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(54) **Drafting device, drafting device assembly, and spinning machine**

(57) An object is to provide a configuration that allows easy relocation of a draft roller (11). A spinning machine (1) includes a frame (40) having a sloping surface (41a), a draft roller unit (30a) including a draft roller (11), and a balancing mechanism (43). The draft roller unit (30a) is provided on the sloping surface (41a) of the frame (40) in a location-adjustable manner. The balancing mechanism (43) exerts an urging force on the draft roller unit (30a) in a direction opposite to a direction in which the draft roller unit (30a) is pulled by its own gravity.

FIG.6A

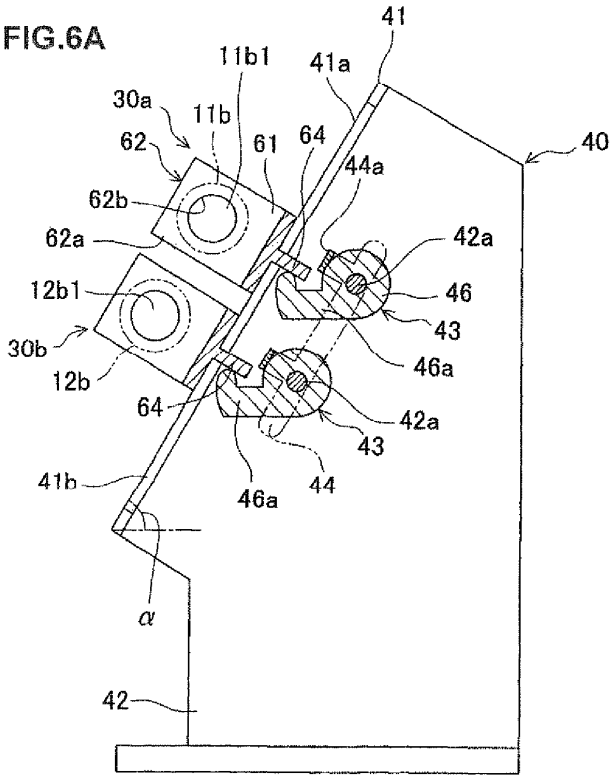

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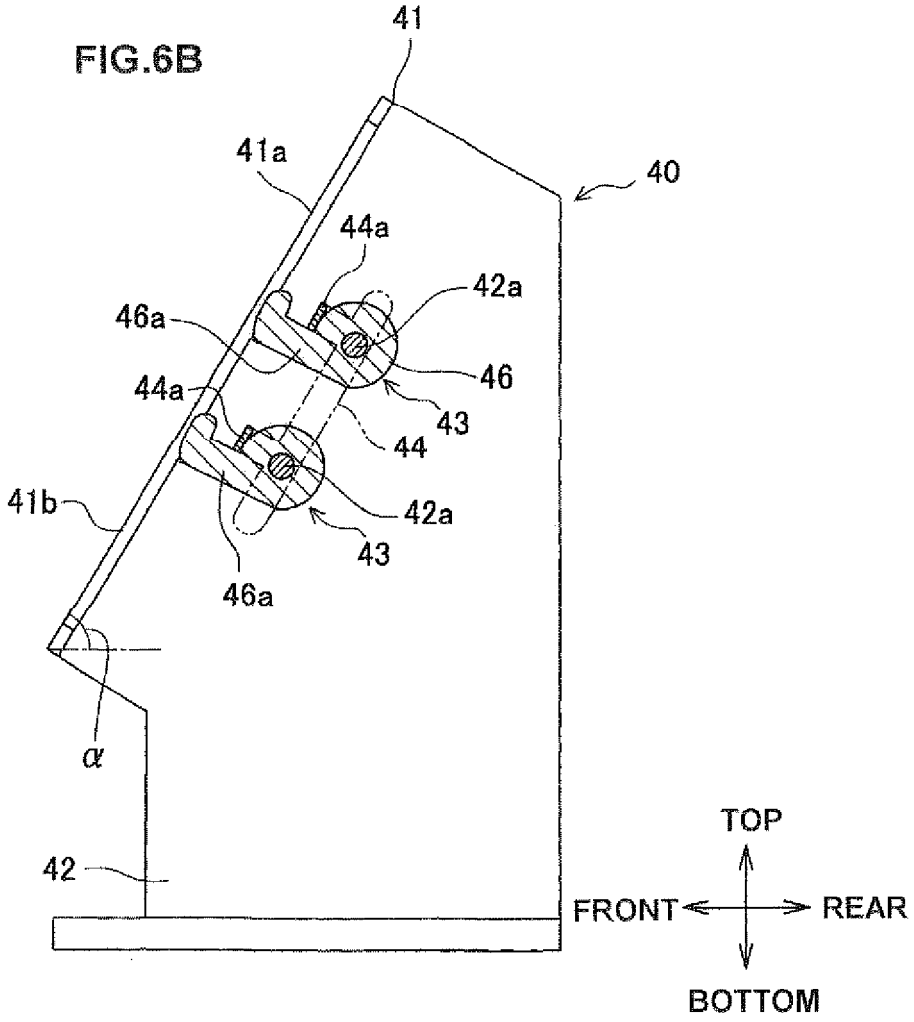
FIG.6B


41
41a
40
44a
42a
46a
46
44a
43
44
41b
42a
43
46a
α
42
TOP
FRONT
REAR
BOTTOM

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a drafting device that drafts a sliver while conveying the sliver. The present invention also relates to a spinning machine that includes a drafting device assembly that includes a plurality of drafting devices.

2. Description of the Related Art

[0002] A drafting device disclosed in Japanese published unexamined application No. 2007-182647 drafts a sliver into a fiber bundle and conveys the fiber bundle to a spinning unit by using four pairs of draft rollers (back rollers, third rollers, middle rollers, and front rollers). Four bottom rollers of the four pairs of the draft rollers are rotatably supported on respective support members placed on a sloping surface. The rotation axes of the bottom rollers are arranged orthogonal to the slope direction of the sloping surface.

[0003] In such a drafting device, it is necessary to adjust a clearance between adjacent draft rollers according to a length of fiber of the sliver and the like. To adjusting a clearance, an operator relocates a bottom roller by moving the corresponding support member along the sloping surface.

[0004] However, the support members with the bottom rollers supported thereon are considerably heavy in weight because the bottom rollers are generally made of metal. Therefore, considerable power is required to move the support member along the sloping surface. In some devices the support member is placed on a steeply sloping surface; because, this configuration makes the drafting device compact in a front-to-rear direction. In some devices, the support member also supports bottom rollers of a plurality of drafting devices or a motor for driving the bottom rollers. In such devices, still more power is required to move the support member along the sloping surface, making it further difficult to relocate the bottom rollers.

SUMMARY OF THE INVENTION

[0005] In view of the above discussion, it is an object of the present invention to provide a spinning machine including a drafting device, in which a draft roller can be relocated easily.

[0006] This object is achieved by a drafting device according to claim 1. According to an aspect of the present invention, a spinning machine includes a frame having a sloping surface; a draft roller unit including a draft roller and arranged on the sloping surface of the frame in a location-adjustable manner; and a balancing mechanism that exerts an urging force on the draft roller unit in a direction opposite to a direction in which the draft roller unit is pulled by its own weight.

[0007] According to another aspect of the present invention, a drafting device includes a draft roller unit including a draft roller and arranged on a sloping surface of a frame in a location-adjustable manner; and a balancing mechanism that exerts an urging force on the draft roller unit in a direction opposite to a direction in which the draft roller unit is pulled by its own weight.

[0008] According to still another aspect of the present invention, a drafting device assembly includes the above drafting device in a plurality, wherein the draft roller units of the drafting devices are coupled together.

[0009] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an elevation view illustrating a schematic configuration of a spinning machine according to an embodiment of the present invention;

FIG. 2 is a side view illustrating a schematic configuration of a drafting device illustrated in FIG. 1 and its surroundings;

FIG. 3 is an elevation view of the drafting device illustrated in FIG. 2;

FIG. 4 is a cross-sectional view of the drafting device taken along a line IV-IV of FIG. 3;

FIG. 5 is a cross-sectional view of the drafting device as viewed along an arrow V of FIG. 3;

FIG. 6A is a cross-sectional view of the drafting device taken along a line VI-VI of FIG. 3; and FIG. 6B depicts the drafting device illustrated in FIG. 6A with a draft roller unit removed therefrom;

FIG. 7 is a cross-sectional view of the drafting device taken along a line VII-VII of FIG. 3; and

FIG. 8 is a schematic diagram illustrating a modification of the embodiment and that corresponds to FIG. 6A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Exemplary embodiments of the present invention are explained below. A front-to-rear direction, a left-to-right (lateral) direction, and a top-to-bottom direction that are perpendicular to one another and that are used in the following explanation are shown in the drawings when necessary. As illustrated in FIG. 1, a spinning machine 1 according to an embodiment of the present invention includes a large number of spinning units 2 that are arranged in the lateral direction of FIG. 1. Each of the spinning units 2 includes a drafting device 3, a spin-

ning device 4, a yarn delivery device 5, a yarn-defect detecting device 6, a splicer device 7, and a winding device 8.

[0012] The drafting device 3 drafts a sliver S, which is fed from the top direction, into a fiber bundle and conveys the fiber bundle to the spinning device 4. The spinning device 4 receives the fiber bundle conveyed from the drafting device 3 and forms a yarn Y by spinning the fiber bundle with an air jet. The yarn delivery device 5 delivers the yarn Y spun by the spinning device 4 to the winding device 8. The yarn-defect detecting device 6 detects a yarn defect in the yarn Y being delivered to the winding device 8. The splicer device 7 removes, when the yarn-defect detecting device 6 has detected a yarn defect, the portion of the yarn Y containing the yarn defect by cutting the portion and performs splicing of the yarn Y, from which the yarn defect has been removed. The winding device 8 receives the yarn Y delivered from the yarn delivery device 5 and winds the yarn Y on a bobbin, thereby forming a package.

[0013] The drafting device 3 is described in detail below. FIG. 2 is a schematic diagram of the drafting device 3 illustrated in FIG. 1 and its surroundings. As illustrated in FIG. 2, the drafting device 3 includes four pairs of draft rollers, each pair of which includes a top roller and a bottom roller in press-contact with each other.

