 17) that draft the fiber bundle (F),

the fiber collecting device has only one suction port (84) arranged facing the bottom roller (15a) of the third roller pair (15) from a downstream side in a drafting direction,

when a distance between adjacent ones of the roller pairs is a first distance (15, 16, 17), at least one of a shape and a position of the suction port (84) is in a first state,

when the distance between the adjacent ones of the roller pairs (15, 16, 17) is a second distance, at least one of the shape and the position of the suction port (84) is in a second state, and

an end portion (84b) of the suction port (84) on the downstream side in the drafting direction is positioned relatively on the downstream side in the drafting direction in the second state than in the first state.

3. The drafting device as claimed in Claim 2, wherein the suction port (84) is arranged facing the bottom rollers (15a, 16a) of a second roller pair (16) and the third roller pair (15) from the downstream side in the drafting direction.

4. The drafting device as claimed in Claim 2 or 3, wherein

the first distance is a distance for drafting a fiber bundle that mainly contains chemical fibers, and

the second distance is a distance for drafting a fiber bundle that mainly contains cotton fibers.

5. The drafting device as claimed in any one of Claims 1 to 4, wherein the fiber collecting device includes a main body (81) having the suction passage (83); and a suction-port adjusting member (82) that adjusts at least one of the shape and the position of the suction port (84) that is connected to the suction passage (84).

6. The drafting device as claimed in Claim 5, wherein the fiber collecting device (80) further includes a positioning member (87) that performs positioning of the main body (81) with respect to the bottom roller (15a) of the third roller pair (15).

7. The drafting device as claimed in any one of Claims 1 to 6, further comprising a cleaning device (73) arranged with respect to at least one bottom roller of the roller pairs after the third roller pair (15) from the downstream side in the drafting direction.

8. The drafting device as claimed in any one of Claims 1 to 7, wherein

the fiber collecting device is arranged with a longitudinal direction thereof parallel to the drafting direction.

9. The drafting device as claimed in Claims 5, wherein the suction-port adjusting member (82) includes an end inclined surface (94) with an end portion thereof inclined around the suction port (84) going toward the end portion.

10. The drafting device as claimed in Claim 9, wherein the end inclined surface (94) is formed on an upper surface of the suction-port adjusting member (82) and gradually inclines downward going toward the end portion.

11. The drafting device as claimed in Claim 9 or 10, wherein the suction-port adjusting member (82) is detachable from and attachable to the main body (18).

12. The drafting device as claimed in any one of Claims 10 to 12, further comprising a positioning member (87) that performs positioning of the main body (81) with respect to an installation target device.

13. The drafting device as claimed in any one of Claims 9 to 12, further comprising a suction-port inclined surface (85) that is arranged between the suction

port (84) and the suction passage (83) and extends from the suction port (84) to a connection opening (83a) of the suction passage (83).

14. A spinning machine comprising:

the drafting device (6) as claimed in any one of Claims 1 to 13;
an air spinning device (7) that forms a yarn (Y) by twisting the fiber bundle (F) drafted in the drafting device (6); and
a winding device (13) that winds the yarn (Y) formed by the air spinning device (7) into a package (P).

