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

(72) Inventors:
- **IMANAKA, Akihito**
  Kyoto-shi, Kyoto, 612-8686 (JP)
- **KITAGAWA, Shigeki**
  Kyoto-shi, Kyoto, 612-8686 (JP)
- **CHIKADA, Hidekazu**
  Kyoto-shi, Kyoto, 612-8686 (JP)

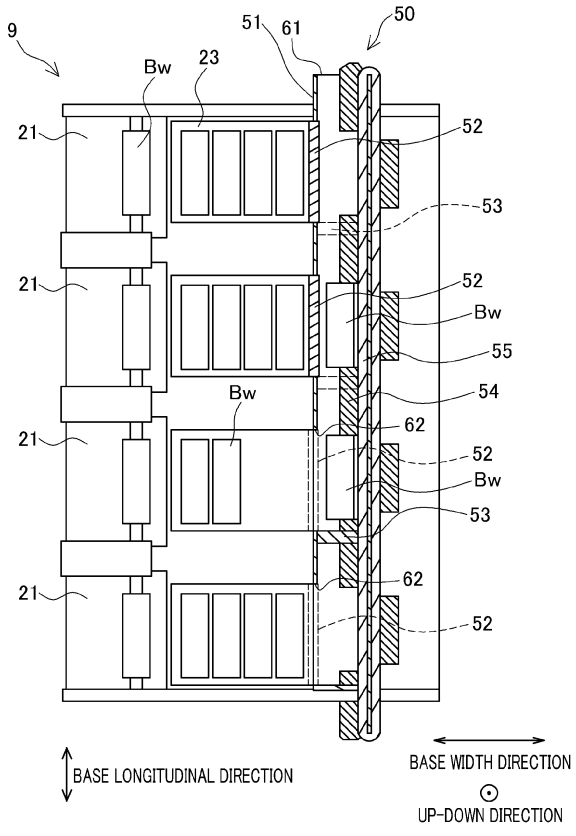
(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) TAKE-UP TUBE REPLENISHMENT DEVICE

(57) An object of the present invention is to effectively replenish, with empty take-up tubes, stockers which are provided in winding units of a false-twist texturing machine.

A take-up tube replenishment device 50 is configured to replenish stockers 23 with empty bobbins Bw in a false-twist texturing machine 1 in which winding units 30 are provided in a base longitudinal direction to form plural stages. Each winding unit 30 includes a winding device 21 and one of the stockers 23. The take-up tube replenishment device 50 includes take-up tube moving paths 51 which are provided to form plural stages corresponding to the winding units 30 provided to form plural stages, which extend along the base longitudinal direction, and in which empty bobbins Bw which are to be used to replenish the stockers 23 are movable in the base longitudinal direction. Each take-up tube replenishment device 51 further includes: a supporting surface 51a which extends along the base longitudinal direction and which is provided for supporting the empty bobbins Bw from below; a replenishment port 61 which is provided at an end portion of each take-up tube moving path 51 in the base longitudinal direction and which is provided for allowing the empty bobbins Bw to be supplied; and guide portions 62 which are provided for guiding, toward the respective stockers 23, the empty bobbins Bw moving in the base longitudinal direction.

FIG.4



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a take-up tube replenishment device configured to replenish a stocker of a false-twist texturing machine with an empty take-up tube.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2011-47074) discloses a false-twist texturing machine including a yarn supplying unit, a winding device, a heater, a cooler, and a false-twisting device. The heater, cooler, and false-twisting device are provided on a yarn path from the yarn supplying unit and the winding device. In the false-twist texturing machine, a package is formed in such a way that a yarn supplied from the yarn supplying unit is false-twisted by members such as the false-twisting device and the yarn is then wound onto a take-up tube by the winding device. The completed package is detached from the winding device. After an empty take-up tube on which no yarn is wound is attached to the winding device, winding of another yarn is performed again by the winding device.

[0003] In the false-twist texturing machine of Patent Literature 1, winding units are aligned in a predetermined arrangement direction to form plural stages. Each winding unit includes the winding device and a stocker (take-up tube holder) arranged to be able to store the empty take-up tube. The stocker stores the empty take-up tube which is supplied to the winding device. When a completed package is detached from the winding device, the empty take-up tube stored in the stocker is supplied to the winding device.

SUMMARY OF THE INVENTION

[0004] To stockers provided in winding units, empty take-up tubes need to be suitably replenished. Traditionally, an operator manually replenishes each stocker with an empty take-up tube. However, when an operation of replenishment of the empty take-up tube is performed after the operator moves to each stocker, this operation is very laborious for the operator. Furthermore, the operation takes time.

[0005] An object of the present invention is to provide a take-up tube replenishment device configured to efficiently replenish a stocker, which is provided in each of winding units of a false-twist texturing machine, with an empty take-up tube.

[0006] A take-up tube replenishment device of the present invention is configured to replenish stockers with empty take-up tubes in a false-twist texturing machine in which winding units are provided to be aligned in a predetermined arrangement direction and to form plural stages, the winding units include winding devices and the stockers, and the stockers are able to store the empty take-up tubes which are to be supplied to the winding devices. This take-up tube replenishment device includes take-up tube moving paths which are provided to form the plural stages corresponding to the winding units provided to form plural stages, which extend along the arrangement direction, and in which the empty take-up tubes to be used to replenish the stockers are movable in the arrangement direction. Each of the take-up tube moving paths includes: a supporting surface which extends along the arrangement direction and which supports the empty take-up tubes from below; a replenishment port which is provided at an end portion of each of the take-up tube moving paths in the arrangement direction and which is provided for allowing the empty take-up tubes to be supplied; and guide portions provided for guiding, to the respective stockers, the empty take-up tubes moving in the arrangement direction.

[0007] According to the present invention, the empty take-up tubes supplied to the take-up tube moving paths through the replenishment ports move in the arrangement direction of the take-up tube moving paths. The empty take-up tubes moving in the arrangement direction are then supplied to the stockers through the guide portions. Therefore, an operator does not need to move to the stockers in order to replenish the stockers with the empty take-up tubes. This makes it possible to effectively move the empty take-up tubes to the stockers which are provided in the winding units of the false-twist texturing machine.

[0008] The take-up tube replenishment device of the present invention further includes first stoppers provided to correspond to the respective guide portions of each of the take-up tube moving paths, and the state of the first stoppers is preferably switchable between an allowable state in which the first stoppers allow the empty take-up tubes to move from each of the take-up tube moving paths to the stockers through the guide portions and a regulated state in which the first stoppers prevent the empty take-up tubes from moving from each of the take-up tube moving paths to the stockers through the guide portions.

[0009] According to the present invention, for example, when one stocker is a replenishment target of the empty take-up tubes, the state of a first stopper of a guide portion provided for guiding an empty take-up tube to the one stocker is changed to the allowable state. Furthermore, in regard to other stockers which are not replenishment targets of the empty take-up tubes, the state of first stoppers of guide portions provided for guiding the empty take-up tubes to the other stockers is changed to the regulated state. This makes it possible to select a stocker which requires replenishment of the empty take-up tubes among the stockers, and to replenish the stocker with the empty take-up tubes.

[0010] The take-up tube replenishment device of the present invention further includes second stoppers provided to correspond to the respective guide portions of each of the take-up tube moving paths, and the state of the second stoppers is switchable between an allowable state in which the second stoppers allow the empty take-

up tubes to move in the arrangement direction of each of the take-up tube moving paths and a guiding state in which the second stoppers guide the empty take-up tubes to the stockers through the guide portions. When the state of the second stoppers is the guiding state, the empty take-up tubes are preferably prevented from moving over the second stoppers along the arrangement direction.

[0011] According to the present invention, for example, when one stocker is a replenishment target of the empty take-up tubes, the state of a second stopper of a guide portion provided for guiding an empty take-up tube to the one stocker is changed to the guiding state. Because of this, this empty take-up tube is prevented from moving over this second stopper along the arrangement direction. It is therefore possible to prevent the empty take-up tubes from moving in the take-up tube moving paths toward some stockers which are not replenishment targets. Furthermore, each second stopper in the guiding state makes it possible to properly guide an empty take-up tube to a stocker which is a replenishment target of the empty take-up tubes. It is therefore possible to properly replenish a target stocker with an empty take-up tube.

[0012] Preferably, the take-up tube replenishment device of the present invention further includes spacers provided for arranging gaps between the adjacent empty take-up tubes in each of the take-up tube moving paths to be identical to gaps between the adjacent guide portions in the arrangement direction.

[0013] For example, when an end portion of each take-up tube moving path on one of both sides of each take-up tube moving path in the arrangement direction is closed, some empty take-up tubes which move in each take-up tube moving path and which are not used to replenish the stockers are sent to the end portion of each take-up tube moving path on one of both sides of each take-up tube moving path in the arrangement direction and stay in each take-up tube moving path. Subsequently, when replenishment of the empty take-up tubes is performed for any stocker while some empty take-up tubes stay in each take-up tube moving path, one of some empty take-up tubes which stay in each take-up tube moving path is moved to this stocker. At this time, when some empty take-up tubes simultaneously move in each take-up tube moving path, the gaps between the adjacent empty take-up tubes may be narrow in the arrangement direction. With this, the empty take-up tubes which stay in each take-up tube moving path may be provided at positions at which the empty take-up tubes are not properly guided to the stockers through the guide portions. According to the present invention, the spacers arrange the gaps between the adjacent empty take-up tubes to be identical to the gaps between the adjacent guide portions. Because of this, the empty take-up tubes which stay in each take-up tube moving path are prevented from being at the positions at which the empty take-up tubes are not properly guided to the stockers through the guide portions, and the replenishment of the stockers with the empty take-up tubes is further ensured.

[0014] Preferably, the take-up tube replenishment device of the present invention further includes a belt to which the spacers are attached and which is able to move and circulate in the arrangement direction in each of the take-up tube moving paths.

[0015] When the spacers are simply provided, the spacers stay in the take-up tube moving paths after the empty take-up tubes moving in the take-up tube moving paths are moved to the stockers. The spacers which stay in the take-up tube moving paths are required to be collected by the operator, which increases the burden on the operator. According to the present invention, the spacers are attached to the belt which is able to move and circulate in the arrangement direction of each take-up tube moving path. With this arrangement, the operator does not need to collect the spacers which stay in the take-up tube moving paths. Therefore, the burden on the operator is decreased.

[0016] Preferably, the take-up tube replenishment device of the present invention further includes an empty take-up tube automatic throwing device arranged to be able to automatically throw the empty take-up tubes into the take-up tube moving paths through replenishment ports.

[0017] According to the present invention, (i) the burden on the operator is decreased and (ii) reduction in work time is obtainable as compared to a case where the operator manually throws the empty take-up tubes to the take-up tube moving paths.

[0018] In the take-up tube replenishment device of the present invention, each of the replenishment ports is preferably provided only at the end portion of each of the take-up tube moving paths on one of both sides of each of the take-up tube moving paths in the arrangement direction.

