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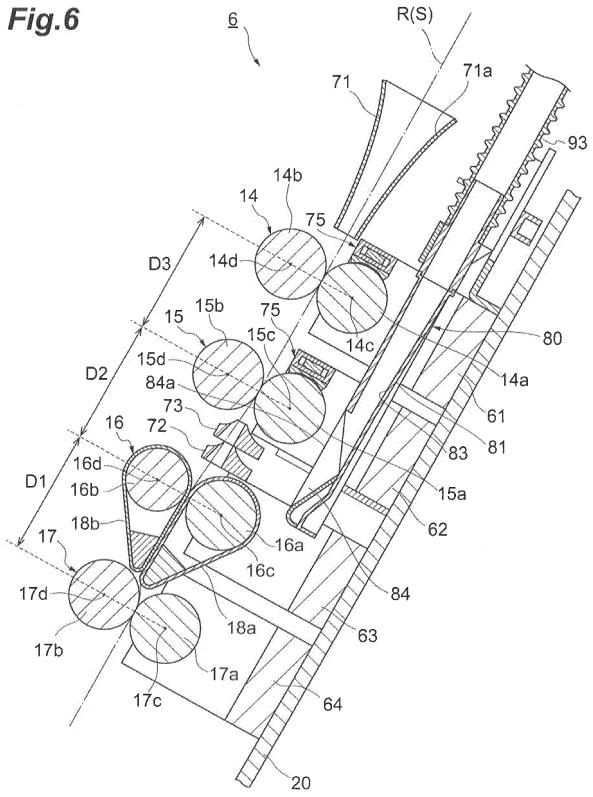
(54) DRAFTING DEVICE, SPINNING MACHINE, AND METHOD OF SPINNING TECHNICAL FIELD

(57) A drafting device includes: a plurality of pairs of rollers disposed in the order of a pair of first rollers, a pair of second rollers, and a pair of third rollers from the downstream side toward the upstream side on a draft path of the fiber bundle and having respective bottom rollers and top rollers; a first supporting unit supporting a first bottom roller of the pair of first rollers; a second supporting unit supporting a second bottom roller of the pair of second rollers; and a third supporting unit supporting a third bottom roller of the pair of third rollers and movably disposed along the draft path. The first bottom roller and the second bottom roller are disposed such that a first distance between the center axis of the first bottom roller and the center axis of the second bottom roller is in a range between 50 mm and 65 mm, inclusive. The third supporting unit moves along the draft path and positions the third bottom roller such that a second distance between the center axis of the second bottom roller and the center axis of the third bottom roller is in a range between 35 mm and 65 mm, inclusive.

Fig.6



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a drafting device, a spinning machine, and a method of spinning.

BACKGROUND

[0002] A drafting device includes, from the most upstream side toward the most downstream side on a draft path of a fiber bundle, a pair of back rollers, a pair of third rollers, a pair of middle rollers, and a pair of front rollers (for example, see Japanese Unexamined Patent Publication No. H11-100725).

SUMMARY

[0003] In a drafting device, the distance between pairs of rollers (the roller gauge) needs to be set based on the effective fiber length of the fiber bundle. The effective fiber length differs between the types of a fiber bundle. If a fiber bundle with long fibers is drafted by a conventional drafting device, for example, having the distance between pairs of rollers set for short fibers, a drafting defect may be caused because the fibers are not sufficiently drafted. If a fiber bundle with short fibers is drafted by a conventional drafting device, for example, having the distance between pairs of rollers set for long fibers, the fibers are difficult to be hooked to the rollers, which may cause unevenness in the diameter of the drafted fiber bundle. Various fiber bundles different in the effective fiber length cannot be thus drafted by such a conventional device.

[0004] Embodiments of the present disclosure aims to provide a drafting device, a spinning machine, and a method of spinning capable of drafting various fiber bundles different in the effective fiber length.

[0005] A drafting device according to embodiments of the present disclosure is configured to draft a fiber bundle supplied to an air spinning device configured to generate yarn by twisting the fiber bundle. The drafting device includes: a plurality of pairs of rollers disposed in the order of a pair of first rollers, a pair of second rollers, and a pair of third rollers from a downstream side toward an upstream side on a draft path of the fiber bundle and having respective bottom rollers and top rollers; a first supporting unit supporting a first bottom roller of the pair of first rollers; a second supporting unit supporting a second bottom roller of the pair of second rollers; and a third supporting unit supporting a third bottom roller of the pair of third rollers and movably disposed along the draft path. The first bottom roller and the second bottom roller are disposed such that a first distance between the center axis of the first bottom roller and the center axis of the second bottom roller is in a range between 50 mm and 65 mm, inclusive. The third supporting unit is configured to move along the draft path and to position the third bottom roller such that a second distance between the center axis of the second bottom roller and the center axis of the third bottom roller is in a range between 35 mm and 65 mm, inclusive.

[0006] The drafting device according to the embodiment of the present disclosure can dispose the second bottom roller and the third bottom roller with the second distance appropriate for the effective fiber length, which prevents drafting defect and the like. The drafting device can thus draft various fiber bundles different in the effective fiber length.

[0007] In embodiments, the first supporting unit fixes the position of the first bottom roller on the draft path, and the second supporting unit fixes the position of the second bottom roller on the draft path. In this configuration, the first distance may be set in a range between 55 mm and 62 mm, inclusive, and the second distance may be adjusted in a range between 38 mm and 43 mm, inclusive. With this arrangement, the drafting device can appropriately draft various fiber bundles different in the effective fiber length in such a manner that fixes the positions of the first supporting unit and the second supporting unit and changes the position of the third supporting unit in the above-described range.

[0008] Conventional drafting devices determine the distance between pairs of rollers based on the effective fiber length of a fiber to be drafted and adjust supporting units and others supporting respective pairs of rollers to have the distance. Conventional drafting devices thus determine the distance between pairs of rollers based on the effective fiber length of a single type of a fiber bundle. With such conventional devices, various fiber bundles different in the effective fiber length cannot be drafted using the same drafting device.

[0009] The drafting device according to embodiments fixes the first distance and adjusts the second distance based on the effective fiber length. The first distance is set at a distance with which both a short fiber and a long fiber can be drafted. Specifically, the first distance is set at a distance for drafting a long fiber with a length of 2 inches. The first distance in the above-described range for drafting a long fiber with a length of 2 inches is adaptable for drafting a short fiber with a length of 1.5 inches in addition to a long fiber with a length of 2 inches. Even with the first distance fixed for a long fiber with a length of 2 inches, the distance less affects drafting a short fiber. By contrast, if the first distance is set for drafting a short fiber with a length of 1.5 inches, the distance is not adaptable for a long fiber. In this case, both a long fiber and a short fiber cannot be drafted together with the distance. As described above, the drafting device according to embodiments is configured with the first distance fixed as a distance adaptable for a long fiber with a length of 2 inches and the second distance adjustable based on the effective fiber length. The drafting device in this configuration is capable of drafting various fiber bundles different in the effective fiber length.

[0010] In embodiments, the pairs of rollers further in-

clude a pair of fourth rollers disposed upstream of the pair of third rollers and having a fourth bottom roller and a fourth top roller. The drafting device further includes a fourth supporting unit supporting the fourth bottom roller and movably disposed along the draft path. The fourth supporting unit may move along the draft path and position the fourth bottom roller such that a third distance between the center axis of the third bottom roller and the center axis of the fourth bottom roller is in a range between 35 mm and 65 mm, inclusive. With this process, the third distance is appropriately set based on the effective fiber length. The drafting device is thus capable of drafting various fiber bundles different in the effective fiber length.

[0011] In embodiments, the third distance may be adjusted in a range between 40 mm and 43 mm, inclusive. With the pair of third rollers and the pair of fourth rollers with the third distance more appropriately set, the drafting device can appropriately draft various fiber bundles different in the effective fiber length.

[0012] In embodiments, a difference between the second distance and the third distance may be adjusted in a range between 3 mm and 5 mm, inclusive, which enables the drafting device to more appropriately draft a fiber bundle.

[0013] In embodiments, the drafting device may include a first limiting unit and a second limiting unit disposed between the pair of second rollers and the pair of third rollers on the draft path and configured to limit a width of the fiber bundle. With this arrangement, even when the distance between the pairs of rollers next to each other is increased based on the effective fiber length, the distance from the pair of rollers in the upstream side to the limiting unit is controlled so as not to be large. The drafting device can prevent fibers, controlling of which is difficult due to a reduction in the draft resistance, from winding on the pair of rollers.

[0014] The spinning machine according to embodiments of the present disclosure includes any of the above-described drafting devices, an air spinning device generating yarn by twisting a fiber bundle drafted by the drafting device, and a winding device winding the yarn.

[0015] In embodiments, a draft ratio between the pair of first rollers and the pair of second rollers may be 20 to 60 times.

[0016] In embodiments, a draft ratio between the pair of second rollers and the pair of third rollers may be one to five times.

[0017] The drafting device of the spinning machine according to embodiments of the present disclosure can draft various fiber bundles different in the effective fiber length, and appropriate drafting of fiber bundles can prevent a reduction in the quality of yarn generated by the air spinning device.

