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(54) **YARN-WINDING DEVICE**

GARNWICKLUNGSVORRICHTUNG

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EP 3 640 173 B1

Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a yarn winding device and a yarn winding method.

BACKGROUND ART

10 **[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

15 **PATENT CITATION**

[0003]

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

SUMMARY OF INVENTION

TECHNICAL PROBLEM

25 **[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.

30 **[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. DE 36 28 735 A1 already discloses 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 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.

45 JP H07 125920 A and EP 0 814 042 A2 show to only provide little less windings on each of the outer ends of the package and also do not teach any steps. Accordingly, these documents indeed formally show two levers, but these are only moved together to restrict the width of the windings slightly from one side or the other. CH 425 572 A shows a sort of stepped package, but it clearly leads away from the present invention in that the steps of this invention are used to provide additional winding space by adding steps on to the outer surface of a normal frusto-conical package, thus giving this package more or less the form of a cylindrical package with a sawtooth formed outer circumference.

50 CH 562 156 only shows to provide notches with narrower diameter on a normal, frusto-conical package.

[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

55 **[0009]** This object is achieved by a winding device according to claims 1 and 7 and a winding method according to claim 12.

[0010] Aspects are explained below as the technical solution. These aspects can be arbitrarily combined as needed,

within the scope of the appended claims.

[0011] 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.

[0012] The rotation support section is a section to which a winding member is attached.

[0013] The yarn guide section is configured to guide the yarn to the winding member, the yarn guide section having a traverse drum.

[0014] 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.

[0015] 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.

[0016] The lever member includes a plurality of lever members provided corresponding to different positions in a rotational axis direction of the traverse drum.

[0017] In this device, if the number of the lever members is two, it is possible to achieve three kinds of winding width.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] The control section may execute the steps depending on predetermined winding pattern information.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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 15,24cm (6 inches): 10,16cm (4 inches): 7,62cm (3 inches), respectively.

[0030] 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.

[0031] 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 10,16cm (4 inches): 9,65cm (3.8 inches): 7,62cm (3 inches), respectively.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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

[0036] According to a yarn winding device of the present invention, freedom of setting change of the winding width is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0037]

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

[0038] 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.

[0039] 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).

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] A unit control section 50 (Fig. 8), which controls the yarn winding section 2, is provided at each of the yarn winding sections 2.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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).

[0052] 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).

[0053] The waxing device 24 applies appropriate wax to the traveling yarn 4.

[0054] A cleaning pipe 25 sucks and removes foreign matter attached to the traveling yarn 4. A base 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

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] 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

[0063] 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.

[0064] 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.

[0065] 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.

[0066] 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).

[0067] 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).

[0068] 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.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] 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).

[0073] 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).

[0074] 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).

[0075] 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.

[0076] 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.

[0077] 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 (15,24cm (6 inches), for example), which is shown as width (A).

[0078] 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 (10,16cm (4 inches), for example), which is shown as width (B).

[0079] 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 (7,62cm (3 inches), for example), which is shown as width (C).

(4) Control Configuration of Yarn winding section

[0080] 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.

[0081] The yarn winding section 2 includes a unit control section 50.

[0082] 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.

[0083] 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.

[0084] 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.

[0085] The above-described package driving mechanism 41 is connected to the unit control section 50.

[0086] 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.

[0087] 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.

[0088] 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.

[0089] The rotation sensor 59 is one that outputs a signal each time the traverse drum 5 rotates by 1/60 rotation.

[0090] 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

[0091] With reference to Fig. 9, a yarn winding operation of the package 7 will be explained.

[0092] 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.

[0093] 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.

[0094] 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.

[0095] 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.

[0096] 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

[0097] 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.

[0098] Below, with reference to Fig. 9, the formation of the package 7 will be explained wherein 2.5w (15,24cm (6 inches)): 2.0w (10,16cm (4 inches)): 1.5w (7,62cm (3 inches)) = 2: 3: 4 (traverse number (layer number)).

[0099] 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 $150 \times 2 = 300$ times, the formation of the first yarn layer 51 is finished.

[0100] 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.

[0101] 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 $120 \times 3 = 360$ times, the formation of the second yarn layer 53 is finished.

[0102] 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 $90 \times 4 = 360$ times, the formation of the third yarn layer 55 is finished.

[0103] 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.

[0104] 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.

[0105] 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.

[0106] 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.

[0107] 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.

[0108] 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).

[0109] 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).

[0110] 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).

[0111] 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).

[0112] 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).

[0113] 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).

[0114] 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.

[0115] 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.

[0116] 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.

[0117] 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.

[0118] 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.

[0119] 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.

[0120] It should be noted that although the above explanation applies to a case where 15,24cm (6 inch) - 2.5w drum grooves are employed, it is possible to utilize 15,24cm (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 15,24cm (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.

[0121] 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.

[0122] 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.

[0123] 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 (10,16cm (4 inches)): 1.5w (9,65cm (3.8 inches)): 1.5w (7,62cm (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

5 **[0124]** 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.

[0125] The cradle 8 has a support portion 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.

10 **[0126]** 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

15 **[0127]** 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 the scope of the appended claims.

[0128] 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 positioned 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.

[0129] The shape of the package may be cone-shaped (truncated cone-shape) or cheese-shaped (cylindrical).

25 **[0130]** Although the number of the guide levers is two in the first embodiment and a package with three steps is manufactured, the number of the guide lever is not limited. The number of the guide levers may be three or more.

[0131] 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.

30 **[0132]** The present invention can be also applied to a spinning machine and an open-end spinning machine.

INDUSTRIAL APPLICABILITY

[0133] The present invention can be widely applied to a yarn winding device.

REFERENCE SIGNS LIST

[0134]

- 40 1: automatic winder
- 2: yarn winding section
- 3: yarn bobbin
- 4: yarn
- 5: traverse drum
- 45 6: winding tube
- 7: package
- 7A: first step
- 7B: second step
- 7C: third step
- 50 8: cradle
- 9: traverse grooves
- 10: rotation axis
- 11: tray
- 14: yarn splicing device
- 55 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 (1), comprising:

a rotation support section (8) to which a winding member (6) is attached;
 a yarn guide section (12) configured to guide the yarn (4) to the winding member (6), the yarn guide section (12) having a traverse drum (5); **characterized in that**
 a first lever member (63) and a second lever member (65) provided in different positions in an rotational axis direction of the traverse drum (5), the first lever (63) and the second lever (65) being configured to move between a non-restriction position at which the first lever member (63) and the second lever member (65) do not restrict a movable position of the yarn (4) in a rotational axis direction of the traverse drum (5) to guide the yarn (4) to the traverse drum (5), and a restriction position at which the first lever member (63) and the second lever member (65) restrict 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 in a case of the non-restriction, thereby guiding the yarn (4) to different traverse grooves (9) of the traverse drum (5) between the restriction position and the non-restriction position, such that the yarn winding device (1) is adapted to perform a step forming winding by repeating yarn winding operations with different widths,
 if the first lever member (63) and the second lever member (65) are positioned at the non-restriction positions, a yarn winding (51) with a first width is performed,
 if the first lever member (63) is positioned at the restriction position and the second lever member (65) is positioned at the non-restriction position, a yarn winding (53) with a second width narrower than the first width is performed, and
 if the second lever member (65) is positioned at the restriction position, a yarn winding (55) is performed with a third width narrower than the second width, thereby performing a step forming winding with two or more level differences.

2. The yarn winding device (1) according to claim 1, further comprising:

a driving section (45, 47) configured to drive the first lever member (63) and the second lever member (65); and
 a control section (50) configured to control the driving section (45, 47), wherein
 the control section (50) controls the driving section (45, 47) to perform a set of the following steps alternately:

a step of locating the first lever member (63) and the second lever member (65) at the non-restriction position;
 a step of locating the first lever member (63) at the restriction position and the second lever member (65)

at the non-restriction position; and
a step of locating the second lever member (65) at the restriction position.

3. The yarn winding device (1) according to claim 2, wherein
the control section (50) executes the steps depending on a predetermined winding pattern information.

4. The yarn winding device (1) according to any of claims 1 to 3, wherein

traverse grooves (9) of the traverse drum (5) include a first groove (71) extending so as to widen a path of the yarn (4) toward a first side (P) in a width direction of the traverse drum (5), and a second groove (73) extending so as to narrow a path of the yarn (4) toward a second side in a width direction of the traverse drum (5), the second groove (73) intersecting the first groove (71) to define a first intersection (75), and a third groove extending so as to narrow a path of the yarn (4) toward the second side in the width direction of the traverse drum (5), the third groove intersecting the second groove (73) to define a second intersection (77),
if the first lever member (63) and the second lever member (65) are positioned at the non-restriction position, the yarn (4) travelling along the first groove (71) passes the first intersection (75) and the second intersection (77) and continues to travel along the first groove (71),
if the first lever member (63) is positioned at the restriction position and the second lever member (65) is positioned at the non-restriction position the yarn (4) travelling along the first groove (71) shifts to the second groove (73) at the first intersection (75) and continues to travel along the second groove (73), and
if the second lever member (65) is positioned at the restriction position the yarn (4) travelling along the second groove (73) shifts to the third groove at the second intersection (77) and continues to travel along the third groove.

5. The yarn winding device (1) according to any of claims 1 to 4, wherein
the rotation support section (8) includes a pair of support sections (8a), and an adaptor (83) that can be detachably attached to at least one of the pair of support sections (8a) and supports an end of the winding member (6).

6. The yarn winding device (1) according to claim 2, wherein
the control section (50) controls the driving section (45, 47) such that the yarn (4) includes a first portion (7A), and a second portion (7B) and a third portion (7C) arranged with each other in a longitudinal direction of the winding member (6), the second portion (7B) having a yarn layer with a diameter larger than that of the first portion (7A) and the third portion (7C) having a yarn layer with a diameter larger than that of the second portion (7B), and the yarn (4) includes a first yarn layer (51) wound at the first portion (7A), the second portion (7B) and the third portion (7C) with a first width from a reference end (P) of the winding member (6), a second yarn layer (53) wound at the second portion (7B) and the third portion (7C) over the first yarn layer (51) with a second width from the reference end (P) of the winding member (6) narrower than the first width, and a third yarn layer (55) wound at the third portion (7C) over the second yarn layer (53) with a third width from the reference end (P) of the winding member (6) narrower than the second width.

