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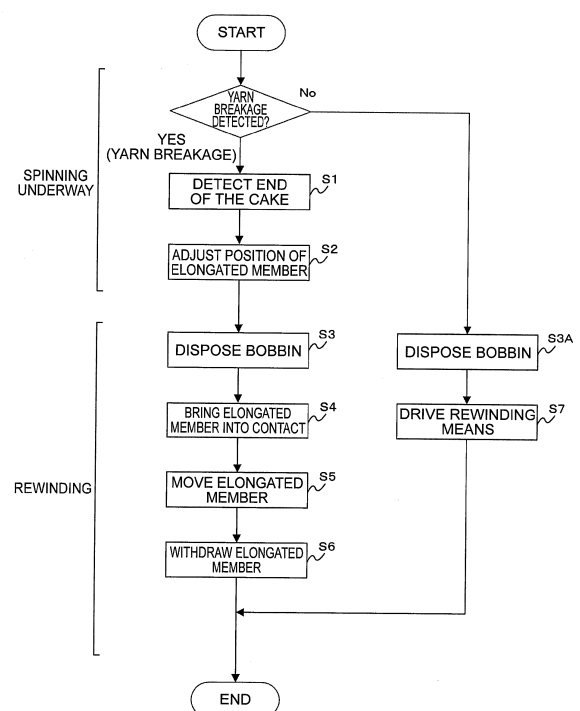
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(54) **REWINDING METHOD EMPLOYED IN POT SPINNING MACHINE FOLLOWING YARN BREAKAGE**

(57) A bobbin (25) and rewinding means are inserted into a pot (12) through an opening (23) of the pot (12). Next, a contact step (S4) is performed. Respective elongated members (73) move in a horizontal direction. In a pot (12) in which yarn breakage has been detected, the elongated member (73) is lifted up in advance, and therefore the elongated member (73) is pressed into contact with an inner wall (22) of the pot (12). Next, a moving step (S5) is performed. The bobbin (25) and the elongated member (73) are raised. As a result, a tip end of the elongated member (73) is pressed into contact with a cake lower end (28b).

FIG. 4



Description**BACKGROUND OF THE INVENTION****1. Field of the Invention**

[0001] The present invention relates to a rewinding method employed in a pot spinning machine following yarn breakage.

2. Description of the Related Art

[0002] A pot spinning method using a cylindrical pot is well known as a spinning method. In a pot spinning method described in Patent Document 1 (Japanese Patent Application Publication Laid-Open No. H11-256434, a cylindrical bobbin is disposed on the outside of a yarn guide coaxially with the yarn guide. Then, after forming a cake by winding yarn spun from the yarn guide around an inner wall of the pot while applying twist to the yarn, rewinding of the yarn onto the bobbin is started.

[0003] When yarn breakage occurs for one of several reasons during spinning, a cutting blade of a yarn-loosening member is brought into contact with the cake formed on the inner wall of the pot in order to lift the yarn up from the cake, whereby rewinding of the yarn onto the bobbin is started anew.

SUMMARY OF THE INVENTION

[0004] With the pot spinning method described in Patent Document 1, however, a problem occurs in that when the cutting blade is brought into contact with the cake, yarn on a lower layer of the cake is lifted up together with the yarn on the uppermost layer of the cake such that a plurality of yarn layers are rewound onto the bobbin together, leading to a defect known as multilayer rewinding. When multilayer rewinding occurs, a large amount of yarn becomes entangled on the bobbin, and this yarn cannot be unraveled during subsequent processes.

[0005] The present invention has been designed to solve the problem described above, and an object thereof is to provide a rewinding method employed in a pot spinning machine following yarn breakage, with which the occurrence frequency of multilayer rewinding can be reduced.

[0006] A rewinding method employed in a pot spinning machine following yarn breakage according to the present invention includes a cake forming step of forming a cake by rotating a pot having an opening and winding yarn drawn out to a predetermined thickness around an inner wall of the pot, an end of the cake detecting step of detecting an end of the cake on the opening side when yarn breakage is detected by a yarn breakage detection unit before completion of the cake forming step, a bobbin disposing step of disposing a bobbin inside the pot through the opening following completion of the cake forming step, and a contact step of bringing an elongated

member into contact with the inner wall of the pot through the opening, closer to the opening side than the end of the cake detected in the end of the cake detecting step.

5 BRIEF DESCRIPTION OF THE DRAWINGS**[0007]**

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

FIG. 2 is a schematic view showing configurational example of a lower portion of the pot spinning machine according to this embodiment of the present invention;

FIG. 3 is a block diagram showing configurational example of a drive control system of the pot spinning machine according to this embodiment of the present invention;

FIG. 4 is a view showing a basic flow of a pot spinning method according to this embodiment of the present invention;

FIG. 5 is a view illustrating an operation of a yarn guide shown in FIG. 1;

FIG. 6 is a view illustrating an operation of the yarn guide shown in FIG. 1 during a cake forming step;

FIG. 7 is a view illustrating operation timings of a bobbin rail and an elongated member according to this embodiment of the present invention;

FIG. 8 is a sectional view illustrating a first state of rewinding according to this embodiment of the present invention;

FIG. 9 is a sectional view illustrating a second state of rewinding according to this embodiment of the present invention;

FIG. 10 is an enlarged view illustrating the operation timing of the bobbin rail shown in FIG. 7 and an operation timing of a solenoid;

FIG. 11 is a sectional view illustrating a third state of rewinding according to this embodiment of the present invention;

FIG. 12 is a sectional view illustrating a fourth state of rewinding according to this embodiment of the present invention; and

FIG. 13 is a sectional view illustrating a fifth state of rewinding according to this embodiment of the present invention.

50 DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Embodiments of the present invention will be described in detail below with reference to the figures.

[0009] First, a pot spinning machine according to an embodiment of the present invention will be described.

[0010] FIG. 1 is a schematic view showing configurational example of an upper portion, above a pot, of the pot spinning machine according to this embodiment of

the present invention.

[0011] 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 with reference to FIG. 1, the configuration of one of the plurality of spindles will be described.

Drafting Device

[0012] A drafting device is provided above the pot 12.

[0013] 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 constituted by 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.

[0014] 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

[0015] 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.

[0016] 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 spun 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.

[0017] A yarn sensor 19 is disposed between the front roller pair 17 and the yarn supply pipe 14. Note that the yarn sensor may be disposed in another desired position rather than 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. The yarn sensor 19 constitutes a yarn breakage detection unit.

Pot

[0018] 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 K of the pot 12. The 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.

[0019] 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 a diameter (referred to hereafter as a "pot inner diameter") that defines an inner volume of the pot 12 and is based on the position of an inner wall 22. The opening 23 opens downward and has a diameter identical to the pot inner diameter.

[0020] FIG. 2 is a schematic view showing configurational example of a lower portion, below the pot, of the pot spinning machine according to this embodiment of the present invention.

[0021] A cylindrical bobbin 25 carried on a bobbin rail 26, the pot 12, which is capable of housing the bobbin 25, a filler (an elongated member) 73, and a wagon unit 75 are provided in the lower portion of the pot spinning machine 1. The bobbin 25 and the elongated member 73 are each provided in a plurality corresponding to the number of spindles along the bobbin rail 26.

Elongated Member

[0022] The bobbin rail 26 is configured to be elevatable in a vertical direction. A slide pipe 71 is provided below the bobbin rail 26 so as to extend along the bobbin rail 26. The slide pipe 71 is supported by a slider guide 72 fixed to the bobbin rail 26 to be capable of moving in a horizontal direction along the bobbin rail 26. The elongated members 73 having an elongated shape are

passed through the bobbin rail 26 and supported on the slide pipe 71 by supporting means, not shown in the figure, to be free to move vertically.

[0023] A solenoid 74 is provided on the slide pipe 71. When the solenoid 74 is switched ON, the slide pipe 71 moves in the extension direction of the bobbin rail 26 so that the elongated members 73 all move together in the horizontal direction along the bobbin rail 26.

[0024] The wagon unit 75 travels along the bobbin rail 26 below the elongated members 73. Further, the wagon unit 75 lifts up a desired elongated member 73 using a push-up arm 76 that is raised and lowered by a servo motor, not shown in the figure. After the elongated member 73 has been lifted up by the wagon unit 75, the elongated member 73 is positioned inside the pot 12 by the raising operation of the bobbin rail 26.

[0025] FIG. 3 is a block diagram showing configurational example of a drive control system of the pot spinning machine according to this embodiment of the present invention.

[0026] As shown in FIG. 3, 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, a bobbin drive unit 55, a rewinding means drive unit 56, the solenoid 74, and the wagon unit 75.

Control Unit

[0027] 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, the bobbin drive unit 55, the rewinding means drive unit 56, the solenoid 74, and the wagon unit 75 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

[0028] 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

[0029] The yarn guide drive unit 53 operates the yarn guide 11. 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

[0030] 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

[0031] The bobbin drive unit 55 operates the bobbin 25. The bobbin drive unit 55 operates the bobbin 25 mounted on the bobbin mounting portion 27 of the bobbin support 13 to move in the vertical direction integrally with the bobbin support 13 and the bobbin rail 26. The bobbin drive unit 55 moves the bobbin 25 in the vertical direction by implementing driving on the basis of a bobbin drive signal applied thereto from the control unit 51.