[0018] In embodiments, the spinning machine may include an input unit configured to receive an input of the effective fiber length of a fiber bundle drafted by the drafting device and a control unit configured to control an operation of the drafting device based on the effective fiber length input through the input unit. This configuration enables the drafting device to operate based on the effective fiber length of the fiber bundle.

[0019] A method of spinning according to embodiments of the present disclosure uses a spinning machine including a drafting device configured to draft a fiber bundle and an air spinning device configured to generate yarn by twisting the fiber bundle drafted by the drafting device. The method of spinning includes: providing the drafting device with a plurality of pairs of rollers disposed in the order of a pair of first rollers, a pair of second rollers, and a pair of third rollers from a downstream side toward an upstream side on a draft path of the fiber bundle and having respective bottom rollers and top rollers, setting a first distance between the center axis of a first bottom roller of the pair of first rollers and the center axis of a second bottom roller of the pair of second rollers in a range between 50 mm and 65 mm, inclusive, adjusting, if the effective fiber length of the fiber bundle is 38 mm, a second distance between the center axis of the second bottom roller and the center axis of a third bottom roller of the pair of third rollers in a range between 35 mm and 45 mm, inclusive, to draft the fiber bundle with the adjusted second distance, and adjusting, if the effective fiber length of the fiber bundle is 51 mm, the second distance in a range between 35 mm and 65 mm, inclusive, to draft the fiber bundle with the adjusted second distance.

[0020] With the method of spinning according to embodiments of the present disclosure, a fiber bundle is drafted by a plurality of pairs of rollers disposed at appropriate positions based on the effective fiber length, which exerts advantageous effects in preventing draft defects and the like. With the method of spinning, various fiber bundles different in the effective fiber length can be drafted, which can prevent a reduction in the quality of yarn generated by the air spinning device.

[0021] According to embodiments of the present disclosure, various fiber bundles different in the effective fiber length can be drafted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

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

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

FIG. 3 is a plane view of a drafting device of the spinning unit of FIG. 2.

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

FIG. 5 is a perspective view illustrating the structure of a second limiting unit and its periphery.

FIG. 6 is a cross-sectional view of the drafting device of the spinning unit of FIG. 2.

DETAILED DESCRIPTION

[0023] Embodiments will now be described with reference to the drawings. In the description of drawings, like numerals indicate like components, and overlapping description will be omitted.

[0024] As illustrated in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a splicing carrier 3, a doffing carrier (not illustrated), a first end frame 4, and a second end frame 5. The spinning units 2 are aligned in a row. Each spinning unit 2 generates yarn Y and winds the yarn into a package P. When the yarn Y is cut or breaks in a spinning unit 2 for any reason, the splicing carrier 3 splices the yarn Y in the spinning unit 2. When the package P becomes a full roll in a spinning unit 2, the doffing carrier doffs the package P and supplies a new bobbin B to the spinning unit 2.

[0025] The first end frame 4 accommodates therein a collection device and the like for collecting fiber waste, yarn waste, and others generated in the spinning unit 2. The second end frame 5 accommodates therein an air supply unit adjusting air pressure of compressed air (air) supplied to the spinning machine 1 and supplying air to the units in the spinning machine 1, a driving motor for supplying power to the units in the spinning unit 2, and others. The second end frame 5 includes a machine control device 100, a display screen 102, and an input key (an input unit) 104. The machine control device 100 intensively manages and controls the units of the spinning machine 1. The display screen 102 can display information on at least the settings or the status of the spinning unit 2. An operator performs necessary operations through the input key 104, thereby setting the spinning unit 2.

[0026] As FIGs. 1 and 2 illustrate, each spinning unit 2 includes, in the order from the upstream side in a direction in which the yarn Y travels, a drafting device 6, an air spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn storage device 11, a waxing device 12, and a winding device 13. A unit controller (the control unit) 10 is provided in every certain number of spinning units 2 and controls operations of the spinning units 2.

[0027] The drafting device 6 drafts a sliver (a fiber bundle) S. The drafting device 6 has, in the order from the upstream side in a direction in which the sliver S travels, a pair of back rollers (a pair of fourth rollers) 14, a pair of third rollers 15, a pair of middle rollers (a pair of second rollers) 16, and a pair of front rollers (a pair of first rollers) 17. Each pair of rollers 14, 15, 16, and 17 has a bottom roller and a top roller. The bottom roller is driven and rotated by a driving motor installed in the second end frame 5 or a driving motor installed in each spinning unit 2. The bottom roller of the pair of middle rollers 16 has an apron belt 18a. The top roller of the pair of middle rollers 16 has an apron belt 18b.

[0028] The air spinning device 7 generates the yarn Y by twisting the fiber bundle F drafted by the drafting device 6 using swirling airflow. More specifically (although not illustrated in the drawings), the air spinning device 7 has a spinning room, a fiber guiding unit, a swirling airflow generating nozzle, and a hollow guide shaft. The fiber guiding unit guides the fiber bundle F supplied from the drafting device 6 disposed upstream thereof to the spinning room. The swirling airflow generating nozzle is disposed around a path on which the fiber bundle F travels. Swirling airflow is generated in the spinning room with the swirling airflow generating nozzle spraying air. The swirling airflow reverses and swirls the fiber tips of a plurality of fibers included in the fiber bundle F. The hollow guide shaft guides the yarn Y from the spinning room to the outside of the air spinning device 7.

[0029] The yarn monitoring device 8 is disposed between the air spinning device 7 and the yarn storage device 11 and monitors information on traveling yarn Y. Specifically, the yarn monitoring device 8 detects whether the yarn Y has any defects based on the monitored information. Upon detection of a defect on the yarn, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects, for example, at least one of the abnormality in the diameter of the yarn Y and a foreign matter contained in the yarn Y as a defect of the yarn Y. The yarn monitoring device 8 further detects yarn breakage and others. The tension sensor 9 disposed between the air spinning device 7 and the yarn storage device 11 measures the tension of traveling yarn Y and transmits a tension measuring signal to the unit controller 10. When the unit controller 10 determines that abnormality has occurred based on at least one of a result of detection by the yarn monitoring device 8 and a result of detection by the tension sensor 9, the yarn Y is cut in the spinning unit 2. Specifically, air supply to the air spinning device 7 stops, generation of the yarn Y is terminated, and the yarn Y is accordingly cut. In another way, the yarn Y may be cut with a cutter separately provided.

[0030] The waxing device 12 disposed between the yarn storage device 11 and the winding device 13 applies wax to the yarn Y.

[0031] The yarn storage device 11 disposed between the air spinning device 7 and the winding device 13 eliminates slack from the yarn Y. The yarn storage device 11 has functions of stably drawing the yarn Y from the air spinning device 7, preventing the yarn Y from slacking by retaining the yarn Y delivered from the air spinning device 7, for example, in the yarn splicing operation of the splicing carrier 3, and preventing fluctuations in the tension of the yarn Y situated downstream of the yarn storage device 11 from spreading to the air spinning device 7.

[0032] The winding device 13 winds the yarn Y onto a bobbin B and forms a package P. The winding device 13 has 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 supporting shaft 24 and has the surface of the bobbin B or

the surface of the package P contact with the surface of the winding drum 22 at appropriate pressure. The driving motor (not illustrated) installed in the second end frame 5 simultaneously drives the winding drums 22 of a plurality of spinning units 2. With this drive, the bobbin B or the package P of each spinning unit 2 is rotated in a direction of winding. The traverse guide 23 of each spinning unit 2 is mounted on a shaft 25 shared by a plurality of spinning units 2. With the driving motor in the second end frame 5 driving the shaft 25 in a direction of the rotational axis of the winding drum 22 in a reciprocating manner, the traverse guide 23 has the yarn Y traverse a rotating bobbin B or package P at a certain width.

[0033] When the yarn Y is cut or breaks in a spinning unit 2 for any reason, the splicing carrier 3 runs to the spinning unit 2 and performs a splicing operation. The splicing carrier 3 has a splicing device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is rotatably supported by a support shaft 31. The suction pipe 27 catches the yarn Y sent from the air spinning device 7 and guides the yarn Y to the splicing device 26. The suction mouth 28 is rotatably supported by a support shaft 32. The suction mouth 28 catches the yarn Y sent from the winding device 13 and guides the yarn Y to the splicing device 2.6. The splicing device 26 splices the guided pieces of the yarn Y with each other. Examples of the splicing device 26 include a splicer using compressed air and a knotter mechanically splicing the yarn Y.

[0034] In the splicing operation, the splicing carrier 3 rotates (reversely rotates) the package P in a reverse direction of winding. Specifically, the cradle arm 21 is moved by an air cylinder (not illustrated) so that the package P is separated from the winding drum 22, and a reverse rotating roller (not illustrated) installed to the splicing carrier 3 reversely rotates the package P.

[0035] The drafting device 6 will now be described in detail. As illustrated in FIGs. 3 and 4, the pair of back rollers 14 has a back bottom roller (a fourth bottom roller) 14a and a back top roller (a fourth top roller) 14b, which are opposite to each other with a draft path R on which a sliver S travels interposed therebetween. The pair of third rollers 15 has a third bottom roller 15a and a third top roller 15b, which are opposite to each other with the draft path R interposed therebetween. The pair of middle rollers 16 has a middle bottom roller (a second bottom roller) 16a and a middle top roller 16b, which are opposite to each other with the draft path R interposed therebetween. The middle bottom roller 16a has the apron belt 18a suspended thereon. The middle top roller 16b has an apron belt 18b suspended thereon. The pair of front rollers 17 has a front bottom roller (a first bottom roller) 17a and a front top roller 17b, which are opposite to each other with the draft path R interposed therebetween.

