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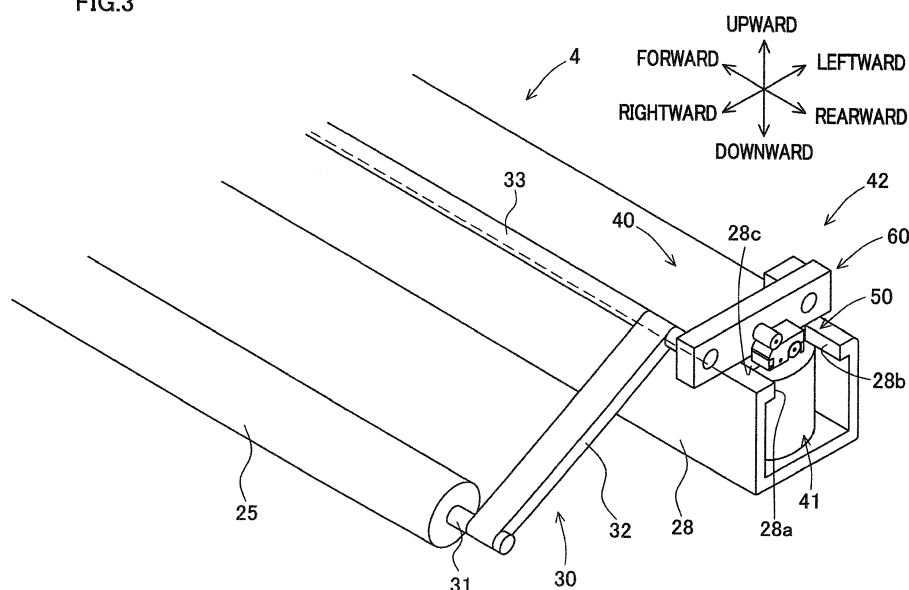
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YARN WINDER

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Postural change of a contact roller is accurately controlled even when a fluid pressure cylinder is employed. A yarn winder includes: a base 20; a bobbin holder 24 which is cantilevered by the base 20 and extends in a horizontal direction, bobbins B on which yarns Y are wound, respectively, being attached to the bobbin holder along an axial direction of the bobbin holder 24; a contact roller 25 which extends in the front-rear direction and applies a contact pressure to packages P formed by winding the yarns Y onto the respective bobbins B; a roller
- supporting member 30 which supports the contact roller 25 to be rotatable; an air cylinder 41 which is configure to posturally change a rear end portion of the roller supporting member 30 at least in the up-down direction; and an intervention mechanism 42 which intervenes between the rear end portion of the roller supporting member 30 and the air cylinder 41 and is configured to increase a load acting on the air cylinder 41 as the air cylinder 41 increases an upward postural change amount of the rear end portion of the roller supporting member 30.

FIG.3



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn winder including a contact roller applying a contact pressure to a package.

[0002] Patent Literature 1 recites a winder which is configured to wind yarns. To be more specific, the winder includes a bobbin holder which extends in the front-rear direction and to which bobbins are attached to be lined up and a contact roller which extends in the axial direction of the bobbin holder and is configured to apply a contact pressure to each of packages formed by winding yarns or the like onto the bobbins. The bobbin holder is cantilevered, and is warped due to the weight of the packages as the diameters of the packages increase. When the bobbin holder becomes no longer parallel to the contact roller, the magnitude of the contact pressure becomes different between the packages, with the result that the packages may be different in quality.

[0003] In this connection, Patent Literature 1 (Japanese Patent No. 3322235) recites a mechanism which is configured to forcibly change the posture of the contact roller in order to keep the bobbin holder to be parallel to the contact roller. To be more specific, both end portions of an elevation frame (supporting member) supporting the contact roller are movably supported by two contact pressure cylinders (fluid cylinders) each including a piston rod. The posture of the contact roller is changed by differentiating the thrust force of one contact pressure cylinder from the thrust force of the other contact pressure cylinder, so that the bobbin holder and the contact roller are arranged to be parallel to each other.

SUMMARY OF THE INVENTION

[0004] Because the degree of warpage of the bobbin holder increases as each package grows fat, it is necessary to accordingly change the posture of the contact roller gradually. However, it is typically very difficult to stably control the postural change solely by adjusting the thrust forces of the fluid cylinders, and the posture of the contact roller may be significantly changed by a slight change in the thrust force of each fluid cylinder.

[0005] An object of the present invention is to accurately control the postural change of a contact roller even when a fluid pressure cylinder is employed.

[0006] According to the first aspect of the invention, a yarn winder includes: a base; a bobbin holder which is cantilevered by the base and extends in a horizontal direction, bobbins on which yarns are wound, respectively, being attached to the bobbin holder along an axial direction of the bobbin holder; a contact roller which extends in the axial direction and applies a contact pressure to packages formed by winding the yarns onto the respective bobbins; a roller supporting member which supports the contact roller to be rotatable; a fluid pressure cylinder

which is configured to posturally change one end portion in the axial direction of the roller supporting member at least in a vertical direction; and an intervention mechanism which intervenes between the one end portion of the roller supporting member and the fluid pressure cylinder and is configured to increase a load acting on the fluid pressure cylinder as the fluid pressure cylinder increases a postural change amount of the one end portion of the roller supporting member in the vertical direction.

[0007] According to the present invention, the angle of the contact roller with respect to the horizontal direction is changeable by posturally changing one end portion of the roller supporting member supporting the contact roller in the vertical direction. The intervention mechanism provided between the one end portion of the roller supporting member and the fluid pressure cylinder increases the load acting on the fluid pressure cylinder, as the postural change amount of the one end portion of the roller supporting member increases. In other words, a larger thrust force of the fluid pressure cylinder is required to further increase the above-described postural change amount. This makes it possible to accurately control the postural change of the contact roller by adjusting the thrust force of the fluid pressure cylinder.

[0008] According to the second aspect of the invention, the yarn winder of the first aspect is arranged such that the fluid pressure cylinder includes a piston rod, the intervention mechanism includes a first intervention portion which includes a pressed member pressed by the piston rod and a supporting portion directly or indirectly supporting the one end portion of the roller supporting member, the first intervention portion being supported by the base via a first fulcrum shaft to be swingable in an up-down direction, and the horizontal distance between a part of the pressed member, at which part the pressed member is in contact with the piston rod, and the first fulcrum shaft decreases as the fluid pressure cylinder increases the postural change amount of the roller supporting member.

[0009] In the present invention, the first intervention portion of the intervention mechanism swings based on the principle of levers, utilizing the first fulcrum shaft as a fulcrum, a part of the pressed member in contact with the piston rod as a force point, and the supporting portion as an action point. In the structure above, the larger the above-described postural change amount is, the shorter the horizontal distance between the part (force point) of the pressed member in contact with the piston rod and the first fulcrum shaft (fulcrum) is, i.e., the shorter the force point distance is. As the force point distance decreases, the force required to move the load further increases. On this account, as the postural change amount increases, the thrust force of the fluid pressure cylinder required to further move the roller supporting member certainly increases.

[0010] According to the third aspect of the invention, the yarn winder of the second aspect is arranged such that the pressed member is a first roller which is rotatable about an axis parallel to the first fulcrum shaft.

[0011] In the present invention, because the first roller which rotates about an axis parallel to the first fulcrum shaft is pressed by the piston rod, the pressed member smoothly follows the elongation and contraction of the piston rod, and hence the first intervention portion stably swings.

[0012] According to the fourth aspect of the invention, the yarn winder of the second or third aspect is arranged such that, the intervention mechanism includes a supported member which is directly supported by the supporting portion and is posturally changeable at least in the vertical direction together with the one end portion of the roller supporting member, the supporting portion includes a supporting surface which makes contact with and supports the supported member, and the horizontal distance between a part of the supporting surface, which part is in contact with the supported member, and the first fulcrum shaft increases as the fluid pressure cylinder increases the postural change amount of the roller supporting member.

[0013] In the present invention, the larger the above-described postural change amount is, the longer the horizontal distance between the part (action point) of the supporting surface in contact with the supported member and the first fulcrum shaft (fulcrum) is, i.e., the longer the action point distance is. As the action point distance increases, the force required to further move the load increases. As a result, as the postural change amount of the one end portion of the roller supporting member increases, the moment of force with which the supported member presses the first intervention portion (i.e., the force against the thrust force of the fluid pressure cylinder) increases. On this account, as the postural change amount increases, the thrust force of the fluid pressure cylinder required to further move the roller supporting member further increases. The details will be given later in an embodiment of the present invention.

[0014] According to the fifth aspect of the invention, the yarn winder of the fourth aspect is arranged such that the supporting portion is attachable to and detachable from the first intervention portion.

[0015] In the present invention, the relationship between the thrust force of the fluid pressure cylinder and the postural change amount of the one end portion of the roller supporting member is changeable in such a way that the relationship between the swing amount of the first intervention portion and the amount of change of the action point distance is changed by replacing the supporting portion with another member having a supporting surface which is different in shape. To put it differently, it is unnecessary to replace the entire first intervention portion with another member when, for example, the postural change amount of the roller supporting member relative to the thrust force of the fluid pressure cylinder is adjusted. It is therefore possible to adjust the postural change amount of the roller supporting member relative to the thrust force of the fluid pressure cylinder only by changing the shape of the supporting surface, without

changing the positions of the first fulcrum shaft, the pressed member, etc. This makes it possible to finely adjust the postural change amount of the roller supporting member relative to the thrust force of the fluid pressure cylinder.

[0016] According to the sixth aspect of the invention, the yarn winder of the fourth or fifth aspect is arranged such that the supported member is a second roller which is rotatable about an axis parallel to the first fulcrum shaft.

[0017] In the present invention, the supported member smoothly follows the swing of the first intervention portion, and the roller supporting member is stably moved.

[0018] According to the seventh aspect of the invention, the yarn winder of any one of the fourth to sixth aspects is arranged such that the supporting surface is provided between the pressed member and the first fulcrum shaft in the horizontal direction.

[0019] In the present invention, because the action point is provided between the fulcrum and the force point in the horizontal direction, the first intervention portion is downsized. Furthermore, because the force point distance is easily increased as compared to the action point distance and the thrust force of the fluid pressure cylinder required to swing the first intervention portion is restrained, increase in size and cost of the fluid pressure cylinder is restrained.

[0020] According to the eighth aspect of the invention, the yarn winder of the seventh aspect is arranged such that, at least when the postural change amount of the roller supporting member is zero, the supporting surface is a curved surface or an inclined surface which extends away from the first fulcrum shaft in the horizontal direction and extends away from a leading end of the piston rod in the vertical direction.

[0021] Depending on the shape or the like of the supporting surface, the supported member may not easily change in posture in the vertical direction, even if the fluid pressure cylinder causes the first intervention portion to swing. This problem is particularly conspicuous when the above-described postural change amount is zero, i.e., when the contact point (action point) is close to the first fulcrum shaft (fulcrum), because the moving distance of the action point is small as compared to the moving distance of the force point. In the present invention, at least when the postural change amount is zero, the supporting surface extends away from the first fulcrum shaft in the horizontal direction and extends away from the leading end of the piston rod in the vertical direction. On this account, when the contact point becomes far from the first fulcrum shaft (i.e., the action point distance increases) as the first intervention portion moves toward the one side, the supported member moves toward the one side along the inclined or curved supporting surface. It is therefore possible to certainly move the supported member in the vertical direction by swinging the first intervention portion, even when the contact point is close to the first fulcrum shaft.

[0022] According to the ninth aspect of the invention,

the yarn winder of the eighth aspect is arranged such that, when the postural change amount of the roller supporting member is zero, the supporting surface is a curved surface which is curved so that the degree of inclination relative to the horizontal direction increases toward the first fulcrum shaft in the horizontal direction.

[0023] In this aspect, the eighth aspect of the present invention is further arranged such that, in the supporting surface, the degree of inclination in the horizontal direction increases toward the first fulcrum shaft. On this account, when the contact point is close to the first fulcrum shaft (i.e., when the action point distance is short), the postural change amount of the supported member on account of the postural change of the first intervention portion is large due to the large inclination of the supporting surface. Meanwhile, when the contact point is far from the first fulcrum shaft (i.e., when the action point distance is long), postural change of the supported member in the vertical direction in response to the postural change of the first intervention portion is large even if the inclination angle of the supporting surface is small. It is therefore possible to arrange the postural change amount of the supported member in response to postural change of the first intervention portion by a unit amount to be more or less identical between a case where the action point distance is short and a case where the action point distance is long.