[0014] More specifically, the drafting device 3 includes a pair of back rollers 11, a pair of third rollers 12, a pair of middle rollers 13, and a pair of front rollers 14 as the four pairs of the draft rollers. The back rollers 11 include a back top roller 11a and a back bottom roller 11b. The third rollers 12 include a third top roller 12a and a third bottom roller 12b. The middle rollers 13 include a middle top roller 13a, around which an apron belt 19a is laid, and a middle bottom roller 13b, around which an apron belt 19b is laid. The front rollers 14 include a front top roller 14a and a front bottom roller 14b. The bottom rollers 11b, 12b, 13b, and 14b are made of metallic material and driven by a motor or the like. In contrast, the top rollers 11a, 12a, 13a, and 14a are made of resin in at least their outer peripheral surfaces, and they are not connected to a motor but driven by rotation of the bottom rollers 11b, 12b, 13b, and 14b.

[0015] These four pairs of the draft rollers 11, 12, 13, and 14 are situated such that each of the top rollers 11a, 12a, 13a, and 14a and a corresponding one of the bottom rollers 11b, 12b, 13b, and 14b vertically face each other. These four pairs of the draft rollers 11, 12, 13, and 14 are arranged along a direction inclined relative to the horizontal plane in this order from an upstream side relative to a running path of the sliver S. Meanwhile, a tilt angle α between the direction along which the draft rollers 11, 12, 13, and 14 are arranged and the horizontal plane is approximately 60 degrees. The drafting device 3 has been made compact in the front-to-rear direction because the tilt angle between the direction along which the draft rollers 11, 12, 13, and 14 are arranged and the horizontal plane is large as mentioned above.

[0016] In the drafting device 3 configured as discussed above, the four pairs of the draft rollers 11, 12, 13, and 14 are rotated at different rotation speeds in a state where the sliver S is pinched between the top rollers 11a, 12a, 13a, and 14a and the bottom rollers 11b, 12b, 13b, and 14b, respectively. These rotations cause the drafting device 3 to draft the sliver S into a fiber bundle and convey the fiber bundle to the spinning device 4. Meanwhile, the sliver S is drafted in a nip between the back rollers 11 and in a nip between the third rollers 12 and stretched by about 2 to 4 times. The sliver S is further drafted in a nip between the third rollers 12 and in a nip between the middle rollers 13 and stretched by about 1.5 to 3 times.

[0017] Of the four bottom rollers 11b, 12b, 13b, and 14b, the back bottom roller 11b and the third bottom roller 12b belong to a draft roller unit 30a and a draft roller unit 30b, respectively. The draft roller unit 30a and the draft roller unit 30b will be described in detail below.

[0018] The draft roller unit 30a including the back bottom rollers 11b and the draft roller unit 30b including the third bottom rollers 12b are described below with reference to FIGS. 3 to 7.

[0019] As illustrated in FIGS. 5 to 7, the draft roller units 30a and 30b are mounted on a frame 40. The frame 40 includes a mounting plate 41, two legs 42, four balancing mechanisms 43, and two coupling members 44.

[0020] The mounting plate 41 is a substantially rectangular plate member made of a metallic material or the like. The mounting plate 41 includes, as its top surface, a sloping surface 41a inclined relative to the horizontal plane. Meanwhile, a tilt angle α between the sloping surface 41a and the horizontal plane is approximately 60 degrees, which is substantially the same as the tilt angle between the direction along which the draft rollers 11, 12, 13, and 14 are arranged and the horizontal plane. The draft roller units 30a and 30b are mounted on the sloping surface 41a as will be described later. A through hole 41c and a through hole 41d are formed in the mounting plate 41 at a left end portion and a right end portion of the mounting plate 41, respectively. The through holes 41c and 41d are elongated in a slope direction of the sloping surface 41a. The through hole 41c is located at a higher position than the through hole 41d in the slope direction of the sloping surface 41a. Meanwhile, a length d1 of the through hole 41c is longer than a length d2 of the through hole 41d.

[0021] The two legs 42 are fixed to the mounting plate 41 on the surface opposite to the sloping surface 41a; thus, the two legs 42 support the mounting plate 41. The leg 42 on the right is fixed at a portion slightly inside relative to a right edge and the leg 42 on the left is fixed at a portion slightly inside relative to a left edge of the mounting plate 41. This arrangement of the two legs 42 causes the right end portion and the left end portion of the mounting plate 41 to serve as extending portions 41b extending farther outward than the legs 42. The through holes 41c and 41d are formed in the extending portions 41b.

[0022] The four balancing mechanism 43 are provided,

as will be described later, to urge the draft roller units 30a and 30b for balancing so that the draft roller units 30a and 30b can be moved along the sloping surface 41a easily. As illustrated in FIGS. 6A and 6B, each of the four balancing mechanisms 43 includes a pivot member 46 and a torsion spring 47. Each of the pivot members 46 is substantially cylindrical and pivotally supported on one of four shafts 42a provided on the legs 42. Two of the four shafts 42a are arranged on right end portions of the two legs 42 while the other two of the four shafts 42a are arranged on left end portions of the two legs 42 along the slope direction of the sloping surface 41a such that the four shafts 42a project laterally outward from the legs 42. A press member 46a that projects outward in a radial direction of the pivot member 46 is provided on a distal end of each of the pivot members 46. The press members 46a are located below the draft roller units 30a and 30b and pressed against contact portions 64 of the draft roller units 30a and 30b as will be described later.

[0023] As illustrated in FIG. 4, the torsion spring 47 mounted on a corresponding one of the pivot members 46 is fixed to the leg 42 at one end and fixed to the press member 46a at the other end. Accordingly, the pivot member 46 is urged by the torsion spring 47 in a circumferential direction of the pivot member 46.

[0024] Each of the two coupling members 44 extends parallel to the sloping surface 41a to couple the distal ends of the two shafts 42a provided on each of the legs 42 together. Coupling the two shafts 42a together with the two coupling members 44 increases the strength of the two shafts 42a. Two stoppers 44a are provided at middle portions of the coupling members 44. Each of the stoppers 44a extends toward the sloping surface 41a in a direction perpendicular to the sloping surface 41a and that is bent laterally inward at a distal end portion of the stopper 44a. As illustrated in FIG. 6B, the thus-bent distal end portions of the stoppers 44a are in contact with the press members 46a in a state where the draft roller units 30a and 30b are not placed on the sloping surface 41a. This prevents the pivot members 46 urged by the torsion springs 47 from further pivoting from positions illustrated in FIG. 6B where the press members 46a are in contact with the stoppers 44a, thereby holding the pivot members 46 at these positions. The stopper 44a is an example of the stopper of the present invention.

[0025] The draft roller unit 30a includes a support member 51, a pair of the bottom rollers 11b belonging to a pair of the drafting devices 3 that are adjacent to each other, and two motor units 52.

[0026] As illustrated in FIGS. 3 and 4, the support member 51 includes a base portion 61, four roller supports 62, four motor supports 63, and the two contact portions 64. The base portion 61 is located on the sloping surface 41a and extends farther outward to the right and to the left than the mounting plate 41; that is, the base portion 61 is elongated in a lateral direction. Substantially circular through holes 61a are formed in the base portion 61 at portions corresponding the through holes 41c. Bolts 71 are inserted from the side of the through holes 61a through pairs of the through hole 61a and the through hole 41c individually. A nut 72 is mounted on a lower end portion of the bolt 71.

[0027] Fastening the bolts 71 causes the draft roller unit 30a to be fixed onto the mounting plate 41 (the frame 40) with the bolts 71 and the nuts 72. In contrast, loosening the bolts 71 releases the draft roller unit 30a, which has been fixed with the bolts 71 and the nuts 72 to the mounting plate 41, from the mounting plate 41, allowing the draft roller unit 30a to be moved along the sloping surface 41a within a range defined by the through holes 61a and the through holes 41c. In the present embodiment, a combination of the bolt 71 and the nut 72 is an example of the fixing member of the present invention.

[0028] A nut support 73 extending in the slope direction of the sloping surface 91a is provided on the lower surface of the extending portion 41b so as to interpose the nut 72 between the nut support 73 and the extending portion 41b. The nut 72, which is substantially U-shaped with its right end portion and left end portion bent downward as viewed in a direction perpendicular to the paper plane of FIG. 4, is configured such that when the bolt 71 is screwed, the two bent end portions of the nut 72 are caught in the nut support 73. This configuration prevents the nut 72 from being rotated by rotation of the bolt 71. This makes it possible to fasten and loosen the bolt 71 only by screwing and unscrewing the bolt 71.

[0029] Even when the bolts 71 are completely removed from the nuts 72 for replacement of the draft roller unit 30a or the like, the nuts 72 remain to be held by the nut supports 73 rather than coming off from the nut supports 73 because the nuts 72 are substantially U-shaped.

[0030] The two roller supports 62 of the draft roller unit 30a are provided at a right end portion and a left end portion, which are laterally farther outside than the mounting plate 41, of the base portion 61. Each of the roller supports 62 includes a pair of projecting portions 62a that face each other and project in a top-to-front direction from the base portion 61, i.e., the projecting portions 62a are perpendicular to the sloping surface 41a. Formed in a distal end portion of each of the projecting portions 62a is a through hole 62b that laterally passes through the projecting portion 62a. A rotating shaft 11b1 of the back bottom roller 11b is inserted into the through holes 62b. Thus, the roller support 62 rotatably supports the back bottom roller 11b at two end portions of the back bottom roller 11b.

[0031] The rotating shaft 11b1 of the back bottom roller 11b extends through a laterally outer one of the pair of the projecting portions 62a. A belt pulley 74 is mounted on a distal end portion of the rotating shaft 11b1.

[0032] In the present embodiment, the back bottom rollers 11b are supported on the two roller supports 62 provided on the right end portion and the left end portion of the base portion 61. These two back bottom rollers 11b individually belong to the drafting devices 3 of two of the spinning units 2 that are adjacent to each other.

This combination of the two drafting devices 3 coupled together in this manner corresponds to the drafting device assembly of the present invention.

[0033] The two motor supports 63 of the draft roller unit 30a are provided at the right end portion and the left end portion, which are laterally farther outside than the mounting plate 41, of the base portion 61. Each of the motor supports 63 includes a pair of projecting portions 63a that face each other and project in a top-to-rear direction from the base portion 61; i.e., the motor supports 63 are substantially parallel to the sloping surface 41a.

