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(71) Applicant: **MURATA KIKAI KABUSHIKI KAISHA**
Minami-ku
Kyoto-shi
Kyoto 601 (JP)

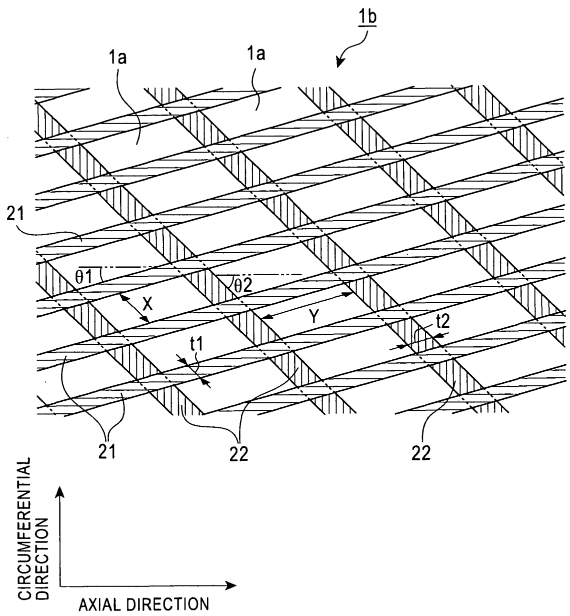
(72) Inventors:
- **Deno, Koji**
Oumihachiman-shi
Shiga (JP)
- **Matsumoto, Tatsumori**
Otsu-shi
Shiga (JP)
- **Toyoda, Takahiro**
Minami-ku
Kyoto-shi
Kyoto (JP)

(74) Representative: **Liedl, Christine et al**
c/o Hansmann & Vogeser,
Albert-Rosshaupter-Strasse 65
81369 München (DE)

(54) **Draft roller in spinning machine**

(57) Owing to the concave and convex shape of a draft roller on which a concave portion is formed using rhombi composed of twill lines, the durability of a rubber draft roller is impaired which roller is used in a pair with the metal draft roller to nip a sliver between them. A drift bottom roller I is constructed by forming a network area having twill lines forming parallelograms into a concave portion that is concave with respect to an outer peripheral surface of a cylinder, the network area having a general shape in which a group of first annular bands 21 is allowed to cross a group of second annular bands 22 on the outer peripheral surface of the cylinder, the first annular bands having the same width and arranged parallel to one another at the same angle θ1 to an axis of the cylinder at the same intervals along the axis, the intervals each being equal to a length X, the second annular bands having the same width and arranged parallel to one another at the same angle to the axis at the same intervals along the axis, the intervals each being equal to a length Y (Fig. 3).

FIG. 3



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Description

Field of the Invention

[0001] The present invention relates to a technique for a draft roller in a spinning machine which is used to draw a sliver.

Background of the Invention

[0002] In the prior art, a draft device for a sliver comprises a plurality of draft roller pairs each composed of a pair of a top roller and a bottom roller. A sliver is drawn by increasing the peripheral speed of feed-in draft roller pairs above that of feed-out draft roller pairs.

[0003] In the draft roller, the top roller, located frontward in the spinning machine, is made of rubber, and the bottom roller, located backward in the spinning machine, is made of metal, and at the frontward position, maintenance operations can be easily performed. To prevent the sliver from slipping between the top roller and the bottom roller, a large number of grooves are formed in an outer peripheral surface of the metal bottom roller parallel to the axis of the roller and at equal intervals. This ensures that the top roller and the bottom roller nip the sliver between them.

[0004] While the draft device is in operation, an accompanied air current is generated along outer peripheral surfaces of the rotating top and bottom rollers. In this case, the accompanied air current may cause a fiber bundle to diffuse along the axes of the top and bottom rollers. Disadvantageously, this reduces the uniformity of a yarn spun in the subsequent process. In particular, with a bottom roller having grooves formed parallel to its axis, the uniformity level decreases significantly. Thus, to prevent such a problem, a well-known technique for a draft roller forms a concave portion using rhombi composed of twill lines (the Unexamined Japanese Patent Application Publication (Tokkai) Nos. 2001-295144 and 2004-256934).

