(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 020 854 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.05.2016 Bulletin 2016/20

(21) Application number: **15190812.6**

(22) Date of filing: **21.10.2015**

(51) Int Cl.:
D01H 5/26 *(2006.01)* ***D01H 5/50*** *(2006.01)*
D01H 5/56 *(2006.01)* ***D01H 5/66*** *(2006.01)*
D01H 5/74 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **13.11.2014 JP 2014230926**

(71) Applicant: **Murata Machinery, Ltd.**
Minami-ku
Kyoto-shi
Kyoto 601-8326 (JP)

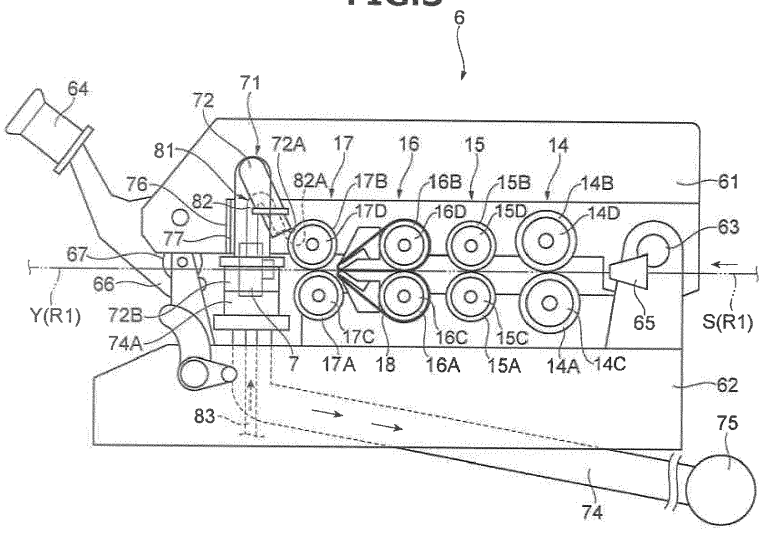
(72) Inventors:
- **IJIMA, Kosuke**
  Kyoto-shi, Kyoto 612-8686 (JP)
- **OKA, Masaki**
  Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Stöckeler, Ferdinand**
Schoppe, Zimmermann, Stöckeler
Zinkler, Schenk & Partner mbB
Patentanwälte
Radlkoferstrasse 2
81373 München (DE)

(54) DRAFTING DEVICE AND SPINNING UNIT

(57) A drafting device (6) that drafts a fiber bundle includes plural drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) arranged in a direction in which the fiber bundle is conveyed, the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) being arranged as plural roller pairs (14, 15, 16, 17), each roller pair (14, 15, 16, 17) having a top roller (14B, 15B, 16B, 17B) and a bottom roller (14A, 15A, 16A, 17A) opposing the top roller (14B, 15B, 16B, 17B); a supporting member (61; 71) that supports the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B); and a resonance preventing structure (77B; 95; 96; 109; 117) that prevents occurrence of resonance between the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) and the supporting member (61; 71) that may be caused by rotation of the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B).

FIG.3



EP 3 020 854 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a drafting device and a spinning unit.

2. Description of the Related Art

[0002] In a spinning unit and a spinning machine that are known, spun yarn is produced by causing a drafting device to draft a fiber bundle and causing an air spinning device to twist the drafted fiber bundle. Japanese Patent Application Laid-open No. 2011-32618 (Patent Document 1) discloses a drafting device in which a drafting roller is cleaned by a pad member capable of being in contact with the outer circumferential surface of the drafting roller. In the drafting device disclosed in Patent Document 1, resonance between the drafting roller and the pad member that may be caused by the rotation of the drafting roller is prevented by pressing the pad member against the drafting roller with the use of a torsion spring. Consequently, it is possible to prevent physical properties of the yarn from being degraded due to the resonance between the drafting roller and the pad member.

SUMMARY OF THE INVENTION

[0003] However, the conventional drafting device has room for improvement from the viewpoint of preventing the physical properties of the yarn from being degraded.

[0004] It is an object of the present invention to provide a drafting device and a spinning unit capable of preventing degradation of the physical properties of yarn.

[0005] According to an aspect of the present invention, a drafting device that drafts a fiber bundle includes plural drafting rollers arranged successively in a direction in which the fiber bundle is conveyed, the drafting rollers being arranged as plural roller pairs, each roller pair having a top roller and a bottom roller opposing the top roller; a supporting member that supports the drafting rollers; and a resonance preventing structure that prevents occurrence of resonance between the drafting rollers and the supporting member that may be caused by rotation of the drafting rollers.

[0006] According to another aspect of the present invention, a spinning unit includes the above drafting device; a spinning device that forms yarn by twisting the fiber bundle drafted by the drafting device; a winding device that winds the yarn supplied thereto from the spinning device into a package; and a controlling section that prohibits the drafting rollers from being driven at such a speed that causes the drafting rollers to resonate with the supporting member in the drafting device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

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 shown in FIG. 1.
FIG. 3 is a side view of a drafting device shown in FIG. 2.
FIG. 4 is another side view of the drafting device shown in FIG. 2;
FIG. 5 is a front view of a suction member shown in FIGS. 3 and 4.
FIG. 6 is an exploded perspective view of a cradle in the drafting device.
FIG. 7A is a partial enlarged view of a cover part shown in FIG. 6.
FIG. 7B is a cross-sectional view at the line VIIB-VIIB in FIG. 7A.
FIG. 8 is a perspective view of front top rollers shown in FIG. 6.
FIG. 9 is a plan view of bottom rollers in the drafting device shown in FIG. 2.
FIG. 10 is a functional block diagram showing functions of the spinning machine.

DETAILED DESCRIPTION

[0008] Exemplary embodiments of the present invention are explained in detail below with reference to the accompanying drawings. The same or corresponding elements in the drawings will be referred to by using the same reference characters, and duplicate explanations thereof will be omitted. The dimensional proportions in the drawings are not necessarily the same as those in the explanation.

[0009] As shown in FIG. 1, a spinning machine 1 includes plural spinning units 2, a yarn joining carrier 3, a first end frame 5A, and a second end frame 5B. The plural spinning units 2 are arranged in a line. In the below explanation, on a path on which a yarn Y runs (i.e., a yarn path), the side on which the yarn Y is formed will be referred to as the upstream side, whereas the side on which the yarn Y is wound will be referred to as the downstream side.

[0010] Each spinning unit 2 forms a yarn Y and winds the formed yarn Y into a package P. When the yarn Y is disconnected in any of the spinning units 2 or when the yarn Y is broken for some reason, the yarn joining carrier 3 performs a yarn joining operation in that spinning unit 2.

[0011] The first end frame 5A houses therein an air source that generates a swirling air current in various components of the spinning units 2 and/or a suction source that generates a suction air current in various components of the spinning units 2, and the like.

[0012] The second end frame 5B houses therein a driving motor and the like to supply power to various com-

ponents of the spinning units 2. The second end frame 5B includes a main controlling device 55, a display section D, and one or more input keys K.

[0013] The main controlling device 55 controls and manages each component of the spinning machine 1 in a centralized manner. The display section D displays specifics of settings and/or information related to the state of the spinning units 2. An operator can perform various settings in the spinning units 2 by appropriately operating the input keys K.

[0014] 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 running direction of the yarn Y in the stated order from the upstream side. These devices are directly or indirectly supported by a machine frame 62, in such a manner that the devices positioned on the upstream side are positioned higher in the height direction of the machine (i.e., the devices positioned on the downstream side are positioned lower in the height direction of the machine).

[0015] One unit controller 50 is arranged for each predetermined number of the spinning units 2. The unit controller 50 controls operations of the spinning units 2. The unit controller 50 controls the operations of the spinning units 2 based on information (signal) output from the main controlling device 55.

[0016] The drafting device 6 drafts a sliver (a fiber bundle) S. The drafting device 6 includes a back roller pair 14, a third roller pair 15, a middle roller pair 16, and a front roller pair 17. These rollers are arranged in the running direction of the sliver S in the stated order from the upstream side.

[0017] The air spinning device 7 forms the yarn Y by twisting a fiber bundle F drafted by the drafting device 6 by using the swirling air current. More specifically (although not shown), the air spinning device 7 includes a spinning chamber, a fiber guiding member, one or more swirling air current generating nozzles, and a hollow guide shaft body. The fiber guiding member guides to the spinning chamber the fiber bundle F supplied thereto from the upstream drafting device 6. The swirling air current generating nozzles are arranged around the path on which the fiber bundle F runs. As a result of the force of air injected from the swirling air current generating nozzles, the swirling air current is generated in the spinning chamber. The swirling air current causes ends of multiple fibers constituting the fiber bundle F to be reversed and swirled. The hollow guide shaft body guides the yarn Y from the inside of the spinning chamber to the outside of the air spinning device 7.

[0018] The yarn monitoring device 8 is arranged between the air spinning device 7 and the yarn pooling device 11. The yarn monitoring device 8 is an optical yarn monitoring device that detects the state of the yarn Y by irradiating light on the running yarn Y. The yarn monitoring device 8 monitors the state of the running yarn Y and detects whether the yarn Y has any yarn defect. When the yarn monitoring device 8 detects a yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 50. As the yarn defect, the yarn monitoring device 8 detects, for example, an abnormal thickness of the yarn Y and/or foreign material in the yarn Y. The yarn monitoring device 8 also detects yarn breakage.

