(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 169 096 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.03.2010 Bulletin 2010/13

(51) Int Cl.:
D01H 4/48 *(2006.01)* ***B65H 51/20*** *(2006.01)*
D01H 9/08 *(2006.01)*

(21) Application number: **09170145.8**

(22) Date of filing: **14.09.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **29.09.2008 JP 2008250748**

(71) Applicant: **Murata Machinery, Ltd.**
3 Minami Ochiai-cho, Kisshoin
Minami-ku, Kyoto-shi, Kyoto (JP)

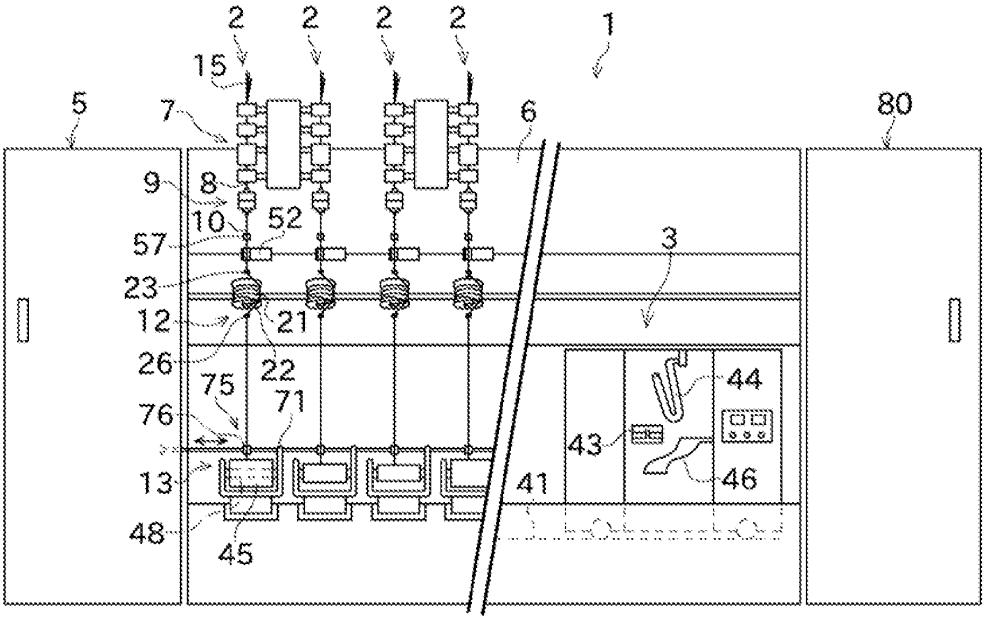
(72) Inventors:
- **Baba, Kenji**
  Kyoto 612-8686 (JP)
- **Hirao, Osamu**
  Kyoto 612-8686 (JP)
- **Oka, Masaki**
  Kyoto 612-8686 (JP)

(74) Representative: **Liedl, Christine et al**
Hansmann & Vogeser
Patent- und Rechtsanwälte
Albert-Rosshaupter-Strasse 65
81369 München (DE)

(54) Spinning machine

(57) A spinning unit 2 of a spinning machine includes a spinning device 9, a winding device 13, and a yarn slack eliminating device 12. The spinning device 9 produces a spun yarn 10 by applying twists to a fiber bundle 8. The winding device 13 forms a package 45 by winding the spun yarn 10 fed from the spinning device 9. The yarn slack eliminating device 12 is provided between the spinning device 9 and the winding device 13, and temporarily accumulates the spun yarn 10 by winding the spun yarn 10 around an outer periphery of a rotating yarn slack eliminating roller 21. The spinning machine applies tension by the yarn slack eliminating device 12 to the spun yarn 10 fed from the spinning device 9 (Fig. 1).

FIG. 1



EP 2 169 096 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine.
More specifically, the present invention relates to a configuration that applies tension to a spun yarn in the spinning machine.

2. Description of the Related Art

[0002] For example, a spinning machine disclosed in Japanese Unexamined Patent Application Publication No. 2004-124333 is conventionally known. Generally, a spinning machine of this type includes a metal delivery roller that is rotationally driven and a rubber nip roller that faces the delivery roller and is dependently rotated. The spinning machine nips and transports a spun yarn, which is fed from a spinning device, by the delivery roller and the nip roller. In other words, the rotation of the delivery roller applies tension to the yarn fed from the spinning device. By applying prescribed tension to the yarn, the yarn can be fed from the spinning device at a prescribed speed and transported downstream at a prescribed speed.

[0003] For example, during a spinning operation in the spinning machine disclosed in Japanese Unexamined Patent Application Publication No. 2004-124333, it is important in terms of a yarn quality to accurately control a yarn thickness (yarn count), yarn feeding tension applied during the spinning operation, and yarn tension applied during a clearing operation (i.e., during a yarn defect detecting operation), or the like, to be prescribed values. In other words, if the yarn thickness and/or the yarn feeding tension applied during the spinning operation change during the spinning operation, the yarn quality is adversely affected. Further, if the tension applied during the clearing operation is not constant, the clearing operation cannot be performed accurately.

[0004] The yarn thickness is defined by a speed ratio of the delivery roller and a back roller. The yarn feeding tension applied during the spinning operation is defined by a speed ratio of the delivery roller and a front roller. The tension applied during the clearing operation is defined by a speed ratio of the delivery roller and a winding device (in the case where a yarn slack eliminating device is provided, the tension applied during the clearing operation is defined by a speed ratio of the delivery roller and the yarn slack eliminating device) . Therefore, a yarn transporting speed of the delivery roller is an important parameter that influences the yarn quality. Accordingly, it is required to transport the yarn at an accurate speed by the delivery roller.