[0036] The pairs of rollers 14, 15, 16, and 17 have the sliver S supplied from a can (not illustrated) travel from the upstream side toward the downstream side while drafting the sliver S and supply a fiber bundle F to the air spinning device 7. A direction along the draft path R will be referred to as a "drafting direction". The upstream side in the drafting direction is simply referred to as an "upstream side", whereas the downstream side in the drafting direction will be referred to as a "downstream side".

[0037] The back bottom roller 14a is rotatably supported by a back roller housing (a fourth supporting unit) 61. The third bottom roller 15a is rotatably supported by a third roller housing (a third supporting unit) 62. The middle bottom roller 16a is rotatably supported by a middle roller housing (a second supporting unit) 63. The front bottom roller 17a is rotatably supported by a front roller housing (a first supporting unit) 64. The bottom rollers 14a, 15a, 16a, and 17a are rotated at a rotational speed different from one another, specifically, at a gradually higher speed toward the downstream roller.

[0038] The roller housings 61, 62, 63, and 64 are installed to a machine frame 20. Specifically, the front roller housing 64 and the middle roller housing 63 are immovably fixed to the machine frame 20. This configuration has the positions of the front bottom roller 17a and the middle bottom roller 16a fixed on the draft path R. In the embodiment, the distance between the front bottom roller 17a and the middle bottom roller 16a is not adjusted, and the front roller housing 64 and the middle roller housing 63 thus may be formed as a single housing.

[0039] The back roller housing 61 and the third roller housing 62 each are movably mounted on the machine frame 20. Each of the back roller housing 61 and the third roller housing 62 is moved along the draft path R and fixed at any position. For example, each of the back roller housing 61 and the third roller housing 62 is slidably provided on the machine frame 20 along the draft path R and fixed to a certain position on the machine frame 20 by a fixing member (not illustrated) . The back bottom roller 14a and the third bottom roller 15a are movably disposed along the draft path R, and the respective positions are adjustable along the draft path R.

[0040] As illustrated in FIG. 6, a first distance D1 between a center axis 17c of the front bottom roller 17a and a center axis 16c of the middle bottom roller 16a is kept constant. The first distance D1 is a distance between a line passing through the center axis 17c of the front bottom roller 17a and perpendicular to the draft path R and another line passing through the center axis 16c of the middle bottom roller 16a and perpendicular to the draft path R.

[0041] A second distance D2 between the center axis 16c of the middle bottom roller 16a and a center axis 15c of the third bottom roller 15a is adjustable by moving the third roller housing 62 along the draft path R. The second distance D2 is a distance between a line passing through the center axis 16c of the middle bottom roller 16a and perpendicular to the draft path R and another line passing through the center axis 15c of the third bottom roller 15a and perpendicular to the draft path R.

[0042] A third distance D3 between the center axis 15c of the third bottom roller 15a and a center axis 14c of the back bottom roller 14a is adjustable by moving at least

one of the back roller housing 61 and the third roller housing 62 along the draft path R. The third distance D3 is a distance between a line passing through the center axis 15c of the third bottom roller 15a and perpendicular to the draft path R and another line passing through the center axis 14c of the back bottom roller 14a and perpendicular to the draft path R.

[0043] The first distance D1, the second distance D2, and the third distance D3 are adjusted based on the effective fiber length of the sliver S. The first distance D1 is in a range between 50 mm and 65 mm, inclusive, more preferably, between 55 mm and 62 mm, inclusive. If the first distance D1 is equal to or less than 49 mm, the sliver S with an effective fiber length of 51 mm, for example, may not be drafted (which means that the fiber bundle F may not be delivered from the drafting device 6) even by driving the drafting device 6. In another case, if the first distance D1 is equal to or less than 49 mm, respective ends of a fiber as a part of the sliver S with an effective fiber length of 51 mm may be nipped by the pair of front rollers 17 and the pair of middle rollers 16, which may cause unevenness in the diameter of the fiber bundle F delivered from the pair of front rollers 17. The unevenness in the diameter of the fiber bundle F may result in unevenness in the diameter of the yarn Y generated from the fiber bundle F, and the yarn monitoring device 8 detects the portion as a yarn defect. If the first distance D1 is equal to or greater than 66 mm, neither ends of a fiber as a part of the sliver S with an effective fiber length of 51 mm may be nipped by the pair of front rollers 17 or the pair of middle rollers 16. Consequently, the drafting device 6 may not be able to control the move of the sliver S. The first distance D1 is set at a distance for drafting the sliver S with a length of 2 inches (51 mm). The first distance D1 for drafting the sliver S with a length of 2 inches is further adaptable for drafting the sliver S with a length of 1.5 inches (38 mm) .

[0044] The second distance D2 is adjusted in a range between 35 mm and 65 mm, inclusive. In other words, the third roller housing 62 is moved to have the third bottom roller 15a positioned with the second distance D2 in a range between 35 mm and 65 mm, inclusive. The range in which the third roller housing 62 moves may be larger than the range to have the second distance D2 between 35 mm and 65 mm, inclusive. If the effective fiber length of the sliver S is 38 mm, the second distance D2 is adjusted between 38 mm and 43 mm, inclusive, more preferably, between 39 mm and 42 mm, inclusive. If the effective fiber length of the sliver S is 51 mm, the second distance D2 is adjusted between 38 mm and 60 mm, inclusive, more preferably, between 50 mm and 60 mm, inclusive.

[0045] If the second distance D2 is equal to or less than 34 mm, respective ends of a fiber as a part of the sliver S with an effective fiber length of 38 mm may be nipped by the pair of front rollers 17 and the pair of middle rollers 16, which may cause unevenness in the diameter of the fiber bundle F delivered from the pair of front rollers 17. The unevenness in the diameter of the fiber bundle F may result in unevenness in the diameter of the yarn Y generated from the fiber bundle F, and the yarn monitoring device 8 detects the portion as a yarn defect. If the second distance D2 is equal to or greater than 66 mm, neither ends of a fiber as a part of the sliver S with an effective fiber length of 38 mm may be nipped by the pair of front rollers 17 or the pair of middle rollers 16. Consequently, the drafting device 6 may not be able to control the move of the sliver S, and, for example, significant unevenness in the diameter may be caused on the yarn Y. The third distance D3 will be described in the same manner.

[0046] The third distance D3 is adjusted in a range between 35 mm and 65 mm, inclusive. In other words, the back roller housing 61 is moved to have the back bottom roller 14a positioned with the third distance D3 in a range between 35 mm and 65 mm, inclusive. The range in which the back roller housing 61 moves may be larger than the range to have the third distance D3 in a range between 35 mm and 65 mm, inclusive. If the effective fiber length of the sliver S is 38 mm, the third distance D3 is adjusted in a range between 40 mm and 50 mm, inclusive, more preferably, between 42 mm and 45 mm, inclusive. If the effective fiber length of the sliver S is 51 mm, the third distance D3 is adjusted between 40 mm and 62 mm, inclusive, more preferably, between 50 mm and 60 mm, inclusive. The second distance D2 and the third distance D3 are determined to have the difference between the second distance D2 and the third distance D3 fall in a range between 3 mm and 5 mm, inclusive.

[0047] The top rollers 14b, 15b, 16b, and 17b are rotatably supported by a drafting cradle 65. The top rollers 14b, 15b, 16b, and 17b are forced to contact with the bottom rollers 14a, 15a, 16a, and 17a, respectively, at certain pressure and are rotated as driven rollers.

[0048] A side guide 66 is mounted on the side surface of the drafting cradle 65. The side guide 66 defines the distance between a center axis 17d of the front top roller 17b and a center axis 16d of the middle top roller 16b, the distance between the center axis 16d of the middle top roller 16b and a center axis 15d of the third top roller 15b, and the distance between the center axis 15d of the third top roller 15b and a center axis 14d of the back top roller 14b.

[0049] In the embodiment, the distance between the center axis 17d of the front top roller 17b and the center axis 16d of the middle top roller 16b is adjusted to the same distance as the first distance D1. The distance between the center axis 16d of the middle top roller 16b and the center axis 15d of the third top roller 15b is adjusted to the same distance as the second distance D2. The distance between the center axis 15d of the third top roller 15b and the center axis 14d of the back top roller 14b is adjusted to the same distance as the third distance D3. The side guide 66 is replaced based on the first distance D1 between the front bottom roller 17a and the middle bottom roller 16a, the second distance D2 be-

tween the middle bottom roller 16a and the third bottom roller 15a, and the third distance D3 between the third bottom roller 15a and the back bottom roller 14a. In FIG. 4, the side guide 66 is illustrated as a member made of a plate. Each of the top rollers 14b, 15b, 16b, and 17b may be positioned with respect to the drafting cradle 65 by a guide provided for each roller or for a certain number of rollers.

