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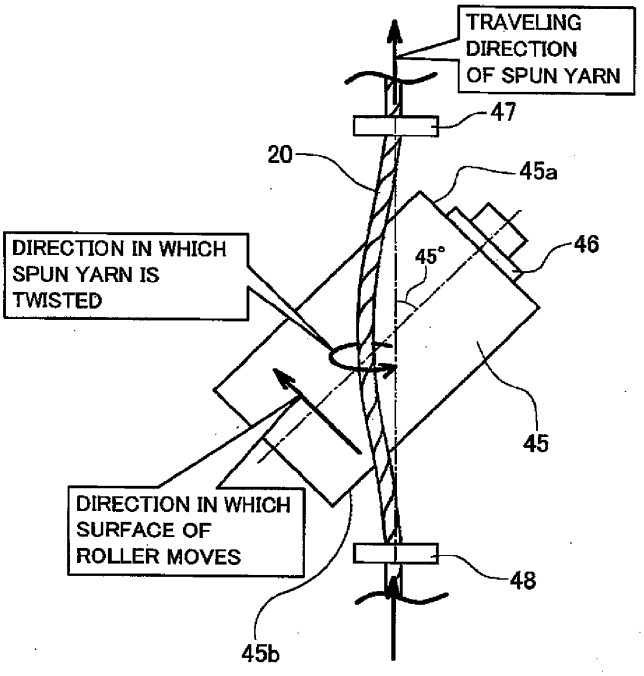
(54) Fluff binding device, tension applying unit, and automatic winder

(57) A fluff binding device (16) includes a fluff binding roller (45), and a yarn guide mechanism. The fluff binding roller (45) is arranged so that an axis line is oblique with respect to a yarn traveling path and so as to be rotatable with the axis line as a center. The yarn guide mechanism brings a spun yarn (20) into contact with one part of an outer peripheral surface of the fluff binding roller (45).

FIG. 4A



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a configuration of a fluff binding device (roller) of an automatic winder. Such devices are also known as fluff reducing device (roller) or hairiness reducing device (roller).

2. Description of the Related Art

[0002] A spun yarn formed through a ring fine spinning, or the like is wound around a yarn supplying bobbin and fed to an automatic winder. The automatic winder splices a plurality of yarn supplying bobbins to rewind into a cone shaped or a cheese shaped package while removing defects of the spun yarn. The spun yarn is a yarn in which short fibers are lined and converged in parallel, and then twisted to give a constant thickness and length. The spun yarn is configured by relatively short fibers, and thus fluff tends to easily form compared to the filament yarn made up of long continuous fibers.

[0003] The rewinding step by the automatic winder is a step of guiding the spun yarn with a great number of yarn guides and winding into a package while applying tension on the spun yarn unwound from the yarn supplying bobbin. Therefore, the spun yarn is subjected to friction every time it passes through the tension applying device and the yarn guide, and hence the fluff that exists at the spun yarn tends to increase.

[0004] Therefore, in the rewinding step by the automatic winder of the related art, a fluff binding device is arranged in a traveling path of the spun yarn to suppress the formation of the fluff. The fluff binding device performs the fluff binding process by injecting gas such as compressed air into the yarn passage, through which the spun yarn passes, thus causing a whirling airflow and ballooning the spun yarn to entangle and involve the fluff into the fiber or fling away the unnecessary fibers that do not contribute to the formation of the yarn. This type of fluff binding device is described in Japanese Laid-Open Patent Publication No. 2001-139231.

[0005] A multiple-disc method is also known for another type of fluff binding device in which a plurality of friction discs is arranged, so that the fluff binding process is carried out by performing temporary twist on the spun yarn traveling through an action position by the rotation of the discs, and involving the fluff that projected out from a surface of the spun yarn into the fiber configuring the relevant spun yarn. This type of fluff binding device is described in Japanese Laid-Open Patent Publication No. 2002-348042.

[0006] However, the fluff binding device described above has a complex mechanism since fluff binding is carried out by compressed air or drive member. Furthermore, the air amount of the compressed air and the drive amount of the drive member had to be adjusted to control the fluff binding amount.

[0007] With respect to the spinning machine, Japanese Laid-Open Utility Model No. 6-83774 describes a fluff suppressing device including a roller for winding the yarn in a spiral form. Japanese Laid-Open Utility Model No. 6-83774 describes slidably moving the yarn while being rolled on a peripheral surface of the rotating roller so that the fluff fiber freed at a yarn surface is wound around the yarn itself thereby obtaining the spun yarn that practically does not have fluff. The configuration of Japanese Laid-Open Utility Model No. 6-83774 is a simple configuration of only one roller, and does not require a complex mechanism as with the Japanese Laid-Open Patent Publication No. 2001-139231 and Japanese Laid-Open Patent Publication No. 2002-348042.

BRIEF SUMMARY OF THE INVENTION

[0008] With the configuration of Japanese Laid-Open Utility Model No. 6-83774, the yarn tightens the roller when the yarn is pulled in a direction of being pulled out from the roller since the yarn is wound in a spiral form around a surface of the roller, and as a result, it is difficult for the yarn to slide on the surface of the roller. If assumed that the yarn does not slide on the surface of the roller, there is a high possibility the yarn may be strained and cut when a traveling speed of the yarn suddenly changes on the downstream side of the roller.

[0009] In this regards, the traveling speed of the yarn rarely changes greatly since a winding speed is relatively slow in the spinning machine and thus the configuration of Japanese Laid-Open Utility Model No. 6-83774 is sufficiently practical. However, in the case of the automatic winder, a fluctuation width of the traveling speed is large since the traveling speed of the yarn (winding speed of the yarn) is fast compared to the spinning machine. Furthermore, the traveling speed of the yarn may suddenly fluctuate in the automatic winder as a result of the disturb control or the like for preventing ribbon winding from being carried out. Therefore, yarn cut is assumed to occur frequently as the fluctuation of the yarn traveling speed cannot be responded in the automatic winder described above in the fluff suppressing device described in Japanese Laid-Open Utility Model No. 6-83774.

[0010] The present invention has been made in view of the above situations, and the main object of the present invention is to provide a fluff binding device capable of effectively suppressing the fluff with a simple configuration and capable of responding to a high speed winding of the automatic winder.

[0011] The problems to be solved by the present invention are as described above, and now the means for solving the problems and the effects thereof will be described.

[0012] According to a first aspect of the present invention, a fluff binding device for suppressing occurrence of fluff of a traveling spun yarn is provided, the fluff binding

device having the following configuration. In other words, the fluff binding device includes a fluff binding roller and a yarn guide mechanism. The fluff binding roller is arranged so that an axis line is oblique with respect to a yarn traveling path and so as to be freely rotatable with the axis line as a center. The yarn guide mechanism brings the spun yarn into contact with one part of an outer peripheral surface of the fluff binding roller.

[0013] According to such configuration, the spun yarn travels on a surface of the fluff binding roller while slidably moving, and the yarn is twisted by the rotating fluff binding roller. The fluff fiber freed on the surface of the spun yarn is wound around the spun yarn itself thus suppressing the fluff due to the twisting action and the friction action at the time of the slidable movement. Therefore, the fluff binding effect can be realized with a simple configuration with only one roller. Furthermore, the spun yarn can slide on the outer peripheral surface of the fluff binding roller when the winding speed of the spun yarn is greatly fluctuated thus preventing yarn cut since the spun yarn is not wound around the fluff binding roller and the spun yarn is merely brought into contact with one part of the outer peripheral surface of the fluff binding roller.

[0014] In the fluff binding device described above, the fluff binding roller preferably cantilever-supports the end on the downstream side in a traveling direction of the spun yarn.

[0015] In other words, in the fluff binding device of the present invention, the yarn travels on the surface of the fluff binding roller, which is arranged oblique with respect to the traveling path of the spun yarn, while slidably moving, and hence the spun yarn drifts towards the end on the upstream side in the traveling path of the fluff binding roller. Therefore, when the end on the upstream side in the yarn traveling path of the fluff binding roller is to be supported, the spun yarn tends to easily entangle to the supporting shaft thereof. In this regards, the spun yarn is less likely to entangle with respect to the supporting shaft of the fluff binding roller according to the configuration described above.

[0016] The fluff binding device described above preferably includes a switching mechanism for switching a tilt of the axis line of the fluff binding roller.

[0017] Therefore, the tilt of the roller can be changed according to a twisting direction of the spun yarn, so that the yarn can be twisted on the upstream side than the fluff binding roller thus involving the fluff for both cases of the twisting direction of the spun yarn being the Z twist and the S twist.

[0018] The fluff binding device is preferably configured as below. In other words, the yarn guide mechanism is arranged to be movable in a direction of traversing the yarn traveling path. The yarn guide mechanism bends the spun yarn traveling through the yarn traveling path to change a contacting length of the spun yarn brought into contact with the outer peripheral surface of the fluff binding roller.

[0019] The fluff binding effect can be adjusted by changing the contacting length of the spun yarn with respect to the fluff binding roller.

[0020] In the fluff binding device described above, a groove lying along a direction substantially orthogonal to the axis line of the fluff binding roller is preferably formed at a surface of the fluff binding roller.

[0021] Therefore, a large fluff binding effect can be obtained by forming a groove in the surface of the fluff binding roller compared to a case when the surface is smoothly formed.

[0022] In the fluff binding device described above, the surface of the fluff binding roller is preferably made of rubber.

[0023] Therefore, an appropriate friction can be generated between the spun yarn and the roller surface by making the roller surface of rubber, so that a large fluff binding effect can be exhibited.

[0024] In the fluff binding device described above, the surface of the fluff binding roller is preferably made from nitrile butadiene rubber.

[0025] In other words, the nitrile butadiene rubber is particularly suitable for the material of the fluff binding roller as it excels in wear resistance and aging resistance, and is strong to tearing.

[0026] In the fluff binding device described above, the surface of the fluff binding roller may be made from urethane.

[0027] J A large fluff binding effect can be obtained by making the fluff binding roller of urethane compared to a case when making the fluff binding roller of metal such as aluminum.

[0028] The fluff binding device is preferably configured as below. In other words, the yarn guide mechanism is configured by an upstream guide member, a downstream guide member, and a yarn guide moving portion. The upstream guide member guides the spun yarn from an upstream side in a yarn traveling direction as seen from the fluff binding roller to the surface of the fluff binding roller through an upstream yarn guide point. The downstream guide member guides the spun yarn brought into contact with the surface of the fluff binding roller further to the downstream side from the fluff binding roller through a downstream yarn guide point. The yarn guide moving portion enables the movement of the downstream guide member and the downstream guide member in a direction in which a virtual line connecting the upstream yarn guide point and the downstream yarn guide point approaches or separates with respect to the axis line of the fluff binding roller.

[0029] According to such configuration, the amount of pushing the spun yarn against the fluff binding roller can be appropriately adjusted, so that the fluff binding device can be made to function as one type of tension adjusting device.

[0030] According to a second aspect of the present invention, a tension applying unit having the following configuration is provided. In other words, the tension applying unit includes the fluff binding device, a gate form

tension applying device for appropriately adjusting spacing between a movable comb tooth portion and a fixed comb tooth portion, and adjusting a tension of a traveling spun yarn; and a bracket. At least one comb tooth of the movable comb tooth portion is positioned on a side of the fluff binding roller than the comb tooth of the fixed comb tooth portion. Thus, the movable comb tooth portion also functions as the upstream guide member of the fluff binding device. The downstream guide member is configured integrally with the movable comb tooth portion. The fluff binding device and the gate form tension applying device are attached with respect to the bracket.

[0031] According to such configuration, the upstream guide (movable comb tooth portion) and the downstream guide move according to the unwinding tension of the spun yarn, so that the amount of pushing the spun yarn against the fluff binding roller can be adjusted according to the unwinding tension of the spun yarn. As described above, the fluff binding device functions as one type of tension adjusting device. Therefore, as a result of the fluff binding device playing some of the functions of the gate form tension applying device of the related art, the gate form tension applying device can be miniaturized. Furthermore, the fluff binding device and the gate form tension applying device can be handled as one collective unit (tension applying unit) by fixing the fluff binding device and the gate form tension applying device to the bracket.