[0005] In the winding device provided downstream of the delivery roller, the yarn is traversed on a surface of a package, and as a result, the yarn tension always changes at a downstream side of the delivery roller. Although such tension change is softened by a yarn tension adjusting device to some degree, the tension change may propagate to the delivery roller, which is provided upstream of the yarn tension adjusting device. At this time, if a yarn nipping force of the delivery roller and the nip roller is not sufficient, slipping may occur between the yarn and the rollers, and the tension change may propagate to the upstream side. As a result, the yarn transporting speed of the delivery roller changes, which thereby deteriorates the yarn quality. In order to prevent such changes in the yarn transporting speed, the yarn nipping force of the delivery roller and the nip roller is preferably strong and stable.

[0006] However, in the conventional configuration in which the yarn is nipped and transported by the two rollers, there are limitations in nipping the yarn with a sufficient force. Accordingly, it has been difficult to achieve a nipping force that is strong enough to be undisturbed by the change in the yarn tension originated at the downstream side. Moreover, the nipping force may vary due to factors such as abrasion occurring on a surface of the rubber nip roller or assembling accuracy of components. Therefore, is has been difficult to manage the nipping force to be equal among a plurality of spinning units, and to keep the quality of the produced yarn to be uniform. Moreover, when the rubber on the surface of the nip roller abrades further, the nipping force decreases, and the yarn slips frequently.

[0007] Some nip rollers adopt a cantilever-supporting type structure in view of maintenance. However, in such a case, it is structurally difficult to adjust the nipping force to be equal at one end and another end of the nip roller. As a result, for example, when the yarn is traversed in the traversing operation, a nip position changes and the nipping force also changes. As a consequence, the yarn tension changes, which resultantly causes a clearer to frequently make false detection.

[0008] The nip roller is a consumable component that needs to be regularly replaced because the rubber on the surface abrades. Fiber dusts (fly wastes) or the like are easily wound around the delivery roller and the nip roller. When the fiber dusts or the like are wound around the delivery roller and the nip roller, an operator needs to remove the fiber dusts or the like. Accordingly, the transporting of the yarn by the delivery roller and the nip roller requires a great burden of maintenance work.

SUMMARY OF THE INVENTION

[0009] In order to overcome the problems described above, preferred embodiments of the present invention provide a spinning machine that can stabilize yarn tension to be applied to a spun yarn fed from a spinning device, and can obtain a spun yarn with a uniform quality.

[0010] According to an aspect of the present invention, a spinning machine includes a spinning device, a winding

device, and a yarn accumulating device. The spinning device produces a spun yarn by applying twists to a fiber bundle. The winding device winds the spun yarn fed from the spinning device and forms a package. The yarn accumulating device is arranged between the spinning device and the winding device. The yarn accumulating device includes a rotary yarn accumulating roller, and temporarily accumulates the spun yarn by winding the spun yarn around the yarn accumulating roller. The spinning machine feeds the spun yarn from the spinning device while applying tension to the spun yarn by the yarn accumulating device.

[0011] As compared with a conventional configuration in which, for example, a spun yarn is nipped and transported by two rollers, in the above-described spinning machine, since tension is applied to the spun yarn by the yarn accumulating roller, a large contact area is provided between the yarn accumulating roller used as a yarn transporting member and the spun yarn. In other words, the above-described spinning machine can apply tension to the spun yarn with a sufficient transporting force. As a result, since the spun yarn does not slip on the yarn accumulating roller and the spun yarn, the spun yarn can be fed from the spinning device at a stable speed. Thus, the spinning machine can produce the spun yarn with a uniform quality.

[0012] In the spinning machine, it is preferable that the spun yarn fed from the spinning device is directly introduced into the yarn accumulating device without via other yarn transporting members.

[0013] Thus, in the above-described spinning machine, the yarn accumulating device can apply tension to the spun yarn fed from the spinning device without being influenced by other yarn transporting members. In a spinning machine that includes other yarn transporting members between a spinning device and a yarn accumulating device, problems arise in that fiber dusts may be wound around such other yarn transporting members. However, the above-described spinning machine can overcome such problems and a maintenance work can be carried out more easily. Further, as compared with the conventional spinning machine, the above-described spinning machine can reduce the number of components. As a result, an entire structure of the spinning machine can be simplified, and a cost can be reduced.

[0014] In the spinning machine, the yarn accumulating roller is preferably made from high abrasion-resistant material (such as metal).

[0015] Thus, the durability of the yarn accumulating roller is improved as compared with that of a rubber roller. Accordingly, as compared with the conventional spinning machine, the above-described spinning machine can reduce the number of consumable components and maintain a stable yarn quality over a long period of time. Moreover, changes in performance arising from abrasion can be reduced in the above-described spinning machine. Therefore, for example, as compared with the conventional configuration in which the spun yarn is transported by the rubber roller, fluctuation in the yarn transporting force among a plurality of spinning units of the spinning machine can be reduced. In other words, the quality of the yarn produced by the plurality of spinning units can be equalized among the spinning units. By making the yarn accumulating roller from material with high workability, such as metal, the yarn accumulating roller can be made easily with high working accuracy. Accordingly, differences in component sizes among the spinning units can be reduced, and the quality of the yarn to be produced can be easily managed to be uniform among the spinning units.

[0016] In the spinning machine, the yarn accumulating device is preferably a yarn slack eliminating device that absorbs changes in the yarn tension applied between the yarn accumulating device and the winding device.

[0017] Accordingly, the changes in the yarn tension between the yarn slack eliminating device and the winding device can be prevented from influencing the yarn tension between the yarn slack eliminating device and the spinning device. As a result, the yarn quality can be further improved. Further, since the yarn slack eliminating device includes both a function of transporting the spun yarn and a function of adjusting the yarn tension, as compared with the conventional configuration in which a yarn transporting member and a tension adjusting member are independently provided, the number of components and the cost of the spinning machine can be reduced.

[0018] In the spinning machine, it is preferable that the spun yarn can be wound around the yarn accumulating roller at least ten times without the spun yarn forming overlaps.

