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(54) YARN-WINDING DEVICE

(57) To improve freedom of setting change in the winding width in the yarn winding device. In a yarn winding device, a first guide member 63 is configured to move between a non-restriction position at which the lever member 63 does not restrict a movable position of the yarn 4 in a rotational axis direction of the traverse drum 5 to guide the yarn to the traverse drum 5 with a predetermined traverse width, and a restriction position at which the first lever member 63 restricts the movable position of the yarn 4 in the rotational axis direction of the traverse drum 5 to supply the yarn 4 to the traverse drum 5 with a traverse width narrower than the predetermined traverse width, thereby guiding the yarn to different traverse grooves of the traverse drum between the restriction position and the non-restriction position, wherein yarn winding operation with different widths are repeated to perform a step forming winding or a yarn winding operation with a traverse width narrower than the predetermined width is continuously effected to perform a yarn winding with a traverse width narrower than the predetermined traverse width.

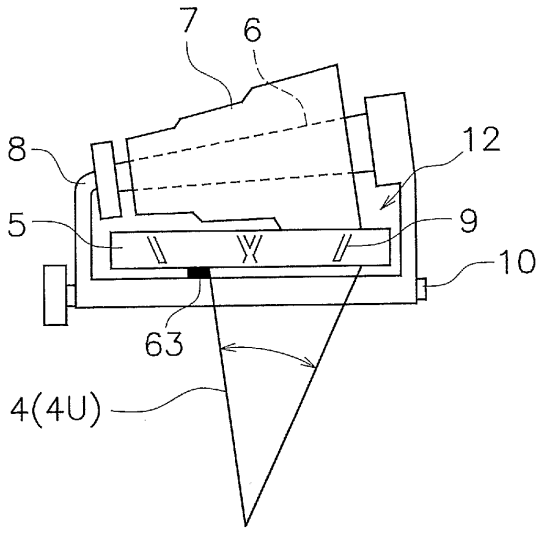

FIG. 5

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Description

TECHNICAL FIELD

[0001] The present invention relates to a yarn winding device.

BACKGROUND ART

[0002] Conventionally, an automatic winder has been known that unwinds a yarn from a yarn supplying bobbin manufactured by a spinning machine, while removing yarn defects such as slub, and splices the yarn of the yarn supply bobbins to manufacture one package (Refer to Patent Citation 1 and Patent Citation 2, for example).

PRIOR ART CITATIONS

PATENT CITATION

[0003]

Patent Citation 1: JPH04-3778A
Patent Citation 2: JPH05-58549A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] In Patent Citation 1, a yarn winding method is recited that moves in/out a switching guide 1 to change the traverse width in the traverse drum-type winder.

[0005] In Patent Citation 2, a yarn winding method is recited that attaches a restriction guide 14 to a yarn guide to restrict the movement of the yarn in one side in a yarn traverse width direction in the traverse drum-type winder.

[0006] However, in the method recited in Patent Citation 1, it is impossible to form a package with steps.

[0007] In the method in Patent Citation 2, it is necessary to attach and detach restriction guides 14 to change the winding width. That is, it is impossible to change the winding width in one package, i.e., it is impossible to form a package with steps.

[0008] It is an object of the present invention to improve freedom of setting change of winding width in a yarn winding device.

TECHNICAL SOLUTION

[0009] Aspects are explained below as the technical solution. These aspects can be arbitrarily combined as needed.

[0010] A yarn winding device according to one aspect of the present invention comprises a rotation support section, a yarn guide section, and a lever member.

[0011] The rotation support section is a section to which a winding member is attached.

[0012] The yarn guide section is configured to guide the yarn to the winding member, the yarn guide section having a traverse drum.

[0013] The lever member is configured to move between a non-restriction position at which the lever member does not restrict a movable position of the yarn in a rotational axis direction of the traverse drum to guide the yarn to the traverse drum with a predetermined traverse width, and a restriction position at which the lever member restricts the movable position of the yarn in the rotational axis direction of the traverse drum to supply the yarn to the traverse drum with a traverse width narrower than the predetermined traverse width, thereby guiding the yarn to different traverse grooves of the traverse drum between the restriction position and the non-restriction position, wherein yarn winding operation with different widths are repeated to perform a step forming winding or a yarn winding operation with a traverse width narrower than the predetermined traverse width is continuously effected to perform a yarn winding with a traverse width narrower than the predetermined traverse width. It should be noted that "different traverse grooves" means that the transfer grooves are not totally the same, and includes the case that the transfer grooves are partially the same. "Predetermined traverse with" means a traverse width determined for each of the traverse drums.

[0014] In this device, by moving the lever member between the restriction position and the non-restriction position, it is possible to change the traverse width of the yarn that is guided to the traverse drum. Specifically, when the lever member is positioned at the non-restriction position, the yarn is guided to the traverse drum with the predetermined

width. When the lever is positioned at the restriction position, the yarn is guided to the traverse drum with a width narrower than the predetermined width so as to travel along the drum grooves different from a case of non-restriction. Accordingly, it is possible to form a yarn layer with a wide winding width and a yarn layer with a narrow winding width. As a result, it is possible to form a package with a narrow winding width, and to form a stepped winding which is constituted by a yarn layer with a narrow width and a yarn layer with a wide width.

[0015] The lever member may include a plurality of lever members provided corresponding to different positions in a rotational axis direction of the traverse drum.

[0016] In this device, if the number of the lever members is two, it is possible to achieve three kinds of winding width.

[0017] The yarn winding device may further comprise:

a driving section configured to drive the lever member; and
a control section configured to control the driving section.

[0018] The control section may control the driving section to perform the following steps alternately:

a step of locating the lever member at the restriction position to guide the yarn to the traverse drum with a traverse width narrower than the predetermined traverse width; and
a step of locating the lever member at the non-restriction position to guide the yarn to the traverse drum with the predetermined traverse width.

[0019] In this device, a yarn layer with a wide winding width and a yarn layer with a narrow width are alternately formed on the winding body so that the package with steps can be obtained.

[0020] The control section may execute the steps depending on predetermined winding pattern information.

[0021] Traverse grooves of the traverse drum may include a first groove extending so as to widen a path of the yarn toward a first side in a width direction of the traverse drum, and a second groove extending so as to narrow a path of the yarn toward a second side in a width direction of the traverse drum, the second groove intersecting the first groove to define an intersection.

[0022] The yarn travelling along the first groove may pass the intersection and continues to travel along the first groove when the lever member is positioned at the non-restriction position.

[0023] The yarn travelling along the first groove may shift to the second groove at the intersection and continues to travel along the second groove when the lever member is positioned at the restriction position.

[0024] The rotation support section may include a pair of support sections, and an adaptor that can be detachably attached to at least one of the pair of support sections and supports an end of the winding member. Accordingly, it is possible to attach winding members having different lengths to the rotation support section.

[0025] The control section may control the driving section such that the yarn includes a first portion and a second portion arranged with each other in a longitudinal direction of the winding member, the second portion having a larger yarn diameter than that of the first portion. The yarn includes a first yarn layer wound at the first portion and the second portion with a first width from a reference end of the winding member, and a second yarn layer alternately layered with the first yarn layer, the second yarn layer being wound only at the second portion with a second width from the reference end of the winding member narrower than first width.

[0026] The control section controls the driving section such that the yarn includes a third portion arranged with the second portion in the longitudinal direction of the winding member, the yarn includes a third yarn layer alternately layered with the first yarn layer and the second yarn layer, and the third layer is wound only at the third portion with a third width from the reference end of the winding member narrower than the second width.

[0027] The control section may control the driving section such that a ratio of traverse numbers of the first yarn layer, the second yarn layer, and the third yarn layer is 2: 3: 4.

[0028] The control section may control the driving section such that drum winding numbers for forming the first yarn layer, the second yarn layer, and the third yarn layer are 2.5w: 2.0w: 1.5w, and the widths of the first yarn layer, the second yarn layer, and the third yarn layer are 6 inches: 4 inches: 3 inches, respectively.

[0029] The control section may control the driving section such that a ratio of traverse numbers of the first yarn layer, the second yarn layer, and the third yarn layer is 1: 2: 2.

[0030] The control section may control the driving section such that drum winding numbers for forming the first yarn layer, the second yarn layer, and the third yarn layer are 2.0w: 1.5w: 1.5w, and the widths of the first yarn layer, the second yarn layer, and the third yarn layer are 4 inches: 3.8 inches: 3 inches, respectively.

[0031] The yarn may include a first portion and a second portion arranged with each other in a longitudinal direction of the winding body. The second portion has a yarn layer with a diameter larger than that of the first portion. The yarn may have a first layer and a second layer alternately layered with each other. The first yarn layer is wound at the first portion and the second portion with a first width from a reference end of the winding member. The second yarn layer is

wound only at the second portion with a second width shorter than the first width from the reference end of the winding member.

[0032] Below, an example will be explained where a first lever member and a second lever member are provided. For example, the first lever member is positioned within the original traverse width of the yarn, and restricts the yarn from further moving at the restriction position to shorten the traverse width of the yarn. The second lever member is positioned within the original traverse width, and restricts the yarn from further moving at the restriction position to further shorten the traverse width of the yarn. In other words, the traverse width of the yarn becomes shorter as one of the turn position shifts in the following order; the original position, the first lever member, and the second lever member. Accordingly, the yarn supplied from traverse drum to the winding member forms a yarn layer with the widest width, a yarn layer having one end corresponding to one end of the previous one and overlapping the previous one partially in the drum width direction with the middle width, and a yarn layer having one end corresponding to one end of the previous one, and partially overlapping the previous one in the drum width direction with the narrowest width.

[0033] A yarn winding method according to another aspect of the present invention, performed by a yarn winding device including a support rotation section to which a winding member is attached, a yarn guiding section having a traverse drum and configured to guide the yarn to the winding member, a lever member configured to move between a non-restriction position at which the lever member does not restrict the a movable position of the yarn in a rotational axis direction of the traverse drum to guide the yarn to the traverse drum with a predetermined traverse width, and a restriction position at which the lever member restricts the movable position of the yarn in the rotational axis direction of the traverse drum to supply the yarn to the traverse drum with a width narrower than the predetermined traverse width, the method repeatedly performing the following steps alternately to realize a step forming winding:

a first step of locating the lever member at the restriction position to guide the yarn to the traverse drum with a width narrower than the predetermined width; and

a second step of locating the lever member at the non-restriction position to guide the yarn to traverse drum with the predetermined traverse width thereby guiding the yarn to a traverse groove of the traverse drum different in the first step or continuously performing the first step to realize a winding with narrower than the predetermined traverse width.

[0034] In this manner, by moving the lever member between the restriction position and the non-restriction position, it is possible to change the traverse width of the yarn that is guided to the traverse drum. Specifically, when the lever member is positioned at the non-restriction position, the yarn is guided to the traverse drum with the predetermined width. When the lever is positioned at the restriction position, the yarn is guided to the traverse drum with a width narrower than the predetermined width so as to travel along the drum grooves different from a case of non-restriction. Accordingly, it is possible to form a yarn layer with a wide winding width and a yarn layer with a narrow winding width. As a result, it is possible to form a package with a narrow winding width, and to form a stepped winding which is constituted by a yarn layer with a narrow width and a yarn layer with a wide width.