[0019] 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 50. When the unit controller 50 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 50 causes the yarn Y to be disconnected in the specific spinning unit 2. More specifically, the yarn Y is cut 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 fed-out 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 package holding part 21, a winding drum 22, and a traverse guide 23.

[0023] The package holding part 21 rotatably supports the bobbin B. The package holding part 21 is swingably supported by a support shaft 24. The package holding part 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 5B 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 are rotated in the winding direction in the spinning units 2. The traverse guides 23 of plural spinning units 2 are arranged on a shaft 25 that is shared among the 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 5B driving the shaft 25 to reciprocate in the rotation axis direction of the winding drum 22.

[0024] When the yarn Y is disconnected or when the yarn Y is broken for some reason in any of the spinning units 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 suction pipe 31, a yarn joining device 37, a suction mouth 38, and a yarn joining carrier controlling section 3A.

[0025] The suction pipe 31 is swingably supported by a support shaft 31A. The suction pipe 31 catches the yarn Y from the air spinning device 7 and guides the yarn Y to the yarn joining device 37. The suction mouth 38 is swingably supported by a support shaft 38A. The suction mouth 38 catches the yarn Y from the winding device 13 and guides the yarn Y to the yarn joining device 37. The yarn joining device 37 joins the yarns Y that were guided thereto. The yarn joining device 37 can be a splicer that uses compressed air, a piecer that uses seed yarn, or a knotter that mechanically joins the yarns Y. The yarn joining carrier controlling section 3A performs various control operations on the yarn joining carrier 3.

[0026] 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 package holding part 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 reverse rotating roller 36 arranged in the yarn joining carrier 3.

[0027] 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 R1 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 R1. The middle roller pair 16 includes a middle bottom roller 16A and a middle top roller 16B opposing each other across the running path R1. An apron belt 18A is stretched over the middle bottom roller 16A of the middle roller pair 16. An 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 R1. The drafting roller pairs 14, 15, 16, and 17 send the sliver S supplied from a not-shown can and guided by a fiber bundle guide 65, from the upstream side to the downstream side, while drafting the sliver S.

[0028] The bottom rollers 14A, 15A, 16A, and 17A are supported by rotation shafts 14C, 15C, 16C, and 17C, respectively. The rotation shafts 14C, 15C, 16C, and 17C are supported by the machine frame 62 via bearings. For example, the front bottom roller 17A is supported by the machine frame 62 via bearings 117 shown in FIG. 9. Together with the rotation shafts 14C, 15C, 16C, and 17C, respectively, the bottom rollers 14A, 15A, 16A, and 17A are driven to rotate by the driving motor arranged in the second end frame 5B or a driving motor arranged in each spinning unit 2. As shown in FIG. 9, in the present embodiment, the bottom rollers 14A and 15A are driven by driving motors arranged in each spinning unit 2, and the bottom rollers 16A and 17A are driven by driving motors 120A and 120B arranged in the second end frame 5B, respectively.

[0029] As shown in FIGS. 3 and 4, the top rollers 14B, 15B, 16B, and 17B are rotatably supported by the support shafts 14D, 15D, 16D, and 17D, respectively. The support shafts 14D, 15D, 16D, and 17D are supported by a cradle 61 via roller supporting structures 90, 90, and 90 (see FIG. 6). The top rollers 14B, 15B, 16B, and 17B are attached to the cradle 61 while being positioned so as to oppose the bottom rollers 14A, 15A, 16A, and 17A, respectively. The top rollers 14B, 15B, 16B, and 17B are driven rollers that are driven to rotate while being in contact with the bottom rollers 14A, 15A, 16A, and 17A, respectively.

[0030] The cradle 61 is swingable about a support shaft 63 between a position (hereinafter, "contact position") at which the top rollers 14B, 15B, 16B, and 17B are in contact with the bottom rollers 14A, 15A, 16A, and 17A, respectively, with predetermined pressure (see FIG. 3) and another position at which the top rollers 14B, 15B, 16B, and 17B are separated from the bottom rollers 14A, 15A, 16A, and 17A, respectively (see FIG. 4).

[0031] The swinging of the cradle 61 is realized by operating a handle 64 arranged on the cradle 61. When the cradle 61 is closed, i.e., when the cradle 61 is in the contact position, a hook part 66 arranged at the lower tip end of the handle 64 is engaged with a fixation roller 67 of the machine frame 62, so that the top rollers 14B, 15B, 16B, and 17B are held in contact with and pressed against the bottom rollers 14A, 15A, 16A, and 17A, respectively.

[0032] The cradle 61 rotatably supports the top rollers 14B, 15B, 16B, and 17B in the drafting devices 6 included in a pair of adjacent spinning units 2. In other words, the cradle 61 is shared by the drafting devices 6, each of which is included in a different one of the two adjacent spinning units 2.

[0033] The drafting device 6 according to the present embodiment includes a suction member (a supporting member) 71 and a blowing member 81. The suction member 71 sucks in fiber waste scattered by the top rollers 14B, 15B, 16B, and 17B. In the present embodiment, the suction member 71 sucks in fiber waste scattered by the front top roller 17B. As shown in FIGS. 3 to 5, the suction member 71 includes a first suction transport tube (a tubular part) 72 and a second suction transport tube 74.

[0034] A suction port 72A is arranged on one end of the first suction transport tube 72. Foreign matter such as fiber waste sucked by the suction port 72A are transported through the first suction transport tube 72. The first suction transport tube 72 is supported by a fixed part 76 of the cradle 61 via a fixing part (a resonance preventing structure) 77. The suction port 72A is positioned downstream of the front top roller 17B and slightly above the contact (nip) position between the front top roller 17B

and the front bottom roller 17A. The suction port 72A is positioned so as to face the front top roller 17B. A first connecting member 72B is arranged on the other end of the first suction transport tube 72.

[0035] The fixing part 77 (see FIG. 5) is a plate-like member. A main surface 77A of the fixing part 77 is fixed to the cradle 61 (see FIGS. 3 and 4) so as to be orthogonal to (so as to intersect) the direction in which the drafting rollers pairs 14, 15, 16, and 17 (which hereinafter may simply be referred to as "drafting rollers") are arranged. More specifically, the first suction transport tube 72 is fixed to the fixed part 76, as a result of fixing members being inserted and being fixed into insertion holes 77C formed in the fixing part 77 and insertion holes (not shown) formed in the cradle 61. The main surface 77A of the fixing part 77 has formed thereon a third reinforcing part (a resonance preventing structure) 77B that protrudes in the thickness direction of the fixing part 77 toward the downstream side with respect to the conveying direction of the sliver S. The third reinforcing part 77B is formed by applying extruding processing to the fixing part 77, which is the plate-like member, from one of the surfaces thereof. The thickness of the third reinforcing part 77B can be equal to or different from the thickness of other parts that do not protrude in the thickness direction.

[0036] A not-shown second reinforcing part can be arranged on the first suction transport tube 72. More specifically, the second reinforcing part can be formed by processing the external surface of the first suction transport tube 72 and it is a part that is arranged along the axial direction of the first suction transport tube 72. The second reinforcing part is a reinforcing part that can be arranged to protrude from the inside toward the outside of the first suction transport tube 72 or can be thickened in the thickness direction of the first suction transport tube 72.

[0037] The second suction transport tube 74 is connectable to the first suction transport tube 72. The fiber waste sucked by the suction port 72A is transported through the second suction transport tube 74 via the first suction transport tube 72. The second suction transport tube 74 is fixed to the machine frame 62.

[0038] A second connecting member 74A is arranged on one end of the second suction transport tube 74. The second connecting member 74A is a part that enables the second suction transport tube 74 to be connected to and disconnected from the first connecting member 72B of the first suction transport tube 72. When the cradle 61 is closed so as to be in the contact position, the second connecting member 74A makes contact with the first connecting member 74B. When the first connecting member 72B makes contact with the second connecting member 74A, the first suction transport tube 72 and the second suction transport tube 74 are connected to each other.

[0039] The other end of the second suction transport tube 74 is connected to a main tube 75. The main tube 75 is positioned on the rear side of the spinning units 2 and serves as a suction transport tube shared among plural the spinning units 2. The main tube 75 is connected to a blower (a suction source) arranged in the first end frame 5A.

[0040] The blowing member 81 removes fiber waste accumulated in the air spinning device 7 by blowing compressed air. In the present embodiment, when a yarn disconnection and/or a yarn breakage occur in any of the spinning units 2, the hollow guide shaft body of the air spinning device 7 moves away (opens) from the fiber guiding member. In that situation, the blowing member 81 removes fiber waste by blowing the compressed air onto the air spinning device 7 (more specifically, the entrance of the fiber guiding member). The blowing member 81 includes a blowing outlet 82A, a first blowing tube 82, and a second blowing tube 83.

[0041] The blowing outlet 82A is arranged on one end of the first blowing tube 82. The blowing member 81 sends the compressed air to the blowing outlet 82A via the first blowing tube 82 and blows the compressed air onto the air spinning device 7. The first blowing tube 82 is positioned with respect to the corresponding one of the first suction transport tubes 72. The other end of the first blowing tube 82 is connected to the first connecting member 72B.

[0042] The second blowing tube 83 is connectable to the first blowing tube 82. The compressed air is sent to the first blowing tube 82 and the blowing outlet 82A via the second blowing tube 83. The second blowing tube 83 is fixed to the machine frame 62. One end of the second blowing tube 83 is connected to the second connecting member 74A. The other end of the second blowing tube 83 is connected to a not-shown air source via a not-shown valve.