[0032] According to a third aspect of the present invention, an automatic winder including the fluff binding device, a yarn supplying bobbin supporting section for supporting a yarn supplying bobbin, and a winding section for winding a spun yarn of the yarn supplying bobbin around a winding bobbin to form a package is provided.

[0033] The automatic winder can form a high quality package at low cost by including a fluff binding device capable of suppressing the fluff with a simple configuration.

[0034] According to a fourth aspect of the present invention, an automatic winder including the tension applying unit; a yarn supplying bobbin supporting section for supporting a yarn supplying bobbin; and a winding section for winding a spun yarn of the yarn supplying bobbin around a winding bobbin to form a package, wherein the tension applying unit is configured to be freely attachable/detachable is provided.

[0035] Since the automatic winder includes the fluff binding device capable of suppressing the fluff with a simple configuration, a high quality package can be formed at low cost. The automatic winder excels in maintenance since the tension applying unit can be detached.

[0036] The automatic winder is preferably configured as below. In other words, the automatic winder includes a yarn splicing device and a control unit. The yarn splicing device splices a yarn end from the yarn supplying bobbin and a yarn end from the winding bobbin. The control unit opens the yarn guide mechanism when the yarn splicing device carries out a yarn splicing operation, and moves the yarn guide mechanism to bring the spun yarn into contact with an outer peripheral surface of the fluff binding roller when the yarn splicing operation is completed and the winding section resumes a winding operation.

[0037] In other words, the yarn can be easily introduced into the fluff binding device by guiding the yarn to the yarn splicing device with the yarn guide mechanism in the open state. Therefore, the fluff can be easily bound by opening and closing the yarn guide mechanism at the time of the yarn splicing operation of the automatic winder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. 1 is a schematic front view of a winder unit arranged in an automatic winder according to one embodiment of the present invention;

[0039] FIG. 2 is a schematic side view of the winder unit;

[0040] FIG. 3 is a front view illustrating a state in which a tension applying unit is detached;

[0041] FIG. 4A is a side view illustrating a configuration of a fluff binding device, FIG. 4B is a front view illustrating the configuration of the fluff binding device;

[0042] FIG. 5 is a side view illustrating a configuration of a fluff binding device according to a variant;

[0043] FIG. 6 is a view illustrating a state of a fluff binding roller seen from an axis line direction thereof;

[0044] FIG. 7A is a view illustrating a state in which comb teeth are deeply geared, and FIG. 7B is a view illustrating a state in which the gearing of the comb teeth is shallow;

[0045] FIG. 8 is a graph illustrating the effects of the fluff binding device of the present embodiment;

[0046] FIG. 9 is a graph illustrating the fluff binding effects of the fluff binding roller by material;

[0047] FIG. 10 is a cross-sectional view illustrating a structure of the fluff binding roller in which the surface is made of rubber; and

[0048] FIG. 11 is a plan view of the fluff binding roller in which a groove is formed in the surface.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0049] An embodiment of the present invention will now be described with reference to the drawings. FIG. 1 and FIG. 2 are schematic views of a winder unit 10 arranged in an automatic winder serving as a yarn winding machine according to one embodiment of the present invention. The automatic winder of the present embodiment includes a plurality of winder units 10 arranged side by side, and a machine control device (not illustrated).

[0050] Each winder unit 10 includes a yarn supplying bobbin supporting section 31, a winding section 32, an unwinding assisting device 12, a tension applying device 13, a fluff binding device 16, a splicer device 14, and a yarn quality measuring instrument 15. The winder unit

also includes a unit main body 11, where each configuration (winding section 32, unwinding assisting device 12, tension applying device 13, fluff binding device 16, splicer device 14, yarn quality measuring instrument 15, and the like) is attached to a side surface of the unit main body 11.

[0051] The yarn supplying bobbin supporting section 31 is configured to hold a yarn supplying bobbin 21, around which a spun yarn manufactured in a spinning step is wound, in a substantially standing state.

[0052] The winding section 32 is configured to wind a spun yarn 20 unwound from the yarn supplying bobbin 21 around a winding bobbin 22 while traversing and form a package 30 of a predetermined shape at a predetermined length, and includes a winding drum 24 and a cradle 23.

[0053] The winding drum 24 is arranged to face the winding bobbin 22. A spiral shaped traverse groove 27 is formed on an outer peripheral surface of the winding drum 24, so that the spun yarn 20 is traversed by the traverse groove 27. An outer peripheral surface of the winding bobbin 22 (or package 30 in which a yarn layer is formed on the outer periphery of the winding bobbin 22) is brought into contact with the outer peripheral surface of the winding drum 24, so that the winding bobbin 22 is rotatably driven when the winding drum 24 is rotatably driven. The winding drum 24 is coupled to an output shaft of a drum drive motor 53, and the operation of the drum drive motor 53 is controlled by a motor control unit (not illustrated).

[0054] The motor control unit is configured to wind the spun yarn 20 unwound from the yarn supplying bobbin 21 around the winding bobbin 22 at an appropriate speed by appropriately controlling the drum drive motor 53 and rotating the winding drum 24 at a predetermined rotation speed. The motor control unit is also configured to carry out a disturb control for preventing ribbon winding. The disturb control is a control of rapidly increasing or decreasing a speed of the rotation of the winding drum 24 in the vicinity of the ribbon winding occurring diameter to cause a slip between the package 30 and the winding drum 24, and distributing a yarn path of the spun yarn 20 to be traversed and winding the spun yarn. The ribbon winding is thereby broken, and the package 30 excelling in unwinding property can be formed.

[0055] The cradle 23 is configured to rotatably grip the winding bobbin 22. The cradle 23 is configured to be rotatable in a direction of moving closer to or moving away from the winding drum 24 with a swing shaft (supporting shaft) (not illustrated) as the center. When the cradle 23 swings, the increase in the diameter of the package 30 involved in the winding of the spun yarn 20 around the winding bobbin 22 can be absorbed. The spun yarn 20 thus can be wound in a state a surface of the package 30 is always and appropriately brought into contact with the winding drum 24 even if the package 30 becomes thicker by the winding and thus the yarn layer diameter increases.

[0056] The winder unit 10 of the present embodiment has a configuration in which the unwinding assisting device 12, the tension applying device 13, the fluff binding device 16, the splicer device 14, and the yarn quality measuring instrument 15 are arranged in order from the upstream side in a yarn traveling path between the yarn supplying bobbin 21 and the winding bobbin 22. In the present specification, "upstream side" and "downstream side" refer to the upstream side and the downstream side when viewed in a traveling direction of the spun yarn 20.

[0057] The unwinding assisting device 12 assists the unwinding of the yarn from the yarn supplying bobbin 21 by lowering a regulation member 40, which is covered on a core tube of the yarn supplying bobbin 21, in cooperation with the unwinding of the yarn from the yarn supplying bobbin 21. The regulation member 40 assists the unwinding of the yarn by being brought into contact with a balloon formed at the upper part of the yarn supplying bobbin 21 by the rotation of the yarn unwound from the yarn supplying bobbin 21 and the centrifugal force, and controlling the balloon to an appropriate size.

[0058] The tension applying device 13 applies a predetermined tension on the traveling spun yarn 20. The tension applying device 13 is configured to a gate form in which a movable comb tooth (movable comb tooth 42) is arranged with respect to a fixed comb tooth (fixed comb tooth 41). As illustrated in FIG. 1, the fixed comb tooth 41 and the movable comb tooth 42 are configured to be able to gear with each other through a predetermined gap. The spun yarn 20 unwound from the yarn supplying bobbin 21 travels while being bent through the geared comb teeth 41, 42. A predetermined tension is thereby applied on the spun yarn 20 wound into the package 30 in the winding section 32, thus improving the quality of the package 30.

[0059] The movable comb tooth 42 is configured to be movable to approach or separate with respect to the fixed comb tooth 41, so that the depth of gearing between the fixed comb tooth 41 and the movable comb tooth 42 can be changed. Since the traveling spun yarn 20 bends greater as the gearing between the fixed comb tooth 41 and the movable comb tooth 42 is deeper, and thus the tension to be applied to the spun yarn 20 can be increased. In other words, an appropriate tension corresponding to the situation can be applied to the spun yarn 20 by enabling the depth of the gearing between the fixed comb tooth 41 and the movable comb tooth 42 to be changed.

[0060] As illustrated in FIG. 1, and the like, the movable comb tooth 42 is fixed at the distal end of a comb tooth drive arm 43. The comb tooth drive arm 43 is configured to swing, so that the movable comb tooth 42 can be moved as described above by swinging the comb tooth drive arm 43. As illustrated in FIG. 2, the tension applying device 13 includes a rotary solenoid 44. The comb tooth drive arm 43 is coupled to the rotary solenoid 44 through a link mechanism, or the like. The winder unit 10 includes a controller (not illustrated) for controlling the operation

of the rotary solenoid 44. With such configuration, the control section controls the operation of the rotary solenoid 44 to move the movable comb tooth 42 in a direction of approaching or separating with respect to the fixed comb tooth 41. At the time of normal winding, a force in the direction of approaching the fixed comb tooth 41 is applied on the movable comb tooth 42 by the rotary solenoid 44. The comb teeth 41, 42 thus can be held in the geared state.

[0061] As the unwinding tension becomes higher at the lower end of the winding bobbin 22, the force of the yarn to be in a linear state (strung state) becomes stronger. As a result of this, the yarn, which travels between the combs 41, 42 while being bent, tries to return to the linear state, the force of pushing back the combs 41, 42 thus acts and the movable comb 42 moves against the force of the rotary solenoid 44. Therefore, as the tension of the spun yarn 20 becomes higher, a phenomenon in which the gearing of the combs 41, 42 becomes shallower occurs. In other words, the combs 41, 42 are deeply geared by the force of the rotary solenoid 44 in a state the unwinding tension of the spun yarn 20 is low, but the spun yarn 20 pushes back the movable comb 42 so that the gearing of the combs 41, 42 becomes shallower as the unwinding tension of the spun yarn 20 becomes higher.

[0062] Therefore, in the gate form tension applying device 13, the depth of the gearing of the combs 41, 42 changes according to the unwinding tension of the yarn, and as a result, the tension to be applied on the spun yarn 20 is automatically adjusted. In other words, a tension stabilized from the upper end to the lower end of the spun yarn 20 can be applied to the spun yarn 20, and a stable fluff binding (to be described later) can be carried out.

[0063] The fluff binding device 16 is arranged immediately on the downstream side of the tension applying device 13. The fluff binding device 16 includes a cylindrical fluff binding roller 45 supported in a freely rotatable manner, and is configured such that the fluff of the spun yarn 20 can be suppressed by having the spun yarn 20 travel while making contact with the fluff binding roller 45. The detailed configuration of the fluff binding device 16 will be described later.

[0064] The tension applying device 13 and the fluff binding device 16 are fixed to a bracket 29, and thus can be handled as one unit (tension applying unit 28). As illustrated in FIG. 3, such tension applying unit 28 is configured to be easily detachable from the unit main body 11 by an appropriate detachment task. The maintenance of the tension applying unit 28 and the unit main body 11 thus can be improved.

[0065] The yarn quality measuring instrument 15 is configured to detect the yarn defect by monitoring a thickness of the traveling spun yarn 20. A cutter (not illustrated) for immediately cutting the spun yarn 20 when the yarn quality measuring instrument 15 detects yarn defect is arranged in the vicinity of the yarn quality measuring instrument 15.

[0066] The splicer device 14 splices the lower yarn from the yarn supplying bobbin 21 and the upper yarn from the package 30 after the yarn quality measuring instrument 15 detects the yarn defect and cuts the yarn, after yarn cut during unwinding from the yarn supplying bobbin 21, or the like. The yarn splicing device 14 for splicing the upper yarn and the lower yarn may be a mechanical type or may be a type that uses fluid such as compressed air.