[0019] In other words, by winding a sufficient length of the spun yarn around the yarn accumulating roller as if to tighten the yarn accumulating roller, the spun yarn transporting force by the rotation of the yarn accumulating roller can be sufficiently stabilized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Fig. 1 is a front view of a spinning machine according to an embodiment of the present invention.

[0021] Fig. 2 is a longitudinal cross-sectional view of the spinning machine.

[0022] Fig. 3 is a longitudinal cross-sectional view of a yarn slack eliminating device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] A spinning machine according to an embodiment of the present invention will be described with reference to the drawings. In the description, "upstream" and "downstream" respectively refer to upstream and downstream in a direction in which a yarn travels during a spinning operation.

[0024] As illustrated in Fig. 1, a spinning machine 1 as

a spinning device includes a plurality of units (spinning units) 2 arranged in a line. The spinning machine 1 includes a yarn splicing cart 3, a blower box 80, and a motor box 5.

[0025] As illustrated in Fig. 1, each spinning unit 2 includes a draft device 7, a spinning device 9, a yarn slack eliminating device (a yarn accumulating device) 12, and a winding device 13, which are arranged in this order from the upstream to the downstream. The draft device 7 is provided near an upper end of a housing 6 of the spinning machine 1. The spinning device 9 carries out a spinning operation on a fiber bundle 8 fed from the draft device 7. After a spun yarn 10 fed from the spinning device 9 passes through a yarn clearer (a yarn defect detecting device) 52, which is described later, the spun yarn 10 is fed by the yarn slack eliminating device 12 and then wound by the winding device 13 into a package 45.

[0026] The draft device 7 drafts a sliver 15 into the fiber bundle 8. As illustrated in Fig. 2, the draft device 7 includes a back roller 16, a third roller 17, a middle roller 19, and a front roller 20. Further, an apron belt 18 is wound around the middle roller 19.

[0027] Although a detailed structure of the spinning device 9 is not illustrated in the drawings, the spinning device 9 according to the present embodiment is a pneumatic type which uses a whirling airflow to apply twists to the fiber bundle 8 and to form the spun yarn 10.

[0028] The yarn slack eliminating device 12 is provided downstream of the spinning device 9. The yarn slack eliminating device 12 includes a function of applying prescribed tension to the spun yarn 10 and feeding the spun yarn 10 from the spinning device 9. The yarn slack eliminating device 12 also includes a function of preventing a yarn slack by accumulating the spun yarn 10 fed from the spinning device 9 during a yarn splicing operation or the like performed by the yarn splicing cart 3 (to be described later). The yarn slack eliminating device 12 further includes a function of adjusting the tension in such a manner that a change in the tension at the winding device 13 (to be described later) is not transmitted to the spinning device 9. As illustrated in Fig. 2, the yarn slack eliminating device 12 includes a slack eliminating roller (a yarn accumulating roller) 21, a yarn hooking member 22, an upstream guide 23, an electric motor 25, a downstream guide 26, and a yarn accumulated amount detecting sensor 27.

[0029] The yarn hooking member 22 can be engaged with (can hook) the spun yarn 10. By integrally rotating with the slack eliminating roller 21 in a state in which the yarn hooking member 22 is engaged with the spun yarn 10, the yarn hooking member 22 can wind the spun yarn 10 around the slack eliminating roller 21.

[0030] The slack eliminating roller 21 can wind and accumulate a certain amount of the spun yarn 10 around the outer surface thereof. The slack eliminating roller 21 is rotationally driven by the electric motor 25. A rotational speed of the electric motor 25 is controlled by a rotational speed control section provided in a not-illustrated unit controller. When the slack eliminating roller 21 rotates, the spun yarn 10 is wound around the slack eliminating roller 21 as if to tighten the slack eliminating roller 21, and pulls the spun yarn 10 that is located upstream of the yarn slack eliminating device 12. In other words, when the slack eliminating roller 21 having the spun yarn 10 wound around the outer surface thereof is rotated at a prescribed rotational speed, prescribed tension can be applied to the spun yarn 10, and the spun yarn 10 can be fed from the spinning device 9 at a prescribed speed and transported towards the downstream side at a prescribed speed.

[0031] By winding a prescribed amount of the spun yarn 10 around the slack eliminating roller 21, a prescribed contact area can be obtained between the slack eliminating roller 21 and the spun yarn 10. Thus, the slack eliminating roller 21 can hold and pull the spun yarn 10 with a sufficient force, and can feed the spun yarn 10 from the spinning device 9 at a stable speed without causing slipping or the like. As illustrated in Fig. 2, other components (such as a conventional delivery roller) for applying tension to the spun yarn 10 are not provided between the spinning device 9 and the yarn slack eliminating device 12. Therefore, the speed at which the yarn is fed from the spinning device 9 is defined by the rotational speed of the slack eliminating roller 21. The spinning machine 1 according to the present embodiment can apply tension to the spun yarn 10 by the yarn slack eliminating device 12 and feed the spun yarn 10 from the spinning device 9 constantly at an accurate speed.

[0032] The yarn accumulated amount sensor 27 contactlessly detects an amount of the spun yarn 10 accumulated (yarn accumulated amount) around the slack eliminating roller 21, and then transmits a detection result to the unit controller.

[0033] The upstream guide 23 is arranged slightly upstream of the slack eliminating roller 21. The upstream guide 23 is a guide member that properly guides the spun yarn 10 to the outer surface of the slack eliminating roller 21. Further, the upstream guide 23 also includes a function of preventing the twists of the spun yarn 10 applied by the spinning device 9 from being transmitted downstream of the upstream guide 23.