[0024] According to the tenth aspect of the invention, the yarn winder of any one of the fourth to ninth aspects is arranged such that the intervention mechanism further includes a second intervention portion which is connected to the one end portion of the roller supporting member and includes a connecting portion which is movable at least in the vertical direction, and the supported member is provided at the second intervention portion.

[0025] In the present invention, the second intervention portion is connected to one end portion of the roller supporting member and includes the supported member. In other words, the first intervention portion indirectly supports the one end portion of the roller supporting member via the supported member of the second intervention portion. The first intervention portion is therefore not required to directly support the roller supporting member, and hence the locations or the like of the first intervention portion and the fluid pressure cylinder can be determined in accordance with the location of the supported member. The degree of freedom in determining the locations or the like of the first intervention portion and the fluid pressure cylinder is therefore increased.

[0026] According to the eleventh aspect of the invention, the yarn winder of the tenth aspect is arranged such that the second intervention portion extends in a direction orthogonal to the axial direction.

[0027] According to the present invention, the second intervention portion extends in a direction orthogonal to the axial direction. This makes it possible to restrain the yarn winder from being further upsized in the axial direction due to the intervention mechanism.

[0028] According to the twelfth aspect of the invention, the yarn winder of the tenth or eleventh aspect is arranged such that the second intervention portion is supported by the base via a second fulcrum shaft to be swingable in an up-down direction.

[0029] According to the present invention, the second intervention portion is supported by the base to be swingable in the up-down direction. This indicates that the entirety of the second intervention portion does not move in the up-down direction. Because it is unnecessary to provide a space for allowing the entirety of the second intervention portion to move in the vertical direction and a guide member or the like for guiding the second intervention portion in the vertical direction, it is possible to restrain increase in size of the apparatus.

[0030] According to the thirteenth aspect of the invention, the yarn winder of any one of the first to twelfth aspects is arranged such that the intervention mechanism and the fluid pressure cylinder are provided at an end portion of the base, the end portion being on the base end side of the bobbin holder in the axial direction.

[0031] On the leading end side of the bobbin holder, operations such as attaching the bobbins to the bobbin holder are typically performed. On this account, when an intervention mechanism or the like is provided at an end portion on the leading end side of the bobbin holder, the space on the working side may be narrowed. In the present invention, because the intervention mechanism and the fluid pressure cylinder are provided at an end portion on the base end side of the bobbin holder, it is possible to prevent the space on the working side from being narrowed.

[0032] According to the fourteenth aspect of the invention, the yarn winder of any one of the first to thirteenth aspects is arranged such that the roller supporting member is supported to be swingable about an axis which is along the axial direction.

[0033] According to the present invention, the roller supporting member is supported to be swingable. This indicates that the entirety of the roller supporting member and the entirety of the contact roller do not move in the up-down direction. Because it is unnecessary to provide a space for allowing the entirety of the roller supporting member or the like to move in the vertical direction and a guide member or the like for guiding the roller supporting member or the like in the vertical direction, it is possible to restrain increase in size of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

FIG. 1 is a profile of a take-up apparatus including a yarn winder of an embodiment.

FIG. 2 is a front elevation of the yarn winder.

FIG. 3 is a perspective view of a rear portion of the contact roller and a tilting mechanism.

FIG. 4 is a rear view of the tilting mechanism.

FIGs. 5(a) to 5(c) illustrate how the tilting mechanism operates.

FIGs. 6(a) to 6(c) illustrate how the posture of the contact roller changes.

FIG. 7 supplements FIG. 5(a).

FIG. 8 is a graph showing the relationship between a postural change amount of a rear end portion of the contact roller and the load on an air cylinder.

FIG. 9 shows a first intervention portion and its surroundings according to a modification.

FIG. 10 shows an intervention mechanism according to another modification.

FIG. 11 shows an intervention mechanism according to a further modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] The following will describe an embodiment of the present invention with reference to FIG. 1 to FIG. 8.

(Outline of Take-Up Apparatus)

[0036] FIG. 1 is a profile of a take-up apparatus 1 including a yarn winder 4 (detailed later) of an embodiment. Hereinafter, the left-right direction in the sheet of FIG. 1 will be referred to as a front-rear direction (axial direction in the present invention). Furthermore, the direction in which gravity acts will be referred to as an up-down direction (vertical direction), whereas a direction orthogonal to the front-rear direction and the up-down direction (i.e., a direction perpendicular to the sheet of the figure) will be referred to as a left-right direction.

[0037] The take-up apparatus 1 includes a first godet roller 11, a second godet roller 12, and a yarn regulating guide 16 for taking up yarns Y spun out from a spinning apparatus 3, and a yarn winder 4 configured to form packages P by winding the taken-up yarns Y onto bobbins B.

[0038] The first godet roller 11 is a roller having an axis substantially in parallel to the left-right direction and is provided above a front end portion of the yarn winder 4. The first godet roller 11 is rotationally driven by a motor which is not illustrated. The second godet roller 12 is a roller having an axis substantially in parallel to the left-right direction, and is provided above and rearward of the first godet roller 11. The second godet roller 12 is rotationally driven by a motor which is not illustrated.

[0039] The second godet roller 12 is movably supported by a guide rail 14. The guide rail 14 extends obliquely upward and rearward. The second godet roller 12 is arranged to be movable along the guide rail 14 by members such as a pulley pair, a belt, and a drive motor which are not illustrated. With this, the second godet roller 12 is movable between a position where winding of the yarns Y is performed and a position which is close to the first godet roller 11 and where yarn threading is performed. In FIG. 2, the position of the second godet roller 12 when the yarns Y are wound is indicated by full lines, whereas the position of the second godet roller 12 when the yarn

threading operation is performed is indicated by one-dot chain lines.

[0040] The yarn regulating guide 16 is provided above the first godet roller 11. The yarn regulating guide 16 is, for example, a known yarn guide with a comb teeth shape. When the yarns Y are threaded thereon, the yarn regulating guide 16 regulates the interval between neighboring yarns Y to a predetermined value.

10 (Yarn Winder)

[0041] The following will describe the yarn winder 4 with reference to FIG. 1 to FIG. 3. FIG. 2 is a front elevation of the yarn winder 4. FIG. 3 is a perspective view of a rear portion of a contact roller 25 and a later-described tilting mechanism 40. The yarn winder 4 includes members such as: a base 20; fulcrum guides 21; traverse guides 22; a turret 23; two bobbin holders 24; a contact roller 25; and a controlling unit 26.

20 **[0042]** As shown in FIG. 1, the base 20 includes a base main body 27 which stands up from a rear portion of the yarn winder 4 and a frame 28 which is fixed to an upper portion of the base main body 27 and extends forward. In the present embodiment, a combination of the base main body 27 and the frame 28 is equivalent to a base of the present invention. The base main body 27 supports the turret 23 or the like. The frame 28 is a hollow column-shaped member. The frame 28 supports the contact roller 25 which extends along the front-rear direction. At an upper part of a rear end portion of the frame 28, a cutout is formed by side face portions 28a and 28b formed at the left and right end portions, respectively, and a side face portion 28c orthogonal to the front-rear direction (see FIG. 3). At the rear end portion of the frame 28, a later-described tilting mechanism 40 is provided.

[0043] The fulcrum guides 21 are provided for the yarns Y, respectively, and are lined up in the front-rear direction. The fulcrum guides 21 are attached to a guide supporting member 29 supported by the frame 28. As the yarns Y are threaded, the fulcrum guides 21 function as fulcrums when the yarns Y are traversed.

[0044] The traverse guides 22 are provided for the yarns Y, respectively, and are lined up in the front-rear direction. The traverse guides 22 are driven by a traverse motor (not illustrated) and are configured to reciprocate in the front-rear direction. With this, the yarns Y threaded onto the traverse guides 22 are traversed about the fulcrum guides 21.

50 **[0045]** The turret 23 is a disc-shaped member having an axis substantially in parallel to the front-rear direction, and is rotatably supported by the base main body 27. The turret 23 is rotationally driven by a turret motor which is not illustrated. The turret 23 cantilevers two bobbin holders 24, and moves the two bobbin holders 24 by rotating about a rotation axis substantially in parallel to the front-rear direction. With this arrangement, it is possible in the yarn winder 4 to swap the positions of the two bobbin holders 24, and hence replacement of the bobbins

B is possible at one bobbin holder 24 while yarns are wound onto the bobbins B attached to the other bobbin holder 24. Furthermore, the turret 23 is arranged to be rotatable in accordance with an increase in amount of the wound yarn Y when the yarn is wound onto to the bobbin B (see the solid arrow in FIG. 2).

[0046] To each of the two bobbin holders 24, bobbins B are attached. The two bobbin holders 24 are rotatably supported at an upper end portion and a lower end portion of the turret 23 supported by the base main body 27, respectively, and protrude forward from the turret 23. To put it differently, the two bobbin holders 24 are cantilevered by the base main body 27 which is provided on the rear side. The axes of the two bobbin holders 24 are substantially in parallel to the front-rear direction. The leading end side (front end portion) of the bobbin holder 24 is typically a working side where operations such as attaching the bobbins B to the bobbin holder 24 are performed.

[0047] The bobbins B are attached to each bobbin holder 24. The bobbins B are respectively provided for the yarns Y and lined up in the front-rear direction. The number of the bobbins B attached to one bobbin holder 24 is, for example, 16. The two bobbin holders 24 are rotationally driven by their respective winding motors (not illustrated).

[0048] The contact roller 25 is a roller having an axis substantially in parallel to the front-rear direction and is provided immediately above the upper bobbin holder 24. The contact roller 25 is configured to make contact with the surfaces of the packages P supported by the upper bobbin holder 24. With this, the contact roller 25 applies a contact pressure to the surfaces of the unfinished packages P, to adjust the shape of each package P.

[0049] In the present embodiment, the contact roller 25 is a so-called swing arm contact roller which is swingably supported by the frame 28 via a roller supporting member 30. As shown in FIG. 1 to FIG. 3, the roller supporting member 30 includes, for example, a supporting portion 31, an arm portion 32, and a swing axis 33. The supporting portion 31 rotatably supports the contact roller 25 at the respective end portions of the contact roller 25 in the front-rear direction. The arm portion 32 has one end portion connected to the supporting portion 31, and extends toward the frame 28 in the direction orthogonal to the front-rear direction. The swing axis 33 is connected to the other end portion of the arm portion 32 and extends along the front-rear direction, and a front end portion and a rear end portion of the swing axis 33 are swingably supported by the frame 28. A rear end portion (one end portion in the present invention) of the swing axis 33 is supported by a later-described tilting mechanism 40. The total weight of the contact roller 25 and the roller supporting member 30 is, for example, about 200kg.

[0050] The controlling unit 26 includes members such as a CPU, a ROM, and a RAM. The controlling unit 26 is configured to control members by the CPU, based on a program stored in the ROM. To be more specific, the

controlling unit 26 includes members such as a turret motor (not illustrated), a traverse motor (not illustrated), and a later-described electro-pneumatic regulator 47 which will be described later.

[0051] In the yarn winder 4 structured as described above, when the upper bobbin holder 24 is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the bobbins B, with the result that the packages P are formed. The shape of each package P is adjusted in such a way that the contact roller 25 makes contact with the surface of the package P and applies a contact pressure while the package P is being formed. The turret 23 rotates in the direction indicated by the solid arrow in FIG. 2 as the diameter of the package P increases (i.e., the package P grows fat) due to the winding of the yarn Y onto the bobbin B. As a result, the distance between the bobbin holder 24 to which the bobbins B onto which the yarns Y are wound and the contact roller 25 is increased. Because the contact roller 25 is swingable about the swing axis 33, the contact between the contact roller 25 and the packages P is maintained as the contact roller 25 swings in accordance with the movement of the bobbin holder 24 and the packages P (see the dotted arrow in FIG. 2).

[0052] With regard to the above, as the packages P grow fat as the yarns Y are wound onto the bobbins B, the cantilevered bobbin holder 24 is warped downward and especially a front portion significantly hangs down on account of the weight of the packages P. When the bobbin holder 24 becomes no longer parallel to the contact roller 25, the magnitude of the contact pressure becomes different between the packages P, with the result that the packages P may be different in quality. In this way, it is necessary to keep the bobbin holder 24 to be parallel to the contact roller 25 by gradually tilting the contact roller 25 in the horizontal direction (front-rear direction) as the packages P grow fat, from the start to the end of the winding of the yarn Y. An example of a power source for tilting the contact roller 25 is an air cylinder, in consideration of costs or the like. However, if, for example, the rear end portion of the swing axis 33 is directly pushed upward by an air cylinder or the like, the degree of inclination of the roller supporting member 30 may significantly vary in response to a slight change in the thrust force of the air cylinder or the like, and hence it is difficult to finely control the posture of the contact roller.