FIG.1

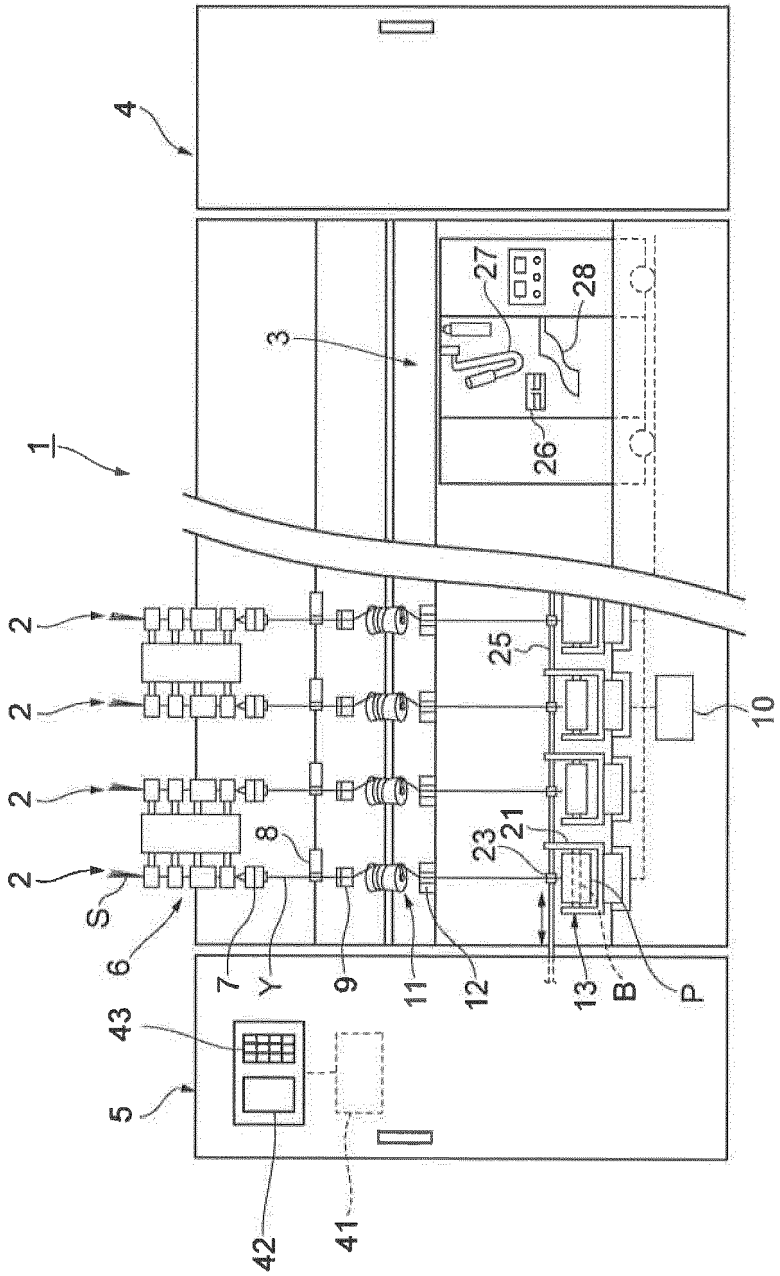


FIG.2

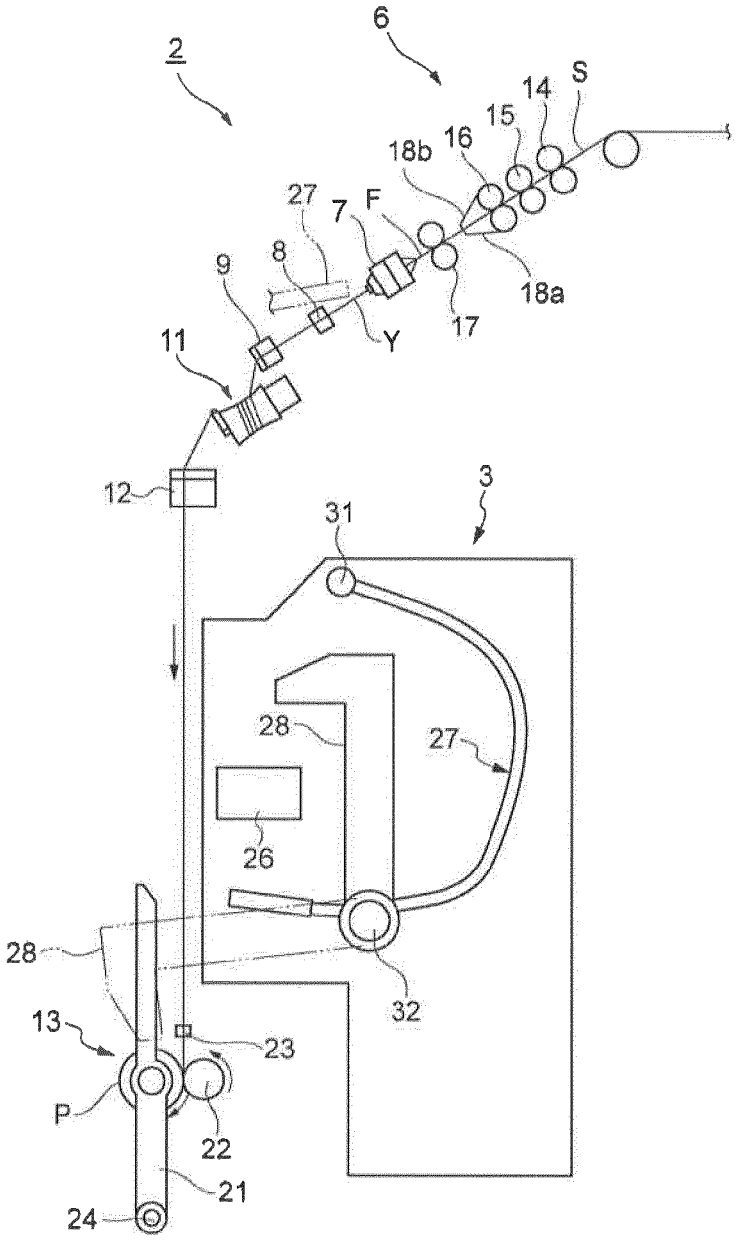
