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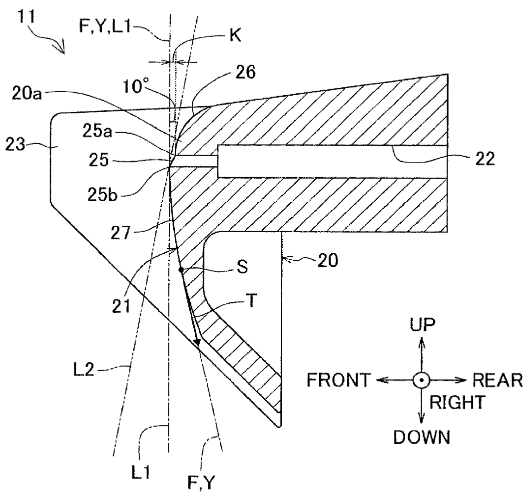
(54) OIL SUPPLY GUIDE AND SPUN YARN TAKE-UP APPARATUS

(57) Oil is evenly applied to a yarn even when the viscosity of the oil is low. A surface 21 of a guide main body 20 of an oil supply guide 11, which is on the front side, extends along the up-down direction. A discharge port 25 is formed in the surface 21 to discharge oil. On the respective sides in the left-right direction of the discharge port 25 on the surface 21, two yarn guiding members 23 are provided to extend along the up-down direction and to be inclined relative to the up-down direction so that the distance between the two yarn guiding members 23 decreases downward. A part of the surface 21, which is below the lower end 25b of the discharge port 25, is a lower curved surface 27 which is curved to protrude forward. When viewed in the left-right direction, the upper end 25a of the discharge port 25 and an upper part 20a of the guide main body 20, which is above the upper end 25a, overlap neither a tangent L1 of the lower curved surface 27 at the lower end 25b of the discharge port 25 nor a linear line L2 which is formed by rotating the tangent L1 by 10 degrees toward the upper end 25a of the discharge port 25 about the lower end 25b of the discharge port 25.

FIG.3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an oil supply guide which applies oil to a yarn spun out from a spinning apparatus and a spun yarn take-up apparatus which includes the oil supply guide.

[0002] An oil supply guide recited in Patent Literature 1 (Japanese Unexamined Patent Publication No. 2016-216838) is an oil supply guide for applying oil to a yarn spun out from a spinning apparatus. The oil supply guide of Patent Literature 1 includes a discharge port through which oil is discharged and a contact surface which is in contact with a yarn. The contact surface includes a first curved surface in which the discharge port is formed and a second curved surface which is positioned below the first curved surface. The yarn makes contact with the contact surface first at the periphery of the discharge port, and leaves the contact surface as the yarn runs in a tangential direction at a predetermined position in the second curved surface.

SUMMARY OF THE INVENTION

[0003] In the oil supply guide of Patent Literature 1, the upper end of the discharge port may protrude forward as compared to the lower end, due to reasons such as a manufacturing error. In such a case, the yarn starts to make contact with the contact surface at around the upper end of the discharge port, and a gap is formed between the yarn and the second curved surface. Oil discharged from the discharge port is accumulated in this gap, and the oil accumulated in the gap is applied to the yarn. In this regard, when the viscosity of the oil is low, the oil tends to flow down from the gap, and hence an amount of the oil in the gap tends to be varied over time. As a result, patchy adherence (uneven adherence) of the oil onto the yarn may occur.

[0004] An object of the present invention is to provide an oil supply guide which is capable of evenly applying oil to a yarn even when the viscosity of the oil is low, and to provide a spun yarn take-up apparatus including the oil supply guide.

[0005] According to a first aspect of the invention, an oil supply guide is configured to apply oil to a yarn which is constituted by filaments spun out from a spinning apparatus, the oil supply guide comprising: a guide main body which has a surface extending along a first direction; a discharge port which is formed in the surface of the guide main body and discharges the oil; and two yarn guiding members which are provided on the surface of the guide main body to be on respective sides of the discharge port in a second direction orthogonal to the first direction, the distance between the two yarn guiding members in the second direction decreasing from one side toward the other side in the first direction, and the two yarn guiding members guiding the filaments toward the center in the second direction of the discharge port, the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port, the contact surface being a curved surface protruding outward of the guide main body, and when viewed in the second direction, an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a tangent of the curved surface at an end on the other side in the first direction of the discharge port.

[0006] Being different from the present invention, assume that, when viewed in the second direction, an end on the one side in the first direction of the discharge port or a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, overlaps a tangent of the curved surface at an end on the other side in the first direction of the discharge port. In this case, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the oil supply guide at the periphery of the discharge port, the yarn makes contact first with the surface of the guide main body at around the end on the one side in the first direction of the discharge port. As a result, a gap is formed between the curved surface and the yarn. Oil discharged from the discharge port is accumulated in this gap, and the oil accumulated in the gap is applied to the yarn. However, when the viscosity of the oil is low and the ejection amount of the oil per unit time is small, the oil does not stay in the gap for a long time and easily drops off. As a result, the amount of the oil in the gap is unstable and patchy adherence (uneven adherence) of the oil onto the yarn Y occurs.

[0007] In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a tangent of the curved surface at an end on the other side in the first direction of the discharge port. On this account, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the guide main body at the periphery of the discharge port, the yarn makes contact first with the curved surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the curved surface and the yarn. On this account, oil can be evenly applied to the yarn even when the viscosity of the oil is low.

[0008] In addition to the above, because in the present invention the contact surface is a curved surface, the yarn in contact with the curved surface leaves the curved surface as the yarn runs in the tangential direction at a part on the other side of the end on the other side of the discharge port. On this account, oil is not scraped off by a corner portion when the yarn leaves the curved surface. This makes it possible to properly control the amount of oil applied to the yarn.

[0009] According to a second aspect of the invention, the oil supply guide of the first aspect is arranged such that, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

[0010] The oil supply guide may be disposed so that the tangent of the contact surface at the end on the other side in the first direction of the discharge port is slightly tilted relative to the running direction of the yarn. According to the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port. With this arrangement, even if the oil supply guide is disposed so that the tangent is tilted by 10 degrees or less relative to the running direction of the yarn, the yarn starts to make contact with the curved surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the curved surface and the yarn.

[0011] According to a third aspect of the invention, an oil supply guide is configured to apply oil to a yarn which is constituted by filaments spun out from a spinning apparatus, the oil supply guide comprising: a guide main body which has a surface extending along a first direction; a discharge port which is formed in the surface of the guide main body and discharges the oil; and two yarn guiding members which are provided on the surface of the guide main body to be on respective sides of the discharge port in a second direction orthogonal to the first direction, the distance between the two yarn guiding members in the second direction decreasing from one side toward the other side in the first direction, and the two yarn guiding members guiding the filaments toward the center in the second direction of the discharge port, the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port, the contact surface including a flat surface which forms an end on the other side in the first direction of the discharge port, and when viewed in the second direction, an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a first extension plane which is an extension of the flat surface.

[0012] Being different from the present invention, assume that, when viewed in the second direction, an end on the one side in the first direction of the discharge port or a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, overlaps a first extension plane. In this case, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the oil supply guide at the periphery of the discharge port, the yarn makes contact first with the surface of the guide main body at around the end on the one side in the first direction of the discharge port. As a result, a gap is formed between the flat surface and the yarn. Oil discharged from the discharge port is accumulated in this gap, and the oil accumulated in the gap is applied to the yarn. However, when the viscosity of the oil is low and the ejection amount of the oil per unit time is small, the oil does not stay in the gap for a long time and easily drops off. As a result, the amount of the oil in the gap is unstable and patchy adherence (uneven adherence) of the oil onto the yarn Y occurs.

[0013] In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap the first extension plane. On this account, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the guide main body at the periphery of the discharge port, the yarn makes contact first with the flat surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the flat surface and the yarn. On this account, oil can be evenly applied to the yarn even when the viscosity of the oil is low.