[0019] According to the present invention, because the empty take-up tubes are supplied through the replenishment ports each of which is provided only at the end portion of each take-up tube moving path on one of both sides of each take-up tube moving path in the arrangement direction, the take-up tube moving paths are easily replenished with the empty take-up tubes as compared to a case where (i) replenishment ports are provided at both end portions of each take-up tube moving path in the arrangement direction and (ii) the empty take-up tubes are supplied through both end portions.

[0020] In the take-up tube replenishment device of the present invention, preferably, as being pressed by an additional empty take-up tube which is additionally supplied to each of the take-up tube moving paths through each of the replenishment ports, the empty take-up tubes in the take-up tube moving paths move in the arrangement direction.

[0021] According to the present invention, as the additional empty take-up tube which is additionally supplied by the operator to each take-up tube moving path presses one empty take-up tube which is adjacent to the addi-

tional empty take-up tube, the empty take-up tubes in each take-up tube moving path move in the arrangement direction. It is therefore possible to cause the empty take-up tubes in each take-up tube moving path to move in the arrangement direction, without providing a device for moving the empty take-up tubes in the arrangement direction. Because of this, the overall structure of the device is unnecessary to be complex, and thus cost reduction of the device is achieved.

[0022] In the take-up tube replenishment device of the present invention, preferably, each of the take-up tube moving paths further includes a conveyance device configured to convey the empty take-up tubes in the arrangement direction.

[0023] According to the present invention, the conveyance device is able to convey, in the arrangement direction, the empty take-up tubes in each take-up tube moving path. Therefore, the operator does not need to manually press the empty take-up tubes into each take-up tube moving path. As a result, the burden on the operator is decreased.

[0024] In the take-up tube replenishment device of the present invention, preferably, each of the take-up tube moving paths further includes wall portions connected to both end portions of each of supporting surfaces in an orthogonal direction orthogonal to the arrangement direction, and the height of each of the wall portions is greater than the diameter of each of the empty take-up tubes.

[0025] According to the present invention, the empty take-up tubes moving in the take-up tube moving paths are less likely to fall off from the take-up tube moving paths. Therefore, the replenishment of the stockers with the empty take-up tubes is reliably performed.

[0026] In the take-up tube replenishment device of the present invention, preferably, each of the take-up tube moving paths further includes a ceiling which extends along the arrangement direction and which connects the wall portions of each of the take-up tube moving paths to each other.

[0027] According to the present invention, the empty take-up tubes moving in the take-up tube moving paths are reliably prevented from falling off from the take-up tube moving paths.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

FIG. 1 is a profile of a false-twist texturing machine of an embodiment.

FIG. 2 is a schematic diagram of a winding part viewed in a direction II of FIG. 1.

FIG. 3 is a schematic diagram of the winding part.

FIG. 4 is a cross section taken along a line IV-IV in FIG. 2.

FIG. 5 is a block diagram of the electrical structure of the false-twist texturing machine.

FIG. 6 is a schematic diagram of a winding part of a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The following will describe an embodiment of the present invention with reference to figures.

(Overall Structure of False-Twist Texturing Machine 1)

[0030] FIG. 1 is a profile showing the overall structure of a false-twist texturing machine 1 of the present embodiment. FIG. 2 is a schematic diagram of a winding part 4 viewed in a direction II of FIG. 1. Hereinafter, a vertical direction to the sheet of FIG. 1 is defined as a base longitudinal direction, and a left-right direction to the sheet of FIG. 1 is defined as a base width direction. A direction orthogonal to the base longitudinal direction and the base width direction is defined as an up-down direction (vertical direction) in which the gravity acts. These definitions of the directions will be suitably used hereinbelow.

[0031] The false-twist texturing machine 1 is able to perform false twisting of yarns Y made of, e.g., synthetic fibers such as nylon (polyamide fibers). The false-twist texturing machine 1 includes a yarn supplying unit 2 configured to supply the yarns Y, a processing unit 3 configured to false-twist the yarns Y supplied from the supplying unit 2, the winding part 4 configured to wind the yarns Y processed by the processing unit 3 onto empty bobbins (take-up tubes of the present invention) to form winding bobbins Bw, and a control unit 40 (see FIG. 5). The yarn supplying unit 2, the processing unit 3, and the winding part 4 include structural elements (described later), and the structural elements are provided to form plural lines in the base longitudinal direction orthogonal to a yarn running surface (surface orthogonal to the direction in which FIG. 1 is viewed) in which yarn paths are provided to reach the winding part 4 from the yarn supplying unit 2 via the processing unit 3.

[0032] The yarn supplying unit 2 includes a creel stand 7 retaining yarn supply packages Ps, and is configured to supply the yarns Y to the processing unit 3. In the processing unit 3, the following members are provided in this order from the upstream in a yarn running direction: first feed rollers 11; twist-stopping guides 12; first heaters 13; coolers 14; false-twisting devices 15; second feed rollers 16; an interlacing device 17; third feed rollers 18; a second heater 19; and fourth feed rollers 20. The winding part 4 is configured to wind the yarns Y for which false twisting has been performed by the processing unit 3 onto the winding bobbins Bw with use of winding devices 21, and to form wound packages Pw.

[0033] The false-twist texturing machine 1 includes a main base 8 and a winding base 9 which are spaced apart from each other in the base width direction. The main base 8 and the winding base 9 are substantially identical in length in the base longitudinal direction, and

provided 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 yarn threading to each device. The yarn paths are formed so that the yarns Y mainly run around the working space 22.

[0034] The false-twist 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 provided to oppose each other. In one span, each device is provided so that the yarns Y running while being aligned in the base longitudinal direction are simultaneously false-twisted. For example, twelve winding devices 21 provided to form three stages and four columns are provided (see FIG. 2) for the winding base 9 included in one span. There is the supporting frame 10 between two adjacent spans. In the present embodiment, the distance between two adjacent winding devices 21 in one span in the base longitudinal direction is identical with the distance between two winding devices 21, which are adjacent to each other over the supporting frame 10, in two adjacent spans in the base longitudinal direction. In the false-twist texturing machine 1, spans are provided in a left-right symmetrical manner to the sheet of FIG. 1, 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). Furthermore, the spans are aligned in the base longitudinal direction.

(Processing Unit)

[0035] The following will describe each structural element of the processing unit 3. The first feed rollers 11 are configured to feed the yarns Y supplied from the yarn supplying unit 2, to the first heaters 13. The first feed rollers 11 are provided above the winding base 9 (see FIG. 1). The first feed rollers 11 are aligned in the base longitudinal direction.

[0036] Each twist-stopping guide 12 prevents twisting, which has been applied to a yarn Y by a later-described 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 provided downstream of the first feed rollers 11 and upstream of the first heaters 13 in the yarn running direction. For example, the twist-stopping guides 12 are respectively provided for the yarns Y supplied from the yarn supplying unit 2 and are aligned in the base longitudinal direction.

[0037] The first heaters 13 are configured to heat the yarns Y fed from the first feed rollers 11, and are provided at the supporting frame 10 (see 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.

[0038] The coolers 14 are configured to heat the yarns Y heated by the first heaters 13. The coolers 14 are provided downstream of the first heaters 13 and upstream of the false-twisting devices 15 in the yarn running direction. The coolers 14 are provided for the yarns Y supplied from the yarn supplying unit 2, and aligned in the base longitudinal direction.

[0039] The false-twisting devices 15 are configured to twist the yarns Y. The false-twisting devices 15 are provided immediately downstream of the coolers 14 in the yarn running direction. The false-twisting devices 15 are aligned in the base longitudinal direction. For example, twelve false-twisting devices 15 are provided in one span.

[0040] The second feed rollers 16 are rollers for feeding the yarns Y twisted by the false-twisting devices 15 toward the interlacing device 17. In the main base 8, the second feed rollers 16 are provided downstream of the false-twisting devices 15 in the yarn running direction. The conveyance speed of conveying the yarns Y by the second feed rollers 16 is higher than the conveyance speed of conveying the yarns Y by the first feed rollers 11. The yarns Y are therefore drawn between the first feed rollers 11 and the second feed rollers 16.

[0041] The interlacing device 17 is configured to interlace the yarns Y by injecting air thereto. The interlacing device 17 is provided below the second feed rollers 16 in the main base 8.

[0042] The third feed rollers 18 are rollers for feeding the yarns Y interlaced by the interlacing device 17 toward the second heater 19. The third feed rollers 18 are provided below the interlacing device 17 in the main base 8. The conveyance speed of conveying the yarns Y by the third feed rollers 18 is lower than the conveyance speed of conveying the yarns Y by the second feed rollers 16. The yarns Y are therefore relaxed between the second feed rollers 16 and the third feed rollers 18.

[0043] The second heater 19 is configured to heat the yarns Y fed from the third feed rollers 18. The second heater 19 is provided below the third feed rollers 18 in the main base 8. The second heater 19 extends along the up-down direction, and one second heater 19 is provided in one span.

[0044] The fourth feed rollers 20 are provided to feed the yarns Y thermally treated by the second heater 19 toward the winding devices 21. The fourth feed rollers 20 are provided at a lower part of the winding base 9. The conveyance speed of conveying the yarns Y by the fourth feed rollers 20 is lower than the conveyance speed of conveying the yarns Y by the third feed rollers 18. The yarns Y are therefore relaxed between the third feed rollers 18 and the fourth feed rollers 20.

[0045] In the processing unit 3 arranged as described above, the yarns Y drawn between the first feed rollers 11 and the second feed rollers 16 are twisted by the false-twisting devices 15. The twist formed by the false-twisting devices 15 is propagated to the twist-stopping guides 12, but is not propagated to upstream of the twist-stopping guides 12 in the yarn running direction. The yarns Y which

are twisted and drawn are heated by the first heaters 13 and thermally set. After that, the yarns Y are cooled by the coolers 14. The yarns Y are untwisted at downstream of the false-twisting devices 15 in the yarn running direction. However, each filament is maintained to be wavy in shape on account of the thermal setting described above. After being false-twisted by the false-twisting devices 15, the yarns Y are interlaced by the interlacing device 17 while being relaxed between the second feed rollers 16 and the third feed rollers 18. Subsequently, the yarns Y are guided to the downstream side in the yarn running direction. The yarns Y are then thermally set by the second heater 19 while being relaxed between the third feed rollers 18 and the fourth feed rollers 20. Finally, the yarns Y fed from the fourth feed rollers 20 are wound by the winding devices 21, and form the wound packages Pw.

(Structure of Winding Part 4)

[0046] The following will describe the structure of the winding part 4 with reference to FIG. 2 and FIG. 3. FIG. 3 is a schematic diagram of the winding part 4 viewed in the base longitudinal direction. As shown in FIG. 3, in the winding part 4, winding units 30 including the winding devices 21, stockers 23, and storage units 24 are provided to be aligned in an arrangement direction and to form plural stages. The arrangement direction is the base longitudinal direction. As shown in FIG. 2, twelve winding units 30 are provided in total for one winding base 9 so as to form four columns in the base longitudinal direction and three stages in the up-down direction.

