(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 101 799 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.12.2022 Bulletin 2022/50

(21) Application number: **22176901.1**

(22) Date of filing: **02.06.2022**

(51) International Patent Classification (IPC):
B65H 54/72 *(2006.01)* ***B65H 57/14*** *(2006.01)*
B65H 57/16 *(2006.01)* ***D01D 13/02*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B65H 54/72; B65H 57/14; B65H 57/16; D01D 7/00; D01D 13/02; B65H 2701/3132

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **10.06.2021 JP 2021097322**

(71) Applicant: **TMT Machinery, Inc.**
Osaka-shi, Osaka 541-0041 (JP)

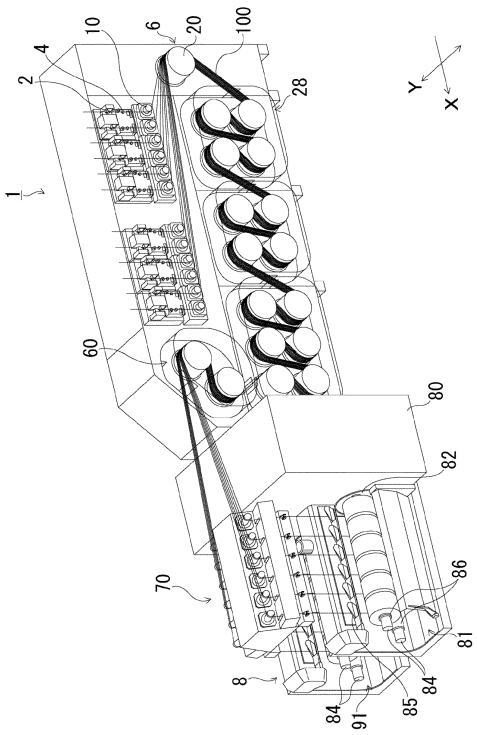
(72) Inventors:
- **TERANO, Kouji**
  Ehime, 791-8513 (JP)
- **KOJIMA, Shogo**
  Kyoto, 612-8686 (JP)
- **KAWAMOTO, Kazuhiro**
  Kyoto, 612-8686 (JP)

(74) Representative: **Betten & Resch**
Patent- und Rechtsanwälte PartGmbB
Maximiliansplatz 14
80333 München (DE)

(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 at least drawing a plurality of yarns 100 spun from a spinning machine, a plurality of yarn suctioning units 4, 4A-4L, 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 changing traveling directions of the plurality of yarns 100, respectively; a drawing section 28, 28A including a plurality of rollers 31-34, 41-44, and 51-58 having a roller for drawing the plurality of yarns 100; and a second guide section 70 for guiding the plurality of yarns 100 to the spooling unit 8. The spooling unit 8 and the drawing section 28, 28A are arranged horizontally and the first guide section 10 is arranged above at least one roller of the drawing section 28, 28A. A first yarn delivery roller 20 is provided on a yarn path from the first guide section 10 to the drawing section 28, 28A. The first yarn delivery roller 20 is arranged below the plurality of yarn suctioning sections 4, 4A-4L and separated in a horizontal direction from the first guide section 10 and the drawing section 28, 28A.

[Fig. 1]



EP 4 101 799 A1

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.,* 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)

[0004] Patent Document 1: US Patent Application Publication No. 2009/0049669

(Problems to be Solved)

[0005] 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

[0006] 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)

[0007]

[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, a plurality of yarn suctioning units capable of suctioning the plurality of yarns, respectively, 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, arranged below the plurality of yarn suctioning units including a plurality of direction-changing rollers for changing traveling directions of the plurality of yarns, respectively;
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 first guide section is arranged above at least one roller of the drawing section,
a first yarn delivery roller is provided on a yarn path from the plurality of direction-changing rollers to the drawing section, and
the first yarn delivery roller is arranged below the plurality of yarn suctioning units and separated in a horizontal direction from the first guide section and the drawing section.

[0008] According to the above-described first aspect [1] of the spun yarn take-up apparatus, the spooling unit and the drawing section are arranged horizontally, and the first yarn delivery roller is arranged below the plurality of yarn suctioning units and separated in a horizontal direction from the first guide section and the drawing section. A height of the first guide section arranged above at least one roller of the drawing section can, therefore, be suppressed, and thereby, a floor level of the spun yarn take-up apparatus can be reduced. As a result, there is no conventional need to divide a 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.

[0009] [2] A second aspect of the present invention is the spun yarn take-up apparatus in the above-described first aspect [1], wherein the first guide section is arranged such that the plurality of direction-changing rollers for respective yarns thereof are mutually displaced to form a single row in a direction orthogonal to an axis direction of a winding axis of the spooling unit when seen in a planar view.

[0010] According to the above-described second aspect [2] of the spun yarn take-up apparatus, the plurality of direction-changing rollers are mutually displaced to form a single row in a direction orthogonal to an axis direction of a winding axis of the spooling unit when seen in a planar view. As a result, any mutual interference or entanglement among the plurality of yarns delivered from the plurality of direction-changing rollers can be prevented. Further, any mutual interference or entanglement among the plurality of yarns can be prevented without the need to guiding for retaining an interval among the plurality of yarns. In particular, in order to arrange the first guide section at a lower position, it is preferred that a distance between the first guide section and the drawing section be reduced in a height direction, which is likely to cause any mutual interference or entanglement among the plurality of yarns. Nevertheless, a remarkable effect can be achieved in that the distance between the first guide section and the drawing section can be reduced while any mutual interference or entanglement among the plurality of yarns being prevented.

[0011] [3] A third aspect of the present invention is the spun yarn take-up apparatus in the above-described second aspect [2], wherein the first guide section is arranged such that the plurality of direction-changing rollers for respective yarns thereof are displaced at an equal interval to form a single row in a direction orthogonal to an axis direction of a winding axis of the spooling unit when seen in a planar view.

[0012] According to the above-described third aspect [3] of the spun yarn take-up apparatus, the plurality of direction-changing rollers are displaced at an equal interval to form a single row in a direction orthogonal to an axis direction of a winding axis of the spooling unit when seen in a planar view. As a result, the yarn setting operation can easily be performed so as to set the plurality of yarns to a guide (not shown) and to an interlacing apparatus (not shown) arranged downstream from the plurality of direction-changing rollers along a yarn traveling direction for retaining intervals among the plurality of yarns.

[0013] [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 each of the plurality of direction-changing rollers is a roller configured to change a traveling direction of each yarn spun downward from the spinning machine to a direction inclined downward from a horizontal direction.

[0014] According to the above-described fourth aspect [4] of the spun yarn take-up apparatus, a traveling direction of each yarn spun downward from the spinning machine is changed by each direction-changing roller to a direction inclined downward from a horizontal direction. Tension can, therefore, be applied to each yarn at a bending angle, which is the same as that of a conventional one including a guide, while a load imposed on each yarn being minimized. As a result, a height can be reduced not through the use of such a conventional guide but through the use of each direction-changing roller. Further, the plurality of direction-changing rollers can be driven individually so that a difference in tension among the plurality of yarns can be reduced.

[0015] [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 the plurality of rollers include rollers aligned in two rows in a horizontal direction.

[0016] According to the above-described fifth aspect [5] of the spun yarn take-up apparatus, the plurality of rollers include rollers aligned in two rows in a horizontal direction, and therefore, a height of the plurality of rollers can be suppressed so that a floor level of the drawing section can be reduced.

[0017] [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 the first yarn delivery roller and the plurality of rollers are arranged such that a winding angle of the plurality of yarns to each roller is smaller than 360°, and an axis direction of each roller is a direction substantially orthogonal to the yarn path when seen in a planar view.

[0018] According to the above-described sixth aspect [6] of the spun yarn take-up apparatus, for each of the first yarn delivery roller and the plurality of rollers, not only the winding angle of the plurality of yarns to each roller is smaller than 360° but also the axis direction of each roller is substantially orthogonal to the yarn path when seen in a planar view. Each of the plurality of yarns is, therefore, allowed to travel while keeping a horizontal position from the first guide section to at least the drawing section so that a traveling direction thereof when seen in a planar view is limited to a direction X. As a result, the

plurality of yarns can travel in such a manner that each yarn path thereof from the first guide section to at least the drawing section is not deviated from other yarn path thereof in an axis direction thereof.

[0019] [7] A seventh aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to sixth aspects [1]-[6], wherein the plurality of rollers have:

at least one preheating roller arranged below the first guide section, wherein a surface temperature thereof is set to be a first temperature, and two or three units thereof are distributed in an up-and-down direction;
at least one drawing roller (drawing godet) arranged below the first guide section, wherein a surface temperature thereof is set to be a second temperature higher than the first temperature, and two or three units thereof are distributed in an up-and-down direction; and
at least one thermal setting roller arranged below the first guide section, wherein a surface temperature thereof is set to be a third temperature higher than the second temperature, and two or three units thereof are distributed in an up-and-down direction.

[0020] According to the above-described seventh aspect [7] of the spun yarn take-up apparatus, two or three of the at least one preheating roller, the at least one drawing roller, and the at least one thermal setting roller are distributed below the first guide section in an up-and-down direction, respectively, thereby capable of reducing a floor level of the drawing section. As a result of floor-level reduction of the drawing section, the plurality of rollers in the drawing section no longer need any yarn setting operation at a high place.

[0021] [8] An eighth aspect of the present invention is the spun yarn take-up apparatus in the above-described seventh aspect [7] further comprising:

at least one first warming box configured to accommodate the at least one preheating roller;
at least one second warming box configured to accommodate the at least one drawing roller; and
at least one third warming box configured to accommodate the at least one thermal setting roller, wherein
a yarn outlet of an adjacent first warming box of the at least one first warming box adjacent to an adjacent second warming box of the at least one second warming box and a yarn inlet of the adjacent second warming box are separated from each other, and wherein
a yarn outlet of the at least one second warming box and a yarn inlet of the at least one third warming box are separated from each other.

[0022] According to the above-described eighth aspect [8] of the spun yarn take-up apparatus, a plurality of warming boxes configured to accommodate the at least one preheating roller, the at least one drawing roller, and the at least one thermal setting roller, respectively. Further, a yarn outlet-side opening of an Nth warming box and a yarn inlet-side opening of an (N+1)th warming box arranged downstream along a yarn traveling direction from the Nth warming box are separated from each other without having any communication therebetween. The heat transfer between the Nth and (N+1)th warming boxes can therefore be suppressed, and a target temperature can also be set and controlled easily for each warming box. It is to be noted that the number of the first warming box, the number of the second warming box, and the number of the third warming box are not limited to one. For example, a plurality of preheating rollers may be accommodated in a plurality of first warming boxes, respectively. Similarly, a plurality of drawing rollers may be accommodated in a plurality of second warming boxes, respectively. Alternatively, a plurality of thermal settings may be accommodated in a plurality of third warming boxes, respectively.

[0023] [9] A ninth aspect of the present invention is the spun yarn take-up apparatus in the above-described seventh aspect [7] or the above-described eighth aspect [8], wherein

at least any rollers out of the at least one preheating roller, the at least one drawing roller, and the at least one thermal setting roller are unitized, and
the at least any rollers are unitized into a first unit having a predetermined number of rollers and a second unit having rollers whose number is different from the predetermined number, and the first unit and the second unit are configured such that the first unit and the second unit are recombinant depending upon an application purpose.

[0024] According to the above-described ninth aspect [9] of the spun yarn take-up apparatus, a plurality of units each having different numbers of rollers from other can be prepared in advance so that the plurality of units are recombinant so as to be set to the spun yarn take-up apparatus depending upon the unitization of rollers in terms of a drawing process, yarn brand or the like. As a result, an easier recombination of rollers depending upon an application purpose can be provided.

[0025] [10] A tenth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to ninth aspects [1]-[9], wherein

a guide roller for guiding the plurality of yarns to the second guide section is arranged downstream from the drawing section along a yarn traveling direction, and
the second guide section is arranged immediately above the spooling unit 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.

[0026] According to the above-described tenth aspect [10] of the spun yarn take-up apparatus, a height of the second guide section can be suppressed, and thereby, setting the plurality of yarns to the second guide section can be performed without the need to perform such a yarn setting operation at a high place.

[0027] [11] An eleventh aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to ninth aspects [1]-[9], wherein

a guide roller is arranged downstream from the drawing section along a yarn traveling direction,
a second yarn delivery roller for guiding the plurality of yarns to the second guide section is arranged between the second guide section and the guide roller along a yarn traveling direction, and
the second guide section is arranged immediately above the spooling unit 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 second yarn delivery roller and a horizontal plane.

[0028] According to the above-described eleventh aspect [11] of the spun yarn take-up apparatus, the guide roller is arranged downstream from the drawing section along a yarn traveling direction. The second yarn delivery roller is arranged between the second guide section and the guide roller along a yarn traveling direction. In such a point, the eleventh aspect [11] is different from the above-described ninth aspect [9] of the spun yarn take-up apparatus. Even in such a case, by arranging the second guide section 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 second yarn delivery roller and a horizontal plane, a height of the second guide section can be suppressed, and as a result, setting the plurality of yarns to the second guide section can be performed without the need to perform such a yarn setting operation at a high place.

