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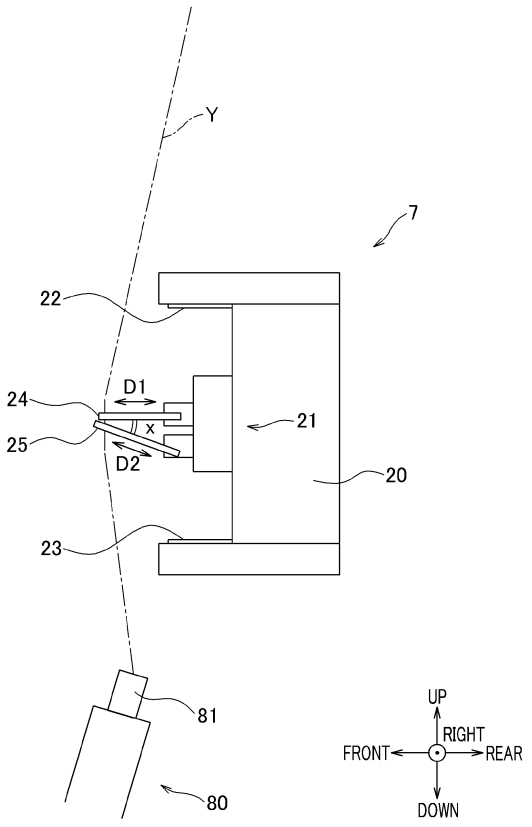
(54) YARN PROCESSING APPARATUS

(57) An object of the present invention is to facilitate yarn threading to two regulatory guides provided on the upstream and downstream sides of a yarn processing unit of a yarn processing apparatus in a yarn running direction.

The yarn processing apparatus 7 includes a yarn processing unit 21, a first regulatory guide 22, a second regulatory guide 23, a first yarn holding component 24, and a second yarn holding component 25. The first yarn holding component 24 includes first retaining grooves 24a, and is movable between a yarn threading position and a handover completion position. The second yarn holding component 25 includes second retaining grooves 25a, and is movable between a yarn threading position and a handover completion position. The first yarn holding component 24 at the yarn threading position is adjacent to the second yarn holding component 25 at the yarn threading position in the yarn running direction. When viewed in a left-right direction, an angle x is an acute angle between (i) a first depth direction D1 that is a direction toward the bottom of each first retaining groove 24a of the first yarn holding component 24 at the yarn threading position and (ii) a second depth direction D2 that is a direction toward the bottom of each second retaining groove 25a of the second yarn holding component 25 at the yarn threading position.

FIG.5



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn processing apparatus configured to perform a predetermined process for yarns.

[0002] A known yarn production system is configured to wind yarns spun out from a spinning apparatus by means of a winding device. For example, Patent Literature 1 discloses a yarn production system (spun yarn take-up winding apparatus of Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2013-057148)) including a spinning apparatus configured to spin out yarns downward and a yarn feed roller which is provided below the spinning apparatus and which is configured to send the yarns.

[0003] In such a yarn production system, a yarn processing apparatus including a yarn processing unit such as a migration nozzle may be provided on yarn paths between the spinning apparatus and the yarn feed roller. The migration nozzle is configured to bundle the yarns by means of injection of compressed air. The migration nozzle is structured in the same manner as, e.g., an interlacing portion of an interlacing device of Patent Literature 2 (Japanese Laid-Open Patent Publication No. 2019-105007) and is configured to bundle the yarns which run substantially parallel to each other at substantially equal intervals. A regulatory guide for regulating the yarns so that the yarns are substantially parallel to each other at substantially equal intervals in the migration nozzle is provided on each of the upstream and downstream sides of the migration nozzle in a yarn running direction. Each regulatory guide is provided with grooves at the same intervals as the yarns in the migration nozzle. As the yarns are threaded to the grooves formed at each regulatory guide, the yarns are enabled to run substantially parallel to each other at substantially equal intervals in the migration nozzle.

SUMMARY OF THE INVENTION

[0004] When the yarns spun out from the spinning apparatus are threaded to the two regulatory guides provided on the upstream and downstream sides of the migration nozzle, a suction gun configured to suck and bundle the yarns is used. The yarns spun out from the spinning apparatus converge at a suction port of the suction gun, and the intervals of the yarns are tapered toward the downstream side in the yarn running direction. Therefore, yarn threading to the two regulatory guides is performed while the position of the suction gun is adjusted by an operator so that the intervals of the yarns match those of the grooves of each regulatory guide. However, when the yarns are threaded to the two regulatory guides of the yarn processing apparatus by the suction gun, the following problem occurs.

[0005] As described above, the yarns are sucked and bundled by the suction gun, and the intervals of these yarns on the upstream side are different from those on the downstream side in the yarn running direction. Meanwhile, the two regulatory guides which are separated from each other in the yarn running direction are provided with the grooves at the same intervals. Therefore, even when (i) the position of the suction gun is adjusted so that the intervals of the yarns match those of the grooves of one regulatory guide and (ii) the yarns are threaded, the intervals of the yarns do not match those of the grooves of the other regulatory guide. As a result, the yarns are unintentionally threaded to undesired grooves of the other regulatory guide instead of corresponding grooves thereof. For this reason, currently, when the yarn threading is performed for the two regulatory guides with use of the suction gun, an operator needs to thread the yarns one by one to the grooves of each regulatory guide. The yarn threading therefore takes time.

[0006] The above-described problem may occur not only in the yarn processing apparatus including the migration nozzle as the yarn processing unit, but also in a yarn processing apparatus provided with yarn regulatory guides described below. That is, the above-described problem may occur in an apparatus (such as an oil nozzle configured to apply oil to yarns and a tension sensor configured to detect the tension of yarns) in which a regulatory guide is provided on each of the upstream and downstream sides of a yarn processing unit so that the yarn processing unit can perform a predetermined process for yarns running substantially parallel to each other at substantially equal intervals.

[0007] An object of the present invention is to facilitate yarn threading to two regulatory guides provided on the upstream and downstream sides of a yarn processing unit of a yarn processing apparatus in a yarn running direction.

[0008] A yarn processing apparatus of the present invention includes: a yarn processing unit configured to perform a predetermined process for yarns running in a yarn running direction while being aligned in an arrangement direction intersecting with the yarn running direction; a first regulatory guide which includes first grooves aligned in the arrangement direction and which is provided upstream of the yarn processing unit in the yarn running direction; a second regulatory guide which includes second grooves provided at the same intervals as the first grooves in the arrangement direction and which is provided downstream of the yarn processing unit in the yarn running direction; a first yarn holding component which includes first retaining grooves provided at the same intervals as the first grooves in the arrangement direction and which is able to hold the yarns that are to be threaded to the first regulatory guide; and a second yarn holding component which includes second retaining grooves provided at the same intervals as the second grooves in the arrangement direction and which is able to hold the yarns that are to be threaded to the second regulatory guide. In this regard, the first yarn holding com-

ponent is movable between a yarn threading position where the yarns are threaded to the first retaining grooves and a handover completion position where the handover of the yarns to the first regulatory guide is completed, the second yarn holding component is movable between a yarn threading position where the yarns are threaded to the second retaining grooves and a handover completion position where the handover of the yarns to the second regulatory guide is completed, and the first yarn holding component at the yarn threading position is adjacent to the second yarn holding component at the yarn threading position in the yarn running direction. Furthermore, when viewed in the arrangement direction, an angle between (i) a first depth direction that is a direction toward the bottom of each of the first retaining grooves of the first yarn holding component at the yarn threading position and (ii) a second depth direction that is a direction toward the bottom of each of the second retaining grooves of the second yarn holding component at the yarn threading position is an acute angle.

[0009] According to the present invention, when yarn threading is performed for the first regulatory guide and the second regulatory guide, the yarns are temporarily held by the first yarn holding component and the second yarn holding component at the respective yarn threading positions. Because the first yarn holding component at the yarn threading position is adjacent to the second yarn holding component at the yarn threading position in the yarn running direction, the yarns are easily threaded at once. As the first yarn holding component and the second yarn holding component which hold the yarns are moved to the respective handover completion positions, the yarns are threaded to the first regulatory guide and the second regulatory guide. Therefore, even when the yarn processing apparatus is provided in an area where the intervals of the yarns are tapered toward the downstream side in the yarn running direction, the yarn threading is easily performed for the first regulatory guide provided upstream of the yarn processing unit in the yarn running direction and the second regulatory guide provided downstream of the yarn processing unit in the yarn running direction.

[0010] Ideally, an operator threads the yarns to the above-described yarn holding components while looking into bottoms of retaining grooves of both yarn holding components, i.e., viewing both yarn holding components in the depth directions of the retaining grooves of both yarn holding components. This is because of the following reason. The intervals of the yarns are tapered toward a suction port of a suction gun. In other words, the intervals of the yarns in the arrangement direction are different depending on positions in the yarn running direction. With this arrangement, when the intervals of the yarns and those of the retaining grooves of both yarn holding components do not match with each other at the same position in the yarn running direction, the intervals of the yarns may be different from those of the retaining grooves of both yarn holding components so that the yarn threading fails. Therefore, ideally, the operator looks into the bottoms of the retaining grooves of both yarn holding components during the yarn threading in order to precisely match the intervals of the yarns with those of the retaining grooves of both yarn holding components at the same position in the yarn running direction. However, when the operator views both yarn holding components while looking into the bottoms of the retaining grooves of both yarn holding components, the visibility regarding the retaining grooves of both yarn holding components is decreased. To be more specific, when the operator views each yarn holding component, bottoms of retaining grooves of each yarn holding component are substantially aligned with not-grooved parts of each yarn holding component. This makes it difficult to distinguish the retaining grooves of each yarn holding component from the not-grooved parts thereof. The yarn threading to each yarn holding component therefore takes time. As a result, the yarn threading to the two regulatory guides also takes time.

[0011] According to the present invention, when viewed in the arrangement direction, the angle between (i) the first depth direction that is a direction toward the bottom of each first retaining groove of the first yarn holding component at the yarn threading position and (ii) the second depth direction that is a direction toward the bottom of each second retaining groove of the second yarn holding component at the yarn threading position is an acute angle. Because of this, even when the operator looks into bottoms of retaining grooves of one of the yarn holding components at the respective yarn threading positions in order to match the intervals of the yarns sucked and bundled by the suction gun with those of the retaining grooves of one of the yarn holding components, the other of the yarn holding components at the respective yarn threading positions is viewed in a direction intersecting with a depth direction corresponding to the other of the yarn holding components. That is, when the operator views the two yarn holding components at the respective yarn threading positions, bottoms of retaining grooves of the other of the two yarn holding components are not substantially aligned with not-grooved parts of the other of the yarn holding components. This makes it easy to distinguish the retaining grooves of the other of the two yarn holding components from the not-grooved parts thereof. According to the present invention, the two yarn holding components at the respective yarn threading positions are adjacent to each other in the yarn running direction. With this arrangement, the operator easily performs the yarn threading for the two yarn holding components by threading the yarns to the retaining grooves of the two yarn holding components with reference to the intervals of retaining grooves of the other of the two yarn holding components. In this regard, the retaining grooves of the other of the two yarn holding components are easily distinguished. This facilitates the yarn threading to the two regulatory guides provided on the upstream and downstream sides of the yarn processing unit of the yarn processing apparatus in the yarn running direction.

[0012] In the yarn processing apparatus of the present invention, preferably, a leading end of the second yarn holding component at the yarn threading position is far from each of the first retaining grooves as compared to a leading end of the first yarn holding component at the yarn threading position in the first depth direction, or the leading end of the first yarn holding component at the yarn threading position is far from each of the second retaining grooves as compared to the leading end of the second yarn holding component at the yarn threading position in the second depth direction.

[0013] In the yarn threading, when the operator views the two yarn holding components at the respective yarn threading positions, the operator has difficulty in fixing the line of sight while both yarn holding components are in sight of the operator. That is, even when the operator focuses on one of the yarn holding components, the operator tends to move the line of sight because the other of the yarn holding components is in sight of the operator. This makes it difficult to perform the yarn threading to the yarn holding components. In the present invention, when the operator views the two yarn holding components at the respective yarn threading positions, a part of or all of the other of the yarn holding components is at least partially hidden behind one of the yarn holding components. Because of this, even when the operator focuses on one of the yarn holding components, a part of or all of the other of the yarn holding components is outside the sight of the operator. This suppresses the movement of the line of sight of the operator. It is therefore possible to further facilitate the yarn threading to the two yarn holding components.