ADVANTAGEOUS EFFECTS

[0035] According to a yarn winding device of the present invention, freedom of setting change of the winding width is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0036]

Fig. 1 is a schematic front diagram illustrating a yarn winding section of an automatic winder in a first embodiment.
Fig. 2 is a schematic diagram illustrating a package.
Fig. 3 is a schematic sectional diagram illustrating the package.
Fig. 4 is a schematic front diagram illustrating a first yarn winding operation.
Fig. 5 is a schematic front diagram illustrating a second yarn winding operation.
Fig. 6 is a schematic front diagram illustrating a third yarn winding operation.
Fig. 7 is an exploded diagram of a traverse drum.
Fig. 8 is a block diagram illustrating the control configuration of the automatic winder.
Fig. 9 is a flowchart for explaining the yarn winding operation.
Fig. 10 is a schematic sectional diagram illustrating the first yarn winding operation.
Fig. 11 is a schematic sectional diagram illustrating the second yarn winding operation.
Fig. 12 is a schematic sectional diagram illustrating the third yarn winding operation.

Fig. 13 is a schematic sectional diagram illustrating the first yarn winding operation.
Fig. 14 is a schematic sectional diagram illustrating the second yarn winding operation.
Fig. 15 is a schematic sectional diagram illustrating the third yarn winding operation.
Fig. 16 is a schematic sectional diagram illustrating the first yarn winding operation.
Fig. 17 is an exploded diagram of the grooves on the traverse drum for illustrating the travelling of the yarn along the grooves in the first yarn winding operation.
Fig. 18 is an exploded diagram of the grooves on the traverse drum for illustrating the travelling of the yarn along the grooves in the second yarn winding operation.
Fig. 19 is an exploded diagram of the grooves on the traverse drum for illustrating the travelling of the yarn along the grooves in the first yarn winding operation.
Fig. 20 is a schematic front diagram illustrating the structure of the cradle in a second embodiment.

BRIEF DESCRIPTION OF DRAWINGS

1. First Embodiment

(1) Basic Structure of Automatic Winder

[0037] According to Fig. 1, an automatic winder 1 will be explained. Fig. 1 is a schematic front diagram illustrating a yarn winding section of an automatic winder in the first embodiment.

[0038] The automatic winder 1 includes a yarn winding section 2. The yarn winding section 2 is a device configured to traverse a yarn 4, which is unwound from a yarn supplying bobbin 3, to wind the yarn 4 around a winding tube 6 (one example of a winding member), thereby forming yarn layers, i.e., a cone-shaped package 7. Although only one yarn winding section 2 is illustrated in Fig. 1, the automatic winder 1 is constituted by a plurality of yarn winding sections 2 located on a machine base (not shown).

[0039] It is noted that the winding tube 6 is a winding member being flangeless at both-ends. Although the winding tube 6 is cone-shaped, it may be cylindrical.

[0040] The yarn supplying bobbin 3, which is attached to a tray, is supplied to the yarn winding section 2 by a conveyor (not shown), and is dispelled after the yarn winding operation.

[0041] The yarn winding section 2, as one example of a winding section, includes a cradle 8 (one example of a rotation support section) that detachably supports the winding tube 6, and a yarn guide section 12 that guides the yarn 4 to the winding tube 6. The yarn guide section 12 includes a traverse drum 5, which rotates at a certain speed contacting a peripheral surface of the winding tube 6 or a peripheral surface of the package 7.

[0042] The cradle 8 supports both ends of the winding tube 6 by rotatably holding them. In addition, the cradle 8 can tilt around a rotational axis 10 so that winding thickening (increase of the yarn layer in diameter) accompanying the yarn 4 winding around the winding tube 6 or the package 7 can be absorbed by the rotation of the cradle 8. The winding tube 6 or the package 7 rotates following up the traverse drum 5 by rolling contact.

[0043] The traverse drum 5 rotates the package 7 as well as traverses the yarn 4 on the surface of the package 7. The traverse drum 5 is driven for rotation by a package driving mechanism 41 (Fig. 8). The package driving mechanism 41 includes a motor and a power transmission mechanism.

[0044] The traverse drum 5 has a peripheral surface on which spiral traverse grooves 9 are formed. The yarn 4 is wound around the peripheral surface of the winding tube 6 while the yarn 4 is traversed by the traverse grooves 9 with a constant width, thereby forming the package 7.

[0045] A unit control section 50 (Fig. 8), which controls the yarn winding section 2, is provided at each of the yarn winding sections 2.

[0046] The yarn winding section 2 includes a yarn splicing device 14, a yarn clearer 15, a waxing device 24, a cleaning pipe 25 along a yarn travelling path between the yarn supplying bobbin 3 and the traverse drum 5 in the above-described order from the yarn supplying bobbin 3 side.

[0047] The yarn splicing device 14 joins a lower yarn 4L as the yarn 4 from the yarn supplying bobbin 3 and an upper yarn 4U as the yarn from the package 7 after a yarn cut when the yarn clearer 15 detects a yarn defect and cuts the yarn 4, or after a yarn breakage of the yarn 4 from the yarn supplying bobbin 3.

[0048] The yarn clearer 15 is a device that detects a thickness of the yarn 20 and includes a sensor for detecting a thickness of the yarn 20 passing a detecting portion of the yarn clearer 15, and an analyzer (not shown) for processing a yarn thickness signal from the sensor. The yarn clearer 15 detects a yarn defect such as slub by monitoring the yarn thickness signal from the sensor. The yarn clearer 15 includes a cutter 16 with which the yarn 4 is immediately cut when a yarn defect is detected.

[0049] A lower yarn sucking, catching, and guiding mechanism 17 for sucking, catching, and guiding the lower yarn 4L on the yarn supplying bobbin 3 side to the yarn splicing device 14 is provided below the yarn splicing device 14. An

upper yarn sucking, catching, and guiding mechanism 20 (suction section) for sucking, catching, and guiding the upper yarn 4U on the package 7 side to the yarn splicing device 14 is provided above the yarn splicing device 14.

[0050] The upper yarn sucking, catching, guiding mechanism 20 is shaped like a pipe and includes an air suction mouth 22 at the tip thereof. The upper yarn sucking, catching, guiding mechanism 20 is composed of a pipe 20a extending from the suction mouth 22 and a shaft 21 that rotatably supports the pipe 20a. The pipe 20a is connected to a shutter device (not shown) via a coupling pipe (not shown). In other words, the base end of the upper yarn sucking, catching, guiding mechanism 20 is connected to a blower (not shown) via the shutter device (not shown).

[0051] The lower yarn sucking, catching, guiding mechanism 17 is also shaped like a pipe and includes an air suction port 19 at the tip thereof. The lower yarn sucking, catching, guiding mechanism 17 is composed of a relay pipe 17a configured to be pivotally movable around a shaft 18, and a coupling pipe (not shown) that couples the relay pipe 17a to a blower duct (not shown).

[0052] The waxing device 24 applies appropriate wax to the traveling yarn 4.

[0053] A cleaning pipe 25 sucks and removes foreign matter attached to the traveling yarn 4. Abase end of the cleaning pipe 25 is connected to the blower via the shutter device (not shown). A suction port is formed at the tip of the cleaning pipe 25. The suction port of the cleaning pipe 25 is located in proximity to the yarn 4 traveling between the waxing device 24 and the traverse drum 5.

(2) Package

[0054] With reference to Fig. 2 and Fig. 3, the package 7 will be explained. Fig. 2 is a schematic diagram illustrating a package. Fig. 3 is a schematic sectional diagram illustrating the package.

[0055] The package 7 is cone-shaped with steps, and has 3 steps in this embodiment. Specifically, it includes a first step 7A (one example of a first portion) having the smallest diameter, a second step 7B (one example of a second portion) having the middle diameter, and a third step 7C having the largest diameter.

[0056] The package 7 includes a first yarn layer 51, a second yarn layer 53, and a third yarn layer 55, which are alternately formed. The first yarn layer 51 is formed completely over the width direction (from the first step 7A to the third step 7C). The second yarn layer 53 is formed on one side of the first yarn layer 51 in the width direction (over the second step 7B through the third step 7C) with a width narrower than that of the first yarn layer 51. The third yarn layer 55 is formed on one side of the second yarn layer 53 in the width direction (at the third step 7C) with a width narrower than that of second yarn layer 53. In other words, the first step 7A is constituted by the first yarn layers 51, the second step 7B is constituted by the first yarn layers 51 and the second yarn layers 53, and the third step 7C is constituted by the first yarn layers 51, the second yarn layers 53, and the third yarn layers 55.

[0057] In other words, the first yarn layer 51 is wound with (A) width a from a reference end (P) close to the figure right side, the second yarn layer 53 is wound with a width (B), which narrower than the first yarn layer 51, from the reference end on figure right side, and the third yarn layer 55 is wound with a width (C), which is narrower than the second yarn layer 53, from the reference end on the figure right side.

[0058] When the yarn is unwound from the package 7, the outermost first yarn layer 51, the third yarn layer 55, the second yarn layer 53, the first yarn layer 51 are repeatedly unwound in this order.

[0059] As described above, since a stepped structure is realized which includes the first step 7A and the second step 7B having different outer diameters, the yarn is unlikely to touch the yarn layer when unwound. Specifically, when the second step 7B is being unwound, the yarn never touches the first step 7A. As a result, unwinding tension is decreased.

[0060] In addition, the first yarn layer 51 and the second yarn layer 53, which constitute the first step 7A and the second step 7B of the yarn, are alternately layered. Accordingly, it is possible to realize the yarn winding by which a dangerous zone of latching is avoided.

[0061] The boundaries between the steps are smoothly changed, i.e., no angular portions are formed on the surface. The reason is that the first yarn layer 51 continuously covers a level difference portion of the second yarn layer 53 from the first step 7A to the second step 7B, the first yarn layer 51 continuously covers the level difference portion of the second yarn layer 53 from the second step 7B to the third step 7C, and the second yarn layer 53 continuously covers the level difference portion of the third yarn layer 55 from the second step 7B to the third step 7C.

(3) Yarn Winding Width Adjustment Device

[0062] The yarn winding section 2 includes a yarn winding width adjustment device 61. The yarn winding width adjustment device 61 restricts the yarn 4 being traversed so as to move the yarn 4 along the traverse grooves 9 different from the previous ones, so that a yarn layer is formed on the winding tube 6 with a width narrower than that in the non-restriction case.

[0063] The yarn winding width adjustment device 61 includes, as shown in Fig. 2, a lever member 62. The lever member 62 includes, as a plurality of lever members, a first guide lever 63 and a second guide lever 65. The first guide

lever 63 and the second guide lever 65 are provided close to a yarn guiding side of the traverse drum 5. Specifically, the first guide lever 63 and the second guide lever 65 are located corresponding to different positions in the rotational axis direction of the traverse drum 5, specifically, from the figure left side to the right in the above-described order.