[0029] [12] A twelfth aspect of the present invention is the spun yarn take-up apparatus in any one of the above-described first to eleventh aspects [1]-[11], wherein

the spooling unit includes two winders arranged in a direction substantially orthogonal to the yarn path when seen in a planar view,
the spun yarn take-up unit delivers the plurality of yarns to the two winders in a distributed manner, and
at least the plurality of yarn suctioning units, the first guide section, the drawing section, the second guide section, and the first yarn delivery roller are all arranged within a range of the spooling unit in a width direction.

[0030] According to the above-described aspect [12] of the spun yarn take-up apparatus, the plurality of yarn suctioning units, the first guide section, the drawing section, the second guide section, and the first yarn delivery roller are all arranged within a range of the spooling unit in a width direction. As a result, for the spun yarn take-up apparatus, not only a floor level thereof can be reduced but also any expansion in a width direction thereof can be suppressed, and thereby, the spun yarn take-up apparatus can be compact in its entirety.

(Advantageous Effects of the Invention)

[0031] 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

[0032]

FIG. 1 is an example of a perspective view schematically illustrating a 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 illustrating the periphery of a first guide section.
FIG. 4 is an example of an arrow view taken along the line A-A shown in FIG. 3.
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 schematically illustrating how yarns are delivered from a preheating-roller warming box to a drawing-roller warming box.
FIG. 7 is an example of a side view schematically illustrating the periphery of a relaxing section, a second guide section, and a spooling unit.
FIG. 8 is an example of a plan view illustrating the periphery of the second guide section.
FIG. 9 is an example of a schematic view illustrating 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 is an example of an arrow view taken along the line B-B shown in FIG. 7.
FIG. 11 is an example of a side view schematically illustrating a spun yarn take-up apparatus in accordance with a first modified example.
FIGS. 12(a)-12(c) each is an example of a side view schematically illustrating a spun yarn take-up apparatus in accordance with a second modified example, and (a)-(c) are examples of a view illustrating their

respective recombination patterns of rollers.

FIG. 13 is an example of a side view schematically illustrating a spun yarn take-up apparatus in accordance with a third modified example.

FIG. 14 is an example of a side view schematically illustrating the periphery of a first guide section and a drawing section in accordance with a fourth modified example.

DESCRIPTIONS OF EMBODIMENTS OF THE INVENTION

[0033] 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.

[0034] 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]

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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 second guide section 70. The first guide section 10, the first yarn delivery roller 20, the drawing section 28, the relaxing section 60, and the second guide section 70 will be described later in detail.

[0040] 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.

[0041] 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.

[0042] 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. A case where the spooling unit 8 is seen in a direction opposite to a direction X will be described later.

[0043] 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.

[0044] 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]

[0045] 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 second guide section 70 included in the spun yarn take-up unit 6.

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

[0046] 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".

[0047] 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.

[0048] 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".

[0049] 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.

[0050] 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.

[0051] 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 dis-

tance 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.

[0052] 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°.

[0053] 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°.

[0054] The plurality of direction-changing rollers 10A-10L have a plurality of motors (not shown) 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.

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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".

[0059] 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 direction-changing rollers 10A-10L, the plurality of traversing apparatuses 85, and the plurality of bobbins 86.

[2-2. Drawing section]

[0060] 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 31-34 to heat the yarns 100 before being drawn, a plurality of drawing rollers (drawing godets) 41-44 arranged downstream along a yarn traveling direction from the preheating rollers 31-34, and a plurality of thermal setting rollers 51-56 arranged downstream along a yarn traveling direction from the drawing rollers 41-44 to condition the drawn yarns 100.

[0061] 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 preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 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 preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 correspond to "a plurality of rollers" of the present invention.

[0062] At least the uppermost stream-side drawing roller 41 among the drawing rollers 41-44 has a yarn delivery velocity lower than that of the downmost stream-side preheating roller 34 among the preheating rollers 31-34. Therefore, the yarn 100 is drawn between the downmost stream-side preheating roller 34 among the preheating rollers 31-34 and the uppermost stream-side drawing roller 41 among the drawing rollers 41-44.

[0063] The preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 include a plurality of motors (not shown) corresponding to their respective rollers so that each of the rollers can be driven individually.

[0064] The preheating rollers 31-34 , the drawing rollers 41-44, and the thermal setting rollers 51-56 all have an axis direction in a direction substantially orthogonal to a yarn path when seen in a planar view (i.e., direction Y) and two rollers arranged in a up-and-down direction in proximity to each other are horizontally arranged along a direction X. However, the number of the rollers arranged in an up-and-down direction is not limited to 2. Therefore, three rollers may also be arranged in an up-and-down direction so long as the yarn setting operation can be performed by one operator.

[0065] The yarn 100 delivered out from the first yarn delivery roller 20 is firstly delivered to the preheating roller 31 and is subsequently pass the preheating rollers 32-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 in this order. While passing the preheating rollers 32-34, the drawing rollers 41-44 and the thermal setting rollers 51-56, the yarn 100 is allowed to travel in an S-like manner from the lower side to the upper side of their respective two rollers arranged in proximity to each other in an up-and-down direction and is subsequently allowed to travel to the lower roller among the two upper and lower rollers arranged at the downstream side.

[0066] The yarn 100 is always wound around the preheating rollers 31-34 , the drawing rollers 41-44, and the thermal setting rollers 51-56, respectively, at a winding angle smaller than 360°.

[0067] The preheating rollers 31-34 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 drawing rollers 41-44 have a surface temperature set to be higher than the surface temperatures of the preheating rollers 31-34 (e.g., 110 °C). The thermal setting rollers 51-56 have a surface temperature set to be higher than the surface temperatures of the drawing rollers 41-44 *(e.g.,* 130 °C).

[0068] The preheating rollers 31-34 have a surface temperature (e.g., 90 °C) corresponding to "the first temperature" of the present invention. The drawing rollers 41-44 have a surface temperature (e.g., 110 °C) corresponding to "the second temperature" of the present invention. The thermal setting rollers 51-56 have a surface temperature (e.g., 130 °C) corresponding to "the third temperature" of the present invention.

[0069] All of the preheating rollers 31-34 do not always have to have the same surface temperature. Therefore, the preheating rollers 31-34 may have different surface temperatures, respectively. Similarly, all of the drawing rollers 41-44 do not always have to have the same surface temperature. Therefore, the drawing rollers 41-44 may have different surface temperatures, respectively. Similarly, all of the thermal setting rollers 51-56 do not always have to have the same surface temperature. Therefore, the thermal setting rollers 51-56 may have different surface temperatures, respectively.

[0070] In this embodiment, all of the preheating rollers 31-34 have an increased surface temperature. However, the present invention is not limited to this. For example, at least one roller among the preheating rollers 31-34 may have an increased surface temperature while the other roller may not have an increased surface temperature. The same applies to the drawing rollers 41-44 and the thermal setting rollers 51-56.

[0071] The drawing section 28 also includes the first warming box 39, the second warming box 49, and the third warming box 59. All of the first warming box 39, the second warming box 49, and the third warming box 59 are formed by heat insulating material. The preheating rollers 31-34 are accommodated in the first warming box 39. The drawing rollers 41-44 are accommodated in the second warming box 49. The thermal setting rollers 51-56 are accommodated in the third warming box 59. This arrangement suppresses the heat dissipation from their respective rollers. In this embodiment, the preheating rollers 31-34 are accommodated in the first warming box 39. The drawing rollers 41-44 are accommodated in the second warming box 49. The thermal setting rollers 51-56 are accommodated in the third warming box 59. However, each group of the above types of rollers do not have to be accommodated in one warming box. For example, the preheating rollers 31-34 may be separately accommodated in the plurality of first warming boxes 39. The drawing rollers 41-44 may be separately accommodated in the plurality of second warming boxes 49. The thermal setting rollers 51-56 may be separately accommodated in the plurality of third warming boxes 59.

[0072] The preheating rollers 31-34 , the drawing rollers 41-44, and the thermal setting rollers 51-56 are accommodated in the warming boxes 39, 49, and 59, respectively, and therefore are not actually visible in the drawings. However, these rollers are shown in their respective drawings referred herein for convenience.

[0073] In this embodiment, four preheating rollers, four drawing rollers, and six thermal setting rollers are arranged, respectively. However, their respective rollers are not limited to these numbers and can be arranged in a different number depending upon an application purpose.

[0074] Next, the following section will describe how the yarn 100 is delivered from any one warming box of the first warming box 39, the second warming box 49, and the third warming box 59 to other warming boxes at the downstream side with reference to FIG. 6. FIG. 6 is an example schematically illustrating how the yarn 100 is delivered from the first warming box 39 to the second warming box 49. FIG. 6 illustrates the cross sections of the first warming box 39 and the second warming box 49 taken in a vertical direction.

[0075] As shown in FIG. 6, the first warming box 39 has an outlet-side opening 36. The second warming box 49 has an inlet-side opening 45. The outlet-side opening 36 and the inlet-side opening 45 do not have communication therebetween and are separated from each other. More specifically, the yarn 100 having exited the first warming box 39 through the outlet-side opening 36 is allowed to contact with outside air to subsequently enter the second warming box 49 through the inlet-side opening 45. The outlet-side opening 36 corresponds to "the yarn outlet of the first warming box" of the present invention. The inlet-side opening 45 corresponds to "the yarn inlet of the second warming box" of the present invention.

[0076] In this manner, the outlet-side opening 36 of the first warming box 39 and the inlet-side opening 45 of the second warming box 49 downstream from the first warming box 39 separated without having any communication therebetween can suppress the heat transfer between the first warming box 39 and the second warming box 49. Although not shown, the outlet-side opening of the second warming box 49 and the inlet-side opening of the third warming box 59 are also separated without having any communication therebetween. The outlet-side opening of the second warming box 49 corresponds to "the yarn outlet of the second warming box" of the present invention. The inlet-side opening of the third warming box 59 corresponds to "the yarn inlet of the third warming box" of the present invention.

[2-3. Relaxing section]

[0077] FIG. 7 is an example of a side view illustrating the periphery of the relaxing section 60, the second guide section 70, and the spooling unit 8. As shown in FIG. 7, the relaxing section 60 is arranged immediately above thermal setting rollers 53-56.

[0078] The relaxing section 60 has: the first relaxing roller 61; the second relaxing roller 62 arranged downstream from the first relaxing roller 61 along a yarn traveling direction; and the fourth warming box 69. 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).

[0079] The yarn 100 delivered out from the downmost stream-side thermal setting roller 56 of the thermal setting rollers 51-56 is allowed to pass the first relaxing roller 61 and the second relaxing roller 62 in this order.

[0080] The first relaxing roller 61 and the second relaxing 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.

[0081] 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 51-56 (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. 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.

[0082] The fourth warming box 69 is formed by heat insulating material. The two relaxing rollers 61 and 62 are accommodated in the fourth warming box 69 so as to suppress the heat dissipation. Although not shown, the outlet-side opening of the third warming box 59 and the inlet-side opening of the fourth warming box 69 are also separated from each other without having any communication therebetween. This arrangement can suppress the heat transfer between the third warming box 59 and the fourth warming box 69.

[0083] 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 allowed to exit the fourth warming box 69 and is subsequently guided to the second guide section 70. The second relaxing roller 62 corresponds to a "guide roller" of the present invention.

[2-4. Second guide section]

[0084] With reference to FIG. 7 and FIG. 8, the following section will describe the second guide section 70. FIG. 8 is an example of a plan view illustrating the periphery of the second guide section 70.

[0085] The second guide section 70 includes mainly a plurality (or six) first winder distribution rollers 70A-70F for example and a plurality (or six) second winder distribution rollers 70G-70L (see FIG. 8). The plurality of yarns 100 delivered out from the second relaxing roller 62 is delivered in divided manner in two directions of a direction toward the first winder distribution rollers 70A-70F and a direction toward the second winder distribution rollers 70G-70L. The first winder distribution rollers 70A-70F are a roller that changes a traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to a downward direction so that the yarns 100 are allowed to travel toward bobbins 86 attached to the winding axis 84 of the first winder 81 (see FIG. 1). The second winder distribution rollers 70G-70L are a roller that changes a traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to a downward direction so that the yarns 100 are allowed to travel toward the bobbins 86 attached to the winding axis 84 of the second winder 91 (see FIG. 1).

[0086] The first winder distribution rollers 70A-70F are arranged immediately above the first winder 81. More specifically, the first winder distribution rollers 70A-70F correspond to the plurality of traversing apparatuses 85 (see FIG. 7) and a plurality of bobbins 86 (see FIG. 7), respectively and are arranged in series in a direction X at a position immediately above the corresponding traversing apparatuses 85. The traversing apparatuses 85 are arranged in series along a direction X at a position immediately above the corresponding traversing apparatuses 85.

[0087] An acute angle larger than or equal to 0° as well as smaller than or equal to 20° is preferably formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective first winder distribution rollers 70A-70F and a horizontal plane. This can reduce the heights of the relaxing section 60 and the second guide section 70. However, this is not always required. Therefore, the acute angle formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective first winder distribution rollers 70A-70F and a horizontal plane may also have a negative value for example or may slightly exceed 20° so long as the height of the second relaxing roller 62 can be reduced. The wording "the acute angle formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to their respective first winder distribution rollers 70A-70F and a horizontal plane" corresponds to an angle β shown in FIG. 9. FIG. 9 is an example a schematic view illustrating an acute angle β formed by a yarn traveling direction of the yarns 100 delivered from the second relaxing roller 62 to the first winder distribution roller 70A and a horizontal plane. FIG. 9 illustrates the first winder distribution roller 70A among the plurality of first winder distribution rollers 70A-70F as an example. In this embodiment, the second relaxing roller 62 is arranged so that the angle β of the 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 yarns 100 delivered from the second relaxing roller

62 to their respective first winder distribution rollers 70A-70F and a horizontal plane.

