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

(11) EP 3 889 328 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
27.11.2024 Bulletin 2024/48

(21) Application number: **21170124.8**

(22) Date of filing: **04.05.2020**

(51) International Patent Classification (IPC):
D02G 1/02 *(2006.01)* ***D02G 1/04*** *(2006.01)*
D02G 1/08 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D02G 1/04; D02G 1/0206; D02G 1/0266; D02G 1/082

(54) **DRAW TEXTURING MACHINE**

STRECKTEXTURIERUNGSMASCHINE

MACHINE D'ÉTIRAGE-TEXTURATION

(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

(30) Priority: **27.05.2019 JP 2019098754**

(43) Date of publication of application:
06.10.2021 Bulletin 2021/40

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
20172699.9 / 3 744 883

(73) Proprietor: **TMT Machinery, Inc.**
Osaka-shi, Osaka 541-0041 (JP)

(72) Inventors:
- **Horimoto, Takayuki**
Kyoto-shi, Kyoto, 612-8686 (JP)
- **Kitagawa, Shigeki**
Kyoto-shi, Kyoto, 612-8686 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(56) References cited:
FR-A1- 2 311 116 **FR-A1- 2 377 463**
GB-A- 933 438 **JP-A- S 532 656**

Processed by Luminess, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a draw texturing machine.

[0002] A draw texturing machine recited in Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2016-141912) performs false twisting of a yarn made of synthetic fibers. The draw texturing machine includes false-twisting devices which are aligned in a predetermined base longitudinal direction and twist running yarns. As the false-twisting devices, for example, a false-twisting device (triaxial false-twisting device) which includes a triaxial friction system recited in Patent Literature 2 (Japanese Laid-Open Patent Publication No. S62-199826) is often used. The triaxial false-twisting device includes three rotational shafts which extend in a predetermined axial direction substantially orthogonal to a base longitudinal direction, and friction discs (circular plate members) which are provided at the respective rotational shafts. Axial centers of the three rotational shafts form apexes of a virtual triangle when viewed in an axial direction. As the circular plate members are rotated in predetermined direction, a yarn which runs inside of the triangle while making a contact with the circular plate members is twisted.

[0003] Examples of false-twisting devices are described in the following publications. FR 2 377 463 A1 relates to a false-twisting device in which the distance between each sleeve can be adjusted in order to process all types of yarn and to thread the yarn. FR 2 311 116 A1 relates to a false-twisting device with a simplified launching operation which does not require the disengagement of the discs. GB 9 33 438 relates to a false-twisting device with an increased yarn speed, and JP S53-2656 to a method for simultaneously processing two yarns with a single-unit temporary twisting device.

[0004] In this stage, to suppress increase in size of the draw texturing machine and to process more yarns, a five-axial false-twisting device (as shown in Patent Literature 3; Japanese Laid-Open Patent Publication No. S53-2656) which includes five rotational shafts and twists two yarns at the same time may be provided instead of the triaxial false-twisting device. In the five-axial false-twisting device, a first false-twisting unit which twists a first yarn and a second false-twisting unit which twists a second yarn are provided. These false-twisting units share one of the five rotational shafts as a common rotational shaft. In the five-axial false-twisting device, two virtual triangles which have the common rotational axis as a common apex are formed when viewed in the axial direction, and two yarns which run inside of these triangles, respectively, are twisted. The five-axial false-twisting device reduces the number of the rotational shafts as compared with a structure in which the two triaxial false-twisting devices are provided, so that increase in size is suppressed and more yarns are processed.

SUMMARY OF THE INVENTION

[0005] In the five-axial false-twisting device described above, yarn threading to the first false-twisting unit and the second false-twisting unit is needed. To be more specific, a yarn needs to be introduced from a gap between predetermined two rotational shafts into the inside of the triangle at each of the first false-twisting unit and the second false-twisting unit. Typically, the yarn threading is performed by an operator at a working space extending in the base longitudinal direction. In this stage, when one of the first false-twisting unit and the second false-twisting unit is placed on a side (far side) which is more distant from the working space than the other, it is very difficult to perform the yarn threading on the false-twisting unit on the far side. Therefore, the first false-twisting unit and the second false-twisting unit need to be aligned in the base longitudinal direction so that both of the first false-twisting unit and the second false-twisting unit face the working space.

[0006] Furthermore, to perform the yarn threading on each false-twisting unit, a structure in which the yarn is introduced from a gap between the two rotational shafts placed on an outer side in the base longitudinal direction is needed (details will be described at the embodiment below). In the structure, when the yarn threading is performed on one five-axial false-twisting device, the working space between the five-axial false-twisting device and an adjacent five-axial false-twisting device placed adjacent in the base longitudinal direction may be narrow, and the yarn threading may be difficult.

[0007] An object of the present invention is to facilitate yarn threading in a draw texturing machine in which five-axial false-twisting devices are aligned in a base longitudinal direction.

[0008] A draw texturing machine according to claim 1 includes:

five-axial false-twisting devices aligned in a base longitudinal direction, each of which being able to apply twisting to two yarns at the same time by circular plate members, the circular plate members being provided at five rotational shafts, the five rotational shafts extending in an axial direction orthogonal to the base longitudinal direction, and a working space being formed along the base longitudinal direction for yarn threading performed by the five-axial false-twisting devices, and each of the five-axial false-twisting devices includes: a first false-twisting unit which includes, among the five rotational shafts, two first independent rotational shafts and a common rotational shaft which virtually form apexes of a first triangle when viewed in the axial direction, the first false-twisting unit applying the twisting to a first yarn running inside of the first triangle; and a second-false twisting unit which includes, among the five-rotational shafts, two second independent rotational shafts and the common rotational shaft which virtually form apexes of a second triangle when viewed in the axial direction, the second false-twisting unit applying the twisting to a second yarn running inside of the second triangle, the two first independent rotational shafts opposing the two second independent rotational shafts over the common rotational shaft in the base longitudinal direction, the first false-twisting unit being configured such that the first yarn is threaded to the first false-twisting unit by being introduced from a gap between the two first independent rotational shafts into the inside of the first triangle, the second false-twisting unit being configured such that the second yarn is threaded to the second false-twisting unit by being introduced from a gap between the two second independent rotational shafts into the inside of the second triangle, one of the two first independent rotational shafts being a first movable shaft placed on a near side which is closer to the working space than the other of the two first independent rotational shafts, the one of the two first independent rotational shafts being movable between a first operating position in which each of the five-axial false-twisting devices is in operation and a first yarn threading position which is on the near side of the first operating position, and one of the two second independent rotational shafts being a second movable shaft placed on the near side of the other of the two second independent rotational shafts, the one of the two second independent rotational shafts being movable between a second operating position in which each of the five-axial false-twisting devices is in operation and a second yarn threading position which is on the near side of the second operating position.

[0009] In the present invention, the first independent rotational shafts of the first false-twisting unit oppose the second independent rotational shafts of the second false-twisting unit over the common rotational shaft in the base longitudinal direction of the five-axial false-twisting device. In other words, the first false-twisting unit and the second false-twisting unit are aligned in the base longitudinal direction. Furthermore, the one of the two first independent rotational shafts is movable between the first operating position and the first yarn threading position which is on the near side of the first operating position. Because of this, a space between the two first independent rotational shafts can be widened in the yarn threading to the first false-twisting unit. Therefore, in a structure in which the five-axial false-twisting devices are aligned in the base longitudinal direction, the yarn threading from the working space is facilitated. Likewise, because the one of the two second independent rotational shafts is movable between the second operating position and the second yarn threading position, a space between the two second independent rotational shafts can be widened in the yarn threading to the second false-twisting unit. As described above, in the draw texturing machine in which the five-axial false-twisting devices are aligned in the base longitudinal direction, the yarn threading is facilitated.

[0010] According to another aspect of the invention, in the draw texturing machine of the first aspect, the first movable shaft and the second movable shaft are swingable with the common rotational shaft as a swing shaft center.

[0011] Assume that the first and second movable shafts move and a distance between these movable shafts and the common rotational shaft changes. In this case, for example, when members (such as belts or gears) need to be lain between the movable shafts and the common rotational shaft in order to transmit power of a driving source, the following problems may occur. For example, when the distance changes in a state in which the belts are lain, the belts may loosen or have damaged because of excessive tension. When the distance changes in a state in which the gears are lain, accuracy of meshing may be decreased in meshing the gears together again.

[0012] In the present invention, because the first movable shaft and the second movable shaft are swingable with the common rotational shaft as the swing shaft center, the movable shafts are movable without changing the distance between the movable shafts and the common rotational shaft. Therefore, it is possible to avoid occurrence of the problems described above.

[0013] Another aspect of the invention, in the draw texturing machine of the invention the first false-twisting unit further includes, a first yarn guide placed upstream of a circular plate member which is the most upstream circular plate member in a first yarn running direction in which the first yarn runs, among the circular plate members, the second false-twisting unit further includes, a second yarn guide placed upstream of a circular plate member which is the most upstream circular plate member in a second yarn running direction in which the second yarn runs, among the circular plate members, and at least one of the first yarn guide and the second yarn guide is a movable yarn guide which is able to be adjusted in position relative to the other.

[0014] Generally, at each false-twisting unit, the circular plate members are placed to form a spiral. In this regard, by which rotational shaft is provided with the most upstream circular plate member placed in the yarn running direction, a yarn path of the first yarn guided by the first yarn guide and a yarn path of the second yarn guided by the second yarn guide may change. In this case, when the yarn path of the first yarn and the yarn path of the second yarn are significantly different, twisting of the first yarn and twisting of the second yarn may be different from each other because of difference in, e.g., bending angles between the yarns. As a result, yarn quality of the first yarn and yarn quality of the second yarn may be different from each other.

[0015] In the present invention, the positions of the movable yarn guides are adjusted so that difference can be suppressed to be small between the yarn path of the first yarn guided by the first yarn guide and the yarn path of the second yarn guided by the second yarn guide. Therefore, the difference in quality can be suppressed between the first yarn and the second yarn.

[0016] According to a further r aspect of the invention, in the draw texturing machine of the third aspect, the first yarn guide and the second yarn guide are aligned in the base longitudinal direction, and the movable yarn guide is movable in a direction crossing the base longitudinal direction when viewed in the axial direction.

[0017] For example, in a structure in which one of the first yarn guide and the second yarn guide is moved along the base longitudinal direction, movable areas may be narrow in order to avoid interference between the one of the first yarn guide and the second yarn guide and the other of the first yarn guide and the second yarn guide. In the present invention, the movable area of the movable yarn guide can be widened while the two yarn guides are suppressed from interfering with each other, so that the yarn paths are effectively adjusted.

[0018] According to another aspect of the invention, in the draw texturing machine of any one of the other aspects, each of the five-axial false-twisting devices is structured as power of a drive source is transmitted to, among the five rotational shafts, an intermediate shaft which is one of three fixed rotational shafts except the first movable shaft and the second movable shaft, and includes a common belt for transmitting the power of the drive source to the others of the three fixed rotational shafts from the intermediate shaft.

[0019] In order to rotationally drive the rotational shafts by one driving source, preferably, belts making low noise and less vibration are used to transmit the power of the driving source. However, when the number of the belts are simply increased to depend on the number of the rotational shafts, the rotational shafts are elongated by increase in part in which the belts are wound around. As a result, size of the device may be disadvantageously increased in the axial direction. In the present invention, the number of the belts can be suppressed to be small because the three fixed rotational shafts are driven together by the common belt. Therefore, increase in length of the rotational shafts is suppressed, and increase in size of the device is suppressed.

[0020] According to a further aspect of the invention, in the draw texturing machine of the invention the intermediate shaft is the common rotational shaft.

[0021] According to the positional relationship of the five rotational shafts described above, a common drive shaft is placed at the center of the five rotational shafts in the base longitudinal direction. In the present invention, to begin with, the power of the driving source is transmitted to the center common rotational shaft. Because of this, the five-axial false-twisting device can be configured to transmit the power further to the other rotational shafts placed around the common rotational shaft. Therefore, the structure for transmitting of the power can be simplified.

[0022] According to yet a further aspect of the invention, in the draw texturing machine of any one of the other aspects, each of the five-axial false-twisting devices further includes a common driving source for driving the five rotational shafts together, and among the five rotational shafts, at a rotational shaft which is not used for processing the yarns, a weight is provided instead of at least one of the circular plate members.

[0023] In the five-axial false-twisting device, two yarns may be twisted at the same time by both of the first false-twisting unit and the second false-twisting unit, or only one yarn may be twisted by one of the first false-twisting unit and the second false-twisting unit. From the perspective of cost reduction, when only one yarn is twisted, preferably, unnecessary circular plate members are detached from a rotational shaft which is not used for processing yarns. However, if the circular plate members are simply detached from some rotational shafts in one five-axial false-twisting device, a load on a common driving source of the one five-axial false-twisting device becomes smaller than a load on each of common driving sources of other five-axial false-twisting devices. Because of this, in the five-axial false-twisting device which some of the circular plate members are detached, five rotational shafts rotate unintentionally at high speed. As a result, yarn quality of yarns which are processed at the five-axial false-twisting device may be greatly different from yarn quality of yarns which are processed at other five-axial false-twisting devices.

[0024] In the present invention, because the weights are provided in place of the unnecessary circular plate members, the rotational shafts are prevented from unintentionally rotating at high speed, thanks to these weights functioning as loads. Therefore, by using members which are more inexpensive than the circular plate members as the weights, the difference in yarn quality is suppressed between the five-axial false-twisting devices while increase in cost is suppressed.

[0025] According to yet another aspect of the invention, in the draw texturing machine of any one of the first to seventh aspects, at least one of the circular plate members provided at the common rotational shaft has higher abrasion resistance at a component which forms a contact part making a contact with the yarns than at least one of the circular plate members provided at a rotational shaft among the five rotational shafts except the common rotational shaft.

[0026] With the circular plate members provided at the other rotational shafts except the common rotational shaft, only the first yarn or the second yarn makes a contact. Meanwhile, with circular plate members provided at the common rotational shaft, both of the first yarn and the second yarn make a contact. In other words, the circular plate members provided at the common rotational shaft may be worn away earlier than the circular plate members provided at the other rotational shafts. In this case, because the circular plate members provided at the common rotational shaft need to be replaced earlier than the other circular plate members, the labor of the replacement may be increased. In the present invention, because the circular plate members provided at the common rotational shaft have higher abrasion resistance than the other circular plate members, it is possible to suppress the circular plate members provided at the common rotational shaft from being worn away earlier than the other circular plate members. Therefore, it is possible to avoid the necessity of replacement of some circular plate members earlier than the other circular plate members.

[0027] According to a further aspect of the invention, in the draw texturing machine of any one of the other aspects, a circular plate member placed at the most upstream in the first yarn running direction in which the first yarn runs in the first false-twisting unit and a circular plate member placed at the most upstream in the second yarn running direction in which the second yarn runs in the second false-twisting unit are placed in a same first plane which is orthogonal to the axial direction, and a circular plate member placed at the most downstream in the first yarn running direction in the first false-twisting unit and a circular plate member placed at the most downstream in the second yarn running direction in the second false-twisting unit are placed in a same second plane which is orthogonal to the axial direction.

[0028] In a structure in which the most upstream circular plate member placed in the first yarn running direction and the most upstream circular plate member placed in the second yarn running direction are placed to be different in position from each other in the axial direction, at least some of the rotational shafts need to be elongated. As a result, firstly, the yarn path of the first yarn and the yarn path of the second yarn may change. When the yarn path of the first yarn and the yarn path of the second yarn are greatly different, twisting of the first yarn and twisting of the second yarn may be different from each other because of difference in, e.g., bending angles between the yarns. As a result, yarn quality of the first yarn and yarn quality of the second yarn may be different from each other. Secondly, the device may be increased in size in the axial direction. In positional relationship between the most downstream circular plate member placed in the first yarn running direction and the most downstream circular plate member placed in the second yarn running direction, the problems described above also occur. In the present invention, the circular plate members can be small in size in the axial direction in a state in which the yarn path of the first yarn and the yarn path of the second yarn are substantially the same. Therefore, the increase in size of the device can be suppressed in the axial direction. In addition to that, in the present invention, form of the yarn path of the first yarn and form of the yarn path of the second yarn can be moved closer to substantially the same when viewed in the base longitudinal direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

FIG. 1 is a profile of a draw texturing machine related to an embodiment.

FIG. 2 is a schematic diagram of the draw texturing machine, expanded along paths of yarns.

FIG. 3 is a view of a winding unit, viewed along an arrow III in FIG. 1.

FIG. 4 is a perspective view of a five-axial false-twisting device.

FIG. 5 shows the five-axial false-twisting device viewed in a direction orthogonal to both of a base longitudinal direction and an axial direction.

FIGs. 6(a) and 6(b) are views of the five-axial false-twisting device viewed in the axial direction, which applies Z-twisting to yarns.

FIGs. 7(a) and 7(b) are views of a five-axial false-twisting device viewed in the axial direction, which applies S-twisting to yarns.

FIG. 8(a) is a reference drawing which shows directions of the five false-twisting device, and FIG. 8(b) is a reference drawing which shows a direction of yarn threading to the five-axial false-twisting device.

FIGs. 9(a) and 9(b) show movements of rotational shafts.

FIG. 10(a) shows a guide supporter, and FIGs. 10(b) and 10(c) show yarn paths.

FIG. 11 shows a driving mechanism which rotates and drives the rotating shafts.

FIGs. 12(a) and 12(b) show a five-axial false-twisting device related to a modification.

FIGs. 13(a) and 13(b) show a five-axial false-twisting device related to another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] The following will describe an embodiment of the present invention. A vertical direction to the sheet of FIG. 1 is defined as a base longitudinal direction, and a left-right direction to the sheet is defined as a base width direction. A direction orthogonal to the base longitudinal direction and the base width direction is defined as the up-down direction (vertical direction) in which the gravity acts.

(Overall Structure of Draw Texturing Machine)

[0031] To begin with, the following will describe an overall structure of a draw texturing machine with reference to FIG. 1 to FIG. 3. FIG. 1 is a profile of a draw texturing machine 1 of the present embodiment. FIG. 2 is a schematic diagram of the draw texturing machine 1, expanded along paths of yarns Y (yarn paths). FIG. 3 is a view of a winding unit, viewed along an arrow III in FIG. 1.

[0032] The draw texturing machine 1 can perform false twisting of a yarn Y made of synthetic fibers such as nylon (polyamide fibers). The draw texturing machine 1 includes a yarn supplying unit 2 for supplying the yarns Y, a processing unit 3 which performs the false twisting of the yarns Y supplied from the supplying unit 2, and a winding unit 4 which winds the yarns Y processed by the processing unit 3 onto a winding bobbins Bw. Component of the yarn supplying unit 2, the processing unit 3, and the winding unit 4 are aligned to form plural lines (as shown in FIG. 2) in the base longitudinal direction orthogonal to a yarn running surface (sheet of FIG. 1) on which yarn paths from the yarn supplying unit 2 to the winding unit 4 through the processing unit 3 are provided.

[0033] The yarn supplying unit 2 includes a creel stand 7 retaining yarn supply packages Ps, and supplies the yarns Y to the processing unit 3. In the processing unit 3, the following members are placed in this order from the upstream in a yarn running direction: first feed rollers 11; twist-stopping guides 12; first heaters 13; coolers 14; five-axial false-twisting devices 15; second feed rollers 16; combining units 17; third feed rollers 18; a second heater 19; and fourth feed rollers 20. The winding unit 4 winds the yarns Y for which the false winding has been performed at the processing unit 3 onto the winding bobbins Bw by winding devices 21, and forms wound packages Pw.