[0014] According to a fourth aspect of the invention, the oil supply guide of the third aspect is arranged such that, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a second extension plane which is formed by tilting the first extension plane by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

[0015] The oil supply guide may be disposed so that the flat surface is slightly tilted relative to the running direction of the yarn. In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap the second extension plane. With this arrangement, even if the oil supply guide is disposed so that the flat surface is tilted by 10 degrees or less relative to the running direction of the yarn, the yarn starts to make contact with the flat surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the flat surface and the yarn.

[0016] According to a fifth aspect of the invention, the oil supply guide of the third or fourth aspect is arranged such that, the contact surface includes a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body.

[0017] According to the present invention, the contact surface includes a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body. On this account, the oil is not scraped off by a corner portion when the yarn in contact with the contact surface leaves the contact surface from the end on the other side in the first direction of the flat surface. This makes it possible to properly control the amount of oil applied to the yarn.

[0018] According the a sixth aspect of the invention, a spun yarn take-up apparatus is configured to take up a yarn which is constituted by filaments spun out from a spinning apparatus, the spun yarn take-up apparatus comprising an oil supply guide which is configured to apply oil to the yarn running from one side to the other side in a first direction, the oil supply guide including: a guide main body which has a surface extending along the first direction; and a discharge port which is formed in the surface of the guide main body and discharges the oil with the viscosity of equal to or lower than 50cSt, the yarn starting to make contact with the surface at a periphery of the discharge port, the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port, the contact surface being a curved surface protruding outward of the guide main body, and when viewed in the second direction, an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a tangent of the curved surface at an end on the other side in the first direction of the discharge port.

[0019] Being different from the present invention, assume that, when viewed in the second direction, an end on the one side in the first direction of the discharge port or a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, overlaps a tangent of the curved surface at an end on the other side in the first direction of the discharge port. In this case, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the oil supply guide at the periphery of the discharge port, the yarn makes contact first with the surface of the guide main body at around the end on the one side in the first direction of the discharge port. As a result, a gap is formed between the curved surface and the yarn. Oil discharged from the discharge port is accumulated in this gap, and the oil accumulated in the gap is applied to the yarn. However, when the viscosity of the oil is low and the ejection amount of the oil per unit time is small, the oil does not stay in the gap for a long time and easily drops off. As a result, the amount of the oil in the gap is unstable and patchy adherence (uneven adherence) of the oil onto the yarn Y occurs.

[0020] In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap the tangent of the curved surface at the end on the other side in the first direction of the discharge port. On this account, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the guide main body at the periphery of the discharge port, the yarn makes contact first with the curved surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the curved surface and the yarn. On this account, oil can be evenly applied to the yarn even when the viscosity of the oil is low and the ejection amount of the oil per unit time is small.

[0021] In addition to the above, because in the present invention the contact surface is a curved surface, the yarn in contact with the curved surface leaves the curved surface as the yarn runs in the tangential direction at a part on the other side of the end on the other side of the discharge port. On this account, oil is not scraped off by a corner portion when the yarn leaves the curved surface. This makes it possible to properly control the amount of oil applied to the yarn.

[0022] According to a seventh aspect of the invention, the spun yarn take-up apparatus of the sixth aspect is arranged such that, the oil supply guide is, when viewed in the second direction, disposed so that an angle between the tangent and a running direction of the yarn immediately before making contact with the surface is equal to or smaller than 10 degrees, and the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

[0023] The oil supply guide may be disposed so that the tangent of the contact surface at the end on the other side in the first direction of the discharge port is slightly tilted relative to the running direction of the yarn. According to the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port. With this arrangement, even if the oil supply guide is disposed so that the tangent is tilted by 10 degrees or less relative to the running direction of the yarn, the yarn starts to make contact with the curved surface at around the end on the other side in the first direction of the discharge port. Therefore the above-described gap in which oil accumulates is not formed or is scarcely formed.

[0024] According an eighth aspect of the invention, a spun yarn take-up apparatus is configured to take up a yarn which is constituted by filaments spun out from a spinning apparatus, the spun yarn take-up apparatus comprising an oil supply guide which is configured to apply oil to the yarn running from one side to the other side in a first direction, the oil supply guide including: a guide main body which has a surface extending along the first direction; and a discharge port which is formed in the surface of the guide main body and discharges the oil with the viscosity of equal to or lower than 50cSt, the yarn starting to make contact with the surface at a periphery of the discharge port, the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port, the contact surface including a flat surface which forms an end on the other side in the first direction of the discharge port, and when viewed in the second direction, an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a first extension plane which is an extension of the flat surface.

[0025] Being different from the present invention, assume that, when viewed in the second direction, an end on the one side in the first direction of the discharge port or a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, overlaps a first extension plane. In this case, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the oil supply guide at the periphery of the discharge port, the yarn makes contact first with the surface of the guide main body at around the end on the one side in the first direction of the discharge port. As a result, a gap is formed between the contact surface and the yarn. Oil discharged from the discharge port is accumulated in this gap, and the oil accumulated in the gap is applied to the yarn. However, when the viscosity of the oil is low and the ejection amount of the oil per unit time is small, the oil does not stay in the gap for a long time and easily drops off. As a result, the amount of the oil in the gap is unstable and patchy adherence (uneven adherence) of the oil onto the yarn Y occurs.

[0026] In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap the first extension plane. On this account, when the yarn is arranged to run on the oil supply guide from one side to the other side in the first direction and to start to make contact with the surface of the guide main body at the periphery of the discharge port, the yarn makes contact first with the flat surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the flat surface and the yarn. On this account, oil can be evenly applied to the yarn even when the viscosity of the oil is low and the ejection amount of the oil per unit time is small.

[0027] According to a ninth aspect of the invention, the spun yarn take-up apparatus of the eighth aspect is arranged such that, the oil supply guide is, when viewed in the second direction, disposed so that an angle between the tangent and a running direction of the yarn immediately before making contact with the surface is equal to or smaller than 10 degrees, and the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap a second extension plane which is formed by tilting the first extension plane by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

[0028] The oil supply guide may be disposed so that the flat surface is slightly tilted relative to the running direction of the yarn. In the present invention, when viewed in the second direction, the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port, do not overlap the second extension plane. With this arrangement, even if the oil supply guide is disposed so that the flat surface is tilted by 10 degrees or less relative to the running direction of the yarn, the yarn starts to make contact with the flat surface at around the end on the other side in the first direction of the discharge port. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the flat surface and the yarn.

[0029] According to a tenth aspect of the invention, the spun yarn take-up apparatus of the eighth or ninth aspect is arranged such that, the oil supply guide includes a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body.

[0030] According to the present invention, the contact surface includes a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body. On this account, the oil is not scraped off by a corner portion when the yarn in contact with the contact surface leaves the end on the other side in the first direction of the flat surface. This makes it possible to properly control the amount of oil applied to the yarn.

[0031] According to an eleventh aspect of the invention, the spun yarn take-up apparatus of any one of the sixth to tenth aspects is arranged such that, the oil supply guide discharges the oil with the density of equal to or higher than 85% from the discharge port.

[0032] The viscosity of the oil is low both when the density of the oil is low and high. However, because the required amount of oil applied to the yarn remains unchanged, an amount of oil discharged from the discharge port per unit time in order to apply a predetermined amount of oil to the yarn is small when the density of the oil is high, as compared to the case where the density of the oil is low. As a result, the amount of the accumulated in the gap tends to be unstable when the density of the oil is high. For this reason, when the density of the oil is equal to or higher than 85%, it is greatly significant to eliminate or minimize the gap in which the oil accumulates between the contact surface (curved surface or flat surface) and the yarn, by arranging the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side of the end on the one side of the discharge port, not to overlap the tangent or the first extension plane.

[0033] According to the present invention, oil can be evenly applied to a yarn even when the viscosity of the oil is low.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

FIG. 1 is a schematic diagram of a spun yarn take-up apparatus including an oil supply guide.

FIG. 2 is a front elevation of the oil supply guide.

FIG. 3 is a cross section taken along a line III-III in FIG. 2.

FIG. 4 shows the relationship between oil density and oil viscosity.