[0088] When a traveling direction of the yarn 100 is changed by the first winder distribution rollers 70A-70F to a downward direction, the yarn 100 is traversed by the corresponding traversing apparatus 85 and is wound around the corresponding bobbin 86 to form a wound package.

[0089] Similarly, the second winder distribution rollers 70G-70L (see FIG. 8) is arranged immediately above the second winder 91. The second winder distribution rollers 70G-70L changes a traveling direction of the plurality of yarns 100 delivered from the second relaxing roller 62 to a downward direction so that the yarns 100 are allowed to travel to the corresponding bobbin (not shown) for their respective yarns 100. Then, the yarns 100 for which a traveling direction is changed by the second winder distribution rollers 70G-70L to a downward direction are traversed by the corresponding traversing apparatus (not shown) and are wound around the corresponding bobbins to form a wound package.

[3. Spooling Unit]

[0090] With reference to FIG. 10, the following section will describe the arrangement (front view) when the spooling unit 8 is seen in a direction opposite to a direction X. FIG. 10 is an example of an arrow view taken along the line B-B shown in FIG. 7.

[0091] As described above, the spooling unit 8 includes the first winder 81 and the second winder 91. The first winder 81 and the second winder 91 are arranged side by side in a direction Y. The first winder 81 has two winding axes 84. Similarly, the second winder 91 has two winding axes 84. The second relaxing roller 62 is arranged at a position in a direction Y displaced to the first winder 81 side from the center line CL of the spooling unit 8. This allows the yarn 100 traveling to the bobbin 86 attached to the winding axis 84 of the first winder 81 to have substantially the same angle as that of the yarn 100 traveling to the bobbin 86 attached to the winding axis 84 of the second winder 91.

[0092] In this embodiment, the main frame 80 has the length of about 1000 mm in a direction Y. The oil supply unit 2, the yarn suctioning unit 4, the first guide section 10, the first yarn delivery roller 20, the drawing section 28, the relaxing section 60, and the second guide section 70 are all arranged within the width of the spooling unit 8 (more particularly within about a half of the length of the main frame 80 in a width direction *(e.g.,* 1000 mm) *(e.g.,* about 500 mm)). This can provide a compact size in a width direction of the spooling unit 8 while securing the work area for the operator. The width direction of the spooling unit 8 corresponds to a direction orthogonal to an axis direction and a vertical direction of winding axis 84 (i.e., direction Y).

[4. Effects]

[0093] According to the spun yarn take-up apparatus 1 of this embodiment described above, the drawing section 28 and the spooling unit 8 are horizontally arranged so that an axis direction of the winding axis 84 is parallel to a traveling direction of the yarn 100 in the drawing section 28 in a planar view on the same floor. Therefore, the first guide section 10 arranged above at least one roller of the drawing section 28 can have a reduced height and the spun yarn take-up apparatus 1 can 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 arranged, 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.

[0094] The preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 are arranged so that two or three of their respective rollers are arranged along a direction X in an up-and-down direction. These rollers are arranged in series when seen in a planar view. This allows the drawing section 28 to have a lower floor. In particular, a spun yarn take-up apparatus for industrial material yarns of 300 denier or more for example requires a longer heating length than in the case of a spun yarn take-up apparatus for clothing yarns. Further, the yarns 100 are wound around their respective rollers at a winding angle smaller than 360° so that the drawing section has an increased number of rollers. Even in such a case, the spun yarn take-up apparatus 1 can have a lower floor.

[0095] The first guide section 10 is arranged immediately above the drawing section 28. The first yarn delivery roller 20 is arranged at a position displaced in a direction opposite to a direction X than any of the first guide section 10 and the drawing section 28. Therefore, the first guide section 10 and the drawing section 28 can have a reduced distance in an up-and-down direction, the first guide section 10 and the drawing section 28 can have a reduced height, and allowing the spun yarn take-up apparatus 1 can have a lowed floor.

[0096] The plurality of yarns 100 spun downward by the spinning machine can receive the tension from the plurality of direction-changing rollers 10A-10L, thereby stabilizing the travel of the yarn 100. 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 and allowing the spun yarn take-up apparatus 1 to have a lower floor. Further, a traveling direction of the yarn 100 can be changed by the roller, and therefore minimizing the burden on the yarn 100.

[0097] The plurality of direction-changing rollers 10A-10L are arranged in a displaced manner in a direction Y, respectively. Therefore, the first guide section 10 and the

drawing section 28 can have a reduced distance therebetween in an up-and-down direction to thereby prevent the mutual interference or entanglement of the plurality of yarns 100 while providing the reduced height of the first guide section 10.

[0098] The plurality of direction-changing rollers 10A-10L have a plurality of corresponding motors (not shown) so as to be driven independently, respectively. Therefore, the plurality of yarns 100 can have a reduced difference in tension thereamong even when their respective direction-changing rollers 10A-10L and the first yarn delivery roller 20 have different distances therebetween.

[0099] According to the spun yarn take-up apparatus 1 of this embodiment, the first yarn delivery roller 20, the preheating rollers 31-34 , the drawing rollers 41-44, the thermal setting rollers 51-56, as well as the relaxing rollers 61 and 62 are all wound around the yarn 100 at a winding angle smaller than 360°. Further, the above respective rollers have an axis direction substantially orthogonal to the yarn traveling direction of the yarn 100 when seen in a planar view (*i.e.*, direction Y). Therefore, the plurality of yarns 100 are allowed to horizontally travel from the first guide section 10 to the second relaxing roller 62 in a traveling direction when seen in a planar view along a direction X or a direction opposite to a direction X. Therefore, the plurality of yarns 100 are allowed to travel so that a yarn path from the first guide section 10 to the second relaxing roller 62 is prevented from being deviated in an axis direction of their respective rollers (*i.e.*, direction Y).

[0100] According to the spun yarn take-up apparatus 1 of this embodiment, the outlet-side opening of the Nth warming box and the inlet-side opening of the (N+1)th warming box arranged downstream along a yarn traveling direction from the Nth warming box are separated from each other without having any communication therebetween. This can consequently reduce the heat transfer between the Nth warming box and the (N+1)th warming box. The reference numeral "N" means a natural number having an upper limit (at the number obtained by deducting 1 from the number of the warming boxes).

[0101] Further, the spun yarn take-up apparatus 1 of this embodiment not only has a lower floor but also has a compact size in a width direction of the spooling unit 8. Therefore, the entire spun yarn take-up apparatus 1 can have a space saving and an improved work efficiency.

[5. Modified Examples]

[0102] 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 examples 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.

[5-1. First modified example]

[0103] In the above-described embodiment, the plurality of oil supply units 2, a plurality of yarn suctioning units 4, and the first guide section 10 are arranged immediately above the drawing section 28 as shown in FIG. 2 for example. However, the present invention is not limited to this. For example, the spun yarn take-up apparatus 1A shown in FIG. 11 is configured such that the plurality of oil supply units 2, the plurality of yarn suctioning units 4, and the first guide section 10 are arranged not immediately above the drawing section 28 but are arranged at a position displaced from the drawing section 28 and the first yarn delivery roller 20 in a direction opposite to a direction X.

[0104] The spun yarn take-up apparatus 1A in accordance with the first modified example has a longer length in a direction X than the spun yarn take-up apparatus 1 described in the above-described embodiment but allows the drawing section 28 to have a lower floor. Further, the yarn 100 is allowed to travel in one direction, and therefore reducing the burden due to an operation to wind yarns.

[5-2. Second modified example]

[0105] In the above-described embodiment, as shown in FIG. 5 for example, the preheating rollers 31-34 are accommodated in the first warming box 39, the drawing rollers 41-44 are accommodated in the second warming box 49, and the thermal setting rollers 51-56 are accommodated in the third warming box 59.

[0106] In the meantime, depending upon the drawing process of the yarn brand for example, the preheating roller, the drawing roller, the thermal setting roller, and the relaxing roller may require the change of the number of all or some rollers.

[0107] When the number of all or some rollers of the preheating roller, the drawing roller, the thermal setting roller, and the relaxing roller is changed depending upon the change of the yarn brand for example, the total number of the rollers may not be changed or may be changed.

[0108] When the total number of the rollers is not changed, the pitch at which the rollers are attached must have the same distance. However, when the warming boxes are changed without the change of the rollers, their respective roller groups (the preheating rollers, the drawing rollers, the thermal setting rollers, and the relaxing rollers) can have a different number of rollers. For example, when four preheating rollers, four drawing rollers, six thermal setting rollers, and two relaxing rollers are used, the warming boxes can be changed to set two preheating rollers, four drawing rollers, and eight thermal setting rollers for example. In this case, the warming box for accommodating the preheating rollers is changed from a warming box for four rollers to a warming box for two rollers and the warming box for accommodating the ther-

mal setting roller is changed from a warming box for six rollers to a warming box for eight rollers. The warming box for accommodating the drawing rollers are the same as the one for four rollers but accommodates rollers different from those accommodated in the one for four rollers. In this manner, when there is no change in the total number of the rollers, rollers can be easily switched depending upon an application purpose by merely changing the warming boxes.

[0109] When the total number of the rollers is changed, a roller, a warming box, and a motor for driving the roller for example are unitized as a unit. This unit is configured such that the unit can be attached to a body frame 90. This provides the entire or partial change of the number of the preheating rollers, the drawing rollers, the thermal setting rollers, and the relaxing rollers. The following section will describe a specific example to change the total number of the rollers with reference to FIG. 12. FIGS. 12(a)-12(c) are an example a side view schematically illustrating the spun yarn take-up apparatus in accordance with the second modified example. FIGS. 12(a)-12(c) illustrate one example of the recombination pattern of their respective rollers.

[0110] In the example shown in FIG. 12, a unit including a roller, a warming box, and a motor for driving the roller for example is configured such that the unit can be attached to the body frame 90 to thereby provide the arbitral change of the number of their respective rollers within a region of the drawing section 28. In particular, the drawing section 28 is horizontally arranged on the same floor as that of the spooling unit 8, and therefore providing an easy recombination of the rollers. In the example shown in FIG. 12, a unit including four rollers for example is removed and a unit including two rollers for example is attached. The following section will describe an example of units.

[0111] The body frame 90 of the spun yarn take-up apparatus 1B shown in FIG. 12(a) has a preheating roller unit 30, a drawing roller unit 40, and a thermal setting roller unit 50. The numbers of the preheating rollers, the drawing rollers, and the thermal setting rollers shown in FIG. 12(a) are the same as those of the spun yarn take-up apparatus 1 described in the above-described embodiment.

[0112] The preheating roller unit 30 is a unit including four preheating rollers 31-34, the first warming box 39 that can accommodate the four preheating rollers 31-34, and four motors (not shown) connected to the four preheating rollers 31-34, respectively.

[0113] The drawing roller unit 40 is a unit including four drawing rollers 41-44, the second warming box 49 that can accommodate the four drawing rollers 41-44, and four motors (not shown) connected to the four drawing rollers 41-44, respectively.

[0114] The thermal setting roller unit 50 is a unit including six thermal setting rollers 51-56, the third warming box 59 that can accommodate six thermal setting rollers 51-56, and six motors (not shown) connected to the six thermal setting rollers 51-56, respectively.

[0115] The body frame 90 of the spun yarn take-up apparatus 1B shown in FIG. 12(b) has the preheating roller unit 30A, the drawing roller unit 40, and the thermal setting roller unit 50A.

[0116] The preheating roller unit 30A is a unit including two preheating rollers 31 and 32, the first warming box 39A that can accommodate the two preheating rollers 31 and 32, and two motors (not shown) connected to the two preheating rollers 31 and 32, respectively.

[0117] The drawing roller unit 40 is as described above.

[0118] The thermal setting roller unit 50A is a unit including four thermal setting rollers 51-54, the third warming box 59A that can accommodate the four thermal setting rollers 51-54, and four motors (not shown) connected to the four thermal setting rollers 51-54, respectively.

[0119] The body frame 90 of the spun yarn take-up apparatus 1B shown in FIG. 12(c) has the preheating roller unit 30A, the drawing roller unit 40A, and the thermal setting roller unit 50B.

[0120] The preheating roller unit 30A is as described above.

[0121] The drawing roller unit 40A is a unit including two drawing rollers 41 and 42, the second warming box 49A that can accommodate the two drawing rollers 41 and 42 and two motors (not shown) connected to the two drawing rollers 41 and 42, respectively.

[0122] The thermal setting roller unit 50B is a unit including eight thermal setting rollers 51-58, the third warming box 59B that can accommodate the eight thermal setting rollers 51-58, and eight motors (not shown) connected to the eight thermal setting rollers 51-58, respectively.