[0014] In the yarn processing apparatus of the present invention, preferably, when viewed in the arrangement direction, the angle between the first depth direction and the second depth direction is 15 degrees or more.

[0015] When the angle between the first depth direction and the second depth direction is viewed in the arrangement direction and excessively small, the increase in visibility is limited in regard to the intervals of the retaining grooves of both yarn holding components at the respective yarn threading positions. In the present invention, when viewed in the arrangement direction, the angle between the first depth direction and the second depth direction is 15 degrees or more. With this arrangement, when the operator tries to look into bottoms of retaining grooves of one of the yarn holding components at the respective yarn threading positions, bottoms of retaining grooves of the other of the two yarn holding components are apparently distinguished from not-grooved parts of the other of the yarn holding components at the respective yarn threading positions. It is therefore possible to further facilitate the yarn threading to the two yarn holding components.

[0016] In the yarn processing apparatus of the present invention, preferably, the first yarn holding component and the second yarn holding component are plate-shaped members.

[0017] In the present invention, the thickness of each of the first yarn holding component and the second yarn holding component formed as plate-shaped members is arranged to be small so that the first yarn holding component and the second yarn holding component at the respective yarn threading positions can be moved close to each other in the yarn running direction. It is therefore possible to further easily thread the yarns in a bundle to the retaining grooves of both yarn holding components.

[0018] Preferably, the yarn processing apparatus of the present invention further includes a synchronizing mechanism configured to synchronize the movement of the first yarn holding component between the yarn threading position and the handover completion position with the movement of the second yarn holding component between the yarn threading position and the handover completion position.

[0019] When (i) the handover of the yarns from one yarn holding component to one regulatory guide is performed at first and (ii) the handover of the yarns from the other yarn holding component to the other regulatory guide is then performed, the yarns may be lifted up and detached from one regulatory guide, in which the handover of the yarns has been completed, in accordance with the handover of the yarns from the other yarn holding component to the other regulatory guide. In the present invention, the handover of the yarns from the first yarn holding component to the first regulatory guide is performable at the same time as the handover of the yarns from the second yarn holding component to the second regulatory guide. It is therefore possible to further reliably perform yarn threading to the two regulatory guides.

[0020] In the yarn processing apparatus of the present invention, preferably, the synchronizing mechanism includes: a first swing arm which is rotatable about a first swing shaft extending along the arrangement direction and which swingably supports the first yarn holding component; and a second swing arm which is rotatable about a second swing shaft extending along the arrangement direction and which swingably supports the second yarn holding component. In this regard, the first swing arm includes a first gear, the second swing arm includes a second gear, and the synchronizing mechanism is configured to rotate the first swing arm and the second swing arm in a synchronous manner by means of the first gear and the second gear which mesh with each other, so as to synchronize the movement of the first yarn holding component with the movement of the second yarn holding component.

[0021] In the present invention, as the first swing arm and the second swing arm are rotated in a synchronous manner by the first gear and the second gear which mesh with each other, the first yarn holding component and the second yarn holding component are swung in a synchronous manner. Because of this, a complicated structure and complicated control are unnecessary for the synchronized movement of the first yarn holding component and the second yarn holding component.

[0022] In the yarn processing apparatus of the present invention, preferably, the yarn threading position of the first yarn holding component is a position where the first yarn holding component viewed in the arrangement direction is deviated from yarn paths of the yarns threaded to the first regulatory guide and the second regulatory guide in an opening direction in which the first grooves are open, and the yarn threading position of the second yarn holding component is a position where the second yarn holding component viewed in the arrangement direction is deviated from the yarn paths of the yarns threaded to the first regulatory guide and the second regulatory guide in an opening direction in which the second grooves are open.

[0023] In the present invention, when the yarns are threaded to the first yarn holding component and the second yarn holding component at the respective yarn threading positions, the yarns are suppressed from being unintentionally threaded to (i) undesired first grooves of the first regulatory guide instead of corresponding first grooves thereof and (ii) undesired second grooves of the second regulatory guide instead of corresponding second grooves thereof. Because of this, the yarns are further reliably threaded to the corresponding first grooves by moving the first yarn holding component to the handover completion position while the yarns are held by the first yarn holding component and not threaded to the first regulatory guide. Similarly, the yarns are further reliably threaded to the corresponding second grooves by moving the second yarn holding component to the handover completion position while the yarns are held by the second yarn holding component and not threaded to the second regulatory guide.

[0024] In the yarn processing apparatus of the present invention, preferably, the first regulatory guide viewed in the arrangement direction is deviated from yarn paths of the yarns threaded to the first yarn holding component at the yarn threading position.

[0025] In the present invention, when the yarns are threaded to the first yarn holding component at the yarn threading position, the yarns are further suppressed from being unintentionally threaded to undesired first grooves of the first regulatory guide instead of corresponding first grooves thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a schematic diagram of a yarn production system.

FIG. 2 is a front view of a yarn processing apparatus when a first yarn holding component is at a yarn threading position and a second yarn holding component is at a yarn threading position.

FIG. 3 is a front view of the yarn processing apparatus when the first yarn holding component is at a handover completion position and the second yarn holding component is at a handover completion position.

FIG. 4 is a cross section of a part of a yarn processing unit, taken along a plane which is parallel to a left-right direction and a front-rear direction.

FIG. 5 is a right side view of the yarn processing apparatus when the first yarn holding component is at the yarn threading position and the second yarn holding component is at the yarn threading position.

FIG. 6 is a right side view of the yarn processing apparatus when the first yarn holding component is at the handover completion position and the second yarn holding component is at the handover completion position.

FIG. 7 is a left side view of the yarn processing apparatus when the first yarn holding component is at the yarn threading position and the second yarn holding component is at the yarn threading position.

FIG. 8 is a left side view of the yarn processing apparatus when the first yarn holding component is at the handover completion position and the second yarn holding component is at the handover completion position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] The following will describe an embodiment of the present invention with reference to figures.

(Overall Structure of Yarn Production System 1)

[0028] The following will describe a preferred embodiment of the present invention with reference to figures. FIG. 1 schematically shows a yarn production system 1. Hereinafter, the up-down direction on the sheet of FIG. 1 will be referred to as an up-down direction, and the left-right direction on the sheet will be referred to as a left-right direction. Furthermore, a direction perpendicular to the sheet of FIG. 1 will be referred to as a front-rear direction, and a direction toward the viewer of FIG. 1 will be referred to as a forward direction. These definitions of the directions will be suitably used hereinbelow.

[0029] The yarn production system 1 is configured to wind yarns Y spun out from a spinning apparatus 2 by means of a winding device 4. The spinning apparatus 2 is configured to spin out molten polymer downward as the yarns Y. As shown in FIG. 1, the yarn production system 1 includes: oil guides 5 which respectively have oil nozzles; guides 6; a yarn processing apparatus 7; two godet rollers 11 and 12; a spun yarn drawing apparatus 3; and the winding device 4. The spinning apparatus 2, the oil guides 5, and the guides 6 are provided on an upper floor (second floor). In this regard, the oil guides 5 and guides 6 are provided below the spinning apparatus 2. The yarn processing apparatus 7, the two godet rollers 11 and 12, the spun yarn drawing apparatus 3, and the winding device 4 are provided on a lower floor (first floor).

[0030] The oil guides 5 are provided below the spinning

apparatus 2, and configured to apply oil to the respective yarns Y spun out downward from the spinning apparatus 2. The guides 6 are provided below the respective oil guides 5 at regular intervals in the left-right direction, and configured to individually guide the oiled yarns Y.

[0031] The yarn processing apparatus 7 is provided below the guides 6 and configured to bundle the yarns Y which are individually guided by the guides 6, by means of injection of compressed air. The yarn processing apparatus 7 includes a first regulatory guide 22 and a second regulatory guide 23 (see FIG. 2). The yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23 run substantially parallel to each other at substantially equal intervals in the left-right direction. The yarn processing apparatus 7 will be detailed later.

[0032] The godet rollers 11 and 12 are provided downstream of the yarn processing apparatus 7 in a yarn running direction as shown in FIG. 1, and rotationally driven by unillustrated motors. The yarns Y spun out from the spinning apparatus 2 are wound onto the godet roller 11 via the oil guides 5, the guides 6, and the yarn processing apparatus 7. The yarns Y are then sent to the spun yarn drawing apparatus 3 by the godet roller 11. The yarns Y heated and drawn by the spun yarn drawing apparatus 3 are wound onto the godet roller 12. The yarns Y are then sent to the winding device 4 by the godet roller 12. Actually, an interlacing device and other godet rollers are provided downstream of the godet roller 12 and upstream of the winding device 4 in the yarn running direction. However, these members are not illustrated in FIG. 1.

[0033] The spun yarn drawing apparatus 3 is configured to heat and draw the yarns Y, and provided below the spinning apparatus 2. The spun yarn drawing apparatus 3 includes a thermal insulation box 60 and five godet rollers 91 to 95 housed in the thermal insulation box 60. At a lower part of a right side portion of the thermal insulation box 60, a yarn inlet 60a is formed to introduce the yarns Y into the thermal insulation box 60. At an upper part of the right side portion of the thermal insulation box 60, a yarn outlet 60b is formed to take the yarns Y out from the thermal insulation box 60.

[0034] The lower three godet rollers 91 to 93 are preheating rollers for preheating the yarns Y before the yarns Y are drawn. The upper two godet rollers 94 and 95 are conditioning rollers for thermally setting the drawn yarns Y. The roller surface temperatures of the upper two godet rollers 94 and 95 are arranged to be higher than those of the lower three godet rollers 91 to 93. Furthermore, the yarn feeding speeds of the upper two godet rollers 94 and 95 are higher than those of the lower three godet rollers 91 to 93.

[0035] To begin with, the yarns Y introduced into the thermal insulation box 60 through the yarn inlet 60a are preheated to a drawable temperature while being transferred by the godet rollers 91 to 93. The preheated yarns Y are drawn on account of a difference between the yarn feeding speed of the godet roller 93 and that of the godet roller 94. Subsequently, the yarns Y are further heated while being transferred by the godet rollers 94 and 95. As a result, the drawn state is thermally set. The yarns Y having been drawn in this way go out from the thermal insulation box 60 through the yarn outlet 60b.

[0036] The winding device 4 is configured to wind the yarns Y, and provided below the spun yarn drawing apparatus 3. The winding device 4 includes a bobbin holder 13, a contact roller 14, etc. The bobbin holder 13 is cylindrical in shape, and extends in the front-rear direction. The bobbin holder 13 is rotationally driven by an unillustrated motor. To the bobbin holder 13, bobbins B are attached so as to be side by side along an axial direction of the bobbin holder 13. The winding device 4 is configured to simultaneously wind the yarns Y onto the bobbins B by rotating the bobbin holder 13, so as to produce packages P. The contact roller 14 is configured to apply a predetermined contact pressure to surfaces of the packages P by making contact with the surfaces of the packages P, so as to adjust the shape of each package P.

(Yarn Processing Apparatus 7)

[0037] The following will detail the yarn processing apparatus 7 with reference to FIG. 2 to FIG. 8. For the sake of convenience, some of the yarns Y are not illustrated in FIG. 2 and FIG. 3. Furthermore, the yarns Y are not illustrated in FIG. 7 and FIG. 8. The yarn processing apparatus 7 includes a base 20, a yarn processing unit 21, the first regulatory guide 22, the second regulatory guide 23, a first yarn holding component 24, a second yarn holding component 25, and a synchronizing mechanism 30 (see FIG. 7). For example, in the up-down direction, the yarn processing apparatus 7 is provided at a position that is slightly higher than the height of the line of sight of an operator who wishes to thread the yarns Y to the yarn processing apparatus 7. This position that is slightly higher than the height of the line of sight of the operator is, e.g., a position that is approximately two meters higher than the floor of the lower floor.

