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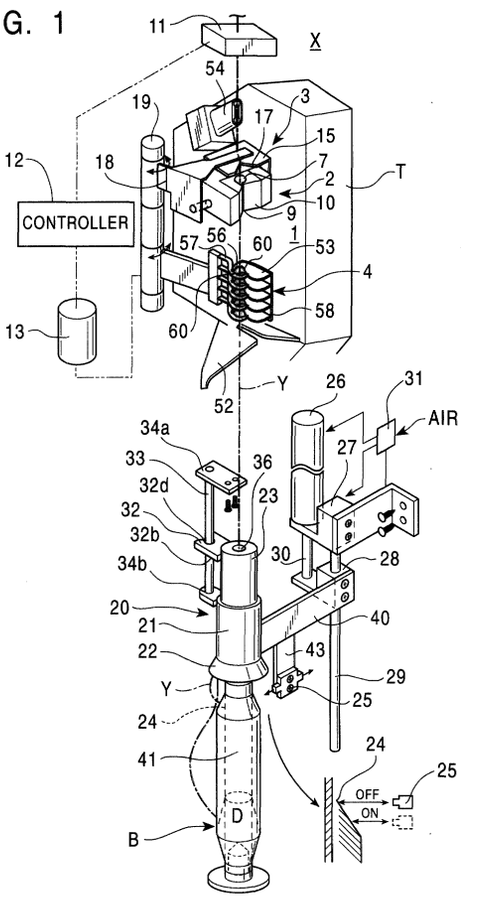
(54) Automatic winder and hariness suppressing device

(57) The present invention provides an automatic winder having a hairiness suppressing device that can stably provide a function of suppressing hairinesses of a spun yarn. The present invention provides an automatic winder comprising a hairiness suppressing device 1 including nozzle means 2 having a yarn passage 7 for allowing a spun yarn Y to pass therethrough, the nozzle means twisting the spun yarn Y by means of a whirling current obtained by injecting a gas through the yarn passage 7, wherein tension control means is provided for controlling tension of the spun yarn Y supplied to the nozzle means 2 at a substantially constant value (Fig. 1).

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to, for example, a hairiness suppressing device for suppressing hairinesses of a spun yarn which is rewound from a supplying bobbin and is wound into a winding package as well as an automatic winder having the hairiness suppressing device.

Background of the Invention

[0002] For example, in ring spinning, a spun yarn is produced by twisting fibers such as cotton or wool to form a spun yarn and winding the yarn around a supplying bobbin. The supplying bobbin with the spun yarn wound thereon is transported to an automatic winder, which then detects and removes any defect in the spun yarn and joins yarns from a large number of supplying bobbins to rewind them into a corn- or cheese-shaped package. In the automatic winder, the spun yarn is released from the supplying bobbin, and the tension is applied to the spun yarn by a tensor, and then the spun yarn is wound into the package via many yarn guides which guides the spun yarn. During the rewinding, each time the spun yarn passes through a tenser or a yarn guide, it is subjected to friction, so that the amount of hairinesses present in the spun yarn after the rewinding is larger than that before the rewinding. Further, the hairinesses of the spun yarn relates to the feeling of the yarn, and although it is not best that the spun yarn has no hairiness, too many hairinesses may disadvantageously cause the yarn to be caught in a guide through which the yarn is passed during a subsequent process.

[0003] Thus, it is known that in the automatic winder a hairiness suppressing device for suppressing the hairinesses of the spun yarn is provided. A known hairiness suppressing device that can appropriately suppress hairinesses of the spun yarn comprises nozzle means for causing a whirling current by injecting air through a yarn passage through which the spun yarn passes. In this hairiness suppressing device, a twist stopping guide is arranged on each of an upstream and a downstream sides of the nozzle means in a yarn running direction. This hairiness suppressing device executes a hairiness suppressing process by using the whirling current to balloon the spun yarn to untwist and additionally twist it, thereby twisting the hairinesses into fibers constituting the spun yarn.

[0004] A problem with the conventional hairiness suppressing device, however, is that the hairiness suppressing effect is unstable.

[0005] Further, if the hairinesses having a length of 3 to 4 mm or more are to be suppressed, the conventional hairiness suppressing device fails to provide the effect as expected. Similarly, when the spun yarn contains longer fibers and thus longer hairinesses, it fails to provide the effect of suppressing the hairinesses of the spun yarn as expected. It is particularly difficult to suppress the hairinesses of wool, which is rigid and contains longer hairinesses.

[0006] It is a first object of the present invention to provide an automatic winder having a hairiness suppressing device that can stably provide a function of suppressing hairinesses of a spun yarn.

[0007] It is a second object of the present invention to provide an automatic winder having a hairiness suppressing device that can sufficiently provide the function of suppressing hairinesses of a spun yarn, regardless of the rigidity or fiber length of the spun yarn.

Summary of the Invention

[0008] According to the present invention, there is provided an automatic winder comprising a hairiness suppressing device including nozzle means having a yarn passage for allowing a spun yarn to pass therethrough, the nozzle means twisting the spun yarn by means of a whirling current obtained by injecting a gas through the yarn passage, the automatic winder having tension control means for controlling tension of the spun yarn fed to the nozzle means at a substantially constant value.

[0009] The tension control means maintains the tension of the spun yarn fed to the nozzle means at a substantially constant value, thereby forming the spun yarn fed to the nozzle means into a regular balloon. Thus, the yarn always undergoes an even centrifugal force, thus stabilizing the hairiness suppressing effect.

[0010] According to the present invention, there is provided an automatic winder, wherein the tension control means is a release assistant device located above a supplying bobbin to regulate the yarn passage for the spun yarn drawn out from the supplying bobbin in such a manner that a regulated position is lowered in response to releasing of the spun yarn from the supplying bobbin.

[0011] Depending on releasing of the yarn from supplying bobbins, the release supporting means can reduce the variation range of the tension of the spun yarn released from the supplying bobbin and can restrain an increase in releasing tension associated with a decrease in the amount of yarn in the supplying bobbin. This makes it possible to feed the spun yarn to the nozzle means located downstream in a yarn running direction or to another component while maintaining the tension of the yarn at a substantially constant and low value.

[0012] According to the present invention, there is provided an automatic winder, wherein the tension control means comprises a tensioning device for applying tension to be added to the spun yarn, a drive device for driving the tensioning device to adjust a value of the tension added by the tensioning device, and a control section for controlling the drive device so as to maintain the

tension of the spun yarn subjected to the added tension at a substantially constant valu e. The tensioning device adjusts the added tension value, thus making it possible to maintain the tension of the spun yarn supplied to the nozzle means at a substantially constant value.

[0013] According to the present invention, there is provided an automatic winder, wherein the tensioning device is located upstream of the nozzle means and is of a gate type. Since the tensioning device located upstream of the nozzle means is of the gate type, each gate can be opened or closed to apply an appropriate tension to the spun yarn.

[0014] According to the present invention, there is provided an automatic winder, wherein the tension control means comprises first control means located above a supplying bobbin and comprising a release assistant device for regulating the yarn passage for the spun yarn drawn out from the supplying bobbin in such a manner that a regulated position is lowered in response to releasing of the spun yarn from the supplying bobbin, and second control means located downstream of the first control means and comprising a tensioning device for applying tension to be added to the spun yarn, a drive device for driving the tensioning device to adjust a value of the tension added by the tensioning device, and a control section for controlling the drive device so as to maintain the tension of the spun yarn subjected to the added tension at a substantially constant value.

[0015] The tension of the spun yarn supplied to the nozzle means can be maintained at a reliably low and substantially constant value by restraining an increase in the tension of the spun yarn released from the supplying bobbin by means of the first control means for controlling the tension of the spun yarn released from the supplying bobbin and by adjusting the added tension of the spun yarn by means of the second control means.

[0016] A hairiness suppressing device of the present invention comprises nozzle means having a yarn passage for allowing the spun yarn to pass therethrough, the nozzle means causing a whirling current by injecting a gas through the yarn passage, and twist stopping means arranged on each of an upstream and a downstream sides of the nozzle means in a yarn running direction, for stopping propagation of twisting applied to the spun yarn by the whirling current. In the hairiness suppressing device, the whirling current in the nozzle means operates to untwist the spun yarn in the upstream side section of the nozzle means, and the distance from the nozzle means to the upstream-side twist stopping means is longer than the distance from the nozzle means to the downstream-side twist stopping means.

[0017] Due to the need to sufficiently untwist constituent fibers or hairinesses of the spun yarn, a untwisting length must be at least equal to or larger than the length of the hairinesses in order to twist long hairinesses into the spun yarn in an additional twisting section located downstream of the nozzle means. An untwisting section located upstream of the nozzle means is desirably long. Further, in the additional twisting section, the ballooning causes the spun yarn to be whirled to apply a centrifugal force to the hairinesses to thereby extend tips of the hairinesses in a direction opposite to a direction in which the hairinesses are to be twisted into the spun yarn. It is thus desirable to reduce the centrifugal force applied to the hairinesses, while reducing the length of the additional twisting section in order to increase an additional twisting effect.

[0018] For the above reasons, in the hairiness suppressing device of the present invention, the distance from the nozzle means to the upstream-side (untwisting-side) twist stopping means is set longer than the distance from the nozzle means to the downstream-side (additional-twisting-side) twist stopping means, in order to meet the conditions for the untwisting and additional twisting sections.

[0019] This makes it possible to effectively restrain long hairinesses. Thus, the present device is preferred for suppressing the hairinesses of a spun yarn containing longer fibers and longer hairinesses.

[0020] In a hairiness suppressing device of the present invention, means for reducing a diameter of a balloon of the spun yarn formed between the nozzle means and the upstream-side twist stopping means is provided therebetween.

[0021] If the diameter of the balloon of the spun yarn increases not only in the additional-twisting section but also in the untwisting section, the tips of the hairinesses tend to be extended in the direction opposite to the direction in which the hairinesses are twisted in the yarn due to the centrifugal force, thereby lessening the hairiness suppressing effect in the untwisting section. To solve this problem, the means for reducing the diameter of the balloon of the spun yarn is provided in the untwisting section to collapse the balloon of the spun yarn to thereby minimize the centrifugal force applied to the tips of the hairinesses despite an increased length of the untwisting section. This allows the yarn to be sufficiently untwisted without extending the hairinesses in the untwisting section, thereby improving the hairiness suppressing effect in the additional-twisting section.

[0022] In a hairiness suppressing device of the present invention, the means for reducing the diameter of the balloon comprises one or more members for regulating the diameter of the balloon of the spun yarn by contacting with a portion of the spun yarn between the nozzle means and the upstream side twist stopping means.