[0123] Therefore, even when the total number of the rollers is changed, a plurality of units having different numbers of their respective rollers prepared in advance can be altered in a roller-recombinant manner to be attached to the body frame 90 in accordance with a drawing process and/or a yarn brand so that the rollers can be easily recombined depending upon an application purpose. The recombination of their respective rollers has been particularly difficult in the conventional case where the spun yarn take-up apparatus has the drawing section at the upper floor. In contrast with this, the roller recombination can be further simplified, in the spun yarn take-up apparatus in which the spooling unit 8 and the drawing section 28 are arranged on the same floor, by the advance preparation of such units that can be arbitrarily attached to the body frame 90 using the region of the drawing section 28.

[0124] When the preheating roller unit 30, the drawing roller unit 40, or the thermal setting roller unit 50 is replaced in a roller-recombinant manner with another unit, the replacement is performed by removing and attaching the connection wiring of the motor. When the number of the rollers of the unit after the replacement is smaller than the number of the rollers of the unit before the replacement, this means excessive motor wiring. Therefore,

empty sockets may be prepared in accordance with the difference in the number of the rollers before and after the replacement and are connected wirings for the adjustment of the wiring arrangement.

[0125] In the second modified example, the unitization of relaxing rollers has not been described. However, as in the unitization of the preheating rollers, the drawing rollers, and the thermal setting rollers, a plurality of units for different numbers of relaxing rollers may also be prepared in advance for the relaxing rollers that can be attached to the body frame 90.

[0126] When a to-be-recombined roller is a preheating roller, the preheating roller unit 30 corresponds to "the first unit" of the present invention and the preheating roller unit 30A corresponds to "the second unit" of the present invention. When a to-be-recombined roller is a drawing roller, the drawing roller unit 40 corresponds to "the first unit" of the present invention and the drawing roller unit 40A corresponds to "the second unit" of the present invention. When a to-be-recombined roller is a thermal setting roller, the thermal setting roller unit 50 corresponds to "the first unit" of the present invention and the thermal setting roller unit 50A or the thermal setting roller unit 50B corresponds to "the second unit" of the present invention.

[5-3 Third modified example]

[0127] In the above-described embodiment, as shown in FIG. 2 for example, the preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 are arranged on the same floor along a direction X. As shown in FIG. 7 for example, the relaxing section 60 is arranged immediately above the thermal setting rollers 53-56. However, the positional relation among the preheating rollers 31-34, the drawing rollers 41-44, the thermal setting rollers 51-56, and the relaxing rollers 61 and 62 is not limited to the above one. Therefore, the positional relation shown in FIG. 13 for example may be used.

[0128] FIG. 13 is an example of a side view schematically illustrating the spun yarn take-up apparatus C in accordance with the third modified example. The spun yarn take-up apparatus 1C shown in FIG. 13 is configured such that the drawing section 28 and the relaxing section 60 are horizontally arranged. More particularly, the first relaxing roller 61 and the second relaxing roller 62 are arranged along a direction X on the same floor as that on which the thermal setting rollers 51-56 are arranged. More specifically, the relaxing section 60 does not always have to be arranged above the thermal setting rollers 51-56 for example. However, in this case, the second relaxing roller 62 as the downmost stream-side roller in the relaxing section 60 and the second guide section 70 have preferably therebetween the second yarn delivery rollers 94 and 95 in a traveling direction of the yarn 100, *i.e.*, upward from the relaxing section 60. In this case, the second yarn delivery roller 95 corresponds to "the second yarn delivery roller" of the present invention. As described above, the second relaxing roller 62 corresponds to the "guide roller" of the present invention. This allows the yarn 100 to be smoothly delivered from the downmost stream-side second yarn delivery roller 95 among the second yarn delivery rollers 94 and 95 to the second guide section 70. The number of the second yarn delivery rollers is not limited to two and therefore 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 yarns wound around the roller peripheral surfaces of the second relaxing roller 62 and the second yarn delivery roller, respectively.

[0129] The spun yarn take-up apparatus 1C in accordance with the third modified example as described above is also preferably configured such that the second guide section 70 is arranged so that the yarns 100 delivered from the second relaxing roller 62 to their respective distribution rollers 70A-70L at a position immediately above the spooling unit 8 have such an acute angle formed by a yarn traveling direction and a horizontal plane that is larger than or equal to 0° as well as smaller than or equal to 20°.

[5-4. Fourth modified example]

[0130] In the above-described embodiment, as shown in FIG. 2 for example, the first guide section 10 is arranged in the vicinity of the upper part of the drawing section 28, the yarn suctioning unit 4 is arranged immediately above the first guide section 10, and the oil supply unit 2 is arranged immediately above the yarn suctioning unit 4. Further, the drawing section 28 and the spooling unit 8 (see FIG. 1) are horizontally arranged. The preheating rollers 31-34, the drawing rollers 41-44, and the thermal setting rollers 51-56 are horizontally arranged in a direction X in series on the same. Further, the preheating rollers 31-34 , the drawing rollers 41-44, and the thermal setting rollers 51-56 are arranged so that two or three rollers are closely adjacently arranged in an up-and-down direction, respectively. However, the present invention is not limited to the above positional relation among the oil supply unit 2, the yarn suctioning unit 4, the first guide section 10, the drawing section 28, and the spooling unit 8. Therefore, the positional relation shown in FIG. 14 for example may be used to include the relaxing section 60.

[0131] FIG. 14 is an example of a side view illustrating the periphery of the first guide section 10 and the drawing section 28A in accordance with the fourth modified example. Although FIG. 14 does not show the spooling unit 8, the drawing section 28A in the fourth modified example includes at least one lower roller horizontally arranged with the spooling unit 8 (see FIG. 1 for example) on the same floor in a direction X in series and at least one upper roller arranged at the same height of those of the oil supply unit 2 and the yarn suctioning unit 4. More specifically, instead of horizontally arranging all of a plurality of rollers

31-34, 41-44, and 51-56 (see FIG. 5) included in the drawing section 28 shown in FIG. 2 for example with the spooling unit 8, a plurality of rollers 31-34, 41-44, and 51-56 included in the drawing section 28A may also be partially arranged horizontally with the spooling unit 8 and other rollers may be arranged at the same height as those of the oil supply unit 2 and the yarn suctioning unit 4. The first guide section 10 is arranged in the vicinity of the upper part of at least one lower roller included in the drawing section 28A. 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. The first yarn delivery roller 20 is arranged at a position displaced from any of the first guide section 10 and the drawing section 28A in a direction opposite to a direction X. Therefore, the spun yarn take-up apparatus can have a reduced height and a lower floor even when the positional relation shown in FIG. 14 for example is arranged among their respective rollers 31-34, 41-44, and 51-56 (see FIG. 5) included in the oil supply unit 2, the yarn suctioning unit 4, the first guide section 10, the first yarn delivery roller 20, and the drawing section 28A.

[0132] In FIG. 14, 15 lower rollers for example and nine upper rollers for example are shown. However, the present invention is not limited to these numbers of rollers. The drawing section 28A includes at least one preheating roller, at least one drawing roller, and at least one thermal setting roller. The numbers of the preheating rollers, the drawing rollers, and the thermal setting rollers can be appropriately determined depending upon the drawing process and/or the yarn brand for example. Therefore, at least one of the preheating rollers, the drawing rollers, and the thermal setting rollers may be used as an upper roller or any of the preheating rollers, the drawing rollers, and the thermal setting rollers may be used as exclusively used as an upper roller.

[0133] In the case of the spun yarn take-up apparatus 1A shown in FIG. 11 for example, a position immediately above the drawing section 28 has an open region between the oil supply unit 2, the yarn suctioning unit 4 and the first guide section 10 and the relaxing section 60. Therefore, in the case of the spun yarn take-up apparatus 1A shown in FIG. 11, some of a plurality of rollers 31-34, 41-44, and 51-56 included in the drawing section 28A may be arranged horizontally with the spooling unit 8 and other rollers may have some of a plurality of rollers included in the drawing section 28 arranged in the above open region.

(Reference Numerals)

[0134]

1 Spun yarn take-up apparatus
4 Yarn suctioning unit
6 Spun yarn take-up unit
8 Spooling unit
10 First guide section
20 First yarn delivery roller
28 Drawing section
70 Second guide section

Claims

1. A spun yarn take-up apparatus (1A, 1B, 1C) 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, a plurality of yarn suctioning units (4, 4A-4L) capable of suctioning the plurality of yarns (100), respectively, 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), arranged below the plurality of yarn suctioning units (4, 4A-4L), including a plurality of direction-changing rollers (10A-10L) for changing traveling directions of the plurality of yarns (100), respectively;
a drawing section (28, 28A) including a plurality of rollers (31-34, 41-44, 51-58) having at least one roller for drawing the plurality of yarns (100) guided by the first guide section (10); and
a second guide section (70) for guiding the plurality of yarns (100) from the drawing section (28, 28A) to the spooling unit (8), and wherein
the spooling unit (8) and the drawing section (28, 28A) are arranged horizontally, and the first guide section (10) is arranged above at least one roller of the drawing section (28, 28A),
a first yarn delivery roller (20) is provided on a yarn path from the plurality of direction-changing rollers (10A-10L) to the drawing section (28, 28A), and
the first yarn delivery roller (20) is arranged below the plurality of yarn suctioning units (4, 4A-4L) and separated in a horizontal direction from the first guide section (10) and the drawing section (28, 28A).

2. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in claim 1, wherein the first guide section (10) is arranged such that the plurality of direction-changing rollers (10A-10L) for respective yarns (100) thereof are mutually displaced to form a single row in a direction orthogonal to an axis direction of a winding axis (84) of the spooling unit (8) when seen in a planar view.

3. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in claim 2, wherein the first guide section (10) is arranged such that the plurality of direction-changing rollers (10A-10L) for respective yarns

(100) thereof are displaced at an equal interval to form a single row in a direction orthogonal to an axis direction of a winding axis (84) of the spooling unit (8) when seen in a planar view.

4. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-3, wherein each of the plurality of direction-changing rollers (10A-10L) is a roller configured to change a traveling direction of each yarn (100) spun downward from the spinning machine to a direction inclined downward from a horizontal direction.

5. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-4, wherein the plurality of rollers (31-34, 41-44, 51-58) include rollers aligned in two rows in a horizontal direction.

6. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-5, wherein the first yarn delivery roller (20) and the plurality of rollers (31-34, 41-44, 51-58) are arranged such that a winding angle of the plurality of yarns (100) to each roller is smaller than 360°, and an axis direction of each roller is a direction substantially orthogonal to the yarn path when seen in a planar view.

7. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-6, wherein the plurality of rollers (31-34, 41-44, 51-58) have:

at least one preheating roller (31-34) arranged below the first guide section (10), wherein a surface temperature thereof is set to be a first temperature, and two or three units thereof are distributed in an up-and-down direction;
at least one drawing roller (41-44) arranged below the first guide section (10), wherein a surface temperature thereof is set to be a second temperature higher than the first temperature, and two or three units thereof are distributed in an up-and-down direction; and
at least one thermal setting roller (51-58) arranged below the first guide section (10), wherein a surface temperature thereof is set to be a third temperature higher than the second temperature, and two or three units thereof are distributed in an up-and-down direction.

8. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in claim 7 further comprising:

at least one first warming box (39, 39A) configured to accommodate the at least one preheating roller (31-34);
at least one second warming box (49, 49A) configured to accommodate the at least one drawing roller (41-44); and
at least one third warming box (59, 59A, 59B) configured to accommodate the at least one thermal setting roller (51-58), wherein
a yarn outlet of an adjacent first warming box (39, 39A) of the at least one first warming box (39, 39A) adjacent to an adjacent second warming box (49, 49A) of the at least one second warming box (49, 49A) and a yarn inlet of the adjacent second warming box (49, 49A) are separated from each other, and wherein
a yarn outlet of the at least one second warming box (49, 49A) and a yarn inlet of the at least one third warming box (59, 59A, 59B) are separated from each other.

9. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in claim 7 or 8, wherein

at least any rollers out of the at least one preheating roller (31-34), the at least one drawing roller (41-44), and the at least one thermal setting roller (51-58) are unitized, and
the at least any rollers are unitized into a first unit (30, 40, 50) having a predetermined number of rollers and a second unit (30A, 40A, 50A, 50B) having rollers whose number is different from the predetermined number, and the first unit and the second unit are configured such that the first unit and the second unit are recombinant depending upon an application purpose.

10. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-9, wherein

a guide roller (62) for guiding the plurality of yarns (100) to the second guide section (70) is arranged downstream from the drawing section (28, 28A) along a yarn traveling direction, and
the second guide section (70) is arranged immediately above the spooling unit (8) 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.

11. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-9, wherein

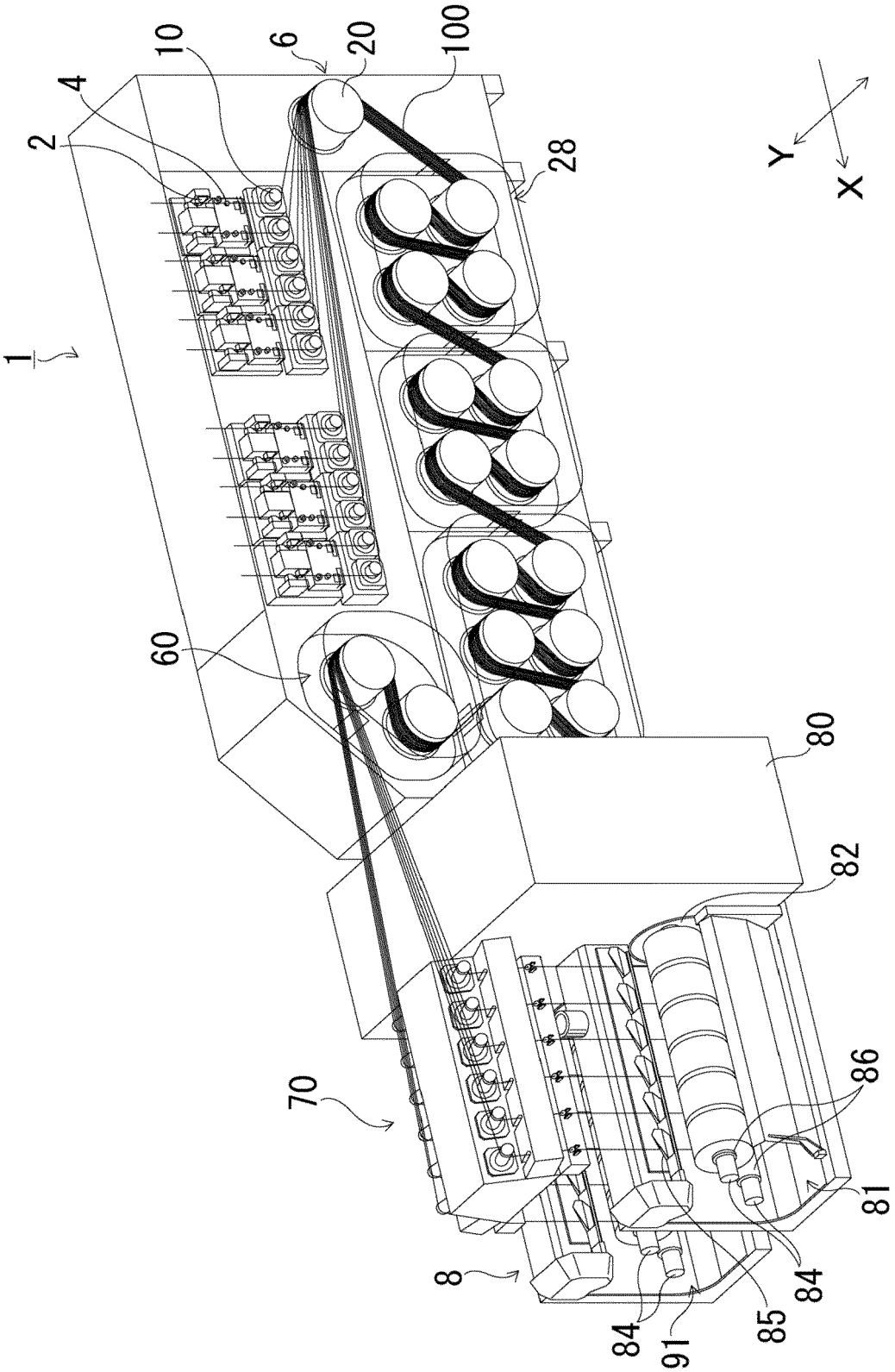
a guide roller (62) is arranged downstream from the drawing section (28, 28A) along a yarn traveling direction,
a second yarn delivery roller (95) for guiding the plurality of yarns (100) to the second guide section (70) is arranged between the second guide section (70) and the guide roller (62) along a yarn traveling direction, and
the second guide section (70) is arranged im-

mediately above the spooling unit (8) 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 yarn delivery roller (95) and a horizontal plane.

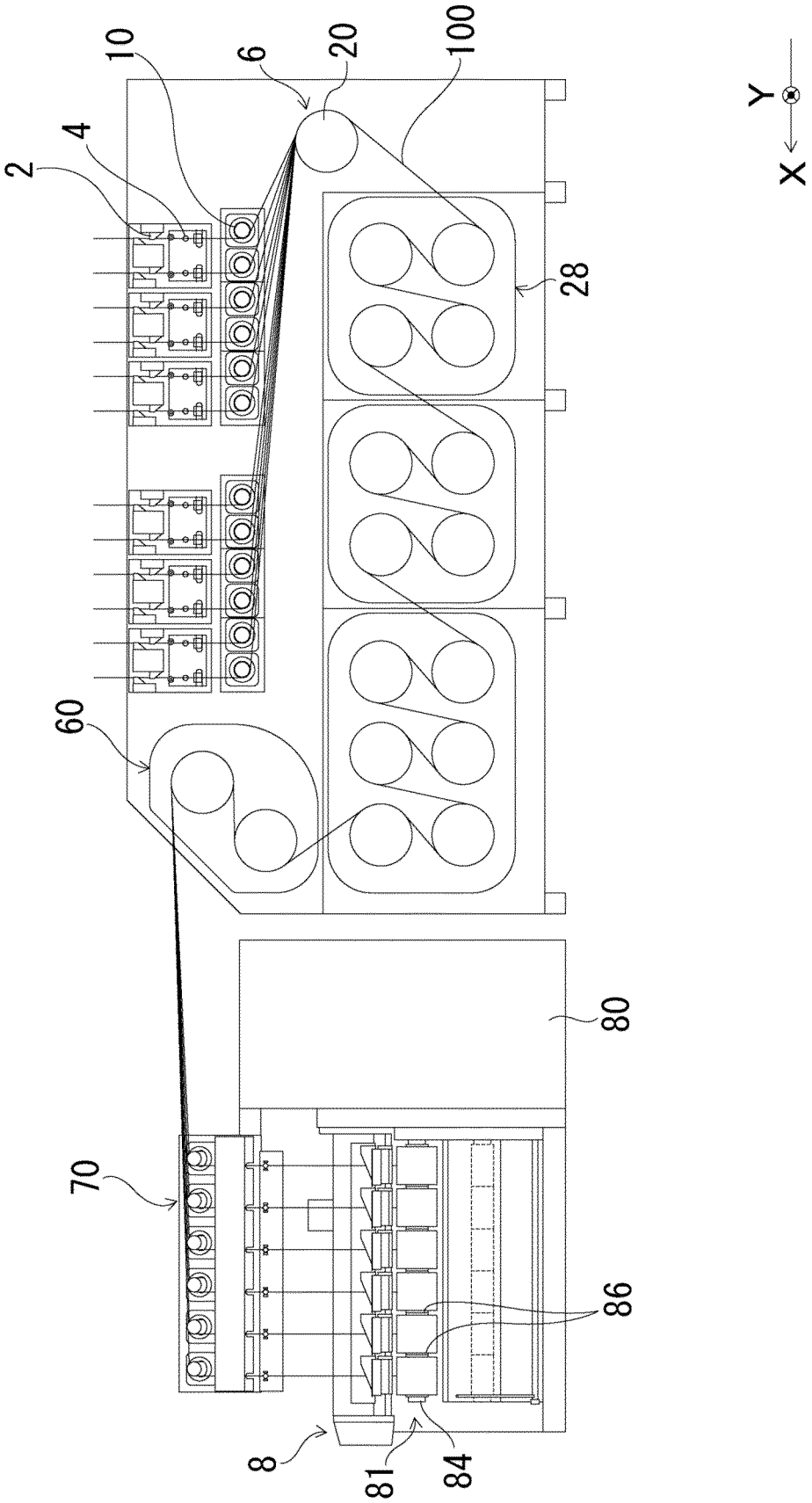
12. The spun yarn take-up apparatus (1A, 1B, 1C) as claimed in any one of claims 1-11, wherein

the spooling unit (8) includes two winders (81, 91) arranged in a direction substantially orthogonal to the yarn path when seen in a planar view, the spun yarn take-up unit (6) delivers the plurality of yarns (100) to the two winders (81, 91) in a distributed manner, and
at least the plurality of yarn suctioning units (4, 4A-4L), the first guide section (10), the drawing section (28, 28A), the second guide section (70), and the first yarn delivery roller (20) are all arranged within a range of the spooling unit (8) in a width direction.

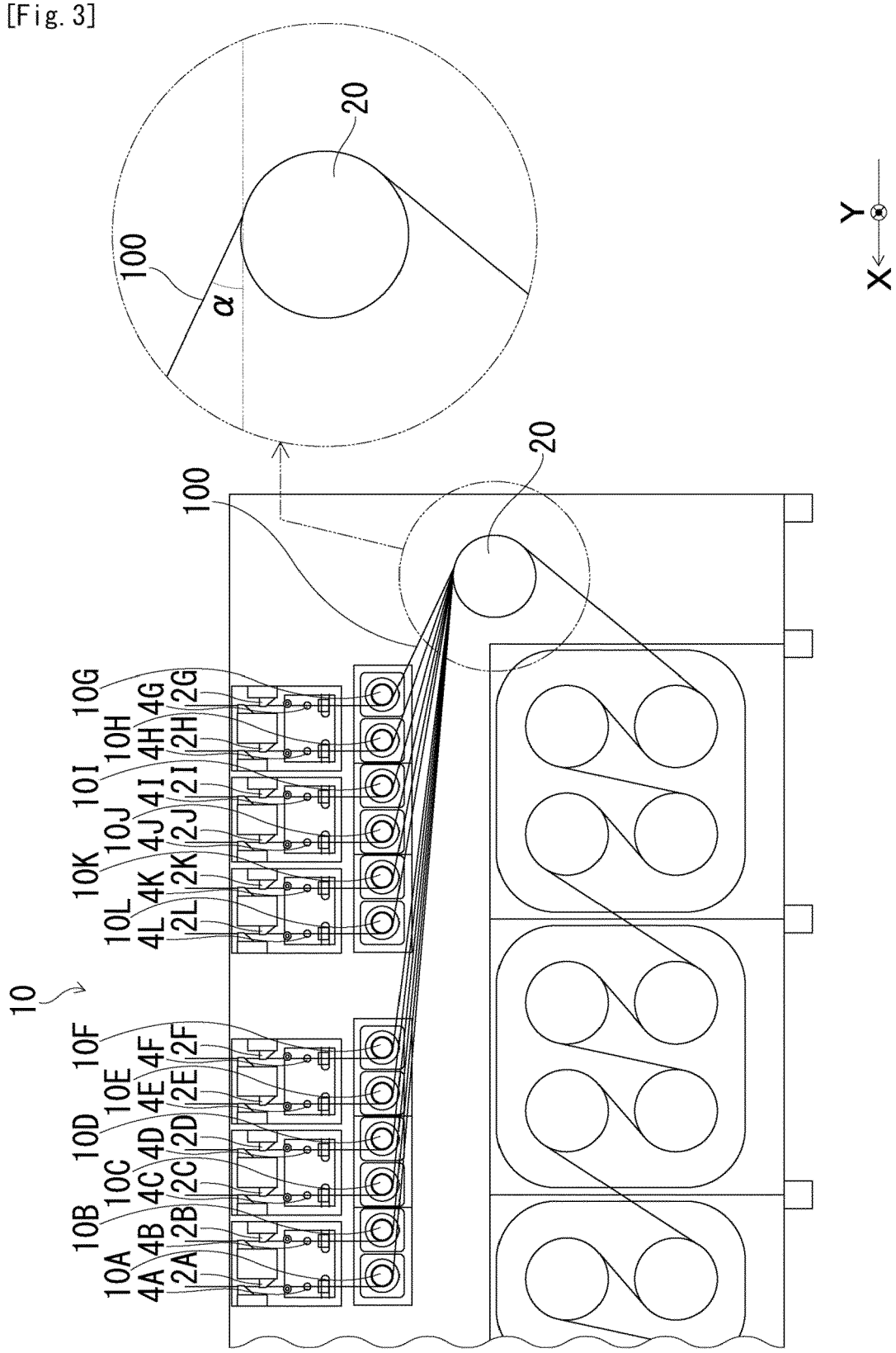
[Fig. 1]