[0047] Each winding device 21 is configured to form one wound package Pw by winding a yarn Y onto a winding bobbin Bw. Each winding device 21 includes a single cradle 31 which rotatably supports the winding bobbin Bw. The winding bobbin Bw supported by the cradle 31 is rotationally driven by, e.g., an unillustrated motor. By rotationally driving the winding bobbin Bw supported by the cradle 31, each winding device 21 winds the yarn Y onto the winding bobbin Bw and forms the wound package Pw. The cradle 31 is rotatable about a rotational shaft 31a extending in the base longitudinal direction.

[0048] Each stocker 23 is able to store empty bobbins Bw (empty take-up tubes) supplied to the winding device 21. In this regard, each empty bobbin Bw is an empty winding bobbin Bw onto which no yarn Y is wound. Each stocker 23 has (i) a bottom surface provided for supporting the empty bobbins Bw from below and (ii) side walls provided on both sides of the empty bobbins Bw, which are placed on the bottom surface, in the base longitudinal direction. The bottom surface of each stocker 23 is inclined downward and toward the winding device 21 in the base width direction. The empty bobbins Bw stored in each stocker 23 move along the inclined bottom surface of each stocker 23 and toward the winding device 21 in the base width direction. A leading end of each stocker 23 is provided on the side in which the winding device 21 is provided (hereinafter, this side will be referred to as the winding device 21 side) in the base width direction, and an unillustrated regulator is provided at this leading end. By making contact with the regulator (not illustrated), the empty bobbins Bw moving along the bottom surface of each stocker 23 are prevented from falling off the leading end of each stocker 23 toward the winding device 21 side in the base width direction. In the present embodiment, each stocker 23 is able to store four empty bobbins Bw at the maximum.

[0049] The empty bobbins Bw stored in each stocker 23 are supplied to the winding device 21 as described below, for example. To begin with, as the cradle 31 rotates about the rotational shaft 31a, a part of the cradle 31 moves to the vicinity of the leading end of each stocker 23 on the winding device 21 side in the base width direction. The part of the cradle 31 is able to support a winding bobbin Bw. Subsequently, regulation by the regulator provided at each stocker 23 is canceled so that one of the empty bobbins Bw stored in each stocker 23 is supported by the cradle 31. The cradle 31 then rotates about the rotational shaft 31a and moves back to a winding position at which a yarn Y is wound by the winding device 21. At the same time, the regulation by the regulator at each stocker 23 is performed again. The empty bobbins Bw stored in each stocker 23 are supplied to the winding device 21 in this way.

[0050] The cradle 31 may be fixed not to be rotatable. In this case, each stocker 23 is rotatable about a rotational shaft extending in the base longitudinal direction. Furthermore, as each stocker 23 rotates with respect to the cradle 31, one of the empty bobbins Bw stored in each stocker 23 is supplied to the winding device 21.

[0051] Each storage unit 24 is configured to store fullywound packages Pw formed by the winding device 21. When the formation of one wound package Pw is completed, the winding bobbin Bw supported by the cradle 31 is detached from the winding device 21 as the cradle 31 rotates about the rotational axis extending in the base longitudinal direction. The wound package Pw is then supplied to the storage unit 24. The storage unit 24 is able to store, e.g., three wound packages Pw at the maximum. When, e.g., yarn breakage occurs while the winding device 21 is winding a yarn Y, a wound package Pw may be supplied to the storage unit 24 even though the formation of the wound package Pw has not been completed.

(Electrical Structure)

[0052] FIG. 5 is a block diagram of the electrical structure of the false-twist texturing machine 1. The control unit 40 is configured to control the yarn supplying unit 2, the processing unit 3, and the winding part 4. FIG. 5 shows the control unit 40 which is connected only to one of plural first stoppers 52 (described later) and one of plural second stoppers 53 (described later). However, the control unit 40 is actually connected also to other first stoppers 52 and other second stoppers 53.

(Structure of Take-up tube replenishment device 50)

[0053] The following will describe the structure of the take-up tube replenishment device 50 with reference to FIG. 2 to FIG. 4. FIG. 4 is a cross section taken along a line IV-IV in FIG. 2 and shows the winding part 4 which is viewed in the up-down direction and in which the take-up tube replenishment device 50 is provided. In FIG. 4, the take-up tube replenishment device 50 is provided in one winding base 9. However, the take-up tube replenishment device 50 is actually provided across plural winding bases 9.

[0054] The take-up tube replenishment device 50 is configured to replenish the stockers 23 with empty bobbins Bw. As shown in FIG. 4, the take-up tube replenishment device 50 includes take-up tube moving paths 51, the first stoppers 52, the second stoppers 53, spacers 54, and belts 55.

[0055] As shown in FIG. 3, the take-up tube moving paths 51 are provided to form plural stages corresponding to the winding units 30 provided to form plural stages. That is, in the present embodiment, the take-up tube moving paths 51 are provided to form three stages in the up-down direction. Each take-up tube moving path 51 is cylindrical in shape, and extends along the base longitudinal direction (arrangement direction). In each cylindrical take-up tube moving path 51, empty bobbins Bw are movable in the base longitudinal direction. A lower part of an inner surface of each cylindrical take-up tube moving path 51 is a supporting surface 51a which supports the empty bobbins Bw from below. As shown in FIG. 2, when viewed in the base width direction, each take-up tube moving path 51 is provided along the base longitudinal direction to include all stockers 23 provided to form one of the stages. A replenishment port 61 (described later; a port for replenishment) is provided on one side of each take-up tube moving path 51 in the base longitudinal direction, and an end portion of each take-up tube moving path 51 on the other side of each take-up tube moving path 51 is closed. In the present embodiment, each take-up tube moving path 51 which is cylindrical in shape includes its wall portion (wall portion of the present invention) and its ceiling (ceiling of the present invention).

[0056] Each take-up tube moving path 51 includes the replenishment port 61 and guide portions 62. The replenishment port 61 is provided for allowing the empty bobbins Bw to be supplied into each take-up tube moving path 51. The replenishment port 61 is provided only at an end portion of each take-up tube moving path 51 on the one side of the take-up tube moving path 51 in the base longitudinal direction. In the present embodiment, the replenishment port 61 is provided at the end portion of each take-up tube moving path 51 in an upper part of the sheet of FIG. 4 (i.e., on the one side of each take-up tube moving path 51 in the base longitudinal direction).

[0057] The guide portions 62 are provided for guiding, to the respective stockers 23, the empty bobbins Bw moving in the base longitudinal direction of each take-up tube moving path 51. In the present embodiment, the guide portions 62 are openings provided at positions, which correspond to the respective stockers 23, on a side surface of each take-up tube moving path 51. When viewed in the base width direction, each guide portion 62 and each stocker 23 overlap each other in the base longitudinal direction. Each take-up tube moving path 51 and the stockers 23 are connected to each other through the guide portions 62. As shown in FIG. 3, each guide portion 62 is open toward the stockers 23 in the base width direction. The guide portions 62 are open obliquely downward from each take-up tube moving path 51 and toward the stockers 23. An empty bobbin Bw in front of one guide portion 62 of each take-up tube moving path 51 moves to one stocker 23 through the one guide portion 62 which is open obliquely downward, without external force in the base width direction.

[0058] As shown in FIG. 4, the first stoppers 52 are provided to correspond to the respective guide portions 62 on the side surface of each take-up tube moving path 51. Each first stopper 52 is a plate member extending in the base longitudinal direction. The state of each first stopper 52 is switchable between an allowable state (indicated by dotted lines in FIG. 4) in which each first stopper 52 allows an empty bobbin Bw to move from the take-up tube moving path 51 to a stocker 23 through a guide portion 62 and a regulated state (indicated by full lines and oblique lines in FIG. 4) in which each first stopper 52 prevents an empty bobbin Bw from moving from the take-up tube moving path 51 to a stocker 23 through a guide portion 62. The state of each first stopper 52 is switchable between the allowable state and the regulated state by being driven by an unillustrated motor. Each first stopper 52 is controlled by the control unit 40. In this regard, the driving source of each first stopper 52 is not limited to the motor. For example, each first stopper 52 may be driven by air (i.e., air pressure).

[0059] Each first stopper 52 in the allowable state allows a corresponding guide portion 62, which is formed on the side surface of the take-up tube moving path 51, to be open. When one first stopper 52 is in the allowable state, an empty bobbin Bw at one guide portion 62 of the take-up tube moving path 51 moves to one stocker 23 through the one guide portion 62 which is open obliquely downward. Each first stopper 52 in the regulated state partially or entirely closes a corresponding guide portions 62 formed on the side surface of each take-up tube moving path 51, to be closed. When the first stoppers 52 are in the regulated state, empty bobbins Bw in each take-up tube moving path 51 are prevented from moving to the stockers 23 through the guide portions 62. The state of each first stopper 52 is switchable between the allowable state and the regulated state in such a way that each first stopper 52 moves in the up-down direction. Each first stopper 52 in the allowable state is positioned above each first stopper 52 in the regulated state. Each first stopper 52 in the allowable state may be positioned to be below each first stopper 52 in the regulated state. The

state of each first stopper 52 may be switchable between the allowable state and the regulated state in such a way that each first stopper 52 moves in the base longitudinal direction. Each first stopper 52 may be provided as a door so that the state of each first stopper 52 is switchable between the allowable state and the regulated state in such a way that each first stopper 52 rotates about an axis extending in the base longitudinal direction, base width direction, or up-down direction.

[0060] As shown in FIG. 4, the second stoppers 53 are provided to correspond to the respective guide portions 62 of each take-up tube moving path 51. Each second stopper 53 is a disc-shaped member which is substantially identical in shape with a cross section of the take-up tube moving path 51. Each second stopper 53 viewed in the up-down direction extends in the base width direction to penetrate the take-up tube moving path 51 from an end portion of the corresponding guide portion 62 on the side opposite to the replenishment port 61 in the base longitudinal direction.

[0061] The state of each second stopper 53 is switchable between an allowable state (indicated by dotted lines in FIG. 4) in which each second stopper 53 allows an empty bobbin Bw to move in the base longitudinal direction of the take-up tube moving path 51 and a guiding state (indicated by solid lines and oblique lines in FIG. 4) in which each second stopper 53 guides an empty bobbin Bw to a stocker 23 through a guide portion 62. When each second stopper 53 is in the guiding state, an empty bobbin Bw is prevented from moving over each second stopper 53 along the base longitudinal direction. The state of each second stopper 53 is switchable between the allowable state and the guiding state by being driven an unillustrated motor. Each second stopper 53 is controlled by the control unit 40. In this regard, the driving source of each second stopper 53 is not limited to the motor. For example, each second stopper 53 may be driven by air (i.e., air pressure).