[0043] As shown in FIG. 6, the cradle 61 of the drafting devices 6 according to the present embodiment includes the roller supporting structures 90, 90, and 90, as well as a cover part 91. The cover part 91 is formed in the shape of a bottomless hollow box by using a metal plate (a plate-like member). The cover part 91 includes attachment parts 92 and 92.

[0044] The attachment parts 92 and 92 are parts formed by perpendicularly bending lower parts of the lateral faces of the cover part 91 outwardly and are used to fix the cover part 91 and the roller supporting structures 90, 90, and 90 to each other. The cover part 91 and the roller supporting structures 90, 90, and 90 are fixed to each other as a result of inserting and fixing insertion fixing parts 92B into insertion holes 90A, 90A, and 90A formed in the roller supporting structures 90 and into insertion holes 92A formed in the attachment parts 92 and 92.

[0045] As shown in FIG. 7A, a triangular rib (a resonance preventing structure) 95 and plural first reinforcing parts (resonance preventing structures) 96 are formed on at least one lateral face 94 of the cover part 91. The lateral face 94 is a face orthogonal to (intersecting) the axial directions of the top rollers 14B, 15B, 16B, and 17B. The lateral face 94 is formed by applying bending

processing to the plate-like member. In other words, the lateral face 94 is formed by applying the bending processing to a position between the attachment part 92 and the lateral face 94 and to a position between the lateral face 94 and a top face 93.

[0046] The triangular rib 95 is a rib formed in the section to which the bending processing was applied and which is positioned between the attachment part 92 and the lateral face 94. As shown in FIG. 7B, the triangular rib 95 diagonally connects the attachment part 92 and the lateral face 94 to each other. The triangular rib 95 is formed at a position that overlaps with the position of the support shaft 17D supporting the front top roller 17B (see FIG. 6) in a planar view of the cover part 91 from above.

[0047] As shown in FIG. 7A, each first reinforcing part 96 is formed on the lateral face 94 so as to protrude in the thickness direction of the plate-like member forming the lateral face 94, i.e., in the direction from the inside toward the outside of the cover part 91. Plural first reinforcing parts 96 extend in the direction orthogonal to (intersecting) the axial directions of the top rollers 14B, 15B, 16B, and 17B and to the direction in which the drafting rollers are arranged. Each first reinforcing part 96 is arranged along the direction in which the drafting rollers are arranged. The first reinforcing parts 96 are reinforcing parts formed by applying extruding processing to the lateral face 94, which is the plate-like member, from the rear surface thereof. The thickness of each of the first reinforcing parts 96 can be equal to or different from the thickness of other parts that do not protrude in the thickness direction. One of the first reinforcing parts 96 is formed at a position that overlaps the position of the support shaft 17D supporting the front top roller 17B in a planar view of the cover part 91 from above. The first reinforcing parts 96 can be formed by increasing the thickness of the plate-like member in a part thereof.

[0048] Plural pressing mechanisms 100 are arranged on the inside of the cover part 91 for the purpose of nipping the sliver S between the top rollers 14B, 15B, 16B, and 17B and the bottom rollers 14A, 15A, 16A, and 17A. Explanation will be given below by taking the pressing mechanism 100 of the front top rollers 17B as an example. As shown in FIG. 8, the pressing mechanism 100 includes a spring holding frame 101, a pressing spring 102, a pressing force adjusting cam 103, and a pressing member 104.

[0049] The spring holding frame 101 is a metal-plate member formed around the pressing spring 102 and is attached to the roller supporting structure 90. The spring holding frame 101 is a hollow member whereby the pressing spring 102, the pressing force adjusting cam 103, and the pressing member 104 can be housed in the space thereof.

[0050] The pressing spring 102 is a coil spring and is installed in the spring holding frame 101 in a compressed state. The pressing force adjusting cam 103 is attached to one end of the pressing spring 102, whereas the pressing member 104 is attached to the other end of the pressing spring 102. The pressing force adjusting cam 103 includes an operating tool 105. The pressing force adjusting cam 103 can be expanded and compressed in the axial directions by rotating the operating tool 105. The operating tool 105 protrudes to the outside through a through hole 101A formed through the spring holding frame 101.

[0051] The pressing member 104 includes a receiving plate 107 that is disc-shaped and that receives the end of the pressing spring 102, as well as a pressing pin 110 that is in the shape of a round rod. A through hole 90B is formed through the roller supporting structure 90 into which the pressing pin 110 can be inserted. The pressing pin 110 is inserted into the through hole 90B from above so as to project into the inside of the roller supporting structure 90. The through hole 90B supports the pressing pin 110 in such a manner that the pressing pin 110 is slidable in the longitudinal direction.

[0052] The end (the lower end) of the pressing pin 110 inserted in the through hole 90B is in contact with a center part, in terms of the axial direction, of the support shaft (a first rod member, a second rod member) 17D for the front top rollers 17B so as to press the support shaft 17D downward with an elastic force of the pressing spring 102. As a result, it is possible to press the front top rollers 17B and 17B supported on the two ends of the support shaft 17D against the opposing front bottom rollers 17A and 17A, respectively.

[0053] A wave washer (a damper) 109 is arranged in a penetrated state on the outside of the operating tool 105 of the pressing force adjusting cam 103. As shown in FIG. 6, under a state in which the pressing mechanism 100 is housed in the cover part 91, the wave washer 109 is held as being sandwiched between the top face 101B of the spring holding frame 101 and the top face 93 of the cover part 91. In place of the wave washer 109, an air damper or a hydraulic damper may be arranged.

[0054] The configuration of each of the pressing mechanisms 100 of the back top rollers 14B, the third top rollers 15B, and the middle top rollers 16B is the same as the configuration of the pressing mechanism 100 of the front top rollers 17B. Therefore, detailed explanations thereof will be omitted. The support shafts 14D, 15D, 16D, and 17D supporting the top rollers 14B, 15B, 16B, and 17B, respectively, are urged by the pressing springs 102 so as to press the bottom rollers 14A, 15A, 16A, and 17A. As a result, the sliver S can be nipped between the top rollers 14B, 15B, 16B, and 17B and the bottom rollers 14A, 15A, 16A, and 17A.

[0055] As shown in FIG. 8, the diameter ϕ of the support shaft 17D supporting the front top rollers 17B may be arranged, preferably, to fall in the range from 8.5% to 11.5% inclusive of a distance P1 between the front top rollers 17B provided on the two ends of the support shaft 17D and may be arranged, more preferably, to fall in the range from 9.0% to 10.0% inclusive of the distance P1. The distance P1 between the front top rollers 17B and 17B arranged on the two ends of the support shaft 17D

denotes the distance between the centers of the front top rollers 17B and 17B along the length of the support shaft 17D in the axial direction. The diameter of each of the support shafts 14D to 16D can be equal to that of the support shaft 17D.

[0056] As shown in FIG. 9, the rotation shaft 17C (a third rod member) supporting the front bottom rollers 17A is supported with respect to the machine frame 62 via the bearings 117. The rotation shaft 17C is connected to the driving motor 120B arranged in the second end frame 5B and is driven by the driving motor 120B. The bearings 117 are fixed to fixed parts 118 that are fixed to the machine frame 62. As a result, the rotation shaft 17C is rotatably supported with respect to the fixed parts 118, i.e., the machine frame 62.

[0057] In the spinning machine 1 according to the present embodiment, the two bearings 117 (e.g., a bearing (a first bearing) 117A and another bearing (a second bearing) 117B) are positioned adjacent to each other in the axial direction of the rotation shaft 17C. The number of the balls in the bearing 117A is different from the number of the balls in the bearing 117B.

[0058] Next, a driving control carried out with respect to the drafting rollers by the main controlling device 55, which is one of the characteristic features of the present embodiment, will be explained, with reference to FIG. 10. The main controlling device 55 includes a Central Processing Unit (CPU), a Read-Only Memory (ROM), a Random Access Memory (RAM), and the like. As shown in FIG. 10, the main controlling device 55 includes a prohibiting section (a controlling section) 55A and a storage section 55B, as conceptual parts that execute a controlling process with respect to the drafting rollers of the drafting devices 6.

[0059] The main controlling device 55 receives a setting of a rotational speed of the drafting rollers from an operator via the input keys K. The storage section 55B stores therein the rotational speed of the drafting rollers per unit time, when the drafting rollers resonate with other members (e.g., the cradle 61, the rotation shafts 14C, 15C, 16C, and 17C, the suction member 71, the bearings 117, and the like.). For example, when the drafting rollers and any of the other members resonate with each other while the drafting rollers are driven to rotate at a rotational speed of 433 m/min, the rotational speeds in the range of $433 \pm \alpha$ m/min can be stored in the storage section 55B.

[0060] When a desired rotational speed is input by the operator via the input keys K, the prohibiting section 55A checks whether the input value corresponds with a value stored in the storage section 55B. When having confirmed that the input value corresponds with the value stored in the storage section 55B, the prohibiting section 55A controls the display section D so as to display that it is not possible to set the input rotational speed. On the contrary, when having confirmed that the input value does not correspond with the value stored in the storage section 55B, the prohibiting section 55A controls the driving motors (e.g., the driving motors 120A and 120B) so as to drive the drafting rollers at the rotational speed corresponding to the input value.

