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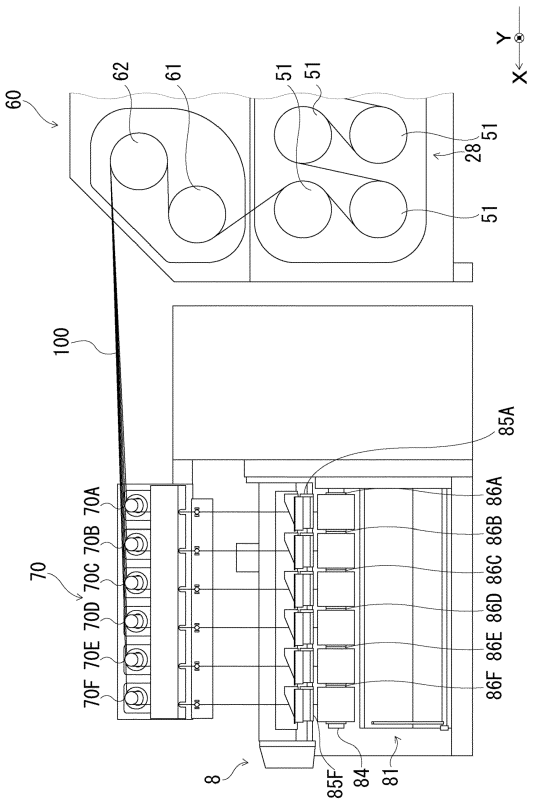
(54) SPUN YARN TAKE-UP APPARATUS

(57) In order to provide a spun yarn take-up apparatus lower in floor level than a conventional apparatus, the spun yarn take-up apparatus comprises a spun yarn take-up unit 6 for taking up and drawing a plurality of yarns 100 spun from a spinning machine, and a spooling unit 8 for winding the plurality of yarns 100 delivered from the spun yarn take-up unit 6 to form a wound package. The spun yarn take-up unit 6 includes: a first guide section 10 for guiding the plurality of yarns 100 downstream along a yarn traveling direction; and a drawing section 28 including a plurality of rollers having at least one roller for drawing the plurality of yarns 100 guided by the first guide section 10; and a second guide section 62, 70 for guiding the plurality of yarns 100 from the drawing section 28 to the spooling unit 8. The spooling unit 8 and the drawing section 28 are arranged horizontally. The second guide section has a second relaxing roller 62 and the distribution section 70. The plurality of yarns 100 from the drawing section 28 are delivered to the spooling unit 8 through the distribution section 70 and the second relaxing roller 62.

[Fig. 6]



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Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates a spun yarn take-up apparatus for taking up yarns spun from a spinning machine so as to form a wound package. In particular, the present invention relates to a spun yarn take-up apparatus for an industrial material yarn of high fineness requiring a long heating length.

DESCRIPTION OF THE BACKGROUND ART

[0002] A spun yarn take-up apparatus for taking up yarns spun from a spinning machine so as to form a wound package has required a yarn setting operation of setting, when the production is started, yarns spun from the spinning machine in such a manner that the spun yarns reach a spooling unit along a yarn path.

[0003] A general spun yarn take-up apparatus has been configured, as disclosed in, *e.g.,*

[0004] Patent Document 1 (see FIG. 1 in particular), such that processing assemblies including a plurality of rollers or the like are arranged below the spinning machine, and the spooling unit is arranged below the processing assemblies. Performing a yarn setting operation for such a spun yarn take-up apparatus has required a first floor staff, i.e., a yarn setting staff expected to set yarns to their respective rollers or the like (mezzanine staff) and a yarn setting staff expected to set yarns to the spooling unit arranged below the plurality of rollers or the like.

(Priot Art Documents)

(Patent Documents)

[0005] Patent Document 1: US Patent Application Publication No. 2009/0049669

(Problems to be Solved)

[0006] In the meantime, manpower savings have recently been required in plants and equipment. The general spun yarn take-up apparatus disclosed in Patent Document 1 has, however, required the yarn setting operation to be performed by at least two staffs having the mezzanine staff expected to set yarns to their respective rollers or the like and the yarn setting staff expected to set yarns to the spooling unit. When the yarn setting operation is performed by two staffs consisting of the mezzanine staff expected to set yarns to their respective rollers or the like and the yarn setting staff expected to set yarns to the spooling unit, it has undesirably taken a longer time because transferring a suctioning gun suctioning yarns between the staffs is required at each operation of setting yarns to their respective rollers or the like and to the spooling unit. Even if the yarn setting operation of setting yarns to their respective rollers or the like and to the spooling unit is performed only by one operator, the operator would have to get in and out of a working truck, which results in not only taking a longer time but also putting an increased burden on the operator because setting yarns at the mezzanine having their respective rollers arranged thereon is a high-place operation. It has urgently been required, therefore, to suppress a height of the spun yarn take-up apparatus having a reduced floor level so as to shorten a yarn setting time and save manpower.

SUMMARY OF THE INVENTION

[0007] In view of the above-described problems, the objective of the present invention is to provide a spun yarn take-up apparatus having a suppressed height so as to be lower in floor level than a conventional apparatus thereby to shorten a yarn setting time and save manpower.

(Means for Solving Problems)

[0008]

[1] A first aspect of the present invention is a spun yarn take-up apparatus comprising a spun yarn take-up unit for taking up and at least drawing a plurality of yarns spun from a spinning machine and a spooling unit for winding the plurality of yarns delivered from the spun yarn take-up unit to form a wound package, wherein
the spun yarn take-up unit includes:

a first guide section for guiding the plurality of yarns spun from the spinning machine downstream along a yarn traveling direction;
a drawing section including a plurality of rollers having at least one roller for drawing the plurality of yarns guided by the first guide section; and
a second guide section for guiding the plurality of yarns from the drawing section to the spooling unit, and wherein
the spooling unit and the drawing section are arranged horizontally, and
the second guide section has: a guide roller arranged downstream from the drawing section along a yarn traveling direction; and a plurality of distribution rollers arranged downstream from the guide roller along a yarn traveling direction, the plurality of distribution rollers provided with a driver arranged above the spooling unit, wherein the plurality of yarns from the drawing section are delivered to the spooling unit through the guide roller and the plurality of distribution rollers.

[0009] According to the above-described first aspect [1] of the spun yarn take-up apparatus, the plurality of yarns from the drawing section are delivered to the spooling unit through the guide roller and the plurality of distribution rollers. As a result of arranging the spooling unit and the drawing section horizontally, a height of the spun yarn take-up apparatus can be suppressed, and thereby, a floor level of the spun yarn take-up apparatus can be reduced. There is, therefore, no conventional need to divide the work area at the first floor into an upper work area and a lower work area to which operators are assigned, respectively, but only one operator can perform the yarn setting operation, thereby to achieve the shortening of a yarn setting time and the savings of manpower.

[0010] [2] A second aspect of the present invention is the spun yarn take-up apparatus in the above-described first aspect [1], wherein

the plurality of distribution rollers are arranged such that an acute angle larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the plurality of yarns delivered from the guide roller and a horizontal plane.

[0011] According to the above-described second aspect [2] of the spun yarn take-up apparatus, a height of the guide roller can be suppressed, and thereby, a floor level of the spun yarn take-up apparatus can be reduced. More specifically, the lower limit of the plurality of distribution rollers in a height direction is determined by other configurations such as the spooling unit. The guide roller and the plurality of distribution rollers are arranged such that an acute angle larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the plurality of yarns delivered from the guide roller to the plurality of distribution rollers and a horizontal plane. As a result, a height of the guide roller and the plurality of distribution rollers can be reduced, and the spun yarn take-up apparatus can be lower in floor level.

[0012] [3] A third aspect of the present invention is the spun yarn take-up apparatus in the above-described first aspect [1] or the above-described second aspect [2], wherein

the plurality of distribution rollers are arranged in series, when seen in a planar view, along a plurality of yarn paths extending from the guide roller to the plurality of distribution rollers, respectively,

the plurality of yarn paths are separated in directions orthogonal thereto, when seen in a planar view, corresponding to the plurality of distribution rollers, respectively, and the plurality of distribution rollers are arranged such that each thereof avoids a yarn path corresponding to other thereof.

[0013] According to the above-described third aspect [3] of the spun yarn take-up apparatus, the plurality of distribution rollers are arranged such that each thereof avoids a yarn path corresponding to other thereof. As a result, a yarn corresponding to each distribution roller delivered from the guide roller can be prevented from having any contact with a roller face of other distribution roller.

[0014] [4] A fourth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to third aspects [1]-[3], wherein the plurality of distribution rollers have roller faces different in height depending upon positions in directions orthogonal to the plurality of yarn paths from the guide roller to the plurality of distribution rollers as well as orthogonal to a vertical direction, respectively.

[0015] According to the above-described fourth aspect [4] of the spun yarn take-up apparatus, the roller faces are different in height depending upon positions in directions orthogonal to the plurality of yarn paths from the guide roller to the plurality of distribution rollers as well as orthogonal to a vertical direction, respectively. It becomes possible, therefore, to secure the plurality of yarn paths along which their respective yarns delivered to the plurality of distribution rollers are allowed to travel. As a result, each yarn delivered from the guide roller to each distribution roller can be prevented from having any contact with a roller face of other distribution roller.

[0016] [5] A fifth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to fourth aspects [1]-[4], wherein at least one of the plurality of distribution rollers has an axis direction inclined with respect to a horizontal direction.

[0017] According to the above-described fifth aspect [5] of the spun yarn take-up apparatus, a simple configuration merely with the at least one distribution roller having an axis direction inclined with respect to a horizontal direction can prevent each yarn delivered from the guide roller to each distribution roller from having any contact with a roller face of other distribution roller.

[0018] [6] A sixth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to fifth aspects [1]-[5], wherein at least one of the plurality of distribution rollers is a conically-shaped or stepped roller different in diameter depending upon positions in directions orthogonal to the plurality of yarn paths from the guide roller to the plurality of distribution rollers as well as orthogonal to a vertical direction, respectively.

[0019] According to the above-described sixth aspect [6] of the spun yarn take-up apparatus, a simple configuration, obtained merely as a result of changing the at least one distribution roller to a conically-shaped or stepped roller different in diameter depending upon positions in directions orthogonal to the plurality of yarn paths and to a vertical direction, can prevent each yarn delivered from the guide roller to each distribution roller from having any contact with a roller face of other distribution roller.

[0020] [7] A seventh aspect of the present invention is the spun yarn take-up apparatus in the above-described first to third aspects [1]-[3], wherein the plurality of distribution rollers are arranged such that a roller face of a

distribution roller the smallest in distance from the guide roller is the smallest in height, and roller faces of the plurality of distribution rollers increase in height with increase in distance from the guide roller.

[0021] According to the above-described seventh aspect [7] of the spun yarn take-up apparatus, a roller face of a distribution roller at the smallest distance from the guide roller has the smallest height, and the larger the distances of the distribution rollers from the guide roller are, the larger the heights of roller faces of the distribution rollers are. A simple configuration, obtained as a result of gradually displacing the arrangement heights of the plurality of distribution rollers, can prevent each yarn delivered from the guide roller to each distribution roller from having any contact with a roller face of other distribution roller.

[0022] [8] A eighth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to seventh aspects [1]-[7] further comprising a plurality of drivers corresponding to the plurality of distribution rollers, respectively.

[0023] According to the above-described eighth aspect [8] of the spun yarn take-up apparatus, the plurality of distribution rollers can be individually driven, thereby capable of reducing differences in tension among the plurality of yarns downstream along their respective yarn paths from the plurality of distribution rollers. As a result, the resultant wound package can have a stable quality.

(Advantageous Effects of the Invention)

[0024] According to the present invention, the spun yarn take-up apparatus can have a suppressed height so as to be lower in floor level than a conventional apparatus thereby to achieve the shortening of a yarn setting time and the savings of manpower.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is an example of a perspective view schematically illustrating the spun yarn take-up apparatus.

FIG. 2 is an example of a side view schematically illustrating the spun yarn take-up apparatus.

FIG. 3 is an example of a side view schematically illustrating the periphery of the first guide section.

FIG. 4 is an example of a plan view illustrating a plurality of oil supply units, a plurality of yarn suctioning units, and a first yarn delivery roller.

FIG. 5 is an example of a side view illustrating the periphery of a drawing section.

FIG. 6 is an example of a side view illustrating the periphery of a relaxing section, a distribution section, and a spooling unit.

FIG. 7 is an example of a plan view illustrating the periphery of the distribution section.

FIG. 8 is an example of a side view illustrating a second relaxing roller and each distribution roller.

FIG. 9 is an example of a schematic view of an acute angle consisting of a yarn traveling direction and a horizontal plane for yarns delivered from a second relaxing roller to their respective distribution rollers.

FIG. 10(A) is an example of a cross-sectional view taken along the line A-A shown in FIG. 8; FIG. 10(B) is an example of a cross-sectional view taken along the line B-B shown in FIG. 8; FIG. 10(C) is an example of a cross-sectional view taken along the line C-C shown in FIG. 8: FIG. 10(D) is an example of a cross-sectional view taken along the line D-D shown in FIG. 8; FIG. 10(E) is an example of a cross-sectional view taken along the line E-E shown in FIG. 8; and FIG. 10(F) is an example of a cross-sectional view taken along the line F-F shown in FIG. 8.

FIG. 11 is an example of a side view schematically illustrating a spun yarn take-up apparatus in accordance with a first modified example.

FIG. 12 illustrates a modified shape and modified attachment embodiment of distribution rollers in accordance with a second modified example.

FIG. 13 illustrates a modified shape and modified attachment embodiment of distribution rollers in accordance with a third modified example.

FIG. 14 illustrates a modified arrangement of distribution rollers in accordance with fourth modified example.

FIGS. 15(A)-(C) each illustrates an example of a positional relation among a first relaxing roller, a second relaxing roller, and distribution rollers different in height position from each other, of which: (A) schematically illustrates a first arrangement pattern; (B) schematically illustrates a second arrangement pattern; and (C) schematically illustrates a third arrangement pattern.

FIGS. 16(A), (B) each illustrates another example of a positional relation among a first relaxing roller, a second relaxing roller, and distribution rollers different in height position from each other, of which: (A) schematically illustrates a fourth arrangement pattern; and (B) schematically illustrates a fifth arrangement pattern.

DESCRIPTIONS OF EMBODIMENTS OF THE INVENTION

[0026] The following section will describe a spun yarn take-up apparatus 1 in accordance with the present invention with reference to the drawings. The spun yarn take-up apparatus 1 in accordance with the present invention is an apparatus configured to take up industrial material yarns of 300 denier or more for example. FIG. 1 is an example of a perspective view schematically illustrating the spun yarn take-up apparatus 1. FIG. 2 is an example of a side view schematically illustrating the spun yarn take-up apparatus 1.

[0027] In this embodiment, a direction X and a direction

Y are defined as shown in FIG. 1 and FIG. 2. The direction X and the direction Y are both arranged in a horizontal direction and are orthogonal to each other. The direction X is one direction indicated by the arrows shown in FIG. 1 and FIG. 2. Therefore, the term "a direction opposite to the direction X" herein is intended to mean a direction opposite to the arrows shown in FIG. 1 and FIG. 2. On the other hand, the direction Y means two directions shown by the arrows in FIG. 1 and FIG. 2.

[1. Entire Configuration of Spun Yarn Take-up Apparatus]

[0028] The following section will schematically describe the entire configuration of the spun yarn take-up apparatus 1 with reference to FIG. 1 and FIG. 2. As shown in FIG. 1 and FIG. 2, the spun yarn take-up apparatus 1 includes mainly, in an order from the upstream side in a yarn traveling direction, an oil supply unit 2, a yarn suctioning unit 4, a spun yarn take-up unit 6, and a spooling unit 8.

[0029] The oil supply unit 2 has a plurality of oil supply units 2. The plurality of oil supply units 2 are arranged in a single row in a left-and-right direction on the paper surface of FIG. 2. The reason for describing the arrangement not by the wording "arranged in a single row in a direction X" but by the wording "arranged in a single row in a left-and-right direction on the paper surface of FIG. 2" will be described later with reference to FIG. 4.