FIG. 5 is equivalent to FIG. 3 and shows an oil supply guide in which the upper end of the discharge port is disposed forward as compared to the oil supply guide of FIG. 3.

FIG. 6(a) shows U% in Comparative Examples 1 to 3. FIG. 6(b) shows U% in Examples 1 to 3. FIG. 6(c) shows the density and viscosity of oil used for measurement.

FIG. 7 is equivalent to FIG. 3 and is a cross section of an oil supply guide of a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] The following will describe a preferred embodiment of the present invention.

(Spun Yarn Take-Up Apparatus)

[0036] As shown in FIG. 1, a spun yarn take-up apparatus 1 takes up synthetic fiber yarns Y formed of filaments f spun out from a spinning apparatus 2, and forms packages P by winding the yarns Y onto bobbins B, respectively. The description below is given on the premise that the up-down direction, front-back direction, and left-right direction in FIG. 1 are respectively the up-down direction relative to the spun yarn take-up apparatus 1 (first direction of the present invention), the front-back direction relative to the spun yarn take-up apparatus 1, and the left-right direction relative to the spun yarn take-up apparatus 1 (second direction of the present invention).

[0037] The spun yarn take-up apparatus 1 includes members such as a cooling unit 3, an oil supply unit 4, a drawing unit 5, take-up rollers 6 and 7, an interlacing device 8, and a winding device 9. In the spinning apparatus 2, to begin with, polymer supplied from a polymer supplier (not illustrated), which is a gear pump, for example, is extruded downward through spinnerets 2a which are lined up in the left-right direction (the direction away from the viewer of FIG. 1). As a consequence, yarns Y formed of filaments F are spun out while being lined up in the left-right direction.

[0038] The yarns Y spun out from the spinnerets 2a of the spinning apparatus 2 travel along a yarn path through the cooling unit 3, the oil supply unit 4, the drawing unit 5, the take-up roller 6, the interlacing device 8, and the take-up roller 7, while being lined up in the left-right direction. The yarns Y are distributed in the front-back direction from the take-up roller 7, and are then wound onto the bobbins B at the winding device 9.

[0039] The cooling unit 3 includes a plurality of cylindrical cooling cylinders 10. Each cooling cylinder 10 is provided below the corresponding spinneret 2a of the spinning apparatus 2. The yarns Y spun out from the spinnerets 2a of the spinning apparatus 2 run downward in internal spaces 10a of the cooling cylinders 10, along the axial direction of the cooling cylinder 10. A flow adjustment section 10b is provided around the internal space 10a. Cooling wind supplied from an unillustrated pressurized air supplier flows into the internal space 10a while being adjusted by the flow adjustment section 10b. The flow adjustment section 10b mainly performs the adjustment in such a way that the flow rate of the cooling wind flowing into the internal space 10a is more or less even in the circumferential direction of the cooling cylinder 10.

[0040] The oil supply unit 4 includes oil supply guides 11 which are provided below the respective cooling cylinders 10. The oil supply guide 11 gathers filaments F spun out from the spinneret 2a into a single yarn Y, and applies oil to the yarn Y (filaments F). The details of the oil supply guide11 will be given later.

[0041] The drawing unit 5 is provided below the oil supply unit 4. The drawing unit 5 includes: a heat retaining box 12; and heating rollers (not illustrated) accommodated in the heat retaining box 12. By the heating rollers, the drawing unit 5 draws the yarns Y while heating them.

[0042] The yarns Y drawn by the drawing unit 5 are sent to the winding device 9 by the take-up rollers 6 and 7. The interlacing device 8 is provided between the take-up roller 6 and the take-up roller 7 to interlace filaments F constituting each yarn Y.

[0043] The winding device 9 includes members such as a frame 13, a turret 14, two bobbin holders 15, a supporting frame 16, a contact roller 17, and a traverse unit 18. The winding device 9 simultaneously winds the yarns Y sent from the take-up roller 7 onto the bobbins B by rotating the bobbin holder 15, so as to form packages P.

[0044] The turret 14 is a disc-shaped member and is attached to the frame 13. The turret 14 is rotationally driven by a motor which is not illustrated. The two bobbin holders 15 are cantilevered by the turret 14 to extend in the front-back direction. To each bobbin holder 15, cylindrical bobbins B are attached to be lined up along the axial direction of the bobbin holder 15. As the turret 14 rotates, the positions of the two bobbin holders 15 are switched between an upper winding position and a lower retracted position.

[0045] The supporting frame 16 is a frame-shaped member which is long in the front-back direction. This supporting frame 16 is fixed to the frame 13. A roller supporting member 19 which is long in the front-back direction is attached to a lower part of the supporting frame 16 so as to be vertically movable relative to the supporting frame 16. The roller supporting member 19 supports the contact roller 17 in a rotatable manner. The contact roller 17 extends in the axial direction of the bobbin holders 15. As this contact roller 17 makes contact with a package P under the formation and the contact roller 17 applies a predetermined contact pressure to the package P, the shape of the package P is adjusted.

[0046] The traverse unit 18 includes traverse guides 18a lined up in the front-back direction. The traverse guides 18a are driven by a motor (not illustrated) and are configured to reciprocate in the front-back direction. As each traverse guide 18a to which the yarn Y is threaded reciprocates, the yarn Y is wound onto the corresponding bobbin B while being traversed about a fulcrum guide 18b.

(Oil Supply Guide)

[0047] As described above, the oil supply guide 11 applies oil to yarns Y each of which is made of filaments F spun out from the spinning apparatus 2. The oil supply guide 11 is made of a ceramic material such as alumina or zirconia, and includes a guide main body 20 as shown in FIG. 2 and FIG. 3. The guide main body 20 has a surface 21 which is on the front side and extends along the up-down direction. With this surface 21, the yarn Y (filaments F) which is sent from the cooling unit 3 and runs downward (i.e., from one side to the other side in the first direction) makes contact.

[0048] The guide main body 20 includes an oil passage 22. The oil passage 22 is formed in the oil supply guide 11 and extends in the front-back direction. The front end of the oil passage 22 is a discharge port 25 formed in the surface 21. As oil is discharged from the discharge port 25, the oil is applied to the yarn Y (filaments F). In the present embodiment, the density of the oil discharged from the discharge port 25 is about 85%. This density of the oil indicates density of all active ingredients other than water, such as oil and an additive. FIG. 4 shows the relationship between oil density and oil viscosity. As shown in FIG. 4, in oil, the viscosity of the oil typically decreases as a difference between an oil amount and a water amount increases. For example, in the case of a particular type of oil, the viscosity is about 45cSt (equal to or lower than 50cSt) when the density is about 85%. As described in, for example, Japanese Patent Publication No. H7-70819, yarn breakage tends to occur when oil with the viscosity higher than 50cSt is applied to the yarn. On this account, it has been known that the viscosity of oil applied to the yarn Y is preferably equal to or lower than 50cSt.

[0049] The surface 21 of the guide main body 20 includes an upper curved surface 26 which is above the upper end 25a (end on one side in the first direction) of the discharge port 25 and a lower curved surface 27 (contact surface and curved surface of the present invention) which is below the lower end 25b (end on the other side in the first direction) of the discharge port 25. The curved surfaces 26 and 27 are curved to protrude outward of the guide main body 20.

[0050] When viewed in the left-right direction (i.e., in the cross section shown in FIG. 3), the upper end 25a of the discharge port 25 and an upper part 20a of the guide main body 20, which is above the upper end 25a of the discharge port 25, do not overlap a tangent L1 of the lower curved surface 27 at the lower end 25b of the discharge port 25. Furthermore, when viewed in the left-right direction, the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 do not overlap a linear line L2 which is obtained by rotating the tangent L1 clockwise in FIG. 3 (toward the upper end 25a of the discharge port 25) by 10 degrees about the lower end 25b of the discharge port 25.

[0051] In the present embodiment, for example, because the length k between the upper end 25a and the lower end 25b of the discharge port 25 is about 0.1[mm] in the direction orthogonal to the tangent L1, the upper end 25a and the lower end 25b of the discharge port 25 have the above-described positional relationship.

