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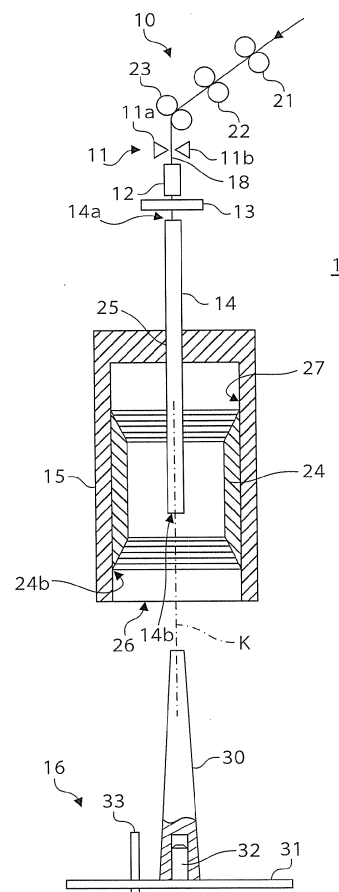
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(54) **POT SPINNING MACHINE**

(57) A pot spinning machine (1) according to the present invention has a drafting device (10) for drawing out yarn (18), a yarn suction pipe (12) for suctioning the drawn-out yarn (18), a cylindrical pot (15), and a yarn guide (14) for guiding the yarn (18), which is supplied thereto through the yarn suction pipe (12), into the pot (15), the pot spinning machine (1) forming a cake (24) by winding the yarn (18) discharged from the yarn guide (14) around an inner wall (27) of the pot (15). The pot spinning machine (1) includes a detection sensor (11) for detecting behavior of the yarn (18) on a yarn path extending from the drafting device (10) to the yarn suction pipe (12), a cutting mechanism (13) for cutting the yarn (18) midway along a yarn path extending from the drafting device (10) to the inner wall (27) of the pot (15) via the yarn suction pipe (12) and the yarn guide (14), and a control unit (50) that executes control to drive the cutting mechanism (13) when determining that the behavior of the yarn (18) is abnormal on the basis of a detection result from the detection sensor (11).

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

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

2. Description of the Related Art

[0002] A pot spinning machine using a cylindrical pot is known as one type of spinning machine. In a pot spinning machine, a cake is formed by rotating the pot at a predetermined rotation frequency and guiding yarn drawn out to a predetermined thickness into the pot through a yarn guide so that the yarn is wound around an inner wall of the pot. Further, when cake formation is complete, the yarn is cut on the upstream side of the yarn guide, whereupon a bobbin is inserted into the pot and the yarn is rewound onto the bobbin from the inner wall of the pot.

[0003] In a pot spinning machine, the yarn may coil around the yarn guide during formation of the cake. In a case where the yarn coils around the yarn guide, the yarn wound around the yarn guide may contact the pot when the yarn guide is moved in order to avoid contact between the yarn guide and the bobbin. Moreover, when the yarn wound around the yarn guide contacts the pot, component damage such as bending of the yarn guide may occur.

[0004] Here, Patent Document 1 (Japanese Patent Application Laid-open No. H08-325854) describes a technique pertaining to a pot spinning machine. In the technique described in Patent Document 1, a cylindrical bobbin is disposed on the outside of a yarn guide coaxially with the yarn guide, and a cut-out is formed in one end of the bobbin. When yarn breakage is detected during cake formation, the bobbin is allowed to fall such that the yarn catches on the cut-out in the bobbin, whereby rewinding of the yarn onto the bobbin begins.

SUMMARY OF THE INVENTION

[0005] With the technique described in Patent Document 1, however, a bobbin having a special structure and a complicated driving mechanism are required.

[0006] More specifically, the bobbin used in the technique described in Patent Document 1 has a special structure in which one end of the bobbin is formed to widen into a skirt shape and the cut-out is formed in that end. Moreover, the technique described in Patent Document 1 employs a configuration in which a flange is formed on an upper portion of the bobbin, latching means is latched to the flange, and the latching means is driven when yarn breakage is detected.

[0007] The present invention has been devised to solve the problems described above, and an object there-

of is to provide a pot spinning machine with which the winding of yarn onto a yarn guide can be suppressed, thereby avoiding component damage, without using a bobbin having a special structure or latching means.

[0008] The present invention is a pot spinning machine that has a yarn suction pipe for suctioning yarn supplied from a drafting device, a cylindrical pot, and a yarn guide for guiding the yarn, which is supplied thereto through the yarn suction pipe, into the pot, the pot spinning machine forming a cake by winding the yarn discharged from the yarn guide around an inner wall of the pot. The pot spinning machine includes a detection sensor for detecting behavior of the yarn on a yarn path extending from the drafting device to the yarn suction pipe, a cutting mechanism for cutting the yarn midway along a yarn path extending from the drafting device to the inner wall of the pot via the yarn suction pipe and the yarn guide, and a control unit that executes control to drive the cutting mechanism when determining that the behavior of the yarn is abnormal on the basis of a detection result from the detection sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

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

FIG. 2 is a schematic side view showing an example configuration of a cutting mechanism provided in the pot spinning machine according to this embodiment of the present invention;

FIG. 3 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. 4 is a view showing a basic flow of a pot spinning method;

FIG. 5 is a schematic plan view showing an arrangement of a detection sensor and the manner in which yarn balloons;

FIG. 6 is a view showing an output signal output by the detection sensor when the yarn balloons;

FIG. 7 is a schematic side view illustrating an operation of the pot spinning machine during a rewinding step;

FIG. 8 is a view illustrating winding of the yarn around a yarn guide;

FIG. 9 is a view illustrating a problem that may occur when the yarn is wound around the yarn guide;

FIG. 10 is a view illustrating a roller windup phenomenon;

FIG. 11 is a view illustrating a yarn blockage phenomenon;

FIG. 12 is a view illustrating the behavior of the yarn when the roller windup phenomenon occurs;

FIG. 13 is a view showing the output signal output

by the detection sensor when the behavior of the yarn becomes abnormal due to the roller windup phenomenon;

FIG. 14 is a view illustrating the behavior of the yarn when the yarn blockage phenomenon occurs;

FIG. 15 is a view showing the output signal output by the detection sensor when the behavior of the yarn becomes abnormal due to the yarn blockage phenomenon;

FIG. 16 is a schematic view showing an example configuration of a pot spinning machine according to another embodiment of the present invention; and FIG. 17 is a schematic side view illustrating an operation performed when a cutting mechanism shown in FIG. 16 is driven.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Embodiments of the present invention will be described in detail below with reference to the figures.

Pot Spinning Machine

[0011] FIG. 1 is a schematic view showing an example configuration of a pot spinning machine according to an embodiment of the present invention.

[0012] As shown in FIG. 1, a pot spinning machine 1 includes a drafting device 10, a detection sensor 11, a yarn suction pipe 12, a cutting mechanism 13, a yarn guide 14, a pot 15, and a bobbin support 16. 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

[0013] The drafting device 10 is a device for drawing out a yarn material such as roving. The drafting device 10 is formed using a plurality of roller pairs constituted by a back roller pair 21, a middle roller pair 22, and a front roller pair 23. The plurality of roller pairs are arranged in order of the back roller pair 21, the middle roller pair 22, and the front roller pair 23 from an upstream side toward a downstream side in a yarn feeding direction.

[0014] The respective roller pairs 21, 22, 23 rotate when driven by a drafting drive unit, to be described below. When rotation frequencies per unit time (rpm) of the respective roller pairs 21, 22, 23 are compared, the rotation frequency of the middle roller pair 22 is higher than the rotation frequency of the back roller pair 21, and the rotation frequency of the front roller pair 23 is higher than the rotation frequency of the middle roller pair 22. Hence, the respective roller pairs 21, 22, 23 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.

Detection Sensor

[0015] The detection sensor 11 is a sensor for detecting the behavior of the yarn on a yarn path extending from the drafting device 10 to the yarn suction pipe 12. The detection sensor 11 is disposed on the downstream side of the drafting device 10 and on the upstream side of the yarn suction pipe 12 in the yarn feeding direction. In this embodiment, as an example, the detection sensor 11 is a sensor that detects, as the behavior of the yarn, ballooning of the yarn suctioned into the yarn suction pipe 12. Ballooning of the yarn is a phenomenon whereby the yarn gyrates in response to the rotation of the pot 15 such that the yarn forms a balloon.