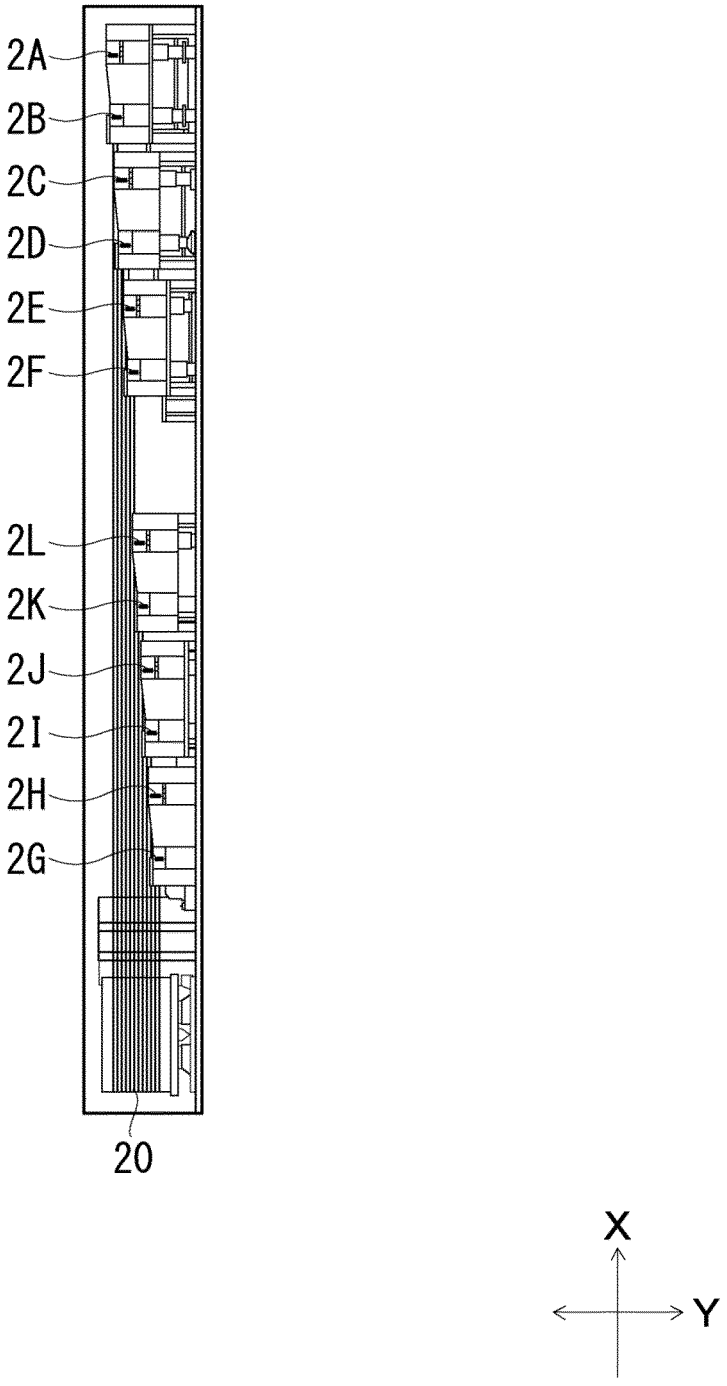
[Fig. 2]



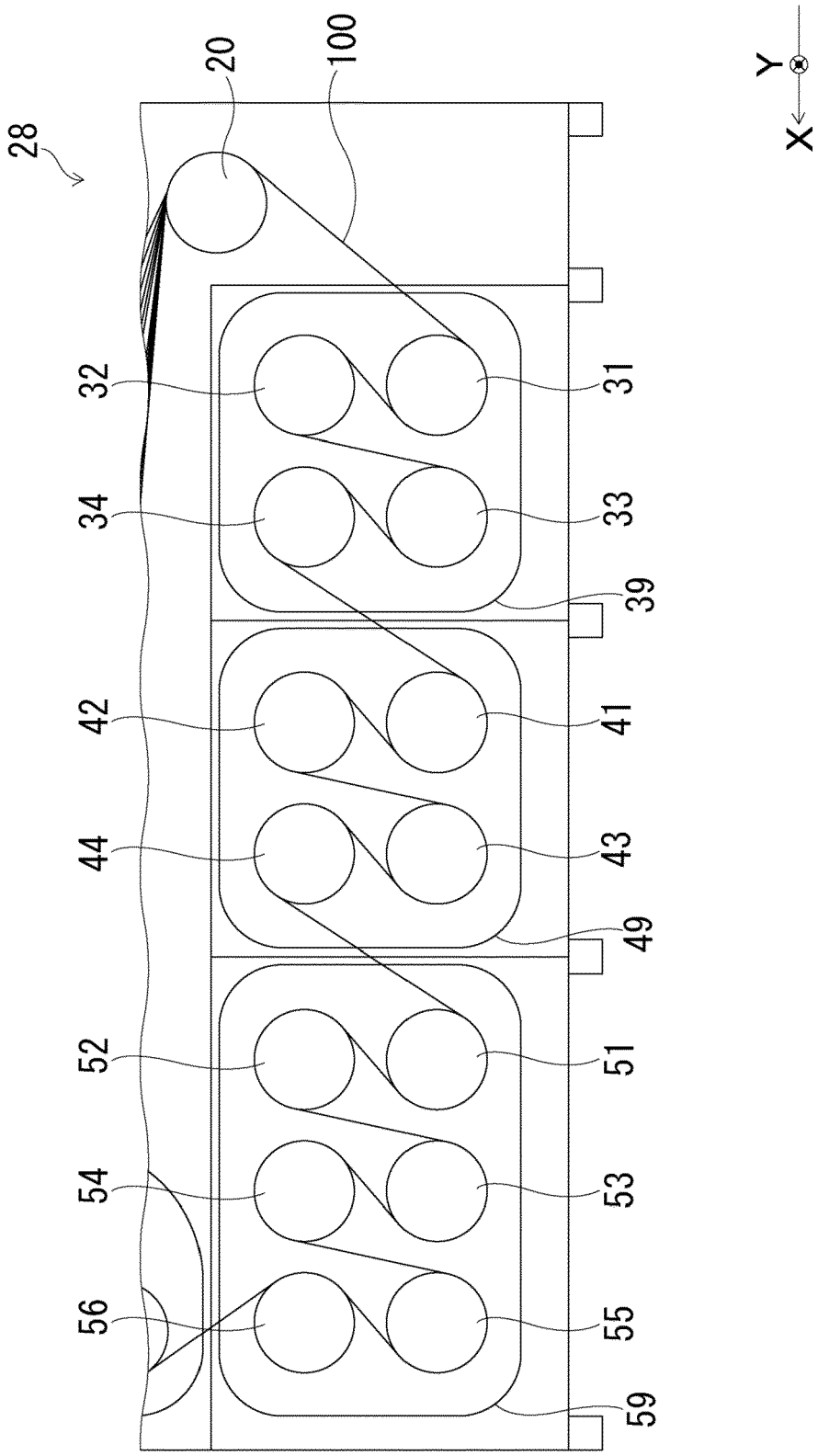
[Fig. 3]


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

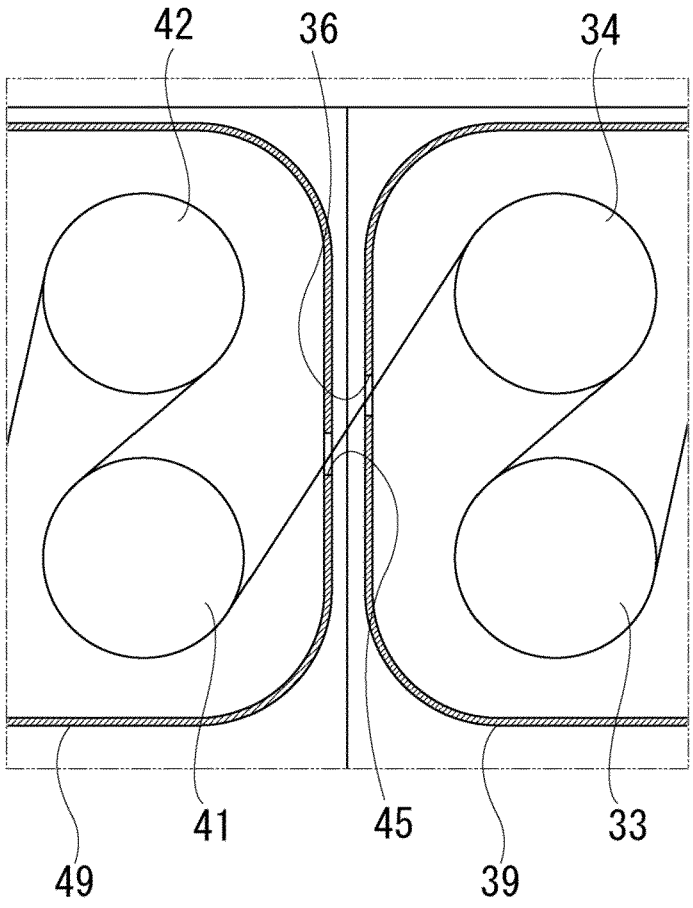
[Fig. 4]



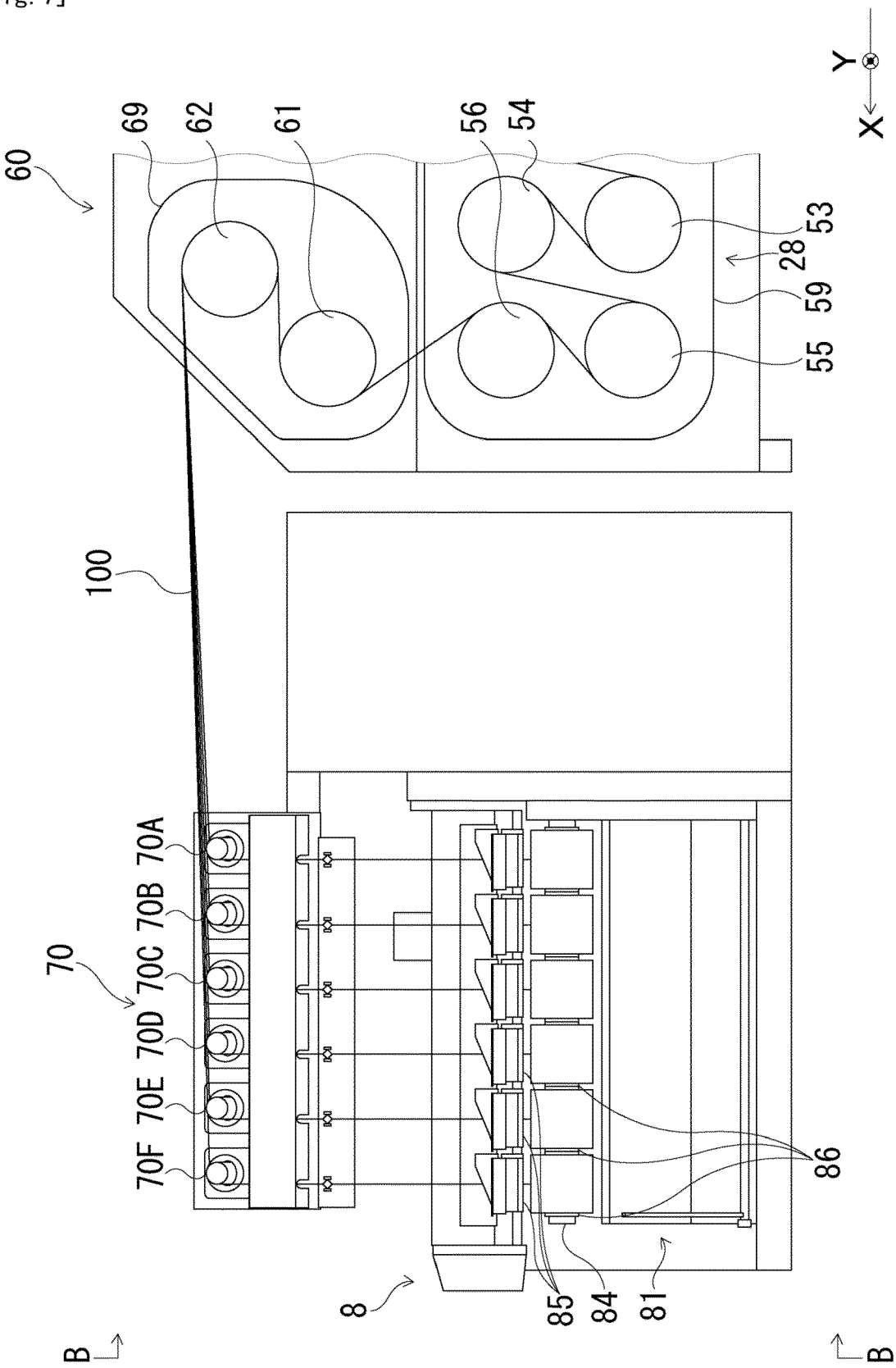
[Fig. 5]