[0053] In this circumstance, a tilting mechanism 40 which is configured to finely move the rear end portion of the roller supporting member 30 is provided in the present embodiment. The following explanation is given with reference to FIG. 3 and FIG. 4. FIG. 4 is a rear view of the tilting mechanism 40.

(Tilting Mechanism)

[0054] As shown in FIG. 3 and FIG. 4, the tilting mechanism 40 includes an air cylinder 41 (a fluid pressure cylinder of the present invention) which is a driving source

and an intervention mechanism 42 which intervenes between the rear end portion of the roller supporting member 30 and the air cylinder 41. The intervention mechanism 42 and the air cylinder 41 are provided at a rear end portion of the frame 28 (i.e., at an end portion on the base end side of the bobbin holder 24 in the front-rear direction).

[0055] The air cylinder 41 is configured to move the rear end portion of the roller supporting member 30 in the up-down direction, via the intervention mechanism 42. The air cylinder 41 is housed in the rear end portion of the frame 28 and is supported by the frame 28. As shown in FIG. 4, the air cylinder 41 includes a cylinder main body 43 in which a working chamber 44 receiving compressed air is formed and a piston rod 45 which elongates or contracts as the compressed air is supplied to or discharged from the working chamber 44. The working chamber 44 is connected to a supply port (not illustrated) connected to a source of the compressed air and an exhaust port (not illustrated) connected to the outside. Between the air cylinder 41 and a pair of the supply port and the exhaust port, for example, the electro-pneumatic regulator 47 is provided to adjust the pressure of the compressed air supplied to the working chamber 44. The electro-pneumatic regulator 47 is configured to adjust the pressure based on an instruction signal from the controlling unit 26. The piston rod 45 protrudes from an upper end portion of the cylinder main body 43, and is able to elongate and contract in the up-down direction because the above-described cutout is formed at the upper part of the rear end portion of the frame 28. At a leading end portion of the piston rod 45, an upper end face 46 is formed to be substantially parallel to the horizontal direction.

[0056] The intervention mechanism 42 intervenes between the rear end portion of the roller supporting member 30 and the air cylinder 41 to transmit the thrust force of the air cylinder 41 to the rear end portion of the roller supporting member 30. The intervention mechanism 42 includes a first intervention portion 50 and a second intervention portion 60.

[0057] The first intervention portion 50 is directly pressed by the piston rod 45 and transmits the thrust force of the air cylinder 41 to the second intervention portion 60. As shown in FIG. 4, the first intervention portion 50 is swingably supported by the frame 28 via a first fulcrum shaft 51 which extends along the front-rear direction. The first intervention portion 50 includes a first main body 52, a first roller 53 (pressed member of the present invention), and a supporting portion 54.

[0058] The first main body 52 is a substantially rectangular member when viewed from behind. The first main body 52 is swingably supported by the side face portion 28c of the frame 28 via the first fulcrum shaft 51 to be able to support the first roller 53 and the supporting portion 54. The first roller 53 is provided at a position which is to the left of (rightward in the sheet of FIG. 4) the first fulcrum shaft 51 by a predetermined distance. The first

roller 53 is a roller which rotates about an axis 59 extending substantially parallel to the first fulcrum shaft 51 and is rotatably supported by the first main body 52. The first roller 53 is in contact with the upper end face 46 of the piston rod 45. The supporting portion 54 is provided to support the second intervention portion 60 from below. The supporting portion 54 is roughly a T-shaped member when viewed from behind. A lower portion of the supporting portion 54 is detachably attached to the first main body 52 by a fixing member 55. In other words, the supporting portion 54 is attachable to and detachable from the first intervention portion 50. In the supporting portion 54, a cutout which is substantially U-shaped when viewed from behind is formed to cover the circumferential surface of the first roller 53 except its lower portion. The supporting portion 54 has a top surface 56. A part of the top surface 56 functions as a supporting surface 57 (indicated by a thick line) which supports the second intervention portion 60 by making contact with a later-described second roller 62 (supported member of the present invention) from below. To put it differently, the supporting surface 57 is a part of the top surface 56, which is able to make contact with the second roller 62. A part of the supporting surface 57, which is in contact with the second roller 62, will be referred to as a contact point 58.

[0059] The supporting surface 57 extends away from the first fulcrum shaft 51 in the left-right direction and extends away from the leading end of the piston rod 45 in the up-down direction, when the roller supporting member 30 is horizontal in the front-rear direction (i.e., in a later-described state in which a postural change amount is zero). The supporting surface 57 is a curved surface which is curved so that the degree of inclination relative to the horizontal direction increases toward the first fulcrum shaft 51 in the horizontal direction. The supporting surface 57 is provided between the first roller 53 and the first fulcrum shaft 51 in the left-right direction.

[0060] The second intervention portion 60 is configured to transmit, to the rear end portion of the roller supporting member 30, a thrust force of the air cylinder 41 transmitted via the first intervention portion 50. The second intervention portion 60 includes a second main body 61 and the second roller 62.

[0061] The second main body 61 is a substantially rectangular member when viewed from behind. The second main body 61 extends in the left-right direction. At a left end portion (right end portion in the sheet of FIG. 4), the second main body 61 is supported by a second fulcrum shaft 63 which is positionally different from the first fulcrum shaft 51, so as to be swingable in the up-down direction relative to the frame 28. At a right end portion (left end portion in the sheet of FIG. 4) of the second main body 61, a connecting portion 64 is connected to the rear end portion of the roller supporting member 30 and is provided to support the roller supporting member 30 to be swingable. To put it differently, the contact roller 25 is connected to the second main body 61 via the roller supporting member 30.

[0062] The second roller 62 is a roller provided at a position which is between the second fulcrum shaft 63 and the connecting portion 64 in the left-right direction and is behind the second main body 61 (i.e., a position close to the viewer of FIG. 4). The second roller 62 is rotatably supported by the second main body 61 and is rotatable about an axis 65 which is substantially parallel to the second fulcrum shaft 63. The second roller 62 is in contact with the supporting surface 57 of the first intervention portion 50 so as to be directly supported by the supporting portion 54. To put it differently, a rear end portion of the roller supporting member 30 is indirectly supported by the supporting portion 54 via the second roller 62. The second roller 62 is swingable in the up-down direction together with the second main body 61. In other words, the second roller 62 is posturally changeable at least in the up-down direction.

(Operation of Tilting Mechanism and Posture of Contact Roller)

[0063] The following will describe how the tilting mechanism 40 operates and how the posture of the contact roller 25 is changed by the operation of the tilting mechanism 40, with reference to FIGs. 5(a) to 5(c) and FIGs. 6(a) to 6(c). FIGs. 5(a) to 5(c) illustrate how the tilting mechanism 40 operates. FIGs. 6(a) to 6(c) illustrate how the posture of the contact roller 25 changes.

[0064] To begin with, the outline of the operation of the tilting mechanism 40 will be described. As the above-described controlling unit 26 controls the electro-pneumatic regulator 47, compressed air with a predetermined pressure is supplied to the working chamber 44 of the air cylinder 41. The piston rod 45 is elongated by the compressed air, and the first roller 53 of the first intervention portion 50 is pressed upward. The first intervention portion 50 is pressed upward via the first roller 53. When the first intervention portion 50 is pressed upward, the second roller 62 of the second intervention portion 60, which is in contact with the supporting surface 57, is pressed upward. When the force of pressing the second roller 62 upward and the downward force exerted by the weight of the contact roller 25 or the like is balanced, the postures of the first intervention portion 50 and the second intervention portion 60 are fixed and hence the postures of the roller supporting member 30 and the contact roller 25 are fixed. When the force of pressing the second roller 62 upward is larger than the downward force, the first intervention portion 50 and the second intervention portion 60 swing upward, and the connecting portion 64 of the second intervention portion 60 and the rear end portion of the roller supporting member 30 move upward (see FIG. 5(a) to FIG. 5(c)). When the rear end portion of the roller supporting member 30 moves upward, the contact roller 25 is tilted and changes its posture so that the rear end portion of the contact roller 25 is at a relatively high position whereas the front end portion of the contact roller 25 is at a relatively low position (see FIG. 6(a) to

FIG. 6(c)).

[0065] With reference to FIG. 5, specific forces acting on the intervention mechanism 42 will be described with the focus on the first intervention portion 50. On the first intervention portion 50, a moment of upward force exerted by the air cylinder 41 and a moment of downward force exerted by the weight of the contact roller 25 act, with the first fulcrum shaft 51 acting as a fulcrum. When these two moments of force are balanced, the first intervention portion 50 remains stationary. When the moment of upward force is larger than the moment of downward force, the first intervention portion 50 swings upward. To put it differently, the first intervention portion 50 is moved based on the principle of levers, utilizing the first fulcrum shaft 51 as a fulcrum, a part of the first roller 53 in contact with the upper end face 46 as a force point, and the contact point 58 of the supporting surface 57 as an action point.

[0066] FIG. 5(a) shows a state of the tilting mechanism 40 before the start of winding of the yarns Y onto the bobbins B. In this state, the posture of the second main body 61 of the second intervention portion 60 is maintained to be substantially horizontal because the moment of force moving the first intervention portion 50 upward and the moment of force moving the first intervention portion downward are balanced. In this state, the upward postural change amount of the rear end portion of the roller supporting member 30 (hereinafter, this will be simply referred to as the postural change amount of the roller supporting member 30) is zero. These two moments of force will be specifically described below.

[0067] First, the moment of upward force will be described. As described above, the piston rod 45 presses the first roller 53 upward. As shown in FIG. 5(a), the moment of upward force with the first fulcrum shaft 51 acting as a fulcrum acts on the first intervention portion 50, because the thrust force $F1a$ of the air cylinder 41 acts on the first roller 53. Provided that the horizontal distance between a part of the first roller 53 where the first roller 53 is in contact with the upper end face 46 of the piston rod 45 and the first fulcrum shaft 51 is a distance $L1a$ (i.e., force point distance), the magnitude of the above-described moment of force is represented as $F1a \times L1a$.

[0068] Subsequent to the above, the moment of downward force will be described. On the second intervention portion 60, a downward force acts on account of the weight of the contact roller 25 or the like. With this, a downward force $F2a$ acts on the contact point 58a of the supporting surface 57 via the second roller 62. The magnitude of the moment of force moving the first intervention portion 50 downward is, as described below, represented as $F2a \times L2a$, provided that the horizontal distance between the contact point 58 and the first fulcrum shaft 51 is a distance $L2a$.

[0069] The details of the moment of downward force will be given with reference to FIG. 7. In the force $F2a$, a component of force in the direction of rotating the first intervention portion 50 is a component in the direction

orthogonal to a line segment connecting the first fulcrum shaft 51 with the contact point 58a, i.e., is a force F_{2aa} . The vector of the force F_{2aa} is inclined with respect to the vector of the force F_{2a} (i.e., the vertical direction) by an angle θ . Provided that the length of the line segment connecting the first fulcrum shaft 51 with the contact point 58a is L , the magnitude of the moment of force moving the first intervention portion 50 downward is calculated by $F_{2aa} \times L$, i.e., $F_{2a} \times \cos\theta \times L$. The line segment connecting the first fulcrum shaft 51 to the contact point 58a is inclined to the horizontal direction by the angle θ . On this account, the magnitude of the above-described distance L_{2a} is represented as $L_{2a} = L \times \cos\theta$. In other words, the magnitude of the above-described moment of force is represented as $F_{2a} \times \cos\theta \times L = F_{2a} \times L_{2a}$. This distance L_{2a} is the action point distance.

[0070] In FIG. 5(a), the above-described two moments of force are balanced. This is represented as $F_{1a} \times L_{1a} = F_{2a} \times L_{2a}$. In other words, $F_{1a} = F_{2a} \times L_{2a} / L_{1a}$. The magnitude of F_{1a} indicates the magnitude of the upward thrust force of the air cylinder 41 and at the same time the magnitude of a downward load acting on the air cylinder 41. Because $L_{1a} > L_{2a}$, the thrust force F_{1a} of the air cylinder 41 is small as compared to the downward force F_{2a} .

[0071] Because the magnitudes of the above-described two moments of forces are balanced, the postures of the first intervention portion 50 and the second intervention portion 60 are fixed and the posture of the second main body 61 of the second intervention portion 60 is maintained to be substantially horizontal. On this account, the posture of the contact roller 25 is also maintained to be substantially horizontal (see FIG. 6(a)).