Rewinding Means Drive Unit

[0032] The rewinding means drive unit 56 operates rewinding means, not shown in the figures, during normal rewinding. The rewinding means drive unit 56 operates the rewinding means by implementing driving on the basis of a rewinding means drive signal applied thereto from the control unit 51.

Pot Spinning Method

[0033] Next, a pot spinning method according to this embodiment of the present invention will be described.

[0034] FIG. 4 is a view showing a basic flow of the pot spinning method.

[0035] As shown in FIG. 4, during a spinning operation, the pot spinning method includes an end of the cake detecting step S1 and an elongated member position adjusting step S2. Further, during a rewinding operation, the pot spinning method includes a bobbin disposing step S3, a contact step S4, a moving step S5, an elongated member withdrawing step S6, a bobbin disposing step S3A, and a rewinding means driving step S7.

[0036] The end of the cake detecting step S1 is a step of detecting a cake lower end 28b (see FIG. 1) of the cake 28 following yarn breakage. The elongated member position adjusting step S2 is a step of adjusting the position of the elongated member 73 corresponding to the spindle in which the yarn breakage has been detected. The rewinding operation includes yarn breakage rewinding using the elongated member 73 corresponding to the spindle in which yarn breakage has occurred, and normal rewinding using the rewinding means corresponding to the spindles in which yarn breakage has not occurred. Yarn breakage rewinding is performed after the bobbin disposing step S3 and includes the contact step S4, the

moving step S5, and the elongated member withdrawing step S6. The bobbin disposing step S3 is a step of inserting the bobbin 25 into the interior of the pot 12 and disposing the bobbin 25 in a position for starting rewinding. The contact step S4 is a step of pushing the elongated member 73 against the inner wall 22 of the pot 12 below the cake lower end 28b. The moving step S5 is a step of moving the elongated member 73 toward the cake lower end 28b. The elongated member withdrawing step S6 is a step of withdrawing the elongated member 73 to its original position. During normal rewinding, which is performed after the bobbin disposing step S3A, the yarn is rewound onto the bobbin 25 by driving the rewinding means in the rewinding means driving step S7. Operations of the pot spinning machine 1 based on the respective steps will be described below.

[0037] It is assumed that before the pot spinning machine 1 is operated, the yarn guide 11 has been disposed near the yarn supply pipe 14, the bobbin 25 has been mounted on the bobbin mounting portion 27 of the bobbin support 13, and the bobbin 25 has been disposed below and away from the pot 12.

Drawing-out Operation

[0038] First, a drawing-out operation is performed using the drafting device 10, as shown in FIG. 1. 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.

[0039] 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.

[0040] 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 a swirling flow of air and then introduced into the yarn guide 11.

[0041] Further, before the start of the drawing-out operation, the control unit 51 applies the pot driving signal to the pot drive unit 54 to rotate the pot 12 at a predetermined rotation frequency.

Cake-forming Step

[0042] Next, the cake-forming step 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 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 spun from the lower end 11a of the yarn guide 11.

[0043] Centrifugal force generated by the rotation of the pot 12 acts on the yarn 18 spun from the lower end 11a of the yarn guide 11, and as a result of this centrifugal force, the yarn 18 is pressed into contact with the inner wall 22 of the pot 12. Further, the yarn 18 pressed against the inner wall 22 of the pot 12 is twisted by the rotation of the pot 12. As a result, the yarn 18 spun 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.

[0044] Furthermore, as shown in FIG. 5, by implementing driving on the basis of the yarn guide drive signal, 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. As a result, the cake 28 is formed on the inner wall 22 of the pot 12. The cake 28 is a laminated body formed from the yarn 18 wound around the inner wall 22 of the pot 12.

[0045] FIG. 6 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.

[0046] In FIG. 6, 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 dis-

placement step amount at a time while performing a vertical reciprocating motion repeatedly at fixed period intervals. This operation of 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 "cake upper end") 28a of the cake 28 shown in FIG. 1, while the Pm position defines a winding end-side end (also referred to hereafter as a "cake lower end") 28b of the cake 28 shown in the same figure.

[0047] The control unit 51 operates the yarn guide 11, as shown in FIGS. 5 and 6, by applying the yarn guide drive signal to the yarn guide drive unit 53. As a result, the cake 28 is formed on the inner wall 22 of the pot 12 in the shape shown in FIG. 5. In this embodiment, the following step is further included after the cake 28 is formed by the operation of the yarn guide 11 in the cake-forming step.

[0048] After the yarn guide 11 reaches the Pm position, the control unit 51 moves the yarn guide 11 downward by a predetermined amount Lh. As a result, as shown in FIG. 5, the portion of the yarn 18a that serves as the rewinding start point for rewinding the yarn onto the bobbin 25 is wound around the inner wall 22 of the pot 12 in the region 22a closer to the opening 23 side than the cake lower end 28b of the cake 28. The portion of the yarn 18a may be wound in a single layer or a plurality of layers. When the portion of the yarn 18a is wound in a single layer, yarn cutting may be performed at a stage where the yarn guide 11 is lowered from the Pm position to a Pn position. Further, when the portion of the yarn 18a is wound in a plurality of layers, yarn cutting may be performed at a stage where an operation for lowering the yarn guide 11 from the Pm position to the Pn position and then raising the yarn guide 11 to a higher position than the Pn position has been performed at least once.

[0049] Here, the difference between "yarn cutting" and "yarn breakage" will be described.

[0050] Yarn cutting is performed intentionally 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. Yarn breakage, on the other hand, 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.

[0051] 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. As a result, the yarn 18 is forcibly cut on the downstream side of the middle roller pair 16.

End of the cake Detecting Step

[0052] When yarn breakage occurs before the cake forming step is complete, the end of the cake detecting step S1 is performed. The end of the cake detecting step

S1 is performed on each pot 12 in which yarn breakage has occurred. When yarn breakage is detected by the yarn sensor 19, a yarn breakage occurrence signal is output to the control unit 51. At this time, the control unit 51 detects the position of the cake lower end 28b of the cake 28 from the input timing of the yarn breakage occurrence signal. As shown in FIG. 6, when yarn breakage occurs above P1 during a period T1 extending 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, for example, P1 serves as the cake lower end 28b, and when yarn breakage occurs during the descent from P1 to P3, the position of the yarn guide 11 at the time of the yarn breakage serves as the cake lower end 28b. Thus, the control unit 51 detects the position of the cake lower end 28b within the pot 12 by determining the period including the input timing of the yarn breakage occurrence signal.

[0053] Note that in the pot 12 in which the yarn breakage occurs, formation of the cake 28 is not continued, whereas in the pots 12 in which yarn breakage has not occurred, the cakes 28 are formed until the cake forming step is complete.

Elongated Member Position Adjusting Step

[0054] Next, in the elongated member position adjusting step S2, the control unit 51 inputs a drive signal into the wagon unit 75 (see FIG. 2) to cause the wagon unit 75 to travel to the position of the pot 12 in which the yarn breakage has occurred. Having reached the position of the pot 12 in which the yarn breakage has occurred, the wagon unit 75 lifts up the elongated member 73 by raising the push-up arm 76 in response to input of a drive signal from the control unit 51. At this time, as shown in FIG. 7, when the elongated member 73 is lifted up at a time U1, the height of the elongated member 73 is raised from A0, at which a tip end of the elongated member 73 is in an initial position, to A1, which is several millimeters below the cake lower end 28b (see FIG. 5) in the contact step S4, to be described below. Once the elongated member 73 has been lifted up, the push-up arm 76 is lowered. The height of the elongated member 73 is maintained by supporting means, not shown in the figure.

Rewinding Operation

[0055] The rewinding operation is performed when the cake forming step is complete. Note that FIGS. 8, 9, and 11 to 13, to be described below, show the pot 12 in which the yarn breakage was detected during the end of the cake detecting step S1.

Bobbin Disposing Step

[0056] The bobbin disposing step S3 is performed on the pot 12 in which the yarn breakage was detected in the cake forming step. In the bobbin disposing step S3,

the bobbin 25 is disposed inside the pot 12 through the opening 23 by the driving implemented by the pot drive unit 54 (see FIG. 3). 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. 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. Accordingly, the bobbin 25 mounted on the bobbin mounting portion 27 (see FIG. 1) moves up together with the bobbin support 13 to several mm below a highest point, as shown in FIG. 9, to be described below. More specifically, as shown in FIG. 7, from a time U2 to a time U3, the height of the bobbin rail 26 is raised from an initial position B0 to B1, which is several mm below the highest point of the bobbin rail 26.

[0057] Further, as shown in FIGS. 8 and 9, the bobbin 25 is inserted into the pot 12 through the opening 23 of the pot 12. Meanwhile, the yarn guide drive unit 53 moves the yarn guide 11 upward 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 lower end 11a of the yarn guide 11 retreats to a position inside the pot 12 where the yarn guide 11 does not contact the bobbin 25.

[0058] Furthermore, in the pot 12 in which the yarn breakage was detected during the end of the cake detecting step S1, the elongated member 73 is lifted up to A1, as shown in FIG. 7, and therefore, as shown in FIG. 9, the elongated member 73 enters the pot 12 together with the bobbin 25 and rises to a height of A2.