[0034] The motor unit 52 has a substantially rectangular solid shape and includes therein a motor 75 for driving the back bottom roller 11b. A belt pulley 76 is mounted on a rotating shaft 75a of the motor 75 on an end portion on a laterally outer side of the motor unit 52. An endless belt 77 is laid around the belt pulley 74 and the belt pulley 76. Accordingly, when the motor 75 is driven, the belt pulley 76 is rotated. The rotation of the belt pulley 76 is transmitted to the belt pulley 74 via the belt 77, causing the back bottom roller 11b to rotate.

[0035] A support portion 52a is provided on each of a right end and a left end of a front top end portion of the motor unit 52. The support portions 52a project in a top-front direction to positions where each of the support portions 52a is adjacent to a corresponding one of the projecting portions 63a in a lateral direction. The support portion 52a is supported on the projecting portion 63a to be pivotable about a shaft 63b.

[0036] A spring mounting portion 52b extending substantially parallel to the sloping surface 41a is provided on each of a right end and a left end of a rear top end portion of the motor unit 52. One end of a tension spring 78 is attached to a distal end portion of the spring mounting portion 52b. The other end of the tension spring 78 is attached to the projecting portion 63a at a portion closer to a distal end of the projecting portion 63a than the shaft 63b supporting the support portion 52a is.

[0037] By being pulled by the tension spring 78, the motor unit 52 is pivoted about the shaft 63b in the direction (clockwise in FIG. 5) in which the belt pulley 76 moves away from the belt pulley 74. This prevents loosening of the belt 77 laid around the belt pulleys 74 and 76.

[0038] The contact portion 64 extends in a direction perpendicular to the sloping surface 41a from a bottom surface of the base portion 61 at a portion slightly farther outward than the mounting plate 41 relative to a lateral direction. The contact portion 64 is in contact with the press member 46a at the bottom surface of the contact portion 64 relative to the slope direction of the sloping surface 41a. Hence, the draft roller unit 30a is urged at the contact portion 64 by the balancing mechanism 43 upward (in a direction opposite to a direction in which the draft roller unit 30a is pulled under its own weight) along the sloping surface 41a. Hence, the draft roller unit 30a is balanced by being urged by the balancing mechanism 43 to thus be prevented from slipping downward along the sloping surface 41a under its own weight.

[0039] As discussed above, in the state where the draft roller units 30a and 30b are not placed on the sloping surface 41a, the press members 46a are prevented by the stoppers 44a from moving and held at the positions illustrated in FIG. 6B. These are positions where, when the draft roller units 30a and 30b are placed on the sloping surface 41a, the press members 46a can be brought into contact with the contact portions 64 (positions where the press members 46a can be pressed against the draft roller units 30a and 30b).

[0040] The draft roller unit 30b has a configuration similar to that of the draft roller unit 30a. The draft roller unit 30b is located on the sloping surface 41a at a portion lower than the portion where the draft roller unit 30a is provided. Note that the draft roller unit 30b has parts that are similar to those of the draft roller unit 30a but opposite to the draft roller unit 30a in orientation on the sloping surface 41a.

[0041] In the draft roller unit 30b arranged at the portion lower than the draft roller unit 30a, the bolts 71 are inserted from the side of the through holes 61a through the through holes 61a and the through holes 41d individually. Fastening the bolts 71 causes the draft roller unit 30b to be fixed onto the mounting plate 41 (the frame 40) with the bolts 71 and the nuts 72. In contrast, loosening the bolts 71 releases the draft roller unit 30b, which has been fixed with the bolts 71 and the nuts 72 to the mounting plate 41, from the mounting plate 41, allowing the draft roller unit 30b to be moved along the sloping surface 41a within a range defined by the through holes 61a and the through holes 41d.

[0042] As discussed above, the length d2 of the through hole 41d is smaller than the length d1 of the through hole 41c. Accordingly, the movable range of the draft roller unit 30b is smaller than the movable range of the draft roller unit 30a.

[0043] In the draft roller unit 30b, a rotating shaft 12b1 of the third bottom roller 12b is inserted into the through hole 62b in the projecting portion 62a in the roller support 62. Thus, the roller support 62 rotatably supports the third bottom roller 12b.

[0044] Furthermore, in the draft roller unit 30b situated in an orientation opposite to that of the draft roller unit 30a, the projecting portions 63a of the motor support 63 project from the base portion 61 in a bottom-front direction, which is opposite to that in the draft roller unit 30a. Accordingly, the projecting portions 63a of the draft roller unit 30a project from the side opposite to the side where the projecting portions 63a of the draft roller unit 30b project relative to the slope direction of the sloping surface 41a. Furthermore, the motor units 52 supported on the projecting portions 63a of the draft roller unit 30a are also arranged on the side opposite to that of the draft roller unit 30b. The projecting portions 63a of the draft roller unit 30b project from the side opposite to the side where the projecting portions 63a of the draft roller unit 30a project relative to the slope direction of the sloping surface 41a. The motor units 52 supported on the pro-

jecting portions 63a of the draft roller unit 30b are also arranged on the side opposite to that of the draft roller unit 30a. Hence, the back bottom rollers 11b and the third bottom rollers 12b can be arranged close to each other relative to the slope direction of the sloping surface 41a because the projecting portions 63a and the motor units 52 are not interposed between the draft roller unit 30a and the draft roller unit 30b.

[0045] Meanwhile, in the drafting device 3, it is preferable for reliable conveyance of the sliver S that the longer the fiber of the sliver S, the greater a clearance between the back rollers 11 and the third rollers 12 and a clearance between the third rollers 12 and the middle rollers 13 relative to the slope direction of the sloping surface 41a. It is not necessary to change a clearance between the middle rollers 13 and the front rollers 14 because the sliver S is conveyed between the middle rollers 13 and the front rollers 14 in a state where the sliver S is pinched between the apron belts 19a and 19b, which allows reliable conveyance irrespective of the length of the fiber.

[0046] Hence, in the present embodiment, as discussed above, the draft roller units 30a and 30b are configured to be movable along the sloping surface 41a. More specifically, in the present embodiment, the draft roller units 30a and 30b are moved along the sloping surface 41a so that the clearance between the back rollers 11 and the third rollers 12 and the clearance between the third rollers 12 and the middle rollers 13 can be changed.

[0047] If the fiber of the sliver S is short, both the clearance between the back rollers 11 and the third rollers 12 and the clearance between the third rollers 12 and the middle rollers 13 shall be reduced. If the fiber of the sliver S is long, both the clearance between the back rollers 11 and the third rollers 12 and the clearance between the third rollers 12 and the middle rollers 13 shall be increased.

[0048] When the draft roller unit 30b is moved in a manner that the third bottom rollers 12b are moved toward the middle bottom rollers 13b, the third bottom rollers 12b are moved away from the back bottom rollers 11b. Accordingly, to move the back bottom rollers 11b toward the third bottom rollers 12b, it is necessary to move the draft roller unit 30a by a greater distance than a distance by which the draft roller unit 30b is moved.

[0049] In contrast, when the draft roller unit 30b is moved in a manner that the third bottom rollers 12b are moved away from the middle bottom rollers 13b, the third bottom rollers 12b are moved toward the back bottom rollers 11b. Accordingly, to move the back bottom rollers 11b away from the third bottom rollers 12b, it is necessary to move the draft roller unit 30a by a greater distance than a distance by which the draft roller unit 30b is moved.

[0050] Hence, to change the clearances between the rollers, the back bottom rollers 11b (the draft roller unit 30a) are moved by a greater distance than a distance by which the third bottom rollers 12b (the draft roller unit 30b) are moved. Accordingly, in the present embodiment, as discussed above, the length d1 of the through hole 41c is set to be greater than the length d2 of the through hole 41d, thereby making the movable range of the draft roller unit 30a greater than the movable range of the draft roller unit 30b.

[0051] By moving the draft roller units 30a and 30b along the sloping surface 41a in this manner, the clearance between the back rollers 11 and the third rollers 12 and the clearance between the third rollers 12 and the middle rollers 13 can be changed. However, in the present embodiment, each of the draft roller units 30a and 30b includes, in addition to the bottom rollers 11b and 12b and the support member 51 for supporting the bottom rollers 11b and 12b, the motor units 52 for driving the bottom rollers 11b and 12b. This makes the draft roller units 30a and 30b heavy in weight. Furthermore, each of the draft roller units 30a and 30b includes the motor units 52 and corresponding ones of the bottom rollers 11b and 12b of the two drafting devices 3. This makes the draft roller units 30a and 30b heavier in weight. In addition, in the present embodiment, the sloping surface 41a is inclined approximately by 60 degrees relative to the horizontal plane; that is, the tilt angle α between the sloping surface 41a and the horizontal plane is large.

[0052] Accordingly, to change the clearances between the draft rollers, it is necessary to move the draft roller units 30a and 30b, which are heavy in weight as explained above, along the sloping surface 41a inclined at the large tilt angle relative to the horizontal plane. To move the draft roller units 30a and 30b upward along the sloping surface 41a, an operator is required to apply considerable power on the draft roller units 30a and 30b, and to move the draft roller units 30a and 30b downward, an operator is required to hold the draft roller units 30a and 30b to support them. As a result, it becomes difficult to relocate the draft roller units 30a and 30b.

[0053] In particular, in the present embodiment, the tilt angle α of the sloping surface 41a relative to the horizontal plane is large (approximately 60 degrees). Accordingly, unless the balancing mechanism 43 are provided, the draft roller units 30a and 30b undesirably slip downward along the sloping surface 41a under their own weights, making it further difficult to relocate the draft roller units 30a and 30b.

[0054] However, in the present embodiment, as explained above, the balancing mechanisms 43 urge the draft roller units 30a and 30b upward along the sloping surface 41a. Accordingly, the draft roller units 30a and 30b are balanced so as not to slip downward along the sloping surface 41a under their own weights.

[0055] Accordingly, in the present embodiment, positions of the draft roller units 30a and 30b can be relocated easily because the magnitude of the force required to move the draft roller units 30a and 30b is reduced by the urging forces exerted by the balancing mechanisms 43.

[0056] Meanwhile, the balancing mechanisms 43 should preferably be configured such that the magnitude of the force to be exerted by the pivot members 46, the

torsion springs 47, and the like to urge the draft roller units 30a and 30b upward along the sloping surface 41a is approximately the same as the magnitude of the forces urging the draft roller units 30a and 30b to slip downward along the sloping surface 41a under their own weights. In other words, the urging forces exerted by the balancing mechanisms 43 should preferably be balanced against the gravitational forces on the draft roller units 30a and 30b.