[0072] The following will describe a postural change of the roller supporting member 30 while the yarns Y are being wound onto the respective bobbins B . FIG. 5(b) shows the state of the tilting mechanism 40 when the postural change amount of the roller supporting member 30 is exactly between zero and the maximum postural change amount.

[0073] When the thrust force of the air cylinder 41 becomes larger than F_{1a} (see FIG. 5(a)), the first intervention portion 50 swings upward with the first fulcrum shaft 51 acting as a fulcrum. Because the inclination of the first intervention portion 50 increases relative to the horizontal direction, the distance L_{1b} which is the horizontal distance between the first roller 53 and the first fulcrum shaft 51 becomes shorter than the distance L_{1a} . The first roller 53 rotates upon making contact with the upper end face 46 of the piston rod 45, and smoothly follows the above-described change of the horizontal distance. To put it differently, the above-described force point distance smoothly changes in accordance with the swing of the first intervention portion 50. As shown in FIG. 5(b), provided that the thrust force of the air cylinder 41 is a thrust force F_{1b} whereas the force point distance is a distance L_{1b} , the magnitude of the moment of upward force is represented as $F_{1b} \times L_{1b}$. The distance L_{1b} is shorter

than the distance L_{1a} (see FIG. 5(a)).

[0074] As the first intervention portion 50 swings as described above, the supporting surface 57 also swings and the second roller 62 in contact with the supporting surface 57 starts to posturally change upward with the second fulcrum shaft 63 acting as a fulcrum. In this regard, because the direction of the swing of the second roller 62 is opposite to the direction of the swing of the supporting surface 57, the second roller 62 moves relative to the supporting surface 57 when the supporting surface 57 swings. As a result, the contact point 58b becomes far from the first fulcrum shaft 51 as compared to the contact point 58a in FIG. 5(a). (In other words, the action point distance is increased.) The second roller 62 rotates upon making contact with the supporting surface 57, and therefore smoothly follows the swing of the first intervention portion 50.

[0075] As described above, the supporting surface 57 extends away from the first fulcrum shaft 51 in the left-right direction and extends upward. On this account, when the first intervention portion 50 posturally changes upward and the contact point 58 becomes far from the first fulcrum shaft 51, postural change of the second roller 62 upward along the supporting surface 57 certainly occurs. Furthermore, the supporting surface 57 is curved so that the inclination angle relative to the horizontal direction increases toward the first fulcrum shaft 51 in the horizontal direction. On this account, even when the action point distance is relatively short, the postural change amount of the second roller 62 in the up-down direction on account of the postural change of the first intervention portion 50 is large due to the large inclination of the curved surface. In this connection, when the action point distance is relatively long, postural change of the second roller 62 in the up-down direction in response to the postural change of the first intervention portion 50 is large even if the inclination angle of the supporting surface 57 is small.

[0076] Provided that the moment of downward force acting on the contact point 58b is F_{2b} and the action point distance is a distance L_{2b} , the magnitude of the moment of downward force is represented as $F_{2b} \times L_{2b}$. In FIG. 5(b), because $F_{1b} \times L_{1b} = F_{2b} \times L_{2b}$, the postures of the first intervention portion 50 and the second intervention portion 60 are fixed. In other words, $F_{1b} = F_{2b} \times L_{2b} / L_{1b}$. In this stage, the rear end portion of the roller supporting member 30 has been moved upward and the contact roller 25 is inclined relative to the horizontal direction (see FIG. 6(b)). At this stage, the yarns Y are being wound onto the bobbins B , and the diameter of each of the packages P is about half as long as the maximum diameter.

[0077] In this state, even if the rear end portion of the roller supporting member 30 with zero postural change amount (i.e., the second main body 61 is substantially horizontal) slightly moves upward, the magnitude of the force F_{2b} remains substantially identical with the magnitude of the force F_{2a} (see FIG. 5(a)). Meanwhile, the distance L_{2b} (action point distance) is longer than the

distance L2a (see FIG. 5 (a)). In addition to the above, the distance L1b (force point distance) is shorter than the distance L1a (see FIG. 5(a)). In other words, when the postural change amount of the roller supporting member 30 is increased, the load on the air cylinder 41 is increased on account of the increase in the action point distance and the decrease in the force point distance. A larger thrust force of the air cylinder is therefore required to further increase the postural change amount of the roller supporting member 30.

[0078] The above-described load increases as the postural change amount of the roller supporting member 30 increases. As shown in FIG. 5(c), when the postural change amount of the roller supporting member 30 is maximum, the distance L1c which is the force point distance is further shortened ($L1c < L1b < L1a$) whereas the distance L2c which is the action point distance is further increased ($L2c > L2b > L2a$). In this state, provided that the thrust force of the air cylinder 41 is a thrust force F1c and the downward force acting on the contact point 58c is a force F2c, an equation $F1c \times L1c = F2c \times L2c$ holds. In this state, the rear end portion of the roller supporting member 30 has been further moved upward and the contact roller 25 is further inclined relative to the horizontal direction (see FIG. 6(c)). In this state, the yarns Y are fully wound onto the packages P.

(Relationship between Postural Change Amount and Load)

[0079] The relationship between the postural change amount of the roller supporting member 30 and the load on the air cylinder 41, which have been described above, will be described by using the graph in FIG. 8. The horizontal axis of the graph indicates a postural change amount of the roller supporting member 30. The vertical axis of the graph indicates a load acting on the air cylinder 41 (i.e., a thrust force required to further move the rear end portion of the roller supporting member 30). As described above, when the postural change amount is zero, the magnitude of the load acting on the air cylinder 41 is F1a.

[0080] When yarns Y are being wound onto the bobbins B, the controlling unit 26 performs, for example, below-described control to cause the contact roller 25 to incline in accordance with a change in inclination of the bobbin holder 24 on account of increase in diameter of the packages P. The controlling unit 26 controls the electro-pneumatic regulator 47 to gradually increase the pressure of the compressed air supplied to the air cylinder 41 over time. Information regarding the pressure change over time is, for example, stored in a ROM, etc. As the pressure increases, the thrust force of the air cylinder 41 gradually increases from F1a. Accordingly, the tilting mechanism 40 operates as described above, and the rear end portion of the roller supporting member 30 gradually moves upward.

[0081] If the yarn winder 4 does not include the inter-

vention mechanism 42 and the rear end portion of the roller supporting member 30 is, for example, directly pressed by the air cylinder 41, the downward force generated by the weight of the contact roller 25, etc. simply and directly acts on the piston rod 45. In such a case, even when the rear end portion of the roller supporting member 30 is moved, the magnitude of the load acting on the air cylinder 41 is scarcely changed as indicated by a two-dot chain line in FIG. 8. On this account, when the thrust force of the air cylinder 41 is only slightly increased from F1a, the rear end portion of the roller supporting member 30 is significantly moved in comparison with a postural change amount required to conform to a change in inclination of the bobbin holder 24 due to the increase in diameter of the packages P. As such, the postural change in the contact roller 25 may not be accurately controlled.

[0082] Meanwhile, in the present embodiment, because the yarn winder 4 includes the intervention mechanism 42, the aforesaid load increases as the postural change amount of the roller supporting member 30 increases. For example, provided that the maximum postural change amount of the roller supporting member 30 is X, the magnitude of the load acting on the air cylinder 41 is above-described F1b when the roller supporting member 30 is posturally changed half as much as the maximum postural change amount, i.e., changed by X/2. Similarly, when the roller supporting member 30 is posturally changed by X, the magnitude of the load acting on the air cylinder 41 is above-described F1c. To put it differently, the load on the air cylinder 41 generated by the weight of the contact roller 25 is amplified by the intervention mechanism 42, as the above-described postural change amount increases. On this account, as the postural change amount increases, the thrust force of the air cylinder 41 required to further move the roller supporting member 30 certainly increases. The relationship between the postural change amount and the load described above may be arranged to be linear as shown in FIG. 8 by adjusting the shape of the supporting surface 57, the positional relationship between the first intervention portion 50 and the second intervention portion 60, etc. The relationship may be different from this, on condition that the postural change amount and the load certainly one-to-one correspond to each other.

[0083] As described above, the intervention mechanism 42 provided between the rear end portion of the roller supporting member 30 and the air cylinder 41 increases the load acting on the air cylinder 41, as the postural change amount of the rear end portion of the roller supporting member 30 increases. In other words, a larger thrust force of the air cylinder 41 is required to further increase the above-described postural change amount. This makes it possible to accurately control the postural change of the contact roller 25 by adjusting the thrust force of the air cylinder 41.

[0084] In addition to the above, the above-described force point distance decreases as the above-described

postural change amount increases. As the force point distance decreases, the force required to further move the load increases. On this account, as the postural change amount increases, the thrust force of the air cylinder 41 required to further move the roller supporting member 30 certainly increases.

[0085] In addition to the above, because the first roller 53 which rotates about an axis parallel to the first fulcrum shaft 51 is pressed by the piston rod 45, the first roller 53 smoothly follows the elongation and contraction of the piston rod 45, and hence the first intervention portion 50 stably swings.

[0086] In addition to the above, as the above-described postural change amount increases, the above-described action point distance increases. As the action point distance increases, the force required to further move the load increases. As a result, as the postural change amount of the rear end portion of the roller supporting member 30 increases, the moment of force with which the second roller 62 of the second intervention portion 60 presses the first intervention portion 50 (i.e., the force against the thrust force of the air cylinder 41) increases. On this account, as the postural change amount increases, the thrust force of the air cylinder 41 required to further move the roller supporting member 30 further increases.

[0087] In addition to the above, the supporting portion 54 is attachable to and detachable from the first intervention portion 50. On this account, the relationship between the thrust force of the air cylinder 41 and the postural change amount of the roller supporting member 30 (i.e., the postural change amount of the contact roller 25) is changeable in such a way that the relationship between the swing amount of the first intervention portion 50 and the amount of change of the above-described action point distance is changed by replacing the supporting portion 54 with another member having a supporting surface which is different in shape from the supporting surface 57. To put it differently, it is unnecessary to replace the entire first intervention portion 50 with another member when, for example, the postural change amount of the roller supporting member 30 relative to the thrust force of the air cylinder 41 is adjusted. It is therefore possible to adjust the postural change amount of the roller supporting member 30 relative to the thrust force of the air cylinder 41 only by changing the shape of the supporting surface 57, without changing the positions of the first fulcrum shaft 51, the first roller 53, etc. This makes it possible to finely adjust the postural change amount of the roller supporting member 30 relative to the thrust force of the air cylinder 41.

[0088] In addition to the above, the second roller 62 smoothly follows the swing of the first intervention portion 50, and the roller supporting member 30 is stably moved.

[0089] In addition to the above, because the supporting surface 57 is provided between the fulcrum and the force point in the horizontal direction, the first intervention portion 50 is downsized. Furthermore, because the force point distance is easily increased as compared to the

action point distance and the thrust force of the air cylinder 41 required to swing the first intervention portion 50 is restrained, increase in size and cost of the air cylinder 41 is restrained.

[0090] In addition to the above, when at least the postural change amount is zero, the supporting surface 57 extends away from the first fulcrum shaft 51 in the horizontal direction and extends away from the leading end of the piston rod 45 in the vertical direction. On this account, when the first intervention portion 50 posturally changes upward and the contact point 58 becomes far from the first fulcrum shaft 51, the second roller 62 moves upward along the supporting surface 57. It is therefore possible to certainly move the second roller 62 in the up-down direction by swinging the first intervention portion 50, even when the contact point 58 is close to the first fulcrum shaft 51 (i.e., when the action point distance is short).

[0091] In addition to the above, the supporting surface 57 is curved so that the degree of inclination relative to the horizontal direction increases toward the first fulcrum shaft 51 in the horizontal direction. On this account, when the action point distance is short, the postural change amount of the second roller 62 on account of the postural change of the first intervention portion 50 is large due to the large inclination of the curved surface. Meanwhile, when the action point distance is long, postural change of the second roller 62 in the up-down direction in response to the postural change of the first intervention portion 50 is large even if the inclination angle of the supporting surface 57 is small. It is therefore possible to arrange the postural change amount of the second roller 62 in response to postural change of the first intervention portion 50 by a unit amount to be more or less identical between a case where the contact point 58 is close to the first fulcrum shaft 51 and a case where the contact point 58 is far from the first fulcrum shaft 51.