7. A yarn winding device (1) comprising:

a rotation support section (8) to which a winding member (6) is attached;
a yarn guide section (12) configured to guide the yarn (4) to the winding member (6), the yarn guide section (12) having a traverse drum (5);
a lever member (63) 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 (4) to the traverse drum (5) with a predetermined traverse width, and a restriction position at which the 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 (4) to different traverse grooves (71, 73) of the traverse drum (5) between the restriction position and the non-restriction position, such that the yarn winding device (1) is adapted to perform a step forming winding by repeating yarn winding operations with different widths and to alternatively effect continuously a yarn winding in which a yarn winding with a traverse width narrower than the predetermined width is performed repeatedly to realize a yarn winding with the width narrower than the predetermined traverse width;
a driving section (45) configured to drive the lever member (63); and
a control section (50) configured to control the driving section, wherein
the control section (50) controls the driving section (45) to alternately perform the following steps: a step of

locating the lever member (63) at the restriction position to guide the yarn (4) to the traverse drum (5) with a traverse width narrower than the predetermined width; and a step of locating the lever member (63) at the non-restriction position to guide the yarn (4) to the traverse drum (5) with the predetermined traverse width, the control section (50) being adapted to control the driving section (45) such that the yarn (4) includes a first portion (7A) and a second portion (7B) arranged with each other in a longitudinal direction of the winding member (6), the second portion (7B) has a yarn layer (53) with a diameter larger than that of the first portion (7A), and the yarn (4) includes a first yarn layer (51) wound at the first portion (7A) and the second portion (7B) with a first width from a reference end (P) of the winding member (6), and a second yarn layer (53) layered alternately with the first yarn layer (51), and the second yarn layer (53) is wound only at the second portion (7B) with a second width from the reference end (P) of the winding member (6) narrower than the first width, **characterized in that** the control section (50) is adapted to control the driving section (47) such that the yarn (4) includes a third portion (7C) arranged with the second portion (7B) in the longitudinal direction of the winding member (6), and the yarn (4) includes a third yarn layer (55) alternately layered with the first yarn layer (51) and the second yarn layer (53), the third layer (55) is wound only at the third portion (7C) with a third width from the reference end (P) of the winding member (6) narrower than the second width.

8. The yarn winding device (1) according to claim 7, wherein the control section (50) is adapted to control the driving section (45, 47) such that a ratio of traverse number of the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) is 2: 3: 4.

9. The yarn winding device (1) according to claim 8, wherein the control section (50) is adapted to control the driving section (45, 47) such that a drum winding number for forming the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) is 2.5w: 2.0w: 1.5w and the widths of the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) are 15,24cm (6 inches): 10, 16cm (4 inches): 7,62cm (3 inches), respectively.

10. The yarn winding device (1) according to claim 7, wherein the control section (50) is adapted to control the driving section (45, 47) such that a ratio of a traverse number of the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) is 1: 2: 2.

11. The yarn winding device (1) according to claim 10, wherein the control section (50) is adapted to control the driving section (45, 47) such that a drum winding number for forming the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) is 2.0w: 1.5w: 1.5w, and the widths of the first yarn layer (51), the second yarn layer (53), and the third yarn layer (55) are 10, 16cm (4 inch): 9,65cm (3.8 inch): 7,62cm (3 inch), respectively.

12. A yarn (4) winding method performed by a yarn winding device (1) including a rotation support section (8) to which a winding member (6) is attached, a yarn guide section (12) having a traverse drum (5) and configured to guide the yarn (4) to the winding member (6), and a first lever member (63) and a second lever member (65) configured to move between a non-restriction position at which the lever member (63, 65) does not restrict a movable position of the yarn (4) in a rotational axis direction of the traverse drum (5) to guide the yarn (4) to the traverse drum (5) with a predetermined traverse width, and a restriction position at which the lever member (63, 65) restricts the movable position of the yarn (4) in the rotational axis direction of the traverse drum (5) to guide the yarn (4) to the traverse drum (5) with a traverse width narrower than the predetermined traverse width, **characterized in that** the method includes repeatedly performing the following steps alternately to realize a step forming winding:

a first step of locating the first lever member (63) and the second lever member (65) at the non-restriction position to guide the yarn (4) to a traverse groove (71) in the traverse drum (5) with a first traverse width; and a second step of locating the first lever member (63) at the restriction position and the second lever member (65) at the non-restriction position to guide the yarn (4) to the traverse drum (5) with a second traverse width narrower than the first traverse width, thereby guiding the yarn (4) to a traverse groove (73) of the traverse drum (5) different from the traverse groove (71) in the first step; and a third step of locating the second lever member (65) at the restriction position to guide the yarn (4) to the traverse drum (5) with a third traverse width narrower than the second traverse width, thereby guiding the yarn (4) to a traverse groove of the traverse drum (5) different from the traverse groove (71, 73) in the first step and the second step.

Patentansprüche

1. Garnwickelvorrichtung (1) umfassend:

einen Drehlagerabschnitt (8), an dem ein Wickelement (6) angebracht ist;
 einen Garnführungsabschnitt (12), der konfiguriert ist, um das Garn (4) zu dem Wickelement (6) zu führen,
 wobei der Garnführungsabschnitt (12) eine Traversiertrommel (5) aufweist; **dadurch gekennzeichnet, dass**
 ein erstes Hebelement (63) und ein zweites Hebelement (65) an in einer Drehachsrichtung der Traversier-
 trommel (5) unterschiedlichen Positionen vorgesehen sind, wobei der erste Hebel (63) und der zweite Hebel
 (65) konfiguriert sind, um sich zu bewegen zwischen einer Nicht-Begrenzungsposition, an der das erste Hebe-
 lelement (63) und das zweite Hebelement (65) die bewegbare Position des Garns (4) in einer Drehachsrichtung
 der Traversiertrommel (5) nicht begrenzen, um das Garn (4) zu der Traversiertrommel (5) zu führen, und einer
 Begrenzungsposition, an der das erste Hebelement (63) und das zweite Hebelement (65) die bewegbare
 Position des Garns (4) in der Drehachsrichtung der Traversiertrommel (5) begrenzen, um das Garn (4) der
 Traversiertrommel (5) mit einer Traversierbreite zuzuführen, die schmäler ist als im Falle der Nicht-Begrenzung,
 um hierdurch das Garn (4) zu unterschiedlichen Traversiernuten (9) der Traversiertrommel (5) zwischen der
 Begrenzungsposition und der Nicht-Begrenzungsposition zu führen, sodass die Garnwickelvorrichtung (4) dazu
 ausgelegt ist, durch Wiederholen von Garnwickeloperationen mit unterschiedlichen Breiten ein stufenformendes
 Wickeln durchzuführen,
 wenn das erste Hebelement (63) und das zweite Hebelement (65) an den Nicht-Begrenzungspositionen
 sind, ein Garnwickeln (51) mit einer ersten Breite durchgeführt wird,
 wenn das erste Hebelement (63) an der Begrenzungsposition positioniert ist und das zweite Hebelement
 (65) an der Nicht-Begrenzungsposition positioniert ist, ein Garnwickeln (53) mit einer zweiten Breite, die schmäler
 ist als die erste Breite, durchgeführt wird, und
 wenn das zweite Hebelement (65) an der Begrenzungsposition positioniert ist, ein Garnwickeln (55) mit einer
 dritten Breite durchgeführt wird, die schmäler ist als die zweite Breite, um hierdurch ein stufenformendes Wickeln
 mit zwei oder mehr Niveaudifferenzen durchzuführen.

2. Die Garnwickelvorrichtung (1) nach Anspruch 1, die ferner umfasst:

einen Antriebsabschnitt (45, 47), der konfiguriert ist, um das erste Hebelement (63) und das zweite Hebe-
 lement (65) anzutreiben; und
 einen Steuerabschnitt (50), der konfiguriert ist, um den Antriebsabschnitt (45, 47) zu steuern, wobei
 der Steuerabschnitt (50) den Antriebsabschnitt (45, 47) steuert, um einen Satz der folgenden Schritte abwech-
 seln durchzuführen:

einen Schritt des Lokalisierens des ersten Hebelements (63) und des zweiten Hebelements (65) an der
 Nicht-Begrenzungsposition;
 einen Schritt des Lokalisierens des ersten Hebelements (63) an der Begrenzungsposition und des zweiten
 Hebelements (65) an der Nicht-Begrenzungsposition; und
 einen Schritt des Lokalisierens des zweiten Hebelements (65) an der Begrenzungsposition.

3. Die Garnwickelvorrichtung (1) nach Anspruch 2, wobei der Steuerabschnitt (50) die Schritte in Abhängigkeit von einer vorbestimmten Wickelmusterinformation ausführt.

4. Die Garnwickelvorrichtung (1) nach einem der Ansprüche 1 bis 3, wobei

Traversiernuten (6) der Traversiertrommel (5) eine erste Nut (71) enthalten, die sich erstreckt, um einen Weg
 des Garns (4) zu einer ersten Seite (P) innerhalb einer Breitenrichtung der Traversiertrommel (P) aufzuweiten,
 sowie eine zweite Nut (73), die sich erstreckt, um einen Weg des Garns (4) zu einer zweiten Seite in Breiten-
 richtung der Traversiertrommel (5) zu verengen, wobei die zweite Nut (73) die erste Nut (71) schneidet, um
 eine erste Kreuzung (75) zu definieren, und eine dritte Nut, die sich erstreckt, um einen Weg des Garns (4) zu
 der zweiten Seite in der Breitenrichtung der Traversiertrommel (5) zu verengen, wobei die dritte Nut die zweite
 Nut (73) schneidet, um eine zweite Kreuzung (77) zu definieren,
 wenn das erste Hebelement (63) und das zweite Hebelement (75) an der Nicht-Begrenzungsposition posi-
 tioniert sind, das entlang der ersten Nut (71) laufende Garn (4) die erste Kreuzung (75) und die zweite Kreuzung
 (77) passiert und weiter entlang der ersten Nut (71) läuft,
 wenn das erste Hebelement (63) an der Begrenzungsposition positioniert ist und das zweite Hebelement

(65) an der Nicht-Begrenzungsposition positioniert ist, das entlang der ersten Nut (71) laufende Garn (4) an der ersten Kreuzung (75) zu der zweiten Nut (73) wechselt und weiter entlang der zweiten Nut (73) läuft, und wenn das zweite Hebelement (65) an der Begrenzungsposition positioniert ist, das entlang der zweiten Nut (73) laufende Garn (4) an der zweiten Kreuzung (77) zu der dritten Nut wechselt und weiter entlang der dritten Nut läuft.

5. Die Garnwickelvorrichtung (1) nach einem der Ansprüche 1 bis 4, wobei der Drehlagerabschnitt (8) ein Paar von Lagerabschnitten (8a) enthält, und einen Adapter (83), der an zumindest einem des Pairs von Lagerabschnitten (8a) abnehmbar angebracht werden kann und ein Ende des Wickelements (6) trägt.