[0064] The first guide lever 63 and the second guide lever 65 can move between a restriction position and a non-restriction position. At the restriction position, the first guide lever 63 and the second guide lever 65 restrict a movable position of the yarn in the rotational axis direction of the traverse drum 5 in a yarn traverse passing area so as to guide the yarn 4 to the traverse drum 5 with a narrow traverse width. At the non-restriction position, the first guide lever 63 and the second guide lever 65 do not restrict a movable position of the yarn in the rotational axis direction of the traverse drum by going out of the yarn traverse passing area so as to guide the yarn to the traverse drum 5 with a predetermined traverse width. The first guide lever 63 and the second guide lever 65 guide the yarn 4 to the different traverse grooves 9 of the traverse drum 5 depending on whether they are positioned at the restriction position or the non-restriction position (later described). "Predetermined width" means a traverse width defined for each of the traverse drums.

[0065] In this embodiment, since the number of the guide lever is two, it is possible to realize a package 7 having three kinds of winding width (later described).

[0066] The yarn winding width adjustment device 61 includes a traverse forming mechanism 43 (Fig. 8) that controls the operation of the first guide lever 63 and the second guide lever 65 (later described).

[0067] With reference to Fig. 4 through Fig. 6, the summary of the first through third yarn winding operation will be explained. Fig. 4 is a schematic front diagram illustrating a first yarn winding operation. Fig. 5 is a schematic front diagram illustrating a second yarn winding operation. Fig. 6 is a schematic front diagram illustrating the third yarn winding operation.

[0068] In the first yarn winding operation, as shown Fig. 4, the first guide lever 63 and the second guide lever 65 are located at the non-restriction positions, so that the yarn 4 is not restricted and is guided to the traverse drum 5 with the widest traverse width. As a result, the first yarn layer 51 is formed.

[0069] In the second yarn winding operation, as shown in Fig. 5, only the first guide lever 63 is positioned at the restriction position, so that the yarn 4 is restricted and is guided to the traverse drum 5 with a middle-sized traverse width. Specifically, the yarn 4 is prevented from being traversed toward the figure left side (on a small diameter side of the package 7) by the first guide lever 63. As a result, the second yarn layer 53 is formed

[0070] In the third yarn winding operation, as shown in Fig. 6, only the second guide lever 65 is positioned at the restriction position, so that the yarn 4 is restricted and is guided to the traverse drum 5 with the narrowest traverse width. Specifically, the yarn 4 is prevented from being traversed to the figure left side (on the small diameter side of the package 7) by the second guide lever 65. As a result, the third yarn layer 55 is formed.

[0071] With reference to Fig. 7, the groove shape of the traverse drum 5 will be explained. Fig. 7 is an exploded diagram of the traverse drum. The rotational direction of the traverse drum 5 is indicated by an arrow (R).

[0072] The traverse grooves of the traverse drum 5 are formed spiral, and mainly include a traverse outward route 71 (one example of a first groove) and a traverse homeward route 73 (one example of a second groove). The traverse outward route 71 extends leftward and diagonally downward in the figure and is shown as three grooves. In other words, the traverse outward route 71 extends so as to widen the path of the yarn leftward in the figure (on a first side in the width direction) when the yarn 4 is guided by the grooves. Specifically, in Fig. 7, the traverse outward route 71 extends in the following order: point (a); point (b); point (c); and point (d).

[0073] The traverse homeward route 73 extends rightward and diagonally downward in the figure, and is indicated as two grooves. In other words, the traverse homeward route 73 extends so as to narrow the path of the yarn toward the figure right side of the traverse drum 5 (on a second side in the width direction). Specifically, in Fig. 7, the traverse homeward route 73 extends in the following order: point (d); point (e); and point (a).

[0074] The traverse outward route 71 and the traverse homeward route 73 include a first intersection 75 (one example of an intersection) and a second intersection 77 (one example of an intersection). The first intersection 75 is provided at a position about 2/3 from the right end of the drum width in Fig. 7. The second intersection 77 is provided at a position about 1/3 from the right end of the drum width in Fig. 7.

[0075] According to the above-described structure, the yarn 4, which has been traversed leftward in the figure at the traverse outward route 71, is then traversed rightward in the figure at the traverse homeward route 73, to the original position. Accordingly, the yarn 4, which is traversed by the traverse grooves 9, is wound around the winding tube 6.

[0076] According to the above-described first yarn winding operation, the width range within which the yarn 4 travels along the traverse grooves 9 on the traverse drum 5 is the entire drum width (6 inches, for example), which is shown as width (A).

[0077] According to the above-described second yarn winding operation, the range within which the yarn travels along the traverse grooves 9 on the traverse drum 5 is the right end of the traverse drum 5 and the first intersection 75 (4 inches, for example), which is shown as width (B).

[0078] According to the above-described third yarn winding operation, the width range within which the yarn 4 travels along the traverse grooves 9 on the traverse drum 5 is between the right end of the traverse drum 5 and the second intersection 77 (3 inches, for example), which is shown as width (C).

(4) Control Configuration of Yarn winding section

[0079] With reference to Fig. 8 and Fig. 9, the control configuration of the yarn winding section 2 will be explained. Fig. 8 is a block diagram illustrating the control configuration of the automatic winder. Fig. 9 is a flowchart for explaining the yarn winding operation.

[0080] The yarn winding section 2 includes a unit control section 50.

[0081] The unit control section 50 is a computer system including a processor (e.g. a CPU), a storage device (e.g. a ROM, a RAM, an HDD, an SSD, and the like), and various interfaces (e.g. an A/D converter, a D/A converter, a communication interface, and the like). The unit control section 50 executes a program stored in a storage unit (corresponding to a part or the whole of storage area of the storage device) so as to perform various control operations.

[0082] The unit control section 50 may be constituted of a single processor or may be constituted of a plurality of processors independent of each other for individual controls.

[0083] A part or the whole of functions of individual elements of the unit control section 50 may be realized as a program that can be executed by the computer system constituting the control unit. Other than that, a part of functions of individual elements of the control unit may be constituted of a custom IC.

[0084] The above-described package driving mechanism 41 is connected to the unit control section 50.

[0085] The above-described traverse forming mechanism 43 is connected to the unit control section 50. The traverse forming mechanism 43 is one for forming the package 7 with steps. The traverse forming mechanism 43 includes a first driving mechanism 45 (one example of a driving portion), a second driving mechanism 47 (one example of a driving portion), and a rotation sensor 59.

[0086] The first driving mechanism 45 is an actuator for moving the first guide lever 63 between the restriction position and the non-restriction position, and is a solenoid, for example. The first driving mechanism 45 may be a motor or a power transmission mechanism.

[0087] The second driving mechanism 47 is an actuator for moving the second guide lever 65 between the restriction position and the non-restriction position, is a solenoid, for example. The second driving mechanism 47 may be a motor or a power transmission mechanism.

[0088] The rotation sensor 59 is one that outputs a signal each time the traverse drum 5 rotates by 1/60 rotation.

[0089] To the unit control section 50, a sensor for detecting the location of the yarn 4, sensors and switches for detecting conditions of the devices, and information input devices (not shown) are connected.

(5) Yarn Winding Operation

[0090] With reference to Fig. 9, a yarn winding operation of the package 7 will be explained.

[0091] Control flowchart is illustrative to be described below, each step may be omitted and replaced if necessary. Also, or more steps are performed simultaneously, may cause some or all runs overlapping.

[0092] Further, each block of the control flow chart is not limited to a single control operation, it can be replaced by a plurality of control operation represented by a plurality of blocks.

[0093] Operation of the device is the result of a command to each device from the control unit, which are represented by the respective steps in a software application.

[0094] First, a method of determining the switching timing of the guide lever will be explained. Drum winding number is number of revolutions of the traverse drum while one traverse is performed (i.e., the yarn reciprocates between both ends of the drum grooves). Therefore, the drum winding number have different number of revolutions of the drum required for one traverse (reciprocating the drum one time) for the different kinds of yarn winding operations. Therefore, signal input number from the rotation sensor 59 are different from each other for the different kinds of yarn winding operations.

[0095] The relationship between the drum winding number, drum rotational number/trv, drum rotation signal input number/trv is as follows, for example.

drum winding number	drum rotational number/trv	drum rotation signal input number/trv
2.5w	2.5	150 times
2.0w	2.0	120 times
1.5w	1.5	90 times

[0096] Accordingly, depending on the state of the guide lever (the restriction position or the non-restriction position), the drum winding number (the number of winding) is determined, and how many drum rotation is necessary for one traverse is determined. Accordingly, for each winding number, a guide lever can move between the restriction position

and the non-restriction position at a proper timing.

[0097] Below, with reference to Fig. 9, the formation of the package 7 will be explained wherein 2.5w (6 inches): 2.0w (4 inches): 1.5w (3 inches) = 2: 3: 4 (traverse number (layer number)).

[0098] At step S1, a first yarn winding operation is performed. Specifically, the unit control section 50 controls the first guide lever 63 and the second guide lever 65 to move to the non-restriction position so as to set the drum winding number to 2.5w. Then, two yarn layers are formed in this state. When the drum rotation signals is input by 150×2 = 300 times, the formation of the first yarn layer 51 is finished.

[0099] At Step S2, it is determined whether or not the package 7 is completed. If it is not completed, the process shifts to Step S3. If it is completed, the process is finished.

[0100] At Step S3, the second yarn winding operation is performed. Specifically, the unit control section 50 controls the first guide lever 63 to the restriction position to switch the drum winding number to 2.0w. And three yarn layers are formed in this state. Then, when the drum rotation signal is input by 120×3 = 360 times, the formation of the second yarn layer 53 is finished.

[0101] At Step S4, the third yarn winding operation is performed. Specifically, the unit control section 50 controls the first guide lever 63 to move to the non-restriction position and the second guide lever 65 to move to the restriction position, thereby switching the drum winding number to 1.5w. Then, four layers are formed in this state. Then, when the drum rotation signal is input by 90×4 = 360 times, the formation of the third yarn layer 55 is finished.

[0102] As described above, the first yarn layer 51, the second yarn layer 53, and the third yarn layer 55 are repeatedly formed, and the first yarn layer 51 is finally formed, thereby completing the package 7.

[0103] It should be noted that the unit control section 50 executes the above-described steps depending on predetermined winding pattern information. Specifically, the unit control section 50, automatically or following the instructions from an operator, reads the winding pattern information stored in a memory, and executes the control based on it. Accordingly, the package manufacturing operation becomes simple. As a modification, an operator can input the winding pattern into the unit control section 50 every time.

[0104] In the above-described package manufacturing method, a step of winding the first yarn layer 51 around the winding tube 6, a step of winding second yarn layer 53 over the first yarn layer 51 in a range in the longitudinal direction of the winding tube 6 shorter than the first yarn layer 51, and a step of winding the third yarn layer 55 over the second yarn layer 53 in a range in the longitudinal direction of the winding tube 6 shorter than the second yarn layer 53, are alternately repeated. As a result, a yarn layer is formed which has a first step 7A, a second step 7B and a third step 7C. The second step 7B and the third step 7C are arranged with the first step 7A in the longitudinal direction of the winding tube 6. The second step 7B has a diameter larger than that of first step 7A. The third step 7C has a diameter larger than that of the second step 7B.