[0030] Although not shown in FIG. 1 and FIG. 2, a spinning machine is arranged above the plurality of oil supply units 2. The plurality of oil supply units 2 are used to coat, with oil solution, a yarn 100 obtained as a filament bundle spun from the spinning machine through the spinning operation. In this embodiment, the spun yarn take-up apparatus 1 includes the oil supply unit 2. However, the present invention is not limited to this. The spinning machine may also include the oil supply unit 2.

[0031] The yarn suctioning unit 4 has a plurality of yarn suctioning units 4 and is generally called an aspirator. When the spun yarn take-up apparatus 1 includes the oil supply unit 2, the plurality of yarn suctioning units 4 are arranged beneath the corresponding oil supply units 2, respectively, and operate to temporarily retain a plurality of yarns 100 by suctioning the yarns 100 when the yarns 100 are wound around their respective rollers or when the yarns 100 are cut for example. Each yarn 100 coated with an oil solution provided by the oil supply unit 2 is delivered downward to pass the front face of the yarn suctioning unit 4 to run toward the first guide section 10 (which will be described later). The plurality of yarn suctioning units 4 are configured such that the flow of compressed fluid is used mainly to generate a suctioning force in a suctioning opening, respectively.

[0032] The spun yarn take-up unit 6 is configured, in an order from the upstream side in a yarn traveling direction, to include mainly the first guide section 10, the first yarn delivery roller 20, a drawing section 28, a relaxing section 60, and the distribution section 70. The first guide section 10, the first yarn delivery roller 20, the drawing section 28, the relaxing section 60, and the distribution section 70 will be described later in detail.

[0033] The spooling unit 8 includes mainly a main frame 80, the first winder 81, and the second winder 91. The first winder 81 and the second winder 91 are arranged in a direction Y. The first winder 81 has the same structure as that of the second winder 91. Therefore, the following section will describe the first winder 81 and will not further describe the second winder 91. In this embodiment, the spooling unit 8 includes two apparatuses of the first winder 81 and the second winder 91. However, the present invention is limited to this. Therefore, the spooling unit 8 includes one winder 1.

[0034] The first winder 81 includes mainly a disk-like turret 82 rotatably arranged in the main frame 80, two winding axes 84 that are cantilever-supported by the turret 82 to have an axis in a direction X, and a plurality of traversing apparatuses 85 to traverse the yarns 100.

[0035] The winding axis 84 is attached with a plurality of bobbins 86 arranged in series. The winding axis 84 is driven by a motor (not shown) to rotate so as to cause a plurality of bobbins 86 attached to the winding axis 84 to rotate so as to wind the yarn 100 around the plurality of rotating bobbins 86. The yarn 100 wound around the bobbin 86 forms a wound package.

[0036] The following section will describe the positional relation between the drawing section 28 owned by the spun yarn take-up unit 6 and the spooling unit 8 with reference to FIG. 1 and FIG. 2 again. The drawing section 28 is arranged upstream from the spooling unit 8 along a yarn traveling direction and is arranged in a direction opposite to a direction X than the spooling unit 8. More specifically, the drawing section 28 and the spooling unit 8 are horizontally arranged so that the same floor have an axis direction of the winding axis 84 that is parallel to a direction along which the yarn 100 travels in the drawing section 28 when seen in a planar view. More specifically, in this embodiment, the drawing section 28 is arranged at substantially the same height as that of the spooling unit 8 in contrast with the conventional spun yarn take-up apparatus in which the work area of the first floor is divided to the upper work area and the lower work area so that the lower work area of first floor has a spooling unit and the upper work area has a drawing section. This arrangement allows the drawing section 28 to be arranged so that one operator can perform the yarn setting operation of the drawing section and the spooling unit without using any working truck for example. This can result in the shortened time required for the yarn setting operation and the manpower saving.

[0037] The drawing section 28 has the first guide section 10 in the vicinity of the upper side thereof. The yarn suctioning unit 4 is arranged immediately above the first guide section 10. The oil supply unit 2 is arranged immediately above the yarn suctioning unit 4. This arrangement of their respective member arranged in proximity to one another provides an effect which will be described

later with regards to the positional relation to the first yarn delivery roller 20.

[2. Spun Yarn Take-up Unit]

[0038] The following section will describe the first guide section 10, the first yarn delivery roller 20, the drawing section 28, the relaxing section 60, and the distribution section 70 included in the spun yarn take-up unit 6.

[2-1. First guide section and first yarn delivery roller]

[0039] FIG. 3 is an example of a side view illustrating the periphery of the first guide section 10. As shown in FIG. 3, the first guide section 10 includes mainly a plurality of (or twelve) direction-changing rollers 10A-10L for example. The plurality of direction-changing rollers 10A-10L are arranged in a single row in a left-and-right direction on the paper surface of FIG. 3. More specifically, the direction-changing rollers 10A-10F are arranged from left to right on the paper surface of FIG. 3, and the direction-changing rollers 10G-10L are arranged from right to left on the paper surface of FIG. 3. The reason for not using the wording "arranged in a single row in a direction X" but using the wording "arranged in a single row in a left-and-right direction on the paper surface of FIG. 3" will be described later with reference to FIG. 4 in relation to the plurality of oil supply units 2 described as being "arranged in a single row in a left-and-right direction on the paper surface of FIG. 2".

[0040] In this embodiment, the plurality of direction-changing rollers 10A-10L are described as being arranged in a single row in a left-and-right direction on the paper surface of FIG. 3. However, the plurality of direction-changing rollers 10A-10L may be horizontally arranged or may also be arranged to be displaced in an up-and-down direction.

[0041] The plurality of direction-changing rollers 10A-10L are rollers to deliver, to the first yarn delivery roller 20 arranged in a direction inclined downward from a horizontal direction, a plurality of (or 12) yarns 100 for example spun in a lower direction from the spinning machine and coated with oil solution. The position "inclined downward from a horizontal direction" is preferably slightly inclined downward from a horizontal direction. For example, the yarns 100 delivered from the direction-changing rollers 10A-10L to the first yarn delivery roller 20 preferably has such an acute angle larger than 5° as well as smaller than or equal to 30° formed by a yarn traveling direction and a horizontal plane. An angle α shown in FIG. 3 corresponds to "an acute angle formed by a yarn traveling direction and a horizontal plane for the yarns 100 delivered from the direction-changing rollers 10A-10L to the first yarn delivery roller 20".

[0042] The yarn 100 having a traveling direction changed by the direction-changing rollers 10A-10F is delivered to the first winder 81 (see FIG. 1) and is wound. The yarn 100 having a traveling direction changed by the direction-changing rollers 10G-10L is delivered to the second winder 91 (see FIG. 1) and is wound.

[0043] The first yarn delivery roller 20 is a roller that is arranged on a yarn path extending from the first guide section 10 to the drawing section 28 and that has, as an axis direction, a direction substantially orthogonal both to a yarn traveling direction and a vertical direction (i.e., direction Y). The first yarn delivery roller 20 is arranged in an up-and-down direction between the first guide section 10 (i.e., plurality of direction-changing rollers 10A-10L) and the drawing section 28 and is arranged in a horizontal direction close to a direction opposite to a direction X than any of the first guide section 10 (more particularly the direction-changing roller 10G) and the drawing section 28. More specifically, the first guide section 10 and the drawing section 28 has a positional relation by which the first guide section 10 and the drawing section 28 are arranged in an up-and-down direction to be superposed to each other when seen in a planar view. On the other hand, the first yarn delivery roller 20 is arranged no to be superposed with any of the first guide section 10 and the drawing section 28 when seen in a planar view and is arranged at a position displaced in a horizontal direction. However, from the space saving viewpoint, the first yarn delivery roller 20 is preferably arranged in the vicinity of the first guide section 10 and the drawing section 28 in a horizontal direction.

[0044] As described above, the first guide section 10 is arranged in the vicinity of the upper part of the drawing section 28 and the first yarn delivery roller 20 is arranged in a direction opposite to a direction X at a position displaced from any of the first guide section 10 and the drawing section 28. This can consequently reduce the distance between the first guide section 10 and the drawing section 28 in an up-and-down direction. This can also reduce the distance between the first guide section 10 and the drawing section 28 in an up-and-down direction. This can provide a reduced height to the first guide section 10, the yarn suctioning unit 4 arranged immediately above the first guide section 10, and the oil supply unit 2 arranged immediately above the yarn suctioning unit 4 and can allow the entire spun yarn take-up apparatus 1 to have a lower floor. This can consequently eliminate the conventional need to divide the work area of the first floor to an upper work area and a lower work area in which operators are provided, respectively. Therefore, a single operator can perform the yarn setting operation, and as a result, achieving the shortened time for the yarn setting operation and the manpower saving.

[0045] The yarn 100 delivered from the first yarn delivery roller 20 proceeds to the drawing section 28. The yarn 100 is wound around the first yarn delivery roller 20 at a winding angle smaller than 360°.

[0046] The plurality of yarns 100 spun downward from the spinning machine abutting their respective roller faces of the plurality of direction-changing rollers 10A-10L are wound at a winding angle larger than or equal to 45° as well as smaller than 90° for example. In particular, the

first yarn delivery roller 20 is arranged in a direction opposite to a direction X with respect to the direction-changing roller 10G and a winding angle α is minimized. This can consequently increase the winding angle to allow the yarns to be wound around their respective direction-changing rollers 10A-10L and can increase the winding angle of the yarns 100 around their respective direction-changing rollers 10A-10L. Therefore, tension can be applied to the yarns 100 between the plurality of direction-changing rollers 10A-10L and the first yarn delivery roller 20, and the yarn 100 is allowed to stabilize traveling downstream from the plurality of direction-changing rollers 10A-10L along a yarn traveling direction. Further, no need is required to provide a guide used in the conventional case to minutely adjust the tension to the yarns, and therefore allowing the oil supply unit 2 and the yarn suctioning unit 4 to be arranged at a correspondingly-lower position than in the case of a spun yarn take-up apparatus including a guide. Further, a traveling direction of the yarn 100 can be changed by the roller, and therefore minimizing the burden on the yarn 100. When the positions at which the yarns on the peripheral surfaces of the plurality of direction-changing rollers 10A-10L are separated from one another are lower in a vertical direction than the position at which the yarn is introduced onto the peripheral surface of the first yarn delivery roller 20, winding angles to their respective roller faces of the plurality of direction-changing rollers 10A-10L exceed 90°.

[0047] The plurality of direction-changing rollers 10A-10L have a plurality of motors (motors 10 which will be described later) corresponding to their respective rollers. When the first yarn delivery roller 20 is displaced from the first guide section 10 and the drawing section 28 in a direction opposite to a direction X, there may be a probability that different distances (i.e., yarn lengths) between their respective direction-changing rollers 10A-10L and the first yarn delivery roller 20 cause different tensions of the plurality of yarns 100. To prevent this, the plurality of direction-changing rollers 10A-10L may be allowed to be individually driven, respectively, thereby to stabilize the yarn delivery velocity to suppress the dispersion of the yarn tensions even when different yarn lengths are caused.

[0048] Next, with reference to FIG. 4, the following section will describe the positional relation among a plurality of oil supply units 2, a plurality of yarn suctioning units 4, and a plurality of direction-changing rollers 10A-10L. FIG. 4 is an example of a plan view illustrating the plurality of oil supply units 2, the plurality of yarn suctioning units 4, and the first yarn delivery roller 20.

[0049] As shown in FIG. 4, the plurality of oil supply units 2A-2L of the oil supply unit 2 are arranged in a left-and-right direction on the paper surface of FIG. 4 as well as are displaced at an equal interval to form a single row in a direction Y (*i.e.,* a direction orthogonal to both of the winding axis 84 (see FIG. 1) and a vertical direction). Although not shown in FIG. 4, the yarn suctioning units 4A-4L (see FIG. 3) are arranged immediately below their respective oil supply units 2A-2L. As in the case of the direction-changing rollers 10A-10L, the oil supply units 2A-2F are arranged from left to right on the paper surface of FIG. 4, and the oil supply unit 2G-2L are arranged from right to left on the paper surface of FIG. 4.

[0050] FIG. 4 does not illustrate the first guide section 10 (the plurality of direction-changing rollers 10A-10L); however, the direction-changing rollers 10A-10L are arranged immediately below their respective yarn suctioning units 4A-4L. Therefore, the plurality of direction-changing rollers 10A-10L are displaced in a direction Y at an equal interval to form a single row. This arrangement allows the plurality of yarns 100 spun from the spinning machine to proceed while being mutually displaced in a direction Y so that the spun yarns are parallel to one another in a planar view, thereby preventing the mutual interference or entanglement of the yarns. In particular, in this embodiment, the first guide section 10 and the drawing section 28 have a reduced distance in an up-and-down direction. Even in such a case, the plurality of yarns 100 are allowed to travel in a parallel manner, and therefore preventing the mutual interference or entanglement of the plurality of yarns. Further, the yarn setting operation can be easily performed on a guide (not shown) and/or an interlacing apparatus (not shown) used to retain the interval among yarns arranged in a yarn path extending from the plurality of direction-changing rollers 10A-10L to the distribution rollers 70A-70L. However, the present invention is not limited to this. Therefore, no guide or interlacing apparatus used to retain the interval among yarns may be arranged in the yarn path extending from the plurality of direction-changing rollers 10A-10L to the distribution rollers 70A-70L.

[0051] The plurality of oil supply units 2A-2L and the plurality of yarn suctioning units 4A-4L have been described as not being "arranged in a direction X so as to be displaced in a direction Y" but as being "arranged in a left-and-right direction on the paper surface of FIG. 4 so as to be displaced in a direction Y". The reason is that, since a direction X means a single direction, when the wording "arranged in a direction X" is interpreted in a limited manner as "arranged in series in a single direction such as a direction X", the above description intends to avoid a risk of being interpreted inconsistently with the wording "displaced in a direction Y". In the description with reference to FIG. 2 and FIG. 3, the same reason applies to the description not including the wording "arranged in a single row in a direction X" but including the wording "arranged in a single row in a left-and-right direction on the paper surface of FIG. 2" or the wording "arranged in a single row in a left-and-right direction on the paper surface of FIG. 3". In other words, the above description intends to avoid a risk that the wording "arranged in a single row in a direction X" is interpreted as being "not displaced in a direction Y".

[0052] The present invention is not particularly limited to the number of the plurality of oil supply units 2, the plurality of yarn suctioning units 4, the plurality of direc-

tion-changing rollers 10A-10L, the plurality of traversing apparatuses 85, and the plurality of bobbins 86.

[2-2. Drawing section]

[0053] FIG. 5 is an example of a side view illustrating the periphery of the drawing section 28. As shown in FIG. 5, the drawing section 28 includes mainly a plurality of preheating rollers 31 to heat the yarns 100 before being drawn, a plurality of drawing rollers (drawing godets) 41 arranged downstream along a yarn traveling direction from the plurality of preheating rollers 31, and a plurality of thermal setting rollers 51 arranged downstream along a yarn traveling direction from the plurality of drawing rollers 41 to condition the drawn yarns 100.

[0054] It is to be noted that the plurality of preheating rollers 31, the plurality of drawing rollers 41, and the plurality of thermal setting rollers 51 accommodated in their respective warming boxes (whose reference numerals are not shown) should not be discernible explicitly in the drawings; however, they are shown in the drawings for convenience.

[0055] In the meantime, the heating length has been conventionally secured by winding yarns around a long roller having a relatively large width a plurality of times. In contrast with this, the spun yarn take-up apparatus 1 of this embodiment allows yarns to be wound around a short roller having a width shorter than the conventional case to reach a distance shorter than the entire periphery of the roller. However, in order to secure the heating length while allowing the yarns to be wound around the roller to reach a distance shorter than the entire periphery of the roller, a higher number of rollers than in the conventional case is required. In the case of a spun yarn take-up apparatus to produce industrial material yarns of 300 denier or more for example in particular, a larger heating length is required than in the case of a spun yarn take-up apparatus for clothing yarns. To solve this, the spun yarn take-up apparatus 1 of this embodiment is configured such that the plurality of preheating rollers 31, the plurality of drawing rollers 41, and the plurality of thermal setting rollers 51 are horizontally arranged in series on the same floor in a direction X. This arrangement can secure the heating length by winding the yarns around the rollers to reach a distance shorter than the entire periphery of each roller (or a winding angle around the roller smaller than 360°) and can provide the drawing section 28 with a lower floor. The plurality of preheating rollers 31, the plurality of drawing rollers 41, and the plurality of thermal setting rollers 51 correspond to "a plurality of rollers" of the present invention.