[0050] The drafting cradle 65 is rotatably provided between a position for having the top rollers 14b, 15b, 16b, and 17b contact with the bottom rollers 14a, 15a, 16a, and 17a, respectively, at certain pressure and a position for having the top rollers 14b, 15b, 16b, and 17b separated from the bottom rollers 14a, 15a, 16a, and 17a, respectively, with a support shaft 67 as the center. The drafting cradle 65 rotatably supports the top rollers 14b, 15b, 16b, and 17b of each of the drafting devices 6 of the spinning units 2 next to each other.

[0051] A guiding unit 71 (not illustrated in FIGs. 1 and 2) is disposed upstream of the pair of back rollers 14. The guiding unit 71 has a through-hole 71a for passing the sliver S therethrough. The guiding unit 71 guides the sliver S supplied from the can (not illustrated) onto the draft path R.

[0052] A first limiting unit 72 and a second limiting unit 73 (not illustrated in FIGs. 1 and 2) are disposed between the pair of third rollers 15 and the pair of middle rollers 16. The first limiting unit 72 and the second limiting unit 73 are sequentially disposed in this order from the downstream side in the drafting direction. The first limiting unit 72 is disposed downstream of the second limiting unit 73, and the first limiting unit 72 and the second limiting unit 73 are disposed adjacent to each other. The first limiting unit 72 has a through-hole 72a for passing the sliver S therethrough and limits the width of the sliver S to the size of the through-hole 72a. The second limiting unit 73 has a through-hole 73a for passing the sliver S therethrough and limits the width of the sliver S to the size of the through-hole 73a. The width of the through-hole 72a may be smaller than the width of the through-hole 73a.

[0053] The first limiting unit 72 is supported by a supporting member (not illustrated). The supporting member is positioned below the draft path R in the height direction of the machine and mounted on the middle roller housing 63 supporting the middle bottom roller 16a. This configuration retains the position of the first limiting unit 72 with respect to the pair of middle rollers 16.

[0054] As illustrated in FIG. 5, the second limiting unit 73 is supported by a supporting member 74. The supporting member 74 is positioned below the draft path R in the height direction of the machine and mounted on the middle roller housing 62 supporting the third bottom roller 15a. This configuration retains the position of the second limiting unit 73 with respect to the pair of third rollers 15.

[0055] The supporting member 74 has a fixing portion 74a, a supporting portion 74b, and an overhanging portion 74c. The fixing portion 74a, the supporting portion 74b, and the overhanging portion 74c are integrally formed, for example, by bending a plate member. The fixing portion 74a is fixed to the middle roller housing 62. The fixing portion 74a is fixed to the middle roller housing 62 by a screw and the like. The plate member is bent and folded in the lower end of the fixing portion 74a. This configuration increases the strength of the fixing portion 74a. The supporting portion 74b supports the second limiting unit 73. The overhanging portion 74c bends substantially perpendicularly to the fixing portion 74a and extends substantially parallel with the draft path R. The overhanging portion 74c overhangs from the upper end of the fixing portion 74a toward the third bottom roller 15a. The front end of the overhanging portion 74c is positioned close to the third bottom roller 15a. The overhanging portion 74c prevents the sliver S from being suctioned into a later-described fiber collection device 80.

[0056] The third bottom roller 15a has a cleaning device 75 (not illustrated in FIGs. 1 and 2). The cleaning device 75 removes fiber pieces attached to the outer peripheral surface of the third bottom roller 15a. The cleaning device 75 is further provided to the back bottom roller 14a.

[0057] The fiber collection device 80 (not illustrated in FIGs. 1 and 2) is disposed in the opposite side of the top rollers 14b, 15b, and 16b with the respective bottom rollers 14a, 15a, and 16a interposed therebetween. As illustrated in FIG. 6, the fiber collection device 80 includes a main body 81, a suction path 83, and a suction mouth 84. As illustrated in FIG. 6, the drafting device 6 is disposed in such a manner that inclines toward a direction in which the bottom rollers 14a, 15a, 16a, and 17a are positioned lower than the respective top rollers 14b, 15b, 16b, and 17b with the pair of back rollers 14 positioned higher and the pair of front rollers 17 positioned lower with respect to the vertical direction.

[0058] The suction path 83 is connected to a collection device such as a blower in the first end frame 4 through a suction pipe 93 provided to the machine frame 20. Fiber pieces generated in the drafting device 6 are sucked from the suction mouth 84, pass through the suction path 83 and the suction pipe 93, and are collected by the collection device. The fiber collection device 80 may be configured such that the position of the suction mouth 84 is adjustable based on at least one of the second distance D2 and the third distance D3.

[0059] A method of spinning using the spinning machine 1 will now be described. Initially, an operator sets the effective fiber length of the sliver S on the settings screen displayed on the display screen 102 through the input key 104. The effective fiber length may be automatically set by setting a lot through the input key 104, may be selected from among a plurality of options displayed on the display screen 102, or may be set by inputting the appropriate value through the input key 104. A machine control device 100 sets the effective fiber length based on information input through the input key 104. The unit

controller 10 controls the drafting device 6 based on the set effective fiber length.

[0060] The second distance D2 and the third distance D3 are adjusted in the drafting device 6. Specifically, positions of the back bottom roller 14a and the third bottom roller 15a are determined by adjusting at least one of the position of the back roller housing 61 and the position of the third roller housing 62 to have the second distance D2 and the third distance D3 adaptable to the effective fiber length set by the machine control device 100. After adjustment of the second distance D2 and the third distance D3, the spinning operation starts in the spinning unit 2. In this embodiment, the total draft ratio of the drafting device 6 is 100 to 300 times. The draft ratio between the pair of front rollers 17 and the pair of middle rollers 16 is 20 to 60 times. The draft ratio between the pair of middle rollers 16 and the pair of third rollers 15 is one to five times. The draft ratio between the pair of third rollers 15 and the pair of back rollers 14 is two to four times. The spinning speed of the spinning machine 1 is, for example, 150 to 600 meters per minute.

[0061] When the spinning operation starts, the sliver S is drafted by the drafting device 6 adjusted in the above-described manner and delivered to the air spinning device 7. The air spinning device 7 twists the fiber bundle F with swirling airflow and generates the yarn Y. The winding device 13 winds the yarn Y generated by the air spinning device 7 into the package P.

[0062] As described above, in the drafting device 6 of the spinning machine 1 according to this embodiment, the first distance D1 is set in a range between 50 mm and 65 mm, inclusive. The third roller housing 62 positions the third bottom roller 15a in a range to have the second distance D2 between 35 mm and 65 mm, inclusive. With this arrangement, the middle bottom roller 16a and the third bottom roller 15a in the drafting device 6 can be disposed at respective positions to have the second distance D2 adaptable for the effective fiber length, which can reduce drafting defects and the like. Consequently, the drafting device 6 can draft various slivers S different in the effective fiber length. More specifically, with a drafting device 6, two types of slivers S including a sliver S with an effective fiber length of 38 mm and a sliver S with an effective fiber length of 51 mm can be drafted by, for example, adjusting the position of the third bottom roller 15a. There is thus no necessity to separately have a drafting device dedicated to a fiber bundle with an effective fiber length of 38 mm and another drafting device dedicated to a fiber bundle with an effective fiber length of 51 mm.

[0063] In this embodiment, the front roller housing 64 and the middle roller housing 63 fix the positions of the front bottom roller 17a and the middle bottom roller 16a, respectively, on the draft path R. The first distance D1 is set in a range between 55 mm and 62 mm, inclusive, whereas the second distance D2 is adjusted in a range between 38 mm and 43 mm, inclusive. In this case, in the drafting device 6, the position of the third roller housing 62 is adjusted in the above-described range with the positions of the front roller housing 64 and the middle roller housing 63 unchanged. In other words, in the drafting device 6, the second distance D2 is adjusted based on the effective fiber length with the first distance D1 fixed.

[0064] The first distance D1 is set at a distance allowing drafting of both a short fiber and a long fiber. Specifically, the first distance D1 is set at a distance for drafting a long fiber with a length of 2 inches. The first distance D1 set in the above-described range allowing drafting of a long fiber with a length of 2 inches is adaptable to a short fiber with a length of 1.5 inches in addition to a long fiber with a length of 2 inches. Consequently, even when the first distance D1 is fixed to a distance for drafting a long fiber with a length of 2 inches, the distance less affects drafting a short fiber. By contrast, if the first distance is set at a distance for drafting a short fiber with a length of 1.5 inches, the distance is not adaptable for drafting a long fiber. Both a short fiber and a long fiber cannot be drafted together with the distance. As described above, the drafting device 6 according to this embodiment has the first distance D1 fixed in a manner adaptable for a long fiber with a length of 2 inches and the second distance D2 adjusted based on the effective fiber length. With this configuration, various slivers S different in the effective fiber length can be drafted using the same drafting device 6.

[0065] Conventional drafting devices have no such concepts that draft various slivers different in the effective fiber length using the same settings of a single drafting device. Such conventional drafting devices determine the distance between pairs of rollers based on the effective fiber length of a single type of sliver to be drafted and adjust supporting units and others supporting the pairs of rollers so as to have the determined distance.