[0057] This configuration causes the gravitational forces on the draft roller units 30a and 30b and the urging forces exerted on the draft roller units 30a and 30b by the balancing mechanisms 43 to be balanced; accordingly, approximately entire power applied by an operator onto the draft roller units 30a and 30b in a direction substantially parallel to the sloping surface 41a acts on movement of the draft roller units 30a and 30b. Hence, the operator can move the draft roller units 30a and 30b easily. The operator can also fasten the bolts 71 to fix the draft roller units 30a and 30b onto the mounting plate 41 easily after moving and positioning the draft roller units 30a and 30b.

[0058] Adjustment of locations of the draft roller units 30a and 30b is performed by moving the draft roller units 30a and 30b along the sloping surface 41a with a spacer having a length that depends on a type of the fiber interposed between the two base portions 61, each belonging to one of the draft roller units 30a and 30b. Even in such a situation, an operator can perform the location adjustment easily because the operator can move the draft roller units 30a and 30b easily.

[0059] In the present embodiment, the pivot members 46 that include the press members 46a, which are to be pressed against the contact portions 64 of the support member 51, and the torsion springs 47 that urge the pivot members 46 are employed as elements of the balancing mechanisms 43 used for urging the draft roller units 30a and 30b. With this configuration, the balancing mechanisms 43 of the present embodiment can be constructed more easily.

[0060] Furthermore, the pivot members 46 urged by the torsion springs 47 are held, in the state where the draft roller units 30a and 30b are not placed on the sloping surface 41a, at the positions where the press members 46a are in contact with the stoppers 44a. This prevents the pivot members 46 from further pivoting from these positions. When the pivot members 46 are at these positions, placing the draft roller units 30a and 30b on the sloping surface 41a brings the contact portions 64 into contact with the press members 46a. Hence, it is not necessary to move the pivot members 46 against the urging forces of the torsion springs 47 to the positions where the press members 46a can be brought into contact with the contact portions 64 prior to placing the draft roller units 30a and 30b on the sloping surface 41a. Accordingly, the operator can place the draft roller units 30a and 30b easily.

[0061] Meanwhile, it is necessary to relocate the top rollers 11a and 12a simultaneously with relocation of the bottom rollers 11b and 12b; however, the top rollers that are made of resin in at least their outer peripheral surfaces are lighter in weight than the bottom rollers made of metallic material. The top rollers are driven rollers that are to be rotated by rotations of the bottom rollers; accordingly, no motor is mounted on a member (not shown) that supports the top rollers. Hence, relocation of the top rollers can be performed more easily as compared to relocation of the bottom rollers.

[0062] Various possible modifications of the embodiment explained above are described below. Explanation of configurations similar to those of the present embodiment is omitted.

[0063] In the embodiment explained above, each of the draft roller units 30a and 30b includes the motor units 52 and corresponding ones of the bottom rollers 11b and 12b of the two drafting devices 3; however, the number of rollers provided in the draft roller units 30a and 30b are not limited thereto. For example, each of the draft roller units 30a and 30b can include the motor unit 52 and a corresponding one of the bottom roller 11b and the bottom roller 12b belonging to a single drafting device 3, or the motor units 52 and corresponding ones of the bottom rollers 11b and bottom rollers 12b belonging to three or more drafting devices.

[0064] In the embodiment explained above, the draft roller units 30a and 30b include the motor units 52 for driving the bottom rollers 11b and 12b; alternatively, the motor units 52 can be provided separately from the draft roller units 30a and 3Cb.

[0065] In the embodiment explained above, the tilt angle α of the sloping surface 41a relative to the horizontal plane is approximately 60 degrees; however, the tilt angle α of the sloping surface 41a is not limited thereto, and can be any angle from 0 degrees to 90 degrees. To configure the drafting device 3 compact in the front-to-rear direction, the tilt angle α should preferably be between 45 degrees and 80 degrees.

[0066] Meanwhile, the tilt angle α of the sloping surface 41a relative to the horizontal plane is not always such an angle that causes the draft roller units 30a and 30b to slip downward along the sloping surface 41a under their own weights unless the balancing mechanisms 43 are provided. For example, the tilt angle α of the sloping surface 41a relative to the horizontal plane can be an angle that will not cause the draft roller units 30a and 30b to slip.

[0067] Even in such a case, the power required to move the draft roller units 30a and 30b upward along the sloping surface 41a is decreased by the urging force exerted by the balancing mechanism 43 on the draft roller units 30a and 30b upward (the direction opposite to the direction in which the draft roller units 30a and 30b are pulled under their own weights) along the sloping surface 41a as in the embodiment discussed above. Hence, an operator can adjust the location of the draft roller units 30a and 30b easily.

[0068] In the embodiment discussed above, the bal-

ancing mechanisms 43 used for urging the draft roller units 30a and 30b include the pivot members 46 each including the press member 46a and the torsion spring 47 that urge the pivot member 46. The balancing mechanisms 43 are also configured such that the press members 46a are brought into contact with the stoppers 44a, thereby holding the pivot members 46 at the positions where the press members 46a can be brought into contact with the contact portions 64 of the draft roller units 30a and 30b in the state where the draft roller units 30a and 30b are not placed on the sloping surface 41a. The configuration of the stoppers that restrict movement of the pivot members 46 is not limited to the stopper 44a provided on the coupling members 44 that couple the two shafts 42b together and any element capable of restricting the movement of the pivot members 46 as the stoppers.

[0069] The stoppers 44a may not be provided. A configuration that does not include the stoppers 44a but yields a similar effect can be implemented by moving the pivot members 46, which are out of the positions where the press members 46a can be brought into contact with the contact portions 64 in the state where the draft roller units 30a and 30b are not placed on the placing surface 41a, to the positions where the press members 46a can be brought into contact with the contact portions 64 against the urging force of the torsion springs 47 immediately before the draft roller units 30a and 30b are placed on the sloping surface 41a.

[0070] The balancing mechanisms 43 may not include the pivot member 46 and the torsion spring 47. For example, the balancing mechanisms 43 can include a compression spring extending parallel to the sloping direction of the sloping surface 41a and a press member that is provided at a top end portion of the compression spring to be pressed against the contact portion 64 of the support member 51. Further alternatively, the balancing mechanisms may not include a spring and, for example, it can include a cylinder or the like.

[0071] In the embodiment explained above, the balancing mechanisms 43 exert the urging forces on the draft roller units 30a and 30b from below, thereby preventing the draft roller units 30a and 30b from slipping downward along the sloping surface 41a under their own weights. However, the balancing mechanisms 43 are not limited to such mechanisms that exert urging forces on the draft roller units 30a and 30b from below.

[0072] In another modification, as illustrated in FIG. 8, balancing mechanisms 80 are provided in lieu of the balancing mechanisms 43 (see FIG. 3). Each of the balancing mechanisms 80 includes two pulleys 81a and 81b supported on the frame 40 and a wire 82 laid on the pulleys 81a and 81b. Each of the balancing mechanisms 80 is connected to one of the draft roller units 30a and 30b at one end of the wire 82. The balancing mechanism 80 includes a weight 83 at the other end of the wire 82. The weight 83 is approximately as heavy as a corresponding one of the draft roller units 30a and 30b. Hence, the draft roller units 30a and 30b are pulled (urged) upward (in the direction opposite to the direction in which the draft roller units 30a and 30b are pulled under their own weights) by the weights 83 via the wires 82 along the sloping surface 41a. Also with this configuration, the draft roller units 30a and 30b are balanced by being pulled by the balancing mechanisms 80 and are thus prevented from slipping downward along the sloping surface 41a under their own weights.

[0073] In the embodiment explained above, the clearance between the back rollers 11 and the third rollers 12 and the clearance between the third rollers 12 and the middle rollers 13 should preferably be changed depending on the length of the fiber of the sliver S because the sliver S is drafted at the two positions, between the back rollers 11 and the third rollers 12 and between the third rollers 12 and the middle rollers 13. Under such a circumstance, the two draft roller units, or, more specifically, the draft roller unit 30a that includes the back bottom rollers 11b and the draft roller unit 30b that includes the third bottom rollers 12b are configured to be movable along the sloping surface 41a; however, the scheme for drafting the sliver S is not limited to this.

[0074] For example, for a situation where the sliver S is to be drafted only at one position, a configuration where only one of the draft roller units is movable along the sloping surface 41a can be employed.

[0075] For a situation where the sliver S is to be drafted at three or more positions, a configuration where three or more draft roller units including three or more bottom rollers are movable along the sloping surface 41a can be employed.

[0076] The embodiment explained above is an example where the present invention is applied to the drafting device 3, in which the sliver S runs downward; however, a drafting device, to which the invention is applicable, is not limited thereto. For example, the present invention is applicable to a drafting device in which, contrary to that in the embodiment explained above, the sliver S runs upward.

[0077] According to a first aspect of the present invention, a spinning machine includes a frame having a sloping surface; a draft roller unit including a draft roller and arranged on the sloping surface of the frame in a location-adjustable manner; and a balancing mechanism that exerts an urging force on the draft roller unit in a direction opposite to a direction in which the draft roller unit is pulled by its own weight.

[0078] In the spinning machine, the draft roller unit is urged in the direction opposite to the direction in which the draft roller unit is pulled by its own weight. This configuration allows an operator to adjust the location of the draft roller unit easily even in a situation where the draft roller unit is heavy in weight or a tilt angle of the sloping surface relative to a horizontal plane is large.

[0079] According to a second aspect of the invention, the spinning machine further includes a fixing member that fixes the draft roller unit to the frame, and the draft

roller unit includes a support member that supports the draft roller. The draft roller unit is movable along the sloping surface in a state where the draft roller unit is not fixed to the frame with the fixing member. The balancing mechanism exerts the urging force on the draft roller unit placed on the sloping surface in a direction opposite to a direction in which the draft roller unit is pulled by its own weight.

[0080] This configuration allows an operator to adjust the location of the draft roller unit by moving the draft roller unit along the sloping surface. Accordingly, the operator can adjust a clearance between the draft roller unit according to a type of fiber of sliver.

[0081] In a situation where the draft roller unit is heavy in weight or the tilt angle of the sloping surface is large, the power that needs to be applied by the operator to move the draft roller unit along the sloping surface is large. This makes it difficult to adjust the location of the draft roller unit.

[0082] However, because the spinning machine includes the balancing mechanism that urges the draft roller unit in the direction opposite to the direction in which the draft roller unit is pulled by its own weight, reduction in the magnitude of the force required to move the draft roller unit by the urging force exerted by the balancing mechanism is achieved. Accordingly, the operator can easily adjust the location of the draft roller unit.