[0023] A specific example of the means for reducing the diameter of the balloon is the one or more members for regulating the diameter of the balloon of the spun yarn by contacting with the yarn. It is preferable to regulate the diameter of the balloon using the plurality of members because the twist stopping effect of each member is hindered.

[0024] In a hairiness suppressing device of the

present invention, as the upstream-side twist stopping means and the means for reducing the diameter of the balloon a gate type tenser having a plurality of comb teeth that contact with the spun yarn to tension the same is provided.

[0025] When as the upstream-side twist stopping means and the means for reducing the diameter of the balloon the gate type tenser is provided, an appropriate radial tension can be applied to the balloon of the spun yarn to prevent the balloon of the spun yarn from being extended in the radial direction without the need to shorten the untwisting section. Thus, the hairinesses can be effectively restrained based on the combination of the effects of the increased length of the untwisting section and of restraining the extension of the diameter of the balloon.

Brief Description of the Drawings

[0026]

Figure 1 is a schematic view of an integral part of an automatic winder according to the present invention.

Figure 2A is a perspective view showing a tenser box of the automatic winder according to the present invention. Figure 2B is an enlarged perspective view of a hairiness suppressing device of the automatic winder according to the present invention.

Figure 3 is a sectional view of nozzle means of the hairiness suppressing device of the automatic winder according to the present invention.

Figure 4 is a top view of the hairiness suppressing device of the automatic winder according to the present invention.

Figure 5 is a view schematically showing the entire configuration of the automatic winder according to the present invention.

Figure 6A is a side sectional view of the hairiness suppressing device wherein a presser guide and movable comb teeth of a gate type tenser are placed in their receding positions. Figure 6B is a side sectional view of the hairiness suppressing device wherein the presser guide and the movable comb teeth of the gate type tenser are placed in their operating positions.

Figure 7 is a view useful in explaining how a spun yarn is released from a supplying bobbin.

Figure 8 is a graph showing variations in releasing tension.

Figure 9 is a view showing another embodiment of the automatic winder according to the present invention.

Figure 10 is a graph showing results of experiments on rewinding of the spun yarn using the automatic winder.

Detailed Description of the Preferred Embodiments

[0027] An automatic winder having a hairiness suppressing device of the present invention will be described below with reference to the drawings. The present invention, however, is not limited to the embodiments described below.

[0028] Figure 5 shows an automatic winder X having a hairiness suppressing device 1 according to the present invention. The automatic winder X comprises winding units 65 arranged in a line. Each winding unit 65 of the automatic winder X comprises a tenser box T composed of a support plate 52, a tensioning device 53, a hairiness suppressing device 1 and a yarn trap 54. Each winding unit 65 releases a spun yarn Y from a supplying bobbin B (a spun bobbin manufactured by a ring spinning machine) supplied at a predetermined position, then passes the spun yarn Y through a balloon regulating member, the tenser box T, a slab catcher 67 for detecting any detect in the spun yarn Y, and other components, and finally winds the yarn, at a high speed of 1000 m/second or more, into a package P rotated by a traversing drum 68. Each winding unit 65 also has au upper-yarn sucking member 70 for guiding a package-side yarn end to a yarn joining device 69 and a lower-yarn sucking member 71 for guiding a supplying bobbin B side yarn end to the yarn joining device 69.

[0029] As shown in Figure 1, the hairiness suppressing device 1 of the automatic winder X according to this embodiment comprises nozzle means 2 for untwisting the spun yarn Y, first control means located above the supplying bobbin B and comprising a release assistant device 20 or the like for reducing the variation range of the releasing tension of the spun yarn Y released from the supplying bobbin B and restraining an increase in releasing tension caused by a decrease in the amount of wound yarn associated with the releasing of the yarn from the supplying bobbin B, a tensioning device 53 (hereafter referred to as a "gate type tenser") located downstream of the first control means, for applying an additional tension to the spun yarn Y fed to the nozzle means 2, and second control means comprising a drive device 13 or the like for adjusting the additional tension applied by the gate type tenser 53, the second control means operating based on a tension detected value provided by a tension sensor 11 located downstream of the nozzle means 2.

[0030] Next, a specific configuration of the hairiness suppressing device 1 will be explained. The hairiness suppressing device 1 shown in Figures 1, 2A and 2B is provided in a yarn running passage (d) in the winding unit 65. The spun yarn Y is formed by twisting fibers such as wool or cotton. The hairiness suppressing device 1 is arranged in the tenser box T of the winding unit 65. The hairiness suppressing device 1 comprises the nozzle means 2, twist stopping means 3, 4 arranged on a downstream and an upstream sides of the nozzle means 2 in a yarn running direction, and the gate type

tenser 53 provided in the winding unit 65 as the tensioning device is also used as the upstream-side twist stopping means 4. More specifically, one of a plurality of comb teeth constituting the gate type tenser 53 is used as the upstream-side twist stopping means 4.

[0031] The nozzle means 2 is composed of a nozzle body 5 made of ceramic and a holder 6 in which the nozzle body 5 is fitted, as also shown in Figures 3 and 4. The nozzle body 5 has a yarn passage 7 formed therein for passing the spun yarn Y through the passage, a plurality of gas injecting holes 8 formed therein for injecting compressed air or the like through the yarn passage 7, and other components. The yarn passage 7 is shaped like a cylinder that penetrates the nozzle body 5 in the yarn running direction. The yarn passage 7 has a yarn introducing slit 9 opened at a position biased in parallel from the axis S of the yarn passage 7 and also has a yarn introducing port 10 located contiguously to the yarn introducing slit 9. The yarn introducing port 10 extends like a fan from the slit 9 and penetrates the nozzle body 5 in its axial direction together with the slit 9.

[0032] The gas injecting holes 8 are each opened in the yarn passage 7 and formed in the middle of the yarn passage 7 in its axial direction (yarn running direction). The gas injecting holes 8 are formed along an inner periphery of the yarn passage 7 and opened into the yarn passage 7 in a tangential direction. The nozzle means 2 injects compressed air into the yarn passage 7 through the gas injecting holes 8 to cause a whirling current along the inner periphery of the yarn passage 7 to thereby whirl and balloon the spun yarn Y. The whirling current in the nozzle means 2 is formed in a direction in which the spun yarn Y is untwisted at the upstream side (supplying bobbin B side) of the nozzle means 2 and is then additionally twisted at the downstream side (package P side) of the nozzle means 2. The direction of the whirling current in the nozzle means 2 depends on the direction in which the gas injecting holes 8 are opened into the yarn passage 7, and thus, if a twisting direction of the spun yarn Y is reversed, the opening direction of the gas injecting holes 8 shown in Figure 3 is also reversed.

[0033] The downstream-side twist stopping means 3 stops propagation of twisting applied to the spun yarn Y by means of the whirling current in the nozzle means 2 and is arranged at the downstream side (package P side) of the nozzle means 2.

[0034] As also shown in Figure 4, the twist stopping means 3 is composed of a twist stopping guide 15 and a presser guide 16. The twist stopping guide 15 is located at the downstream side (package P side) of the yarn passage 7 at a distance (a) from the gas injecting holes 8 in the nozzle means 2 and is fixed to a side surface of the holder 6 of the nozzle means 2 (see Figure 2). The twist stopping guide 15 has a V-shaped guide notch 17 opened from the axis S of the yarn passage 7 to above the yarn introducing port 10. A bottom of the guide notch 17 is located near and above the axis S of the yarn passage 7 (see Figure 4). The presser guide 16 is located at the downstream side (package P side) of the twist stopping guide 15 in the spun yarn running direction, and the presser guide 16 is arranged in a line with the twist stopping guide 15. The presser guide 16 is supported by a shaft 19 via a lever 18 and can be swung around the shaft 19. Thus, the presser guide 16 is placed in a receding position (see Figure 6A) where the spun yarn Y can be introduced into the guide notch 17 of the twist stopping guide 15 or in an operating position (see Figure 6B) where the spun yarn Y is held in the guide notch 17 in such a manner as to be bent by the twist stopping guide 15.

[0035] The gate type tenser 53 constituting the second control means is also used as the upstream-side twist stopping means 4 to operate to stop propagation of twisting applied to the spun yarn Y by means of the whirling current in the nozzle means 2, and the gate type tenser 53 is arranged at the upstream side (supplying bobbin B side) of the nozzle means 2 in the spun yarn running direction.

[0036] The gate type tenser 53, also used as the twist stopping means 4, applies an additional tension the spun yarn Y by coming into contact therewith, and comprises fixed comb teeth 56 and a plurality of movable comb teeth 57. The comb teeth 56, 57 are alternately arranged at intervals across the yarn running passage (d) in its direction. Further, one of the comb teeth 56, 57 (in this embodiment, the comb tooth 56 at a point (q)) acts as the twist stopping means 4. The fixed comb teeth 56 are fixed to the tenser box T via a plate 58. The movable comb teeth 57 are supported by the shaft 19 via an arm 59 and can be swung around the shaft 19 (see Figure 1). The movable teeth 57 are connected to a controller 12 partly constituting tension control means, described later, via the drive device 13, more specifically, the solenoid 13. The controller 12 is connected to the tension sensor 11 provided downstream of the nozzle means 2 so that depending on the value of the tension of the spun yarn Y as measured by the tension sensor 11, the tension sensor 11 can drive the solenoid 13 to urge the movable comb teeth 57 toward the fixed comb teeth 56 to thereby adjust pressure on the spun yarn Y together with circular guide sections 60 located at tips of the comb teeth 56, 57, thus adjusting the tension of the spun yarn Y.

[0037] Further, the plurality of comb teeth 56, 57 of the gate type tenser 53 come in contact with the spun yarn Y between the nozzle means 2 and the twist stopping means 4 to apply an appropriate tension to ballooning of the spun yarn Y caused by the whirling current in the nozzle means 2. The tension is applied in such a manner that the drive device 13 such as a solenoid, for example, which effects driving depending on the tension value measured by the tension sensor 11 located downstream of the nozzle means 2 urges the movable comb teeth 57 toward the fixed comb teeth 56 to apply an appropriate tension to thereby restrain extension of the

balloon in its radial direction. Moreover, depending on the tension value from the tension sensor 11, the movable comb teeth 57 are driven away from the fixed comb teeth 56 to reduce the tension acting on the spun yarn Y to thereby extend the balloon in its radial direction. That is, the plurality of comb teeth 56, 57 also act as means for adjusting the diameter of the balloon of the spun yarn Y.

[0038] The comb tooth 56 located at the point (q) and acting as the twist stopping means 4 of the gate type tenser 53 is arranged upstream (supplying bobbin B side) of the yarn passage 7 at a distance (b) from the gas injecting holes 8 in the nozzle means 2 (see Figure 2). The distance (b) depends on conditions such as the distance (a) from the gas injecting holes 8 to the twist stopping guide 15 and an average length L of fibers in the spun yarn Y.