[0067] A lower yarn guiding pipe 25 for catching the lower yarn from the yarn supplying bobbin 21 and guiding the lower yarn to the splicer device 14 and an upper yarn guiding pipe 26 for catching the upper yarn from the package 30 and guiding the upper yarn to the splicer device 14 are arranged on the lower side and the upper side of the splicer device 14. The lower yarn guiding pipe 25 and the upper yarn guiding pipe 26 are respectively configured to swing with a shaft 33, 35 as the center. A suction hole 36 is formed at the tip end of the lower yarn guiding pipe 25 and a suction mouth 34 is arranged at the tip end of the upper yarn guiding pipe 26. The lower yarn guiding pipe 25 and the upper yarn guiding pipe 26 are respectively connected to an appropriate negative pressure source to cause the suction hole 36 and the suction mouth 34 to generate a suction flow, and suck and catch the yarn ends of the upper yarn and the lower yarn.

[0068] The fluff binding device 16 will now be specifically described with reference to FIGS. 4A and 4B. The fluff binding device 16 includes the fluff binding roller 45 and a yarn guide mechanism. In FIGS. 4A and 4B, a thickness of the spun yarn 20 is emphatically drawn than that of an actual thickness to illustrate a twisting direction of the spun yarn 20.

[0069] The yarn guide mechanism includes an upstream guide (upstream guide member) 48, a downstream guide (downstream guide member) 47, and a yarn guide moving portion. As hereinafter described, the rotary solenoid 44 serves as the yarn guide moving portion in the present embodiment.

[0070] The upstream guide 48 for guiding the spun yarn 20 on the upstream side and guiding the spun yarn 20 to the fluff binding roller 45 is arranged on the upstream side of the fluff binding roller 45. The downstream guide 47 for guiding the spun yarn 20 further traveling to the downstream side from the fluff binding roller 45 is arranged on the downstream side of the fluff binding roller 45. A point where the spun yarn 20 and the upstream guide 48 are brought into contact with each other is an upstream guide point, and a point where the spun yarn 20 and the downstream guide 47 are brought into contact with each other is a downstream guide point. In other words, the spun yarn 20 is guided up to the fluff binding roller through the upstream guide point, and further guided towards the downstream side from the fluff binding roller through the downstream guide point.

[0071] In the present embodiment, the tension applying device 13 is arranged on the upstream side of the

fluff binding roller 45, where the spun yarn 20 is pulled out from the tension applying device 13 to a side of the fluff binding roller 45 while being guided by the comb tooth on the most downstream side, as illustrated in FIG. 1. The comb tooth on the most downstream side is one of the comb teeth that configure the movable comb 42. In other words, the tooth on the most downstream side of the movable comb 42 serves as a function for the upstream guide 48 of the fluff binding device 16.

[0072] As illustrated in the side view of FIG. 4A, the fluff binding roller 45 is arranged with an axis line thereof tilted 45 degrees with respect to the yarn traveling path. More precisely, as seen from a direction orthogonal to a virtual line connecting the upstream guide point and the downstream guide point and the axis line, the axis line is tilted 45 degrees with respect to the virtual line. In the following description, an end closer to the winding bobbin 22 of the ends of the obliquely disposed fluff binding roller is referred to as a downstream end 45a, and an end closer to the yarn supplying bobbin 21 is referred to as an upstream end 45b. The fluff binding roller 45 is supported by a roller supporting member 46 so as to be freely rotatable about the axis line thereof. The roller supporting member 46 is fixed to the bracket 29.

[0073] As illustrated in FIG. 4B, the fluff binding roller 45 is arranged to interfere with the virtual line connecting the upstream guide point and the downstream guide point. With such configuration, the spun yarn 20 between the upstream guide point and the downstream guide point travels through a curved path along a surface of the fluff binding roller 45 while making contact with a surface of the fluff binding roller 45, as illustrated in FIG. 4B.

[0074] As described above, the spun yarn 20 between the upstream guide point and the downstream guide point travels through a path curved along the surface of the fluff binding roller 45. As a predetermined tension is applied on the spun yarn 20 by the tension applying device 13, a force to return to the linear state (strung state) acts thereon. Therefore, the spun yarn 20 travels while being pushed against the surface of the fluff binding roller 45. As a result, a friction force is generated between the spun yarn 20 and the surface of the fluff binding roller 45, and the fluff binding roller 45, which is instructed to freely rotate, receives the force from the traveling spun yarn 20 thus being driven and rotated about the axis line. The traveling direction of the spun yarn 20 and a rotation direction of the fluff binding roller 45 are indicated with a thick arrow in FIGS. 4A and 4B.

[0075] If the fluff binding roller 45 is arranged such that the axis line is orthogonal to the traveling path of the yarn, the traveling direction of the spun yarn 20 and a direction in which the surface of the rotating fluff binding roller 45 moves coincide with each other at the contracting portion of the spun yarn 20 and the surface of the fluff binding roller 45. In this case, therefore, the spun yarn 20 can travel without slipping while being pushed against the surface of the fluff binding roller 45 being driven and rotated. Actually, it is not possible to prevent slipping completely, but this will be ignored herein for simplification.

[0076] However, in the present embodiment, the traveling direction of the spun yarn 20 and the direction in which the surface of the rotating fluff binding roller 45 moves do not coincide with each other at the contacting portion of the spun yarn 20 and the surface of the fluff binding roller 45 since the axis line of the fluff binding roller 45 is oblique with respect to the traveling path of the yarn. More specifically, a shift occurs between the traveling direction of the yarn and the direction in which the surface of the fluff binding roller 45 moves as seen from a direction orthogonal to the traveling path of the yarn and an axis line direction of the fluff binding roller 45 (state of FIG. 4A). Therefore, the spun yarn 20 travels while slidably moving on the surface of the fluff binding roller 45.

[0077] The freed fluff fiber can be wound around the spun yarn 20 itself by such slidably moving action, so that the fluff of the spun yarn 20 can be reduced.

[0078] Furthermore, the spun yarn 20 that travels while being pushed against the surface receives a force of being drifted in an oblique direction (upper left direction in FIG. 4A) since the surface of the fluff binding roller 45 moves obliquely, as described above. However, the spun yarn 20 does not drift by a constant distance or more on the surface of the fluff binding roller 45 but rolls on the surface since the position is regulated by the upstream guide 48 and the downstream guide 47. The spun yarn 20 is thus twisted in a constant direction at the contacting portion of the spun yarn 20 and the fluff binding roller 45.

[0079] A direction in which the spun yarn 20 is twisted by the fluff binding roller 45 is determined by a relationship of the traveling direction of the spun yarn 20 and a tilt of the fluff binding roller 45. In the present embodiment, the fluff binding roller 45 is arranged such that twist is applied on a portion on the upstream side than the fluff binding roller 45 of the spun yarn 20. In the example of FIGS. 4A and 4B, for example, a state in which the twist is applied on the spun yarn 20 when the spun yarn 20 is Z twisted is illustrated. That is, as illustrated in FIG. 4A, the fluff binding roller 45 is arranged such that a tilt direction of the portion where the spiral of the fiber of the spun yarn 20 can be seen and a tilt direction of the axis line of the fluff binding roller 45 coincide with each other as seen from a direction orthogonal to the traveling direction of the spun yarn 20 and the axis line of the fluff binding roller 45 and from the position at where the spun yarn 20 is on the near side than the fluff binding roller 45.

[0080] As described above, since the yarn is twisted in a twist applying direction by the fluff binding roller 45, the spun yarn 20 from the upstream guide 48 to the front surface of the fluff binding roller 45 can be recognized as a yarn being applied with the twist. The spun yarn 20 separated from the front surface of the fluff binding roller 45 tries to return to the original state by the restoring force of the spun yarn 20 since the force of twisting does not exist. Therefore, the yarn from the front surface of the fluff binding roller 45 to the downstream guide 47 can be

recognized as a yarn which applied twist is being resolved. Therefore, the freed fluff fiber can be wound around the spun yarn itself thus reducing the fluff by temporarily applying twist on the spun yarn 20.

[0081] If the spun yarn of S twist is traveled with the fluff binding roller 45 arranged as in Fig. 4, the spun yarn may be untwisted by the twisting force. Therefore, the fluff binding roller 45 is to be arranged with the front and the back reversed as illustrated in Fig. 5 when traveling the spun yarn of S twist. The fluff binding device 16 of the present embodiment includes a switching mechanism for switching the arrangement of the fluff binding roller 45 to the arrangement of Fig. 4 and the arrangement of Fig. 5 in order to respond to both the Z twist and the S twist. Although not illustrated, the switching mechanism is a mechanism for rotating the fluff binding roller 45 180 degrees with the yarn path, through which the spun yarn 20 travels, as the center. The arrangement of the fluff binding roller 45 can be easily switched according to the twisting direction of the yarn.

[0082] Therefore, the fluff binding device 16 of the present embodiment can suppress the fluff of the spun yarn 20 with a simple configuration in which only one fluff binding roller 45 is arranged and in which the drive source of the fluff binding roller 45 is not necessary. Furthermore, energy saving can be achieved since the fluff binding roller 45 is configured to be driven and rotated and does not require energy for the rotatable drive.

[0083] Moreover, the fluff binding roller 45 rotates at a speed corresponding to a traveling speed of the spun yarn 20 with the configuration of the fluff binding roller 45 being driven and rotated by the traveling spun yarn 20. In other words, a stable fluff binding can be realized according to the traveling speed of the spun yarn 20 with a simple configuration as described above.

[0084] When the automatic winder carries out a yarn defect removing operation or replaces the yarn supplying bobbin 21, a state in which the spun yarn 20 is not brought into contact temporarily with the front surface of the fluff binding roller 45 is realized. In such state, however, the fluff binding roller 45 continuously rotates by the rotation energy up to the relevant point. Since the fluff binding roller 45 is continuously rotating even after the automatic winder completes splicing and resumes the winding operation of the spun yarn 20, acceleration can be carried out in a short time up to a rotation speed corresponding to the traveling speed of the spun yarn 20.

[0085] In the present embodiment, as illustrated in FIG. 4A, the downstream end 45a of the fluff binding roller 45 is cantilever-supported by the roller supporting member 46. This is to prevent the spun yarn 20 from winding around the roller supporting member. In other words, since the spun yarn 20 easily drifts towards the upper left side of FIG. 4A, as described above, the yarn end easily scatters towards the left side of FIG. 4A when the spun yarn 20 breaks, or the like. Therefore, when the upstream end 45b of the fluff binding roller 45 is supported by the roller supporting member, the roller supporting member is arranged on the left side (more precisely, lower left side of FIG. 4A) seen from the fluff binding roller 45. The broken yarn end thus easily moves towards the roller supporting member. As a result, the spun yarn 20 easily winds around on the roller supporting member.

[0086] In this regards, the roller supporting member 46 is positioned on the side opposite to a direction in which the broken yarn end easily scatters when the upstream end 45b of the fluff binding roller 45 is cantilever-supported by the roller supporting member 46, so that the spun yarn 20 can be prevented from being entangled with the roller supporting member 46.

[0087] As illustrated in FIGS. 4A and 4B, in the present embodiment, the spun yarn 20 is merely brought into contact with the outer peripheral surface of the fluff binding roller 45, and the spun yarn 20 is not wound around the fluff binding roller 45. Specifically, as illustrated in FIG. 6, the spun yarn 20 is brought into contact with only about half of the outer peripheral surface of the fluff binding roller 45 as seen from the axis line direction of the fluff binding roller 45. The spun yarn 20 can slide on the front surface of the fluff binding roller 45 by a certain extent since the spun yarn 20 is not wound around the fluff binding roller 45. Therefore, a speed fluctuation can be absorbed as the spun yarn slides on the fluff binding roller 45 even if the speed fluctuation due to traversing, and sudden speed change due to performance of the disturb control or the like occur, and the spun yarn 20 is instantaneously pulled towards the downstream side. Such sliding prevents the yarn from breakage.