[0056] At least the uppermost stream-side drawing roller 41 among the plurality of drawing rollers 41 has a yarn delivery velocity lower than that of the downmost stream-side preheating roller 31 among the plurality of preheating rollers 31. Therefore, the yarn 100 is drawn between the downmost stream-side preheating roller 31 among the plurality of preheating rollers 31 and the uppermost stream-side drawing roller 41 among the plurality of drawing rollers 41.

[0057] The plurality of preheating rollers 31 have a surface temperature set to be equal to or higher than the glass transition point of the yarn 100 (*e.g.,* 90 °C). The plurality of drawing rollers 41 have a surface temperature set to be higher than the surface temperatures of the plurality of preheating rollers 31 (*e.g.,* 110 °C). The plurality of thermal setting rollers 51 have a surface temperature set to be higher than the surface temperatures of the plurality of drawing rollers 41 (*e.g.,* 130 °C).

[0058] In this embodiment, all of the plurality of preheating rollers 31 have an increased surface temperature; however, the present invention is not limited to this. At least one roller among the plurality of preheating rollers 31 may have an increased surface temperature while the other roller may not have an increased surface temperature, for example. Similarly, in this embodiment, any of all the plurality of drawing rollers 41 and all the plurality of thermal setting rollers 51 have an increased surface temperature; however, the present invention is not limited to this. At least one roller among any of all the plurality of drawing rollers 41 and all the plurality of thermal setting rollers 51 may have an increased surface temperature while the other roller may not have an increased surface temperature, for example. Further, all of the plurality of preheating rollers 31 do not always have to have the same surface temperature. Therefore, the plurality of preheating rollers 31 may have different surface temperatures, respectively. Similarly, any of all the plurality of drawing rollers 41 and all the plurality of thermal setting rollers 51 do not always have to have the same surface temperature. Therefore, any of the plurality of drawing rollers 41 and the plurality of thermal setting rollers 51 may have different surface temperatures, respectively.

[2-3. Relaxing section]

[0059] FIG. 6 is an example of a side view illustrating the periphery of the relaxing section 60, the distribution section 70, and the spooling unit 8. As shown in FIG. 6, the relaxing section 60 is arranged immediately above thermal setting rollers 51.

[0060] The relaxing section 60 has the first relaxing roller 61 and the second relaxing roller 62 arranged downstream from the first relaxing roller 61 along a yarn traveling direction. The first relaxing roller 61 and the second relaxing roller 62 are a roller that has, as an axis direction, a direction substantially orthogonal both to a yarn traveling direction of a yarn path when seen in a planar view (i.e., direction Y).

[0061] The yarn 100 delivered out from the downmost stream-side thermal setting roller 51 of the plurality of thermal setting rollers 51 is allowed to pass the first relaxing roller 61 and the second relaxing roller 62 in this order. It is to be noted that the second relaxing roller 62 corresponds to a "guide roller" of the present invention.

[0062] The first relaxing roller 61 and the second re-

laxing roller 62 are arranged to be mutually displaced in an up-and-down direction. The first relaxing roller 61 and the second relaxing roller 62 are arranged so that the first relaxing roller 61 is mutually displaced to a direction X side in a direction X and the second relaxing roller 62 is mutually displaced in a direction opposite to a direction X. The arrangement of the first relaxing roller 61 and the second relaxing roller 62 as described above can provide the reduced height to the second relaxing roller 62, and therefore providing an easier yarn setting operation to the second relaxing roller 62.

[0063] The yarn 100 is wound around the first relaxing roller 61 and the second relaxing roller 62 at a winding angle smaller than 360°. The relaxing rollers 61 and 62 have a surface temperature set to be lower than those of the thermal setting rollers 51 (*e.g.,* 100 °C) so that the internal strain of the yarn 100 is relaxed. However, the first relaxing roller 61 and the second relaxing roller 62 do not always have to have the same surface temperature. Therefore, the relaxing rollers 61 and 62 may have different surface temperatures.

[0064] Further, any of the first relaxing roller 61 and the second relaxing roller 62 does not always have to have an increased surface temperature. For example, at least one roller of the first relaxing roller 61 and the second relaxing roller 62 may have an increased surface temperature while the other roller may not have an increased surface temperature.

[0065] The yarn 100, which is delivered out from the second relaxing roller 62 in the relaxing section 60 arranged downstream along a yarn traveling direction, is guided to the distribution section 70. The relaxing section 60 and the distribution section 70 correspond to a "second guide section" of the present invention.

[2-4. Distribution section]

[0066] As shown in FIG. 6, the distribution section 70 includes a plurality of distribution rollers 70A-70F. The plurality of distribution rollers 70A-70F are horizontally arranged in series in a direction X in an order of the distribution roller 70A, the distribution roller 70B, the distribution roller 70C, the distribution roller 70D, the distribution roller 70E, and the distribution roller 70F.

[0067] One winding axis 84 of the first winder 81 can be attached with a plurality of bobbins 86A-86F. In this illustrative embodiment, the plurality of bobbins 86A-86F are attached to the winding axis 84 of the first winder 81 in a direction X in an order of the bobbin 86A, the bobbin 86B, the bobbin 86C, the bobbin 86D, the bobbin 86E, and the bobbin 86F.

[0068] The plurality of distribution rollers 70A-70F correspond to the plurality of bobbins 86A-86F, respectively. The distribution rollers 70A-70F change travelling directions of their respective yarns 100 delivered from the second relaxing roller 62 to a downward direction. In this manner, the plurality of yarns 100 are delivered from their respective distribution rollers 70A-70F to the corresponding bobbins 86A-86F.

[0069] The plurality of bobbins 86A-86F wind the yarn 100 for which a travelling direction is changed by the corresponding distribution rollers 70A-70F, respectively, to form a wound package. The plurality of traversing apparatuses 85A-85F corresponding to the plurality of bobbins 86A-86F are arranged immediately above their respective 86A-86F. In FIG. 6, only the traversing apparatus 85A and the traversing apparatus 85F have their reference numerals for convenience, and the traversing apparatuses 85B-85E do not have reference numerals. The plurality of traversing apparatuses 85A-85F (i.e., a plurality of distribution rollers 70A-70F corresponding to the plurality of bobbins 86A-86F) are arranged immediately above the plurality of traversing apparatuses 85A-85F, respectively.

[0070] FIG. 7 is an example of a plan view illustrating the periphery of the distribution section 70. As shown in FIG. 7, the distribution section 70 includes a plurality of distribution rollers 70G-70L in addition to the above-described plurality of distribution rollers 70A-70F. The plurality of yarns 100 delivered out from the second relaxing roller 62 are delivered in a direction toward the distribution rollers 70A-70F and in a direction toward the distribution rollers 70G-70L.

[0071] As described above, the plurality of distribution rollers 70A-70F correspond to the plurality of bobbins 86A-86F attached to the winding axis 84 of the first winder 81. On the other hand, the plurality of distribution rollers 70G-70L correspond to a plurality of bobbins (not shown) attached to the winding axis 84 of the second winder 91 (see FIG. 1). Thus, the plurality of distribution rollers 70G-70L change, as in the plurality of distribution rollers 70A-70F, travelling directions of their respective yarns 100 delivered from the second relaxing roller 62 to a downward direction.

[0072] As described above, the yarn 100 delivered from the downmost stream-side thermal setting roller 51 (see FIG. 6) of the drawing section 28 (see FIG. 6) is delivered to the spooling unit 8 through the relaxing section 60 and the distribution section 70. More specifically, the yarn 100 delivered from the downmost stream-side thermal setting roller 51 is allowed to once travel upstream from the drawing section 28 and is wound by the spooling unit 8 through the relaxing section 60 and the distribution section 70. Thus, even when the spooling unit 8 and the drawing section 28 are arranged horizontally on the same floor, the yarn 100 delivered from the drawing section 28 (*i.e.,* the downmost stream-side thermal setting roller 51) can be wound by the spooling unit 8. More specifically, the yarn 100 delivered from the downmost stream-side thermal setting roller 51 is wound by the spooling unit 8 through the relaxing section 60 and the distribution section 70 arranged at a position higher than that of the spooling unit 8. This can consequently contribute to the horizontal arrangement of the drawing section 28 and the spooling unit 8 on the same floor. As a result, the drawing section 28 can have a reduced

height and a lower level of floor. Thus, the spun yarn take-up apparatus 1 can have a reduced height and a lower level of floor.

[2-5. Yarn path from relaxing section to distribution section]

[0073] Next, the following section will describe a yarn path from the relaxing section 60 to the distribution section 70 with reference to FIG. 7. As shown in FIG. 7, a plurality (or 12) yarns 100 for example delivered from the second relaxing roller 62 are allowed to pass any of a plurality of yarn paths 96A-96L separated in a direction orthogonal to the plurality of yarn paths 96A-96L when seen in a planar view.

[0074] The yarn path 96A is a path along which the yarn 100 allowed to travel to the distribution roller 70A. The yarn 100 allowed to travel along the yarn path 96A is the yarn 100 delivered from the direction-changing roller 10A. Similarly, the yarn paths 96B-96L are paths of the yarns 100 extending to their respective distribution rollers 70B-70L. The yarns 100 allowed to travel along their respective yarn paths 96B-96L are the yarns 100 delivered from their respective direction-changing rollers 10B-10L.

[0075] The yarn paths 96A-96F are mutually separated in a direction Y. Similarly, the yarn paths 96G-96L are mutually separated in a direction Y. As described above with reference to FIG. 4, the plurality of direction-changing rollers 10A-10L (see FIG. 3) are arranged so as to be displaced in a direction Y, respectively. The plurality of yarns 100 are allowed to travel from the first guide section 10 (see FIG. 2) to the second relaxing roller 62 while being parallel to one another so as to have their respective travelling directions when seen in a planar view only in a direction X. Thus, the yarns 100 are allowed to travel from the first guide section 10 (see FIG. 2) to the drawing section 28 (see FIG. 2) so that the yarn paths are prevented from being deviated in axis directions of their respective rollers (the direction-changing rollers 10A-10L, the first yarn delivery roller 20, the plurality of preheating rollers 31, the plurality of the first drawing rollers 41, the plurality of thermal setting rollers 51, the plurality of relaxing rollers 61 and 62).

[2-6. Positional relation among relaxing section and distribution section]

[0076] Next, the following section will describe, when a plurality of distribution rollers 70A-70F are horizontally arranged in series in a direction X, a positional relation among the relaxing section 60 and the distribution section 70, and more particularly, a height positional relation among the downmost stream-side second relaxing roller 62 of the relaxing section 60 and their respective distribution rollers 70A-70F.

[0077] FIG. 8 is an example of a side view of the second relaxing roller 62 and their respective distribution rollers 70A-70F. As in the spun yarn take-up apparatus 1 of this embodiment, a plurality of (or 12 in this illustrative embodiment) yarns 100 for example delivered from the drawing section 28 (see FIG. 6) are wound by the spooling unit 8 through the relaxing section 60 and the distribution section 70, the following requirements must be fulfilled. More specifically, the yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution rollers 70F and 70L (see FIG. 7) for example must be prevented from having any contact with other distribution rollers 70A-70E and 70G-70K (see FIG. 7) and a roller face of other roller (*e.g.*, the first relaxing roller 61 (*e.g.*, see FIG. 6)) arranged upstream from the second relaxing roller 62. Thus, the relaxing section 60 (the first relaxing roller 61, the second relaxing roller 62) and the distribution rollers 70A-70L must be arranged within a range fulfilling this requirement.

[0078] In the meantime, a height direction along which the distribution rollers 70A-70F are arranged has a lower limit determined, for example, by a relative positional relation with the traversing apparatus 85A-85F and the bobbins 86A-86F (see FIG. 8) for example. Thus it is preferable to decide a height position of the second relaxing roller 62 within a range fulfilling the above requirement, with the distribution rollers 70A-70F arranged in a position of the lower limit in a height direction or a position close to it, so as to reduce a height of the second relaxing roller 62. In this embodiment, the second relaxing roller 62 is arranged such that an acute angle formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane is larger than or equal to 0° as well as smaller than or equal to 20° for example, although this angle is different depending upon distances from the second relaxing roller 62 to contact points of the distribution rollers 70A-70L (see FIG. 7). As described above, by arranging the second relaxing roller 62 at a position as lowest as possible, the second relaxing roller 62 can be prevented from being subjected to a yarn setting operation at a high place. The wording "an acute angle formed by a yarn traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane" corresponds to an angle β shown in FIG. 9. FIG. 9 is an example of a schematic view illustrating an acute angle β formed by a yarn traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to the distribution roller 70A and a horizontal plane. FIG. 9 illustrates the distribution roller 70A among the plurality of distribution rollers 70A-70F as an example. In this embodiment, the second relaxing roller 62 is arranged such that an acute angle larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane.

[0079] However, the distribution rollers 70A-70F are

horizontally arranged in series in a direction X as described above. Thus, an acute angle β formed by a yarn traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane is different depending upon distances from the second relaxing roller 62 to their respective distribution rollers 70A-70F. In particular, decrease in distance from the second relaxing roller 62 causes an increase in angle β described above. More specifically, an acute angle β formed by a yarn traveling direction of the yarn 100 delivered from the second relaxing roller 62 to the distribution roller 70A and a horizontal plane is the maximum while an acute angle β formed by a yarn traveling direction of the yarn 100 delivered from the second relaxing roller 62 to the distribution roller 70F and a horizontal plane is the minimum. Thus, when an angle β described above is larger than 0° as well as smaller than or equal to 20°, the second relaxing roller 62 may be arranged such that an angle β formed by a yarn traveling direction of the yarn 100 delivered from the second relaxing roller 62 to the distribution roller 70F is larger than 0° as well as an acute angle β formed by a yarn traveling direction of the yarn 100 delivered from the second relaxing roller 62 to the distribution roller 70A is smaller than or equal to 20°.

[0080] The distribution rollers 70A-70F and the distribution rollers 70G-70L (see FIG. 7) have a one-to-one relation therebetween, respectively. Thus, an angle β formed by yarn traveling directions of their respective yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70G-70L and a horizontal plane is substantially the same as an angle β formed by yarn traveling directions of their respective yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane.

[2-7. Attachment embodiment of distribution rollers]

[0081] Next, the following section will describe the attachment embodiment of each of the distribution rollers 70A-70L with reference to FIGS. 10(A) to 10(F). FIGS. 10(A) to 10(F) are an example of a cross-sectional view taken along a direction orthogonal to a direction X at a position downstream along a direction X from the distribution rollers 70A-70L. More particularly, FIG. 10(A) is a cross-sectional view taken along the line A-A shown in FIG. 8. FIG. 10(B) is a cross-sectional view taken along the line B-B shown in FIG. 8. FIG. 10(C) is a cross-sectional view taken along the line C-C shown in FIG. 8. FIG. 10(D) is a cross-sectional view taken along the line D-D shown in FIG. 8. FIG. 10(E) is a cross-sectional view taken along the line E-E shown in FIG. 8. FIG. 10(F) is a cross-sectional view taken along the line F-F shown in FIG. 8.

[0082] As shown in FIGS. 10(A)-10(F), all of the distribution rollers 70A-70L have an axis direction inclined with respect to a horizontal direction. The reason for an axis of the distribution rollers 70A-70L inclined with respect to a horizontal direction is that each of the plurality of distribution rollers 70A-70L can avoid a yarn 100 passing a yarn path 96A-96L corresponding to other of the plurality of distribution rollers 70A-70L. Further, a simple configuration in which the distribution rollers 70A-70L merely have an axis direction inclined with respect to a horizontal direction can avoid any contact between a yarn corresponding to each distribution roller and a roller face of other distribution roller.