[0092] In addition to the above, the first intervention portion 50 indirectly supports the rear end portion of the roller supporting member 30 via the second roller 62 of the second intervention portion 60. The first intervention portion 50 is therefore not required to directly support the roller supporting member 30, and hence the locations or the like of the first intervention portion 50 and the air cylinder 41 can be determined in accordance with the location of the second roller 62. The degree of freedom in determining the locations or the like of the first intervention portion 50 and the air cylinder 41 is therefore increased.

[0093] In addition to the above, because the second intervention portion 60 extends in the left-right direction orthogonal to the front-rear direction, increase in size of the yarn winder 4 in the front-rear direction due to the existence of the intervention mechanism 42 is restrained.

[0094] In addition to the above, the second intervention portion 60 is supported by the frame 28 via the second fulcrum shaft 63 so as to be swingable in the up-down direction. This indicates that the entirety of the second

intervention portion 60 does not move in the up-down direction. Because it is unnecessary to provide a space for allowing the second intervention portion 60 to posturally change in the up-down direction and a guide member or the like for guiding the second intervention portion 60 in the up-down direction, it is possible to restrain increase in size of the apparatus.

[0095] In addition to the above, because the intervention mechanism 42 and the air cylinder 41 are provided at the rear end portion of the bobbin holder 24, it is possible to prevent the space on the working side from being narrowed.

[0096] In addition to the above, the roller supporting member 30 is supported to be swingable about the swing axis 33. This indicates that the entirety of the roller supporting member 30 and the entirety of the contact roller 25 do not move in the up-down direction. Because it is unnecessary to provide a space for allowing the roller supporting member 30, etc. to move in the up-down direction and a guide member or the like for guiding the roller supporting member 30, etc. in the up-down direction, it is possible to restrain increase in size of the apparatus.

[0097] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals and the explanations thereof are not repeated.

(1) In the embodiment above, the supporting surface 57 of the first intervention portion 50 is a curved surface which is curved so that the degree of inclination relative to the horizontal direction increases toward the first fulcrum shaft 51 in the horizontal direction. The disclosure, however, is not limited to this arrangement. For example, as shown in FIG. 9(a), a supporting surface 57a of a supporting portion 54a of a first intervention portion 50a is a slope surface instead of the curved surface. Alternatively, as shown in FIG. 9(b), the inclination of a supporting surface 57b of a supporting portion 54b of a first intervention portion 50b relative to the horizontal direction increases in the direction away from the first fulcrum shaft 51 in the horizontal direction. Alternatively, the supporting surface may be a horizontal plane when the postural change amount of the roller supporting member 30 is zero.

(2) While in the embodiment above the supporting surface 57 of the first intervention portion 50 is provided between the first roller 53 and the first fulcrum shaft 51 in the left-right direction, this positional relationship may be changed. For example, as shown in FIG. 9(c), the first roller 53 may be provided between a supporting surface 57c of a supporting portion 54c of a first intervention portion 50c and the first fulcrum shaft 51 in the left-right direction. Alternatively, as shown in FIG. 9(d), the first fulcrum shaft 51 may be provided between a first roller 53 of a first

intervention portion 50d and a supporting surface 57d of a supporting portion 54d in the left-right direction. In FIG. 9(d), as indicated by solid arrows, the supporting surface 57d and the second roller 62 posturally change upward as the piston rod 45 provided above the first roller 53 presses the first roller 53 downward.

(3) While in the embodiment above the supporting portion 54 of the first intervention portion 50 is detachably attached to the first main body 52, the first main body and the supporting portion may be, for example, integrally formed.

(4) While in the embodiment above the first intervention portion 50 includes the first roller 53, the disclosure is not limited to this arrangement. The first intervention portion 50 may not include the first roller 53, and a supporting portion having a flat bottom surface may be pressed by the piston rod 45.

(5) While in the embodiment above the second roller 62 is provided between the second fulcrum shaft 63 of the second intervention portion 60 and the connecting portion 64 in the left-right direction, the disclosure is not limited to this arrangement. As shown in FIG. 10, the second fulcrum shaft 63 may be provided between the second roller 62 and the connecting portion 64 in a second main body 61a of a second intervention portion 60a. In this case, as indicated by solid arrows, the connecting portion 64 and the roller supporting member 30 move upward as the piston rod 45 provided above the first intervention portion 50 presses the first intervention portion 50 downward. In this modification, the lower side is equivalent to the one side in the present invention.

(6) While in the embodiment above the second intervention portion 60 includes the second roller 62, the disclosure is not limited to this arrangement. A slide member or the like, which simply slides along the supporting surface of the first intervention portion 50, may be provided in place of the second roller 62. In this case, the slide member is equivalent to the supported member of the present invention.

(7) While in the embodiment above the second intervention portion 60 extends in the left-right direction orthogonal to the front-rear direction, the disclosure is not limited to this arrangement. For example, the second intervention portion 60 may extend in the front-rear direction.

(8) While in the embodiment above the second intervention portion 60 is swingably supported by the frame 28, the disclosure is not limited to this arrangement. For example, as shown in FIG. 11, a second main body 61b of a second intervention portion 60b is supported to be movable in the up-down direction along a guide member 70 (as indicated by a solid arrow).

(9) While in the embodiment above the intervention mechanism 42 includes the second intervention portion 60 and the roller supporting member 30 is indi-

rectly supported by the supporting portion 54, the disclosure is not limited to this arrangement. For example, a supported member is provided at the rear end portion of the roller supporting member 30 and the supported member is directly supported by the first intervention portion.

(10) While in the embodiment above the air cylinder 41 and the intervention mechanism 42 are provided at the rear end portion of the frame 28, these members may be provided at the front end portion or both end portions of the frame 28.

(11) The intervention mechanism may be different from the mechanism described in the embodiment above. A different mechanism may be employed as long as the load acting on the air cylinder 41 increases as the postural change amount of the roller supporting member 30 increases in the up-down direction.

(12) While in the embodiment above the first intervention portion 50 is pressed by the air cylinder 41, a fluid pressure cylinder such as a hydraulic cylinder may be used in place of the air cylinder.

(13) While in the embodiment above the contact roller 25 is swingably supported by the base 20 in the yarn winder 4, the disclosure is not limited to this arrangement. For example, the present invention may be applied to a yarn winder including a so-called linear-motion-type moving mechanism with which a supporting member supporting a contact roller 25 moves up and down while keeping its posture (see e.g., Japanese Unexamined Patent Publication No. 2011-255979).

Claims

1. A yarn winder comprising:

a base;
 a bobbin holder which is cantilevered by the base and extends in a horizontal direction, bobbins on which yarns are wound, respectively, being attached to the bobbin holder along an axial direction of the bobbin holder;
 a contact roller which extends in the axial direction and applies a contact pressure to packages formed by winding the yarns onto the respective bobbins;
 a roller supporting member which supports the contact roller to be rotatable;
 a fluid pressure cylinder which is configured to posturally change one end portion in the axial direction of the roller supporting member at least in a vertical direction; and
 an intervention mechanism which intervenes between the one end portion of the roller supporting member and the fluid pressure cylinder, the intervention mechanism being configured to

increase a load acting on the fluid pressure cylinder as the fluid pressure cylinder increases a postural change amount of the one end portion of the roller supporting member in the vertical direction.

2. The yarn winder according to claim 1, wherein, the fluid pressure cylinder includes a piston rod, the intervention mechanism includes a first intervention portion which includes a pressed member pressed by the piston rod and a supporting portion directly or indirectly supporting the one end portion of the roller supporting member, the first intervention portion being supported by the base via a first fulcrum shaft to be swingable in an up-down direction, and the horizontal distance between a part of the pressed member, at which part the pressed member is in contact with the piston rod, and the first fulcrum shaft decreases as the fluid pressure cylinder increases the postural change amount of the roller supporting member.
3. The yarn winder according to claim 2, wherein, the pressed member is a first roller which is rotatable about an axis parallel to the first fulcrum shaft.
4. The yarn winder according to claim 2 or 3, wherein, the intervention mechanism includes a supported member which is directly supported by the supporting portion and is posturally changeable at least in the vertical direction together with the one end portion of the roller supporting member, the supporting portion includes a supporting surface which makes contact with and supports the supported member, and the horizontal distance between a part of the supporting surface, which part is in contact with the supported member, and the first fulcrum shaft increases as the fluid pressure cylinder increases the postural change amount of the roller supporting member.
5. The yarn winder according to claim 4, wherein, the supporting portion is attachable to and detachable from the first intervention portion.
6. The yarn winder according to claim 4 or 5, wherein, the supported member is a second roller which is rotatable about an axis parallel to the first fulcrum shaft.
7. The yarn winder according to any one of claims 4 to 6, wherein, the supporting surface is provided between the pressed member and the first fulcrum shaft in the horizontal direction.
8. The yarn winder according to claim 7, wherein, when the postural change amount of the roller supporting member is zero,

the supporting surface is a curved surface or an inclined surface which extends away from the first fulcrum shaft in the horizontal direction and extends away from a leading end of the piston rod in the vertical direction. 5

9. The yarn winder according to claim 8, wherein, when the postural change amount of the roller supporting member is zero, the supporting surface is a curved surface which is curved so that the degree of inclination relative to the horizontal direction increases toward the first fulcrum shaft in the horizontal direction. 10 15

10. The yarn winder according to any one of claims 4 to 9, wherein, the intervention mechanism further includes a second intervention portion which is connected to the one end portion of the roller supporting member and includes a connecting portion which is movable at least in the vertical direction, and the supported member is provided at the second intervention portion. 20 25

11. The yarn winder according to claim 10, wherein, the second intervention portion extends in a direction orthogonal to the axial direction.

12. The yarn winder according to claim 10 or 11, wherein, the second intervention portion is supported by the base via a second fulcrum shaft to be swingable in an up-down direction. 30

13. The yarn winder according to any one of claims 1 to 12, wherein, the intervention mechanism and the fluid pressure cylinder are provided at an end portion of the base, the end portion being on the base end side of the bobbin holder in the axial direction. 35 40

14. The yarn winder according to any one of claims 1 to 13, wherein, the roller supporting member is supported to be swingable about an axis which is along the axial direction. 45

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FIG.1

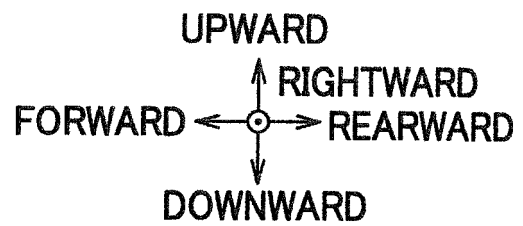
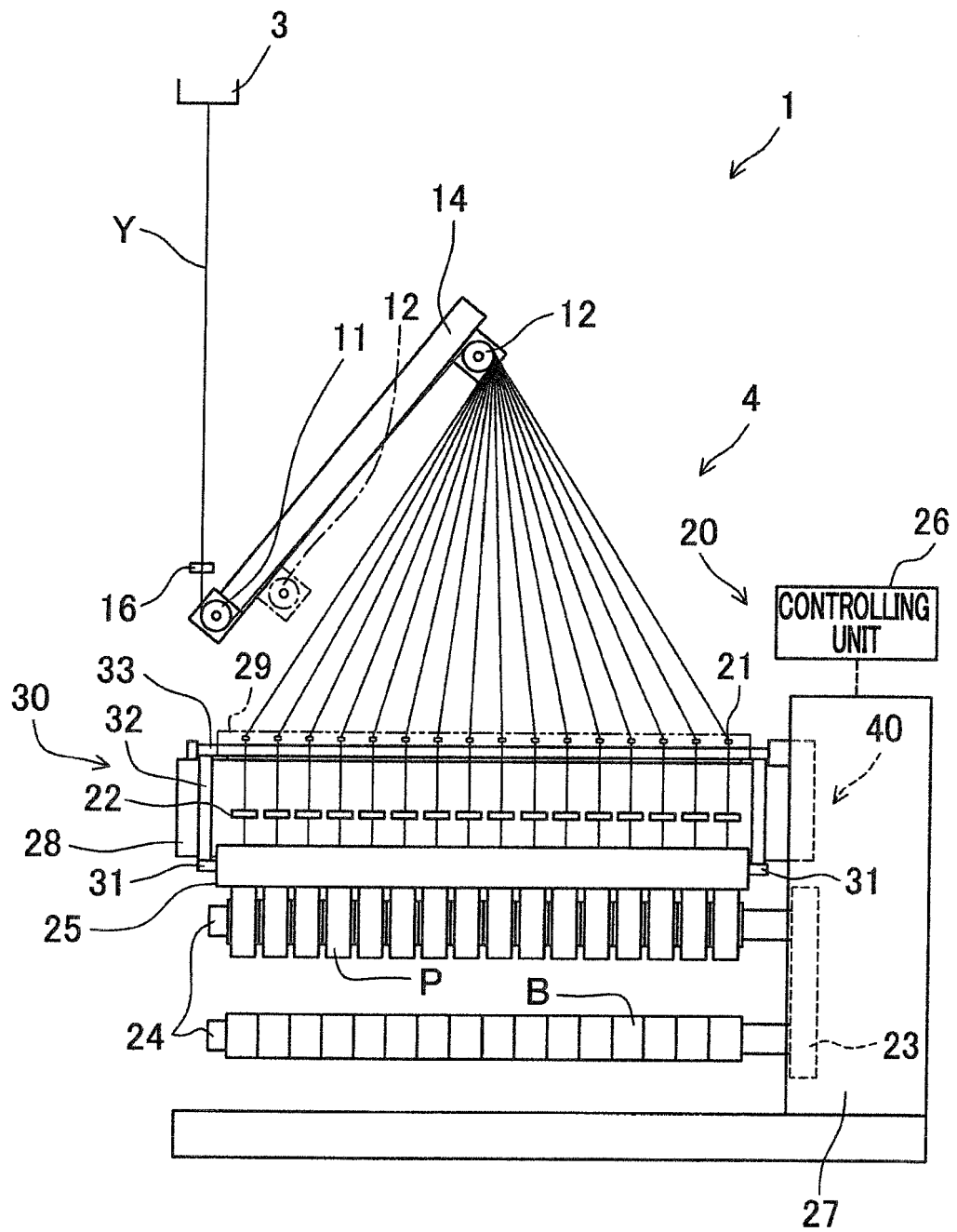