[0038] The base 20 is substantially rectangular parallelepiped in shape. The yarn processing unit 21 is configured to perform a predetermined process for the yarns Y running while being aligned in an arrangement direction (the left-right direction of FIG. 2) To be more specific, the yarn processing unit 21 is configured to bundle the yarns Y by means of the injection of compressed air. As shown in FIG. 3 and FIG. 4, the yarn processing unit 21 is formed by interlacing pieces 26 aligned in the left-right direction on a front surface of the base 20 in the front-rear direction. In this regard, the interlacing pieces 26 are not illustrated in FIG. 2. As shown in FIG. 1, the yarn processing unit 21 is provided below the guides 6 and above the godet roller 11.

[0039] As shown in FIG. 4, the yarn processing unit 21 includes yarn running spaces 31, yarn introduction passages 32, and injection passages 33. The yarn running spaces 31 extend along the yarn running direction, and are aligned at substantially equal intervals in the arrange-

ment direction (the left-right direction of FIG. 4) intersecting with the yarn running direction. In this regard, an interval between each two adjacent yarn running spaces 31 indicates a distance between the centers of each two adjacent yarn running spaces 31 in the left-right direction (see FIG. 4). The yarn running spaces 31 are provided in the respective interlacing pieces 26. When viewed in the yarn running direction, each yarn running space 31 is substantially elliptical in shape and is long in the left-right direction. In the yarn running direction, each yarn running space 31 extends over the entire length of a corresponding interlacing piece 26 and is open at both ends.

[0040] The yarn introduction passages 32 are provided for the respective yarn running spaces 31 to introduce the yarns Y into the yarn running spaces 31. In the yarn running direction, each yarn introduction passage 32 extends over the entire length of an interlacing piece 26 and is open at both ends. Each yarn introduction passage 32 includes a first yarn passage 36, a second yarn passage 37, and a third yarn passage 38.

[0041] Each first yarn passage 36 is a gap formed between two adjacent interlacing pieces 26, and extends in the front-rear direction at a substantially front half of an interlacing piece 26. A front end of each first yarn passage 36 in the front-rear direction is an insertion slot 36a from which a yarn Y is inserted.

[0042] Each second yarn passage 37 is connected to a rear end of the first yarn passage 36 in the front-rear direction, and extends rightward from the junction with the first yarn passage 36. Each third yarn passage 38 is connected to a right end of the second yarn passage 37, and extends forward from the junction with the second yarn passage 37 in the front-rear direction. A front end of the third yarn passage 38 in the front-rear direction is connected to a yarn running space 31.

[0043] As shown in FIG. 4, approximately a left half of a front surface of each interlacing piece 26 is provided on the left side of a substantial central part of the front surface of the interlacing piece 26 in the left-right direction. This left half of the front surface of the interlacing piece 26 is an inclined surface 26a inclined relative to the left-right direction so that its left end is provided behind its right end, i.e., behind the substantial central part of the front surface of the interlacing piece 26. In the present embodiment, the substantial central part of the front surface of the interlacing piece 26 is provided slightly on the right side of an actual central part of the front surface of the interlacing piece 26 in the left-right direction. Meanwhile, approximately a right half of the front surface of the interlacing piece 26 is provided on the right side of the substantial central part of the front surface of the interlacing piece 26 in the left-right direction. This right half of the front surface of the interlacing piece 26 is an inclined surface 26b inclined relative to the left-right direction so that its right end is provided behind its left end, i.e., behind the substantial central part of the front surface of the interlacing piece 26. With these arrangements, the inclined surfaces 26a and 26b are provided on both sides of each first yarn passage 36 in the left-right direction. Because of this, each of the yarns Y threaded to the later-described first regulatory guide 22 and the later-described second regulatory guide 23 so as to run substantially parallel to each other is guided by the inclined surfaces 26a and 26b and threaded to the first yarn passage 36.

[0044] The injection passages 33 are individually provided for the yarn running spaces 31. That is, the injection passages 33 are formed for the respective interlacing pieces 26 and extends in the front-rear direction. A leading end (front end) of each injection passage 33 is an injection port 33a that is an opening on a rear wall surface of the junction between the second yarn passage 37 and the third yarn passage 38 in the front-rear direction. With this arrangement, the injection port 33a opposes a yarn running space 31 across the third yarn passage 38 in the front-rear direction. A rear end of the injection passage 33 is connected to a fluid supply source 40 via a fluid supply path 43. A valve 39 is provided on the fluid supply path 43. When the valve 39 is open, fluid such as air supplied from the fluid supply source 40 is supplied to the injection passage 33 via the fluid supply path 43 and is injected into the yarn running space 31 through the injection port 33a of the injection passage 33. As a result, a swirling flow is generated in the yarn running space 31 so as to bundle filaments forming a yarn Y running in the yarn running space 31.

[0045] As shown in FIG. 2, FIG. 5, etc., the first regulatory guide 22 is provided upstream of the yarn processing unit 21 in the yarn running direction and on the front surface of the base 20 in the front-rear direction. As shown in FIG. 2, the first regulatory guide 22 includes first grooves 22a aligned at regular intervals in the left-right direction which is the arrangement direction of the yarns Y. An interval between each two adjacent first grooves 22a indicates a distance between the centers of each two adjacent first grooves 22a in the left-right direction. The intervals of the first grooves 22a are the same as the yarn running spaces 31. Each first groove 22a is an opening on the front side in the front-rear direction. A forward direction in the front-rear direction is equivalent to an opening direction of the present invention, in which each first groove 22a is open. As shown in FIG. 5, when viewed in the left-right direction, the first regulatory guide 22 is deviated from yarn paths of the yarns Y threaded to the first yarn holding component 24 (described later) at a yarn threading position. In other words, the first regulatory guide 22 is provided behind the yarn paths of the yarns Y threaded to the first yarn holding component 24 at the yarn threading position in the front-rear direction.

[0046] As shown in FIG. 2, FIG. 5, etc., the second regulatory guide 23 is provided downstream of the yarn processing unit 21 in the yarn running direction and on the front surface of the base 20 in the front-rear direction. As shown in FIG. 2, the second regulatory guide 23 includes second grooves 23a aligned at the same intervals as the first grooves 22a in the left-right direction. An in-

terval between each two adjacent second grooves 23a indicates a distance between the centers of each two adjacent second grooves 23a in the left-right direction. Each second groove 23a is an opening on the front side in the front-rear direction. A direction toward the front side in the front-rear direction is equivalent to an opening direction of the present invention, in which each second groove 23a is open.

[0047] The positions of the first grooves 22a are substantially the same as the second grooves 23a in the left-right direction. When the yarns Y running in the yarn running direction are threaded to the adjacent first grooves 22a and the adjacent second grooves 23a, (i) the movement of the yarns Y in the left-right direction is regulated and (ii) yarn paths are defined. The first regulatory guide 22 and the second regulatory guide 23 are configured to support the yarns Y when the yarns Y are bundled in the yarn processing unit 21. The positions of the first grooves 22a are substantially the same as the second grooves 23a in the left-right direction. This includes the case where the positions of the first grooves 22a are identical with those of the second grooves 23a in the left-right direction and the case where the positions of the first grooves 22a are slightly different from those of the second grooves 23a in the left-right direction.

[0048] The first yarn holding component 24 is able to hold the yarns Y that are to be threaded to the first regulatory guide 22. The first yarn holding component 24 is a plate-shaped member extending in the left-right direction. The first yarn holding component 24 includes first retaining grooves 24a provided at the same intervals as the first grooves 22a in the left-right direction. An interval between each two adjacent first retaining grooves 24a indicates a distance between the centers of each two adjacent first retaining grooves 24a in the left-right direction. The movement of the yarns Y threaded to the first retaining grooves 24a is regulated in the left-right direction. The positions of the first grooves 22a are substantially the same as the first retaining grooves 24a in the left-right direction. The first yarn holding component 24 is movable between a yarn threading position (see FIG. 2 and FIG. 5) at which the yarns Y are threaded to the first yarn retaining grooves 24a and a handover completion position (see FIG. 3 and FIG. 6) at which the handover of the yarns Y to the first regulatory guide 22 is completed. In this regard, the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23 indicate the yarn paths of the yarns shown in FIG. 6. The positions of the first grooves 22a are substantially the same as the first retaining grooves 24a in the left-right direction. This includes the case where the positions of the first grooves 22a are identical with those of the first retaining grooves 24a in the left-right direction and the case where the positions of the first grooves 22a are slightly different from those of the first retaining grooves 24a in the left-right direction.

[0049] As shown in FIG. 2 and FIG. 5, the first yarn holding component 24 at the yarn threading position is provided downstream of the first regulatory guide 22 in the yarn running direction and in front of the yarn processing unit 21 in the front-rear direction. As shown in FIG. 5, when viewed in the left-right direction, the first yarn holding component 24 at the yarn threading position is deviated in the forward direction from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23. That is, the yarn threading position of the first yarn holding component 24 is a position where the first yarn holding component 24 viewed in the left-right direction is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23, in the opening direction in which the first grooves 22a are open. As shown in FIG. 3 and FIG. 6, the first yarn holding component 24 at the handover completion position is provided upstream of the first regulatory guide 22 in the yarn running direction and behind the first regulatory guide 22 in the front-rear direction. To be more specific, the handover completion position of the first yarn holding component 24 is a position where the first yarn holding component 24 is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23. When the first yarn holding component 24 is moving from the yarn threading position to the handover completion position, the first yarn holding component 24 hands over the yarns Y to the respective first grooves 22a.

[0050] The second yarn holding component 25 is able to hold the yarns Y that are to be threaded to the second regulatory guide 23. The second yarn holding component 25 is provided downstream of the first yarn holding component 24 in the yarn running direction. The second yarn holding component 25 is a plate-shaped member extending in the left-right direction. The second yarn holding component 25 includes second retaining grooves 25a provided at the same intervals as the second grooves 23a in the left-right direction. An interval between each two adjacent second retaining grooves 25a indicates a distance between the centers of each two adjacent second retaining grooves 25a in the left-right direction. The movement of the yarns Y threaded to the second retaining grooves 25a is regulated in the left-right direction. The positions of the second grooves 23a are substantially the same as the second retaining grooves 25a in the left-right direction. The second yarn holding component 25 is movable between a yarn threading position (see FIG. 2 and FIG. 5) at which the yarns Y are threaded to the second yarn retaining grooves 25a and a handover completion position (see FIG. 3 and FIG. 6) at which the handover of the yarns Y to the second regulatory guide 23 is completed. The positions of the second grooves 23a are substantially the same as the second retaining grooves 25a in the left-right direction. This includes the case where the positions of the second grooves 23a are identical with those of the second retaining grooves 25a in the left-right direction and the case where the positions of the second grooves 23a are slightly different from

those of the second retaining grooves 25a in the left-right direction.

[0051] As shown in FIG. 2 and FIG. 5, the second yarn holding component 25 at the yarn threading position is provided upstream of the second regulatory guide 23 in the yarn running direction, downstream of the first yarn holding component 24 in the yarn running direction, and in front of the yarn processing unit 21 in the front-rear direction. As shown in FIG. 5, when viewed in the left-right direction, the second yarn holding component 25 at the yarn threading position is deviated in the forward direction from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23. That is, the yarn threading position of the second yarn holding component 25 is a position where the second yarn holding component 25 viewed in the left-right direction is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23, in the opening direction in which the second grooves 23a are open. As shown in FIG. 3 and FIG. 6, the second yarn holding component 25 at the handover completion position is provided downstream of the second regulatory guide 23 in the yarn running direction and behind the second regulatory guide 23 in the front-rear direction. To be more specific, the handover completion position of the second yarn holding component 25 is a position where the second yarn holding component 25 is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23. When the second yarn holding component 25 is moving from the yarn threading position to the handover completion position, the second yarn holding component 25 hands over the yarns Y to the respective second grooves 23a.

[0052] As shown in FIG. 2 and FIG. 5, the first yarn holding component 24 at the yarn threading position is adjacent to the second yarn holding component 25 at the yarn threading position in the yarn running direction. In this regard, when the first yarn holding component 24 and the second yarn holding component 25 are adjacent to each other, a distance between a front end of the first yarn holding component 24 at the yarn threading position and a front end of the second yarn holding component 25 at the yarn threading position is 0 to 10 mm.