[0083] In view of the objective that "a yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution roller 70F and 70L is prevented from having any contact with a roller face of other distribution rollers 70A-70E and 70G-70K", the distribution roller 70F and the distribution roller 70L do not always have to have an axis direction inclined with respect to a horizontal direction.

[0084] The following section will describe in detail the attachment embodiment of the distribution rollers 70A-70L. The distribution rollers 70A-70F are attached to an attachment face 72a at one side of an attachment frame 72 (a right side of the paper surface of FIG. 10). The distribution rollers 70G-70L are attached to an attachment face 72b at the other side of the attachment frame 72 (a left side of the paper surface of FIG. 10). The attachment frame 72 is arranged, on the paper surface of FIG. 10, such that the attachment face 72a at one side is inclined toward a right side from upper to lower sides and the attachment face 72b at the other side is inclined toward a left side from upper to lower sides. The distribution rollers 70A-70F each is attached so as to have an axis direction orthogonal to the attachment face 72a at one side. Thus, the distribution rollers 70A-70F each has an axis direction extending upward from a base end attached to the attachment face 72a at one side to a tip end at an opposite side of the base end. Similarly, the distribution rollers 70G-70L each is attached such that an axis direction is orthogonal to the attachment face 72b at the other side. Thus, the distribution rollers 70G-70L each has an axis direction extending upward from a base end to a tip end. In this embodiment, the distribution rollers 70A-70F are attached to the attachment face 72a at one side such that an acute angle formed by an axis direction and a horizontal direction is approximately 30°. On the other hand, the distribution rollers 70G-70L are attached to the attachment face 72b at the other side such that an acute angle formed by an axis direction and a horizontal direction is approximately 30°.

[0085] As described above, the distribution rollers 70A-70L are inclined to face upward from a base end to a tip end. This arrangement can prevent a yarn 100 from having any contact with surfaces of other distribution rollers until the yarn 100 reaches the corresponding distribution roller. As a result, the plurality of yarns 100 are parallelly allowed to enter the distribution rollers 70A-70F and the distribution rollers 70G-70L, thereby allowing the first relaxing roller 61 and their respective distribution rollers

70A-70L to have a reduced height.

[0086] When the distribution rollers 70A-70L are horizontally arranged along a yarn path of the plurality of yarns 100 (i.e., direction X), at a point having the same distance from the second relaxing roller 62, the yarn 100 passing the yarn path to a distribution roller having a larger distance from the second relaxing roller 62 is allowed to travel at a high position. Thus, in theory, it may be considered that the yarns 100 are prevented from having any contact with surfaces of other distribution rollers without requiring any inclination of the distribution rollers 70A-70L. However, there is actually the deflection or vibration for example of the yarns 100, thus causing a risk where, if there is no inclination of the distribution rollers 70A-70L, the yarn 100 may have a contact with the surfaces of other distribution rollers or other parts. To solve this, according to this embodiment, the distribution rollers 70A-70L are attached so as to have an upward axis direction from a base end to a tip end. By doing this, a yarn path along which the yarns 100 reach the corresponding distribution roller is allowed to have thereon the yarn paths 96B-96F and 96H-L of the yarns and thus a space in which the yarns are allowed to travel even when the yarn 100 has deflection or vibration for example. In particular, the yarns 100 to the contact points of the distribution rollers 70F and 70L having the maximum distance to the second relaxing roller 62 are allowed to travel while not having any contact with roller faces of other distribution rollers 70A-70E and 70G-70K.

[0087] The distribution rollers 70A-70L include the corresponding motors 76, respectively. In the case of the spun yarn take-up apparatus 1 of this illustrative embodiment, different distances are arranged from the second relaxing roller 62 to the distribution rollers 70A-70L, causing a risk where the plurality of yarns 100 may have different tensions at the downstream side of the distribution rollers 70A-70L. The yarns 100 having different tensions makes it difficult to provide wound packages having a fixed quality depending upon a bobbin around which the yarns are wound. To prevent this, the plurality of distribution rollers 70A-70L are allowed to be driven individually to reduce a difference in tension among the plurality of yarns 100 at the downstream side of the distribution rollers 70A-70L, thereby providing wound packages having a stable quality.

[3. Effects]

[0088] According to the spun yarn take-up apparatus 1 of this embodiment described above, the plurality of the yarns 100 from the drawing section 28 are delivered to the spooling unit 8 through the second relaxing roller 62 and distribution section 70. Thus, the drawing section 28 and the spooling unit 8 can be horizontally arranged on the same floor so that an axis direction of the winding axis 84 is parallel to a travelling direction of the yarns 100 in the drawing section 28 when seen in a planar view. This can consequently eliminate a conventional need to divide a work area of a first floor to an upper work area and a lower work area in which operators are provided, respectively. Thus, a single operator can perform a yarn setting operation thereby to achieve a reduced time for such a yarn setting operation and manpower saving.

[0089] The second relaxing roller 62 and the distribution rollers 70A-70L are arranged such that an angle β larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 and a horizontal plane. In the meantime, a height direction along which the distribution rollers 70A-70L are arranged has a lower limit determined, for example, by a relative positional relation with the plurality of traversing apparatus 85A-85F and bobbins 86A-86F for example. Thus, heights of the second relaxing roller 62 and the distribution rollers 70A-70L can be reduced by arranging the second relaxing roller 62 and the distribution rollers 70A-70L such that an angle β larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 and a horizontal plane.

[0090] The plurality of distribution rollers 70A-70L are arranged to form a single row along a yarn path from the second relaxing roller 62 to the distribution rollers. The yarn path from the second relaxing roller 62 to the distribution rollers 70A-70L has a plurality of yarn paths 96A-96L separated in a direction orthogonal to the yarn path when seen in a planar view corresponding to the plurality of distribution rollers 70A-70L. The plurality of distribution rollers 70A-70L are arranged so as to avoid each yarn path 96A-96L corresponding to other distribution rollers 70A-70L. More specifically, the distribution rollers 70A-70L have an axis direction inclined with respect to a horizontal direction. Thus, the yarn 100 delivered from the second relaxing roller 62 can be prevented from having any contact with roller faces of other distribution rollers 70A-70L.

[0091] The plurality of distribution rollers 70A-70L have their corresponding motors 76. Thus, the plurality of distribution rollers 70A-70L can be driven independently, thereby to reduce differences in tension among the plurality of yarns 100 downstream from the plurality of distribution rollers 70A-70L. Thus, a resultant wound package can have a stable quality. In particular, the plurality of distribution rollers 70A-70L have different distances from the second relaxing roller 62, and thus tend to cause differences in tension. However, the plurality of distribution rollers 70A-70L having their corresponding motors 76 can reduce differences in tension among the plurality of yarns 100 downstream from the plurality of distribution rollers 70A-70L for stability.

[4. Modified Examples]

[0092] Next, the following section will describe a modified example including various modifications to the spun yarn take-up apparatus 1 of this embodiment. However,

the modified example will be described based on an assumption that components having the same configurations as those of the above-described embodiment are denoted with the same reference numerals and will not be further described.

[4-1. First modified example]

[0093] In the above-described embodiment, the drawing section 28 is horizontally arranged at the same floor as that of the spooling unit 8 as shown in FIG. 2 for example. The yarn 100 delivered from the drawing section 28 is delivered to the spooling unit 8 through the relaxing section 60 arranged above the drawing section 28 and the distribution section 70. However, the invention is not limited to this. More specifically, the relaxing section 60 does not always have to be arranged above the drawing section 28.

[0094] FIG. 11 is an example of a side view schematically illustrating the spun yarn take-up apparatus 1A in accordance with the first modified example. The spun yarn take-up apparatus 1A shown in FIG. 11 has the relaxing section 60 arranged downstream from the drawing section 28. The second yarn delivery rollers 94 and 95 are arranged above the relaxing section 60. Then, the yarn 100 delivered from the relaxing section 60 is delivered to the spooling unit 8 through the second yarn delivery rollers 94 and 95 and the distribution section 70. Even in such a case, the yarn 100 delivered to the relaxing section 60 is allowed to once travel upstream from the drawing section 28 and the relaxing section 60, and can be delivered to the spooling unit 8 through the distribution section 70 and the second yarn delivery rollers 94 and 95. Thus, even when the spooling unit 8 and the drawing section 28 are horizontally arranged on the same floor, the yarn 100 delivered from the drawing section 28 can be wound by the spooling unit 8. The number of the second yarn delivery rollers is not limited to two, and may be one or three or more. The number of the second yarn delivery rollers can be appropriately selected depending upon a contact angle and a contact area of the yarn 100 delivered from the relaxing section 60 wound around the peripheral surface of the second yarn delivery roller. In the spun yarn take-up apparatus 1A in accordance with the first modified example, the second yarn delivery roller corresponds to the "guide roller" of the present invention.

[4-2. Second modified example]

[0095] In the above-described embodiment, as shown in FIG. 10 for example, the distribution rollers 70A-70L are attached within a range from a base end to a tip end so as to have an axis direction directed upward. By attaching the distribution rollers 70A-70L in this manner, the yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution rollers 70F and 70L is prevented from having any contact with roller faces of other distribution rollers 70A-70E and 70G-70K. However, a shape of the distribution rollers 70A-70L and an attachment embodiment of the distribution rollers 70A-70L do not always have to be a shape and an attachment embodiment shown in FIG. 10, and may also be those shown in FIG. 12 for example.

[0096] FIG. 12 illustrates the second modified example of a modification of shapes of the distribution rollers and attachment embodiments of the distribution rollers. In FIG. 12, the modification of the shapes of the distribution rollers prevents the yarns 100 from the second relaxing roller 62 to contact points of the farthest distribution rollers 77F and 77L for example from having any contact with roller faces of other distribution rollers 77A-77E and 77G-77K.

[0097] More specifically, the distribution rollers 77A-77L shown in FIG. 12 are a distribution roller having a conical cross section with a roller diameter increasing from a base end to a tip end, and attached to an attachment face 72a at one side of an attachment frame 72 (a right side of the paper surface of FIG. 12) or an attachment face 72b at the other side (a left side of the paper surface of FIG. 12) so as to have an axis direction in a direction Y. Even in such a case, a height of a roller face can be changed depending upon a position in a direction Y, and a yarn path on which the yarns 100 reach the corresponding distribution rollers is allowed to have therein a space in which the yarns 100 can travel. As a result, the yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution rollers 77F and 77L is prevented from having any contact with roller faces of other distribution rollers 77A-77E and 77G-77K.

[0098] The distribution roller 77F and distribution roller 77L do not always have to have a conical cross section as in a distribution roller attached to have an inclined axis direction.

[4-3. Third modified example]

[0099] FIG. 13 illustrates the third modified example of a modification of shapes of the distribution rollers and attachment embodiments of the distribution rollers based upon the same concept as that of the second modified example. FIG. 13 also shows that the yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution rollers 78F and 78L for example is prevented from having any contact with roller faces of other distribution rollers 78A-78E and 78G-78K.

[0100] More specifically, the distribution rollers 78A-78L shown in FIG. 13 is a stepped distribution roller having a roller diameter increasing from a base end to a tip end in a stepped manner and attached to an attachment face 72a at one side of an attachment frame 72 (a right side of the paper surface of FIG. 13) or an attachment face 72b at the other side (a left side of the paper surface of FIG. 13) so as to have an axis direction in a direction Y. Even in such a case, a height of a roller face can be changed depending upon a position in a direction Y, and a yarn path on which the yarns 100 reach the correspond-

ing distribution rollers is allowed to have therein a space in which the yarns 100 can travel. As a result, the yarn 100 from the second relaxing roller 62 to a contact point of the farthest distribution rollers 78F and 78L is prevented from having any contact with roller faces of other distribution rollers 78A-78E and 78G-78K.

[0101] The distribution roller 78F and distribution roller 78L do not always have to be a stepped distribution roller as in the distribution rollers attached to have an inclined axis direction.

[0102] The shape of the distribution roller and the attachment embodiment of the distribution roller do not always have to be the same. For example, as described in this illustrative embodiment, a plurality of distribution rollers may include a distribution roller attached to have an inclined axis direction, the distribution roller having a conical cross section described in the modified example 2, and the stepped distribution roller described in the modified example 3.

[4-4. Fourth modified example]

[0103] In the above-described embodiment, as shown in FIG. 8 for example, the distribution rollers 70A-70F are horizontally arranged in series in a direction X. However, the invention is not limited to this. The arrangement shown in FIG. 14 may be used. FIG. 14 illustrates the fourth modified example of a modification of the arrangement of the distribution rollers 70A-70F. As shown in FIG. 14 for example, the distribution rollers 70A-70F may be arranged along a direction X so as to have different height positions, respectively. More specifically, height positions of the distribution rollers 70A-70F do not have to be horizontal so long as the yarn 100 travelling on the yarn path 96F from the second relaxing roller 62 to a contact point of the farthest distribution roller 70F for example is prevented from having any contact with roller faces of other distribution rollers 70A-70E. Although not shown in FIG. 14, the same applies to the distribution rollers 70G-70L. As described above, the configuration shown in FIG. 14 can provide a simple configuration, in which a plurality of distribution rollers 70A-70F having different height positions are merely arranged, can prevent the yarns 100 delivered from the second relaxing roller 62 from having any contact with roller faces of other distribution rollers.

[0104] When the distribution rollers 70A-70F are arranged along a direction X so as to have different height positions as shown in FIG. 14, an acute angle β equal to or smaller than 0° can be formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane.

[0105] FIGS. 15(A) to 15(C) illustrate an example of a positional relation among the first relaxing roller 61, the second relaxing roller 62, and the distribution rollers 70A-70F when the distribution rollers 70A-70F having different height positions are arranged, respectively. FIG. 15(A) schematically illustrates the first arrangement pattern. FIG. 15(B) schematically illustrates the second arrangement pattern. FIG. 15(C) schematically illustrates the third arrangement pattern.

[0106] The first arrangement pattern to the third arrangement pattern shown in FIGS. 15(A)-15(C) are all configured so that the yarn 100 from the second relaxing roller 62 to the contact point of distribution roller 70F is prevented from having a contact with the roller faces of other distribution rollers 70A-70E and the first relaxing roller 61. All of the first arrangement pattern to the third arrangement pattern shown in FIGS. 15(A)-15(C) allow a yarn path in which the yarn 100 reaches the corresponding distribution roller to have thereon a space in which the yarn 100 can travel. Thus, the yarn 100 from the second relaxing roller 62 to the contact point of the distribution roller 70F can be prevented from having a contact with the roller faces of other distribution rollers 70A-70E and the first relaxing roller 61. According to the first arrangement pattern shown in FIG. 15(A) and the third arrangement pattern shown in FIG. 15(C), an acute angle β smaller than 0° can be formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70F and a horizontal plane.

[0107] FIGS. 16(A)-16(B) are a schematic view illustrating another example of the positional relation among the first relaxing roller 61, the second relaxing roller 62, and the distribution rollers 70A-70F when the distribution rollers 70A-70F having different height positions are arranged, respectively. FIG. 16(A) is a schematic view illustrating the fourth arrangement pattern. FIG. 16(B) is a schematic view illustrating the fifth arrangement pattern.

[0108] The fourth arrangement pattern shown in FIG. 16(A) is configured such that the yarn 100 from the second relaxing roller 62 to a contact point of the distribution roller 70F has a contact with roller faces of other distribution rollers 70A-70E. The fifth arrangement pattern shown in FIG. 16(B) is configured such that the yarn 100 from the second relaxing roller 62 to a contact point of the distribution roller 70F has a contact with roller face of the first relaxing roller 61. Thus, the fourth arrangement pattern and fifth arrangement pattern cannot be used as a positional relation among the first relaxing roller 61, the second relaxing roller 62, and the distribution rollers 70A-70F.