[0052] The oil supply guide 11 is disposed so that, when viewed in the left-right direction, the tangent L1 is substantially parallel to the running direction of the yarn Y (filaments F) supplied from the cooling unit 3.

[0053] On the surface 21 of the guide main body 20, two yarn guiding members 23 are provided. The two yarn guiding members 23 are provided at parts of the surface 21, which are to the right of and to the left of the discharge port 25, respectively. In other words, the two yarn guiding members 23 are provided on the surface 21 to be on the respective sides of the discharge port 25 in the left-right direction. The two yarn guiding members 23 are inclined relative to the up-down direction so that, from above to below, the two yarn guiding members 23 converge toward the center in the left-right direction of the discharge port 25. For this reason, the distance between the two yarn guiding members 23 in the left-right direction decreases downward (i.e., in the direction from one side to the other side in the first direction). The filaments F supplied from the cooling unit 3 are guided by the two yarn guiding members 23 in directions toward the center in the left-right direction of the discharge port 25, while passing the oil supply guide 11. As a result, the filaments F are gradually converged and eventually form a single yarn Y.

(Advantageous Effects)

[0054] Now, being different from the present embodiment, assume that oil is applied to a yarn Y by an oil supply guide 11' shown in FIG. 5. In the oil supply guide 11', a surface 21' includes an upper curved surface 26' above an upper end 25a' of a discharge port 25' and a lower curved surface 27' below a lower end 25b' of the discharge port 25'. The curved surfaces 26' and 27' are curved to protrude outward of the guide main body 20'. When viewed in the left-right direction (i.e., in the cross section shown in FIG. 5), an upper part 20a' of the guide main body 20', which is above the upper end 25a of the discharge port 25', overlaps a tangent L1' of the lower curved surface 27' at the lower end 25b' of the discharge port 25'.

[0055] In this case, when the yarn Y supplied from the cooling unit 3 is arranged to start to make contact with the surface 21' at the periphery of the discharge port 25', the yarn Y makes contact first with either the upper end 25a' of the discharge port 25' of the upper curved surface 26' or a part above the upper end 25a'. Thereafter, the yarn Y makes contact with a part A of the lower curved surface 27', which is below the lower end 25b' of the discharge port 25'. As the yarn Y runs from a part S' which is further below the part A of the lower curved surface 27' and runs along a tangent T' at the part S', the yarn Y leaves the lower curved surface 27'.

[0056] In this case, there is a gap C between the yarn Y and a region of the lower curved surface 27', which is between the lower end 25b' of the discharge port 25' and the part A, with the result that oil discharged from the discharge port 25' is accumulated in the gap C. The oil accumulated in the gap C is applied to the yarn Y. In this regard, when the viscosity of the oil is low and an amount of the oil discharged from the discharge port 25' per unit time is small, the oil tends to flow out without staying in the gap C for a long time. As a result, the amount of the oil accumulated in the gap C is unstable, and the amount of the oil applied to the yarn Y is unstable, too. As a result, patchy adherence (uneven adherence) of the oil onto the yarn Y occurs. In this regard, the viscosity of oil is low when the density of the oil is low (e.g., equal to or lower than 30%). However, because the required amount of oil applied to the yarn Y remains unchanged, an amount of oil discharged from the discharge port 25' per unit time is small when the density of the oil is high, i.e., about 85%, as compared to the case where the density of the oil is low. As a result, the amount of the oil accumulated in the gap C tends to be unstable when the density of the oil is high, as compared to the case where the density of the oil is low.

[0057] In an oil supply guide, when viewed in the left-right direction, if the upper end of a discharge port is on a tangent of a lower curved surface at the lower end of the discharge port, the above-described problem does not occur. However, in such an oil supply guide, with only a slight error in manufacturing, the positional relationship between the tangent of the lower curved surface at the lower end of the discharge port, the upper end of the discharge port, and an upper part of a guide main body above the upper end of the discharge port when viewed in the left-right direction easily becomes identical with the positional relationship in the oil supply guide 11'. In such a case, uneven adherence to the yarn Y may occur as in the case of the oil supply guide 11'.

[0058] Meanwhile, in the present embodiment, when viewed in the left-right direction, the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 do not overlap the tangent L1 of the lower curved surface 27 at the lower end 25b of the discharge port 25. On this account, when the yarn Y (filaments F) supplied from the cooling unit 3 is arranged to start to contact with the surface 21 at the periphery of the discharge port 25, the yarn Y makes contact first with the lower curved surface 27 at around the lower end 25b of the discharge port 25, and does not make contact with the upper curved surface 26. Therefore a gap in which oil accumulates is not formed or is scarcely formed between the lower curved surface 27 and the yarn Y. As a result, the oil discharged from the discharge port 25 is directly applied to the yarn Y, and hence an amount of oil applied to the yarn Y is stable and uneven adherence to the yarn Y is less likely to occur.

[0059] The oil supply guide 11 may be disposed so that the tangent L1 is slightly tilted relative to the running direction of the yarn Y supplied from the cooling unit 3. In this regard, in the present embodiment, when viewed in the left-right direction, the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 do not overlap the linear line L2 which is obtained by rotating the tangent L1 clockwise in FIG. 3 (toward the upper end 25a of the discharge port 25) by 10 degrees about the lower end 25b of the discharge port 25. With this arrangement, even when the oil supply guide 11 is disposed so that the tangent L1 is tilted 10 degrees or less relative to the running direction of the yarn Y supplied from the cooling unit 3, a gap in which oil accumulates is not formed or is scarcely formed between the lower curved surface 27 and the yarn Y in the same manner as in the case above. Therefore uneven adherence to the yarn Y is less likely to occur.

[0060] In the present embodiment, as the yarn Y runs from a part S below a part at which the yarn Y makes contact first (i.e., the lower end 25b of the discharge port 25) and runs along a tangent T at the part S, the yarn Y leaves the lower curved surface 27. On this account, oil on the yarn Y is not scraped off by a corner portion when the yarn Y leaves the oil supply guide 11. This makes it possible to properly control the amount of oil applied to the yarn Y.

[Examples]

[0061] The following will describe examples of the present invention.

[0062] FIG. 6(a) shows measurement results (Comparative Examples 1 to 3) of U% of a yarn after oil was applied thereto, when three types of oils, namely, oils G1, G2, and G3 were applied to the yarn Y by using the oil supply guide 11' in which the upper part 20a' of the guide main body 20' overlapped the tangent L1' of the lower curved surface 27' at the lower end 25b' of the discharge port 25' when viewed in the left-right direction.

[0063] FIG. 6(b) shows measurement results (Examples 1 to 3) of U% of a yarn after oil was applied thereto, when three types of oils, namely, oils G1, G2, and G3, were applied to the yarn Y by using the oil supply guide 11 in which the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 did not overlap the tangent L1 of the lower curved surface 27 at the lower end 25b of the discharge port 25 when viewed in the left-right direction.

[0064] U% of the yarn indicates the degree of variation in diameter of the yarn after the application of oil thereto. The diameter of the yarn varies in accordance with the amount of oil. U% decreases as the degree of uneven adherence of oil to the yarn decreases. The yarn used for the measurement was a polyester yarn. As shown in FIG. 6(c), the oil G1 was oil with the density of 85[%] and the viscosity of 45[cSt]. The oil G2 was oil with the density of 90[%] and the viscosity of 38[cSt]. The oil G3 was oil with the density of 98[%] and the viscosity of 23[cSt].

[0065] The measurement results of U% in Comparative Examples 1 to 3 shown in FIG. 6(a) are average values of measurement results of U% when oil supply guides 11' were prepared and oil was applied to a yarn by each of these oil supply guides 11'. In the oil supply guides 11' used for the measurement in Comparative Examples 1 to 3, an average curvature radius of the lower curved surface 27' was 32.6[mm]. Furthermore, in the oil supply guides 11', an average deviation in the front-back direction of the upper end 25a' forward from the lower end 25b' of the discharge port 25' was 0.055[mm].