[0088] In a case where the spun yarn 20 is wound around the fluff binding roller 45, the spun yarn 20 from the yarn supplying bobbin 21 is required to again be wound around the fluff binding roller 45 when guiding the yarn from the yarn supplying bobbin 21 up to the splicer device 14 when yarn cut occurs. However, the device is assumed to become extremely complicated in order to automatically realize such operation of winding the spun yarn 20 around the fluff binding roller 45. In this regards, in the present embodiment, the spun yarn 20 is brought into contact with only about half of the outer periphery of the fluff binding roller 45. Therefore, when yarn cut occurs, the spun yarn 20 is guided so as to be handed over to the downstream guide 47 and the upstream guide 48 when guiding the spun yarn 20 from the yarn supplying bobbin 21 up to the splicer device 14 by means of the lower yarn guiding pipe 25. With such guidance, the spun yarn 20 can be set to the state of FIGS. 4A and 4B. Therefore, the complicating configuration for winding the yarn around the periphery of the fluff binding roller 45 becomes unnecessary with the configuration of brining the spun yarn 20 into contact with only about half of the fluff binding roller 45.

[0089] The configuration of the downstream guide 47 will now be described. As illustrated in FIGS. 7A and 7B, the downstream guide 47 is fixed with respect to the upstream guide 48 (movable comb tooth 42). More specifically, the downstream guide 47 is attached to the comb

tooth drive arm 43 for driving the movable comb tooth 42. As described above, the movable comb tooth 42 can be moved by the solenoid 44 in a direction of approaching or separating with respect to the fixed comb tooth 41. When the movable comb tooth (upstream guide) 42 is moved by the rotary solenoid 44, the downstream guide 47 fixed to the movable comb tooth 42 also integrally moves. Therefore, the rotary solenoid 44 has a function of the yarn guide moving portion.

[0090] When the upstream guide 48 and the downstream guide 47 move as described above, the virtual line connecting the upstream guide point and the downstream guide point moves in a direction of approaching or separating with respect to the axis line of the fluff binding roller 45. The control unit controls the rotary solenoid 44 and moves the upstream guide 48 and the downstream guide 47 in a direction of traversing the yarn traveling path. Therefore, as illustrated in FIG. 7A and FIG. 7B, to what extent the spun yarn 20 come into contact with the front surface of the fluff binding roller 45 is to be curved and traveled can be adjusted. As illustrated in FIG. 7A and FIG. 7B, the spun yarn 20 between the upstream guide point and the downstream guide point is pushed stronger against the front surface of the fluff binding roller 45 as the movable comb tooth 42 and the fixed comb tooth 41 are geared deeper. As a result, the spun yarn 20 greatly curves and travels along the front surface of the fluff binding roller 45.

[0091] As described above, the upstream guide 48 and the downstream guide 47 movably arranged in the direction of traversing the yarn traveling path are moved by the rotary solenoid 44, and the yarn traveling path is bent so that the contacting length of the spun yarn 20 with respect to the outer peripheral surface of the fluff binding roller 45 can be changed, whereby the adjustment of the fluff binding action can be carried out.

[0092] The rotary solenoid 44 is controlled to move the upstream guide 48 and the downstream guide 47 in a direction in which the movable comb tooth 42 and the fixed comb tooth 41 move apart, so that the virtual line connecting the upstream guide point and the downstream guide point does not interfere with the fluff binding roller 45. Such position is referred to as "open position" of the upstream guide 48 and the downstream guide 47. In other words, the control unit controls the rotary solenoid 44 and moves the upstream guide 48 and the downstream guide 47 to the open position to obtain a state in which the spun yarn 20 does not come into contact with the surface of the fluff binding roller 45. As opposed to the open position, the position (position illustrated in FIGS. 4A and 4B and FIGS. 7A and 7B) of the upstream guide 48 and the downstream guide 47 when the spun yarn 20 is pushed against the surface of the fluff binding roller 45 is referred to as "close position".

[0093] With such configuration, the control unit controls the rotary solenoid 44 and moves the upstream guide 48 and the downstream guide 47 up to the open position when the yarn cut occurs and the yarn splicing operation is carried out. When the spun yarn 20 from the yarn supplying bobbin 21 is guided to the splicer device 14 by the lower yarn guiding pipe 25 in such a state, the spun yarn 20 can be handed to the downstream guide 47 and the upstream guide 48. When the yarn splicing operation in the splicer device 14 is completed and the winding section resumes winding, the control unit controls the rotary solenoid 44 to move the downstream guide 47 and the upstream guide 48 to the close position. The spun yarn 20 can be set to the state of FIGS. 4A and 4B. Therefore, the spun yarn 20 can be easily introduced to the fluff binding device 16 by opening and closing the downstream guide 47 and the upstream guide 48 at the time of yarn splicing.

[0094] As described above, the tension applying device 13 of the present embodiment is configured such that the gearing of the comb teeth 41, 42 becomes shallow as the unwinding tension increases at the lower end of the winding bobbin 22. Therefore, the fluff binding device 16 of the present embodiment is configured to weaken the pushing of the spun yarn 20 with respect to the surface of the fluff binding roller 45 (to reduce the curvature of the spun yarn 20 at the surface of the fluff binding roller 45) as the unwinding tension increases. Therefore, the pushing amount of the spun yarn 20 with respect to the fluff binding roller 45 can be automatically adjusted according to change in the unwinding tension of the spun yarn 20, so that a constant stable fluff binding can be realized from the upper end to the lower end of the spun yarn 20.

[0095] In the fluff binding device 16 of the present embodiment, the spun yarn 20 is pushed against the fluff binding roller 45, and the spun yarn 20 is traveled while being curved at the surface of the fluff binding roller 45, and hence a constant resistance applies on the spun yarn 20 that passes through the fluff binding device 16. Looking from a different standpoint, the fluff binding device 16 of the present embodiment can be recognized as functioning as one type of tension applying device. Furthermore, as described above, the fluff binding device 16 of the present embodiment can adjust the pushing amount of the spun yarn 20 with respect to the surface of the fluff binding roller 45 and the curved amount of the spun yarn according to the change in the unwinding tension of the spun yarn 20. In other words, the fluff binding device 16 of the present embodiment serving as a tension applying device has a function of adjusting the tension to be applied on the spun yarn 20 according to the unwinding tension of the spun yarn 20. Therefore, the fluff binding device 16 of the present embodiment includes some of the functions of the gate form tension applying device 13.

[0096] The tension applying device 13 of the present embodiment is miniaturized compared to the conventional gate form tension applying device. Specifically, the number of teeth of the comb teeth 41, 42 can be reduced compared to the conventional gate form tension applying device, and the dimension in a vertical direction of FIGS.

7A and 7B can be reduced. Therefore, the fluff binding device 16 can compensate for the function of the tension applying device even if the tension applying device 13 is miniaturized, and hence the tension applying function similar to the conventional gate form tension applying device can be exhibited in the tension applying unit 28 as a whole. Furthermore, a space for arranging the fluff binding device 16 can be ensured on the downstream side of the tension applying device 13 by miniaturizing the tension applying device 13 in the vertical direction, so that the entire tension applying unit 28 can be compactly configured.

[0097] The fluff binding effect by the fluff binding device 16 of the present embodiment will now be described. The inventors of the present invention conducted an experiment of actually carrying out winding by the automatic winder including the fluff binding device 16 and measuring the rate of increase of the number of fluffs in order to check the fluff binding effects by the fluff binding roller 45. The results are illustrated in Fig. 8. The rate of increase of the number of fluffs represents the proportion in which the number of fluffs of greater than or equal to 3 mm contained per 100 m of the spun yarn is increased by the winding of the automatic winder with percentage. In the experiment of Fig. 8, the fluff binding roller with urethane groove (to be descried later) is used.

[0098] Fig. 8 illustrates the result of carrying out winding with the automatic winder not including the fluff binding device, and the result of carrying out winding with the automatic winder including the fluff binding device of the present invention. As illustrated in Fig. 8, when the winding of the spun yarn is carried out with the automatic winder not including the fluff binding device, the rate of increase in the number of fluffs is substantially 140%, and it can be recognized that the fluff is increasing. In the case of the automatic winder including the fluff binding device of the present embodiment, the rate of increase in the number of fluffs is about 35%. Therefore, it is apparent that the fluff can be greatly suppressed by using the fluff binding device of the present embodiment compared to a case when the fluff binding device is not arranged. The effects of the present invention are thereby confirmed.

[0099] The material of the fluff binding roller 45 will now be described. The inventors of the present invention conducted an experiment of forming the surface of the fluff binding roller 45 using various types of materials, carrying out winding of the spun yarn 20 using such fluff binding roller, and measuring the increased amount of fluff to determine the optimum material for the fluff binding roller 45. The results are illustrated in Fig. 9. As illustrated in Fig. 9, in this experiment, the rollers of aluminum buff (buffing is performed on roller made of aluminum), NBR (roller made of nitrile butadiene rubber having smooth surface), urethane slide (polishing is performed on roller made of urethane), and the like are compared.

[0100] If the surface of the fluff binding roller 45 is made of rubber such as NBR, a structure for ensuring the rigidity of the fluff binding roller 45 becomes necessary. An example of a structure of such fluff binding roller 45 is illustrated in a cross-sectional view of FIG. 10. The fluff binding roller 45 illustrated in FIG. 10 has a configuration in which an aluminum tube 55 is further arranged inside a rubber tube 54 configuring the outer peripheral surface of the fluff binding roller 45. The rigidity of the roller thus can be ensured by the aluminum tube 55 while making the surface of the fluff binding roller 45 of rubber. Furthermore, both ends of the rubber tube 54 and the aluminum tube 55 are blocked by a lid member 56 made of aluminum, and the lid member 56 is attached to a rotation shaft 58 with a bearing 57 interposed therebetween. According to such configuration, the inertia can be reduced by forming the fluff binding roller 45 to a hollow form.

[0101] It is apparent as a result of the experiment that the rate of increase in the number of fluffs is small (fluff binding effect is large) when the fluff binding roller made of nitrile butadiene rubber and made of urethane is used, as illustrated in FIG. 9. In particular, an appropriate friction force can be generated between the fluff binding roller 45 and the spun yarn 20 by making the surface of the fluff binding roller 45 of rubber, and thus a large fluff binding effect is assumed to be obtained. The nitrile butadiene rubber excels in wear resistance and aging resistance, and also has a property in being strong to tearing. The wear of the surface is assumed to easily occur at the fluff binding roller 45 of the present embodiment by the slidable movement of the spun yarn 20, and thus the nitrile butadiene rubber having the above properties is particularly suited for the material of the surface of the fluff binding roller 45.

[0102] The inventors of the present invention also created a roller (with NBR groove) made of nitrile butadiene rubber with a microscopic groove on the surface, and a roller (with urethane groove) made of urethane with a microscopic groove on the surface, and conducted the experiment described above. Specifically, as illustrated in Fig. 11, a helical groove 59 extending along a direction substantially orthogonal to the axis line of the fluff binding roller 45 is formed on the outer peripheral surface of the fluff binding roller 45. Alternatively, a plurality of grooves 59 arranged in parallel to each other and orthogonally to the axis line of the fluff binding 45 roller may be provided. The shape of the grooves 59 is not particularly limited, but is preferably a shape without a sharp portion to suppress the damage on the spun yarn 20. For instance, the cross-sectional contour when cut at the plane passing through the axis line of the roller becomes a wavy groove.

[0103] As illustrated in FIG. 9, in either case of being made of nitrile butadiene rubber and made of urethane, the effect of suppressing the fluff is recognized to be greater when the groove is formed on the roller surface compared to a case when the roller surface is a smooth shape. Therefore, the fluff binding effect can be improved by forming the groove on the surface of the fluff binding roller 45.

[0104] As described above, the fluff binding device 16

of the present embodiment includes the fluff binding roller 45 and the yarn guide mechanism. The fluff binding roller 45 is arranged so that the axis line is oblique with respect to the yarn traveling path, and is arranged to be freely rotatable with the axis line center. The yarn guide mechanism brings the spun yarn 20 into contact with one part of the outer peripheral surface of the fluff binding roller 45 as seen in the axis line direction.

[0105] According to such configuration, the spun yarn 20 is traveled while slidably moving the surface of the fluff binding roller 45, and the yarn is twisted by the rotating fluff binding roller 45. The fluff fiber freed on the surface of the spun yarn 20 is wound around the spun yarn 20 itself so that the fluff can be suppressed by the twisting action and the friction action at the time of the slidable movement. Therefore, the fluff binding effect can be realized with a simple configuration of arranging one roller. Moreover, the spun yarn 20 can slide on the outer peripheral surface of the fluff binding roller when a winding speed of the spun yarn 20 is greatly fluctuated thereby preventing yarn cut since the yarn is not wound around the fluff binding roller 45 and the spun yarn 20 is merely brought into contact with one part of the outer peripheral surface of the fluff binding roller 45.