[0066] A technical issue of the drafting device 6 according to this embodiment is to draft various fiber bundles different in the effective fiber length with a single unit of the drafting device 6. To resolve this technical issue, the drafting device 6 employs such a matter that the first distance D1 is fixed to the above-described range for drafting the sliver S with a length of 2 inches and the second distance D2 is adjusted based on the effective fiber length of the sliver S. This matter result from the technical issue, and the conventional drafting devices with no such technical issues thus never arrive at the configuration of the drafting device 6 according to this embodiment.

[0067] In this embodiment, the drafting device 6 includes the back roller housing 61 supporting the back bottom roller 14a of the pair of back rollers 14 and movably disposed along the draft path R. The back roller housing 61 positions the back bottom roller 14a such that the third distance D3 is in a range between 35 mm and 65 mm, inclusive. With this arrangement, the drafting device 6 can appropriately set the third distance D3 based on the effective fiber length and accordingly draft various slivers S different in the effective fiber length.

[0068] In this embodiment, the third distance D3 is adjusted in a range between 40 mm and 43 mm, inclusive. The drafting device 6 can appropriately draft various slivers S different in the effective fiber length by positioning the pair of third rollers 15 and the pair of back rollers 14 with the third distance D3 more appropriately set.

[0069] In this embodiment, the difference between the second distance D2 and the third distance D3 is adjusted in a range between 3 mm and 5 mm, inclusive. This arrangement enables the drafting device 6 to more appropriately draft the sliver S.

[0070] In this embodiment, the drafting device 6 includes the first limiting unit 72 and the second limiting unit 73 disposed between the pair of middle rollers 16 and the pair of third rollers 15 and limiting the width of the sliver S. Even if the distance between pairs of rollers next to each other is increased based on the effective fiber length, these limiting units can prevent an increase in the distance from the pair of rollers in the upstream side to the first limiting unit 72 and the second limiting unit 73. The drafting device 6 can prevent a fiber, controlling of which is difficult due to a decrease in the draft resistance, from winding on a pair of rollers.

[0071] In this embodiment, the spinning machine 1 includes the input key 104 configured to receive an input of the effective fiber length of the sliver S drafted by the drafting device 6. The spinning unit 2 includes the unit controller 10 configured to control an operations of the drafting device 6 based on the effective fiber length input through the input key 104. With this configuration, the drafting device 6 can operate based on the effective fiber length of the sliver S.

[0072] An embodiment has been described as above; however, the present invention is not limited thereto.

[0073] In the embodiment, such an exemplary configuration has been described that the front roller housing 64 and the middle roller housing 63 are immovably fixed to the machine frame 20. The front roller housing 64 and the middle roller housing 63 may be movably mounted on the machine frame 20, which means that the positions of the front bottom roller 17a and the middle bottom roller 16a may be adjustable.

[0074] In the embodiment, such an exemplary configuration has been described that the third roller housing 62 and the back roller housing 61 are movably mounted on the machine frame 20. However, the third roller housing 62 and the back roller housing 61 may be immovably fixed to the machine frame 20. In this case, the front roller housing 64 and the middle roller housing 63 are disposed such that the first distance D1 is in a range between 50 mm and 65 mm, inclusive, and the position of the middle roller housing 63 with respect to the third roller housing 62 is adjusted to have the second distance D2 in a range between 35 mm and 45 mm, inclusive.

[0075] In the embodiment, such an exemplary configuration has been described that an operator moves at least one of the position of the back roller housing 61 and the position of the third roller housing 62 and adjusts the positions of the back bottom roller 14a and the third bottom roller 15a. In another way, the positions of the back bottom roller 14a and the third bottom roller 15a may be automatically adjusted. Specifically, the back roller housing 61 and the third roller housing 62 may be moved by, for example, an actuator based on the effective fiber length of the sliver S set by the machine control device 100 of the spinning machine 1. In this manner, the layout of the drafting device 6 can be automatically adjusted based on the effective fiber length.

[0076] In the embodiment, such an exemplary configuration has been described that the center axes 14c, 15c, 16c, and 17c of the bottom rollers 14a, 15a, 16a, and 17a and the center axes 14d, 15d, 16d, and 17d of the top rollers 14b, 15b, 16b, and 17b are aligned, respectively, on the straight lines perpendicular to the draft path R. The bottom roller and the corresponding top roller may not be aligned on a straight line, and the top roller may be off-set with respect to the bottom roller in the front-to-back direction on the draft path R.

[0077] The air spinning device 7 may further include a needle retained by the fiber guiding unit and projecting into the spinning room so as to prevent twist of the fiber bundle F from spreading upstream of the air spinning device 7. In another case, instead of using the needle, the air spinning device 7 may prevent twist of the fiber bundle from spreading upstream of the air spinning device using an end in the downstream side of the fiber guiding unit. Instead of the above configuration, the air spinning device 7 may include a pair of air jet nozzles for twisting the fiber bundle F in respective directions opposite to each other.

[0078] In the spinning unit 2, the yarn storage device 11 has a function of drawing the yarn Y from the air spinning device 7; however, the yarn Y may be drawn from the air spinning device 7 by a delivery roller and a nip roller. In the case of using a delivery roller and a nip roller to draw the yarn Y from the air spinning device 7, a slack tube absorbing slack of the yarn Y with suction airflow, a mechanical compensator, or the like may replace the yarn storage device 11.

[0079] The devices in the spinning machine 1 are disposed in a manner that the yarn Y supplied in the upper side is wound in the lower side in the height direction of the machine. The devices may be disposed such that the yarn supplied in the lower side is wound in the upper side.

[0080] In the spinning machine 1, at least one of the bottom rollers of the drafting device 6 and the traverse guide 23 are driven by power from the second end frame 5 (in other words, driven by power shared by a plurality of spinning units 2). Instead of this configuration, the devices (such as the drafting device, the spinning device, and the winding device) of each spinning unit 2 may be driven on a per-spinning unit 2 basis.

[0081] The tension sensor 9 may be disposed upstream of the yarn monitoring device 8 in a direction in which the yarn Y travels. The unit controller 10 may be provided in each spinning unit 2. The waxing device 12,

the tension sensor 9, and the yarn monitoring device 8 may be omitted from each spinning unit 2.

[0082] FIG. 1 illustrates the spinning machine 1 winding the yarn into the package P in a cheese-like shape; however, the spinning machine 1 can wind yarn into a package in a corn-like shape. In the case with a package in a corn-like shape, although the yarn traverse causes slack on the yarn, the slack can be absorbed by the yarn storage device 11. Materials and shapes of the components are not limited to those described as above, and various materials and shapes may be employed.

[0083] At least a part of the above-described embodiments may be combined as appropriate.

[0084] A drafting device according to embodiments of the present disclosure drafts a fiber bundle. The drafting device includes: a plurality of pairs of rollers disposed in the order of a pair of first rollers, a pair of second rollers, and a pair of third rollers from the downstream side toward the upstream side on a draft path of the fiber bundle and having respective bottom rollers and top rollers; a first supporting unit supporting a first bottom roller of the pair of first rollers; a second supporting unit supporting a second bottom roller of the pair of second rollers; and a third supporting unit supporting a third bottom roller of the pair of third rollers and movably disposed along the draft path. The first bottom roller and the second bottom roller are disposed such that a first distance between the center axis of the first bottom roller and the center axis of the second bottom roller is in a range between 50 mm and 65 mm, inclusive. The third supporting unit positions the third bottom roller such that a second distance between the center axis of the second bottom roller and the center axis of the third bottom roller is in a range between 35 mm and 65 mm, inclusive.

[0085] The drafting device according to embodiments of the present disclosure can dispose the second bottom roller and the third bottom roller with the second distance adaptable for the effective fiber length, which prevents drafting defects and the like. The drafting device can thus draft various fiber bundles different in the effective fiber length.

[0086] The drafting device according to embodiments of the present disclosure drafts a fiber bundle. The drafting device includes a plurality of pairs of rollers disposed in the order of a pair of first rollers, a pair of second rollers, and a pair of third rollers from the downstream side toward the upstream side on the draft path of the fiber bundle and having respective bottom rollers and top rollers. The first bottom roller of the pair of first rollers and the second bottom roller of the pair of second rollers are disposed such that the first distance between the center axis of the first bottom roller and the center axis of the second bottom roller is in a range between 50 mm and 65 mm, inclusive. The second bottom roller and the third bottom roller of the pair of third rollers are disposed such that the second distance between the center axis of the second bottom roller and the center axis of the third bottom roller is in a range between 35 mm and 45 mm, inclusive.

[0087] The drafting device according to embodiments of the present disclosure can dispose the second bottom roller and the third bottom roller with the second distance adaptable for the effective fiber length, which prevents drafting defects and the like. The drafting device can thus draft various fiber bundles different in the effective fiber length.