[0034] The yarn clearer 52 is arranged at a position that is located on a front surface of the housing 6 of the spinning machine 1 and between the spinning device 9 and the yarn slack eliminating device 12. The spun yarn 10, which is spun by the spinning device 9, passes through the yarn clearer 52 before being wound by the yarn slack eliminating device 12. The yarn clearer 52 monitors a thickness of the traveling spun yarn 10. When a yarn defect of the spun yarn 10 is detected, the yarn clearer 52 transmits a yarn defect detection signal to the not-illustrated unit controller. In the conventional spinning machine (such as the spinning machine disclosed in Japanese Unexamined Patent Application Publication No. 2004-124333), a yarn clearer monitored a spun yarn transported by the delivery roller. As a result, in the con-

ventional spinning machine, when slipping occurred between the spun yarn and the delivery roller (and the nip roller), the yarn clearer erroneously detected a yarn defect. According to the present embodiment, the spun yarn 10 can be fed from the spinning device 9 by the yarn slack eliminating device 12 (without causing slipping or the like) at a stable speed with stable tension. Thus, the yarn clearer 52 can accurately detect yarn defects.

[0035] When receiving the yarn defect detection signal, the unit controller immediately cuts the spun yarn 10 by a cutter 57, and stops the draft device 7 and the spinning device 9 or the like. The unit controller transmits a control signal to the yarn splicing cart 3, and controls the yarn splicing cart 3 to travel to the front of the spinning unit 2. Then, the unit controller re-drives the spinning device 9 or the like, controls the yarn splicing cart 3 to perform a yarn splicing operation, and resumes a winding operation. At this time, during a period of time from when the spinning device 9 resumes the spinning operation to when the winding operation is resumed, the yarn slack eliminating device 12 accumulates the spun yarn 10, which is continuously fed from the spinning device 9, around the slack eliminating roller 21 and eliminates a slack of the spun yarn 10.

[0036] The yarn splicing cart 3 includes a splicer (yarn joining device) 43, a suction pipe 44, and a suction mouth 46. When a yarn breakage or a yarn cutting occurs in a certain spinning unit 2, the yarn splicing cart 3 travels on a rail 41 to such spinning unit 2 and stops. While vertically swinging around a shaft, the suction pipe 44 sucks and catches an end of the spun yarn 10 fed from the spinning device 9, and then guides the caught spun yarn 10 to the splicer 43. While vertically swinging around a shaft, the suction mouth 46 sucks and catches an end of the spun yarn 10 from the package 45, which is supported by the winding device 13, and then guides the caught spun yarn 10 to the splicer 43. The splicer 43 performs a yarn splicing operation on the guided yarn ends.

[0037] The winding device 13 includes a cradle arm 71 that is supported on a supporting shaft 70 in a manner that the cradle arm 71 can swing around the supporting shaft 70. The cradle arm 71 can support a bobbin 48, around which the spun yarn 10 is wound, in a manner that the bobbin 48 can be rotated.

[0038] The winding device 13 includes a winding drum 72 and a traverse device 75. The winding drum 72 is driven in contact with the bobbin 48 or an outer peripheral surface of the package 45, which is formed by winding the spun yarn 10 around the bobbin 48. The traverse device 75 includes a traverse guide 76 that can be engaged with the spun yarn 10. By driving the winding drum 72 by a not-illustrated electric motor while reciprocating the traverse guide 76 by a not-illustrated driving unit, the package 45 that is in contact with the winding drum 72 is rotated, and the spun yarn 10 is traversed and wound.

[0039] With reference to Fig. 3, a detailed structure of the yarn slack eliminating device 12 will be described. The slack eliminating roller 21 is made from high abrasion-resistant material, and is fixed on a motor shaft 25a of the electric motor 25. A side on which the slack eliminating roller 21 has the yarn hooking member 22 is referred to as a tip end, and a side on which the slack eliminating roller 21 has the electric motor 25 will be referred to as a base end. The outer peripheral surface 21a of the slack eliminating roller 21 includes a base-end taper portion 21b, a cylindrical portion 21c, and a tip-end taper portion 21d in this order from the base end to the tip end.

[0040] The cylindrical portion 21c slightly tapers toward the tip end. The cylindrical portion 21c is flatly connected (without difference in level) with the taper portions 21b and 21d. In order to obtain a sufficient transporting force for the spun yarn 10 by the slack eliminating roller 21, it is preferable that the spun yarn 10 is wound around the outer peripheral surface 21a of the slack eliminating roller 21 at least ten times without the spun yarn 10 forming overlaps. Therefore, the size of the cylindrical portion 21c is formed such that the accumulated spun yarn 10 can be wound around at least ten times. The yarn accumulated amount sensor 27 faces the cylindrical portion 21c. The yarn accumulated amount sensor 27 detects an accumulated amount of the spun yarn 10 wound around the slack eliminating roller 21, and then transmits a detection result to the unit controller.

[0041] Each of the base-end taper portion 21b and the tip-end taper portion 21d has a slightly tapered shape with a larger diameter at a corresponding end side. Around the outer peripheral surface 21a of the slack eliminating roller 21, the base-end taper portion 21b smoothly moves the supplied spun yarn 10 from a larger diameter portion to a smaller diameter portion towards the cylindrical portion 21c so as to orderly wind the spun yarn 10 around the surface of the cylindrical portion 21c. The tip-end taper portion 21d has a function of preventing the wound spun yarn 10 from slipping off all at once when unwinding the spun yarn 10 from the slack eliminating roller 21. The tip-end taper portion 21d also has a function of sequentially rewinding the spun yarn 10 from the smaller diameter portion to the larger diameter portion at the end surface so as to smoothly feed the spun yarn 10.

[0042] The yarn hooking member 22 is arranged coaxially with the slack eliminating roller 21, and rotates independently or integrally with the slack eliminating roller 21 in accordance with a condition. More specifically, the yarn hooking member 22 includes a flyer shaft 33 and a flyer 38. The flyer shaft 33 is supported in a manner that the flyer shaft 33 can rotate with respect to the slack eliminating roller 21. The flyer 38 is fixed to a tip end of the flyer shaft 33.