[0053] When viewed in the left-right direction as shown in FIG. 5, an angle x is an acute angle between (i) a first depth direction D1 that is a direction toward the bottom of each of the first retaining grooves 24a of the first yarn holding component 24 at the yarn threading position and (ii) a second depth direction D2 that is a direction toward the bottom of each of the second retaining grooves 25a of the second yarn holding component 25 at the yarn threading position. To be more specific, when viewed in the left-right direction, the angle x between the first depth direction D1 and the second depth direction D2 is preferably 15 degrees or more. For example, the angle x is 20 degrees. In the present embodiment, the first depth direction D1 is parallel to the front-rear direction, and the second depth direction D2 is inclined relative to the front-rear direction so that, at the yarn threading position, the front end of the second yarn holding component 25 is higher than the rear end thereof.

[0054] As shown in FIG. 5, in the first depth direction D1, a leading end of the second yarn holding component 25 at the yarn threading position is far from each first retaining groove 24a as compared to a leading end of the first yarn holding component 24 at the yarn threading position. In the present embodiment, the leading end of the second yarn holding component 25 at the yarn threading position is on the front side of the leading end of the first yarn holding component 24 at the yarn threading position in the front-rear direction.

[0055] The synchronizing mechanism 30 is configured to synchronize the movement of the first yarn holding component 24 between the yarn threading position and the handover completion position with that of the second yarn holding component 25 between the yarn threading position and the handover completion position. As shown in FIG. 7, the synchronizing mechanism 30 includes a first swing arm 41 which is rotatable about a first swing shaft 51 extending along the left-right direction and a second swing arm 42 which is rotatable about a second swing shaft 52 extending along the left-right direction.

[0056] As shown in FIG. 2, the first swing arm 41 cantilevers a left end of the first yarn holding component 24 at its leading end part. The first swing arm 41 is configured to rotate about the first swing shaft 51 so as to enable the first yarn holding component 24 to swing (see a full-line arrow in FIG. 7) between the yarn threading position and the handover completion position. When the first yarn holding component 24 is at the yarn threading position, the first swing arm 41 extends in the front-rear direction (see FIG. 7). When the first yarn holding component 24 is at the handover completion position, the first swing arm 41 extends upward and forward (see FIG. 8).

[0057] As shown in FIG. 2, the second swing arm 42 cantilevers a left end of the second yarn holding component 25 at its leading end part. The second swing arm 42 is configured to rotate about the second swing shaft 52 so as to enable the second yarn holding component 25 to swing (see a full-line arrow in FIG. 7) between the yarn threading position and the handover completion position. When the second yarn holding component 25 is at the yarn threading position, the second swing arm 42 extends in the front-rear direction (see FIG. 7). When the second yarn holding component 25 is at the handover completion position, the second swing arm 42 extends downward and forward (see FIG. 8).

[0058] As shown in FIG. 7, the first swing arm 41 has a first gear 53 with four teeth, and the second swing arm 42 has a second gear 54 with five teeth. The first gear 53 meshes with the second gear 54. The number of teeth forming the first gear 53 may not be four. The number of teeth forming the second gear 54 may not be five.

[0059] The synchronizing mechanism 30 is configured to rotate the first swing arm 41 and the second swing arm

42 in a synchronous manner by means of the first gear 53 and the second gear 54 which mesh with each other. For example, the synchronizing mechanism 30 includes an unillustrated motor configured to rotationally drive one of the first swing shaft 51 and the second swing shaft 52. However, the synchronizing mechanism 30 may not include the motor. Alternatively, the synchronizing mechanism 30 may include, e.g., a lever (not illustrated) attached to one of the first swing arm 41 and the second swing arm 42. In this case, as the operator pulls the lever, the one of the first swing arm 41 and the second swing arm 42 starts to rotate. Because the first gear 53 meshes with the second gear 54, the other of the first swing arm 41 and the second swing arm 42 starts to rotate accordingly.

(Yarn Threading to Yarn Processing Apparatus 7)

[0060] The following will describe specific processes of threading the yarns Y to the first regulatory guide 22 and second regulatory guide 23 of the yarn processing apparatus 7. In the yarn production system 1, yarn threading to the two regulatory guides of the yarn processing apparatus 7 is performed after yarn threading to the guides 6. The yarn threading to the first regulatory guide 22 and second regulatory guide 23 of the yarn processing apparatus 7 is performed by using, e.g., a suction gun 80. The suction gun 80 is configured to suck and converge the yarns Y.

[0061] Before the yarn threading to the yarn processing apparatus 7, the synchronizing mechanism 30 moves the first yarn holding component 24 and the second yarn holding component 25 to the respective yarn threading positions in advance (see FIG. 2). Subsequently, as shown in FIG. 5, the operator threads the yarns Y which are sucked and bundled by the suction gun 80 to (i) the respective first retaining grooves 24a of the first yarn holding component 24 and (ii) the respective second retaining grooves 25a of the second yarn holding component 25. In this regard, the operator performs the yarn threading to the first yarn holding component 24 and the second yarn holding component 25 while viewing the first yarn holding component 24 and the second yarn holding component 25 which are provided at the yarn processing apparatus 7 provided at the position slightly higher than the height of the line of sight of the operator.

[0062] The following will specifically describe the behavior of the operator who threads the yarns Y to the first yarn holding component 24 and the second yarn holding component 25 by using the suction gun 80. The operator views the first yarn holding component 24 and the second yarn holding component 25 while trying to look into the bottom of each first retaining groove 24a from a position slightly lower than the yarn processing apparatus 7. In other words, while trying to adjust the line of sight of the operator to be in parallel with the first depth direction D1 of the first yarn holding component 24 as much as possible, the operator at the position slightly lower than the yarn processing apparatus 7 looks up at the first yarn holding component 24 and the second yarn holding component 25. In this regard, as described above, the leading end of the second yarn holding component 25 at the yarn threading position is on the front side of the leading end of the first yarn holding component 24 at the yarn threading position in the front-rear direction (see FIG. 5). With this arrangement, when the operator at the position slightly lower than the yarn processing apparatus 7 looks up at the first yarn holding component 24 at the yarn threading position and the second yarn holding component 25 at the yarn threading position, the first yarn holding component 24 is provided at least partially hidden behind the second yarn holding component 25. As described above, the angle x between (i) the first depth direction D1 of each first retaining groove 24a of the first yarn holding component 24 at the yarn threading position and (ii) the second depth direction D2 of each second retaining groove 25a of the second yarn holding component 25 at the yarn threading position is 20 degrees (see FIG. 5). With this arrangement, when the operator views the first yarn holding component 24 and the second yarn holding component 25 while trying to look into the bottom of each first retaining groove 24a, the operator actually views the second yarn holding component 25. The bottoms of the second retaining grooves 25a of the second yarn holding component 25 are not aligned with not-grooved parts of the second yarn holding component 25. With this arrangement, the operator easily distinguishes the second retaining grooves 25a of the second yarn holding component 25 from the not-grooved parts thereof. The operator therefore performs the yarn threading to the first yarn holding component 24 and the second yarn holding component 25, and adjusts the position of the suction gun 80 so that the intervals of the second retaining grooves 25a which are easily distinguishable match those of the yarns Y which are sucked by a suction port 81 of the suction gun 80. As described above, the first yarn holding component 24 at the yarn threading position is adjacent to the second yarn holding component 25 at the yarn threading position in the yarn running direction. With this arrangement, the yarns Y are threaded to the first yarn holding component 24 and the second yarn holding component 25 substantially at the same time.

[0063] Subsequently, the first yarn holding component 24 at the yarn threading position and the second yarn holding component 25 at the yarn threading position are moved to the respective handover completion positions in a synchronous manner by the synchronizing mechanism 30. To be more specific, when viewed from the right side in the left-right direction, the first yarn holding component 24 is swung from the yarn threading position to the handover completion position as the first swing arm 41 rotates counterclockwise (indicated by a full-line arrow in FIG. 7) about the first swing shaft 51. When viewed from the right side in the left-right direction, the second yarn holding component 25 is swung from the yarn

threading position to the handover completion position as the second swing arm 42 rotates clockwise (indicated by a full-line arrow in FIG. 7) about the second swing shaft 52.

[0064] When the first yarn holding component 24 is moving from the yarn threading position to the handover completion position, the yarns Y held by the first yarn holding component 24 are handed over to the respective first grooves 22a of the first regulatory guide 22. To be more specific, after the yarns Y threaded to the first retaining grooves 24a make contact with bottoms of the first grooves 22a of the first regulatory guide 22, the first yarn holding component 24 is further moving toward the handover completion position. In this way, the yarns Y threaded to the first retaining grooves 24a are handed over to the first grooves 22a. As a result, the yarn threading to the first regulatory guide 22 is completed.

[0065] When the second yarn holding component 25 is moving from the yarn threading position to the handover completion position, the yarns Y held by the second yarn holding component 25 are handed over to the respective second grooves 23a of the second regulatory guide 23. To be more specific, after the yarns Y threaded to the second retaining grooves 25a make contact with bottoms of the second grooves 23a of the second regulatory guide 23, the second yarn holding component 25 is further moving toward the handover completion position. In this way, the yarns Y threaded to the second retaining grooves 25a are handed over to the second grooves 23a. As a result, the yarn threading to the second regulatory guide 23 is completed.

[0066] The yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23 are guided by the inclined surfaces 26a and 26b of the yarn processing unit 21, and threaded to the first yarn passages 36.

(Effects)

[0067] The yarn processing apparatus 7 of the present embodiment further includes: the first regulatory guide 22 provided upstream of the yarn processing unit 21 in the yarn running direction; the second regulatory guide 23 provided downstream of the yarn processing unit 21 in the yarn running direction; the first yarn holding component 24 which is able to hold the yarns Y that are to be threaded to the first regulatory guide 22; and the second yarn holding component 25 which is able to hold the yarns Y that are to be threaded to the second regulatory guide 23. The first yarn holding component 24 includes the first retaining grooves 24a, and is movable between the yarn threading position and the handover completion position. The second yarn holding component 25 includes the second retaining grooves 25a, and is movable between the yarn threading position and the handover completion position. The first yarn holding component 24 at the yarn threading position is adjacent to the second yarn holding component 25 at the yarn threading position in the yarn running direction. When viewed in the left-right direction, the angle x is an acute angle between (i) the first depth direction D1 that is a direction toward the bottom of each first retaining groove 24a of the first yarn holding component 24 at the yarn threading position and (ii) the second depth direction D2 that is a direction toward the bottom of each second retaining groove 25a of the second yarn holding component 25 at the yarn threading position.

[0068] In the present embodiment, when viewed in the left-right direction, the angle x is an acute angle between (i) the first depth direction D1 of each first retaining groove 24a of the first yarn holding component 24 at the yarn threading position and (ii) the second depth direction D2 of each second retaining groove 25a of the second yarn holding component 25 at the yarn threading position. Because of this, even when the operator tries to look into the bottom of each first retaining groove 24a of the first yarn holding component 24 at the yarn threading position in order to match the intervals of the yarns Y sucked and bundled by the suction gun 80 with those of the first retaining grooves 24a, the second yarn holding component 25 at the yarn threading position is viewed in a direction intersecting with the second depth direction D2 of the second retaining grooves 25a. When the operator views the two yarn holding components at the respective yarn threading positions, the bottoms of the second retaining grooves 25a of the second yarn holding component 25 are not substantially aligned with the not-grooved parts of the second yarn holding component 25. This makes it easy to distinguish the second retaining grooves 25a of the second yarn holding component 25 from the not-grooved parts thereof. In the present embodiment, the two yarn holding components at the respective yarn threading positions are adjacent to each other in the yarn running direction. With this arrangement, the operator easily performs the yarn threading to the two yarn holding components by threading the yarns Y to the respective retaining grooves of the two yarn holding components with reference to the intervals of the second retaining grooves 25a of the second yarn holding component 25 which are easily distinguishable. This facilitates the yarn threading to the two regulatory guides provided on the upstream and downstream sides of the yarn processing unit 21 of the yarn processing apparatus 7 in the yarn running direction.

