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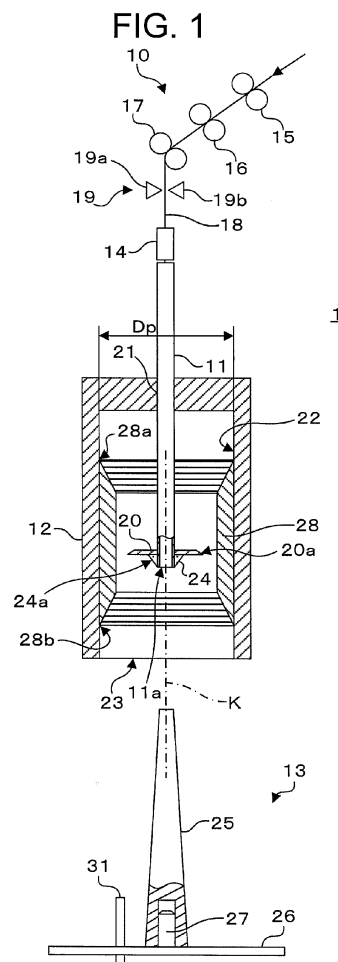
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(54) **POT SPINNING MACHINE AND POT SPINNING METHOD**

(57) The present invention is a pot spinning machine (1) including a yarn guide (11) and a pot (12) into which the yarn guide (11) is inserted, yarn (18) being discharged from a lower end of the yarn guide (11) inside the pot (12), and a cake (28) being formed by winding the yarn (18) around an inner wall (22) of the pot (12) using centrifugal force accompanying rotation of the pot (12), the pot spinning machine (1) further including a cutter (20) for cutting string yarn (33) present in a space inside the pot (12) away from the inner wall (22) of the pot (12).



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a pot spinning machine and a pot spinning method.

2. Description of the Related Art

[0002] A pot spinning method using a cylindrical pot is well known as a spinning method. A pot spinning method can be broadly divided into three steps. The first step is for drawing out a yarn material to a predetermined thickness. The second step is for forming a cake by winding the yarn drawn out in the first step around the inner wall of a pot. The third step is for rewinding the yarn forming the cake around a bobbin from the inner wall of the pot.

[0003] In the second step, the pot is rotated at a predetermined rotation frequency and the yarn drawn out in the first step is guided into the pot through a yarn guide. The yarn guided into the pot is discharged from one end of the yarn guide and pressed against the inner wall of the pot by centrifugal force accompanying rotation of the pot. At this time, the yarn discharged from the yarn guide is wound around the inner wall of the pot while being twisted by the rotation of the pot.

[0004] Further, in the second step, the cake is formed on the inner wall of the pot by moving one end of the yarn guide to an opening side of the pot while causing the yarn guide to reciprocate in a central axis direction of the pot. When formation of the cake is complete, the yarn is cut. Yarn cutting is performed by cutting the yarn on an upstream side of the yarn guide in a yarn feed direction.

[0005] When yarn cutting is performed, tension in the yarn is released instantaneously. When the tension in the yarn is released, the yarn flies out of one end of the yarn guide vigorously as a reaction. As a result, a part of the yarn that flies out of the yarn guide may float up in a loop shape, and the yarn that floats up may be present in a space inside the pot while remaining separated from the inner wall of the pot. Yarn that is present away from the inner wall of the pot in this manner is also known as a string. In this specification, yarn forming a string will be referred to as string yarn. The string yarn bends upon reception of the centrifugal force that accompanies rotation of the pot but is present independently, away from the yarn wound around the inner wall of the pot. Moreover, respective ends of the string yarn catch on the yarn wound around the inner wall of the pot so as to be supported in a fixed state.

[0006] When string yarn is present in the space inside the pot in this manner, the string yarn may contact the outer peripheral surface of the yarn guide, for example, so as to coil around the yarn guide together with the other yarn. Alternatively, while the bobbin is being inserted into the pot, for example, the string yarn may contact the outer

peripheral surface of the bobbin so that rewinding of the yarn onto the bobbin starts earlier than envisaged. In both cases, the yarn cannot be wound appropriately onto the bobbin, and as a result, a rewinding defect occurs.

[0007] Patent Document 1 (Japanese Examined Patent Publication No. S29-8226) describes a pot spinning machine in which a pair of yarn-guiding aprons are provided on a downstream side of a pair of front rollers constituting a drafting device so that tip ends of the pair of aprons can be disposed inside a pot. In the invention described in Patent Document 1, even when yarn is cut on the upstream side of the pair of aprons, the cut yarn can be guided into the pot while remaining nipped by the pair of aprons. Hence, at the point where the yarn end serving as the cutting point of the yarn passes through the tip ends of the pair of aprons, the distance from the yarn end to the pot inner wall is short. As a result, the yarn end can be wound around the inner wall of the pot while suppressing the formation of string yarn.

SUMMARY OF THE INVENTION

[0008] In the invention described in Patent Document 1, however, the pair of aprons are used instead of a yarn guide, and therefore the following problems occur. A yarn guide is structured simply in a vertically elongated cylindrical shape, whereas the pair of aprons have a complicated structure including rollers for supporting the aprons and other members. Moreover, to shift the winding position of the yarn relative to the inner wall of the pot in the central axis direction of the pot, a mechanism for raising and lowering the pot itself is required. Furthermore, since the pair of aprons are introduced into the pot, the component size increases. With the invention described in Japanese Examined Patent Publication No. S29-8226, therefore, the configuration of the pot spinning machine is complicated and large in scale, and the cost of implementing the invention is high.

[0009] The present invention has been devised to solve the problems described above, and an object thereof is to provide a pot spinning machine and a pot spinning method with which the occurrence of rewinding defects due to the formation of string yarn can be suppressed at low cost.

[0010] The present invention is a pot spinning machine including a yarn guide and a pot into which the yarn guide is inserted, yarn being discharged from one end of the yarn guide inside the pot, and a cake being formed by winding the yarn around an inner wall of the pot using centrifugal force accompanying rotation of the pot, the pot spinning machine further including a cutter for cutting string yarn that is present in a space inside the pot away from the inner wall of the pot.

[0011] Further, the present invention is a pot spinning method for forming a cake by rotating a pot in a state where a yarn guide is inserted into the pot so that yarn discharged from one end of the yarn guide is wound around an inner wall of the pot, the pot spinning method

including cutting string yarn that is present in a space inside the pot away from the inner wall of the pot using a cutter either during or after formation of the cake.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a schematic view showing a configurational example of main parts of a pot spinning machine according to an embodiment of the present invention;

FIG. 2 is a sectional view showing a partial enlargement of FIG. 1;

FIG. 3 is a side view illustrating respective configurations of a cutter and a guide member;

FIG. 4 is a view seen in the direction of an arrow IV in FIG. 3;

FIG. 5 is a block diagram showing an example configuration of a drive control system of the pot spinning machine according to this embodiment of the present invention;

FIG. 6 is a view showing a basic flow of a pot spinning method;

FIG. 7 is a view showing the condition inside a pot during a cake-forming step;

FIG. 8 is a view illustrating an operation of a yarn guide during the cake-forming step;

FIG. 9 is a view showing a state in which string yarn is formed inside the pot;

FIG. 10 is a schematic view showing the manner in which the cutter approaches the string yarn present inside the pot;

FIG. 11 is a schematic view showing a state in which the string yarn present inside the pot has been pressed down by lowering the yarn guide;

FIG. 12 is a side view showing a state in which the string yarn is in contact with a blade of the cutter;

FIG. 13 is a side view showing a configuration in which the cutter is provided on the yarn guide without the guide member;

FIG. 14 is a view showing the condition inside the pot at the start of a rewinding step;

FIG. 15 is a view showing the condition inside the

pot at the end of the rewinding step;

FIG. 16 is a view showing a configuration in which a cutter is disposed at an incline on the yarn guide;

FIG. 17 is a view illustrating a first modified example of the present invention;

FIG. 18 is a view illustrating a second modified example of the present invention; and

FIG. 19 is a view illustrating a third modified example of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Embodiments of the present invention will be described in detail below with reference to the figures.

Pot Spinning Machine

[0014] First, a pot spinning machine according to an embodiment of the present invention will be described.

[0015] FIG. 1 is a schematic view showing a configurational example of main parts of the pot spinning machine according to this embodiment of the present invention.

[0016] As shown in FIG. 1, a pot spinning machine 1 includes a drafting device 10, a yarn guide 11, a pot 12, and a bobbin support 13. Note that these constituent elements together constitute a single spindle, which serves as a single spinning unit. The pot spinning machine 1 includes a plurality of spindles, but here, the configuration of one of the plurality of spindles will be described.

Drafting Device

[0017] The drafting device 10 is a device for drawing out a yarn material such as roving to a predetermined thickness. The drafting device 10 is formed using a plurality of roller pairs including a back roller pair 15, a middle roller pair 16, and a front roller pair 17. The plurality of roller pairs are arranged in order of the back roller pair 15, the middle roller pair 16, and the front roller pair 17 from an upstream side toward a downstream side in a conveyance direction of the yarn material.

[0018] The respective roller pairs 15, 16, 17 rotate when driven by a drafting drive unit, to be described below. When rotation frequencies per unit time (rpm) of the respective roller pairs 15, 16, 17 are compared, the rotation frequency of the middle roller pair 16 is higher than the rotation frequency of the back roller pair 15, and the rotation frequency of the front roller pair 17 is higher than the rotation frequency of the middle roller pair 16. Hence, the respective roller pairs 15, 16, 17 have different rotation frequencies, and using these rotation frequency differences, or in other words rotation speed differences, the drafting device 10 draws the yarn material out thinly.

In the following description, the rotation frequencies of the roller pairs will also be referred to as rotation speeds. The rotation frequency and the rotation speed of each roller pair have a mutual corresponding relationship.

Yarn Guide

[0019] The yarn guide 11 guides yarn 18 drawn out to the predetermined thickness by the drafting device 10 into the pot 12. The yarn guide 11 is formed in the shape of a long, narrow tube. The yarn guide 11 has a circular shape on a cross-section cut in an orthogonal direction to a length direction thereof.