(Reference Numerals)

[0109]

1	Spun yarn take-up apparatus
6	Spun yarn take-up unit
8	Spooling unit
10	First guide section
20	First yarn delivery roller
28	Drawing section
62	Second relaxing roller (second guide sec-

tion)
70A-70L Distribution roller (second guide section)

Claims

1. A spun yarn take-up apparatus (1, 1A) comprising a spun yarn take-up unit (6) for taking up and at least drawing a plurality of yarns (100) spun from a spinning machine and a spooling unit (8) for winding the plurality of yarns (100) delivered from the spun yarn take-up unit (6) to form a wound package, wherein the spun yarn take-up unit (6) includes:

   a first guide section (10) for guiding the plurality of yarns (100) spun from the spinning machine downstream along a yarn traveling direction;
   a drawing section (28) including a plurality of rollers (31, 41, 51) having at least one roller for drawing the plurality of yarns (100) guided by the first guide section (10); and
   a second guide section (60, 70) for guiding the plurality of yarns (100) from the drawing section (28) to the spooling unit (8), and wherein
   the spooling unit (8) and the drawing section (28) are arranged horizontally, and
   the second guide section (60, 70) has: a guide roller (62) arranged downstream from the drawing section (28) along a yarn traveling direction; and a plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) arranged downstream from the guide roller (62) along a yarn traveling direction, the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) provided with a driver arranged above the spooling unit (8), wherein the plurality of yarns (100) from the drawing section (28) are delivered to the spooling unit (8) through the guide roller (62) and the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L).

2. The spun yarn take-up apparatus (1, 1A) as claimed in claim 1, wherein the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) are arranged such that an acute angle larger than or equal to 0° as well as smaller than or equal to 20° is formed by a yarn traveling direction of the plurality of yarns (100) delivered from the guide roller (62) and a horizontal plane.

3. The spun yarn take-up apparatus (1, 1A) as claimed in claim 1 or 2, wherein

   the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) are arranged in series, when seen in a planar view, along a plurality of yarn paths (96A-96L) extending from the guide roller (62) to the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L), respectively,
   the plurality of yarn paths (96A-96L) are separated in directions orthogonal thereto, when seen in a planar view, corresponding to the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L), respectively, and
   the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) are arranged such that each thereof avoids a yarn path (96A-96L) corresponding to other thereof.

4. The spun yarn take-up apparatus (1, 1A) as claimed in any one of claims 1-3, wherein the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) have roller faces different in height depending upon positions in directions orthogonal to the plurality of yarn paths (96A-96L) from the guide roller (62) to the plurality of distribution rollers (70A-70L) as well as orthogonal to a vertical direction, respectively.

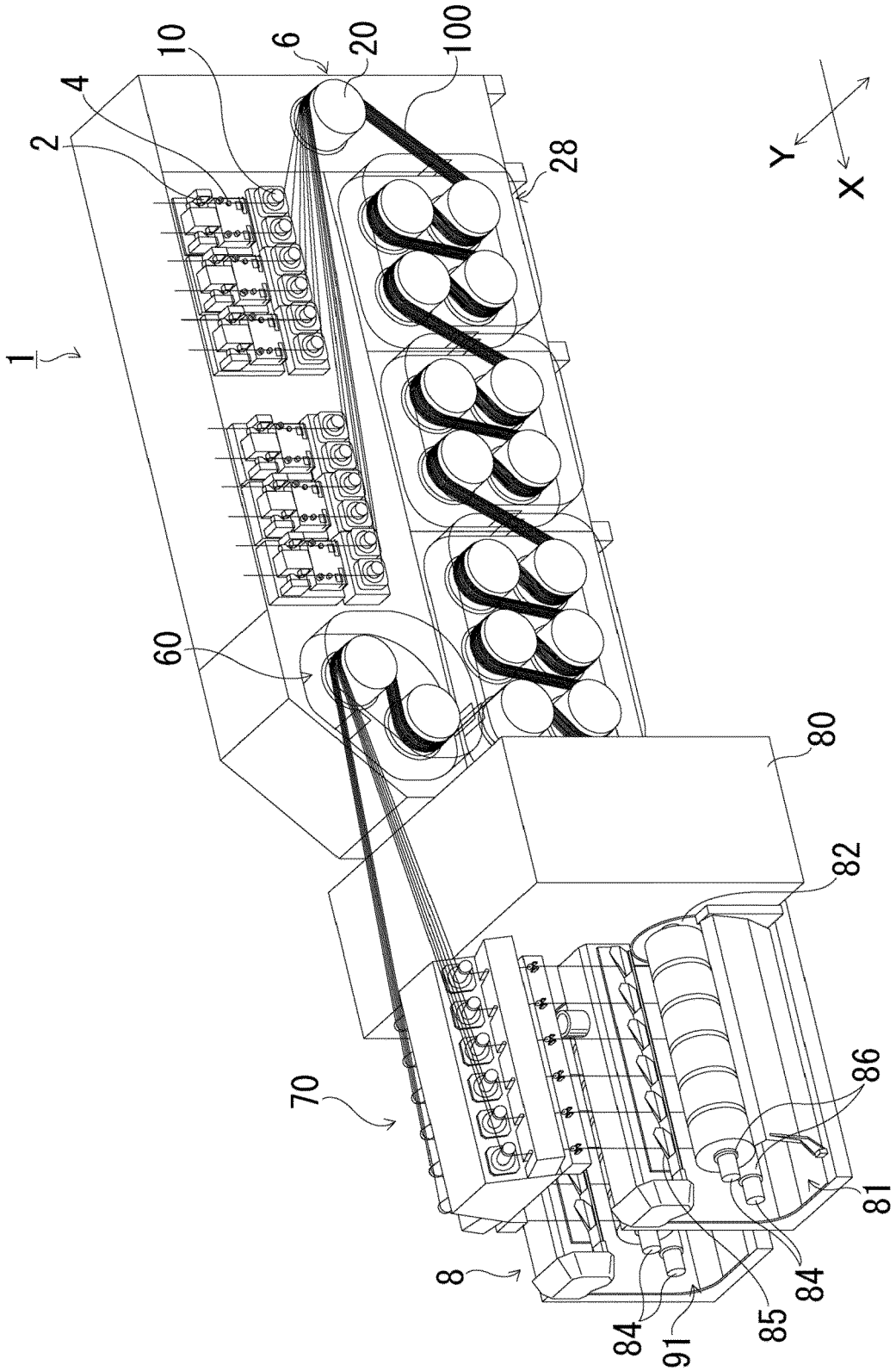
5. The spun yarn take-up apparatus (1, 1A) as claimed in any one of claims 1-4, wherein at least one of the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) has an axis direction inclined with respect to a horizontal direction.

6. The spun yarn take-up apparatus (1, 1A) as claimed in any one of claims 1-5, wherein at least one of the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) is a conically-shaped or stepped roller different in diameter depending upon positions in directions orthogonal to the plurality of yarn paths (96A-96L) from the guide roller (62) to the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) as well as orthogonal to a vertical direction, respectively.

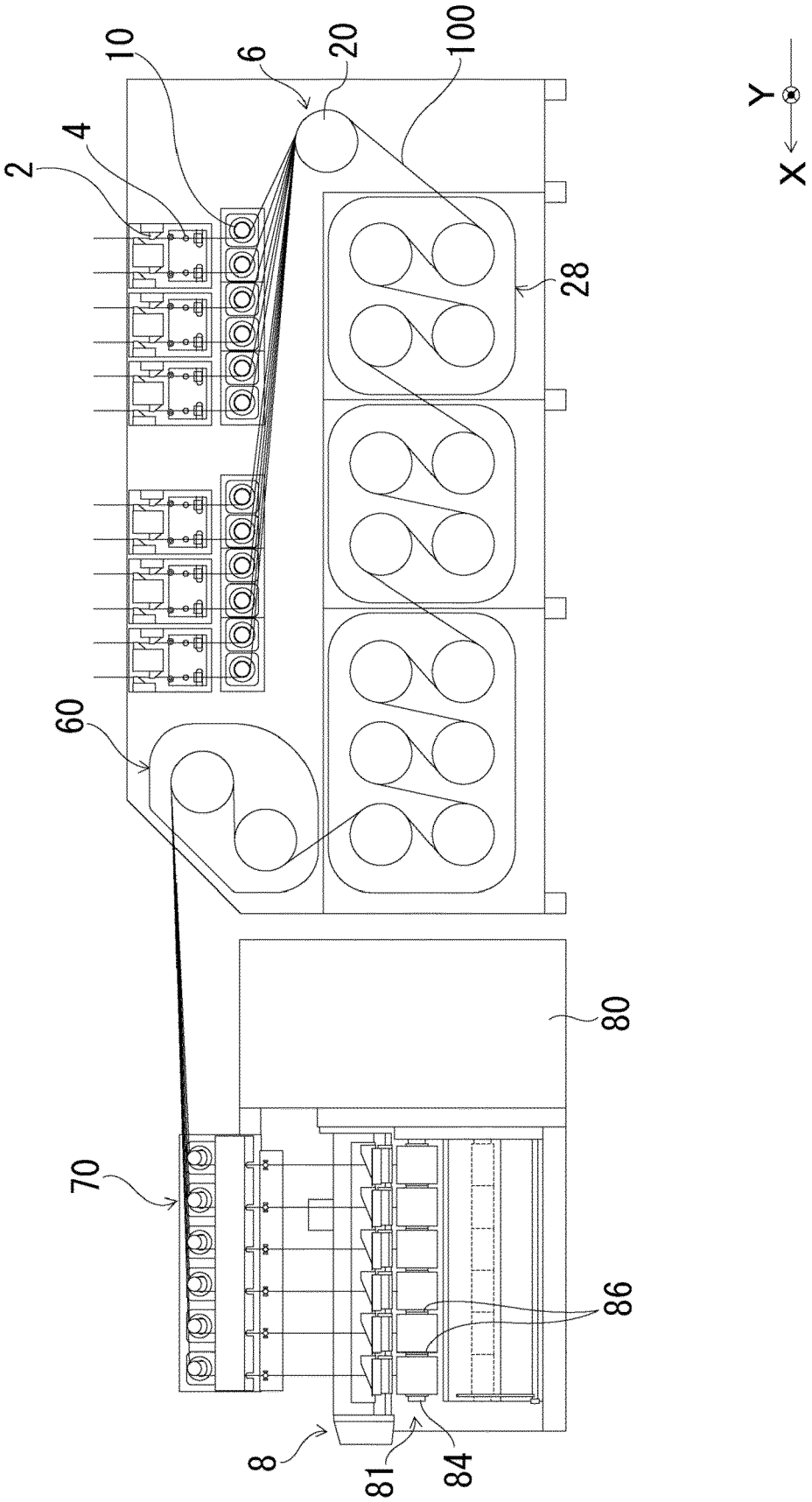
7. The spun yarn take-up apparatus (1, 1A) as claimed in any one of claims 1-3, wherein the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) are arranged such that a roller face of a distribution roller (70A, 70G) the smallest in distance from the guide roller (62) is the smallest in height, and roller faces of the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L) increase in height with increase in distance from the guide roller (62).

8. The spun yarn take-up apparatus (1, 1A) as claimed in any one of claims 1-7 further comprising a plurality of drivers corresponding to the plurality of distribution rollers (70A-70L, 77A-77L, 78A-78L), respectively.

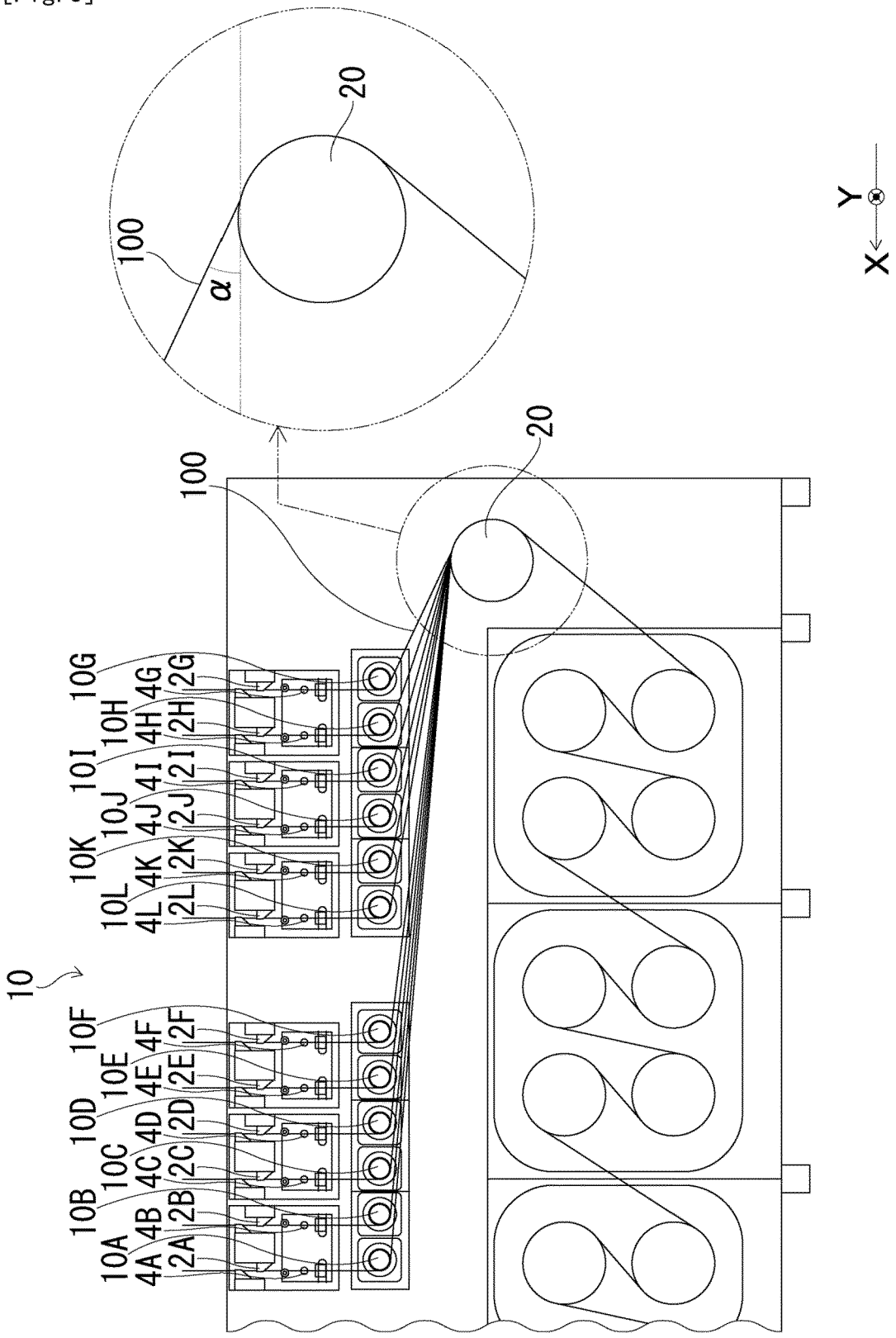
[Fig. 1]



[Fig. 2]



[Fig. 3]