[0083] According to a third aspect of the invention, the draft roller unit is provided in a plurality, and the balancing mechanism is provided for each of the draft roller units.

[0084] This configuration allows locations of the draft roller units to be adjusted easily. Accordingly, an operator can adjust a clearance between the draft roller units according to a type of fiber of sliver more flexibly. Hence, a spun yarn excellent in quality can be produced with the spinning machine.

[0085] According to a fourth aspect of the invention, the urging force exerted by the balancing mechanism is balanced by the weight of the draft roller unit in the spinning machine.

[0086] This configuration causes approximately an entire power applied by an operator on the draft roller unit along the sloping surface to act on movement of the draft roller unit because the urging force exerted by the balancing mechanism is balanced by the weight of the draft roller unit. Accordingly, the operator can adjust the location of the draft roller unit more easily.

[0087] According to a fifth aspect of the invention, the spinning machine further includes a stopper. The stopper prevents, in a state where the draft roller unit is not placed on the sloping surface, the balancing mechanism from undesirably moving the draft roller unit further out of a range where the balancing mechanism can urge the draft roller unit.

[0088] The balancing mechanism is constantly tensioned to urge the draft roller unit. Accordingly, in the state where the draft roller unit is not placed on the sloping surface, the balancing mechanism can undesirably move the draft roller unit to bring the draft roller unit out of the range where the balancing mechanism can urge the draft roller unit. If the balancing mechanism has been moved out of the range where the balancing mechanism can urge the draft roller unit, it is necessary for an operator to relocate the balancing mechanism immediately before placing the draft roller unit on the sloping surface.

[0089] However, in the spinning machine according to the present aspect, the stopper prevents the balancing mechanism from moving the draft roller unit out of the range where the balancing mechanism can urge the draft roller unit. Accordingly, it is unnecessary for an operator to relocate the balancing mechanism before placing the draft roller unit on the sloping surface. This allows the operator to place the draft roller unit on the sloping surface easily.

[0090] According to a sixth aspect of the invention, the balancing mechanism of the spinning machine includes a spring and a press member. The spring is supported on the frame. The press member is located below the draft roller unit and that is to be pressed against the draft roller unit by being urged by the spring.

[0091] This configuration allows the balancing mechanism to be constructed easily from the spring and the press member.

[0092] According to a seventh aspect of the invention, the spring of the spinning machine is a torsion spring. The press member is urged by the torsion spring.

[0093] The press member is urged in a direction rotating about an axis of the torsion spring. Accordingly, if the torsion spring is used as the spring, the press member urged by the torsion spring is more likely to be moved out of a range where the press member can be pressed against the draft roller unit while the draft roller unit is not placed on the sloping surface.

[0094] However, in the spinning machine according to the present aspect, the stopper prevents the press member urged by the torsion spring from being moved further out of the range where the press member can be pressed against the draft roller unit. Accordingly, this configuration eliminates the necessity for an operator to move the press member against the urging force of the torsion spring into the range where the press member can be pressed against the draft roller unit before placing the draft roller unit on the sloping surface. This allows the operator to place the draft roller unit on the sloping surface easily.

[0095] According to an eighth aspect of the invention, in the spinning machine, the draft roller unit is supported on the support member, and the draft roller unit includes a motor that drives the draft roller.

[0096] Providing the motor that drives the draft roller on the draft roller unit further increases the weight of the draft roller unit. Even for such a situation, the spinning machine allows an operator to adjust the location of the draft roller unit easily because the support member is urged in the direction opposite to the direction in which the draft roller unit is pulled by its own weight.

[0097] According to a ninth aspect of the invention, in

the spinning machine, a tilt angle of the sloping surface relative to the horizontal plane is an angle at which unfixing the draft roller unit from the frame causes the draft roller unit to slip along the sloping surface under its own weight unless the balancing mechanism is provided.

[0098] When relocation or fixation to the frame of the draft roller unit is performed in a situation where the sloping surface is inclined by such a large tilt angle as to cause the draft roller unit to slip under its own weight, the draft roller unit slips along the sloping surface. This makes it difficult for an operator to adjust the location of the draft roller unit. However, in the spinning machine, the draft roller unit is less likely to slip along the sloping surface under its own weight because the balancing mechanism is urging the draft roller unit in the direction opposite to the direction in which the draft roller unit is pulled by its own weight. Accordingly, the spinning machine allows an operator to adjust the location of the draft roller unit easily.

[0099] According to a tenth aspect of the invention, the spinning machine is configured such that a tilt angle of the sloping surface relative to the horizontal plane is from 45 degrees to 80 degrees.

[0100] When the tilt angle of the sloping surface is from 45 degrees to 80 degrees relative to the horizontal plane, the spinning machine can be configured compact in the front-to-rear direction. However, this can also cause slippage of the draft roller unit along the sloping surface. This makes it difficult for an operator to adjust the location of the draft roller unit. However, when the spinning machine has the configuration of the aspect, the draft roller unit is less likely to slip along the sloping surface under its own weight because the balancing mechanism is urging the draft roller unit in the direction opposite to the direction in which the draft roller unit is pulled by its own weight. Accordingly, the spinning machine allows an operator to adjust the location of the draft roller unit easily.

[0101] According to an eleventh aspect of the invention, a drafting device includes a balancing mechanism and a draft roller unit that includes a draft roller. The draft roller unit is provided on the sloping surface of the frame in a location-adjustable manner. The balancing mechanism exerts an urging force on the draft roller unit in a direction opposite to a direction in which the draft roller unit is pulled by its own weight.

[0102] In the drafting device according to the present aspect, the draft roller unit is urged in the direction opposite to the direction in which the draft roller unit is pulled by its own weight. This configuration allows an operator to adjust the location of the draft roller unit easily even when the draft roller unit is heavy in weight or when a tilt angle of the sloping surface relative to the horizontal plane is large.

[0103] According to a twelfth aspect of the invention, a drafting device assembly includes the drafting device in a plurality. The draft roller units of the drafting devices are coupled together.

[0104] A drafting device assembly that includes a plurality of draft roller units that are coupled together is typically heavy in weight. Even for such a situation, the drafting device assembly of the present aspect allows an operator to adjust locations of the draft roller units easily because the draft roller units are urged in the direction opposite to the direction in which the draft roller units are pulled by its own weight.

[0105] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the present invention.

Claims

1. A spinning machine (1) comprising:

a frame (40) having a sloping surface (41a);
a draft roller unit (30) including a draft roller (11) and arranged on the sloping surface (41a) of the frame (40) in a location-adjustable manner; and
a balancing mechanism (43) that exerts an urging force on the draft roller unit (30) in a direction opposite to a direction in which the draft roller unit (30) is pulled by its own weight.

2. The spinning machine (1) according to Claim 1, further comprising a fixing member (46) that fixes the draft roller unit (30) to the frame (40), wherein
the draft roller unit (30) includes a support member (51) that supports the draft roller (11),
in a state where the draft roller unit (30) is not fixed to the frame (40) with the fixing member (46), the draft roller unit (30) is movable along the sloping surface (41a), and
the balancing mechanism (43) exerts the urging force on the draft roller unit (30) placed on the sloping surface (41a) in a direction opposite to a direction in which the draft roller unit (30) is pulled by its own weight.

3. The spinning machine (1) according to Claim 1 or 2, wherein
the draft roller unit (30) is provided in a plurality, and
the balancing mechanism (43) is provided for each of the draft roller units (30a,30b).

4. The spinning machine (1) according to any one of Claims 1 to 3, wherein the urging force exerted by the balancing mechanism (43) is balanced by the weight of the draft roller unit (30).

5. The spinning machine (1) according to any one of

Claims 1 to 4, further comprising a stopper (44a) that prevents, in a state where the draft roller unit (30) is not placed on the sloping surface (41a), the balancing mechanism (43) from moving the draft roller unit (30) out of a range where the balancing mechanism (43) is capable of urging the draft roller unit (30).

6. The spinning machine (1) according to any one of Claims 1 to 5, wherein the balancing mechanism (43) includes:

a spring (47) supported on the frame (40); and
a press member (46a) located below the draft roller unit (30) and that is pressed against the draft roller unit (30) by being urged by the spring (47).

7. The spinning machine (1) according to Claim 6, wherein
the spring (47) is a torsion spring, and
the press member (46a) is urged by the torsion spring (47).

8. The spinning machine (1) according to any one of Claims 1 to 7, wherein the draft roller unit (30) further includes a motor (52) that drives the draft roller (11).

9. The spinning machine (1) according to any one of Claims 1 to 8, wherein the sloping surface (41a) is inclined relative to a horizontal plane at a tilt angle at which unfixing the draft roller unit (30) from the frame (40) causes the draft roller unit (30) to slip along the sloping surface (41a) under its own weight unless the balancing mechanism (43) is provided.

10. The spinning machine (1) according to any one of Claims 1 to 9, wherein the tilt angle of the sloping surface (41a) relative to the horizontal plane is from 45 degrees to 80 degrees.

11. A drafting device (3) comprising:

a draft roller unit (30) including a draft roller (11) and arranged on a sloping surface (41a) of a frame (40) in a location-adjustable manner; and
a balancing mechanism (43) that exerts an urging force on the draft roller unit (30) in a direction opposite to a direction in which the draft roller unit (30) is pulled by its own weight.

12. A drafting device assembly comprising the drafting device (3) according to Claim 11 in a plurality, wherein the draft roller units (30a) of the drafting devices (3) are coupled together.