[0016] Ballooning of the yarn occurs on the downstream side of the drafting device 10 and on the upstream side of a yarn discharge outlet 14b of the yarn guide 14. More specifically, the yarn balloons between the drafting device 10 and the yarn suction pipe 12, in the interior of the yarn suction pipe 12, between the yarn suction pipe 12 and the yarn guide 14, and in the interior of the yarn guide 14. In particular, ballooning occurs between the drafting device 10 and the yarn suction pipe 12 when the yarn gyrates about a central axis of the yarn suction pipe 12. In terms of the behavior of the yarn, a state in which the yarn balloons on the upstream side of the yarn suction pipe 12 is a normal state.

[0017] The detection sensor 11 is formed using an optical sensor combining a light emitter 11a and a light receiver 11b, for example. In this embodiment, the light emitter 11a is constituted by a light-emitting diode, and the light receiver 11b is constituted by a photodiode. The detection sensor 11 outputs a signal having a steadily higher voltage or current, or in other words a Hi level signal, as the amount of light received by the light receiver 11b from the light emitted by the light emitter 11a increases.

Yarn Suction Pipe

[0018] The yarn suction pipe 12 suctions yarn 18 supplied from the drafting device 10 and feeds the suctioned yarn to the yarn guide 14. The yarn suction pipe 12 suctions the yarn 18 drawn out by the drafting device 10 into the yarn suction pipe 12 using a swirling flow of air.

Cutting Mechanism

[0019] The cutting mechanism 13 cuts the yarn 18 midway along a yarn path extending from the drafting device 10 to an inner wall 27 of the pot 15 via the yarn suction pipe 12 and the yarn guide 14. In this embodiment, as an example, the cutting mechanism 13 is disposed between the yarn suction pipe 12 and the yarn guide 14 in the yarn feeding direction.

[0020] The cutting mechanism 13 is constituted by an electric cutter, for example, and FIG. 2 shows a specific example of a configuration thereof in this case.

[0021] As shown in FIG. 2, the cutting mechanism 13 includes a cutting blade 131, an actuator 132, and a blade receiving portion 133. The cutting blade 131 has a sharp blade edge 131a. The actuator 132 moves the cutting blade 131 rapidly in a direction A. The actuator 132 is formed using a solenoid or the like, for example. The blade receiving portion 133 is a part that receives the blade edge 131a when the cutting blade 131 is moved by an operation of the actuator 132. The blade edge 131a of the cutting blade 131 is disposed to face the blade receiving portion 133 across a yarn path J.

[0022] In the cutting mechanism 13 having the configuration described above, when the actuator 132 is operated, the cutting blade 131 first moves in a direction approaching the blade receiving portion 133, and as a result of this movement, the blade edge 131a impinges on the blade receiving portion 133. Thus, the yarn present on the yarn path J can be cut by the cutting blade 131. Next, the cutting blade 131 moves in a direction heading away from the blade receiving portion 133. In this embodiment, the cutting blade 131 is disposed midway along the yarn path extending from the yarn suction pipe 12 to the yarn guide 14, and therefore the yarn is cut between the yarn suction pipe 12 and the yarn guide 14. Note, however, that the position in which the yarn is cut by the cutting mechanism 13 may be set between the front roller pair 23 and the yarn suction pipe 12.

Yarn Guide

[0023] Returning to FIG. 1, the yarn guide 14 guides the yarn 18, which is conveyed thereto from the drafting device 10 through the yarn suction pipe 12, into the pot 15. The yarn guide 14 is formed in the shape of a long, narrow tube. The yarn guide 14 has a circular shape on a cross-section cut in an orthogonal direction to a length direction thereof. The yarn guide 14 is disposed on the downstream side of the drafting device 10 and coaxially with the yarn suction pipe 12 and the pot 15. The yarn guide 14 is inserted into the pot 15 through an upper portion of the pot 15. An upper end of the yarn guide 14 is open so as to serve as a yarn guide inlet 14a, and a lower end of the yarn guide 14 is open so as to serve as the yarn discharge outlet 14b. The yarn 18 guided through the yarn guide inlet 14a of the yarn guide 14 is discharged through the yarn discharge outlet 14b of the yarn guide 14.

Pot

[0024] The pot 15 is used to form a cake 24 and rewind the yarn. The pot 15 is formed in a cylindrical shape. The pot 15 is provided to be capable of rotating about a central axis K of the pot 15. The central axis K of the pot 15 is disposed parallel to the vertical direction. Accordingly, one side of the central axis direction of the pot 15 is an upward side and the other side is a downward side. A yarn guide insertion port 25 is formed in an upper end

side of the pot 15. The yarn guide insertion port 25 is an opening through which the yarn guide 14 is inserted into the pot 15. An opening 26 is formed in a lower end of the pot 15. The opening 26 opens downward and has a diameter identical to the pot inner diameter.

Bobbin Support

[0025] The bobbin support 16 supports the bobbin 30. The bobbin support 16 includes a bobbin base 31 and a bobbin mounting portion 32. The bobbin base 31 is formed in a plate shape. The bobbin mounting portion 32 is fixed to the bobbin base 31. The bobbin mounting portion 32 is formed in a columnar shape and disposed so as to project upward from an upper surface of the bobbin base 31.

[0026] The bobbin mounting portion 32 is a part on which the bobbin 30 is detachably mounted. The bobbin mounting portion 32 is disposed coaxially with the yarn guide 14 and the pot 15 so as to oppose the yarn guide 14 in the central axis direction of the pot 15. Further, the bobbin mounting portion 32 is disposed below the yarn guide 14. Hence, when the bobbin 30 is mounted on the bobbin mounting portion 32, the bobbin 30 is disposed facing the yarn guide 14 on the central axis K of the pot 15.

[0027] The bobbin 30 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 30 corresponds to a general-use bobbin also used in ring spinning and so on. The bobbin 30 has a hollow structure on at least one end side thereof. By fitting the hollow part on one end side of the bobbin 30 to the bobbin mounting portion 32, the bobbin 30 is supported so as to stand vertically upright from the bobbin base 31.

[0028] The outer peripheral diameter of the bobbin 30 is set to be smaller than the minimum diameter of the cake 24 formed on the inner wall 27 of the pot 15. Thus, contact between the bobbin 30 and the cake 24 can be avoided when the bobbin 30 is inserted into the pot 15 through the opening 26 in the pot 15 and disposed therein.

[0029] Further, a yarn-loosening member 33 is attached to the bobbin base 31. The yarn-loosening member 33 loosens yarn serving as a rewinding start point from the cake 24 by contacting a winding end-side end 24b of the cake 24. The cake 24 is a laminated body of yarn, which is formed on the inner wall 27 of the pot 15 by operations of the yarn guide 14 and the pot 15, to be described below.

[0030] FIG. 3 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.

[0031] As shown in FIG. 3, the pot spinning machine 1 includes a control unit 50, a drafting drive unit 51, a cutter drive unit 52, a yarn guide drive unit 53, a pot drive unit 54, and a bobbin drive unit 55.

Control Unit

[0032] The control unit 50 performs overall control of all of the operations of the pot spinning machine 1. The drafting drive unit 51, the cutter 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 50 as operation control subjects. The detection sensor 11 is also electrically connected to the control unit 50.

Drafting Drive Unit

[0033] The drafting drive unit 51 rotates the back roller pair 21, the middle roller pair 22, and the front roller pair 23 at the respective predetermined rotation frequencies thereof. The drafting drive unit 51 rotates the back roller pair 21, the middle roller pair 22, and the front roller pair 23 by implementing driving on the basis of a drafting drive signal applied to the drafting drive unit 51 from the control unit 52.

Cutter Drive Unit

[0034] The cutter drive unit 52 moves the cutting blade 131 in the A direction by operating the actuator 132. The cutter drive unit 52 moves the cutting blade 131 by implementing driving on the basis of a cutter drive signal applied to the cutter drive unit 52 from the control unit 50.

Yarn Guide Drive Unit

[0035] The yarn guide drive unit 53 moves the yarn guide 14 in the vertical direction. The yarn guide drive unit 53 moves the yarn guide 14 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 50.

Pot Drive Unit

[0036] The pot drive unit 54 rotates the pot 15. The pot drive unit 54 rotates the pot 15 using the central axis K of the pot 15 as a rotational center by implementing driving on the basis of a pot drive signal applied thereto from the control unit 50.