[0069] In the present embodiment, in the first depth direction D1, the leading end of the second yarn holding component 25 at the yarn threading position is far from each first retaining groove 24a as compared to the leading end of the first yarn holding component 24 at the yarn threading position. In the yarn threading, when the operator views the two yarn holding components at the respective yarn threading positions, the operator has difficulty in fixing the line of sight while both of the yarn holding components are in sight of the operator. That is, even when the operator focuses on one of the yarn holding components, the operator tends to move the line of sight because the other of the yarn holding components is also

in sight of the operator. This makes it difficult to perform the yarn threading to the yarn holding components. In the present embodiment, when the operator views the two yarn holding components at the respective yarn threading positions, a part of or all of the first yarn holding component 24 is at least partially hidden behind the second yarn holding component 25. Because of this, even when the operator focuses on the second yarn holding component 25, a part of or all of the first yarn holding component 24 is outside the sight of the operator. This suppresses the movement of the line of sight of the operator. It is therefore possible to further facilitate the yarn threading to the two yarn holding components.

[0070] In the present embodiment, when viewed in the left-right direction, the angle x between the first depth direction D1 and the second depth direction D2 is 20 degrees. When the angle x between the first depth direction D1 and the second depth direction D2 is viewed in the left-right direction and excessively small, the increase in visibility is limited in regard to the intervals of retaining grooves of each yarn holding component at the yarn threading position. In the present embodiment, when viewed in the left-right direction, the angle x between the first depth direction D1 and the second depth direction D2 is 15 degrees or more. With this arrangement, when the operator tries to look into the bottom of each retaining groove 24a of the first yarn holding component 24 at the yarn threading position, the bottoms of the second retaining grooves 25a of the second yarn holding component 25 at the yarn threading position are apparently distinguished from the not-grooved parts thereof. It is therefore possible to further facilitate the yarn threading to the two yarn holding components.

[0071] In the present embodiment, the first yarn holding component 24 and the second yarn holding component 25 are plate-shaped members. In the present embodiment, the thickness of each of the first yarn holding component 24 and the second yarn holding component 25 formed as plate-shaped members is arranged to be small so that the first yarn holding component 24 and the second yarn holding component 25 at the respective yarn threading positions can be moved close to each other in the yarn running direction. It is therefore possible to further easily thread the yarns Y in a bundle to retaining grooves of each yarn holding component.

[0072] In the present embodiment, the yarn processing apparatus 7 includes the synchronizing mechanism 30 configured to synchronize the movement of the first yarn holding component 24 between the yarn threading position and the handover completion position with that of the second yarn holding component 25 between the yarn threading position and the handover completion position. When (i) the handover of the yarns Y from one yarn holding component to one regulatory guide is performed at first and (ii) the handover of the yarns Y from the other yarn holding component to the other regulatory guide is then performed, the yarns Y may be lifted up and detached from one regulatory guide, in which the handover of the yarns Y has been completed, in accordance with the handover of the yarns Y from the other yarn holding component to the other regulatory guide. In the present embodiment, the handover of the yarns Y from the first yarn holding component 24 to the first regulatory guide 22 is performable at the same time as the handover of the yarns Y from the second yarn holding component 25 to the second regulatory guide 23. It is therefore possible to further reliably perform the yarn threading to the two regulatory guides.

[0073] In the present embodiment, the synchronizing mechanism 30 includes: the first swing arm 41 which is rotatable about the first swing shaft 51 extending along the left-right direction and which swingably supports the first yarn holding component 24; and the second swing arm 42 which is rotatable about the second swing shaft 52 extending along the left-right direction and which swingably supports the second yarn holding component 25. The first swing arm 41 has the first gear 53, and the second swing arm 42 has the second gear 54. The synchronizing mechanism 30 is configured to rotate the first swing arm 41 and the second swing arm 42 in a synchronous manner by means of the first gear 53 and the second gear 54 which mesh with each other, so as to synchronize the movement of the first yarn holding component 24 and that of the second yarn holding component 25. In the present embodiment, as the first swing arm 41 and the second swing arm 42 are rotated in a synchronous manner by the first gear 53 and the second gear 54 which mesh with each other, the first yarn holding component 24 and the second yarn holding component 25 are swung in a synchronous manner. Because of this, a complicated structure and complicated control are unnecessary for the synchronized movement of the first yarn holding component 24 and the second yarn holding component 25.

[0074] In the present embodiment, the yarn threading position of the first yarn holding component 24 is a position where the first yarn holding component 24 viewed in the left-right direction is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23, in the opening direction in which the first grooves 22a are open. The yarn threading position of the second yarn holding component 25 is a position where the second yarn holding component 25 viewed in the left-right direction is deviated from the yarn paths of the yarns Y threaded to the first regulatory guide 22 and the second regulatory guide 23, in the opening direction in which the second grooves 23a are open. In the present embodiment, when the yarns Y are threaded to the first yarn holding component 24 at the yarn threading position and the second yarn holding component 25 at the yarn threading position, the yarns Y are suppressed from being unintentionally threaded to (i) undesired first grooves 22a of the first regulatory guide 22 instead of corresponding first grooves 22a thereof and (ii) undesired second grooves 23a of the second regulatory guide 23 instead of corresponding second grooves 23a thereof. Because of this, the yarns Y are further reliably threaded

to the corresponding first grooves 22a by moving the first yarn holding component 24 to the handover completion position while the yarns Y are held by the first yarn holding component 24 and not threaded to the first regulatory guide 22. Similarly, the yarns Y are further reliably threaded to the corresponding second grooves 23a by moving the second yarn holding component 25 to the handover completion position while the yarns Y are held by the second yarn holding component 25 and not threaded to the second regulatory guide 23.

[0075] In the present embodiment, when viewed in the left-right direction, the first regulatory guide 22 is deviated from yarn paths of the yarns Y threaded to the first yarn holding component 24 at the yarn threading position. In the present embodiment, when the yarns Y are threaded to the first yarn holding component 24 at the yarn threading position, the yarns Y are further suppressed from being unintentionally threaded to undesired first grooves 22a of the first regulatory guide 22 instead of corresponding first grooves 22a thereof.

(Modifications)

[0076] 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.

[0077] In the embodiment above, in the first depth direction D1, the leading end of the second yarn holding component 25 at the yarn threading position is far from each first retaining groove 24a as compared to the leading end of the first yarn holding component 24 at the yarn threading position. However, in the second depth direction D2, the leading end of the first yarn holding component 24 at the yarn threading position may be far from each second retaining groove 25a as compared to the leading end of the second yarn holding component 25 at the yarn threading position. In other words, the leading end of the first yarn holding component 24 at the yarn threading position may be on the front side of the leading end of the second yarn holding component 25 at the yarn threading position in the front-rear direction.

[0078] In the embodiment above, when viewed in the left-right direction, the angle x between the first depth direction D1 and the second depth direction D2 is 15 degrees or more. However, when viewed in the left-right direction, the angle x between the first depth direction D1 and the second depth direction D2 may be an acute angle of less than 15 degrees.

[0079] In the embodiment above, the yarn processing apparatus 7 is configured to bundle the yarns Y by means of the injection of compressed air. However, the disclosure is not limited to this yarn processing apparatus. Examples of the yarn processing apparatus include an apparatus in which regulatory guides (e.g., the first regulatory guide and the second regulatory guide) are provided on the upstream and downstream sides of a yarn processing unit in order to perform a predetermined process for yarns Y running substantially parallel to each other at substantially equal intervals in the yarn processing unit. Examples of the yarn processing apparatus also include an apparatus including, as the yarn processing unit, a member such as an oil nozzle configured to apply oil to the yarns Y and a tension sensor configured to detect the tension of the yarns Y.

[0080] In the embodiment above, the first yarn holding component 24 is swung by the first swing arm 41, and the second yarn holding component 25 is swung by the second swing arm 42. However, the first yarn holding component 24 and the second yarn holding component 25 are not limited to components of a swing type. For example, the first yarn holding component 24 may be movable between the yarn threading position and the handover completion position by moving in the up-down direction and the front-rear direction. Similarly, the second yarn holding component 25 may be movable between the yarn threading position and the handover completion position by moving in the up-down direction and the front-rear direction. To be more specific, the first yarn holding component 24 at the yarn threading position is moved upward and then rearward so as to reach the handover completion position. The second yarn holding component 25 at the yarn threading position is moved downward and then rearward so as to reach the handover completion position. Alternatively, the first yarn holding component 24 may be movable between the yarn threading position and the handover completion position in an oblique direction. Similarly, the second yarn holding component 25 may be movable between the yarn threading position and the handover completion position in an oblique direction.

[0081] In the embodiment above, the yarn processing apparatus 7 includes the synchronizing mechanism 30 configured to synchronize the movement of the first yarn holding component 24 with that of the second yarn holding component 25. However, the yarn processing apparatus 7 may not include the synchronizing mechanism 30. In this case, the movement of the first yarn holding component 24 between the yarn threading position and the handover completion position is performed independently from that of the second yarn holding component 25 between the yarn threading position and the handover completion position.

[0082] In the embodiment above, the yarn threading to the yarn processing apparatus 7 is performed by using the suction gun 80. However, the yarn threading may be performed by using hook guides configured to converge the yarns Y at one position.

[0083] In the embodiment above, the first yarn holding component 24 at the yarn threading position and the second yarn holding component 25 at the yarn threading position are provided downstream of the first regulatory guide 22 and upstream of the second regulatory guide 23 in the yarn running direction. However, the first yarn holding component 24 at the yarn threading position and

the second yarn holding component 25 at the yarn threading position may be provided upstream of the first regulatory guide 22 in the yarn running direction or downstream of the second regulatory guide 23 in the yarn running direction.

[0084] In the embodiment above, the yarn processing apparatus 7 is provided below the guides 6 and above the godet roller 11 in the yarn production system 1. However, the position of the yarn processing apparatus 7 is not limited to this. When (i) the intervals of yarns on the upstream side are different from those on the downstream side in the yarn running direction because of the yarn threading using the suction gun 80, etc. and (ii) the yarns Y are threaded to two regulatory guides (the first regulatory guide and the second regulatory guide) which are separated from each other in the yarn running direction and which have groove portions (the first grooves and the second grooves) provided at the same intervals in the arrangement direction, the present invention is effective.

[0085] In the embodiment above, the yarns Y which are converged at the suction gun 80 are placed in the yarn running spaces 31 formed at the yarn processing unit 21. In the arrangement direction of the yarns Y, the intervals of the yarns Y on the upstream side are larger than those on the downstream side in the yarn running direction (i.e., the intervals of the yarns Y in the arrangement direction are tapered with respect to the yarn running direction). In the arrangement direction of the yarns Y placed in the yarn running spaces 31, however, the intervals of the yarns Y on the upstream side may be narrower than those on the downstream side in the yarn running direction (i.e., the intervals of the yarns Y in the arrangement direction may be flared with respect to the yarn running direction).

Claims

1. A yarn processing apparatus (7) comprising: a yarn processing unit (21) configured to perform a predetermined process for yarns (Y) running in a yarn running direction while being aligned in an arrangement direction intersecting with the yarn running direction;

a first regulatory guide (22) which includes first grooves (22a) aligned in the arrangement direction and which is provided upstream of the yarn processing unit (21) in the yarn running direction;

a second regulatory guide (23) which includes second grooves (23a) provided at the same intervals as the first grooves (22a) in the arrangement direction and which is provided downstream of the yarn processing unit (21) in the yarn running direction;

a first yarn holding component (24) which includes first retaining grooves (24a) provided at the same intervals as the first grooves (22a) in the arrangement direction and which is able to hold the yarns (Y) that are to be threaded to the first regulatory guide (22); and

a second yarn holding component (25) which includes second retaining grooves (25a) provided at the same intervals as the second grooves (23a) in the arrangement direction and which is able to hold the yarns (Y) that are to be threaded to the second regulatory guide (23),

the first yarn holding component (24) being movable between a yarn threading position where the yarns (Y) are threaded to the first retaining grooves (24a) and a handover completion position where the handover of the yarns (Y) to the first regulatory guide (22) is completed,

the second yarn holding component (25) being movable between a yarn threading position where the yarns (Y) are threaded to the second retaining grooves (25a) and a handover completion position where the handover of the yarns (Y) to the second regulatory guide (23) is completed,

the first yarn holding component (24) at the yarn threading position being adjacent to the second yarn holding component (25) at the yarn threading position in the yarn running direction, and

when viewed in the arrangement direction, an angle (x) between (i) a first depth direction (D1) that is a direction toward the bottom of each of the first retaining grooves (24a) of the first yarn holding component (24) at the yarn threading position and (ii) a second depth direction (D2) that is a direction toward the bottom of each of the second retaining grooves (25a) of the second yarn holding component (25) at the yarn threading position being an acute angle.