6. Die Garnwickelvorrichtung (1) nach Anspruch 2, wobei der Steuerabschnitt (50) den Antriebsabschnitt (45, 47) derart steuert, dass das Garn (4) einen ersten Abschnitt (7A) und einen zweiten Abschnitt (7B) und einen dritten Abschnitt (7C) enthält, die miteinander in einer Längsrichtung des Wickelements (6) angeordnet sind, der zweite Abschnitt (7B) eine Garnlage mit einem größeren Durchmesser als jenem des ersten Abschnitts (7A) aufweist und der dritte Abschnitt (7C) eine Garnlage mit einem größeren Durchmesser als jenem des zweiten Abschnitts (7B) aufweist, und das Garn (4) eine erste Garnlage (51) enthält, die an dem ersten Abschnitt (7A), dem zweiten Abschnitt (7B) und dem dritten Abschnitt (7C) mit einer ersten Breite von einem Referenzende (P) des Wickelements (6) gewickelt ist, eine zweite Garnlage (53), die an dem zweiten Abschnitt (7B) und dem dritten Abschnitt (7C) über die erste Garnlage (51) mit einer zweiten Breite von dem Referenzende (P) des Wickelements (6) schmaler als die erste Breite gewickelt ist, und eine dritte Garnlage (55), die an dem dritten Abschnitt (7C) über die zweite Garnlage (53) mit einer dritten Breite von dem Referenzende (P) des Wickelements (6) schmaler als die zweite Breite gewickelt ist.

7. Garnwickelvorrichtung (1), umfassend:

einen Drehlagerabschnitt (8), an dem ein Wickelement (6) angebracht ist;
einen Garnführungsabschnitt (12), der konfiguriert ist, um das Garn (4) zu dem Wickelement (6) zu führen, wobei der Garnführungsabschnitt (12) eine Traversiertrommel (5) aufweist;
ein Hebelement (63), das konfiguriert ist, um sich zu bewegen zwischen einer Nicht-Begrenzungsposition, an der das Hebelement (63) eine bewegbare Position des Garns (4) in einer Drehachsrichtung der Traversiertrommel (5) nicht begrenzt, um das Garn (4) zu der Traversiertrommel mit einer vorbestimmten Traversierbreite zu führen, und einer Begrenzungsposition, an der das Hebelement (63) die bewegbare Position des Garns (4) in der Drehachsrichtung der Traversiertrommel (5) begrenzt, um das Garn der Traversiertrommel (5) mit einer Traversierbreite zuzuführen, die schmaler ist als die vorbestimmte Traversierbreite, um hierdurch das Garn (4) unterschiedlichen Traversiernuten (71, 73) der Traversiertrommel (5) zwischen der Begrenzungsposition und der Nicht-Begrenzungsposition zu führen, sodass die Garnwickelvorrichtung (1) dazu ausgelegt ist, durch Wiederholen von Garnwickeloperationen mit unterschiedlichen Breiten, ein stufenförmiges Wickeln auszuführen, und um abwechselnd ein kontinuierliches Garnwickeln zu bewirken, bei dem ein Garnwickeln mit einer schmaleren Traversierbreite als der vorbestimmte Breite wiederholt ausgeführt wird, um ein Garnwickeln mit der Breite zu realisieren, die schmaler ist als die vorbestimmte Traversierbreite;
einen Antriebsabschnitt (45), der konfiguriert ist, um das Hebelement (63) anzutreiben; und
einen Steuerabschnitt (55), der konfiguriert ist, um den Antriebsabschnitt zu steuern, wobei der Steuerabschnitt (50) den Antriebsabschnitt (45) steuert, um abwechselnd die folgenden Schritte durchzuführen: einen Schritt des Lokalisierens des Hebelements (63) an der Begrenzungsposition, um das Garn (4) zu der Traversiertrommel (5) mit einer Traversierbreite zu führen, die schmaler ist als die vorbestimmte Breite; und einen Schritt des Lokalisierens des Hebelements (63) an der Nicht-Begrenzungsposition, um das Garn (4) zu der Traversiertrommel (5) mit der vorbestimmten Traversierbreite zu führen, der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsabschnitt (45) derart zu steuern, dass das Garn (4) einen ersten Abschnitt (7A) und einen zweiten Abschnitt (7B) enthält, die miteinander in einer Längsrichtung des Wickelements (6) angeordnet sind, wobei der zweite Abschnitt (7B) eine Garnlage (53) mit einem größeren Durchmesser als jenem des ersten Abschnitts (7A) aufweist, und das Garn (4) eine erste Garnlage (51) enthält, die an dem ersten Abschnitt (7A), und einen zweiten Abschnitt (7B) mit einer ersten Breite an einem Referenzende (P) des Wickelements (6) gewickelt ist und eine zweite Garnlage (53), die abwechselnd mit der ersten Garnlage (51) gelegt ist, und die zweite Garnlage (53) nur an dem zweiten Abschnitt (7B) mit einer zweiten Breite von dem Referenzende (P) des Wickelements (6) schmaler als die erste Breite gewickelt ist, **dadurch gekennzeichnet, dass** der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsabschnitt (47) derart zu steuern, dass das Garn (4) einen dritten Abschnitt (7C) enthält, der mit dem zweiten Abschnitt (7B) in der Längsrichtung des Wickelements (6) angeordnet ist, und das Garn (4) eine dritte Garnlage (55) enthält, die

abwechselnd mit der ersten Garnlage (51) und der zweiten Garnlage (53) gelegt ist, wobei die dritte Lage (55) nur an dem dritten Abschnitt (7C) mit einer dritten Breite von dem Referenzende (P) des Wickelements (6) schmaler als die zweite Breite gewickelt ist.

- 5 8. Die Garnwickelvorrichtung (1) nach Anspruch 7, wobei
der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsabschnitt (45, 47) derart zu steuern, dass das Verhältnis
der Traversierzahl der ersten Garnlage (51), der zweiten Garnlage (53) und der dritten Garnlage (55) 2: 3: 4 beträgt.
- 10 9. Die Garnwickelvorrichtung (1) nach Anspruch 8, wobei
der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsabschnitt (45, 47) derart zu steuern, dass eine Trommel-
wickelzahl zur Bildung der ersten Garnlage (51), der zweiten Garnlage (53) und der dritten Garnlage (55) 2,5w:
2,0w: 1,5w beträgt, und die Breiten der ersten Garnlage (51), der zweiten Garnlage (53) und der dritten Garnlage
(55) jeweils 15,24 cm (6 Zoll) : 10,16 cm (4 Zoll) : 7,62 cm (3 Zoll) betragen.
- 15 10. Die Garnwickelvorrichtung (1) nach Anspruch 7, wobei der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsab-
schnitt (45, 47) derart zu steuern, dass ein Verhältnis einer Traversierzahl der ersten Garnlage (51), der zweiten
Garnlage (53) und der dritten Garnlage (55) 1: 2: 2 beträgt.
- 20 11. Die Garnwickelvorrichtung (1) nach Anspruch 10, wobei
der Steuerabschnitt (50) dazu ausgelegt ist, den Antriebsabschnitt (45, 47) derart zu steuern, dass eine Trommel-
wickelzahl zur Bildung der ersten Garnlage (51), der zweiten Garnlage (53) und der dritten Garnlage (55) 2,0w:
1,5w: 1,5w beträgt, und die Breiten der ersten Garnlage (51), der zweiten Garnlage (53) und der dritten Garnlage
(55) jeweils 10,16 cm (4 Zoll): 9,65 cm (3,8 Zoll): 7,62 cm (3 Zoll) betragen.
- 25 12. Garn (4) -Wickelverfahren, durchgeführt von einer Garnwickelvorrichtung (1), die einen Drehlagerabschnitt (8) ent-
hält, an dem ein Wickelement (6) angebracht ist, einen Garnführungsabschnitt (12), der eine Traversiertrommel
(5) aufweist und konfiguriert ist, um das Garn (4) zu dem Wickelement (6) zu führen, und ein erstes Hebelement
(63) und ein zweites Hebelement (65), die konfiguriert sind, um sich zu bewegen zwischen einer Nicht-Begren-
30 zungsposition, an der das Hebelement (63, 65) eine bewegbare Position des Garns (4) in einer Drehachsrichtung
der Traversiertrommel (5) begrenzt, um das Garn (4) zu der Traversiertrommel (5) mit einer vorbestimmten Traver-
sierbreite zu führen, und einer Begrenzungsposition, an der das Hebelement (63, 65) die bewegbare Position des
Garns (4) in der Drehachsrichtung der Traversiertrommel (5) begrenzt, um das Garn (4) der Traversiertrommel (5)
mit einer Traversierbreite zuzuführen, die schmaler ist als die vorbestimmte Traversierbreite, **dadurch gekenn-**
35 **zeichnet, dass**
das Verfahren enthält, die folgenden Schritte abwechselnd wiederholt durchzuführen, um ein stufenbildendes Wi-
ckeln durchzuführen:

einen ersten Schritt des Lokalisierens des ersten Hebelements (63) und des zweiten Hebelements (65) an
der Nicht-Begrenzungsposition, um das Garn (4) zu einer Traversiernut (71) in der Traversiertrommel (5) mit
40 einer ersten Traversierbreite zu führen; und
einen zweiten Schritt des Lokalisierens des ersten Hebelements (63) an der Begrenzungsposition und des
zweiten Hebelements (65) an der Nicht-Begrenzungsposition, um das Garn zu der Traversiertrommel (5) mit
einer zweiten Traversierbreite zu führen, die schmaler ist als die erste Traversierbreite, um hierdurch das Garn
(4) zu einer Traversiernut (73) der Traversiertrommel (5) zu führen, die sich von der Traversiernut (71) in dem
45 ersten Schritt unterscheidet; und
einen dritten Schritt des Lokalisierens des zweiten Hebelements (65) an der Begrenzungsposition, um das
Garn (4) zu der Traversiertrommel (5) mit einer dritten Traversierbreite zu führen, die schmaler ist als die zweite
Traversierbreite, um hierdurch das Garn (4) zu einer Traversiernut der Traversiertrommel (5) zu führen, die
sich von der Traversiernut (71, 73) in dem ersten Schritt und dem zweiten Schritt unterscheidet.
- 50

Revendications

- 55 1. Dispositif de bobinage de fil (1), comprenant :

une section de support de rotation (8) à laquelle est fixé un élément de bobinage (6) ;
une section de guidage de fil (12) conçue pour guider le fil (4) vers l'élément de bobinage (6), la section de
guidage de fil (12) comportant un tambour de course de fil (5) ; **caractérisé en ce que**

un premier élément de levier (63) et un second élément de levier (65) disposés à des positions différentes dans une direction d'axe de rotation du tambour de course de fil (5), le premier levier (63) et le second levier (65) étant conçus pour se déplacer entre une position de non-limitation au niveau de laquelle le premier élément de levier (63) et le second élément de levier (65) ne limitent pas une position de déplacement possible du fil (4) dans une direction d'axe de rotation du tambour de course de fil (5) de façon à guider le fil (4) par rapport au tambour de course de fil (5), et une position de limitation au niveau de laquelle le premier élément de levier (63) et le second élément de levier (65) limitent la position de déplacement possible du fil (4) dans la direction d'axe de rotation du tambour de course de fil (5) pour amener le fil (4) vers le tambour de course de fil (5) sur une largeur de course de fil plus étroite que dans un cas de la non-limitation, guidant ainsi le fil (4) vers différentes rainures de course de fil (9) du tambour de course de fil (5) entre la position de limitation et la position de non-limitation, de sorte que le dispositif de bobinage de fil (1) soit apte à mettre en œuvre un bobinage de formation étagé par une répétition d'opérations de bobinage de fil sur différentes largeurs, si le premier élément de levier (63) et le second élément de levier (65) sont positionnés aux positions de non-limitation, un bobinage de fil (51) est exécuté sur une première largeur, si le premier élément de levier (63) est positionné à la position de limitation et si le second élément de levier (65) est positionné à la position de non-limitation, un bobinage de fil (53) est exécuté sur une deuxième largeur plus étroite que la première largeur, et si le second élément de levier (65) est positionné à la position de limitation, un bobinage de fil (55) est exécuté sur une troisième largeur plus étroite que la deuxième largeur, exécutant ainsi un bobinage de formation étagé avec au moins deux différences de niveau.