[0034] The draw texturing machine 1 includes a main base 8 and a winding base 9 which are placed to be spaced apart from each other in the base width direction. The main base 8 and the winding base 9 are provided to extend in a substantially same length in the base longitudinal direction, and placed to oppose each other. An upper part of the main base 8 is connected to an upper part of the winding base 9 by a supporting frame 10. Each device forming the processing unit 3 is mainly attached to the main base 8 or the supporting frame 10. The main base 8, the winding base 9, and the supporting frame 10 form a working space 22 in which an operator performs an operation such as the yarn threading to each device. The yarn paths are formed so that the yarns Y mainly run around the working space 22.

[0035] The draw texturing machine 1 includes units which are termed spans each of which includes a pair of the main base 8 and the winding base 9 placed to oppose each other. In one span, each device is placed so that the yarns Y running while being aligned in the base longitudinal direction can be false-twisted at the same time. For example, twelve winding devices 21 are provided for one winding base 9 (as shown in FIG. 3). In addition to that, one winding device 21 can wind a yarn Y or two yarns Y at the same time as described below. In other words, in the present embodiment, twenty four yarns Y can be simultaneously wound at maximum in one span. In the draw texturing machine 1, the spans are placed in a left-right symmetrical manner to the sheet, with a center line C of the base width direction of the main base 8 as a symmetry axis (main base 8 is shared between the left span and the right span), and the spans are aligned in the base longitudinal direction.

(Processing Unit)

[0036] The structure of the processing unit 3 will be described with reference to FIG. 1 and FIG. 2.

[0037] Each first feed roller 11 sends the yarns Y supplied from the yarn supplying unit 2 to the first heater 13. The first feed rollers 11 are placed above the winding base 9 (as shown in FIG. 1). The first feed rollers 11 are aligned in the base longitudinal direction. For example, as shown in FIG. 2, each first feed roller 11 can send the two yarns Y to the first heater 13. However, the disclosure is not limited to this.

[0038] Each twist-stopping guide 12 prevents twisting which has been applied to the yarn Y at the five-axial false-twisting device 15 from being propagated to the upstream of each twist-stopping guide 12 in the yarn running direction. The twist-stopping guides 12 are placed downstream of the first feed rollers 11 in the yarn running direction, and placed upstream of the first heater 13 in the yarn running direction. The twist-stopping guides 12 are, for example, provided for the yarns Y supplied from the yarn supplying unit 2, respectively, and aligned in the base longitudinal direction.

[0039] Each first heater 13 heats the yarns Y sent from the first feed rollers 11, and are placed at the supporting frame 10 (as shown in FIG. 1). The first heaters 13 are provided for the yarns Y supplied from the yarn supplying unit 2, and aligned in the base longitudinal direction. For example, as shown in FIG. 2, each first heater 13 can heat four yarns Y. However, the disclosure is not limited to this.

[0040] Each cooler 14 cools the yarns Y heated at each first heater 13. The coolers 14 are placed downstream of each first heater 13 in the yarn running direction, and placed upstream of the five-axial false-twisting devices 15 in the yarn running direction. For example, as recited in Japanese Laid-Open Patent Publication No. 2011-47074, the coolers 14 can cool the yarns Y by airflow. The coolers 14 are provided for the yarns Y supplied by the yarn supplying unit 2, and aligned in the base longitudinal direction. For example, as shown in FIG. 2, each cooler 14 can cool four yarns Y. However, the disclosure is not limited to this.

[0041] The five-axial false-twisting devices 15 are a kind of a false-twisting device having a disc-friction system, and each five-axial false-twisting device 15 simultaneously twists two yarns Y, i.e., a yarn Y1 (first yarn of the present invention) and a yarn Y2 (second yarn of the present invention) in the same direction. The five-axial false-twisting devices 15 are placed directly downstream of the coolers 14 in the yarn running direction. The five-axial false-twisting devices 15 are aligned in the base longitudinal direction. In this regard, to the five-axial false-twisting device 15 which is placed at an end portion in the base longitudinal direction, only one yarn Y is threaded (see the five-axial false-twisting device 15 at the left end portion of the sheet of FIG. 2). For example, thirteen five-axial false-twisting devices 15 are provided in one span (not shown in the figure). The specific details of the five-axial false-twisting devices 15 will be given later.

[0042] Each second feed roller 16 sends the yarns Y processed at the five-axial false-twisting devices 15 to the combining unit 17. The second feed rollers 16 are placed above the upper part of the main frame 8 (as shown in FIG. 1). The second feed rollers 16 are aligned in the base longitudinal direction. For example, as shown in FIG. 2, each second feed roller 16 can send two yarns Y to the combining unit 17. However, the disclosure is not limited to this. In this regard, the second feed rollers 16 convey the yarns Y at a higher conveyance speed than the first feed rollers 11, and the yarns Y are drawn between the first feed rollers 11 and the second feed rollers 16.

[0043] Each combining unit 17 can combine the yarn Y1 and the yarn Y2. In the present embodiment, each combining unit 17 can combine the following yarns Y: a yarn Y1 which is processed at one five-axial false-twisting device 15; and a yarn Y2 which is processed at another five-axial false-twisting device 15 placed adjacent to the five-axial false-twisting device 15 in the base longitudinal direction. However, the disclosure is not limited to this. The combining units 17 are placed below the second feed rollers 16 (as shown in FIG. 1). Each combining unit 17 includes two interlace nozzles 31 and 32 (as shown in FIG. 2). Each combining unit 17 blows air onto the yarn Y1 and the yarn Y2 (as shown at the left part of the sheet of FIG. 2) which are, for example, passing the inside of the interlace nozzle 31, and each combining unit 17 combines the yarn Y1 and the yarn Y2 by air-interlace which the yarn Y1 is interlaced with the yarn Y2 by airflow. In this regard, each combining unit 17 can guide the two yarns Y to downstream in the yarn running direction, without combining the yarn Y1 and the yarn Y2. In this case, the yarn Y1 passes the inside of the interlace nozzle 31, and the yarn Y2 passes the inside of the interlace nozzle 32 (as shown on the right part of the sheet of FIG. 2).

[0044] Each third feed roller 18 sends the yarns Y running downstream of each combining unit 17 in the yarn running direction to the second heater 19. The third feed rollers 18 are placed below the combining units 17 (as shown in FIG. 1). The third feed rollers 18 are aligned in the base longitudinal direction. For example, as shown in FIG. 2, each third feed roller 18 can send two yarns Y to the second heater 19. However, the disclosure is not limited to this. In this regard, the second feed rollers 18 convey the yarns Y at a slower conveyance speed than the second feed rollers 16, and the yarns Y are relaxed between the second feed rollers 16 and the third feed rollers 18.

[0045] The second heater 19 heats the yarns Y supplied from the third feed rollers 18. The second heater 19 is placed below the third feed rollers 18 (as shown in FIG. 1). The second heater 19 extends along the vertical direction, and one second heater 19 is provided in one span.

[0046] Each fourth feed roller 20 sends the yarns Y heated by the second heater 19 to the winding device 21, and are placed at the lower part of the working space 22 (as shown in FIG. 1). The fourth feed rollers 20 are aligned in the base longitudinal direction. For example, as shown in FIG. 2, each fourth feed roller 20 can send two yarns Y to the winding device 21. However, the disclosure is not limited to this. The fourth feed rollers 20 convey the yarns Y at a slower conveyance speed than the third feed rollers 18, and the yarns Y are relaxed between the third feed rollers 18 and the fourth feed rollers 20.

[0047] In the processing unit 3 described above, two yarns Y which have been drawn between the first feed rollers 11 and the second feed rollers 16 are twisted at each five-axial false-twisting device 15. The twisting formed by the five-axial false-twisting devices 15 propagates to the twist-stopping guides 12 but does not propagate to the upstream of the twist-stopping guides 12 in the yarn running direction. The yarn Y which is twisted and drawn is heated at each first heater 13 and thermally set. After that, the yarn Y is cooled at each cooler 14. The yarn Y is untwisted at the downstream of each five-axial false-twisting device 15. However, each filament is maintained to be wavy in shape on account of the thermal setting described above. Subsequently, after the two yarns Y (yarn Y1 and yarn Y2) false-twisted by each five-axial false-twisting device 15 are combined by the combining unit 17 while being relaxed between the second feed rollers 16 and the third feed rollers 18, the two yarns Y are guided to the downstream side in the yarn running direction. Alternatively, the two false-twisted yarns Y are guided to the downstream side in the yarn running direction without being combined. Furthermore, the yarn Y is thermally set at the second heater 19 while being relaxed between the third feed roller 18 and the fourth feed roller 20. Finally, the yarn Y sent from each fourth feed roller 20 is wound by each winding device 21, and forms each package Pw.

(Winding Unit)

[0048] The structure of the winding unit 4 will be described with reference to FIG. 2 and FIG. 3. The winding unit 4 includes the winding devices 21 which wind the yarns Y onto the winding bobbins Bw. For example, as recited in Japanese Laid-Open Patent Publication No. 2009-74219, each winding device 21 can wind the yarn Y or the yarns Y onto the winding bobbin Bw or two winding bobbins Bw. Each winding device 21 includes fulcrum guides 41 which are fulcrums when the yarns Y are traversed, a traverse unit 42 which traverses the yarns Y, a single cradle 43 which supports the winding bobbins Bw to be rotatable, and a controller 44 (as shown in FIG. 3).

[0049] As described above, each fulcrum guide 41 is a guide which is a fulcrum when the yarn Y is traversed. Three fulcrum guides 41 are provided at each winding device 21 to be aligned along, for example, the base longitudinal direction (as shown in FIG. 2). For example, when the yarn Y formed by yarn combination at the combining unit 17 is guided, the yarn Y is threaded to the central one among the three fulcrum guides 41 (as shown at the left part of the sheet of FIG. 2). When two yarns Y which are sent without being combined are guided, the two yarns Y are threaded to two fulcrum guides 41 at both ends among the three fulcrum guides 41, respectively (as shown at the right part of the sheet of FIG. 2).

[0050] For example, the traverse unit 42 can traverse the yarns Y by traverse guides 45 which are attached to an endless belt driven in a reciprocating manner by a motor. The number of the traverse guides 45 which are attached to the endless belt can be changed depending on the number of the yarns Y which are traversed. For example, one traverse guide 45 is provided for the traverse unit 42 which traverses the yarn Y formed by yarn combination at one combining unit 17 (as shown at the left part of the sheet of FIG. 2). Meanwhile, two traverse guides 45 are provided for the traverse unit 42 which traverses the yarns Y which are sent without being combined (as shown at the right part of the sheet of FIG. 2). A traveling range of the traverse guides 45 can be changed depending on the number of the yarns Y to be traversed. Information related to settings such as the number of the yarns Y which are traversed or the traveling range of the traverse guides 45 is stored in, for example, the controller 44.

[0051] The cradle 43 can support one or more (one or two) winding bobbin Bw (wound package Pw) to be rotatable. In other words, the cradle 43 can be switched between a state of supporting one winding bobbin Bw and a state of supporting two winding bobbins Bw. The cradle 43 is provided at each winding device 21. A contact roller 46 which makes a contact with surfaces of the wound packages Pw is placed directly upstream of the wound packages Pw in the yarn running direction. The winding bobbins Bw which are supported by the cradle 43 are rotationally driven, for example, by an unillustrated motor. In the structure described above, the contact roller 46 in contact with the surfaces of the wound packages Pw applies a contact pressure onto the wound packages Pw while being rotationally driven by friction. Alternatively, instead of rotationally driving the winding bobbins Bw by a motor, the contact roller 46 may be rotationally driven by an unillustrated motor. In the structure described above, the wound packages Pw in contact with the contact roller 46 are rotationally driven by the friction.

[0052] The controller 44 controls an operation of the traverse unit 42 and an operation of the motor which rotationally drives the winding bobbins Bw. In addition to that, the controller 44 can change the setting related to the number of the yarns Y which are wound onto one winding device 21. In this regard, the controller 44 can switch an operational mode between a first mode in which one yarn Y is wound onto one winding bobbin Bw (as shown at the left part of the sheet of FIG. 2) and a second mode in which two yarns Y are wound onto two winding bobbins Bw (as shown at the right part of the sheet of FIG. 2).

[0053] In the winding unit 4 structured as above, the yarn Y which is sent from the fourth feed roller 20 described above is wound onto the winding bobbin Bw by each winding device 21, and forms each wound package Pw. When two yarns Y are combined by one combining unit 17, the operational mode of the corresponding winding device 21 is set in the first mode. In addition to that, when the two yarns Y are guided to the downstream side in the yarn running direction without being combined, the operational mode of the corresponding winding device 21 is set in the second mode.

(Structure of False-Twisting Device)

[0054] The structure of the five-axial false-twisting device 15 will be described with reference to FIG. 4 to FIG. 7(b). FIG. 4 is a perspective view of the five-axial false-twisting device 15. FIG. 5 shows the five-axial false-twisting device 15 viewed in a direction orthogonal to both of a base longitudinal direction and an axial direction of a rotational shaft 53 described below (hereinafter, this direction will be simply referred to as an axial direction). FIGs. 6(a) and 6(b) show the five-axial false-twisting device 15 viewed in the axial direction, which applies Z-twisting to yarns Y. FIGs. 7(a) and 7(b) show the five-axial false-twisting device 15 viewed in the axial direction, which applies S-twisting to yarns Y. In FIG. 6(b) and FIG. 7(b), circular plate members 57 described below are indicated by two-dot chain lines so that supporting tables 54 to 56 described below are shown. One side and the other side in the base longitudinal direction are defined as shown in FIG. 4 to FIG. 7(b). In the five-axial false-twisting device 15, the side which is close to the working space 22 (as shown in FIG. 1) is defined as the near side (as shown in FIG. 1, FIG. 4, FIGs. 6(a) and 6(b), and FIGs. 7(a) and 7(b)), and the side which is distant from the working space 22 is defined as the far side (as shown in FIG. 4, FIGs. 6(a) and 6(b), and FIGs. 7(a) and 7(b)). In FIG. 6(a) to FIG. 7(b), a yarn guide 61 described below is not shown.

[0055] Each five-axial false-twisting device 15 can twist (perform the Z-twisting or S-twisting on) two yarns Y (yarn Y1 and yarn Y2) in the same direction at the same time. In other words, as shown in FIG. 4 to FIG. 7(b), a first false-twisting unit 51 which applies twisting to the yarn Y1 and a second false-twisting unit 52 which applies the twisting to the yarn Y2 are provided at the five-axial false-twisting device 15. The five-axial false-twisting devices 15 are aligned in the base longitudinal direction (as shown in FIG. 2).

[0056] As shown in FIG. 4 to FIG. 7(b), the five-axial false-twisting device 15 includes five rotational shafts 53, the supporting tables 54, 55, and 56, the circular plate members 57, a driving mechanism 58, and the yarn guides 61, 62, and 63, as components which form the first false-twisting unit 51 and the second false-twisting unit 52. The five rotational shafts 53 (common rotational shaft 71, first independent rotational shafts 72 and 73, second independent rotational shafts 74 and 75) are axial members which extend in the axial direction substantially orthogonal to the base longitudinal direction. In this regard, the axial direction may not necessarily be substantially orthogonal to the base longitudinal direction. Among the five rotational shafts 53, the first false-twisting unit 51 includes the common rotational shaft 71 which is placed at the center in the base longitudinal direction and two first independent rotational shafts 72 and 73 which are placed on the one side in the base longitudinal direction of the common rotational shaft 71. The second false-twisting unit 52 includes the common rotational shaft 71 and two second independent rotational shafts 74 and 75 which are placed on the other side in the base longitudinal direction of the common rotational shaft 71. In other words, the common rotational shaft 71 is shared between the first false-twisting unit 51 and the second false-twisting unit 52. As shown in FIG. 6(a) and FIG. 7(a), the rotational shafts 53 are placed so that the axial centers of these shafts form apexes of two virtual equilateral triangles (first triangle 201 and second triangle 202) when viewed in the axial direction. The common rotational shaft 71 and the first independent rotational shafts 72 and 73 form the apexes of the first triangle 201. The common rotational shaft 71 and the second independent rotational shafts 74 and 75 form the apexes of the second triangle 202. The first independent rotational shafts 72 and 73 oppose the second independent rotational shafts 74 and 75 over the common rotational shaft 71 in the base longitudinal direction.

[0057] The supporting tables 54, 55, and 56 are tables supporting the rotational shafts 53 to be rotatable via unillustrated bearings. The supporting table 54 cantilevers, in a rotatable manner, the common rotational shaft 71, the first independent rotational shaft 72 which is placed on the far side among the first independent rotational shafts 72 and 73, and the second independent rotational shaft 74 which is placed on the far side among the second independent rotational shafts 74 and 75. The supporting table 55 is attached to the supporting table 54 and placed on the near side of the supporting table 54, and cantilevers the first independent rotational shaft 73 on the near side, in a rotatable manner. The supporting table 56 is attached to the supporting table 54 and placed on the near side of the supporting table 54, and cantilevers the second independent rotational shaft 75 of the near side, in a rotatable manner. The upper side of the sheet in FIG. 4 and FIG. 5 is a leading end side in the axial direction, and the lower side of the sheet is a base end side in the axial direction. The yarns Y run from the leading end side in the axial direction of the rotational shaft 53 to the base end side. In other words, the leading end side in the axial direction is the upstream side in the yarn running direction. The base end side in the axial direction is the downstream side in the yarn running direction. A running direction of a yarn Y1 is defined as a first yarn running direction, and a running direction of a yarn Y2 is defined as a second yarn running direction (as shown in FIG. 5). The Base end parts of the supporting tables 54, 55, and 56 in the axial direction are covers 54a, 55a, and 56a covering part of the driving mechanism 58, respectively (as shown in FIG. 4 and FIG. 5).

[0058] The circular plate members 57 are members which are attached to each of the rotational shafts 53 and apply the twisting to yarns Y by making a contact with the yarns Y. The present embodiment assumes that the circular plate members 57 are attached to all rotational shafts 53 of all five-axial false-twisting devices 15, in order to simplify the description. Furthermore, in the present embodiment, three or four circular plate members 57 are attached to each of the rotational shafts 53 (as shown in, e.g., FIG. 4). However, the disclosure is not limited to this.

[0059] To begin with, among the circular plate members 57, circular plate members 57 which are attached to the common rotational shaft 71 and the first independent rotational shafts 72 and 73 are provided at the first false-twisting unit 51, and placed to form a spiral extending in the axial direction. The direction of the spiral formed by the circular plate members 57 is determined by the direction of the twisting performed on the yarns Y. In other words, the circular plate members 57 of the first false-twisting unit 51 are placed to form a spiral in a counterclockwise direction when a five-axial false-twisting device 15 which performs the Z-twisting on the yarns Y (five-axial false-twisting device 15a; as shown in FIGs. 6(a) and 6(b)) is viewed from the leading end side in the axial direction. On the other hand, the circular plate members 57 of the first false-twisting unit 51 are placed to form a spiral in a clockwise direction when a five-axial false-twisting device 15 which performs the S-twisting on the yarns Y (five-axial false-twisting device 15b; as shown in FIGs. 7(a) and 7(b)) is viewed from the leading end side in the axial direction.

[0060] Circular plate members 57 which are attached to the common rotational shaft 71 and the second independent rotational shafts 74 and 75 are provided at the second false-twisting unit 52, and placed to form a spiral extending in the axial direction. The direction of the spiral formed by the circular plate members 57 provided at the second false-twisting unit 52 is identical with the direction of the spiral formed by the circular plate members 57 provided at the first false-twisting unit 51.

