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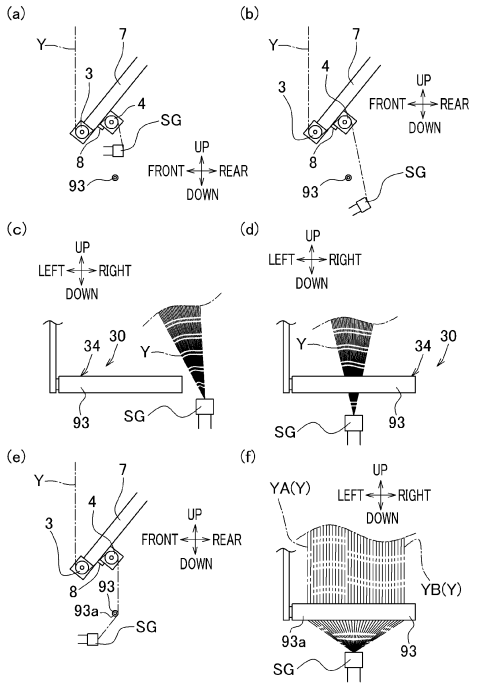
(54) YARN WINDER

(57) The efficiency in yarn threading is improved when yarn threading to yarn guides of a pair of winding units is performed. Each of paired winding units 5 of a spun yarn take-up machine 1 includes fulcrum guides 20 aligned in a front-rear direction. The spun yarn take-up machine 1 includes a yarn threading mechanism 30 configure to perform yarn threading to the fulcrum guides 20. The yarn threading mechanism 30 includes paired holding units 31 which are provided to correspond to the respective winding units 5 and are configured to hold respective groups of yarns Y and a drive mechanism 32 configured to the move the paired holding units 31. The drive mechanism 32 moves the paired holding units 31 from capturing positions where the yarns Y can be captured to yarn threading start positions that are rearward of the capturing position and further moves the paired holding units 31 to yarn threading completion positions that are forward of the yarn threading start positions, so as to thread all of the yarns Y to the fulcrum guides 20.

FIG.9



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn winder.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2017-114573) recites a yarn winder including two (a pair of) winding units each of which winds running yarns. To be more specific, each of the paired winding units includes a bobbin holder to which bobbins are attached to be aligned in a predetermined axial direction (arrangement direction) and fulcrum guides that are aligned in the arrangement direction and function as fulcrums about which the respective yarns are traversed. The paired winding units oppose each other in a direction orthogonal to the arrangement direction. The yarn winder further includes a yarn threading member by which the yarns are threaded to the fulcrum guides of the paired winding units. To be more specific, the yarn threading member includes two (paired) yarn holding members each holding a group of yarns and a supporter supporting the paired yarn holding members so that the yarn holding members get close to each other or are remote from each other. Each of the paired winding unit is provided with a guide rail for guiding the paired yarn holding units. The two (paired) guide rails are tilted away from each other in opposite directions relative to the arrangement direction.

[0003] When threading running yarns to fulcrum guides, an operator causes the paired yarn holding members that are close to each other to hold the respective groups of the yarns. Thereafter, the operator moves the supporter in the arrangement direction while one yarn holding member is engaged with one guide rail and the other yarn holding member is engaged with other guide rail. The paired yarn holding members move away from each other along the paired guide rails, with the result that the yarns are threaded one by one into the fulcrum guides of the paired winding units. In this way, the yarns are simultaneously threaded to the paired winding units.

SUMMARY OF THE INVENTION

[0004] When the yarn threading to the fulcrum guides is performed with the arrangement above, the amount of time required to complete the yarn threading may significantly vary depending on the proficiency of the operator. When the yarn threading takes an excessive amount of time, problems such as large production loss occur. A similar problem may occur when yarn guides are provided to be aligned in the arrangement direction, in addition to the fulcrum guides.

[0005] An object of the present invention is to improve the efficiency in yarn threading when yarn threading to yarn guides of a pair of winding units is performed.

[0006] According to a first aspect of the invention, a yarn winder comprises paired winding units opposing each other in a predetermined opposing direction, each of the paired winding units supporting bobbins to be aligned in an arrangement direction orthogonal to the opposing direction and to be rotatable, wherein, each of the paired winding units includes yarn guides that are provided to correspond to yarns wound onto the respective bobbins and are aligned in the arrangement direction, the yarn winder further comprises a yarn threading mechanism arranged to perform yarn threading to the yarn guides of both of the paired winding units, the yarn threading mechanism includes: paired holding units which are attached to the paired winding units, respectively, and are configured to hold groups of the yarns, respectively; and a drive mechanism configured to move the paired holding units, and the drive mechanism moves a first holding unit that is one of the paired holding units and a second holding unit that is the other of the paired holding units from capturing positions where the yarns running between the paired winding units in the opposing direction can be captured to yarn threading start positions that are on one side in the arrangement direction of the capturing positions, and further moves the first holding unit and the second holding unit to yarn threading completion positions that are on the other side in the arrangement direction of the yarn threading start positions, so as to thread the yarns held by the paired holding units to the yarn guides, respectively.

[0007] When yarn threading is performed to respective yarn guides of paired winding units, after paired holding units are caused to capture and hold the yarns at the capturing positions, it is necessary to move the holding units to yarn threading start positions and then to yarn threading completion positions. According to the arrangement above, after the holding units capture the yarns at the capturing positions, the holding units can be moved by the drive mechanism without needing human labor. This makes it possible to improve the accuracy of the yarn threading, irrespective of the proficiency of the operator. The efficiency in yarn threading is therefore improved when yarn threading to yarn guides of a pair of winding units is performed.

[0008] According to a second aspect of the invention, the yarn winder of the first aspect is arranged so that the yarn guides of each of the paired winding units are arranged to be movable between predetermined distanced positions and gathered positions where the yarn guides are close to one another in the arrangement direction as compared to the distanced positions.

[0009] According to this arrangement, as the yarn guides are positioned at the gathered positions at the time of the yarn threading, the moving distance of the paired holding units is shortened. It is therefore possible to suppress problems such as upsizing of the drive mechanism, as compared to a case where the moving distance of the paired holding units is long.

[0010] According to a third aspect of the invention, the yarn winder of the first or second aspect is arranged so that the drive mechanism includes a first drive unit configured to move the first holding unit and a second drive

unit configured to move the second holding unit, and the first drive unit and the second drive unit are independently operable.

[0011] In this arrangement, the first holding unit and the second holding unit are individually movable. This makes it possible to increase the number of options of how the operations of the first holding unit and the second holding unit are controlled.

[0012] According to a fourth aspect of the invention, the yarn winder of the third aspect further comprises a first control unit configured to control the drive mechanism, the first control unit differentiating a timing to control the first drive unit from a timing to control the second drive unit.

[0013] This arrangement allows one of the paired holding units to start to move earlier as compared to the other. The arrangement is effective when a problem occurs if the paired holding units simultaneously start to move.

[0014] According to a fifth aspect of the invention, the yarn winder of any one of the first to fourth aspects further comprises: a first yarn feed roller which, when at least one of the paired holding units is at the yarn threading start position, is provided upstream of the at least one of the paired holding units in a yarn running direction in which the yarns run and is provided on the other side in the arrangement direction of the at least one of the paired holding units; a second yarn feed roller which, when the at least one of the paired holding units is at the yarn threading start position, is provided between the first yarn feed roller and the at least one of the paired holding units in the yarn running direction and is provided on the one side in the arrangement direction of the first yarn feed roller; a roller movement mechanism configured to move the second yarn feed roller between a roller yarn placement position where yarn placement to the second yarn feed roller is performed and a one side position that is on the one side in the arrangement direction of the roller yarn placement position; a first control unit configured to control the drive mechanism; and a second control unit configured to control the roller movement mechanism, after the second control unit moves the second yarn feed roller from the roller yarn placement position to the one side position, the first control unit starting to move the at least one of the paired holding units from the yarn threading start position to the yarn threading completion position.

[0015] In the present invention, when the second yarn feed roller is at the one side position, the winding angle of the yarns on the second yarn feed roller is larger than the winding angle when the second yarn feed roller is at the roller yarn placement position. (This will be detailed in the embodiment below.) When the winding angle increases, the force with which the second yarn feed roller holds the yarns increases. On this account, when the at least one of the paired holding units holding the yarns is moved, yarn shaking is suppressed as compared to a case where the second yarn feed roller is at the roller yarn placement position.

[0016] According to a sixth aspect, the yarn winder of any one of the first to fifth aspects is arranged so that the drive mechanism includes: a first guide rail which guides the first holding unit at least in the arrangement direction; a first holding unit drive unit which is configured to move the first holding unit along the first guide rail; a second guide rail which guides the second holding unit at least in the arrangement direction; and a second holding unit drive unit which is configured to move the second holding unit along the second guide rail.

[0017] In this connection, for example, in an arrangement in which paired holding units are attached to leading end portions of paired multi-articulated arms and the paired holding units are moved by driving the paired arms, precise control is required and labor for teaching, etc. may be enormous. According to the arrangement above, the holding units can be precisely moved by a simple arrangement.

[0018] According to a seventh aspect of the invention, the yarn winder of the sixth aspect is arranged so that the drive mechanism includes: a first rail drive unit which is configured to move the first guide rail; and a second rail drive unit which is configured to move the second guide rail.

[0019] Typically, when paired holding units are moved from capturing positions to yarn threading start positions, it is necessary to prevent yarns from interfering with yarn guides. On the other hand, when the paired holding units are moved from the yarn threading start positions to yarn threading completion positions, it is necessary to thread the yarns to yarn guides, respectively. On this account, desired tracks of movement of the holding units are different between a case where the holding units are moved from the capturing positions to the yarn threading start positions and a case where the holding units are moved from the yarn threading start positions to the yarn threading completion positions. (Details will be given in the embodiment below.) This makes it possible to suitably change the tracks of movement of the holding units even though the first guide rail and the second guide rail are arranged to be simple in shape.

[0020] According to an eighth aspect of the invention, the yarn winder of the seventh aspect is arranged so that the first rail drive unit is configured to swing the first guide rail, and the second rail drive unit is configured to swing the second guide rail.

[0021] This arrangement narrows the movable ranges of the first guide rail and the second guide rail as compared to an arrangement in which the first guide rail and the second guide rail are entirely moved in a parallel manner. It is therefore possible to avoid an interference between the first guide rail and the second guide rail and other members.

[0022] According to a ninth aspect of the invention, the yarn winder of any one of the sixth to eighth aspects is arranged so that the paired winding units include a first supporting member supporting the first holding unit drive unit and a second supporting member supporting the

second holding unit drive unit, the first holding unit drive unit includes a first main body integrated with the first supporting member, and the second holding unit drive unit includes a second main body integrated with the second supporting member.

[0023] The expression "integrated" indicates that plural members are fixed to one another by a fastener, or plural members can be treated as a single member because they are, for example, welded. With the arrangement above, because the first main body and the first supporting member are integrated, high rigidity is achieved. Because an adverse influence of driving vibration of the yarn winder on the first holding unit drive unit is suppressed, the durability of the first holding unit drive unit is improved. The same applies to the second holding unit drive unit.

[0024] According to a tenth aspect of the invention, the yarn winder of any one of the first to ninth aspects is arranged so that the paired holding units are movable from predetermined holding unit retracted positions to the capturing positions.

[0025] When the yarn threading is performed, if the paired holding units are provided at the capturing positions in advance, the holding units may obstruct the yarn threading. The arrangement is effective in such a case.

[0026] According to an eleventh aspect of the invention, the yarn winder of the tenth aspect is arranged so that the holding unit retracted positions are identical with the yarn threading completion positions.

[0027] With this arrangement, an operation to return the holding units to the holding unit retracted positions is unnecessary after the movement of the holding units to the yarn threading completion positions (i.e., after the completion of the yarn threading). It is therefore possible to suppress structural and operational complication of the yarn threading mechanism.

[0028] According to a twelfth aspect of the invention, the yarn winder of the tenth or eleventh aspect is arranged so that the distance in the opposing direction between a first capturing position that is the capturing position of the first holding unit and a second capturing position that is the capturing position of the second holding unit is shorter than the distance in the opposing direction between a first holding unit retracted position that is the holding unit retracted position of the first holding unit and a second holding unit retracted position that is the holding unit retracted position of the second holding unit, and the first capturing position and the second capturing position are different from each other in a direction orthogonal to both the opposing direction and the arrangement direction.

[0029] With this arrangement, when the first holding unit and the second holding unit are moved to the capturing positions substantially simultaneously, it is possible to prevent the first holding unit and the second holding unit from interfering with each other.

[0030] According to a thirteenth aspect of the invention, the yarn winder of any one of the tenth to twelfth aspects is arranged so that the drive mechanism is capable of moving the paired holding units from the holding unit retracted positions to predetermined capture preparation positions, and the yarn threading mechanism includes an adjustment unit which is capable of adjusting positions of the paired holding units within an adjustment range including the capture preparation positions and the capturing positions, when operated by an operator after the paired holding units are positioned at the capture preparation positions.

[0031] With this arrangement, the operator is able to finely adjust the positions of the paired holding units when the holding units capture the yarns. This allows the holding units to reliably capture the yarns. The efficiency in the yarn threading is therefore further improved.

[0032] According to a fourteenth aspect of the invention, the yarn winder of the thirteenth aspect is arranged so that the capture preparation positions are on the other side in the arrangement direction of the capturing positions, and the adjustment unit includes a slide which supports the paired holding units to be slidable at least in the arrangement direction.

[0033] With this arrangement, the positions in the arrangement direction of the holding units can be finely adjusted by a simple structure.

[0034] According to a fifteenth aspect of the invention, the yarn winder of the fourteenth aspect is arranged so that the drive mechanism includes a guide portion which is provided on a track of movement of the paired holding units and guides the paired holding units moving from the holding unit retracted positions to at least the other side in the arrangement direction, the slide is at a predetermined first slide position when the paired holding units are at the holding unit retracted positions, and when the paired holding units are moved to the other side in the arrangement direction by the guide portion, the slide is moved to a second slide position that is on the other side in the arrangement direction of the first slide position to move the paired holding units to the capture preparation positions.

[0035] When the paired holding units move from the holding unit retracted positions to positions in the vicinity of the capturing positions, problems such as yarn shaking may occur if the holding units unintentionally make contact with the yarns. According to the arrangement above, by the guide portion (and the slide), the paired holding units having been moved from the holding unit retracted positions are guided to the other side in the arrangement direction. It is therefore possible to certainly avoid unintentional contact between the holding units and the yarns when the holding units are moved to the capture preparation positions.

[0036] According to a sixteenth aspect of the invention, the yarn winder of any one of the first to eleventh aspects is arranged so that the paired holding units oppose each other in the opposing direction after being moved to the capturing positions, the yarn threading mechanism includes a stopper which is provided between the paired

holding units in the opposing direction and is configured to restrict movement of the paired holding units in the opposing direction, and the stopper is positionally adjustable at least in the opposing direction to adjust the capturing positions.

[0037] With this arrangement, as the position of the stopper is suitably adjusted in advance, it is possible to capture the yarns by the paired holding units without needing manual movement of the paired holding units by the operator.

[0038] According to a seventeenth aspect of the invention, the yarn winder of any one of the first to sixteenth aspects further comprises a regulatory guide which holds the yarns before wound by the paired winding units to be aligned in the opposing direction and arranges intervals in the opposing direction of the yarns to be predetermined intervals, the yarn threading mechanism includes a separation roller that, when the yarn threading is performed, is positionable downstream of the regulatory guide in a yarn running direction of the yarns and is rotatable, and the separation roller has a circumferential surface capable of making contact with the yarns, and is capable of widen the intervals of the yarns in the opposing direction along the circumferential surface.

[0039] In yarn threading, yarns are typically sucked and held by, for example, a suction gun. In this regard, because the intervals of the yarns are narrowed at around the suction port of the suction gun, it may be difficult to hold the yarns in plural groups. In this connection, according to the arrangement above, the separation roller widens the intervals of the yarns running at a position downstream in the yarn running direction of the regulatory guide, in the opposing direction. As a result, the yarns can be easily captured by the holding units, as respective groups of yarns. The efficiency in the yarn threading is therefore further improved.

[0040] According to an eighteenth aspect of the invention, a yarn winder comprises: paired winding units opposing each other in a predetermined opposing direction, each of the paired winding units supporting bobbins to be aligned in an arrangement direction orthogonal to the opposing direction and to be rotatable, wherein, each of the paired winding units includes yarn guides that are provided to correspond to yarns wound onto the respective bobbins and are aligned in the arrangement direction, the yarn winder further comprises: a regulatory guide which holds the yarns before wound by the paired winding units to be aligned in the opposing direction and arranges intervals in the opposing direction of the yarns to be predetermined intervals; and a yarn threading mechanism arranged to perform yarn threading to the yarn guides of both of the paired winding units, the yarn threading mechanism includes: paired holding units which are attached to the paired winding units, respectively, and are configured to hold groups of the yarns, respectively; and a separation roller that, when the yarn threading is performed, is provided downstream of the regulatory guide in the yarn running direction of the yarns and is rotatable, and the separation roller has a circumferential surface capable of making contact with the yarns and is capable of widen the intervals of the yarns in the opposing direction along the circumferential surface.

[0041] This arrangement makes it possible to widen the intervals of the yarns in the opposing direction by the separation roller. As a result, the yarns can be easily captured by the holding units, as respective groups of yarns. In a manner similar to the first aspect of the invention, the efficiency in yarn threading is therefore improved when yarn threading to yarn guides of a pair of winding units is performed.

[0042] According to a nineteenth aspect of the invention, the yarn winder of the seventeenth or eighteenth aspect is arranged so that the separation roller has a rotational axis that extends along the opposing direction.

[0043] In this arrangement, the direction (rotational axis direction) in which the rotational axis of the separation roller extends is substantially in parallel to the direction in which the yarns are aligned by the regulatory guide. It is therefore possible to suppress increase in size of the separation roller in the rotational axis direction as compared to a case where the rotational axis direction is tilted relative to the opposing direction (i.e., a case where the rotational axis direction is different from the direction in which the yarns are aligned).

[0044] According to a twentieth aspect of the invention, the yarn winder of any one of the seventeenth to nineteenth aspects is arranged so that each of the paired holding units has retaining grooves that are aligned to retain the respective yarns, and intervals of entrances of the retaining grooves in a direction in which the retaining grooves are aligned are identical with the predetermined intervals in the opposing direction.

[0045] In this arrangement, the intervals of the entrances of the retaining grooves are as wide as the predetermined intervals. As a result, the yarns can be easily captured by the holding units, as respective groups of yarns. The efficiency in the yarn threading is therefore effectively improved.

[0046] According to a twenty-first aspect of the invention, the yarn winder of any one of the seventeenth to twentieth aspects is arranged so that the separation roller is movable between a predetermined roller retracted position and a roller contact position where the separation roller is able to make contact with the yarns.

[0047] When the separation roller is at the roller contact position at the time of not widening the intervals of the yarns, the separation roller may be obstructive. The arrangement is effective in such a case.

[0048] According to a twenty-second aspect of the invention, the yarn winder of the twenty-first aspect is arranged so that the yarn threading mechanism includes a roller supporter supporting the separation roller to be rotatable, and the roller supporter is able to rotate about a predetermined rotation shaft to move the separation roller between the roller retracted position and the roller contact position.

[0049] To allow the separation roller to be movable between the roller retracted position and the roller contact position, the roller supporter may be movable in, for example, a linear manner. However, an apparatus for linearly moving a member typically includes a long sliding movable portion and a fixed portion that is positionally fixed, and a slight gap is formed between the movable portion and the fixed portion. On this account, when running yarns make contact with the separation roller, the angle of the movable portion relative to the fixed portion may be slightly changed. Even if the change of the angle is slight, the positions of the roller supporter and the separation roller may be significantly changed, because the movable portion is long. Due to this, the position of the separation roller may be significantly deviated from the target position. In such a case, the positions of the yarns relative to the holding units may be greatly deviated, and the holding units may not be able to correctly hold the yarns.

[0050] In this regard, according to the arrangement above, the roller supporter is arranged to be rotatable about the rotation shaft. On this account, the separation roller is movable as the roller supporter rotates together with the rotation shaft. It is therefore possible to suppress the above-described positional deviations of the roller supporter and the separation roller as compared to an arrangement in which the roller supporter is linearly moved. This makes it possible to improve the positional accuracy of the separation roller.

[0051] According to a twenty-third aspect of the invention, the yarn winder of the twenty-second aspect is arranged so that the rotation shaft extends in a direction in which the rotational axis of the separation roller extends.

[0052] With this arrangement, the separation roller looks like a simple circle (i.e., the separation roller looks small in size) when viewed in the direction in which the rotation shaft extends. It is therefore possible to downsize the movable range of the separation roller as compared to a case where the direction in which the rotation shaft extends is deviated from the direction in which the rotational axis of the separation roller extends. Due to this, an interference of the separation roller with another member is effectively avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053]

FIG. 1 is a front elevation of a spun yarn take-up machine of an embodiment.

FIG. 2 is a side view of the spun yarn take-up machine.

FIG. 3 illustrates movement of fulcrum guides.

FIGs. 4(a) to 4(c) are explanatory views of constituent features included in a yarn threading mechanism.

FIGs. 5(a) and 5(b) are enlarged views of paired holding units, respectively. FIG. 5(c) is viewed along an arrow V(c) in FIG. 5(a).

FIG. 6 is a schematic diagram showing the relationship between a linear slider and a path of compressed air, whereas FIG. 6(b) is a schematic diagram showing the relationship between an air cylinder and the path of the compressed air.

Each of FIG. 7(a) and FIG. 7(b) shows an adjustment unit.

Each of FIG. 8(a) and FIG. 8(b) illustrates a yarn interval increaser.

FIGs. 9(a) to 9(f) illustrate operations until yarns are pressed onto a separation roller in yarn threading to the spun yarn take-up machine.

FIGs. 10(a) to 10(c) illustrate a state in which the holding unit is at a holding unit retracted position.

FIGs. 11(a) to 11(c) illustrate movement of the holding unit to a capture preparation position.

FIGs. 12(a) to 12(c) illustrate fine adjustment of the position of the holding unit.

FIG. 13 illustrates the positional relationship between the paired holding units at the capturing positions.

FIGs. 14(a) to 14(c) illustrate retraction of the holding unit.

FIGs. 15(a) to 15(c) illustrate movement of the holding unit to a yarn threading start position.

FIG. 16(a) illustrates the position of a second godet roller at the time of yarn threading to fulcrum guides.

FIG. 16(b) is a reference drawing.

FIGs. 17(a) to 17(c) illustrate movement of the holding unit to a yarn threading completion position.

FIG. 18 illustrates how yarns are threaded to fulcrum guides, respectively.

FIGs. 19(a) to 19(d) illustrate a positioning member of a modification.