Bobbin Drive Unit

[0037] The bobbin drive unit 55 moves the bobbin 30 in the vertical direction. The bobbin drive unit 55 moves the bobbin base 31 in the vertical direction by implementing driving on the basis of a bobbin drive signal applied thereto from the control unit 50. When the bobbin 30 is mounted on the bobbin mounting portion 32 and the bobbin base 31 is moved in the vertical direction, the bobbin 30 and the yarn-loosening member 33 move in the vertical direction integrally with the bobbin base 31.

Pot Spinning Method

[0038] FIG. 4 is a view showing a basic flow of the pot spinning method.

[0039] As shown in FIG. 4, the pot spinning method includes a drawing-out step S1, a cake-forming step S2, and a rewinding step S3.

[0040] The drawing-out step S1 is a step for drawing out a yarn material such as roving. The cake-forming step S2 is a step for forming the cake 24 by winding the yarn drawn out in the drawing-out step S1 around the inner wall 27 of the pot 15. The rewinding step S3 is a step for rewinding the yarn forming the cake 24 onto the bobbin 30. Operations of the pot spinning machine 1 based on the respective steps will be described below.

Drawing-out Step

[0041] The drawing-out step S1 is performed using the drafting device 10. The drafting drive unit 51 rotates the back roller pair 21, the middle roller pair 22, and the front roller pair 23 at the respective predetermined rotation speeds thereof by implementing driving on the basis of the drafting drive signal applied thereto from the control unit 50. As a result, the yarn material, such as roving, is conveyed by the rotation of the respective roller pairs 21, 22, 23.

[0042] At this time, the control unit 50 sets the rotation speed of the back roller pair 21 at a lower speed than the rotation speed of the middle roller pair 22 and sets the rotation speed of the middle roller pair 22 at a lower speed than the rotation speed of the front roller pair 23. Accordingly, the yarn is drawn out between the back roller pair 21 and the middle roller pair 22 by the rotation speed difference between these roller pairs. Similarly, the yarn is drawn out between the middle roller pair 22 and the front roller pair 23 by the rotation speed difference between these roller pairs.

[0043] 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 21, the middle roller pair 22, and the front roller pair 23. The yarn 18 drawn out in this manner is then pulled into the yarn suction pipe 12 using a swirling flow of air and then introduced from the yarn guide inlet 14a into the yarn guide 14.

[0044] Further, the pot drive unit 54 rotates the pot 15 at a predetermined rotation frequency prior to the start of the drawing-out step S1 by implementing driving on the basis of the pot drive signal applied thereto from the control unit 50.

Cake-forming Step

[0045] The cake-forming step S2 is performed using the yarn guide 14 and the pot 15. The yarn guide drive unit 53 moves the yarn guide 14 by a predetermined amount in a direction heading away from the yarn suction pipe 12, or in other words downward, by implementing

driving on the basis of the yarn guide drive signal applied thereto from the control unit 50. Further, the pot drive unit 54 continues to rotate the pot 15 by implementing driving on the basis of the pot drive signal applied thereto from the control unit 50.

[0046] Note that the yarn 18 guided to the yarn guide 14 from the yarn suction pipe 12 is discharged from the yarn discharge outlet 14b of the yarn guide 14. Further, the yarn 18 fed out by the front roller pair 23 balloons on the upstream side of the yarn suction pipe 12 in accordance with the rotation of the pot 15. FIG. 5 shows the manner in which this occurs. FIG. 5 shows the yarn suction pipe 12 from above. As shown in FIG. 5, the yarn 18 balloons on the upstream side of the yarn suction pipe 12 so as to gyrate about the central axis of the yarn suction pipe 12. At this time, the yarn 18 periodically crosses a sensor optical axis H of the detection sensor 11 constituted by the light emitter 11a and the light receiver 11b. Accordingly, as shown in FIG. 6, the output signal from the detection sensor 11 becomes a pulse signal that reflects the ballooning of the yarn 18. More specifically, the detection sensor 11 outputs a pulse signal that shifts to a Hi level when the yarn 18 moves away from the sensor optical axis H and shifts to a Low level when the yarn 18 blocks the sensor optical axis H.

[0047] Note that the intensity of the light emitted by the light emitter 11a of the detection sensor 11 is at a maximum on the sensor optical axis H, which forms the center of an optical path of the detection sensor 11. Therefore, if the diameter of the yarn 18 is smaller than the optical path of the detection sensor 11, the signal output by the light receiver 11b during ballooning of the yarn 18 is a waveform signal. In this embodiment, however, to facilitate understanding of the content of the invention, the signal output by the detection sensor 11 during ballooning of the yarn 18 is assumed to be a rectangular pulse signal. This pulse signal is obtained by, for example, converting the waveform signal output by the light receiver 11b into a rectangular signal by comparing the waveform signal with a preset threshold.

[0048] In the cake-forming step S2, centrifugal force generated by the rotation of the pot 15 acts on the yarn 18 discharged from the yarn discharge outlet 14b of the yarn guide 14, and the yarn 18 is pressed against the inner wall 27 of the pot 15 by this centrifugal force. Further, the yarn 18 discharged from the yarn discharge outlet 14b of the yarn guide 14 is wound around the inner wall 27 of the pot 15 in a state where twisting is applied thereto by the rotation of the pot 15.

[0049] Furthermore, in the cake-forming step S2, the yarn guide drive unit 53, by implementing driving on the basis of the aforesaid yarn guide drive signal, displaces the position of the yarn guide 14 relatively downward while moving the yarn guide 14 in a vertical reciprocating motion repeatedly at predetermined period intervals. The yarn 18 is thus wound around the inner wall 27 of the pot 15, and while shifting the winding position thereof, the yarn 18 is laminated, with the result that the cake 24 is

formed. Formation of the cake 24 is completed at the stage where yarn cutting is performed. Yarn cutting is performed under the control of the control unit 50. More specifically, the control unit 50 controls the driving implemented by the drafting drive unit 51 so that rotation of the back roller pair 21 and the middle roller pair 22 is stopped while the front roller pair 23 continue to rotate. As a result, the yarn 18 is forcibly cut on the downstream side of the middle roller pair 22.

[0050] Here, the difference between "yarn cutting" and "yarn breakage" will be described. Yarn cutting is performed intentionally by the control unit 50 at the stage where the yarn 18 is wound around the inner wall 27 of the pot 15 in a predetermined amount set in advance, or in other words when formation of the cake 24 is complete. Yarn breakage is a phenomenon whereby the yarn 18 breaks for any of various reasons before being wound around the inner wall 27 of the pot 15 in the predetermined amount, or in other words midway through formation of the cake 24.

Rewinding Step

[0051] The rewinding step S3 is performed using the pot 15, the bobbin 30, and the yarn-loosening member 33. In the rewinding step S3, as shown in FIG. 7, the yarn guide 14 is moved upward by the driving implemented by the yarn guide drive unit 53, while the pot 15 continues to rotate as a result of the driving implemented by the pot drive unit 54. Further, in the rewinding step S3, the bobbin 30 and the yarn-loosening member 33 are disposed inside the pot 15 through the opening 26 by the driving implemented by the bobbin drive unit 55. At this time, the control unit 50 adjusts driving timing of the yarn guide drive unit 53 and the bobbin drive unit 55 to ensure that the bobbin 30 does not contact the yarn guide 14.

[0052] Furthermore, the bobbin drive unit 55 moves the bobbin base 31 upward. Accordingly, the bobbin 30 mounted on the bobbin mounting portion 32 and the yarn-loosening member 33 attached to the bobbin base 31 move upward together. At this time, an upper end of the yarn-loosening member 33 contacts the winding end-side end 24b of the cake 24. Thus, the yarn forming the cake 24 is loosened in the location contacted by the yarn-loosening member 33 such that the loosened yarn is removed from the inner wall 27 of the pot 15 and wound around the bobbin 30. As a result, rewinding of the yarn from the pot 15 onto the bobbin 30 is started using the loosened yarn as the rewinding start point.

[0053] Once all of the yarn forming the cake 24 has been rewound onto the bobbin 30, the control unit 50 moves the bobbin base 31 downward by driving the bobbin drive unit 55. As a result, the bobbin 30 and the yarn-loosening member 33 move downward together, whereby the rewinding step S3 is completed. The rewound bobbin 30 is then removed from the bobbin mounting portion 32, whereupon an empty bobbin 30 is mounted on the bobbin mounting portion 32 and a similar operation to

that described above is executed.