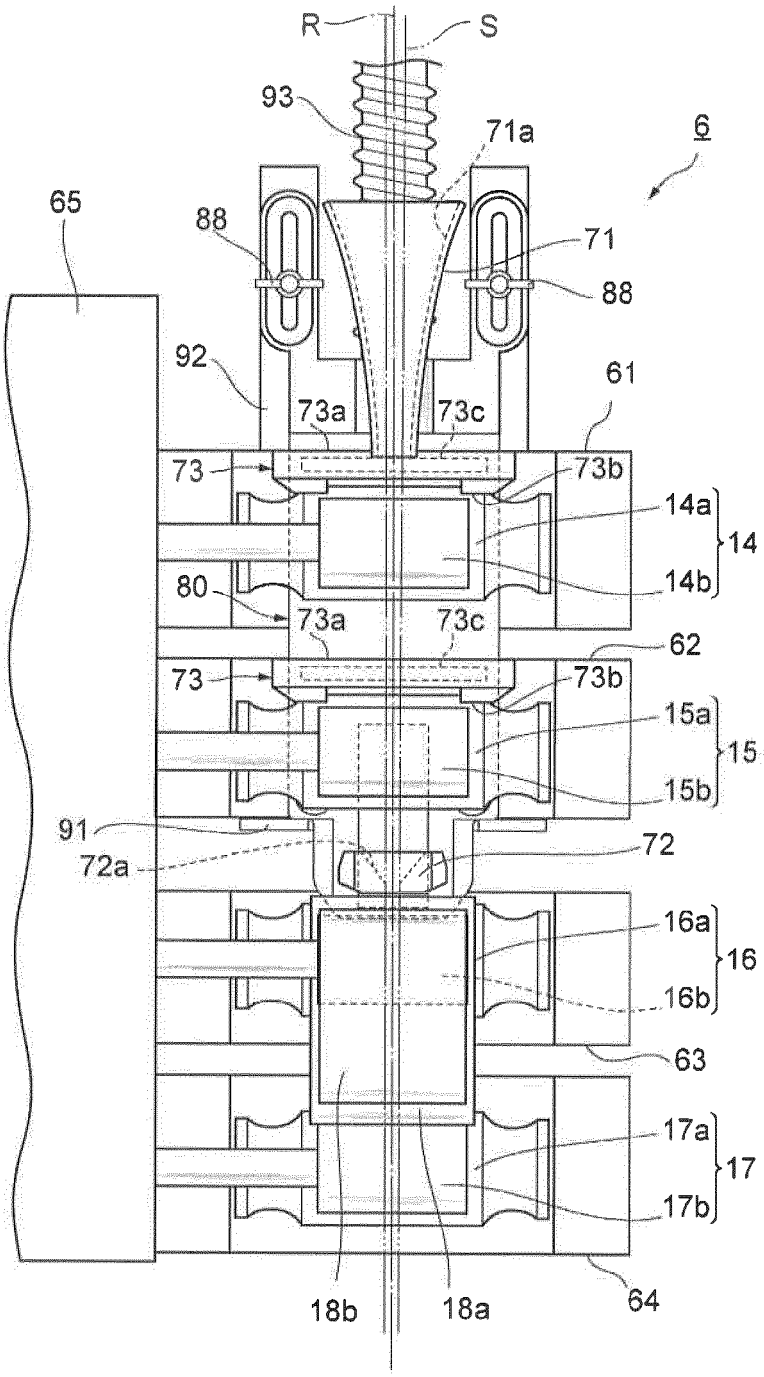

6
2
S
14
15
16
18b
27
7
F
9
8
18a
17
Y
11
12
3
31
28
27
26
28
32
13
23
P
22
21
24