[0020] The yarn guide 11 is disposed coaxially with the pot 12 on the downstream side of the drafting device 10. A lower portion of the yarn guide 11 is inserted into the pot 12. The yarn guide 11 guides the yarn 18, which is supplied from the front roller pair 17 through a yarn supply pipe 14, into the pot 12. The yarn 18 drawn out by the drafting device 10 is pulled into the yarn supply pipe 14 using a swirling flow of air, for example, and then introduced into the yarn guide 11 through the yarn supply pipe 14. The yarn 18 introduced into the yarn guide 11 is discharged from a lower end 11a of the yarn guide 11. The yarn guide 11 is provided to be movable in a vertical direction by a yarn guide drive unit, to be described below.

[0021] A cutter 20 is provided on the yarn guide 11. Further, a guide member 24 is provided on the yarn guide 11 together with the cutter 20. The cutter 20 and the guide member 24 are disposed inside the pot 12 near a lower end 11a of the yarn guide 11. The respective configurations of the cutter 20 and the guide member 24 will be described below using FIGS. 2, 3, and 4. FIG. 2 is a sectional view showing a partial enlargement of FIG. 1. In FIG. 2, the central axis of the yarn guide 11 is indicated by a dot-dash line. FIG. 3 is a side view illustrating the respective configurations of the cutter and the guide member, and FIG. 4 is a view seen in the direction of an arrow IV in FIG. 3.

Cutter

[0022] The cutter 20 is provided to cut string yarn 33 (see FIG. 9) present in a space inside the pot 12 away from the inner wall 22 of the pot 12. The cutter 20 is formed in a disc shape. A blade 20a is formed around the entire outer periphery of the cutter 20. The blade 20a of the cutter 20 is formed in a circular shape when seen from the central axis direction of the yarn guide 11. Further, the blade 20a of the cutter 20 is formed to be sharp enough to cut the yarn 18. The cutter 20 can be formed using a metallic material such as cemented carbide, for example.

[0023] The cutter 20 is disposed horizontally so as to be orthogonal to the central axis direction of the yarn guide 11. A hole corresponding to the outer diameter of the yarn guide 11 is formed in the center of the cutter 20, and the yarn guide 11 is fitted into this hole. An outer

peripheral diameter of the cutter 20 is set to be smaller than a minimum inner diameter of a cake 28 so that the blade 20a of the cutter 20 does not contact the cake 28. Further, the cutter 20 is disposed in a position removed from the lower end 11a of the yarn guide 11 by a predetermined distance G (see FIG. 2) in the central axis direction of the yarn guide 11. The predetermined distance G is set so that even when a yarn end floats up in a loop shape following yarn cutting or yarn breakage, the yarn end does not float up past the cutter 20.

Guide Member

[0024] The guide member 24 is disposed in a position closer to the lower end 11a of the yarn guide 11 than the cutter 20. As shown in FIG. 3, the guide member 24 is formed in a truncated cone shape. An outer peripheral surface of the guide member 24 forms a tapered surface 24a. The tapered surface 24a is formed in order to guide the string yarn 33 to the blade 20a of the cutter 20 without causing the string yarn 33 to coil around the yarn guide 11. The tapered surface 24a is formed to be smooth so that the yarn that contacts the tapered surface 24a while attempting to float up in a loop shape immediately after yarn cutting or yarn breakage, to be described below, slides down along the incline of the tapered surface 24a. The tapered surface 24a is tapered such that the diameter of each part of the tapered surface 24a toward the lower end 11a of the yarn guide 11 varies continuously. An incline angle θ (see FIG. 2) of the tapered surface 24a relative to the central axis of the yarn guide 11 should be set at no less than 10 degrees.

[0025] The guide member 24 can be formed from ceramic, metal, or the like, for example. When the yarn guide 11 and the guide member 24 are both formed from metallic materials, the two components can be formed integrally. In this case, stainless steel or the like, for example, can be applied as the metallic material. Further, when the yarn guide 11 and the guide member 24 are formed separately, a through hole having a diameter that corresponds to the outer diameter of the yarn guide 11 may be formed in the guide member 24, and the guide member 24 may be fixed to the yarn guide 11 by adhesion, screwing, press-fitting, or the like, for example. As regards the cutter 20, meanwhile, the cutter 20 may be fixed to either the guide member 24 formed integrally with the yarn guide 11 or the guide member 24 fixed to the yarn guide 11 by screwing, adhesion, or the like, for example. Moreover, the cutter 20 may be fixed directly to the yarn guide 11.

[0026] A maximum outer diameter D_g of the guide member 24 is set to be smaller than the outer peripheral diameter of the cutter 20. Further, an upper surface of the guide member 24 contacts a lower surface of the cutter 20. As a result, a corner 32 is formed in a boundary part between the tapered surface 24a of the guide member 24 and the lower surface of the cutter 20. The corner 32 is formed at an obtuse angle.

Yarn Sensor

[0027] A yarn sensor 19 is disposed between the front roller pair 17 and the yarn supply pipe 14. The yarn sensor 19 is a sensor for detecting the state of the yarn drawn out by the drafting device 10. In this embodiment, yarn breakage is used as an example of a state of the yarn detected by the yarn sensor 19. Further, in this embodiment, the yarn sensor 19 is formed using an optical sensor combining a light-emitting device 19a and a light-receiving device 19b, for example.

Pot

[0028] The pot 12 is used to form a cake 28 and rewind the yarn. The pot 12 is formed in a cylindrical shape. The pot 12 is provided to be capable of rotating about a central axis of the pot 12. A central axis K of the pot 12 is disposed parallel to the vertical direction. Accordingly, one side of the central axis direction of the pot 12 is an upward side and the other side is a downward side.

[0029] The pot 12 rotates when driven by a pot driving unit, to be described below. A yarn guide insertion port 21 is formed in an upper end side of the pot 12. The yarn guide insertion port 21 is an opening through which the yarn guide 11 is inserted into the pot 12. An opening 23 is formed in a lower end of the pot 12. The yarn guide insertion port 21 opens upward and has a smaller diameter than an inner diameter D_p (see FIG. 1) of the pot 12. The inner diameter D_p of the pot 12 serves as a diameter that defines an inner volume of the pot 12 and is based on the position of the inner wall 22. The opening 23 opens downward at a diameter identical to the inner diameter D_p of the pot 12.

Bobbin Support

[0030] The bobbin support 13 supports the bobbin 25. The bobbin support 13 includes a bobbin base 26 and a bobbin mounting portion 27. The bobbin base 26 is formed in a plate shape. The bobbin mounting portion 27 is fixed to the bobbin base 26. The bobbin mounting portion 27 is formed in a columnar shape and disposed so as to project upward from an upper surface of the bobbin base 26.

[0031] The bobbin mounting portion 27 is a part on which the bobbin 25 is detachably mounted. The bobbin mounting portion 27 is disposed coaxially with the pot 12 so as to oppose the yarn guide 11 in the central axis direction of the pot 12. Further, the bobbin mounting portion 27 is disposed below the yarn guide 11. Hence, when the bobbin 25 is mounted on the bobbin mounting portion 27, the bobbin 25 is disposed facing the yarn guide 11 on the central axis K of the pot 12.

[0032] The bobbin 25 has a tapered structure such that a bobbin outer peripheral diameter varies continuously from one end side toward the other end side in a bobbin central axis direction. The bobbin 25 has a hollow struc-

ture on at least one end side thereof. By fitting the hollow part on one end side of the bobbin 25 to the bobbin mounting portion 27, the bobbin 25 is supported so as to stand vertically upright from the bobbin base 26.

[0033] The bobbin support 13 is provided to be movable in the vertical direction by a bobbin drive unit, to be described below. The outer peripheral diameter of the bobbin 25 is set to be smaller than the minimum inner diameter of the cake 28 formed on the inner wall 22 of the pot 12. Thus, contact between the bobbin 25 and the cake 28 can be avoided when the bobbin 25 is inserted into the pot 12 through the opening 23 in the pot 12 and disposed therein.

[0034] Further, a yarn loosening member 31 is attached to the bobbin base 26. The yarn loosening member 31 loosens yarn serving as a rewinding start point from the cake 28 by contacting a winding end-side end 28b of the cake 28. The cake 28 is a laminated body of yarn formed on the inner wall 22 of the pot 12 by operations of the yarn guide 11 and the pot 12, to be described below.

[0035] FIG. 5 is a block diagram showing an example configuration of a drive control system of the pot spinning machine according to this embodiment of the present invention.

[0036] As shown in FIG. 5, the pot spinning machine 1 includes a control unit 51, a drafting drive unit 52, a yarn guide drive unit 53, a pot drive unit 54, and a bobbin drive unit 55.

Control Unit

[0037] The control unit 51 performs overall control of all of the operations of the pot spinning machine 1. The drafting drive unit 52, the yarn guide drive unit 53, the pot drive unit 54, and the bobbin drive unit 55 are electrically connected to the control unit 51 as operational control objects. The yarn sensor 19 is also electrically connected to the control unit 51. When yarn breakage occurs in the drafting device 10, the yarn sensor 19 outputs a yarn breakage occurrence signal informing the control unit 51 of the yarn breakage.

Drafting Drive Unit

[0038] The drafting drive unit 52 rotates the back roller pair 15, the middle roller pair 16, and the front roller pair 17 at the respective predetermined rotation frequencies thereof. The drafting drive unit 52 rotates the back roller pair 15, the middle roller pair 16, and the front roller pair 17 by implementing driving on the basis of a drafting drive signal applied to the drafting drive unit 52 from the control unit 51.

Yarn Guide Drive Unit

[0039] The yarn guide drive unit 53 moves the yarn guide 11 in the vertical direction. The yarn guide drive

unit 53 operates the yarn guide 11 to move in the vertical direction. The yarn guide drive unit 53 moves the yarn guide 11 in the vertical direction by implementing driving on the basis of a yarn guide drive signal applied to the yarn guide drive unit 53 from the control unit 51.

Pot Drive Unit

[0040] The pot drive unit 54 rotates the pot 12. The pot drive unit 54 rotates the pot 12 using the central axis K of the pot 12 as a rotational center by implementing driving on the basis of a pot drive signal applied thereto from the control unit 51.

Bobbin Drive Unit

[0041] The bobbin drive unit 55 moves the bobbin 25 in the vertical direction. The bobbin drive unit 55 moves the bobbin 25 mounted on the bobbin mounting portion 27 of the bobbin support 13 in the vertical direction together with the yarn loosening member 31 by implementing driving on the basis of a bobbin drive signal applied thereto from the control unit 51.