FIG.2

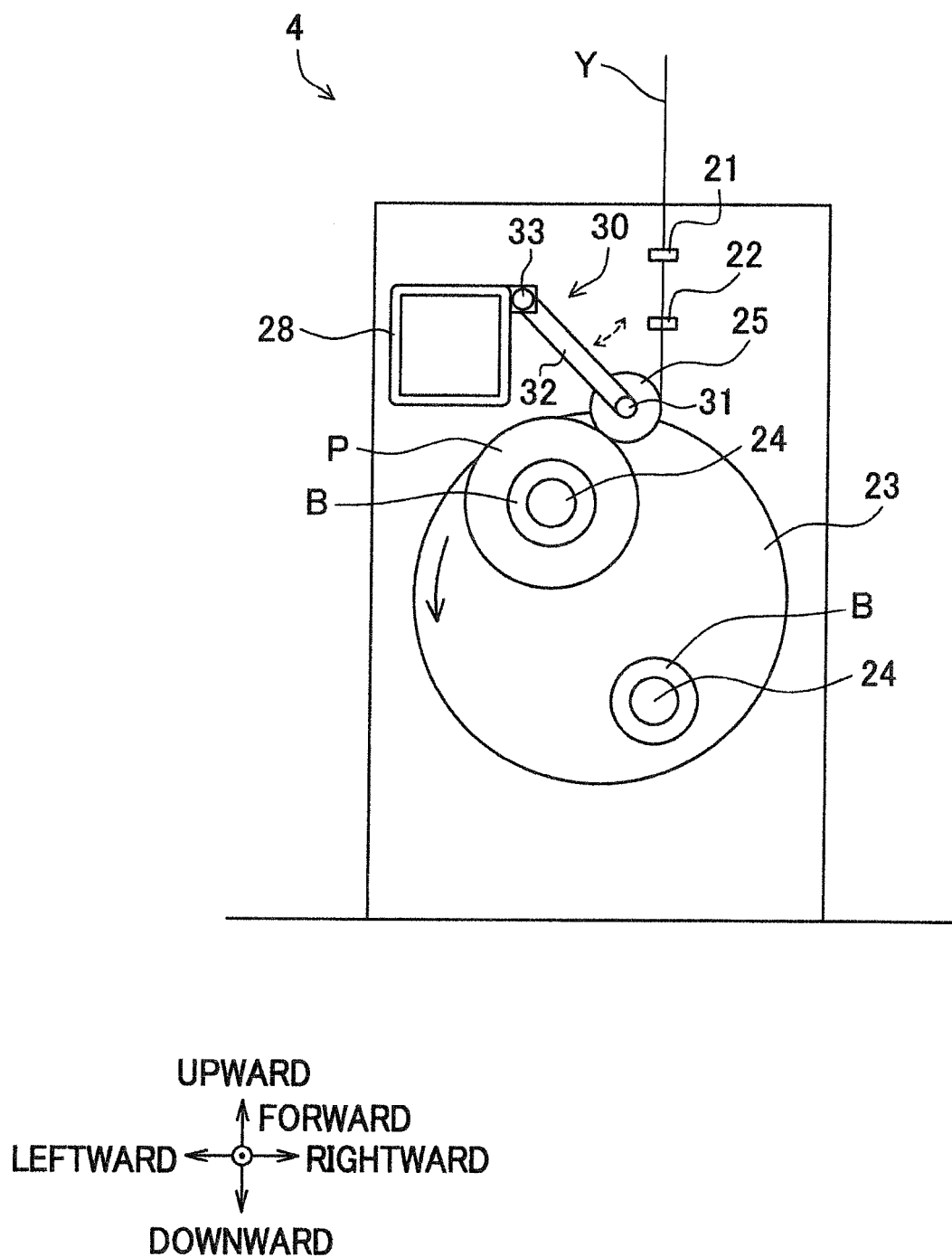


FIG.3

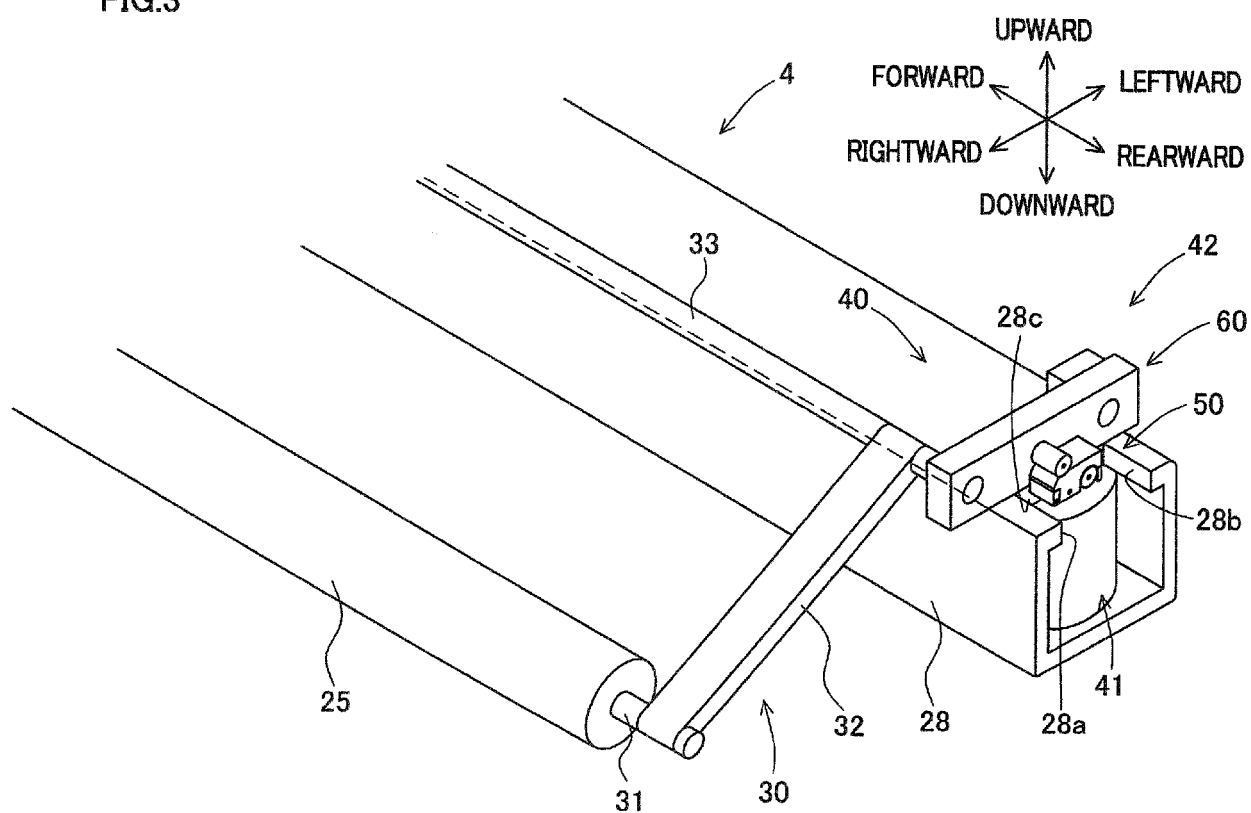


FIG.4

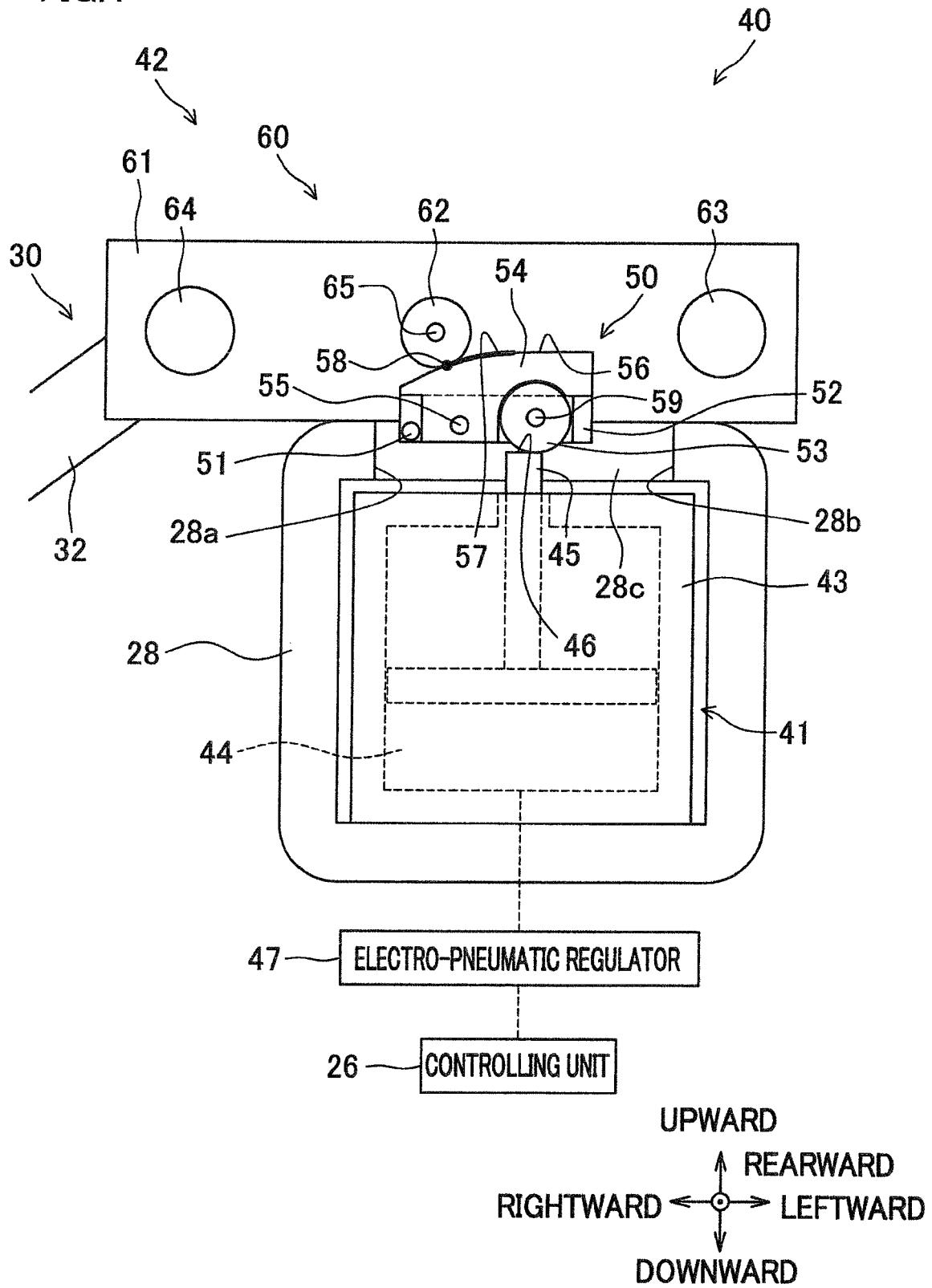
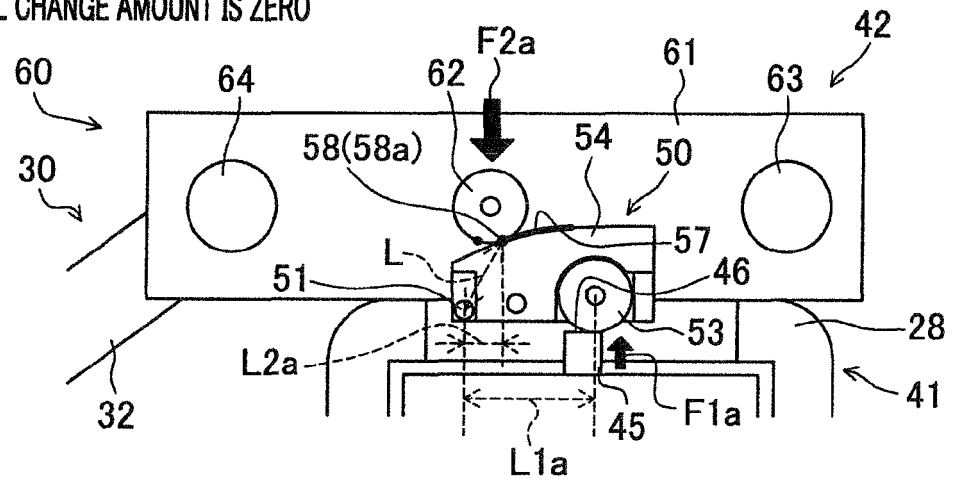
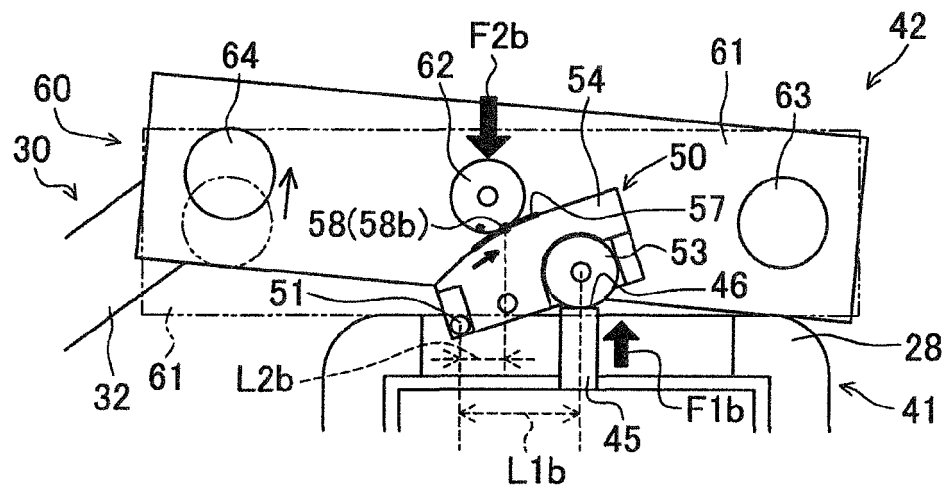