[0066] The measurement results of U% in Examples 1 to 3 shown in FIG. 6(b) are average values of measurement results of U% when oil supply guides 11 were prepared and oil was applied to a yarn by each of these oil supply guides 11. In the oil supply guides 11 used for the measurement in Examples 1 to 3, an average curvature radius of the lower curved surface 27 was 32.7[mm]. Furthermore, in the oil supply guides 11, an average deviation in the front-back direction of the upper end 25a rearward from the lower end 25b of the discharge port 25 was 0.058[mm].

[0067] The ratio Q shown in FIG. 6(b) is a ratio of U% in each example to U% in a comparative example in which measurement was done using the same oil as in the corresponding example. It is shown that, the smaller the ratio Q is, the more the uneven adherence of oil is improved. In any of Examples 1 to 3, the ratio Q was smaller than 1, indicating that the uneven adherence of oil was restrained as compared to Comparative Examples 1 to 3.

[0068] A preferred embodiment of the present invention has been described. It should be noted that the present invention is not limited to the above-described embodiment, and various changes, substitutions, and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

[0069] While in the embodiment above the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 do not overlap the linear line L2 when viewed in the left-right direction, the disclosure is not limited to this arrangement. When viewed in the left-right direction, the upper end 25a of the discharge port 25 and the upper part 20a of the guide main body 20 may overlap the linear line L2 as long as they do not overlap the tangent L1. Also in this case, uneven adherence to the yarn Y is prevented at least by disposing the oil supply guide such that the tangent L1 is substantially parallel to the running direction of the filaments F (yarn Y) supplied from the cooling unit 3.

[0070] While in the embodiment above a part of the surface 21 of the guide main body 20, which is positioned below the lower end 25b of the discharge port 25, is the lower curved surface 27, the disclosure is not limited to this arrangement. According to a modification, as shown in FIG. 7, in an oil supply guide 101, a surface 121 on the front side of a guide main body 120 includes: a flat surface 126 which is above the upper end 125a of a discharge port 125 and constitutes the upper end of the discharge port 125; a flat surface 127 (flat surface of the present invention) which is below the lower end 125b of the discharge port 125 and constitutes the lower end of the discharge port 125; a flat surface 128 below the flat surface 127; and a flat surface 129 below the flat surface 128. The flat surface 126 is inclined relative to the up-down direction to form a positive slope in the rearward direction. The flat surface 127 is substantially parallel to the up-down direction. The flat surfaces 128 and 129 are inclined relative to the up-down direction to form negative slopes in the rearward direction. Relative to the up-down direction, the inclination angle of the flat surface 129 is larger than the inclination angle of the flat surface 128. The flat surface 127 and the flat surface 128 are connected to each other by a curved surface 130 which is curved to protrude outward of the guide main body 120. The flat surface 128 and the flat surface 129 are connected to each other by a curved surface 131 which is curved to protrude outward of the guide main body 120. In this modification, a combination of the flat surfaces 127 and 128 and the curved surface 130 is equivalent to the contact surface of the present invention.

[0071] In the modification, the upper end 125a of the discharge port 125 and an upper part 120a of the guide main body 120, which is above the upper end 125a of the discharge port 125, do not overlap a first extension plane H1 which is an extension of the flat surface 127 including the lower end 125a of the discharge port 125. Furthermore, the upper end 125a of the discharge port 125 and the upper part 120a of the guide main body 120 do not overlap a second extension plane H2 which is formed by tilting the first extension plane H1 by 10 degrees clockwise about the lower end 125b of the discharge port 125 when viewed in the direction in FIG. 7.

[0072] In this case, when the yarn Y is arranged to start to make contact with the surface 121 of the guide main body 120 at the periphery of the discharge port 125, the yarn Y makes contact with the flat surface 127 first at around the lower end 125b of the discharge port 125 and does not make contact with the flat surface 126. After running on the flat surface 127, the curved surface 130, and the flat surface 128 in order, the yarn Y leaves the surface 121 from the junction between the flat surface 128 and the curved surface 131. Also in this case, oil is evenly applied to the yarn Y because no gap is formed between the flat surface 127 and the yarn Y.

[0073] In the modification, because the flat surface 127 is connected with the flat surface 128 by the curved surface 130, oil on the yarn Y is not scraped off by a corner portion when the yarn Y runs from the flat surface 127 to the flat surface 128 (i.e., when the yarn Y leaves the lower end of the flat surface 127). Because the flat surface 128 is connected with the flat surface 129 by the curved surface 131, the yarn Y leaves the surface 121 in the tangential direction at the junction between the curved surface 131 and the flat surface 128. On this account, oil on the yarn Y is not scraped off by a corner portion when the yarn Y leaves the lower end of the flat surface 128. This makes it possible to properly control the amount of oil applied to the yarn Y.

[0074] In the modification, a part of the surface 121 of the guide main body 120, which is above the upper end 125a of the discharge port 125, is the flat surface 126. Alternatively, a part of the surface 121, which is above the upper end 125a of the discharge port 125, may be a curved surface in the same manner as in the embodiment above. Furthermore, in the embodiment above, a part of the surface 21, which is above the upper end 25a of the discharge port 25, may be a flat surface in the same manner as in the modification.

[0075] In addition to the above, while in the modification the flat surface 127 and the flat surface 128 are connected by the curved surface 130 and the flat surface 128 and the flat surface 129 are connected by the curved surface 131, the disclosure is not limited to this arrangement. The flat surface 127 may be directly connected to the flat surface 128, and the junction between the flat surfaces 127 and 128 may be a corner portion. Similarly, the flat surface 128 may be directly connected to the flat surface 129, and the junction between the flat surfaces 128 and 129 may be a corner portion.

[0076] While in the embodiment above the density of the oil is about 85%, the disclosure is not limited to this arrangement. The density of the oil may be higher than 85%. Furthermore, the viscosity of the oil may not be equal to or lower than 50cSt because the density of the oil is equal to or higher than 85%. For example, the viscosity of the oil may be equal to or lower than 50cSt because the density of the oil is low, i.e., equal to or lower than 30%. Furthermore, the viscosity of the oil may be equal to or lower than 50cSt even when the density of the oil is equal to or higher than 30% and equal to or lower than 85%. Also in these cases, uneven adherence to the yarn Y tends to occur when the oil is applied to the yarn Y by using the oil supply guides 11' shown in FIG. 5, in the same manner as in the embodiment above.

[0077] While in the embodiment above the drawing unit including the heat retaining box and the heating rollers is provided, the disclosure is not limited to this arrangement. For example, the present invention may be applied to POY production facility which does not require drawing by heating. In such a case, for example, the density of the oil is equal to or lower than 15% and the viscosity of the oil is equal to or lower than 50cSt.

Claims

1. An oil supply guide configured to apply oil to a yarn which is constituted by filaments spun out from a spinning apparatus, the oil supply guide comprising:

   a guide main body which has a surface extending along a first direction;

a discharge port which is formed in the surface of the guide main body and discharges the oil; and

two yarn guiding members which are provided on the surface of the guide main body to be on respective sides of the discharge port in a second direction orthogonal to the first direction, the distance between the two yarn guiding members in the second direction decreasing from one side toward the other side in the first direction, and the two yarn guiding members guiding the filaments toward the center in the second direction of the discharge port,

the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port,

the contact surface being a curved surface protruding outward of the guide main body, and

when viewed in the second direction,

an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,

do not overlap a tangent of the curved surface at an end on the other side in the first direction of the discharge port.

2. The oil supply guide according to claim 1, wherein, when viewed in the second direction,
the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

3. An oil supply guide configured to apply oil to a yarn which is constituted by filaments spun out from a spinning apparatus, the oil supply guide comprising:

a guide main body which has a surface extending along a first direction;

a discharge port which is formed in the surface of the guide main body and discharges the oil; and

two yarn guiding members which are provided on the surface of the guide main body to be on respective sides of the discharge port in a second direction orthogonal to the first direction, the distance between the two yarn guiding members in the second direction decreasing from one side toward the other side in the first direction, and the two yarn guiding members guiding the filaments toward the center in the second direction of the discharge port,

the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port,

the contact surface including a flat surface which forms an end on the other side in the first direction of the discharge port, and

when viewed in the second direction,

an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,

do not overlap a first extension plane which is an extension of the flat surface.