[0061] Advantageous effects of the drafting device 6 according to the above embodiments will be explained below. By using the drafting device 6 according to the present embodiment, it is possible to prevent the occurrence of resonance between the supporting members, which directly or indirectly support the drafting rollers, and the drafting rollers that may be caused by the rotation of the drafting rollers. As a result, it is possible to prevent degradation of the physical properties of the yarn.

[0062] In the above embodiments, because the lateral face 94 of the cradle 61 is reinforced by the triangular rib 95 as shown in FIG. 7A, it is possible to reduce vibration of the cradle 61 caused by the rotation of the top rollers 14B, 15B, 16B, and 17B. As a result, it is possible to prevent the occurrence of resonance between the cradle 61, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0063] In the above embodiments, the first reinforcing parts 96 are formed on the lateral face 94 of the cradle 61, as shown in FIG. 7A. Each first reinforcing part 96 extends in the direction that intersects the direction in which vibration is applied by the top rollers 14B, 15B, 16B, and 17B. The first reinforcing parts 96 are arranged side by side along the direction in which the vibration is applied by the top rollers 14B, 15B, 16B, and 17B. With these arrangements, vibration of the cradle 61 in the direction in which the vibration is applied by the top rollers 14B, 15B, 16B, and 17B is inhibited. As a result, it is possible to prevent the occurrence of resonance between the cradle 61, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0064] In the above embodiments, the diameter ϕ of the support shaft 17D is, as shown in FIG. 8, arranged to fall in the range from 8.5% to 11.5% inclusive of the distance P1 between the front top rollers 17B and 17B arranged on the two ends of the support shaft 17D. As a result, it is possible to prevent the occurrence of resonance between the support shaft 17D, which serves as a supporting member, and the drafting rollers (the front top rollers 17B) that may be caused by the rotation of the drafting rollers.

[0065] In the above embodiments, by arranging the wave washer 109 between the cradle 61 and the pressing spring 102 as shown in FIG. 8, it is possible to prevent the vibration transmitted from the support shaft 17D from being further transmitted to the cradle 61. As a result, it is possible to prevent the occurrence of resonance between the cradle 61, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0066] In the above embodiments, because the fixing part 77 is reinforced by the third reinforcing part 77B as shown in FIG. 5, it is possible to reduce vibration of the fixing part 77 that may be caused by the rotation of the

top rollers 14B, 15B, 16B, and 17B. As a result, it is possible to prevent the occurrence of resonance between the suction member 71, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0067] In the above embodiments, as shown in FIG. 5, the third reinforcing part 77B protruding in the direction in which the vibration is applied by the top rollers 14B, 15B, 16B, and 17B is formed on the main surface 77A of the fixing part 77. With this arrangement, it is possible to inhibit the vibration of the fixing part 77 in the direction in which the vibration is applied by the top rollers 14B, 15B, 16B, and 17B. As a result, it is possible to prevent the occurrence of resonance between the suction member 71, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0068] In the above embodiments, the bearing 117A and the bearing 117B are positioned adjacent to each other as shown in FIG. 9. The bearing 117A includes the balls of which the number is adjusted to be different from the number of the balls in the bearing 117B. As a result, it is possible to prevent the occurrence of resonance between the bearings 117, which serve as supporting members, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0069] In the above embodiments, it is prohibited to set the drafting rollers to be driven at such a rotational speed at which the drafting rollers may resonate with at least one of the supporting members such as the cradle 61, the support shafts 14D, 15D, 16D, and 17D, the suction member 71, the bearings 117, and the like. With this arrangement, it is possible to prevent the occurrence of resonance between at least one of the supporting members such as the cradle 61, the support shafts 14D, 15D, 16D, and 17D, the suction member 71, the bearings 117, and the like and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0070] Embodiments of the present invention have been explained above; however, the present invention is not to be limitedly interpreted to the above embodiments.

[0071] In the above embodiments, the example is explained in which each of the drafting devices 6 includes the cradle 61, the support shafts 14D, 15D, 16D, and 17D, the suction member 71, and the bearings 117, as the supporting members. Explained as examples of the resonance preventing structures are: the triangular rib 95 and the first reinforcing parts 96 arranged on the lateral face 94 of the cover part 91 of the cradle 61, the support shafts 14D, 15D, 16D, and 17D of which the diameters are adjusted, the pressing mechanism 100 provided with the wave washer 109, the suction member 71 having the fixing part 77 that has the third reinforcing part 77B formed thereon, and the bearings 117A and 117B that are positioned adjacent to each other and include the balls in the mutually-different numbers. However, the drafting device of the present invention does not necessarily have to include all of these components. The drafting device may include any of these components that are used in combination as appropriate.

[0072] In the above embodiments, the example is explained in which the main controlling device 55 carries out control so that such a rotational speed at which resonance may occur between the drafting rollers and at least one of the supporting members cannot be set as the rotational speed of the drafting rollers (the drafting roller pairs 14, 15, 16, and 17). However, the spinning units do not necessarily have to have this function.

[0073] In the above embodiments, the example is explained in which the cover part 91 of the cradle 61 is formed by the metal plate; however, the cover part 91 can be formed with cast metal. When the cover part 91 is formed with cast metal, the cradle 61 becomes more stable because the weight of the cover part 91 increases. As a result, it is possible to prevent the occurrence of resonance between the cradle 61, which serves as a supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0074] In the above embodiments, the example is explained in which four roller pairs are arranged as the drafting rollers. However, more or less roller pairs, such as three pairs or five pairs may be arranged.

[0075] In the above embodiments, the example is explained in which the main controlling device 55 carries out the driving control with respect to the drafting rollers (the pairs of drafting rollers 14, 15, 16, and 17). However, the unit controller 50 or a controller arranged for each of the spinning units 2 may carry out such a driving control.

[0076] The air spinning device can further include a needle that is held by the fiber guiding member so as to protrude into the spinning chamber to prevent the twist of the fiber bundle from being transmitted to the upstream side of the air spinning device. Alternatively, instead of using such a needle, the air spinning device can be configured so that a downstream end part of the fiber guiding member prevents the twist of the fiber bundle from being transmitted to the upstream side of the air spinning device. Furthermore, in place of the configurations explained above, the air spinning device may include a pair of air jet nozzles each of which apply a twist in opposite directions.

[0077] In each of the spinning units 2, the yarn pooling device 11 has the function of pulling the yarn Y from the air spinning device 7. However, the yarn may be pulled from the air spinning device 7 by using a delivery roller and a nip roller. In a configuration where 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 may be arranged in place of the yarn pooling device 11.

[0078] The spinning machine 1 is configured so that at least one of the bottom rollers in the drafting device 6 and the traverse guide 23 are driven by the power supplied from the second end frame 5B (i.e., the driving pow-

er is shared among plural spinning units 2). However, the various components (e.g., the drafting device, the spinning device, the winding device, and the like) included in each of the spinning units 2 may be driven independently of the various components included in the other spinning units 2.

[0079] The tension sensor 9 can be arranged upstream of the yarn monitoring device 8 in terms of the running direction of the yarn Y. The unit controller 50 can be arranged for each spinning unit 2. The spinning units 2 each do not necessarily have to include the waxing device 12, the tension sensor 9, and the yarn monitoring device 8.

[0080] Although FIG. 1 illustrates the example in which the spinning machine 1 winds yarn Y into a cheese-shaped package P, the spinning machine 1 is also able to wind the yarn Y into a cone-shaped package. When the yarn Y is wound into a cone-shaped package, the yarn may slacken due to the traversing of the yarn. However, the yarn pooling device 11 is able to absorb the slack.

[0081] In the above embodiments, the example is explained in which the drafting device 6 is provided in the spinning machine 1. However, the drafting device 6 can be provided in any of other types of textile machines such as a ring spinning frame or a drawing frame.

[0082] According to an aspect of the present invention, a drafting device that drafts a fiber bundle includes plural drafting rollers arranged in a direction in which the fiber bundle is conveyed, the drafting rollers being arranged as plural roller pairs, each roller pair having a top roller and a bottom roller opposing the top roller; a supporting member that supports the drafting rollers; and a resonance preventing structure that prevents occurrence of resonance between the drafting rollers and the supporting member that may be caused by rotation of the drafting rollers.

[0083] The drafting device configured in this manner is able to prevent the occurrence of resonance between the supporting member, which directly or indirectly supports the drafting rollers, and the drafting rollers that may be caused by the rotation of the drafting rollers. As a result, it is possible to prevent degradation of the physical properties of the yarn.

[0084] In the above drafting device, the supporting member can include a cradle that rotatably supports the top rollers.

[0085] The drafting device configured in this manner is able to prevent the occurrence of resonance between the cradle, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0086] In the above drafting device, the cradle can have a lateral face that is formed by applying bending processing to a plate-like member. The resonance preventing structure can be at least one of a rib that is formed in a region including a section to which the bending processing is applied, and first reinforcing parts each of which is formed by processing the lateral face and each of which extends in a direction intersecting axial directions of the top rollers and a direction in which the roller pairs are arranged, the first reinforcing parts being arranged side by side along the direction in which the roller pairs are arranged.

[0087] In the drafting device configured in this manner, at least the lateral face of the cradle is reinforced by the rib or vibration of the cradle in the direction in which vibration is applied by the top rollers is inhibited by the first reinforcing parts formed on the lateral face of the cradle. As a result, it is possible to prevent the occurrence of resonance between the cradle, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0088] In the above drafting device, the supporting member can include a first rod member that is supported by the cradle and that rotatably supports on two ends thereof, one of the top rollers and a top roller of an adjacent drafting device arranged adjacent to the drafting device in an axial direction of the top rollers, and the resonance preventing structure can be realized by a dimension of a diameter of the first rod member formed so as to fall in a range from 8.5% to 11.5% inclusive of a distance between the adjacent top rollers.