2. The yarn processing apparatus (7) according to claim 1, wherein, a leading end of the second yarn holding component (25) at the yarn threading position is far from each of the first retaining grooves (24a) as compared to a leading end of the first yarn holding component (24) at the yarn threading position in the first depth direction (D1), or

the leading end of the first yarn holding component (24) at the yarn threading position is far from each of the second retaining grooves (25a) as compared to the leading end of the second yarn holding component (25) at the yarn threading position in the second depth direction (D2).

3. The yarn processing apparatus (7) according to claim 1 or 2, wherein, when viewed in the arrangement direction, the angle (x) between the first depth direction (D1) and the second depth direction (D2) is 15 degrees or more.

4. The yarn processing apparatus (7) according to any one of claims 1 to 3, wherein, the first yarn holding component (24) and the second yarn holding component (25) are plate-shaped members.

5. The yarn processing apparatus (7) according to any one of claims 1 to 4, further comprising a synchronizing mechanism (30) configured to synchronize the movement of the first yarn holding component (24) between the yarn threading position and the handover completion position with the movement of the second yarn holding component (25) between the yarn threading position and the handover completion position.

6. The yarn processing apparatus (7) according to claim 5, wherein, the synchronizing mechanism (30) includes:

a first swing arm (41) which is rotatable about a first swing shaft (51) extending along the arrangement direction and which swingably supports the first yarn holding component (24); and a second swing arm (42) which is rotatable about a second swing shaft (52) extending along the arrangement direction and which swingably supports the second yarn holding component (25),
the first swing arm (41) includes a first gear (53), the second swing arm (42) includes a second gear (54), and
the synchronizing mechanism (30) is configured to rotate the first swing arm (41) and the second swing arm (42) in a synchronous manner by means of the first gear (53) and the second gear (54) which mesh with each other, so as to synchronize the movement of the first yarn holding component (24) with the movement of the second yarn holding component (25).

7. The yarn processing apparatus (7) according to any one of claims 1 to 6, wherein, the yarn threading position of the first yarn holding component (24) is a position where the first yarn holding component (24) viewed in the arrangement direction is deviated from yarn paths of the yarns (Y) threaded to the first regulatory guide (22) and the second regulatory guide (23) in an opening direction in which the first grooves (22a) are open, and
the yarn threading position of the second yarn holding component (25) is a position where the second yarn holding component (25) viewed in the arrangement direction is deviated from the yarn paths of the yarns (Y) threaded to the first regulatory guide (22) and the second regulatory guide (23) in an opening direction in which the second grooves (23a) are open.

8. The yarn processing apparatus (7) according to claim 7, wherein, the first regulatory guide (22) viewed in the arrangement direction is deviated from yarn paths of the yarns (Y) threaded to the first yarn holding component (24) at the yarn threading position.

FIG.1

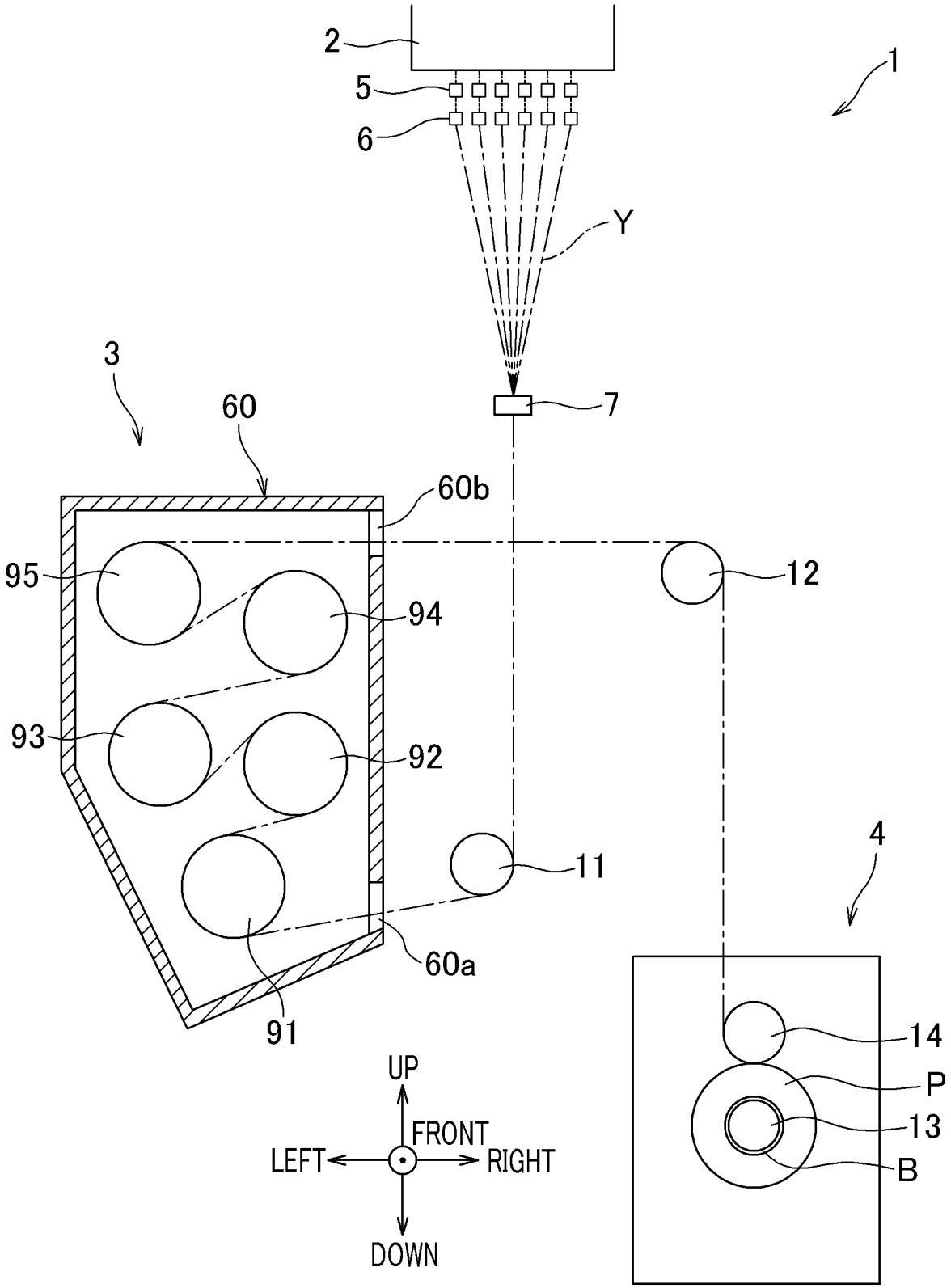

2
5
6
1
Y
3
60
7
60b
95
12
94
93
92
11
4
60a
91
14
P
13
B
UP
FRONT
LEFT
RIGHT
DOWN

FIG.2

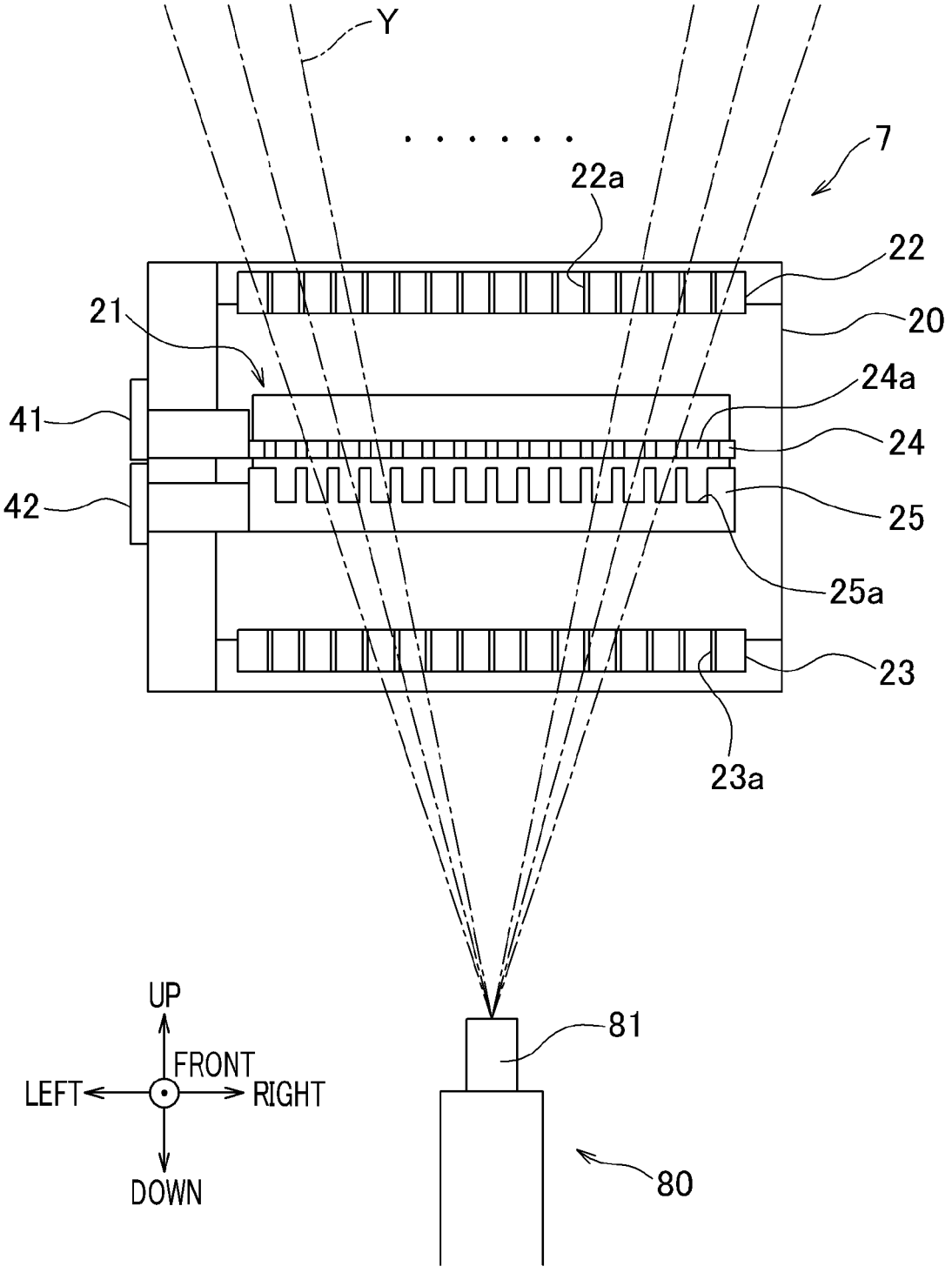
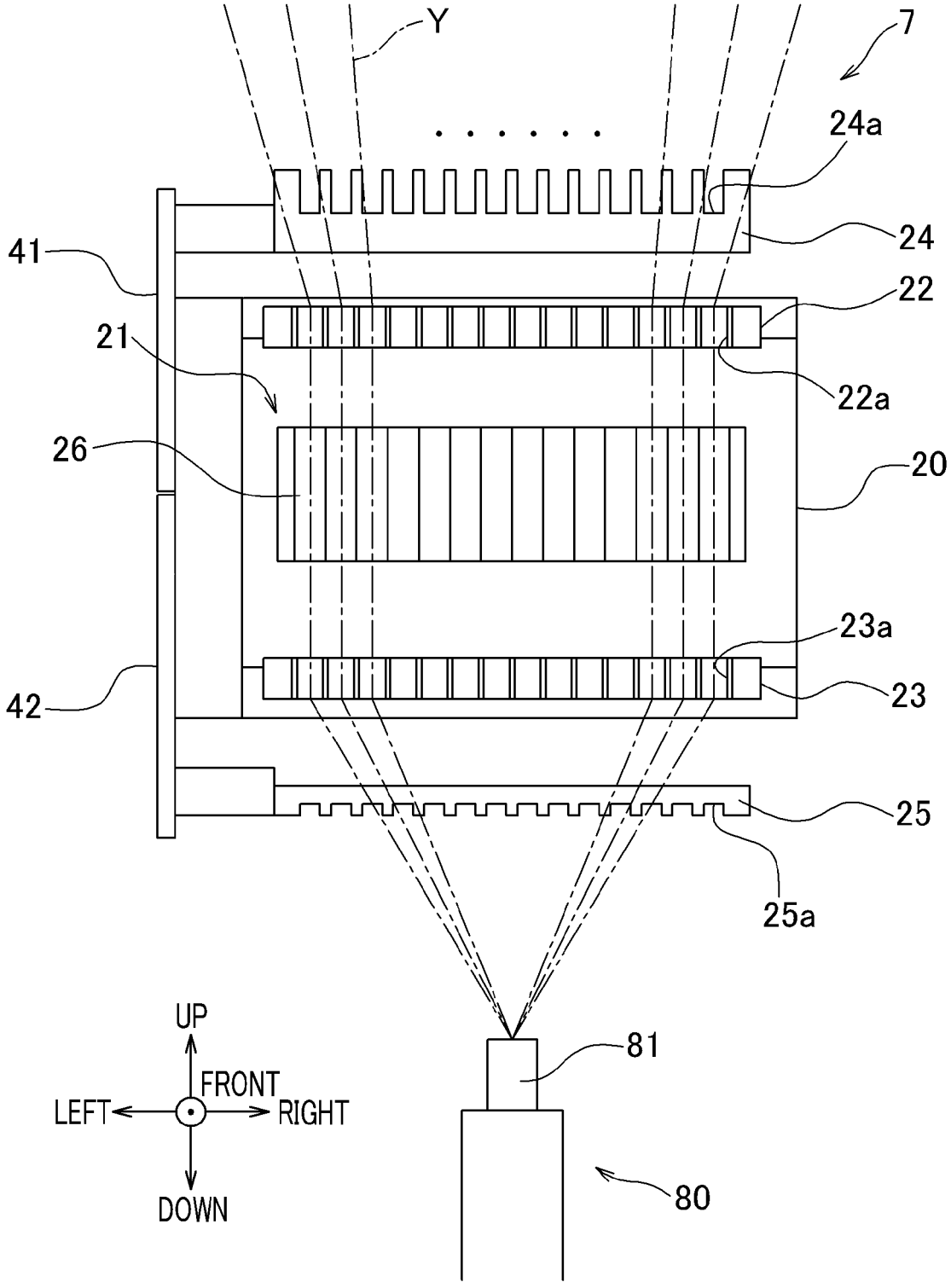