[0061] As shown in FIG. 5, the following members are placed in a first plane 203 orthogonal to the axial direction: a circular plate member 57 which is placed at the most upstream in the first yarn running direction of the first false-twisting unit 51(circular plate member 81); and a circular plate member 57 which is placed at the most upstream in the second yarn running direction of the second false-twisting unit 52 (circular plate member 82). In other words, the position of the circular plate member 81 in the axial direction and the position of the circular plate member 82 in the axial direction are substantially the same. In addition to that, the following members are placed in a second plane 204 orthogonal to the axial direction: a circular plate member 57 which is placed at the most downstream in the first yarn running direction of the first false-twisting unit 51 (circular plate member 83); and a circular plate member 57 which is placed at the most downstream in the second yarn running direction of the second false-twisting unit 52 (circular plate member 84). In other words, the position of the circular plate member 83 in the axial direction and the position of the circular plate member 84 in the axial direction are substantially the same. Because of this, increase in length of each of the rotational shafts 53 is suppressed as compared with cases in which the positions of the circular plate member 81 and the circular plate member 82 are different in the axial direction or the positions of the circular plate member 83 and the circular plate member 84 are different in the axial direction.

[0062] The circular plate members 57 of the first false-twisting unit 51 and the circular plate members 57 of the second false-twisting unit 52 are placed point-symmetrical about the common rotational shaft 71 as a symmetrical axis, when viewed in the axial direction. For a specific example, in the five-axial false-twisting device 15a (as shown in FIGs. 6(a) and 6(b)), the circular plate member 81 of the first false-twisting unit 51 is attached to the first independent rotational shaft 73 on the near side. In addition to that, the circular plate member 82 of the second false-twisting unit 52 is attached to the second independent rotational shaft 74 on the far side.

[0063] Contact parts where the circular plate members 57 makes a contact with the yarn Y are made of, for example, polyurethane. In the present embodiment, at least one circular plate member 57 which includes the contact part in contact with the yarn Y is made of polyurethane is attached to each of the rotational shafts 53. Meanwhile, circular plate members 57 (circular plate members 81 and 82) with which the running yarn Y makes a contact at first and circular plate members 57 (circular plate members 83 and 84) with which the running yarn Y makes a contact at last are easily worn away. Therefore, the contact parts of the circular plate members 81, 82, 83, and 84 in contact with the yarn Y are made of, for example, ceramic which has a higher abrasion resistance than polyurethane. Because of this, the circular plate members 81, 82, 83, and 84 are suppressed from being worn away. However, the disclosure is not limited to this. All contact parts of all circular plate members 57 in contact with the yarn Y may be made of polyurethane.

[0064] The driving mechanism 58 is a mechanism which rotationally drives five rotational shafts 53 in the same direction. The driving mechanism 58 includes a motor 85 (as shown in FIG. 4; a drive source and a common driving source of the present invention), and belts 86, 87, 88, and 89 for transmitting the power of the motor 85 to each of the rotational shafts (as shown in FIG. 5). A driving mechanism 58 of the five-axial false-twisting device 15 (five-axial false-twisting device 15a) which performs the Z-twisting on the yarn Y rotationally drives the rotational shafts 53 counterclockwise (indicated by arrows in FIGs. 6(a) and 6(b)), when viewed from the leading end side in the axial direction. A driving mechanism 58 of the five-axial false-twisting device 15 (five-axial false-twisting device 15b) which performs the S-twisting on the yarn Y rotationally drives the rotational shafts 53 clockwise (indicated by arrows in FIGs. 7(a) and 7(b)), when viewed from the leading end side in the axial direction. The specific details of the driving mechanism 58 will be described later.

[0065] Two yarn guides 61, two yarn guides 62, and two yarn guides 63 are provided to correspond to the first false-twisting unit 51 and the second false-twisting unit 52, as shown in FIG. 5. To begin with, the yarn guide 61 of the first false-twisting unit 51 (yarn guide 61a; a first yarn guide of the present invention) is placed directly upstream of the circular plate member 81 in the first yarn running direction. The yarn guide 62 (yarn guide 62a) of the first false-twisting unit 51 is placed directly downstream of the circular plate member 83 in the first yarn running direction. The yarn guide 63 (yarn guide 63a) of the first false-twisting unit 51 is placed directly downstream of the yarn guide 62a in the first yarn running direction, and fixed to one end portion of the supporting table 55 in the base longitudinal direction. In addition to that, the yarn guide 61 of the second false-twisting unit 52 (yarn guide 61b; a second yarn guide of the present invention) is placed directly upstream of the circular plate member 82 in the second yarn running direction. The yarn guide 62 (yarn guide 62b) of the second false-twisting unit 52 is placed directly downstream of the circular plate member 84 in the second yarn running direction. The yarn guide 63 (yarn guide 63b) of the first false-twisting unit 52 is placed directly downstream of the yarn guide 62b in the second yarn running direction, and fixed to the other end portion of the supporting table 56 in the base longitudinal direction.

[0066] In the five-axial false-twisting device 15 structured as described above, the yarns Y are placed to form paths (yarn paths) described below. As shown in FIG. 5, to begin with, a yarn Y1 is placed to form a spiral while making a contact with the circular plate members 57 of the first false-twisting unit 51 via the yarn guide 61a. The yarn Y1 in contact with the circular plate members 57 is placed to be inside the first triangle 201 (as shown in FIG. 6(a)) and runs through the inside of the first triangle 201, when viewed in the axial direction. Subsequently, the yarn Y1 runs toward the downstream side in the first yarn running direction via the yarn guides 62a and 63a. A yarn Y2 is placed to form a spiral while making a contact with the circular plate members 57 of the second false-twisting unit 52 via the yarn guide 61b. The yarn Y2 in contact with the circular plate members 57 is placed to be inside the second triangle 202 (as shown in FIG. 6(a)) and runs through the inside of the second triangle 202, when viewed in the axial direction. Subsequently, the yarn Y2 runs toward the downstream side in the second yarn running direction via the yarn guides 62b and 63b.

[0067] While causing the yarns Y to run as described above, the driving mechanism 58 rotationally drives the five rotational shafts 53 in the same direction in order to apply the twisting to the yarns Y in contact with the rotating circular plate members 57. To be more specific, in the five-axial false-twisting device 15a for the Z-twisting (as shown in FIGs. 6(a) and 6(b)), Z-twisting is applied to both of the yarn Y1 and the yarn Y2. In the five-axial false-twisting device 15b for the S-twisting (as shown in FIGs. 7(a) and 7(b)), S-twisting is applied to both of the yarn Y1 and the yarn Y2.

[0068] In the five-axial false-twisting device 15 described above, yarn threading to the first false-twisting unit 51 and the second false-twisting unit 52 is needed. To be more specific, the yarn Y1 needs to be introduced from a gap between predetermined two rotational shafts 53 into the inside of the first triangle 201, and then threaded to the yarn guides 61, 62, and 63. The yarn Y2 needs to be introduced from a gap between predetermined two rotational shafts 53 into the inside of the second triangle 202, and needs to be threaded to the yarn guides 61, 62, and 63. The yarn threading is performed by an operator at the working space 22 (as shown in FIG. 1). As shown in a reference drawing in FIG. 8(a), if one of the first false-twisting unit 51 and the second false-twisting unit 52 is placed on the far side which is more distant than the other (distant from the working space 22), it is very difficult to perform the yarn threading on the false-twisting unit on the far side (second false-twisting unit 52 in FIG. 8(a)). Therefore, the first false-twisting unit 51 and the second false-twisting unit 52 need to be aligned in the base longitudinal direction so that both of the first false-twisting unit 51 and the second false-twisting unit 52 face the working space 22 (as shown in the reference drawing in FIG. 8(b)).

[0069] As described above, the circular plate members 57 of the first false-twisting unit 51 and the circular plate members 57 of the second false-twisting unit 52 are placed point-symmetrically with each other, when viewed in the axial direction. In this structure, there are three ways of the yarn threading to the circular plate members 57 as shown in FIG. 8(b). The first way is, as shown at the left part of the sheet of FIG. 8(b), to perform the yarn threading on the first false-twisting unit 51 from the near side, and to perform the yarn threading on the second false-twisting unit 52 from the far side (as indicated by arrows 205 and 206 in FIG. 8(b)). The second way is, as shown at the central part of the sheet of FIG. 8(b), to perform the yarn threading on the first false-twisting unit 51 from the far side, and to perform the yarn threading on the second false-twisting unit 52 from the near side (as indicated by arrows 207 and 208 in FIG. 8(b)). The third way is, as shown at the right part of the sheet of FIG. 8(b), to perform the yarn threading on the first false-twisting unit 51 from one side in the base longitudinal direction, and to perform the yarn threading on the second false-twisting unit 52 from the other side in the base longitudinal direction (as indicated by arrows 209 and 210 in FIG. 8(b)). In this regard, to find another way to perform the yarn threading, the circular plate members 57 of the first false-twisting unit 51 and the circular plate members 57 of the second false-twisting unit 52 may not be placed point-symmetrically with each other. However, such an arrangement is unrealistic because of the following reasons. When the circular plate members 57 of the first false-twisting unit 51 and the circular plate members 57 of the second false-twisting unit 52 are placed not point-symmetrically with each other, the positions of the circular plate members 57 of the first false-twisting unit 51 and the positions of the circular plate members 57 of the second false-twisting unit 52 are different from each other in the axial direction. In this case, the yarn quality of the yarn Y1 and the yarn quality of the yarn Y2 may be different from each other because the yarn path of the yarn Y1 and the yarn path of the yarn Y2 are very different. In addition to that, size of the device may be disadvantageously increased because the rotational shaft 53 is elongated. As described above, in reality, the circular plate members 57 of the first false-twisting unit 51 and the circular plate members 57 of the second false-twisting unit 52 need to be placed point-symmetrically with each other.

[0070] Among the three ways described above, the first and second ways are unrealistic because the yarn threading from the far side is difficult. Therefore, the five-axial false-twisting device 15 needs to employ the third way. To be more specific, the five-axial false-twisting device 15 of the present embodiment is configured such that the yarn Y1 is threaded from a gap between two first independent rotational shafts 72 and 73 and the yarn Y2 is threaded from a gap between two second independent rotational shafts 74 and 75. However, in this structure, when yarn threading is performed on one five-axial false-twisting device 15, a working space between the five-axial false-twisting device 15 and another five-axial false-twisting device 15 which is an adjacent device in the base longitudinal direction may be narrow (as shown in FIG. 8(b)), and the yarn threading may be difficult. Therefore, in the present embodiment, the five-axial false-twisting device 15 has a structure described below in order to facilitate the yarn threading.

(Specific Details of Five-Axial False-Twisting Device)

[0071] The specific details of the five-axial false-twisting device 15 will be described with reference to FIGs. 9(a) and 9(b). FIG. 9(a) shows a five-axial false-twisting device 15 when the first independent rotational shaft 73 is placed at a first operating position (described below) and the second independent rotational shaft 75 is placed at a second operating position (described below). FIG. 9(b) shows a five-axial false-twisting device 15 when the first independent rotational shaft 73 is placed at a first yarn threading position (described below) and the second independent rotational shaft 75 is placed at a second yarn threading position (described below).

[0072] The supporting table 55 which supports the first independent rotational shaft 73 placed on the near side among the first independent rotational shafts 72 and 73 (i.e., a first movable shaft placed on one side of the present invention) to be rotatable is attached to the supporting table 54 to be able to swing with an axial center of the common rotational shaft 71 as a swing shaft center. In other words, the supporting tables 54 and 55 are hinged to each other to be able to open and close. Because of this, the first independent rotational shaft 73 can move between the operating position (first operating position; as shown in FIG. 9(a)) where the five-axial false-twisting device 15 is in operation (applying the twisting on the yarns Y) and the threading position (first yarn threading position; as shown in FIG. 9(b)) which is on the near side of the first operating position. Because of this, a space between two first independent rotational shafts 72 and 73 can be widened in the yarn threading. Therefore, in a structure in which the five-axial false-twisting devices 15 are aligned in the base longitudinal direction, yarn threading of the yarn Y1 from the working space 22 is facilitated (indicated by an arrow 211 in FIG. 9(b)). To be more specific, the first independent rotational shaft 73 can change a distance to the first independent rotational shaft 72 while maintaining a distance to the common rotational shaft 71, when viewed in the axial direction. Likewise, the supporting table 56 which supports the second independent rotational shaft 75 placed on the near side among the second independent rotational shafts 74 and 75 (one side, i.e., a second movable shaft of the present invention) to be rotatable is attached to the supporting table 54 to be able to swing with the axial center of the common rotational shaft 71 as the swing shaft center. Because of this, the second independent rotational shaft 75 can move between the operating position (second operating position; as shown in FIG. 9(a)) when the five-axial false-twisting device 15 is in operation and the yarn threading position (second yarn threading position; as shown in FIG. 9(b)) which is on the near side of the second operating position. Because of this, a space between two second independent rotational shafts 74 and 75 can be widened in the yarn threading. Therefore, in the structure in which the five-axial false-twisting devices 15 are aligned in the base longitudinal direction, yarn threading of the yarn Y2 from the working space 22 is facilitated (indicated by an arrow 212 in FIG. 9(b)). In this way, the yarn threading to the five-axial false-twisting device 15 is facilitated. In this regard, the supporting tables 54, 55, and 56 may support the common rotational shaft 71 to be rotatable through an unillustrated bearing.

[0073] When the first independent rotational shaft 73 and the second independent rotational shaft 75 are moved to the yarn threading positions from the operating positions, these rotational shafts 53 move to the near side and to the inner side in the base longitudinal direction of the five-axial false-twisting device 15 (common rotational shaft 71 side). Therefore, it is possible to avoid interference between the five-axial false-twisting devices 15 which are placed adjacent to each other in the base longitudinal direction, in the yarn threading. In other words, the space between the five-axial false-twisting devices 15 does not need to be widened in order to allow the first independent rotational shaft 73 and the second independent rotational shaft 75 to be movable. Therefore, increase in size of the draw texturing machine 1 in the base longitudinal direction is suppressed, and the yarn threading is facilitated.

[0074] In addition to that, as described above, the yarn guide 63a is fixed to the supporting table 55, and the yarn guide 63b is fixed to the supporting table 56. Therefore, when the first independent rotational shaft 73 moves to the first yarn threading position from the first operating position, the yarn guide 63a also moves to the near side and to the inner side (common rotational shaft 71 side) in the base longitudinal direction of the five-axial false-twisting device 15 (as shown in FIG. 9(b)). Furthermore, when the second independent rotational shaft 75 moves to the second yarn threading position from the second operating position, the yarn guide 63b also moves to the near side and to the inner side (common rotational shaft 71 side) in the base longitudinal direction of the five-axial false-twisting device 15 (as shown in FIG. 9(b)). Yarn threading to the yarn guide 63 is facilitated because the yarn guides 63a and 63b (yarn guide 63) move to the near side (toward an operator). Furthermore, the yarn guide 63 moves to the inner side (common rotational shaft 71 side) in the base longitudinal direction of the five-axial false-twisting device 15 so that space between the yarn guide 63 of the five-axial false-twisting device 15 and a yarn guide 63 of an adjacent five-axial false-twisting device 15 is widened. Therefore, the yarn threading to the yarn guide 63 is further facilitated.

[0075] In this stage, preferably, when the first independent rotational shaft 73 is moved to the first yarn threading position from the first operating position, a rotational angle of the supporting table 55 is, for example, 27° to 30°. Because the rotational angle described above is 27° or more, when the first independent rotational shaft 73 is placed at the first yarn threading position, the circular plate members 57 attached to the first independent rotational shaft 72 and the circular plate members 57 attached to the first independent rotational shaft 73 do not substantially overlap when viewed in the axial direction (as show in FIG. 9(b)). Therefore, the following operations are facilitated: to introduce the yarn Y1 from a gap between the first independent rotational shafts 72 and 73 into the first triangle 201; and to perform the yarn threading to the yarn guides 61, 62, and 63. Furthermore, because the rotational angle is 30° or less, a problem such that the supporting tables 55 and 56 interfere with each other and unintentionally move is suppressed, and the yarn threading is smoothly performed. A rotational angle of the supporting table 56 when the second independent rotational shaft 75 is moved to the second yarn threading position from the second operating position is similarly arranged.

[0076] The common rotational shaft 71, the first independent rotational shaft 72, and the second independent rotational shaft 74 are attached to the supporting table

54 to be rotatable, and are fixed in position. In other words, among five rotational shafts 53, the common rotational shaft 71, the first independent rotational shaft 72, and the second independent rotational shaft 74 are equivalent to three fixed rotational shafts of the present invention. The first independent rotational shaft 73 and the second independent rotational shaft 75 are not equivalent to the three fixed rotational shafts of the present invention.

[0077] Other structures of the five-axial false-twisting device 15 will be described with reference to, e.g., FIGs. 10(a) to 10(c) and FIG. 11. FIG. 10(a) shows a guide supporter 90 (described below) viewed from the leading end side in the axial direction. FIG. 10(b) shows yarn paths viewed in the base longitudinal direction before positions of the yarn guides 61a and 61b are adjusted. FIG. 10(c) shows yarn paths viewed in the base longitudinal direction after the positions of the yarn guides 61a and 61b are adjusted. FIG. 11 shows a driving mechanism viewed from the base end side in the axial direction.

(Yarn Guides and Its Surroundings)

[0078] The structure of the yarn guides 61a and 61b and its surroundings will be described. As shown in FIG. 4 and FIG. 10(a), the five-axial false-twisting device 15 includes the guide supporter 90 supporting the yarn guides 61a and 61b placed upstream in the yarn running direction. The guide supporter 90 includes, for example, a first supporting member 91 and a second supporting member 92. The first supporting member 91 is a member extending in the axial direction, and attached to a one side end of the supporting table 54 on the far side in the base longitudinal direction. The second supporting member 92 is a member attached to the leading end portion of the first supporting member 91 in the axial direction. The second supporting member 92 includes an extending portion 93 which extends to the inner side in the base longitudinal direction of the five-axial false-twisting device 15 and a pair of guide mounting portions 94a and 94b which are provided integrally with the extending portion 93 and extend in a direction substantially orthogonal to both of the axial direction and the base longitudinal direction. The guide mounting portion 94a is placed on one side (first false-twisting unit 51 side) in the base longitudinal direction of the five-axial false-twisting device 15. The guide mounting portion 94b is placed on the other side (second false-twisting unit 52 side) in the base longitudinal direction of the five-axial false-twisting device 15.

[0079] As shown in FIG. 4, an attachment hole 95a is formed at the guide mounting portion 94a in order to mount the yarn guide 61a, and an attachment hole 95b is formed at the guide mounting portion 94b in order to mount the yarn guide 61b. In addition to that, as shown in FIG. 10(a), the yarn guide 61a is attached to the guide mounting portion 94a by a fastener 96a which includes an unillustrated screw passing through the attachment hole 95a. Likewise, the yarn guide 61b is attached to the guide mounting portion 94b by a fastener 96b. Furthermore, the attachment holes 95a and 95b extend in a direction substantially orthogonal to both of the axial direction and the base longitudinal direction (as shown in FIG. 4). Because of this, the yarn guides 61a and 61b are movable yarn guides which are able to be adjusted in position in a direction substantially orthogonal to the base longitudinal direction, when viewed in the axial direction. To be more specific, the yarn guide 61a can be moved along the attachment hole 95a when the fastener 96a is loosened. The yarn guide 61a can be fixed in position by fastening the fastener 96a. The yarn guide 61b is similarly arranged.