Claims

1. A drafting device (6) configured to draft a fiber bundle supplied to an air spinning device (7) configured to generate yarn by twisting the fiber bundle, the drafting device (6) comprising:

a plurality of pairs of rollers disposed in an order of a pair of first rollers (17), a pair of second rollers (16), and a pair of third rollers (15) from a downstream side toward an upstream side on a draft path of the fiber bundle and having respective bottom rollers (17a, 16a, and 15a) and top rollers (17b, 16b, and 15b);
a first supporting unit (64) supporting a first bottom roller (17a) of the pair of first rollers (17);
a second supporting unit (63) supporting a second bottom roller (16a) of the pair of second rollers (16); and
a third supporting unit (62) supporting a third bottom roller (15a) of the pair of third rollers (15) and movably disposed along the draft path, wherein
the first bottom roller (17a) and the second bottom roller (16a) are disposed such that a first distance between a center axis (17c) of the first bottom roller (17a) and a center axis (16c) of the second bottom roller (16a) is in a range between 50 mm and 65 mm, inclusive, and
the third supporting unit (62) is configured to move along the draft path and to position the third bottom roller (15a) such that a second distance between the center axis (16c) of the second bottom roller (16a) and a center axis (15c) of the third bottom roller (15a) is in a range between 35 mm and 65 mm, inclusive.

2. The drafting device (6) according to claim 1, wherein
the first supporting unit (64) fixes a position of the first bottom roller (17a) on the draft path,
the second supporting unit (63) fixes a position of the second bottom roller (16a) on the draft path,
the first distance is in a range between 55 mm and 62 mm, inclusive, and
the second distance is adjusted in a range between 38 mm and 43 mm, inclusive.

3. The drafting device (6) according to claim 1 or 2, wherein the pairs of rollers further include a pair of

fourth rollers (14) disposed upstream of the pair of third rollers (15) and having a fourth bottom roller (14a) and a fourth top roller (14b), the drafting device (6) comprising:

a fourth supporting unit (61) supporting the fourth bottom roller (14a) and movably disposed along the draft path, wherein
the fourth supporting unit (61) is configured to move along the draft path and to position the fourth bottom roller (14a) such that a third distance between the center axis (15c) of the third bottom roller (15a) and a center axis (14c) of the fourth bottom roller (14a) is in a range between 35 mm and 65 mm, inclusive.

4. The drafting device (6) according to claim 3, wherein the third distance is adjusted in a range between 40 mm and 43 mm, inclusive.

5. The drafting device (6) according to claim 3 or 4, wherein a difference between the second distance and the third distance is adjusted in a range between 3 mm and 5 mm, inclusive.

6. The drafting device (6) according to any one of claims 1 to 4, comprising:

a first limiting unit (72) and a second limiting unit (73) disposed between the pair of second rollers (16) and the pair of third rollers (15) on the draft path and configured to limit a width of the fiber bundle.

7. The drafting device (6) according to any one of claims 1 to 6, wherein a draft ratio between the pair of first rollers (17) and the pair of second rollers (16) is 20 to 60 times.

8. The drafting device (6) according to any one of claims 1 to 7, wherein a draft ratio between the pair of second rollers (16) and the pair of third rollers (15) is one to five times.

9. A spinning machine (1) comprising:

the drafting device (6) according to any one of claims 1 to 8;
an air spinning device (7) configured to generate yarn by twisting the fiber bundle drafted by the drafting device (6); and
a winding device (13) configured to wind the yarn.

10. The spinning machine (1) according to claim 9, comprising:

an input unit (104) configured to receive an input of an effective fiber length of the fiber bundle drafted by the drafting device (6); and
a control unit (10) configured to control an operation of the drafting device (6) based on the effective fiber length input through the input unit (104).

11. A method of spinning using a spinning machine (1) including a drafting device (6) configured to draft a fiber bundle and an air spinning device (7) configured to generate yarn by twisting the fiber bundle drafted by the drafting device, the method of spinning comprising:

providing the drafting device (6) with a plurality of pairs of rollers disposed in an order of a pair of first rollers (17), a pair of second rollers (16), and a pair of third rollers (15) from a downstream side toward an upstream side on a draft path of the fiber bundle and having respective bottom rollers (17a, 16a, 15a) and top rollers (17b, 16b, 15b);
setting a first distance between a center axis (17c) of a first bottom roller (17a) of the pair of first rollers (17) and a center axis (16c) of a second bottom roller (16a) of the pair of second rollers (16) in a range between 50 mm and 65 mm, inclusive;
adjusting, if an effective fiber length of the fiber bundle is 38 mm, a second distance between the center axis (16c) of the second bottom roller (16a) and a center axis (15c) of a third bottom roller (15a) of the pair of third rollers (15) in a range between 35 mm and 45 mm, inclusive, to draft the fiber bundle with the adjusted second distance; and
adjusting, if an effective fiber length of the fiber bundle is 51 mm, the second distance in a range between 35 mm and 65 mm, inclusive, to draft the fiber bundle with the adjusted second distance.