[0039] The specific conditions are listed below.

(1) Twisting long hairinesses into the yarn requires an untwisting length of the spun yarn Y which is at least equal to or larger than the hairiness length or the average fiber length, and the distance (b), the length of the untwisting section, is desirably large.
(2) When the spun yarn Y is additionally tensioned, the spun yarn Y is ballooned and thus whirled to apply a centrifugal force to hairinesses, so that tips of the hairinesses are bent in a direction opposite to a direction in which the hairinesses are twisted into the spun yarn Y. Accordingly, it is desirable to reduce the centrifugal force applied to the hairinesses and the distance (a) , the length of the additional-twisting section.

[0040] Due to the conditions set forth in (1) and (2), it is preferable to increase the distance (b) above the distance (a), to increase the sum of the distances (a) and (b) above the average fiber length of the spun yarn Y, and to increase the distance (b) above the average fiber length of the spun yarn Y. The average fiber length refers to the average of the lengths of many fibers constituting the yarn.

[0041] Further, the plurality of comb teeth 56, 57 of the gate type tenser 53 are located between the nozzle means 2 and the comb tooth 56, located at the point (q) and acting as the twist stopping means 4. The plurality of comb teeth 56, 57 come into contact with the spun yarn Y between the nozzle means 2 and the twist stopping means 4, so that based on an urging force of a spring applied to the movable comb teeth 57, an appropriate radial tension is applied to ballooning of the spun yarn Y caused by the whirling current in the nozzle means 2, thus restraining the extension of the balloon in its radial direction. That is, the plurality of comb teeth 56, 57 act as means for reducing the diameter of the balloon of the spun yarn Y.

[0042] The release assistant device 20 is provided upstream of the gate type tenser 53, that is, at the supplying bobbin B side and constitutes first control means located above the supplying bobbin B and having a balloon regulating member for regulating the yarn passage for the spun yarn Y drawn out from the supplying bobbin B in such a manner that a regulated portion is lowered in response to releasing of the spun yarn Y from the supplying bobbin B, as shown in Figure 1.

[0043] The release supporting means 20 constituting the first control means is composed of the following main parts; a cylindrical body 23 (see Figure 7) fixed to the automatic winder X and having an opening 36 which is located at the top of the release assistant device 20 and which is used as an outlet for the spun yarn Y, a cylinder body 21 located outside the cylindrical body 23 so as to cover the same and which elevates and lowers depending on the amount of yarn in the supplying bobbin B, and a follow-up mechanism of the cylinder body 21 comprising a sensor 25, a cylinder 26 and a controller (not shown in the drawings) which operates the cylinder 26 responsive to a signal from the sensor 25.

[0044] The cylinder body 21 has a first arm 40 having an elevating and lowering block 28 attached to a side surface thereof. The elevating and lowering block 28 is vertically slidably inserted into a rod 29 hanging from a fixed block 27 and is connected to a piston rod 30 of the cylinder 26 which is extended perpendicularly from the fixed block 27 so that the cylinder body 21 can be elevated and lowered as the rod 30 of the cylinder 26 advances and recedes. The cylinder body 21 lowers sequentially in such a manner as to maintain a constant distance from a chess portion 24 of the supplying bobbin B and to cover a core tube 41 of the supplying bobbin B. In order that the size of the balloon of the spun yarn Y may be larger than the outer diameter of the supplying bobbin B at a releasing position, a terminal portion 22 of the cylinder body 21 is broadened to regulate the extension of the balloon of the spun yarn Y and maintain an appropriate extension in order to obtain a releasing angle, thereby restraining sluffing and hairinesses.

[0045] Further, the cylinder body 21 has the cylindrical body 23 fixed to a body frame of the automatic winder X and having a through-hole 231. The through-hole 231 forms an opening 36 at an upper end of the cylindrical body 23, the opening 36 being used as an outlet for the spun yarn Y. Further, the cylindrical body 23 is tapered at its lower end to constitute a node 232 (see Figure 7). Moreover, the core tube 41 of the supplying bobbin B and a yarn layer are slightly coned in such a manner that the yarn layer has a minimum outer diameter at its top and that the outer diameter of the core tube 41 at a lower limit position of the cylinder body 21 is larger than that of its top.

[0046] Further, the cylinder body 21 has an arm 32 attached thereto and having a slit 32d and a magnet 32b stuck to an underside thereof. The slit 32d is guided by a stopper shaft 22 in such a manner that the cylinder body 21 stops lowering when the magnet 32b and the arm 32 collides against a plate 34b located at a lower

end of the stopper shaft 33. That is, when the amount of yarn remaining on the supplying bobbin B is 30% of the full amount, the cylinder body 21 stops lowering. Moreover, the cylindrical body 23 is fixed immediately above the core tube 41 and serves to broaden the balloon of the spun yarn Y released from the chess portion 24 when a large amount of yarn remains in the supplying bobbin B. Furthermore, when the amount of yarn in the supplying bobbin B decreases, the cylindrical body 23 serves to stabilize the baloon form of the spun yarn Y formed by the cylinder body 21. Thus, the release assistant device 20 composed of the cylinder body 21 and the other components acts as the first control means for controlling tension, the means being capable of adjusting the tension of the spun yarn Y by moving the cylinder body 21 up and down.

[0047] Next, the sensor 25, the cylinder 26, and the controller as a follow-up machanism will be described. The sensor 25 attached to a second arm 43 of the cylinder body 21 detects the chess portion 24 of the supplying bobbin B, and the controller receives an input from the sensor 25 to actuate a directional control valve 31 to cause the piston rod 30 of the cylinder 26 to advance gradually, thus maintaining a substantially constant distance between the cylinder body 21 and the chess portion 24. The sensor 25 may be a diffuse reflection sensor. As shown in the drawings, as the yarn is released from the chess portion 24, the distance from the sensor 25 to the chess portion 24 increases until the sensor 25 issues an OFF signal. In receipt of the OFF signal, the controller moves the piston rod 30 of the cylinder 26 forward via the directional control valve 31. Then, the distance from the sensor 25 to the chess portion 24 decreases until the sensor 25 issues an ON signal. In receipt of the ON signal, the controller stops the piston rod 30 of the cylinder 26 via the directional control valve 31. Repetition of this operation causes the cylinder body 21 to lower sequentially in connection with the releasing. The sensor 25 monitoring the chess portion 24 is not limited to the horizontal position with respect to the chess portion 24 but may be attached at an arbitrary angle between a position immediately above the chess portion 24 and a position that is level with the chess portion 24.

[0048] Next, the operation of the automatic winder X having the hairiness suppressing device 1 will be explained with reference to Figures 5 to 7 in connection with rewinding. Although Figure 5 shows how the spun yarn Y is being rewound, that is, the spun yarn Y is extended between the supplying bobbin B and the package P, the description starts with the state where the spun yarn Y has not been extended between the supplying bobbin B and the package P yet, that is, rewinding of the spun yarn Y has not been started yet.

[0049] In Figure 5, before the spun yarn Y is rewound, a traversing drum 68 of each winding unit 65 is stopped. Then, the presser guide 16 of the twist stopping means 3 is swung to the position where it recedes from the twist stopping guide 15. Further, the movable comb teeth 57 of the gate type tenser 53 are swung to recede from between the fixed comb teeth 56. In these conditions, the spun yarn Y is released from the supplying bobbin B, introduced into the guide sections 60 of the fixed comb teeth 56 and into the yarn passage 7 in the nozzle means 2 (see Figure 6A), and then joined to the winding bobbin B on the traversing drum 68.

[0050] After the spun yarn Y has been joined to the winding bobbin Bf, the presser guide 16 is swung to push the spun yarn Y in the V-shaped notch 17 of the twist stopping guide 15. Further, the movable comb teeth 57 are swung toward the fixed comb teeth 56 to sandwich the spun yarn Y between the movable comb teeth 57 and the fixed comb teeth 56 in a zigzag manner. In these conditions, compressed air is injected through the yarn passage 7 from the gas injecting holes 8 in the nozzle means 2 to cause a whirling current in the yarn passage 7 (see Figure 6B).

[0051] Subsequently, the traversing drum 68 is driven to release and run the spun yarn Y from the supplying bobbin B, thus starting to rewind the spun yarn Y.

[0052] A description will be given of a method for releasing the spun yarn Y from the supplying bobbin B using the release assistant device 20 constituting the above-mentioned first control means. Figures 7A to 7C show how the cylinder body 21 regulates the balloon. Figure 7A shows that after the supply of a new supplying bobbin B following the discharge of an empty bobbin, the terminal portion 22 of the cylinder body 21 has lowered to an operating state where it covers the core tube 41. Figure 7B shows a 50% bobbin state where the cylinder body 21 has further lowered. In particular, the cylinder body 21 lowers sequentially in such a manner as to follow up the releasing of the chess portion 24, and the size of the balloon of the yarn released from the chess portion 24 is larger than the outer diameter of the supplying bobbin B at the releasing position. Consequently, the friction between a portion of the yarn remaining on the supplying bobbin B and a released portion of the yarn decreases to restrain sluffing and hairinesses. Figure 7C shows a 30% bobbin state. In particular, when the amount of yarn remaining on the bobbin is close to 30% of the full amount, the releasing tension tends to increase rapidly, but the cylinder body 21 and the cylindrical body 23 with the node 232 serve to form a stable balloon to restrain the rapid increase in releasing tension. Further, after the amount of yarn remaining on the bobbin has reached 30% of the full amount, the chess portion 24 is gradually deformed and further lowering the cylinder body 21 no longer improves the effect of restraining sluffing and hairinesses.

[0053] Referring back to Figures 5 and 6, the running spun yarn Y starts to be ballooned using the V-shaped notch 17 of the twist stopping guide 15 and the gate type tenser 53 as the twist stopping points (p) and (q) (nodes). The spun yarn Y is ballooned by means of the whirling current injected through the yarn passage 7 in

such a manner that the spun yarn Y is untwisted at the upstream side of the nozzle means 2 in the yarn running direction and is then additionally twisted at the downstream side of the nozzle means 2 in the same direction.

[0054] Once the ballooning is started, the running spun yarn Y is tensioned due to its contact with the comb teeth 56, 57 of the gate type tenser 53, which acts as the second control means and the twist stopping means 4. At this time, the solenoid 13 is driven to urge the movable comb teeth 56 toward the fixed comb teeth 57 to thereby apply a higher tension to the spun yarn Y beforehand so as to regulate the extension of the balloon. Thus, the balloon of the spun yarn Y is collapsed (squeezed) toward the downstream side (the side of the nozzle means 2) of the spun yarn Y at the plurality of points in the comb teeth 56, 57 of the gate type tenser 53. Further, since the balloon of the spun yarn Y is collapsed at the plurality of points, two or more balloons B1, B2 are formed between the twist stopping points (p) and (q). Thus, even if the spun yarn Y has a large average fiber length and contains long hairinesses, the hairiness suppressing process can be effectively executed.