[0080] As described above, the circular plate member 81 of the first false-twisting unit 51 and the circular plate member 82 of the second false-twisting unit 52 are placed point-symmetrically with each other (as shown in FIG. 6(a)). In other words, the positions of the circular plate members 81 and 82 are different from each other when viewed in the base longitudinal direction. Therefore, as shown in FIG. 10(b), a bending angle of the yarn Y1 running via the yarn guide 61a and a bending angle of the yarn Y2 running via the yarn guide 61b are different from each other if the yarn guides 61a and 61b are placed to overlap with each other when viewed in the base longitudinal direction. In this case, yarn quality of the yarn Y1 and yarn quality of the yarn Y2 may be different from each other. In this regard, in the present embodiment, relative positional relationship between the yarn guides 61a and 61b can be adjusted because the yarn guides 61a and 61b are the movable yarn guides. Therefore, a gap between the bending angle of the yarn Y1 and the bending angle of the yarn Y2 can be reduced by adjusting the positions of the yarn guides 61a and 61b properly (as shown in FIG. 10(c)).

(Driving Mechanism)

[0081] The following will describe the driving mechanism 58 in a detailed manner. As shown in FIG. 11, the driving mechanism 58 includes the motor 85 and belts 86, 87, 88, and 89. The motor 85 is placed on the farther side than the supporting table 54, and is a drive source for driving all of five rotational shafts. The belt 86 is an endless belt for transmitting the power of the motor 85 to the common rotational shaft 71 (intermediate shaft of the present invention). The belt 86 is wound around a pulley 101 attached to a drive shaft 85a of the motor 85 and a pulley 102 attached to the common rotational shaft 71.

[0082] The belt 87 (common belt of the present invention) is an endless belt for transmitting the power of the motor 85, via the common rotational shaft 71, to the first independent rotational shaft 72 and the second independent rotational shaft 74 which are two of three fixed rotational shafts. The belt 87 is wound around a pulley 103 attached to the common rotational shaft 71, a pulley

104 attached to the first independent rotational shaft 72, and a pulley 105 attached to the second independent rotational shaft 74 (as shown in FIG. 5 and FIG. 11).

[0083] The belt 88 is an endless belt for transmitting the power of the motor 85 to the first independent rotational shaft 73 via the common rotational shaft 71. The belt 88 is wound around a pulley 106 attached to the common rotational shaft 71 and a pulley 107 attached to the first independent rotational shaft 73 (as shown in FIG. 5 and FIG. 11). The belt 89 is an endless belt for transmitting the power of the motor 85 to the second independent rotational shaft 75 via the common rotational shaft 71. The belt 89 is wound around a pulley 108 attached to the common rotational shaft 71 and a pulley 109 attached to the second independent rotational shaft 75 (as shown in FIG. 5 and FIG. 11).

[0084] If a belt for transmitting the power to the first independent rotational shaft 72 and a belt for transmitting the power to the second independent rotational shaft 74 are provided individually instead of the belt 87 for driving both of the first independent rotational shaft 72 and the second independent rotational shaft 74, the number of belts is increased. As a result, the number of pulleys attached to the common rotational shaft 71 is increased, and the length of the common rotational shaft 71 is disadvantageously increased. In this regard, in the present embodiment, increase in number of belts is suppressed because the three fixed rotational shafts are driven together by the belt 87.

[0085] As described above, the first independent rotational shaft 73 is movable between the first operating position and the first yarn threading position which is on the near side of the first operating position. Because of this, the space between two first independent rotational shafts 72 and 73 can be widened in the yarn threading to the first false-twisting unit 51. Therefore, in a structure in which the five-axial false-twisting devices 15 are aligned in the base longitudinal direction, the yarn threading from the working space 22 is facilitated. Likewise, because the second independent rotational shaft 75 is movable between the second operating position and the second yarn threading position, the space between the second independent rotational shafts 74 and 75 can be widened in the yarn threading to the second false-twisting unit 52. As described above, in the draw texturing machine 1 in which the five-axial false-twisting devices 15 are aligned in the base longitudinal direction, the yarn threading is facilitated.

[0086] The first independent rotational shaft 73 and the second independent rotational shaft 75 can swing with the common rotational shaft 71 as the swing shaft center. In other words, the distance between the first independent rotational shaft 73 and the common rotational shaft 71 and the distance between the second independent rotational shaft 75 and the common rotational shaft 71 are not changed when the first independent rotational shaft 73 and the second independent rotational shaft 75 are moved. Therefore, it is possible to avoid damage of the belts 88 and 89 because of looseness or excessive tension.

[0087] The positions of the yarn guides 61a and 61b are adjusted so that a difference between the yarn path of the yarn Y1 guided by the yarn guide 61a and the yarn path of the yarn Y2 guided by the yarn guide 61b is suppressed to be small. Therefore, the difference in quality between the yarn Y1 and the yarn Y2 is suppressed.

[0088] The yarn guides 61a and 61b are movable in the direction substantially orthogonal to the base longitudinal direction, when viewed in the axial direction. Therefore, movable areas of the yarn guides 61a and 61b can be widened while the yarn guides 61a and 61b are suppressed from interfering with each other, so that the yarn paths are effectively adjusted.

[0089] Because the belt 87 can drive the common rotational shaft 71, the first independent rotational shaft 72, and the second independent rotational shaft 74 together, increase in number of belts is suppressed. Therefore, increase in length of the rotational shaft 53 is suppressed, and increase in size of the device is suppressed.

[0090] The power of the motor 85 is transmitted to the common rotational shaft 71 placed at the center in the base longitudinal direction among five rotational shafts 53. Because of this, the five-axial false-twisting device 15 can be configured to transmit the power further to the other rotational shafts 53 placed around the common rotational shaft 71. Therefore, the structure for transmitting of the power can be simplified.

[0091] The circular plate member 81 placed at the most upstream in the first yarn running direction of the first false-twisting unit 51 and the circular plate member 82 placed at the most upstream in the second yarn running direction of the second false-twisting unit 52 are placed in the same first plane 203. Furthermore, the circular plate member 83 placed at the most downstream in the first yarn running direction of the first false-twisting unit 51 and the circular plate member 84 placed at the most downstream in the second yarn running direction of the second false-twisting unit 52 are placed in the same second plane 204. Because of this, the circular plate members 57 are small in size in the axial direction. Therefore, the increase in size of the device can be suppressed in the axial direction.

[0092] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals, and the explanations thereof are not repeated.

[0093]

(1) In the present embodiment, in the draw texturing machine 1, the circular plate members 57 are attached to all rotational shafts 53 of all five-axial false-twisting devices 15. However, the disclosure is not limited to this. An unnecessary circular plate member 57 may be detached from a rotational shaft 53 which is not used for processing yarns Y (for example,

some of the rotational shafts 53 of the five-axial false-twisting device 15 placed at the most left part in FIG. 2), for an object such as cost reduction. In this regard, in a structure in which five rotational shafts 53 are driven together by the above-described motor 85, the following problems may occur. If circular plate members 57 are simply detached from some rotational shafts 53 in one five-axial false-twisting device 15, a load on the motor 85 of the five-axial false-twisting device 15 becomes smaller than a load on each of motors 85 of other five-axial false-twisting devices 15. Because of this, in the five-axial false-twisting device 15 from which some of the circular plate members 57 are detached, five rotational shafts 53 rotate unintentionally at high speed. As a result, yarn quality of yarns which are processed at the five-axial false-twisting device 15 may be greatly different from yarn quality of yarns which are processed at other five-axial false-twisting devices 15. In this regard, as shown in FIGs. 12(a) and 12(b), in the five-axial false-twisting device 15 from which some of the circular plate members 57 are detached, weights may be provided in place of the detached circular plate members 57. For example, as shown in FIG. 12(a), in a five-axial false-twisting device 15c in which circular plate members 57 are detached from first independent rotational shafts 72 and 73, weights 110 may be provided in place of the circular plate members 57. Likewise, as shown in FIG. 12(b), in a five-axial false-twisting device 15d in which circular plate members 57 are detached from second independent rotational shafts 74 and 75, weights 110 may be provided in place of the circular plate members 57. Because of this, the rotational shafts 53 are prevented from rotating unintentionally at high speed, thanks to these weights 110 functioning as loads. Therefore, by using members which are more inexpensive than the circular plate members 57 as the weights 110, the difference in yarn quality between the five-axial false-twisting devices 15 is suppressed while increase in cost is suppressed.

Alternatively, instead of providing the weights 110, the five-axial false-twisting device 15 from which some of the circular plate members 57 are detached may perform feedback control on the number of rotations of the motor 85. For example, the five-axial false-twisting device 15 may include an unillustrated inverter device for controlling the number of rotations of the motor 85 which drives five rotational shafts 53 together. Alternatively, as another way, the five-axial false-twisting device 15 from which some of the circular plate members 57 are detached may include five unillustrated motors which rotationally drive the rotational shafts 53 individually.

(2) In the embodiment above, the circular plate members 57, which include the contact parts making a contact with the yarns Y and being made of polyurethane, are attached to each of the rotation shafts 53. However, the disclosure is not limited to this. In other words, both of the yarn Y1 and the yarn Y2 make a contact with the circular plate members 57 provided at the common rotational shaft 71 in principle, so that these circular plate members 57 may be worn away earlier than the other circular plate members 57 provided to other rotational shafts 53. For this reason, for example, the contact parts, making a contact with the yarns Y, of all of the circular plate members 57 attached to the common rotational shaft 71 may be made of ceramic which has higher abrasion resistance than polyurethane. In other words, the abrasion resistance of the contact parts, making a contact with the yarns Y, of the circular plate members 57 attached to the common rotational shaft 71 may be higher than the abrasion resistance of the contact parts, making a contact with the yarn Y, of the circular plate members 57 attached to other rotational shafts 53 except the common rotational shaft 71. Because of this, it is possible to suppress the circular plate members 57 provided at the common rotational shaft 71 from being worn earlier than the other circular plate members 57. Therefore, it is possible to avoid the necessity of replacement of some circular plate members 57 earlier than the other circular plate members 57. In this regard, materials of the contact parts, making a contact with the yarns Y, of the circular plate members 57 are not limited to the above-described polyurethane or ceramic.

(3) In the present embodiment, the circular plate member 81 of the first false-twisting unit 51 and the circular plate member 82 of the second false-twisting unit 52 are placed in the same first plane 203. However, the disclosure is not limited to this. The circular plate members 81 and 82 may not be necessarily placed in the same plane. Likewise, the circular plate member 83 of the first false-twisting unit 51 and the circular plate member 84 of the second false-twisting unit 52 may not be necessarily placed in the same second plane 204.

(4) In the present embodiment, by the belt 86, the power is transmitted to the common rotational shaft 71 from the motor 85 (i.e., the common rotational shaft 71 is equivalent to the intermediate shaft of the present invention). However, the disclosure is not limited to this. For example, by the belt 86, the five-axial false-twisting device 15 may be structured so that the power is transmitted to the first independent rotational shaft 72 or the second independent rotational shaft 74 from the motor 85.

(5) In the present embodiment, by the belt 87, the power is transmitted to the first independent rotational shaft 72 and the second independent rotational shaft 74 through the common rotational shaft 71. However, the disclosure is not limited to this. In other words, the power transmitted to the common rotational shaft 71 may be transmitted to the first inde-

pendent rotational shaft 72 and the second independent rotational shaft 74 through individual belts, respectively.

(6) In the present embodiment, the rotational shafts 53 are driven by belts. However, the disclosure is not limited to this. For example, gears or chains may be provided instead of the belts, as transmission members which transmit power of the drive source to each of the rotational shafts 53.

(7) In the present embodiment, the yarn guides 61a and 61b are movable in the direction orthogonal to the base longitudinal direction, when viewed in the axial direction. However, the disclosure is not limited to this. A movable direction of the yarn guides 61a and 61b may be tilted from the direction orthogonal to the base longitudinal direction. In other words, the yarn guides 61a and 61b may be movable in a direction crossing the base longitudinal direction.

(8) In the embodiment described above, both of the yarn guides 61a and 61b can be adjusted in position. However, the disclosure is not limited to this. That is to say, only one of the yarn guides 61a and 61b may be adjustable in position relative to the other. In other words, at least one of the yarn guides 61a and 61b may be adjustable in position relative to the other.

(9) In the modification described in the (8), at least one of the yarn guides 61a and 61b may be able to be adjusted in position relative to the other. However, the disclosure is not limited to this. The yarn guides 61a and 61b may not be necessarily able to be adjusted in position.

(10) In the present embodiment, the first independent rotational shaft 73 and the second independent rotational shaft 75 are able to swing with the common rotational shaft 71 as the swing shaft center. However, the disclosure is not limited to this. For example, the first independent rotational shaft 73 and the second independent rotational shaft 75 may be movable linearly.

(11) In the present embodiment, the draw texturing machine 1 includes the combining units 17. However, the draw texturing machine 1 may not include the combining units 17.

(12) In the present embodiment, the winding device 21 can switch the operational mode between the first mode in which the yarn Y is wound to one winding bobbin Bw and the second mode in which the yarns Y are wound to two winding bobbins Bw. However, the disclosure is not limited to this. For example, the winding device 21 may be able to select an operational mode in which the yarns Y are wound to three or more winding bobbins Bw. Alternatively, the winding device 21 may wind the yarn Y to only one winding bobbin Bw.

(13) In the embodiment described above, the draw texturing machine 1 performs the false twisting on the yarns Y made of nylon. However, the disclosure is not limited to this. For example, the draw texturing machine 1 may perform false twisting on yarns made of, e.g., polyester.

(14) In the structure in which the common rotational shaft 71 is supported to be rotatable by the supporting tables 54, 55, and 56 via the unillustrated bearings, when, for example, the supporting table 55 is swung, the supporting table 56 may be passively swung with friction unintentionally and the following problem may occur. For example, in a case in which the yarn threading to the second false-twisting unit 52 has been completed already and the supporting table 56 is unintentionally swung to the near side, the yarn Y2 may be accidentally detached from the second false-twisting unit 52, and the yarn threading may be necessarily performed again. In this connection, the five-axial false-twisting device 15 may include a locking mechanism for preventing the rotational shaft 53 from moving unintentionally to the yarn threading position from the operating position. All components of one locking mechanism may be provided at one corresponding five-axial false-twisting device 15. Alternatively, as shown in FIGs. 13(a) and 13(b), a locking mechanism 120 may be provided across a supporting table 55 of one five-axial false-twisting device 15 and a supporting table 56 of an adjacent five-axial false-twisting device 15 placed adjacent to the one five-axial false-twisting device 15. To be more specific, as shown in FIG. 13(b), the locking mechanism 120 includes a long plate member 121, a rotation shaft 122 provided at a near-side surface of a supporting table 56 of one five-axial false-twisting device 15, and a protruding portion 123 provided at a near-side surface of a supporting table 55 of an adjacent five-axial false-twisting device 15. One end portion of the plate member 121 in an extending direction is attached to the near-side surface of the supporting table 56 via the rotation shaft 122. In other words, the plate member 121 is attached to the supporting table 56 to be rotatable. The other end portion of the plate member 121 in the extending direction is provided with, e.g., a U-shaped cutout 121a. Because of this, the other end portion of the plate member 121 is an engaging portion which can be engaged with the protruding portion 123. When the plate member 121 is engaged with the protruding portion 123 (as indicated by full lines in FIG. 13(b)), the supporting tables 55 and 56 provided with the locking mechanism 120 are prevented from unintentionally moving to the near side. When the plate member 121 is disengaged from the protruding portion 123 (as indicated by two-dot chain lines in FIG. 13(b)), the supporting tables 55 and 56 described above can be moved to the near side. In addition to that, in a case in which a yarn Y1 processed at one five-axal false-twisting device 15 is combined with a yarn Y2 processed at a five-axial false-twisting device 15 placed adjacent to the one five-axial false-twisting device 15, the locking mechanism 120 de-

scribed above may be provided.

Claims

1. A draw texturing machine (1) comprising: five-axial false-twisting devices (15) aligned in a base longitudinal direction, each of which being able to apply twisting to two yarns (Y) at the same time by circular plate members (57), the circular plate members (57) being provided at five rotational shafts (53), the five rotational shafts (53) extending in an axial direction orthogonal to the base longitudinal direction, and a working space (22) being formed along the base longitudinal direction for yarn threading performed by the five-axial false-twisting devices (15), and
each of the five-axial false-twisting devices (15) including:

    a first false-twisting unit (51) which includes, among the five rotational shafts (53), two first independent rotational shafts (72, 73) and a common rotational shaft (71) which virtually form apexes of a first triangle (201) when viewed in the axial direction, the first false-twisting unit (51) applying the twisting to a first yarn (Y1) running inside of the first triangle (201); and
    a second-false twisting unit (52) which includes, among the five-rotational shafts (53), two second independent rotational shafts (74, 75) and the common rotational shaft (71) which virtually form apexes of a second triangle (202) when viewed in the axial direction, the second false-twisting unit (52) applying the twisting to a second yarn (Y2) running inside of the second triangle (202),
    the two first independent rotational shafts (72, 73) opposing the two second independent rotational shafts (74, 75) over the common rotational shaft (71) in the base longitudinal direction,
    the first false-twisting unit (51) being configured such that the first yarn (Y1) is threaded to the first false-twisting unit (51) by being introduced from a gap between the two first independent rotational shafts (72, 73) into the inside of the first triangle (201),
    the second false-twisting unit (52) being configured such that the second yarn (Y2) is threaded to the second false-twisting unit (52) by being introduced from a gap between the two second independent rotational shafts (74, 75) into the inside of the second triangle (202),
    one of the two first independent rotational shafts (72, 73) being a first movable shaft (73) placed on a near side which is closer to the working space (22) than the other of the two first independent rotational shafts (72, 73), the one of the two first independent rotational shafts (72, 73) being movable between a first operating position in which each of the five-axial false-twisting devices (15) is in operation and a first yarn threading position which is on the near side of the first operating position, and
    one of the two second independent rotational shafts (74, 75) being a second movable shaft (75) placed on the near side of the other of the two second independent rotational shafts (74, 75), the one of the two second independent rotational shafts (74, 75) being movable between a second operating position in which each of the five-axial false-twisting devices (15) is in operation and a second yarn threading position which is on the near side of the second operating position;
    wherein, each of the five-axial false-twisting devices (15) further includes a locking mechanism (120) for preventing the first movable shaft (73) from moving to the first yarn threading position from the first operating position and for preventing the second movable shaft (75) from moving to the second yarn threading position from the second operating position.

2. The draw texturing machine (1) according to claim 1, wherein, the first movable shaft (73) and the second movable shaft (75) are swingable with the common rotational shaft (71) as a swing shaft center.

3. The draw texturing machine (1) according to claim 1 or 2, wherein, the first false-twisting unit (51) further includes, a first yarn guide (61a) placed upstream of a circular plate member (81) which is the most upstream circular plate member in a first yarn running direction in which the first yarn (Y1) runs, among the circular plate members (57),

    the second false-twisting unit (52) further includes, a second yarn guide (61b) placed upstream of a circular plate member (82) which is the most upstream circular plate member in a second yarn running direction in which the second yarn (Y2) runs, among the circular plate members (57), and
    at least one of the first yarn guide (61a) and the second yarn guide (61b) is a movable yarn guide which is able to be adjusted in position relative to the other.

4. The draw texturing machine (1) according to claim 3, wherein, the first yarn guide (61a) and the second yarn guide (61b) are aligned in the base longitudinal direction, and
the movable yarn guide is movable in a direction crossing the base longitudinal direction when viewed in the axial direction.