FIG.3


R
S
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73a
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73b
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14
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73a
73c
62
73
73b
15a
15
15b
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72
72a
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17a
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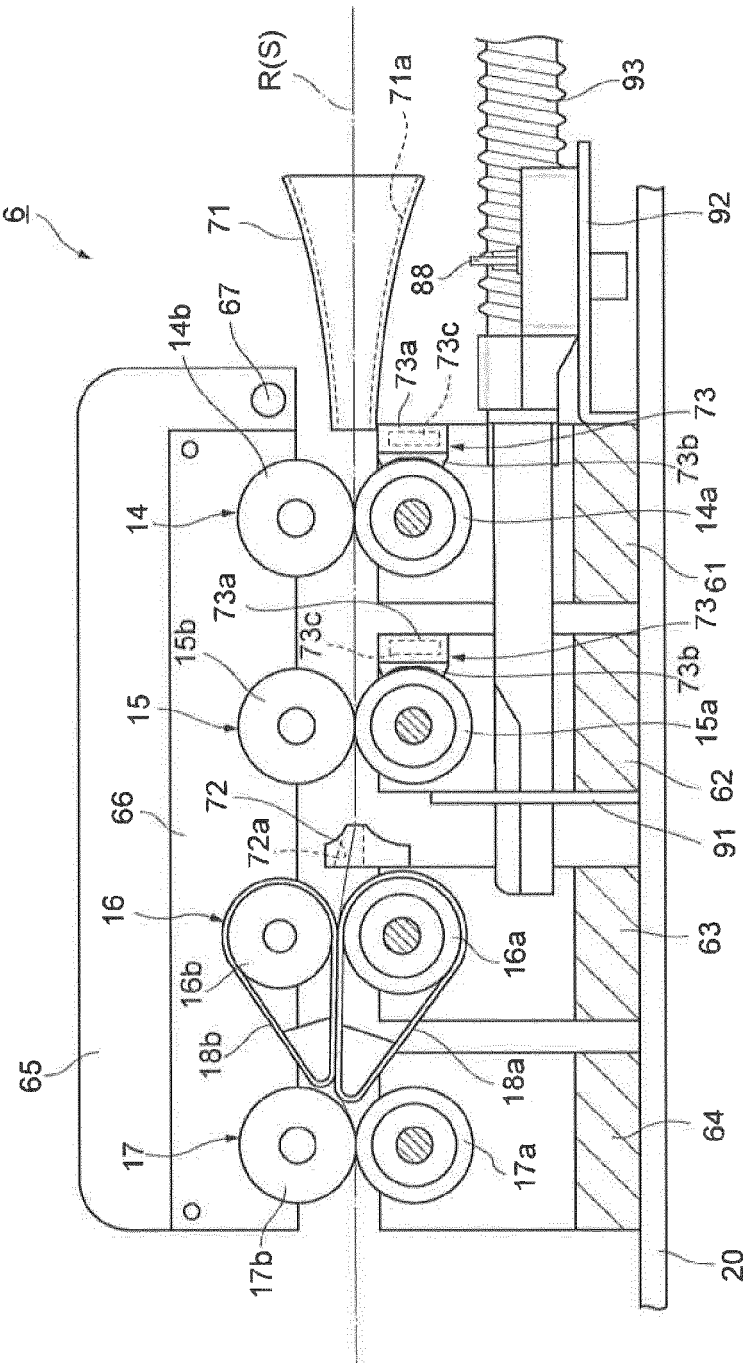
18a
64