Yarn Winding around Yarn Guide

[0054] Next, winding of the yarn around the yarn guide, which may occur during formation of the cake, will be described.

[0055] First, when the yarn 18 contacts the outer peripheral surface of the yarn guide 14 for any of various reasons during formation of the cake 24, the yarn 18 may start to coil around the yarn guide 14 as a result. In this case, as shown in FIG. 8, the yarn 18 forming the cake 24 up to that point is wound around the yarn guide 14 by the rotation of the pot 15. Hence, as shown in FIG. 9, when the yarn guide 14 is withdrawn upward in the re-winding step S3, the yarn 18 wound around the yarn guide 14 may contact the pot 15, causing component damage such as bending of the yarn guide 14.

[0056] The yarn 18 is more likely to coil around the yarn guide 14 when a roller windup phenomenon or a yarn blockage phenomenon occurs. The roller windup phenomenon is a phenomenon whereby the yarn 18 is wound up by the front roller pair 23. The yarn blockage phenomenon is a phenomenon whereby the yarn 18 blocks the yarn suction pipe 12. These phenomena will be described respectively below.

Roller Windup Phenomenon

[0057] The front roller pair 23 of the drafting device 10 rotate so as to feed the yarn 18 toward the yarn suction pipe 12. At this time, when a projection or protuberance is present on the surface of a roller of the front roller pair 23, the yarn 18 may catch on the projection so as to be wound up by the roller, as shown in FIG. 10. Consequently, the yarn 18 inside the yarn guide 14 is pulled back in an opposite direction to the normal direction such that the yarn 18 inside the yarn guide 14 moves upward while winding in yarn 18a forming another layer of the cake 24 up to that point. As a result, the yarn 18a forming the other layer may contact the outer peripheral surface of the yarn guide 14 such that the yarn 18 is wound around the yarn guide 14.

[0058] Note that a projection may be formed on the surface of one of the rollers of the front roller pair 23 when an adhesive substance adheres to the surface, for example. An adhesive substance may be intermixed with the yarn material supplied to the drafting device 10 so that when the yarn 18 passes between the front roller pair 23, the adhesive substance adheres to the surface of the roller, thereby forming a projection.

Yarn Blockage Phenomenon

[0059] The yarn 18 supplied from the drafting device 10 is drawn out to a predetermined thickness. As shown in FIG. 11, however, when a part 18b that is thicker than the other parts is present in a part of the yarn 18, the

thick part 18b may catch on the yarn suction pipe 12 and cause a yarn blockage. When a yarn blockage occurs, the yarn 18 is no longer fed to the yarn guide 14 from the yarn suction pipe 12, and therefore excessive twisting is applied to the stationary yarn 18 on the downstream side of the yarn suction pipe 12 by the rotation of the pot 15. Hence, the yarn 18 on the downstream side of the yarn suction pipe 12 is shrunk by the excessive twisting, and as a result, the yarn 18 is pulled into the yarn guide 14 through the yarn discharge outlet 14b. Accordingly, the yarn 18 inside the yarn guide 14 shrinks while winding in the yarn 18 forming another layer of the cake 24 up to that point. As a result, the yarn 18 forming the other layer may contact the outer peripheral surface of the yarn guide 14 such that the yarn 18 is wound around the yarn guide 14.

Operation for Suppressing Yarn Winding around Yarn Guide

[0060] The pot spinning machine 1 according to this embodiment of the present invention suppresses winding of the yarn 18 around the yarn guide 14 by implementing the following operation.

[0061] First, the control unit 50 determines whether the behavior of the yarn 18 suctioned into the yarn suction pipe 12 is normal or abnormal on the basis of the output signal from the detection sensor 11 at least from the start to the end of formation of the cake 24. When, at this time, the yarn 18 suctioned into the yarn suction pipe 12 is ballooning, the output signal from the detection sensor 11 becomes a pulse signal of a predetermined period, which alternates repeatedly between the Hi level and the Low level. Therefore, when the detection sensor 11 outputs a pulse signal of a predetermined period, this means that the detection sensor 11 has detected ballooning of the yarn.

[0062] When the yarn 18 is wound up by the front roller pair 23 in the manner described above, on the other hand, the yarn 18 tilts diagonally between the front roller pair 23 and the yarn suction pipe 12 (see FIG. 10). Further, when the yarn 18 tilts diagonally, the yarn 18 contacts the edge of the yarn suction pipe 12, with the result that the yarn 18 no longer balloons on the upstream side of the yarn suction pipe 12. More specifically, as shown in FIG. 12, the yarn 18 is pulled to a position deviating greatly from the sensor optical axis H of the detection sensor 11, or in other words a position on the outside of a trajectory C of the ballooning. Accordingly, almost all of the light emitted from the light emitter 11a reaches the light receiver 11b without being blocked by the yarn 18, leading to an increase in the amount of light received by the light receiver 11b. As a result, as shown in FIG. 13, the level of the output signal from the detection sensor 11 becomes fixed on the Hi side.

[0063] Further, when a yarn blockage occurs in the yarn suction pipe 12, as shown in FIG. 14, the sensor optical axis H of the detection sensor 11 is blocked by

the thick part 18b of the yarn and the yarn 18 no longer balloons on the upstream side of the yarn suction pipe 12. Accordingly, most of the light emitted from the light emitter 11a is blocked by the thick part 18b of the yarn, leading to a reduction in the amount of light received by the light receiver 11b. As a result, as shown in FIG. 15, the level of the output signal from the detection sensor 11 becomes fixed on the Low side.

[0064] When the detection sensor 11 outputs a pulse signal of a predetermined period (FIG. 6), the control unit 50 determines that the yarn is ballooning on the upstream side of the yarn suction pipe 12, or in other words that the behavior of the yarn is normal. Further, when the detection sensor 11 outputs a fixed-level signal (FIG. 13 or 15), the control unit 50 determines that the yarn is not ballooning on the upstream side of the yarn suction pipe 12, or in other words that the behavior of the yarn is abnormal. A method described below, for example, may be considered as a specific method for determining whether the behavior of the yarn is normal or abnormal.

[0065] First, during formation of the cake 24, the pot 15 rotates at high speed. Further, the yarn 18 gyrates at high speed on the upstream side of the yarn suction pipe 12 in accordance with the rotation of the pot 15, whereby the yarn 18 forms a balloon. Hence, while the yarn 18 is ballooning, the detection sensor 11 outputs a pulse signal having an extremely short period. The control unit 50 counts the pulse frequency of the pulse signal output by the detection sensor 11 at predetermined time intervals, for example, and then determines that the behavior of the yarn is normal when the counted pulse frequency equals or exceeds a preset threshold, and that the behavior of the yarn is abnormal when the counted pulse frequency is smaller than the threshold.

[0066] Having determined that the behavior of the yarn is abnormal, the control unit 50 outputs the cutter drive signal to the cutter drive unit 52 in order to drive the cutting mechanism 13 immediately. Accordingly, the cutting blade 131 is moved quickly in the A direction by the operation of the actuator 132 such that the yarn 18 on the yarn path J is cut by the blade edge 131a of the cutting blade 131. When the yarn 18 is cut by the cutting mechanism 13 in this manner, the yarn 18 inside the yarn guide 14 at the time of cutting is discharged through the yarn discharge outlet 14b of the yarn guide 14 and wound around the inner wall 27 of the pot 15. Hence, winding of the yarn 18 around the yarn guide 14 can be suppressed, thereby avoiding component damage, without using a bobbin having a special structure or latching means. Moreover, when the yarn 18 is wound around the yarn guide 14, the yarn 18 must be removed from the yarn guide 14 in subsequent recovery processing, but according to this embodiment, such recovery processing is unnecessary, and therefore an improvement in the productivity of the pot spinning can be achieved.

[0067] When suppressing winding of the yarn 18 around the yarn guide 14 caused by the roller windup phenomenon, the position in which the yarn is cut by the

cutting mechanism 13 may be set at any position on the yarn path from the drafting device 10 to the inner wall 27 of the pot 15. When suppressing winding of the yarn 18 around the yarn guide 14 caused by the yarn blockage phenomenon, on the other hand, the yarn 18 must be cut below the thick part 18b of the yarn 18 blocking the yarn suction pipe 12. Therefore, the position in which the yarn is cut by the cutting mechanism 13 must be set at a position downstream of the yarn suction pipe 12 on the yarn path from the drafting device 10 to the inner wall 27 of the pot 15.