[0043] A permanent magnet is attached to either one of the flyer shaft 33 and the slack eliminating roller 21, and a magnetic hysteresis material is attached to another one of the flyer shaft 33 and the slack eliminating roller 21. A torque generating member is composed of these magnetic mechanisms, and generates a resistance torque that is against the rotation of the yarn hooking

member 22 with respect to the slack eliminating roller 21.

[0044] The flyer 38 rotates integrally with the flyer shaft 33. The flyer 38 is formed to appropriately curve towards the outer peripheral surface 21a of the slack eliminating roller 21. Accordingly, the flyer 38 can be engaged with (can hook) the spun yarn 10 to guide the spun yarn 10 to the outer peripheral surface 21a of the slack eliminating roller 21.

[0045] With the above configuration, the yarn slack eliminating device 12 hooks the spun yarn 10 on the flyer 38 and winds the spun yarn 10 around the slack eliminating roller 21. Accordingly, the yarn slack eliminating device 12 can eliminate the slack of the spun yarn 10 and adjust winding tension.

[0046] The yarn hooking member 22 can rotate independently from the slack eliminating roller 21, and the resistance torque that is against the rotation of the yarn hooking member 22 is added to the yarn hooking member 22 by the magnetic mechanisms. The slack eliminating roller 21 is rotated by the electric motor 25 at prescribed rotational speed. When the flyer 38 is engaged with the spun yarn 10, if the tension applied to the spun yarn 10 is greater than the resistance torque, the yarn hooking member 22 rotates independently from the slack eliminating roller 21 and unwinds the spun yarn 10 from the slack eliminating roller 21. If the tension applied to the spun yarn 10 is small, the yarn hooking member 22 rotates integrally with the slack eliminating roller 21 and winds the spun yarn 10 around the slack eliminating roller 21. While the spun yarn 10 is wound from the base end of the slack eliminating roller 21, the spun yarn 10 is unwound from the tip end of the slack eliminating roller 21.

[0047] Accordingly, when the tension of the spun yarn 10 decreases (when the spun yarn 10 is likely to slack), the yarn slack eliminating device 12 winds the spun yarn 10, and when the tension of the spun yarn 10 increases, the yarn slack eliminating device 12 unwinds the spun yarn 10. Accordingly, the yarn slack eliminating device 12 can eliminate the slack of the spun yarn 10 and apply appropriate tension to the spun yarn 10. Moreover, as described above, the yarn hooking member 22 operates to absorb changes in the tension applied to the spun yarn 10 between the yarn slack eliminating device 12 and the winding device 13. Therefore, the yarn slack eliminating device 12 can prevent the changes in the tension from influencing the spun yarn 10 between the spinning device 9 and the yarn slack eliminating device 12. As a result, the spun yarn 10 can be fed from the spinning device 9 at a stable speed by the yarn slack eliminating device 12.

[0048] In order to steadily transport the spun yarn 10 by the slack eliminating roller 21 (i.e., in order to steadily feed the spun yarn 10 from the spinning device 9), it is necessary to always maintain the state in which a certain amount of the spun yarn 10 is wound around the slack eliminating roller 21. Therefore, in the present embodiment, a feedback control is performed on the cradle arm 71 in accordance with a signal transmitted from the yarn accumulated amount sensor 27.

[0049] Basically, the tension applied to the spun yarn 10 (the spun yarn 10 between the yarn slack eliminating device 12 and the winding device 13) hooked on the yarn hooking member 22 is defined by a yarn feeding speed of the slack eliminating roller 21 (i.e., by a speed at which the spun yarn 10 is fed from the spinning device 9) and a winding speed of the winding device 13. In other words, when the winding speed is greater than the yarn feeding speed, the tension applied to the spun yarn 10 increases, and the spun yarn 10 is gradually unwound from the slack eliminating roller 21. When the winding speed is lower than the yarn feeding speed, the tension applied to the spun yarn 10 decreases, and the spun yarn 10 is gradually wound around the slack eliminating roller 21. Since the rotational speed of the slack eliminating roller 21 (spinning speed) is normally constant, the tension applied to the spun yarn 10 hooked on the yarn hooking member 22 is changed mostly by the winding speed of the winding device 13. The speed at which the spun yarn 10 is fed from the spinning device 9 is defined by the rotational speed of the roller driving section 25 controlled by the rotational speed control section.

[0050] In a normal winding operation, in order to apply appropriate winding tension to the spun yarn 10, the rotational speed of the winding drum 72 is set in a manner that the winding speed is slightly greater than the yarn feeding speed of the slack eliminating roller 21 (i.e., greater than the spinning speed of the spinning device 9) . Accordingly, the spun yarn 10 wound around the slack eliminating roller 21 is gradually unwound, and the yarn accumulated amount is reduced.

[0051] When the yarn accumulated amount sensor 27 detects that the yarn accumulated amount has fallen below a prescribed value (for example, when the number of times the spun yarn 10 is wound around the slack eliminating roller 21 becomes less than or equal to ten times), the unit controller of the spinning unit 2 controls the cradle arm 71 to swing towards the left in Fig. 2 by driving a not-illustrated lift cylinder, and moves the package 45 away from the winding drum 72. Accordingly, the package 45 loses a driving force, and although inertial rotation continues, the winding speed thereof gradually decreases.

[0052] As a result, the spun yarn 10 is gradually wound by the yarn hooking member 22, and the yarn accumulated amount of the slack eliminating roller 21 is restored. However, when the spun yarn 10 exceeding an amount that can be accumulated around the cylindrical portion 21c is wound around the slack eliminating roller 21, a position where the spun yarn 10 is wound around the slack eliminating roller 21 shifts to the base-end taper portion 21b, and the spun yarn 10 is wound on the larger diameter side. As a result, the spun yarn 10 cannot be fed from the spinning device 9 at an accurate speed. Accordingly, the yarn accumulated amount sensor 27 detects when the accumulated amount of the spun yarn 10 exceeds the prescribed value. When the yarn accumulated amount sensor 27 detects that the accumulated

amount of the spun yarn 10 has exceeded the prescribed value, the unit controller controls the cradle arm 71 to swing towards the right in Fig. 2, and controls the package 45 to make contact with the winding drum 72. As a result, the winding speed is restored, and the spun yarn 10 is unwound from the slack eliminating roller 21.