4. The oil supply guide according to claim 3, wherein, when viewed in the second direction,
the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a second extension plane which is formed by tilting the first extension plane by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

5. The oil supply guide according to claim 3 or 4, wherein, the contact surface includes a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body.

6. A spun yarn take-up apparatus configured to take up a yarn which is constituted by filaments spun out from a spinning apparatus,
the spun yarn take-up apparatus comprising an oil supply guide which is configured to apply oil to the yarn running from one side to the other side in a first direction,
the oil supply guide including:

a guide main body which has a surface extending along the first direction; and

a discharge port which is formed in the surface of the guide main body and discharges the oil with the viscosity of equal to or lower than 50cSt,

the yarn starting to make contact with the surface at a periphery of the discharge port,

the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port,

the contact surface being a curved surface protruding outward of the guide main body, and

when viewed in the second direction,
an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a tangent of the curved surface at an end on the other side in the first direction of the discharge port.

7. The spun yarn take-up apparatus according to claim 6, wherein,
the oil supply guide is,
when viewed in the second direction,
disposed so that an angle between the tangent and a running direction of the yarn immediately before making contact with the surface is equal to or smaller than 10 degrees, and
the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a linear line which is formed by tilting the tangent by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

8. A spun yarn take-up apparatus configured to take up a yarn which is constituted by filaments spun out from a spinning apparatus,
the spun yarn take-up apparatus comprising an oil supply guide which is configured to apply oil to the yarn running from one side to the other side in a first direction,
the oil supply guide including:

a guide main body which has a surface extending along the first direction; and
a discharge port which is formed in the surface of the guide main body and discharges the oil with the viscosity of equal to or lower than 50cSt, the yarn starting to make contact with the surface at a periphery of the discharge port,
the surface of the guide main body having a contact surface to which the yarn makes contact, the contact surface being on the other side in the first direction of the discharge port,
the contact surface including a flat surface which forms an end on the other side in the first direction of the discharge port, and
when viewed in the second direction,
an end on the one side in the first direction of the discharge port and a part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a first extension plane which is an extension of the flat surface.

9. The spun yarn take-up apparatus according to claim 8, wherein,
the oil supply guide is,
when viewed in the second direction,
disposed so that an angle between the tangent and a running direction of the yarn immediately before making contact with the surface is equal to or smaller than 10 degrees, and
the end on the one side in the first direction of the discharge port and the part of the guide main body, which is on the one side in the first direction of the end on the one side of the discharge port,
do not overlap a second extension plane which is formed by tilting the first extension plane by 10 degrees toward the end on the one side in the first direction of the discharge port about the end on the other side in the first direction of the discharge port.

10. The spun yarn take-up machine according to claim 8 or 9, wherein,
the oil supply guide includes
a curved surface which is connected to an end on the other side in the first direction of the flat surface and is curved to protrude outward of the guide main body.

11. The spun yarn take-up apparatus according to any one of claims 6 to 10, wherein, the oil supply guide discharges the oil with the density of equal to or higher than 85% from the discharge port.