[0105] The operation of changing the width of the yarn layers will be explained in detail, as below. By moving the first guide lever 63 and the second guide lever 65 between the restriction position and the non-restriction position, it is possible to change the traverse width of the yarn 4 being guided to the traverse drum 5. Specifically, when the first guide lever 63 and the second guide lever 65 are positioned at the non-restriction positions, the yarn 4 is guided to the traverse drum 5 with a wide traverse width. When the first guide lever 63 and the second guide lever 65 are at the restriction positions, the yarn 4 is guided to the traverse drum 5 with a narrow traverse width, then passes traverse grooves different from that when not restricted, and the yarn 4 is wound around the winding tube 6 with a narrow winding width. Accordingly, the first yarn layer with a wide winding width and the second yarn layer with a narrow winding width can be formed, for example. Therefore, as the present embodiment, the yarn layer with a narrow winding width and the yarn layer with a wide winding width can be combined with each other on one package, thereby obtaining the package 7 with stepped portions.

[0106] With reference to Fig. 10 through Fig. 16, formation of the yarn layer in the above-described winding operation will be explained in detail. Fig. 10 through Fig. 16 are schematic sectional diagrams illustrating the yarn winding operations.

[0107] As shown in Fig. 10, as a first yarn winding operation, the first yarn layer 51 is formed over the entire surface of the winding tube 6 (Step S1 in Fig. 9).

[0108] As shown in Fig. 11, as a second yarn winding operation, the second yarn layer 53 is formed over the first yarn layer 51 (Step S3 in Fig. 9).

[0109] As shown in Fig. 12, as a third yarn winding operation, the third yarn layer 55 is formed on the second yarn layer 53 (Step S4 in Fig. 9).

[0110] As shown in Fig. 13, as the first yarn winding operation, the first yarn layer 51 is formed on the previous first yarn layer 51, the second yarn layer 53 and the third yarn layer 55 (Step S1 in Fig. 9).

[0111] As shown in Fig. 14, as the second yarn winding operation, the second yarn layer 53 is formed on the first yarn layer 51 (Step S3 in Fig. 9).

[0112] As shown in Fig. 15, as the third yarn winding operation, the third yarn layer 55 is formed on the second yarn layer 53 (Step S4 in Fig. 9).

[0113] As shown in Fig. 16, as the first yarn winding operation, the first yarn layer 51 is formed on the third yarn layer

55 (Step S1 in Fig.9). As a result, the package 7 is finished.

[0114] As described above, since the first yarn layer 51 covers the level difference portion between the second yarn layer 53 and the third yarn layer 55, change in height of the yarn layer at the level difference portion is decreased, so that the height changes gently. Accordingly, the number of the yarn layers can be increased, and the weight of the package 7 can be increased.

[0115] It should be noted that a set of the first yarn layer 51, the second yarn layer 53 and the third yarn layer 55 can be repeated three times or more although there are two such repetitions in the above-described embodiment.

[0116] It should be further noted that the number of kinds of the yarn layers constituting a repeated set can be two or four or more although there are three in the above-described embodiment.

[0117] With reference to Fig. 17 through Fig. 19, travelling of the yarn along the groove will be explained. Fig. 17 through Fig. 19 are exploded diagrams of the grooves on the traverse drum for illustrating the travelling of the yarn along the grooves in the yarn winding operations.

[0118] As shown in Fig. 17, the first yarn winding operation (step S1 in Fig. 9), the yarn 4 travels along the traverse grooves 9 of the traverse drum 5 in the following order: point (a); point (b); point (c); point (d); point (e); and point (a). More specifically, since the first guide lever 63 is positioned at the non-restriction position, the yarn 4, travelling along the traverse outward route 71, passes the first intersection 75 and continues to travel along the traverse outward route 71. As a result, the first yarn layer 51 is formed.

[0119] It should be noted that although the above explanation applies to a case where 6 inch - 2.5w drum grooves are employed, it is possible to utilize 6 inch - 2.0w drum grooves as necessary. In other words, variation of the traverse width can be increased. In the yarn winding operation employing 6 inch - 2.0w drum grooves, the yarn 4 travels along the traverse grooves 9 of the traverse drum 5, specifically, in the following order: point (a); branch point 79; point (e); junction point 81; point (d); point (e); and point (a) in Fig. 7.

[0120] As shown in Fig. 18, in the second yarn winding operation (Step S3 in Fig. 9), the yarn 4 travels along the traverse grooves 9 of the traverse drum 5 in the following order: point (a); point (b); point (c); first intersection 75; point (e); and point (a). More specifically, since the first guide lever 63 is positioned at the restriction position, the yarn 4, which travels along the traverse outward route 71, shifts to the traverse homeward route 73 at the first intersection 75, and then travels along the traverse homeward route 73. As a result, the second yarn layer 53 is formed.

[0121] As shown in Fig. 19, in the third yarn winding operation (Step S4 in Fig. 9), the yarn 4 travels along the traverse grooves 9 of the traverse drum 5 in the following order: point (a); point (b); second intersection 77; and point (a). More specifically, since the second guide lever 65 is positioned at the restriction position, the yarn 4, which travels along the traverse outward route 71, shifts to the traverse homeward route 73 at the second intersection 77, and travels along the traverse homeward route 73 after that. As a result, the third yarn layer 55 is formed.

[0122] Although the package with winding width of 6 inches is explained in this embodiment, the present invention can be applied to a package of a different size. For example, the present invention can be applied to a package with a winding width of 4 inches. As one example, a package can be used which employs 2.0w (4 inches): 1.5w (3.8 inches): 1.5w (3 inches) = 1: 2: 2 (traverse number (layer number)). In this case, the dangerous zone of the latching can be avoided, too.

2. Second Embodiment

[0123] With reference to Fig. 20, an embodiment of a cradle will be explained. Fig. 20 is a schematic front diagram illustrating the structure of the cradle in the second embodiment.

[0124] The cradle 8 has a support potion 8a at one end, to which an adaptor 83 is detachably attached. The adaptor 83 supports the end portion of the winding tube 6. According, it is possible to attach winding tubes 6 with different lengths to the cradle 8.

[0125] The adaptor may be provided at another support end of the cradle, or both support end portions of the cradle, as modifications.

3. Other Embodiments

[0126] The above explained embodiments of the present invention, but the present invention is not limited to the above-mentioned embodiments and various modifications are possible within a range that does not depart from the essence of the invention. In particular, the embodiments and modified examples written in the present specification can be arbitrarily combined as needed.

[0127] Although a stepped winding as a combination of a yarn layer with a narrow winding width and a yarn layer with a wide winding width is realized in one package in the previous embodiment, it is possible to perform other yarn winding methods. For example, if the lever member is position at the restriction position to continuously guide the yarn to the traverse drum with a narrow traverse width, a package with a narrow winding width can be obtained. Specifically, if the

first guide lever 63 is positioned at the restriction position to continuously perform the yarn winding, a package with a middle-sized width can be obtained. If the second guide lever 65 is positioned at the restriction position to continuously perform the yarn winding, a package with a narrow width can be obtained.

[0128] The shape of the package may be cone-shaped (truncated cone-shape) or cheese-shaped (cylindrical).

[0129] Although the number of the guide levers is two in the first embodiment and a package with three steps is manufacture, the number of the guide lever is not limited. For example, only one guide lever can be used to manufacture a package with steps. The number of the guide levers may be three or more.

[0130] Although the number of the guide levers positioned at the restriction position at one time is one in the first embodiment, this number is not limited. For example, the number of the guide levers moving to the restriction position at one time may be two. In this case, the traverse width of the yarn is limited between the two guide levers.

[0131] The present invention can be also applied to a spinning machine and an open-end spinning machine.

INDUSTRIAL APPLICABILITY

[0132] The present invention can be widely applied to a yarn winding device.

REFERENCE SIGNS LIST

[0133]

1: automatic winder
2: yarn winding section
3: yarn bobbin
4: yarn
5: traverse drum
6: winding tube
7: package
7A: first step
7B: second step
7C: third step
8: cradle
9: traverse grooves
10: rotation axis
11: tray
14: yarn splicing device
15: yarn clearer
16: cutter
17: lower yarn sucking, catching, guiding mechanism
17a: relay pipe
19: air suction port
20: upper yarn sucking, catching, guiding mechanism
20a: pipe
22: suction mouth
24: waxing device
25: cleaning pipe
41: package driving mechanism
43: traverse forming mechanism
45: first driving mechanism
47: second driving mechanism
50: unit control section
51: first yarn layer
53: second yarn layer
55: third yarn layer
59: rotation sensor
61: yarn winding width adjustment device
63: first guide lever
65: second guide lever
71: traverse outward route

73: traverse homeward route
75: first intersection
77: second intersection

Claims

1. A yarn winding device, comprising:

a rotation support section to which a winding member is attached;
a yarn guide section configured to guide the yarn to the winding member, the yarn guide section having a traverse drum; and
a lever member configured to move between a non-restriction position at which the lever member does not restrict a movable position of the yarn in a rotational axis direction of the traverse drum to guide the yarn to the traverse drum with a predetermined traverse width, and a restriction position at which the lever member restricts the movable position of the yarn in the rotational axis direction of the traverse drum to supply the yarn to the traverse drum with a traverse width narrower than the predetermined traverse width, thereby guiding the yarn to different traverse grooves of the traverse drum between the restriction position and the non-restriction position wherein yarn winding operations with different widths are repeated to perform a step forming winding or a yarn winding operation with a traverse width narrower than the predetermined traverse width is continuously effected to perform a yarn winding with a traverse width narrower than the predetermined traverse width.

2. The yarn wingding device according to claim 1, wherein
the lever member includes a plurality of lever members provided corresponding to different positions in a rotational axis direction of the traverse drum.

3. The yarn wingding device according to claim 1 or 2, further comprising:

a driving section configured to drive the lever member; and
a control section configured to control the driving section, wherein
the control section controls the driving section to perform a set of the following steps alternately:

a step of locating the lever member at the restriction position to guide the yarn to the traverse drum with a traverse width narrower than the predetermined traverse width; and
a step of locating the lever member at the non-restriction position to guide the yarn to the traverse drum with the predetermined traverse width.

4. The yarn winding device according to claim 3, wherein
the control section executes the steps depending on predetermined winding pattern information.

5. The yarn winding device according to one of claims 1 to 4, wherein traverse grooves of the traverse drum include a first groove extending so as to widen a path of the yarn toward a first side in a width direction of the traverse drum, and a second groove extending so as to narrow a path of the yarn toward a second side in a width direction of the traverse drum, the second groove intersecting the first groove to define an intersection,
wherein the yarn travelling along the first groove passes the intersection and continues to travel along the first groove when the lever member is positioned at the non-restriction position,
wherein the yarn travelling along the first groove shifts to the second groove at the intersection and continues to travel along the second groove when the lever member is positioned at the restriction position.

6. The yarn winding device according to any of claims 1 through 5, wherein the rotation support section includes a pair of support sections, and an adaptor that can be detachably attached to at least one of the pair of support sections and supports an end of the winding member.