FIGs. 20(a) and 20(b) illustrate the shape of the paired holding units, and FIG. 20(c) shows alignment of the paired holding units.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0054] The following will describe an embodiment of the present invention. Hereinafter, directions shown in FIGs. 1 to 3 will be consistently used as an up-down direction, a left-right direction, and a front-rear direction, for convenience of explanation. The up-down direction is a vertical direction in which the gravity acts. The left-right direction (opposing direction in the present invention) is a direction orthogonal to the up-down direction and is a direction in which paired winding units 5 oppose each other. The front-rear direction (arrangement direction of the present invention) is a direction which is orthogonal to both the up-down direction and the left-right direction, and is a direction in which bobbins B (described later) are aligned. A direction in which each yarn Y (described later) runs will be referred to as a yarn running direction.

(Spun Yarn Take-Up Machine)

[0055] The following will outline a spun yarn take-up machine 1 (i.e., a yarn winder of the present invention) of an embodiment, with reference to FIG. 1 and FIG. 2. FIG. 1 is a front view of the spun yarn take-up machine 1. FIG. 2 is a side view of the spun yarn take-up machine 1. FIG. 2 shows one (winding unit 5A) of a later-described pair of winding units 5.

[0056] The spun yarn take-up machine 1 is configured to simultaneously form packages P by taking up plural (e.g., 32 in the present embodiment) yarns Y spun out from a spinning apparatus 2 and winding the yarns Y onto bobbins B. Each yarn Y is a multi-filament yarn having filaments (not illustrated). Each filament is a synthetic fiber made of, e.g., polyester.

[0057] For example, the spun yarn take-up machine 1 includes a first godet roller 3 (first yarn feed roller of the present invention), a second godet roller 4 (second yarn feed roller of the present invention), a pair of winding units 5 (winding units 5A and 5B), and a controller 6 (first control unit and second control unit of the present invention). The first godet roller 3 and the second godet roller 4 are arranged to take up yarns Y and feed them to the downstream side in a yarn running direction. The first godet roller 3 and the second godet roller 4 are supported by a long supporting body 7 that extends obliquely rearward and upward from a position above front end portions of the paired winding units 5.

[0058] The first godet roller 3 is a roller having a rotational axis substantially in parallel to the left-right direction. The first godet roller 3 is attached to a front end portion of the supporting body 7. The first godet roller 3 is rotationally driven by an unillustrated motor. The yarns Y spun out from the spinning apparatus 2 are sent to the second godet roller 4 while being aligned in the left-right direction and wound onto the first godet roller 3.

[0059] The second godet roller 4 is a roller having a rotational axis substantially in parallel to the left-right direction. The second godet roller 4 is provided above and rearward of the first godet roller 3. The second godet roller 4 is rotationally driven by an unillustrated motor. The second godet roller 4 is provided at a position obliquely rearward of and above the first godet roller 3, and is attached to the supporting body 7. The second godet roller 4 is arranged to be movable in the extending direction of the supporting body 7. The second godet roller 4 is movable between a front position indicated by two-dot chain lines in FIG. 2 and a rear position indicated by full lines in the figure by, for example, a roller movement mechanism 9 including an unillustrated motor, pulleys, and an endless belt. The front position (roller yarn placement position of the present invention) is a position forward of and below the rear position (one side position of the present invention) and is close to the first godet roller 3 as compared to the rear position. The front position is a position where yarn placement to the second godet roller 4 is performed. The rear position is a position where a later-described winding operation is performed. In addition, the rear position is a position where yarn threading to later-described fulcrum guides 20 is performed (as detailed later).

[0060] Each of the yarns Y is sent from the first godet roller 3 to the second godet roller 4, and then sent to one of the paired winding units 5. A half of the yarns Y is sent to the winding unit 5A and the remaining half of the yarns Y is sent to the winding unit 5B. A yarn path of each yarn Y running from the first godet roller 3 to the second godet roller 4 extends obliquely upward and rearward.

[0061] In the yarn running direction, a regulatory guide 8 is provided between the first godet roller 3 and the second godet roller 4. The regulatory guide 8 is provided to hold the yarns Y to be aligned in the left-right direction and to arrange the intervals in the left-right direction of the yarns Y to be predetermined intervals.

[0062] Each of the paired winding units 5 (winding units 5A and 5B) is configured to simultaneously form packages P by winding the yarns Y onto the bobbins B. The winding unit 5A and the winding unit 5B are provided below the first godet roller 3 and the second godet roller 4. The winding unit 5A and the winding unit 5B are provided to be symmetric in the left-right direction (i.e., plane symmetric) (see FIG. 1). To be more specific, the winding unit 5A on the left side and the winding unit 5B on the right side are provided on the respective sides of the second godet roller 4 in the left-right direction and are arranged to oppose each other over the yarn path of the yarns Y sent from the second godet roller 4. Each of the winding units 5 winds a half of the yarns Y (e.g., 16 yarns in the present embodiment) sent from the second godet roller 4. To be more specific, the winding unit 5A winds the left 16 yarns YA whereas the winding unit 5B winds the right 16 yarns YB.

[0063] The controller 6 is, for example, a typical computer and is configured to control the entire spun yarn take-up machine 1. The controller 6 is electrically connected to parts of the spun yarn take-up machine 1 to control the parts based on a predetermined program. The controller 6 includes an unillustrated input unit to which the operator is able to make an input.

(Structure of Winding Units)

[0064] The structure of the paired winding units 5 will be further detailed with reference to FIG. 1 to FIG. 3. FIG. 3 illustrates movement of later-described fulcrum guides 20. As shown in FIG. 1, each of the paired winding units 5 includes a supporting frame 11, a turret 12, and two bobbin holders 13. As described above, the winding unit 5A and the winding unit 5B are symmetric in the left-right direction. Unless otherwise stated, the description of each constituent feature is applicable to both the winding unit 5A and the winding unit 5B.

[0065] The supporting frame 11 is a member extending in the front-rear direction. The supporting frame 11 is cantilevered by a base 14 that stands vertically, and pro-

trudes forward (see FIG. 2). The turret 12 is a discshaped member having a rotational axis substantially parallel to the front-rear direction. The turret 12 is rotatably supported by the base 14. The turret 12 is rotationally driven by a turret motor which is not illustrated. Each of the two bobbin holders 13 is rotatably supported by the turret 12 and protrudes forward from the front surface of the turret 12. The rotational axes of the two bobbin holders 13 are substantially in parallel to the front-rear direction. When viewed in the front-rear direction, two bobbin holders 13 are provided to be point symmetric about the center of the turret 12 (see FIG. 1). To each bobbin holder 13, the bobbins B provided for the respective yarns Y are attached to be lined up in the front-rear direction. The bobbins B are rotatably supported by each of the two bobbin holder 13. Each of the two bobbin holders 13 is independently rotated and driven by an unillustrated winding motor.

[0066] In the present embodiment, each winding unit 5 includes the base 14 (see FIG. 1). However, the disclosure is not limited to this. For example, two supporting frames 11 and two turrets 12 of the respective winding units 5A and 5B may be attached to the same base (not illustrated).

[0067] Each winding unit 5 includes guide units 15, traverse guides 16, and a contact roller 17. To be more specific, above the supporting frame 11, a guide supporter 18 is provided to extend in the front-rear direction (see FIG. 2). The guide units 15 are attached to the guide supporter 18 to be movable along the front-rear direction. The guide units 15 are provided to correspond to the respective bobbins B and are aligned along the front-rear direction. Each of the guide units 15 includes a main body 19 and a fulcrum guide 20 (yarn guide of the present invention). The main body 19 is attached to the guide supporter 18 to be movable. The fulcrum guide 20 is fixed to the main body 19 and functions as a fulcrum about which the yarn Y is traversed by each traverse guide 16. The fulcrum guides 20 (fulcrum guides 20A) of the winding unit 5A are fixed to the right ends of the main bodies 19. The fulcrum guides 20 (fulcrum guides 20B) of the winding unit 5B are fixed to the left ends of the main bodies 19. For further details of the guide units 15, see e.g., Japanese Laid-Open Patent Publication No. 2017-114573 described above.

[0068] The guide units 15 (i.e., the fulcrum guides 20) are movable between winding positions (distanced positions; see FIG. 2) where the yarns Y are wound onto the bobbins B and gathered positions (see FIG. 3) where the guide units 15 are close to one another in the front-rear direction as compared to the distanced positions. To be more specific, for example, the guide units 15 that are adjacent to one another in the front-rear direction are connected with one another by an unillustrated belt. The rearmost guide unit 15 is movable in the front-rear direction by, for example, an unillustrated linear slider. As the linear slider is driven, the guide units 15 are movable between the distanced positions where they are distanced from one another and gathered positions where they are gathered on the front side as compared to the distanced positions. As described later, yarn threading to the fulcrum guides 20 is performed when the fulcrum guides 20 are at the gathered positions.

[0069] The traverse guides 16 are aligned in the front-rear direction. Each of the traverse guides 16 is driven by, for example, an unillustrated traverse motor, and traverses the corresponding yarn Y in the front-rear direction. The contact roller 17 is a roller having a rotational axis substantially in parallel to the front-rear direction, and is provided immediately above the upper bobbin holder 13. The contact roller 17 is configured to make contact with the surfaces of the packages P supported by the upper bobbin holder 13. With this, the contact roller 17 applies a contact pressure to the surface of each package P to adjust the shape of each package P.

[0070] In each of the paired winding units 5 structured as described above, when the upper bobbin holder 13 is rotationally driven, the yarns Y traversed by the traverse guides 16 are wound onto the bobbins B, with the result that the packages P are formed. When the formation of the packages P is completed, the turret 12 rotates to switch over the upper and lower positions of the two bobbin holders 13. As a result, the bobbin holder 13 having been at the lower position is moved to the upper position, which allows the yarns Y to be wound onto the bobbins B attached to the bobbin holder 13 having been moved to the upper position, to form packages P. The bobbin holder 13 to which the fully-formed packages P are attached is moved to the lower position. The fully-formed packages P are then collected by, e.g., an unillustrated package collector.

[0071] At this stage, typically, yarn threading to the spun yarn take-up machine 1 is required as preparation for winding the yarns Y onto the bobbins B. In known arrangements, an operator manually performs yarn threading to fulcrum guides 20 of the above-described paired winding units 5 by using a known yarn threading member (see e.g., Japanese Laid-Open Patent Publication No. 2017-114573). However, when the yarn threading is manually performed, the amount of time required to complete the yarn threading may significantly vary depending on the proficiency of the operator. When the yarn threading takes an excessive amount of time, problems such as large production loss occur. On this account, the spun yarn take-up machine 1 of the present embodiment has the following arrangement (yarn threading mechanism 30 described later) in order to improve the efficiency in yarn threading when yarn threading to the fulcrum guides of the pair of winding units 5 is performed.

(Yarn Threading Mechanism)

[0072] The following will describe the structure of the yarn threading mechanism 30 mainly with reference to FIG. 4 to FIG. 8. FIG. 4(a) is a plan view of a pair of holding units 31 (described later) and a drive mechanism

32 (described later) included in the yarn threading mechanism 30. FIG. 4(b) is a side view of a later-described drive unit 32A (first drive unit of the present invention). FIG. 4(c) is a side view of a later-described drive unit 32B (second drive unit of the present invention). FIGs. 5(a) and 5(b) are enlarged views of the paired holding units 31, respectively. FIG. 5(c) is viewed along an arrow V(c) in FIG. 5(a). FIG. 6(a) is a schematic diagram showing the relationship between a later-described linear slider 64A (or a linear slider 64B) and a path of compressed air. FIG. 6(b) is a schematic diagram showing the relationship between a later-described air cylinder 65A (or an air cylinder 65B) and a path of compressed air. Each of FIG. 7(a) and FIG. 7(b) is a plan view of an adjustment unit 33 (described later). FIG. 8(a) is a side view of a yarn interval increaser 34 (described later). FIG. 8(b) is a view of the yarn interval increaser 34, viewed along an arrow VIII(b) in FIG. 8(a).

[0073] The yarn threading mechanism 30 includes paired holding units 31 (see e.g., FIG. 4(a)), a drive mechanism 32 (see e.g., FIG. 4(a)), an adjustment unit 33 (see e.g., FIG. 7(a)), and a yarn interval increaser 34 (see e.g., FIG. 8(a)). Roughly speaking, the yarn threading mechanism 30 is arranged such that, as the paired holding units 31 are moved by the drive mechanism 32 while the paired holding units 31 hold the yarns Y, the yarns Y are threaded to the respective fulcrum guides 20 without needing human labor. The adjustment unit 33 and the yarn interval increaser 34 are arranged to be treated secondarily when the yarns Y are caught by the paired holding units 31. The following will describe the details.

(Holding Units)

[0074] The paired holding units 31 (holding units 31A and 31B) are arranged to hold respective groups of running yarns Y. As shown in FIG. 4(a), the holding unit 31A (first holding unit of the present invention) and the holding unit 31B (second holding unit of the present invention) are arranged to be substantially symmetric in the left-right direction. The holding unit 31A on the left side is arranged to hold yarns YA (see FIG. 1). The holding unit 31B on the right side is arranged to hold yarns YB (see FIG. 1).

[0075] The holding unit 31A is attached to the winding unit 5A through the drive unit 32A (described later) of the drive mechanism 32. To be more specific, between the supporting frame 11 and the guide supporter 18 of the winding unit 5A in the up-down direction, a supporting member 35 (supporting member 35A shown in FIG. 3 and FIGs. 4(a) and 4(b)) that is positionally fixed is provided. The supporting member 35 includes, for example, a rod member 36 extending in the front-rear direction and a plate member 37 fixed to a front portion of the rod member 36. The holding unit 31A is attached to the supporting member 35A through the drive unit 32A. Likewise, the holding unit 31B is attached to the supporting member 35 (supporting member 35B shown in FIG. 3 and FIGs. 4(a) and 4(c)) of the winding unit 5B through the drive unit 32B (described later) of the drive mechanism 32. The position in the up-down direction of the supporting member 35A (first supporting member of the present invention) is, for example, lower by about 5mm than the position in the up-down direction of the supporting member 35B (second supporting member of the present invention). This value, about 5mm, is larger than the thickness of a later-described comb guide 41, for example.

[0076] As shown in FIG. 5(a), the holding unit 31A includes the comb guide 41 and an interposed member 42. The comb guide 41 is a plate member that is comb-shaped on the whole. The comb guide 41 includes a main body 43 and a connection part 44. The main body 43 has retaining grooves 45 in which the respective yarns Y are retained. The retaining grooves 45 are aligned at least in the left-right direction. The entrance of each retaining groove 45 is formed at a rear end portion of the main body 43. The intervals of the entrances of the retaining grooves 45 in the direction in which the retaining grooves 45 are aligned are substantially identical with the intervals (predetermined intervals) in the left-right direction of the yarns Y, which are defined by the regulatory guide 8. At an intermediate portion of the main body 43 in the front-rear direction, a through hole 46 is formed to extend in the left-right direction and penetrate the main body 43 in the up-down direction, for example. With this arrangement, a grip 47 holdable by the operator is formed at a front end portion of the main body 43, for example.

[0077] The connection part 44 of the holding unit 31A is a part connected to a left end portion of a rear end portion of the main body 43. The connection part 44 is connected to the interposed member 42 through a swing shaft 48 whose axial direction is in parallel to the up-down direction. This allows the comb guide 41 to be swingable relative to the interposed member 42. The connection part 44 has adjustment holes 49 and 50 which, for example, penetrate the connection part 44 in the up-down direction and extend in the circumferential direction of the swing shaft 48.

[0078] As shown in FIG. 5(c), a pin 57 extending downward is fixed to the lower end of the connection part 44. The pin 57 is a member guided obliquely rightward and forward (i.e., at least forward) by a below-described guide 53, when the holding unit 31A moves (as described later). As shown in FIG. 5(a), to a right side face in the vicinity of the front end portion of the supporting member 35A, the guide 53 which is formed by, for example, a sheet metal is attached. The guide 53 includes a base portion 54 extending upward from the supporting member 35A and a guide portion 55 extending rightward from an upper end portion of the base portion 54. The guide portion 55 has a guiding surface 56 which, for example, faces obliquely leftward and forward and extends obliquely rightward and forward. The position in the up-down direction of the guiding surface 56 at least partially overlaps the position in the up-down direction of the pin 57. The guiding surface 56 is provided on a track along which the pin

57 is moved by the drive unit 32A.

[0079] The interposed member 42 is, for example, a roughly L-shaped member when viewed in the up-down direction. The interposed member 42 is provided below the comb guide 41. The interposed member 42 supports the comb guide 41 through the swing shaft 48 so that the comb guide 41 is swingable. The interposed member 42 has, for example, bolt holes 51 and 52 penetrating the interposed member 42 in the up-down direction. The bolt hole 51 is formed to positionally correspond to the adjustment hole 49. A bolt (not illustrated) having a head is screwed into the bolt hole 51 through the adjustment hole 49. The bolt hole 52 is formed to positionally correspond to the adjustment hole 50. A similar bolt (not illustrated) is screwed into the bolt hole 52 through the adjustment hole 50. As the heads of these bolts press the comb guide 41 from above, the comb guide 41 is fixed relative to the interposed member 42. When the heads of the bolts are loosened, the position of the comb guide 41 relative to the interposed member 42 may be adjusted. The interposed member 42 is fixed to a support arm 61A (described later) of the drive unit 32A.

[0080] As shown in FIG. 5(b), the holding unit 31B includes the comb guide 41 and an interposed member 42, in the same manner as the holding unit 31A. The holding unit 31B is provided to the right of the holding unit 31A, and the holding unit 31B and the holding unit 31A are arranged to be symmetric in the left-right direction. The holding unit 31B is not further detailed in this description.

(Drive Mechanism)

[0081] The drive mechanism 32 is configured to move the paired holding units 31. As shown in FIG. 4(a), the drive mechanism 32 includes the drive unit 32A configured to move the holding unit 31A and the drive unit 32B configured to move the holding unit 31B. The drive unit 32A and the drive unit 32B are able to drive independently. The following will detail the drive unit 32A. FIG. 4(a) to FIG. 4(c) show a state in which the paired holding units 31 are at positions (holding unit retracted positions) where the yarn threading is not performed.

[0082] The drive unit 32A is attached to the supporting member 35A of the winding unit 5A. As shown in FIG. 4(a), the drive unit 32A includes the support arm 61A, a guide rail 62A (first guide rail of the present invention), a swing arm 63A, a linear slider 64A (first holding unit drive unit of the present invention), and an air cylinder 65A (first rail drive unit of the present invention). In summary, the support arm 61A to which the holding unit 31A is attached is moved at least in the front-rear direction along the guide rail 62A on account of the operation of the linear slider 64A. The guide rail 62A is able to switch the direction of movement of the support arm 61A and the holding unit 31A by being swung together with the swing arm 63A by the air cylinder 65A.

[0083] The support arm 61A is a long member extending at least in the front-rear direction. The holding unit 31A is fixed to a front end portion of the support arm 61A. At the front end portion of the support arm 61A, a sliding portion 71 is provided to be slidable along the guide rail 62A. The sliding portion 71 may be a pin extending in the up-down direction, for example. When the guide rail 62A is swung, the sliding portion 71 is movable in accordance with the swing of the guide rail 62A. At a rear end portion of the support arm 61A, a through hole 72 is formed to penetrate the arm in the up-down direction (see FIG. 4(a) and FIG. 7(a)). The through hole 72 is relatively long in the front-rear direction. The rear end portion of the support arm 61A is attached to a slider 82 (described later) of the linear slider 64A to be swingable, through a pin 73 that extends in the up-down direction and is inserted into the through hole 72. With this arrangement, the support arm 61A is swingable relative to the slider 82 and movable to some degree in the front-rear direction. In other words, relative to the slider 82, the support arm 61A is movable between a predetermined arm front position (second slide position of the present invention) and an arm rear position (first slide position of the present invention) that is rearward of the arm front position. To put it differently, the support arm 61A supports the holding unit 31A to be slidable at least in the front-rear direction. The support arm 61A is included in a slide of the present invention.

[0084] The guide rail 62A is a substantially linear rail extending at least in the front-rear direction. The guide rail 62A is disposed to guide the support arm 61A at least in the front-rear direction. The guide rail 62A is engaged with the sliding portion 71 of the support arm 61A. The guide rail 62A is fixed to a right end portion of the swing arm 63A by an unillustrated fastener (e.g., a bolt and a nut). Alternatively, the guide rail 62A may be integrally formed with the swing arm 63A by, for example, welding.

[0085] The swing arm 63A is, for example, a plate-shaped arm extending at least in the front-rear direction. The swing arm 63A is, for example, provided at a front portion of the drive unit 32A as shown in FIG. 4 (a). A rear end portion of the swing arm 63A is connected to the supporting member 35A through a swing shaft 75 whose axial direction is in parallel to the up-down direction. The swing arm 63A is therefore swingable together with the guide rail 62A. In the swing arm 63A, a guide hole 76 is formed to penetrate the arm in the up-down direction and extend at least in the front-rear direction. Into the guide hole 76, a pin 86 attached to the later-described air cylinder 65A is inserted. The guide hole 76 formed in the swing arm 63A extends obliquely forward and leftward.

[0086] When a direction orthogonal to the extending direction of the guide hole 76 is defined as an orthogonal direction, the size in the orthogonal direction (hereinafter, width) of the guide hole 76 is, except at the front end portion, very slightly larger than the outer diameter of the pin 86. With this arrangement, the pin 86 is movable along the extending direction of the guide hole 76. Furthermore,

as shown in FIG. 7(a), the width of the guide hole 76 at the front end portion of the guide hole 76 is slightly larger than the outer diameter of the pin 86. (To be more specific, the width is larger than the outer diameter by about 5mm.) To put it differently, the front end portion of the guide hole 76 has a play 77 to allow the swing arm 63A to be swingable relative to the pin 86 freely to some degree. (The reason of this arrangement will be described later.)