[0089] As a result, it is possible to prevent the occurrence of resonance between the first rod member, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0090] In the above drafting device, an elastic member that presses in a direction in which the bottom rollers are arranged a second rod member that rotatably supports the top rollers on two ends thereof can be arranged in the cradle, and the resonance preventing structure can be a damper arranged between the cradle and the elastic member.

[0091] In the drafting device configured in this manner, the damper arranged between the cradle and the elastic member prevents vibration transmitted from the second rod member from being further transmitted to the cradle. As a result, it is possible to prevent the occurrence of resonance between the cradle, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0092] In the above drafting device, the supporting member can include a suction member that includes a tubular part having a suction port arranged facing at least one of the drafting rollers; and a fixing part configured with a plate-like member for fixing the tubular part to the cradle that rotatably supports the top rollers. The resonance preventing structure can be at least one of a second reinforcing part formed by processing an external surface of the tubular part, and a third reinforcing part formed by processing the fixing part.

[0093] In the drafting device configured in this manner, because at least one of the tubular part and the fixing part is reinforced by one or both of the second reinforcing part and the third reinforcing part, it is possible to reduce

vibration of the tubular part and the fixing part that may be caused by the rotation of the top rollers. As a result, it is possible to prevent the occurrence of resonance between the suction member, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0094] In the above drafting device, a main surface of the fixing part can be fixed to the cradle so as to intersect the direction in which the drafting roller is arranged.

[0095] In the drafting device configured in this manner, vibration of the fixing part in the direction in which vibration is applied by the top rollers is inhibited. As a result, it is possible to prevent the occurrence of resonance between the suction member, which serves as the supporting member, and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0096] In the above drafting device, the supporting member can include a first bearing and a second bearing each of which rotatably supports a third rod member that supports the bottom rollers of one of the drafting rollers with respect to a machine frame. The first bearing and the second bearing can be positioned adjacent to each other, and the resonance preventing structure can be realized by adjusting number of balls in the second bearing to be different from number of balls in the first bearing.

[0097] The drafting device configured in this manner is able to prevent the occurrence of resonance between the bearings, which serve as the supporting member, that may be caused by the rotation of the drafting rollers.

[0098] According to another aspect of the present invention, a spinning unit includes the above drafting device; a spinning device that forms yarn by twisting the fiber bundle drafted by the drafting device; a winding device that winds the yarn supplied thereto from the spinning device into a package; and a controlling section that prohibits the drafting rollers from being driven at such a speed that causes the drafting rollers to resonate with the supporting member in the drafting device.

[0099] In the spinning unit configured in this manner, the drafting rollers are prohibited from being driven at such a rotational speed that causes the drafting rollers to resonate with other supporting member such as the cradle, the first rod member, the second rod member, the suction member, the bearings, and the like. As a result, it is possible to prevent the occurrence of resonance between the supporting member and the drafting rollers that may be caused by the rotation of the drafting rollers.

[0100] According to at least one aspect of the present invention, it is possible to prevent the physical properties of the yarn from being degraded. As for the physical properties of the "yarn" mentioned herein, the term "yarn" denotes not only yarn, but also fibers in a bundle form such as a sliver.

[0101] In the above explanation, the meaning of "plural" also includes "a predetermined number of".

Claims

1. A drafting device (6) adapted to draft a fiber bundle (S), the draft device (6) comprising:

   plural drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) arranged successively in a direction in which the fiber bundle (S) is conveyed, the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) being arranged as plural roller pairs (14, 15, 16, 17), each roller pair (14, 15, 16, 17) having a top roller (14A, 15A, 16A, 17A) and a bottom roller (14B, 15B, 16B, 17B) opposing the top roller (14A, 15A, 16A, 17A);
   a supporting member (61; 14D, 15D, 16D, 17D; 71; 117) adapted to support the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B); and
   a resonance preventing structure (95; 96; 14D, 15D, 16D, 17D; 100; 71; 117A, 117B; 109) adapted to prevent occurrence of resonance between the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) and the supporting member (61; 14D, 15D, 16D, 17D; 71; 117) that may be caused by rotation of the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B).

2. The drafting device (6) as claimed in Claim 1, wherein the supporting member includes a cradle (61) adapted to rotatably support the top rollers (14A, 15A, 16A, 17A).

3. The drafting device (6) as claimed in Claim 2, wherein
   the cradle (61) has a lateral face (94) that is formed by applying bending processing to a plate-like member and extending between a top face (93) of the cradle (61) and an attachment part (92) of the cradle (61), wherein supporting structures (90) supporting the supporting member (61; 14D, 15D, 16D, 17D; 71; 117) are fixed to the attachment part (92), and
   the resonance preventing structure is at least one of a rib (95) that is formed in a region including a section to which the bending processing is applied, and first reinforcing parts (96) each of which is formed by processing the lateral face (94) and each of which extends in a direction intersecting axial directions of the top rollers (14A, 15A, 16A, 17A) and a direction in which the roller pairs (14, 15, 16, 17) are arranged, the first reinforcing parts (96) being arranged side by side along the direction in which the roller pairs (14, 15, 16, 17) are arranged.

4. The drafting device (6) as claimed in Claim 2 or 3, wherein the supporting member includes a rod member (14D, 15D, 16D, 17D) supported by the cradle (61) and adapted to rotatably support on two ends thereof, one of the top rollers (14B, 15B, 16B, 17B) and a top roller (14B, 15B, 16B, 17B) of an adjacent

drafting device (6) arranged adjacent to the drafting device (6) in an axial direction of the top rollers (14B, 15B, 16B, 17B), and
the resonance preventing structure is realized by a dimension of a diameter of the rod member (14D, 15D, 16D, 17D) formed so as to fall in a range from 8.5% to 11.5% inclusive of a distance between the adjacent top rollers (14B, 15B, 16B, 17B).

5. The drafting device (6) as claimed in claim 4, wherein the cradle (61) is provided with an elastic member (102) adapted to press the rod member (14D, 15D, 16D, 17D) such that the two top rollers (14B, 15B, 16B, 17B) are pressed against the respective opposing bottom rollers (14A, 15A, 16A, 17A), and
the resonance preventing structure comprises a damper (109) arranged between the cradle (61) and the elastic member (102).

6. The drafting device (6) as claimed in any one of Claims 2 and 3, further comprising a rod member (14D, 15D, 16D, 17D) adapted to rotatably support the top rollers (14B, 15B, 16B, 17B) on two ends thereof,
wherein the cradle (61) is provided with an elastic member (102) adapted to press the rod member (14D, 15D, 16D, 17D) such that the two top rollers (14B, 15B, 16B, 17B) are pressed against the respective opposing bottom rollers (14A, 15A, 16A, 17A), and
the resonance preventing structure is a damper (109) arranged between the cradle (61) and the elastic member (102).

7. The drafting device (6) as claimed in any one of Claims 2 to 6, wherein
the supporting member includes a suction member (71) that includes a tubular part (72) having a suction port (72A) arranged facing at least one of the drafting rollers (17B), and a fixing part (77) configured with a plate-like member for fixing the tubular part (72) to the cradle (61), and
the resonance preventing structure is at least one of a second reinforcing part formed by processing an external surface of the tubular part (72), and a third reinforcing part (77B) formed by processing the fixing part (77).

8. The drafting device (6) as claimed in Claim 7, wherein a main surface (77A) of the fixing part (77) is fixed to the cradle (61) so as to intersect the direction in which the drafting roller (14B, 15B, 16B, 17B) is arranged.

9. The drafting device (6) as claimed in any one of Claims 1 to 8, wherein
the supporting member (117) includes a first bearing (117A) and a second bearing (117B) each of which rotatably supports a third rod member (17C) adapted to support the bottom rollers 17A) of one of the drafting rollers (14A, 15A, 16A, 17A) with respect to a machine frame (62),
the first bearing (117A) and the second bearing (117B) are positioned adjacent to each other, and
the resonance preventing structure is realized by adjusting a number of balls in the second bearing (117B) to be different from a number of balls in the first bearing (117A).

10. A spinning unit (2) comprising:

the drafting device (6) as claimed in any one of Claims 1 to 9;
a spinning device (7) adapted to form a yarn (Y) by twisting the fiber bundle (S, F) drafted by the drafting device (6);
a winding device (13) adapted to wind the yarn (Y) supplied thereto from the spinning device (7) into a package (P); and
a controlling section (50; 55) adapted to prohibit the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) from being driven at such a speed that causes the drafting rollers (14A, 15A, 16A, 17A, 14B, 15B, 16B, 17B) to resonate with the supporting member (61; 14D, 15D, 16D, 17D; 71; 117) in the drafting device (6).