[0055] The running spun yarn Y is falsely twisted in response to the ballooning. The false twisting is carried out such that the spun yarn Y is untwisted on the upstream side (the side of the tenser 53) of the nozzle means 2 and is additionally twisted on the downstream side (the side of the twist stopping guide 15) of the nozzle means 2. The false twisting is stopped from propagation by the twist stopping points (p) and (q) of the twist stopping means 15 and the tenser 53 and is limited to between the twist stopping points (p) and (q). The formed balloon is subjected to a substantially constant tension and is always formed into a substantially constant size. In an untwisting section, the distance (b) is longer than the average fiber length of the spun yarn Y, so that the untwisting is sufficient to twist long hairinesses into fibers. Further, in the untwisting section, the effect of squeezing the balloon B2 of the spun yarn Y reduces a centrifugal force applied to the hairinesses to prevent tips of the hairinesses from extending in the direction opposite to the direction in which the hairinesses are twisted into the yarn. Moreover, in an additional-twisting section, the distance (a) is set shorter than the distance (b) to reduce the centrifugal force applied to the hairinesses to prevent the tips of the hairinesses from extending in the direction opposite to the direction in which the hairinesses are twisted into the yarn. Thus, the spun yarn Y is untwisted sufficiently for the hairiness suppressing process and then additionally twisted to twist the long hairinesses into the fibers constituting the yarn, thereby achieving the hairiness suppressing process.

[0056] Next, specific effects provided by the automatic winder X having the hairiness suppressing device 1 according to this embodiment will be explained with reference to Figure 8. Figure 8A shows that the first and second control means of the tension controlling means according to this embodiment are used. Figure 8B shows that only the first control means, that is, the release assistant device 20 is used. Figure 8C shows that neither of the tension controlling means is used. In Figure 8A, the second control means adjusts the added tension depending on the amount of yarn in the supplying bobbin B as shown in the figure and regulates the size of the balloon of the yarn released from the supplying bobbin B to maintain a constant releasing tension from the start of winding. In Figure 8B, the releasing tension is low at the start of winding and is high at the end of winding. In Figure 8C, the yarn break by tension or sluffing often occurs.

[0057] The running spun yarn Y is subjected to the hairiness suppressing process by means of the hairiness suppressing device 1 and is wound into the package P on the winding bobbin Bf. With the automatic winder X having the hairiness suppressing device 1 according to the present invention, the releasing tension was constant from the start to end of winding, as shown in Figure 8A. Consequently, a stable hairiness suppressing effect was obtained, and the package P obtained was composed of a spun yarn with few hairinesses.

[0058] Further, for example, upon finding a defect in the spun yarn Y during rewinding, each winding unit 65 cuts the spun yarn Y, removes the defect, and joins the yarn Y. At this time, the hairiness suppressing device 1 stops the gas injection and a suction nozzle 54 sucks and catches a yarn end on the supplying bobbin B. The lower-yarn sucking member 71 is swung to the neighborhood of the support plate 52 and sucks the yarn end caught by the suction nozzle 54 to guide it to the yarn joining device 69. At this time, the movable comb teeth 57 of the gate type tenser 53, the presser guide 16 of the nozzle means 2 and other components are at the receding position (see Figure 6A) , and the yarn end on the supplying bobbin B is passed through the tenser 53, the nozzle means 2 and the downstream-side twist stopping means 3. At the same time, the upper-yarn sucking member 70 sucks the yarn end from the package P and guides it to the yarn joining device 69, which then performs a joining operation. Once the joining is completed, the tenser 53 of the tenser box T, the hairiness suppressing device 1, and other components are placed in an operating position (see Figure 6B), where a rewinding operation, combined with a hairiness suppressing process for the spun yarn Y, is started.

[0059] According to the hairiness suppressing device 1 of the present invention, the distances (a) and (b) are determined depending on the average fiber length of the spun yarn Y based on the conditions described above in (1) and (2), and the gate type tenser 53 applies an appropriate radial tension to the balloon B2 of the spun yarn Y in such a manner that the balloon B2 is squeezed at one or more points. Then, the hairiness suppressing process can be effectively executed even if the spun yarn Y has a large average fiber length and contains

long hairinesses.

[0060] Further, the hairiness suppressing device 1 can effectively execute the hairiness suppressing process even on a rigid spun yarn Y.

[0061] In the illustrated hairiness suppressing device 1 of the present invention, the gate type tenser 53 also acts as the upstream-side twist stopping means 4, but the present invention is not limited to this. For example, the upstream-side twist stopping means 4 can comprise a twist stopping guide and a presser guide similarly to the downstream-side twist stopping means 3. This configuration also ensures a sufficient distance to untwist the spun yarn Y, so that the hairiness suppressing process can be effectively executed not only on short-fiber yarns but also on spun yarns having long fibers and thus long hairinesses mixed therein. In this case, the tensioning device must be separately provided but may comprise a gate type tenser or a disk type tenser.

[0062] Figure 10 shows results of experiments on rewinding of the spun yarn Y using the automatic winder X. The results of the experiments in Figure 10 indicate the relationship between the rate of an increase in the amount of hairinesses after rewinding and the length of hairinesses.

[0063] Experimental conditions were as follows: The spun yarn was formed by twisting rigid wool and has a fiber length L of 64 mm. Further, the rewinding speed of the automatic winder was set at 800 m/min.

[0064] The experiments were conducted in connection with an example as the present invention and comparative examples 1 and 2.

[0065] In the example as the present invention, the hairiness suppressing device 1 of the present invention was provided to rewind the spun yarn using the automatic winder. As shown in Figure 2, the gate type tenser 53 was also used as the upstream-side twist stopping means 4, and the distance (b) was set longer than the distance (a) and than the average fiber length of the spun yarn.

[0066] In the comparative example 1, the hairiness suppressing device was not provided and the spun yarn was rewound using the automatic winder.

[0067] In the comparative example 2, the hairiness suppressing device was provided to rewind the spun yarn using the automatic winder. The twist stopping guide was arranged both upstream and downstream of the nozzle means, and the distance from the nozzle means to the twist stopping means (a) was set equal to the distance from the nozzle means to the twist stopping means (b).

[0068] Figure 10 indicates that the example as the present invention restrains the rate of an increase in the amount of hairinesses compared to the comparative examples 1 and 2. This means that while the automatic winder is rewinding the spun yarn, even if the contact of the spun yarn with the tenser or the like increases the amount of hairinesses, the hairiness suppressing device of the present invention effectively executes the hairiness suppressing process. In particular, when hairinesses are 3 to 4 mm long, the example as the present invention is more effective than the comparative examples 1 and 2. The reason why the example as the present invention can effectively suppress hairinesses is assumed to be because the distance (b) is longer than the distance (a) and than the average fiber length of the spun yarn and because the balloon of the spun yarn is squeezed within the distance (b).

[0069] Thus, the example as the present invention is optimal for suppressing hairinesses not only in short-fiber yarns but also spun yarns having long fibers and containing long hairinesses. It is also optimal for suppressing hairinesses of rigid spun yarns of a large average fiber length.

[0070] In the illustrated automatic winder X of the present invention, the gate type tenser 53 acts as the tensioning device for applying an additional tension to the spun yarn Y supplied to the nozzle means 2 of the second controlling means, but the tensioning device may comprise a disk type tenser.

[0071] Further, although the first control means of the tension controlling means of this embodiment lowers the cylinder body 21 based on the distance between the sensor 25 provided in the release assistant device 20 arranged above the supplying bobbin and the chess portion 24 of the supplying bobbin B, thereby restraining an increase in releasing tension. The cylinder body 21, however, may be lowered, for example, based on the elapsed time.

[0072] Moreover, the second control means controls the tension of the spun yarn by being driven based on the tension measured by the tension sensor 11 located downstream of the nozzle means 2. Like the first control means, however, the second control means may control the tensioning device, comprising the gate type sensor 53, based on a decrease in the amount of yarn wound around the supplying bobbin, i.e., may reduce the value of additional tension consistently with the amount of remaining yarn.

[0073] Further, the upstream-side twist stopping means may comprise various means. It may be, for example, the same as the downstream-side twist stopping means, or means for stopping the twisting of the spun yarn Y using a single twist stopping guide, means for stopping the twisting by abutting two plates together to sandwich the spun yarn Y therebetween, or means for stopping the twisting by inserting one plate between two plates and squeezing the balloon of the spun yarn Y at a plurality of points.

[0074] The automatic winder of the present invention can effectively suppress hairinesses occurring when the yarn is released from the supplying bobbin B or when the tenser 53 tensions the yarn, thereby making it possible to rewind the spun yarn Y with hairinesses suppressed. The automatic winder of the present invention rewinds the yarn from the supplying bobbin into a package and, for example, may rewind yarns from a plurality

of supplying bobbins into a single package. The supplying bobbin has the spun yarn wound thereon and may be a spinning bobbin or a package.

[0075] Further, a suction nozzle 54 may be arranged near the outlet of the hairiness suppressing device 1 so that hairinesses from the hairiness suppressing device 1 can be collected while being prevented from splashing. Moreover, a waxing device for waxing the spun yarn may be additionally installed downstream of the hairiness suppressing device 1. Furthermore, the gas used to generate the whirling current to twist the spun yarn Y formed by twisting fibers may be vapors or humidified air containing water droplets, in addition to compressed air. The use of vapors makes it possible to heat the spun yarn Y passing through the yarn passage 7 and the inner periphery of the yarn passage 7 so that the yarn can be processed as if it was ironed when coming into contact with the inner periphery of the yarn passage 7, thus providing such a heat set that maintains a reduced amount of hairinesses. Further, when the spun yarn Y is exposed to humidified air or vapors, its hairinesses can be softened. Thus, the spun yarn 7, which has been twisted through the yarn passage 7, can have hairinesses entangled therewith, the hairinesses having been softened by false twisting based on untwisting and additional twisting. Moreover, the gas used to generate the whirling current may be dried and heated air.

[0076] The automatic winder of the present invention is not limited to the above embodiment. For example, as shown in Figure 9, even if the nozzle means 2 and the gate type tenser 53 are arranged upside down, the tension of the spun yarn Y supplied to the nozzle means 2 can be maintained at a substantially constant value to stabilize the effect of suppressing hairinesses of the spun yarn Y, simply by using the release assistant device capable of restraining an increase in tension associated with a decrease in the amount of yarn in the supplying bobbin B, the tension being applied in connection with the releasing of the yarn from the supplying bobbin B. In this case, the gate type tenser 53 operates differently from the above described embodiment and adjusts a winding tension of the spun yarn Y. Further, although not illustrated, the waxing device may be provided between the gate type sensor 53 and the suction nozzle 54. In this embodiment, the additional tension effected by the gate type tenser 53 is not applied to the spun yarn Y supplied to the nozzle means 2, thus reducing the tension of the spun yarn Y supplied to the nozzle means.