[0062] Through an unillustrated slit formed in the take-up tube moving path 51, each second stopper 53 is movable between the inside of the take-up tube moving path 51 and the outside of the take-up tube moving path 51. Each second stopper 53 in the allowable state is positioned at the outside of the take-up tube moving path 51 so that the inside of the take-up tube moving path 51 is open in the base longitudinal direction. Each second stopper 53 in the guiding state is positioned at the inside of the take-up tube moving path 51 so that (i) the inside of the take-up tube moving path 51 is closed in the base longitudinal direction and (ii) a path is formed to allow an empty bobbin Bw to be guided to a stocker 23 through a guide portion 62. As such, the state of each second stopper 53 is switchable between the allowable state and the guiding state in such a way that each second stopper 53 moves in the up-down direction. Each second stopper 53 in the allowable state is positioned above each second stopper 53 in the guiding state. Each second stopper 53 in the allowable state may be positioned to be below each second stopper 53 in the guiding state. The state of each second stopper 53 may be switchable between the allowable state and the guiding state in such a way that each second stopper 53 moves in the base width direction.

[0063] The spacers 54 are provided for arranging gaps between the adjacent empty bobbins Bw in each take-up tube moving path 51 to be identical to gaps between the adjacent guide portions 62 in the base longitudinal direction. In the present embodiment, the spacers 54 do not interfere with the second stoppers 53 in the guiding states. For example, a cutout is formed at a lower part of each second stopper 53. Furthermore, each spacer 54 is arranged to be positioned at the cutout formed in each second stopper 53 in the guiding state. In this regard, the phrase "arranging gaps between the adjacent empty bobbins Bw to be identical to gaps between the adjacent guide portions 62 in the base longitudinal direction" indicates that gaps between barycentric positions of adjacent empty bobbins Bw are identical to gaps between barycentric positions of the guide portions 62 in the base longitudinal direction.

[0064] To the belts 55, the spacers 54 are attached at regular intervals. Each belt 55 is able to move and circulate in the base longitudinal direction of a corresponding take-up tube moving path 51. As shown in FIG. 4, each belt 55 is an annular belt and is arranged to run inside and outside a corresponding take-up tube moving path 51 in the base width direction along the base longitudinal direction. In the present embodiment, each belt 55 is manually moved. The spacers 54 are movable together with the belts 55 in the base longitudinal direction. The belts 55 do not interfere with the second stoppers 53 in the guiding state. For example, the belts 55 are arranged to be positioned at the cutouts formed in the second stoppers 53 in the guiding state. Each belt 55 may run inside and outside a corresponding take-up tube moving path 51 in the up-down direction, along the base longitudinal direction.

[0065] The following describes a series of steps of replenishing one stocker 23 with an empty bobbin Bw by the take-up tube replenishment device 50 in the present embodiment. To begin with, an operator visually checks and determines which stocker 23 is a target of replenishment of empty bobbins Bw (this may be referred to as a replenishment target). For example, as shown in FIG. 4, when two empty bobbins Bw are stored in the third stocker 23 from the replenishment port 61 in the base longitudinal direction (hereinafter, this stocker 23 may be simply referred to as the third stocker 23) among the stockers 23, this stocker 23 is the replenishment target of empty bobbins Bw. In this regard, the operator may freely determine the remaining number of empty bobbins Bw stored in a stocker 23 which is to be determined as a replenishment target of empty bobbins Bw. To begin with, the operator inputs information of the stocker 23 which is the replenishment target of empty bobbins Bw into an operation terminal (not illustrated). The information input

into the operation terminal is sent to the control unit 40.

[0066] Subsequently, the control unit 40 controls switching of the state of the first stoppers 52 and that of the second stoppers 53 based on a signal. For example, when the third stocker 23 is the replenishment target of empty bobbins Bw, the control unit 40 controls the switching so that (i) the state of a first stopper 52 corresponding to the third stocker 23 is changed to the allowable state and (ii) the state of other first stoppers 52 is changed to the regulated state. Furthermore, the control unit 40 controls the switching so that (i) the state of a second stopper 53 corresponding to the third stocker 23 is changed to the guiding state and (ii) the state of other stoppers 53 is changed to the allowable state. In this regard, the switching of the state of the first stoppers 52 and that of the second stoppers 53 by the control unit 40 may be performed based on an electrical signal which is input in such a way that the operator presses a button provided in the vicinity of the replenishment port 61.

[0067] The operator then replenishes the take-up tube moving path 51 with an empty bobbin Bw through the replenishment port 61. The empty bobbin Bw is then positioned between adjacent spacers 54. At this time, there are empty bobbins Bw which are to be supplied in order in the take-up tube moving path 51. The empty bobbin Bw which is additionally supplied to the take-up tube moving path 51 through the replenishment port 61 presses, through the spacers 54, these empty bobbins Bw in the take-up tube moving path 51 so that these bobbins Bw move in the base longitudinal direction. These empty bobbins Bw move together with the spacers 54 and the belt 55 in the base longitudinal direction.

[0068] Subsequently, when one of the empty bobbins Bw moving in the base longitudinal direction of the take-up tube moving path 51 reaches a position corresponding to the third stocker 23 which is the replenishment target, the one of the empty bobbins Bw is moved to the third stocker 23 through the guide portion 62 of the first stopper 52 of the third stocker 23 in the allowable state and along the second stopper 53 of the third stocker 23 in the guiding state. When the number of empty bobbins Bw stored in the third stocker 23 reaches the maximum number, i.e., four, the control unit 40 controls the switching so that (i) the state of the first stopper 52 of the third stocker 23 is changed to the regulated state and (ii) the state of the second stopper 53 of the third stocker 23 is changed to the allowable state. After that, the replenishment of empty bobbins Bw stops until any stocker 23 becomes a target of replenishment of empty bobbins Bw. When any stocker 23 becomes the replenishment target of empty bobbins Bw, the series of steps described above are performed.

(Effects)

[0069] The take-up tube replenishment device 50 of the present embodiment includes the take-up tube moving paths 51 which are provided to form plural stages corresponding to the winding units 30 provided to form plural stages, which extend along the base longitudinal direction, and in which empty bobbins Bw which are to be used to replenish the stockers 23 are movable in the base longitudinal direction. Each take-up tube replenishment device 51 further includes: the supporting surface 51a which extends along the base longitudinal direction and which is provided for supporting the empty bobbins Bw from below; the replenishment port 61 which is provided at the end portion of each take-up tube moving path 51 on the one side of each take-up tube moving path 51 in the base longitudinal direction and which is provided for allowing the empty bobbins Bw to be supplied; and the guide portions 62 which are provided for guiding, toward the respective stockers 23, the empty bobbins Bw moving in the base longitudinal direction. In the embodiment above, the empty bobbins Bw supplied to the take-up tube moving paths 51 through the replenishment ports 61 move in the base longitudinal direction of the take-up tube moving paths 51. The empty bobbins Bw moving in the base longitudinal direction are then supplied to the stockers 23 through the guide portions 62. Therefore, the operator does not need to move to each stocker 23 in order to replenish each stocker with an empty bobbin Bw. Because of this, the empty bobbins Bw are efficiently moved to the stockers 23 provided in the winding units 30 of the false-twist texturing machine 1.

[0070] The take-up tube replenishment device 50 of the present embodiment further includes the first stoppers 52 provided to correspond to the respective guide portions 62 of the take-up tube moving paths 51. The state of each first stopper 52 is switchable between the allowable state in which each first stopper 52 allows an empty bobbin Bw to move from a take-up tube moving path 51 to a stocker 23 through a guide portion 62 and the regulated state in which each first stopper 52 prevents an empty bobbin Bw from moving from a take-up tube moving path 51 to a stocker 23 through a guide portion 62. With this arrangement, the state of a first stopper 52 corresponding to a guide portion 62 provided for allowing an empty bobbin Bw to be guided to one stocker 23 which is a replenishment target of empty bobbins Bw is changed to the allowable state. Furthermore, the state of other first stoppers 52 corresponding to guide portions 62 provided for allowing empty bobbins Bw to be guided to stockers 23 which are not replenishment targets of empty bobbins Bw is changed to the regulated state. This makes it possible to select a stocker 23 which requires replenishment of empty bobbins Bw among the stockers 23, and to replenish the stocker 23 with empty bobbins Bw.

[0071] The take-up tube replenishment device 50 of the present embodiment further includes the second stoppers 53 provided to correspond to the respective guide portions 62 of the take-up tube moving paths 51. The state of each second stopper 53 is switchable between the allowable state in which each second stopper 53 allows an empty bobbin Bw to move in the base longitudinal direction of a take-up tube moving path 51 and the guiding state in which each second stopper 53 guides

an empty bobbin Bw to a stocker 23 through a guide portion 62. When each second stopper 53 is in the guiding state, an empty bobbin Bw is prevented from moving over each second stopper 53 along the base longitudinal direction. In the embodiment above, as the state of a second stopper 53 corresponding to a guide portion 62 provided for allowing an empty bobbin Bw to be guided to one stocker 23 which is a replenishment target of empty bobbins Bw is changed to the guiding state, the empty bobbin Bw is prevented from moving over the second stopper 53 along the base longitudinal direction. It is therefore possible to prevent empty bobbins Bw from moving in the take-up tube moving paths 51 toward the stockers 23 which are not replenishment targets. Each second stopper 53 in the guiding state makes it possible to properly guide an empty bobbin Bw to a stocker 23 which is a replenishment target. It is therefore possible to properly replenish a target stocker 23 with an empty bobbin Bw.

[0072] The take-up tube replenishment device 50 of the present embodiment further includes the spacers 54 which are provided for arranging the gaps between the adjacent empty bobbins Bw in each take-up tube moving path 51 to be identical to the gaps between the adjacent guide portions 62 in the base longitudinal direction. In the present embodiment, the end portion of each take-up tube moving path 51 on the other side of each take-up tube moving path 51 in the base longitudinal direction (on the side opposite to the side in which each replenishment port 61 is provided in the base longitudinal direction) is closed. Alternatively, a different position of each take-up tube moving path 51 may be closed in the base longitudinal direction by one of the second stoppers 53 in the guiding state. In these cases, one or more of empty bobbins Bw moving in each take-up tube moving path 51 are sent to (i) the end portion of each take-up tube moving path 51 on the other side of each take-up tube moving path 51 in the base longitudinal direction or (ii) the one of the second stoppers 53 in the guiding state and stay in each take-up tube moving path 51. The one or more of the empty bobbins Bw are not used to replenish the stockers 23. Subsequently, when the replenishment of empty bobbins Bw is performed for any stocker 23 while the empty bobbins Bw stay in each take-up tube moving path 51, any of the empty bobbins Bw which stay in each take-up tube moving path 51 is moved to this stocker 23. At this time, when the empty bobbins Bw simultaneously move in each take-up tube moving path 51, the gaps between the adjacent empty bobbins Bw may be narrow in the arrangement direction. With this, the empty bobbins Bw which stay in each take-up tube moving path 51 may be provided at positions at which the empty bobbins Bw are not properly guided to the stockers 23 through the guide portions 62. In the present embodiment, the spacers 54 arrange the gaps between the adjacent empty bobbins Bw to be identical to the gaps between the adjacent guide portions 62. Because of this, the empty bobbins Bw which stay in each take-up tube moving path 51 are prevented from being at the positions at which the empty bobbins Bw are not properly guided to the stockers 23 through the guide portions 62, and the replenishment of the stockers 23 with empty bobbins Bw is further ensured.