[0053] As described above, by swinging the cradle arm 71 by the lift cylinder, the package 45 can be controlled to make contact with the winding drum 72 or move away from the winding drum 72, and the winding speed of the winding device 13 can be adjusted. By detecting the yarn accumulated amount of the slack eliminating roller 21 by the yarn accumulated amount sensor 27, and by controlling the winding speed of the winding device 13 while transmitting the detection result to the unit controller, the state in which a certain amount of the spun yarn 10 is accumulated around the slack eliminating roller 21 can always be maintained.

[0054] As described above, the spinning machine 1 according to the present embodiment includes the spinning device 9, the winding device 13, and the yarn slack eliminating device 12. The spinning device 9 produces the spun yarn 10 by applying twists to the fiber bundle 8. The winding device 13 forms the package 45 by winding the spun yarn 10 fed from the spinning device 9. The yarn slack eliminating device 12 is arranged between the spinning device 9 and the winding device 13, and temporarily accumulates the spun yarn 10 by winding the spun yarn 10 around the rotating slack eliminating roller 21. The spinning machine 1 feeds the spun yarn 10 from the spinning device 9 while applying tension by the yarn slack eliminating device 12.

[0055] The spinning machine 1 applies tension to the spun yarn 10 (more specifically, the fiber bundle 8 to which twists are applied) by the slack eliminating roller 21 around which the spun yarn 10 is wound. Accordingly, for example, as compared with the conventional structure in which a spun yarn is nipped and transported by two rollers, the spinning machine 1 has a larger contact area between the slack eliminating roller 21 used as a yarn transporting member and the spun yarn 10. As a result, tension can be applied to the spun yarn 10 with a sufficient transporting force. Accordingly, in the spinning machine 1, the spun yarn 10 can be fed from the spinning device 9 at stable speed without causing slipping or the like between the slack eliminating roller 21 and the spun yarn 10. The spinning machine 1 can produce the spun yarn 10 with a uniform quality.

[0056] In the spinning machine 1 according to the present embodiment, the spun yarn 10 fed from the spinning device 9 is directly fed to the yarn slack eliminating device 12 without via other yarn transporting members.

[0057] Thus, the spinning machine 1 can apply tension, through the yarn slack eliminating device 12, to the spun yarn 10 fed from the spinning device 9 without being influenced by such other yarn transporting members. Moreover, in a spinning machine provided with other yarn transporting members between the spinning device 9 and the yarn slack eliminating device 12, problems may arise in that fiber dusts may be wound around the other yarn transporting members. However, the spinning machine 1 can overcome such problems, and a maintenance work can be carried out easily. Further, the spinning machine 1 can reduce the number of components to simplify the entire spinning machine 1, and can reduce a cost.

[0058] In the spinning machine 1 according to the present embodiment, the slack eliminating roller 21 is made from abrasion-resistant material.

[0059] Thus, the durability of the slack eliminating roller 21 is improved as compared with that of a rubber roller. Accordingly, as compared with the structure of the conventional spinning machine, the spinning machine 1 can reduce the number of consumable components and can maintain a stable yarn quality over a long period of time. Further, since changes in performance arising from abrasion can be reduced in the spinning machine 1, for example, as compared with the conventional structure in which the spun yarn is transported by the rubber roller, fluctuations in the yarn transporting force among the plurality of spinning units 2 of the spinning machine 1 can be reduced. As a result, the quality of the yarns produced by the plurality of spinning units 2 can be equalized among the spinning units 2.

[0060] In the spinning machine 1 according to the present embodiment, the yarn slack eliminating device 12 absorbs the changes in the yarn tension between the yarn slack eliminating device 12 and the winding device 13.

[0061] Accordingly, the changes in the yarn tension between the yarn slack eliminating device 12 and the winding device 13 can be prevented from influencing the yarn tension between the yarn slack eliminating device 12 and the spinning device 9. As a result, the yarn quality can be further improved. Moreover, since the yarn slack eliminating device 12 includes both the function of transporting the spun yarn 10 and the function of adjusting the yarn tension, as compared with the conventional structure in which a yarn transporting member and a tension adjusting member are independently provided, the number of components of the spinning machine 1 can be reduced, and the cost can also be reduced.

[0062] In the spinning machine 1 according to the present embodiment, the spun yarn 10 can be wound around the slack eliminating roller 21 at least ten times without the spun yarn 10 forming overlaps.

[0063] A sufficient length of the spun yarn 10 is wound around the slack eliminating roller 21 as if to tighten the slack eliminating roller 21. As a result, the spun yarn 10 tightens the slack eliminating roller 21, and the transporting force for the spun yarn 10 by the rotation of the slack eliminating roller 21 can be sufficiently stabilized.

[0064] The preferred embodiments of the present invention have been described above. However, for example, the above-described structure may be modified as described below.

[0065] A method of applying torque between the yarn

hooking member 22 and the slack eliminating roller 21 is not limited to the above-described magnetic mechanisms. In place of such mechanisms, for example, a frictional force or an electromagnetic mechanism may be used.

[0066] The yarn hooking member 22 is not indispensable. For example, as the spinning machine disclosed in Japanese Unexamined Patent Application Publication No. 2004-124333, the spinning machine 1 may use a yarn slack eliminating device that does not include a yarn hooking member capable of rotating with respect to the slack eliminating roller. Even with such a structure, the yarn can also be fed from the spinning device at a stable speed by winding the yarn around the rotating slack eliminating roller. However, in the yarn slack eliminating device 12 including the yarn hooking member 22 as described in the above embodiment, the yarn tension can be adjusted by the yarn hooking member 22. Accordingly, it is not necessary to provide a yarn tension adjusting device independently, and a complicated structure that increases and/or decreases the yarn accumulated amount of the slack eliminating roller is not necessary. In view of downsizing of the spinning machine 1, it is preferable to use the yarn slack eliminating device 12 including the yarn hooking member 22 described in the above embodiment.