Pot Spinning Method

[0042] Next, a pot spinning method according to this embodiment of the present invention will be described.

[0043] FIG. 6 is a view showing a basic flow of the pot spinning method.

[0044] As shown in FIG. 6, the pot spinning method includes a drawing-out step S1, a cake-forming step S2, and a rewinding step S3.

[0045] The drawing-out step S1 is a step for drawing out a yarn material such as roving to a predetermined thickness. The cake-forming step S2 is a step for forming the cake 28 by winding the yarn drawn out to the predetermined thickness in the drawing-out step S1 around the inner wall 22 of the pot 12. The rewinding step S3 is a step for rewinding the yarn forming the cake 28 onto the bobbin 25. Operations of the pot spinning machine 1 based on the respective steps will be described below.

[0046] Note that before the pot spinning machine 1 is operated, the yarn guide 11 is disposed near the yarn supply pipe 14, the bobbin 25 is mounted on the bobbin mounting portion 27 of the bobbin support 13, and the bobbin 25 is disposed below and away from the pot 12. Further, the lower portion of the yarn guide 11 is disposed so as to be inserted into the pot 12.

Drawing-out Step

[0047] The drawing-out step S1 is performed using the drafting device 10. The drafting drive unit 52 rotates the back roller pair 15, the middle roller pair 16, and the front roller pair 17 at the respective predetermined rotation speeds thereof by implementing driving on the basis of the drafting drive signal applied thereto from the control

unit 51. As a result, the yarn material, such as roving, is conveyed by the rotation of the respective roller pairs 15, 16, 17.

[0048] At this time, the control unit 51 sets the rotation speed of the back roller pair 15 at a lower speed than the rotation speed of the middle roller pair 16 and sets the rotation speed of the middle roller pair 16 at a lower speed than the rotation speed of the front roller pair 17. Accordingly, the yarn is drawn out between the back roller pair 15 and the middle roller pair 16 by the rotation speed difference between these roller pairs. Similarly, the yarn is drawn out between the middle roller pair 16 and the front roller pair 17 by the rotation speed difference between these roller pairs.

[0049] As a result, the yarn material, such as roving, is drawn out to the predetermined thickness while passing in order through the back roller pair 15, the middle roller pair 16, and the front roller pair 17. The yarn 18 drawn out in this manner is then pulled into the yarn supply pipe 14 using, for example, a swirling flow of air, and then introduced into the yarn guide 11.

[0050] Further, prior to the start of the drawing-out step S1, the pot drive unit 54 rotates the pot 12 at a predetermined rotation frequency by implementing driving on the basis of the pot drive signal applied thereto from the control unit 51.

Cake-forming Step

[0051] The cake-forming step S2 is performed using the yarn guide 11 and the pot 12. The yarn guide drive unit 53 moves the yarn guide 11 by a predetermined amount downward by implementing driving on the basis of the yarn guide drive signal applied thereto from the control unit 51. Further, the pot drive unit 54 continues to rotate the pot 12 by implementing driving on the basis of the pot drive signal applied thereto from the control unit 51. Note that when the yarn guide 11 is moved downward, the yarn guide 11 is set in a position removed from the yarn supply pipe 14. Further, the yarn 18 introduced into the yarn guide 11 from the yarn supply pipe 14 is discharged from the lower end 11a of the yarn guide 11.

[0052] Centrifugal force generated by the rotation of the pot 12 acts on the yarn 18 discharged from the lower end 11a of the yarn guide 11, and as a result of this centrifugal force, the yarn 18 is pressed against the inner wall 22 of the pot 12. Further, the yarn 18 discharged from the lower end 11a of the yarn guide 11 is wound around the inner wall 22 of the pot 12 in a state where twist is applied thereto by the rotation of the pot 12.

[0053] Furthermore, in the cake-forming step S2, as shown in FIG. 7, the yarn guide drive unit 53 displaces the position of the yarn guide 11 relatively downward while moving the yarn guide 11 in a vertical reciprocating motion repeatedly at predetermined intervals by implementing driving on the basis of the aforesaid yarn guide drive signal. As a result, the yarn 18 is wound in a plurality of layers around the inner wall 22 of the pot 12, thereby

forming the cake 28. Note that the cutter 20 and the guide member 24 are not shown in FIG. 7.

[0054] FIG. 8 is a view illustrating the operation of the yarn guide during the cake-forming step. The vertical axis of the figure shows the position of the yarn guide in the pot central axis direction, and the horizontal axis shows time.

[0055] In FIG. 8, first, the yarn guide 11 descends to a P1 position, then ascends to a P2 position, then descends to a P3 position, and then ascends to a P4 position. In other words, the yarn guide 11 repeatedly performs a vertical reciprocating motion. In this case, a period T1 from the point at which the yarn guide 11 reaches the P1 position to the point at which the yarn guide 11 reaches the P3 position and a period T2 from the point at which the yarn guide 11 reaches the P2 position to the point at which the yarn guide 11 reaches the P4 position each serve as one period. Further, to displace the position of the yarn guide 11 relatively downward, the P3 position is set to be lower than the P1 position and the P4 position is set to be lower than the P2 position. A vertical deviation H1 between the P1 position and the P3 position and a vertical deviation H2 between the P2 position and the P4 position each serve as a displacement step amount of the yarn guide 11 during one period. In other words, the yarn guide 11 is displaced downward by one fixed displacement step amount at a time while performing a vertical reciprocating motion repeatedly at fixed intervals.

[0056] This operation for moving the yarn guide 11 continues until the yarn guide 11 reaches a Pm position. In this case, the P1 position defines a winding start-side end (also referred to hereafter as a "starting end") 28a of the cake 28 shown in FIG. 1, while the Pm position defines the winding end-side end (also referred to hereafter as a "terminal end") 28b of the cake 28 shown in the same figure. Furthermore, a period in which the yarn guide 11 moves from the P1 position to the Pm position corresponds to a period midway through formation of the cake 28, and a period following the point at which the yarn guide 11 reaches the Pm position corresponds to a period after formation of the cake 28.

[0057] The control unit 51 operates the yarn guide 11, as shown in FIGS. 7 and 8, by applying the yarn guide drive signal to the yarn guide drive unit 53. Then yarn cutting is performed when the yarn guide 11 reaches the Pm position. The formation of the cake 28 is complete by the yarn cutting. Yarn cutting is performed under the control of the control unit 51. More specifically, the control unit 51 controls the driving implemented by the drafting drive unit 52 so that rotation of both the back roller pair 15 and the middle roller pair 16 is stopped while the front roller pair 17 continue to rotate. Accordingly, the yarn 18 is forcibly cut on the downstream side of the middle roller pair 16. As a result, the cake 28 is formed on the inner wall 22 of the pot 12 in the shape shown in FIG. 1.

[0058] As shown in FIG. 9, when yarn cutting is performed in the manner described above, the string yarn 33 may be formed in the space inside the pot 12. FIG. 9

is a view showing the interior of the pot 12 from the opening 23 side. In FIG. 9, a rotation direction R of the pot 12 is indicated by an arrow, while the cutter 20 and the guide member 24 are not shown.

[0059] As described in the "Description of the Related Art", the string yarn 33 is formed when tension in the yarn is released by yarn cutting such that a part of the yarn that flies out from the lower end 11a of the yarn guide 11 as a result exists in the space inside the pot 12 away the inner wall 22 of the pot 12. The vicinity of an apex 33a of the string yarn 33 curves at a gentler curvature than the yarn 18 wound around the inner wall 22 of the pot 12. Respective ends 33b of the string yarn 33 are caught on the yarn 18 wound around the inner wall 22 of the pot 12 so as to be supported in a fixed state. Hence, when the string yarn 33 is present in the space inside the pot 12, the string yarn 33 may contact the outer peripheral surface of the yarn guide 11 or the outer peripheral surface of the bobbin 25, as described above, and as a result, a rewinding defect may occur.

[0060] In this embodiment, therefore, in the cake-forming step S2, once formation of the cake 28 is complete, the control unit 51 moves the yarn guide 11, which has reached the Pm position shown in FIG. 8, downward by a predetermined amount Lh. As a result, the yarn guide 11 is displaced from the Pm position to a Pn position. Further, when the string yarn 33 is formed by the yarn cutting described above, the string yarn 33 is cut by the blade 20a of the cutter 20 as the yarn guide 11 moves from the Pm position to the Pn position. The predetermined amount Lh is set at an amount required for the string yarn 33 to contact the blade 20a of the cutter 20 provided on the yarn guide 11 when the string yarn 33 is present in the space inside the pot 12.

[0061] Here, a situation in which the cutter 20 cuts the string yarn 33 will be described.

[0062] First, as shown in FIG. 10, when the yarn guide 11 is lowered in a state where the string yarn 33 is present inside the pot 12, the string yarn 33 is pressed down by the descending yarn guide 11, as shown in FIG. 11, while being rotated by the rotation of the pot 12, as indicated by an arrow R in FIG. 10. At this time, the string yarn 33 contacts either the tapered surface 24a of the guide member 24 or the lower surface of the cutter 20. More specifically, when a diameter Lr from the central axis of the pot 12, shown in FIG. 9, to the apex 33a of the string yarn 33 is smaller than the maximum outer diameter Dg of the guide member 24, shown in FIG. 2, the string yarn 33 contacts the tapered surface 24a of the guide member 24. When the diameter Lr from the central axis of the pot 12 to the apex 33a of the string yarn 33 equals or exceeds the maximum outer diameter Dg of the guide member 24, on the other hand, the string yarn 33 contacts the lower surface of the cutter 20.

[0063] When the string yarn 33 contacts the tapered surface 24a of the guide member 24, the vicinity of the apex 33a of the string yarn 33 is guided by the tapered surface 24a as the yarn guide 11 descends so as to move

to the corner 32, as shown by an arrow M1 in FIG. 3. When the string yarn 33 contacts the lower surface of the cutter 20, on the other hand, the vicinity of the apex 33a of the string yarn 33 is guided by the lower surface of the cutter 20 as the yarn guide 11 descends so as to move to the corner 32, as shown by an arrow M2 in FIG. 3. When the vicinity of the apex 33a of the string yarn 33 reaches the corner 32, movement of the string yarn 33 in a radial direction is suppressed. Therefore, when the yarn guide 11 descends further thereafter, the string yarn 33 contacts the blade 20a of the cutter 20, as shown in FIG. 12. At this time, respective sides of the string yarn 33 projecting from the cutter 20 stand upright in the direction of dotted-line arrows in accordance with the descent of the yarn guide 11. As a result, the string yarn 33 is wound around the blade 20a of the cutter 20. A winding angle α at which the string yarn 33 is wound around the blade 20a of the cutter 20 is the angle formed by the lower surface of the cutter 20 and the string yarn 33 projecting from the cutter 20.