[0077] Instead of the tension controlling means described above, the rotation speed of the traversing drum may be controlled to control the winding speed to thereby maintain the tension of the spun yarn at a substantially constant value. In the above embodiment, the movable comb teeth 57 may be urged toward the fixed comb teeth using a spring.

[0078] According to the automatic winder of the present invention, the tension of the spun yarn supplied to the nozzle means is maintained at a substantially constant value, thereby obtaining a stable hairiness suppressing effect. Further, if the tension is maintained at a substantially constant and appropriate value, a high hairiness suppressing effect is obtained.

[0079] According to the hairiness suppressing device of the present invention, the distance from the nozzle means to the upstream-side (untwisting-side) twist stopping means is set longer than the distance from the nozzle means to the downstream-side (additional twisting-side) twist stopping means, thus making it possible to effectively suppress long hairinesses. Thus, the present invention is optimal for suppressing hairinesses of spun yarns containing long fibers and thus long hairinesses.

Claims

1. An automatic winder comprising a hairiness suppressing device including nozzle means having a yarn passage for allowing a spun yarn to pass therethrough, the nozzle means twisting the spun yarn by means of a whirling current obtained by injecting a gas through the yarn passage, the automatic winder being **characterized by** having:

   tension control means for controlling tension of said spun yarn fed to said nozzle means at a substantially constant value.

2. An automatic winder according to Claim 1, **characterized in that** said tension control means is a release assistant device located above a supplying bobbin to regulate the yarn passage for said spun yarn drawn out from said supplying bobbin in such a manner that a regulated position is lowered in response to releasing of the spun yarn from said supplying bobbin.

3. An automatic winder according to Claim 1, **characterized in that** said tension control means comprises a tensioning device for applying tension to be added to the spun yarn, a drive device for driving said tensioning device to adjust a value of the tension added by the tensioning device, and a control section for controlling said drive device so as to maintain the tension of said spun yarn subjected to the added tension at a substantially constant value.

4. An automatic winder according to Claim 3, **characterized in that** said tensioning device is located upstream of said nozzle means and is of a gate type.

5. An automatic winder according to Claim 1, **characterized in that** said tension control means comprises first control means located above a supplying bobbin and comprising a release assistant device for regulating the yarn passage for said spun yarn drawn out from said supplying bobbin in such a manner that a regulated position is lowered in re-

sponse to releasing of the spun yarn from said supplying bobbin, and second control means located downstream of said first control means and comprising a tensioning device for applying tension to be added to the spun yarn, a drive device for driving said tensioning device to adjust a value of the tension added by the tensioning device, and a control section for controlling said drive device so as to maintain the tension of said spun yarn subjected to the added tension at a substantially constant value.

6. A hairiness suppressing device provided in a yarn running passage for a spun yarn, the device comprising:

nozzle means having a yarn passage for allowing said spun yarn to pass therethrough, the nozzle means causing a whirling current by injecting a gas through the yarn passage; and twist stopping means arranged on an upstream and a downstream sides of said nozzle means in a yarn running direction, for stopping propagation of twisting applied to said spun yarn by said whirling current, the device being **characterized in that**:

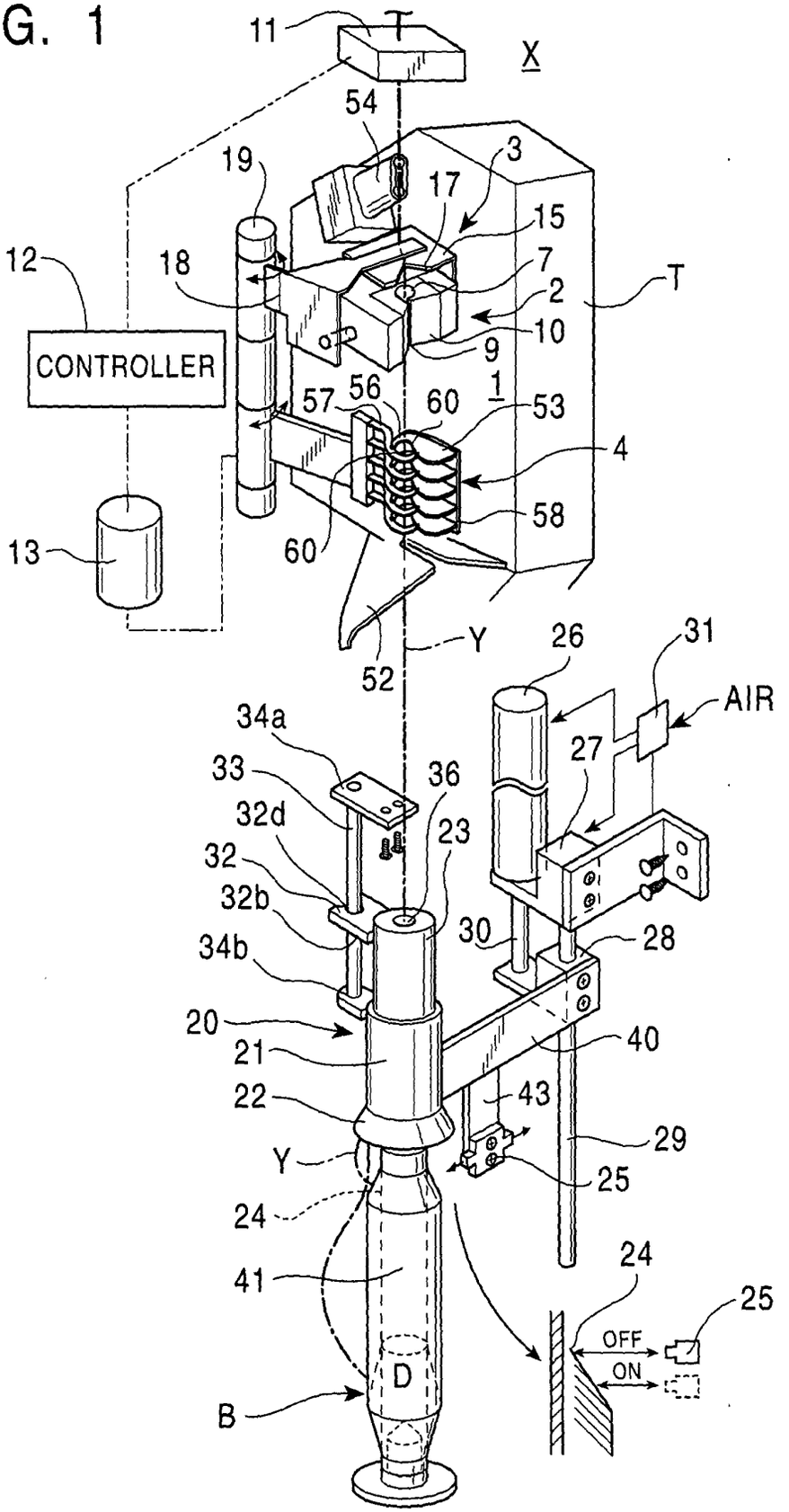
the whirling current in said nozzle means operates to untwist the upstream side of said spun yarn, and a distance from said nozzle means to said upstream-side twist stopping means is larger than a distance from the nozzle means to said downstream-side twist stopping means.

7. A hairiness suppressing device according to Claim 6, **characterized in that** means for reducing a diameter of a balloon of said spun yarn formed between said nozzle means and said upstream-side twist stopping means is provided therebetween.

8. A hairiness suppressing device according to Claim 7, **characterized in that** said means for reducing the diameter of the balloon comprises one or more members for regulating the diameter of the balloon of the spun yarn by contacting with a portion of the spun yarn between said nozzle means and said upstream side twist stopping means.

9. A hairiness suppressing device according to Claim 8, **characterized in that** as said upstream-side twist stopping means and said means for reducing the diameter of the balloon a gate type tenser having a plurality of comb teeth that contact with the spun yarn to tension the same is provided.

FIG. 1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19
3
17
15
12
18
7
2
T
CONTROLLER
10
9
1
57
56
60
53
4
58
13
60
Y
26
31
52
AIR
34a
27
33
36
32d
23
32
32b
30
28
34b
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40
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43
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29
Y
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24
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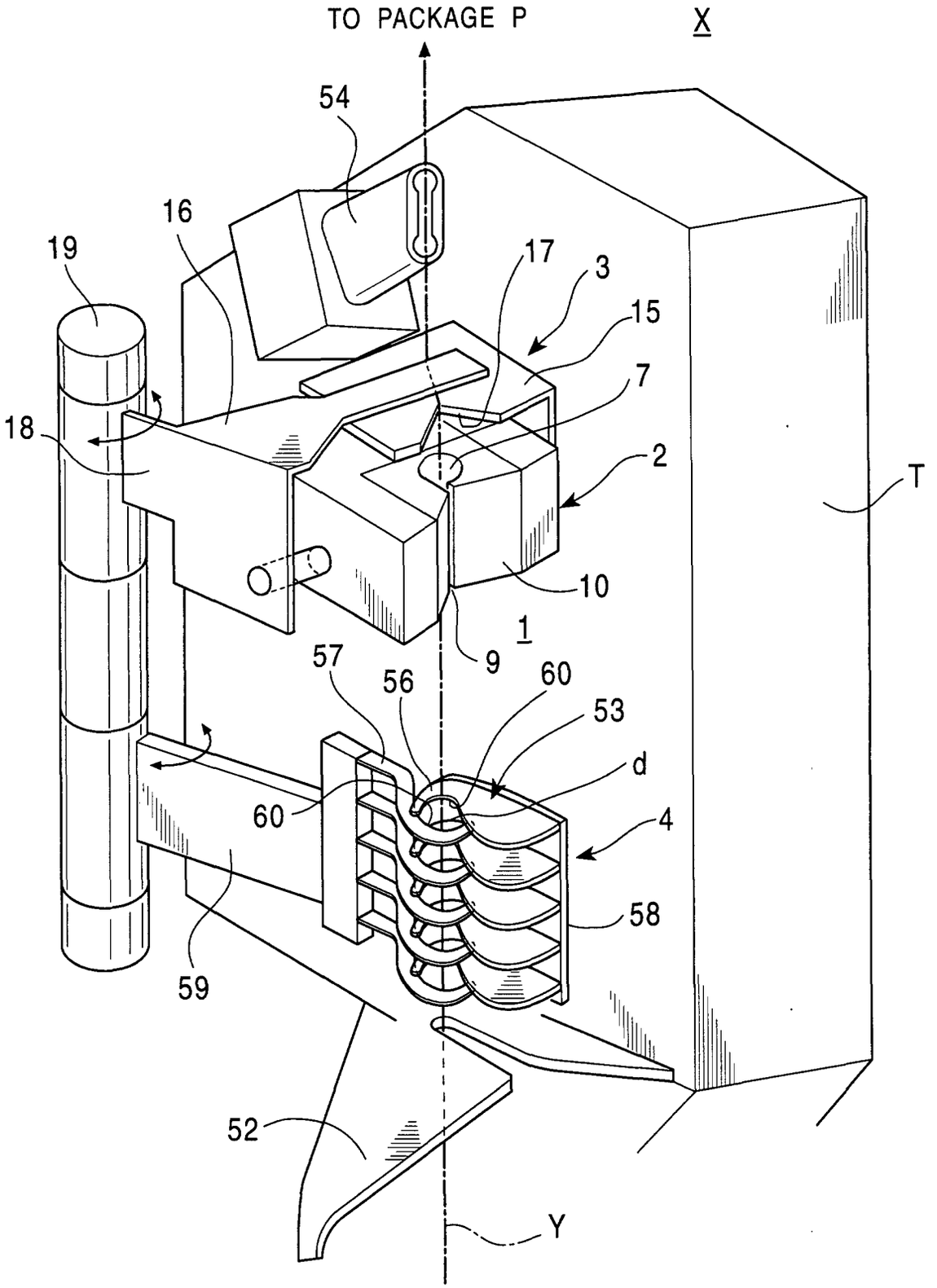
41
25
OFF
ON
D
B