2. Dispositif de bobinage de fil (1) selon la revendication 1, comprenant en outre :

une section d'entraînement (45, 47) conçue pour entraîner le premier élément de levier (63) et le second élément de levier (65) ; et
une section de commande (50) configurée pour commander la section d'entraînement (45, 47), dans lequel la section de commande (50) commande la section d'entraînement (45, 47) pour qu'elle mette en œuvre de manière alternée les étapes d'un ensemble des étapes suivantes :

une étape consistant à positionner le premier élément de levier (63) et le second élément de levier (65) à la position de non-limitation ;
une étape consistant à positionner le premier élément de levier (63) à la position de limitation et le second élément de levier (65) à la position de non-limitation ; et
une étape consistant à positionner le second élément de levier (65) à la position de limitation.

3. Dispositif de bobinage de fil (1) selon la revendication 2, dans lequel la section de commande (50) exécute les étapes en fonction d'informations de motif de bobinage prédéterminées.

4. Dispositif de bobinage de fil (1) selon l'une quelconque des revendications 1 à 3, dans lequel

des rainures de course de fil (9) du tambour de course de fil (5) comprennent une première rainure (71) s'étendant de façon à élargir un trajet du fil (4) en direction d'un premier côté (P) dans une direction de largeur du tambour de course de fil (5), et une deuxième rainure (73) s'étendant de façon à rétrécir un trajet du fil (4) en direction d'un second côté dans une direction de largeur du tambour de course de fil (5), la deuxième rainure (73) en intersection avec la première rainure (71) pour définir une première intersection (75), et une troisième rainure s'étendant de façon à rétrécir un trajet du fil (4) en direction du second côté dans la direction de largeur du tambour de course de fil (5), la troisième rainure en intersection avec la deuxième rainure (73) pour définir une seconde intersection (77), si le premier élément de levier (63) et le second élément de levier (65) sont positionnés à la position de non-limitation, le fil (4) parcourant la première rainure (71) passe la première intersection (75) et la seconde intersection (77) et continue à parcourir la première rainure (71), si le premier élément de levier (63) est positionné à la position de limitation et si le second élément de levier (65) est positionné à la position de non-limitation, le fil (4) parcourant la première rainure (71) se décale vers la deuxième rainure (73) au niveau de la première intersection (75) et continue à parcourir la deuxième rainure (73), et si le second élément de levier (65) est positionné à la position de limitation, le fil (4) parcourant la deuxième rainure (73) se décale vers la troisième rainure au niveau de la seconde intersection (77) et continue à parcourir la troisième rainure.

5. Dispositif de bobinage de fil (1) selon l'une quelconque des revendications 1 à 4, dans lequel la section de support de rotation (8) comprend deux sections de support (8a), et un adaptateur (83) qui peut être fixé de manière démontable à au moins une section des deux sections de support (8a) et qui supporte une extrémité de l'élément de bobinage (6).

6. Dispositif de bobinage de fil (1) selon la revendication 2, dans lequel la section de commande (50) commande la section d'entraînement (45, 47) de sorte que le fil (4) comprenne une première partie (7A) et une deuxième partie (7B) ainsi qu'une troisième partie (7C) disposées les unes par rapport aux autres dans une direction longitudinale de l'élément de bobinage (6), la deuxième partie (7B) comportant une couche de fil ayant un diamètre supérieur à celui de la première partie (7A), et la troisième partie (7C) comportant une couche de fil ayant un diamètre supérieur à celui de la deuxième partie (7B), et que le fil (4) comprenne une première couche de fil (51) bobinée au niveau de la première partie (7A), de la deuxième partie (7B) et de la troisième partie (7C) sur une première largeur à partir d'une extrémité de référence (P) de l'élément de bobinage (6), une deuxième couche de fil (53) bobinée au niveau de la deuxième partie (7B) et de la troisième partie (7C) par-dessus la première couche de fil (51) sur une deuxième largeur à partir de l'extrémité de référence (P) de l'élément de bobinage (6) plus étroite que la première largeur, et une troisième couche de fil (55) bobinée au niveau de la troisième partie (7C) par-dessus la deuxième couche de fil (53) sur une troisième largeur à partir de l'extrémité de référence (P) de l'élément de bobinage (6) plus étroite que la deuxième largeur.

7. Dispositif de bobinage de fil (1), comprenant :

une section de support de rotation (8) à laquelle est fixé un élément de bobinage (6) ;
une section de guidage de fil (12) conçue pour guider le fil (4) vers l'élément de bobinage (6), la section de guidage de fil (12) comportant un tambour de course de fil (5) ;

un élément de levier (63) conçu pour se déplacer entre une position de non-limitation au niveau de laquelle l'élément de levier (63) ne limite pas une position de déplacement possible du fil (4) dans une direction d'axe de rotation du tambour de course de fil (5) de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une largeur de course de fil prédéterminée, et une position de limitation au niveau de laquelle l'élément de levier (63) limite la position de déplacement possible du fil (4) dans la direction d'axe de rotation du tambour de course de fil (5) pour amener le fil (4) vers le tambour de course de fil (5) sur une largeur de course de fil plus étroite que la largeur de course de fil prédéterminée, guidant ainsi le fil (4) vers différentes rainures de course de fil (71, 73) du tambour de course de fil (5) entre la position de limitation et la position de non-limitation, de sorte que le dispositif de bobinage de fil (1) soit apte à mettre en œuvre un bobinage de formation étagé par une répétition d'opérations de bobinage de fil sur différentes largeurs et à exécuter en alternance de manière continue un bobinage de fil lors duquel un bobinage de fil sur une largeur de course de fil plus étroite que la largeur prédéterminée est exécuté de manière répétée pour obtenir un bobinage de fil sur la largeur plus étroite que la largeur de course de fil prédéterminée ;

une section d'entraînement (45) conçue pour entraîner l'élément de levier (63) ; et

une section de commande (50) configurée pour commander la section d'entraînement, dans lequel

la section de commande (50) commande la section d'entraînement (45) pour mettre en œuvre de manière alternée les étapes suivantes : une étape consistant à positionner l'élément de levier (63) à la position de limitation de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une largeur de course de fil plus étroite que la largeur prédéterminée ; et une étape consistant à positionner l'élément de levier (63) à la position de non-limitation de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur la largeur de course de fil prédéterminée,

la section de commande (50) étant apte à commander la section d'entraînement (45) de sorte que le fil (4) comprenne une première partie (7A) et une deuxième partie (7B) disposées l'une par rapport à l'autre dans une direction longitudinale de l'élément de bobinage (6), que la deuxième partie (7B) comporte une couche de fil (53) ayant un diamètre supérieur à celui de la première partie (7A), et que le fil (4) comprenne une première couche de fil (51) bobinée au niveau de la première partie (7A) et de la deuxième partie (7B) sur une première largeur à partir d'une extrémité de référence (P) de l'élément de bobinage (6), et une deuxième couche de fil (53) disposée en couches de manière alternée avec la première couche de fil (51), et que la deuxième couche de fil (53) ne soit bobinée qu'au niveau de la deuxième partie (7B) sur une deuxième largeur à partir de l'extrémité de référence (P) de l'élément de bobinage (6) plus étroite que la première largeur,

caractérisé en ce que la section de commande (50) est apte à commander la section d'entraînement (47) de sorte que le fil (4) comprenne une troisième partie (7C) disposée avec la deuxième partie (7B) dans la direction longitudinale de l'élément de bobinage (6), et que le fil (4) comprenne une troisième couche de fil (55) disposée en couches de manière alternée avec la première couche de fil (51) et avec la seconde couche de fil (53), la

troisième couche (55) n'étant bobinée qu'au niveau de la troisième partie (7C) sur une troisième largeur à partir de l'extrémité de référence (P) de l'élément de bobinage (6) plus étroite que la deuxième largeur.

8. Dispositif de bobinage de fil (1) selon la revendication 7, dans lequel la section de commande (50) est apte à commander la section d'entraînement (45, 47) de sorte qu'un rapport de nombre de course de fil de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soit 2:3:4.

9. Dispositif de bobinage de fil (1) selon la revendication 8, dans lequel la section de commande (50) est apte à commander la section d'entraînement (45, 47) de sorte qu'un nombre de bobinage du tambour pour la formation de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soit 2,5w ; 2,0w ; 1,5w et que les largeurs de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soient respectivement 15,24 cm (6 pouces) ; 10,16 cm (4 pouces) ; 7,62 cm (3 pouces).

10. Dispositif de bobinage de fil (1) selon la revendication 7, dans lequel la section de commande (50) est apte à commander la section d'entraînement (45, 47) de sorte qu'un rapport d'un nombre de course de fil de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soit 1:2:2.

11. Dispositif de bobinage de fil (1) selon la revendication 10, dans lequel la section de commande (50) est apte à commander la section d'entraînement (45, 47) de sorte qu'un nombre de bobinage du tambour pour la formation de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soit 2,0w ; 1,5w ; 1,5w, et que les largeurs de la première couche de fil (51), de la deuxième couche de fil (53) et de la troisième couche de fil (55) soient respectivement 10,16 cm (4 pouces) ; 9,65 cm (3,8 pouces) ; 7,62 cm (3 pouces).