[0064] Hence, the string yarn 33 wound around the blade 20a of the cutter 20 is pressed against the blade 20a of the cutter 20 while being rotated by the rotation of the pot 12. Further, the winding angle α at which the string yarn 33 is wound around the blade 20a of the cutter 20 increases gradually in accordance with the descent of the yarn guide 11. As a result, the string yarn 33 is frayed and cut by the blade 20a of the cutter 20 midway through the descent of the yarn guide 11 from the Pm position to the Pn position. When the string yarn 33 is cut in this manner, the yarn previously forming the string yarn 33 is pressed against the inner wall 22 of the pot 12 by the centrifugal force that accompanies the rotation of the pot 12. In other words, the string yarn 33 is eliminated from the space inside the pot 12.

[0065] Note that the timing at which the respective sides of the string yarn 33 start to stand upright may vary depending on the situation at the time. In certain cases, therefore, the string yarn 33 may be cut by the cutter 20 at a timing before the vicinity of the apex 33a of the string yarn 33 reaches the corner 32.

[0066] Moreover, as shown in FIG. 13, in a case where the guide member 24 is not provided on the yarn guide 11, the respective sides of the string yarn 33 stand upright after the string yarn 33 contacts the lower surface of the cutter 20. Likewise in this case, the string yarn 33 is frayed by contact with the blade 20a of the cutter 20, and as a result, the string yarn 33 can be cut by the cutter 20. In other words, the string yarn 33 can be cut by the cutter 20 without providing the guide member 24 on the yarn guide 11.

[0067] However, when the guide member 24 is provided on the yarn guide 11, the apex 33a of the string yarn 33 catches on the corner 32, whereby movement of the string yarn 33 is suppressed, and as a result, the respective sides of the string yarn 33 can stand upright more easily. Further, the yarn attempting to float up in a loop shape within the pot 12 immediately after yarn cutting or

yarn breakage can be caused to slide down using the incline of the tapered surface 24a of the guide member 24. Hence, the yarn that forms a loop shape and attempts to coil around the vicinity of the lower end of the yarn guide 11 can be forced to slide down the tapered surface 24a of the guide member 24, and as a result, coiling of the yarn can be avoided.

[0068] Further, as regards the movement speed at which the yarn guide 11 is lowered, the control unit 51 preferably drive-controls the yarn guide drive unit 53 as follows. First, the movement speed of the yarn guide 11 during formation of the cake 28 is set as V1, and the movement speed of the yarn guide 11 after formation of the cake 28 is set at V2. The movement speed V1 corresponds to the movement speed at which the yarn guide 11 is moved from the Pm-1 position to the Pm position, for example. The movement speed V2 corresponds to the movement speed at which the yarn guide 11 is moved from the Pm position to the Pn position. In this case, the control unit 51 preferably drive-controls the yarn guide drive unit 53 so that the movement speed V2 is lower than the movement speed V1. By making the movement speed V2 lower than the movement speed V1, the amount of time the string yarn 33 is in contact with the blade 20a of the cutter 20 increases, and therefore the string yarn 33 can be cut more reliably. Note that when the yarn guide 11 is moved from the Pm-1 position to the Pn position, the yarn guide 11 may be stopped temporarily after reaching the Pm position or moved continuously without being temporarily stopped.

[0069] The cake-forming step S2 ends when cake formation and yarn cutting have been performed as described above and the operation for lowering the yarn guide 11 in order to cut the string yarn 33 is complete. Further, the drawing-out step S1 described above is performed in parallel with the cake-forming step S2 and ends when yarn cutting is performed in the cake-forming step S2.

40 Rewinding Step

[0070] The rewinding step S3 is performed using the pot 12, the bobbin 25, and the yarn loosening member 31. In the rewinding step S3, the bobbin 25 and the yarn loosening member 31 are disposed inside the pot 12 through the opening 23 by the driving implemented by the yarn guide drive unit 53, the pot drive unit 54, and the bobbin drive unit 55.

[0071] The yarn guide drive unit 53 moves the yarn guide 11 upward, as shown in FIG. 14, by implementing driving on the basis of the yarn guide drive signal applied thereto from the control unit 51. As a result, before the bobbin 25 enters the pot 12, the yarn guide 11 retreats to a position inside the pot 12 where the yarn guide 11 does not contact the bobbin 25. The pot drive unit 54 continues to rotate the pot 12 by implementing driving on the basis of the pot drive signal applied thereto from the control unit 51.

[0072] The bobbin drive unit 55 moves the bobbin support 13 upward by implementing driving on the basis of the bobbin drive signal applied thereto from the control unit 51. As a result, the bobbin 25 mounted on the bobbin mounting portion 27 (see FIG. 1) and the yarn loosening member 31 attached to the bobbin base 26 move upward together. Further, the bobbin 25 and the yarn loosening member 31 enter the pot 12 through the opening 23 of the pot 12. At this time, an upper end of the yarn loosening member 31 contacts the terminal end 28b of the cake 28 in a position indicated by a dotted line in FIG. 14. Accordingly, in the contact location of the yarn loosening member 31, the yarn wound at the terminal end 28b of the cake 28 is loosened, and the loosened yarn is wound around the bobbin 25 away from the inner wall 22 of the pot 12. As a result, rewinding of the yarn onto the bobbin 25 is started using the loosened yarn as the rewinding start point.

[0073] Subsequently, when all of the yarn forming the cake 28 has been rewound onto the bobbin 25, as shown in FIG. 15, the control unit 51 moves the bobbin support 13 downward by applying the bobbin drive signal to the bobbin drive unit 55. As a result, the bobbin 25 and the yarn loosening member 31 move downward together, whereby the rewinding step S3 is complete.

[0074] As a result of the operation described above, the bobbin 25 is obtained with a yarn tube 29 wound thereon. The bobbin 25 with the yarn tube 29 wound thereon is removed from the bobbin mounting portion 27. An empty bobbin 25 is then mounted on the bobbin mounting portion 27, whereupon a similar operation to that described above is performed.

[0075] Note that the string yarn 33 may be formed not only by the yarn cutting described above but also by yarn breakage, which occurs when the yarn 18 breaks midway through formation of the cake 28. The difference between "yarn cutting" and "yarn breakage" is as follows. Yarn cutting is performed intentionally by the control unit 51 at the stage where the yarn 18 is wound around the inner wall 22 of the pot 12 in a predetermined amount set in advance, or in other words when formation of the cake 28 is complete. Yarn breakage is a phenomenon whereby the yarn 18 breaks for one of various reasons before being wound around the inner wall 22 of the pot 12 in the predetermined amount, or in other words midway through formation of the cake 28.

[0076] When yarn breakage occurs midway through formation of the cake 28, the yarn guide 11 has not yet descended to the Pm position at the point where the yarn breakage occurs. Therefore, the yarn guide 11 continues to displace downward by a fixed displacement step amount at a time even after the string yarn 33 has been formed by the yarn breakage. Hence, following the occurrence of yarn breakage, under similar principles to those described above, the string yarn 33 contacts the blade 20a of the cutter 20 as the yarn guide 11 descends from the Pm position to the Pn position. As a result, the string yarn 33 can be cut by the cutter 20 even when

formed midway through formation of the cake 28.

Effects of Embodiment

[0077] This embodiment of the present invention employs a configuration in which the cutter 20 is provided near the lower end 11a of the yarn guide 11 and either during or after formation of the cake 28, the string yarn 33 present in the space inside the pot 12 away from the inner wall 22 of the pot 12 is cut by the cutter 20. Hence, a situation in which the string yarn 33 contacts the outer peripheral surface of the yarn guide 11 or the outer peripheral surface of the bobbin 25 can be avoided without employing a complicated, large-scale configuration such as the pair of aprons described in Patent Document 1. As a result, the occurrence of a rewinding defect caused by the formation of the string yarn 33 can be suppressed at low cost.

[0078] Further, in this embodiment of the present invention, the disc-shaped cutter 20 having the blade 20a, which is circular when seen from above, is employed. Therefore, the string yarn 33 can be cut in any location on the outer periphery of the cutter 20. Moreover, the cutter 20 has a simple structure and can therefore be implemented at low cost.

Modified Examples etc.

[0079] The technical scope of the present invention is not limited to the embodiments described above, and also includes embodiments obtained by applying various modifications and amendments within a scope in which the specific effects obtained by the constituent elements of the invention and combinations thereof can be derived.

[0080] For example, in the above embodiment, the disc-shaped cutter 20 is disposed horizontally so that the cutter 20 is orthogonal to the central axis direction of the yarn guide 11, but the present invention is not limited thereto, and instead, as shown in FIG. 16, for example, the cutter 20 may be disposed in an inclined attitude relative to an orthogonal direction to the central axis of the yarn guide 11. An inclined attitude means that the cutter 20 is inclined so that an incline angle β of the cutter 20 is at least 2 degrees relative to an orthogonal direction to the central axis of the yarn guide 11, indicated by a dot-dash line in the figure. A preferred range of the incline angle β is no less than 5 degrees and no more than 20 degrees.

[0081] When the cutter 20 is disposed at an incline, as described above, the blade 20a of the cutter 20 can be disposed so as to exist over a wide range in the central axis direction of the yarn guide 11. Therefore, when the yarn guide 11 is lowered, the string yarn 33 can be kept in contact with the blade 20a of the cutter 20 for a long time. Hence, the likelihood and frequency with which the string yarn 33 contacts the blade 20a of the cutter 20 can be increased even when an axial deviation occurs between the central axis of the pot 12 and the central axis

of the yarn guide 11, for example. As a result, the string yarn 33 can be cut even more reliably.