[0073] The take-up tube replenishment device 50 of the present embodiment further includes the belts 55 to which the spacers 54 are attached and which are able to move and circulate in the base longitudinal direction of the respective take-up tube moving paths 51. When the spacers 54 are simply provided, the spacers 54 stay in the take-up tube moving paths 51 after the empty bobbins Bw moving in the take-up tube moving paths 51 are moved to the stockers 23. The spacers 54 which stay in the take-up tube moving paths 51 are required to be collected by the operator, which increases the burden on the operator. In the embodiment above, the spacers 54 are attached to the belts 55 which are able to move and circulate in the base longitudinal direction of the take-up tube moving paths 51. With this arrangement, the operator does not need to collect the spacers 54 which stay in the take-up tube moving paths 51. Therefore, the burden on the operator is decreased.

[0074] In the take-up tube replenishment device 50 of the present embodiment, each replenishment port 61 is provided only at the end portion of a corresponding take-up tube moving path 51 on the one side of a corresponding take-up tube moving path 51 in the base longitudinal direction. In the embodiment above, because the empty bobbins Bw are supplied through the replenishment ports 61 each of which is provided only at the end portion of each take-up tube moving path 51 on one of both sides of each take-up tube moving path 51 in the arrangement direction, the empty bobbins Bw are easily supplied to the take-up tube moving paths 51 as compared to a case where (i) replenishment ports 61 are provided at both end portions of each take-up tube moving path 51 in the arrangement direction and (ii) the empty bobbins Bw are supplied through both end portions.

[0075] In the take-up tube replenishment device 50 of the present embodiment, as being pressed by an empty bobbin Bw which is additionally supplied to each take-up tube moving path 51 through the replenishment port 61, empty bobbins Bw in each take-up tube moving path 51 move in the base longitudinal direction. In the embodiment above, as the empty bobbin Bw which is additionally supplied by the operator to the take-up tube moving path 51 presses an empty bobbin Bw which is adjacent to the additionallysupplied empty bobbin Bw, the empty bobbins Bw in each take-up tube moving path 51 move in the base longitudinal direction. It is therefore possible to cause the empty bobbins Bw in each take-up tube moving path 51 to move in the base longitudinal direction, without providing a device for moving the empty bobbins Bw in the base longitudinal direction. Because of this, the overall structure of the device is unnecessary to be complex, and thus cost reduction of the device is achieved.

[0076] In the take-up tube replenishment device 50 of

the present embodiment, each take-up tube moving path 51 is cylindrical in shape and extends in the base longitudinal direction. In the embodiment above, the empty bobbins Bw moving in the take-up tube moving paths 51 are reliably prevented from falling off from the take-up tube moving paths 51. Therefore, the replenishment of the stockers 23 with the empty bobbins Bw is reliably performed.

(Modifications)

[0077] 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.

[0078] In the present invention, a take-up tube replenishment device 150 shown in FIG. 6 may include an empty take-up tube automatic throwing device 70 arranged to be able to automatically throw empty bobbins Bw to the take-up tube moving paths 51 through the replenishment ports 61. For example, the empty take-up tube automatic throwing device 70 includes a take-up tube tank 71, a take-up tube path 72, and automatic throwing devices 73. The take-up tube tank 71 is able to store a large number of empty bobbins Bw. The take-up tube path 72 is connected to three replenishment ports 61 of the take-up tube moving paths 51 provided to form three stages. The automatic throwing devices 73 are configured to automatically throw the empty bobbins Bw in the take-up tube path 72 to the take-up tube moving paths 51 through the replenishment ports 61. Each automatic throwing device 73 is formed of, e.g., an air cylinder. The empty bobbins Bw stored in the take-up tube tank 71 are sent downward through the take-up tube path 72. At this time, the axial direction of each empty bobbin Bw is adjusted to be identical to the base longitudinal direction. Among the empty bobbins Bw sent downward through the take-up tube path 72, empty bobbins Bw at the replenishment ports 61 are automatically thrown into the take-up tube moving paths 51 by the automatic throwing devices 73. A junction between the take-up tube path 72 and each replenishment port 61 is tapered, and an empty bobbin Bw pressed by one of the automatic throwing devices 73 which are the air cylinders is guided to each replenishment port 61 along the tapered surface of the junction. With this arrangement, (i) the burden on the operator is decreased and (ii) reduction in work time is obtainable as compared to a case where the operator manually throws an empty bobbin Bw into each take-up tube moving path 51. The take-up tube replenishment device 150 may be provided in the take-up tube path 72 and may include a positioning plate which positions an empty bobbin Bw to a vertical position at which the empty bobbin Bw can be supplied to each replenishment port 61. The positioning plate is movable between a positioning position at which the positioning plate performs positioning of empty bobbins Bw and a retracted position at which the positioning plate does not prevent empty bobbins Bw from moving downward. The empty bobbins Bw positioned by the positioning plate at the positioning position are pressed by the automatic throwing devices 73, which are the air cylinders, so that the take-up tube moving paths 51 are replenished with the empty bobbins Bw through the replenishment ports 61.

[0079] The structure of an empty take-up tube throwing device is not limited to the example shown in FIG. 6. For example, the empty take-up tube throwing device may be arranged to be able to automatically throw the empty bobbins Bw into the take-up tube moving paths 51 through the replenishment ports 61 with use of a robotic arm, etc.

[0080] In the embodiment above, as being pressed by an empty bobbin Bw which is additionally supplied to each take-up tube moving path 51 through the replenishment port 61, empty bobbins Bw in each take-up tube moving path 51 move in the base longitudinal direction. However, each take-up tube moving path 51 may include a conveyance device configured to convey the empty bobbins Bw in the base longitudinal direction. The conveyance device is, e.g., a conveyor provided on the bottom surface of each take-up tube moving path 51. The empty bobbins Bw on the conveyor are conveyed in the base longitudinal direction as the conveyor is driven. The conveyance device may be configured to press, by air, the empty bobbins Bw into the end portion of each take-up tube moving path 51 on the side in which the replenishment port 61 is provided in the base longitudinal direction. Furthermore, the conveyance device may be configured to suck the empty bobbins Bw by air from the end portion of each take-up tube moving path 51 on the side opposite to the side in which the replenishment port 61 is provided in the base longitudinal direction. In this case, the conveyance device can convey the empty bobbins Bw in each take-up tube moving path 51 in the base longitudinal direction. Therefore, the operator does not need to manually press the empty bobbins Bw into each take-up tube moving path 51. As a result, the burden on the operator is decreased.

[0081] When each take-up tube moving path 51 includes the conveyor as the conveyance device configured to convey the empty bobbins Bw in the base longitudinal direction, the spacers 54 may be attached to the conveyor. In this case, the conveyor is equivalent to a belt of the present invention.

[0082] In the embodiment above, each take-up tube moving path 51 is cylindrical in shape and extends along the base longitudinal direction. However, an upper part of each take-up tube moving path 51 in the up-down direction may be open so that a cross section orthogonal to the base longitudinal direction of each take-up tube moving path 51 is semi-circular in shape. Alternatively, each take-up tube moving path 51 may be a flat plate member, or a flat plate member which has side walls on its both sides in the base width direction.

[0083] In the embodiment above a replenishment tar-

get of empty bobbins Bw is visually selected from among the stockers 23 by the operator. However, the stocker 23 which is the replenishment target of empty bobbins Bw may be determined by a sensor provided in the stocker 23. For example, when the sensor recognizes that the number of empty bobbins Bw stored in the stocker 23 is small, the sensor determines that this stocker 23 is the replenishment target of empty bobbins Bw. In this case, a signal including information of the stocker 23 which is the replenishment target of empty bobbins Bw is sent to the control unit 40 from the sensor. Subsequently, the control unit 40 automatically controls the switching of the state of the first stoppers 52 and that of the second stoppers 53 based on the signal. In this regard, the switching of the state of the first stoppers 52 and that of the second stoppers 53 by the control unit 40 may be performed based on an electrical signal which is input in such a way that the operator presses a button provided in the vicinity of each replenishment port 61.

[0084] In the embodiment above, each take-up tube moving path 51 and the stockers 23 are connected to each other through the guide portions 62. However, each take-up tube moving path 51 and the stockers 23 may not be connected to each other and there may be gaps between each take-up tube moving path 51 and the stockers 23. In this case, each guide portion 62 includes (i) an opening provided on the take-up tube moving path 51 and (ii) a passage between the take-up tube moving path 51 and a stocker 23.

[0085] In the embodiment above, the take-up tube replenishment device 50 further includes the belts 55 to which the spacers 54 are attached. However, the take-up tube replenishment device 50 may not include the belts 55. For example, independent spacers 54 are provided between the adjacent empty bobbins Bw in each take-up tube moving path 51. In this case, the operator suitably collects the spacers 54 which stay in each take-up tube moving path 51. The take-up tube replenishment device 50 may not include the spacers 54. In this case, a conveyor is preferably provided on the bottom surface of each take-up tube moving path 51. By adjusting the positions of empty bobbins Bw on this conveyor, the gaps between the adjacent empty bobbins Bw in each take-up tube moving path 51 are arranged to be identical to the gaps between the adjacent guide portions 62 in the base longitudinal direction.

[0086] In the embodiment above, the take-up tube replenishment device 50 further includes the first stoppers 52 and the second stoppers 53. However, the take-up tube replenishment device 50 may include the first stoppers 52 or the second stoppers 53. Among the first stoppers 52 and the second stoppers 53, when only the first stoppers 52 are provided, each empty bobbin Bw supplied to the take-up tube moving path 51 through the replenishment port 61 is moved to a stocker 23 corresponding to one first stopper 52 in the allowable state and is not moved to stockers 23 corresponding to other first stoppers 52 in the regulated state. In this case, a conveyor is preferably provided on the bottom surface of the take-up tube moving path 51. When one of empty bobbins Bw moving in the take-up tube moving path 51 reaches a position corresponding to one guide portion 62 provided for allowing an empty bobbin Bw to be guided to a stocker 23 which is a replenishment target, the operation of the conveyor is stopped so that the empty bobbin Bw is appropriately guided to the stocker 23.