FIG.5

(a) POSTURAL CHANGE AMOUNT IS ZERO



(b) POSTURAL CHANGE AMOUNT IS INTERMEDIATE



(c) POSTURAL CHANGE AMOUNT IS MAXIMUM

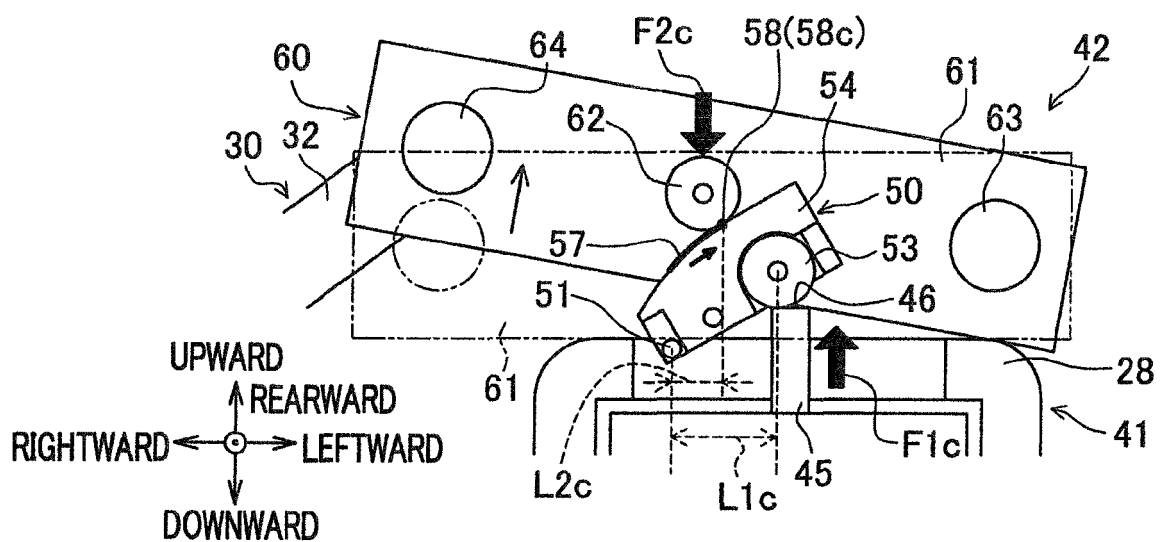
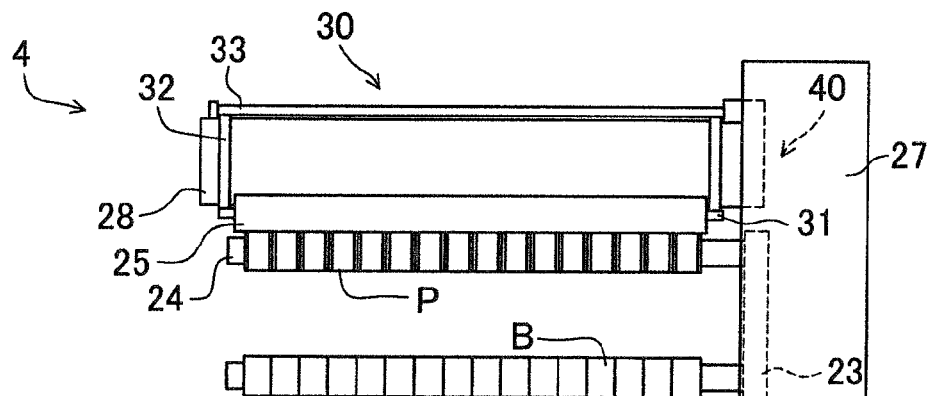
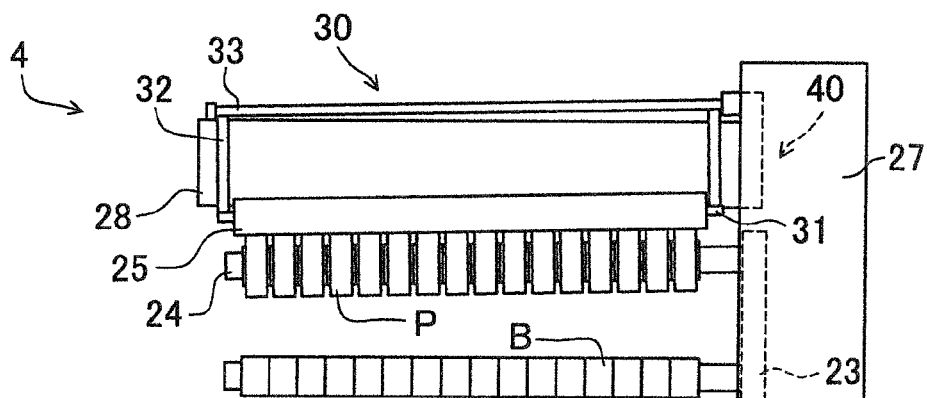


FIG.6

(a) POSTURAL CHANGE AMOUNT IS ZERO



(b) POSTURAL CHANGE AMOUNT IS INTERMEDIATE



(c) POSTURAL CHANGE AMOUNT IS MAXIMUM

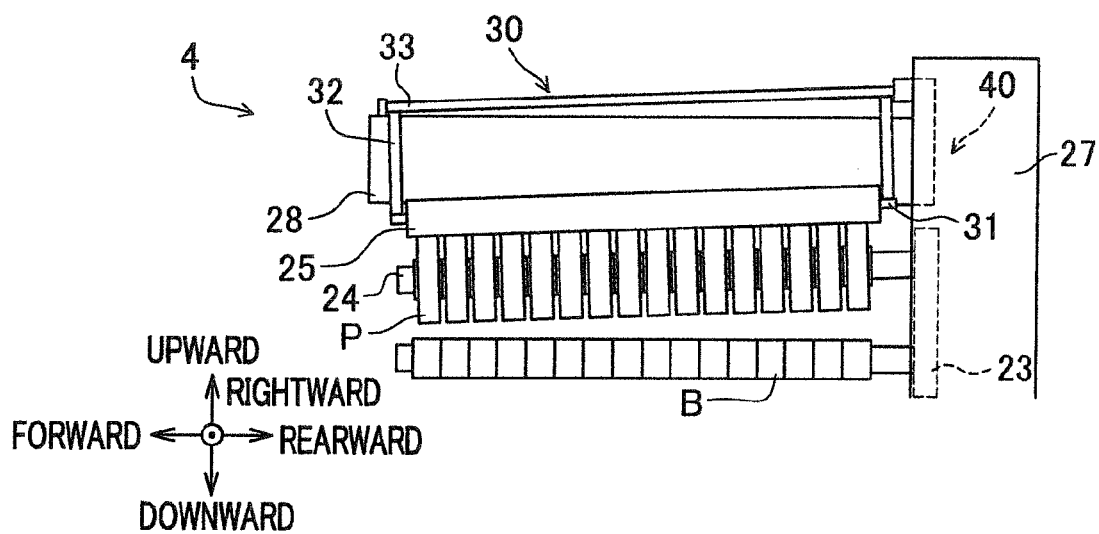


FIG.7

$$\begin{aligned} F_{2aa} \times L &= F_{2a} \times \cos \theta \times L \\ &= F_{2a} \times L_{2a} \end{aligned}$$