[0087] The linear slider 64A is an apparatus for moving the support arm 61A in the front-rear direction. The linear slider 64A is a known rodless cylinder driven by compressed air, for example. The linear slider 64A includes a cylinder main body 81 (cylinder main body 81A) and the slider 82. The cylinder main body 81A (first main body of the present invention) extends in the front-rear direction. The cylinder main body 81A is fixed to a rear portion of the supporting member 35A by, for example, an unillustrated fastener. In other words, the cylinder main body 81A is integrated with the supporting member 35A. Alternatively, the cylinder main body 81A may be welded to the supporting member 35A, for example. The slider 82 is arranged to be slidable in the front-rear direction along the cylinder main body 81. To the slider 82, the support arm 61A is attached to be swingable. The slider 82 is movable between the vicinity of the front end portion and the vicinity of the rear end portion of the cylinder main body 81, in response to the supply of compressed air to the cylinder main body 81 and the discharge of compressed air from the cylinder main body 81. To be more specific, as shown in FIG. 6 (a), the cylinder main body 81 has a piston chamber 81F provided forward of the slider 82 and a piston chamber 81R provided rearward of the slider 82. The piston chamber 81F is connected to a supply port Ps and a discharge port Pe2 for supplying and discharging compressed air, through, for example, an electromagnetic valve EV1 that is a known five-way electromagnetic valve. The piston chamber 81R is connected to the supply port Ps and a discharge port Pe1 through the electromagnetic valve EV1. The electromagnetic valve EV1 is electrically connected to the controller 6. As the controller 6 controls the electromagnetic valve EV1, the supply and discharge of the compressed air are controlled. As the compressed air is supplied from the supply port Ps to the piston chamber 81F and the compressed air is discharged from the piston chamber 81R to the discharge port Pe1, the slider 82 moves rearward. As the compressed air is supplied from the supply port Ps to the piston chamber 81R and the compressed air is discharged from the piston chamber 81F to the discharge port Pe2, the slider 82 moves forward. In place of the linear slider 64A, another cylinder mechanism driven by fluid such as compressed air or a motor-driven drive mechanism (e.g., a ball screw mechanism or a rack-and-pinion mechanism) may be provided.

[0088] The air cylinder 65A is an apparatus for swinging the swing arm 63A and the guide rail 62A. The air cylinder 65A includes a cylinder main body 83 and a piston rod 84. The cylinder main body 83 extends in the front-rear direction. The cylinder main body 83 is attached to a front portion of the supporting member 35A. The piston rod 84 extends rearward from the rear end of the cylinder main body 83, for example. The piston rod 84 is extendable and contractible by the supply of compressed air to the cylinder main body 83 and the discharge of compressed air from the cylinder main body 83. To be more specific, as shown in FIG. 6(b), the cylinder main body 83 includes a piston chamber 83F that is a front chamber and a piston chamber 83R that is a rear chamber. The piston chamber 83F is connected to a supply port Ps and a discharge port Pe2 for supplying and discharging compressed air, through an electromagnetic valve EV2 having an arrangement similar to the above-described five-way electromagnetic valve. The piston chamber 83R is connected to the supply port Ps and a discharge port Pe1 through the electromagnetic valve EV2. As the compressed air is supplied from the supply port Ps to the piston chamber 83F and the compressed air is discharged from the piston chamber 83R to the discharge port Pe1, the piston rod 84 moves rearward. As the compressed air is supplied from the supply port Ps to the piston chamber 83R and the compressed air is discharged from the piston chamber 83F to the discharge port Pe2, the piston rod 84 moves forward. At the upper end of a rod end 85 attached to a leading end portion of the piston rod 84, the pin 86 is provided to extend upward (see e.g., FIG. 4(a) and FIG. 10(b)). The pin 86 is inserted into the guide hole 76 of the swing arm 63A. To an upper end portion of the pin 86, for example, a circular plate member 87 larger in diameter than the pin 86 is attached in order to prevent the pin 86 from being detached from the guide hole 76. In place of the air cylinder 65A, another cylinder mechanism driven by fluid or a motor-driven drive mechanism (e.g., a ball screw mechanism or a rack-and-pinion mechanism) may be provided.

[0089] The drive unit 32B is attached to the supporting member 35B of the winding unit 5B. As shown in FIG. 4(a), being similar to the drive unit 32A, the drive unit 32B includes a support arm 61B, a guide rail 62B (second guide rail of the present invention), a swing arm 63B, a linear slider 64B (second holding unit drive unit of the present invention), and an air cylinder 65B (second rail drive unit of the present invention). The support arm 61B supports the holding unit 31B to be slidable in at least the front-rear direction. In addition to the support arm 61A, the support arm 61B is included in the slide of the present invention. The linear slider 64B is structurally similar to the linear slider 64A and is driven by compressed air independently from the linear slider 64A. The air cylinder 65B is structurally similar to the air cylinder 65A and is driven by compressed air independently from the air cylinder 65A. The cylinder main body 81 (cylinder main body 81B) of the linear slider 64B is fixed to a rear portion of the supporting member 35B by, for example,

an unillustrated fastener (i.e., is integrated with the supporting member 35B). The cylinder main body 81B is equivalent to a second main body of the present invention. Because the drive unit 32B and the drive unit 32A are symmetric in the left-right direction, further details of the drive unit 32B will not be given.

[0090] In both the linear sliders 64A and 64B described above, for the sake of convenience, a position (indicated by full lines in FIG. 4(b) and FIG. 4(c)) in the vicinity of the front end portion of the cylinder main body 81 is termed "front end position". A position (indicated by two-dot chain lines in FIG. 4(b) and FIG. 4(c)) in the vicinity of the rear end portion of the cylinder main body 81 is termed "rear end position".

[0091] In both the air cylinders 65A and 65B described above, for the sake of convenience, positions (indicated by full lines in FIG. 4(b) and FIG. 4(c)) of the rod end 85 and the pin 86 when the piston rod 84 is extended are termed "extended positions". Positions (indicated by two-dot chain lines shown in FIG. 4(b) and FIG. 4(c)) of the rod end 85 and the pin 86 when the piston rod 84 is contracted are termed "contracted positions"

(Adjustment Unit)

[0092] The adjustment unit 33 is arranged to allow the positions of the paired holding units 31 to be finely adjustable by the operator, when yarn threading is performed. As shown in FIGs. 7(a) and 7(b), the adjustment unit 33 is included in each of the drive unit 32A and the drive unit 32B. The adjustment unit 33 (adjustment unit 33A) of the drive unit 32A includes the above-described swing arm 63A. To be more specific, the adjustment unit 33A has the play 77 of the guide hole 76 formed in the swing arm 63A. The adjustment unit 33A is arranged to exert its function when the pin 86 of the air cylinder 65A is at the contracted position. (Details will be given later.) Likewise, the adjustment unit 33 (adjustment unit 33B) of the drive unit 32B includes the above-described swing arm 63B.

(Yarn Interval Increaser)

[0093] The yarn interval increaser 34 is provided to widen the intervals of the yarns Y in the left-right direction on the downstream side in the yarn running direction of the second godet roller 4 (i.e., on the downstream side in the yarn running direction of the regulatory guide 8), when yarn threading is performed. As shown in FIG. 8(a), for example, in the winding unit 5A that is the left one of the paired winding units 5, a frame 90 that is positionally fixed is provided above the guide supporter 18. The yarn interval increaser 34 is provided at the frame 90. The yarn interval increaser 34 includes a rotation arm 91 (roller supporter of the present invention), a grip 92, and a separation roller 93.

[0094] The rotation arm 91 is, for example, a roughly L-shaped member when viewed in the left-right direction (see FIG. 8 (a)). The rotation arm 91 is attached to the frame 90 through a rotation shaft 94 extending in the left-right direction. With this arrangement, the rotation arm 91 is rotatable about the rotation shaft 94. When viewed in the left-right direction, the rotation arm 91 is positioned rearward of the first godet roller 3 (see FIG. 8(a)), for example. The rotation arm 91 is, for example, positioned below the second godet roller 4 (see FIG. 8 (a)) at the front position.

[0095] The grip 92 is a portion held by a hand when the operator rotates the rotation arm 91. For example, as shown in FIG. 8(b), the grip 92 extends at least rightward from the base end portion of the rotation arm 91.

[0096] The separation roller 93 is attached to the leading end portion of the rotation arm 91 to be rotatable. The separation roller 93 is cantilevered by the rotation arm 91. The rotational shaft of the separation roller 93 extends along the left-right direction. In other words, the direction in which the rotation shaft 94 extends is substantially identical with the direction in which the rotational axis of the separation roller 93 extends. The separation roller has a circumferential surface 93a that is able to make contact with the yarns Y. When the running yarns Y are in contact with the circumferential surface 93a, the separation roller 93 is passively rotated on account of the friction force acting between the roller and the yarns Y.

[0097] As the rotation arm 91 is rotated by the operator, the separation roller 93 is movable between a predetermined roller retracted position and a predetermined roller contact position. To be more specific, for example, a position (indicated by two-dot chain lines in FIG. 8 (a)) in the vicinity of the first godet roller 3 is the roller retracted position. A position (indicated by full lines in FIG. 8 (a)) directly below the second godet roller 4 is the roller contact position. At least when positioned at the roller contact position, the separation roller 93 is substantially at the same position as the regulatory guide 8 and the second godet roller 4 in the left-right direction.

(Method of Yarn Threading)

[0098] The following will describe a method of threading the yarns Y to the fulcrum guides 20 by using the above-described yarn threading mechanism 30, with reference to FIG. 9(a) to FIG. 18. FIGs. 9(a) to 9(f) illustrate operations until the yarns Y are pressed onto the separation roller 93 in yarn threading to the spun yarn take-up machine 1. FIGs. 10(a) to 10(c) illustrate a state in which the holding unit 31A is at a holding unit retracted position. FIGs. 11(a) to 11(c) illustrate movement of the holding unit 31A to a capture preparation position (described later). FIGs. 12(a) to 12(c) illustrate fine adjustment of the position of the holding unit 31A. FIG. 12 (b) is an enlarged view of a region R2 shown in FIG. 12 (a). FIG. 13 illustrates the positional relationship between the paired holding units 31 at the capturing position. FIGs. 14(a) to 14(c) illustrate retraction of the holding unit 31A. FIGs. 15(a) to 15(c) illustrate movement of the holding

unit 31A to a yarn threading start position. FIG. 16(a) illustrates the position of the second godet roller 4 at the time of yarn threading to the fulcrum guides 20. FIG. 16(b) is a referential figure. FIGs. 17(a) to 17(c) illustrate movement of the holding unit 31A to a yarn threading completion position. FIG. 18 illustrates how the yarns Y are threaded to the fulcrum guides 20, respectively. FIG. 10(a) to FIG. 18 only show the holding unit 31A as a representative.

[0099] The following will describe the outline of the yarn threading in the present embodiment. To begin with, the operator threads the yarns Y to the first godet roller 3, the regulatory guide 8, and the second godet roller 4. Then the operator temporarily presses the yarns Y onto the separation roller 93. Subsequently, by the operation of the yarn threading mechanism 30, the yarns Y are held by the paired holding units 31. (This includes an operation performed by the operator.) Lastly, by the operation of the yarn threading mechanism 30, the yarns Y held by the holding units 31 are threaded to the respective fulcrum guides 20.

[0100] The following will detail the yarn threading. Before the start of the yarn threading, the piston rod 84 of each of the air cylinder 65A and the air cylinder 65B is at the above-described extended position (see FIG. 10(b)). The slider 82 of each of the linear slider 64A and the linear slider 64B is at the above-described front end position (see FIG. 10(c)). Each holding unit 31 is therefore at the predetermined holding unit retracted position (see FIG. 4(a) and FIG. 10(a)). The separation roller 93 is at the roller retracted position (indicated by two-dot chain lines in FIG. 8 (a)). The support arms 61A and 61B are at the arm rear positions.

[0101] At the start of the yarn threading, the operator performs a predetermined input to an input unit (not illustrated) of the controller 6. In accordance with the input signal, the controller 6 controls the parts of the spun yarn take-up machine 1 so that the state of the spun yarn take-up machine 1 is in a yarn threading preparation state described below. That is to say, the controller 6 moves the second godet roller 4 to the front position (see FIG. 9(a)). At this stage, the controller 6 functions as the second control unit of the present invention. Furthermore, the controller 6 moves the fulcrum guides 20 to the gathered positions (see FIG. 3).

[0102] Subsequently, the operator operates the grip 92 of the yarn interval increaser 34 to rotate the rotation arm 91, so as to move the separation roller 93 from the roller retracted position to the roller contact position (as indicated by full lines in FIG. 8(a) and FIG. 9(a)).

[0103] The operator then sucks and holds the yarns Y (to be more specific, all of 32 yarns YA and YB) by using a suction gun SG (see FIG. 9(a)) arranged to be able to suck and hold the yarns Y. By operating the suction gun SG, the operator threads the yarns Y to the first godet roller 3, the regulatory guide 8, and the second godet roller 4 in this order (see FIG. 9(a)).

[0104] Subsequently, the operator operates the suction gun SG to move the leading end portion of the suction gun SG to a position below and to the right of the separation roller 93 (see FIGs. 9(b) and 9(c)), and further moves the yarns Y to a position just behind the separation roller 93 (see FIG. 9(d)). At this stage, the intervals of the yarns Y running from the regulatory guide 8 toward the suction gun SG narrow toward the suction gun SG.

[0105] Thereafter, the operator moves the leading end portion of the suction gun SG forward to cause the yarns Y to make contact with the circumferential surface 93a of the separation roller 93 (see FIG. 9(e) and FIG. 9(f)). As a result, the separation roller 93 is passively rotated by the friction force between the roller and the running yarns Y. At this stage, the intervals in the left-right direction of the yarns Y in contact with the separation roller 93 are widened to be substantially as wide as the intervals in the left-right direction of the yarns Y regulated by the regulatory guide 8 (see FIG. 9(f)). As a result, yarn paths that are aligned in the left-right direction and are substantially in parallel to one another are formed. This is because, typically, the intervals of the yarns Y in contact with a rotating roller are substantially identical with the intervals determined at a location immediately upstream of the roller in the yarn running direction. For details of this principle, see Japanese Laid-Open Patent Publication No. 2012-021240, for example.

[0106] After the intervals of the yarns Y are widened by the separation roller 93, the operator makes an input for starting the operation of the yarn threading mechanism 30 to the input unit of the controller 6. In accordance with the input signal, the controller 6 controls the parts of the yarn threading mechanism 30. At this stage, the controller 6 functions as the first control unit of the present invention. The description below mainly explains the operations of the holding unit 31A and the drive unit 32A, and details of the operations of the holding unit 31B and the drive unit 32B are omitted. Simply put, in the present embodiment, the controller 6 controls the drive unit 32B and the drive unit 32A substantially simultaneously. On this account, the holding unit 31B and the drive unit 32B are driven substantially simultaneously and in a symmetric manner in the left-right direction with the holding unit 31A and the drive unit 32A.

[0107] To begin with, the controller 6 controls the air cylinder 65A to move the piston rod 84 from the extended position (see FIG. 10(b)) to the contracted position (see FIG. 11(b) . When the pin 86 moves forward as a result, the swing arm 63A and the guide rail 62A are passively swung counterclockwise as the guide hole 76 of the swing arm 63A follows the pin 86 (see FIG. 11(a)). Due to this, the front end portion of the support arm 61A and the holding unit 31A follow the guide rail 62A and are swung rightward (see FIG. 11(a)). Consequently, the holding unit 31A starts to move from the holding unit retracted position to a position in the vicinity of the capturing position (described later) where the yarns YA can be captured (see the rightward arrow in FIG. 11(a)). In this connection, as described above, the guide 53 is attached to the support-

ing member 35 (see the region R1 in FIG. 11(a) and its enlarged view). The guide portion 55 (more specifically, the guiding surface 56) of the guide 53 is provided on the track of movement of the pin 57 of the comb guide 41. Because of this, the pin 57 moves while being in contact with the guiding surface 56, and hence the comb guide 41 moving from the holding unit retracted position is guided at least forward along the guiding surface 56 (see the arrow in the enlarged view of the region R1 in FIG. 11(a)). As the comb guide 41 is guided forward, the support arm 61A to which the holding unit 31A is attached moves to the arm front position (see the arrow pointing obliquely rightward and forward in FIG. 11(a)). Consequently, the holding unit 31A moves from the holding unit retracted position to the capture preparation position where the operator causes the holding unit 31A to capture the yarns YA. The capture preparation position is a position that is at least forward of the capturing position. Although not illustrated, the capture preparation position of the holding unit 31A is immediately above a left portion of the separation roller 93 and immediately in front of the yarns YA. When the holding unit 31A is moved from the holding unit retracted position to the capture preparation position, the holding unit 31B is moved from the holding unit retracted position to the capture preparation position where the operator performs the operation to capture the yarns YB. Although not illustrated, the capture preparation position of the holding unit 31B is immediately above a right portion of the separation roller 93 and immediately in front of the yarns YB. The capture preparation positions of the paired holding units 31 are between the second godet roller 4 and the separation roller 93 in the up-down direction. To put it differently, the capture preparation positions of the paired holding units 31 are positions that are on the downstream side of the second godet roller 4 and on the upstream side of the separation roller 93 in the yarn running direction. In this state, the controller 6 temporarily stops the operation of the yarn threading mechanism 30.

[0108] Subsequently, as described below, the operator finely adjusts, within a predetermined adjustment range, the positions of the holding unit 31A and the holding unit 31B at the capture preparation positions by operating the adjustment units 33A and 33B, so as to cause the holding unit 31A to capture the yarns YA and cause the holding unit 31B to capture the yarns YB. The adjustment range encompasses the capture preparation position and the capturing position.

[0109] As described above, the guide hole 76 is formed in each of the swing arms 63A and 63B. The width of the guide hole 76 is very slightly larger than the outer diameter of the pin 86, except at the front end portion. On this account, when the pin 86 is inserted into a portion of the guide hole 76 which is not the front end portion, it is hardly possible to manually swing the swing arms 63A and 63B. On the other hand, the front end portion of the guide hole 76 has the play 77. On this account, when the pin 86 is inserted into the front end portion of the guide hole 76 (i.e., when the piston rod 84 is at the contracted position), the pin 86 is loosely fitted in the play 77. The operator can therefore manually swing the swing arms 63A and 63B in the left-right direction (see FIGs. 12(a) and 12(b)). Furthermore, as described above, the operator is able to move the support arms 61A and 61B between the arm front positions and the arm rear positions. Therefore the support arms 61A and 61B equivalent to the slide of the present invention are encompassed in the adjustment unit of the present invention. The operator is able to manually move the holding unit 31A and the holding unit 31B in the adjustment range from the capture preparation positions to the capturing positions, so as to cause the retaining grooves 45 of the holding unit 31A and the holding unit 31B to capture the respective yarns Y (see FIG. 13). For example, the operator moves the comb guide 41 by holding the grip 47 by a hand.

[0110] Hereinafter, the holding unit retracted position of the holding unit 31A will be referred to as a first holding unit retracted position, whereas the capturing position of the holding unit 31A will be referred as a first capturing position. Likewise, the holding unit retracted position of the holding unit 31B will be referred to as a second holding unit retracted position, whereas the capturing position of the holding unit 31B will be referred as a second capturing position. In the left-right direction, the distance between the first capturing position and the second capturing position is shorter than the distance between the first holding unit retracted position and the second holding unit retracted position. As described above, the position in the up-down direction of the supporting member 35 of the winding unit 5A is different from the position in the up-down direction of the supporting member 35 of the winding unit 5B. On this account, the first capturing position and the second capturing position are different from each other in the up-down direction (i.e., a direction orthogonal to both the opposing direction and the arrangement direction in the present invention). Due to this, as shown in FIG. 13, the holding unit 31A and the holding unit 31B do not interfere with each other even if the holding unit 31A and the holding unit 31B at the capturing positions partially overlap each other when viewed in the up-down direction.

[0111] After causing the holding unit 31A and the holding unit 31B to capture the yarns Y, the operator makes an input to the input unit of the controller 6 to continue the yarn threading. The controller 6 continues the yarn threading in accordance with the input signal. To begin with, for example, the controller 6 returns the second godet roller 4 to the rear position (see the full lines in FIG. 2) .

[0112] Subsequently, the controller 6 controls the linear slider 64A to move the slider 82 from the front end position to the rear end position (see FIG. 14 (c)). As a result, the rear end portion of the support arm 61A is moved to the rear side (one side in the arrangement direction in the present invention) along the cylinder main body 81, and the front end portion of the support arm 61A is moved obliquely rearward and leftward along the guide

rail 62A (see FIG. 14(a)). Consequently, the holding unit 31A holding the yarns YA move obliquely rearward and leftward along the guide rail 62A. Likewise, as the linear slider 64B is controlled, the holding unit 31B moves obliquely rearward and rightward along the guide rail 62B (not illustrated).

[0113] Thereafter, the controller 6 controls the air cylinder 65A to move the piston rod 84 from the contracted position to the extended position (see FIG. 15(b)). Consequently, the pin 86 is moved rearward, and this causes the swing arm 63A to be swung (moved) leftward. Due to this, the inclination angle of the guide rail 62A is changed relative to the front-rear direction, and the inclination angle of the holding unit 31A is also changed (see FIG. 15(a)). To be more specific, the guide rail 62A extends obliquely forward and leftward from a position in the vicinity of the fulcrum guide 20A that is the rearmost fulcrum guide of the winding unit 5A, toward a position in the vicinity of the frontmost fulcrum guide 20A. In this case, the holding unit 31A is at the yarn threading start position of the present invention. The yarn threading start position is rearward of the capturing position. Likewise, as the air cylinder 65B is controlled, the holding unit 31B is moved to the yarn threading start position (not illustrated).

[0114] With reference to FIG. 16(a), the following will describe the positional relationship between the first godet roller 3, the second godet roller 4, and the holding unit 31A when the holding unit 31A (one of the paired holding units of the present invention) is at the yarn threading start position. In this case, the first godet roller 3 is on the upstream side of the holding unit 31A in the yarn running direction and is forward of the holding unit 31A. The second godet roller 4 is provided between the first godet roller 3 and the holding unit 31A in the yarn running direction and is rearward of the first godet roller 3. Furthermore, the second godet roller 4 is at the rear position. The winding angle of the yarns Y on the second godet roller 4 in this case is larger than the winding angle when the second godet roller 4 is at the front position (see FIG. 16(b)). Because the force with which the second godet roller 4 holds the yarns Y is strong in this case, yarn shaking is suppressed.

[0115] Furthermore, the controller 6 controls the linear slider 64A to move the slider 82 from the rear end position to the front end position (see FIG. 17(c)). As a result, the front end portion of the support arm 61A is moved to the front side (the other side in the arrangement direction in the present invention) along the cylinder main body 81, and the front end portion of the support arm 61A is moved obliquely forward and rightward along the guide rail 62A (see FIG. 17(a) and FIG. 18). As a result, the yarns YA retained in the respective retaining grooves 45 of the holding unit 31A are threaded to the corresponding fulcrum guides 20A, respectively (see FIG. 18). The holding unit 31A moves to the yarn threading completion position that is at least forward of the yarn threading start position (see the full lines in FIG. 17(a)). As the holding unit 31A moves from the yarn threading start position to the yarn threading completion position, all of the yarns YA are threaded to the corresponding fulcrum guide 20A, respectively. Likewise, as the linear slider 64B is controlled, the holding unit 31B moves from the yarn threading start position to the yarn threading completion position (not illustrated). As a result, all of the yarns YB retained in the respective retaining grooves 45 of the holding unit 31B are threaded to the corresponding fulcrum guides 20B, respectively. In this way, the yarn threading to all of the fulcrum guides 20 is completed.