[0087] Among the first stoppers 52 and the second stoppers 53, when only the second stoppers 53 are provided, empty bobbins Bw are supplied to the take-up tube moving path 51 through the replenishment port 61 and are moved to (i) a stocker 23 of one second stopper 53 in the guiding state and (ii) stockers 23 provided on the replenishment port 61 side in the base longitudinal direction of the stocker 23 of the one second stopper 53. Furthermore, when only the second stoppers 53 are provided, the empty bobbins Bw are supplied to the take-up tube moving path 51 through the replenishment port 61 and are not moved to stockers 23 provided on the side opposite to the side in which the replenishment port 61 is provided in the base longitudinal direction as compared to the stocker 23 of the one second stopper 53 in the guiding state. In this case, a pushing mechanism configured to push out the empty bobbins Bw in the take-up tube moving path 51 to stockers 23 is preferably provided in the take-up tube moving path 51. When an empty bobbin Bw reaches one second stopper 53 in the guiding state, the empty bobbin Bw is pushed out to a stocker 23 of the one second stopper 53 by the pushing mechanism so as to be used to replenish the stocker 23. When the pushing mechanism is provided, a movement prevention member may be provided in the take-up tube moving path 51 so as to prevent the empty bobbins Bw in the take-up tube moving path 51 from naturally moving to the stockers 23 through the guide portions 62 which are open obliquely downward. The empty bobbins Bw which are pushed out by the pushing mechanism get over the movement prevention member and reach the stockers 23.

[0088] Among the first stoppers 52 and the second stoppers 53, when only the second stoppers 53 are provided, the state of the guide portions 62 may be switchable between an upward state in which the guide portions 62 are open upward and a downward state in which the guide portions 62 are open downward and toward the stockers 23. When one of the empty bobbins Bw moving in the take-up tube moving path 51 reaches a position corresponding to one guide portion 62 provided for allowing an empty bobbin Bw to be guided to a stocker 23 which is a replenishment target, the state of the one guide portion 62 is changed to the downward state. Because of this, the one of the empty bobbins Bw moving in the take-up tube moving path 51 moves to the stocker 23 through the one guide portion 62. When the one of the empty bobbins Bw moving in the take-up tube moving path 51 is at one of positions of other guide portions 62 provided for allowing empty bobbins Bw to be guided to

the stockers 23 which are not replenishment targets, the other guide portions 62 are in the upward state. Because of this, the one of the empty bobbins Bw moving in the take-up tube moving path 51 cannot move to the stockers 23 through the other guide portions 62. In this regard, switching of the state of the guide portions 62 between the upward state and the downward state is performed as, e.g., the take-up tube moving path 51 rotates about a rotational shaft extending along the base longitudinal direction.

[0089] In the present invention, the take-up tube replenishment device 50 may not include the first stoppers 52 and the second stoppers 53. In this case, when there are plural stockers 23 which are replenishment targets of empty bobbins Bw, empty bobbins Bw supplied to the take-up tube moving path 51 through the replenishment port 61 are moved to the stockers 23 in order from one of the stockers 23 which is the closest to the replenishment port 61. Furthermore, a stocker 23 which stores the maximum number of empty bobbins Bw is prevented from being replenished with empty bobbins Bw by an empty bobbin Bw which is stored latest in this stocker 23. For example, when each stocker 23 is able to store four empty bobbins Bw at the maximum, a stocker 23 in which four empty bobbins Bw are stored is prevented from being replenished with empty bobbins Bw by the fourth empty bobbin Bw stored in this stocker 23.

[0090] In the embodiment above, each take-up tube moving path 51 is cylindrical in shape. However, each take-up tube moving path 51 may not be cylindrical in shape. For example, when viewed in the base longitudinal direction, each take-up tube moving path 51 may be trapezoidal in shape or a polygon in shape. Alternatively, each take-up tube moving path 51 may extend along the base longitudinal direction and have (i) a supporting surface which supports empty bobbins Bw from below and (ii) wall portions to which both end portions of the supporting surface in the base width direction are connected. In addition to that, an upper part of each take-up tube moving path 51 in the up-down direction may be open. In this case, the height of each wall portion in the up-down direction is preferably greater than the diameter of each empty bobbin Bw. To be more specific, when viewed in the base longitudinal direction, each take-up tube moving path 51 may be U-shaped or irregular U-shaped.

[0091] In the embodiment above, twelve winding devices 21 provided to form three stages and four columns are provided for the winding base 9 included in one span. However, the arrangement of the winding devices 21 is not limited to this. For example, sixteen winding devices 21 provided to form four stages and four columns may be provided for the winding base 9 included in one span, or twenty winding devices 21 provided to form five stages and four columns may be provided for the winding base 9 included in one span.

Claims

1. A take-up tube replenishment device (50, 150) being configured to replenish stockers (23) with empty take-up tubes (Bw) in a false-twist texturing machine (1) in which winding units (30) are provided to be aligned in a predetermined arrangement direction and to form plural stages, the winding units (30) including winding devices (21) and the stockers (23), the stockers (23) being able to store the empty take-up tubes (Bw) which are to be supplied to the winding devices (21), the take-up tube replenishment device (50, 150) comprising

   take-up tube moving paths (51) which are provided to form plural stages corresponding to the winding units (30) provided to form the plural stages, which extend along the arrangement direction, and in which the empty take-up tubes (Bw) to be used to replenish the stockers (23) are movable in the arrangement direction,
   each of the take-up tube moving paths (51) including:

      a supporting surface (51a) which extends along the arrangement direction and which supports the empty take-up tubes (Bw) from below;
      a replenishment port (61) which is provided at an end portion of the corresponding take-up tube moving path (51) in the arrangement direction and which is provided for allowing the empty take-up tubes (Bw) to be supplied; and
      guide portions (62) provided for guiding, to the respective stockers (23), the empty take-up tubes (Bw) moving in the arrangement direction.

2. The take-up tube replenishment device (50, 150) according to claim 1, further comprising first stoppers (52) provided to correspond to the respective guide portions (62) of each of the take-up tube moving paths (51), wherein,
   the state of the first stoppers (52) is switchable between an allowable state in which the first stoppers (52) allow the empty take-up tubes (Bw) to move from each of the take-up tube moving paths (51) to the stockers (23) through the guide portions (62) and a regulated state in which the first stoppers (52) prevent the empty take-up tubes (Bw) from moving from each of the take-up tube moving paths (51) to the stockers (23) through the guide portions (62).

3. The take-up tube replenishment device (50, 150) according to claim 1 or 2, further comprising second stoppers (53) provided to correspond to the respective guide portions (62) of each of the take-up tube

moving paths (51), wherein,

the state of the second stoppers (53) is switchable between an allowable state in which the second stoppers (53) allow the empty take-up tubes (Bw) to move in the arrangement direction of each of the take-up tube moving paths (51) and a guiding state in which the second stoppers (53) guide the empty take-up tubes (Bw) to the stockers (23) through the guide portions (62), and

when the state of the second stoppers (53) is the guiding state, the empty take-up tubes (Bw) are prevented from moving over the second stoppers (53) along the arrangement direction.

4. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 3, further comprising spacers (54) provided for arranging gaps between the adjacent empty take-up tubes (Bw) in each of the take-up tube moving paths (51) to be identical to gaps between the adjacent guide portions (62) in the arrangement direction.

5. The take-up tube replenishment device (50, 150) according to claim 4, further comprising a belt (55) to which the spacers (54) are attached and which is able to move and circulate in the arrangement direction in each of the take-up tube moving paths (51).

6. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 5, further comprising an empty take-up tube automatic throwing device (70) arranged to be able to automatically throw the empty take-up tubes (Bw) into the take-up tube moving paths (51) through replenishment ports (61).

7. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 6, wherein, each of the replenishment ports (61) is provided only at the end portion of each of the take-up tube moving paths (51) on one of both sides of each of the take-up tube moving paths (51) in the arrangement direction.

8. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 7, wherein, as being pressed by an additional empty take-up tube (Bw) which is additionally supplied to each of the take-up tube moving paths (51) through each of the replenishment ports (61), the empty take-up tubes (Bw) in the take-up tube moving paths (51) move in the arrangement direction.

9. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 7, wherein, each of the take-up tube moving paths (51) further includes a conveyance device configured to convey the empty take-up tubes (Bw) in the arrangement direction.

10. The take-up tube replenishment device (50, 150) according to any one of claims 1 to 9, wherein, each of the take-up tube moving paths (51) further includes wall portions which are connected to both end portions of each of supporting surfaces (51a) in an orthogonal direction orthogonal to the arrangement direction, the height of each of the wall portions is greater than the diameter of each of the empty take-up tubes (Bw).

11. The take-up tube replenishment device (50, 150) according to claim 10, wherein, each of the take-up tube moving paths (51) further includes a ceiling which extends along the arrangement direction and which connects the wall portions of each of the take-up tube moving paths (51) to each other.

FIG.1

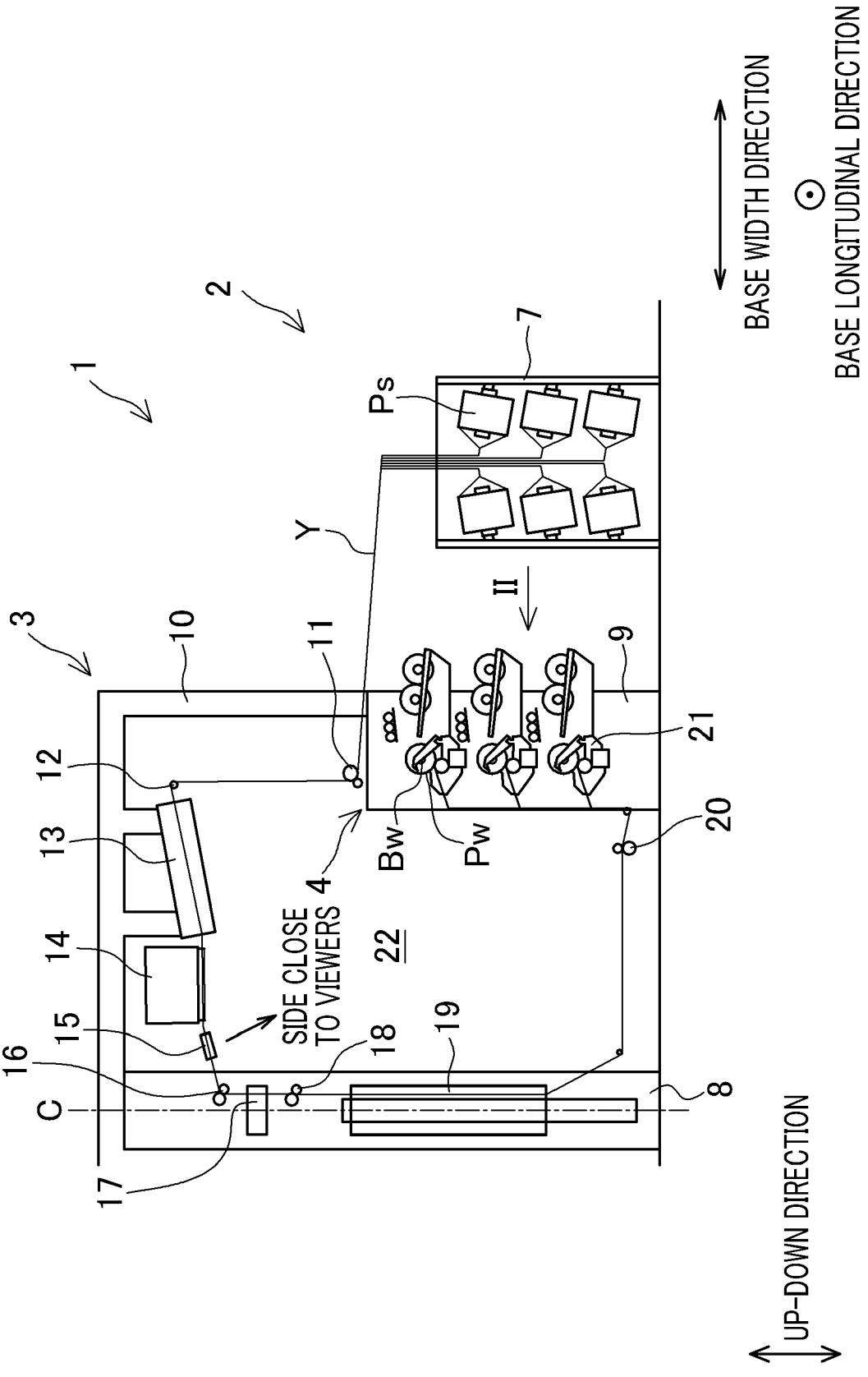

BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION
UP-DOWN DIRECTION
SIDE CLOSE TO VIEWERS
1
2
3
4
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
Ps
Y
II
Bw
Pw
C