[0082] Furthermore, in the above embodiment, the cutter 20 is provided on the yarn guide 11 singly, but the present invention is not limited thereto, and a configuration in which a plurality of cutters 20 are provided at intervals in the central axis direction of the yarn guide 11 may be employed instead.

[0083] Moreover, the cutter for cutting the string yarn 33 is not limited to the disc-shaped cutter 20. For example, as shown in FIG. 17, a cutter 40 having a downward-oriented blade 40a may be used. Alternatively, as shown in FIG. 18, a configuration in which a rectilinear cutter 41 extending in the radial direction of the guide member 24 is provided and a blade 41a of the cutter 41 is disposed in a downward orientation may be employed. Further, as shown in FIG. 19, a sawtooth-shaped cutter 42 having a blade 42a on the outer periphery thereof may be used. When the cutter 42 is used, the cutter 42 may be disposed so that the blade 42a of the cutter 42 is inclined at an angle in the rotation direction R of the pot 12.

[0084] Note that the disc-shaped cutter 20 described above and the sawtooth-shaped cutter 42 shown in FIG. 19 differ from each other in the respective shapes of the blades 20a and 42a. More specifically, the blade 20a of the cutter 20 has an even circular blade shape, whereas the blade 42a of the cutter 42 has an uneven sawtooth shape.

[0085] Furthermore, in the above embodiment, an example using the tapered bobbin 25 was described, but the present invention is not limited thereto, and a straight bobbin may also be used.

[0086] Moreover, in the above embodiment, a configuration in which the cutter for cutting the string yarn is provided on the yarn guide 11 was employed, but the present invention is not limited thereto, and instead, for example, a configuration in which the cutter is provided on the upper end of the bobbin 25 may be employed. Alternatively, a configuration in which cutters are provided on both the yarn guide 11 and the bobbin 25 may be employed. Further, a configuration in which a cutter is provided on an elevating mechanism, not shown in the figures, separately to the yarn guide 11 and the bobbin 25 and the string yarn is cut by causing the cutter to advance further into the pot 12 than the bobbin 25 may be employed. Furthermore, when a cutter is provided on the bobbin 25 or the elevating mechanism, a guide member may be provided together with the cutter, similarly to the above embodiment.

[0087] When a cutter is provided on the yarn guide 11, the string yarn 33 can be cut using the operation performed in the cake-forming step S2 to lower the yarn guide 11. Further, when a cutter is provided on the bobbin 25, the string yarn 33 can be cut using the operation performed in the rewinding step S3 to raise the bobbin 25. When a cutter is provided on the aforesaid elevating mechanism, on the other hand, the elevating mechanism must be operated separately to the operations of the yarn

guide 11 and the bobbin 25. Therefore, when a cutter is provided on at least one of the yarn guide 11 and the bobbin 25, the string yarn 33 can be cut with substantially no reduction in the productivity of the pot spinning, in contrast to a case where a cutter is provided on the elevating mechanism.

[0088] The present invention is a pot spinning machine including a yarn guide and a pot into which the yarn guide is inserted, yarn being discharged from a lower end of the yarn guide inside the pot, and a cake being formed by winding the yarn around an inner wall of the pot using centrifugal force accompanying rotation of the pot, the pot spinning machine further including a cutter for cutting string yarn present in a space inside the pot away from the inner wall of the pot.

Claims

1. A pot spinning machine (1) comprising:
 - a yarn guide (11); and
 - a pot (12) into which the yarn guide (11) is inserted,
 - yarn (18) being discharged from one end of the yarn guide (11) inside the pot (12), and a cake (28) being formed by winding the yarn (18) around an inner wall (22) of the pot (12) using centrifugal force accompanying rotation of the pot (12),
 - the pot spinning machine (1) being **characterized by** further comprising a cutter (20) for cutting string yarn (33) present in a space inside the pot (12) away from the inner wall (22) of the pot (12).
2. The pot spinning machine (1) according to claim 1, wherein the cutter (20) is provided on the yarn guide (11).
3. The pot spinning machine (1) according to claim 2, further comprising a guide member (24) that is provided on the yarn guide (11) together with the cutter (20) and has a tapered surface (24a) for guiding the string yarn (33) to a blade (20a) of the cutter (20).
4. The pot spinning machine (1) according to claim 2 or 3, wherein the cutter (20) is disposed in an inclined attitude relative to an orthogonal direction to a central axis of the yarn guide (11) .
5. The pot spinning machine (1) according to any one of claims 1 to 4, wherein the cutter (20) is a disc-shaped cutter.
6. A pot spinning method for forming a cake (28) by rotating a pot (12) in a state where a yarn guide (11) is inserted into the pot (12) so that yarn (18) dis-

charged from one end of the yarn guide (11) is wound around an inner wall (22) of the pot (12), the method being **characterized by** comprising cutting string yarn (33) present in a space inside the pot (12) away from the inner wall (22) of the pot (12) using a cutter (20) either during or after formation of the cake (28).