Y
7
22a
22
21
20
24a
41
24
42
25
25a
23
23a
81
80
UP
FRONT
LEFT
RIGHT
DOWN

FIG.3


Y
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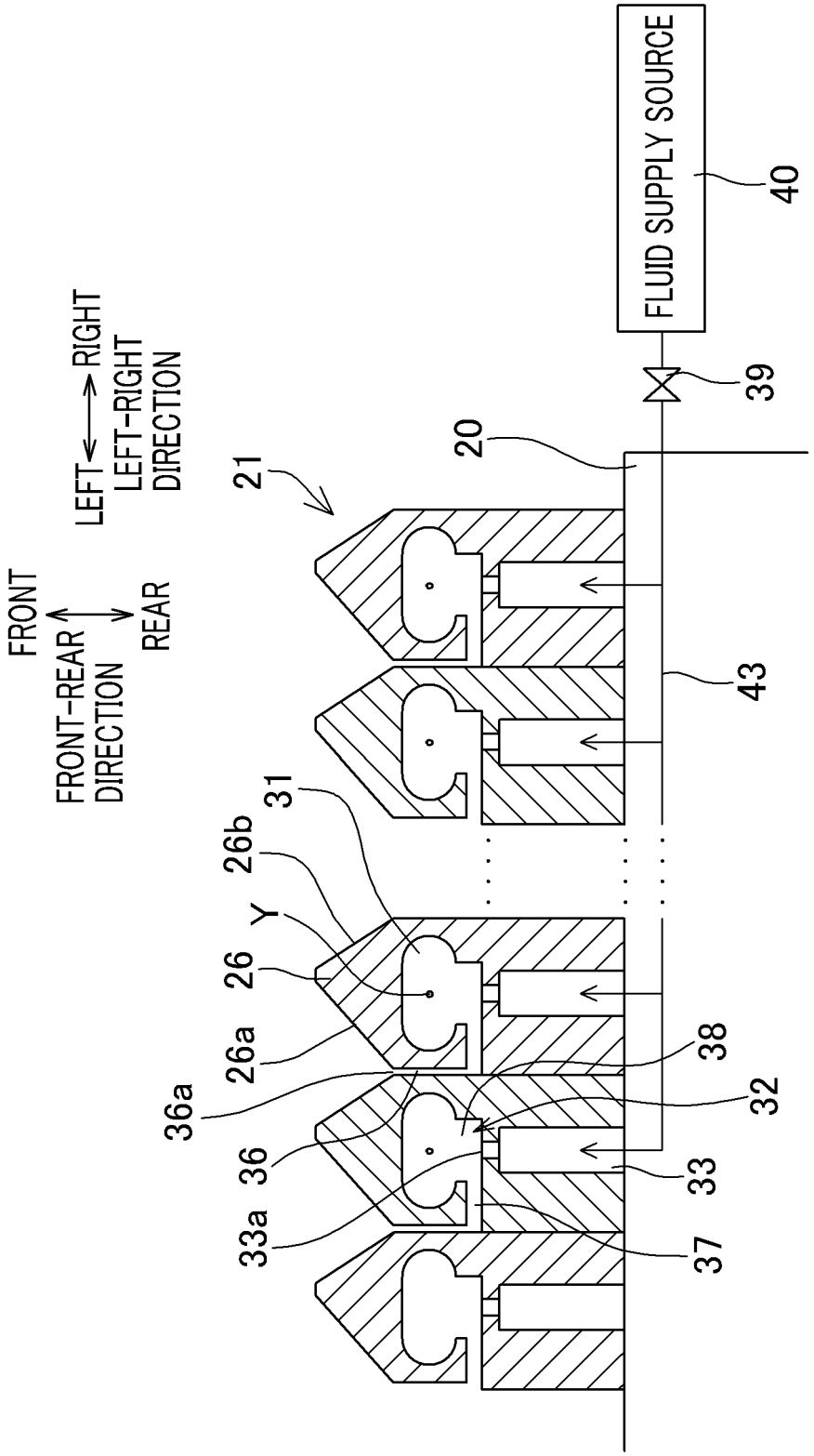
24a
24
41
22
21
22a
26
20
23a
42
23
25
25a
81
UP
FRONT
LEFT
RIGHT
DOWN
80

FIG.4


FLUID SUPPLY SOURCE
40
39
20
21
LEFT
RIGHT
LEFT-RIGHT DIRECTION
FRONT
REAR
FRONT-REAR DIRECTION
43
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26b
Y
26
26a
36a
36
33a
38
32
33
37