20
100
α
Y
X
100
20
10
10A
4A
2A
10B
4B
2B
10C
4C
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10D
4D
2D
10E
4E
2E
10F
4F
2F
10L
4L
2L
10K
4K
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4I
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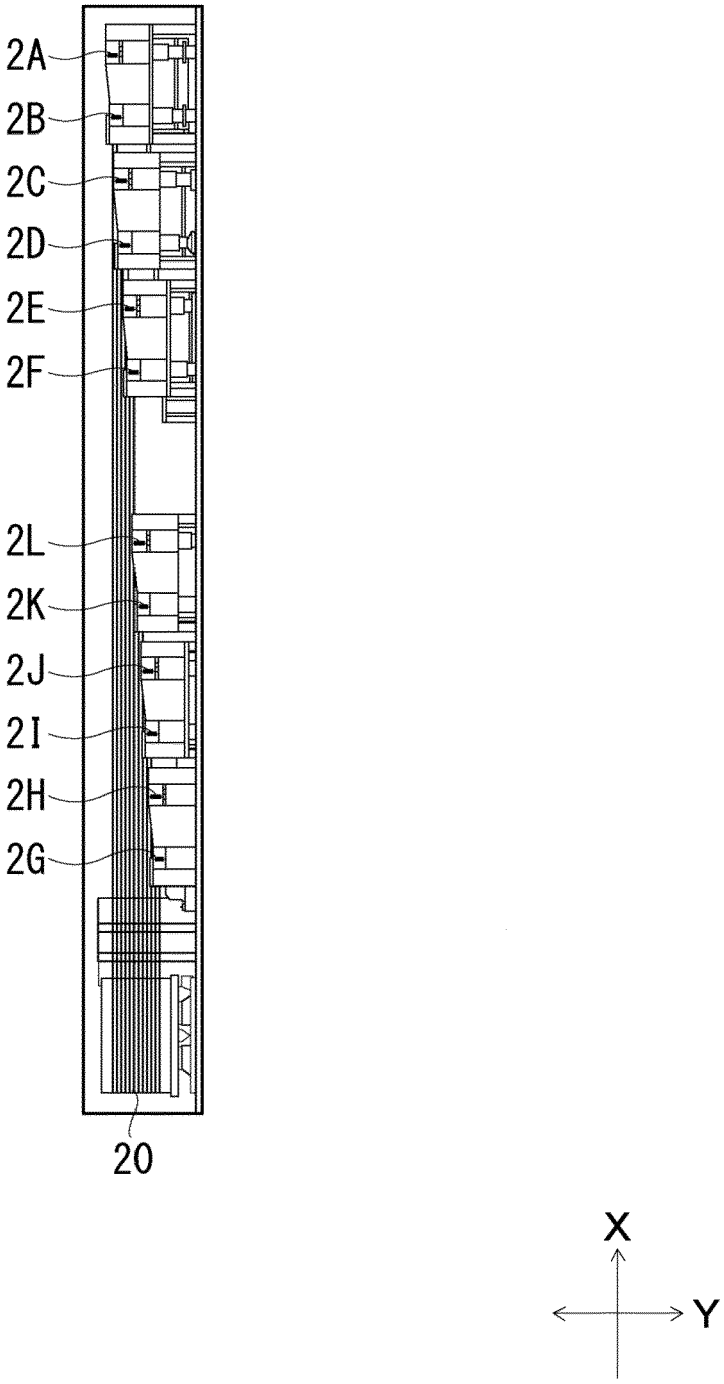
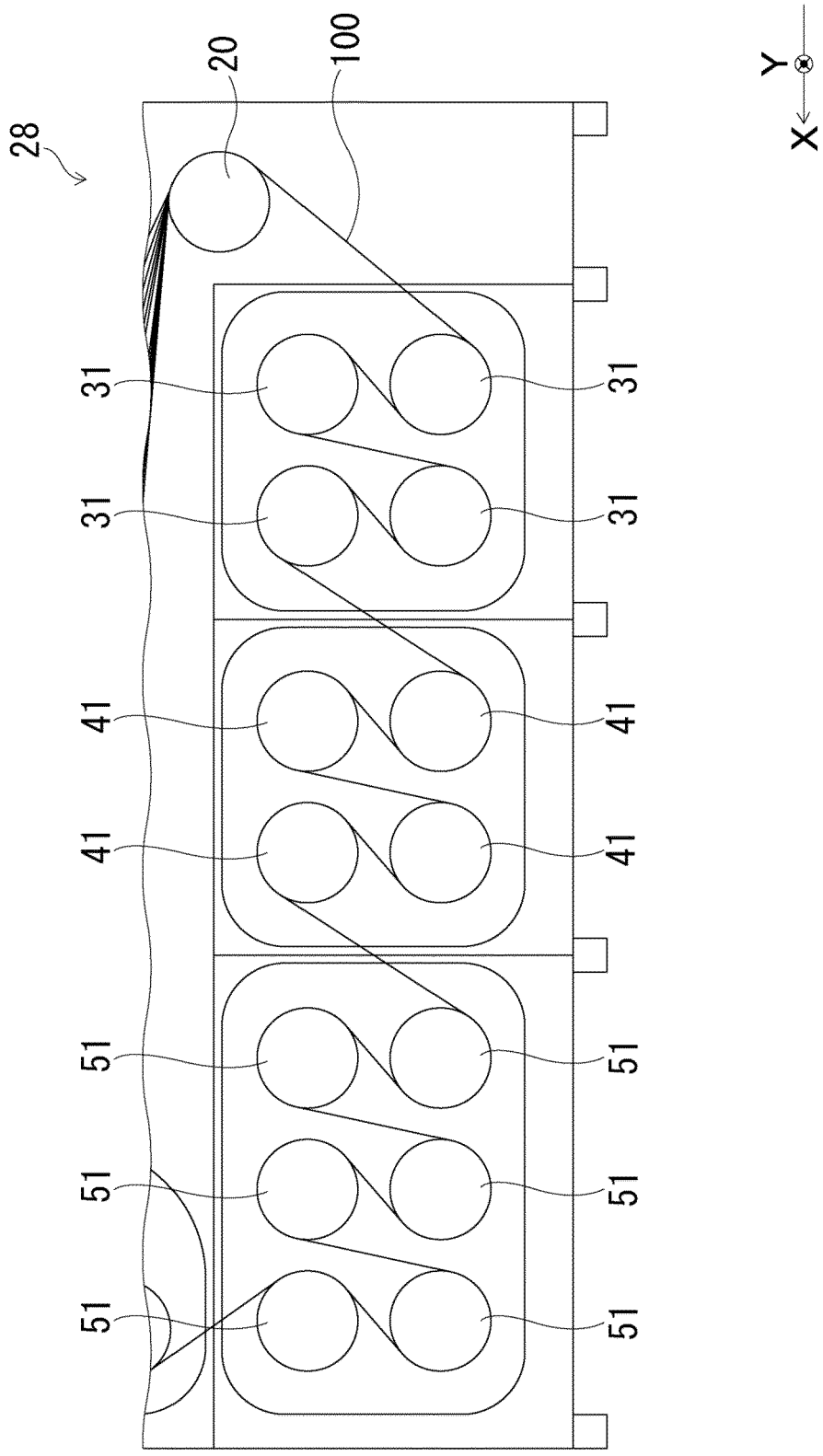
4H
2H
10G
4G
2G

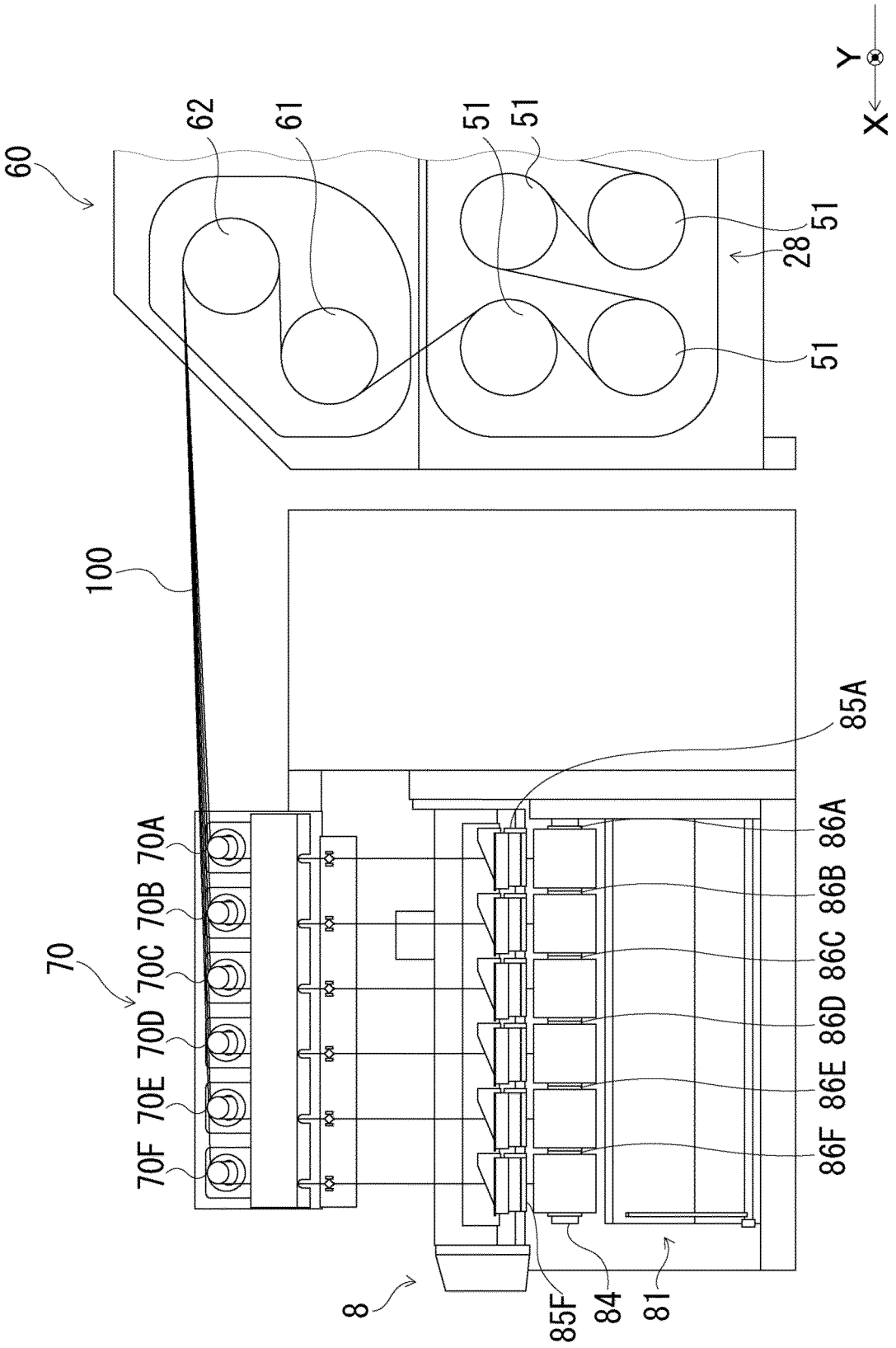
[Fig. 4]



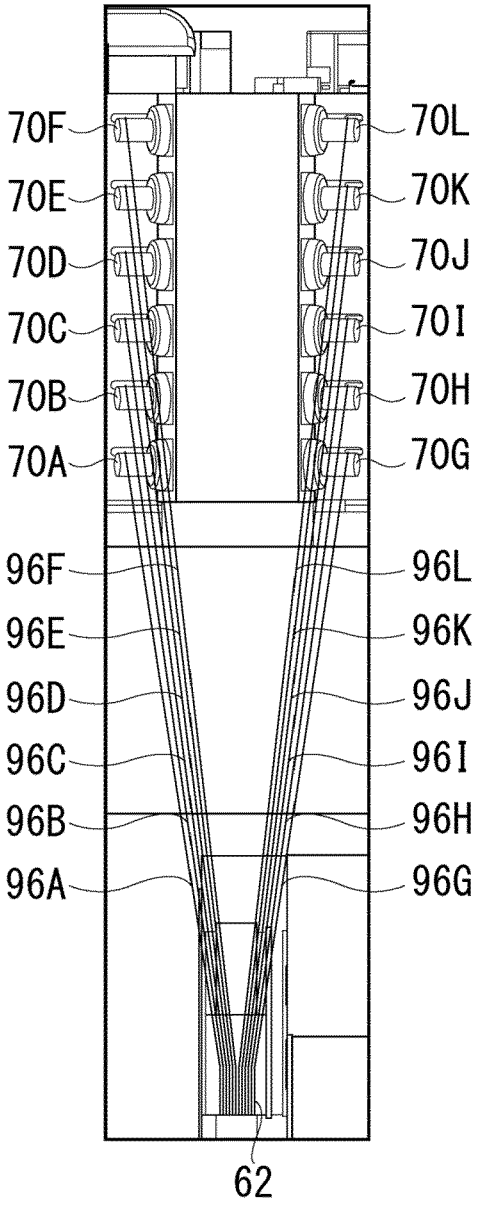
[Fig. 5]



[Fig. 6]


Y
X
60
62
61
51
51
51
28
51
100
85A
86A
86B
86C
86D
86E
86F
70
70A
70B
70C
70D
70E
70F
8
85F
84
81

[Fig. 7]


70F
70E
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70K
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70I
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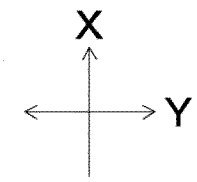
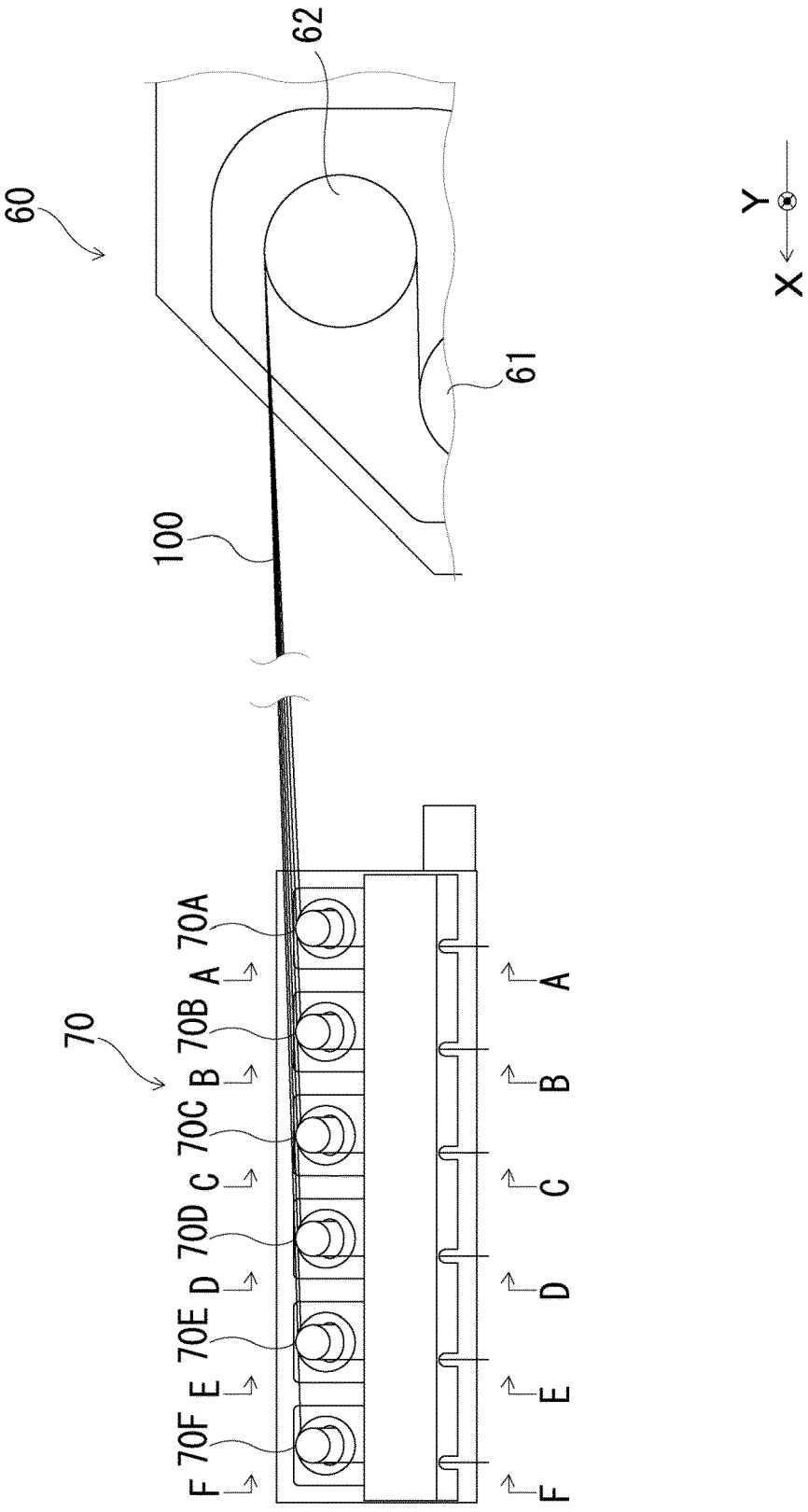
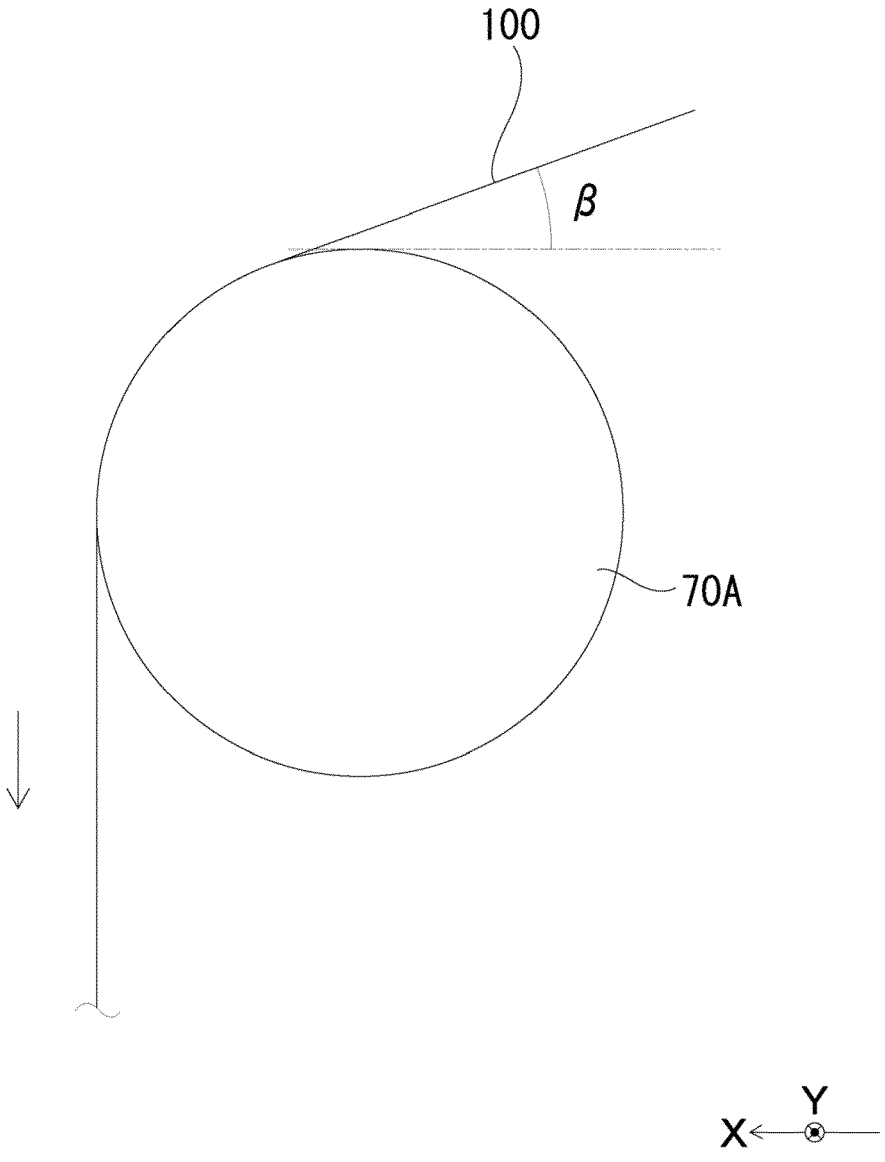
96L
96K
96J
96I
96H
96G
62