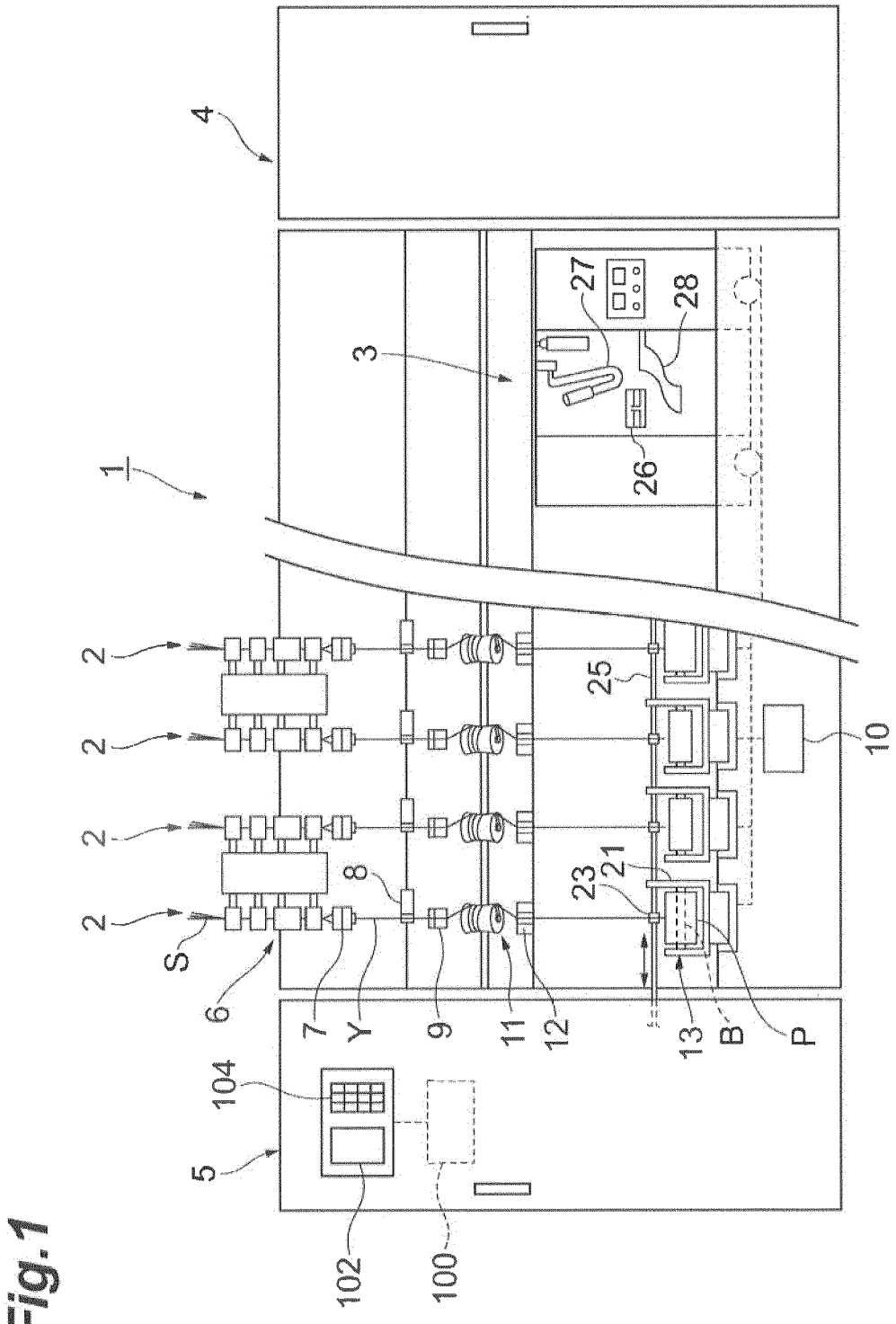

Fig.1

Fig.2

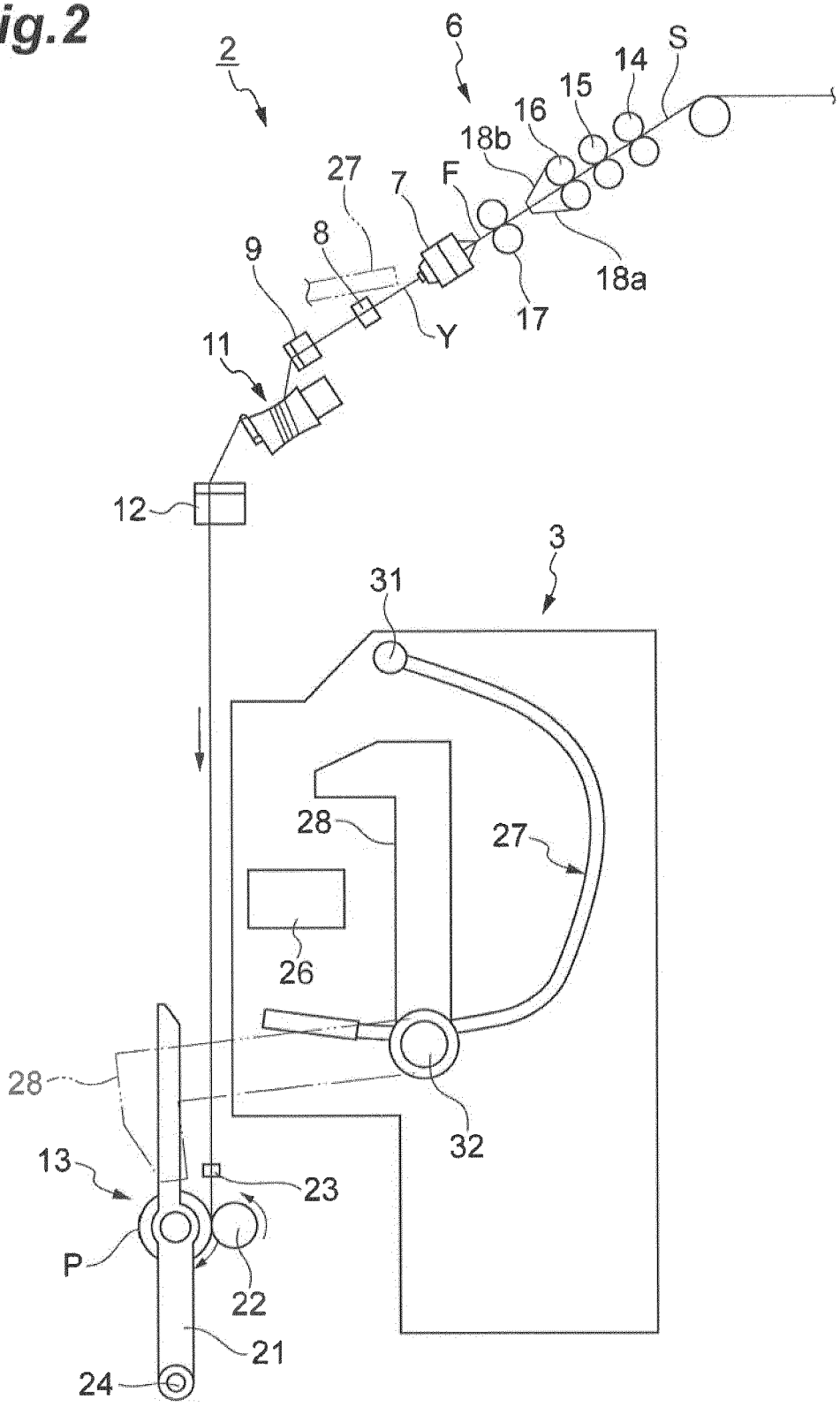
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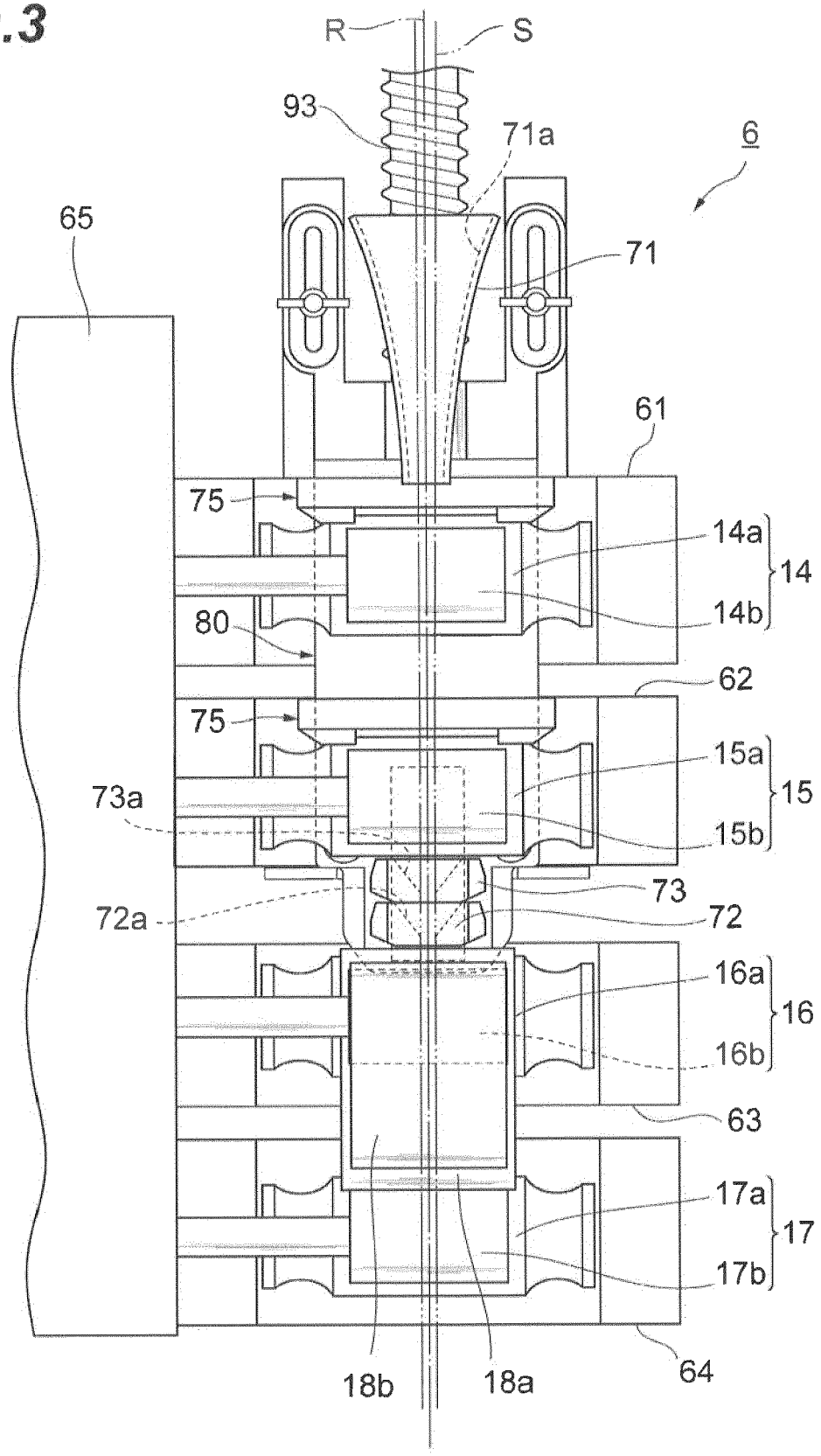
Fig.3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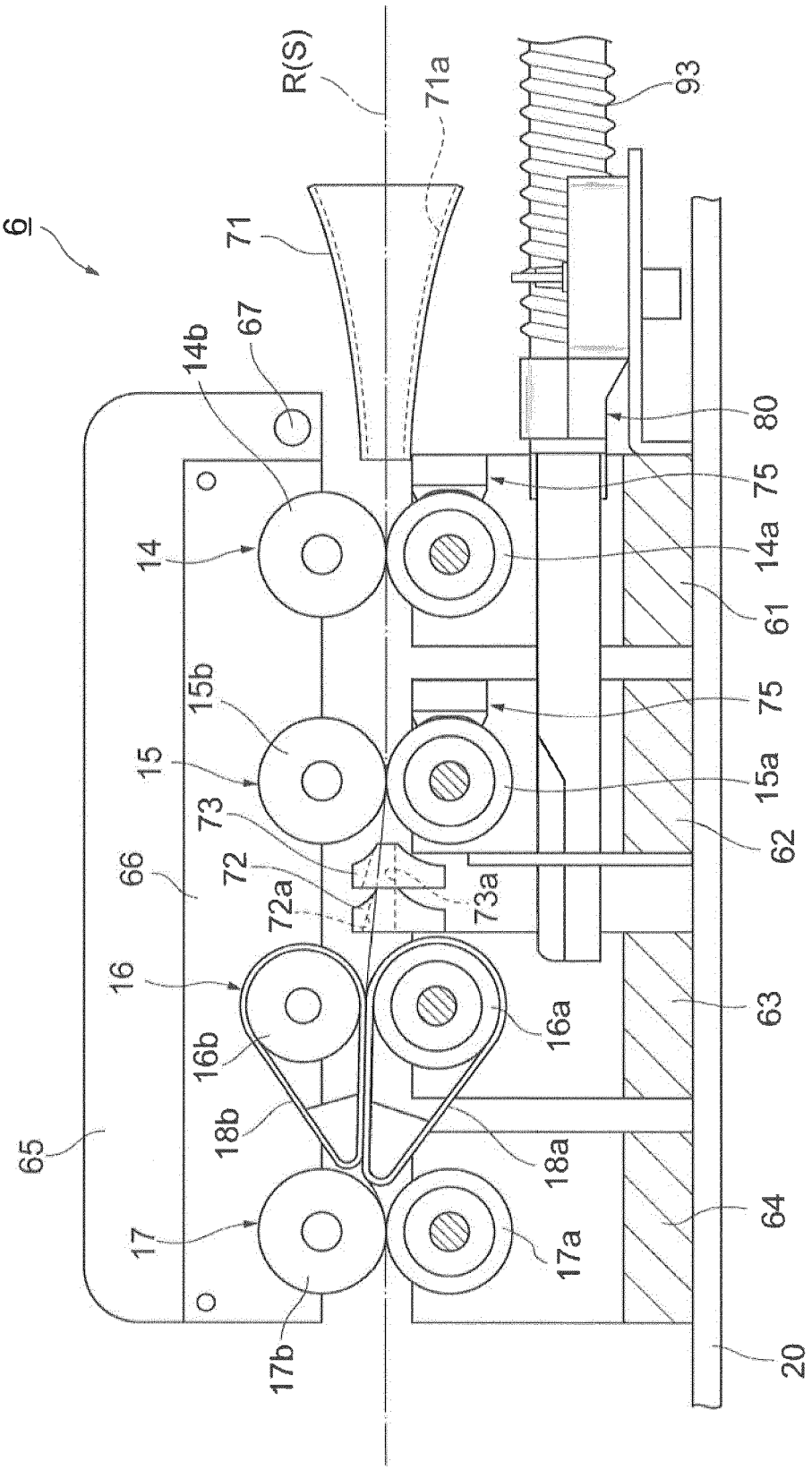
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17b
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Fig.4