[0106] The fluff binding roller 45 has the downstream end 45a cantilever supported in the fluff binding device 16 of the present embodiment.

[0107] In other words, in the fluff binding device 16 of the present embodiment, the spun yarn 20 travels on the surface of the fluff binding roller 45 arranged obliquely with respect to the traveling path of the spun yarn 20 while slidably moving, and thus the spun yarn 20 is drifted towards the end on the upstream side of the traveling path of the fluff binding roller 45. Therefore, when configured to support the end on the upstream side in the yarn traveling path of the fluff binding roller 45, the yarn may easily get entangled to the supporting shaft. In this regards, the spun yarn 20 is less likely to get entangled to the supporting shaft of the fluff binding roller 45 according to the configuration described above.

[0108] The fluff binding device 16 of the present embodiment includes a switching mechanism for switching the tilt of the axis line of the fluff binding roller.

[0109] As the tilt of the fluff binding roller 45 can be changed according to the twisting direction of the spun yarn 20, the yarn can be accordingly twisted on the upstream side than the fluff binding roller 45 thus involving the fluff in both cases of the twisting direction of the spun yarn 20 being Z twist and S twist.

[0110] In the fluff binding device 16 of the present embodiment, the upstream guide 48 and the downstream guide 47 are arranged to be movable in the direction of traversing the yarn traveling path. The yarn guide mechanism bends the spun yarn 20 traveling through the yarn traveling path to change the contacting length of the spun yarn 20 brought into contact with the outer peripheral surface of the fluff binding roller 45.

[0111] Therefore, the fluff binding effect can be adjusted by changing the contacting length of the spun yarn 20 with respect to the fluff binding roller 45.

[0112] In the fluff binding device 16 of the present embodiment, grooves lying along the direction substantially orthogonal to the axis line of the fluff binding roller 45 are preferably formed on the surface of the fluff binding roller 45.

[0113] A great fluff binding effect can be obtained by forming grooves on the surface of the fluff binding roller 45 compared to a case when the surface is smoothly formed.

[0114] Furthermore, in the fluff binding device 16 of the present embodiment, the surface of the fluff binding roller 45 is preferably made of nitrile butadiene rubber.

[0115] In other words, the nitrile butadiene rubber is particularly suited for the material of the fluff binding roller as it excels in wear resistance and aging resistance and it is strong to tearing.

[0116] In the fluff binding device 16 of the present embodiment, it is similarly effective to form the surface of fluff binding roller 45 with urethane. In other words, a great fluff binding effect can be obtained by making the fluff binding roller 45 of urethane compared to a case when making the fluff binding roller 45 of metal such as aluminum.

[0117] In the fluff binding device 16 of the present embodiment, the yarn guide mechanism is configured by the upstream guide 48, the downstream guide 47, and the rotary solenoid 44. The upstream guide 48 guides the spun yarn 20 from the upstream side in a yarn traveling direction as seen from the fluff binding roller 45 to the surface of the fluff binding roller 45 through the upstream yarn guide point. The downstream guide 47 guides the spun yarn 20 brought into contact with the surface of the fluff binding roller 45 farther to the downstream side from the fluff binding roller 45 through the downstream yarn guide point. The rotary solenoid 44 can move the upstream guide 48 and the downstream guide 47 in a direction in which the virtual line connecting the upstream guide point and the downstream guide point approach or separate with respect to the axis line of the fluff binding roller 45.

[0118] According to such configuration, the amount of pushing the spun yarn 20 against the fluff binding roller 45 can be appropriately adjusted so that the fluff binding device 16 can function as one type of tension adjusting device.

[0119] The tension applying unit 28 of the present embodiment includes the fluff binding device 16, the gate form tension applying device 13 for appropriately adjusting the spacing between the movable comb 42 and the fixed comb 41, and adjusting the tension of the traveling spun yarn 20, and the bracket 29. At least one of the comb teeth of the movable comb 42 is positioned nearer to the side of the fluff binding roller 45 than any comb tooth of the fixed comb 41. Therefore, the movable comb 42 also serves as the upstream guide 48 of the fluff binding device 16. The downstream guide 47 is configured

integrally with the movable comb 42. The fluff binding device 16 and the tension applying device 13 are attached with respect to the bracket 29.

[0120] According to such configuration, the upstream guide 48 and the downstream guide 47 move according to the unwinding tension of the spun yarn 20, so that the amount of pushing the spun yarn 20 against the fluff binding roller 45 can be adjusted according to the unwinding tension of the spun yarn 20. Furthermore, the fluff binding device 16 functions as one type of tension adjusting device. Therefore, as a result of the fluff binding device 16 playing some of the function of the conventional gate form tension applying device, the tension applying device 13 can be miniaturized. Furthermore, the fluff binding device 16 and the tension applying device 13 can be handled as one collective unit (tension applying unit 28) as the fluff binding device 16 and the tension applying device 13 are fixed to the bracket 29.

[0121] The automatic winder of the present embodiment includes the fluff binding device 16, the yarn supplying bobbin supporting section 31 for supporting the yarn supplying bobbin 21, and the winding section 32 for winding the spun yarn 20 of the yarn supplying bobbin 21 around the winding bobbin 22 and forming the package 30.

[0122] The automatic winder can form a high quality package at low cost since the fluff binding device 16 capable of suppressing the fluff with a simple configuration is arranged.

[0123] The automatic winder of the present embodiment is configured to freely attach/detach the tension applying unit 28.

[0124] The automatic winder excels in maintenance property as the tension applying unit 28 can be detached.

[0125] The automatic winder of the present embodiment is configured as below. In other words, the automatic winder includes the splicer device 14 and the control unit. The splicer device 14 splices the yarn end from the yarn supplying bobbin 21 and the yarn end from the winding bobbin 22. The control unit moves the upstream guide 48 and the downstream guide 47 to the open position when the splicer device 14 carries out the splicing operation, and moves the upstream guide 48 and the downstream guide 47 to the close position and brings the spun yarn 20 into contact with the outer peripheral surface of the fluff binding roller 45 when the yarn splicing operation is completed and the winding section resumes the winding operation.

[0126] That is, the spun yarn 20 is easily introduced into the fluff binding device 16 by guiding the spun yarn 20 to the splicer device 14 with the yarn guide mechanism opened. The fluff can be easily bound by opening and closing the yarn guide mechanism during the yarn splicing operation of the automatic winder.

[0127] The preferred embodiments of the present invention have been described above, but the above described configuration may be modified as below.

[0128] In the embodiment described above, the angle of tilting the axis line of the fluff binding roller with respect to the yarn traveling path is 45 degrees, but this is not the sole case, and the angle of tilting the axis line of the fluff binding roller may be any angle. However, as the axis line of the fluff binding roller becomes closer to parallel with respect to the yarn traveling path, the force of twisting the spun yarn becomes greater, but the fluff rolling roller becomes difficult to rotate. On the contrary, as the axis line of the fluff binding roller becomes closer to right angle with respect to the yarn traveling path, the fluff binding roller becomes easy to rotate but the force of twisting the spun yarn becomes small. In view of such aspects, the angle of tilting the axis line of the fluff binding roller with respect to the yarn traveling path is inappropriate when too large or too small, and thus the tilting angle of 45 degrees is particularly suitable as in the embodiment described above.

[0129] In the above described embodiment, the fluff binding roller 45 has a structure of being supported in a freely rotatable manner, but a drive source for driving the fluff binding roller 45 may be arranged. In this case, the fluff binding roller 45 is driven by the drive source in accordance with the traveling speed of the yarn.

[0130] In the above described embodiment, the gate form tension applying device is adopted, but this is not the sole case, and a disc form tension applying device may be used. However, the movable comb tooth 42 of the tension applying device 13 can also serve as the upstream guide 47 when the gate form tension applying device 13 is used as in the embodiment described above. Therefore, the fluff binding device 16 of the present embodiment is particularly suited to being combined with the gate form tension applying device.

[0131] In the above described embodiment, the configuration in which the fluff binding device 16 and the tension applying device are handled as one unit has been adopted, but such configuration may be omitted.

[0132] In the above described embodiment, the upstream guide 48 and the downstream guide 47 are configured to be movable, but such configuration may be omitted, and the upstream guide 48 and the downstream guide 47 may be fixed. However, the fluff binding process corresponding to the unwinding tension of the spun yarn 20 can be carried out since the pushing amount of the spun yarn 20 with respect to the fluff binding roller 45 can be adjusted by having the upstream guide 48 and the downstream guide 47 movable. Furthermore, the upstream guide 48 and the downstream guide 47 may be fixed, and the fluff binding roller 45 may be configured to be movable.

[0133] In FIG. 10, and the like, an example in which the fluff binding roller 45 is formed to a hollow form has been described, but the fluff binding roller 45 may, of course, be formed to a solid state. In FIG. 10, and the like, an example of forming the fluff binding roller 45 using a plurality of materials such as rubber and aluminum has been described, but the entire fluff binding roller maybe formed with one material.

[0134] The fluff binding device and the tension applying unit of the present invention can be applied not only to the automatic winder, but to other types of yarn winding machines such as a spinning machine.

Claims

1. A fluff binding device (16) for suppressing occurrence of fluff of a traveling spun yarn, the fluff binding device **characterized by** comprising a fluff binding roller (45) arranged so that an axis line of the fluff binding roller (45) is oblique with respect to a yarn traveling path and so as to be freely rotatable with the axis line as a center, and a yarn guide mechanism (47), (48), (44) for bringing the spun yarn into contact with one part of an outer peripheral surface of the fluff binding roller (45).

2. The fluff binding device (16) according to claim 1, **characterized in that** the fluff binding roller (45) cantilever supports an end on a downstream side in a traveling direction of the spun yarn.

3. The fluff binding device (16) according to claim 1 or 2, further **characterized by** including a switching mechanism for switching a tilt of the axis line of the fluff binding roller (45).

4. The fluff binding device (16) according to any one of claims 1 to 3, **characterized in that** the yarn guide mechanism (47), (48), (44) is arranged to be movable in a direction of traversing the yarn traveling path, the yarn guide mechanism (47), (48), (44) bends the spun yarn traveling through the yarn traveling path to change a contacting length of the spun yarn brought into contact with the outer peripheral surface of the fluff binding roller (45).

5. The fluff binding device (16) according to any one of claims 1 to 4, **characterized in that** grooves (59) lying along a direction substantially orthogonal to the axis line of the fluff binding roller (45) are formed at a surface of the fluff binding roller (45).

6. The fluff binding device (16) according to any one of claims 1 to 5, **characterized in that** the surface of the fluff binding roller (45) is made of rubber (54).

7. The fluff binding device (16) according to any one of claims 1 to 5, **characterized in that** the surface of the fluff binding roller (45) is made of nitrile butadiene rubber.

8. The fluff binding device (16) according to any one of claims 1 to 5, **characterized in that** the surface of the fluff binding roller (45) is made of urethane.

9. The fluff binding device (16) according to any one of claims 1 to 8, **characterized in that**
the yarn guide mechanism (47), (48), (44) is configured by, an upstream guide member (48) for guiding the spun yarn from an upstream side in a yarn traveling direction as seen from the fluff binding roller (45) to the surface of the fluff binding roller (45) through an upstream yarn guide point,
a downstream guide member (47) for guiding the spun yarn brought into contact with the surface of the fluff binding roller (45) further to the downstream side from the fluff binding roller (45) through a downstream yarn guide point, and
a yarn guide moving portion (44) for enabling the movement of the upstream guide member (48) and the downstream guide member (47) in a direction in which a virtual line connecting the upstream yarn guide point and the downstream yarn guide point approaches or separates with respect to the axis line of the fluff binding roller (45).