FIG. 2A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X
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16
19
17
3
15
7
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2
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10
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9
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53
d
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4
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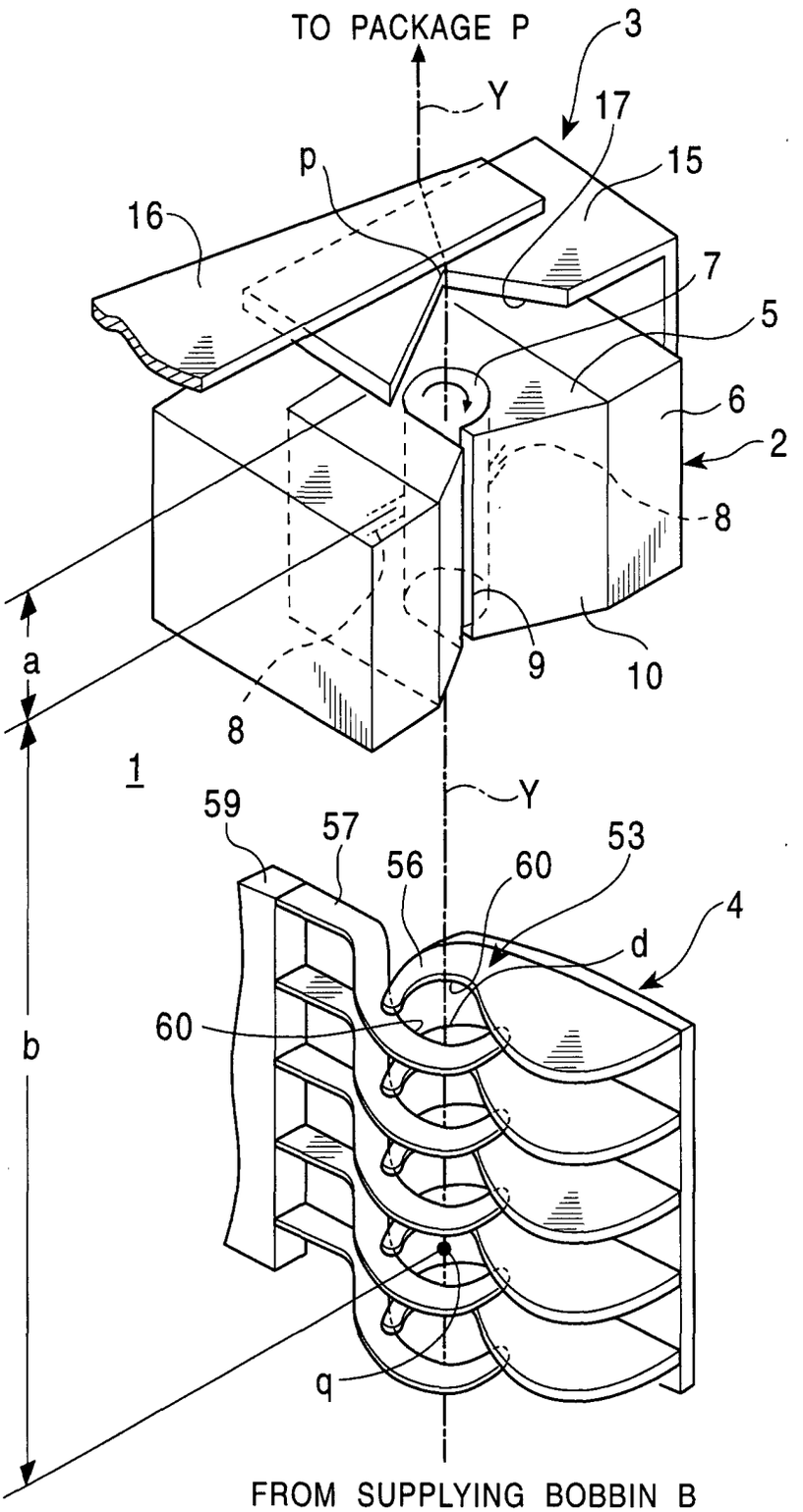
59
52
Y
FROM SUPPLYING BOBBIN B

FIG. 2B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6
2
8
a
9
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57
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4
d
60
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q
FROM SUPPLYING BOBBIN B