X
Y

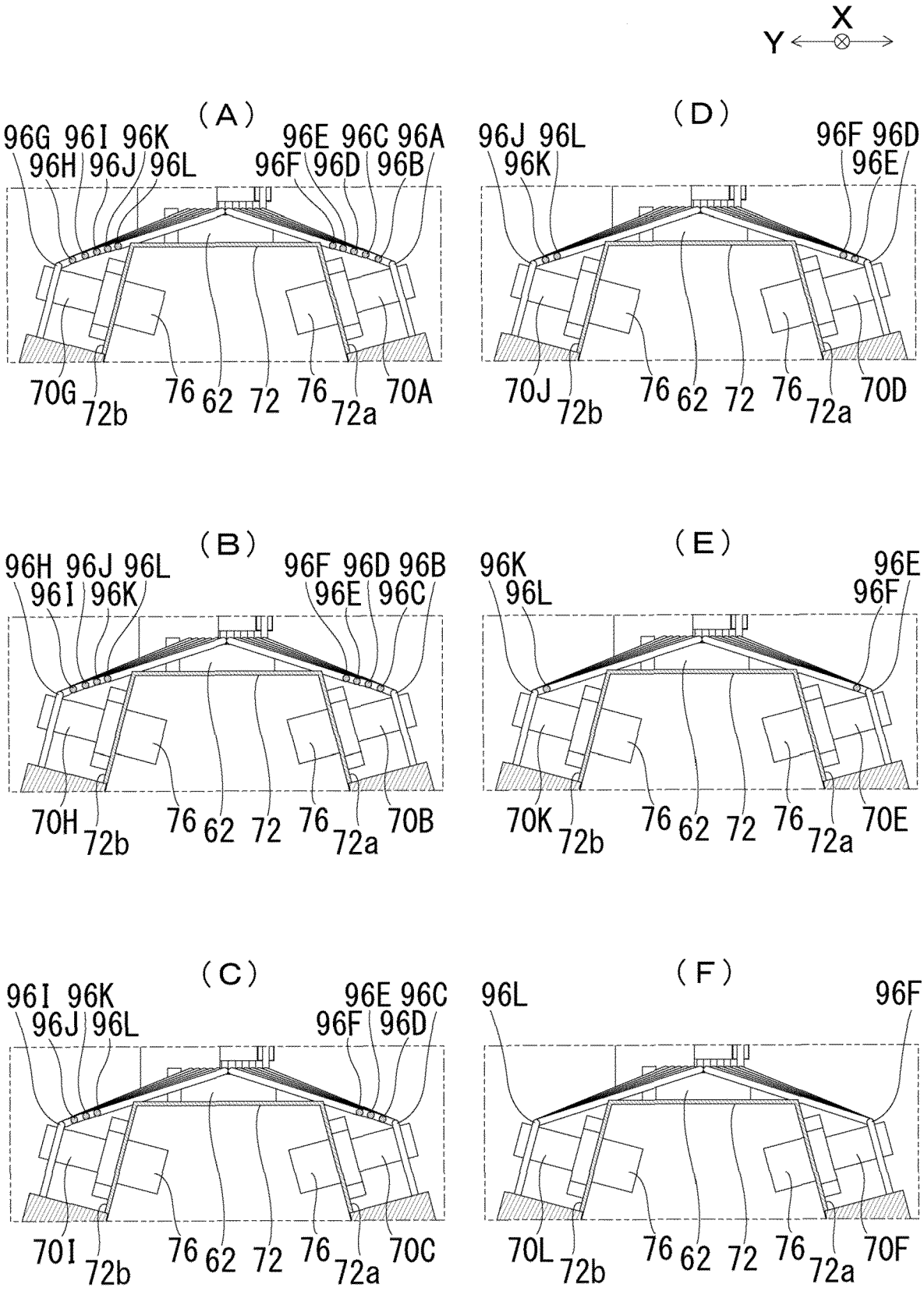
[Fig. 8]



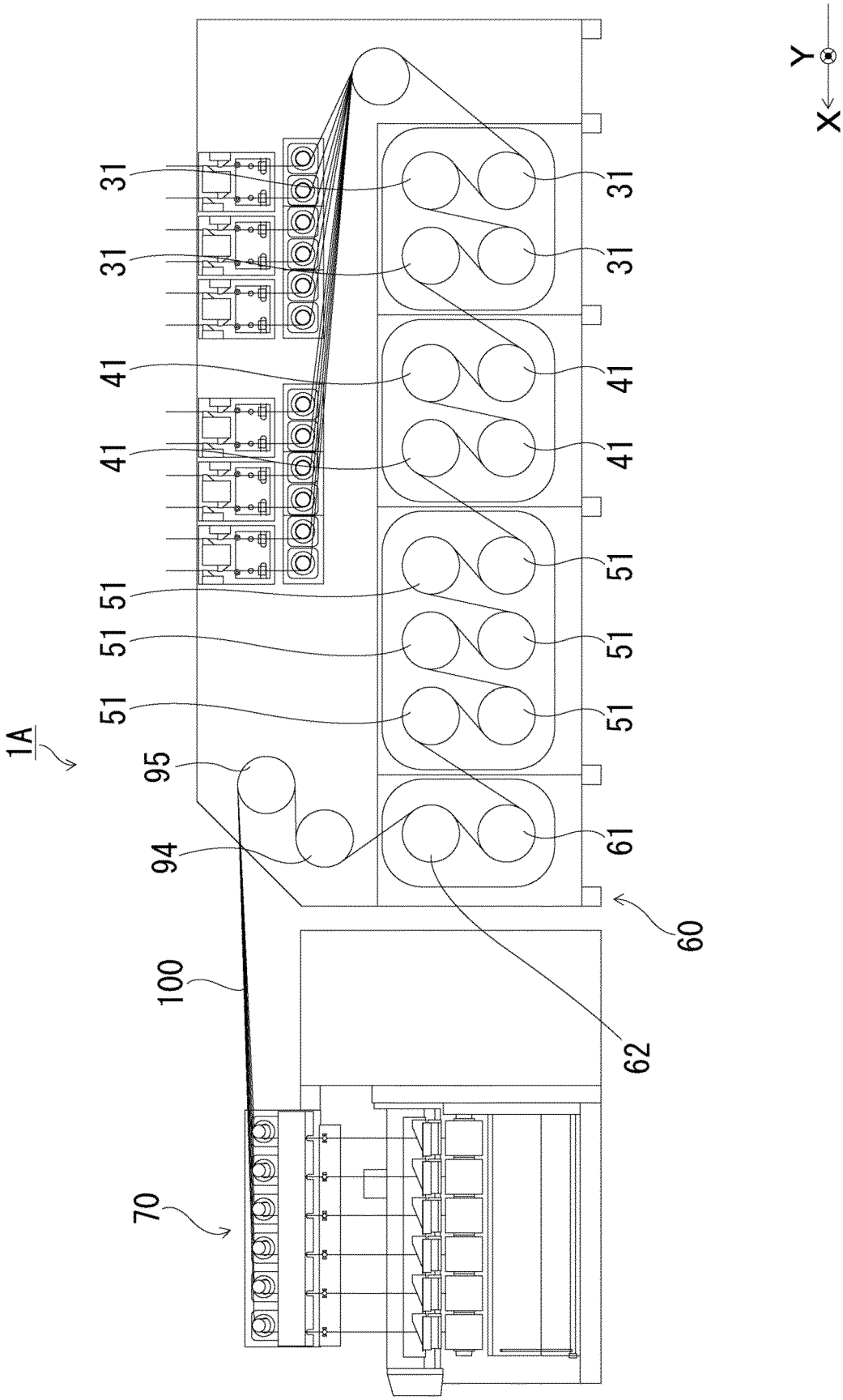
[Fig. 9]



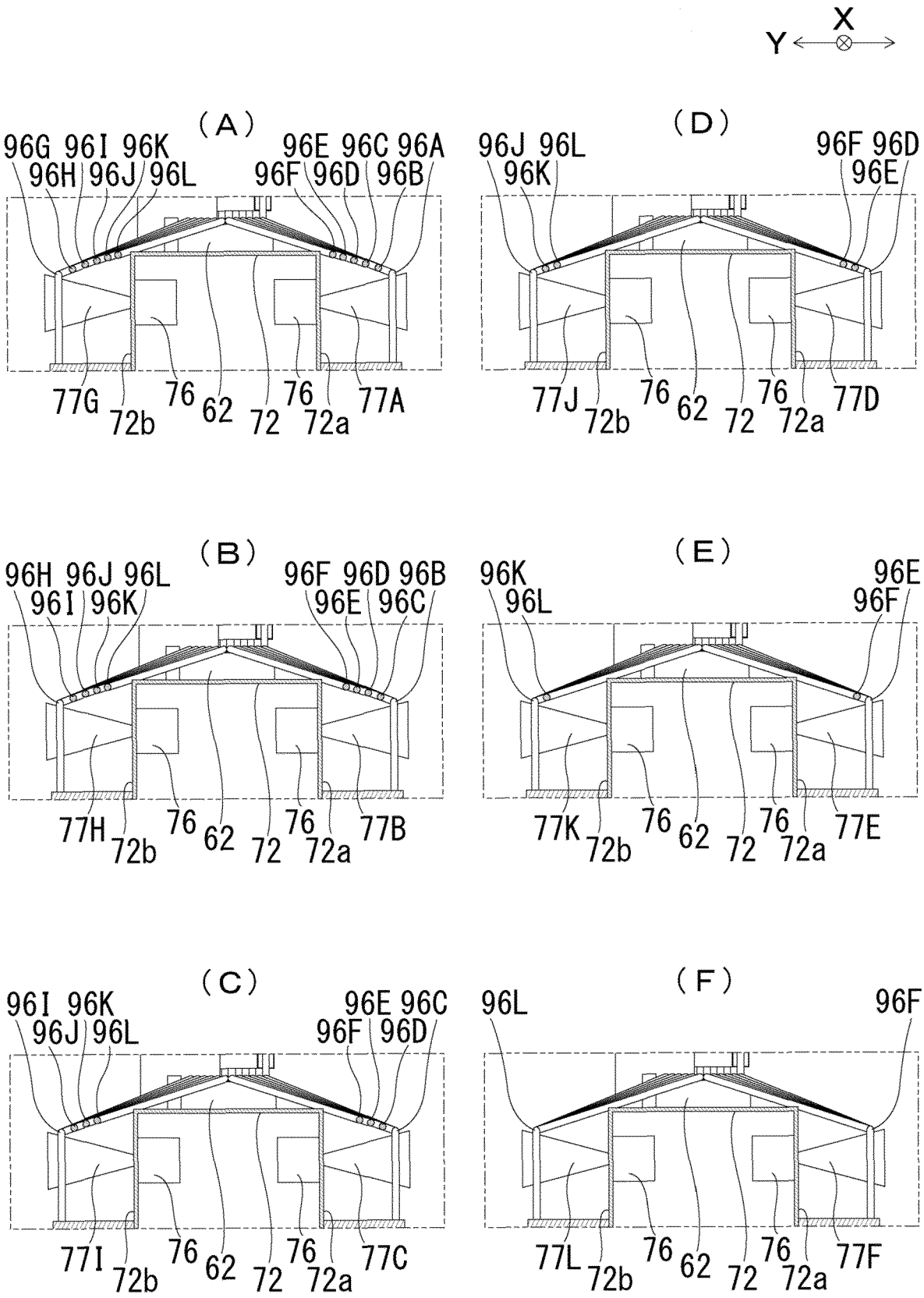
[Fig. 10]


X
Y
(A)
96G 96I 96K
96H 96J 96L
96E 96C 96A
96F 96D 96B
70G
72b
76
62
72
76
72a
70A
(D)
96J 96L
96K
96F 96D
96E
70J
72b
76
62
72
76
72a
70D
(B)
96H 96J 96L
96I 96K
96F 96D 96B
96E 96C
70H
72b
76
62
72
76
72a
70B
(E)
96K
96L
96E
96F
70K
72b
76
62
72
76
72a
70E
(C)
96I 96K
96J 96L
96E 96C
96F 96D
70I
72b
76
62
72
76
72a
70C
(F)
96L
96F
70L
72b
76
62
72
76
72a
70F

[Fig. 11]



[Fig. 12]