[0005] As shown in Figure 6, a concave portion 100a is formed on an outer peripheral surface of a draft roller disclosed in the Unexamined Japanese Patent Application Publication (Tokkai) Nos. 2001-295144 and 2004-256934, using rhombi composed of twill lines. Convex portions 100b are rhombic portions each enclosed and partitioned by the concave portion 100a. The vertices V1, V2, V3, V4 of the rhombic portions, the convex portions 100b, are lined up along the axis and circumferences L1, L2 ... Ln of the draft roller.

[0006] When the metal bottom roller is rotated in contact with the rubber top roller, the rubber top roller is finally worn away and must thus be replaced with a new one. If a bottom roller is used which has such an outer peripheral surface as shown in Figure 6, then after long use, vertical stripes (which extend in the circumferential direction) may disadvantageously be formed on the outer peripheral surface of a top roller (made of rubber) paired with the bottom roller. This is because the vertices of the rhombic portions, the convex portions, are lined up along the circumference of the bottom roller, so that the vertices consecutively hit the circumference corresponding to the vertices in the axial direction of the top roller as the bottom roller rotates.

[0007] That is, a problem to be solved is that, owing to the concave and convex shape of the draft roller, in which the concave portion is formed using rhombi composed of twill lines, the durability of the rubber draft roller is impaired, which is used in a pair with the metal draft roller to nip a sliver between them.

Summary of the Invention

[0008] A description has been given of the problem to be solved by the present invention. Now, a description will be given of a method for solving the problem.

[0009] In Claim 1, a network area including parallelograms enclosed by virtual lines crossing an axis of a roller at different angles is formed on an outer peripheral surface of the roller as concave and convex portions, and vertices of the same parallelogram or adjacent parallelograms are misaligned from one another in an axial direction so that the vertices of the parallelograms are not lined up in a circumferential direction.

[0010] According to Claim 2, a network area having twill lines forming parallelograms is formed into portions that are concave or convex with respect to an outer peripheral surface of a cylinder, the network area having a general shape in which a group of first annular bands is allowed to cross a group of second annular bands on the outer peripheral surface of the cylinder, the first annular bands having the same width on the outer peripheral surface of the cylinder and arranged parallel to one another at the same angle to an axis of the cylinder at the same intervals along the axis, the second annular bands having the same width and arranged parallel to one another at the same angle to the axis at the same intervals along the axis, and relationships expressed by Equation (1) and Equation (2), shown below, are not simultaneously satisfied for the angle $\theta 1$ of the first annular bands to the axis of the cylinder, the angle $\theta 2$ of the second annular bands to the axis of the cylinder, the width t1 of each of the first annular bands in a direction along the second annular bands, the width t2 of each of the second annular bands in a direction along the first annular bands, a length X between the adjacent first annular bands in the direction along the second annular bands, and a length Y between the adjacent second annular bands in the direction along the first annular bands,

$$Y \cdot \sin\theta 1 = X \cdot \sin\theta 2 \ldots\ldots (1)$$

$$t1 \cdot \sin\theta 1 = t2 \cdot \sin\theta 2 \ldots\ldots (2)$$

[0011] According to Claim 3, a relationship expressed by Equation (6), shown below, is satisfied for the angles θ1, θ2 and the lengths X, Y.