FIG.1

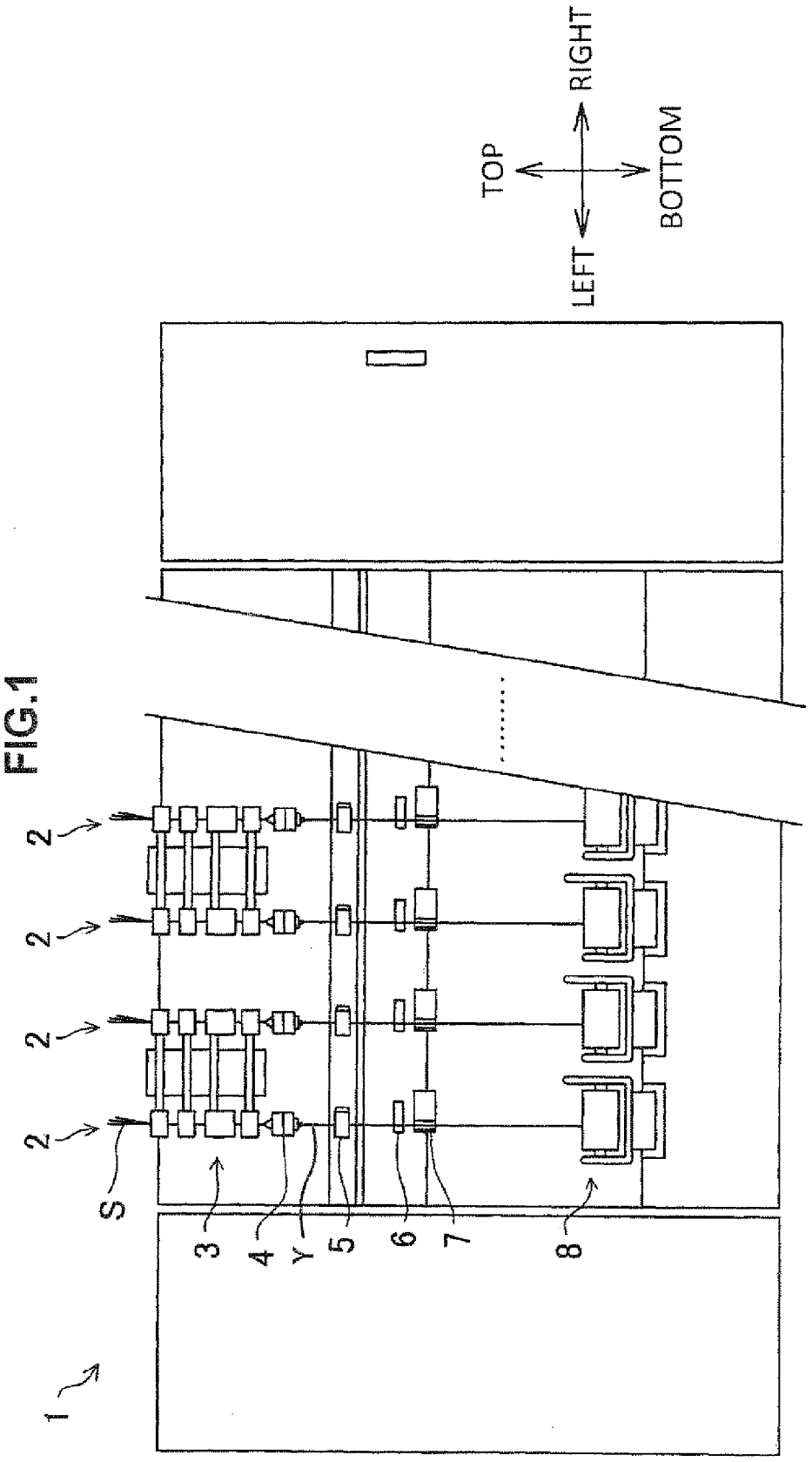
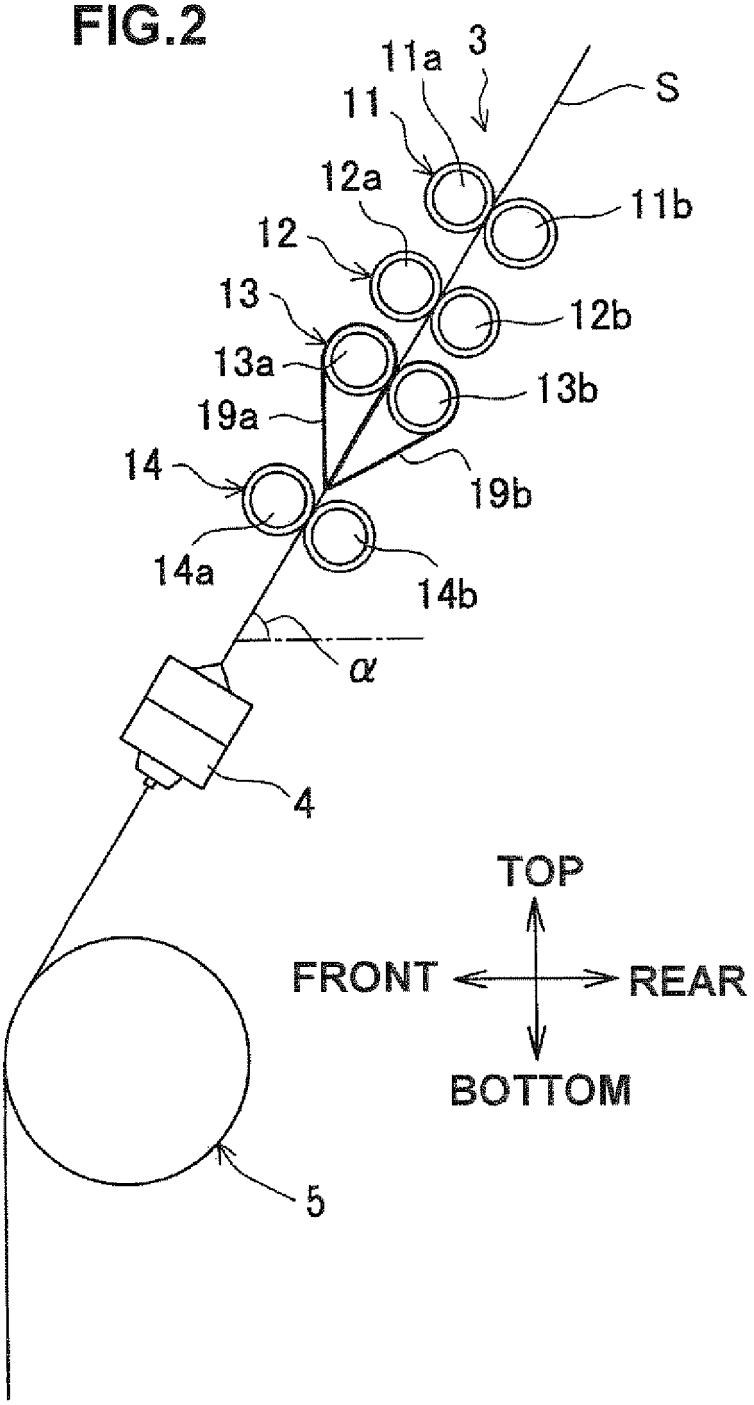


FIG.2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12a
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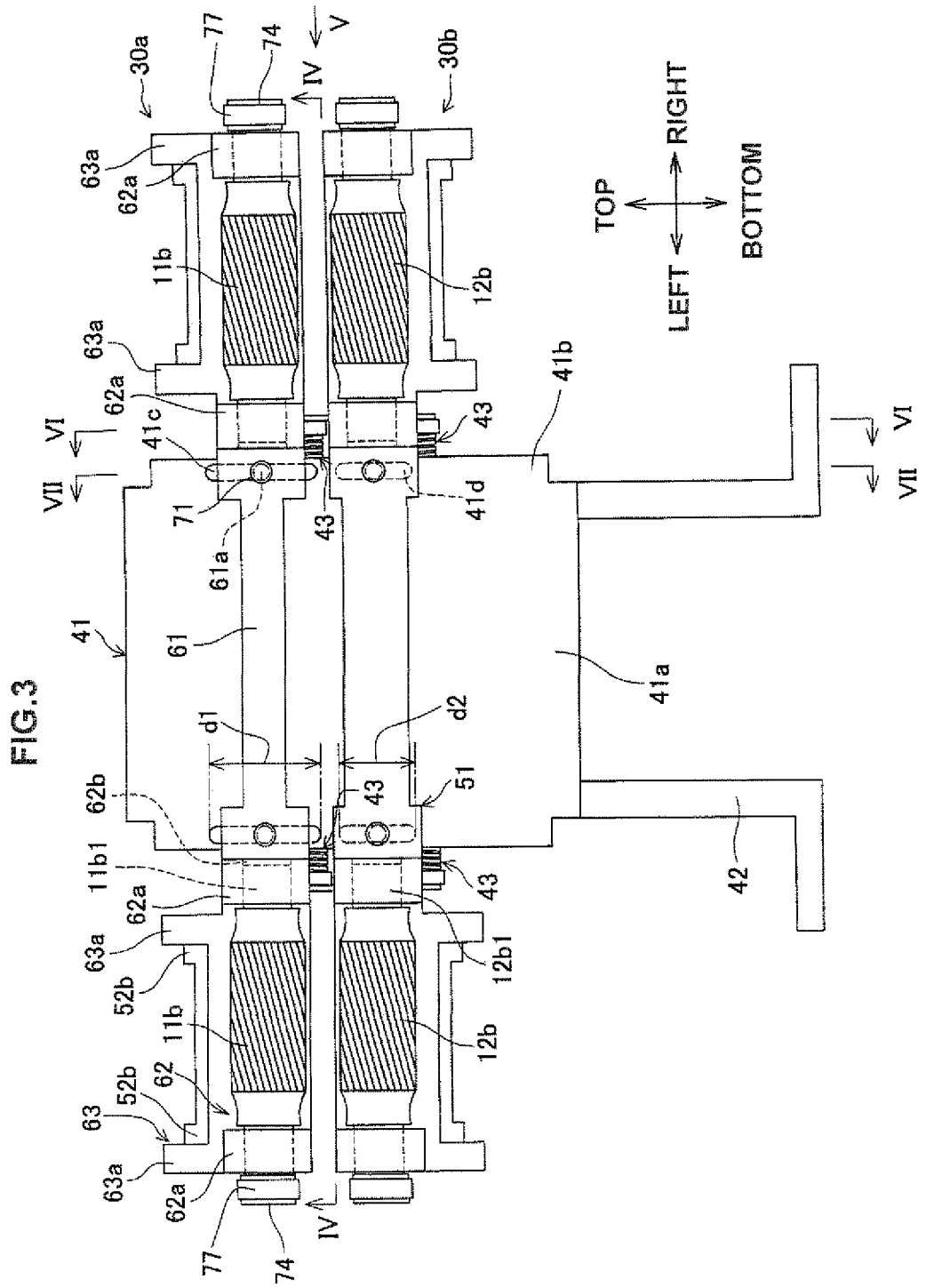
REAR
BOTTOM
5