Yarn Breakage Rewinding

[0059] When yarn breakage occurs during the cake forming step, the portion of the yarn 18a is not formed normally, and therefore rewinding cannot be performed by normal rewinding. In the pot 12 where the yarn breakage has occurred, however, the yarn end of the broken yarn is, in many cases, positioned below the cake 28 and pressed against the inner wall 22 of the pot 12 by the centrifugal force. Hence, yarn breakage rewinding is performed as described below.

Contact Step

[0060] In yarn breakage rewinding, first, the contact step S4 is performed. As shown in FIG. 7 and the enlarged view in FIG. 10, when the solenoid 74 (see FIG. 2) is switched ON on the basis of a solenoid drive signal applied thereto from the control unit 51 at the time U3, the slide pipe 71 moves along the bobbin rail 26. Accordingly, the respective elongated members 73 move along the bobbin rail 26 in the horizontal direction. Further, as shown in FIG. 11, in the pot 12 in which the yarn breakage was detected during the end of the cake detecting step S1, the elongated member 73 is lifted up in advance, and therefore the elongated member 73 is pressed into con-

tact with the inner wall 22 of the pot 12. At this time, the height of the tip end of the elongated member 73 is several mm below the lower end of the cake 28.

[0061] By pressing the elongated member 73 against the inner wall 22 of the pot 12 so that the height of the tip end of the elongated member 73 is several mm below the lower end of the cake 28, the end of the broken yarn inside the pot 12 contacts the elongated member 73 and starts to coil around the bobbin 25 disposed on the central axis K (see FIG. 1) of the pot 12. In many cases, therefore, by implementing the contact step S4 on the pot 12 in which the yarn breakage has occurred, rewinding onto the bobbin 25 can be started using the end of the broken yarn inside the pot 12 as a rewinding start point.

Moving Step

[0062] Next, the moving step S5 is performed. As shown in FIGS. 7 and 12, the bobbin drive unit 55 moves the bobbin rail 26 upward to the highest point B2 by implementing driving on the basis of the bobbin drive signal applied thereto from the control unit 51. Accordingly, the bobbin 25 and the elongated member 73 ascend. The elongated member 73 moves upward by a distance X from the height A2 to A3 while remaining pressed against the inner wall 22 of the pot 12. As a result, the tip end of the elongated member 73 is pressed into contact with the cake lower end 28b of the cake 28.

[0063] Even in a case where the end of the broken yarn is not positioned at the height A2 so that the yarn 18 cannot be rewound onto the bobbin 25 in the contact step S4, the tip end of the elongated member 73 is brought into contact with the yarn end in the moving step S5, and therefore yarn breakage rewinding can be started using the yarn on the uppermost layer of the cake lower end 28b, of the yarn forming the cake 28, as the rewinding start point.

[0064] In the rewinding method following yarn breakage described in Patent Document 1, the cutting blade is brought into contact with the cake, and therefore yarn on a lower layer of the cake is lifted up together with the yarn on the uppermost layer of the cake such that multilayer rewinding occurs. In this embodiment, on the other hand, the height of the cake lower end 28b is detected in the end of the cake detecting step S1, whereupon the tip end of the elongated member 73 is brought into contact with the cake lower end 28b in the moving step S5, and therefore a plurality of layers of the yarn forming the cake 28 are not lifted up at the same time. As a result, multilayer rewinding can be suppressed.

[0065] When a preset time U4 arrives, the solenoid 74 is switched OFF, as shown in FIG. 10, on the basis of a solenoid drive signal applied thereto from the control unit 51. As a result, the elongated member 73 returns to its original position in the horizontal direction, whereby the elongated member 73 separates from the inner wall 22, as shown in FIG. 13.

Elongated Member Withdrawing Step

[0066] When all of the yarn forming the cake 28 has been rewound onto the bobbin 25 at a time U5, as shown in FIG. 7, the elongated member withdrawing step S6 is performed. The control unit 51 lowers the bobbin rail 26 by applying the bobbin drive signal to the bobbin drive unit 55. Next, at a time U6, the control unit 51 raises and lowers the push-up arm 76 in order to lower the raised elongated member 73 by applying a drive signal to the wagon unit 75 shown in FIG. 2. As a result, yarn breakage rewinding is complete.

Normal Rewinding

[0067] Further, in each of the pots 12 in which yarn breakage is not detected during the cake forming step, the bobbin disposing step S3A is performed for the purpose of normal rewinding, as shown in FIG. 4. The bobbin disposing step S3A includes identical operations to the bobbin disposing step S3 described above, and is performed simultaneously with the bobbin disposing step S3.

[0068] Next, the rewinding means driving step S7 (see FIG. 4) is performed. When the rewinding means, not shown in the figures, contacts the portion of the yarn 18a (see FIG. 5), the portion of the yarn 18a starts to coil around the bobbin 25 disposed on the central axis K (see FIG. 1) of the pot 12. Thus, in the pots 12 in which yarn breakage has not occurred, rewinding onto the bobbin 25 can be started using the portion of the yarn 18a discharged into the pot 12 as the rewinding start point.

[0069] As a result of the operations described above, the bobbin 25 is obtained with a yarn tube wound thereon. The bobbin 25 with the yarn tube wound thereon is removed from the bobbin mounting portion 27. An empty bobbin 25 is then mounted on the bobbin mounting portion 27, whereupon similar operations to those described above are performed.

[0070] Hence, by providing the cake forming step of forming the cake 28 by rotating the pot 12 having the opening 23 and winding the yarn 18 drawn out to a predetermined thickness around the inner wall 22 of the pot 12, the end of the cake detecting step S1 for detecting the cake lower end 28b on the opening side of the cake 28 when breakage of the yarn 18 is detected by the yarn breakage detection unit before completion of the cake forming step, the bobbin disposing step S3 for disposing the bobbin 25 inside the pot 12 through the opening 23 following completion of the cake forming step, and the contact step S4 for bringing the elongated member 73 into contact with the inner wall 22 of the pot 12 through the opening 23, closer to the opening side than the cake lower end 28b of the cake, detected in the end of the cake detecting step S1, the occurrence frequency of multilayer rewinding can be reduced.

[0071] Further, the moving step S5 is provided after the contact step S4 to raise the elongated member 73

while keeping the elongated member 73 in contact with the inner wall 22 of the pot 12 so that the elongated member 73 contacts the cake lower end 28b on the opening side of the cake 28. Hence, rewinding can be started from the cake lower end 28b even when the yarn 18 cannot be rewound onto the bobbin 25 in the contact step S4, and as a result, the occurrence frequency of multilayer rewinding can be reduced.

[0072] Furthermore, in the end of the cake detecting step S1, the position of the cake lower end 28b is detected on the basis of the detection timing of the yarn breakage, and therefore the position of the cake lower end 28b can be detected by a simple method. Moreover, the tip end of the elongated member 73 is brought into contact with the cake lower end 28b, and therefore multilayer rewinding can be suppressed.

[0073] Further, the cake lower end 28b of the cake 28 is used as the rewinding start point, and therefore the occurrence frequency of multilayer rewinding can be reduced without greatly modifying the configuration of the pot from that of a pot of a conventional pot spinning machine.

[0074] Furthermore, the pot 12 is provided in a plurality, and in the contact step S4, the elongated members 73 are brought into contact with the inner walls 22 of the plurality of pots 12 simultaneously. Therefore, the time required to implement the entire spinning method is shortened in comparison with a method in which the pots 12 in which yarn breakage occurs are rewound one at a time, and as a result, an improvement in productivity is achieved.

[0075] Note that in this embodiment, the pot spinning method includes the moving step S5, but the moving step S5 does not have to be included. Through experiment, it was found that in many cases, the yarn that serves as the rewinding start point following yarn breakage is pressed against the inner wall 22 of the pot 12 on the opening 23 side of the cake lower end 28b, and therefore the yarn can be rewound by pressing the elongated member 73 against the inner wall 22 in the contact step S4.

[0076] Further, in this embodiment, the bobbin 25 that can be applied to ring spinning is used, but the present invention may be implemented using a different bobbin.

[0077] Furthermore, in this embodiment, the yarn sensor 19 constituted by an optical sensor is used, but a yarn sensor employing a different detection system may be used. For example, a mechanical yarn sensor that detects yarn breakage mechanically through contact with the yarn may be used.

[0078] Moreover, in this embodiment, the elongated member 73 is brought into contact with the cake lower end 28b, but instead, the elongated member may be brought into contact with the cake upper end 28a. Furthermore, a different cake-forming step (a step such as that disclosed in Japanese Patent Application Publication Laid-Open No. H04-308227, for example) to the cake-forming step shown in FIG. 6 may be performed.

[0079] A bobbin and rewinding means are inserted into

a pot through an opening of the pot. Next, a contact step is performed. Respective elongated members move in a horizontal direction. In a pot in which yarn breakage has been detected, the elongated member is lifted up in advance, and therefore the elongated member is pressed into contact with an inner wall of the pot. Next, a moving step is performed. The bobbin and the elongated member are raised. As a result, a tip end of the elongated member is pressed into contact with a cake lower end.