FIG.4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R(S)
71a
93
71
92
88
67
14b
73a
73c
73
73b
14
14a
61
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73c
73
15b
73b
15
15a
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18a
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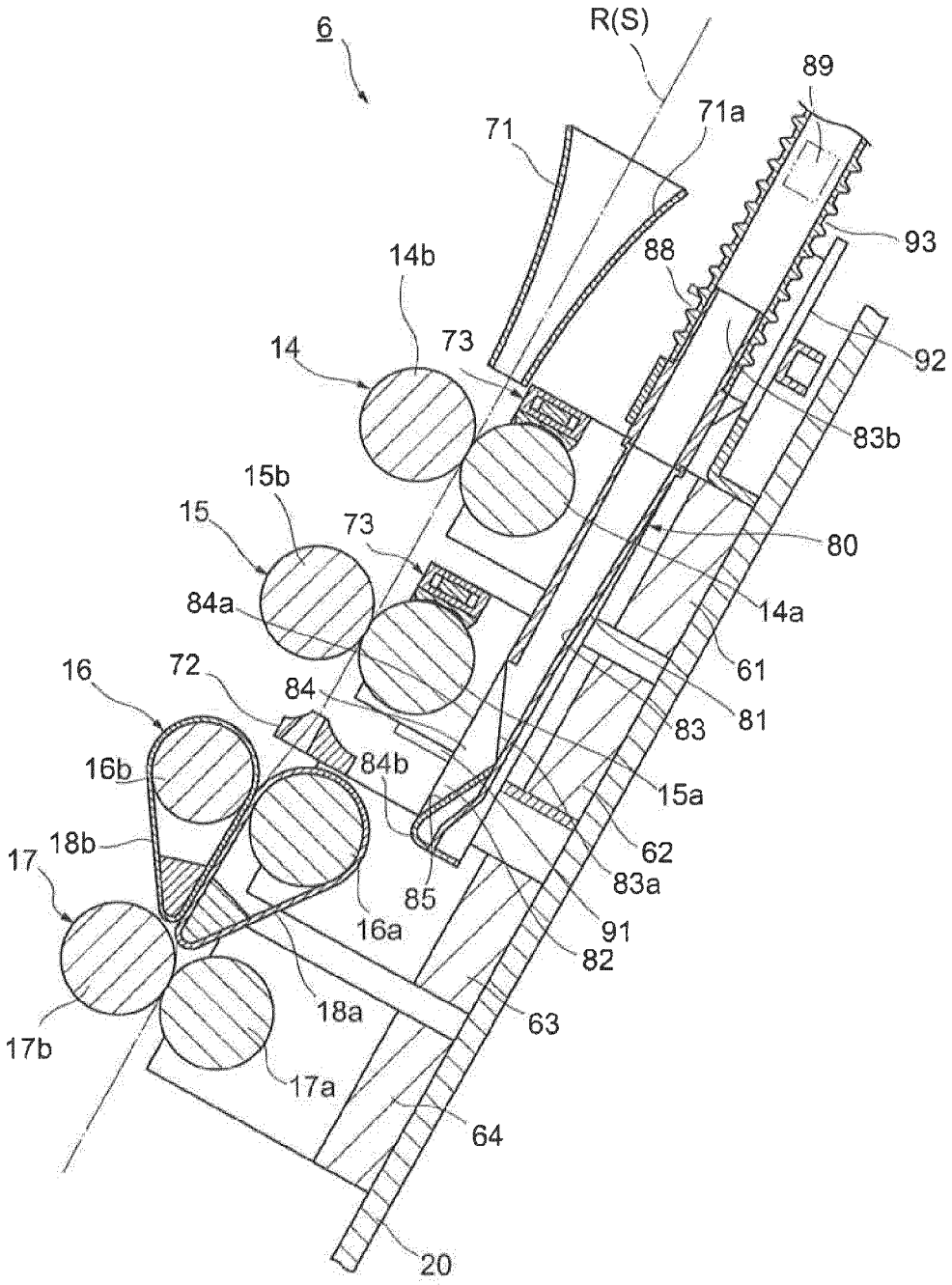
17
17a
64
17b
20