[0068] Further, when the yarn 18 is cut by driving the cutting mechanism 13 during formation of the cake 24, the position of the winding end-side yarn end shifts further upward than in a case where yarn cutting is performed by halting the rotation of the back roller pair 21 and the middle roller pair 22. In this case, the height of the yarn-loosening member 33 is modified in accordance with the position of the winding end-side yarn end before driving the bobbin drive unit 55 in the rewinding step S3, whereupon the bobbin base 31 is raised by driving the bobbin drive unit 55. Thus, the yarn-loosening member 33 can be brought into contact with the yarn end of the cake 24 formed up to that point so that the yarn is rewound onto the bobbin 30 from the pot 15 even when the cutting mechanism 13 is driven during formation of the cake 24.

Another Embodiment

[0069] FIG. 16 is a schematic view showing an example configuration of a pot spinning machine according to another embodiment of the present invention.

[0070] The pot spinning machine 1 shown in the figure differs from that of the embodiment described above in the configuration of the cutting mechanism 13, but all other configurations are identical. The cutting mechanism 13 includes a cutter 135 and a yarn guide dropping mechanism 136.

[0071] The cutter 135 is attached to the yarn guide 14 in the vicinity of the yarn discharge outlet 14b. The cutter 135 is formed in a disc shape. A blade 135a is formed around the entire outer periphery of the cutter 135. The blade 135a of the cutter 135 is formed in a circular shape when seen from the central axis direction of the yarn guide 14. Further, the blade 135a of the cutter 135 is formed to be sharp enough to be able to cut the yarn 18. The cutter 135 may be formed from a metallic material such as cemented carbide, for example.

[0072] The yarn guide dropping mechanism 136 is used to drop the yarn guide 14, and includes an opening/closing chuck 136a for gripping the yarn guide 14. The chuck 136a grips the yarn guide 14 when closed and releases the yarn guide 14 when open. The open/closed state of the chuck 136a is controlled by the control unit 50. The yarn guide dropping mechanism 136 moves in the vertical direction integrally with the yarn guide 14 in response to the driving implemented by the yarn guide drive unit 53. Further, the chuck 136a of the yarn guide

dropping mechanism 136 performs an opening/closing operation in response to the driving implemented by the cutter drive unit 52. When the chuck 136a opens in response to the driving implemented by the cutter drive unit 52, the yarn guide 14 falls under its own weight instantaneously. A flange (not shown) that catches on a yarn guide insertion port 25 of the pot 15 is formed on an upper end of the yarn guide 14 to prevent the yarn guide 14 from falling through the yarn guide insertion port 25 at this time.

[0073] In the pot spinning machine 1 according to this embodiment, the control unit 50, having determined on the basis of the output signal from the detection sensor 11 that an abnormality has occurred in the behavior of the yarn 18, outputs the cutter drive signal to the cutter drive unit 52. Accordingly, the chuck 136a of the yarn guide dropping mechanism 136 opens in response to the driving implemented by the cutter drive unit 52 such that the yarn guide 14 falls. At this time, the cutter 135 falls together with the yarn guide 14. As shown in FIG. 17, the yarn 18 thus comes into contact with the cutter 135. At this time, the yarn 18 rubs against the blade 135a of the cutter 135 as the pot 15 rotates. Therefore, the yarn 18 can be cut by the cutter 135 in the vicinity of the yarn discharge outlet 14b of the yarn guide 14. As a result, similarly to the embodiment described above, winding of the yarn 18 around the yarn guide 14 can be suppressed without using a bobbin having a special structure or latching means.

Modified Examples, etc.

[0074] 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.

[0075] For example, in the above embodiments, the behavior of the yarn is detected using the detection sensor 11 constituted by the light emitter 11a and the light receiver 11b, but the present invention is not limited thereto, and instead, a configuration in which an image sensor, not shown in the figures, is used to detect whether or not the yarn has been wound up by the front roller pair 23 or whether or not a yarn blockage has occurred in the yarn suction pipe 12, for example, as the behavior of the yarn on the upstream side of the yarn suction pipe 12 may be employed. More specifically, an image of the roller surfaces of the front roller pair 23 may be captured by the image sensor, and the behavior of the yarn may be detected on the basis of the captured image data. Alternatively, an image of the yarn suctioned into the yarn suction pipe 12 may be captured by the image sensor, and the behavior of the yarn may be detected on the basis of the captured image data. In this case, the control unit 50 may take in the image data captured by the image sensor, execute image processing thereon, and on the

basis of a result of the image processing, determine that the behavior of the yarn is abnormal when either the yarn 18 has been wound up by the front roller pair 23 or the yarn suction pipe 12 is blocked by the yarn 18.

[0076] A pot spinning machine according to the present invention has a drafting device for drawing out yarn, a yarn suction pipe for suctioning the drawn-out yarn, a cylindrical pot, and a yarn guide for guiding the yarn, which is supplied thereto through the yarn suction pipe, into the pot, the pot spinning machine forming a cake by winding the yarn discharged from the yarn guide around an inner wall of the pot. The pot spinning machine includes a detection sensor for detecting behavior of the yarn on a yarn path extending from the drafting device to the yarn suction pipe, a cutting mechanism for cutting the yarn midway along a yarn path extending from the drafting device to the inner wall of the pot via the yarn suction pipe and the yarn guide, and a control unit that executes control to drive the cutting mechanism when determining that the behavior of the yarn is abnormal on the basis of a detection result from the detection sensor.

Claims

1. A pot spinning machine (1) having:

a yarn suction pipe (12) for suctioning yarn (18) supplied from a drafting device (10);
a cylindrical pot (15); and
a yarn guide (14) for guiding the yarn (18), which is supplied thereto through the yarn suction pipe (12), into the pot (15),
the pot spinning machine (1) forming a cake (24) by winding the yarn (18) discharged from the yarn guide (14) around an inner wall (27) of the pot (15),
the pot spinning machine (1) comprising:

a detection sensor (11) for detecting behavior of the yarn on a yarn path extending from the drafting device (10) to the yarn suction pipe (12);
a cutting mechanism (13) for cutting the yarn (18) midway along a yarn path extending from the drafting device (10) to the inner wall (27) of the pot (15) via the yarn suction pipe (12) and the yarn guide (14); and
a control unit (50) that executes control to drive the cutting mechanism (13) when determining that the behavior of the yarn is abnormal on the basis of a detection result from the detection sensor (11).

2. The pot spinning machine (1) according to claim 1, **characterized in that** the detection sensor (11) detects ballooning of the yarn (18) that is suctioned into the yarn section pipe (12) as the behavior of the yarn.