10. A tension applying unit (28) **characterized by** comprising:

the fluff binding device (16) according to claim 9;
a gate form tension applying device (13) for appropriately adjusting spacing between a movable comb tooth portion (42) and a fixed comb tooth portion (41), and adjusting a tension of a traveling spun yarn; and
a bracket (29); wherein
at least one comb tooth of the comb teeth of the movable comb portion (42) is positioned nearer to a side of the fluff binding roller (45) than any comb tooth of the fixed comb portion (41), so that the movable comb portion (42) also functions as the upstream guide member (48) of the fluff binding device (16) and the downstream guide member (47) is configured integrally with the movable comb portion (42); and
the fluff binding device (16) and the gate form tension applying device (13) are attached with respect to the bracket (29).

11. An automatic winder **characterized by** comprising:

the fluff binding device (16) according to any one of claims 1 to 9;
a yarn supplying bobbin supporting section (31) for supporting a yarn supplying bobbin; and
a winding section (32) for winding a spun yarn of the yarn supplying bobbin around a winding bobbin to form a package (30).

12. An automatic winder according to claim 11, **characterized by** comprising:

a yarn supplying bobbin supporting section (31)

for supporting a yarn supplying bobbin; and
a winding section (32) for winding a spun yarn of the yarn supplying bobbin around a winding bobbin to form a package (30); wherein
the fluff binding device (16) is configured to be freely attachable/detachable.

13. The automatic winder according to claim 11 or 12, **characterized in that** the automatic winder further comprises:

a yarn splicing device (14) for splicing a yarn end from the yarn supplying bobbin and a yarn end from the winding bobbin; and
a control unit for opening the yarn guide mechanism when the yarn splicing device (14) carries out a yarn splicing operation, and moving the yarn guide mechanism to bring the spun yarn into contact with an outer peripheral surface of the fluff binding roller (45) when the yarn splicing operation is completed and the winding section (32) resumes a winding operation.

FIG. 1

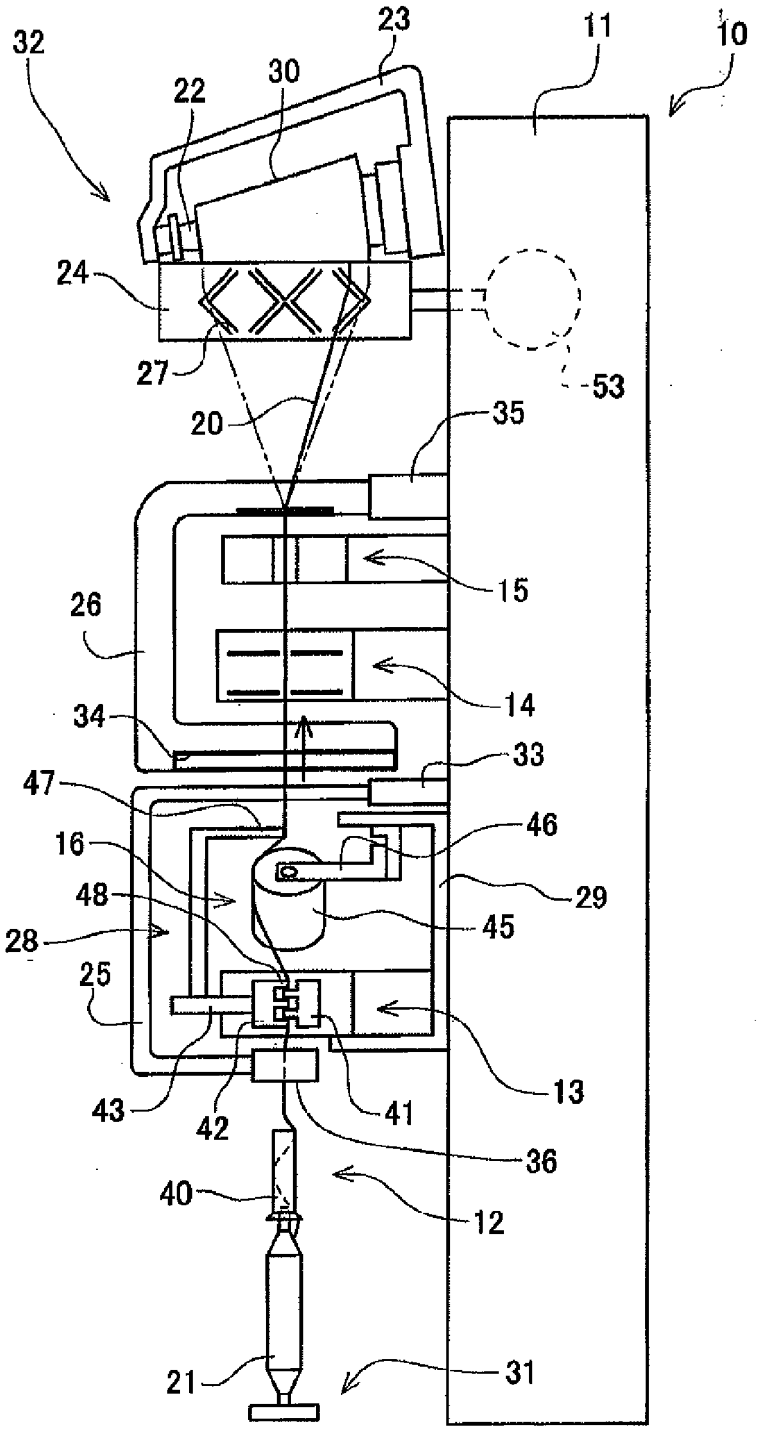

32
23
11
10
22
30
24
27
53
20
35
15
26
14
34
33
47
46
16
29
48
45
28
25
13
43
42
41
36
40
12
21
31

FIG. 2

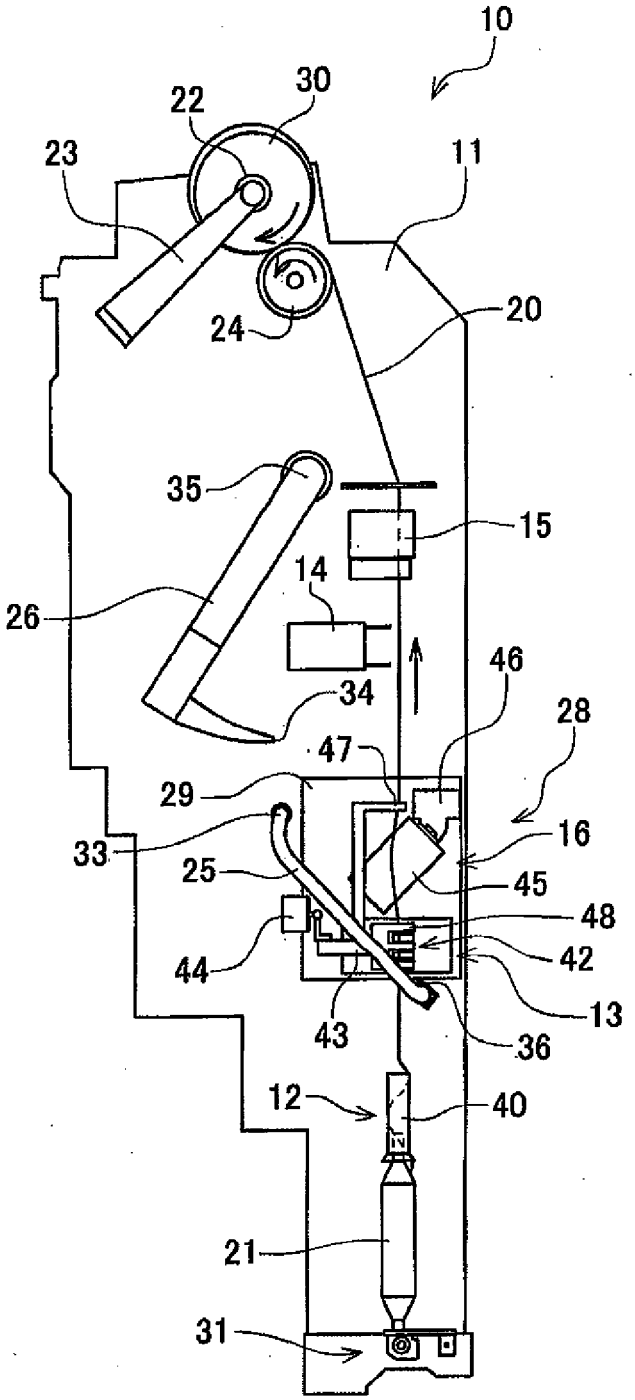

10
30
22
23
11
24
20
35
15
14
26
46
34
28
47
29
16
33
25
45
48
44
42
13
43
36
12
40
21
31

FIG. 3

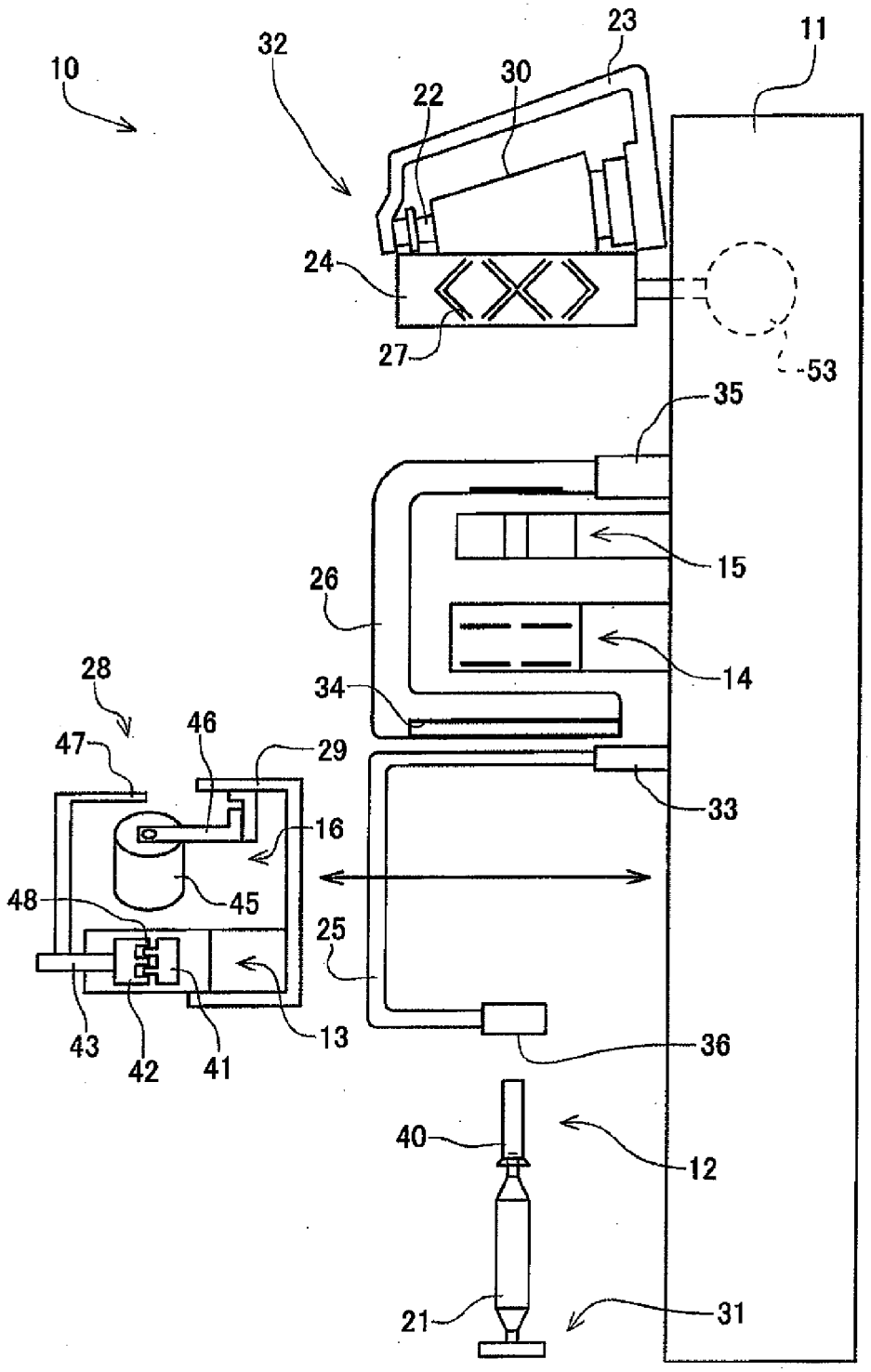

10
32
23
11
22
30
24
27
53
35
15
26
14
34
28
46
29
47
33
16
48
45
25
43
42
41
13
36
40
12
21
31