FIG.3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43
71
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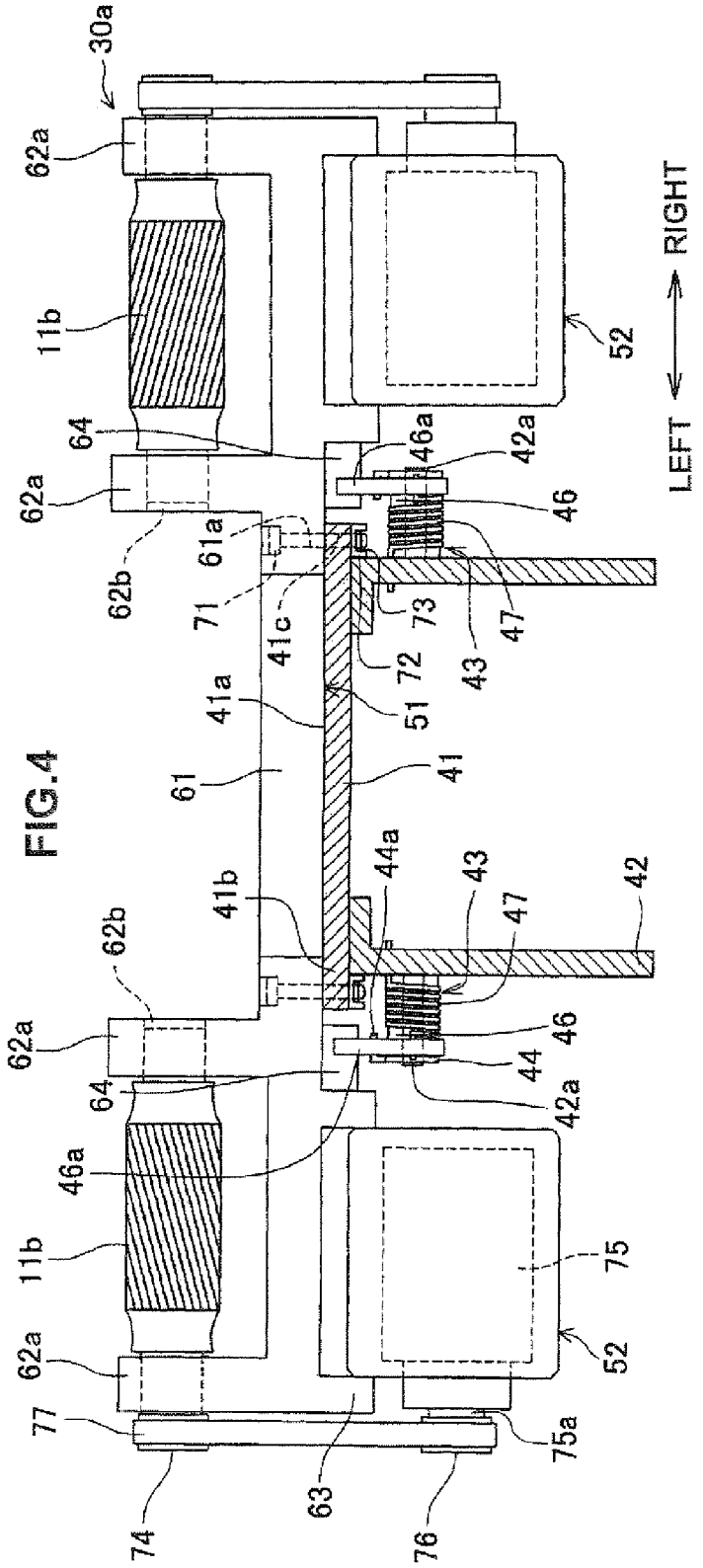
12b1

FIG.4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11b
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62b
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RIGHT
41a
51
61
41
41b
44a
43
47
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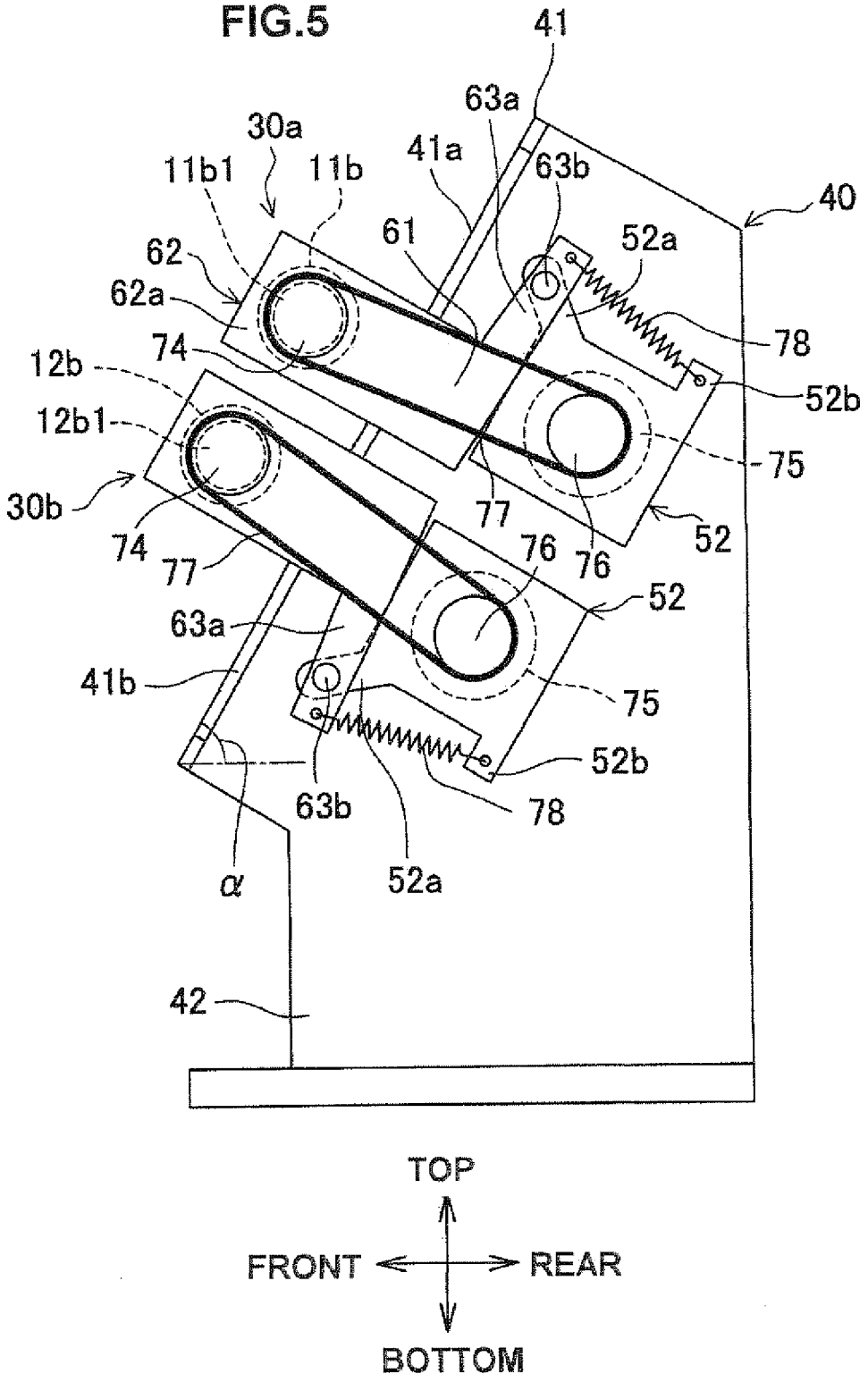
46
44
42a

FIG.5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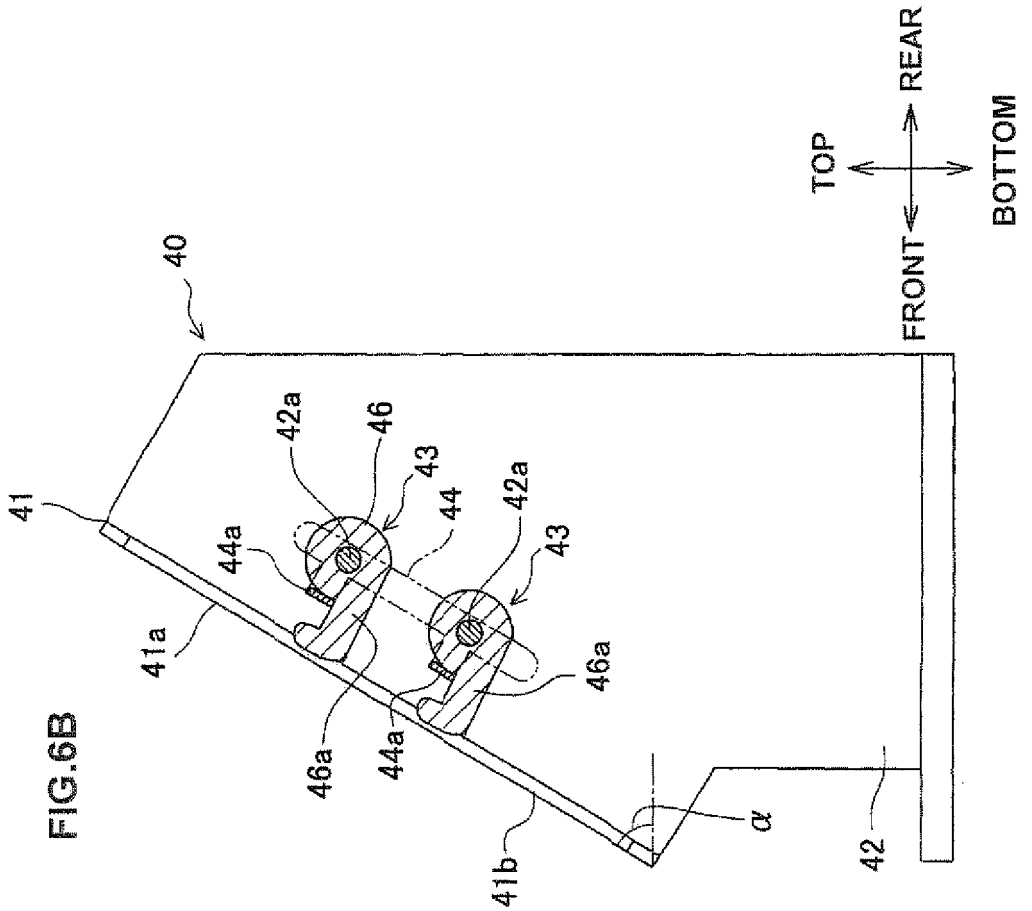
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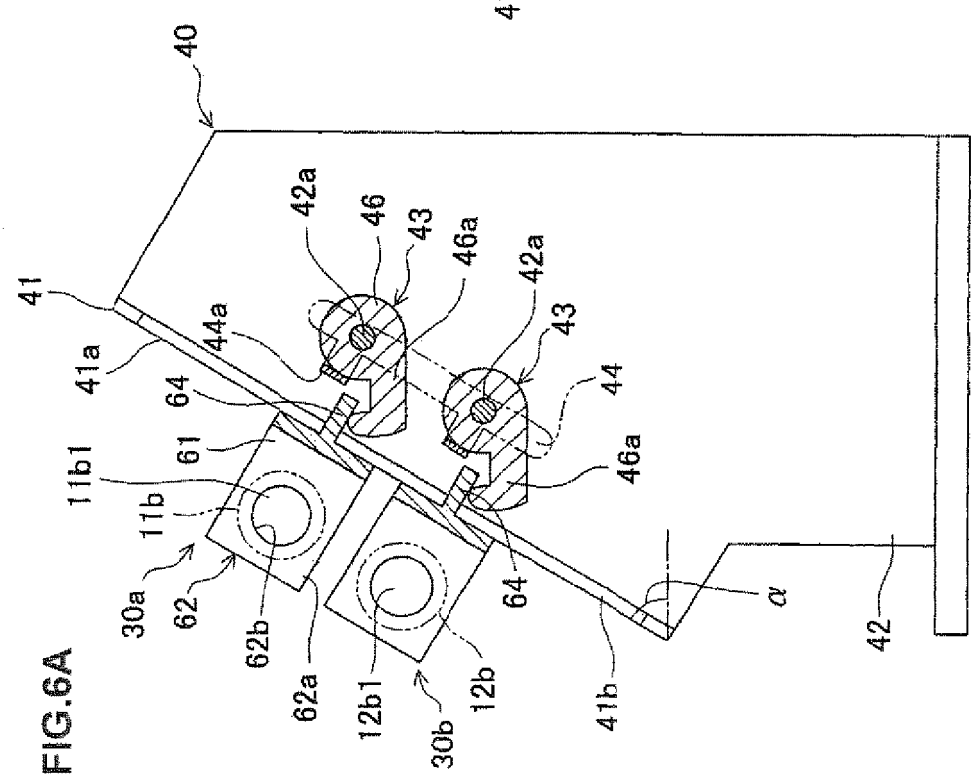
46a
α