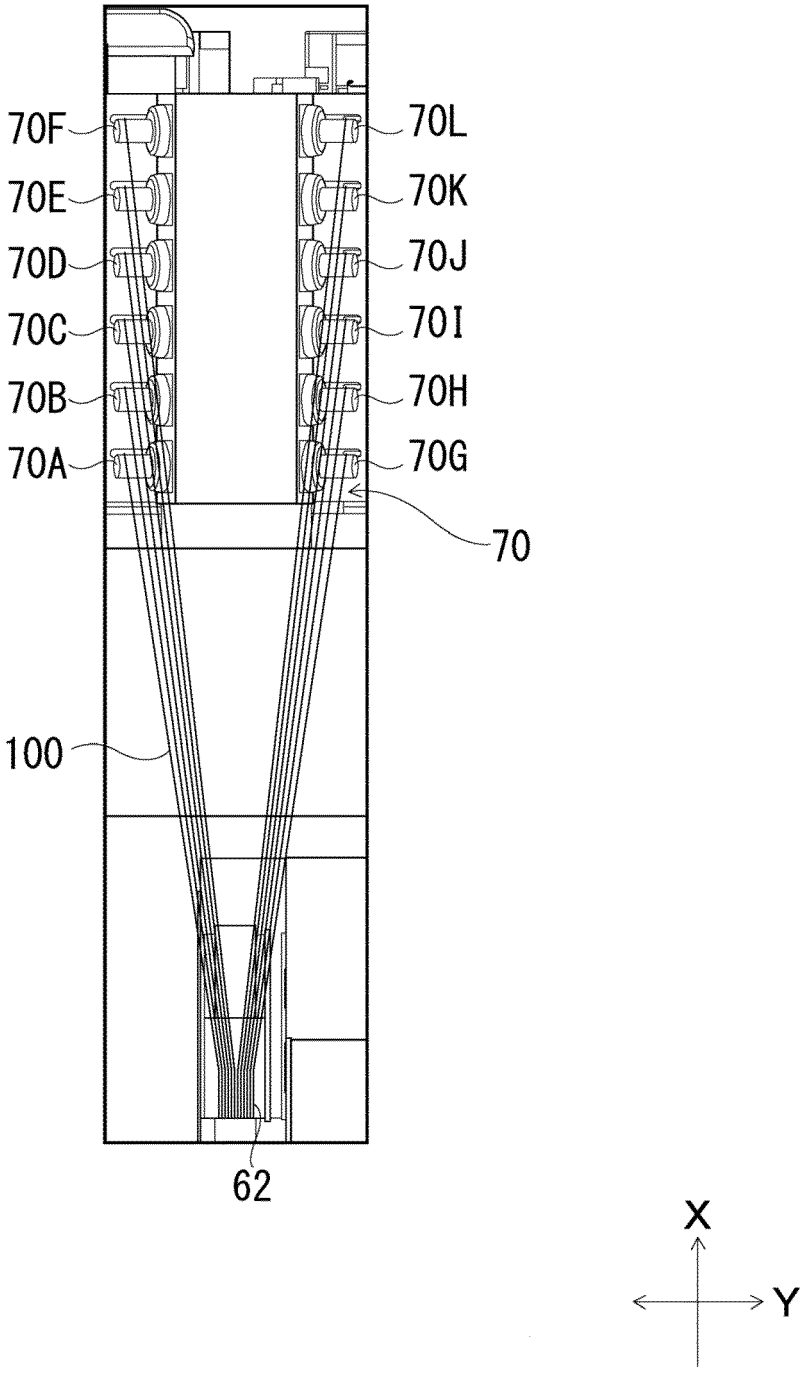
[Fig. 6]



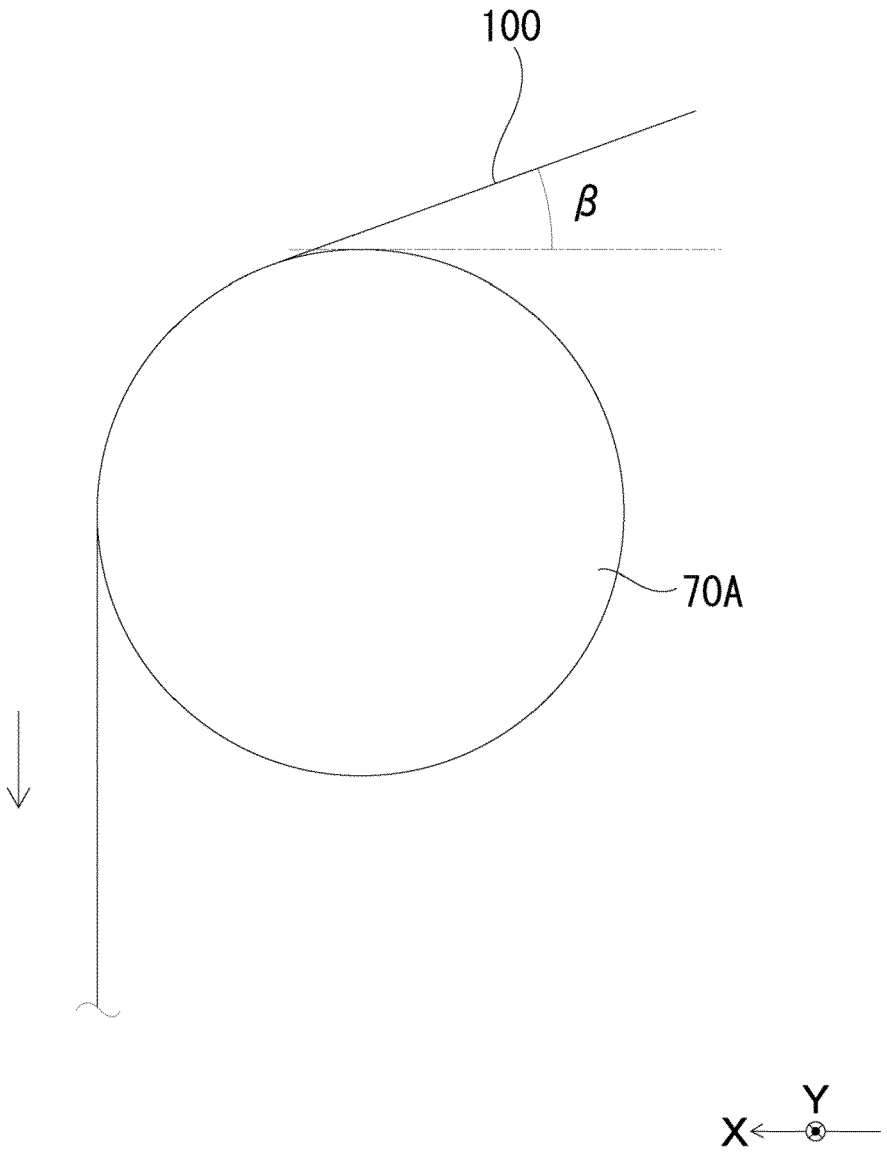
[Fig. 7]


Y
X
60
69
62
61
56
54
53
28
59
55
100
70
70A
70B
70C
70D
70E
70F
86
8
85
84
81
B
B

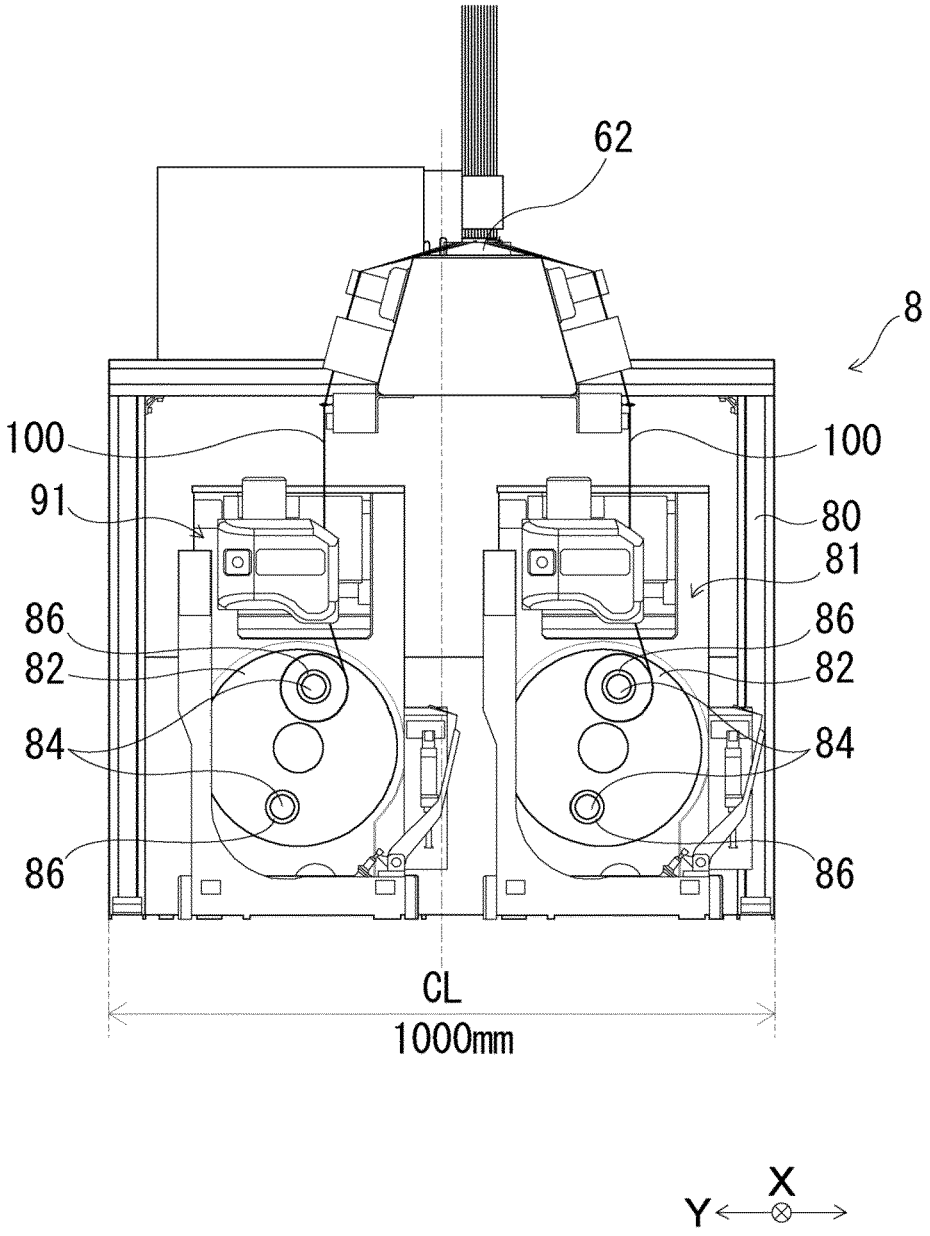
[Fig. 8]



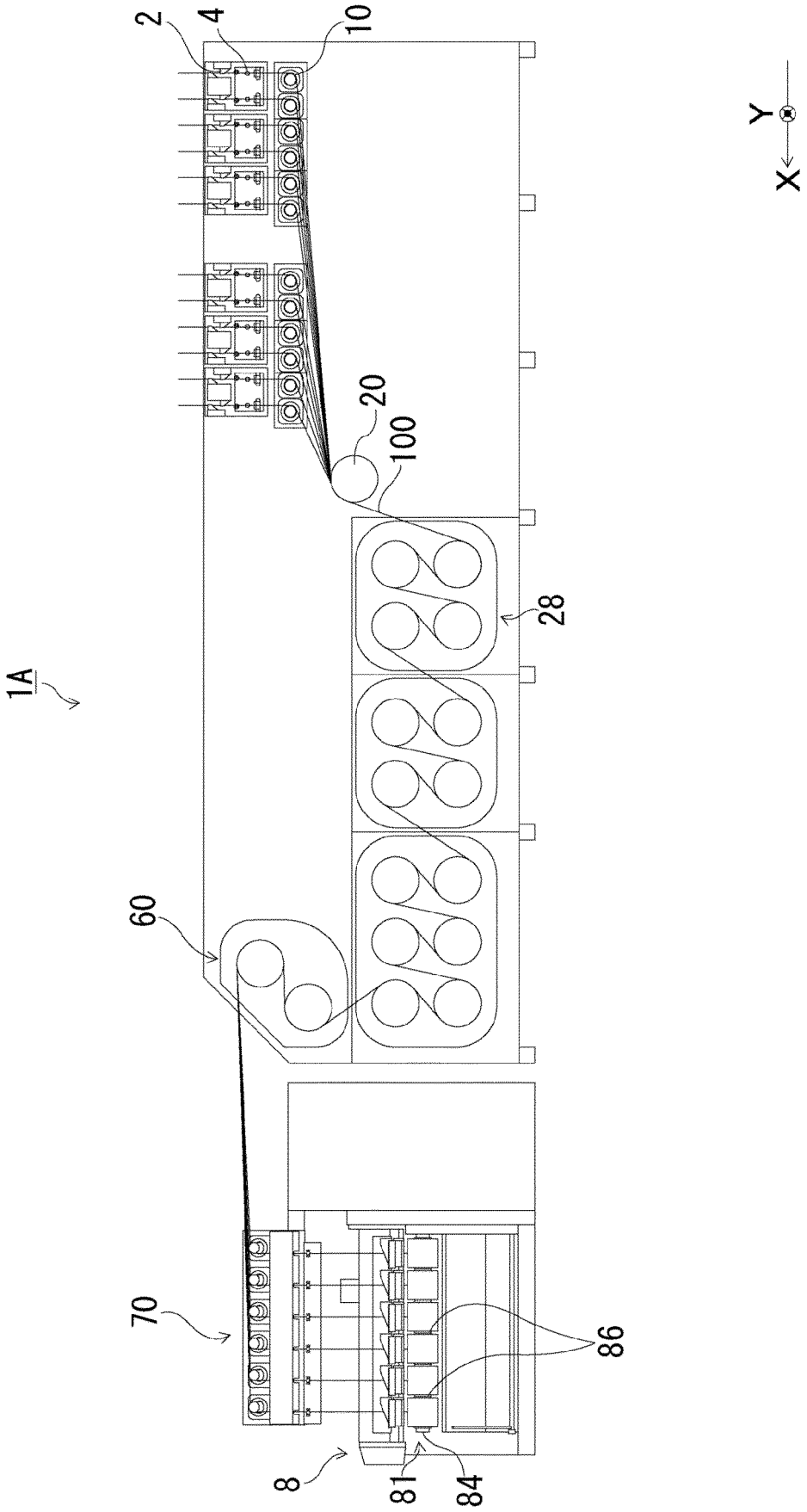
[Fig. 9]