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Claims

1. A rewinding method employed in a pot spinning machine (1) following yarn breakage, the rewinding method comprising:
 - a cake forming step of forming a cake (28) by rotating a pot (12) having an opening (23) and winding yarn (18) drawn out to a predetermined thickness around an inner wall (22) of the pot (12);
 - an end of the cake detecting step (S1) of detecting an end of the cake (28) on the opening (23) side when yarn breakage is detected by a yarn breakage detection unit before completion of the cake forming step;
 - a bobbin disposing step (S3) of disposing a bobbin (25) inside the pot (12) through the opening (23) following completion of the cake forming step; and
 - a contact step (S4) of bringing an elongated member (73) into contact with the inner wall (22) of the pot (12) through the opening (23), closer to the opening (23) side than the end of the cake (28) detected in the end of the cake detecting step (S1).
2. The rewinding method employed in a pot spinning machine (1) following yarn breakage according to claim 1, further comprising, after the contact step (S4), a moving step (S5) of raising the elongated member (73) while keeping the elongated member (73) in contact with the inner wall (22) of the pot (12) so that the elongated member (73) contacts the end of the cake (28) on the opening (23) side.
3. The rewinding method employed in a pot spinning machine (1) following yarn breakage according to claim 1 or 2, wherein, in the end of the cake detecting step (S1), the position of the end of the cake (28) is detected on the basis of a detection timing of the yarn breakage.
4. The rewinding method employed in a pot spinning machine (1) following yarn breakage according to any one of claims 1 to 3, wherein the end of the cake (28) is a lower end (28b) of the cake (28).

5. The rewinding method employed in a pot spinning machine (1) following yarn breakage according to any one of claims 1 to 4, wherein, when the pot (12) is provided in a plurality, in the contact step (S4), the elongated members (73) are brought into contact with the inner walls (22) of the plurality of pots (12) simultaneously.