$$Y = (\tan\theta 2 \ / \ \tan\theta 1) \cdot X \ldots\ldots (6)$$

[0012] According to Claim 4, those of apical angles of each of the parallelograms formed of the twill lines which are located at ends of the parallelogram in a circumferential direction of a roller are obtuse.
[0013] The present invention exerts the effects described below.
[0014] In Claim 1, the vertices of the same parallelogram or adjacent parallelograms are not lined up. Consequently, no load is imposed on any particular area of the front roller 2. This suppresses the formation of vertical stripes on the circumference of the rubber top roller 2.
[0015] According to Claim 2, the durability of a rubber draft roller is prevented from being impaired, the rubber draft roller being used in a pair with the above roller to nip a sliver between them.
[0016] According to Claim 3, not only the effect of Claim 2 is produced but also problems such as the following situation are prevented: a sliver nipped between the above roller and the rubber draft roller is pushed out toward one side in the axial direction of the rollers, which are used in a pair.
[0017] According to Claim 4, the effect of Claim 2 or 3 is produced but also the durability of the rubber draft roller is improved, the rubber draft roller being used in a pair with the above roller to nip a sliver between them.

Brief Description of the Drawings

[0018]

Figure 1 is a perspective view showing the configuration of a pneumatic spinning machine to which a front bottom roller in accordance with the present embodiment is applied.
Figure 2 is a perspective view showing the front bottom roller.
Figure 3 is a partial development of an outer peripheral surface of the front bottom roller showing the configuration of a network area.
Figure 4 is a partial development of the outer peripheral surface of the front bottom roller.
Figure 5 is a diagram showing forces acting on a parallelogrammic convex portion.
Figure 6 is a partial development of the outer peripheral surface of a conventional draft roller on which a concave portion is formed using rhombi composed of twill lines.

Detailed Description of the Preferred Embodiments

[0019] With reference to the drawings, a description will be given of a front bottom roller 1 that is an embodiment of the present invention. The front bottom roller 1, the present embodiment, is a component of a draft device 7 provided in a pneumatic spinning machine 3 described below.
[0020] First, the configuration of the pneumatic spinning machine 3 will be described with reference to Figure 1. The pneumatic spinning machine 3, which manufactures a spun yarn 9, has the following components arranged in the following order along a route (hereinafter referred to as a manufacturing route) along which the spun yarn 9 is manufactured from a sliver 6: a can 5 located at the most upstream position on the manufacturing route, the draft device 7, a pneumatic spinning device 10, a yarn feeding device 15, a yarn defect detecting device 16, and a yarn winding device 17.
[0021] The pneumatic spinning device 10 utilizes a whirling air current to generate a spun yarn 9 from fibers constituting the sliver 6. The yarn feeding device 15 feeds the spun yarn 9 manufactured by the pneumatic spinning device 10, out to the yarn winding device 17. The yarn feeding device 15 comprises a delivery roller 18 and a nip roller 19 which feed

out the spun yarn 9 while nipping it between them. The yarn winding device 17 traverses and winds the spun yarn 9 manufactured by the pneumatic spinning device 10, around a bobbin in its axial direction to form a package 4. The yarn defect detecting device 16 detects a yarn defect in the spun yarn 9 being fed to the yarn winding device 17, and on the basis of yarn defect detection information from the yarn defect detecting device 16, an inappropriate yarn is prevented from being wound into the package 4.

[0022] The configuration of the draft device 7 will be described. The draft roller 7 comprises four draft roller pairs each of which nips the sliver 6 between the rollers to draw (draft) the sliver 6. The four pairs of draft rollers are a back roller pair 11, third roller pair 12, a second roller pair 13, and a front roller pair 14 which are arranged in this order in the direction in which the sliver 6 is conveyed.

[0023] Each draft roller pair comprises an upper roller and a lower roller; the draft roller pair nips the sliver 6 so that the upper and lower rollers the pair sandwiches the sliver between them (in the direction of gravity). The back roller pair 11 comprises a back top roller 11U and a back bottom roller 11D. The third roller pair 12 comprises a third top roller 12U and a third bottom roller 12D. The second roller pair 13 comprises a second top roller 13U and a second bottom roller 13D, and apron belt is wound around each of the rollers 13U, 13D. The front roller pair 14 comprises a front top roller 2 and a front bottom roller 1.