FIG. 4A

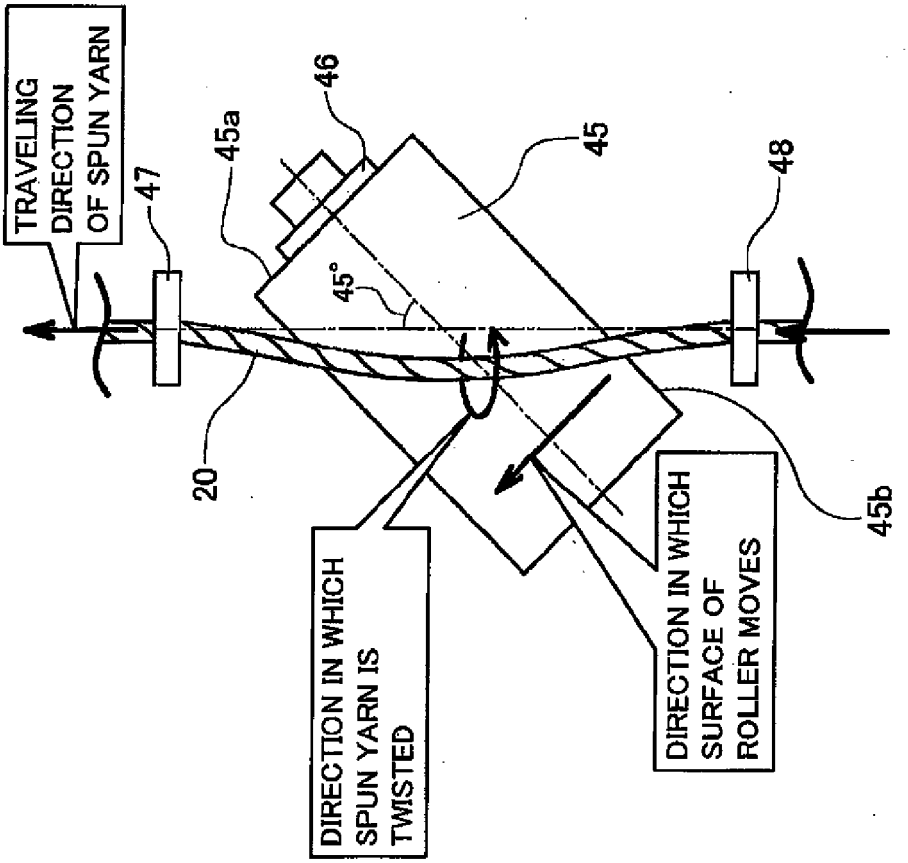

TRAVELING DIRECTION OF SPUN YARN
47
45a
46
45
48
45°
20
45b
DIRECTION IN WHICH SPUN YARN IS TWISTED
DIRECTION IN WHICH SURFACE OF ROLLER MOVES