7. The yarn winding device according to claim 3, wherein
the control section controls the driving section such that the yarn includes a first portion and a second portion arranged with each other in a longitudinal direction of the winding member, the second portion has a diameter larger than that of the first portion, and the yarn includes a first yarn layer wound at the first portion and the second portion with a first width from a reference end of the winding member, and a second yarn layer layered alternately with the

first yarn layer, the second yarn layer is wound only at the second portion with a second width from the reference end of the winding member narrower than the first width.

8. The yarn winding device according to claim 7, wherein
the control section controls the driving section such that the yarn includes a third portion arranged with the second portion in the longitudinal direction of the winding member, the yarn includes a third yarn layer alternately layered with the first yarn layer and the second yarn layer, and the third layer is wound only at the third portion with a third width from the reference end of the winding member narrower than the second width.

9. The yarn winding device according to claim 8, wherein
the control section controls the driving section such that a ratio of traverse number of the first yarn layer, the second yarn layer, and third yarn layer is 2: 3: 4.

10. The yarn winding device according to claim 9, wherein
the control section controls the driving section such that a drum winding number for forming the first yarn layer, the second yarn layer, and the third yarn layer are 2.5w: 2.0w: 1.5w and the widths of the first yarn layer, the second yarn layer, and the third yarn layer are 6 inches: 4 inches: 3 inches, respectively.

11. The yarn winding device according to claim 8, wherein the control section controls the driving section such that a ratio of a traverse number of the first yarn layer, the second yarn layer, and the third yarn layer is 1: 2: 2.

12. The yarn winding device according to claim 11, wherein
the control section controls the driving section such that a drum winding number for forming the first yarn layer, the second yarn layer, and the third yarn layer are 2.0w: 1.5w: 1.5w, and the widths of the first yarn layer, the second yarn layer, and the third yarn layer are 4 inches: 3.8 inches: 3 inches, respectively.

13. A yarn winding method performed by a yarn winding device including a support rotation section to which a winding member is attached, a yarn guide section having a traverse drum and configured to guide the yarn to the winding member, a lever member configured to move between a non-restriction position at which the lever member does not restrict a movable position of the yarn in a rotational axis direction of the traverse drum to guide the yarn to the traverse drum with a predetermined traverse width, and a restriction position at which the lever member restricts the movable position of the yarn in the rotational axis direction of the traverse drum to supply the yarn to the traverse drum with a width narrower than the predetermined traverse width, the method repeatedly performing the following steps alternately to realize a step forming winding:

a first step of locating the lever member at the restriction position to guide the yarn to the traverse drum with a width narrower than the predetermined traverse width; and
a second step of locating the lever member at the non-restriction position to guide the yarn to the traverse drum with the predetermined traverse width, thereby guiding the yarn to a traverse groove of the traverse drum different in the first step or continuously performing the first step to realize a winding width narrower than the predetermined traverse width.