12. Procédé de bobinage d'un fil (4) mis en œuvre par un dispositif de bobinage de fil (1) comprenant une section de support de rotation (8) à laquelle est fixé un élément de bobinage (6), une section de guidage de fil (12) comportant un tambour de course de fil (5) et conçue pour guider le fil (4) vers l'élément de bobinage (6), et un premier élément de levier (63) et un second élément de levier (65) conçus pour se déplacer entre une position de non-limitation au niveau de laquelle l'élément de levier (63, 65) ne limite pas une position de déplacement possible du fil (4) dans une direction d'axe de rotation du tambour de course de fil (5) de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une largeur de course de fil prédéterminée, et une position de limitation au niveau de laquelle l'élément de levier (63, 65) limite la position de déplacement possible du fil (4) dans la direction d'axe de rotation du tambour de course de fil (5) de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une largeur de course de fil plus étroite que la largeur de course de fil prédéterminée, **caractérisé en ce que** le procédé consiste à mettre en œuvre de manière répétée les étapes suivantes de manière alternée pour obtenir un bobinage de formation étagé :

une première étape consistant à positionner le premier élément de levier (63) et le second élément de levier (65) au niveau de la position de non-limitation de façon à guider le fil (4) vers une rainure de course de fil (71) ménagée dans le tambour de course de fil (5) sur une première largeur de course de fil ; et
une deuxième étape consistant à positionner le premier élément de levier (63) au niveau de la position de limitation et le second élément de levier (65) au niveau de la position de non-limitation de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une deuxième largeur de course de fil plus étroite que la première largeur de course de fil, guidant ainsi le fil (4) vers une rainure de course de fil (73) du tambour de course de fil (5) différente de la rainure de course de fil (71) de la première étape ; et
une troisième étape consistant à positionner le second élément de levier (65) à la position de limitation de façon à guider le fil (4) par rapport au tambour de course de fil (5) sur une troisième largeur de course de fil plus étroite que la deuxième largeur de course de fil, guidant ainsi le fil (4) vers une rainure de course de fil du tambour de course de fil (5) différente de la rainure de course de fil (71, 73) de la première étape et de la deuxième étape.