FIG.2

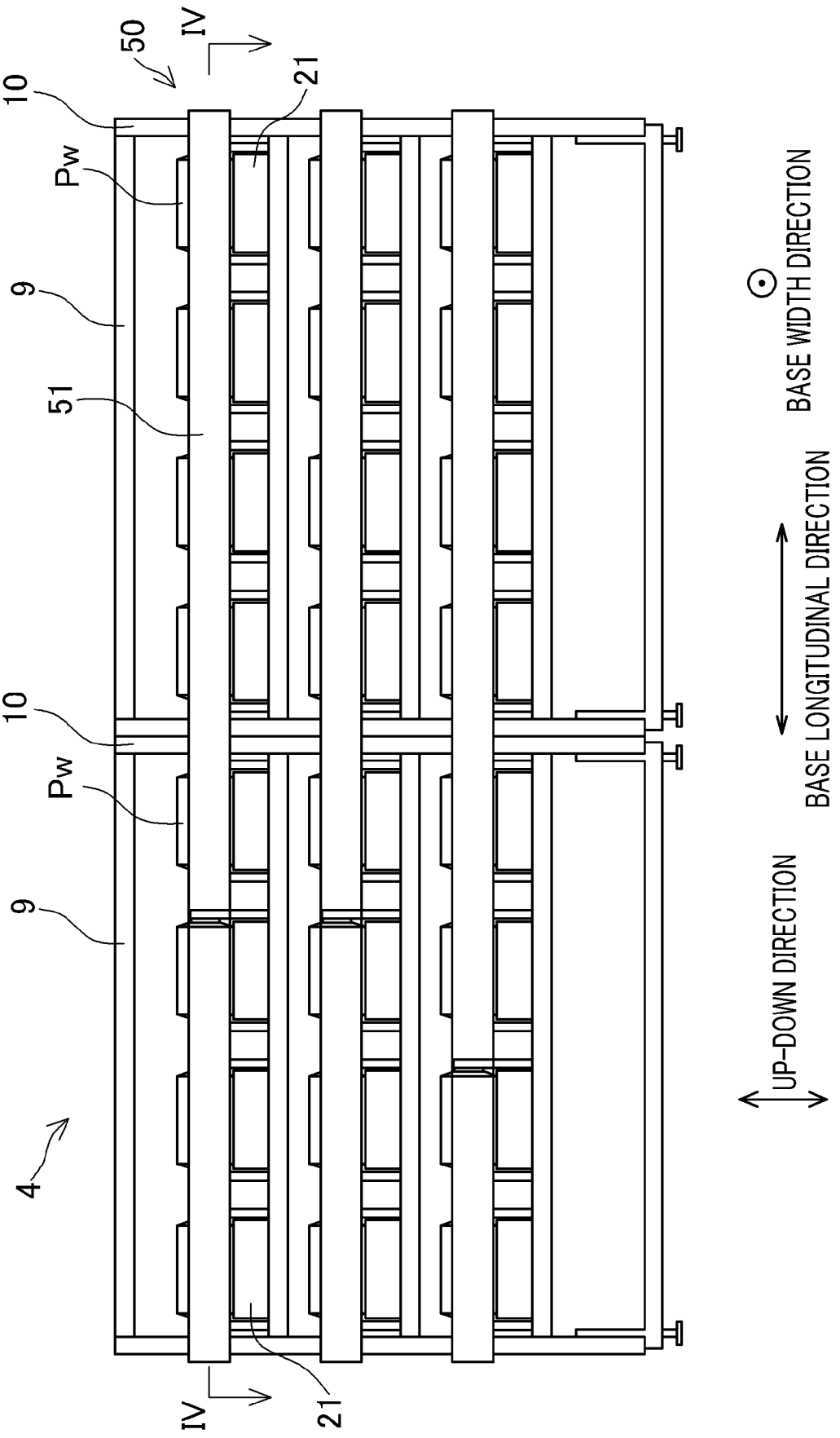

50
IV
21
10
Pw
9
51
10
Pw
9
4
IV
21
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION
UP-DOWN DIRECTION

FIG.3

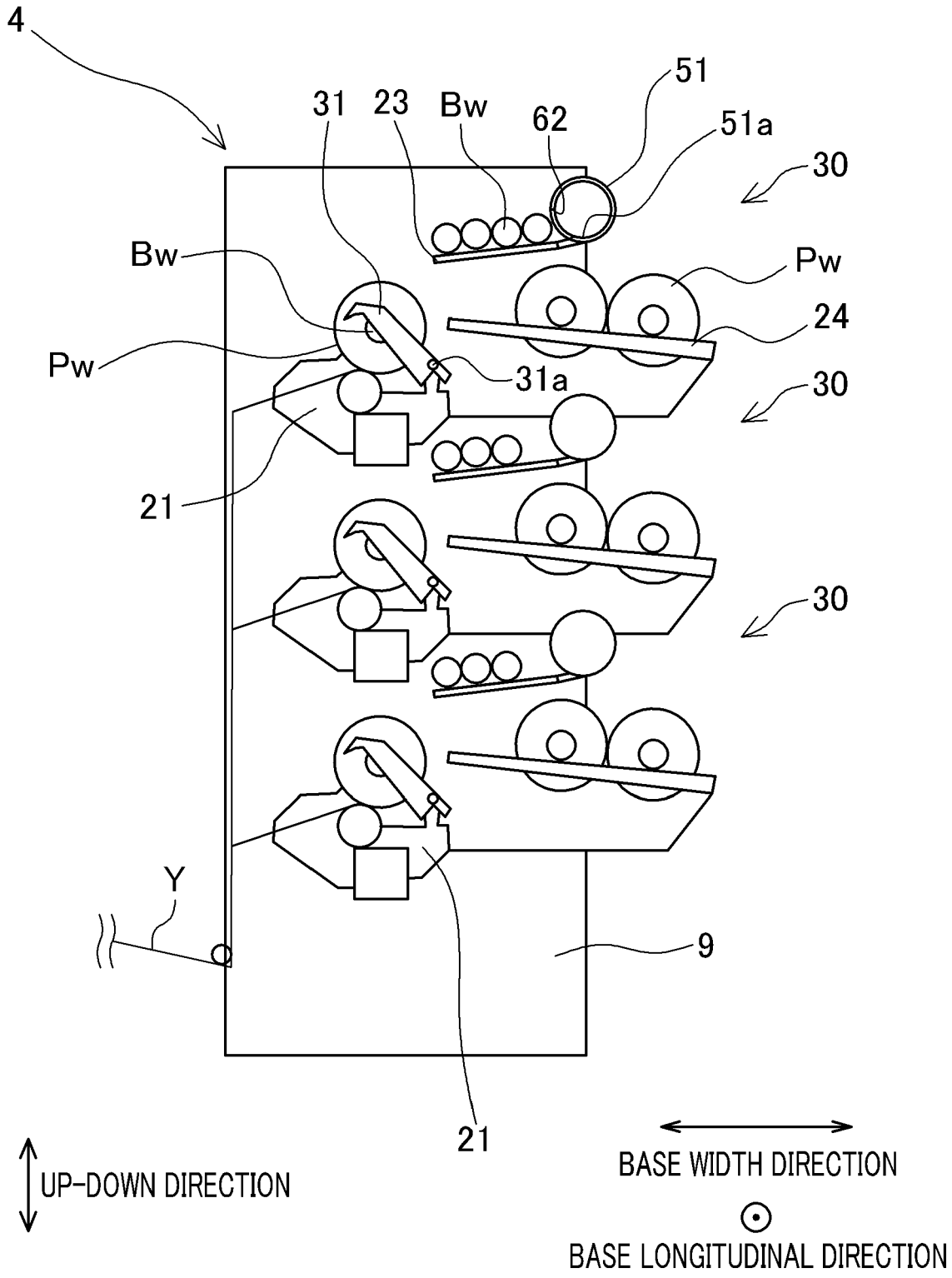

4
51
31
23
Bw
62
51a
30
Bw
Pw
24
Pw
31a
30
21
30
Y
9
21
UP-DOWN DIRECTION
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.4