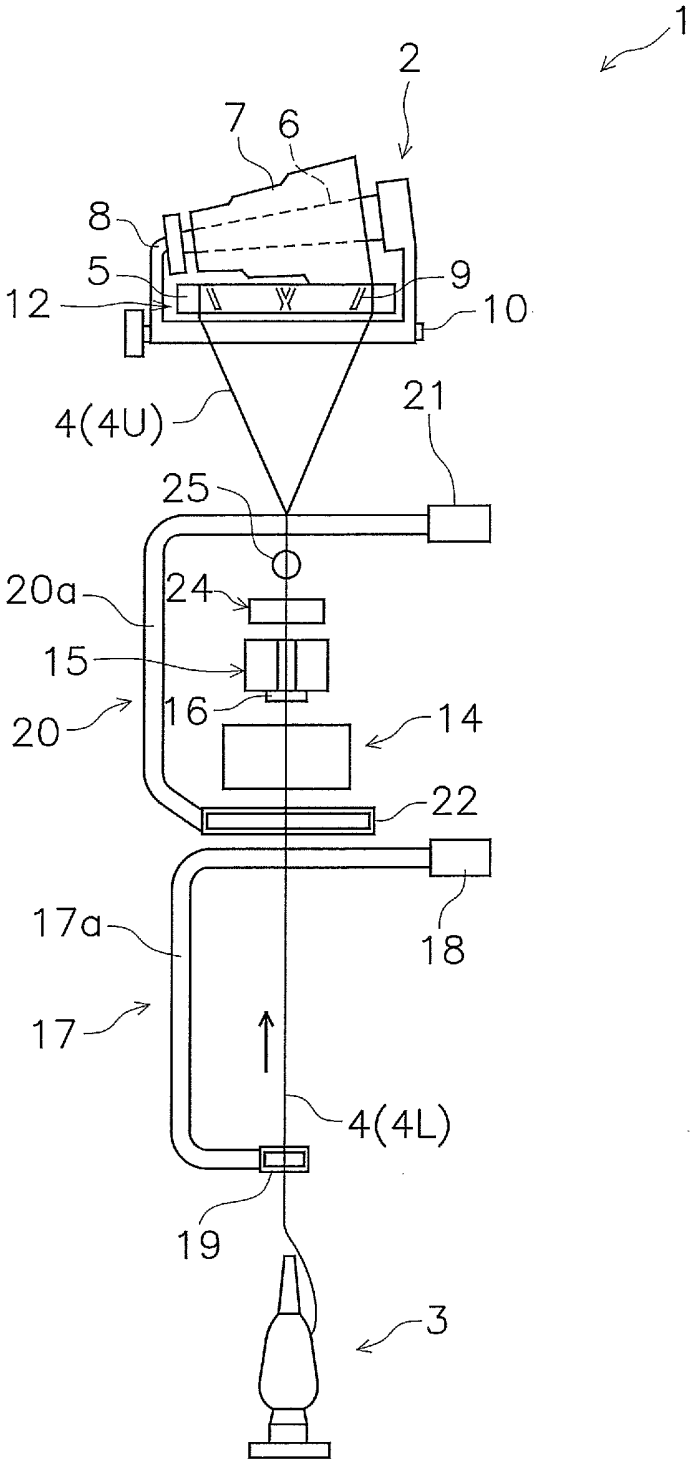

FIG. 1

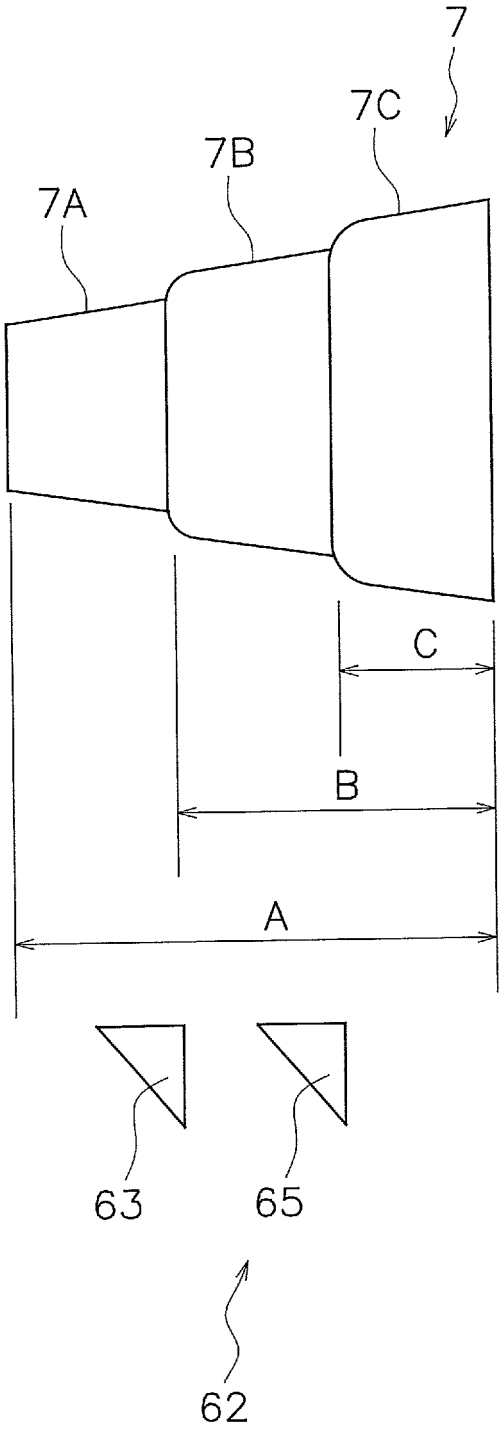

FIG. 2

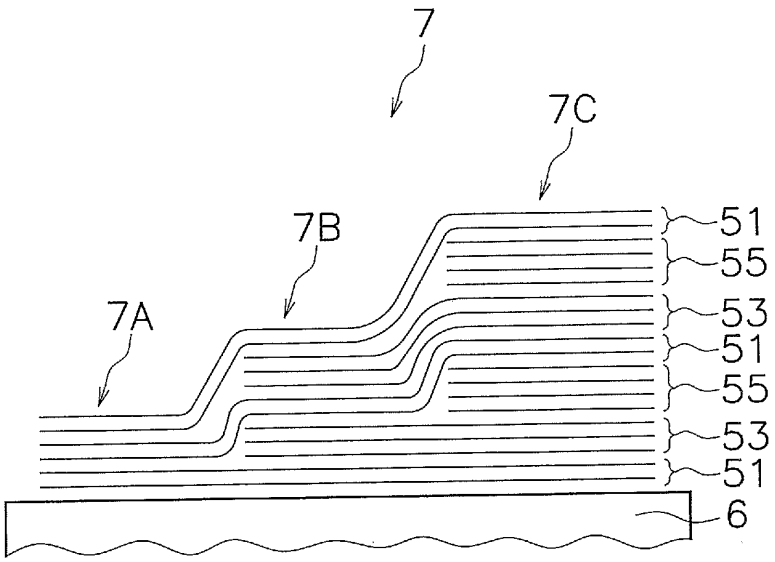

FIG. 3

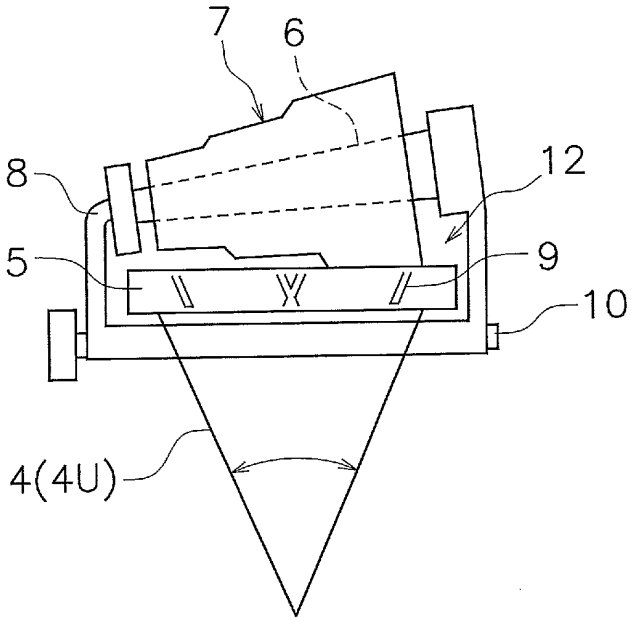

FIG. 4

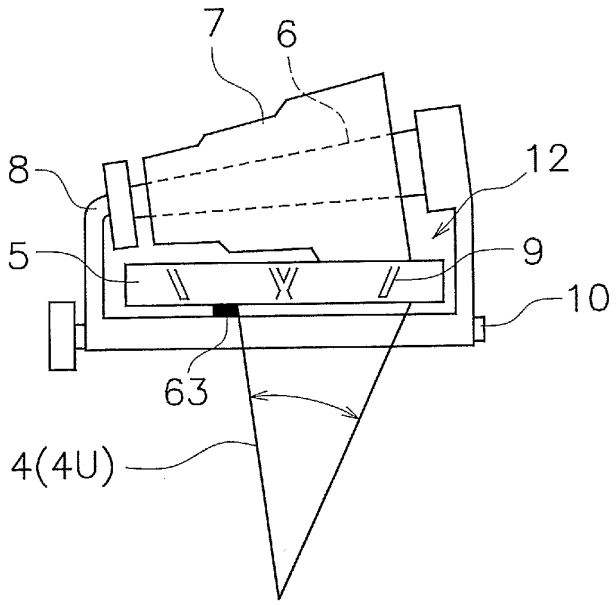

FIG. 5

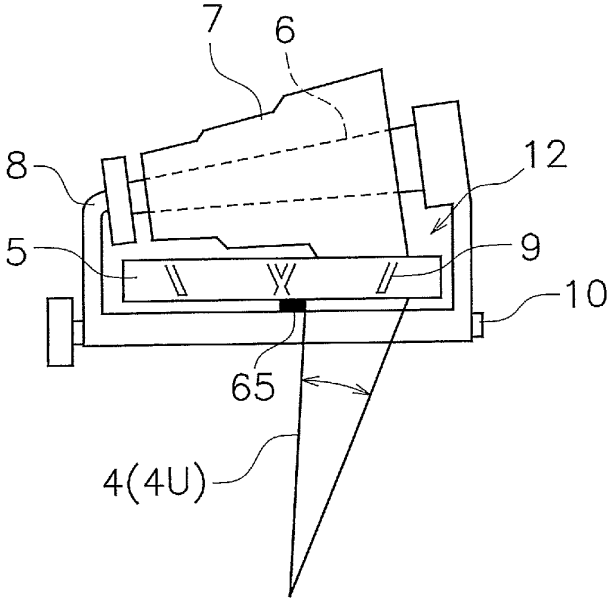

FIG. 6

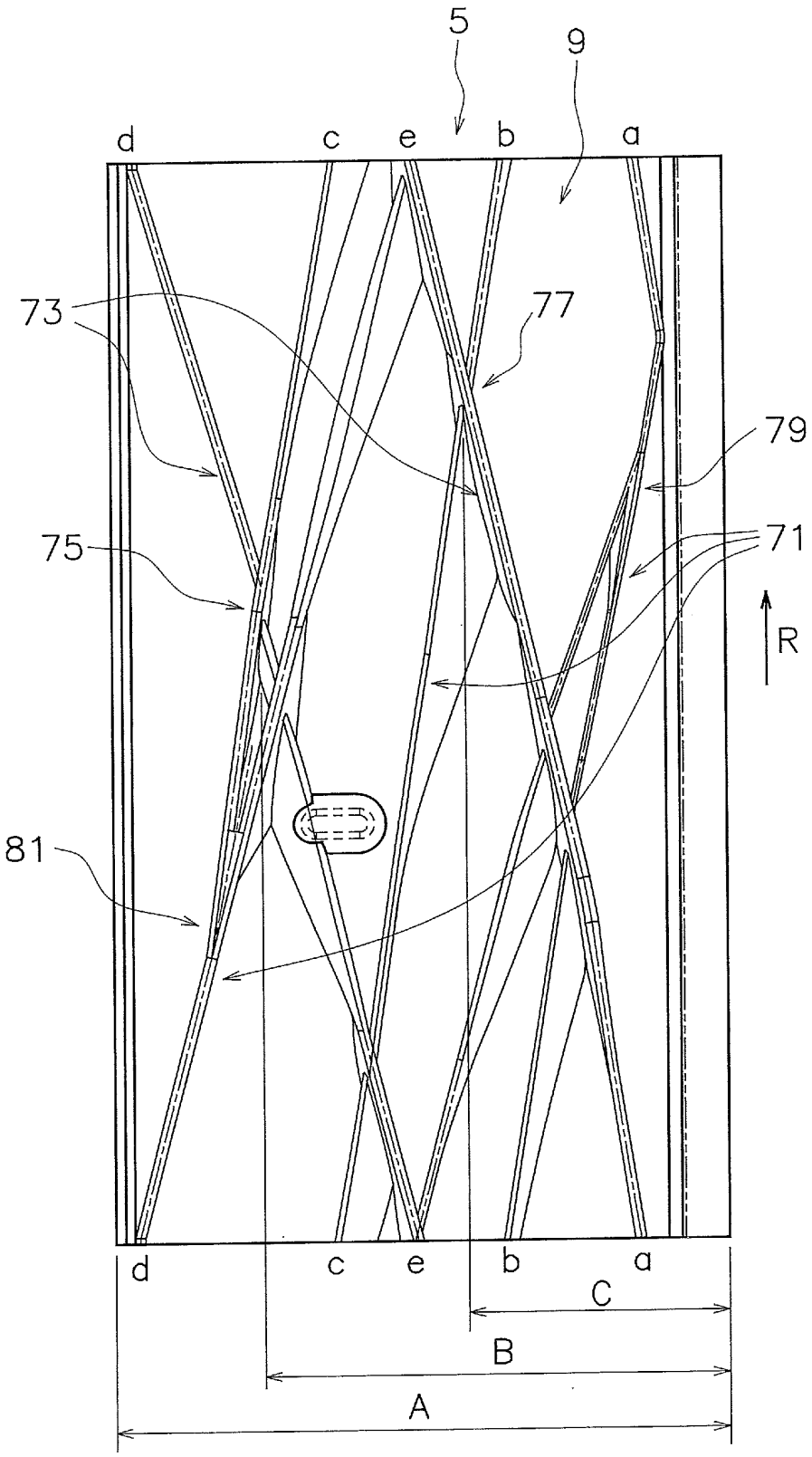

FIG. 7

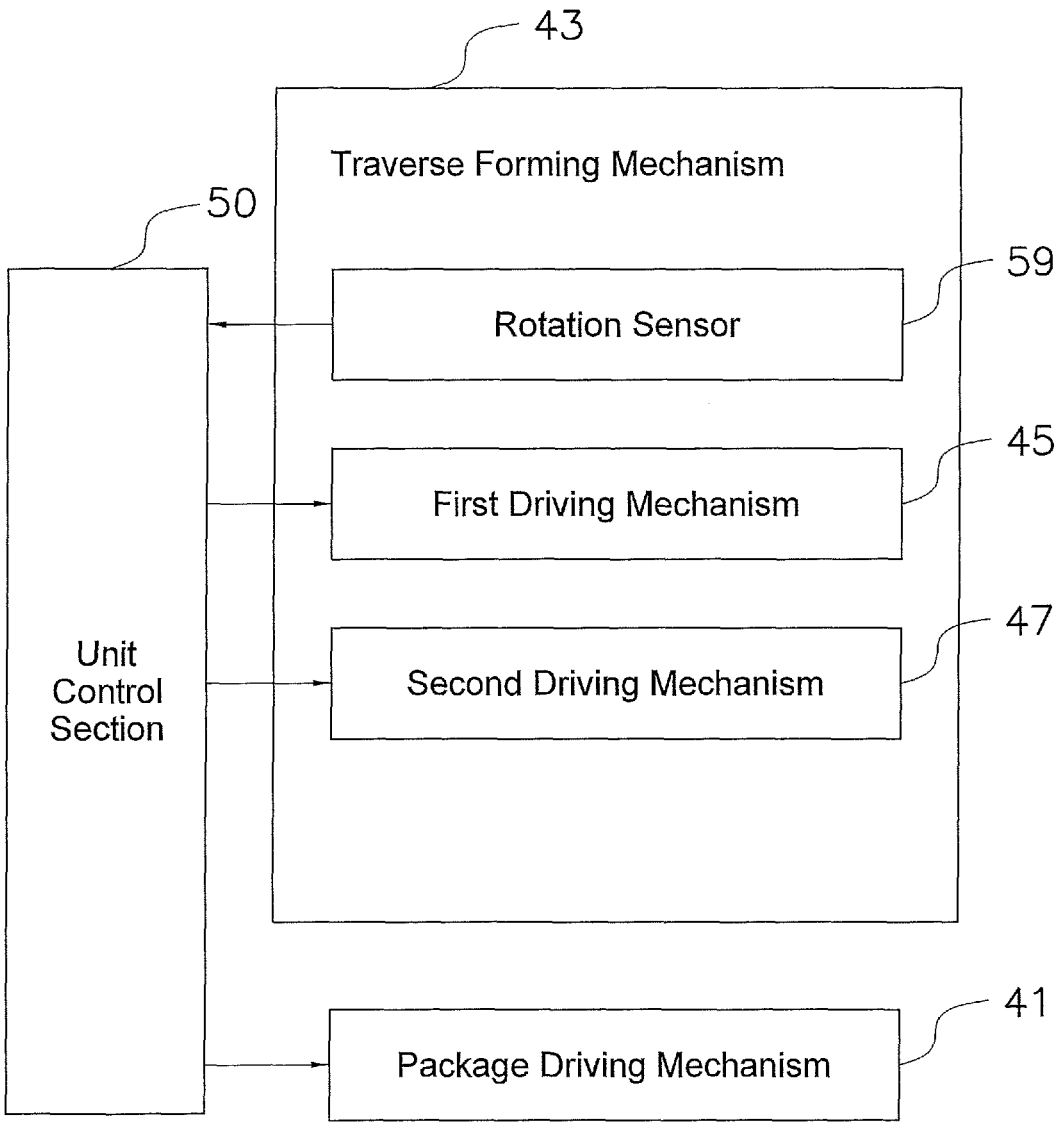
43
Traverse Forming Mechanism
50
59
Rotation Sensor
45
First Driving Mechanism
47
Second Driving Mechanism
Unit
Control
Section
41
Package Driving Mechanism