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FIG. 1

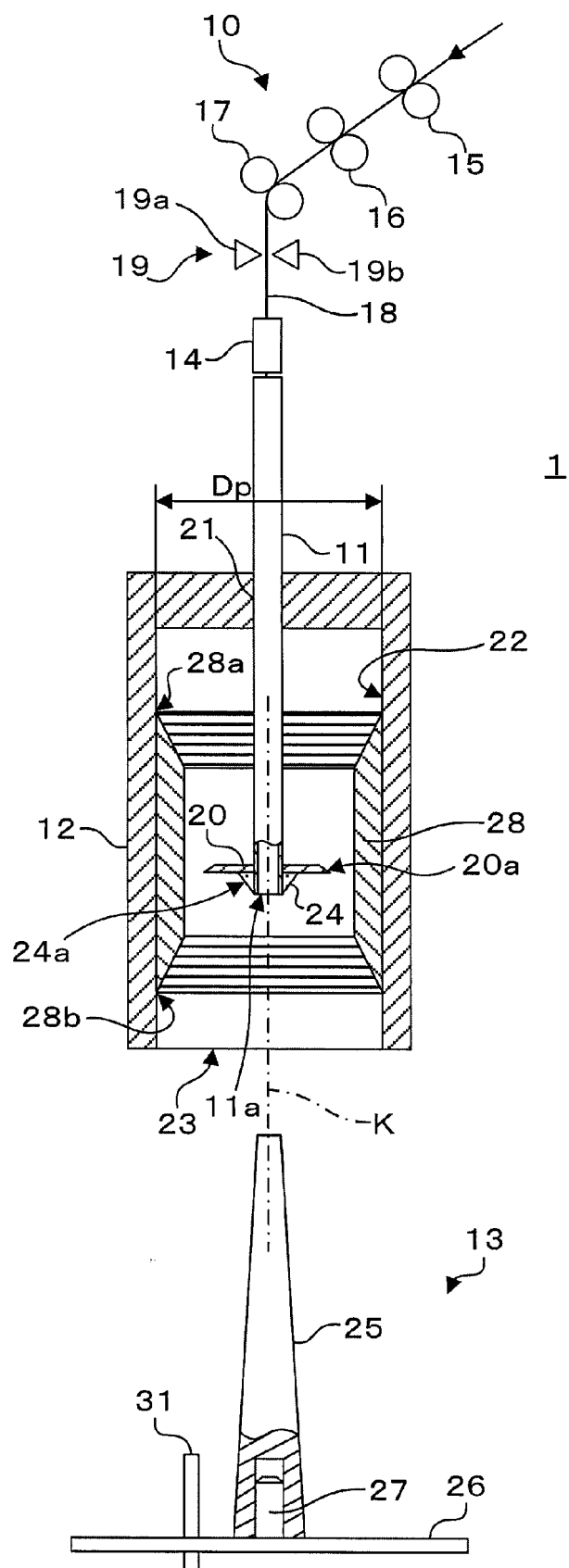


FIG. 2

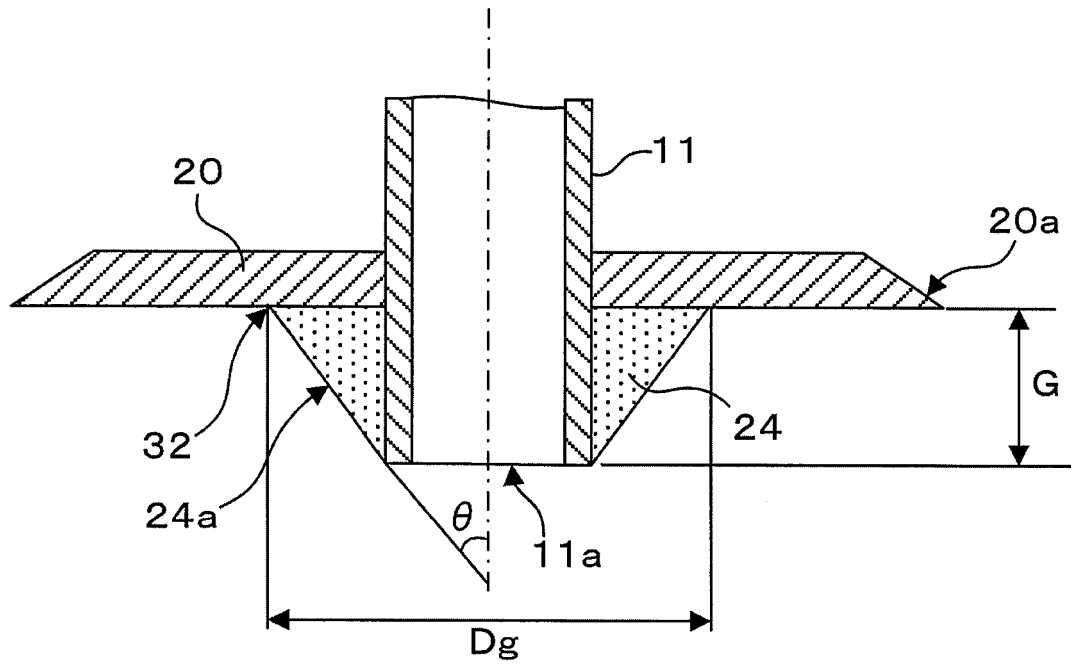


FIG. 3

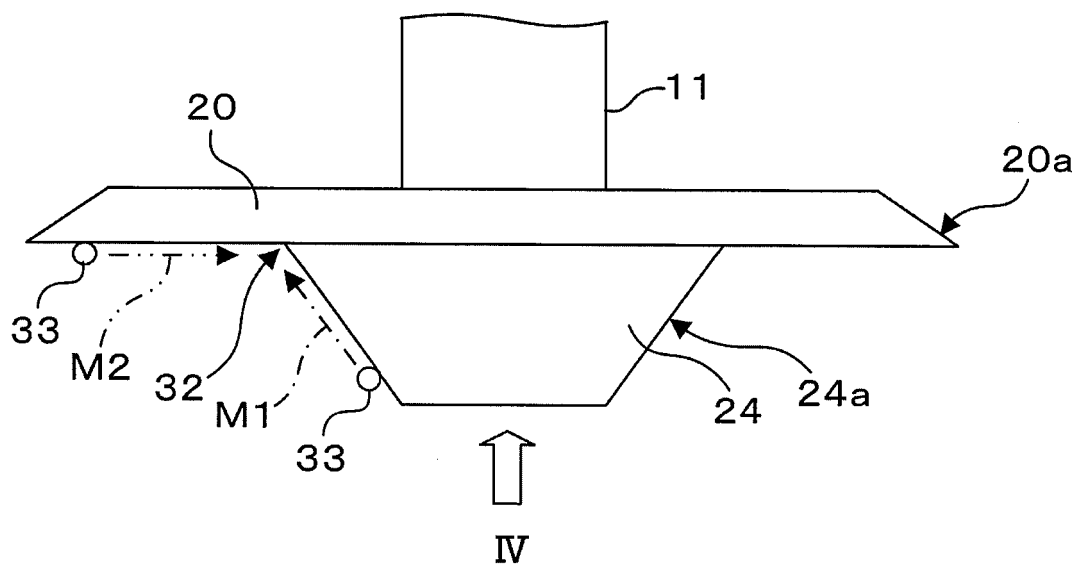


FIG. 4

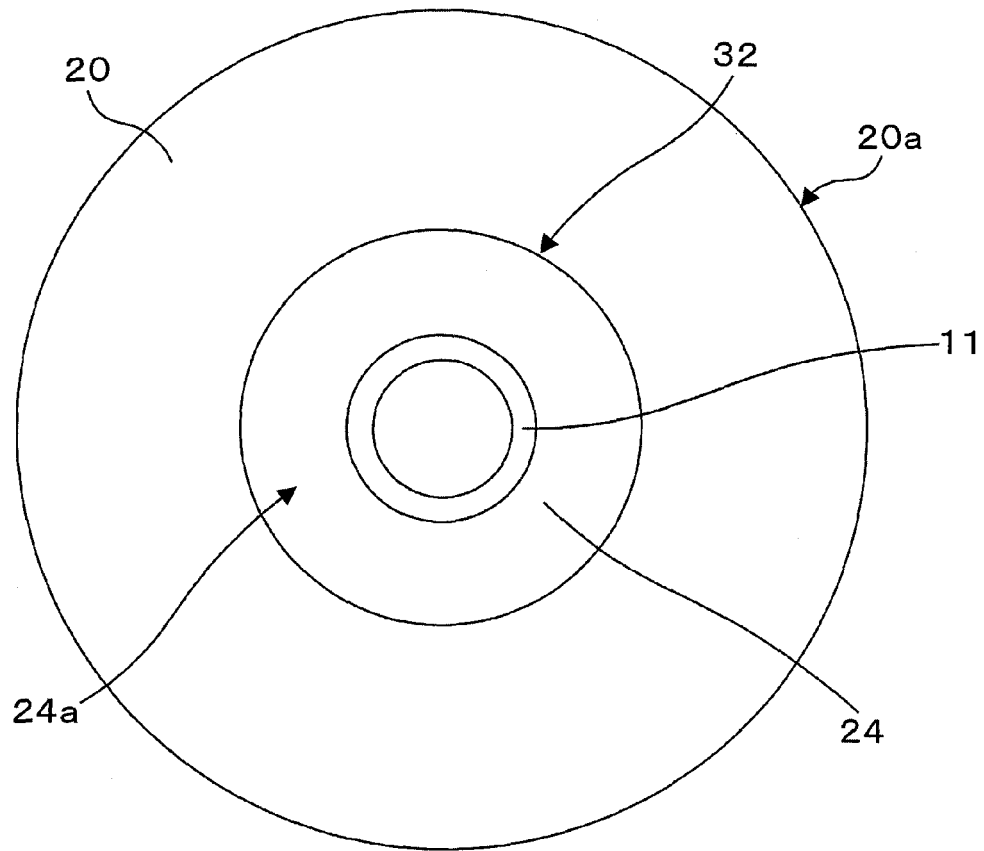


FIG. 5

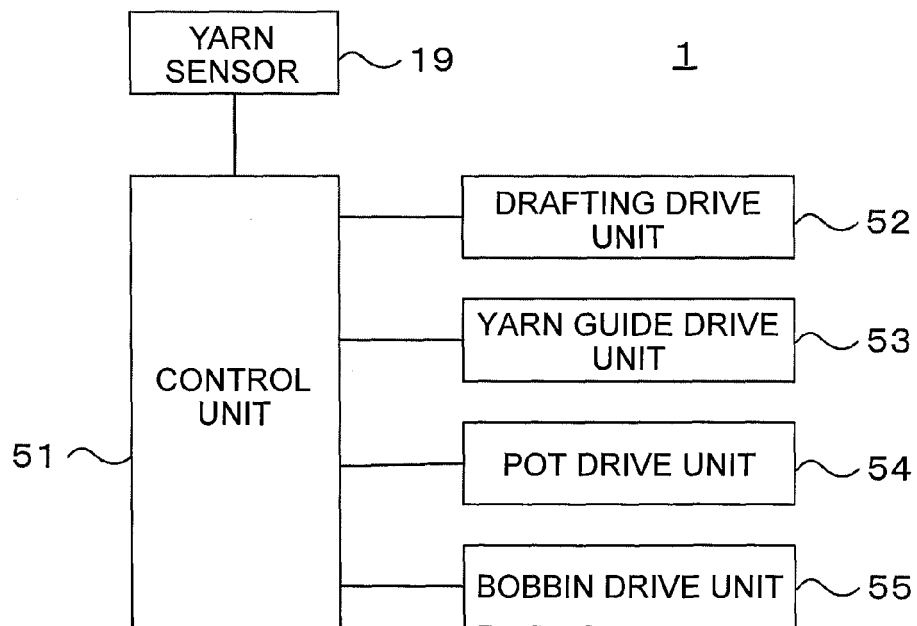


FIG. 6

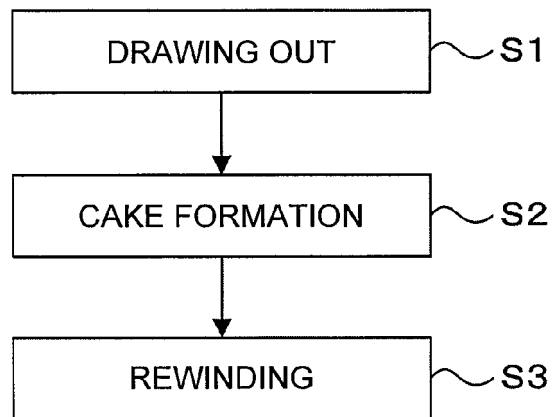


FIG. 7

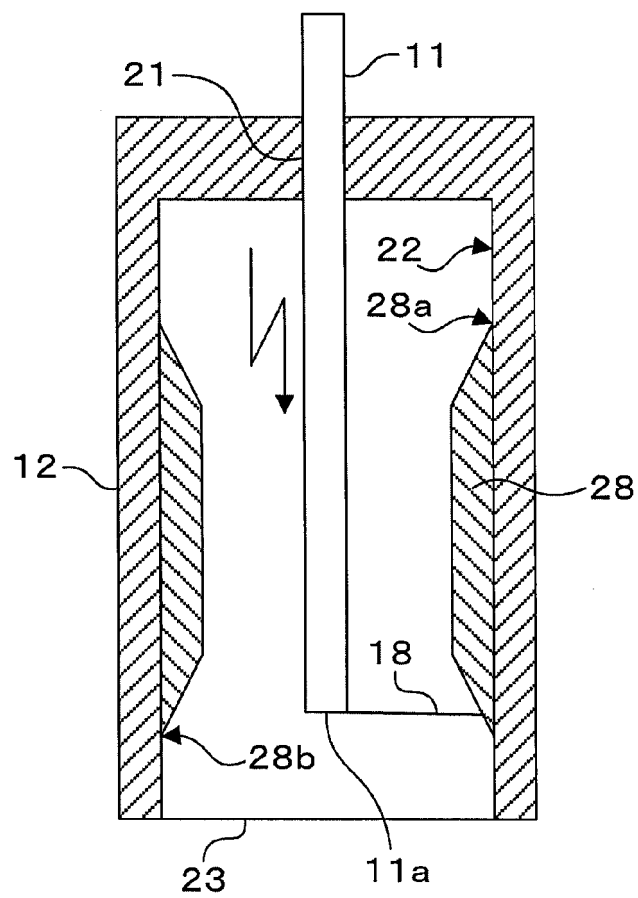


FIG. 8