FIG. 3

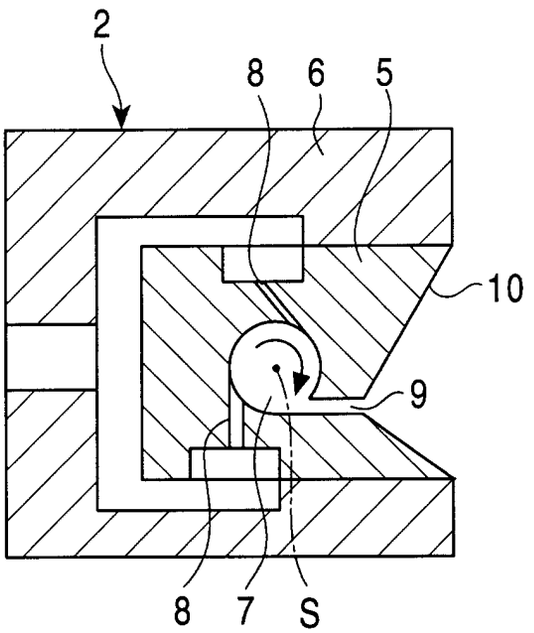


FIG. 4

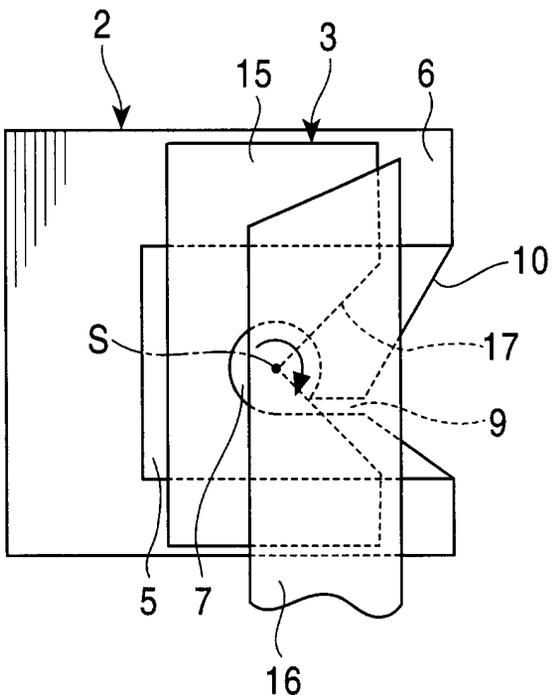


FIG. 5

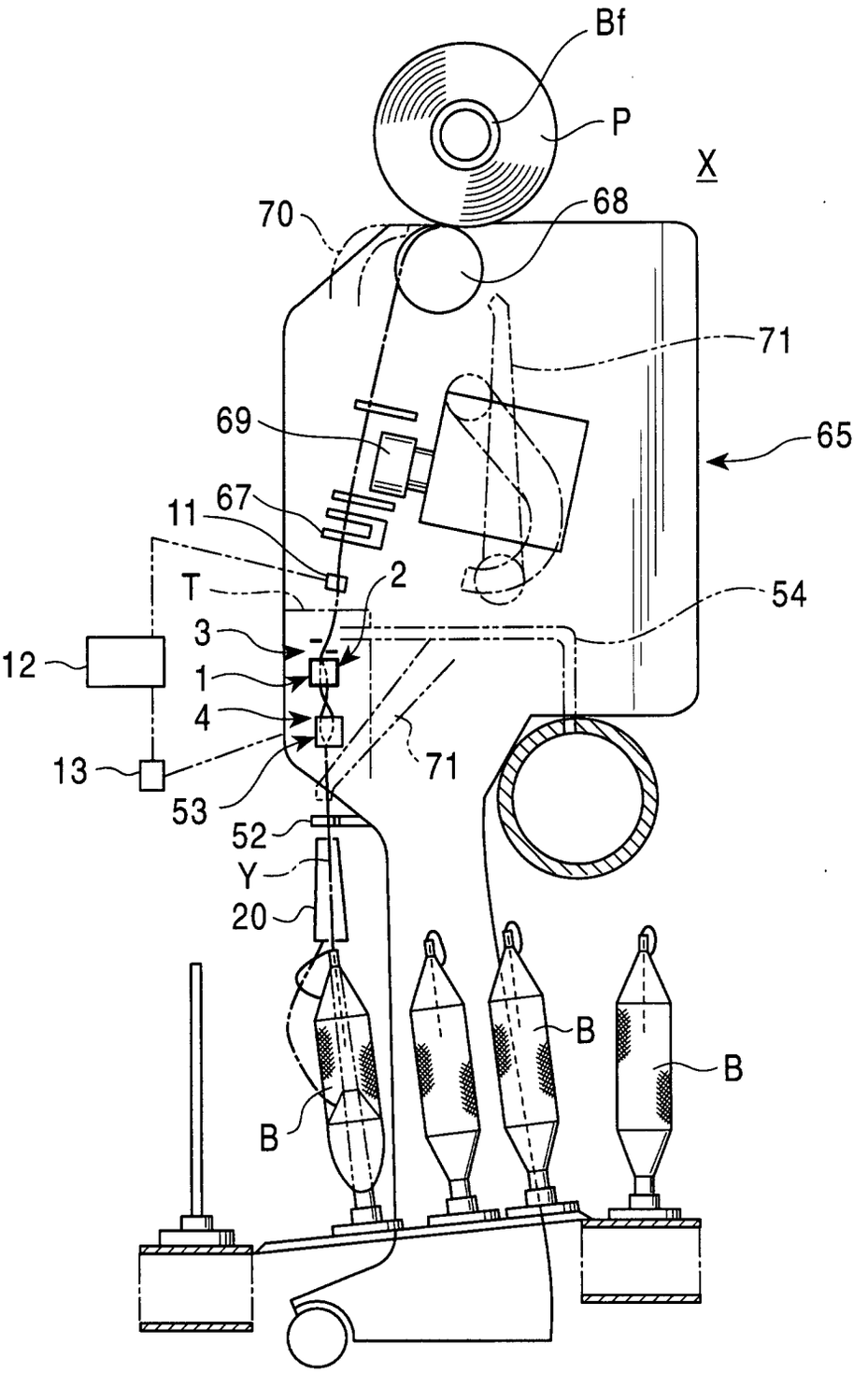
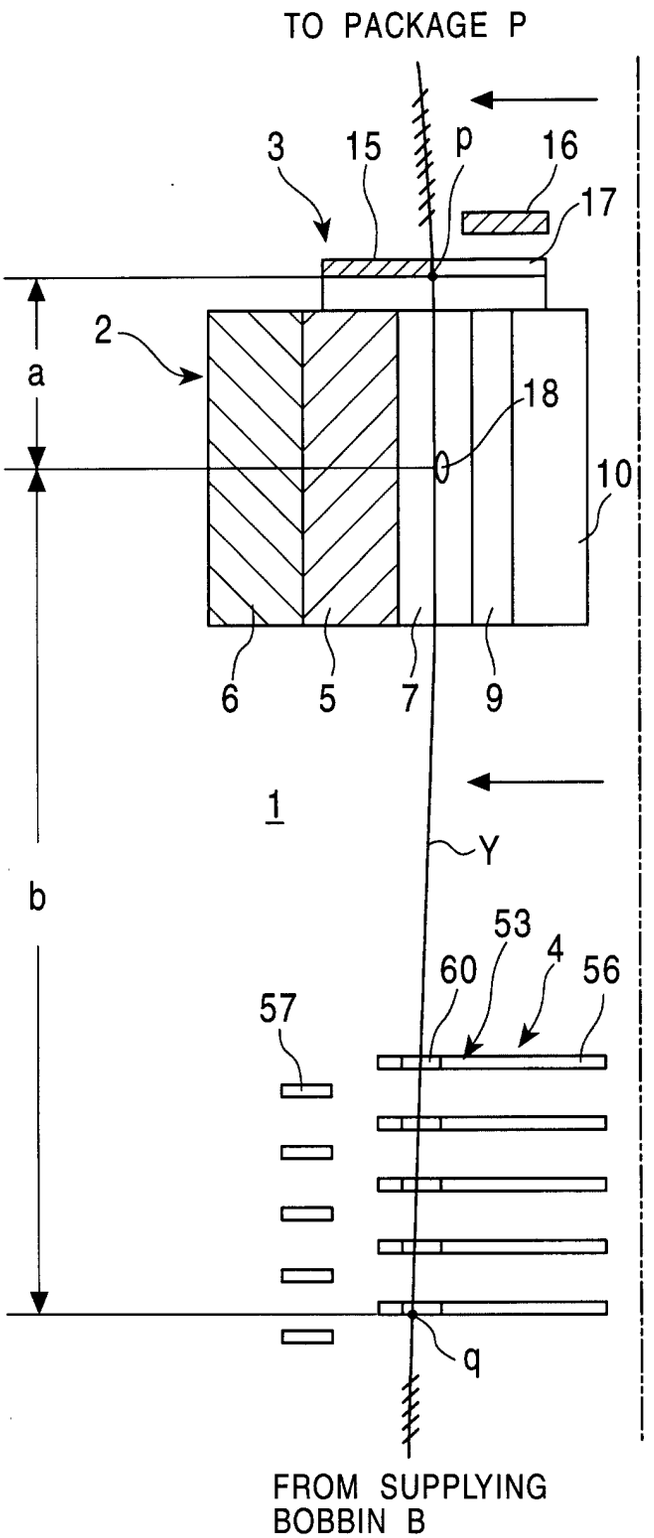


FIG. 6A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a
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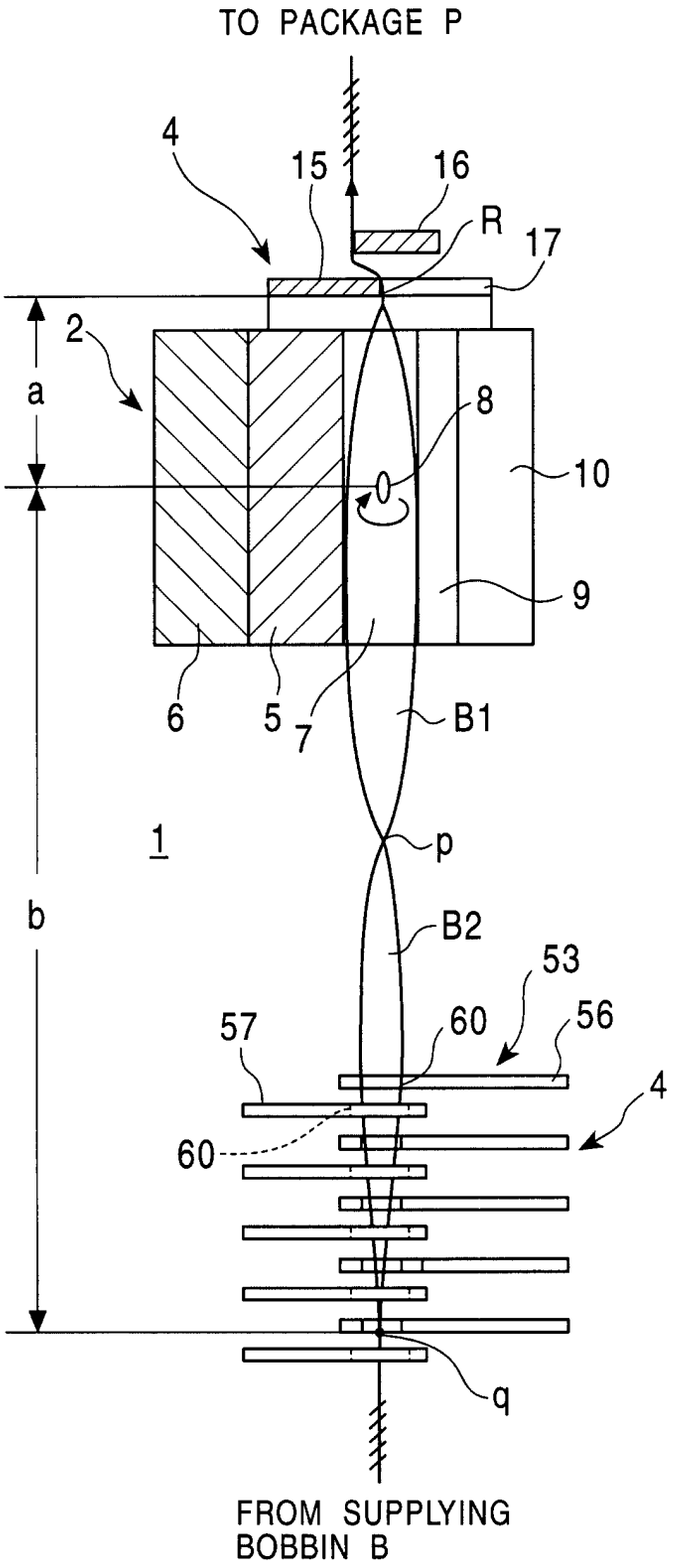
FROM SUPPLYING BOBBIN B

FIG. 6B


TO PACKAGE P
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B1
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53
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FROM SUPPLYING BOBBIN B

FIG. 7A

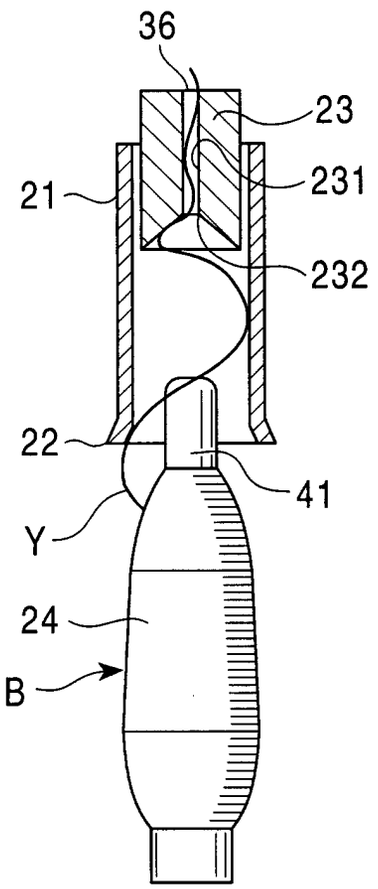


FIG. 7B

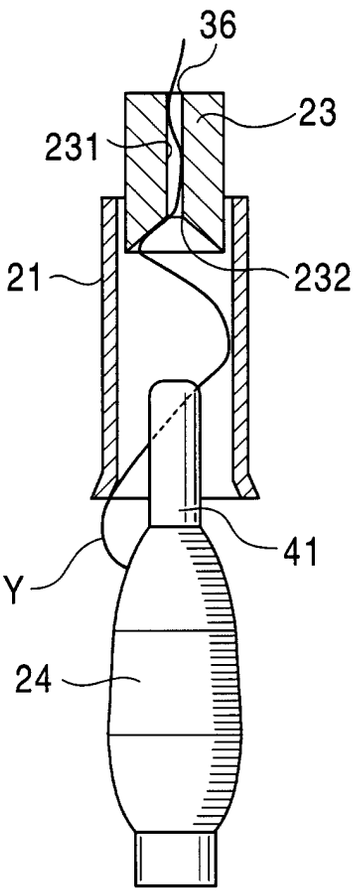
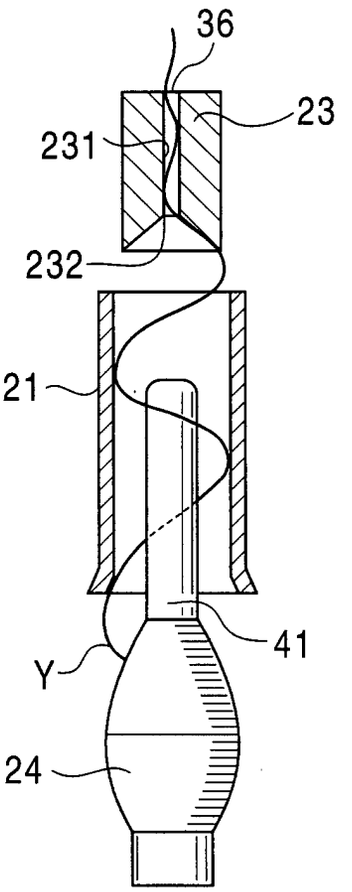