5. The draw texturing machine (1) according to any one of claims 1 to 4, wherein, each of the five-axial false-twisting devices (15) is structured as power of a drive source (85) is transmitted to, among the five rotational shafts (53), an intermediate shaft (71) which is one of three fixed rotational shafts (71, 72, and 74) except the first movable shaft (73) and the second movable shaft (75), and
includes a common belt (87) for transmitting the power of the drive source (85) to the others of the three fixed rotational shafts (71, 72, and 74) from the intermediate shaft (71).

6. The draw texturing machine (1) according to claim 5, wherein, the intermediate shaft (71) is the common rotational shaft (71).

7. The draw texturing machine (1) according to any one of claims 1 to 6, wherein, each of the five-axial false-twisting devices (15) further includes a common driving source (85) for driving the five rotational shafts (53) together, and
among the five rotational shafts (53), at a rotational shaft (53) which is not used for processing the yarns (Y), a weight (110) is provided instead of at least one of the circular plate members (57).

8. The draw texturing machine (1) according to any one of claims 1 to 7, wherein, at least one of the circular plate members (57) provided at the common rotational shaft (71) has higher abrasion resistance at a component which forms a contact part making a contact with the yarns (Y) than at least one of the circular plate members (57) provided at a rotational shaft (53) among the five rotational shafts (53) except the common rotational shaft (71).

9. The draw texturing machine (1) according to any one of claims 1 to 8, wherein, a circular plate member (81) placed at the most upstream in the first yarn running direction in which the first yarn (Y1) runs in the first false-twisting unit (51) and a circular plate member (82) placed at the most upstream in the second yarn running direction in which the second yarn (Y2) runs in the second false-twisting unit (52) are placed in a same first plane (203) which is orthogonal to the axial direction, and
a circular plate member (83) placed at the most downstream in the first yarn running direction in the first false-twisting unit (51) and a circular plate member (84) placed at the most downstream in the second yarn running direction in the second false-twisting unit (52) are placed in a same second plane (204) which is orthogonal to the axial direction.

10. The draw texturing machine (1) according to any one of claims 1 to 9, wherein the common rotational shaft (71) is supported to be rotatable by supporting tables (54,55,56).

11. The draw texturing machine (1) according to claim 10, wherein the supporting tables (54,55,56) support the common rotational shaft (71) to be rotatable via one or more bearings.

Patentansprüche

1. Strecktexturierungsmaschine (1), umfassend: fünfachsige Falschdrallvorrichtungen (15), die in einer Basislängsrichtung ausgerichtet sind, wobei jede in der Lage ist, Zusammendrehen auf zwei Faden (Y) gleichzeitig durch kreisförmige Plattenelemente (57) anzuwenden, wobei die kreisförmigen Plattenelemente (57) an fünf Drehwellen (53) bereitgestellt sind, wobei sich die fünf Drehwellen (53) in einer axialen Richtung orthogonal zur Basislängsrichtung erstrecken und ein Arbeitsraum (22) entlang der Basislängsrichtung zum durch die fünfachsigen Falschdrallvorrichtungen (15) durchgeführtes Fadeneinfädeln gebildet ist, und
jede der fünfachsigen Falschdrallvorrichtungen (15) Folgendes einschließt:

eine erste Falschdralleinheit (51), die unter den fünf Drehwellen (53) zwei erste unabhängige Drehwellen (72, 73) und eine gemeinsame Drehwelle (71) einschließt, die in die axiale Richtung betrachtet virtuell Scheitelpunkte eines ersten Dreiecks (201) bilden, wobei die erste Falschdralleinheit (51) das Zusammendrehen auf einen ersten Faden (Y1) anwendet, der innerhalb des ersten Dreiecks (201) läuft; und
eine zweite Falschdralleinheit (52), die unter den fünf Drehwellen (53) zwei zweite unabhängige Drehwellen (74, 75) und die gemeinsame Drehwelle (71) einschließt, die in die axiale Richtung betrachtet virtuell Scheitelpunkte eines zweiten Dreiecks (202) bilden, wobei die zweite Falschdralleinheit (52) das Zusammendrehen auf einen zweiten Faden (Y2) anwendet, der innerhalb des zweiten Dreiecks (202) läuft,
wobei die zwei ersten unabhängigen Drehwellen (72, 73) in der Basislängsrichtung den zwei zweiten unabhängigen Drehwellen (74, 75) über die gemeinsame Drehwelle (71) gegenüberliegend sind,
wobei die erste Falschdralleinheit (51) so konfiguriert ist, dass der erste Faden (Y1) in die erste Falschdralleinheit (51) eingefädelt wird, indem er aus einem Spalt zwischen den zwei ersten unabhängigen Drehwellen (72, 73) in das Innere des ersten Dreiecks (201) eingeführt wird,
wobei die zweite Falschdralleinheit (52) so konfiguriert ist, dass der zweite Faden (Y2) in die zweite Falschdralleinheit (52) eingefädelt wird,

indem er aus einem Spalt zwischen den zwei zweiten unabhängigen Drehwellen (74, 75) in das Innere des zweiten Dreiecks (202) eingeführt wird,

wobei eine der zwei ersten unabhängigen Drehwellen (72, 73) eine erste bewegliche Welle (73) ist, die an einer nahen Seite positioniert ist, die näher an dem Arbeitsraum (22) liegt als die andere der zwei ersten unabhängigen Drehwellen (72, 73), wobei eine der zwei ersten unabhängigen Drehwellen (72, 73) zwischen einer ersten Betriebsposition, in der jede der fünfachsigen Falschdrallvorrichtungen (15) in Betrieb ist, und einer ersten Fadeneinfädelposition, die an der nahen Seite zu der ersten Betriebsposition liegt, beweglich ist, und

eine der zwei zweiten unabhängigen Drehwellen (74, 75) eine zweite bewegliche Welle (75) ist, die an der nahen Seite der anderen der zwei zweiten unabhängigen Drehwellen (74, 75) positioniert ist, wobei eine der zwei zweiten unabhängigen Drehwellen (74, 75) zwischen einer zweiten Betriebsposition, in der jede der fünfachsigen Falschdrallvorrichtungen (15) in Betrieb ist, und einer zweiten Fadeneinfädelposition, die an der nahen Seite zu der zweiten Betriebsposition liegt, beweglich ist;

wobei jede der fünfachsigen Falschdrallvorrichtungen (15) weiter einen Verriegelungsmechanismus (120) einschließt, um zu verhindern, dass sich die erste bewegliche Welle (73) von der ersten Betriebsposition zu der ersten Fadeneinfädelposition bewegt, und zu verhindern, dass sich die zweite bewegliche Welle (75) von der zweiten Betriebsposition zu der zweiten Fadeneinfädelposition bewegt.

2. Strecktexturierungsmaschine (1) nach Anspruch 1, wobei die erste bewegliche Welle (73) und die zweite bewegliche Welle (75) mit der gemeinsamen Drehwelle (71) als Wellenschwingmittelpunkt schwenkbar sind.

3. Strecktexturierungsmaschine (1) nach Anspruch 1 oder 2, wobei die erste Falschdralleinheit (51) weiter eine erste Fadenführung (61a) einschließt, die stromaufwärts vor einem kreisförmigen Plattenelement (81) positioniert ist, das unter den kreisförmigen Plattenelementen (57) in einer ersten Fadenlaufrichtung, in der der erste Faden (Y1) läuft, das am stromaufwärtigsten kreisförmigen Plattenelement ist,

die zweite Falschdralleinheit (52) weiter eine zweite Fadenführung (61b) einschließt, die stromaufwärts vor einem kreisförmigen Plattenelement (82) positioniert ist, das unter den kreisförmigen Plattenelementen (57) in einer zweiten Fadenlaufrichtung, in der der erste Faden (Y2) läuft, das am stromaufwärtigsten kreisförmigen Plattenelement ist, und

mindestens eine der ersten Fadenführung (61a) und der zweiten Fadenführung (61b) eine bewegliche Fadenführung ist, die in der Lage ist, in Position in Bezug auf die andere angepasst zu werden.

4. Strecktexturierungsmaschine (1) nach Anspruch 3, wobei die erste Fadenführung (61a) und die zweite Fadenführung (61b) in der Basislängsrichtung ausgerichtet sind, und

die bewegliche Fadenführung in einer Richtung, die die Basislängsrichtung in der axialen Richtung betrachtet quert, beweglich ist.

5. Strecktexturierungsmaschine (1) nach einem der Ansprüche 1 bis 4, wobei jede der fünfachsigen Falschdrallvorrichtungen (15) als Leistung einer Antriebsquelle (85) strukturiert ist, die unter den fünf Drehwellen (53) an eine Zwischenwelle (71) übertragen wird, die eine von drei fixen Drehwellen (71, 72 und 74) außer der ersten beweglichen Welle (73) und der zweiten beweglichen Welle (75) ist, und

einen gemeinsamen Riemen (87) zum Übertragen der Leistung der Antriebsquelle (85) an die anderen der drei fixen Drehwellen (71, 72 und 74) von der Zwischenwelle (71) einschließt.

6. Strecktexturierungsmaschine (1) nach Anspruch 5, wobei die Zwischenwelle (71) die gemeinsame Drehwelle (71) ist.

7. Strecktexturierungsmaschine (1) nach einem der Ansprüche 1 bis 6, wobei jede der fünfachsigen Falschdrallvorrichtungen (15) weiter eine gemeinsame Antriebsquelle (85) zum Antreiben der fünf Drehwellen (53) zusammen einschließt, und

unter den fünf Drehwellen (53) an einer Drehwelle (53), die nicht zum Verarbeiten der Faden (Y) verwendet wird, anstelle von mindestens einem der kreisförmigen Plattenelemente (57) ein Gewicht (110) bereitgestellt ist.

8. Strecktexturierungsmaschine (1) nach einem der Ansprüche 1 bis 7, wobei mindestens eines der kreisförmigen Plattenelemente (57), das an der gemeinsamen Drehwelle (71) bereitgestellt ist, eine höhere Abriebfestigkeit an einer Komponente aufweist, die einen Kontaktteil bildet, der einen Kontakt mit den Faden (Y) herstellt, als mindestens eines der kreisförmigen Plattenelemente (57), das an einer Drehwelle (53) unter den fünf Drehwellen (53) außer der gemeinsamen Drehwelle (71) bereitgestellt ist.

9. Strecktexturierungsmaschine (1) nach einem der Ansprüche 1 bis 8, wobei ein kreisförmiges Platten-

element (81), das in der ersten Fadenlaufrichtung, in der der erste Faden (Y1) läuft, am stromaufwärtigsten in der ersten Falschdralleinheit (51) positioniert ist, und ein kreisförmiges Plattenelement (82), das in der zweiten Fadenlaufrichtung, in der der zweite Faden (Y2) läuft, am stromaufwärtigsten in der zweiten Falschdralleinheit (52) positioniert ist, in einer gleichen ersten Ebene (203) positioniert sind, die orthogonal zur axialen Richtung ist, und
ein kreisförmiges Plattenelement (83), das an in der ersten Fadenlaufrichtung in der ersten Falschdralleinheit (51) am stromabwärtigsten positioniert ist und ein kreisförmiges Plattenelement (84), das in der zweiten Fadenlaufrichtung in der zweiten Falschzdralleinheit (52) am stromabwärtigsten positioniert ist, in einer gleichen zweiten Ebene (204) positioniert sind, die orthogonal zur axialen Richtung ist.

10. Strecktexturierungsmaschine (1) nach einem der Ansprüche 1 bis 9, wobei die gemeinsame Drehwelle (71) durch Stütztische (54,55,56) gestützt wird, um drehbar zu sein.

11. Strecktexturierungsmaschine (1) nach Anspruch 10, wobei die Stütztische (54,55,56) die gemeinsame Drehwelle (71) über ein oder mehrere Lager stützen, um drehbar zu sein.

Revendications

1. Machine d'étirage-texturation (1) comprenant : des dispositifs de fausse torsion à cinq axes (15) alignés dans une direction longitudinale de base, chacun étant apte à appliquer une torsion à deux fils (Y) en même temps par des éléments de plaque circulaires (57), les éléments de plaque circulaires (57) étant disposés au niveau de cinq arbres de rotation (53), les cinq arbres de rotation (53) s'étendant dans une direction axiale orthogonale à la direction longitudinale de base, et un espace de travail (22) étant formé le long de la direction longitudinale de base pour l'enfilage de fil mis en oeuvre par les dispositifs de fausse torsion à cinq axes (15), et
chacun des dispositifs de fausse torsion à cinq axes (15) incluant :

une première unité de fausse torsion (51) qui inclut, parmi les cinq arbres de rotation (53), deux premiers arbres de rotation indépendants (72, 73) et un arbre de rotation commun (71) qui forment virtuellement des sommets d'un premier triangle (201) vu dans la direction axiale, la première unité de fausse torsion (51) appliquant la torsion à un premier fil (Y1) s'étendant à l'intérieur du premier triangle (201) ; et
une seconde unité de fausse torsion (52) qui inclut, parmi les cinq arbres de rotation (53), deux seconds arbres de rotation indépendants (74, 75) et l'arbre de rotation commun (71) qui forment virtuellement des sommets d'un second triangle (202) vu dans la direction axiale, la seconde unité de fausse torsion (52) appliquant la torsion à un second fil (Y2) s'étendant à l'intérieur du second triangle (202),
les deux premiers arbres de rotation indépendants (72, 73) s'opposant aux deux seconds arbres de rotation indépendants (74, 75) sur l'arbre de rotation commun (71) dans la direction longitudinale de base,
la première unité de fausse torsion (51) étant configurée de telle sorte que le premier fil (Y1) est enfilé sur la première unité de fausse torsion (51) en étant introduit depuis un espace entre les deux premiers arbres de rotation indépendants (72, 73) à l'intérieur du premier triangle (201),
la seconde unité de fausse torsion (52) étant configurée de telle sorte que le second fil (Y2) soit enfilé sur la seconde unité de fausse torsion (52) en étant introduit depuis un espace entre les deux seconds arbres de rotation indépendants (74, 75) à l'intérieur du second triangle (202),
l'un des deux premiers arbres de rotation indépendants (72, 73) étant un premier arbre mobile (73) placé sur un côté proche qui est plus proche de l'espace de travail (22) que l'autre des deux premiers arbres de rotation indépendants (72, 73), ledit un des deux premiers arbres de rotation indépendants (72, 73) étant mobile entre une première position de fonctionnement dans laquelle chacun des dispositifs de fausse torsion à cinq axes (15) est en fonctionnement et une première position d'enfilage de fil qui est située sur le côté proche de la première position de fonctionnement, et
l'un des deux seconds arbres de rotation indépendants (74, 75) étant un second arbre mobile (75) placé sur le côté proche dudit autre des deux seconds arbres de rotation indépendants (74, 75), ledit un des deux seconds arbres de rotation indépendants (74, 75) étant mobile entre une seconde position de fonctionnement dans laquelle chacun des dispositifs de fausse torsion à cinq axes (15) est en fonctionnement et une seconde position d'enfilage de fil qui est située sur le côté proche de la seconde position de fonctionnement ;
dans laquelle chacun des dispositifs de fausse torsion à cinq axes (15) inclut en outre un mécanisme de verrouillage (120) pour empêcher le premier arbre mobile (73) de se déplacer vers la première position d'enfilage de fil à partir de la première position de fonctionnement et pour

empêcher le second arbre mobile (75) de se déplacer vers la seconde position d'enfilage de fil à partir de la seconde position de fonctionnement.

2. Machine d'étirage-texturation (1) selon la revendication 1, dans laquelle le premier arbre mobile (73) et le second arbre mobile (75) peuvent osciller avec l'arbre de rotation commun (71) comme centre d'arbre oscillant.

3. Machine d'étirage-texturation (1) selon la revendication 1 ou la revendication 2, dans laquelle la première unité de fausse torsion (51) inclut en outre un premier guide-fil (61a) placé en amont d'un élément de plaque circulaire (81) qui est l'élément de plaque circulaire le plus en amont dans une première direction d'extension de fil dans laquelle le premier fil (Y1) s'étend, parmi les éléments de plaque circulaires (57),

la seconde unité de fausse torsion (52) inclut en outre un second guide-fil (61b) placé en amont d'un élément de plaque circulaire (82) qui est l'élément de plaque circulaire le plus en amont dans une seconde direction d'extension de fil dans laquelle le second fil (Y2) s'étend, parmi les éléments de plaque circulaires (57), et
au moins l'un parmi le premier guide-fil (61a) et le second guide-fil (61b) est un guide-fil mobile qui peut être réglé en position par rapport à l'autre.

4. Machine d'étirage-texturation (1) selon la revendication 3, dans laquelle le premier guide-fil (61a) et le second guide-fil (61b) sont alignés dans la direction longitudinale de base, et
le guide-fil mobile est mobile dans une direction traversant la direction longitudinale de base lorsqu'il est vu dans la direction axiale.

5. Machine d'étirage-texturation (1) selon l'une quelconque des revendications 1 à 4, dans laquelle chacun des dispositifs de fausse torsion à cinq axes (15) est structuré de telle sorte que la puissance d'une source d'entraînement (85) est transmise, parmi les cinq arbres de rotation (53), à un arbre intermédiaire (71) qui est l'un de trois arbres de rotation fixes (71, 72 et 74) à l'exception du premier arbre mobile (73) et du second arbre mobile (75), et
inclut une courroie commune (87) pour transmettre la puissance de la source d'entraînement (85) aux autres des trois arbres de rotation fixes (71, 72 et 74) à partir de l'arbre intermédiaire (71).

6. Machine d'étirage-texturation (1) selon la revendication 5, dans laquelle l'arbre intermédiaire (71) est l'arbre de rotation commun (71).

7. Machine d'étirage-texturation (1) selon l'une quelconque des revendications 1 à 6, dans laquelle chacun des dispositifs de fausse torsion à cinq axes (15) inclut en outre une source d'entraînement commune (85) pour entraîner les cinq arbres de rotation (53) ensemble, et
parmi les cinq arbres de rotation (53), au niveau d'un arbre de rotation (53) qui n'est pas utilisé pour traiter les fils (Y), un poids (110) est prévu à la place d'au moins l'un des éléments de plaque circulaires (57).