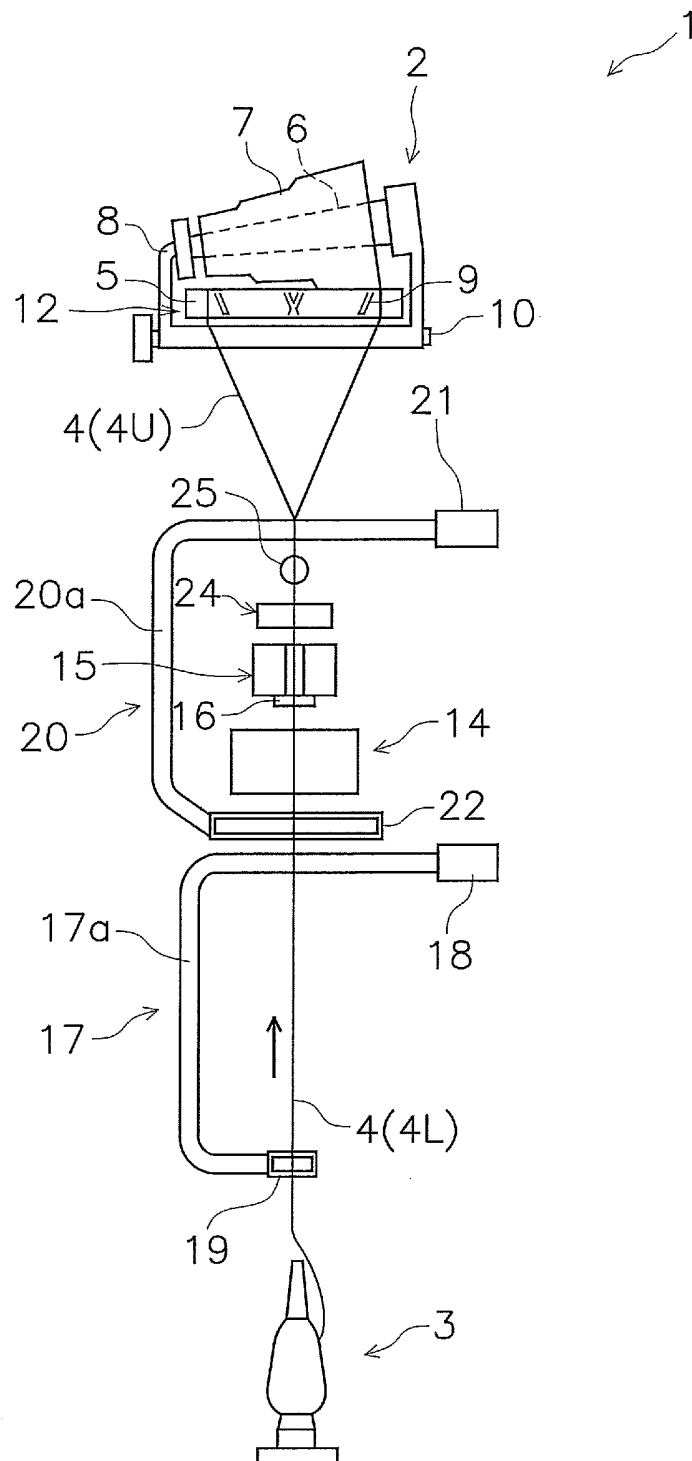


FIG. 1

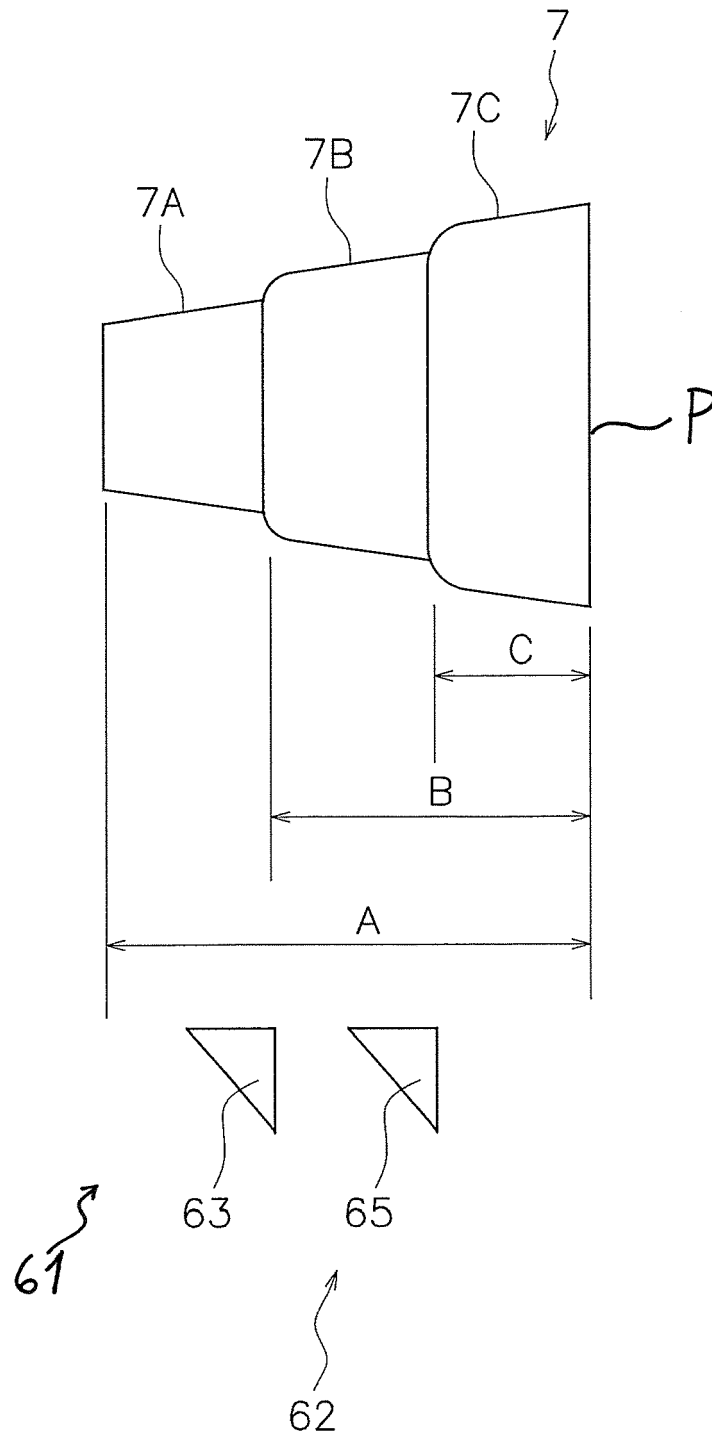


FIG. 2

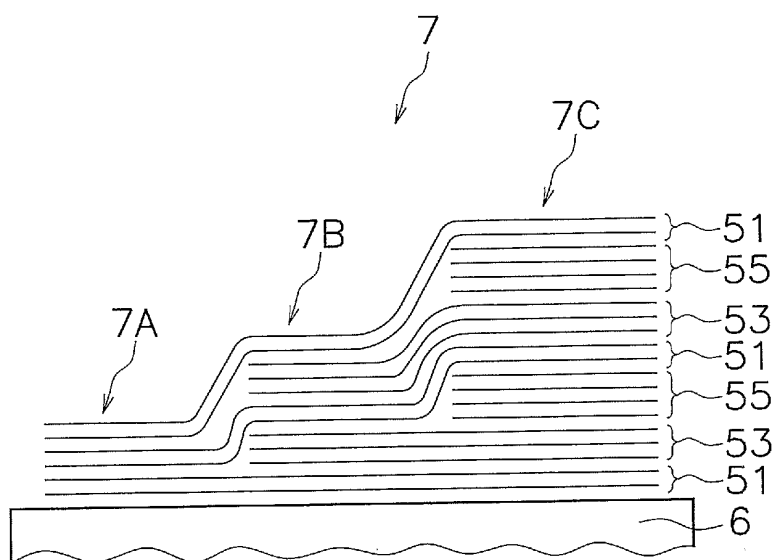


FIG. 3

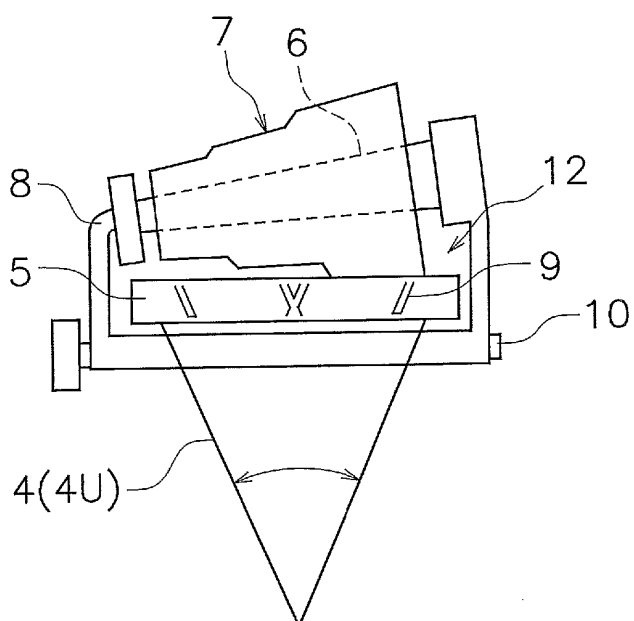


FIG. 4

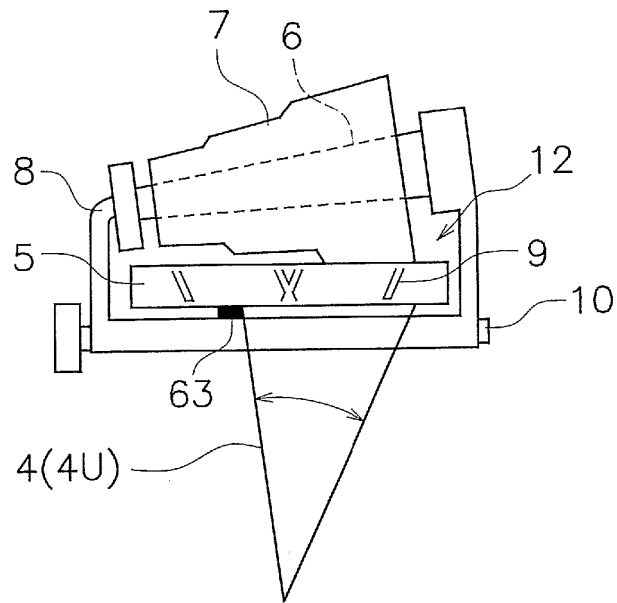


FIG. 5

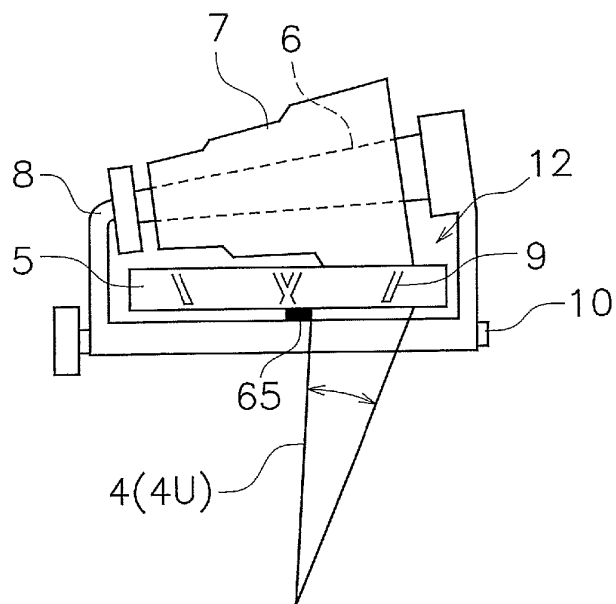


FIG. 6

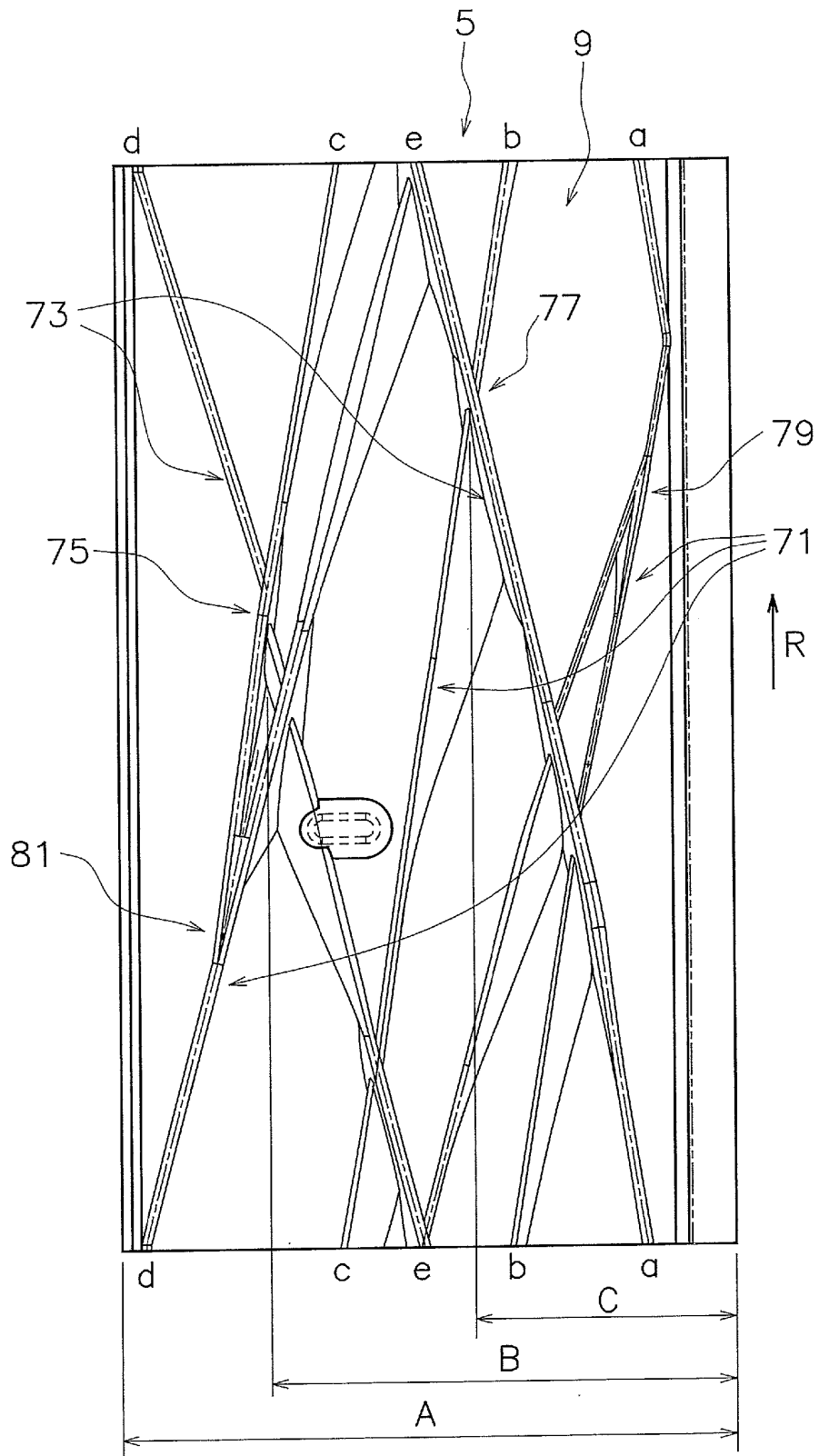


FIG. 7