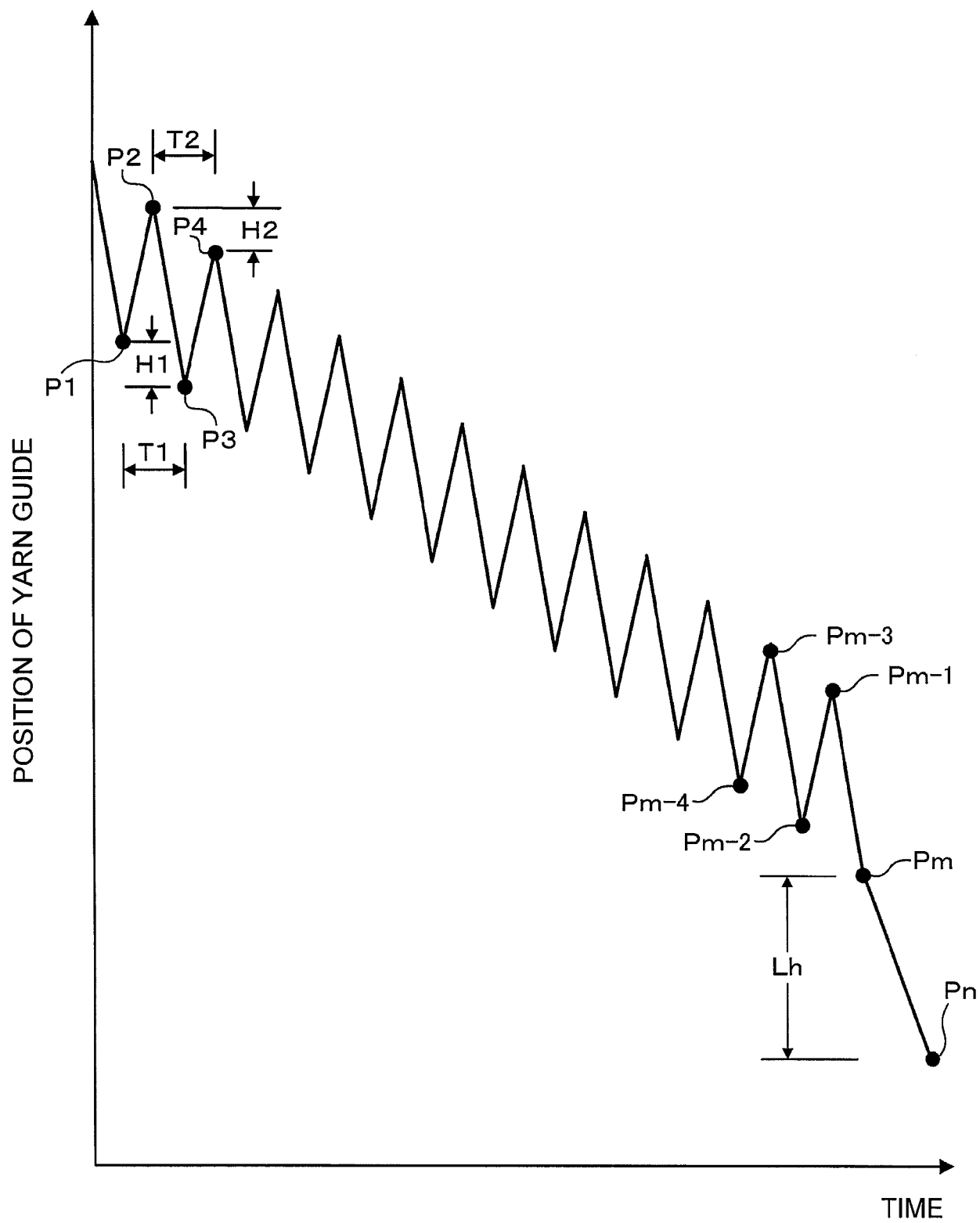


FIG. 9

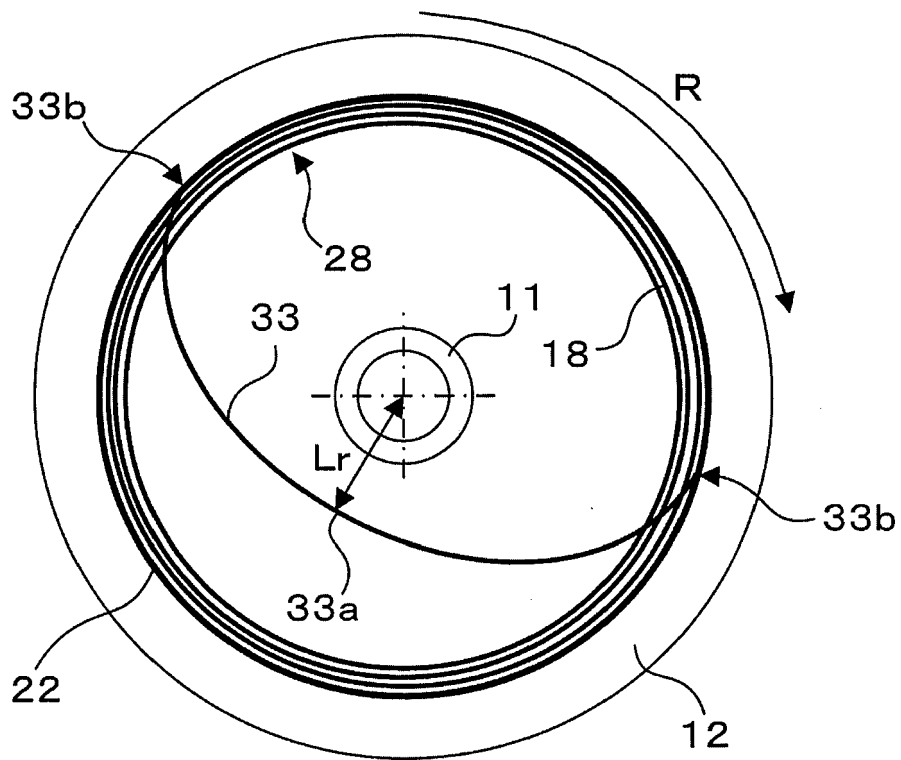


FIG.10

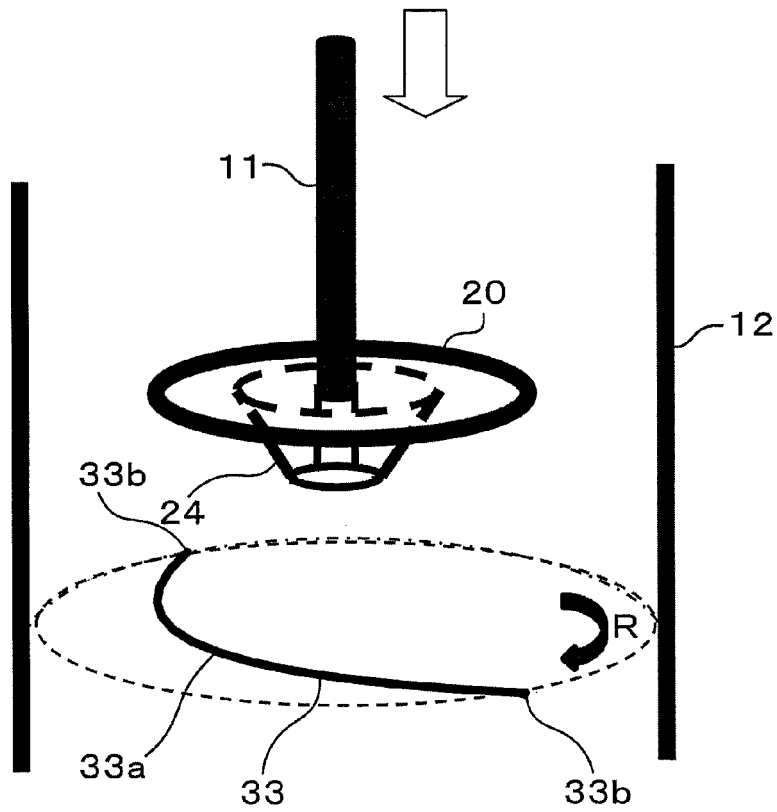


FIG.11

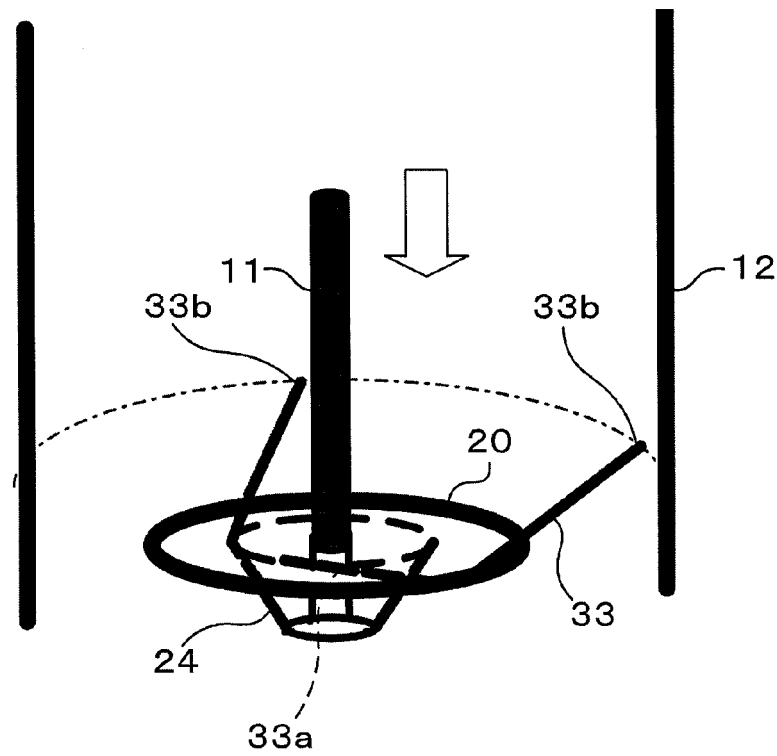


FIG.12

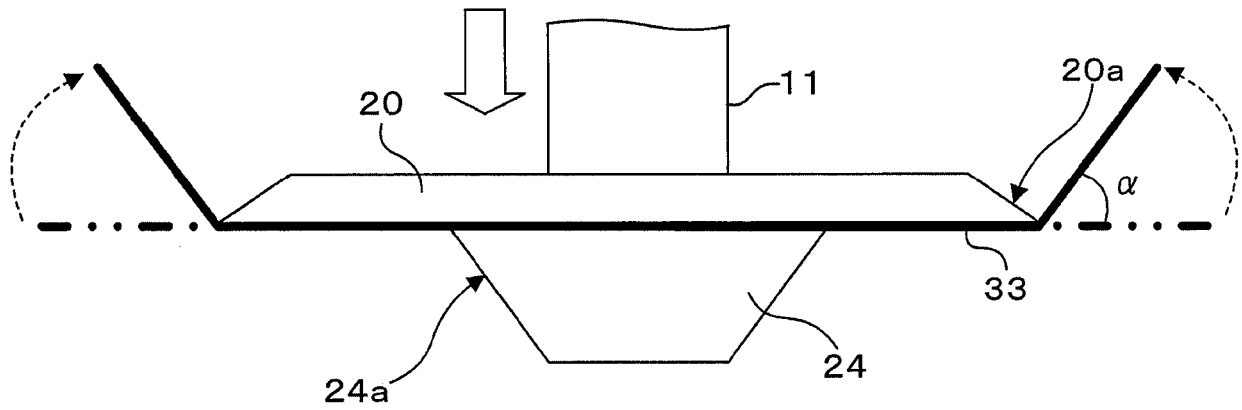


FIG.13

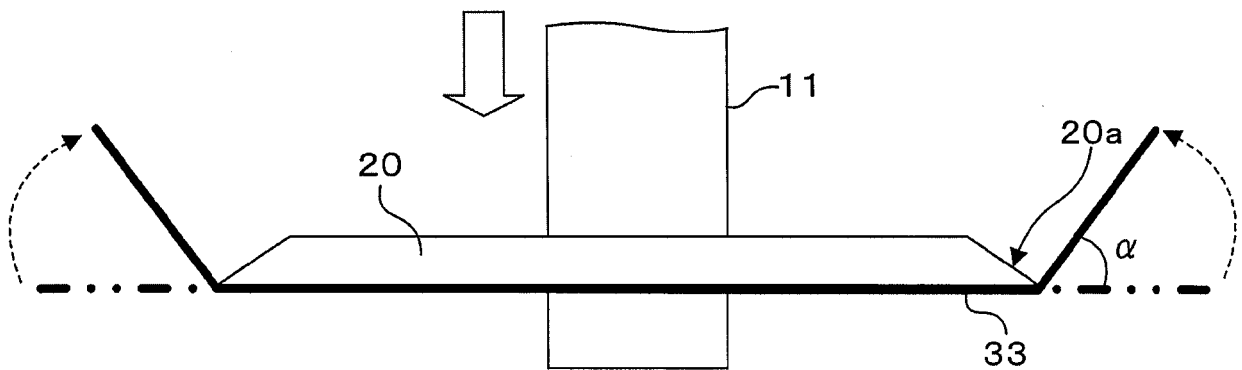


FIG.14

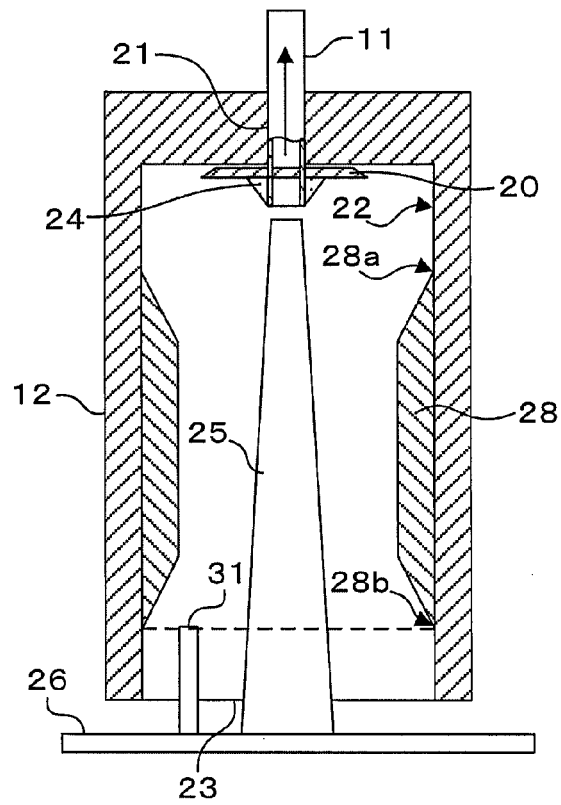


FIG.15

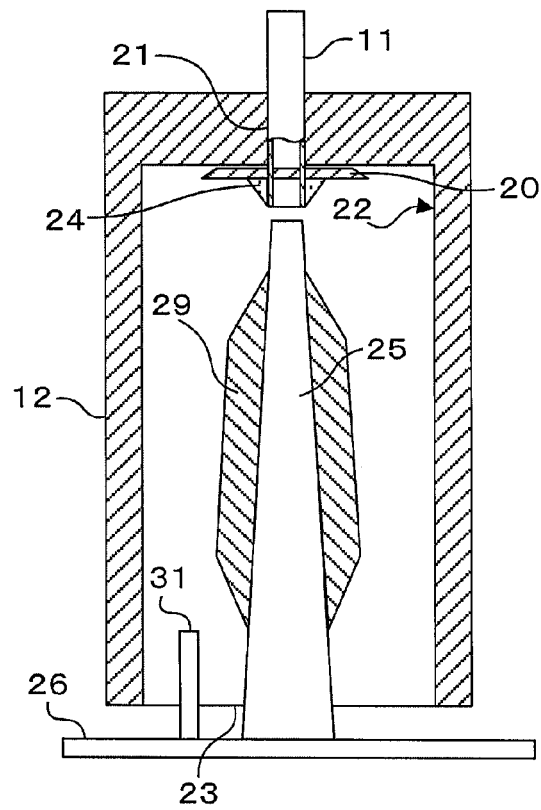


FIG.16

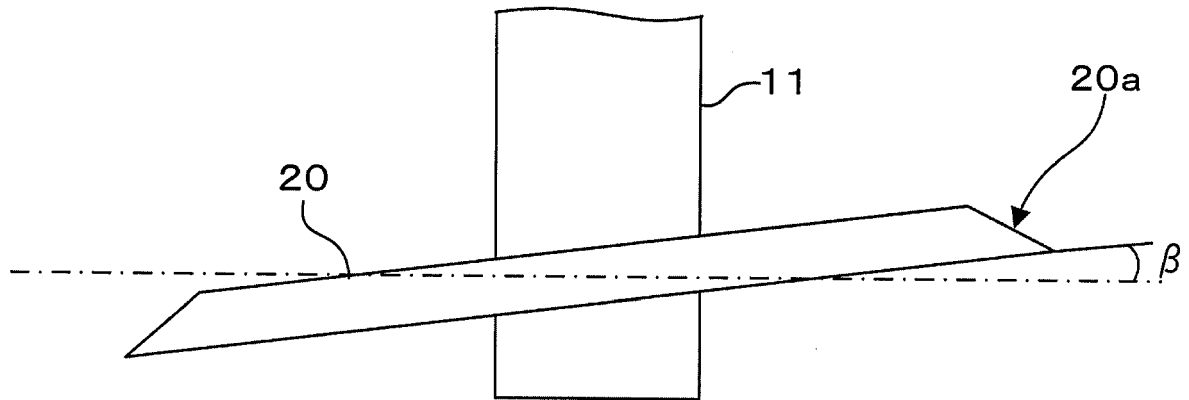