FIG. 7C



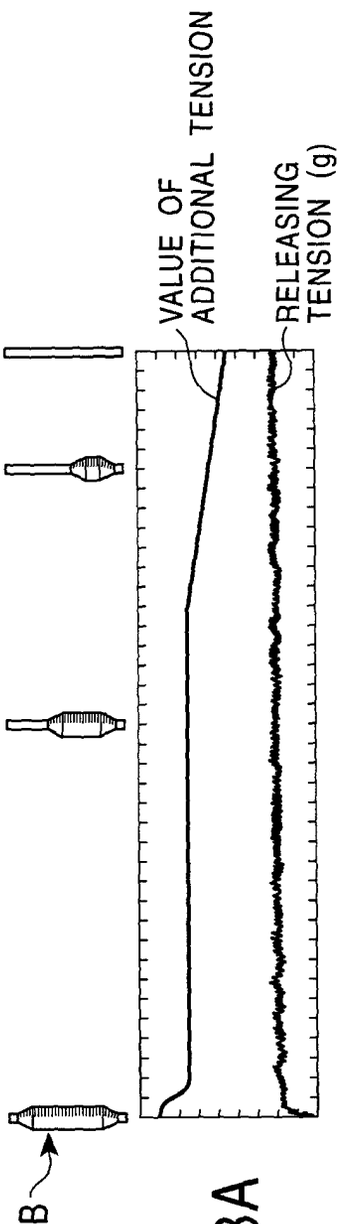


FIG. 8A

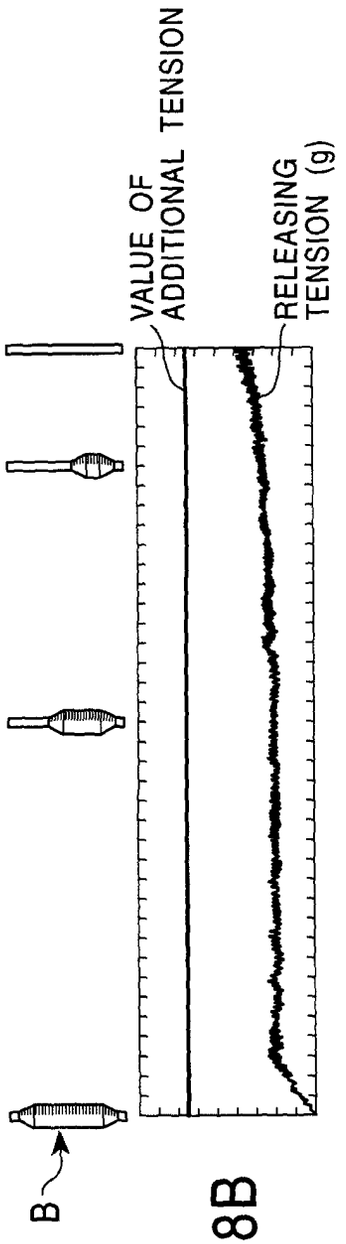


FIG. 8B

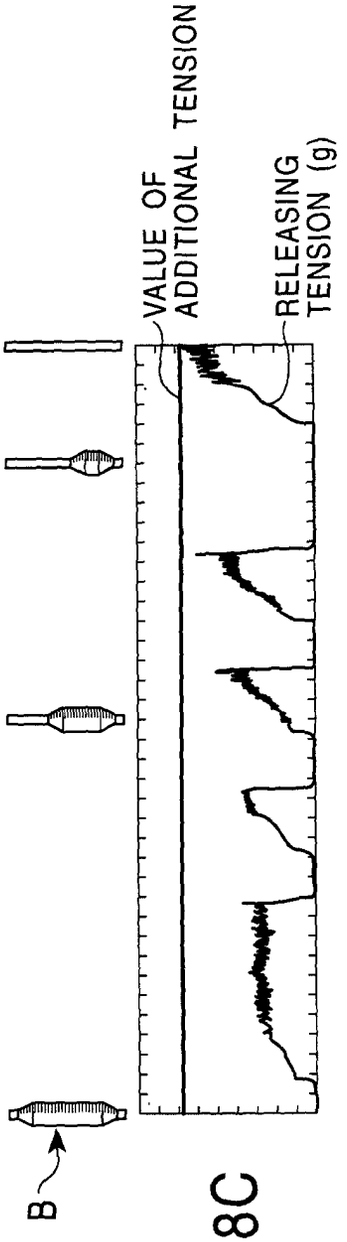


FIG. 8C

FIG. 9

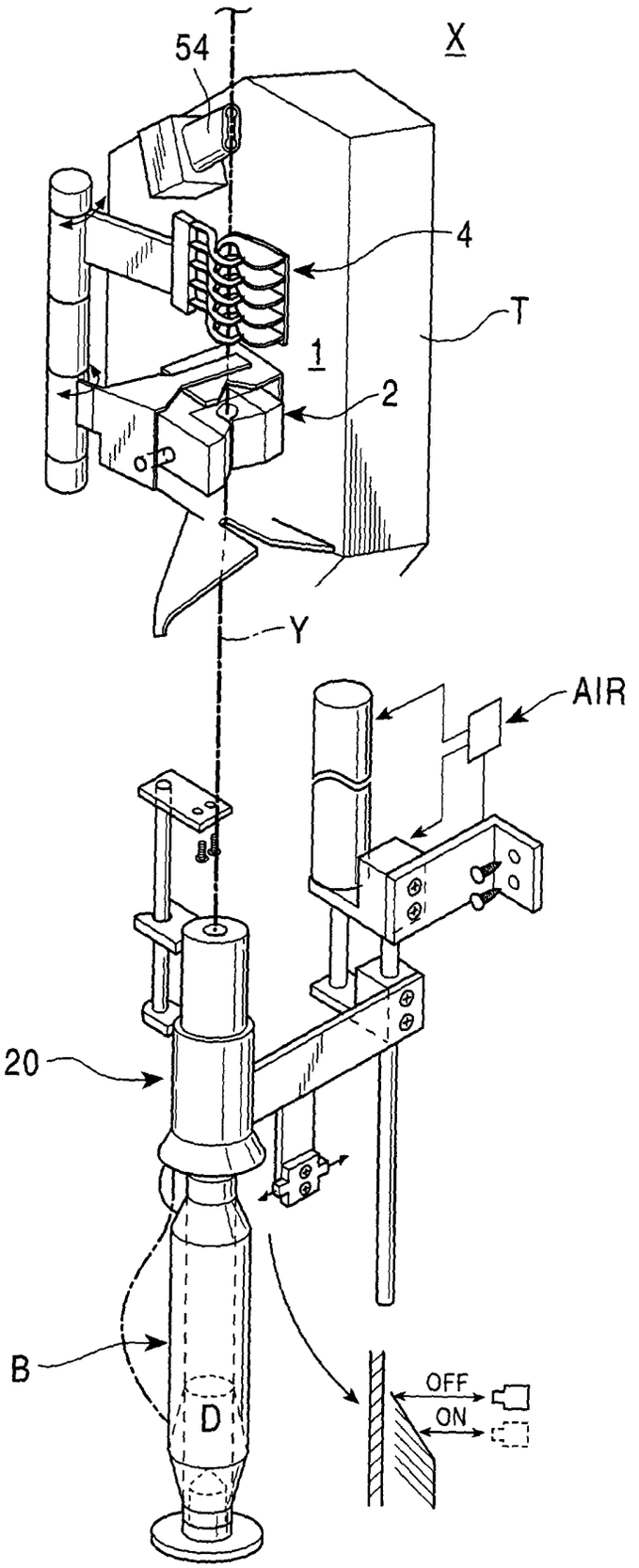
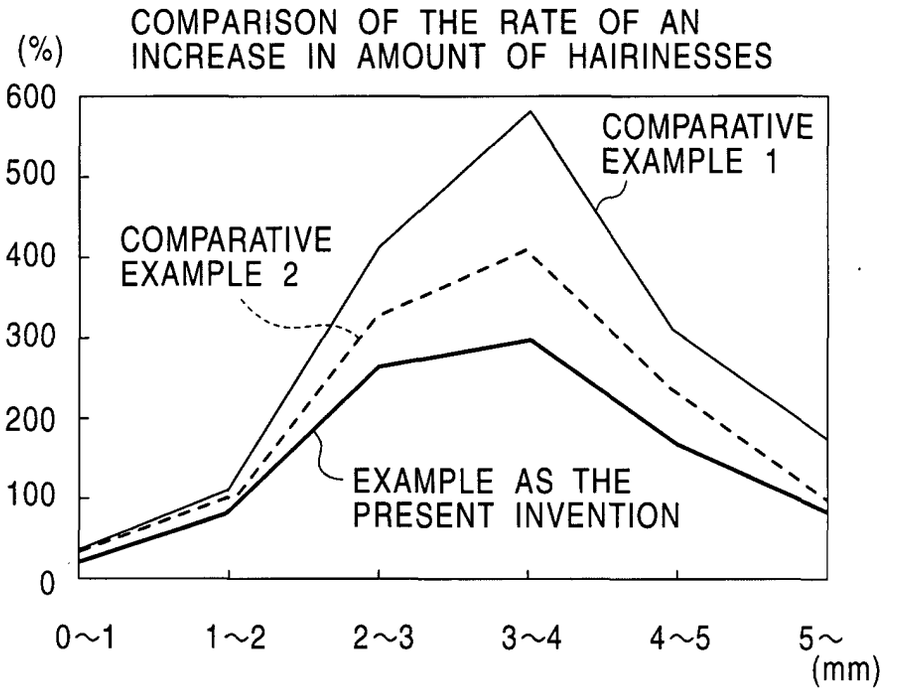


FIG. 10


COMPARISON OF THE RATE OF AN INCREASE IN AMOUNT OF HAIRINESSES
(%)
600
500
400
300
200
100
0
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
EXAMPLE AS THE PRESENT INVENTION
0~1
1~2
2~3
3~4
4~5
5~
(mm)