FIG.1

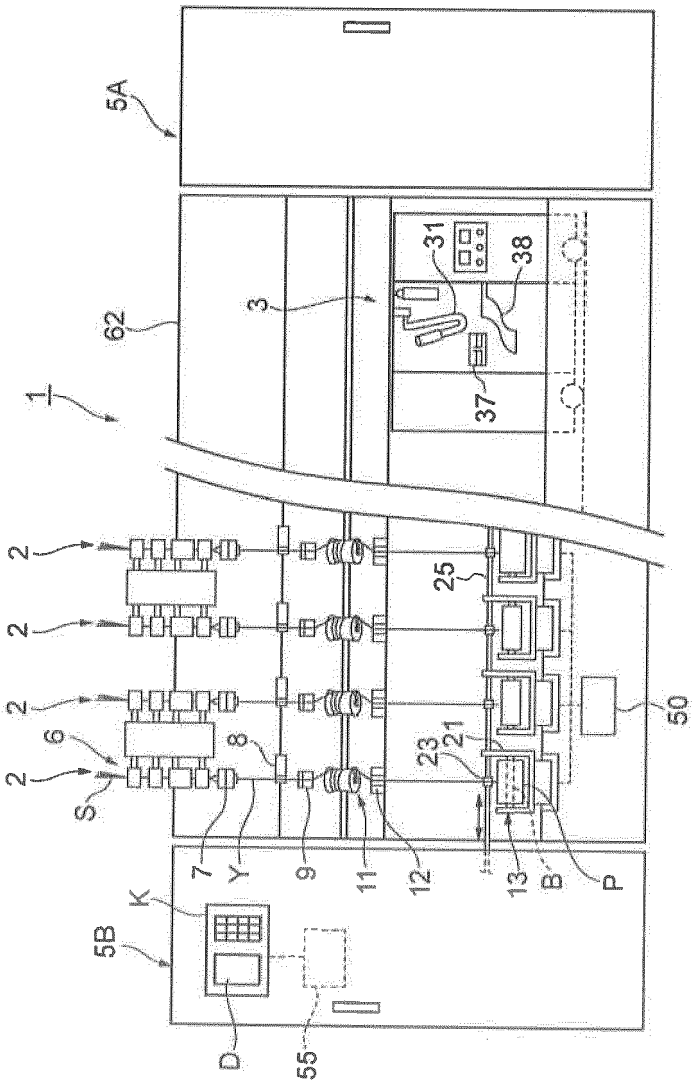


FIG.2

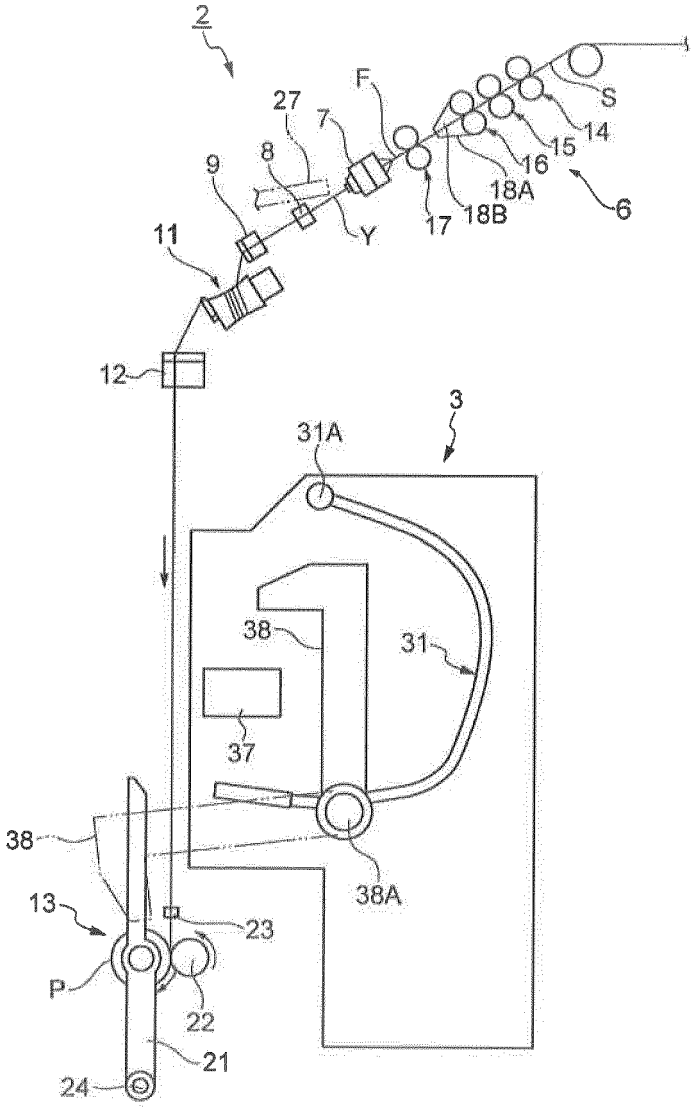

2
F
27
7
S
14
15
16
8
9
18A
6
18B
17
Y
11
12
3
31A
38
31
37
38
38A
13
23
P
22
21
24

FIG.3

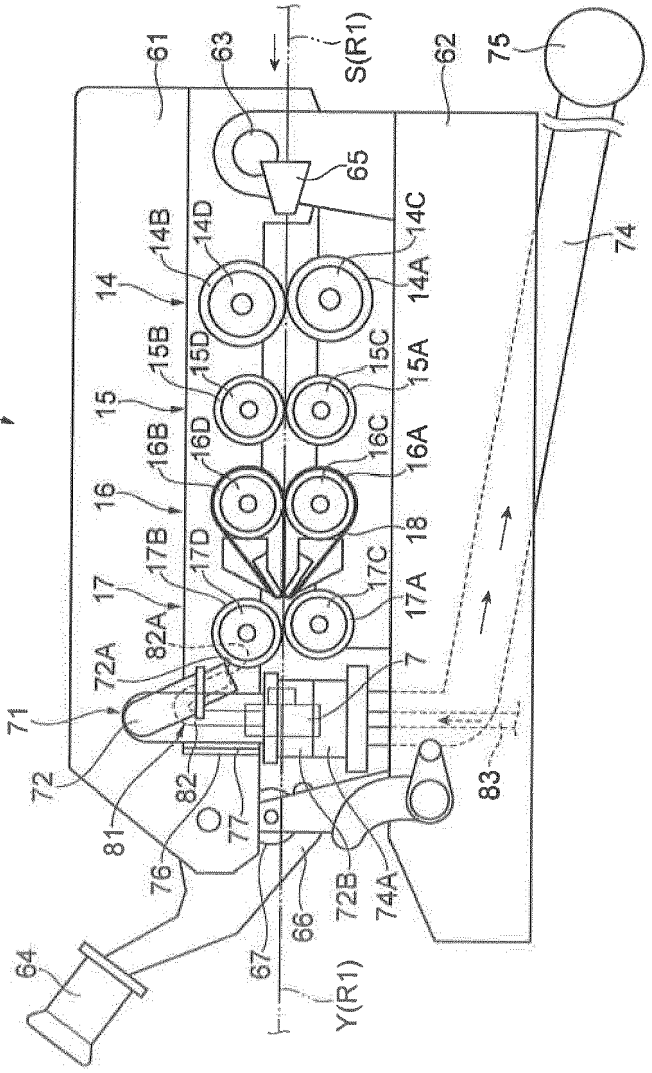

6
61
63
S(R1)
62
75
74
65
14B
14D
14C
14A
14
15B
15D
15C
15A
15
16B
16D
16C
16A
16
17B
17D
17C
17A
18
17
82A
72A
7
71
72
82
83
81
77
76
72B
74A
66
64
67
Y(R1)

FIG.4

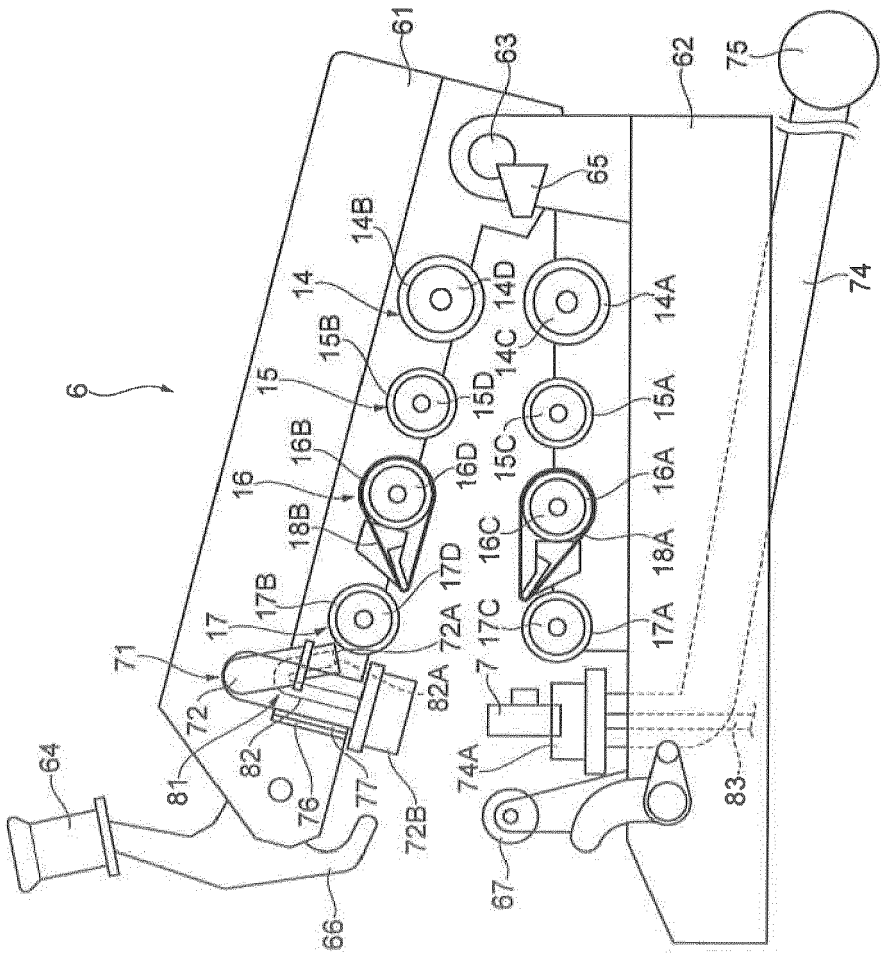

6
61
63
62
75
65
74
14B
14
14D
14A
14C
15B
15
15D
15A
15C
16B
16
16D
16A
16C
18B
18A
17D
17B
17
17C
17A
72A
71
72
82A
7
74A
82
81
76
77
72B
64
66
67
83