FIG. 8

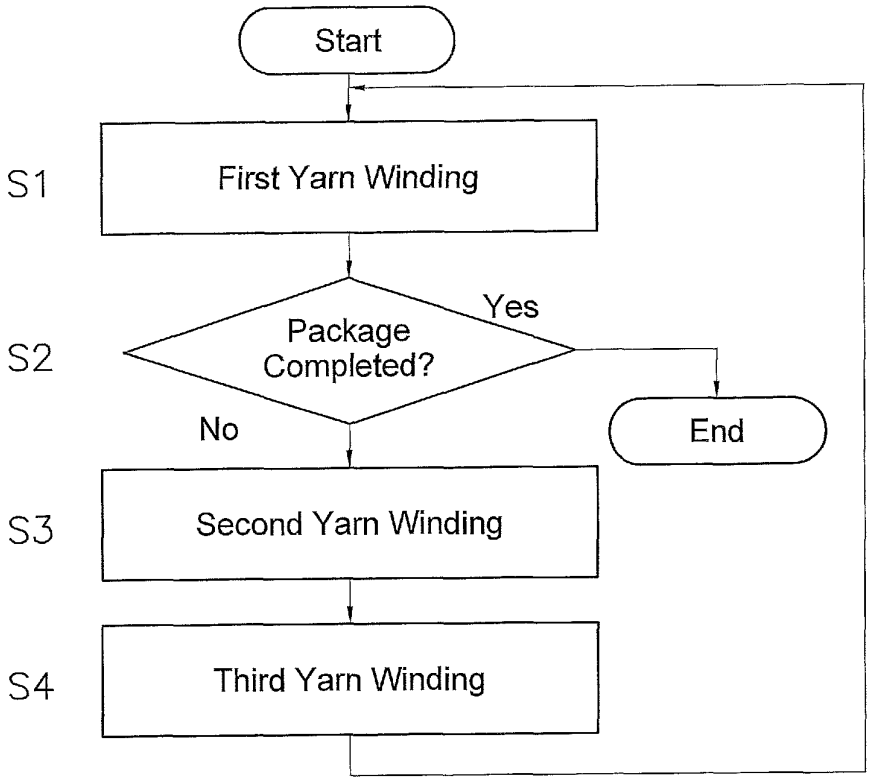
Start
S1
First Yarn Winding
S2
Package Completed?
Yes
No
End
S3
Second Yarn Winding
S4
Third Yarn Winding