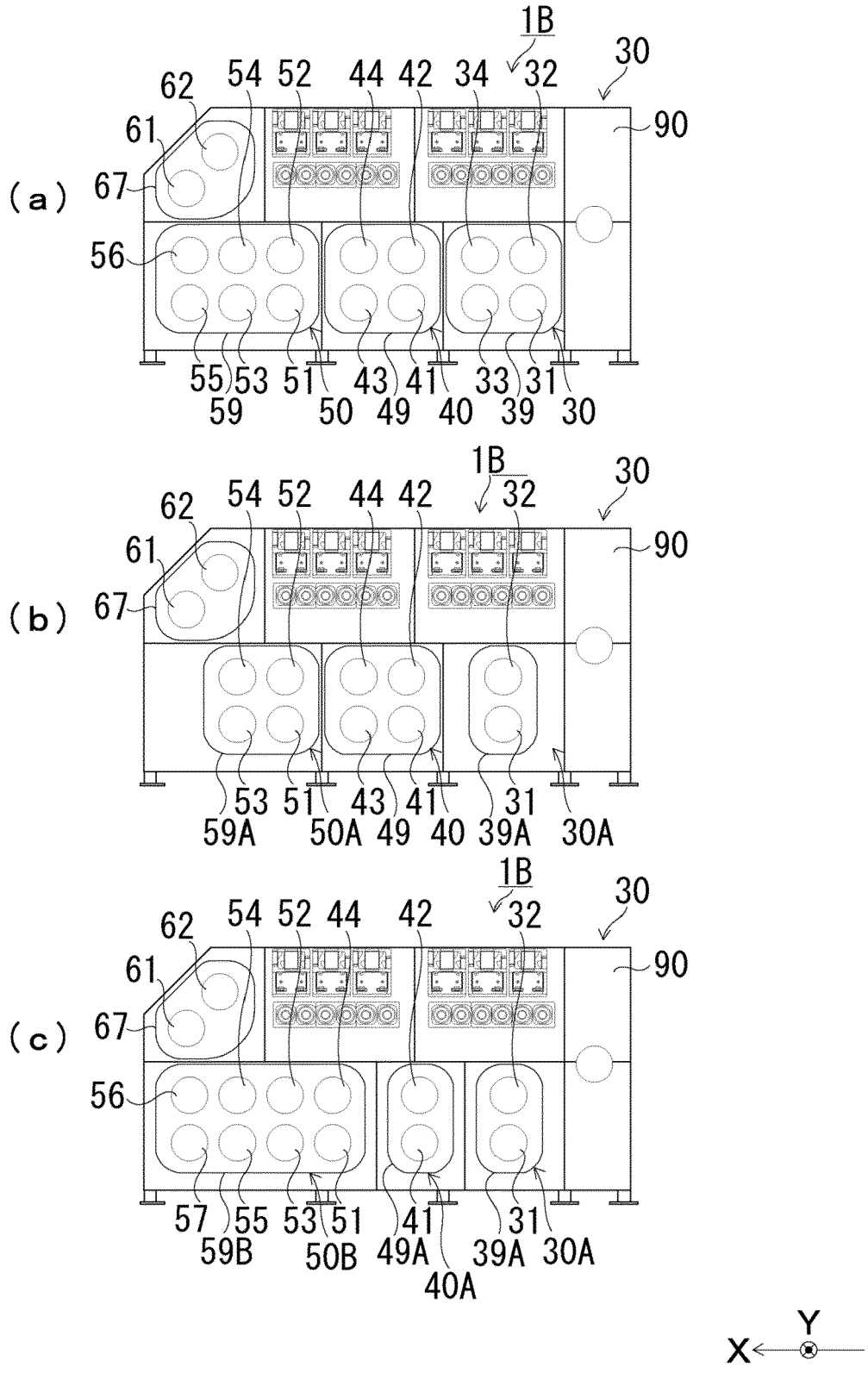
[Fig. 10]



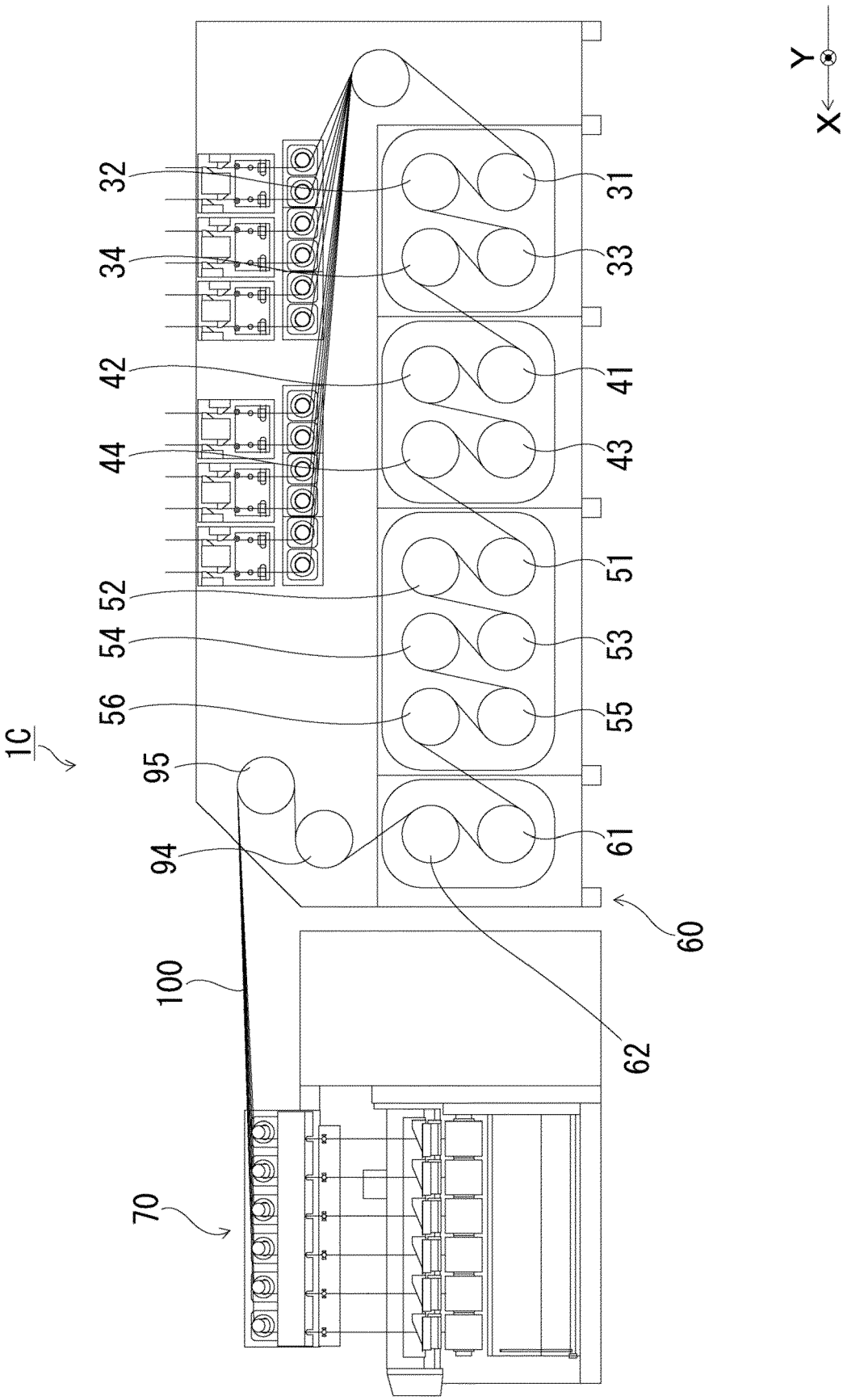
[Fig. 11]



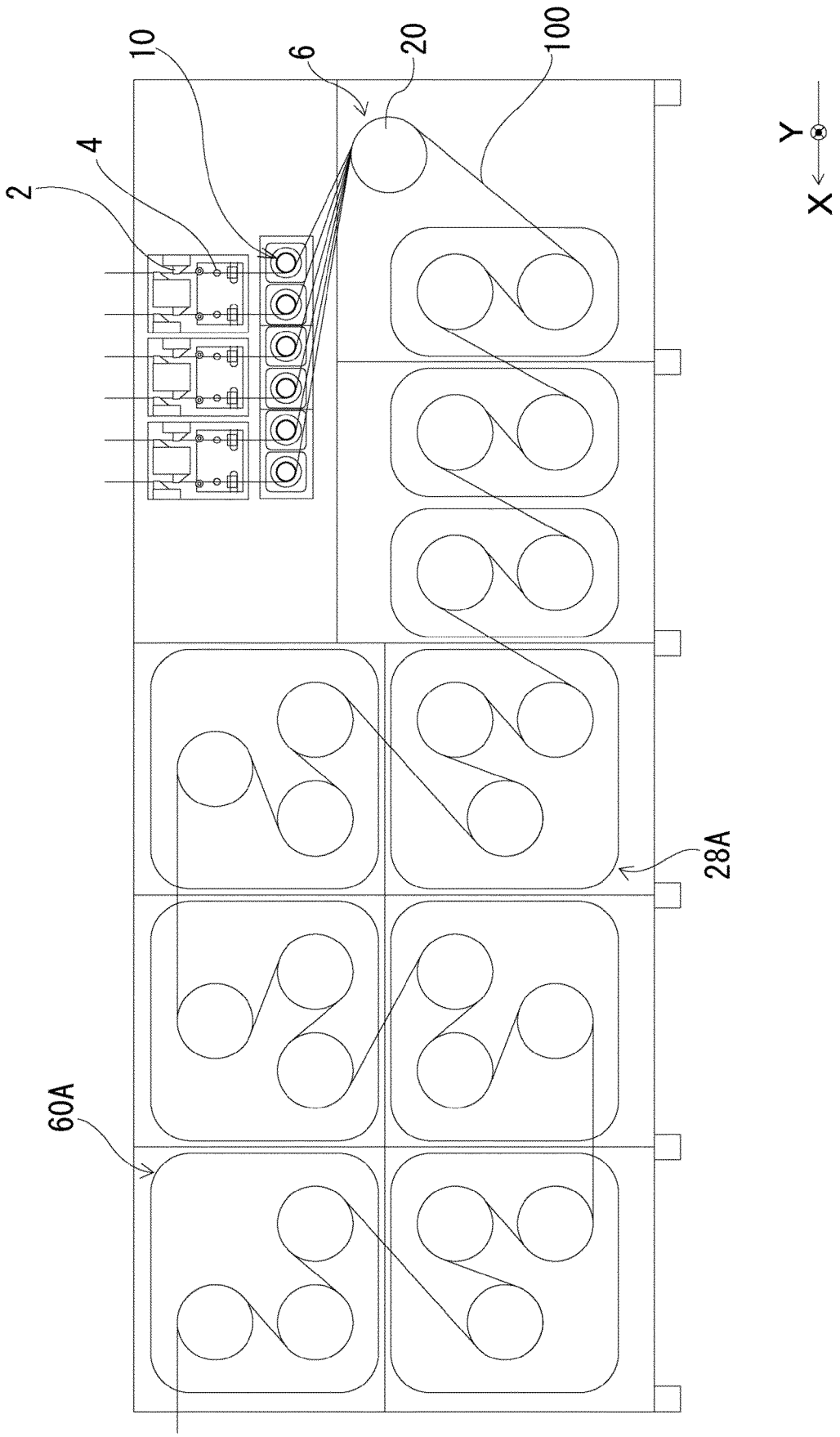
[Fig. 12]


(a)
1B
30
62
54
52
44
42
34
32
61
90
67
56
55
53
51
43
41
33
31
59
50
49
40
39
30
(b)
1B
30
62
54
52
44
42
32
61
90
67
53
51
43
41
31
59A
50A
49
40
39A
30A
(c)
1B
30
62
54
52
44
42
32
61
90
67
56
57
55
53
51
41
31
59B
50B
49A
39A
30A
40A
Y
X

[Fig. 13]



[Fig. 14]



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 17 6901

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 486 592 A1 (SAURER GMBH & CO KG [DE]) 15 December 2004 (2004-12-15) * paragraphs [0023] - [0039]; figures 1, 2 *	1-12	INV. B65H54/72 B65H57/14 B65H57/16 D01D13/02
A	EP 1 253 222 A2 (BARMAG BARMER MASCHF [DE]) 30 October 2002 (2002-10-30) * figure 3 *	1	
A	EP 1 300 496 A1 (NEUMAG GMBH & CO KG [DE]) 9 April 2003 (2003-04-09) * figures 1, 3 *	1	
A	DE 10 2009 021131 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 3 December 2009 (2009-12-03) * figure 6 *	1	

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

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 17 6901

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1486592 A1	15-12-2004	DE 10326850 A1	30-12-2004
		EP 1486592 A1	15-12-2004
EP 1253222 A2	30-10-2002	AT 433507 T	15-06-2009
		DE 10120551 A1	31-10-2002
		EP 1253222 A2	30-10-2002
EP 1300496 A1	09-04-2003	CN 1407156 A	02-04-2003
		EP 1300496 A1	09-04-2003
		US 2003068394 A1	10-04-2003
DE 102009021131 A1	03-12-2009	CN 101591816 A	02-12-2009
		DE 102009021131 A1	03-12-2009

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20090049669 **[0004]**