[0116] When the holding unit 31A and the holding unit 31B reach the yarn threading completion positions, the state of the linear sliders 64A and 64B and the air cylinders 65A and 65B is substantially identical with the state before the start of the yarn threading (see FIGs. 10(a) to 10(c) and FIGs. 17(a) to 17(c)). To put it differently, the above-described holding unit retracted position and the above-described yarn threading completion position are the same position. In other words, the holding unit 31A and the holding unit 31B return to the holding unit retracted positions at the same time as the completion of the yarn threading to the fulcrum guides 20.

[0117] Thereafter, the controller 6 returns the fulcrum guides 20 to the winding positions (distanced positions). Furthermore, the controller 6 controls the parts of the paired winding units 5 to perform, for example, the yarn threading to the bobbins B. (Details are omitted.) As a result, it becomes possible to start winding of the yarns Y onto the respective bobbins B.

[0118] As described above, in the present embodiment, after the paired holding units 31 capture the yarns Y at the capturing positions, the paired holding units 31 can be moved by the drive mechanism 32 without needing human labor. This makes it possible to improve the accuracy of the yarn threading, irrespective of the proficiency of the operator. The efficiency in the yarn threading is therefore improved when the yarn threading to the yarn guides 20 (the fulcrum guides 20A and 20B) of the paired winding units 5 (winding units 5A and 5B) is performed.

[0119] The fulcrum guides 20 are movable between the distanced positions and the gathered positions. As the fulcrum guides 20 are positioned at the gathered positions at the time of the yarn threading, the moving distance of the paired holding units 31 is shortened. It is therefore possible to suppress problems such as upsizing of the drive mechanism 32, as compared to a case where the moving distance of the paired holding units 31 is long.

[0120] In the present embodiment, the holding unit 31A and the holding unit 31B are individually movable. This makes it possible to increase the number of options of how the operations of the holding unit 31A and the holding unit 31B are controlled.

[0121] In the present embodiment, when the second godet roller 4 is at the rear position, the winding angle of the yarns Y on the second godet roller 4 is larger than

the winding angle when the second godet roller 4 is at the front position. When the winding angle increases, the force with which the second godet roller 4 holds the yarns Y increases. On this account, when the paired holding units 31 holding the yarns Y are moved, yarn shaking is suppressed as compared to a case where the second godet roller 4 is at the front position.

[0122] The drive mechanism 32 includes the guide rails 62A and 62B and the linear sliders 64A and 64B. In this connection, for example, in an arrangement in which paired holding units 31 are attached to leading end portions of paired multi-articulated arms (not illustrated) and the paired holding units 31 are moved by driving the paired arms, precise control is required and labor for teaching, etc. may be enormous. In the present embodiment, the holding units 31 can be precisely moved by a simple arrangement.

[0123] The drive mechanism 32 includes the air cylinders 65A and 65B that are configured to move the guide rails 62A and 62B. This makes it possible to suitably change the tracks of movement of the holding units 31 even though the guide rails 62A and 62B are arranged to be simple in shape.

[0124] The air cylinders 65A and 65B are arranged to swing the guide rails 62A and 62B, respectively. This arrangement narrows the movable ranges of the guide rails 62A and 62B as compared to an arrangement in which the guide rails 62A and 62B are entirely moved in a parallel manner. It is therefore possible to avoid an interference between the guide rails 62A and 62B and other members.

[0125] In addition to the above, because the cylinder main body 81 and the supporting member 35 are integrated, high rigidity is achieved. Because an adverse influence of driving vibration of the spun yarn take-up machine 1 on the linear sliders 64A and 64B is suppressed, the durability of the linear sliders 64A and 64B is improved.

[0126] The paired holding units 31 are arranged to be movable from the holding unit retracted positions to the capturing positions. When the yarn threading is performed, if the paired holding units 31 are provided at the capturing positions in advance, the holding units 31 may obstruct the yarn threading. The present embodiment is effective in such a case.

[0127] The holding unit retracted position and the yarn threading completion position are the same position. On this account, an operation to return the holding units 31 to the holding unit retracted positions is unnecessary after the movement of the holding units 31 to the yarn threading completion positions (i.e., after the completion of the yarn threading). It is therefore possible to suppress structural and operational complication of the yarn threading mechanism 30.

[0128] The first capturing position and the second capturing position are different from each other in the up-down direction. Due to this, when the holding unit 31A and the holding unit 31B are moved to the capturing positions substantially simultaneously, it is possible to prevent the holding unit 31A and the holding unit 31B from interfering with each other.

[0129] The yarn threading mechanism 30 includes the adjustment unit 33. With this arrangement, the operator is able to finely adjust the positions of the paired holding units 31 when the holding units 31 capture the yarns Y. This allows the holding units 31 to reliably capture the yarns Y. The efficiency in the yarn threading is therefore further improved.

[0130] The adjustment unit 33 includes the slides (support arms 61A and 61B) that support the paired holding units 31 to be slidable at least in the front-rear direction. With this arrangement, the positions in the front-rear direction of the holding units 31 can be finely adjusted by a simple structure.

[0131] By the guide portion 55 (and the slides), the paired holding units 31 having been moved from the holding unit retracted positions are guided forward. It is therefore possible to certainly avoid unintentional contact between the holding units 31 and the yarns Y when the holding units 31 are moved to the capture preparation positions.

[0132] The yarn threading mechanism 30 includes the regulatory guide 8 and the separation roller 93. This arrangement makes it possible to widen the intervals of the yarns Y in the left-right direction by the separation roller 93. As a result, the yarns Y can be easily captured by the holding units 31, as respective groups of yarns. The efficiency in the yarn threading is therefore further improved.

[0133] The rotational axis of the separation roller 93 extends along the left-right direction (i.e., the direction substantially in parallel to the direction in which the yarns Y are aligned by the regulatory guide 8). It is therefore possible to suppress increase in size of the separation roller 93 in the rotational axis direction as compared to a case where the rotational axis direction is tilted relative to the left-right direction (i.e., a case where the rotational axis direction is different from the direction in which the yarns Y are aligned).

[0134] In each holding unit 31, the intervals of the entrances of the retaining grooves 45 are substantially identical with the predetermined intervals defined by the regulatory guide 8. In other words, the intervals of the entrances of the retaining grooves 45 are as wide as the predetermined intervals. As a result, the yarns Y can be easily captured by the holding units 31, as respective groups of yarns. The efficiency in the yarn threading is therefore further improved.

[0135] The separation roller 93 is arranged to be movable between the roller retracted position and the roller contact position. When the separation roller 93 is at the roller contact position at the time of not widening the intervals of the yarns Y, the separation roller 93 may be obstructive. The present invention is effective in such a case.

[0136] As the rotation arm 91 rotates about the rotation

shaft 94, the separation roller 93 is movable between the roller retracted position and the roller contact position. On this account, as compared to an arrangement in which, for example, a member (roller supporter) supporting the separation roller 93 is linearly moved, it is possible to suppress positional deviations of the roller supporter and the separation roller 93. This makes it possible to improve the positional accuracy of the separation roller 93.

[0137] The rotation shaft 94 extends in the direction in which the rotational axis of the separation roller 93 extends. With this arrangement, the separation roller 93 looks like a simple circle (i.e., the separation roller 93 looks small in size) when viewed in the direction in which the rotation shaft 94 extends. It is therefore possible to downsize the movable range of the separation roller 93 as compared to a case where the direction in which the rotation shaft 94 extends is deviated from the direction in which the rotational axis of the separation roller 93 extends. Due to this, an interference of the separation roller 93 with another member is effectively avoided.

[0138] 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 adjustment unit 33 is provided at least in the swing arms 63A and 63B (i.e., the play 77 formed at the front end portion of the guide hole 76 contributes to the position adjustment of the paired holding units 31). However, the disclosure is not limited to this. For example, the comb guide 41 may be swingable relative to the above-described interposed member 42. With this arrangement, the interposed member 42 may function as the adjustment unit of the present invention. Alternatively, another adjustment unit operable by the operator may be provided. For example, in place of the interposed member 42, the comb guide 41 may be connected to each of the support arms 61A and 61B through an unillustrated spring (e.g., a compression coil spring, a tension coil spring, and/or a torsion coil spring).

(2) In the embodiment above, the position in the up-down direction of the supporting member 35 of the winding unit 5A is, for example, lower by about 5mm than the position in the up-down direction of the supporting member 35 of the winding unit 5B. With this, the first capturing position and the second capturing position are different from each other in the up-down direction. However, the disclosure is not limited to this. For example, the position in the up-down direction of the supporting member 35 of the winding unit 5A may be substantially identical with the position in the up-down direction of the supporting member 35 of the winding unit 5B. In this case, the drive mechanism 32 may be arranged such that the moving distance in the up-down direction of the holding unit 31A from the first holding unit retracted position is different from the moving distance in the up-down direction of the holding unit 31B from the second holding unit retracted position. Alternatively, the first capturing position may be positionally substantially identical with the second capturing position in the up-down direction, as long as the holding unit 31A does not overlap the holding unit 31B when viewed in the up-down direction.

(3) In the embodiment above, after the paired holding units 31 move from the holding unit retracted positions to the capture preparation positions, the operator operates the adjustment unit 33 to move each of the paired holding units 31 to the capturing position and to cause each of the paired holding units 31 to capture the yarns Y. However, the disclosure is not limited to this. For example, as shown in FIG. 19(a) to FIG. 19(d), a yarn threading mechanism 101 may be provided to cause paired holding units 131 (described later) to capture yarns Y without needing human labor. To be more specific, the yarn threading mechanism 101 includes a positioning member 110. The positioning member 110 is configured to position the capture preparation positions of the paired holding units 131 by regulating the movement in the left-right direction of the holding units 131.

[0139] The positioning member 110 may be, for example, fixed to the rotation arm 91 of the yarn interval increaser 34 as shown in FIG. 19(a) and FIG. 19(b). In other words, the positioning member 110 may be arranged to be rotatable together with the rotation arm 91. The positioning member 110 is movable together with the rotation arm 91 between a predetermined first position (see two-dot chain lines in FIG. 19(a)) and a second position (see full lines in FIG. 19(a)) where the paired holding units 31 are positioned. The following will describe the structure of the positioning member 110 at the second position. The positioning member 110 includes, for example, an extending member 111, a position adjustment member 112, and a stopper member 113 (stopper of the present invention), as shown in FIG. 19(a) to FIG. 19(c). The extending member 111 is fixed to, for example, the rotation arm 91 and extends in the left-right direction (see FIG. 19(b)). A part of the extending member 111, which extends in the left-right direction, is a flat plate in shape, for example. In a right end portion of the extending member 111, a through hole 114 is formed to penetrate the portion in the thickness direction and to extend, for example, in the left-right direction. The position adjustment member 112 is, for example, a flat plate in shape. The position adjustment member 112 has a through hole 115 (see FIG. 19(d)) penetrating the member in the thickness direction. A male screw part of a bolt 116 can be inserted into the through hole. A front portion of the position adjustment member 112 is attached to a right end portion of the extending member 111 by, for

example, the bolt 116 and a nut 117. The male screw part of the bolt 116 is inserted into the through hole 114 and the through hole 115. When the bolt 116 and the nut 117 are loosened, the position adjustment member 112 can be moved in the left-right direction relative to the extending member 111 by the operator. The stopper member 113 is fixed to a rear portion of the position adjustment member 112. The stopper member 113 is, for example, a block-shaped member that extends in the up-down direction when it is at the second position. When provided at the second position, the stopper member 113 is between the paired holding units 131 (see FIG. 20(a) and FIG. 20(b)) in the left-right direction. The stopper member 113 has, for example, a shape with which the paired holding units 131 having moved to the capture preparation positions are engageable with the stopper member 113 and movement of the paired holding units 131 is not obstructed when the paired holding units 131 retract from the capturing positions. For example, when the stopper member 113 is at the second position, a rear portion of the stopper member 113 is curved when viewed from above (i.e., a curved surface 118) and a front portion of the stopper member 113 extends along the front-rear direction (i.e., a flat surface 119). The length in the left-right direction (i.e., the width) of the curved surface 118 decreases toward the front. The capture preparation positions of the paired holding units 131 are adjusted by adjusting the position in the left-right direction of the stopper member 113. The paired holding units 131 are able to capture the yarns Y after they are moved to the capturing positions that are rearward of the capture preparation positions. It is noted that the stopper member 113 may not be shaped in this way. The stopper member 113 may be differently shaped in accordance with the shapes of the paired holding units 131. In this modification, the above-described adjustment unit 33 may not be provided.

[0140] The paired holding units 131 (see FIG. 20(a) and FIG. 20(b)) are arranged as described below. As shown in FIG. 20(a), a comb guide 141A of a holding unit 131A has a main body 143. As a difference between the main body 143 and the above-described main body 43 (see FIG. 5(a)), the main body 143 has a contact surface 144 (a curved surface 145 and a flat surface 146) that can make contact with the stopper member 113. The curved surface 145 is shaped along the curved surface 118 whereas the flat surface 146 is shaped along the flat surface 119. A comb guide 141B of a holding unit 131B and the comb guide 141A are symmetric in shape in the left-right direction (see FIG. 20(b)). The shape of the contact surface 144 is not limited to the above-described shape.

[0141] In the arrangement above, when the paired holding units 131 are moved by the drive mechanism 32 (see e.g., FIG. 4(a)) from the holding unit retracted positions to the capturing positions, the paired holding units 131 are arranged to oppose each other in the left-right direction. At this stage, the paired holding units 131 are in contact with the stopper member 113 to sandwich the stopper member 113 in the left-right direction (see FIG. 20(c)). With this, the positions of the paired holding units 131 are determined. As the position of the stopper member 113 is suitably adjusted in advance, the paired holding units 131 can be provided at optimum capturing positions. Thereafter, as the paired holding units 131 retract, the yarns Y are captured by the paired holding units 131 and groups of the yarns Y are held by the respective units. It is therefore possible to capture the yarns Y by the paired holding units 131 without needing manual movement of the paired holding units 131 by the operator. It is noted that, in this arrangement, the comb guides 141A and 141B may not have the above-described through hole 46 and grip 47.

[0142] In an arrangement in which the positioning member 110 is provided, apparatuses (the first rail drive unit and the second rail drive unit of the present invention) configured to move the paired holding units 131 from the holding unit retracted positions to the capturing positions are preferably driven by pressure of fluid in the same manner as, for example, in the above-described air cylinders 65A and 65B. This arrangement reduces load on the first rail drive unit and the second rail drive unit, which is exerted when the paired holding units 131 are pressed back by the stopper member 113 on account of the law of action and reaction.

[0143] (4) In the modification (3) described above, the positioning member 110 is attached to the yarn interval increaser 34. The disclosure, however, is not limited to this arrangement. The positioning member 110 may be movable by another mechanism. Alternatively, the positioning member 110 may not be movable.

[0144] (5) In the embodiment above, the drive mechanism 32 is arranged to cause the holding unit retracted position to be identical with the yarn threading completion position. However, the disclosure is not limited to this. The drive mechanism 32 may be arranged so that, after the yarn threading to the fulcrum guides 20 is completed, the paired holding units 31 are moved to positions different from the yarn threading completion positions. For example, after the completion of the yarn threading, if the paired holding units 31 are provided at the yarn threading completion positions, the holding units 31 may be obstructive. The arrangement is effective in such a case.

[0145] (6) In the embodiment above, the air cylinders 65A and 65B are arranged to swing the guide rails 62A and 62B. However, the disclosure is not limited to this. For example, a mechanism configured to horizontally move the guide rails 62A and 62B may be provided.

[0146] (7) In the embodiment above, the guide rails 62A and 62B are linear in shape and the positions of the guide rails 62A and 62B are changed according to an object. However, the disclosure is not limited to this. For example, paired guide rails (not illustrated) that do not need to be moved may be provided to extend along the track of movement of the paired holding units 31.

[0147] (8) In the embodiment above, the paired holding

units 31 are moved by the linear sliders 64A and 64B. However, the disclosure is not limited to this. For example, in an arrangement in which paired holding units 31 may be attached to leading end portions of paired multi-articulated arms (not illustrated) and the paired holding units 31 may be moved by driving the paired arms. In this case, however, teaching for suitably moving the paired arms is required.

[0148] (9) In the embodiment above, the fulcrum guides 20 are movable between the distanced positions and the gathered positions. However, the disclosure is not limited to this. The fulcrum guides 20 may be immovable. In this case, however, the drive mechanism 32 may be upsized in the front-rear direction.

[0149] (10) In the embodiment above, the controller 6 returns the second godet roller 4 to the rear position before the movement of the paired holding units 31 from the yarn threading start positions to the yarn threading completion positions starts. However, the disclosure is not limited to this. The timing to return the second godet roller 4 to the rear position falls within an interval between the capture of the yarns Y by the paired holding units 31 and the completion of the yarn threading to the bobbins B.

[0150] (11) In the embodiment above, the paired holding units 31 are moved from the holding unit retracted positions to the capturing positions. However, the disclosure is not limited to this. As long as the paired holding units 31 are not obstructive, the paired holding units 31 may be provided at the capturing positions (or the capture preparation positions) from the beginning.

[0151] (12) In the embodiment above, the intervals of the entrances of the retaining grooves 45 in the direction in which the retaining grooves 45 are aligned are substantially identical with the predetermined intervals in the left-right direction defined by the regulatory guide 8. However, the disclosure is not limited to this. The intervals of the entrances of the retaining grooves 45 may be different from the predetermined intervals.

[0152] (13) In the embodiment above, the rotation shaft 94 of the yarn interval increaser 34 extends along the rotational axis of the separation roller 93. However, the disclosure is not limited to this. The direction in which the rotation shaft 94 extends may be deviated from the direction in which the rotational axis of the separation roller 93 extends.

[0153] (14) In the embodiment above, the yarn interval increaser 34 is arranged so that the separation roller 93 is rotatable about the rotation shaft 94. However, the disclosure is not limited to this. For example, the yarn interval increaser 34 may be arranged to allow the separation roller 93 to linearly move. With this arrangement, the separation roller 93 may be moved between the roller retracted position and the roller contact position.

[0154] (15) In the embodiment above, the separation roller 93 is moved by the operator. However, the disclosure is not limited to this. An unillustrated driving device may be provided to move the separation roller 93 between the roller retracted position and the roller contact position.

[0155] In this modification, the yarn threading mechanism 101 having the above-described positioning member 110 may be provided. In this case, the operator is able to complete the yarn threading to the fulcrum guides 20 by the yarn threading mechanism 101, only by performing yarn placement to the first godet roller 3, the second godet roller 4, and the separation roller 93 and an input to the input unit of the controller 6. In this case, an automatic yarn threading device (not illustrated) having a robotic arm (not illustrated) recited in, for example, Japanese Laid-Open Patent Publication No. 2017-82379 may be further provided. In place of the operator, the automatic yarn threading device may perform the yarn placement to the first godet roller 3, the second godet roller 4, and the separation roller 93 and the communication with the controller 6. This arrangement makes it possible to perform the yarn threading without needing any human involvement.

[0156] (16) In the embodiment above, the separation roller 93 is movable between the roller retracted position and the roller contact position. However, the disclosure is not limited to this. As long as the separation roller 93 is not obstructive, the separation roller 93 may be immovable.

[0157] (17) In the embodiment above, the rotational axis of the separation roller 93 extends along the left-right direction. However, the disclosure is not limited to this. The rotation axis of the separation roller 93 may be slightly deviated from the left-right direction.

[0158] (18) For example, the linear sliders 64A and 64B may be arranged to function as the adjustment unit and the slide of the present invention, as described below. After moving the holding units 31A and 31B from the holding unit retracted positions to the capture preparation positions, the controller 6 may control the electromagnetic valve EV1 (see FIG. 6(a)) that is a five-way electromagnetic valve to discharge compressed air from both of the piston chambers 81F and 81R. With this arrangement, the operator is able to manually move the slider 82 in the front-rear direction. In this case, the through hole 72 of each of the support arms 61A and 61B may not extend in the front-rear direction. In this case, furthermore, the guide portion 55 may not be provided.

[0159] An arrangement by which the compressed air is discharged from both of the piston chambers 81F and 81R is not limited to the arrangement shown in FIG. 6(a). For example, two three-way electromagnetic valves (not illustrated) may be provided in place of the electromagnetic valve EV1, and a path for supplying and discharging compressed air may be suitably provided to discharge the compressed air from both of the piston chambers 81F and 81R. When the linear sliders 64A and 64B are not arranged to function as the adjustment unit and the slide of the present invention, another type of electromagnetic valve such as a known four-way electromagnetic valve may be provided.

[0160] (19) A constituent feature equivalent to the slide

of the present invention may not be provided.

[0161] (20) In the embodiment above, the controller 6 controls the drive unit 32A and the drive unit 32B substantially simultaneously. However, the disclosure is not limited to this. The controller 6 may differentiate a timing to control the drive unit 32A from a timing to control the drive unit 32B. This allows, for example, one of the paired holding units 31 to start to move earlier as compared to the other. This modification is effective when a problem occurs if the paired holding units 31 simultaneously start to move. For example, a timing to move from the holding unit retracted position to the capture preparation position may be differentiated between the holding unit 31A and the holding unit 31B. With this arrangement, an erroneous operation due to unintended touch to a member is avoided as compared to a case where, for example, the holding units 31A and 31B are provided both at the capture preparation positions and to be close to each other when an unskilled operator causes the paired holding units 31 to capture the yarns Y.

[0162] (21) The paths connecting the linear slider 64A with the supply port Ps and the discharge ports Pe1 and Pe2 are not limited to those shown in FIG. 6(a). The same applies to the linear slider 64B. Furthermore, the paths connecting the air cylinder 65A with the supply port Ps and the discharge ports Pe1 and Pe2 are not limited to those shown in FIG. 6(b) . The same applies to the air cylinder 65B.

[0163] (22) While in the embodiment above the drive unit 32A and the drive unit 32B are independently operable, the disclosure is not limited to this arrangement. For example, the paths of the compressed air may be arranged so that the drive unit 32A and the drive unit 32B are driven in an integrated manner.

[0164] (23) In the embodiment above, the cylinder main body 81 of the linear slider 64A is fixed to the supporting member 35. (The linear slider 64B is similarly arranged.) However, the disclosure is not limited to this. For example, a swing shaft (not illustrated) may be provided at a rear end portion of the cylinder main body 81 to extend in the up-down direction, and the cylinder main body 81 may be swingable about the swing shaft. In this case, the guide rail 62A and the cylinder main body 81 swing together. (The same applies to the guide rail 62B.) The support arm 61A may be fixed to the slider 82. (The same applies to the support arm 61B.)