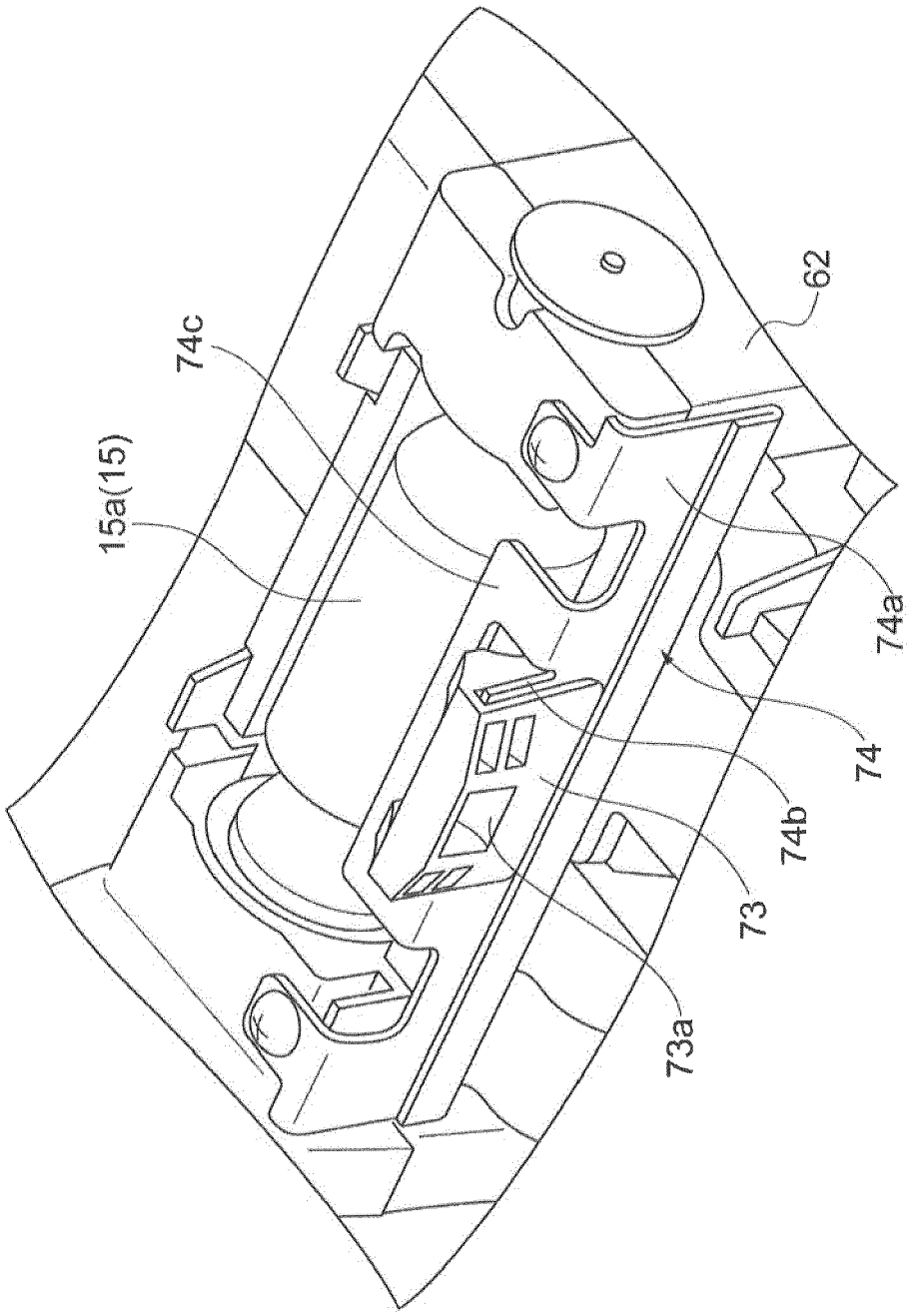
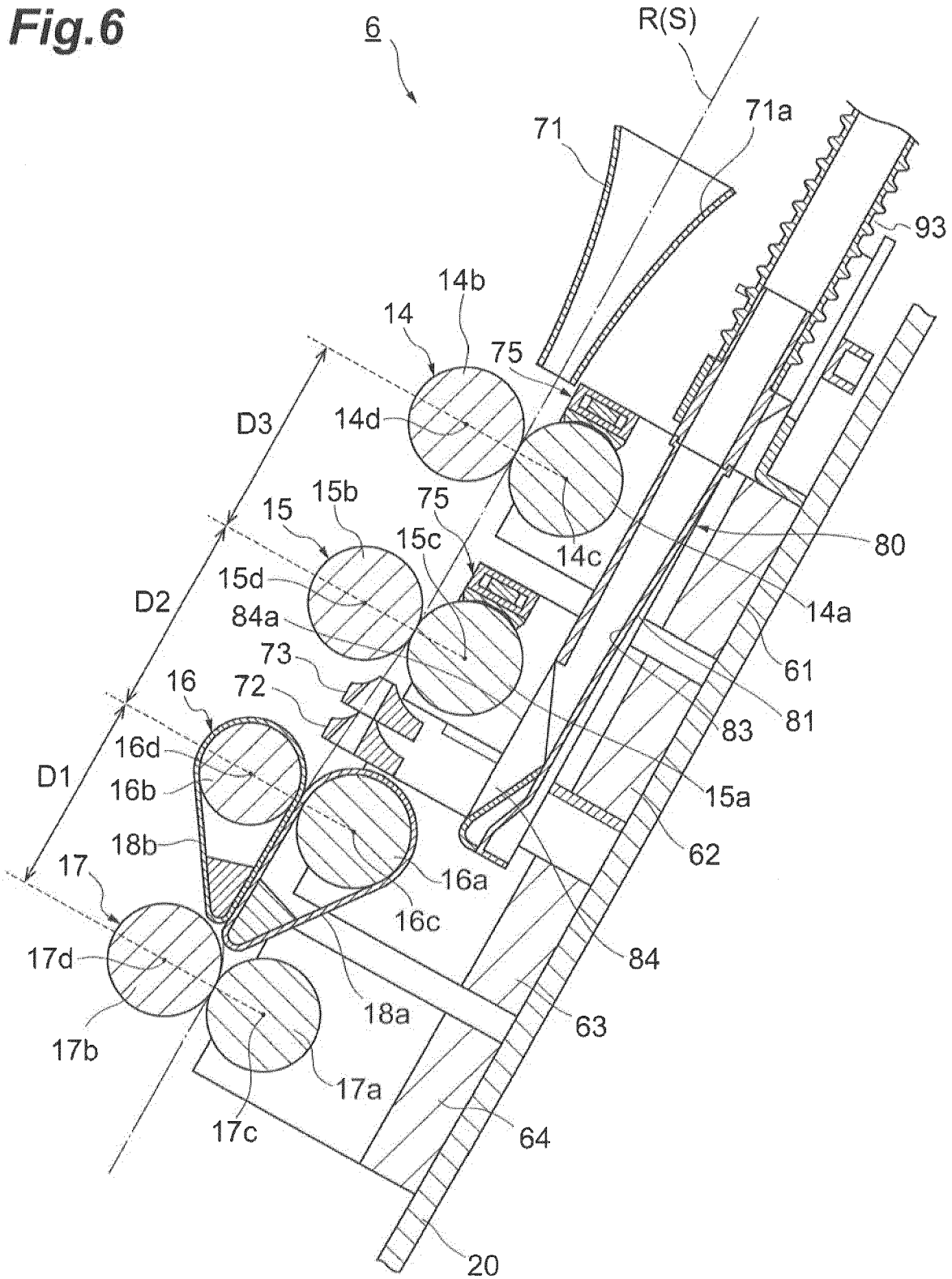


Fig.5

Fig.6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EUROPEAN SEARCH REPORT

Application Number
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REFERENCES CITED IN THE DESCRIPTION

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