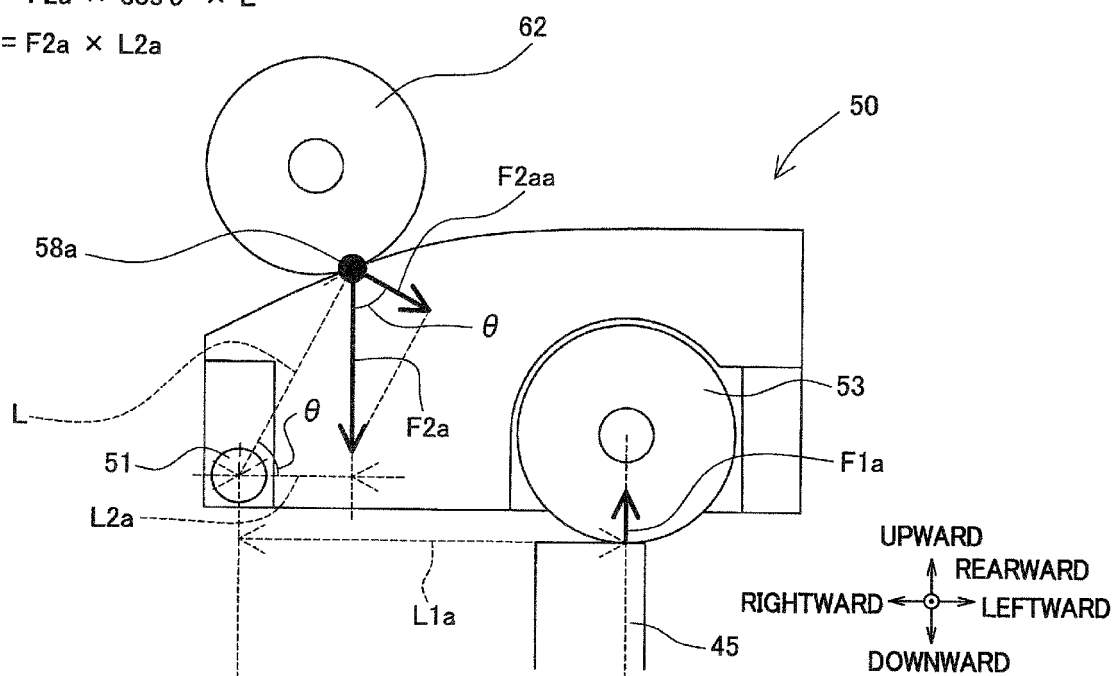


FIG.8

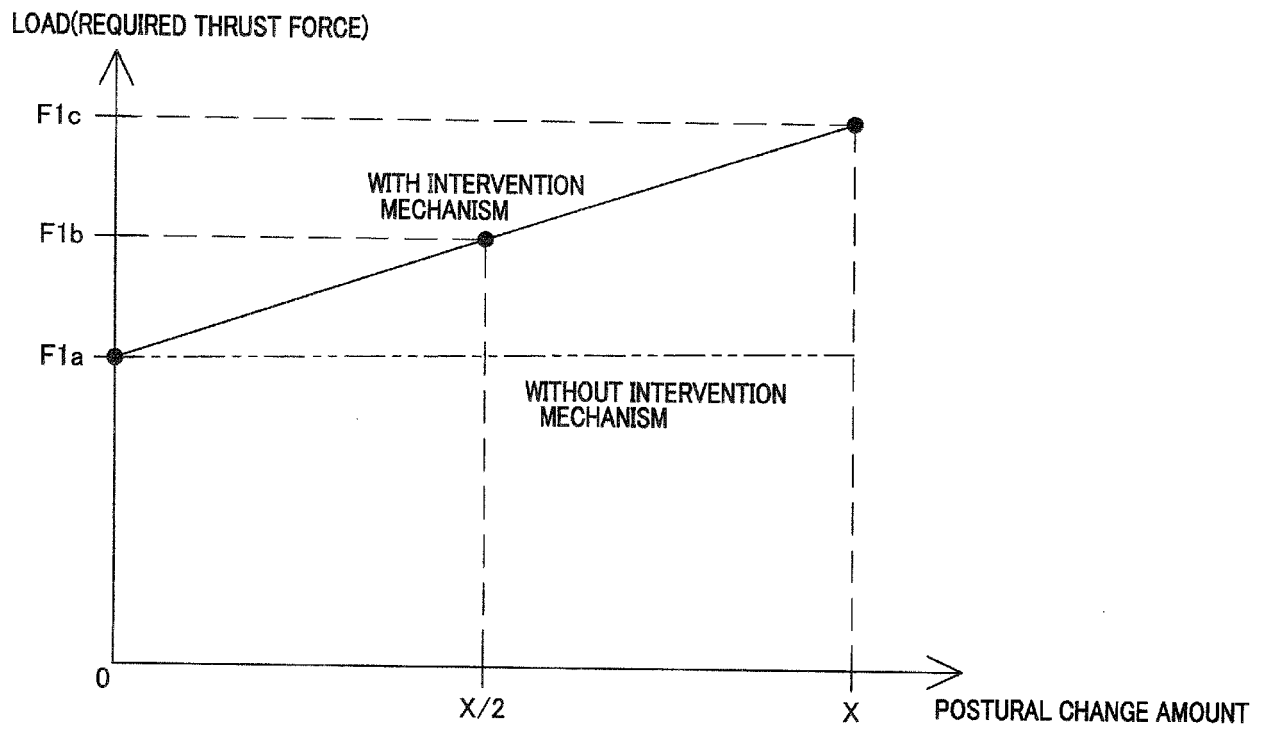
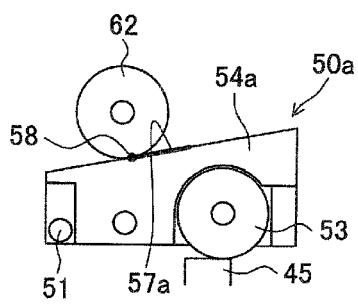
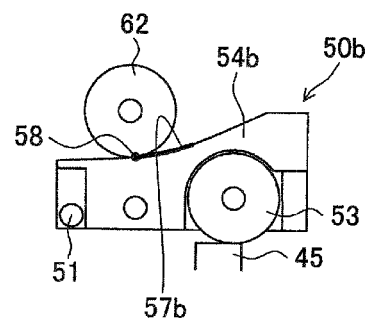


FIG.9

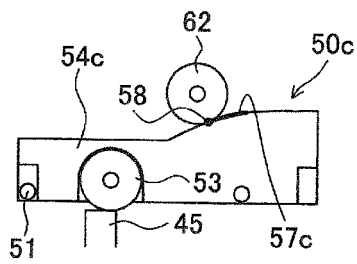
(a)



(b)



(c)



(d)

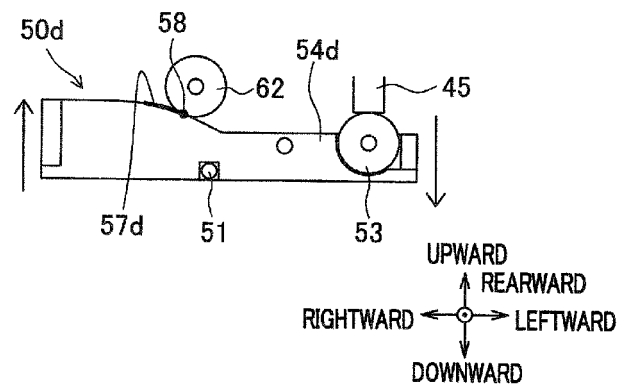


FIG.10

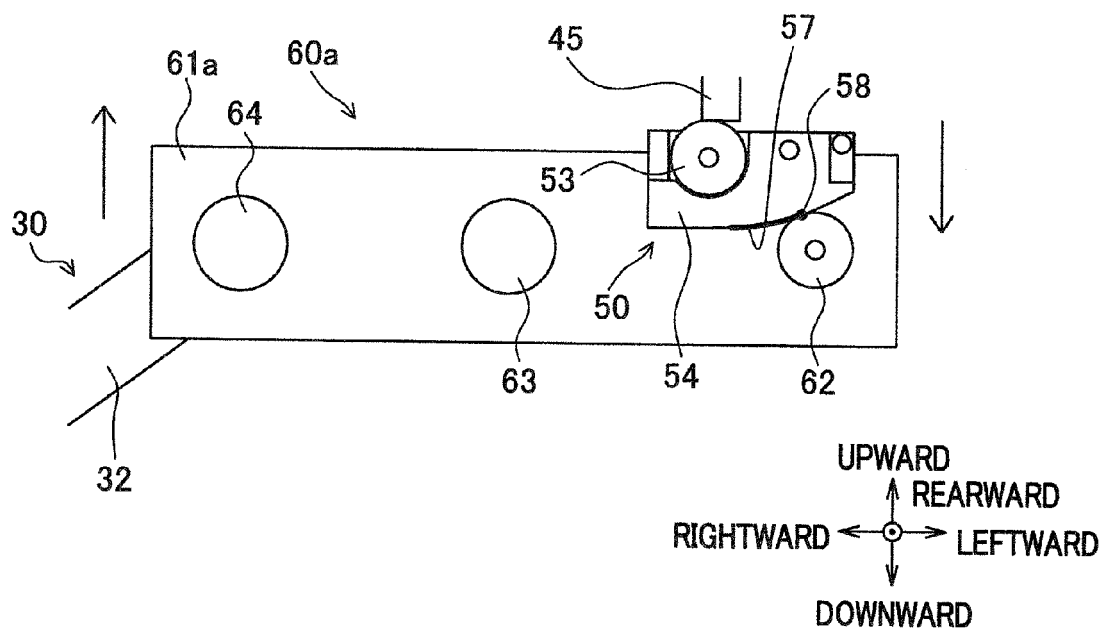
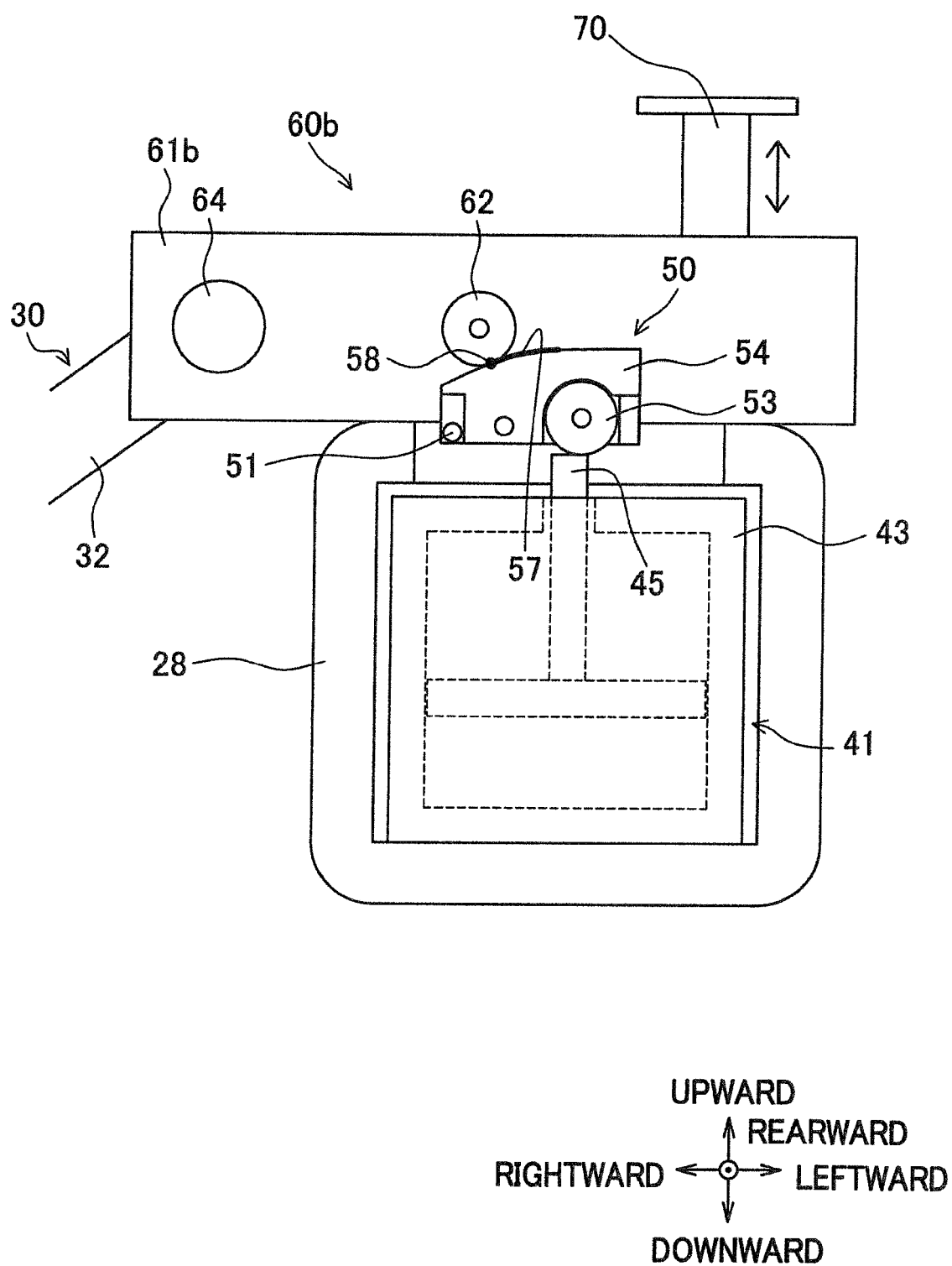


FIG.11





EUROPEAN SEARCH REPORT

Application Number
EP 18 17 5981

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A	* column 2, line 40 - line 44 *	2-12	B65H54/42
	* column 3, line 18 - line 42 *		B65H54/52
	* page 3, line 64 - page 4, line 5 *		B65H54/547
	* column 5, line 1 - line 18 *		
	* figures 1,7A, 7B, 9 *		
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	* the whole document *		
A,D	EP 2 392 532 A2 (TMT MACHINERY INC) 7 December 2011 (2011-12-07)	1-14	
	* the whole document *		
A	JP H03 46969 A (MURATA MACHINERY LTD) 28 February 1991 (1991-02-28)	1-14	
	* figure 6 *		
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		2 November 2018	Guisan, Thierry
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The members are as contained in the European Patent Office EDP file on
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