FIG.17

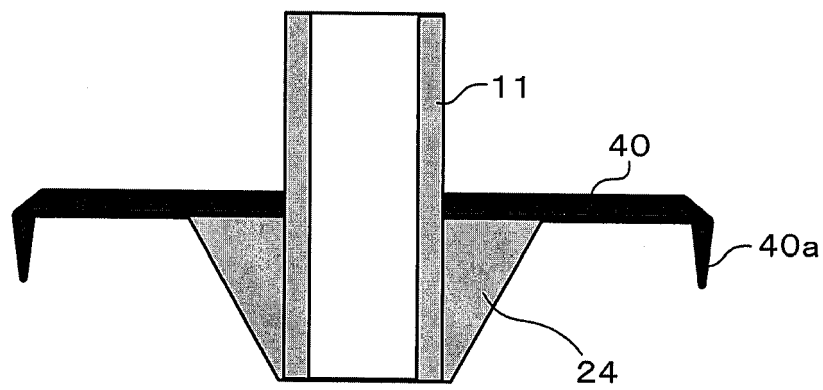


FIG.18

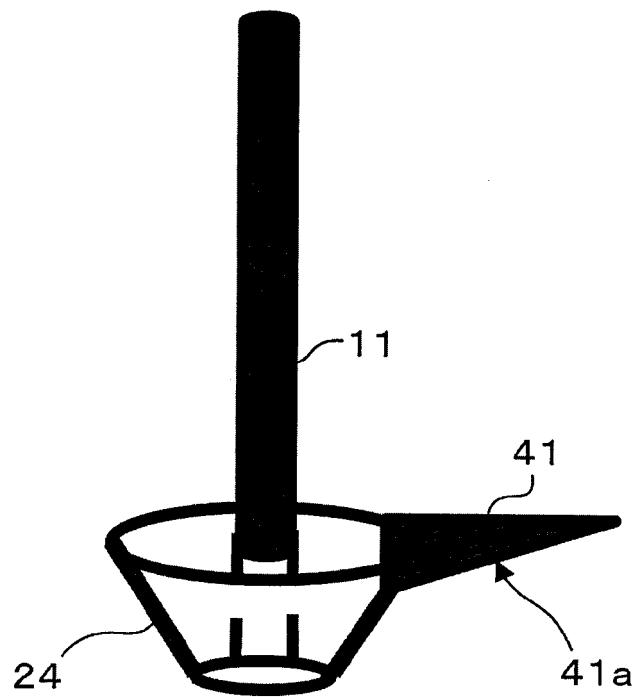
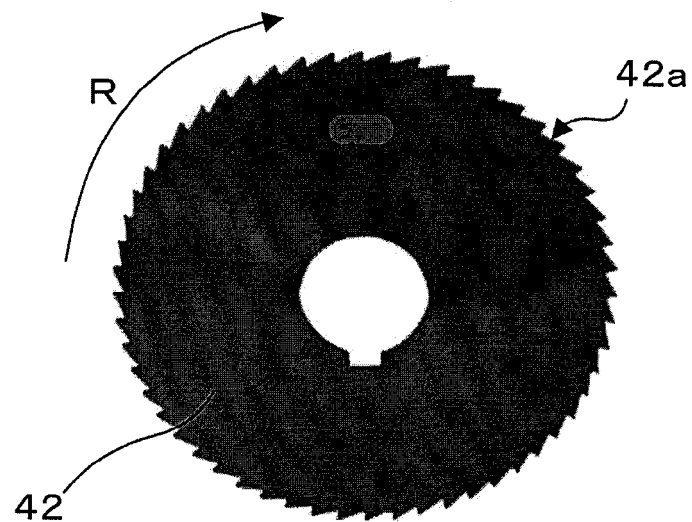


FIG.19





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Application Number
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Place of search Munich		Date of completion of the search 3 July 2019	Examiner Todarello, Giovanni
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