FIG. 1

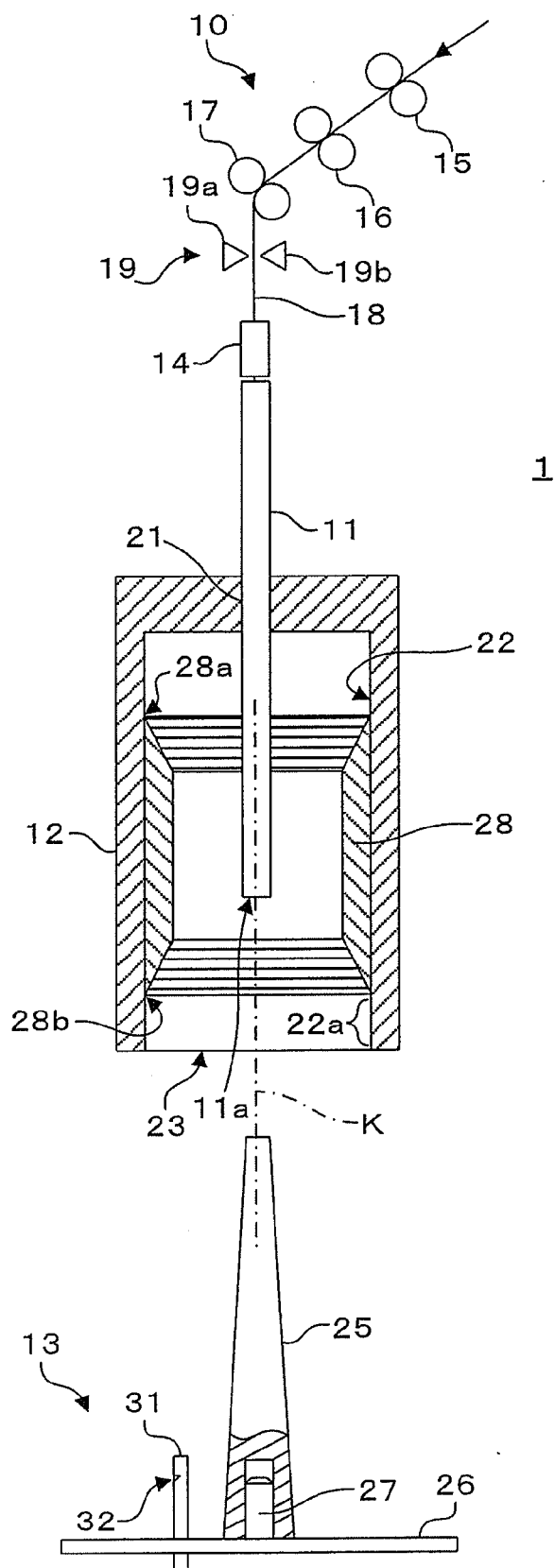


FIG. 2

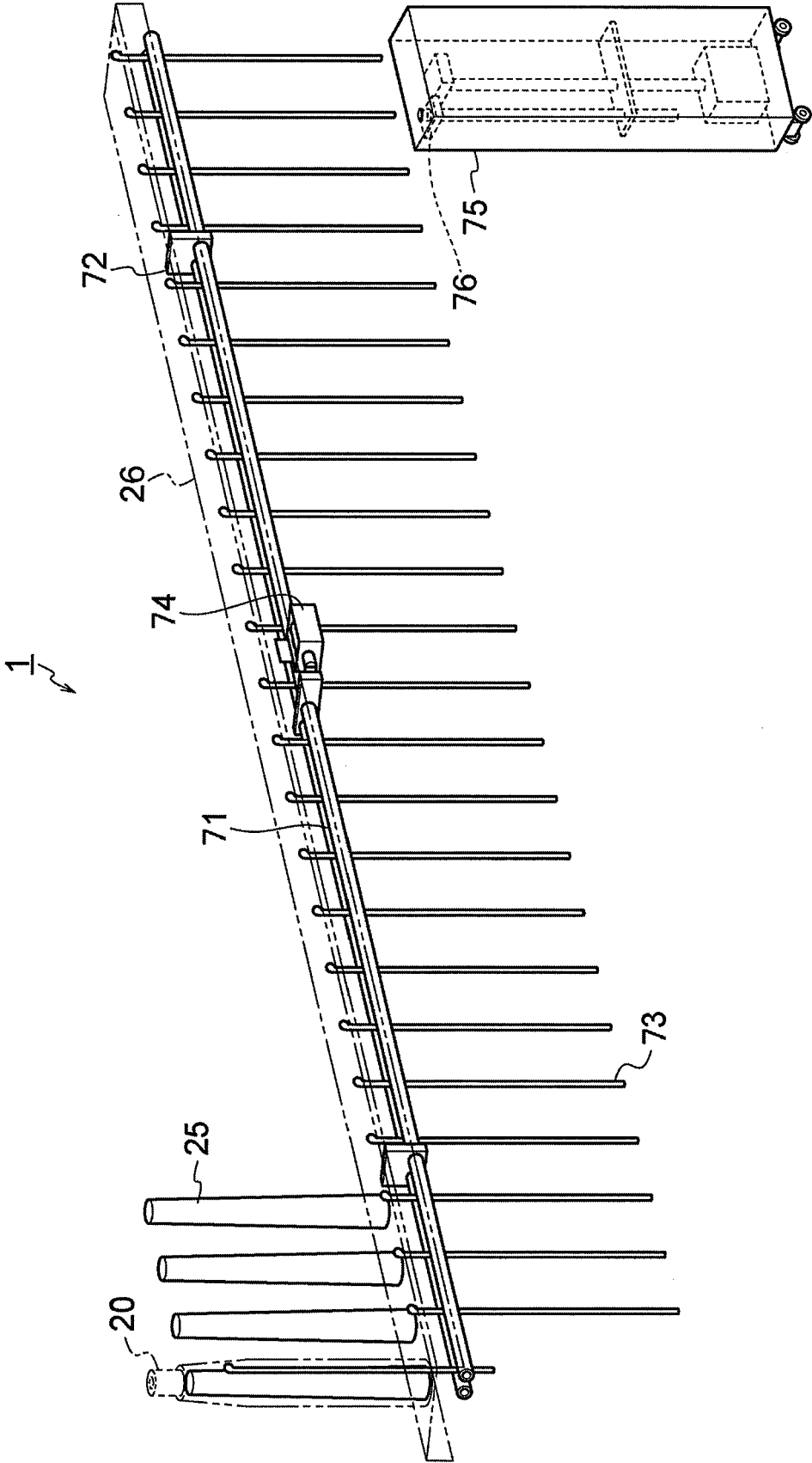


FIG. 3

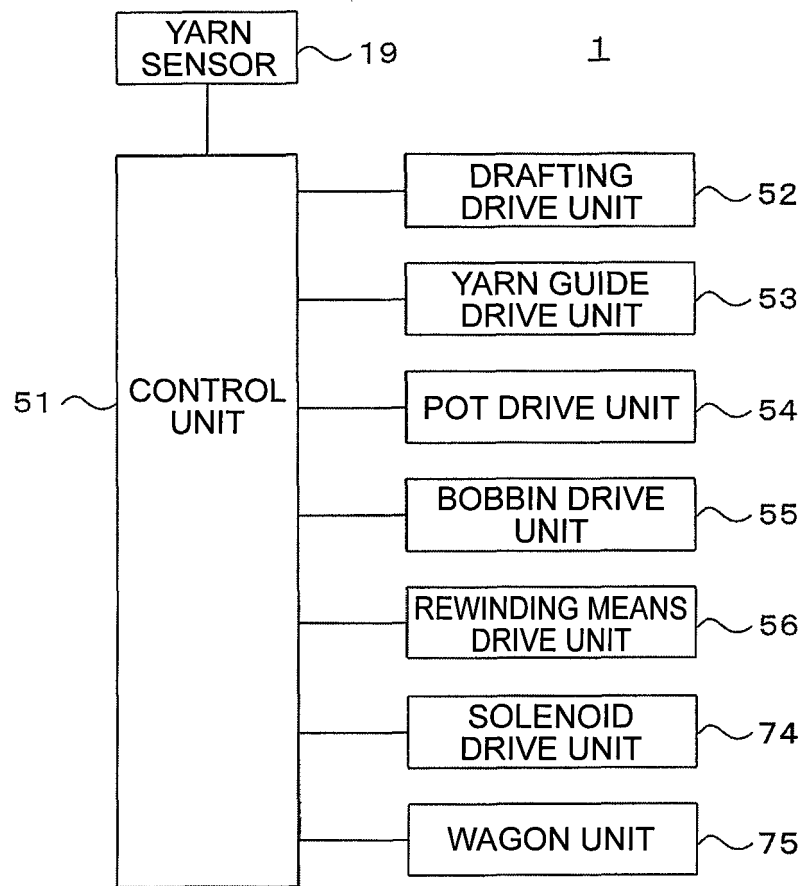


FIG. 4

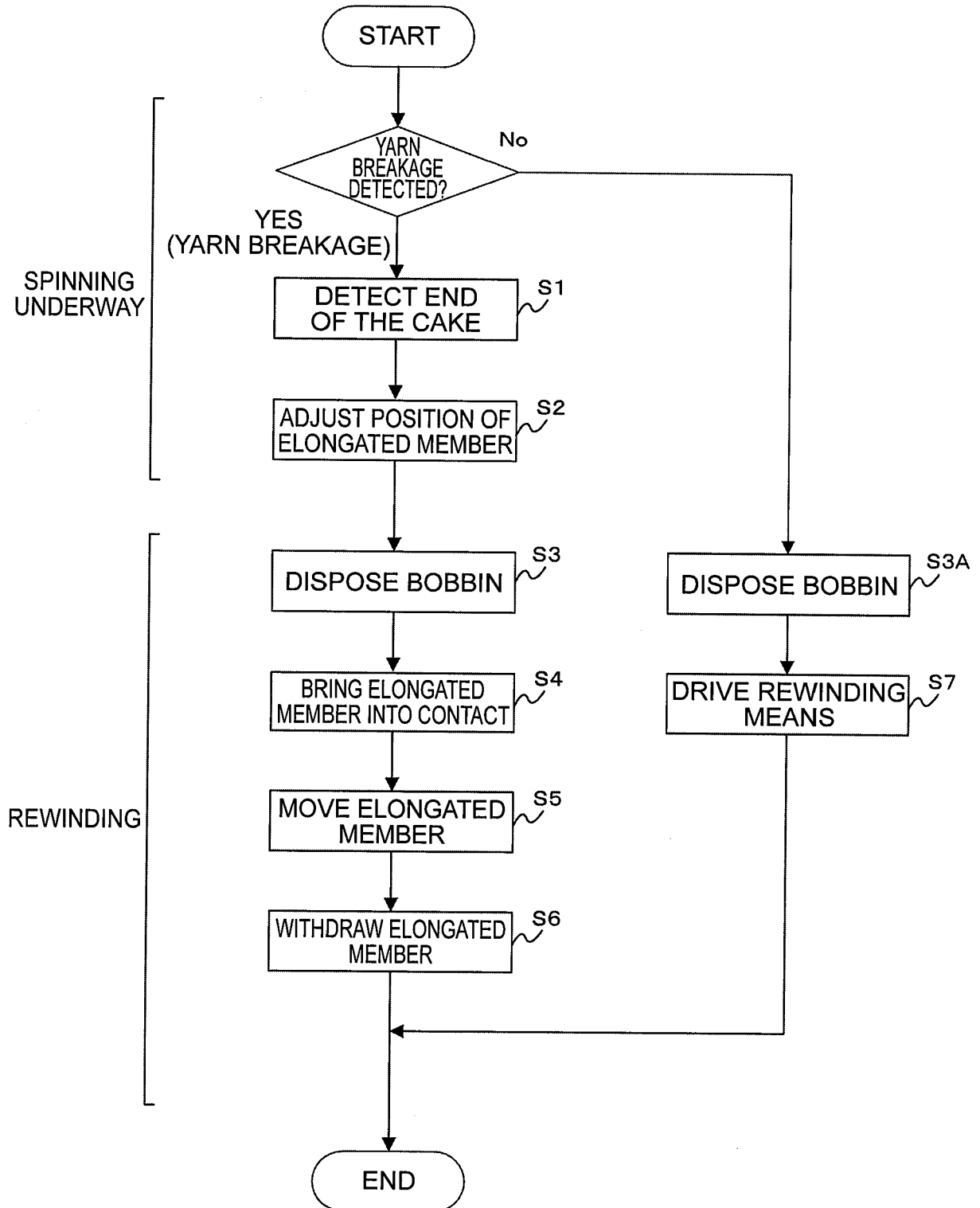


FIG. 5