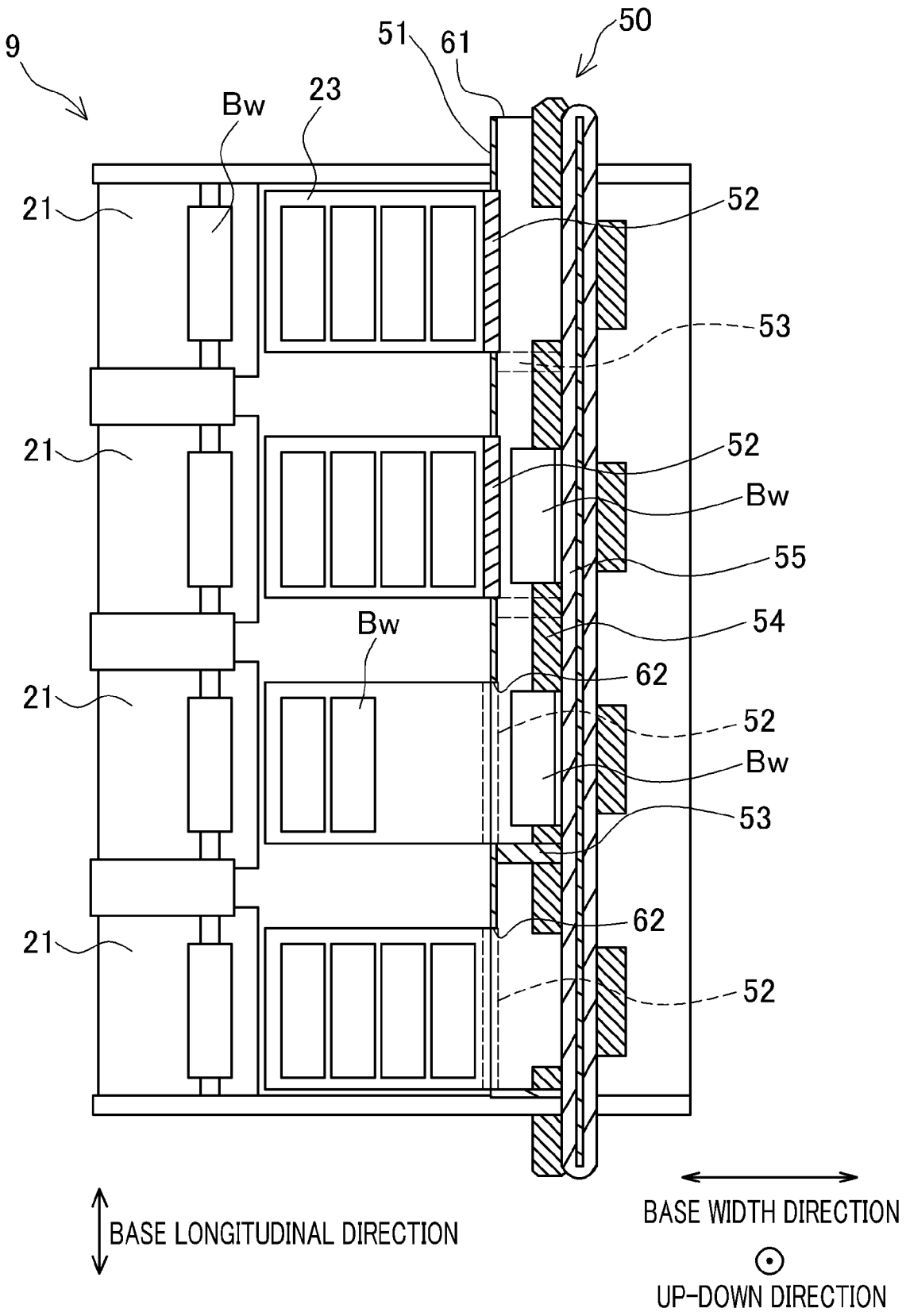

9
51
61
50
Bw
23
21
52
53
21
52
Bw
55
Bw
54
62
21
52
Bw
53
62
21
52
BASE LONGITUDINAL DIRECTION
BASE WIDTH DIRECTION
UP-DOWN DIRECTION

FIG.5

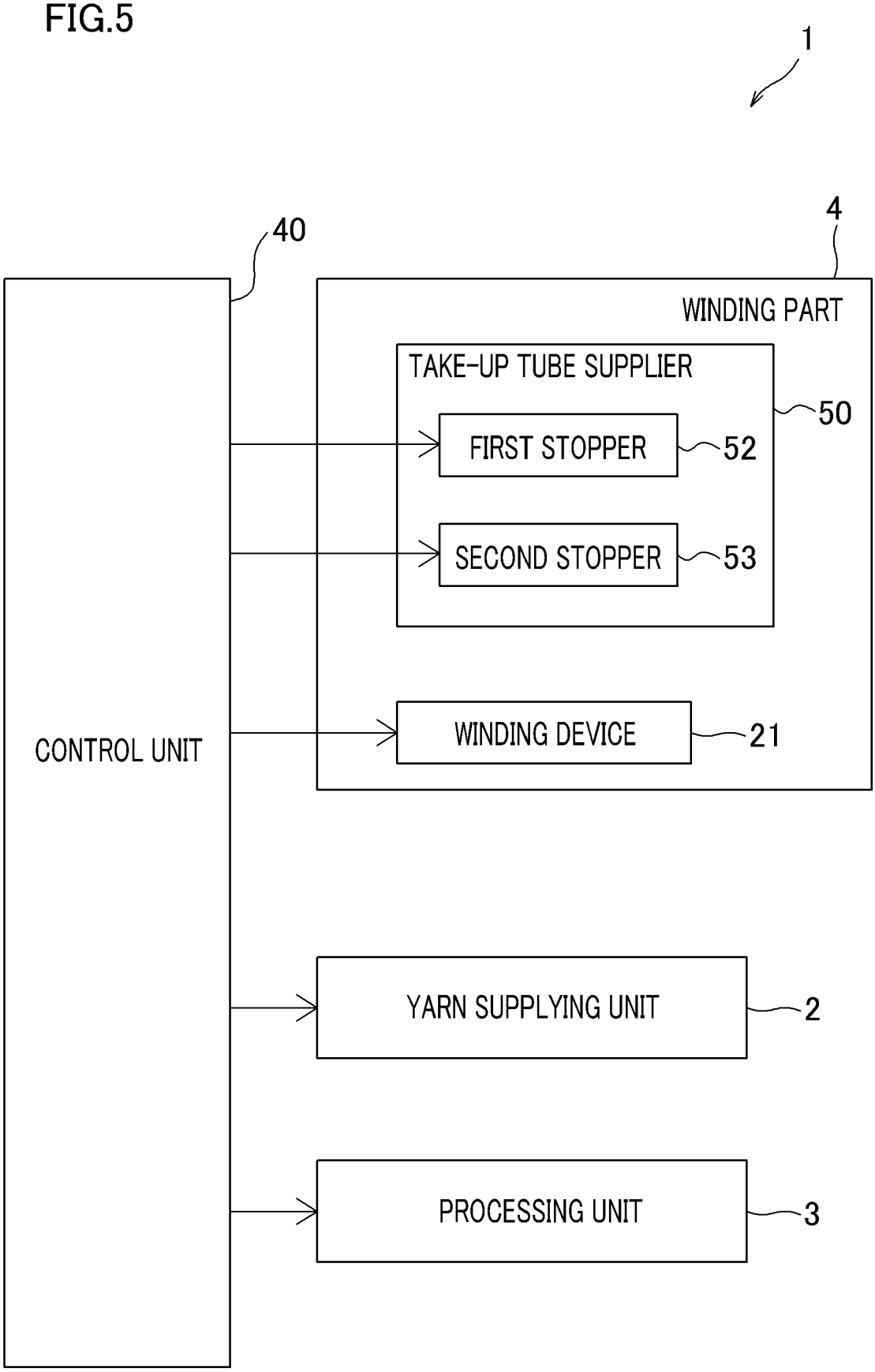
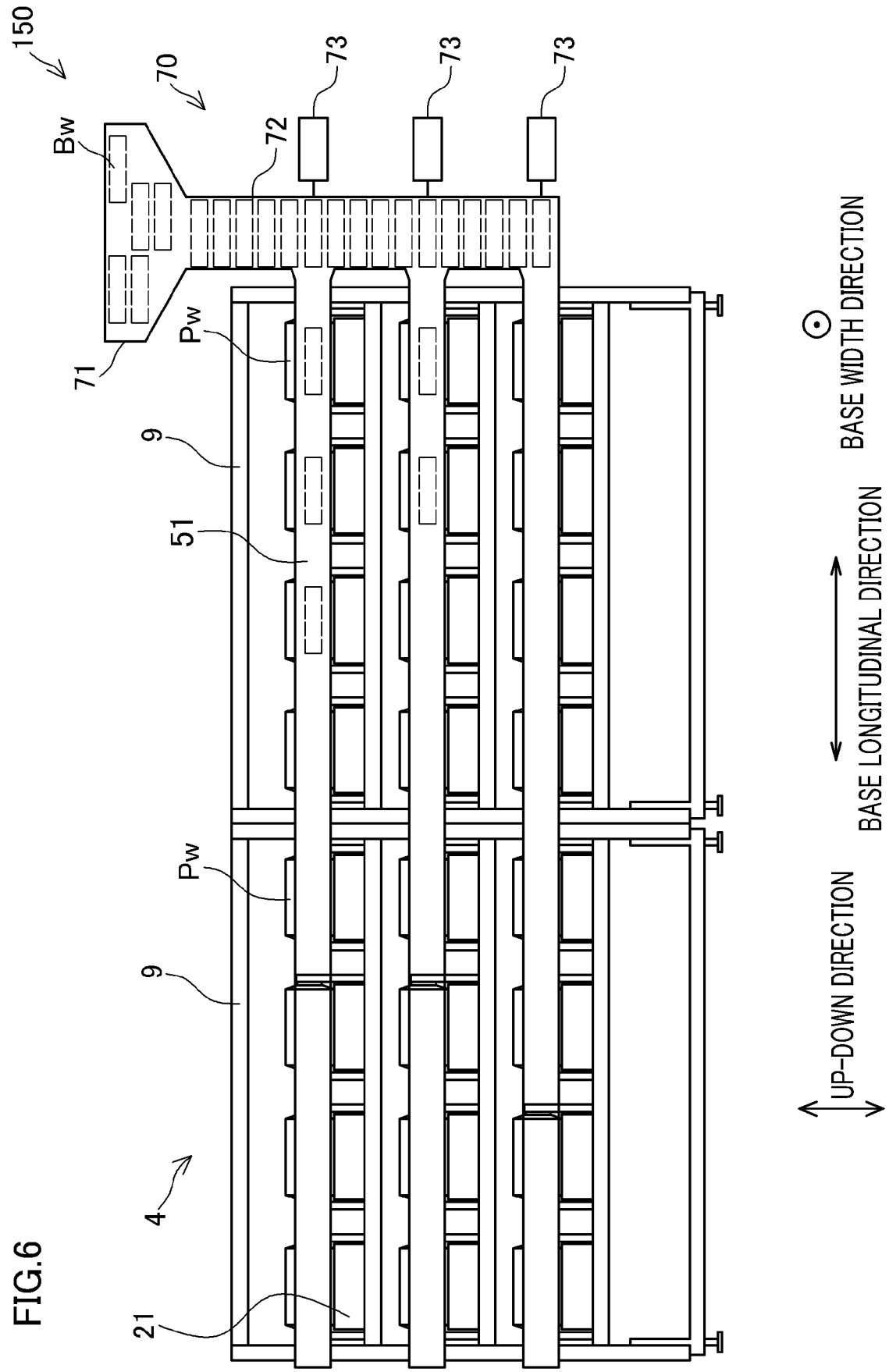

1
4
40
WINDING PART
TAKE-UP TUBE SUPPLIER
50
FIRST STOPPER
52
SECOND STOPPER
53
CONTROL UNIT
WINDING DEVICE
21
YARN SUPPLYING UNIT
2
PROCESSING UNIT
3

FIG.6


150
70
73
73
73
Bw
72
71
Pw
9
51
Pw
9
4
21
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION
UP-DOWN DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 3537

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X	DE 37 15 130 A1 (GEBALD GREGOR [DE]; LANGEN MANFRED [DE]) 24 November 1988 (1988-11-24)	1-3,6-10	INV. B65H67/06
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X	DE 43 28 033 A1 (SCHLAFHORST & CO W [DE]) 23 February 1995 (1995-02-23) * column 3, line 63 - column 6, line 32; figures 1-4 *	1,3,6-9	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 March 2023	Pussemier, Bart

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29-03-2023

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		US 5168695 A	08-12-1992

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

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