[0165] (24) In the embodiment above, the yarn threading mechanism 30 includes both the drive mechanism 32 configured to move the paired holding units 31 and the yarn interval increaser 34 (separation roller 93). However, the disclosure is not limited to this. The yarn threading mechanism 30 may include only one of the drive mechanism 32 and the yarn interval increaser 34. Even if only one of these members is provided, the efficiency in yarn threading to the fulcrum guides 20 of each of the paired winding units 5 can be improved. When the yarn threading mechanism 30 does not include the drive mechanism 32, for example, a yarn threading member operable by the operator (see e.g., Japanese Laid-Open Patent Publication No. 2017-114573) is used for yarn threading. When the yarn threading mechanism 30 does not have the yarn interval increaser 34, the intervals of retaining grooves (not illustrated) formed in paired holding units (not illustrated) are narrower than the intervals of the above-described retaining grooves 45. When the yarn threading mechanism 30 does not have the yarn interval increaser 34, the capturing positions of the holding units 31A and 31B are between the second godet roller 4 and the suction gun SG in the yarn running direction.

[0166] (25) In the embodiment above, the yarn threading mechanism 30 is arranged to thread the yarns Y to the fulcrum guides 20 of the paired winding units 5. However, the disclosure is not limited to this. For example, when the spun yarn take-up machine 1 has other yarn guides (not illustrated) that are aligned in the front-rear direction, a yarn threading mechanism (not illustrated) may be provided to thread yarns Y to these yarn guides.

[0167] (26) While the spun yarn take-up machine 1 includes the paired winding units 5 (winding units 5A and 5B), the disclosure is not limited to this arrangement. The spun yarn take-up machine 1 may include, for example, only the winding unit 5A among the winding units 5A and 5B. In this case, the yarn threading mechanism 30 may include the holding unit 31A and the drive unit 32A and may not include the holding unit 31B and the drive unit 32B. In addition to this or alternatively, the yarn threading mechanism 30 may include the yarn interval increaser 34.

[0168] (27) In addition to the spun yarn take-up machine 1, the present invention can be applied to various yarn winders configured to wind yarns Y.

Further Aspects

[0169] The following numbered paragraphs disclose further aspects of the present invention.

1. A yarn winder (1) comprising paired winding units (5, 5A, 5B) opposing each other in a predetermined opposing direction, each of the paired winding units (5, 5A, 5B) supporting bobbins (B) to be aligned in an arrangement direction orthogonal to the opposing direction and to be rotatable, wherein,

   each of the paired winding units (5, 5A, 5B) includes yarn guides (20, 20A, 20B) that are provided to correspond to yarns (Y, YA, YB) wound onto the respective bobbins (B) and are aligned in the arrangement direction,
   the yarn winder (1) further comprises a yarn threading mechanism (30) arranged to perform yarn threading to the yarn guides (20, 20A, 20B) of both of the paired winding units (5, 5A, 5B),
   the yarn threading mechanism (30) includes:

paired holding units (31, 31A, 31B) which are attached to the paired winding units (5, 5A, 5B), respectively, and are configured to hold groups of the yarns (Y, YA, YB), respectively; and
a drive mechanism (32) configured to move the paired holding units (31, 31A, 31B), and the drive mechanism (32) moves a first holding unit (31A) that is one of the paired holding units (31, 31A, 31B) and a second holding unit (31B) that is the other of the paired holding units (31, 31A, 31B) from capturing positions where the yarns (Y, YA, YB) running between the paired winding units (5, 5A, 5B) in the opposing direction can be captured to yarn threading start positions that are on one side in the arrangement direction of the capturing positions, and further moves the first holding unit (31A) and the second holding unit (31B) to yarn threading completion positions that are on the other side in the arrangement direction of the yarn threading start positions, so as to thread the yarns (Y, YA, YB) held by the paired holding units (31, 31A, 31B) to the yarn guides (20, 20A, 20B), respectively.

2. The yarn winder (1) according to 1, wherein, the yarn guides (20, 20A, 20B) of each of the paired winding units (5, 5A, 5B) are arranged to be movable between predetermined distanced positions and gathered positions where the yarn guides (20, 20A, 20B) are close to one another in the arrangement direction as compared to the distanced positions.

3. The yarn winder (1) according to 1 or 2, wherein,

the drive mechanism (32) includes a first drive unit (32A) configured to move the first holding unit (31A) and a second drive unit (32B) configured to move the second holding unit (31B), and the first drive unit (32A) and the second drive unit (32B) are independently operable.

4. The yarn winder (1) according to 3, further comprising

a first control unit (6) configured to control the drive mechanism (32),
the first control unit (6) differentiating a timing to control the first drive unit (32A) from a timing to control the second drive unit (32B).

5. The yarn winder (1) according to any one of 1 to 4, further comprising:

a first yarn feed roller (3) which, when at least one of the paired holding units (31, 31A, 31B) is at the yarn threading start position, is provided upstream of the at least one of the paired holding units (31, 31A, 31B) in a yarn running direction in which the yarns (Y, YA, YB) run and is provided on the other side in the arrangement direction of the at least one of the paired holding units (31, 31A, 31B);
a second yarn feed roller (4) which, when the at least one of the paired holding units (31, 31A, 31B) is at the yarn threading start position, is provided between the first yarn feed roller (3) and the at least one of the paired holding units (31, 31A, 31B) in the yarn running direction and is provided on the one side in the arrangement direction of the first yarn feed roller (3);
a roller movement mechanism (9) configured to move the second yarn feed roller (4) between a roller yarn placement position where yarn placement to the second yarn feed roller (4) is performed and a one side position that is on the one side in the arrangement direction of the roller yarn placement position;
a first control unit (6) configured to control the drive mechanism (32); and
a second control unit (6) configured to control the roller movement mechanism (9),
after the second control unit (6) moves the second yarn feed roller (4) from the roller yarn placement position to the one side position, the first control unit (6) starting to move the at least one of the paired holding units (31, 31A, 31B) from the yarn threading start position to the yarn threading completion position.

6. The yarn winder (1) according to any one of 1 to 5, wherein,
the drive mechanism (32) includes:

a first guide rail (62A) which guides the first holding unit (31A) at least in the arrangement direction;
a first holding unit drive unit (64A) which is configured to move the first holding unit (31A) along the first guide rail (62A);
a second guide rail (62B) which guides the second holding unit (31B) at least in the arrangement direction; and
a second holding unit drive unit (64B) which is configured to move the second holding unit (32A) along the second guide rail (62B).

7. The yarn winder (1) according to 6, wherein,
the drive mechanism (32) includes:

a first rail drive unit (65A) which is configured to move the first guide rail (62A); and
a second rail drive unit (65B) which is configured to move the second guide rail (62B).

8. The yarn winder (1) according to 7, wherein,

the first rail drive unit (65A) is configured to swing the first guide rail (62A), and
the second rail drive unit (65B) is configured to swing the second guide rail (62B).

9. The yarn winder (1) according to any one of 6 to 8, wherein,

the paired winding units (5, 5A, 5B) include a first supporting member (35A) supporting the first holding unit drive unit (64A) and a second supporting member (35B) supporting the second holding unit drive unit (64B),
the first holding unit drive unit (64A) includes a first main body (81A) integrated with the first supporting member (35A), and
the second holding unit drive unit (64B) includes a second main body (81B) integrated with the second supporting member (35B).

10. The yarn winder (1) according to any one of 1 to 9, wherein, the paired holding units (31, 31A, 31B) are movable from predetermined holding unit retracted positions to the capturing positions.

11. The yarn winder (1) according to 10, wherein, the holding unit retracted positions are identical with the yarn threading completion positions.

12. The yarn winder (1) according to 10 or 11, wherein,

the distance in the opposing direction between a first capturing position that is the capturing position of the first holding unit (31A) and a second capturing position that is the capturing position of the second holding unit (31B) is shorter than the distance in the opposing direction between a first holding unit retracted position that is the holding unit retracted position of the first holding unit (31A) and a second holding unit retracted position that is the holding unit retracted position of the second holding unit (31B), and
the first capturing position and the second capturing position are different from each other in a direction orthogonal to both the opposing direction and the arrangement direction.

13. The yarn winder (1) according to any one of 10 to 12, wherein,

the drive mechanism (32) is capable of moving the paired holding units (31, 31A, 31B) from the holding unit retracted positions to predetermined capture preparation positions, and
the yarn threading mechanism (30) includes an adjustment unit (33, 33A, 33B) which is capable of adjusting positions of the paired holding units within an adjustment range including the capture preparation positions and the capturing positions, when operated by an operator after the paired holding units (31, 31A, 31B) are positioned at the capture preparation positions.

14. The yarn winder (1) according to 13, wherein,

the capture preparation positions are on the other side in the arrangement direction of the capturing positions, and
the adjustment unit (33, 33A, 33B) includes a slide (61A, 61B) which supports the paired holding units (31, 31A, 31B) to be slidable at least in the arrangement direction.

15. The yarn winder (1) according to 14, wherein,

the drive mechanism (32) includes a guide portion (55) which is provided on a track of movement of the paired holding units (31, 31A, 31B) and guides the paired holding units (31, 31A, 31B) moving from the holding unit retracted positions to at least the other side in the arrangement direction,
the slide (61A, 61B) is at a predetermined first slide position when the paired holding units (31, 31A, 31B) are at the holding unit retracted positions, and
when the paired holding units (31, 31A, 31B) are moved to the other side in the arrangement direction by the guide portion (55), the slide (61A, 61B) is moved to a second slide position that is on the other side in the arrangement direction of the first slide position to move the paired holding units (31, 31A, 31B) to the capture preparation positions.

16. The yarn winder (1) according to any one of 1 to 11, wherein,

the paired holding units (31, 31A, 31B) oppose each other in the opposing direction after being moved to the capturing positions,
the yarn threading mechanism (30) includes a stopper (113) which is provided between the paired holding units (31, 31A, 31B) in the opposing direction and is configured to restrict movement of the paired holding units in the opposing direction, and
the stopper (113) is positionally adjustable at least in the opposing direction to adjust the capturing positions.

17. The yarn winder (1) according to any one of 1 to 16, further comprising

a regulatory guide (8) which holds the yarns (Y, YA, YB) before wound by the paired winding units (5, 5A, 5B) to be aligned in the opposing direction and arranges intervals in the opposing direction of the yarns (Y, YA, YB) to be predetermined intervals,
the yarn threading mechanism (30) includes a separation roller (93) that, when the yarn threading is performed, is positionable downstream of the regulatory guide (8) in a yarn running direction of the yarns (Y, YA, YB) and is rotatable, and
the separation roller (93) has a circumferential surface (93a) capable of making contact with the yarns (Y, YA, YB), and is capable of widen the intervals of the yarns (Y, YA, YB) in the opposing direction along the circumferential surface (93a).

18. A yarn winder (1) comprising paired winding units (5, 5A, 5B) opposing each other in a predetermined opposing direction, each of the paired winding units (5, 5A, 5B) supporting bobbins (B) to be aligned in an arrangement direction orthogonal to the opposing direction and to be rotatable, wherein,

each of the paired winding units (5, 5A, 5B) includes yarn guides (20, 20A, 20B) that are provided to correspond to yarns (Y, YA, YB) wound onto the respective bobbins (B) and are aligned in the arrangement direction,
the yarn winder (1) further comprises: a regulatory guide (8) which holds the yarns (Y, YA, YB) before wound by the paired winding units (5, 5A, 5B) to be aligned in the opposing direction and arranges intervals in the opposing direction of the yarns (Y, YA, YB) to be predetermined intervals; and
a yarn threading mechanism (30) arranged to perform yarn threading to the yarn guides (20, 20A, 20B) of both of the paired winding units (5, 5A, 5B),
the yarn threading mechanism (30) includes:

paired holding units (31, 31A, 31B) which are attached to the paired winding units (5, 5A, 5B), respectively, and are configured to hold groups of the yarns (Y, YA, YB), respectively; and
a separation roller (93) that, when the yarn threading is performed, is provided downstream of the regulatory guide (8) in the yarn running direction of the yarns (Y, YA, YB) and is rotatable, and
the separation roller (93) has a circumferential surface (93a) capable of making contact with the yarns (Y, YA, YB) and is capable of widen the intervals of the yarns (Y, YA, YB) in the opposing direction along the circumferential surface (93a).

19. The yarn winder (1) according to 17 or 18, wherein, the separation roller (93) has a rotational axis that extends along the opposing direction.

20. The yarn winder (1) according to any one of 17 to 19, wherein,

each of the paired holding units (31, 31A, 31B) has retaining grooves (45) that are aligned to retain the respective yarns (Y, YA, YB), and
intervals of entrances of the retaining grooves (45) in a direction in which the retaining grooves (45) are aligned are identical with the predetermined intervals in the opposing direction.

21. The yarn winder (1) according to any one of 17 to 20, wherein, the separation roller (93) is movable between a predetermined roller retracted position and a roller contact position where the separation roller (93) is able to make contact with the yarns (Y, YA, YB).

22. The yarn winder (1) according to 21, wherein,

the yarn threading mechanism (30) includes a roller supporter (91) supporting the separation roller (93) to be rotatable, and
the roller supporter (91) is able to rotate about a predetermined rotation shaft (94) to move the separation roller (93) between the roller retracted position and the roller contact position.

23. The yarn winder (1) according to 22, wherein, the rotation shaft (94) extends in a direction in which the rotational axis of the separation roller (93) extends.

Claims

1. A yarn winder (1) comprising paired winding units (5, 5A, 5B) opposing each other in a predetermined opposing direction, each of the paired winding units (5, 5A, 5B) supporting bobbins (B) to be aligned in an arrangement direction orthogonal to the opposing direction and to be rotatable, wherein,

each of the paired winding units (5, 5A, 5B) includes yarn guides (20, 20A, 20B) that are provided to correspond to yarns (Y, YA, YB) wound onto the respective bobbins (B) and are aligned in the arrangement direction,
the yarn winder (1) further comprises: a regulatory guide (8) which holds the yarns (Y, YA, YB) before wound by the paired winding units (5, 5A, 5B) to be aligned in the opposing direction and

arranges intervals in the opposing direction of the yarns (Y, YA, YB) to be predetermined intervals; and
a yarn threading mechanism (30) arranged to perform yarn threading to the yarn guides (20, 20A, 20B) of both of the paired winding units (5, 5A, 5B),
the yarn threading mechanism (30) includes:

paired holding units (31, 31A, 31B) which are attached to the paired winding units (5, 5A, 5B), respectively, and are configured to hold groups of the yarns (Y, YA, YB), respectively; and
a separation roller (93) that, when the yarn threading is performed, is provided downstream of the regulatory guide (8) in the yarn running direction of the yarns (Y, YA, YB) and is rotatable, and
the separation roller (93) has a circumferential surface (93a) capable of making contact with the yarns (Y, YA, YB) and is capable of widen the intervals of the yarns (Y, YA, YB) in the opposing direction along the circumferential surface (93a).

2. The yarn winder (1) according to claim 1, wherein, the separation roller (93) has a rotational axis that extends along the opposing direction.

3. The yarn winder (1) according to claim 1 or 2, wherein,

each of the paired holding units (31, 31A, 31B) has retaining grooves (45) that are aligned to retain the respective yarns (Y, YA, YB), and
intervals of entrances of the retaining grooves (45) in a direction in which the retaining grooves (45) are aligned are identical with the predetermined intervals in the opposing direction.

4. The yarn winder (1) according to any one of claims 1 to 3, wherein, the separation roller (93) is movable between a predetermined roller retracted position and a roller contact position where the separation roller (93) is able to make contact with the yarns (Y, YA, YB).

5. The yarn winder (1) according to claim 4, wherein,

the yarn threading mechanism (30) includes a roller supporter (91) supporting the separation roller (93) to be rotatable, and
the roller supporter (91) is able to rotate about a predetermined rotation shaft (94) to move the separation roller (93) between the roller retracted position and the roller contact position.

6. The yarn winder (1) according to claim 5, wherein, the rotation shaft (94) extends in a direction in which the rotational axis of the separation roller (93) extends.