[0067] Any layout of the spinning unit 2 may be adopted as long as the yarn slack eliminating device 12 applies tension to the spun yarn 10 fed from the spinning device 9, and the layout is not limited to the layout described in the above embodiment. For example, another yarn guiding member (for example, a roller that does not nip the yarn) that does not affect tension of the yarn may be provided.

[0068] The configuration of the above spinning machine 1 is just an example, and, for example, the yarn splicing cart 3 may be omitted, or an automatic doffing cart that automatically replaces a wound package may be further provided.

Claims

1. A spinning machine comprising:

a spinning device (9) which produces a spun yarn by applying twists to a fiber bundle;
a winding device (13) which winds the spun yarn fed from the spinning device (9) and forms a package; and
a yarn accumulating device (12) which is arranged between the spinning device (9) and the winding device (13), and includes a function of directly feeding the spun yarn from the spinning device (9) while applying tension to the spun yarn and a function of temporarily accumulating the spun yarn.

2. The spinning machine according to claim 1, **characterized in that** the yarn accumulating device (12) includes:

a substantially tubular yarn accumulating roller (21);
a roller driving section (25) that drives and rotates the yarn accumulating roller (21); and
a rotational speed control section that controls a rotational speed of the roller driving section (25).

3. The spinning machine according to claim 2, **characterized in that** a speed at which the spun yarn is fed from the spinning device (9) is defined by the rotational speed of the roller driving section (25) controlled by the rotational speed control section.

4. The spinning machine according to claim 2 or claim 3, **characterized in that** the yarn accumulating device (12) further includes:

a yarn hooking member (22) which can rotate independently or integrally with the yarn accumulating roller (21) while being engaged with the spun yarn fed from the spinning device (9); and
a torque generating member which generates a resistance torque that is against rotation of the yarn hooking member (22) with respect to the yarn accumulating roller (21),

wherein when torque that is generated by tension acting upon the spun yarn engaged with the yarn hooking member (22) is greater than the resistance torque generated by the torque generating member, the yarn hooking member (22) rotates independently from the yarn accumulating roller (21), and
wherein when the torque that is generated by the tension acting upon the spun yarn engaged with the yarn hooking member (22) is smaller than the resistance torque generated by the torque generating member, the yarn hooking member (22) rotates integrally with the yarn accumulating roller (21).

5. The spinning machine according to any one of claim 2 through claim 4, **characterized in that** the yarn accumulating roller (21) is made from high abrasion-resistant material.

6. The spinning machine according to any one of claim 2 through claim 5, **characterized in that** an outer periphery of the yarn accumulating roller (21) has a length that the spun yarn can be wound at least ten times or more without the spun yarn forming overlaps.

7. The spinning machine according to claim 6, **charac-**

terized by further comprising a yarn accumulated amount detecting sensor (27) that detects an amount of the spun yarn accumulated around the yarn accumulating roller (21).

8. The spinning machine according to any one of claim 1 through claim 7, **characterized by** further comprising a yarn defect detecting section (52) that detects a yarn defect in the spun yarn,
wherein the yarn defect detecting section (52) is provided between the spinning device (9) and the yarn accumulating device (12) in a yarn feeding direction.

FIG. 1

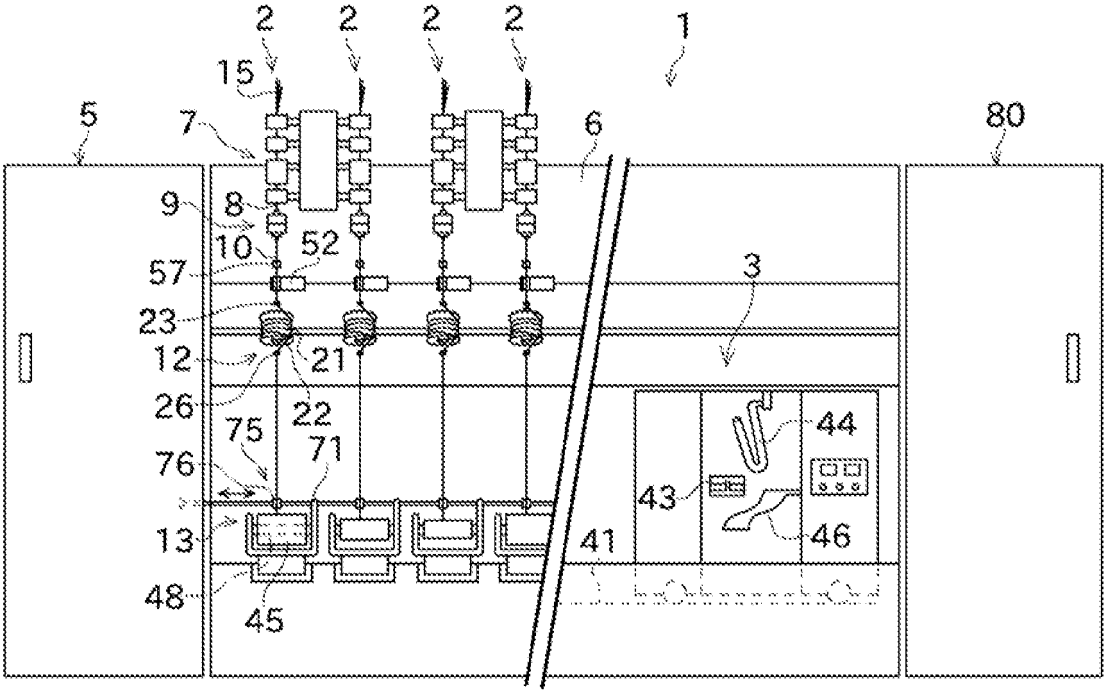

2
2
2
2
1
15
5
7
6
80
9
8
10
52
57
3
23
12
21
26
22
75
71
44
76
43
13
41
46
48
45