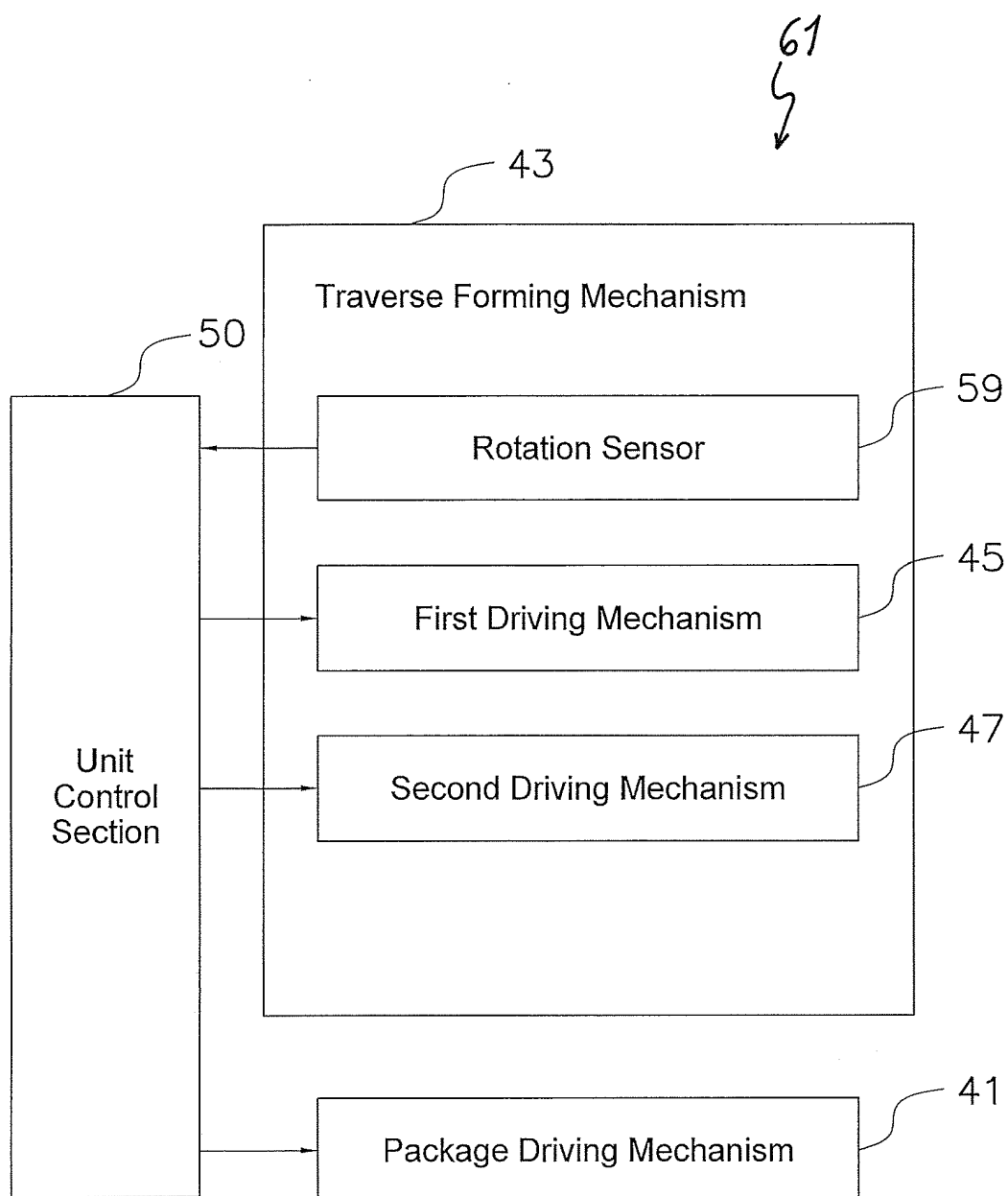


FIG. 8

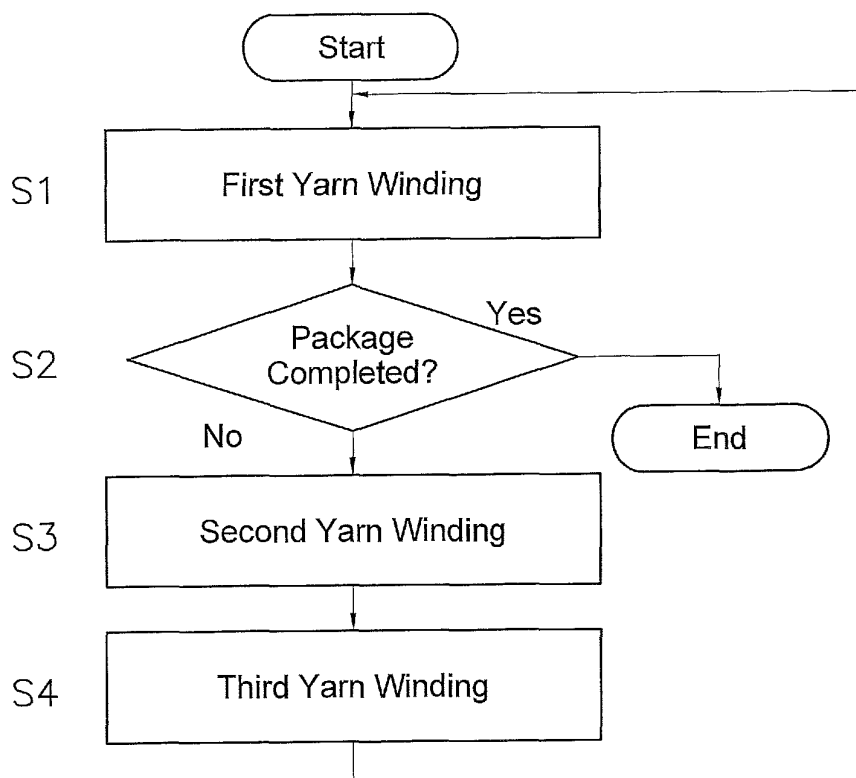


FIG. 9

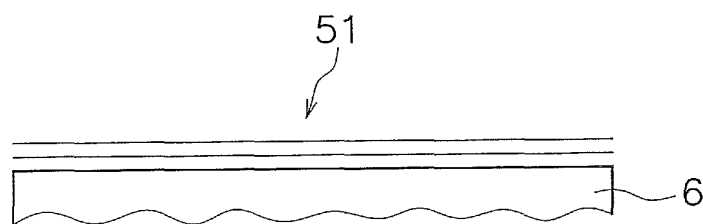


FIG. 10

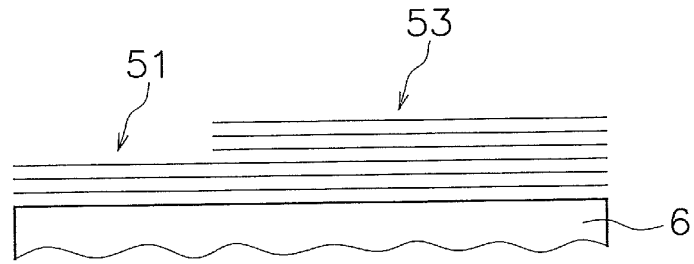


FIG. 11

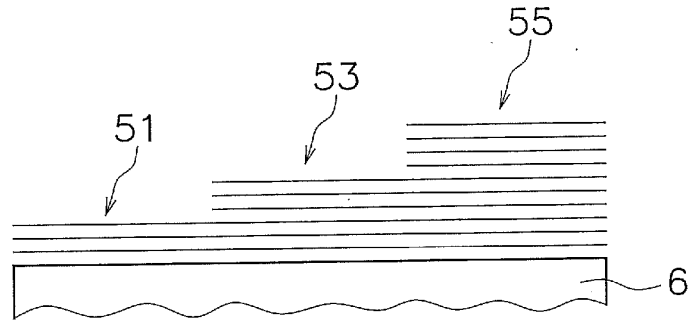


FIG. 12

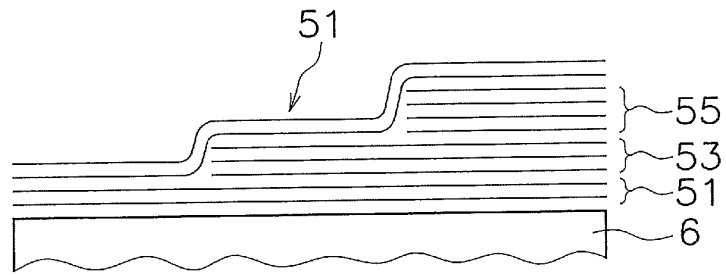


FIG. 13

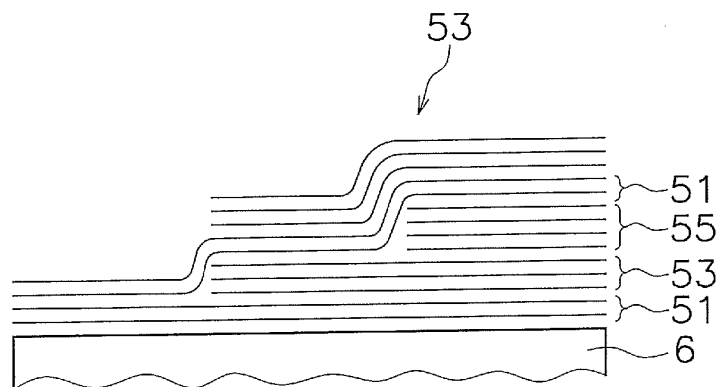


FIG. 14

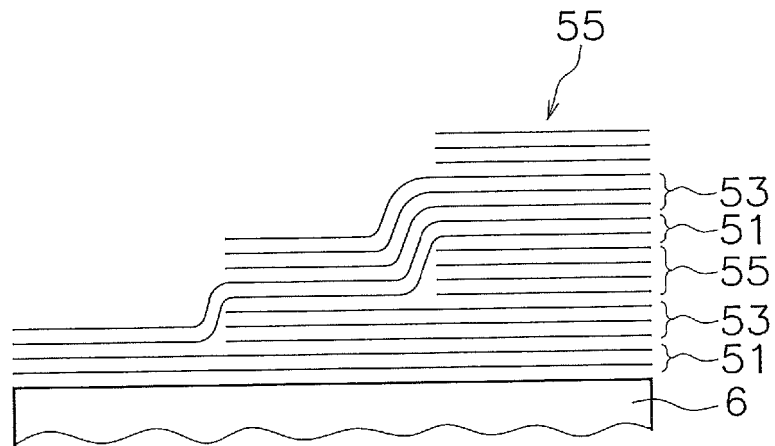