FIG. 1

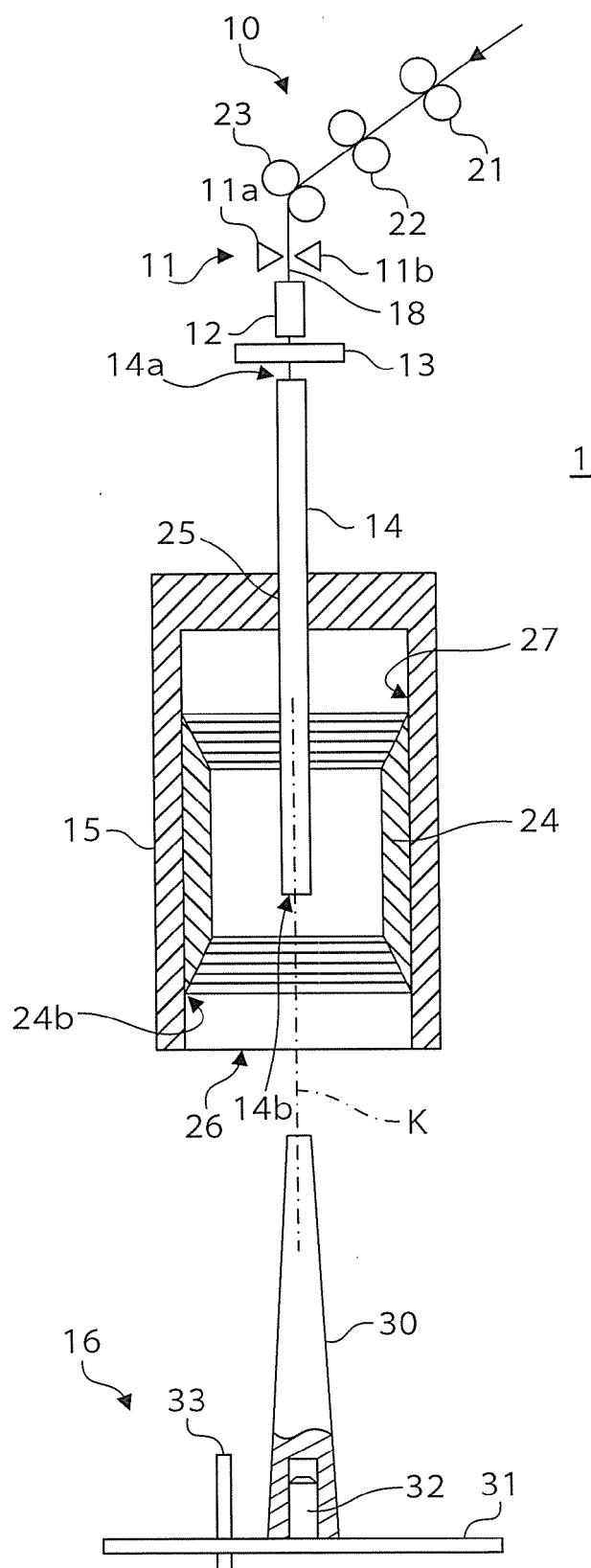


FIG. 2

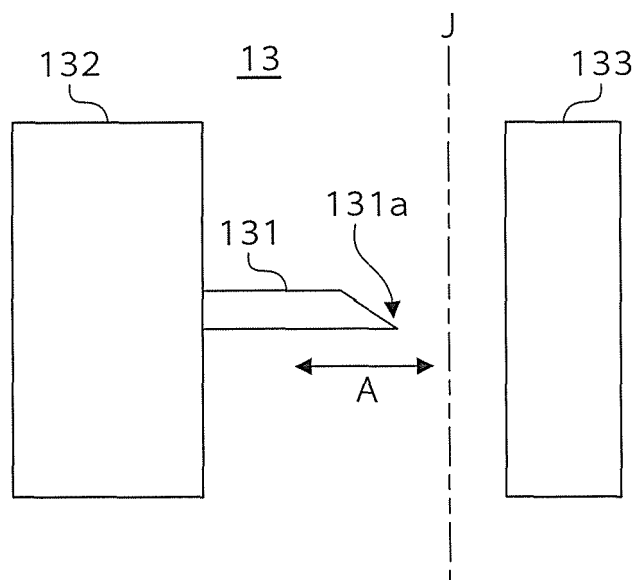


FIG. 3

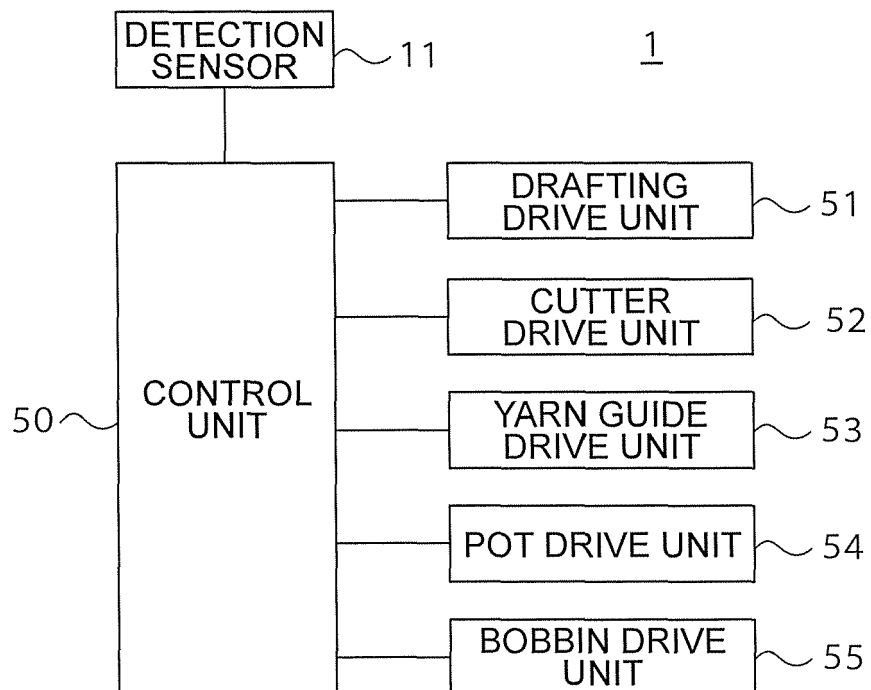


FIG. 4

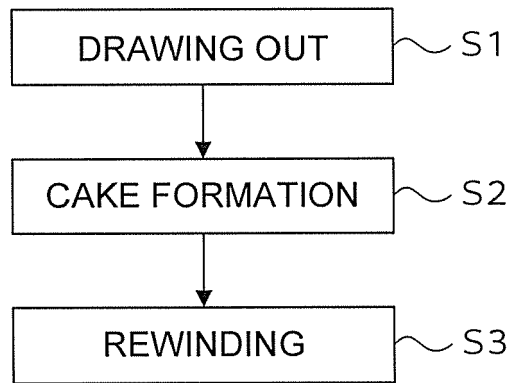


FIG. 5

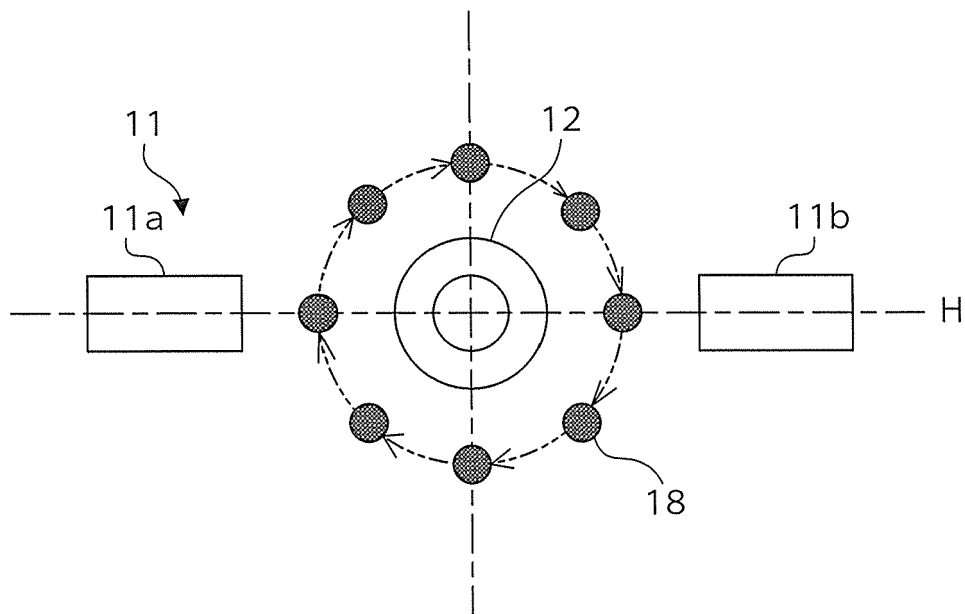


FIG. 6

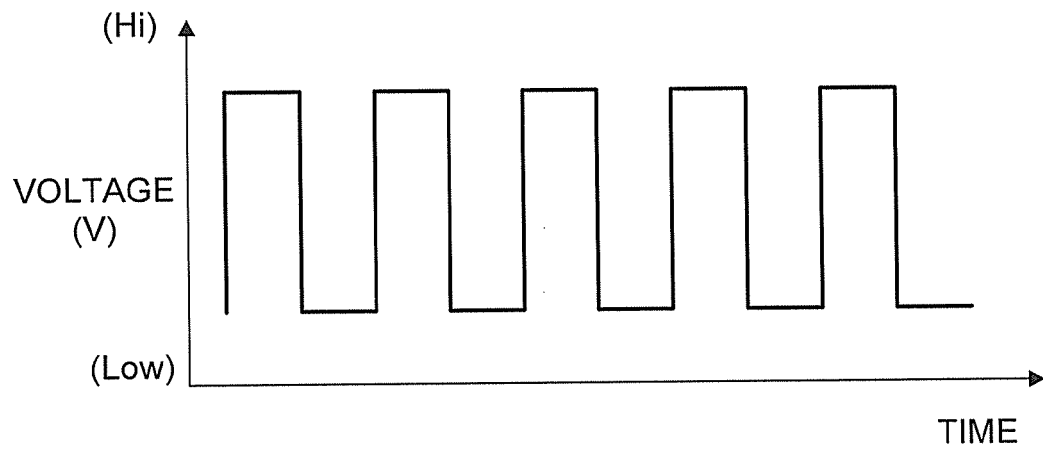


FIG. 7

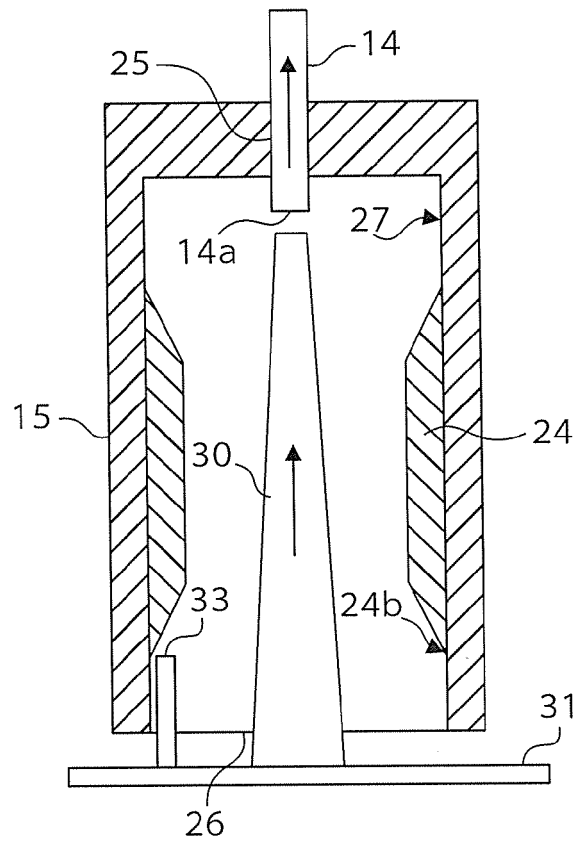


FIG. 8

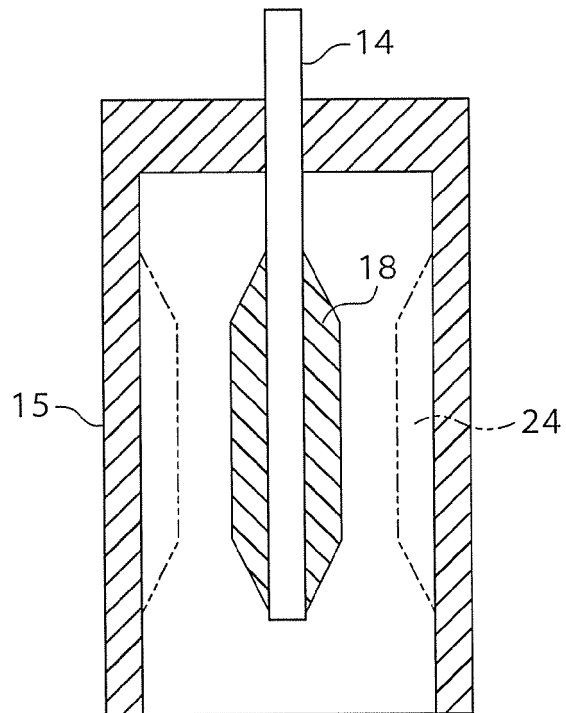


FIG. 9