FIG.1

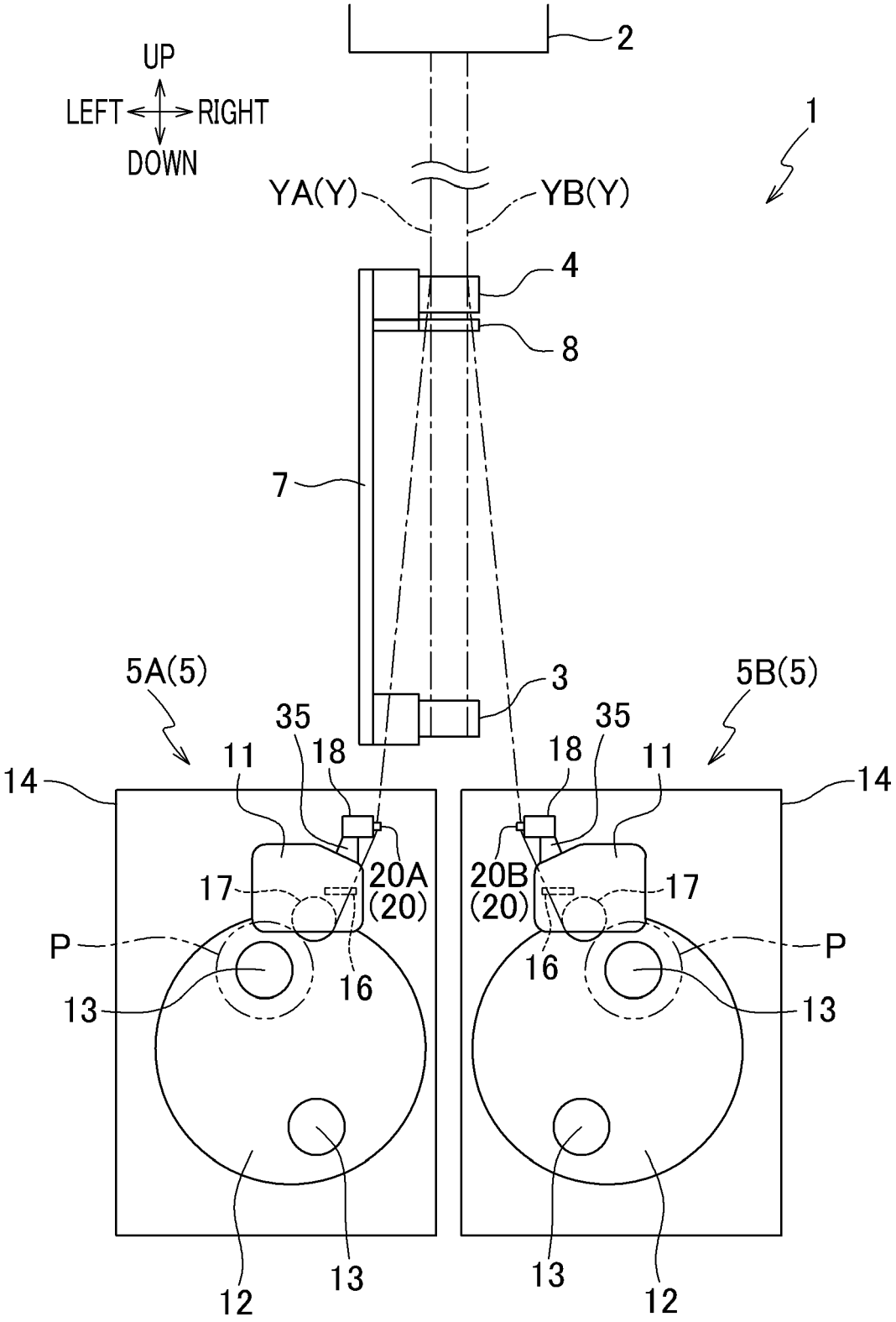

UP
LEFT
RIGHT
DOWN
2
1
YA(Y)
YB(Y)
4
8
7
3
5A(5)
5B(5)
35
11
18
14
17
20A
(20)
20B
(20)
P
16
13
12

FIG.2

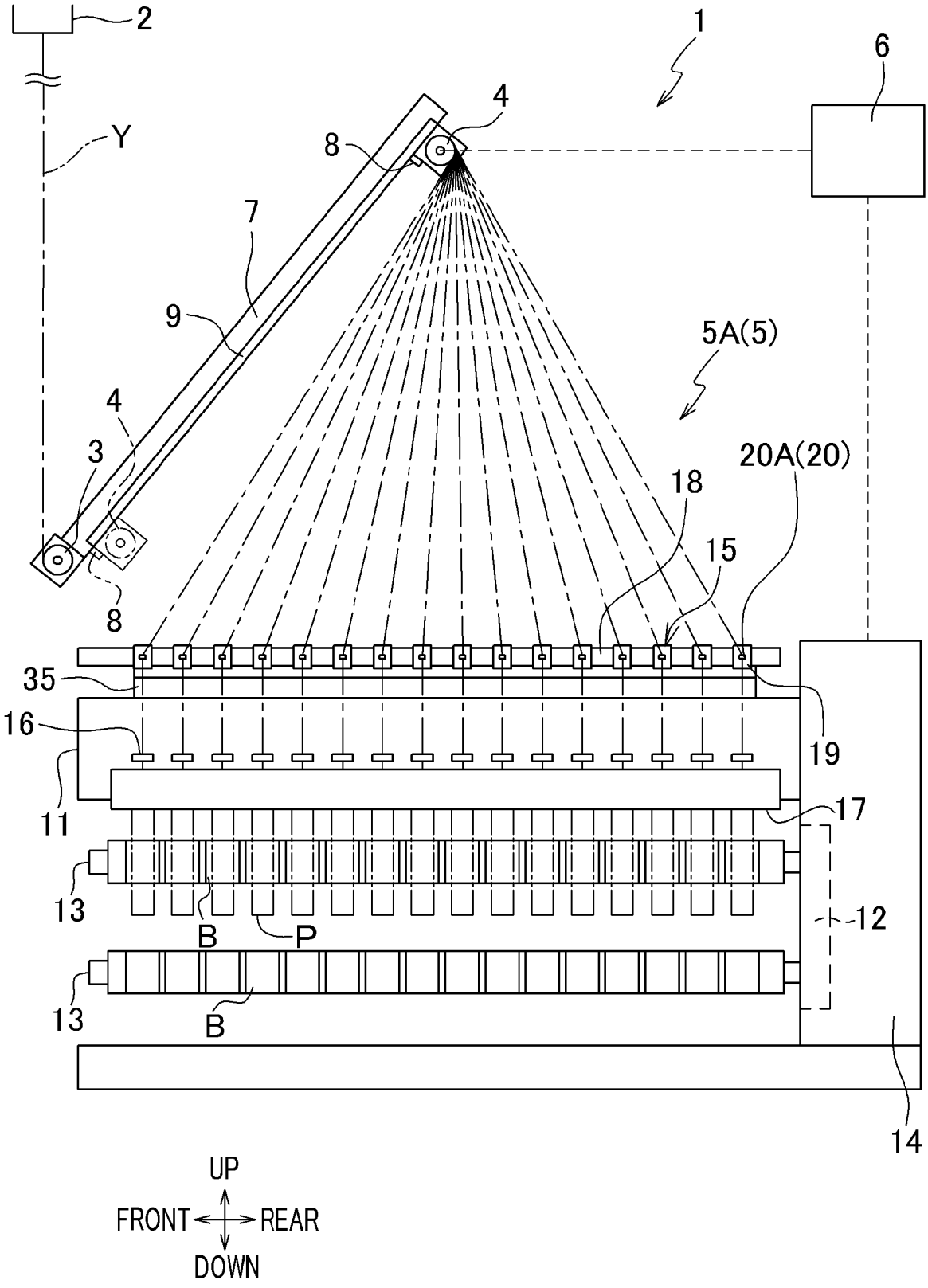

2
1
6
Y
4
8
7
9
5A(5)
4
3
20A(20)
18
15
8
35
16
19
11
17
13
12
B
P
13
B
14
UP
FRONT
REAR
DOWN

FIG.3

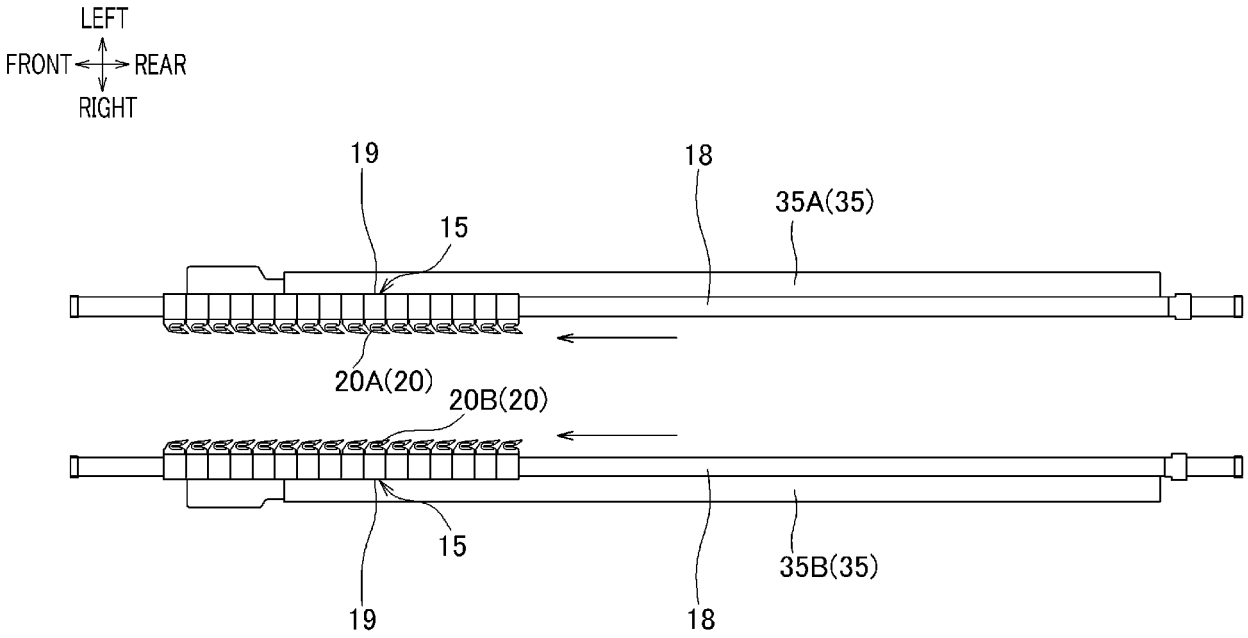

LEFT
FRONT
REAR
RIGHT
19
18
35A(35)
15
20A(20)
20B(20)
15
35B(35)
19
18

FIG.4

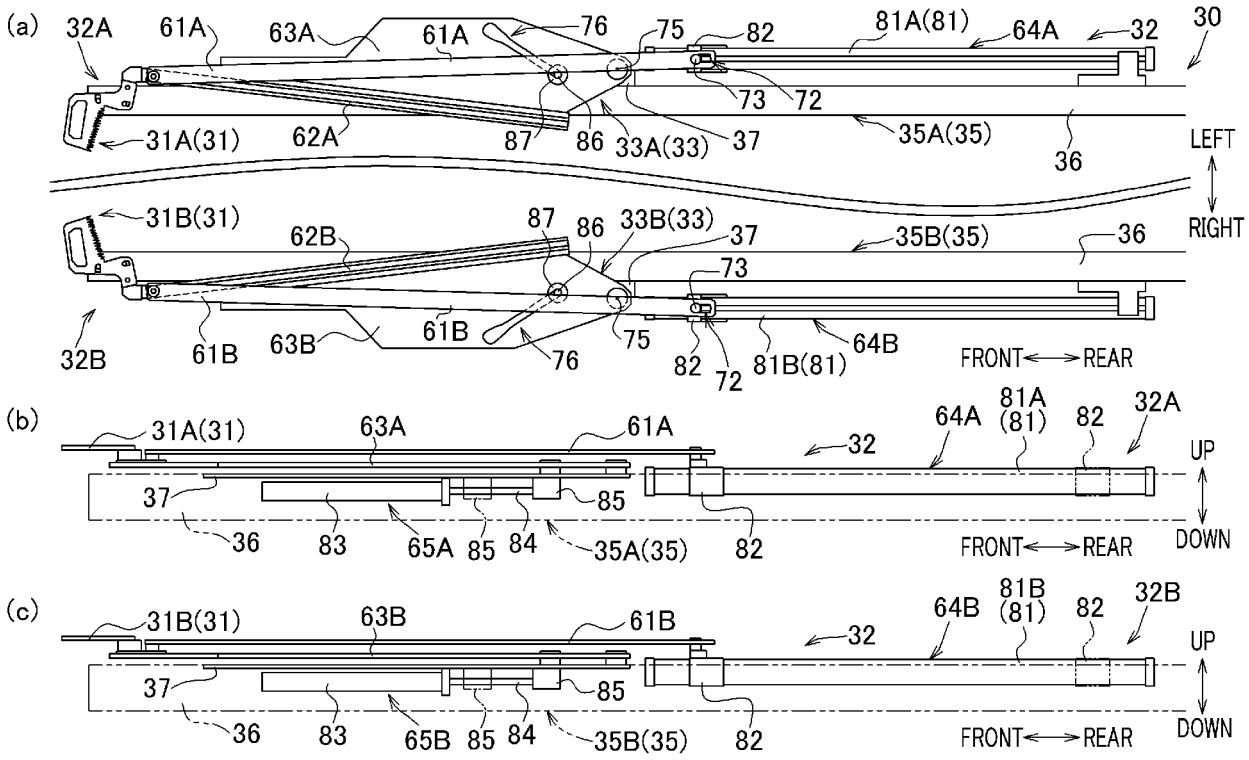

(a)
32A
61A
63A
61A
76
75
82
81A(81)
64A
32
30
73
72
31A(31)
62A
87
86
33A(33)
37
35A(35)
36
LEFT
RIGHT
31B(31)
62B
87
86
33B(33)
37
35B(35)
36
73
32B
61B
63B
61B
76
75
82
72
81B(81)
64B
FRONT
REAR
(b)
31A(31)
63A
61A
32
64A
81A (81)
82
32A
UP
37
85
36
83
65A
85
84
35A(35)
82
FRONT
REAR
DOWN
(c)
31B(31)
63B
61B
32
64B
81B (81)
82
32B
UP
37
85
36
83
65B
85
84
35B(35)
82
FRONT
REAR
DOWN

FIG.5

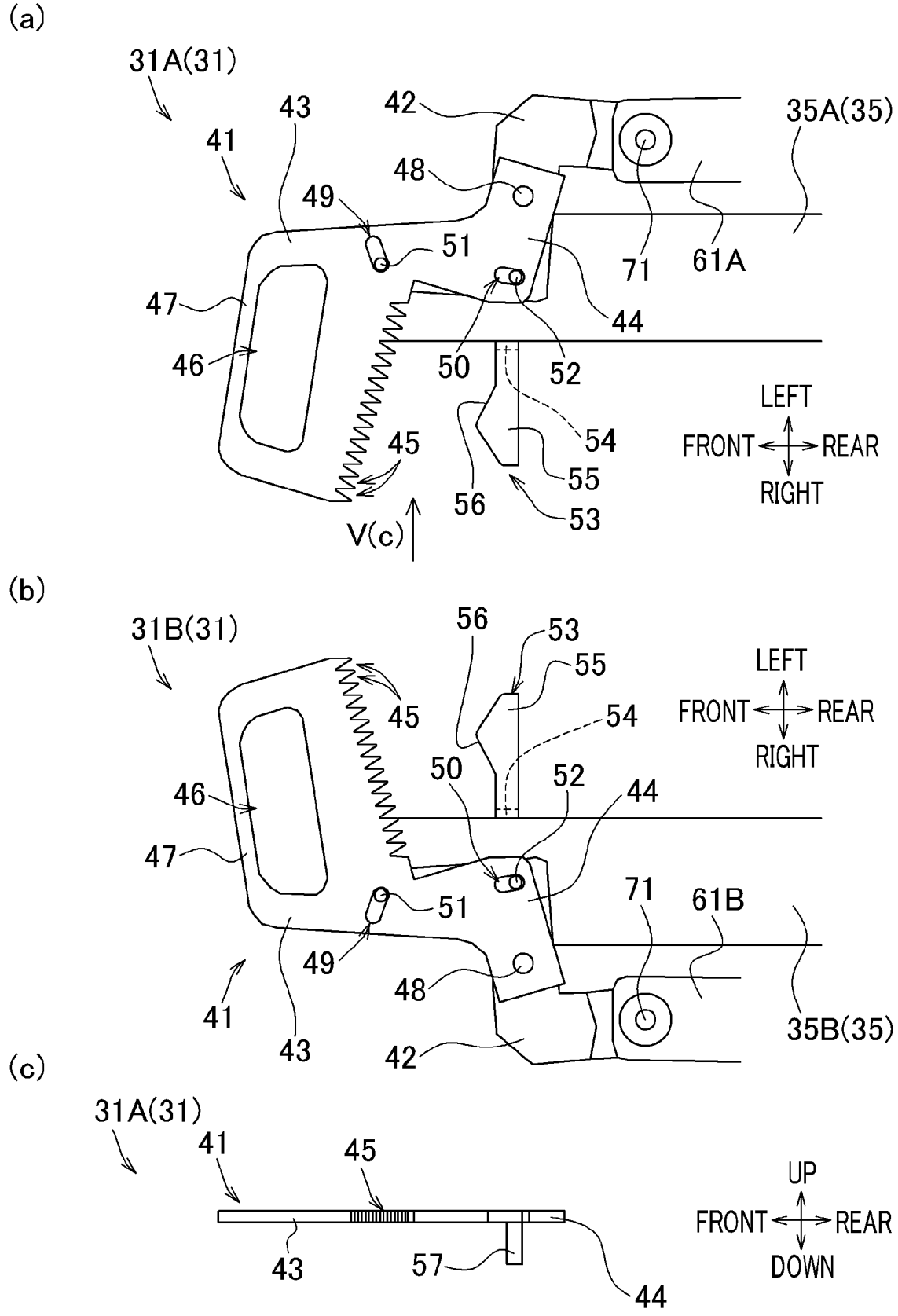
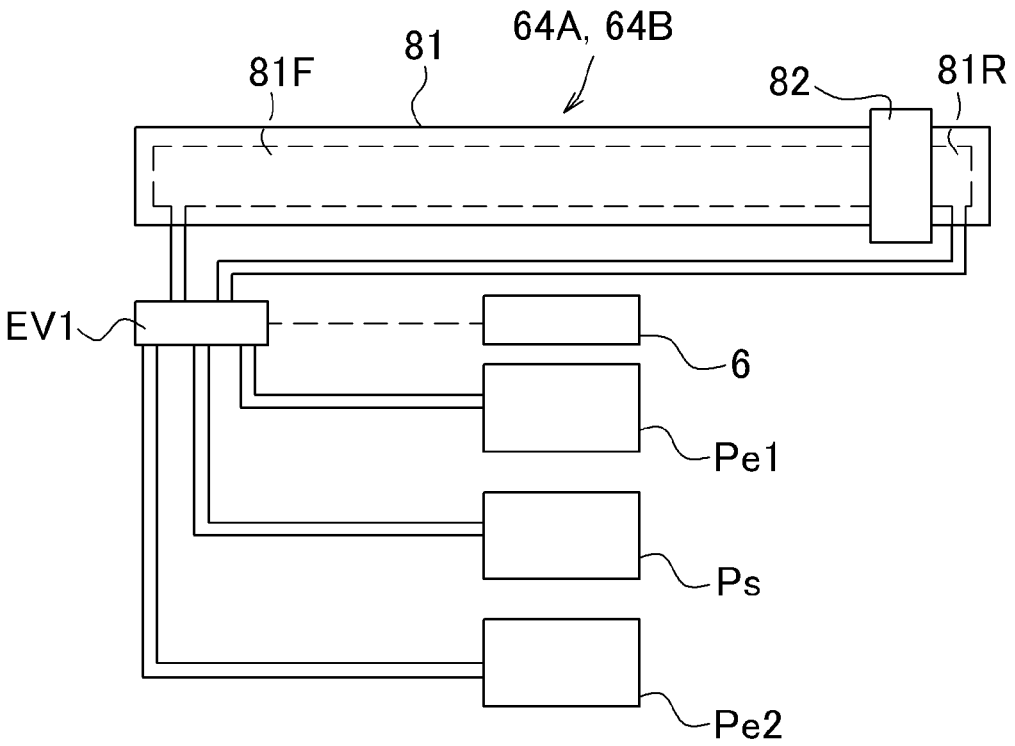

(a)
31A(31)
41
43
42
35A(35)
48
49
51
71
61A
47
44
46
50
52
45
54
55
56
53
V(c)
LEFT
FRONT
REAR
RIGHT
(b)
31B(31)
56
53
55
45
54
50
52
44
46
47
71
61B
51
49
48
41
43
42
35B(35)
(c)
31A(31)
41
45
43
57
44
UP
FRONT
REAR
DOWN

FIG.6

(a)


64A, 64B
81
81F
82
81R
EV1
6
Pe1
Ps
Pe2

(b)

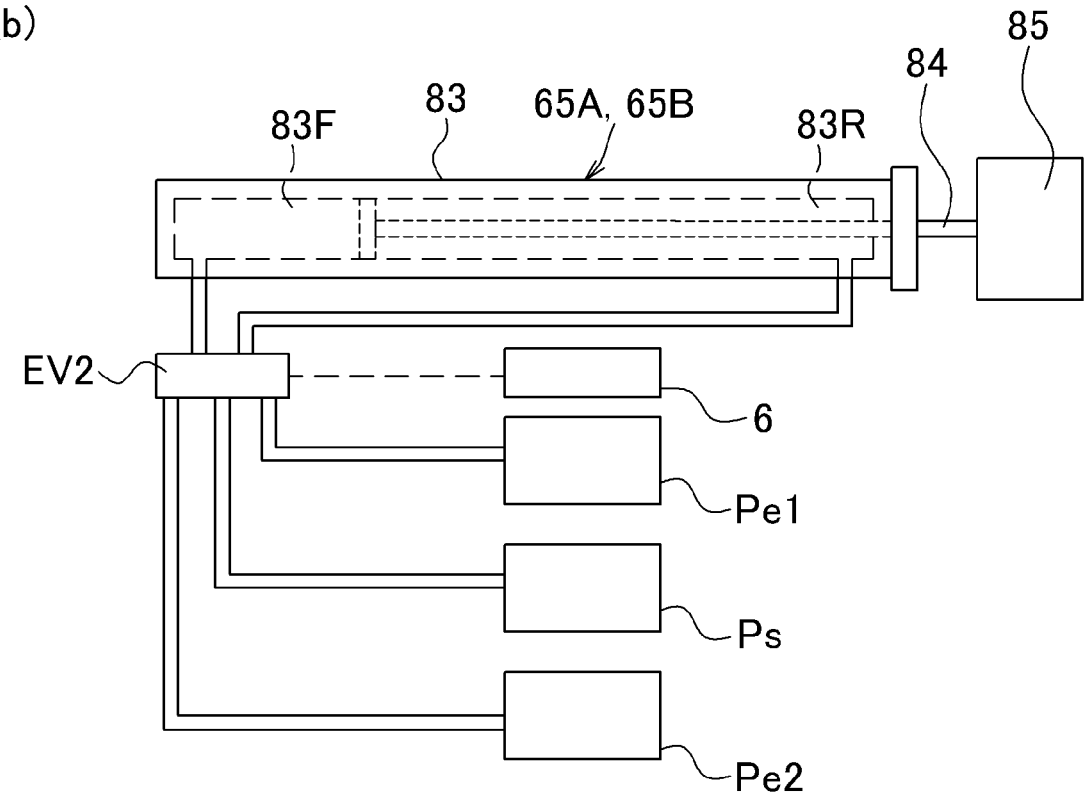
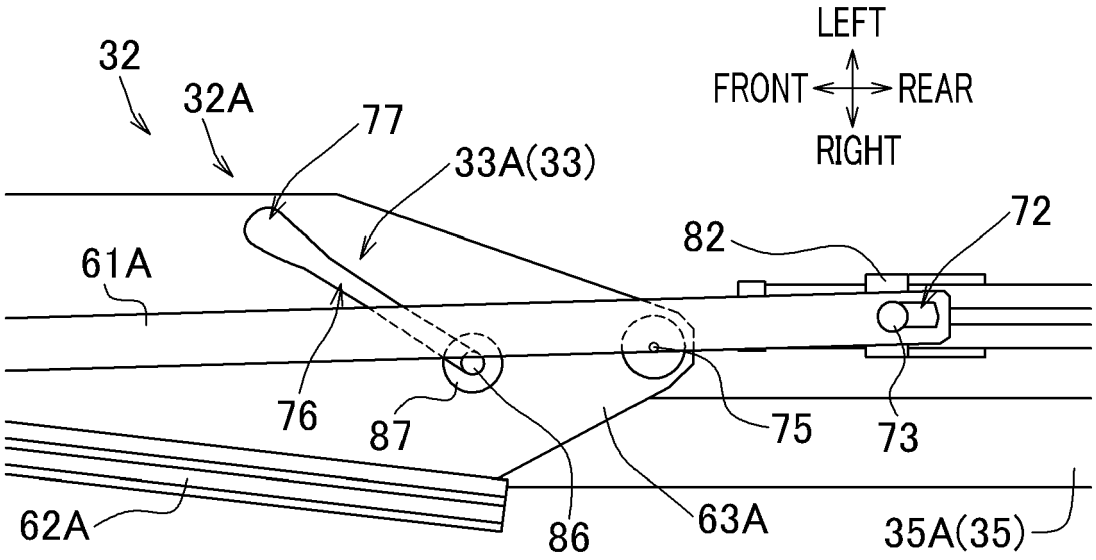

85
84
83
65A, 65B
83F
83R
EV2
6
Pe1
Ps
Pe2

FIG.7

(a)


32
32A
77
33A(33)
LEFT
FRONT
REAR
RIGHT
72
82
61A
76
87
75
73
62A
86
63A
35A(35)

(b)

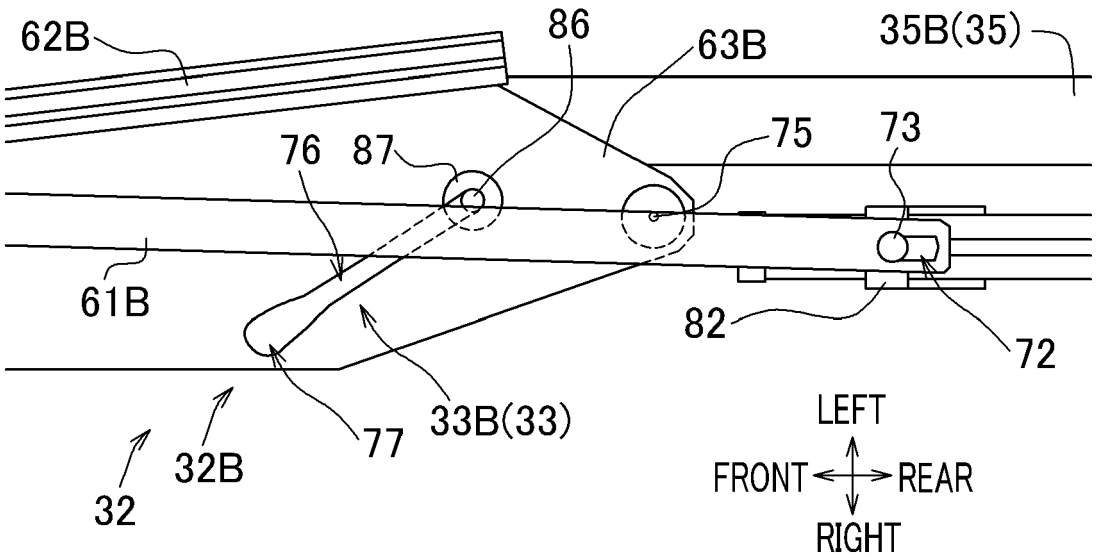

62B
86
63B
35B(35)
76
87
75
73
61B
82
72
77
33B(33)
32B
32
LEFT
FRONT
REAR
RIGHT

FIG.8

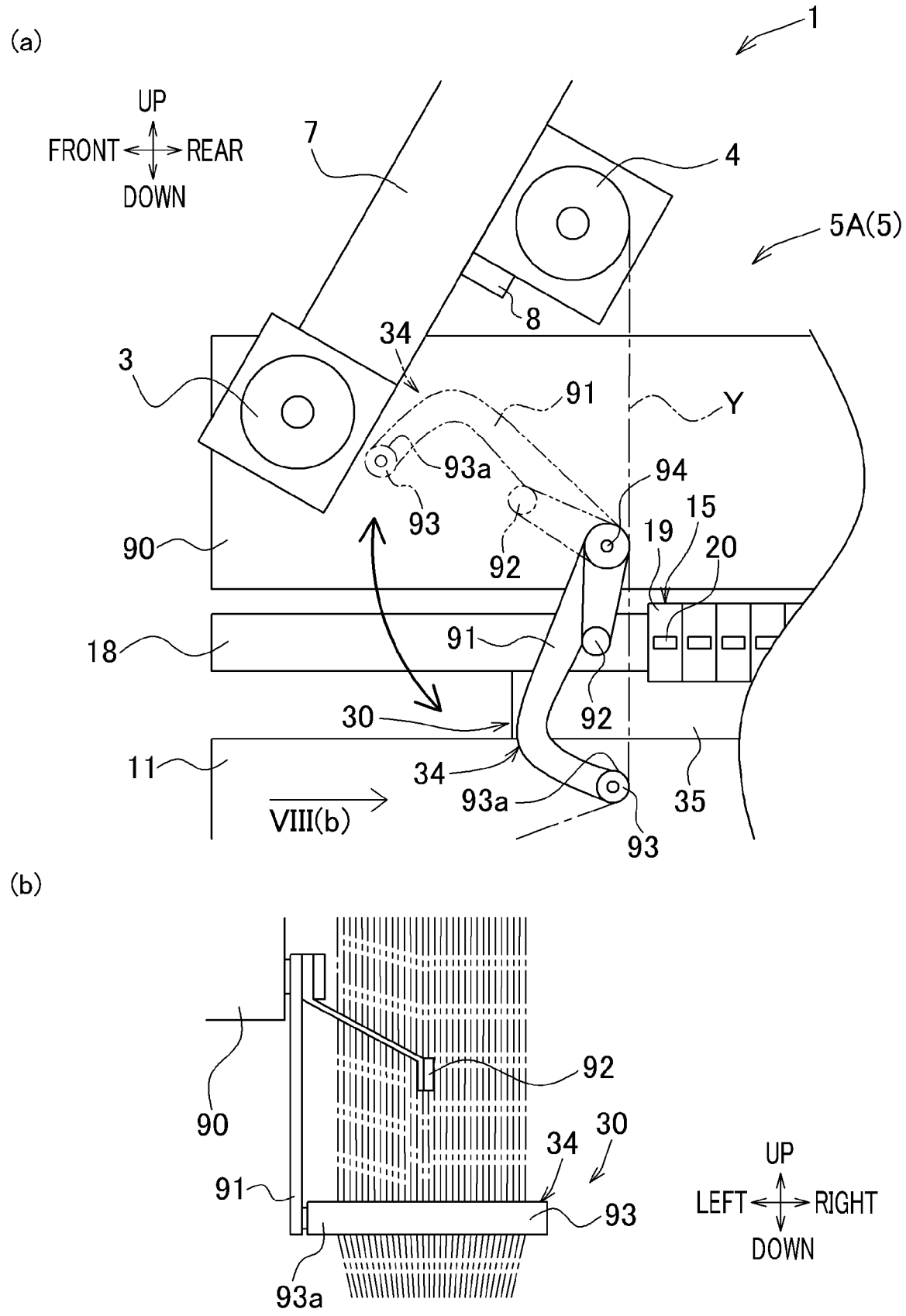

(a)
1
UP
FRONT
REAR
DOWN
7
4
5A(5)
8
34
3
91
Y
93a
94
15
93
19
20
90
92
18
91
30
92
11
34
93a
35
VIII(b)
93
(b)
92
90
30
34
91
93
93a
UP
LEFT
RIGHT
DOWN