FIG.6B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46a
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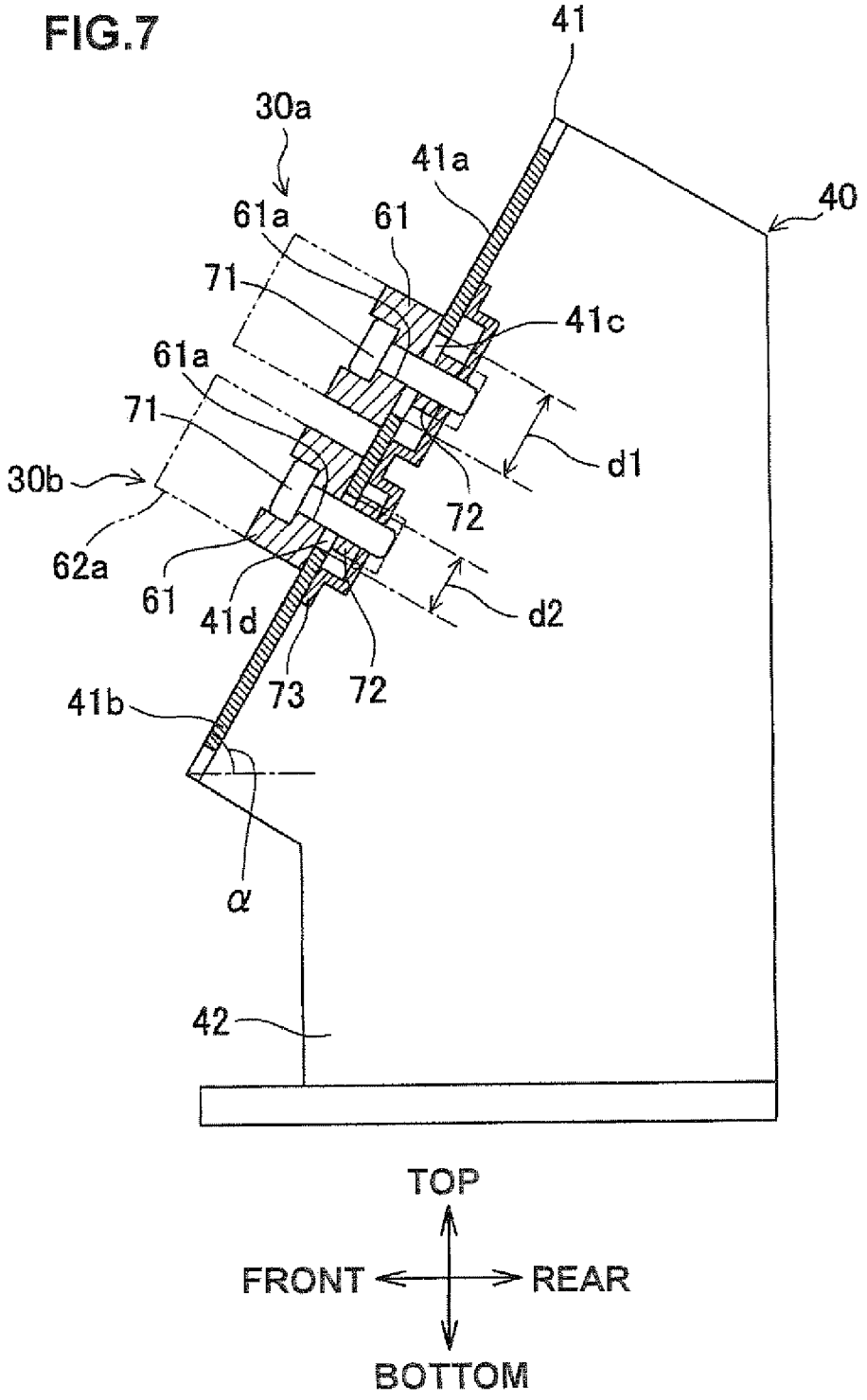
12b
12b1
30a
30b
41b
α

FIG.6A

FIG.7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41b
α
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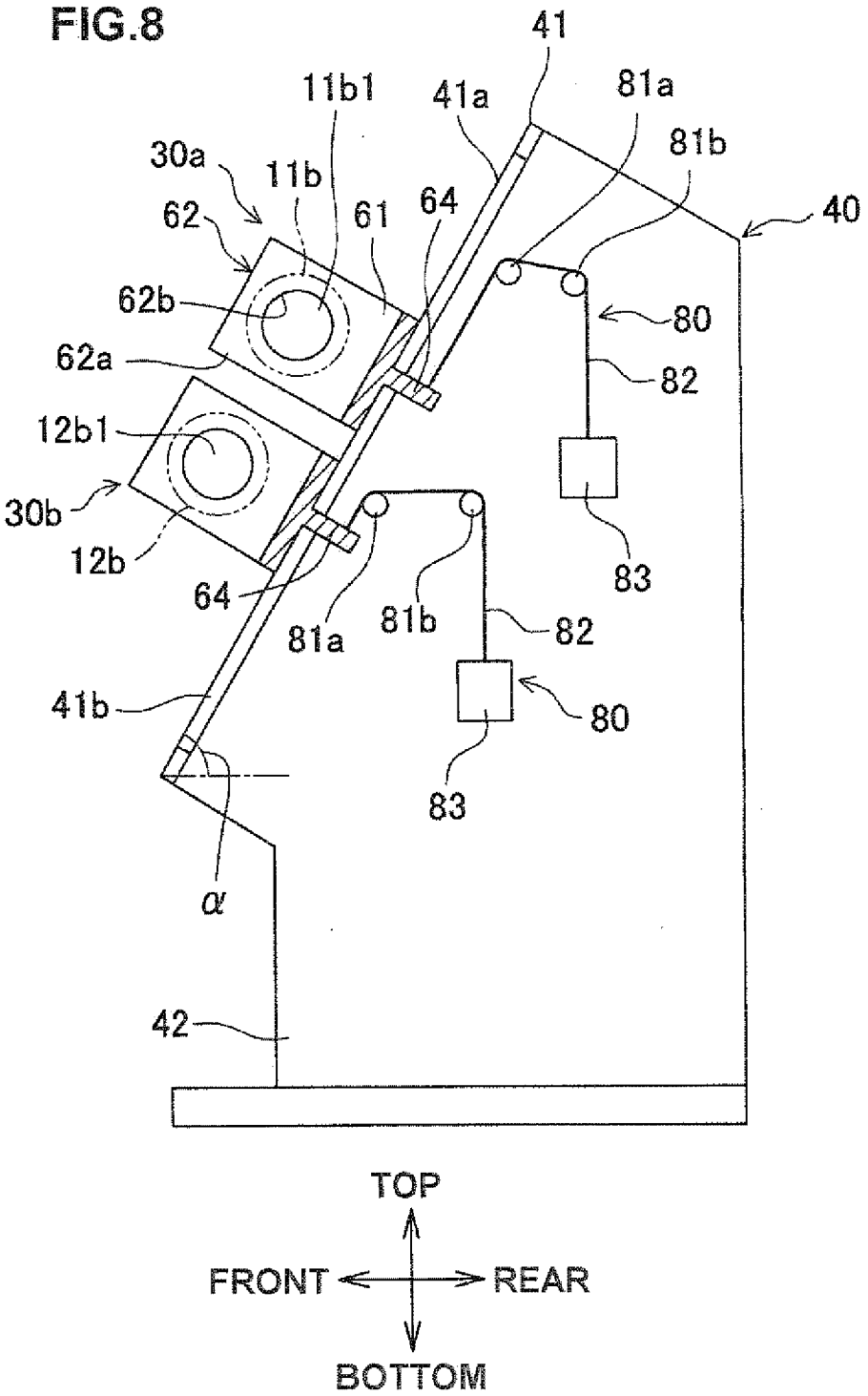
REAR
BOTTOM

FIG.8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12b
83
64
81a
81b
82
41b
80
83
α
42
TOP
FRONT
REAR
BOTTOM

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