FIG. 15

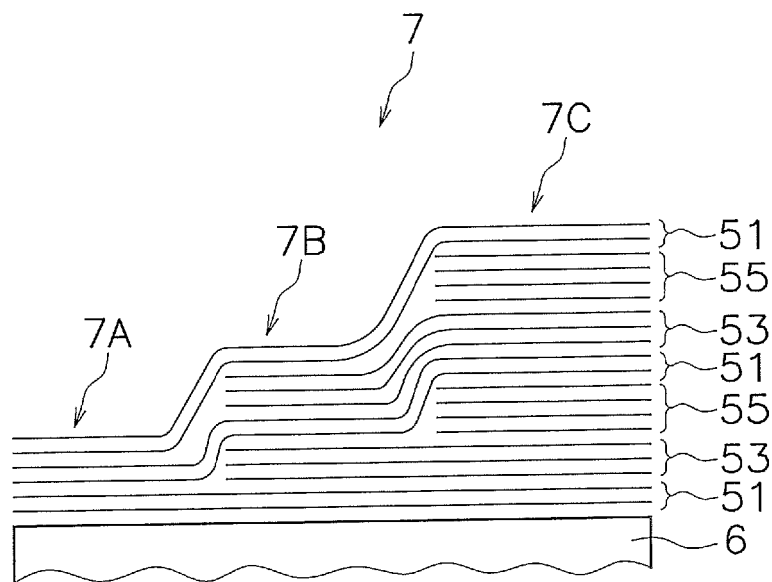


FIG. 16

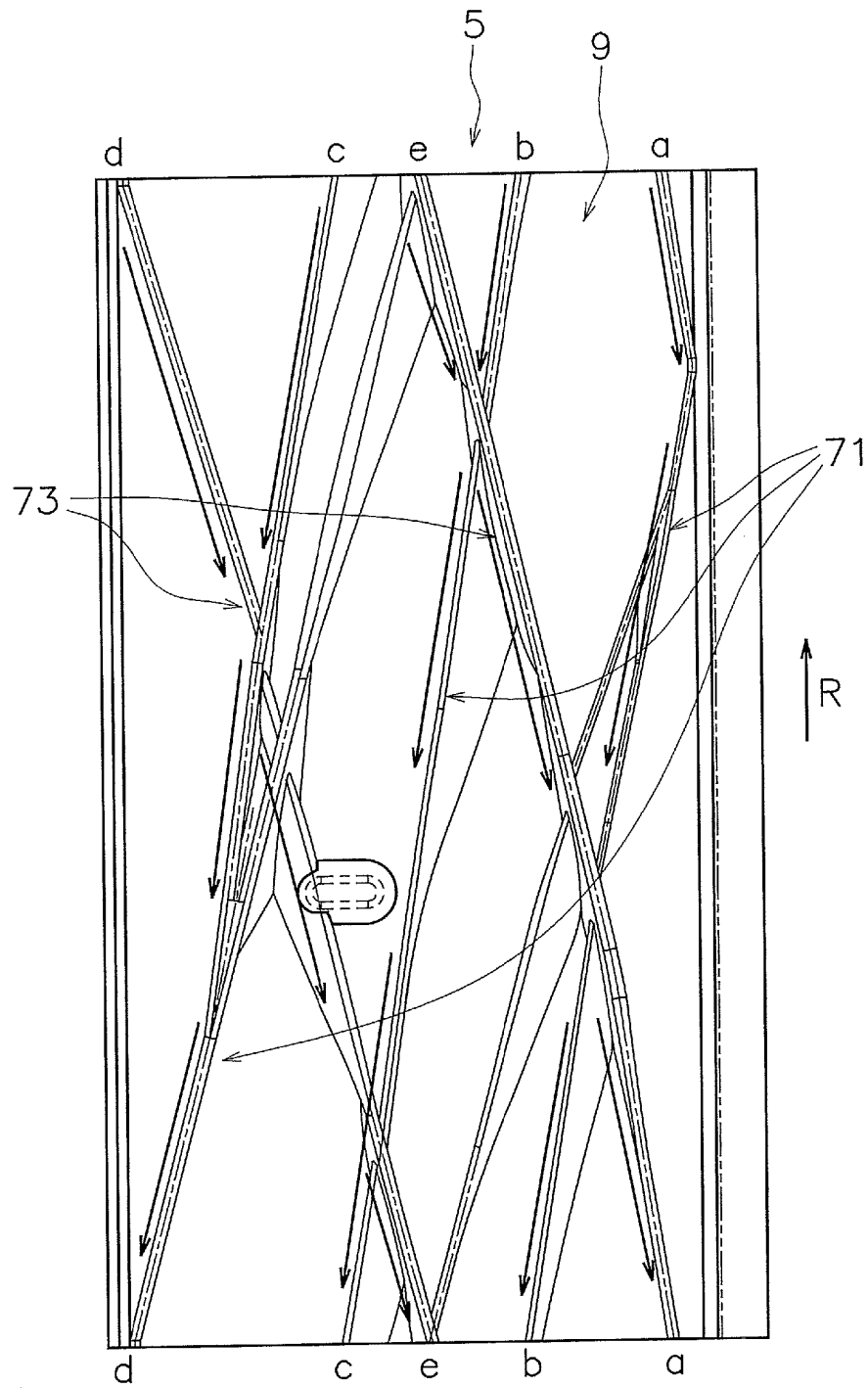


FIG. 17

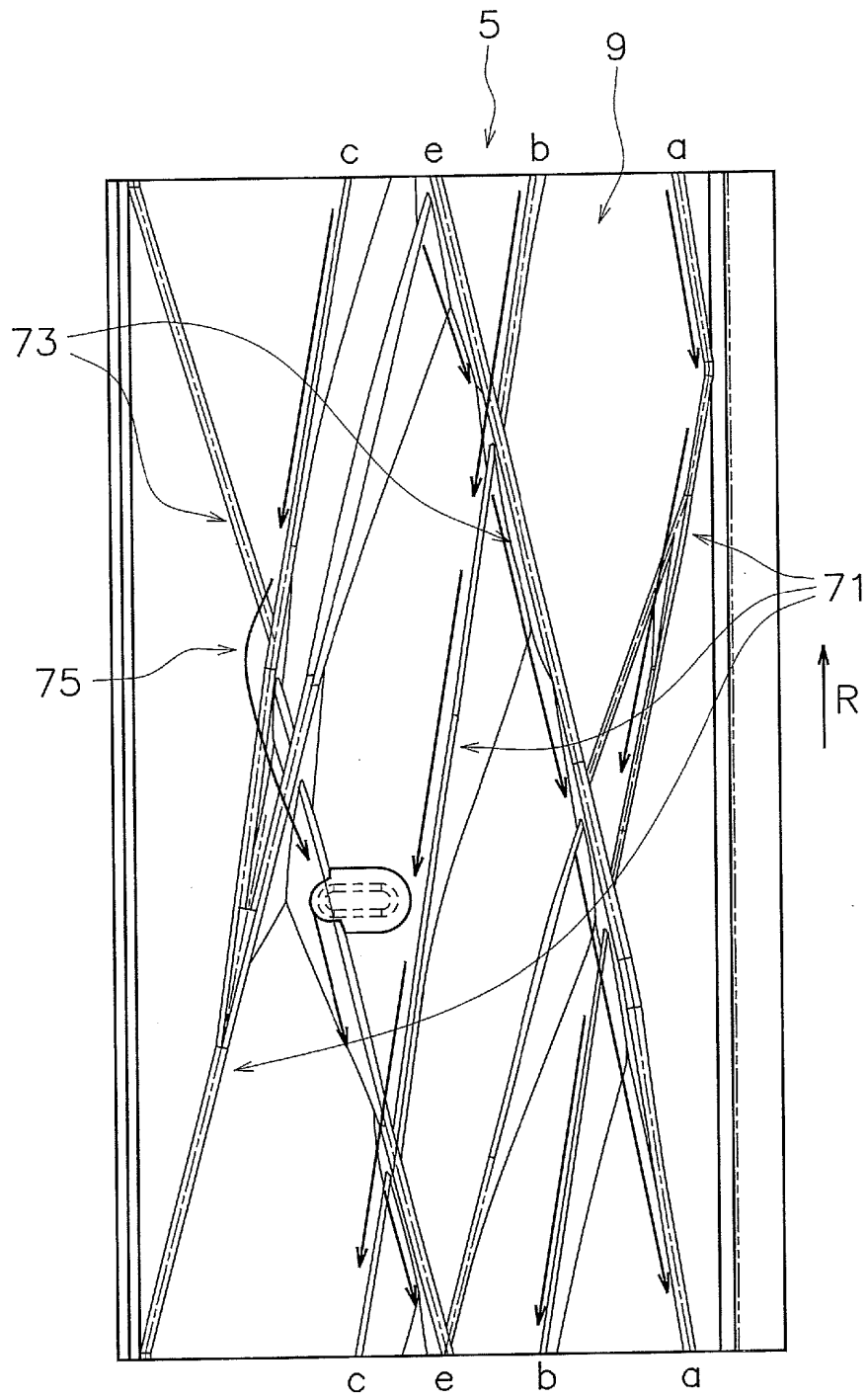


FIG. 18

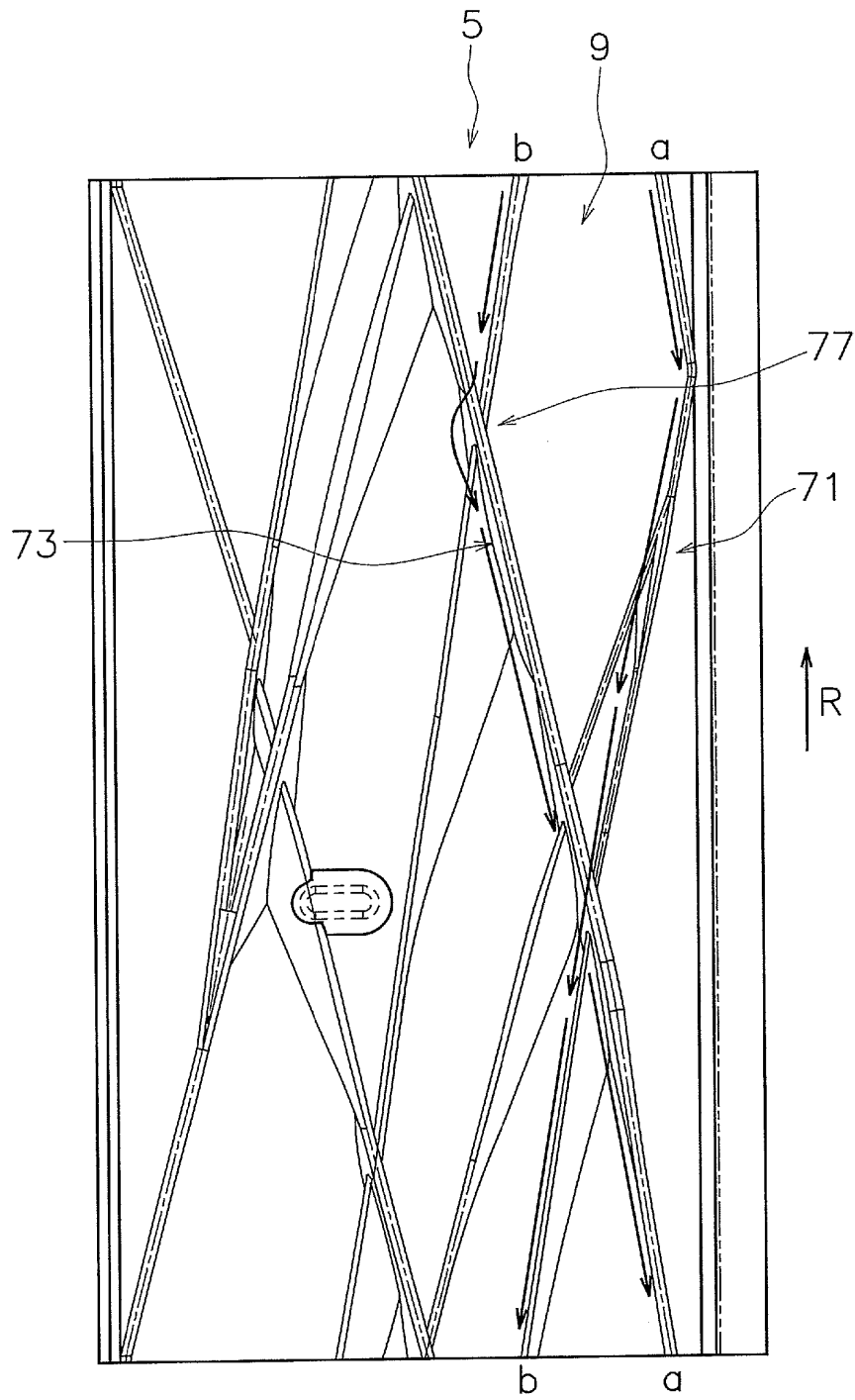


FIG. 19

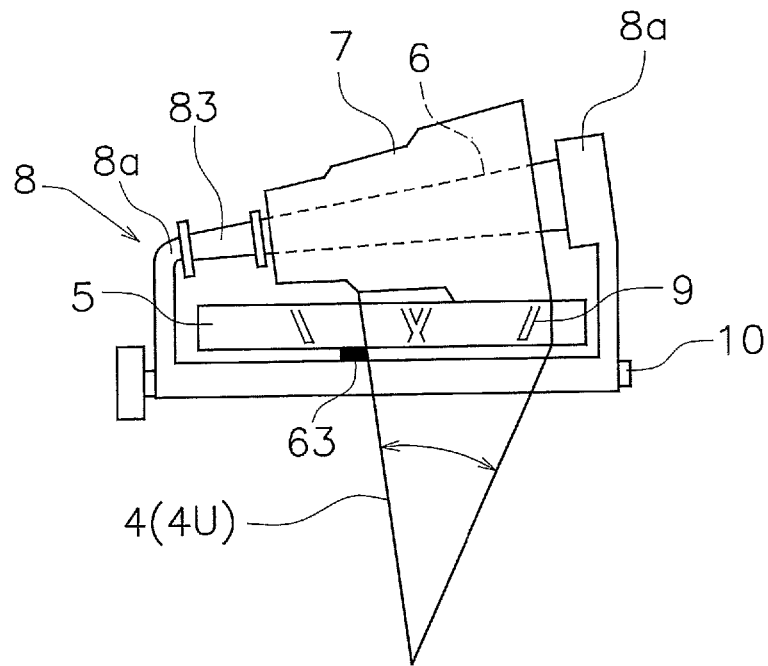


FIG. 20

REFERENCES CITED IN THE DESCRIPTION

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