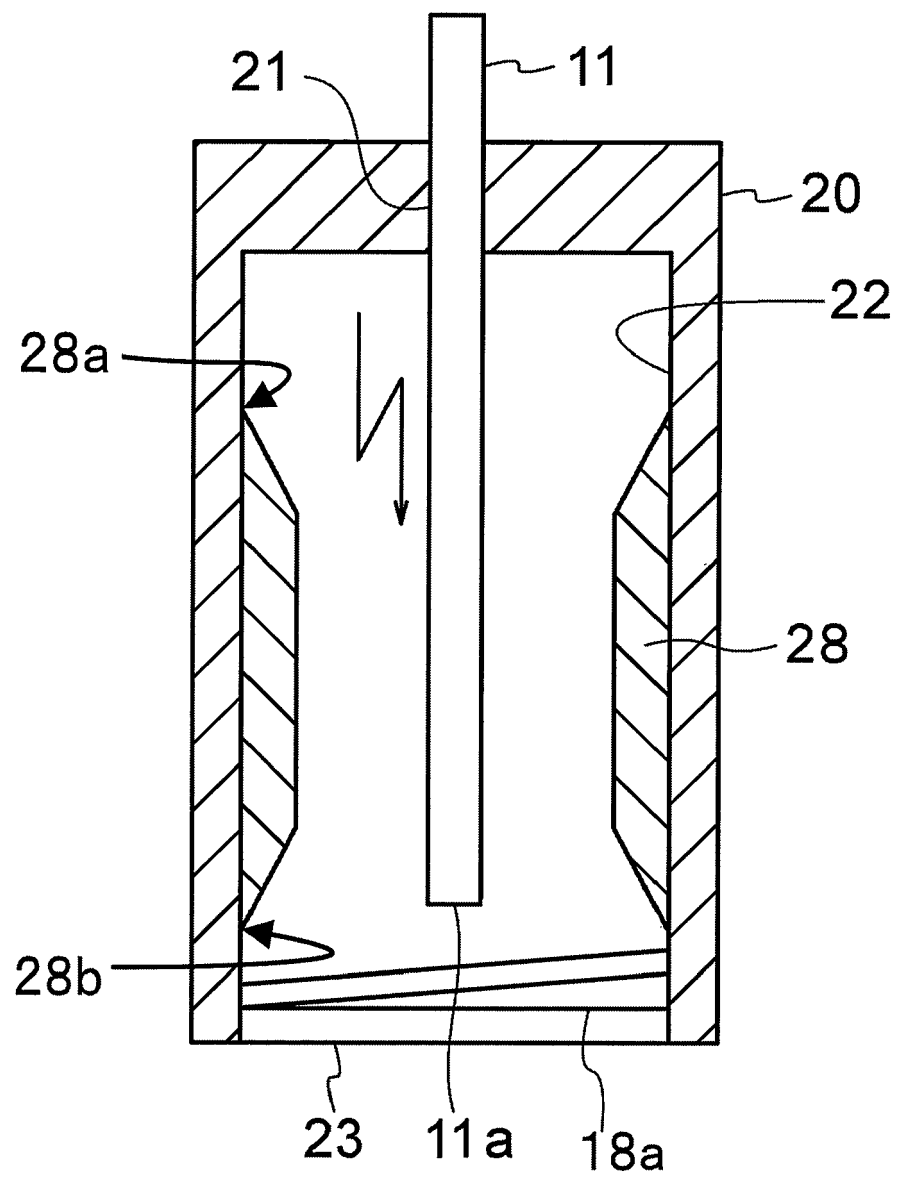


FIG. 6

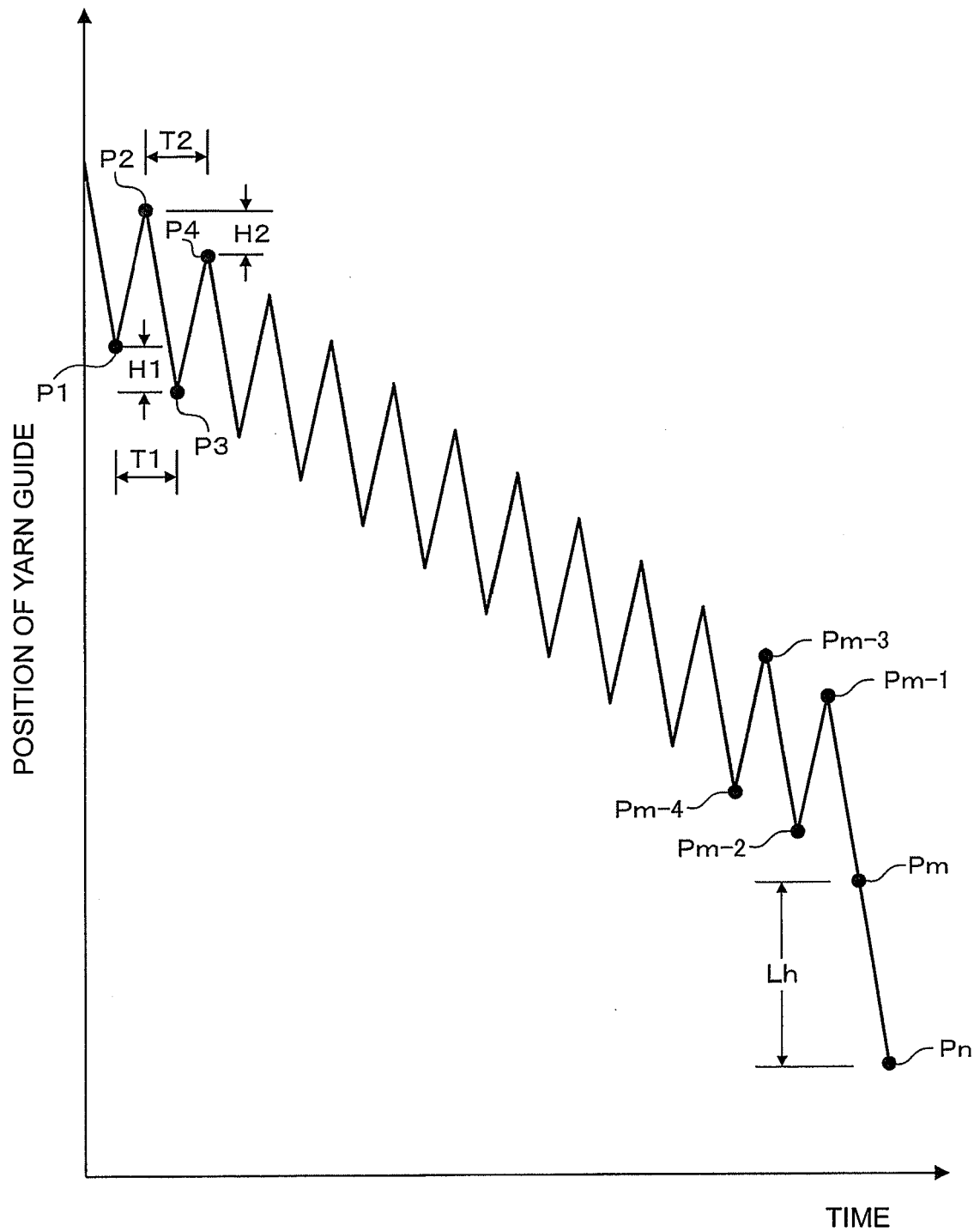


FIG. 7

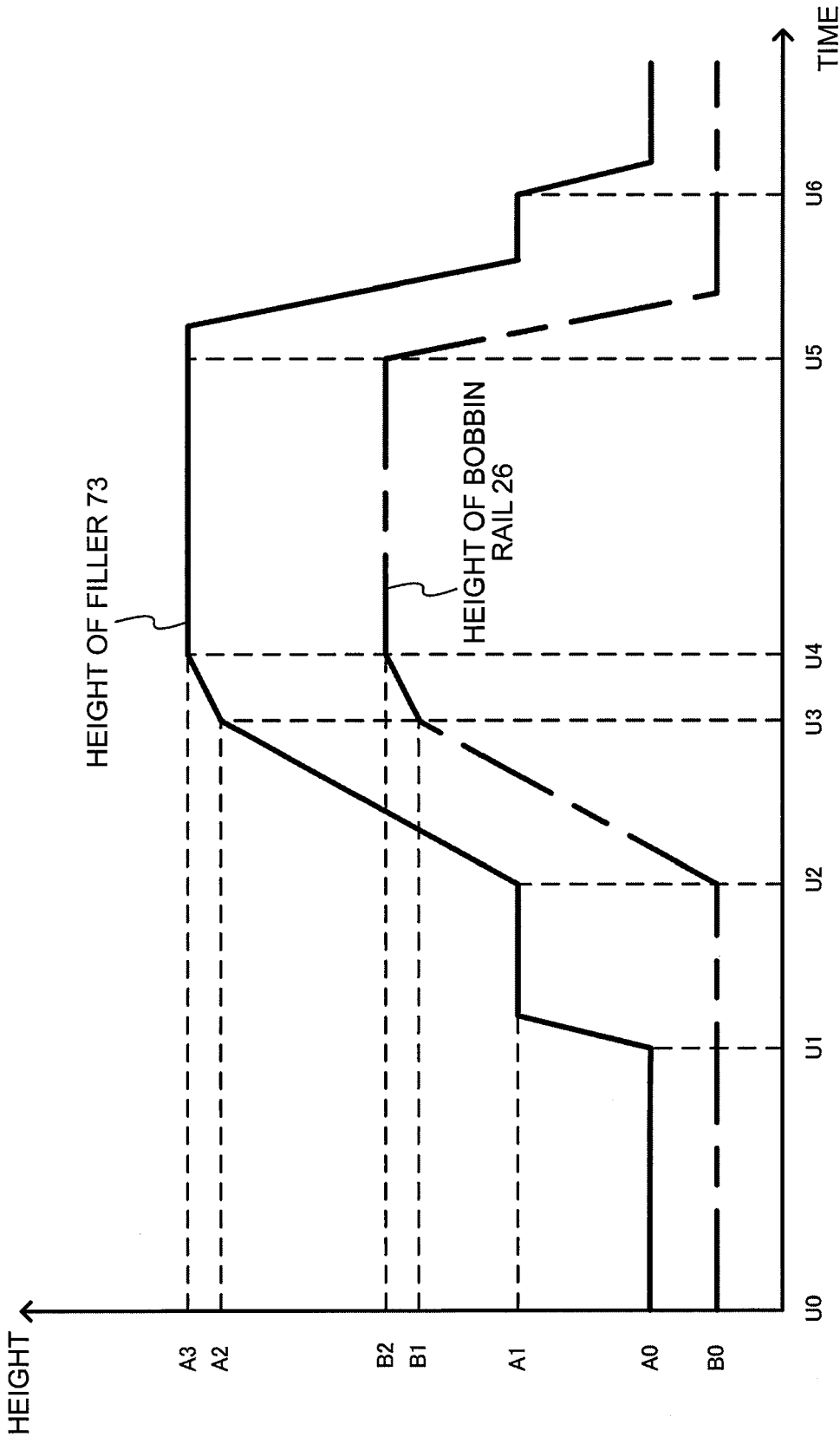


FIG. 8

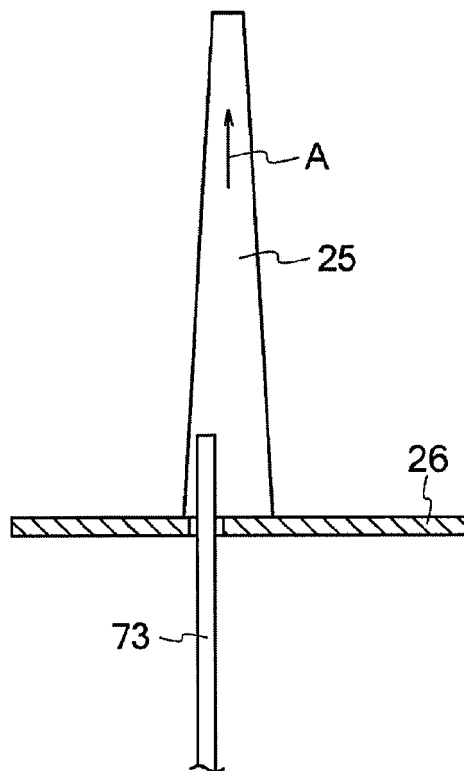
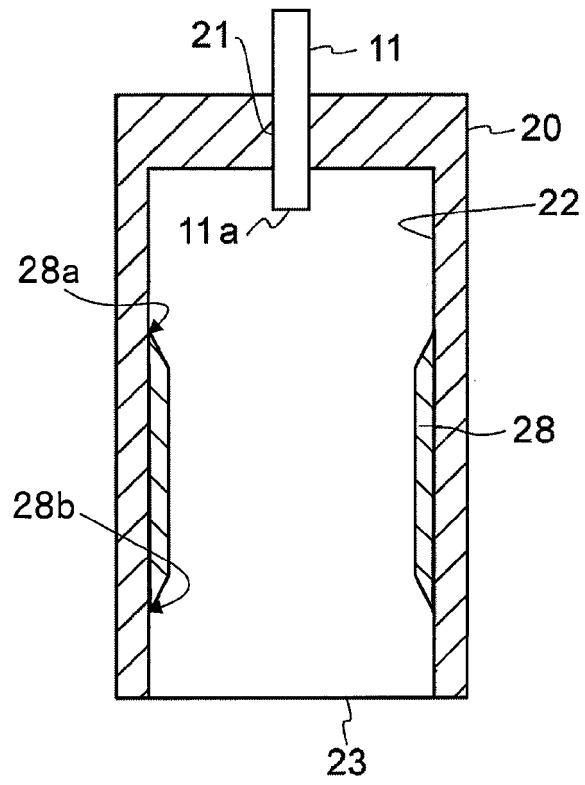