FIG.5

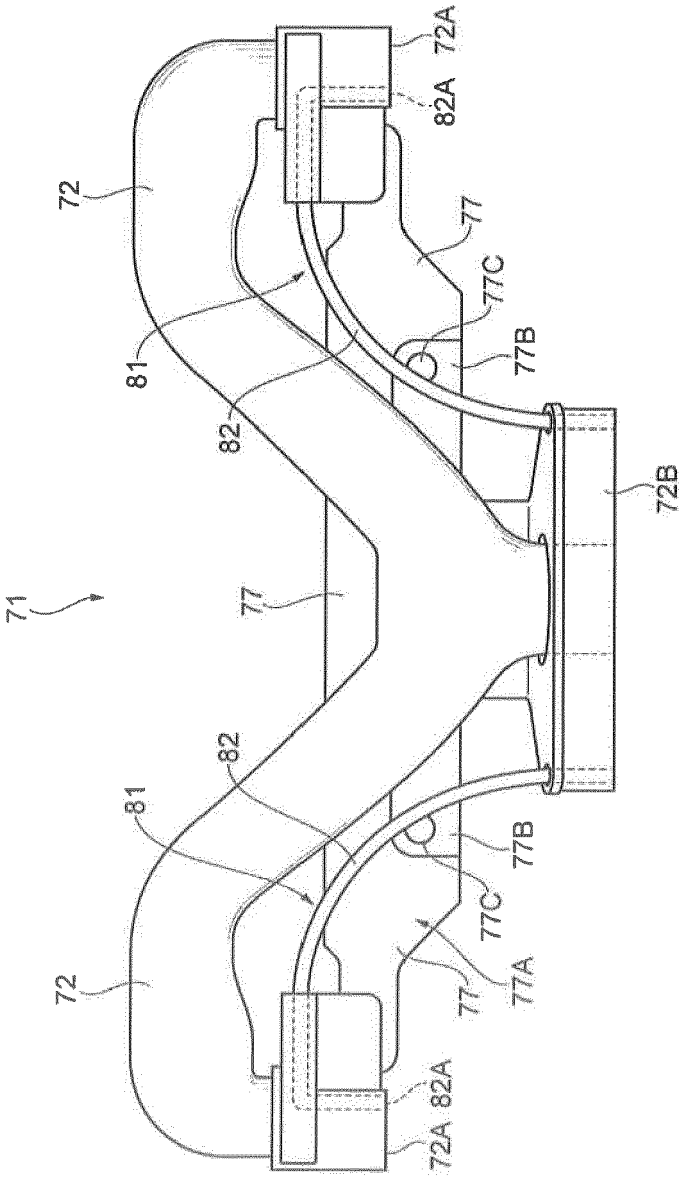

71
72
72A
82A
77
77C
77B
81
82
72B
77
82
81
77B
77C
77A
77
72
72A
82A

FIG.6

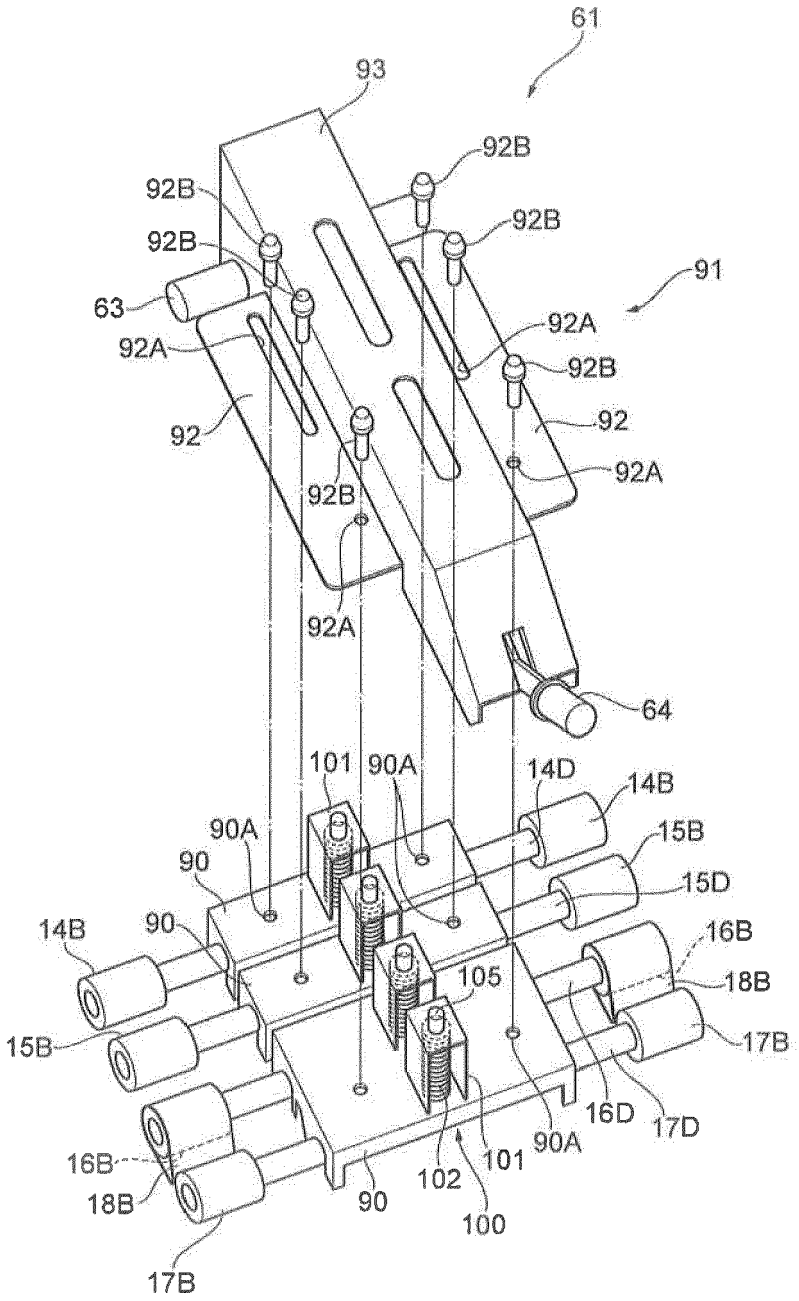

61
93
92B
92B
92B
92B
91
63
92A
92A
92B
92
92
92A
92B
92A
64
101
90A
14D
14B
90A
15B
90
15D
14B
90
16B
105
18B
15B
17B
16D
17D
90A
16B
101
102
18B
90
100
17B