FIG.5


6
R(S)
89
71a
71
93
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61
16
72
84
81
83
16b
84b
15a
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17
83a
85
91
16a
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18a
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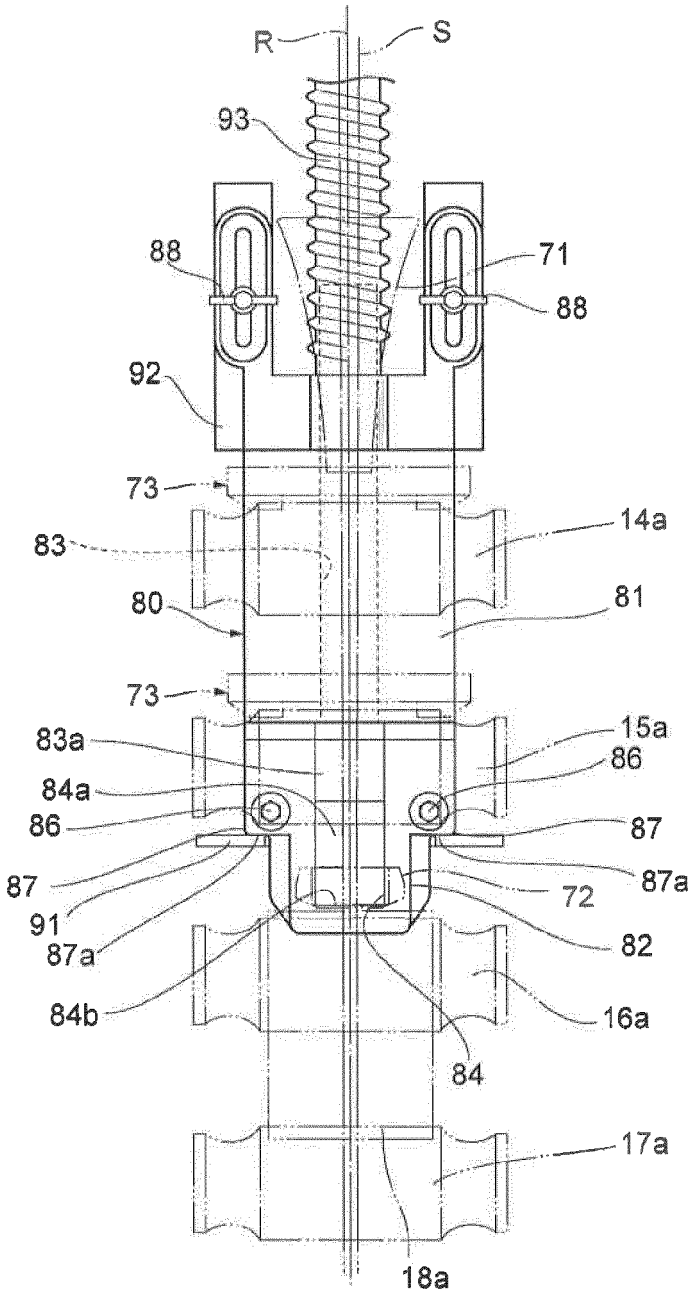
17b
17a
64
20

FIG.6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84b
16a
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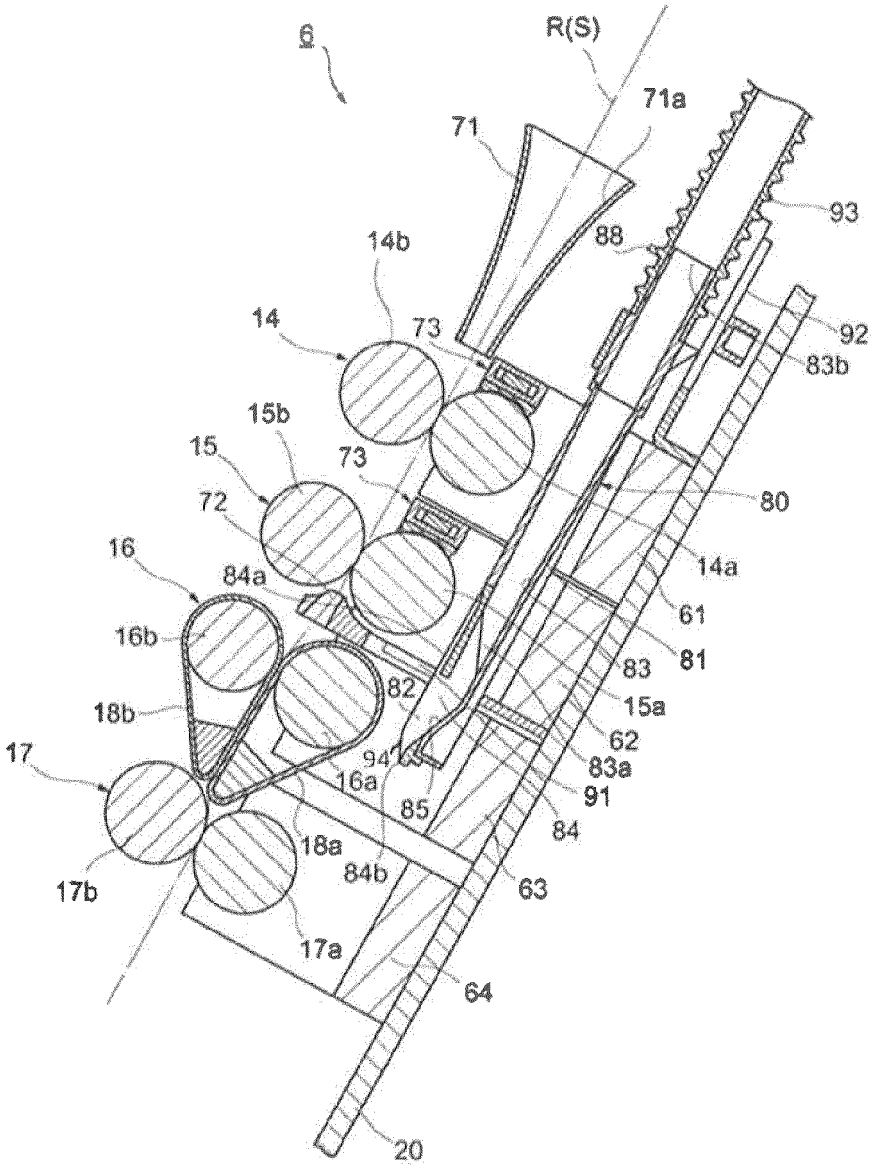
17a
18a