FIG.5

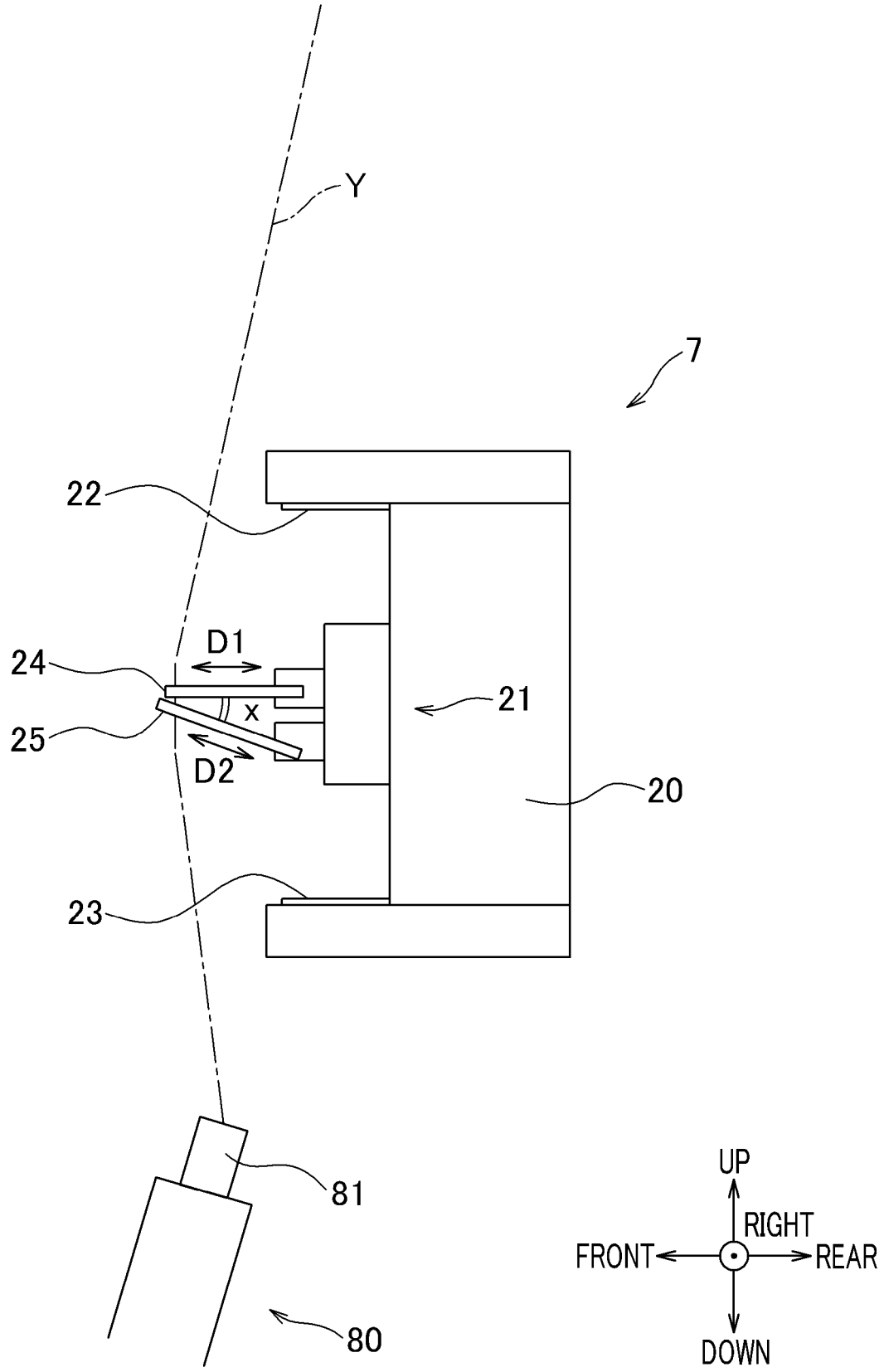


FIG.6

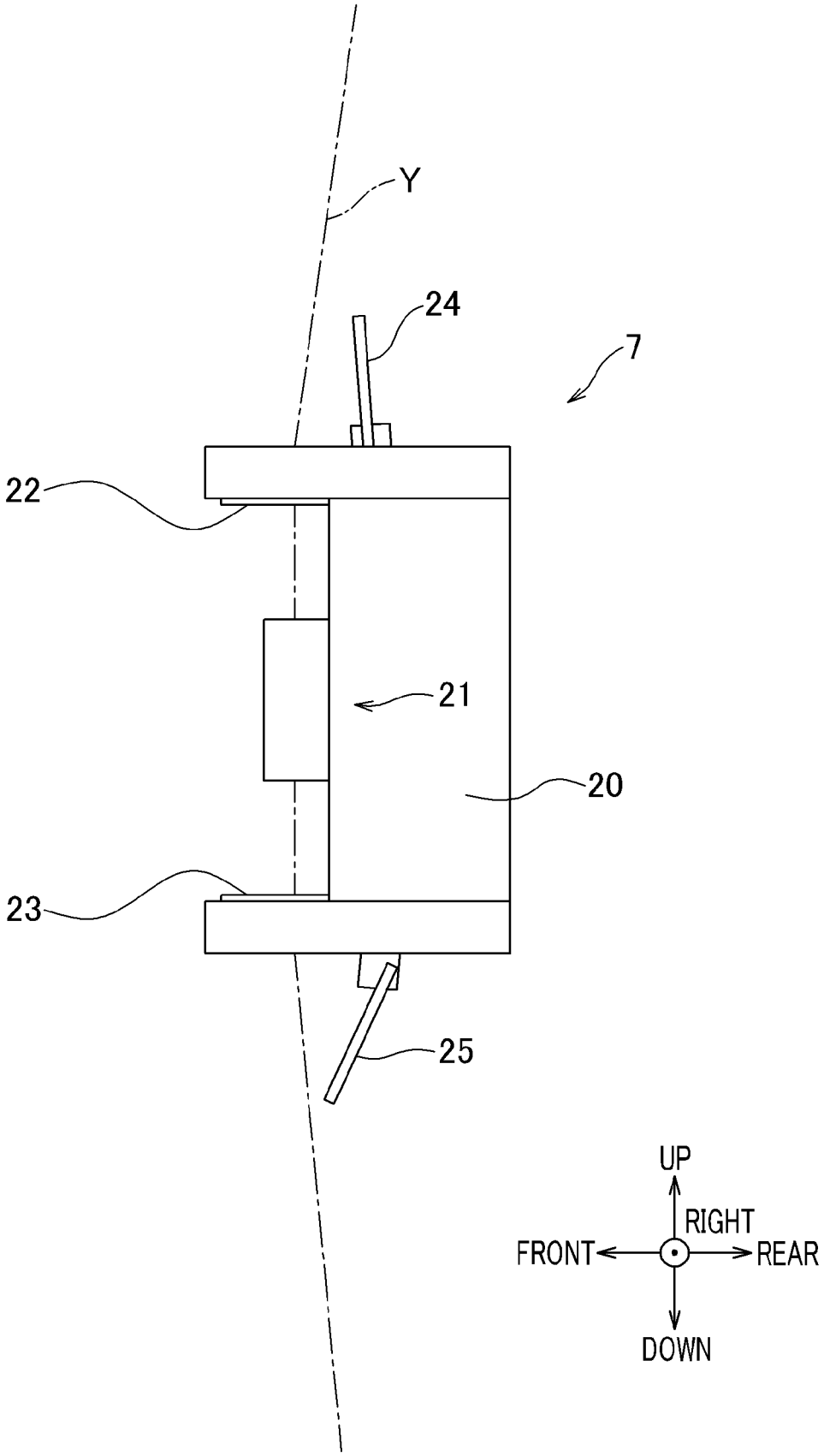


FIG.7

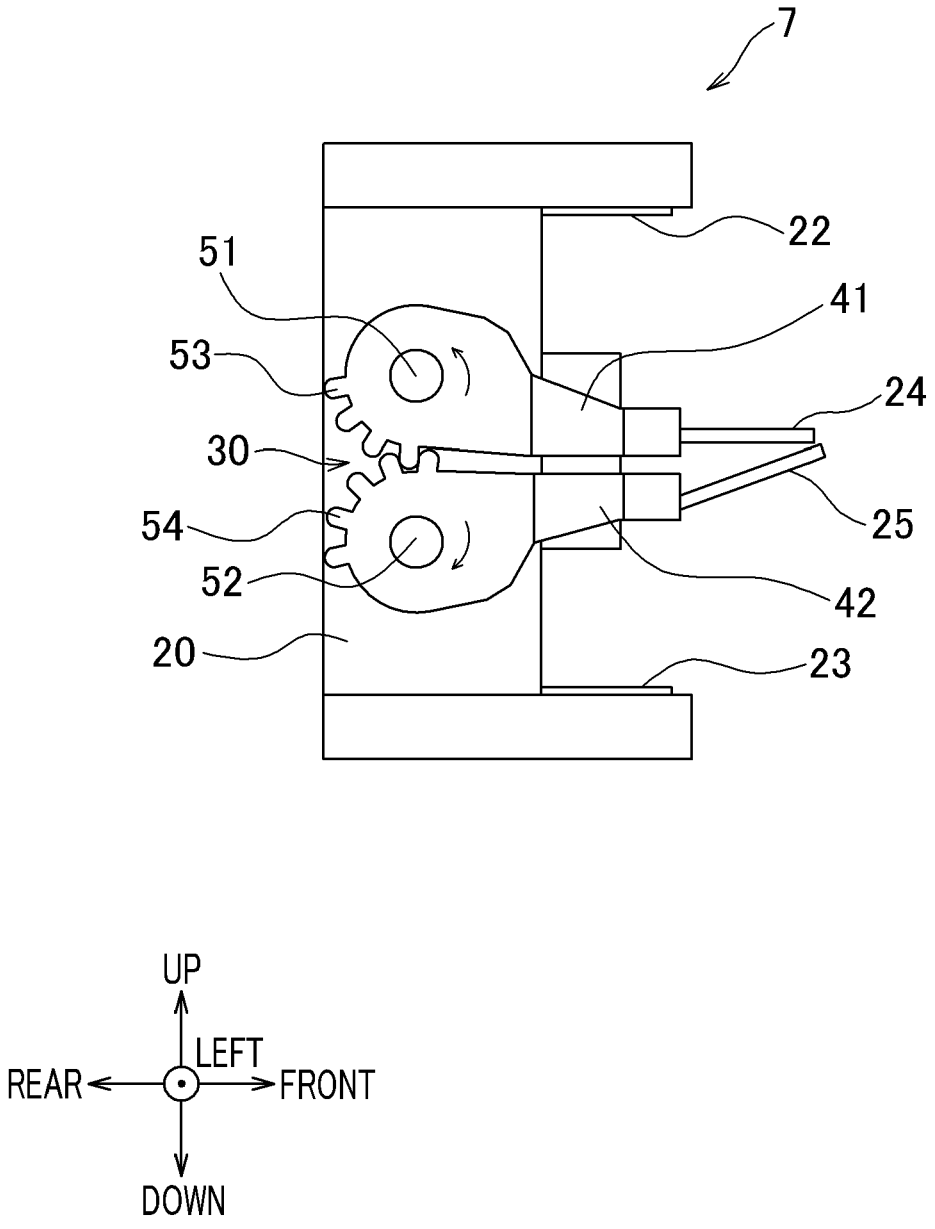
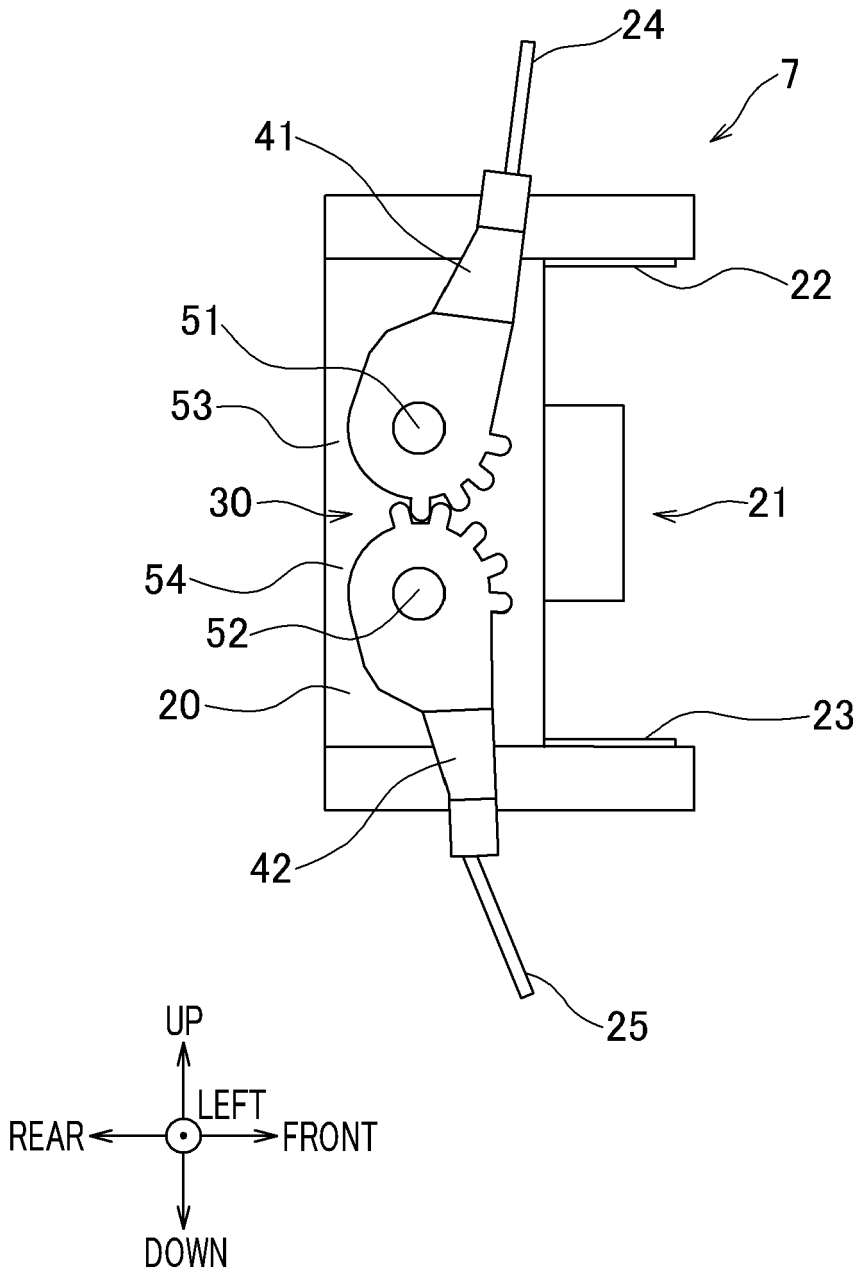


FIG.8



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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 5670

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2019 105007 A (TMT MACHINERY INC) 27 June 2019 (2019-06-27) * paragraphs [0048] - [0057]; figures 2-4, 7-10 *	1-8	INV. B65H57/00 B65H57/16 D02J1/08 B65H57/04 B65H57/28
A	& EP 3 498 898 A1 (TMT MACHINERY INC [JP]) 19 June 2019 (2019-06-19) * paragraphs [0047] - [0056]; figures 2-4, 7-10 *	1-8	
A	EP 2 407 407 A2 (TMT MACHINERY INC [JP]) 18 January 2012 (2012-01-18) * figures 5A-8B *	1	
A	EP 3 967 794 A1 (TMT MACHINERY INC [JP]) 16 March 2022 (2022-03-16) * figures 2-4 *	1	
A	JP 2015 187324 A (TMT MACHINERY INC) 29 October 2015 (2015-10-29) * figures 2-8 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H D02J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 January 2024	Pussemier, Bart

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19-01-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2019105007 A	27-06-2019	CN 109914000 A	21-06-2019
		EP 3498898 A1	19-06-2019
		JP 7128572 B2	31-08-2022
		JP 2019105007 A	27-06-2019
EP 2407407 A2	18-01-2012	CN 102328850 A	25-01-2012
		EP 2407407 A2	18-01-2012
		EP 2639191 A1	18-09-2013
		JP 5642441 B2	17-12-2014
		JP 2012021240 A	02-02-2012
EP 3967794 A1	16-03-2022	CN 114182402 A	15-03-2022
		EP 3967794 A1	16-03-2022
		JP 2022047628 A	25-03-2022
JP 2015187324 A	29-10-2015	CN 104911725 A	16-09-2015
		JP 6450214 B2	09-01-2019
		JP 2015187324 A	29-10-2015

EPO FORM P0459

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Patent documents cited in the description

- JP 2013057148 A **[0002]**
- JP 2019105007 A **[0003]**