FIG. 9

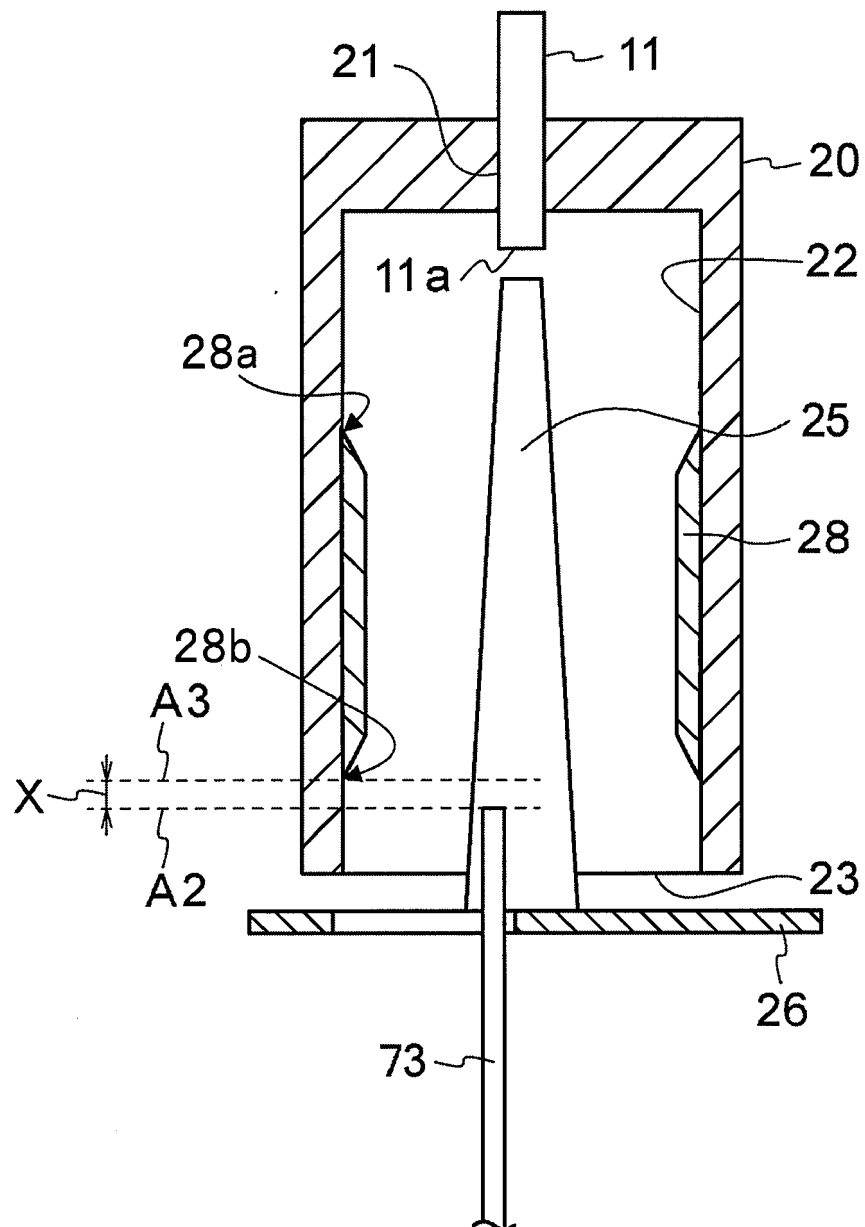


FIG. 10

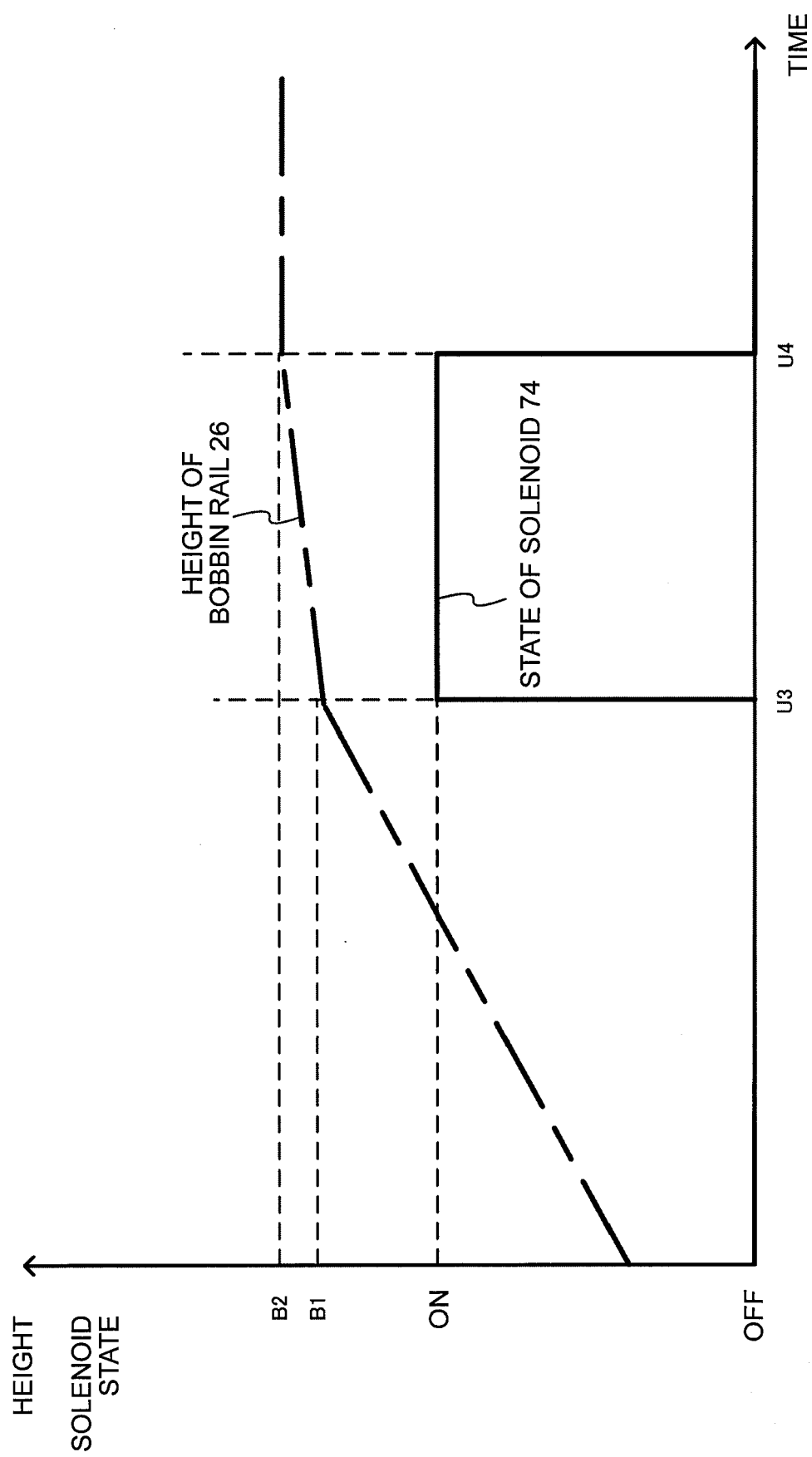


FIG. 11

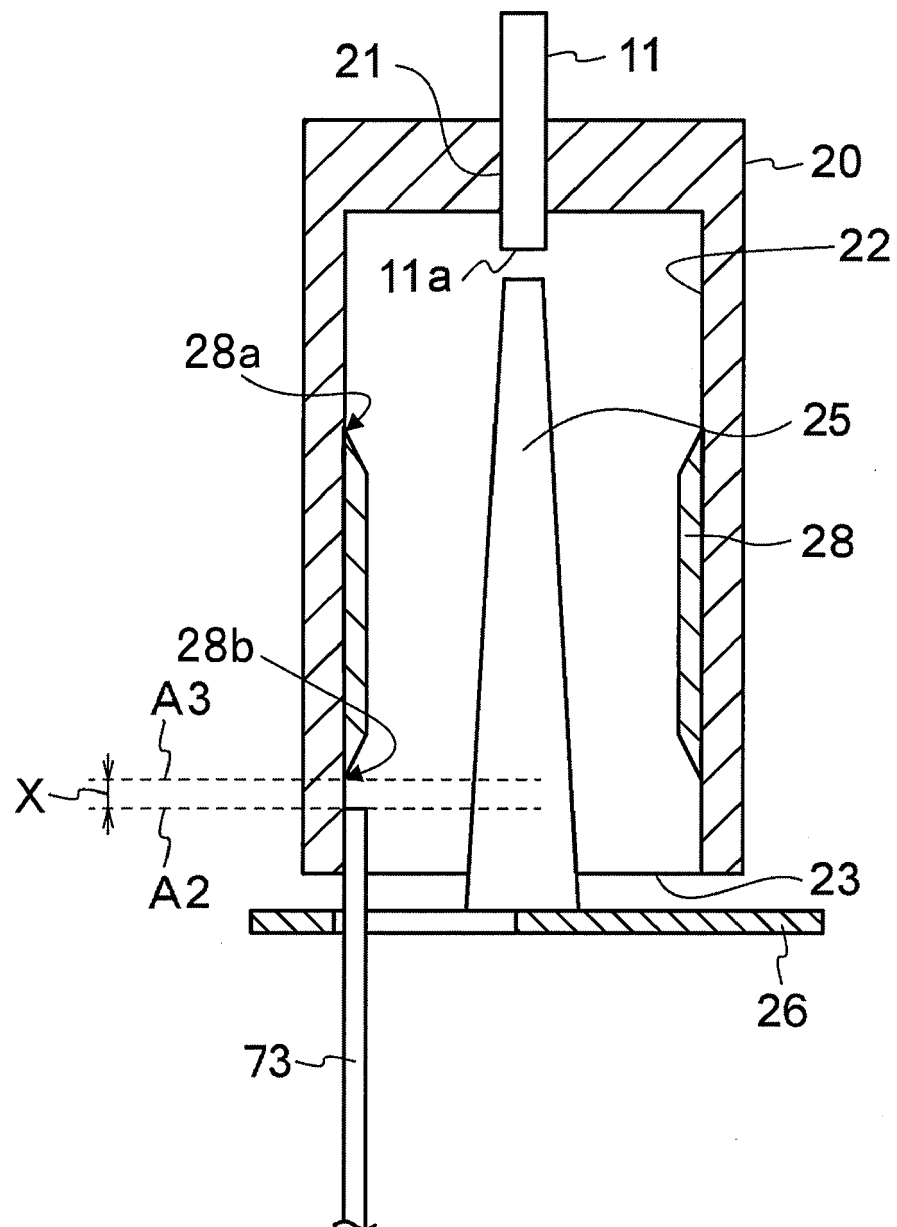


FIG. 12

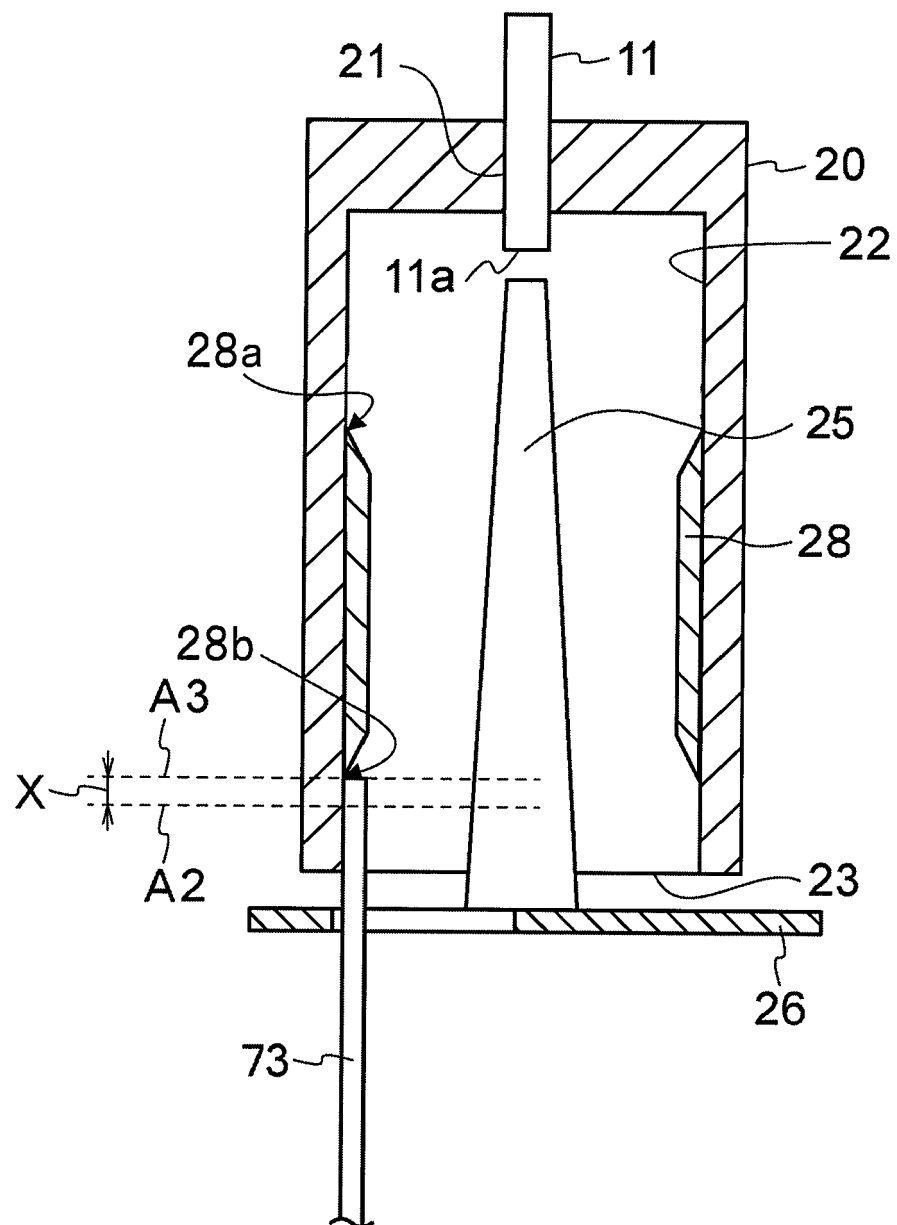
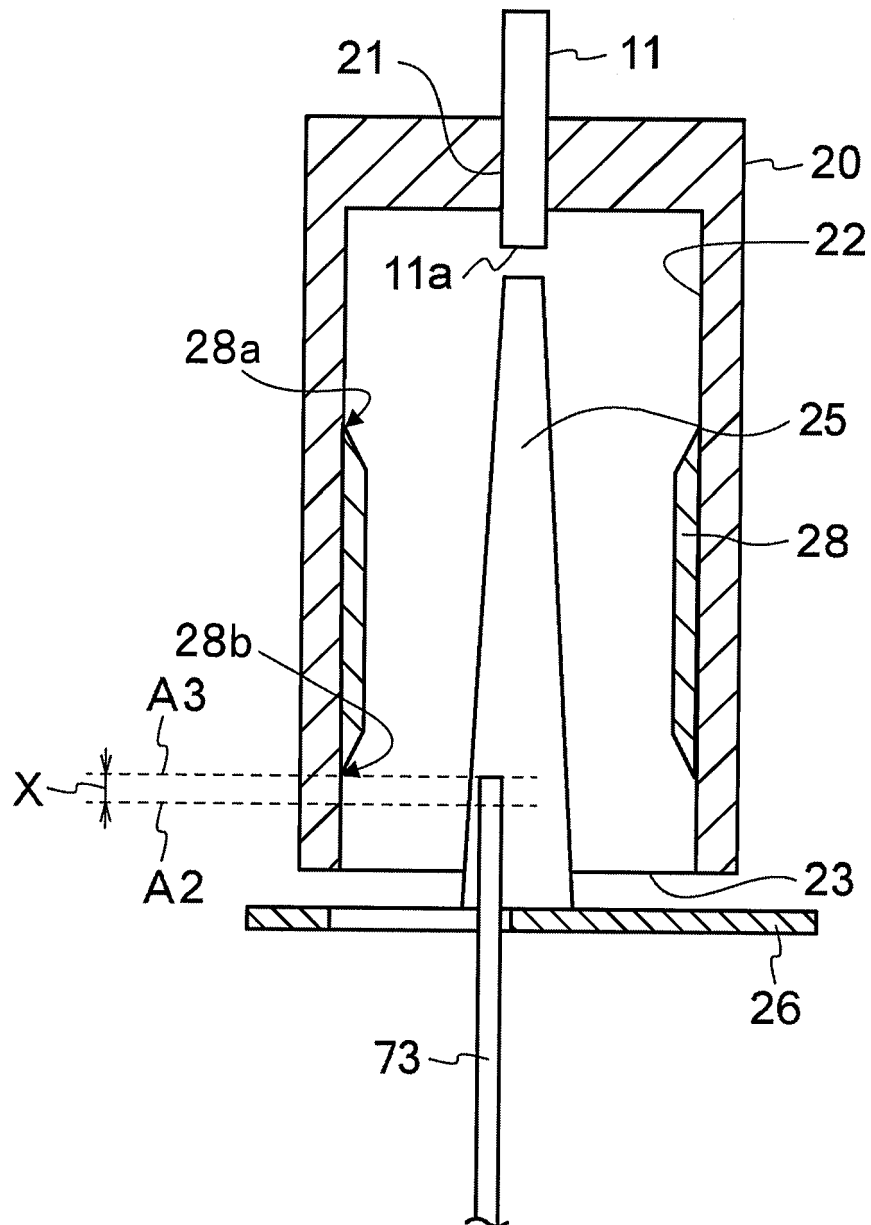


FIG. 13





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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 June 2019	Examiner Todarello, Giovanni
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