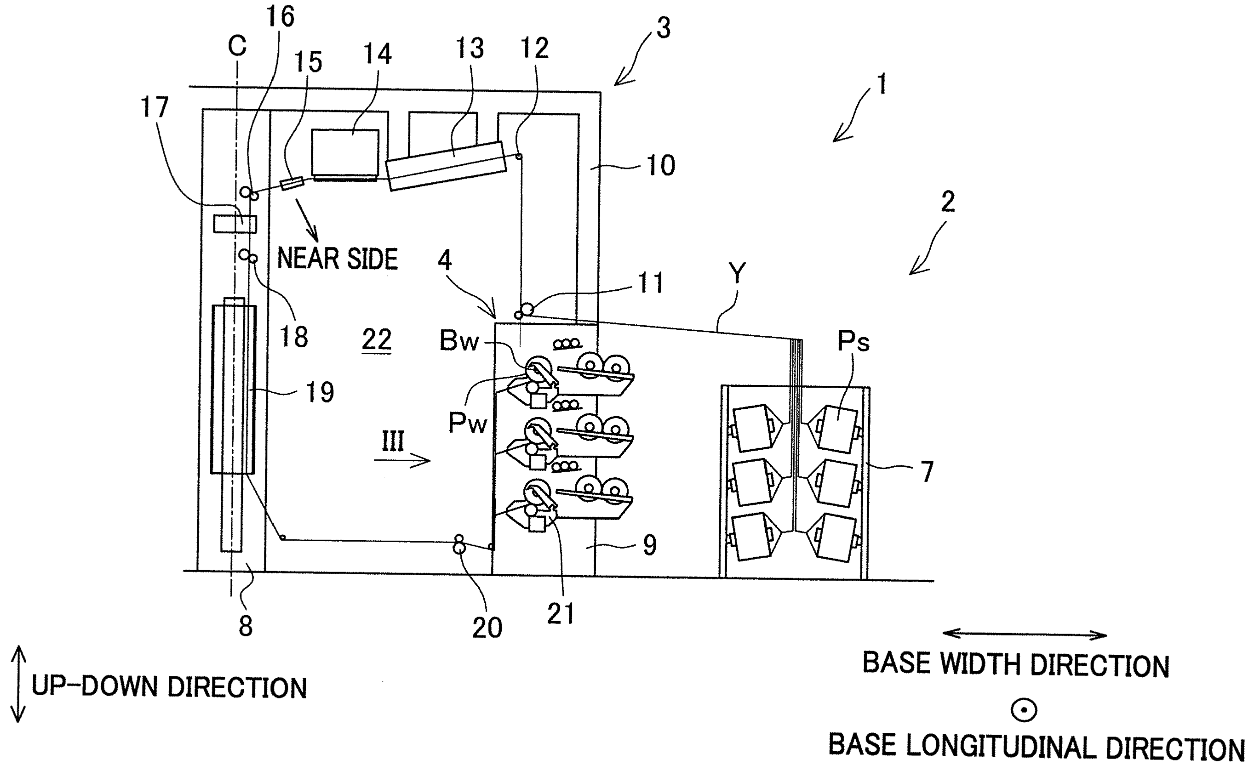
8. Machine d'étirage-texturation (1) selon l'une quelconque des revendications 1 à 7, dans laquelle au moins l'un des éléments de plaque circulaires (57) prévus au niveau de l'arbre de rotation commun (71) présente une résistance à l'abrasion plus élevée au niveau d'un composant qui forme une partie de contact établissant un contact avec les fils (Y) qu'au moins l'un des éléments de plaque circulaires (57) prévus au niveau d'un arbre de rotation (53) parmi les cinq arbres de rotation (53), à l'exception de l'arbre de rotation commun (71).

9. Machine d'étirage-texturation (1) selon l'une quelconque des revendications 1 à 8, dans laquelle, un élément de plaque circulaire (81) placé le plus en amont dans la première direction d'extension de fil dans laquelle le premier fil (Y1) s'étend dans la première unité de fausse torsion (51) et un élément de plaque circulaire (82) placé au niveau le plus en amont dans la seconde direction d'extension de fil dans laquelle le second fil (Y2) s'étend dans la seconde unité de fausse torsion (52), sont placés dans un même premier plan (203) qui est orthogonal à la direction axiale, et
un élément de plaque circulaire (83) placé au niveau le plus en aval dans la première direction d'extension de fil dans la première unité de fausse torsion (51) et un élément de plaque circulaire (84) placé au niveau le plus en aval dans la seconde direction d'extension de fil dans la seconde unité de fausse torsion (52) sont placés dans un même second plan (204) qui est orthogonal à la direction axiale.

10. Machine d'étirage-texturation (1) selon l'une quelconque des revendications 1 à 9, dans laquelle l'arbre de rotation commun (71) est supporté pour pouvoir tourner par des tables de support (54, 55, 56).

11. Machine d'étirage-texturation (1) selon la revendication 10, dans laquelle les tables de support (54, 55, 56) supportent l'arbre de rotation commun (71) pour qu'il puisse tourner par le biais d'un ou plusieurs roulements.

FIG.1



16
C
15
14
13
12
3
1
17
10
2
NEAR SIDE
4
11
Y
18
22
Bw
Ps
19
Pw
III
7
9
8
20
21
UP–DOWN DIRECTION
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.2

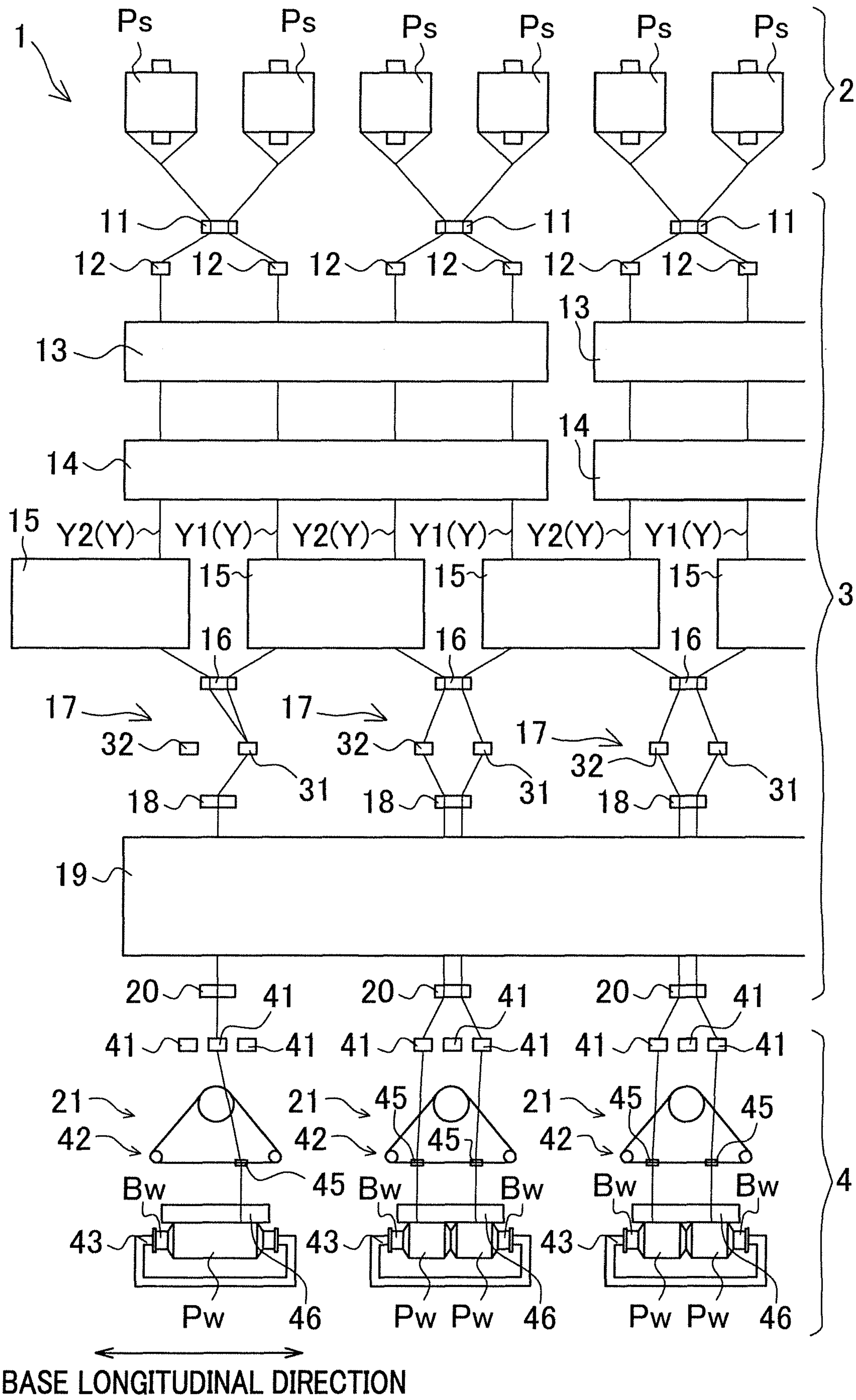

1
Ps
Ps
Ps
Ps
Ps
Ps
2
11
11
11
12
12
12
12
12
12
13
13
14
14
15
Y2(Y)
Y1(Y)
Y2(Y)
Y1(Y)
Y2(Y)
Y1(Y)
15
15
15
3
16
16
16
17
17
17
32
32
32
31
31
31
18
18
18
19
20
20
20
41
41
41
41
41
41
41
41
41
41
41
41
21
21
21
42
42
42
45
45
45
45
45
Bw
Bw
Bw
Bw
Bw
43
43
43
4
Pw
Pw
Pw
Pw
Pw
46
46
46
BASE LONGITUDINAL DIRECTION

FIG.3

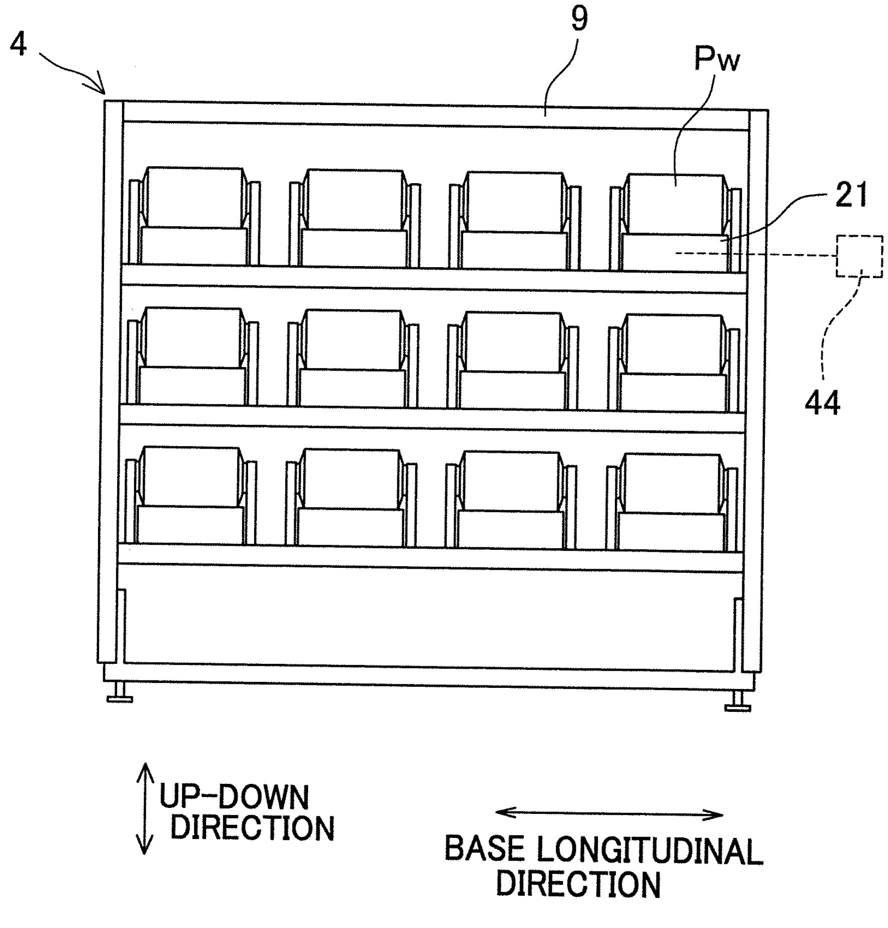


FIG.4

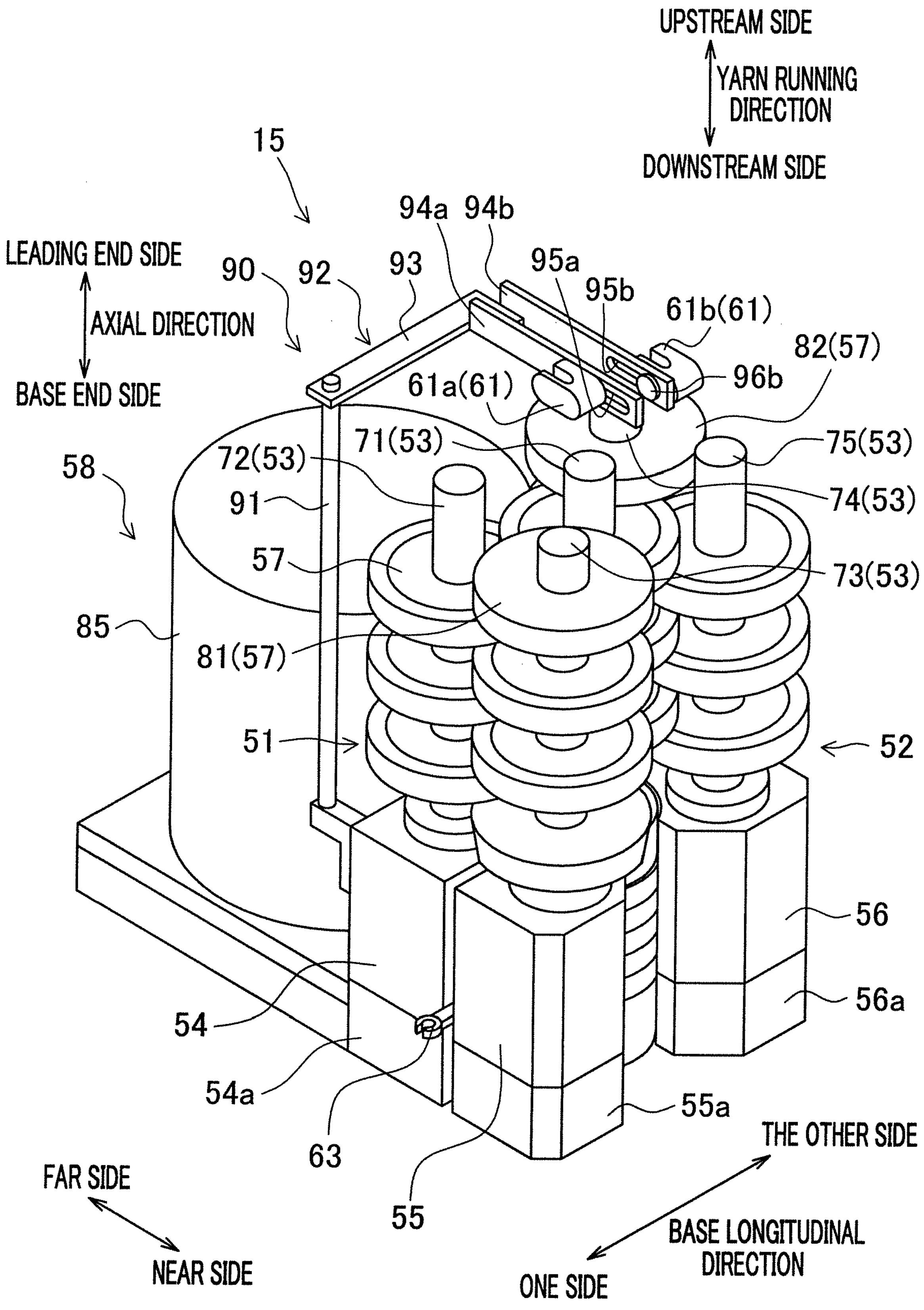

UPSTREAM SIDE
YARN RUNNING DIRECTION
DOWNSTREAM SIDE
15
94a 94b
LEADING END SIDE
AXIAL DIRECTION
BASE END SIDE
90
92
93
95a
95b
61b(61)
82(57)
96b
61a(61)
75(53)
71(53)
72(53)
74(53)
58
91
57
73(53)
85
81(57)
51
52
56
56a
54
54a
63
55a
55
THE OTHER SIDE
FAR SIDE
NEAR SIDE
BASE LONGITUDINAL DIRECTION
ONE SIDE

FIG.5

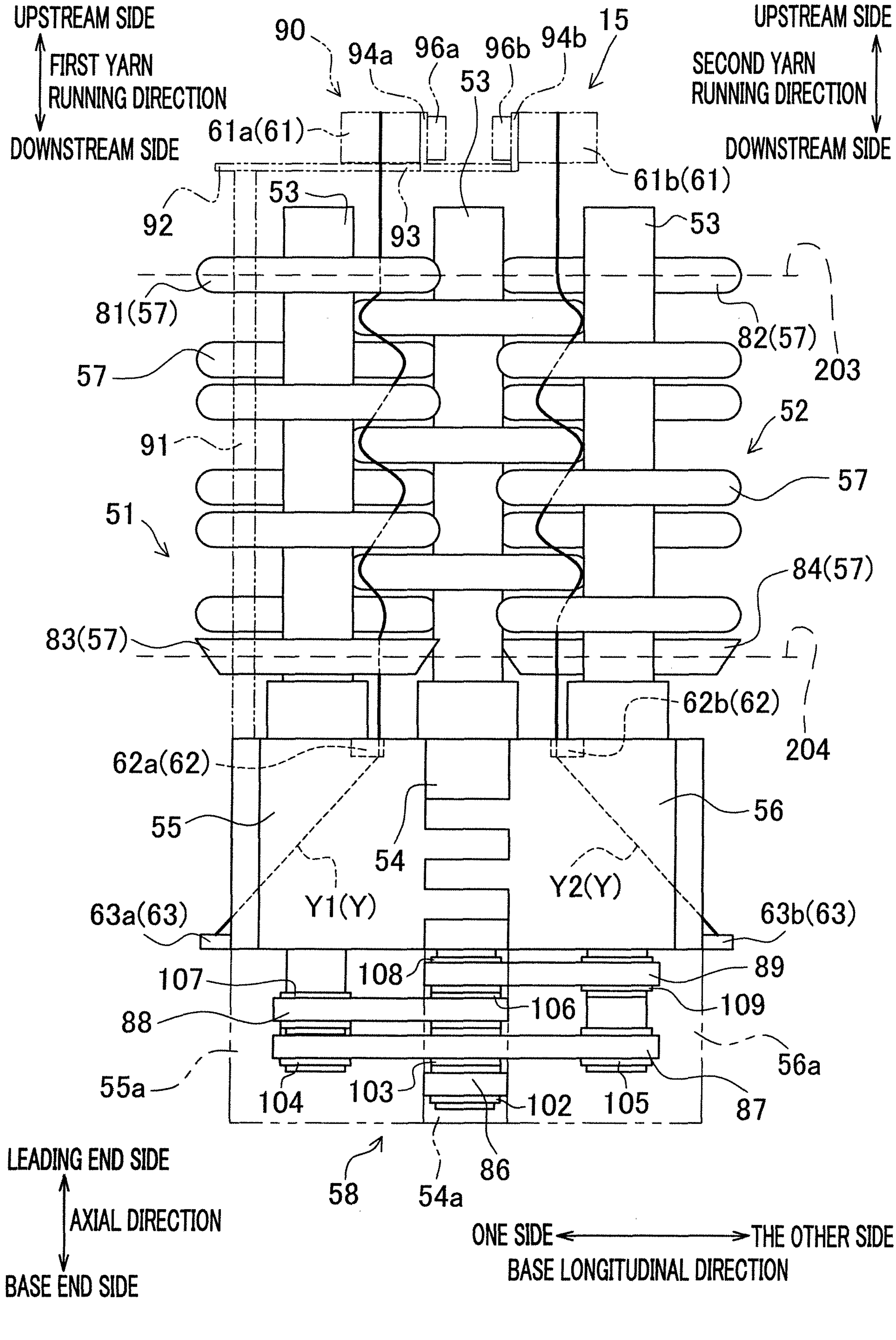

UPSTREAM SIDE
FIRST YARN RUNNING DIRECTION
DOWNSTREAM SIDE
UPSTREAM SIDE
SECOND YARN RUNNING DIRECTION
DOWNSTREAM SIDE
90
94a
96a
96b
94b
15
53
61a(61)
61b(61)
92
93
53
53
81(57)
82(57)
203
57
52
91
57
51
84(57)
83(57)
62b(62)
204
62a(62)
55
56
54
Y1(Y)
Y2(Y)
63a(63)
63b(63)
107
108
89
88
106
109
56a
55a
104
103
102
105
87
58
54a
86
LEADING END SIDE
AXIAL DIRECTION
BASE END SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION

FIG.6

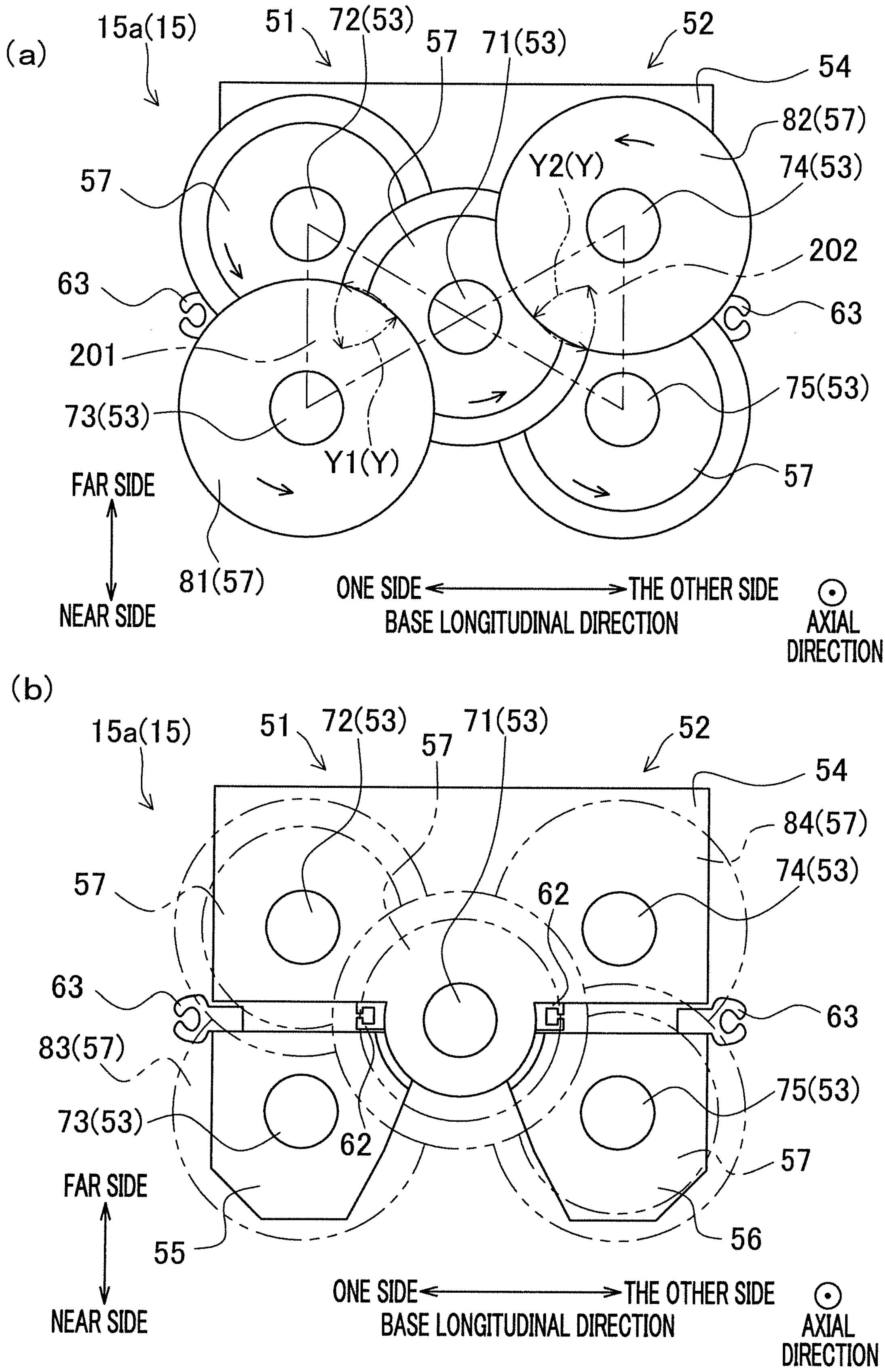

(a)
15a(15)
51
72(53)
57
71(53)
52
54
82(57)
Y2(Y)
74(53)
57
202
63
63
201
75(53)
73(53)
Y1(Y)
57
FAR SIDE
NEAR SIDE
81(57)
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION
(b)
15a(15)
51
72(53)
57
71(53)
52
54
84(57)
74(53)
57
62
63
63
83(57)
75(53)
73(53)
62
57
FAR SIDE
55
56
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

FIG.7

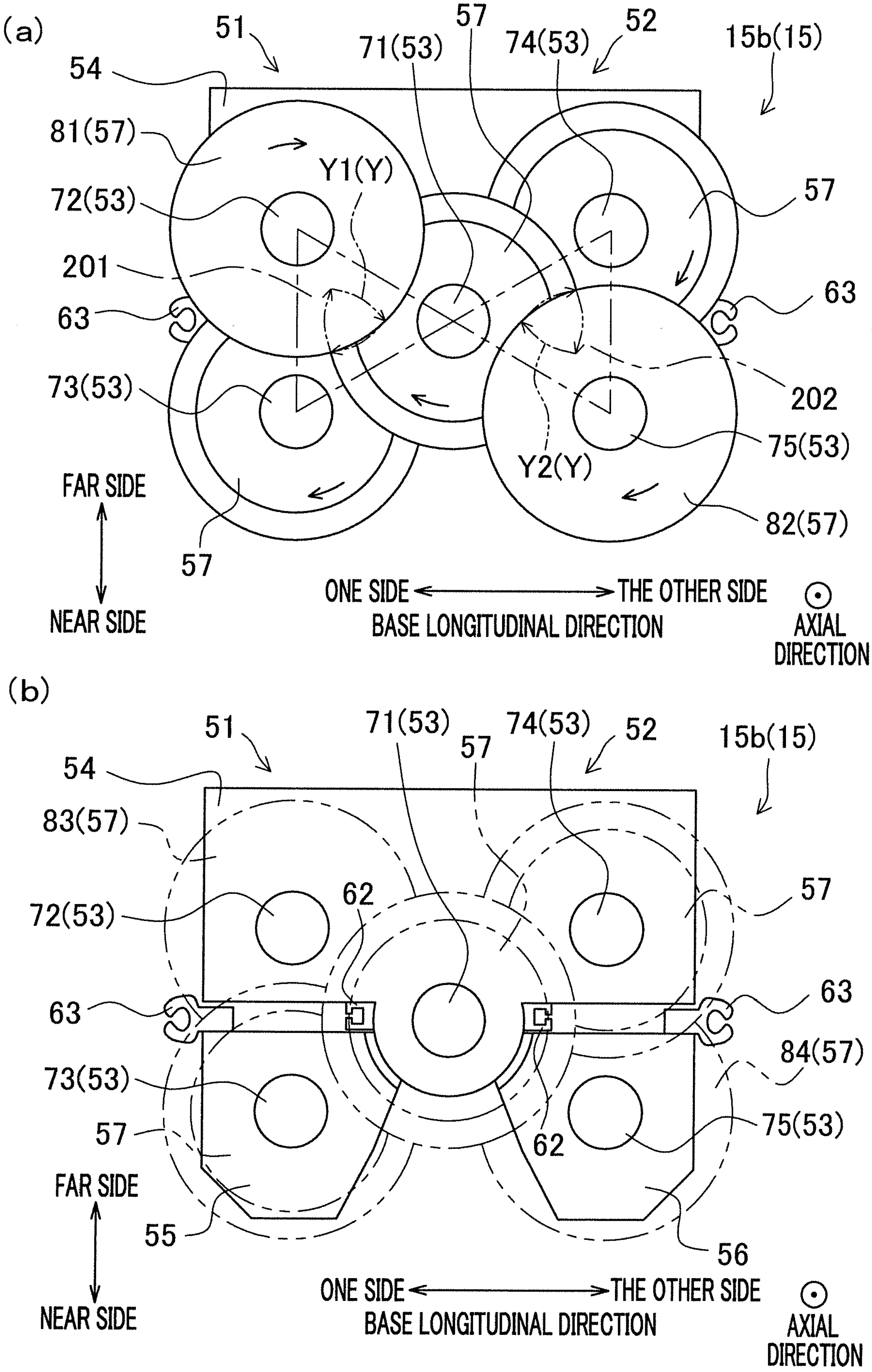
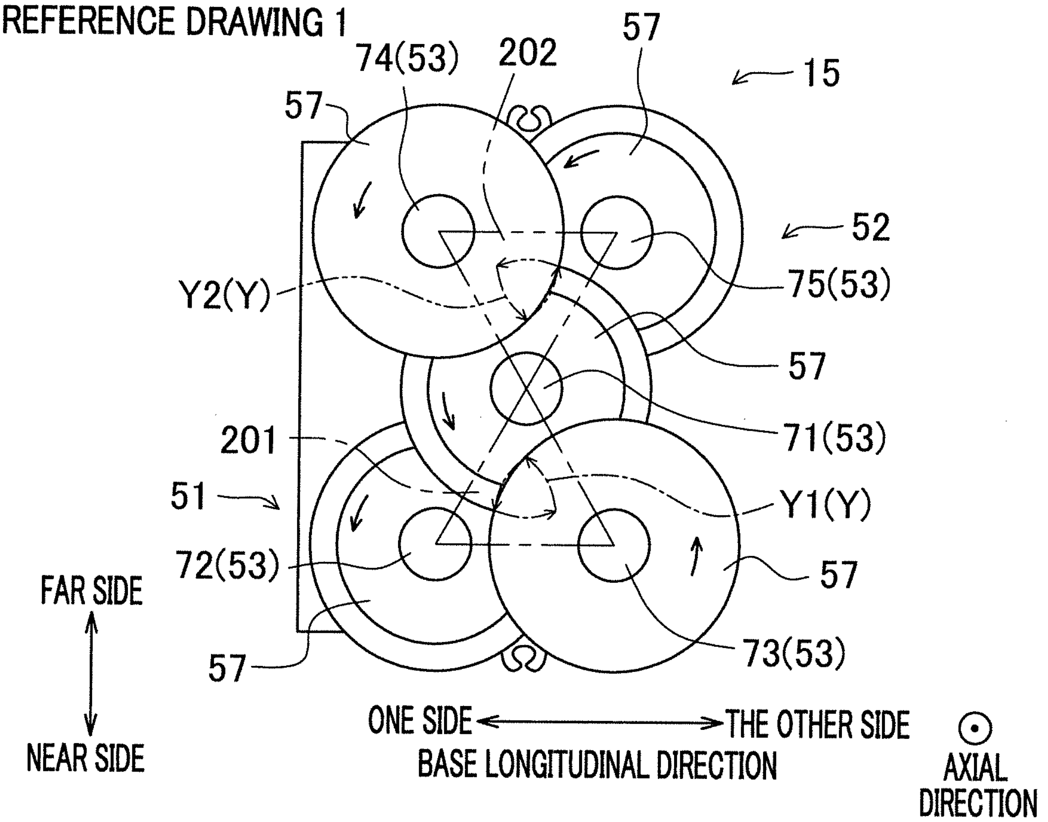

(a)
51
54
81(57)
72(53)
201
63
73(53)
57
71(53)
74(53)
52
15b(15)
Y1(Y)
57
63
202
75(53)
Y2(Y)
82(57)
FAR SIDE
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION
(b)
51
54
83(57)
72(53)
62
63
73(53)
57
55
71(53)
57
74(53)
52
15b(15)
57
63
84(57)
75(53)
62
56
FAR SIDE
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

FIG.8

(a) REFERENCE DRAWING 1



(b) REFERENCE DRAWING 2

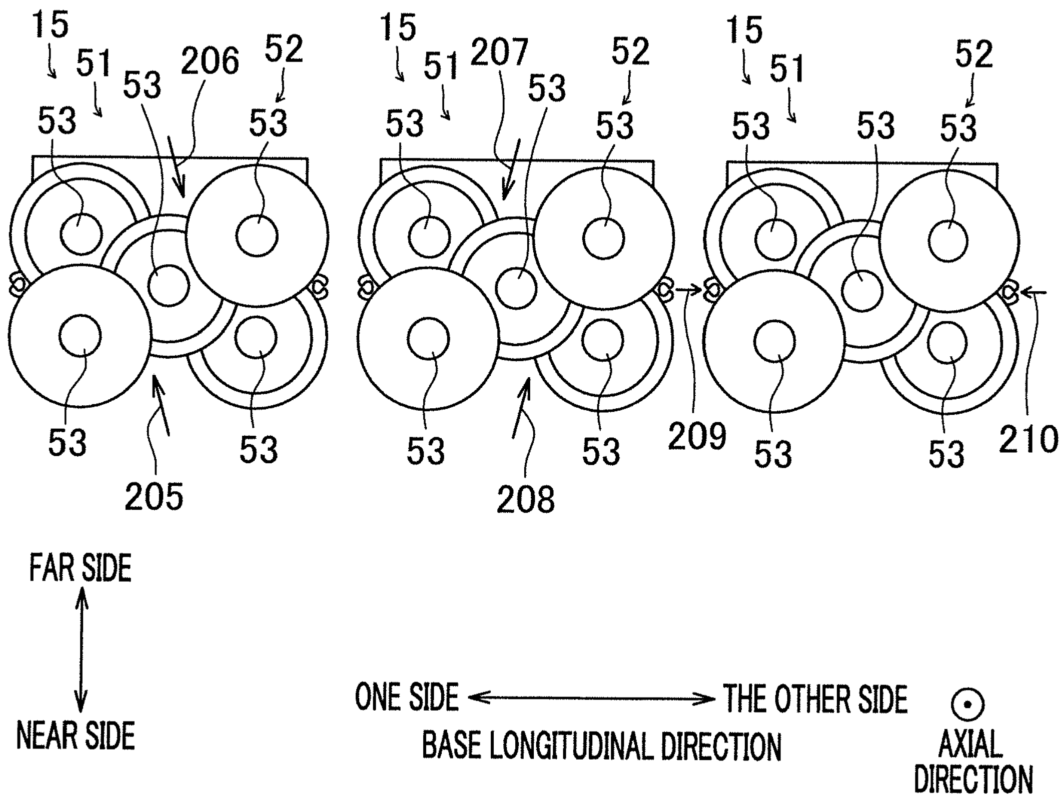


FIG.9

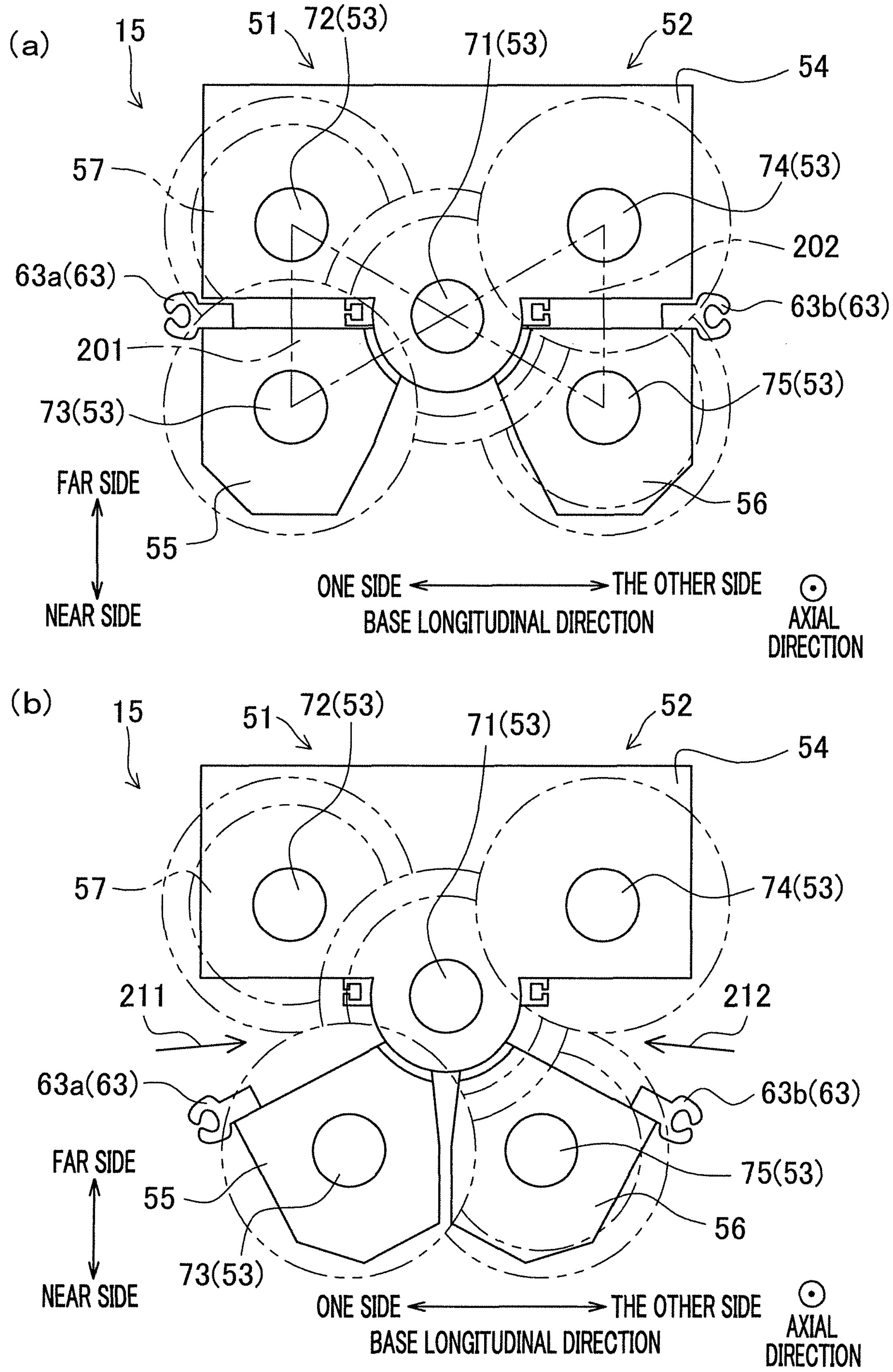

(a)
15
51
72(53)
71(53)
52
54
57
74(53)
202
63a(63)
63b(63)
201
75(53)
73(53)
FAR SIDE
56
55
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION
(b)
15
51
72(53)
71(53)
52
54
57
74(53)
211
212
63a(63)
63b(63)
FAR SIDE
55
75(53)
56
73(53)
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