FIG.7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71
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73
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83b
15b
15
73
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80
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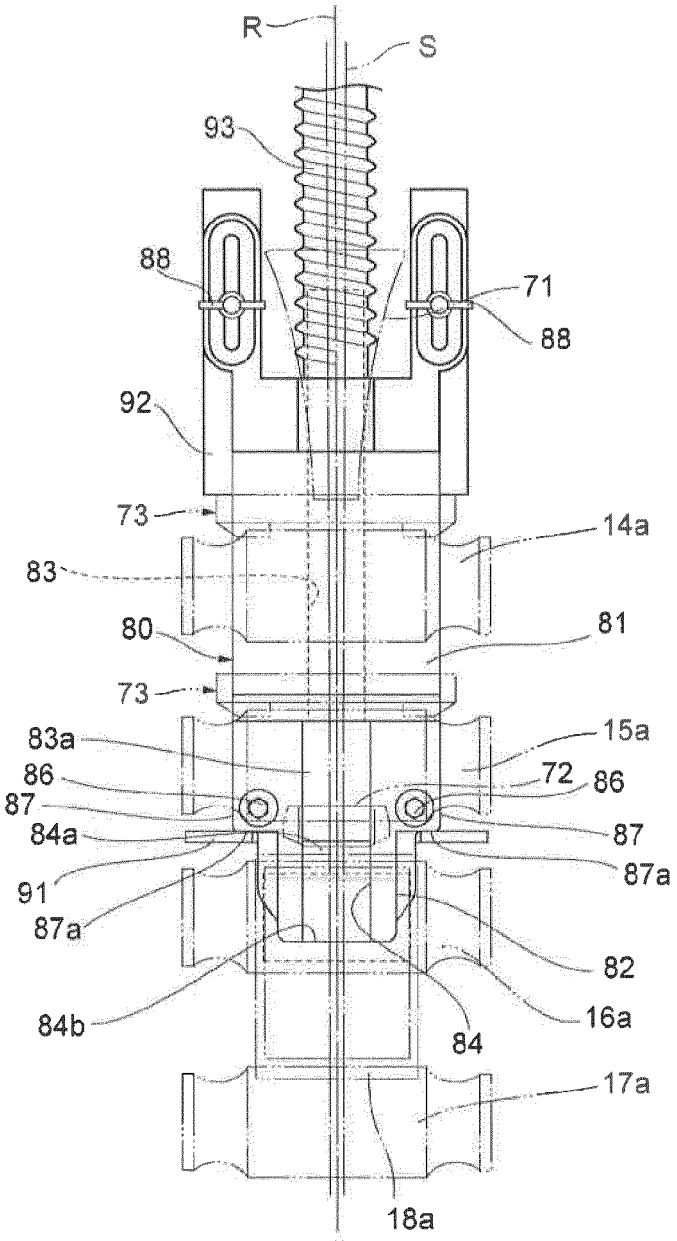
61
16b
81
83
82
15a
18b
62
17
94
83a
16a
91
85
84
18a
84b
63
17b
17a
64
20

FIG.8


R
S
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86
87
84a
87
87a
91
87a
82
16a
84b
84
17a
18a

REFERENCES CITED IN THE DESCRIPTION

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