FIG.1

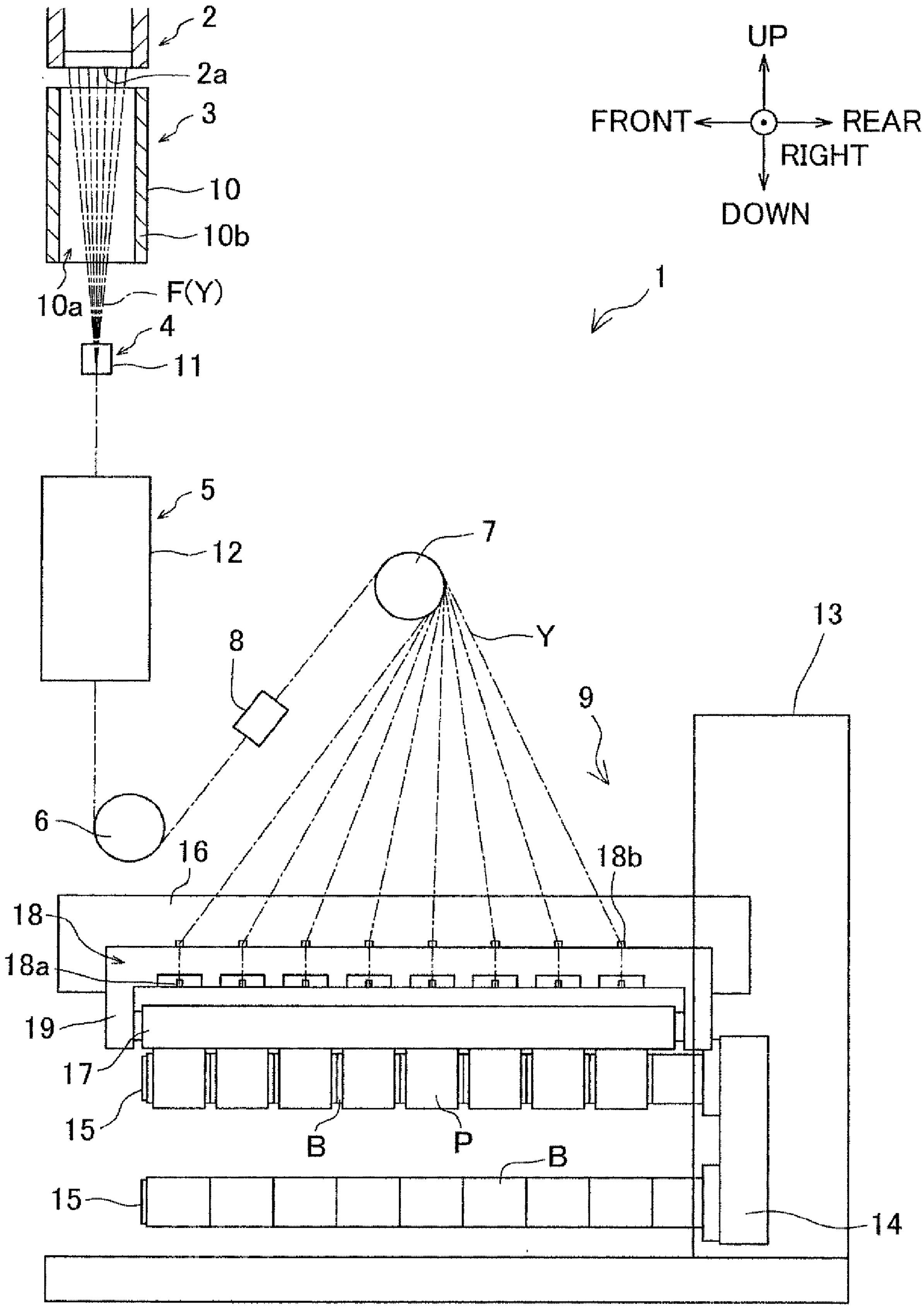

2
2a
3
10
10b
10a
F(Y)
4
11
5
12
7
8
Y
13
9
6
16
18b
18
18a
19
17
15
B
P
B
15
14
UP
FRONT
REAR
RIGHT
DOWN
1

FIG.2

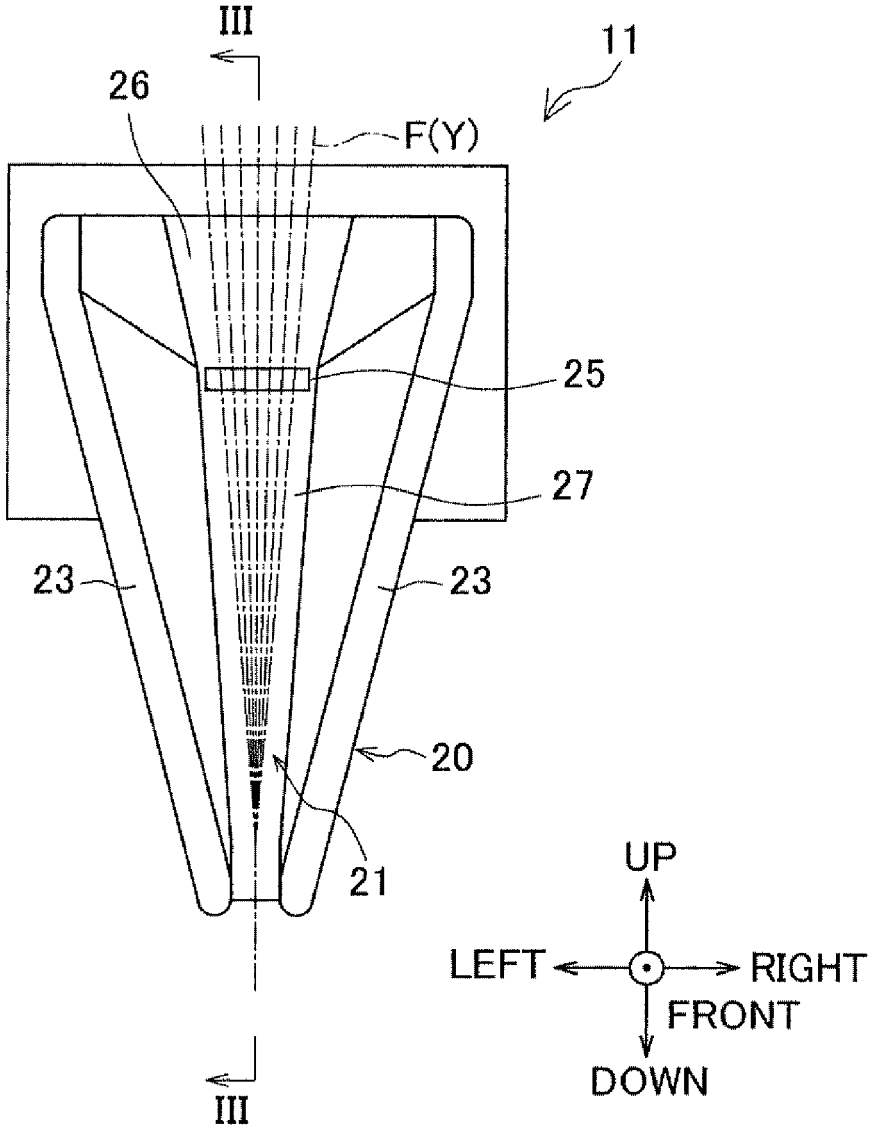
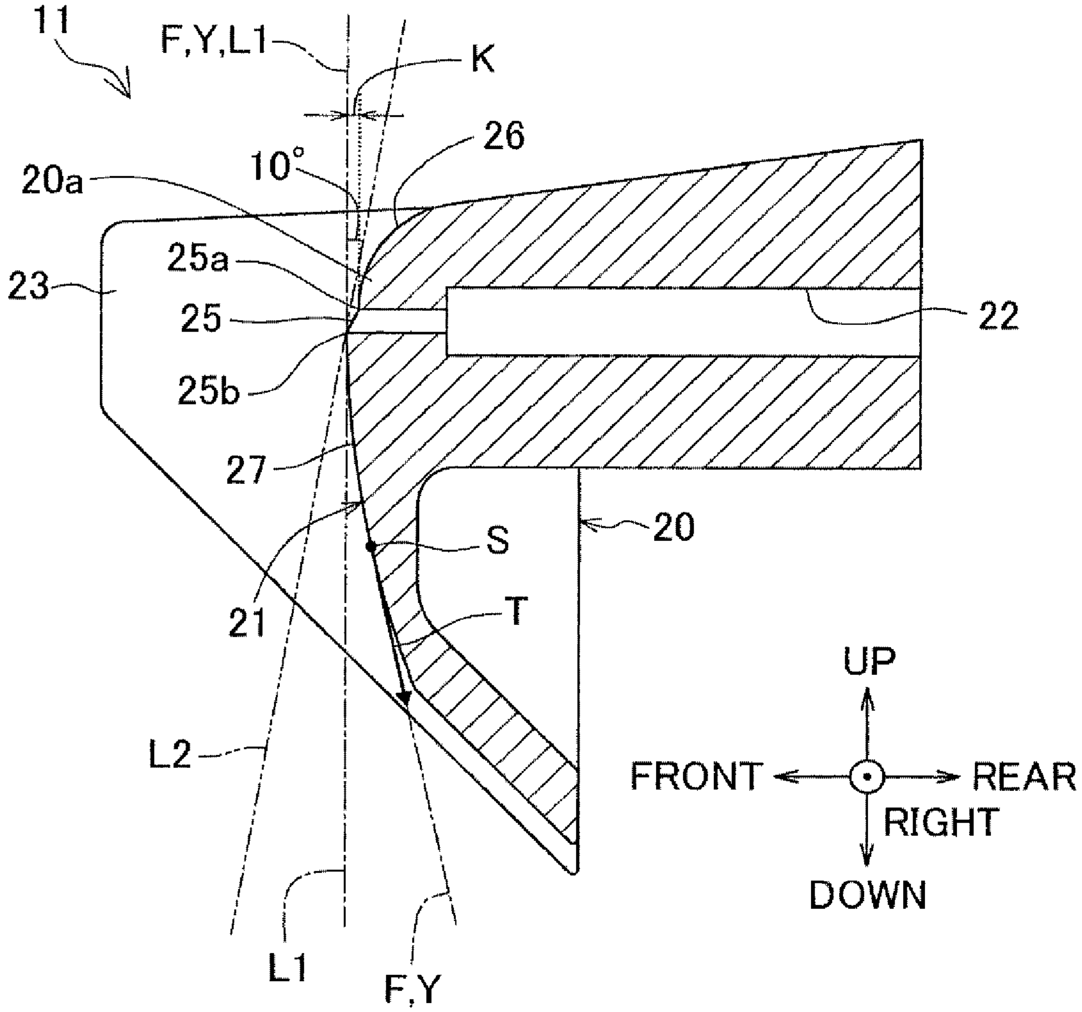


FIG.3


11
F,Y,L1
K
26
10°
20a
25a
23
25
22
25b
27
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S
21
T
UP
L2
FRONT
REAR
RIGHT
DOWN
L1
F,Y