FIG.10

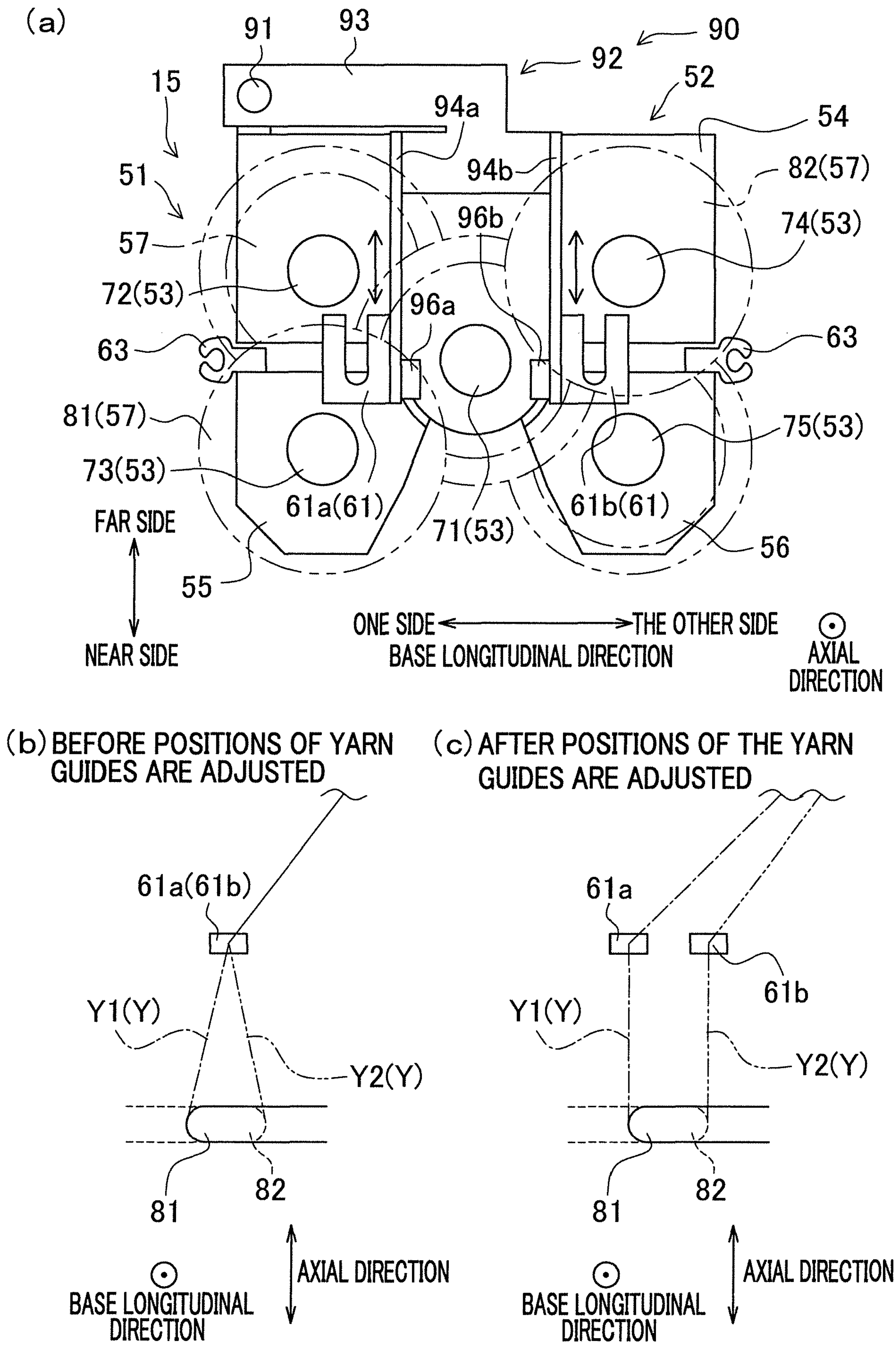

(a)
91
93
90
92
52
15
94a
54
51
94b
82(57)
96b
74(53)
57
72(53)
96a
63
63
81(57)
75(53)
73(53)
61a(61)
61b(61)
71(53)
56
FAR SIDE
55
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION
(b) BEFORE POSITIONS OF YARN GUIDES ARE ADJUSTED
61a(61b)
Y1(Y)
Y2(Y)
81
82
AXIAL DIRECTION
BASE LONGITUDINAL DIRECTION
(c) AFTER POSITIONS OF THE YARN GUIDES ARE ADJUSTED
61a
61b
Y1(Y)
Y2(Y)
81
82
AXIAL DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.11

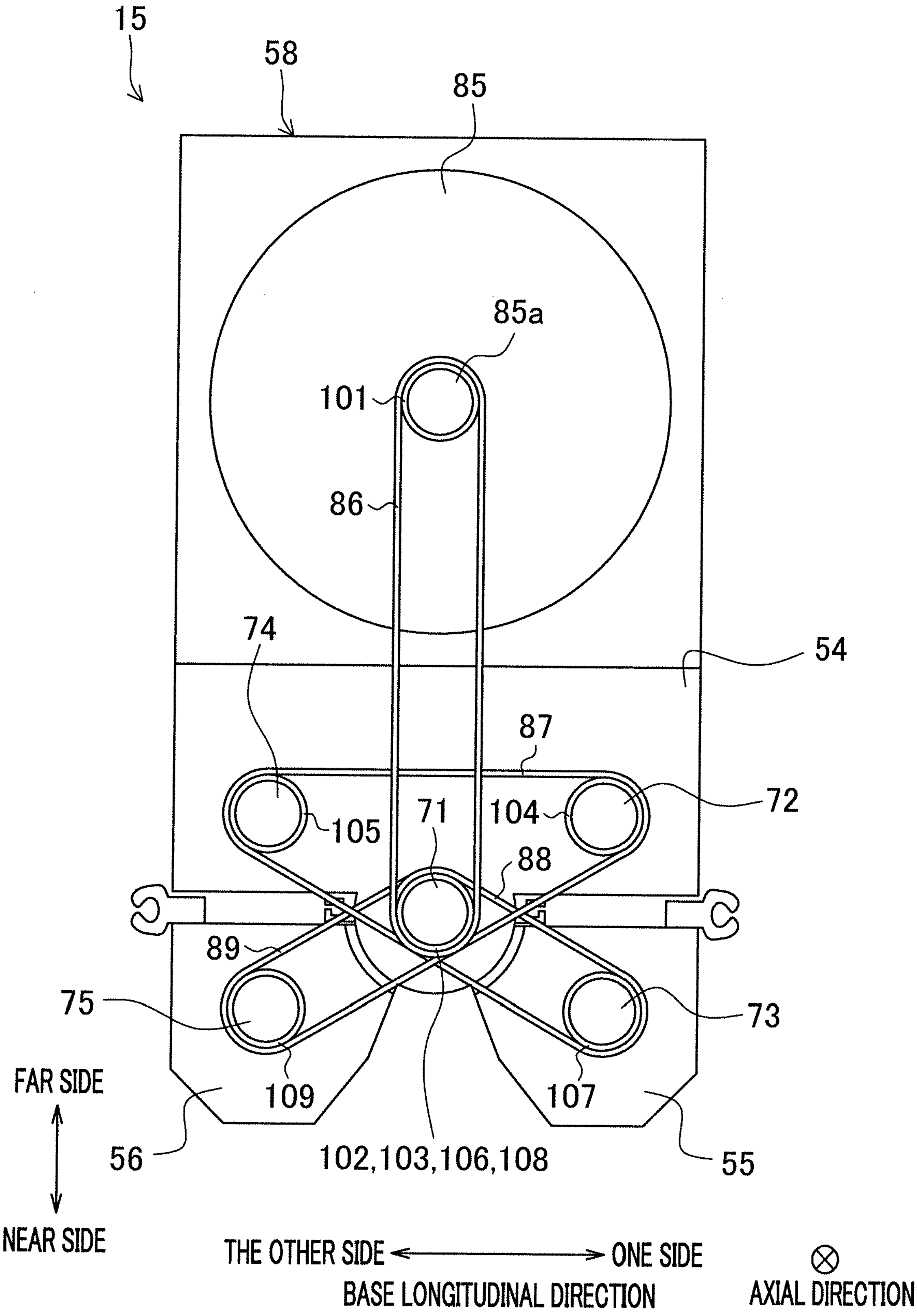
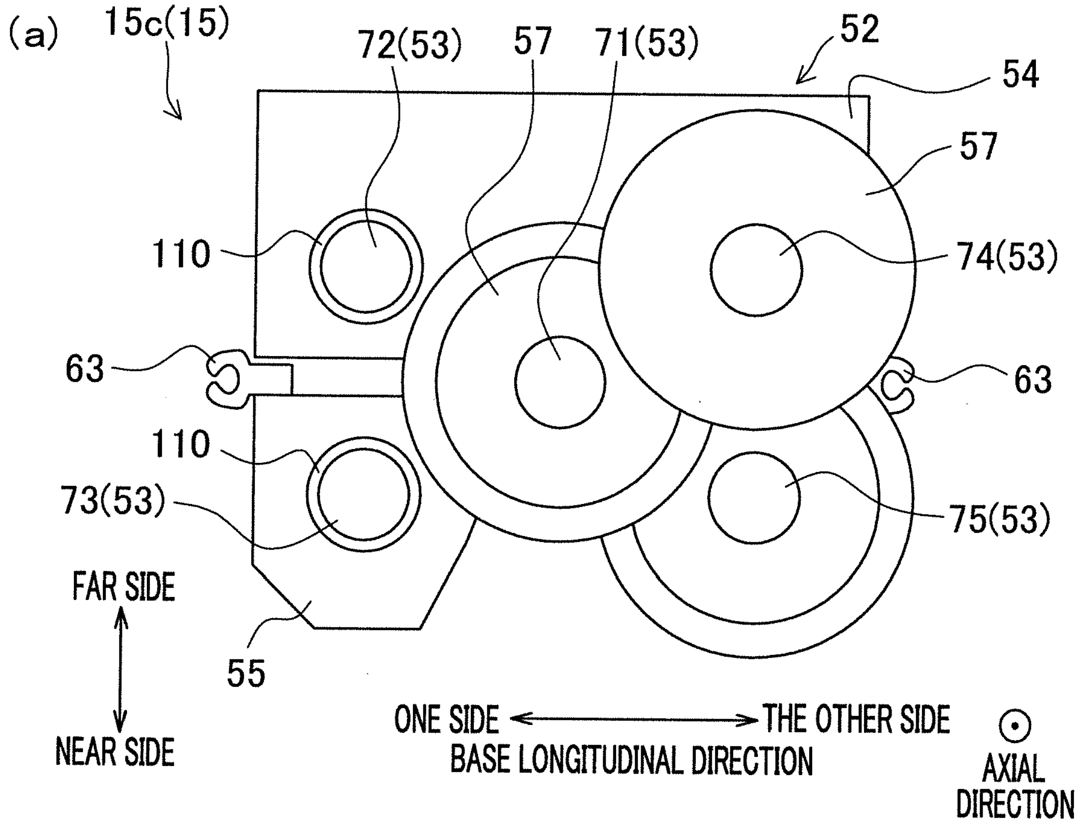

15
58
85
85a
101
86
74
54
87
72
71
104
105
88
89
75
73
109
107
FAR SIDE
NEAR SIDE
56
102,103,106,108
55
THE OTHER SIDE
ONE SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

FIG.12

(a)


15c(15)
72(53)
57
71(53)
52
54
57
110
74(53)
63
63
110
73(53)
75(53)
FAR SIDE
55
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

(b)

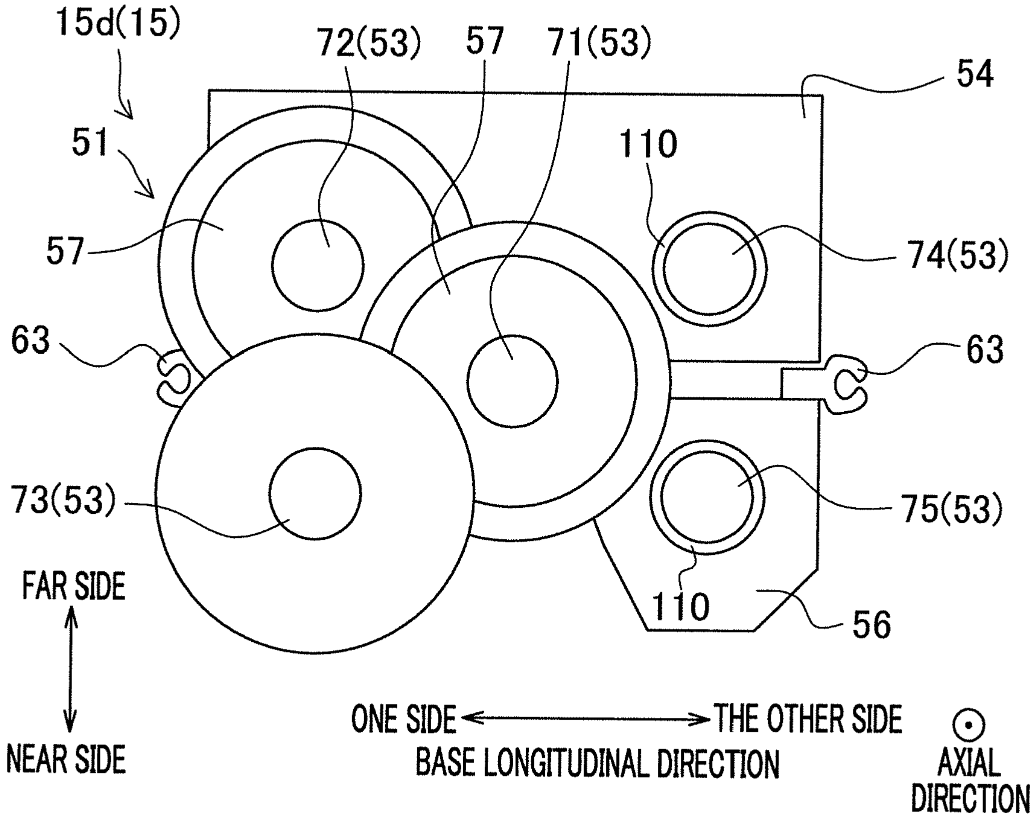
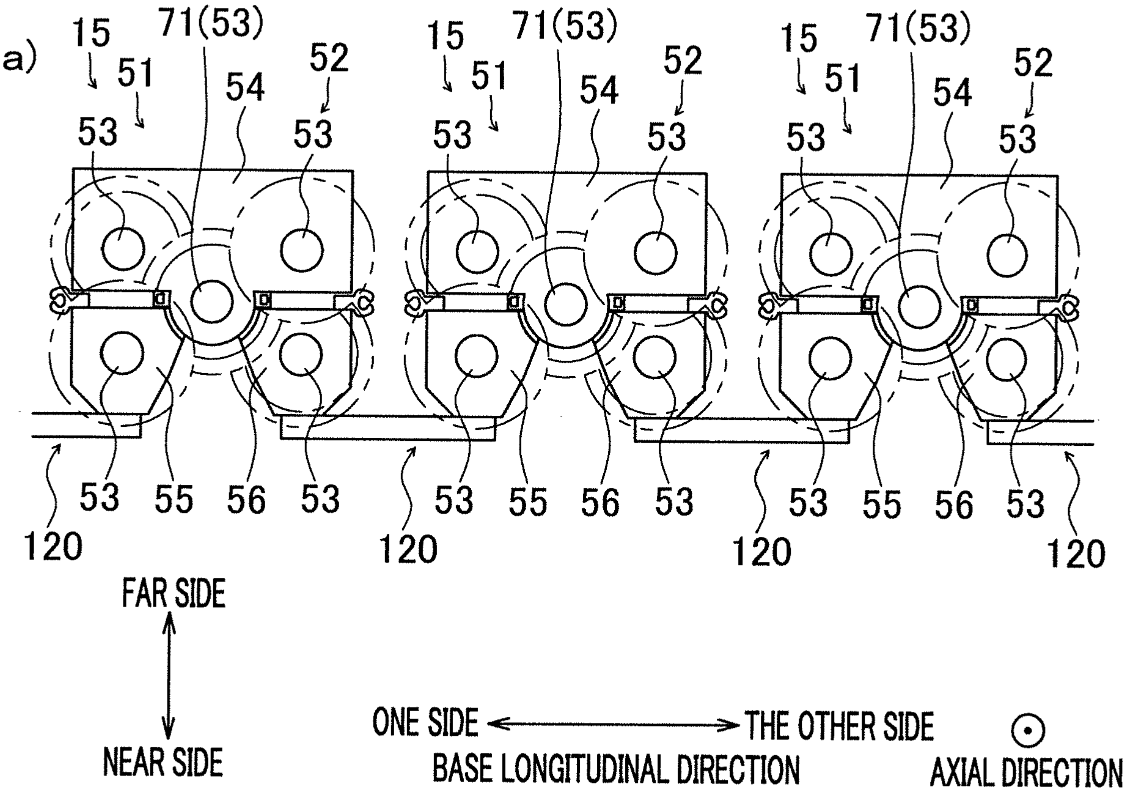
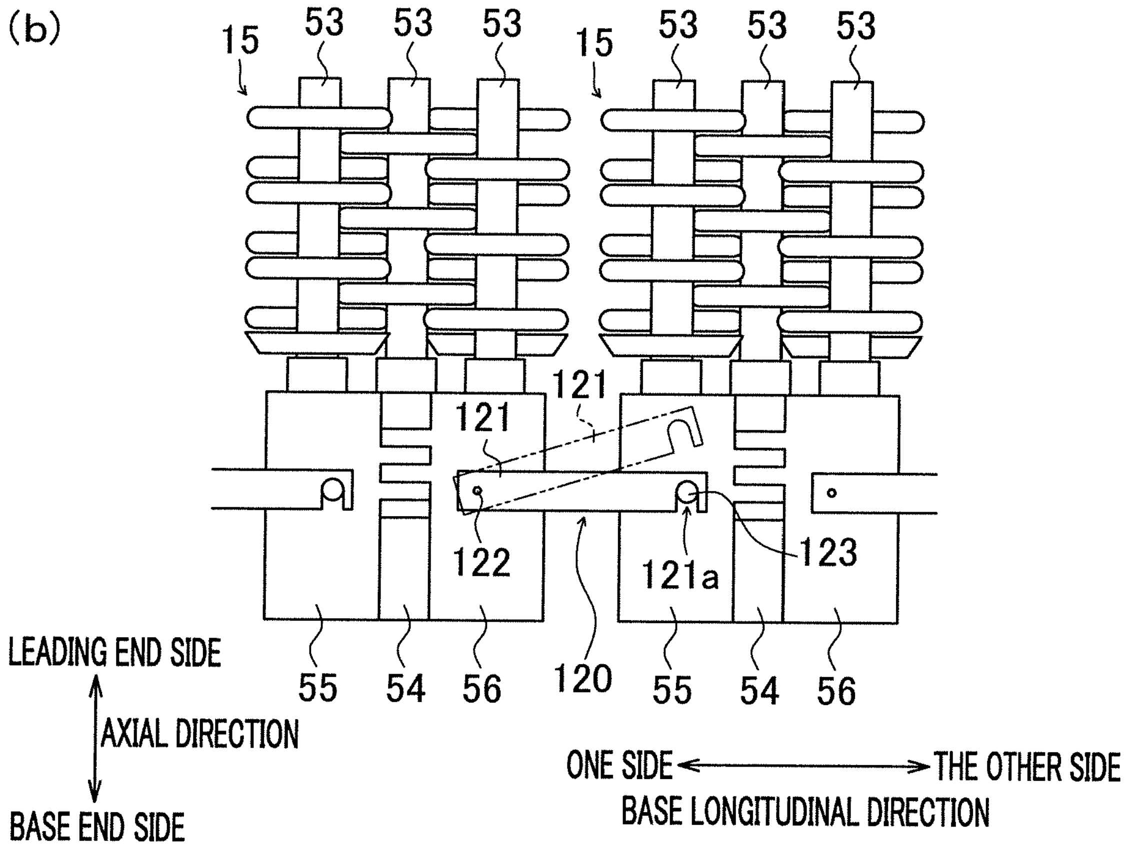

15d(15)
72(53)
57
71(53)
54
51
110
57
74(53)
63
63
73(53)
75(53)
FAR SIDE
110
56
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

FIG.13

(a)


15
51
71(53)
54
52
53
55
56
120
FAR SIDE
NEAR SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION
AXIAL DIRECTION

(b)


15
53
121
122
121a
123
55
54
56
120
LEADING END SIDE
AXIAL DIRECTION
BASE END SIDE
ONE SIDE
THE OTHER SIDE
BASE LONGITUDINAL DIRECTION

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

- JP 2016141912 A **[0002]**
- JP 62199826 A **[0002]**
- FR 2377463 A1 **[0003]**
- FR 2311116 A1 **[0003]**
- GB 933438 A **[0003]**
- JP 53002656 A **[0003] [0004]**
- JP 2011047074 A **[0040]**
- JP 2009074219 A **[0048]**