FIG.9

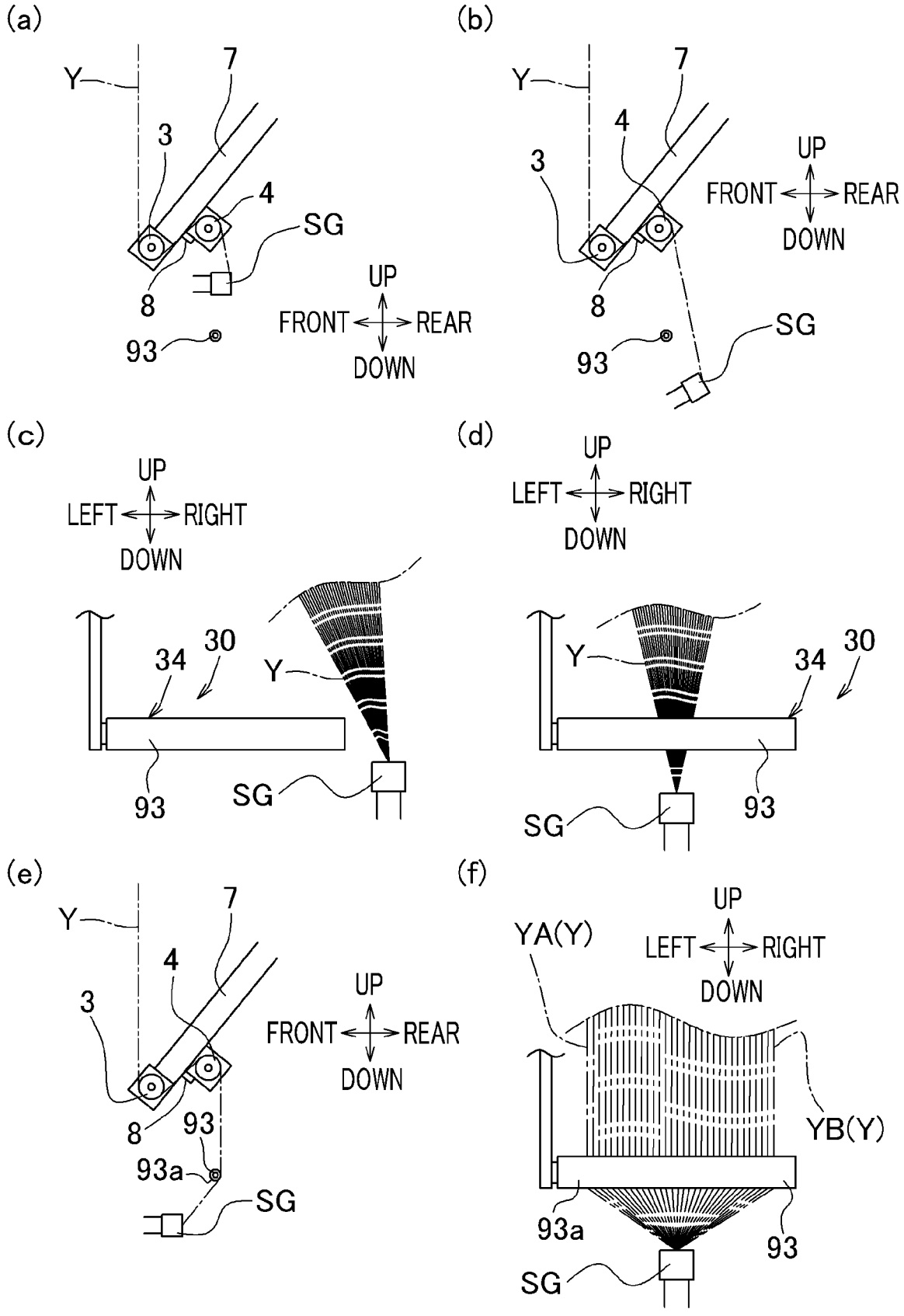

(a)
Y
7
3
4
SG
8
93
UP
FRONT
REAR
DOWN
(b)
Y
7
4
3
UP
FRONT
REAR
DOWN
8
93
SG
(c)
UP
LEFT
RIGHT
DOWN
34
30
Y
93
SG
(d)
UP
LEFT
RIGHT
DOWN
Y
34
30
SG
93
(e)
Y
7
4
3
UP
FRONT
REAR
DOWN
8
93
93a
SG
(f)
YA(Y)
UP
LEFT
RIGHT
DOWN
YB(Y)
93a
93
SG

FIG.10

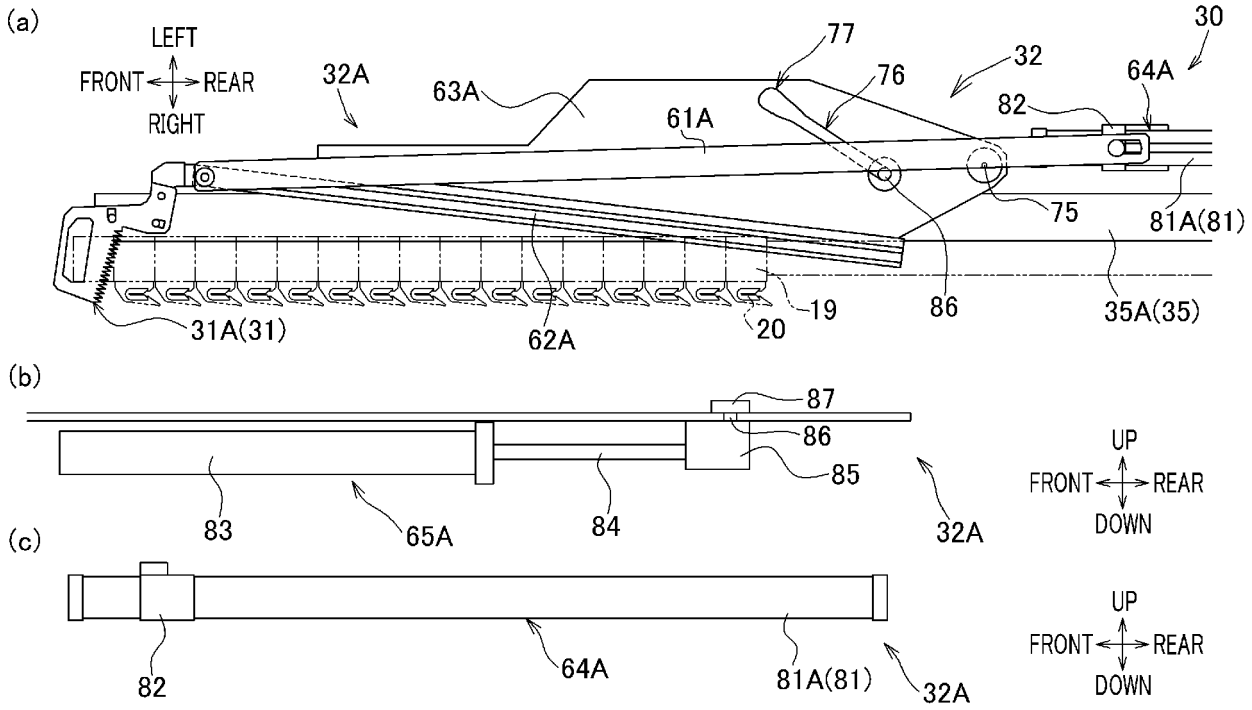

(a)
LEFT
FRONT
REAR
RIGHT
32A
63A
61A
77
76
32
64A
30
82
75
81A(81)
31A(31)
62A
20
19
86
35A(35)
(b)
87
86
85
83
65A
84
32A
UP
FRONT
REAR
DOWN
(c)
82
64A
81A(81)
32A
UP
FRONT
REAR
DOWN

FIG.11

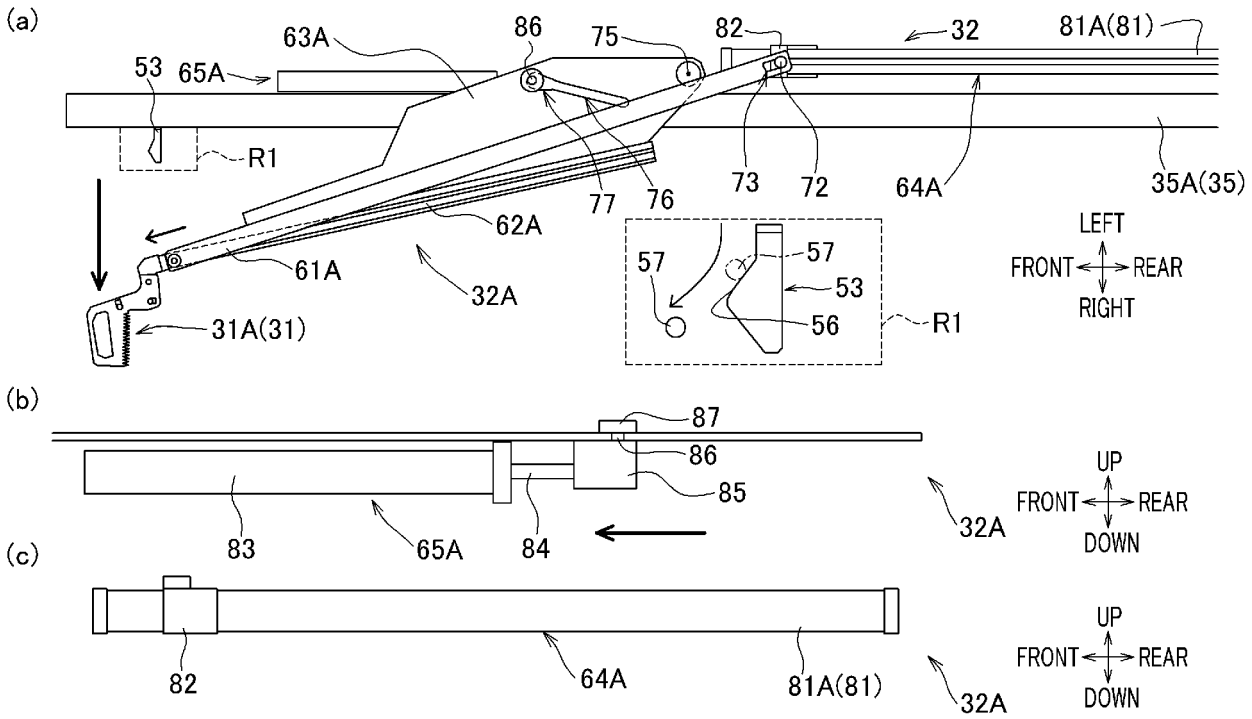

(a)
63A
86
75
82
32
81A(81)
53
65A
R1
77
76
73
72
64A
35A(35)
62A
61A
32A
31A(31)
57
57
53
56
R1
LEFT
FRONT
REAR
RIGHT
(b)
87
86
85
83
65A
84
32A
UP
FRONT
REAR
DOWN
(c)
82
64A
81A(81)
32A
UP
FRONT
REAR
DOWN

FIG.12

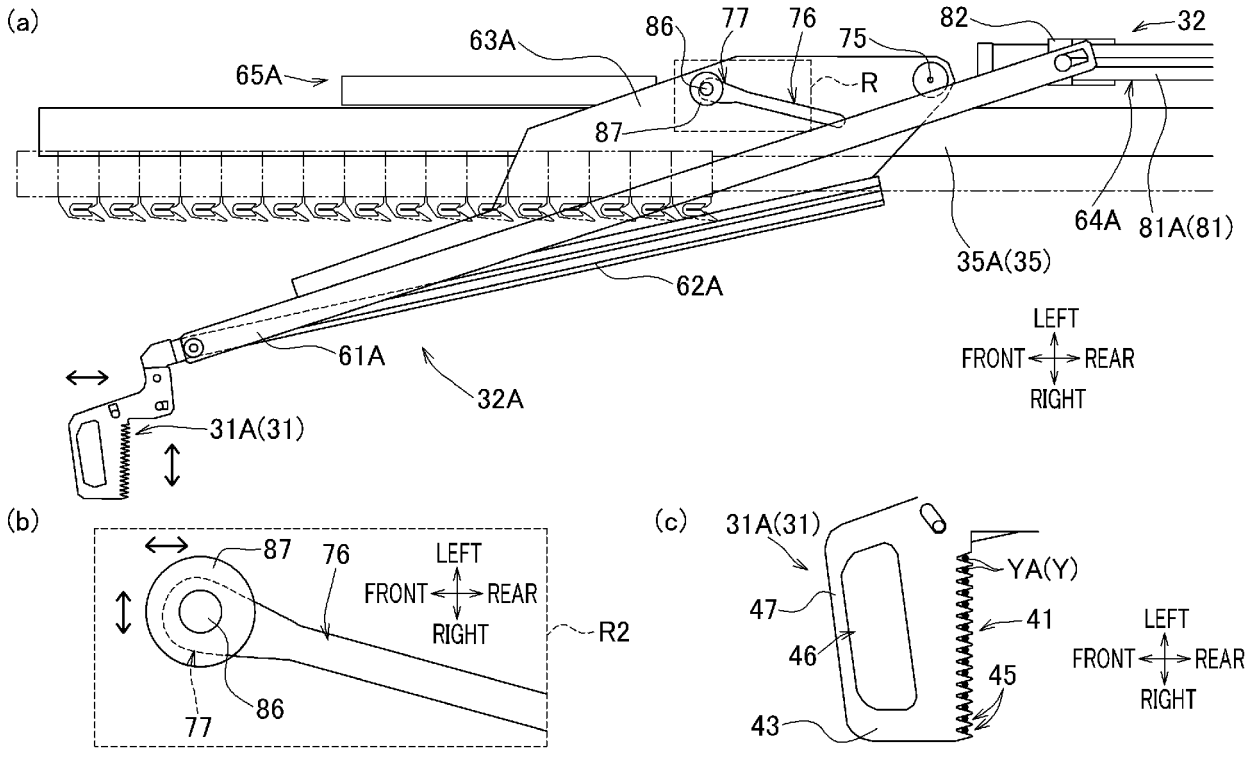

(a)
63A
86
77
76
75
82
32
65A
R
87
64A
81A(81)
35A(35)
62A
61A
32A
31A(31)
LEFT
FRONT
REAR
RIGHT
(b)
87
76
LEFT
FRONT
REAR
RIGHT
R2
77
86
(c)
31A(31)
YA(Y)
47
41
46
45
43
LEFT
FRONT
REAR
RIGHT

FIG.13

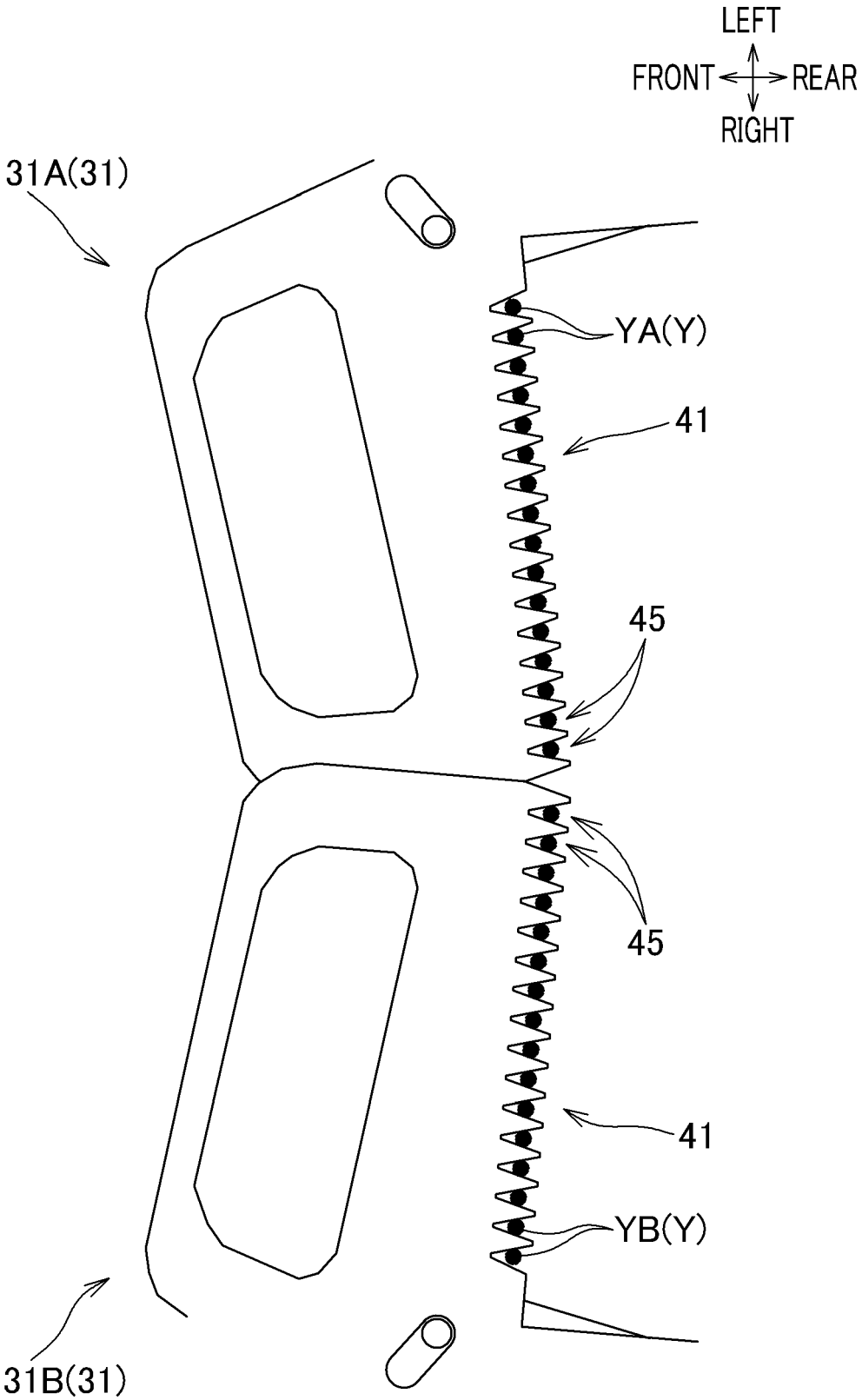


FIG.14

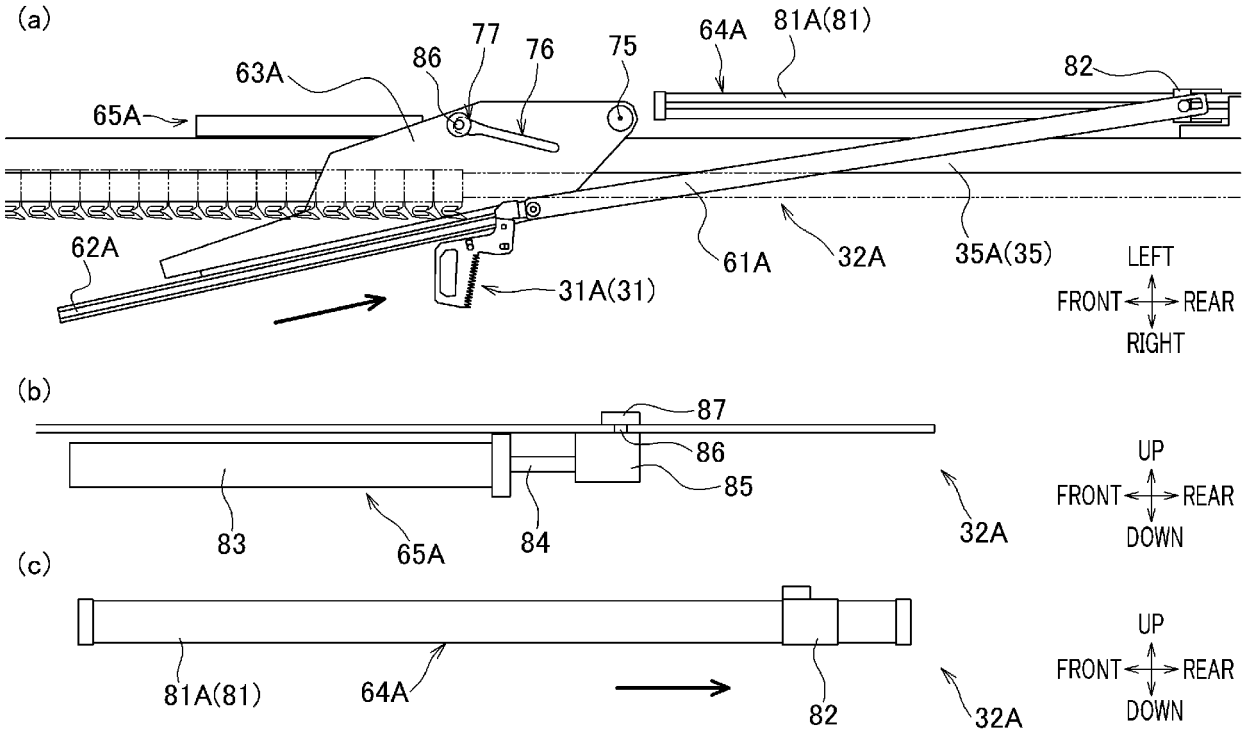

(a)
63A
86
77
76
75
64A
81A(81)
82
65A
62A
31A(31)
61A
32A
35A(35)
LEFT
FRONT
REAR
RIGHT
(b)
87
86
85
83
65A
84
32A
UP
FRONT
REAR
DOWN
(c)
81A(81)
64A
82
32A
UP
FRONT
REAR
DOWN