FIG.4

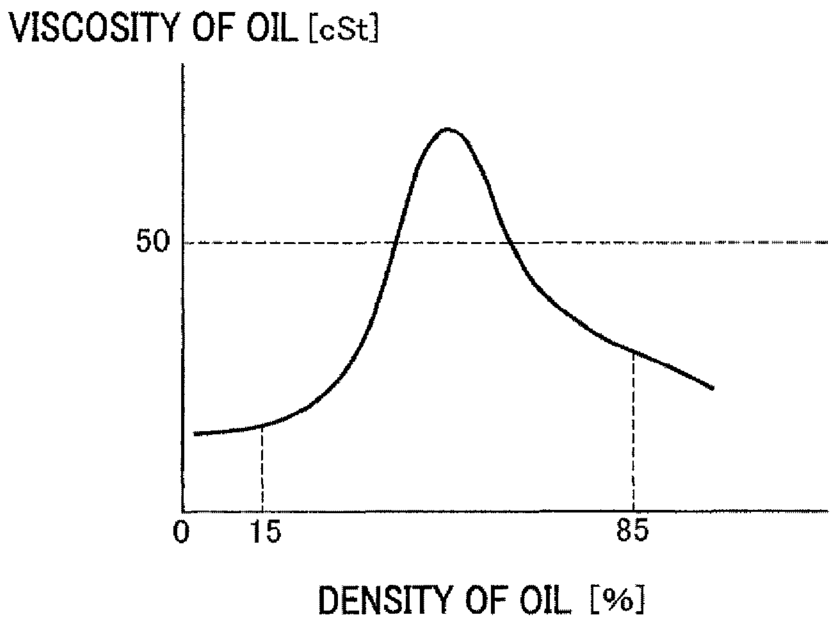


FIG.5

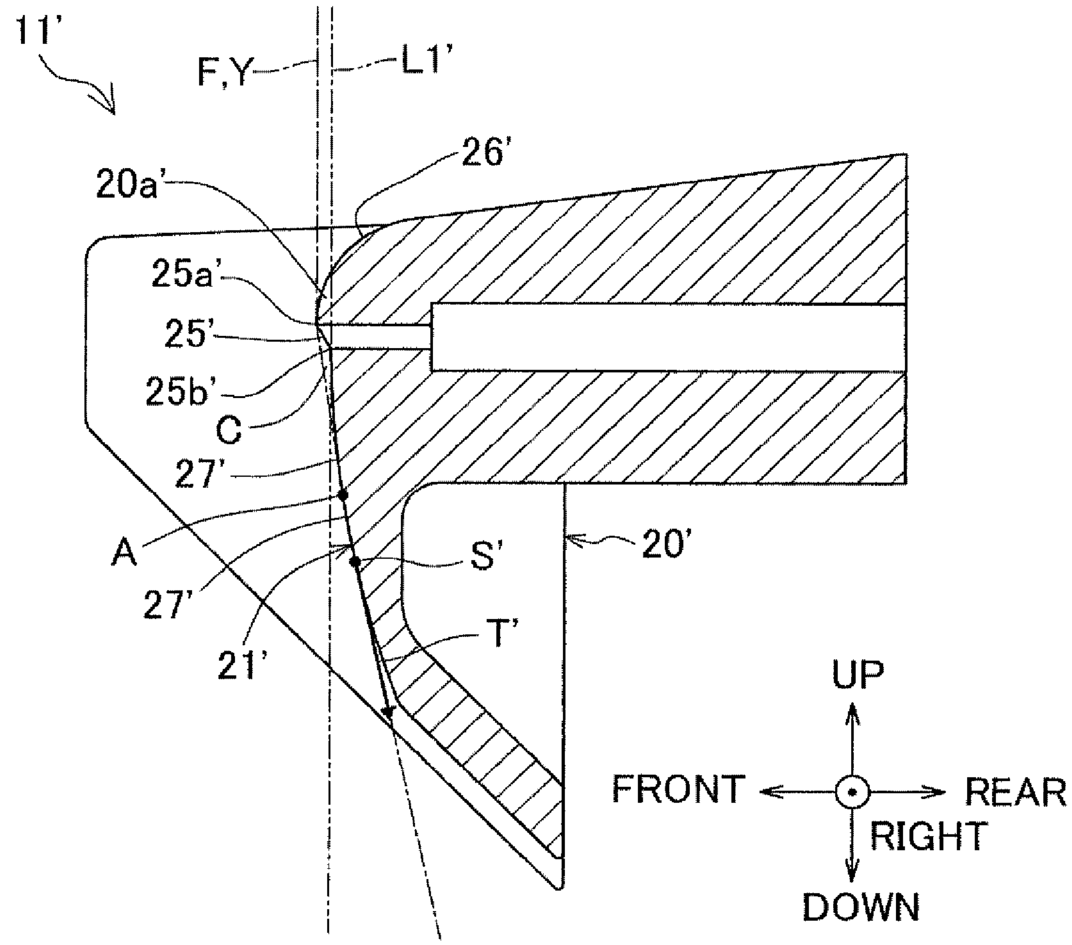

11'
F,Y
L1'
26'
20a'
25a'
25'
25b'
C
27'
A
27'
S'
21'
T'
20'
UP
FRONT
REAR
RIGHT
DOWN

FIG.6

(a)

	TYPE OF OIL	U%
COMPARATIVE EXAMPLE 1	OILG1	1.11
COMPARATIVE EXAMPLE 2	OILG2	1.12
COMPARATIVE EXAMPLE 3	OILG3	1.43

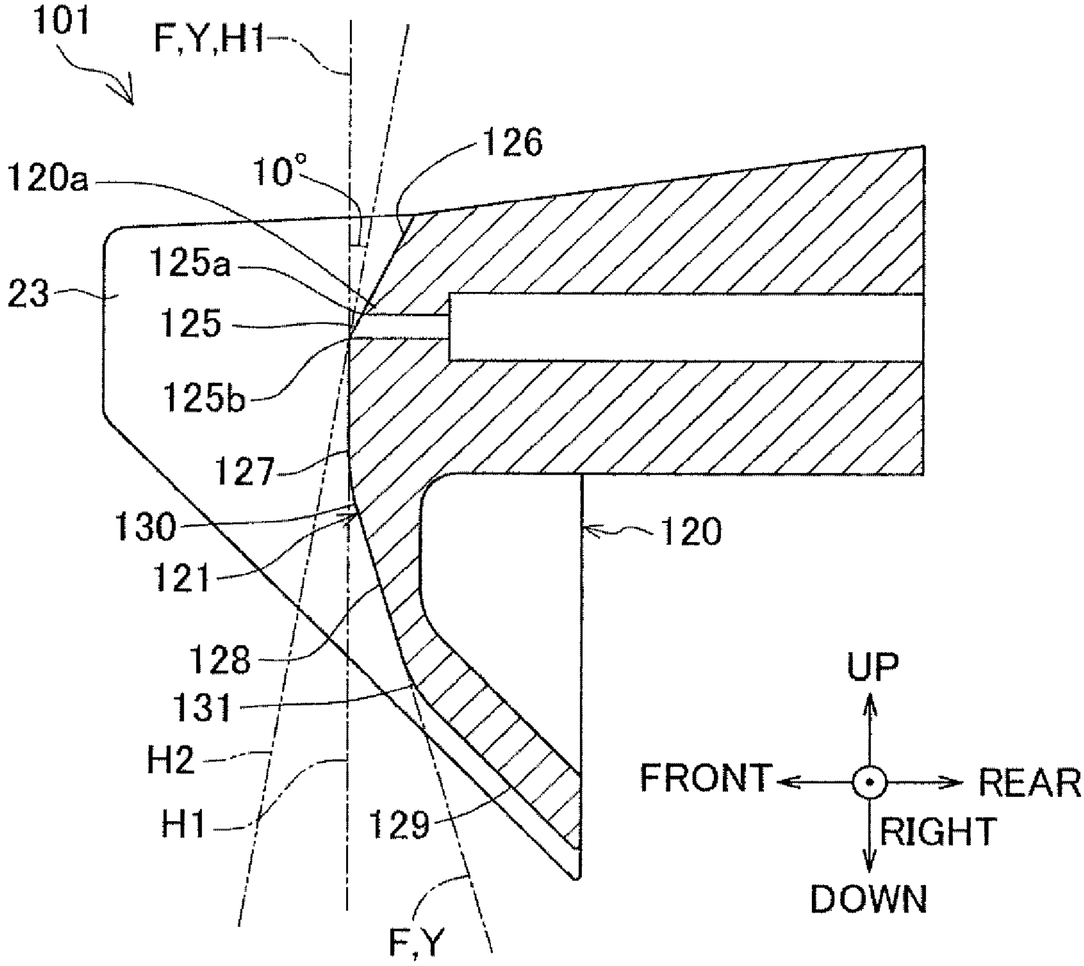
(b)

	TYPE OF OIL	U%	$Q\left(=\frac{\text{[U\% IN EXAMPLE]}}{\text{[U\% IN COMPARATIVE EXAMPLE]}}\right)$
EXAMPLE1	OILG1	0.98	0.88
EXAMPLE2	OILG2	0.96	0.86
EXAMPLE3	OILG3	1.22	0.85

(c)

TYPE OF OIL	DENSITY[%]	VISCOSITY[cSt]
OILG1	85	45
OILG2	90	38
OILG3	98	23

FIG.7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125
125b
127
130
120
121
128
131
H2
H1
129
F,Y
UP
FRONT
REAR
RIGHT
DOWN

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 15 1154

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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