FIG. 2

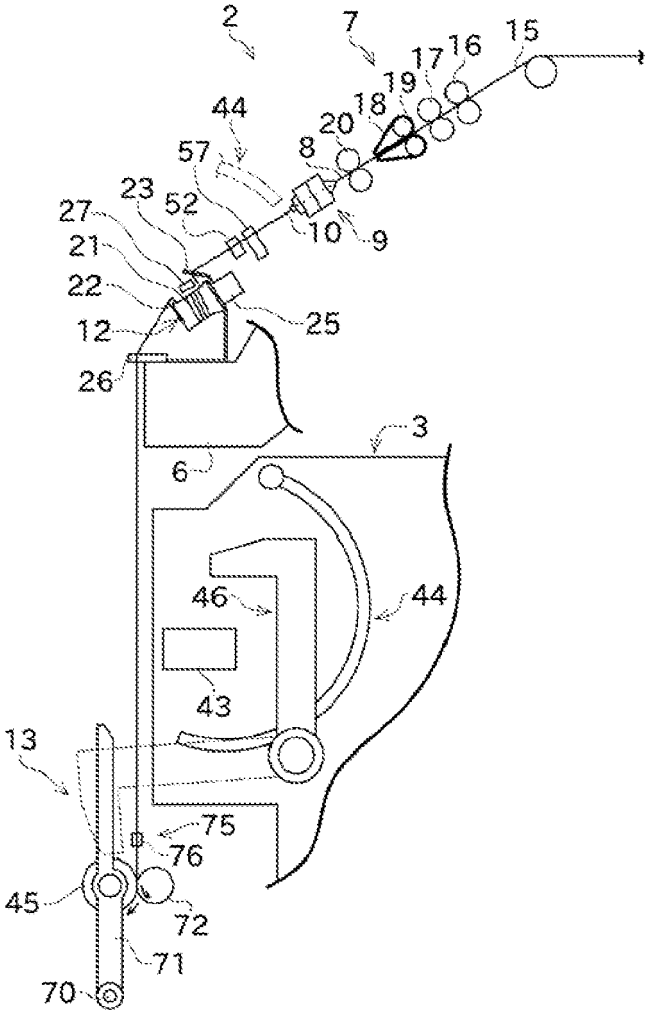
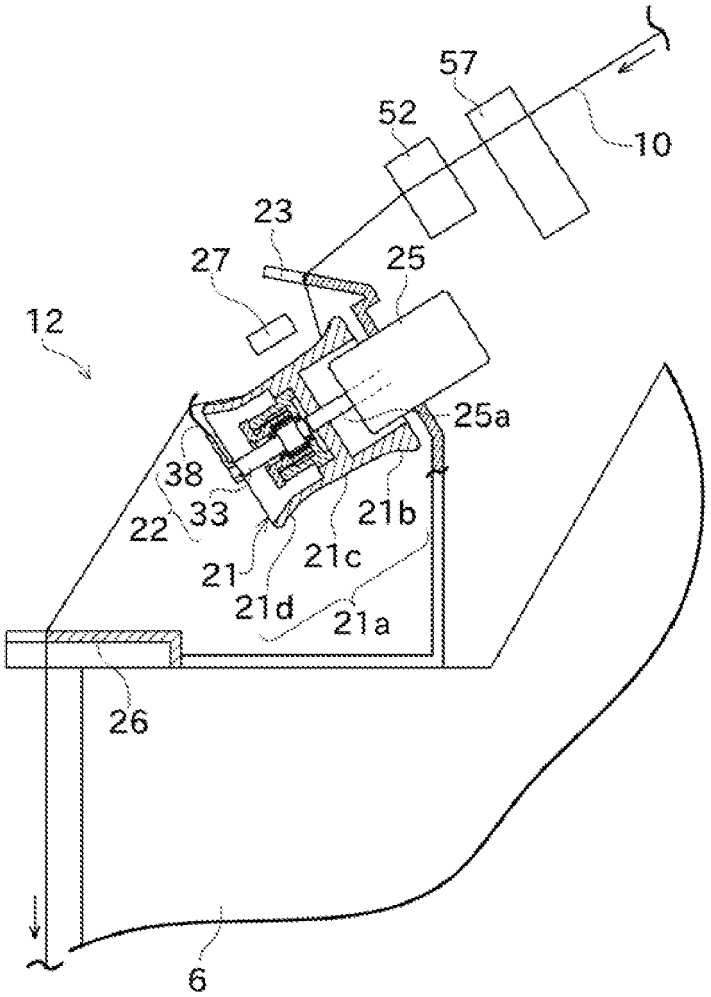

2
7
15
16
17
19
18
20
44
8
57
23
52
27
21
22
12
26
10
9
25
3
6
46
44
43
13
75
76
45
72
71
70

FIG. 3



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 17 0145

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 460 015 A1 (MURATA MACHINERY LTD [JP]) 22 September 2004 (2004-09-22) * figures 10, 11a, 11b * -----	1-8	INV. D01H4/48 B65H51/20 D01H9/08
A	DE 34 15 447 A1 (VYZK USTAV BAVLNARSKY [CS]) 10 January 1985 (1985-01-10) * abstract; figure 1 * -----	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

D01H
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 January 2010	Dupuis, Jean-Luc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 0145

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-01-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1460015 A1	22-09-2004	CN 1533975 A	06-10-2004
		DE 602004001410 T2	05-07-2007
DE 3415447 A1	10-01-1985	CS 237357 B1	16-07-1985
		IT 1173968 B	24-06-1987
		JP 60036268 A	25-02-1985
		SU 1787917 A1	15-01-1993

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2004124333 A **[0002] [0003] [0034] [0066]**