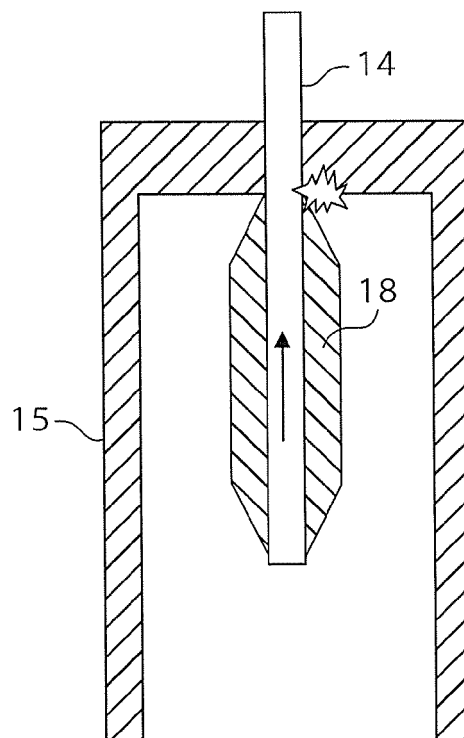


FIG.10

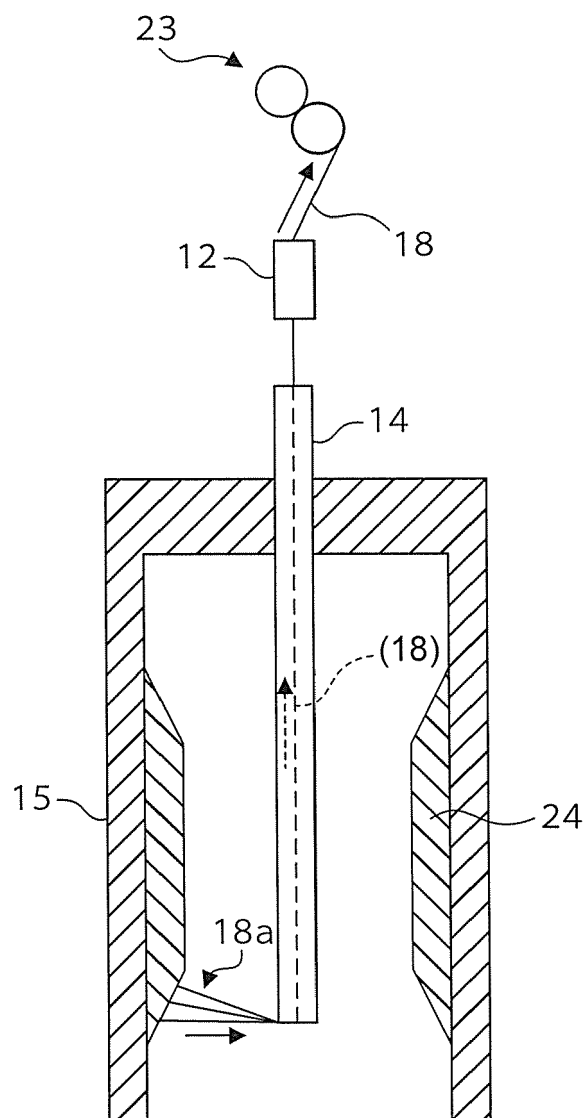


FIG.11

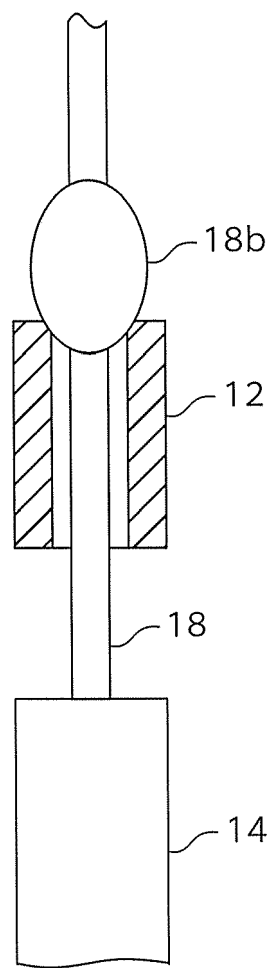


FIG.12

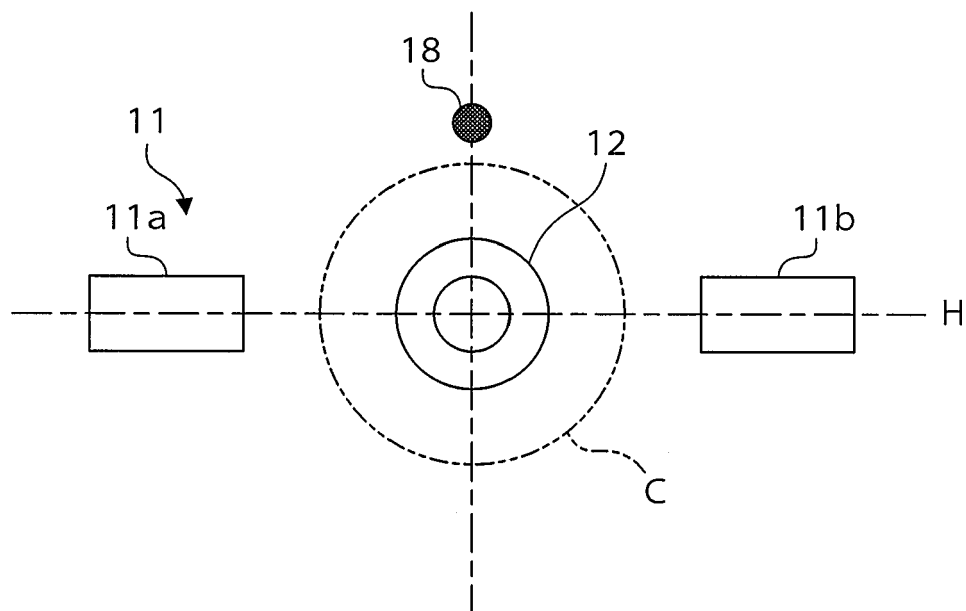


FIG.13

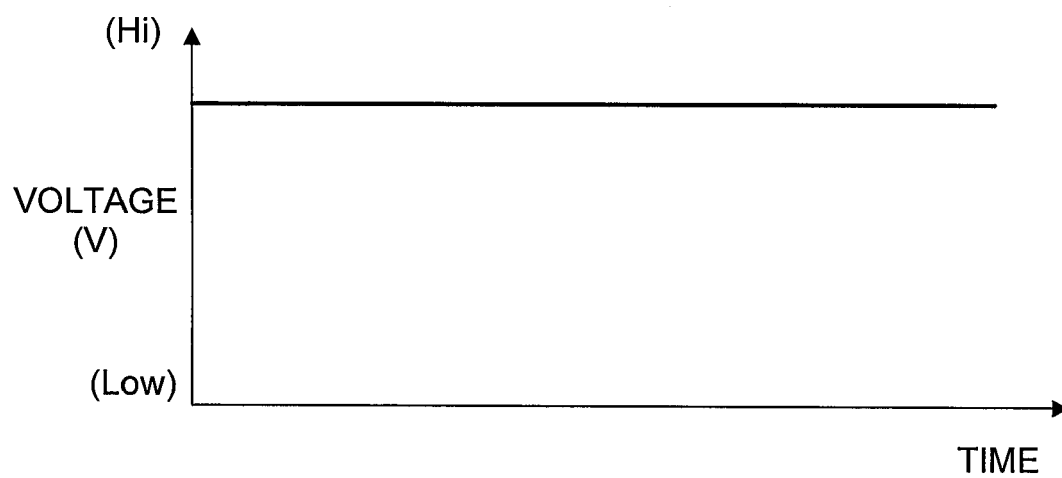


FIG.14

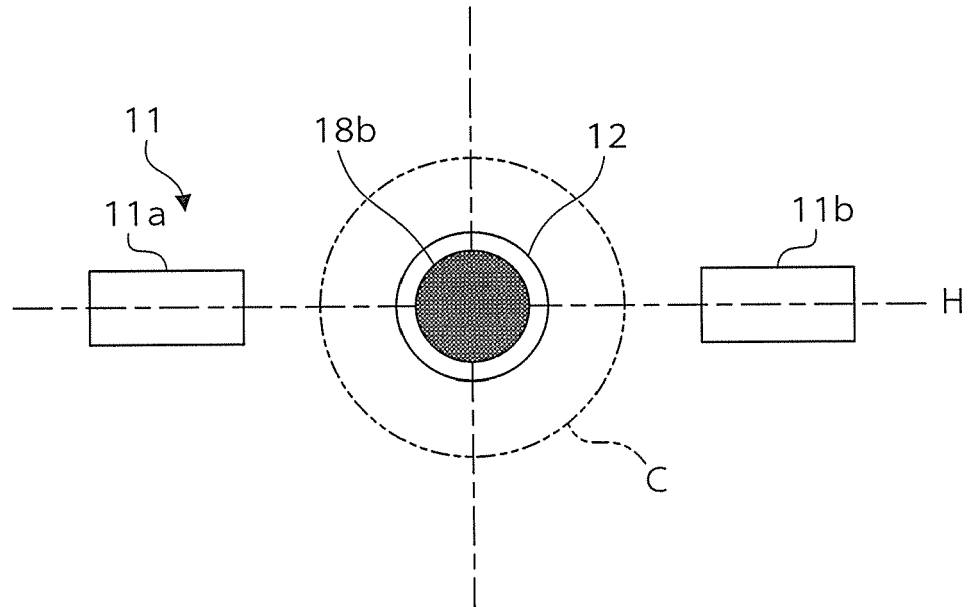


FIG.15



FIG.16

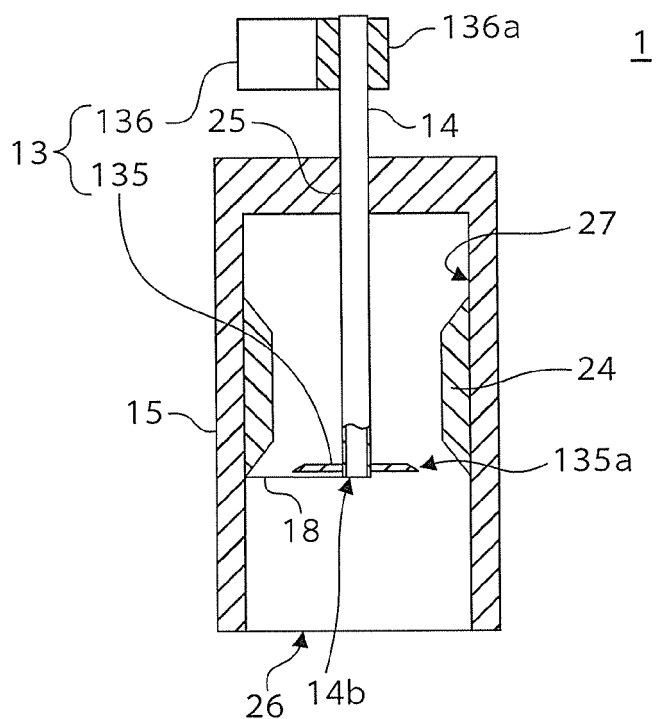
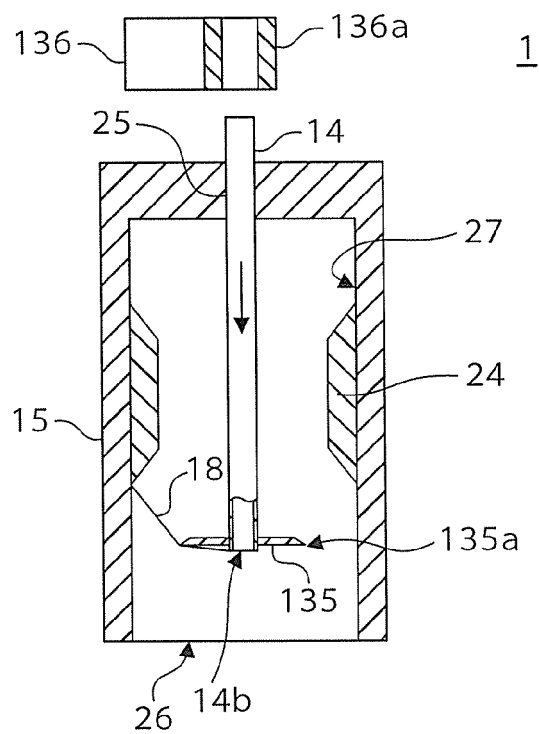


FIG.17





EUROPEAN SEARCH REPORT

Application Number
EP 19 16 2135

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A	----- US 5 765 353 A (ROLAND VOLKER [DE] ET AL) 16 June 1998 (1998-06-16) * column 2, line 58 - column 3, line 12 * * column 4, line 55 - column 6, line 27; figures 1-3 *	1,2	TECHNICAL FIELDS SEARCHED (IPC) D01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 August 2019	Examiner Todarello, Giovanni
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