FIG.7A

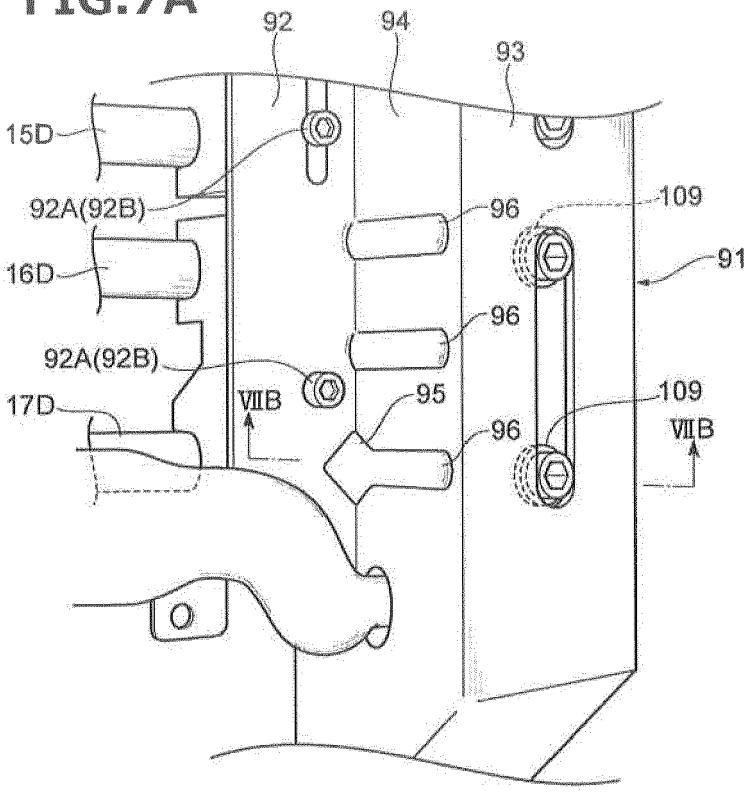

92
94
93
15D
92A(92B)
16D
92A(92B)
17D
VIIB
95
96
96
96
109
109
91
VIIB

FIG.7B

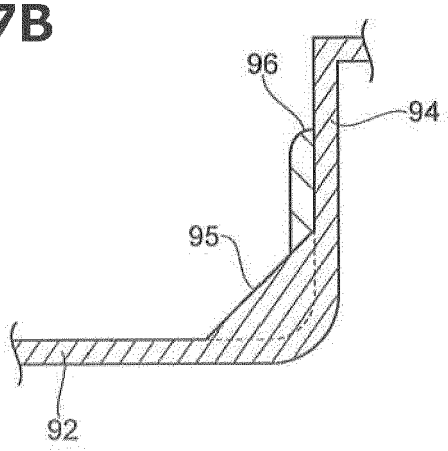

96
94
95
92

FIG.8

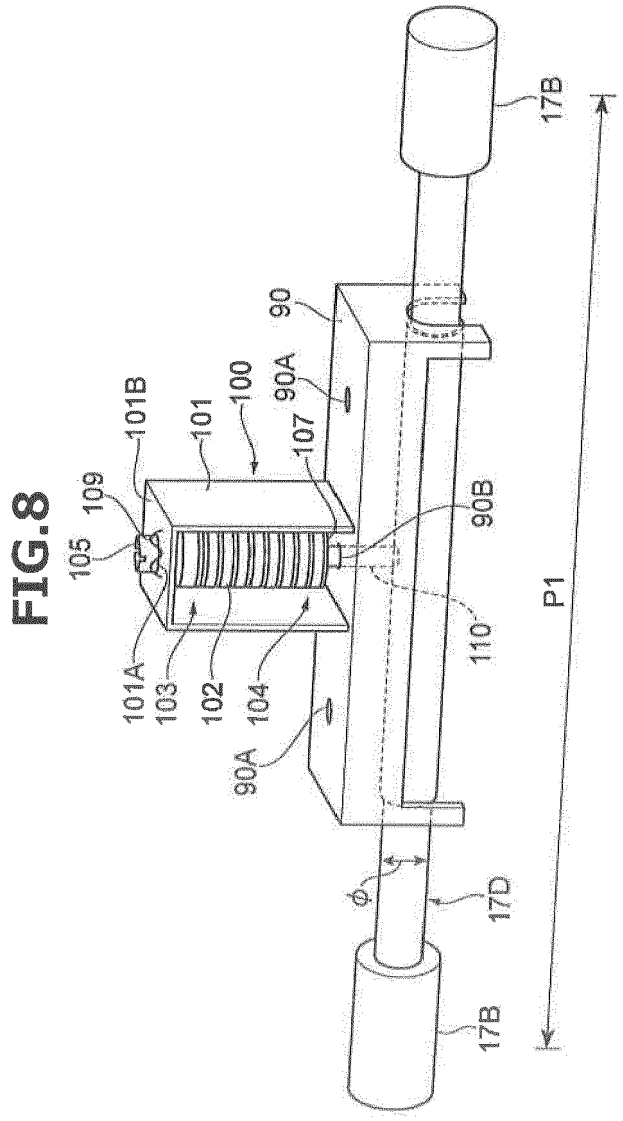

17B
90
90A
100
101
101B
107
109
105
90B
110
P1
101A
103
102
104
90A
ϕ
17D
17B

FIG.9

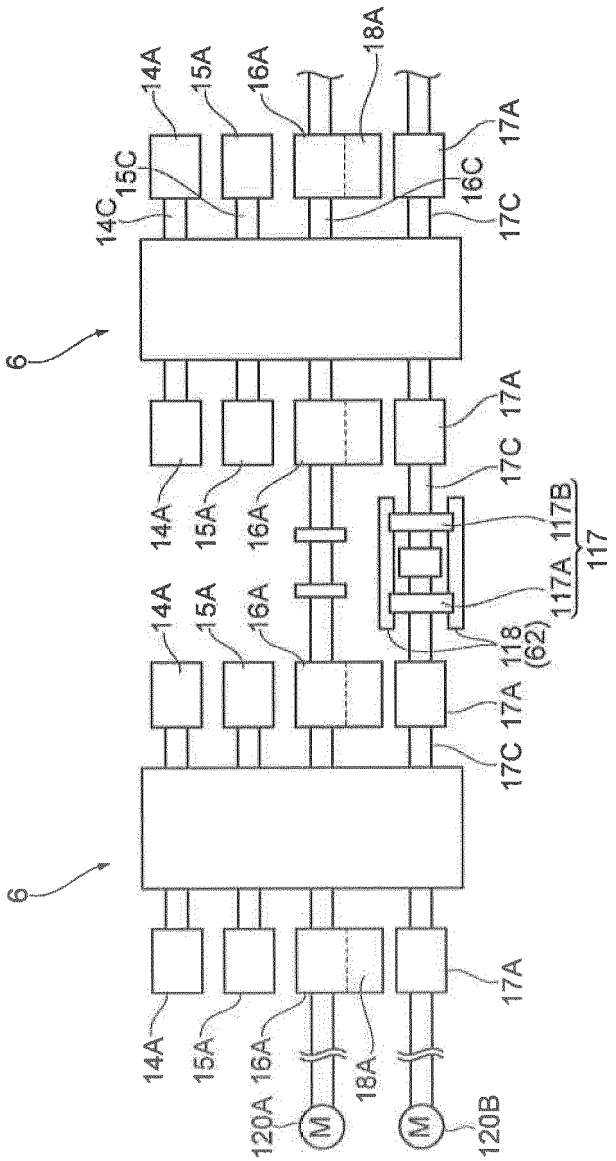
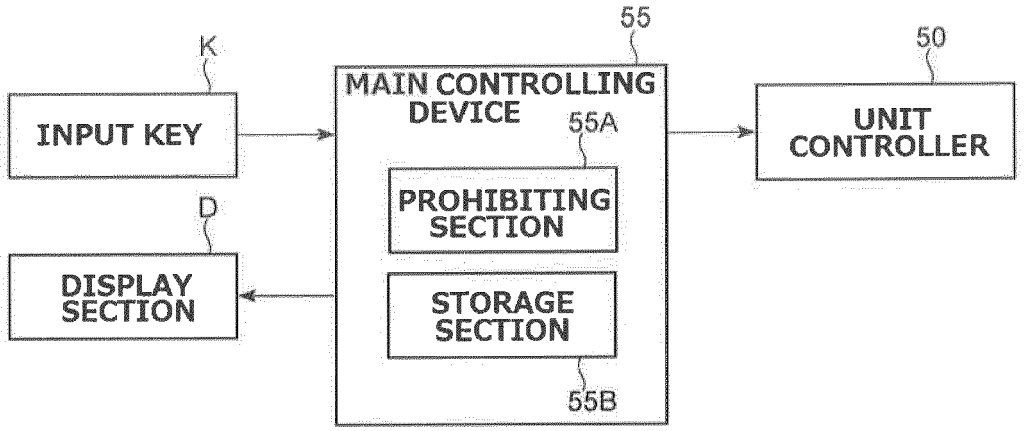


FIG.10


55
K
50
INPUT KEY
MAIN CONTROLLING DEVICE
55A
UNIT CONTROLLER
PROHIBITING SECTION
D
DISPLAY SECTION
STORAGE SECTION
55B

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 19 0812

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 058 421 A2 (OERLIKON ACCOTEX TEXPARTS GMBH [DE]) 13 May 2009 (2009-05-13) * paragraph [0018] - paragraph [0021] * * figures 1-4 *	1,2,5,6	INV. D01H5/26 D01H5/50 D01H5/56 D01H5/66
X	US 2 049 322 A (SANDERS WILLIAM H) 28 July 1936 (1936-07-28) * page 3, column 1, line 23 - page 4, column 1, line 18 * * figures 1-3 *	1,2,5,6	D01H5/74
X	EP 2 570 526 A1 (MARZOLI SPA [IT]) 20 March 2013 (2013-03-20) * figures 4, 5 *	1,2,7,8	
A	EP 1 731 636 A2 (RIETER AG MASCHF [CH]) 13 December 2006 (2006-12-13) * paragraph [0024] * * figure 4 *	4	
A	CN 202 913 120 U (CHEN WEIXIONG) 1 May 2013 (2013-05-01) * the whole document *	9	TECHNICAL FIELDS SEARCHED (IPC) D01H
A	JP 2010 168690 A (MURATA MACHINERY LTD) 5 August 2010 (2010-08-05) * abstract; figures 1-4 *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 April 2016	Hausding, Jan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 19 0812

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-04-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2058421 A2	13-05-2009	CN 101429691 A	13-05-2009
		DE 102007053712 A1	14-05-2009
		EP 2058421 A2	13-05-2009
		JP 2009121016 A	04-06-2009
US 2049322 A	28-07-1936	FR 779827 A	05-04-2016
		GB 429240 A	05-04-2016
		US 2049322 A	28-07-1936
EP 2570526 A1	20-03-2013	BR 102012023067 A2	06-08-2013
		CN 102995178 A	27-03-2013
		EP 2570526 A1	20-03-2013
EP 1731636 A2	13-12-2006	CN 1876913 A	13-12-2006
		DE 102005027194 A1	07-12-2006
		EP 1731636 A2	13-12-2006
		JP 2006342480 A	21-12-2006
		US 2006272131 A1	07-12-2006
CN 202913120 U	01-05-2013	NONE	
JP 2010168690 A	05-08-2010	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2011032618 A **[0002]**