FIG. 4B

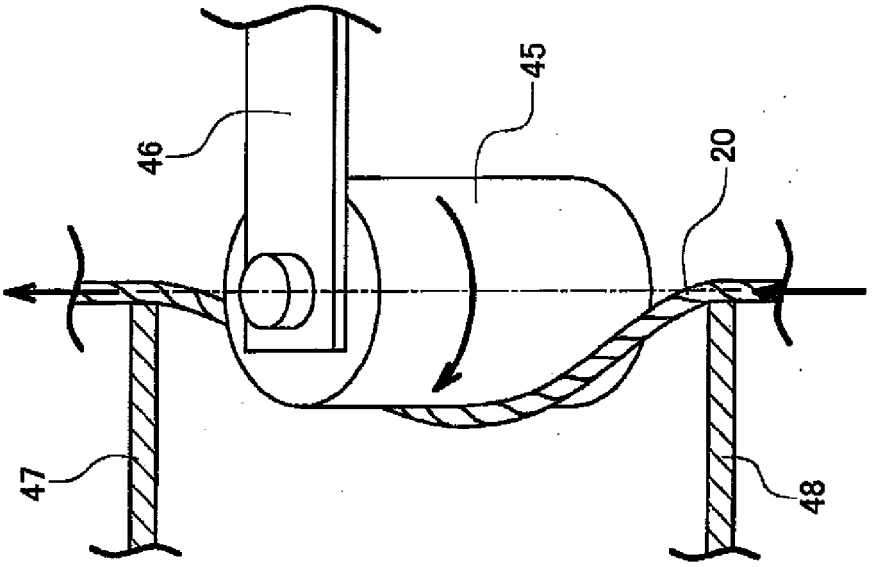

46
45
20
47
48

FIG. 5

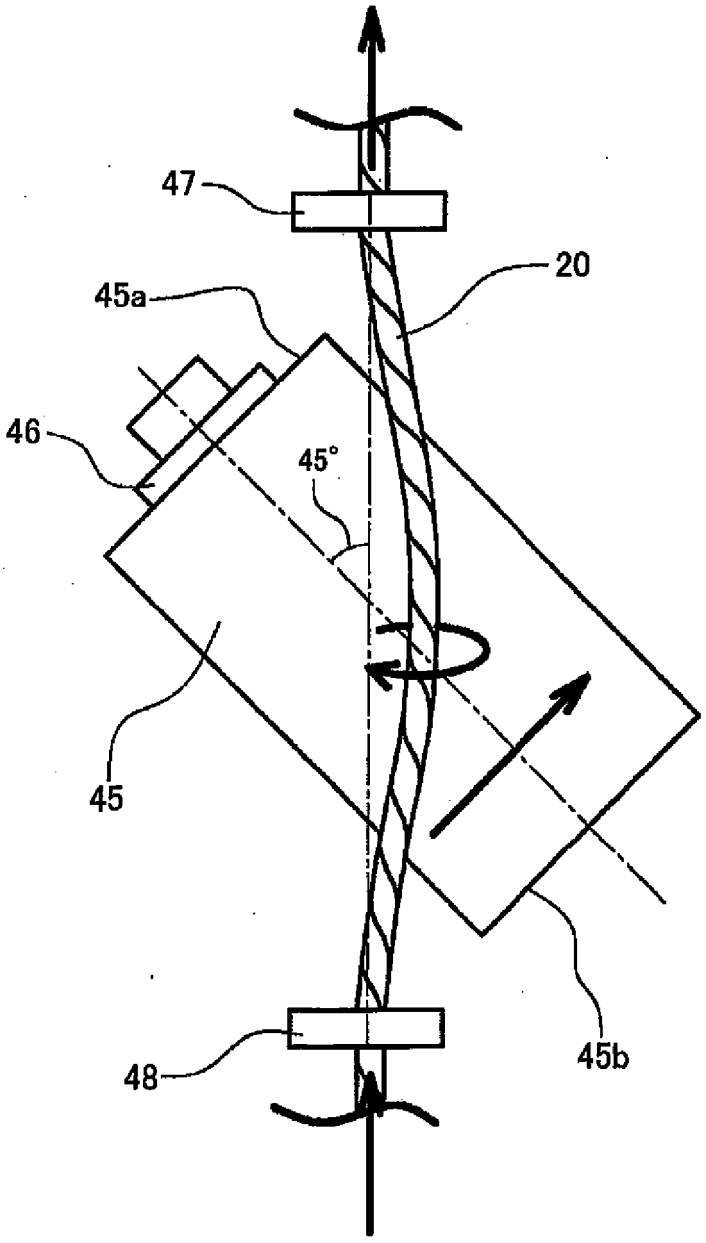


FIG. 6

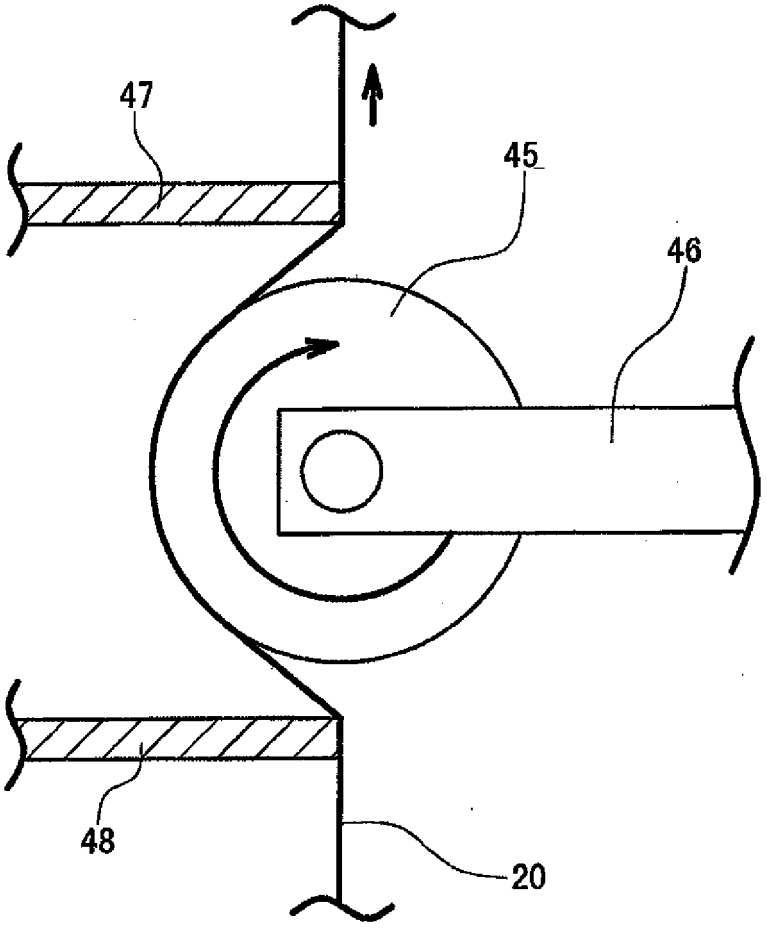


FIG. 7A

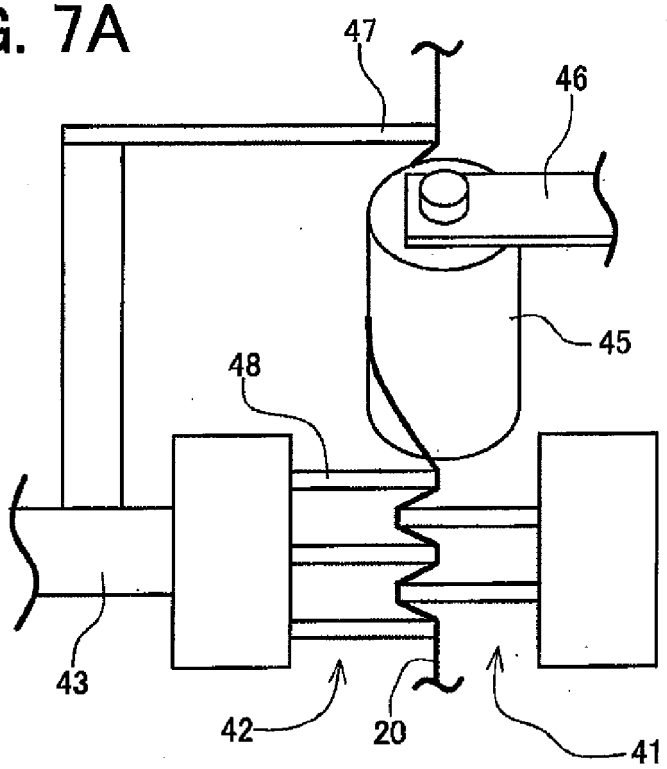


FIG. 7B

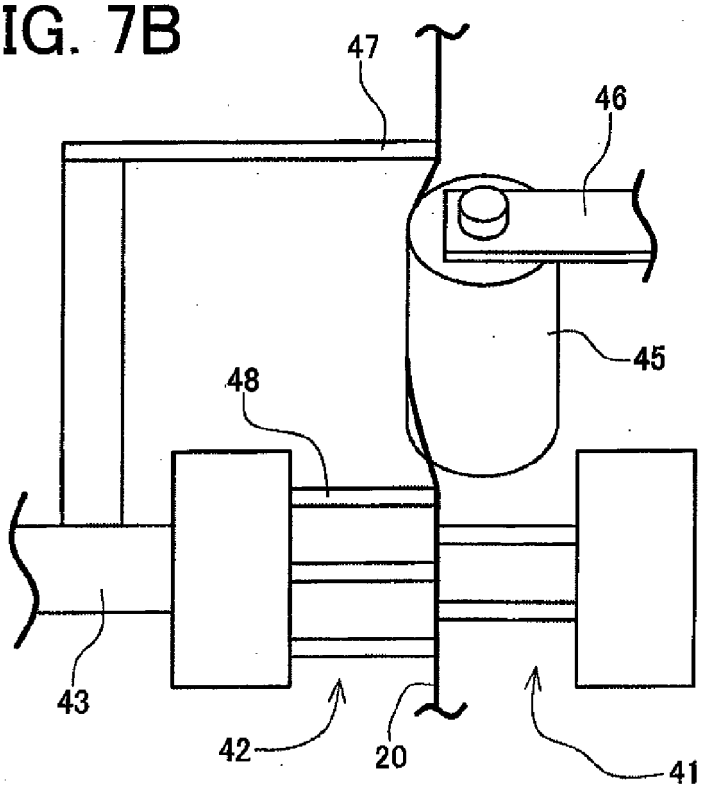


FIG. 8

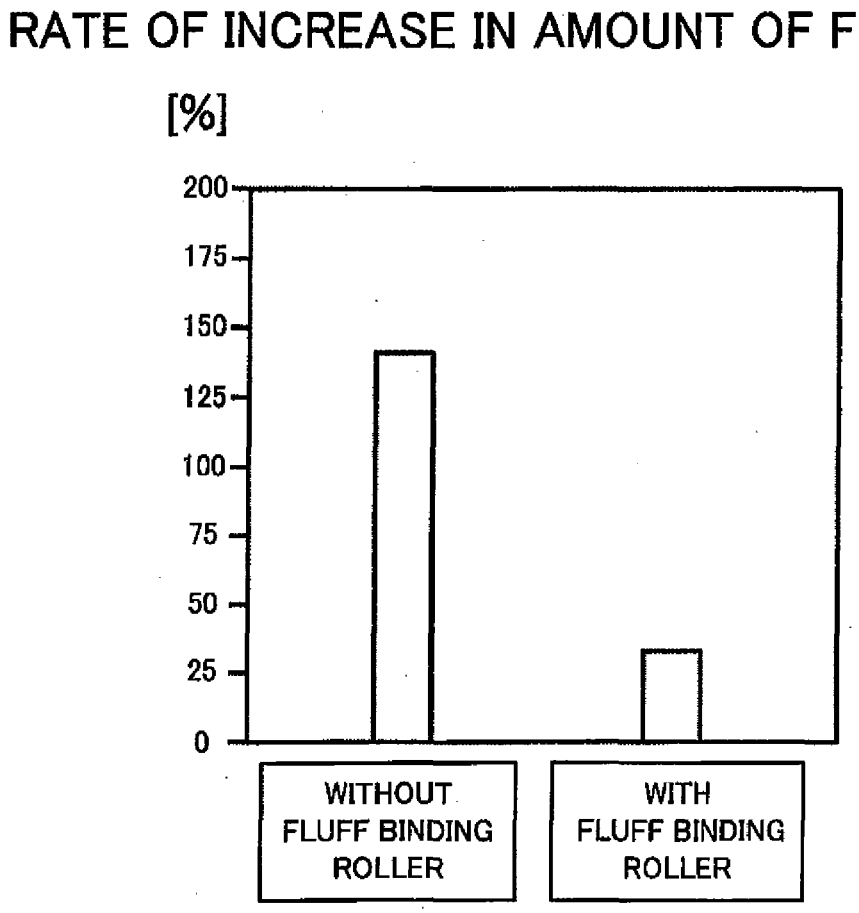

RATE OF INCREASE IN AMOUNT OF FLUFF
[%]
200
175
150
125
100
75
50
25
0
WITHOUT FLUFF BINDING ROLLER
WITH FLUFF BINDING ROLLER

FIG. 9

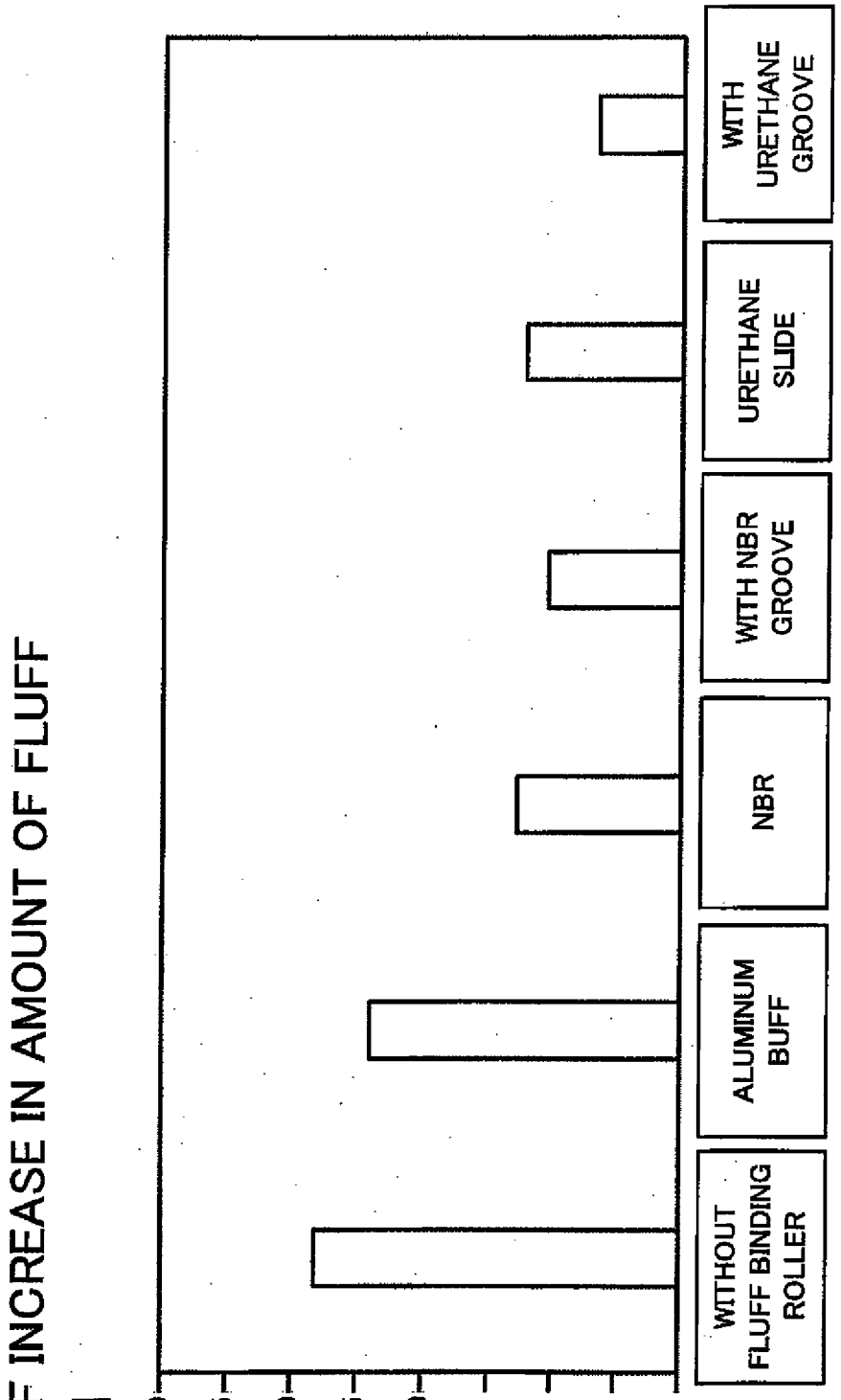

RATE OF INCREASE IN AMOUNT OF FLUFF
[%]
200
175
150
125
100
75
50
25
0
WITHOUT FLUFF BINDING ROLLER
ALUMINUM BUFF
NBR
WITH NBR GROOVE
URETHANE SLIDE
WITH URETHANE GROOVE

FIG. 10

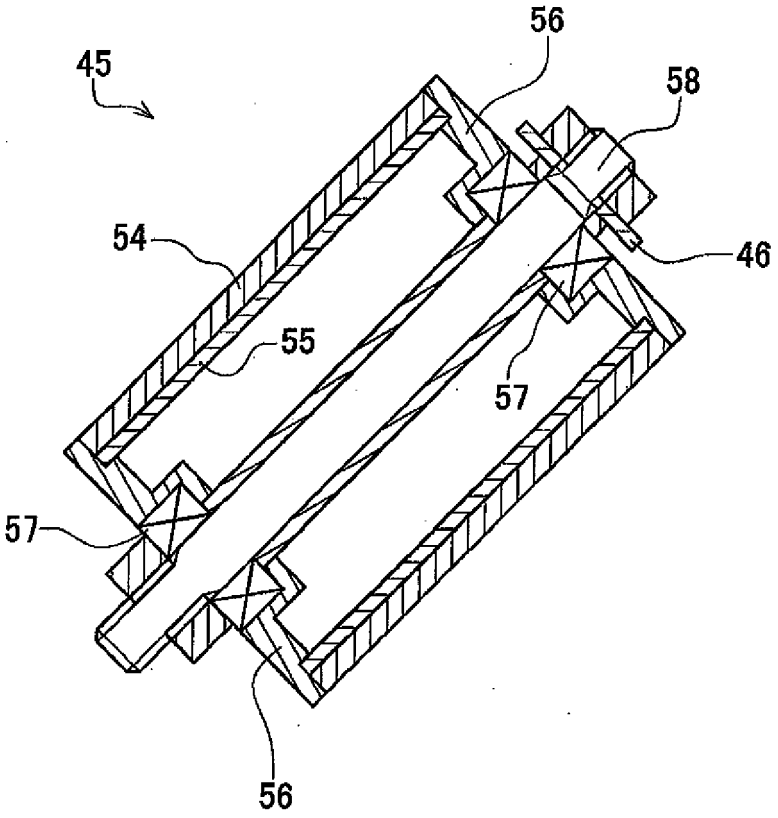
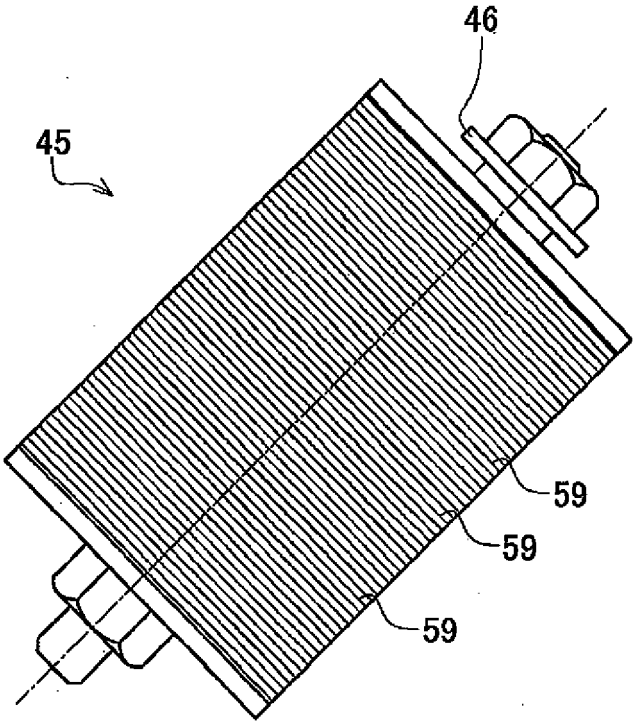


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001139231 A **[0004] [0007]**
- JP 2002348042 A **[0005] [0007]**
- JP 6083774 A **[0007] [0008] [0009]**