X
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96H 96J 96L
96E 96C 96A
96F 96D 96B
77G
72b
76
62
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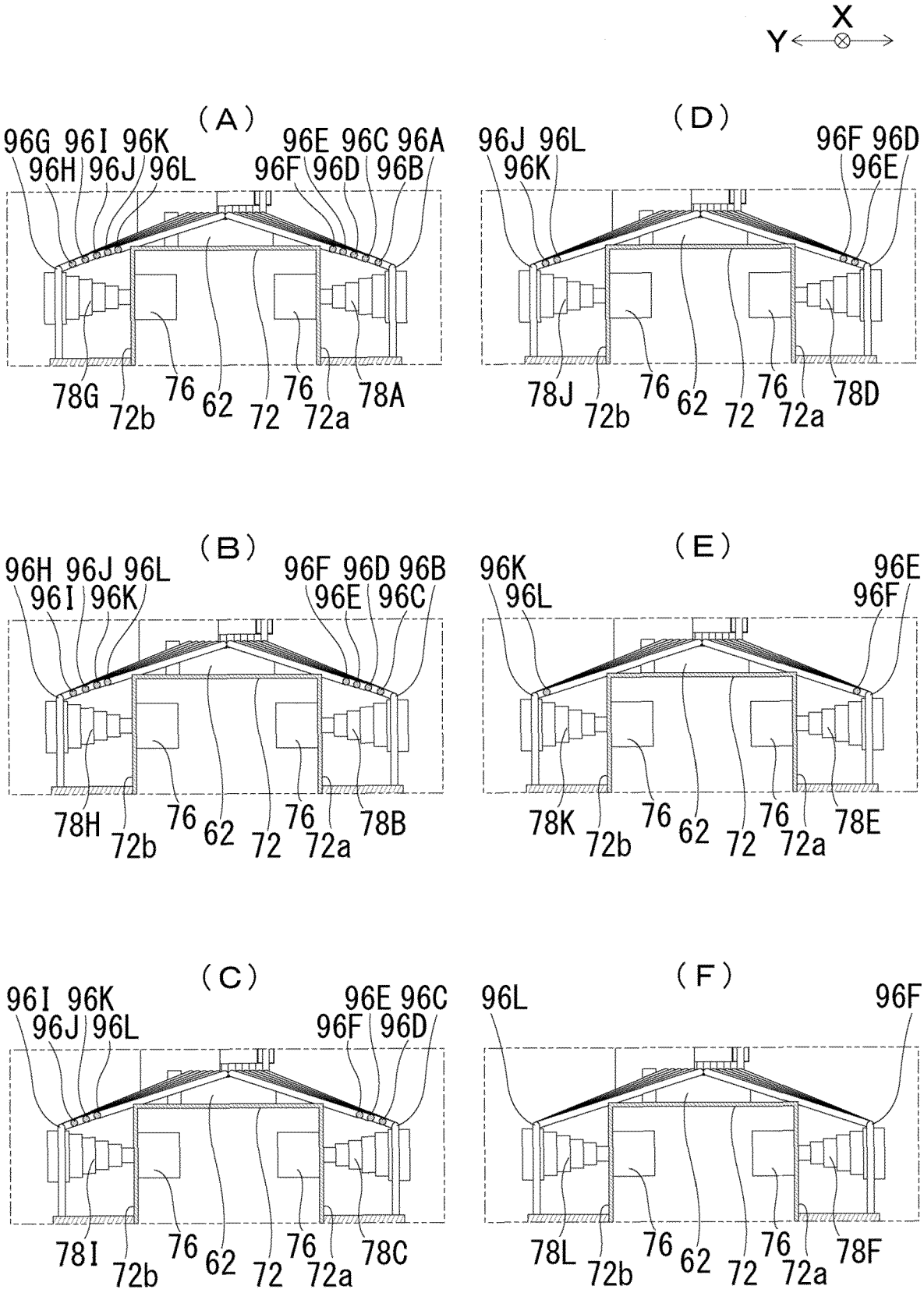
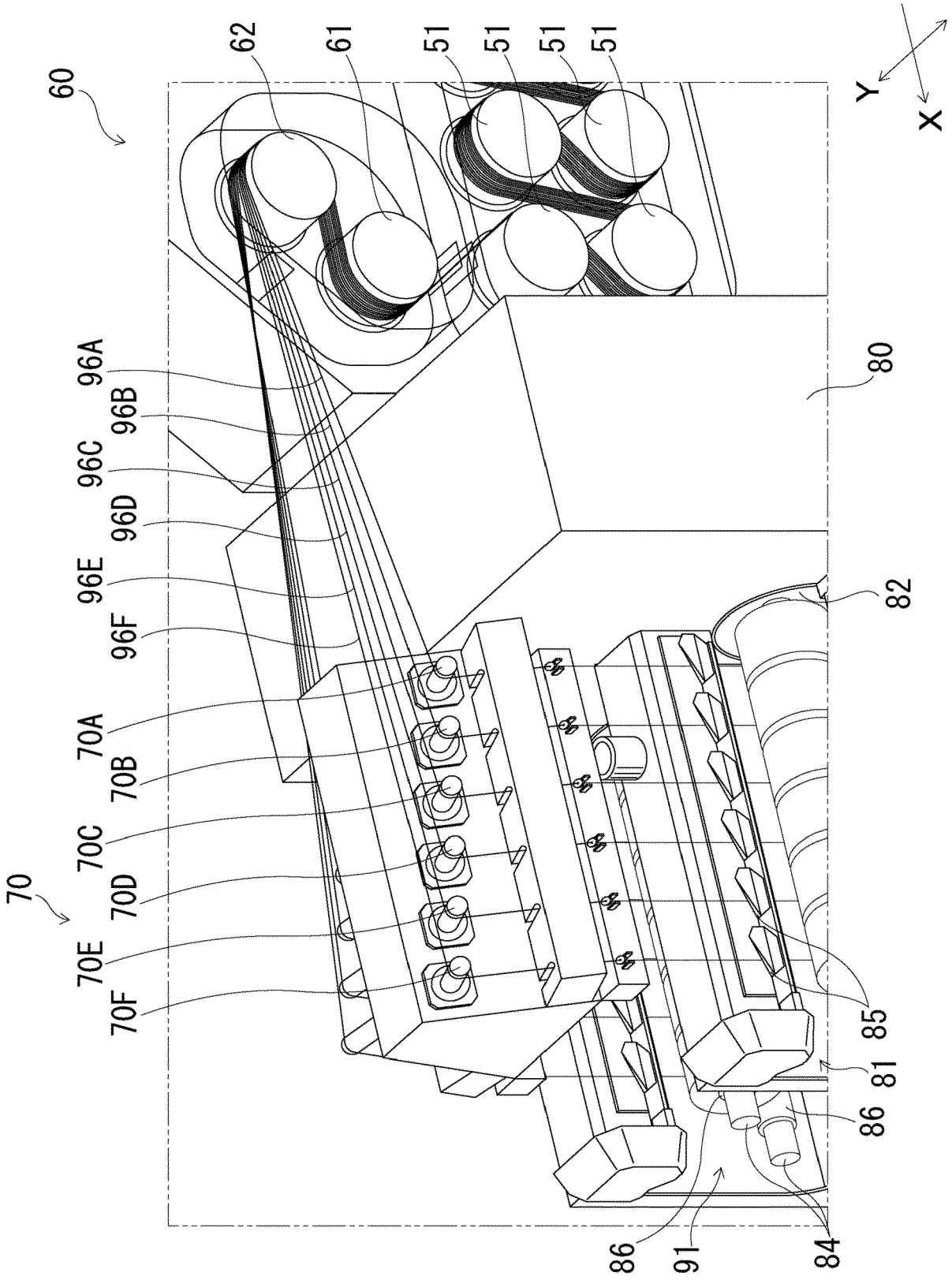
72a
77A
(D)
96J 96L
96K
96F 96D
96E
77J
72b
76
62
72
76
72a
77D
(B)
96H 96J 96L
96I 96K
96F 96D 96B
96E 96C
77H
72b
76
62
72
76
72a
77B
(E)
96K
96L
96E
96F
77K
72b
76
62
72
76
72a
77E
(C)
96I 96K
96J 96L
96E 96C
96F 96D
77I
72b
76
62
72
76
72a
77C
(F)
96L
96F
77L
72b
76
62
72
76
72a
77F

[Fig. 13]


X
Y
(A)
96G 96I 96K
96H 96J 96L
96E 96C 96A
96F 96D 96B
78G 72b 76 62 72 76 72a 78A
(D)
96J 96L
96K
96F 96D
96E
78J 72b 76 62 72 76 72a 78D
(B)
96H 96J 96L
96I 96K
96F 96D 96B
96E 96C
78H 72b 76 62 72 76 72a 78B
(E)
96K
96L
96E
96F
78K 72b 76 62 72 76 72a 78E
(C)
96I 96K
96J 96L
96E 96C
96F 96D
78I 72b 76 62 72 76 72a 78C
(F)
96L
96F
78L 72b 76 62 72 76 72a 78F

[Fig. 14]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51
51
Y
X
96A
96B
96C
96D
96E
96F
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70E
70F
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85
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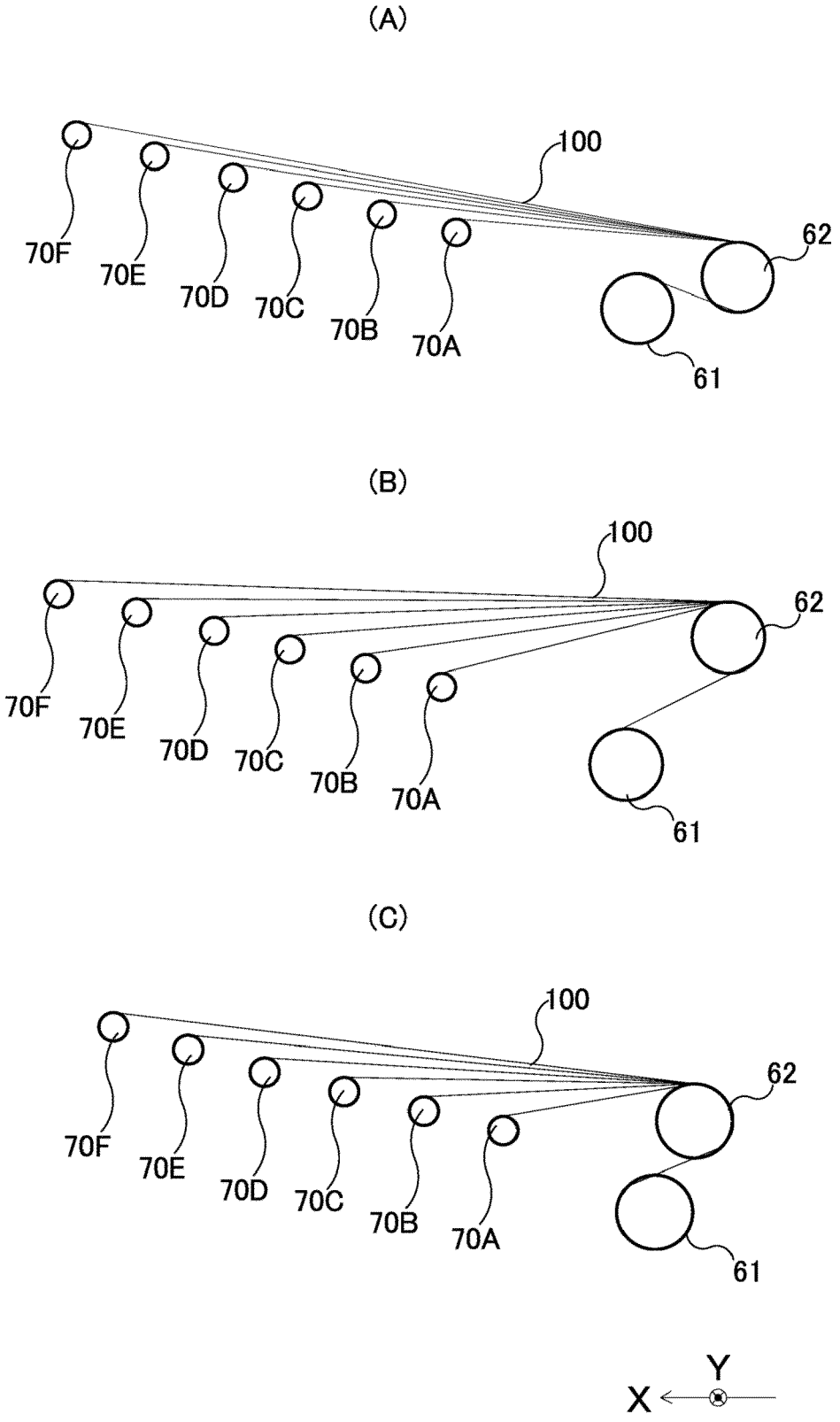
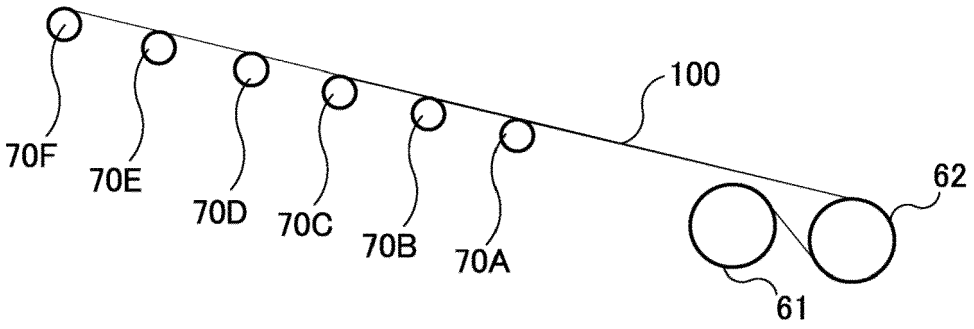
86
86
91
84

[Fig. 15]

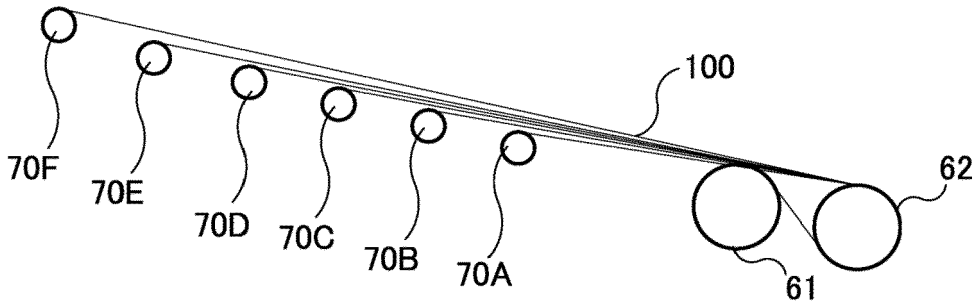

(A)
100
62
70F
70E
70D
70C
70B
70A
61
(B)
100
62
70F
70E
70D
70C
70B
70A
61
(C)
100
62
70F
70E
70D
70C
70B
70A
61
Y
X

[Fig. 16]

(A)


70F
70E
70D
70C
70B
70A
100
62
61

(B)


70F
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70D
70C
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70A
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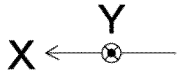
Y
X

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 6936

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 1 486 592 A1 (SAURER GMBH & CO KG [DE]) 15 December 2004 (2004-12-15) * paragraphs [0023] - [0030]; figure 1 *	1,8 2-7	INV. B65H51/06 B65H54/72 B65H57/16
Y	EP 2 456 913 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 30 May 2012 (2012-05-30) * paragraphs [0036] - [0049]; figure 1 *	1,8	D01D13/02
Y	DE 10 2013 000824 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 14 August 2013 (2013-08-14) * claim 1 *	1,8	
Y	WO 2016/180679 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 17 November 2016 (2016-11-17) * claim 4 *	1	
Y	WO 2019/101717 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 31 May 2019 (2019-05-31) * claim 6 *	1,8	
Y	WO 2017/001659 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 5 January 2017 (2017-01-05) * claim 1 *	1,8	TECHNICAL FIELDS SEARCHED (IPC) B65H D01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 October 2022	Pussemier, Bart

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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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14-10-2022

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