FIG.15

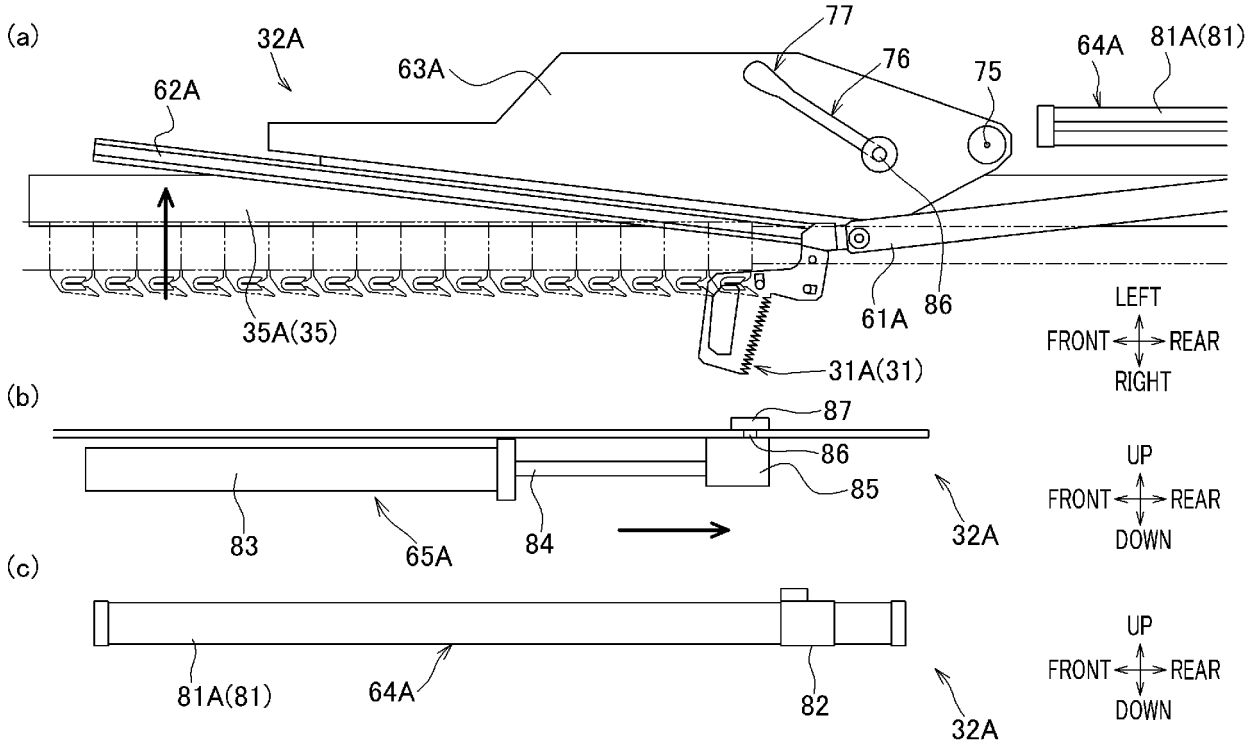

(a)
32A
62A
63A
77
76
75
64A
81A(81)
35A(35)
61A
86
31A(31)
LEFT
FRONT
REAR
RIGHT
(b)
87
86
85
83
65A
84
32A
UP
FRONT
REAR
DOWN
(c)
81A(81)
64A
82
32A
UP
FRONT
REAR
DOWN

FIG.16

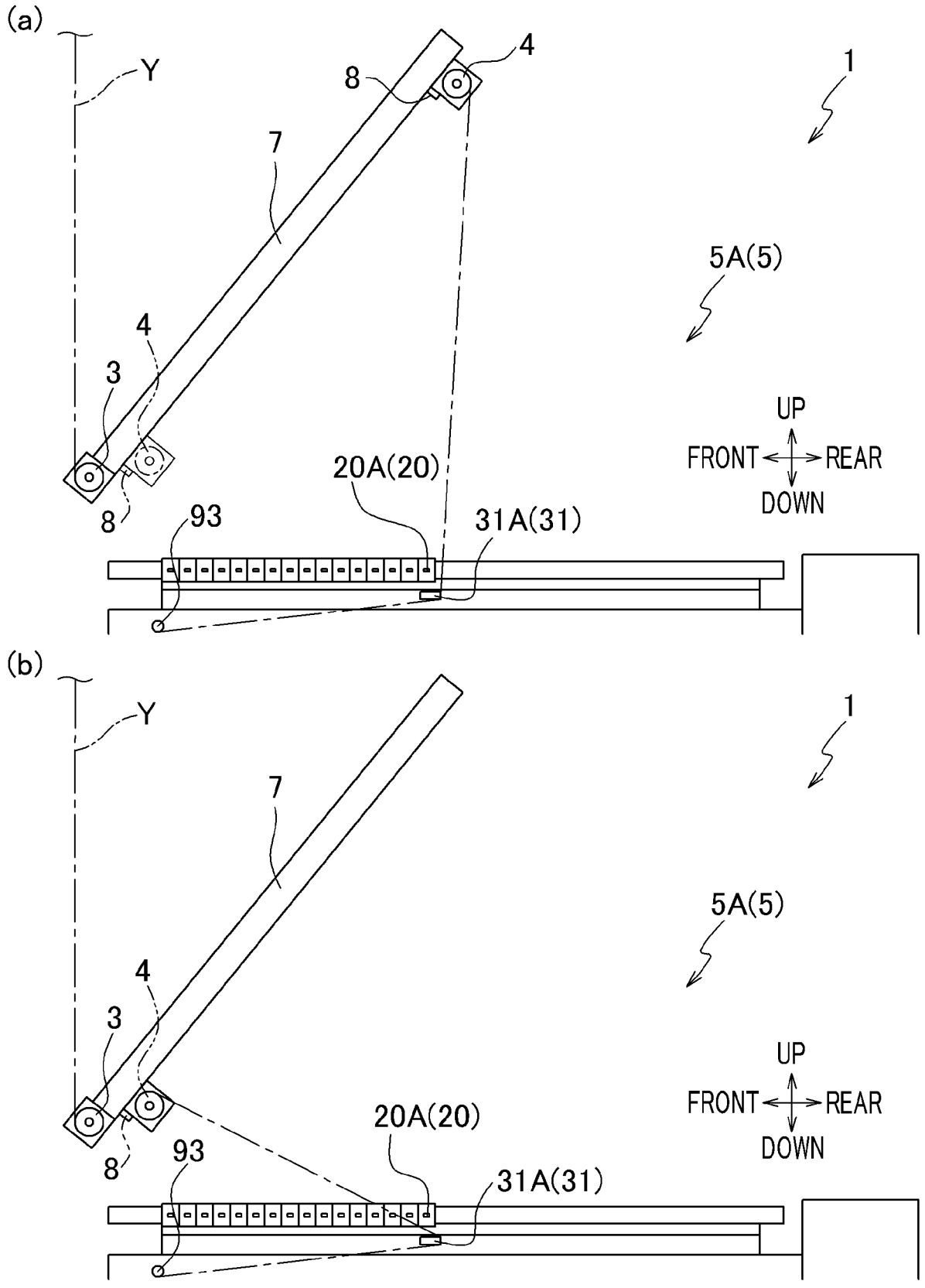

(a)
Y
8
4
1
7
5A(5)
4
3
UP
FRONT
REAR
DOWN
20A(20)
8
93
31A(31)
(b)
Y
1
7
5A(5)
4
3
UP
FRONT
REAR
DOWN
20A(20)
8
93
31A(31)

FIG.17

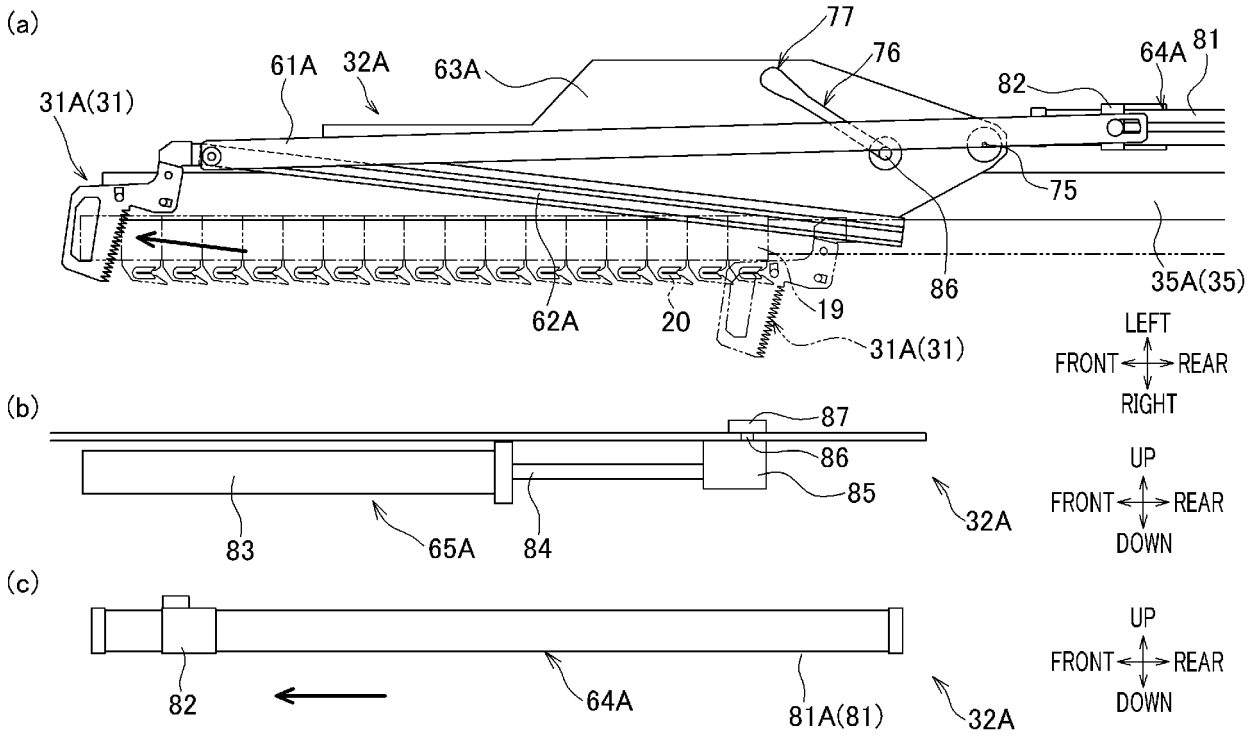

(a)
77
76
64A
81
61A
32A
63A
82
31A(31)
75
86
35A(35)
62A
20
19
31A(31)
LEFT
FRONT
REAR
RIGHT
(b)
87
86
85
32A
83
65A
84
UP
FRONT
REAR
DOWN
(c)
82
64A
81A(81)
32A
UP
FRONT
REAR
DOWN

FIG.18

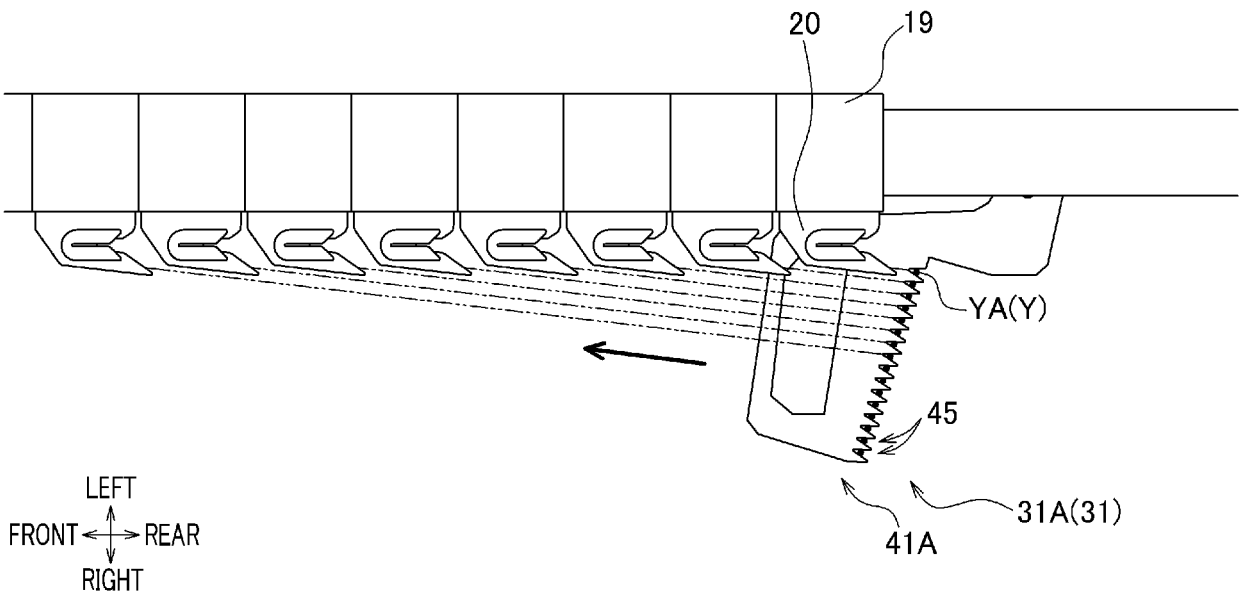


FIG.19

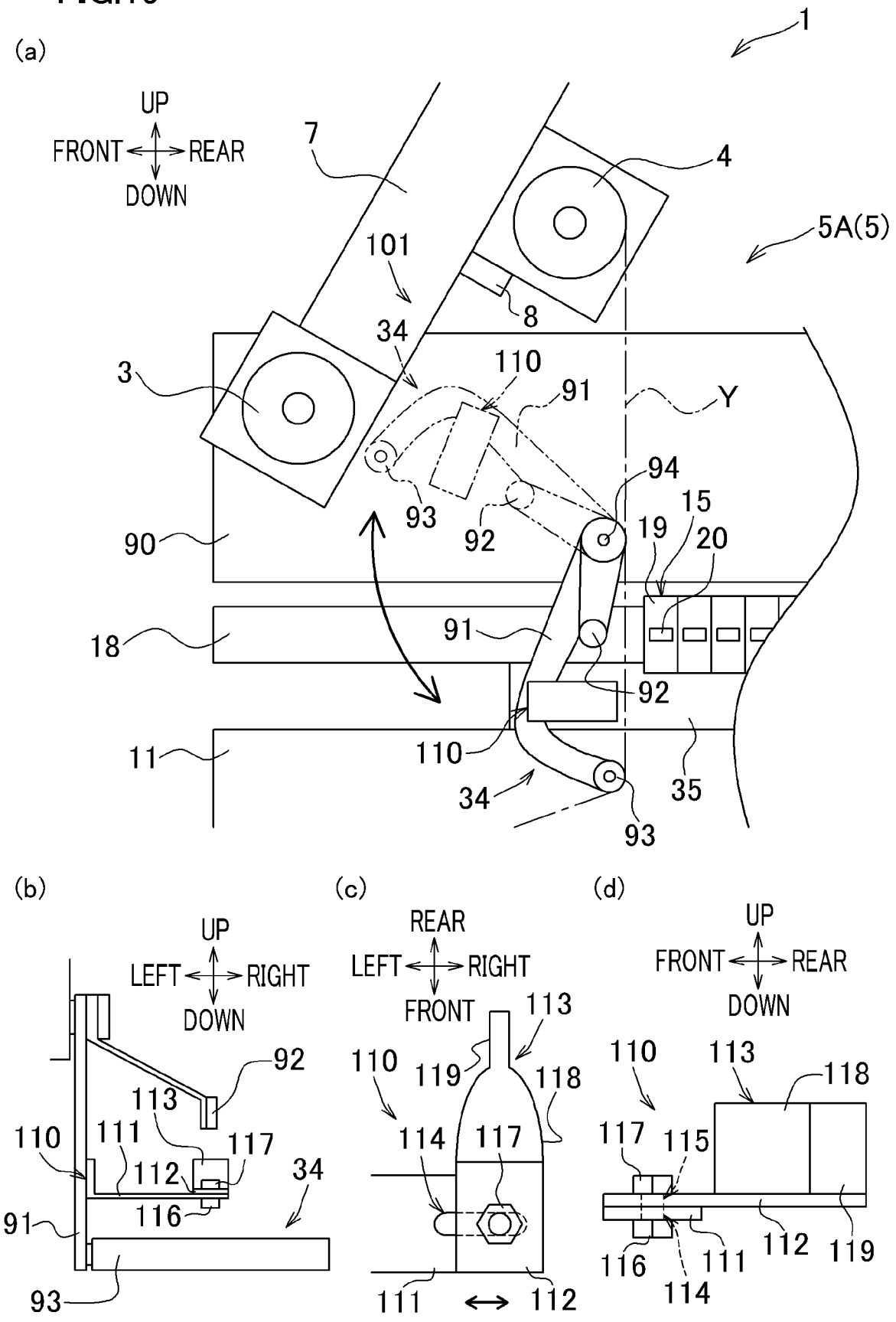
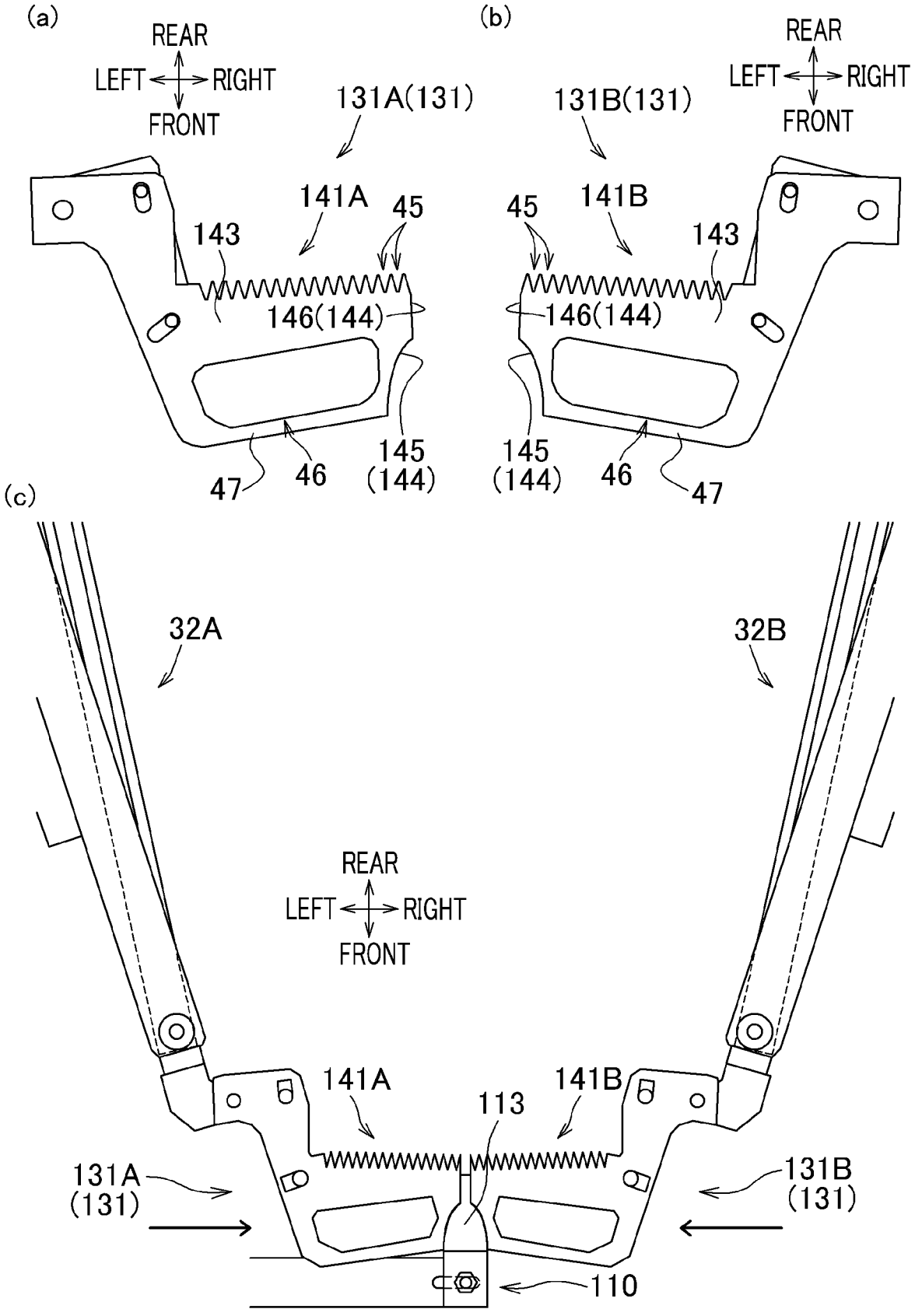

(a)
1
UP
FRONT
REAR
DOWN
7
4
5A(5)
101
8
34
3
110
91
Y
94
93
92
15
19
20
90
18
91
92
11
110
34
35
93
(b)
UP
LEFT
RIGHT
DOWN
92
113
110
111
117
112
34
116
91
93
(c)
REAR
LEFT
RIGHT
FRONT
113
110
119
118
114
117
111
112
(d)
UP
FRONT
REAR
DOWN
110
113
118
117
115
116
111
112
119
114

FIG.20


(a)
REAR
LEFT
RIGHT
FRONT
131A(131)
141A
45
143
146(144)
47
46
145
(144)
(b)
REAR
LEFT
RIGHT
FRONT
131B(131)
45
141B
143
146(144)
145
(144)
46
47
(c)
32A
32B
REAR
LEFT
RIGHT
FRONT
141A
141B
113
131A
(131)
131B
(131)
110

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- JP 2017082379 A **[0155]**