FIG. 9

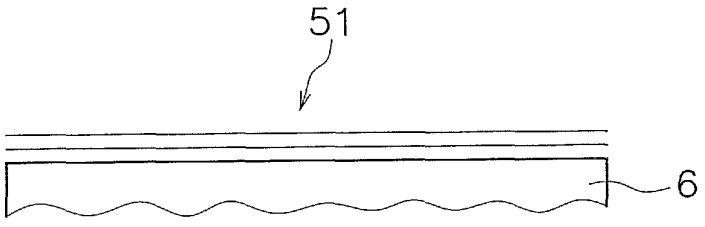
51
6

FIG. 10

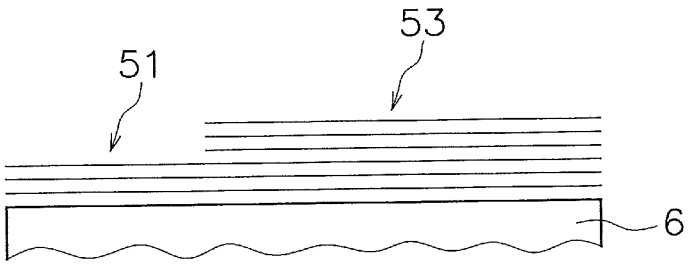

FIG. 11

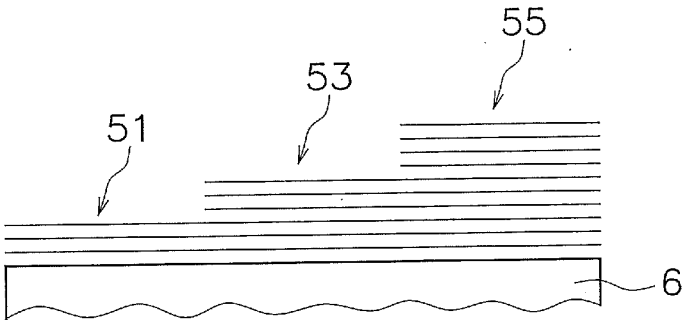

FIG. 12

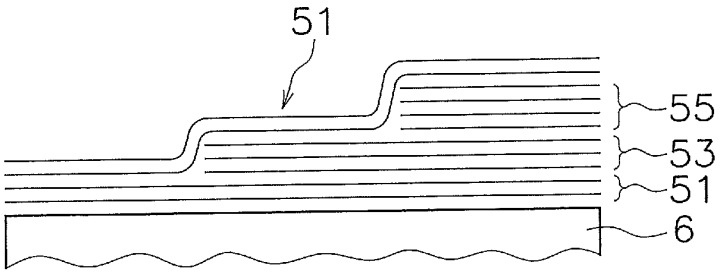

FIG. 13

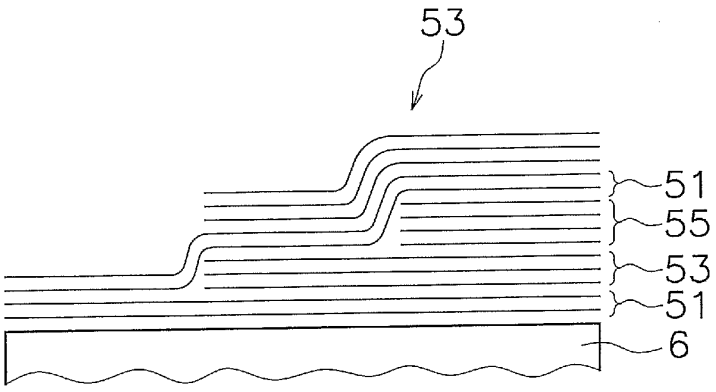

FIG. 14

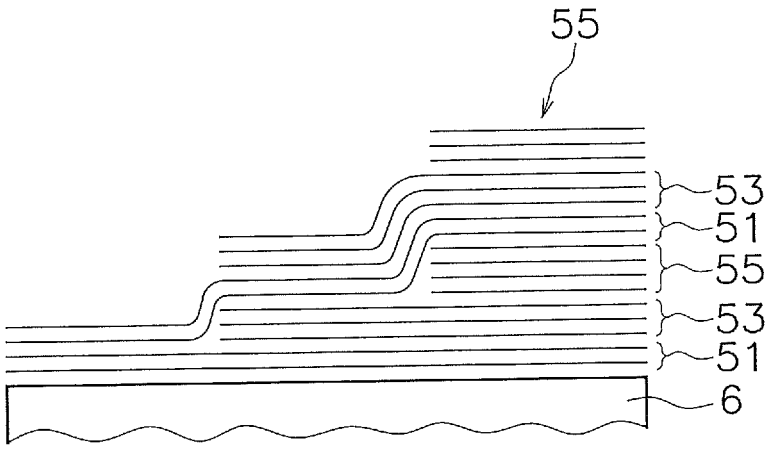

FIG. 15

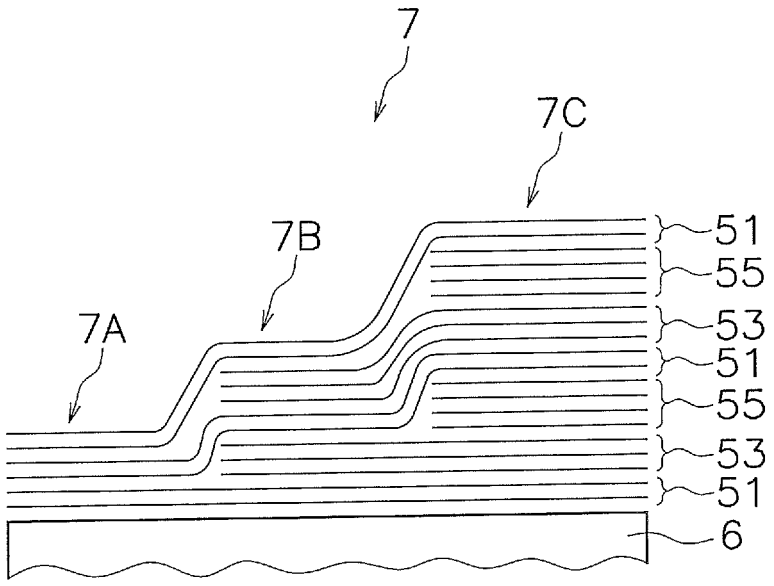

FIG. 16

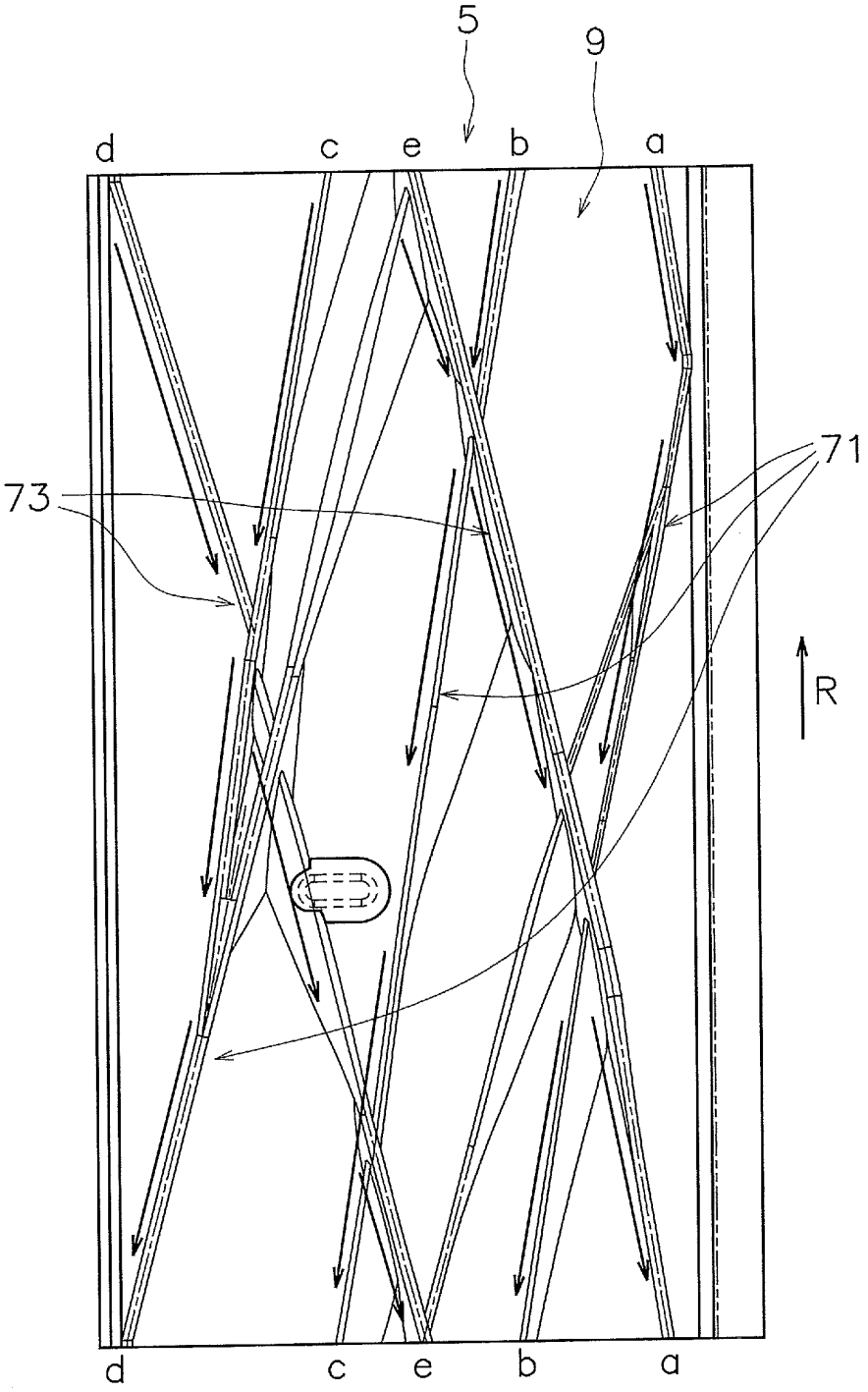

FIG. 17

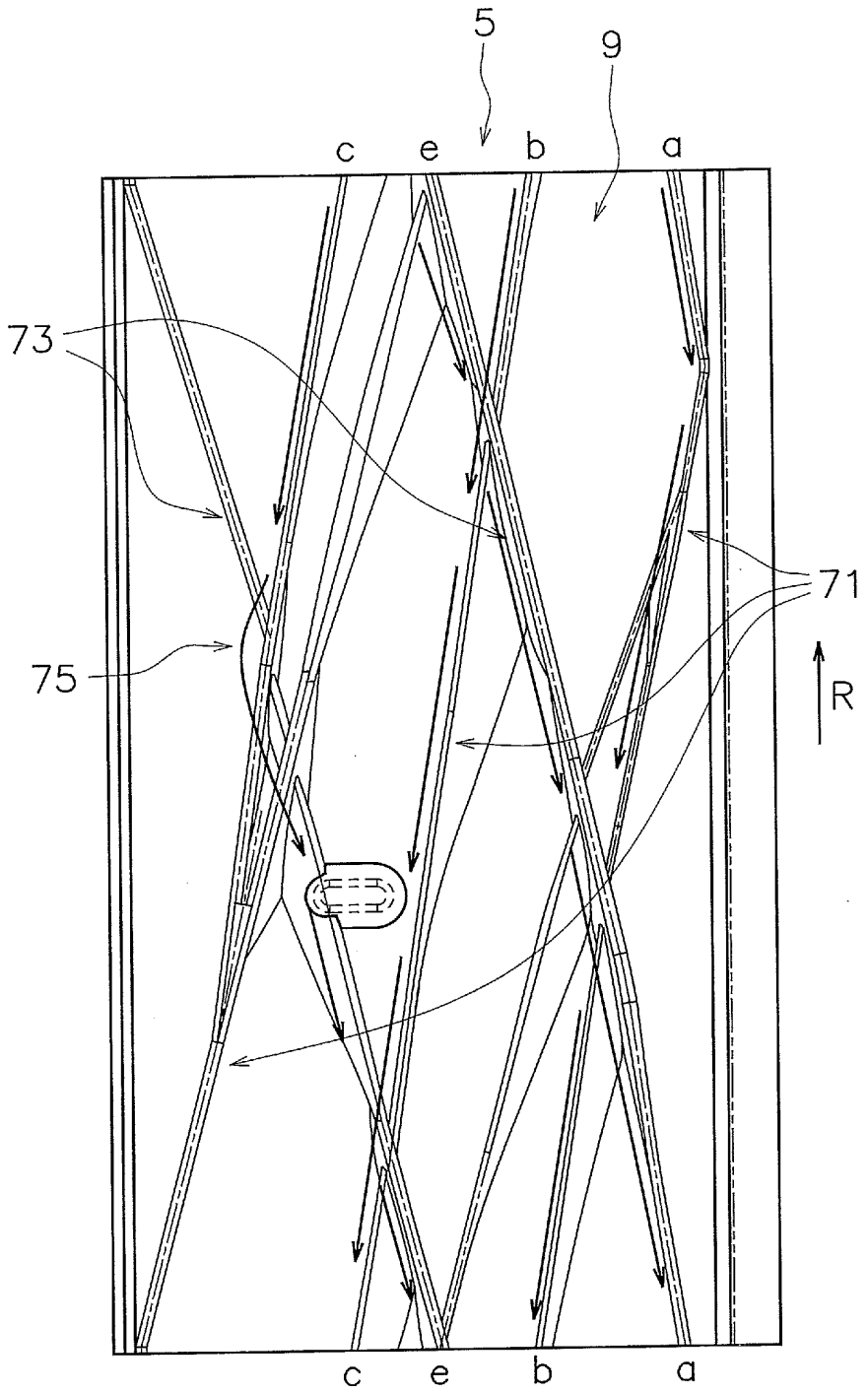

FIG. 18

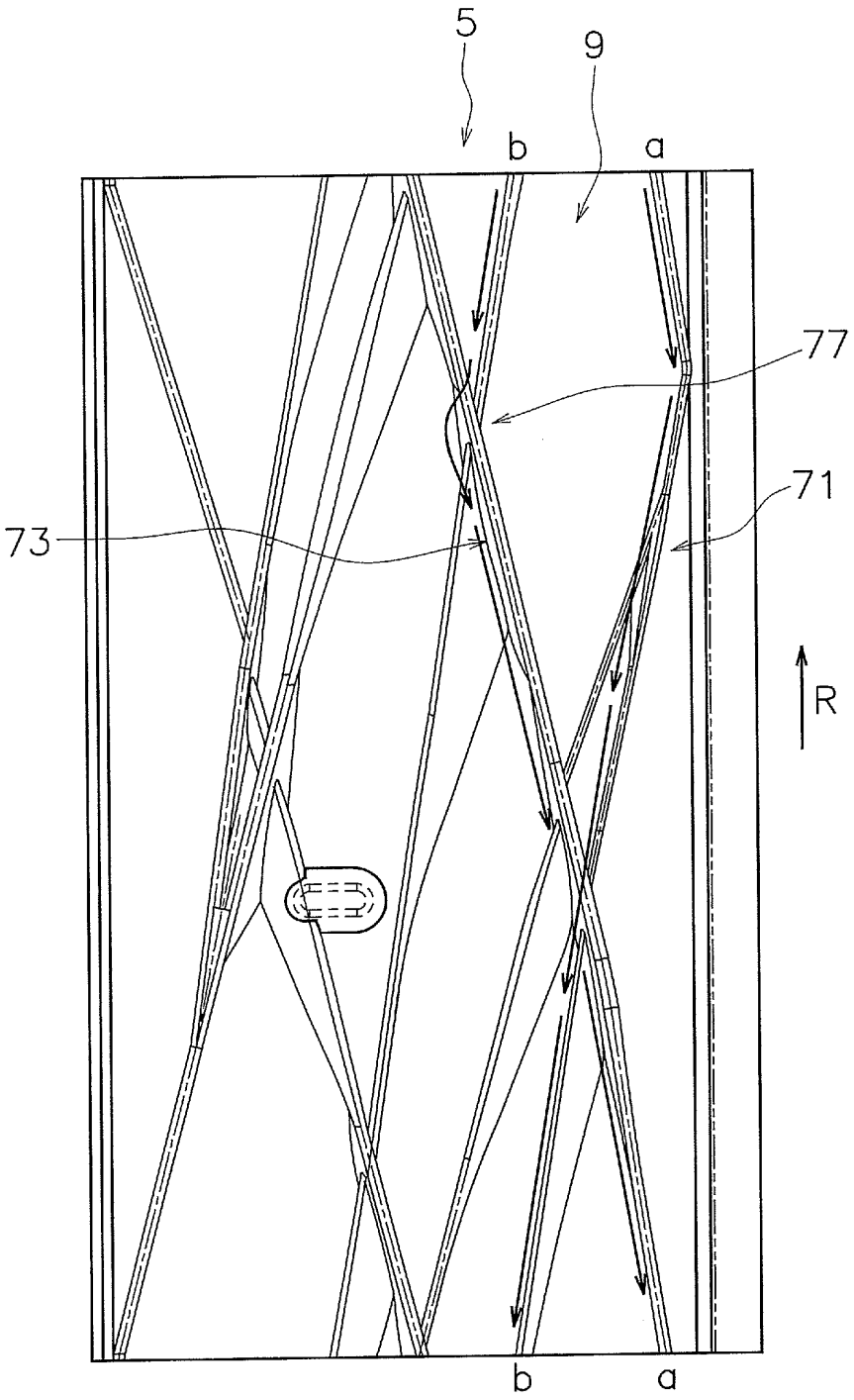

FIG. 19

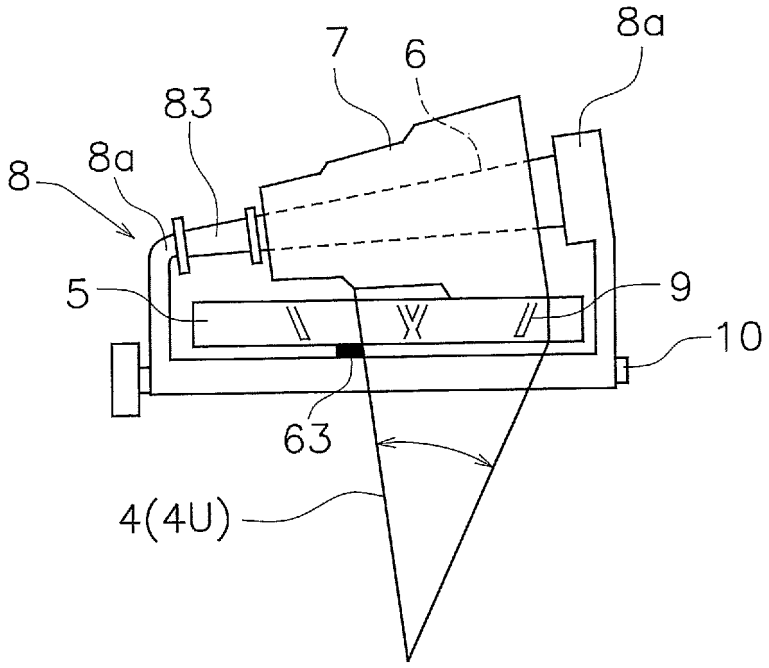

FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/021234

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. B65H54/48(2006.01)i, B65H54/28(2006.01)i, B65H54/553(2006.01)i, B65H55/04(2006.01)i, B65H57/28(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. B65H54/48, B65H54/28, B65H54/553, B65H55/04, B65H57/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 07-125920 A (MURATA MACHINERY, LTD.) 16 May 1995, paragraphs [0006], [0008]-[0013], [0015], fig. 1, 2 (Family: none)	1-5, 13 6-7 8-12
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 069992/1990 (Laid-open No. 028878/1992)(MITANI KK) 09 March 1992, specification, page 9, lines 9-16, page 10, line 6 to page 11, line 2, fig. 4, 5 (Family: none)	6-7
A	US 2296420 A (CAMPBELL, Lester) 22 September 1942 (Family: none)	8-12

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
05 July 2018 (05.07.2018)	17 July 2018 (17.07.2018)

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