[0024] As shown in Figure 2, the front bottom roller 1 is used in a pair with the front top roller 2. The front top roller 2 is provided in contact with the front bottom roller 1 to cooperate with the front bottom roller 1 in nipping the sliver 6 between the rollers to draw the sliver 6. In this case, the front bottom roller 1 is made of metal and is thus a rigid body. In contrast, the front top roller 2 is made of hard rubber and is thus an elastic body. Thus; the front top roller 2 is slightly dented when contacting the front bottom roller 1, and the frictional resistance from the contact portion causes the front top roller 2 to be rotated as the front bottom roller 1 is rotatively driven.

[0025] Further, as shown in Figure 2, an outer peripheral surface of the front bottom roller 1 is formed to have concaves and convexes. A concave portion 1b is formed in a network area composed of twill lines forming parallelograms. The parallelogrammic areas each enclosed by the twill lines correspond to convex portions 1a. Here, a top surface of the convex portion la, la, ... and a bottom surface of the concave portion 1b each constitute a part of the outer peripheral surface of a cylinder. Naturally, the cylinder having the outer peripheral surface of which is partly composed of the convex portions 1a, 1a,

... has a longer diameter than the cylinder having the outer peripheral surface of which is partly composed of the concave portion 1b.

[0026] Thus, the outer peripheral surface of the front bottom roller 1 has the concave and convexes. Accordingly, the problems described below may occur in the front top roller 2, placed in contact with the front bottom roller 1. First, the concave and convex pattern on the outer peripheral surface of the front bottom roller 1 may impose a load on a particular area of the front top roller 2, thus hollowing out this area. Second, the concave and convex pattern on the outer peripheral surface of the front bottom roller 1 may unbalance the force exerted on the front top roller 2 by the front bottom roller 1, in the axial direction of the front top roller 2 while the front bottom roller 1 is being rotatively driven. When the force is unbalanced in the axial direction, rotative driving of the front bottom driver 1 may cause the sliver 6 nipped between the rollers 1, 2 to be pushed out toward one side in the axial direction. Now, a description will be given of a specific configuration that prevents the occurrence of the above two problems.

[0027] First, with reference to Figure 3, a detailed description will be given of the configuration of the network area (in which the concave portion 1b is formed). Figure 3 is a development of the outer peripheral surface of the front bottom roller (hereinafter referred to as a roller) 1. The horizontal direction in Figure 3 is the axial direction of the roller 1 and the vertical direction in Figure 3 is the circumferential direction of the roller 1. The network area is formed by two band groups (a group of first annular bands 21 and a group of second annular bands 22) crossing each other along the outer peripheral surface of a cylinder (corresponding substantially to the roller 1). The cylinder has the concave portion 1b (network area) partly constituting its outer peripheral surface. In this case, the first annular bands 21 and the second annular bands 22 extend along the outer peripheral surface of the cylinder and are inclined to the axis of the cylinder (axis of the roller 1), and the first annular bands 21 and the second annular bands 22 are connected together so as to cover the outer peripheral surface of the cylinder. Further, the group of first annular bands 21, 21, ... are arranged along the axis of the cylinder (axis of the roller 1) at the same intervals, and the group of second annular bands 22, 22, ... are also arranged along the axis of the cylinder at the same intervals.

[0028] The annular bands belonging to each group are inclined at the same angle to the axis, are arranged at the same intervals along the axis (spacing between the adjacent annular bands), and have the same width with respect to the direction in which they extend. The first annular bands 21 are inclined at the same angle θ1 to the axis and have the same length X, corresponding to the spacing, and the same width t1. Here, the length X and the width t1 are measured along the direction in which the second annular bands 22 extend. If the annular bands have the same length X and the same width t1, they are arranged at the same intervals and have the same width with respect to the extending direction.

Further, the second annular bands 22 are inclined at the same angle θ2 to the axis, and have the same length Y and the same width t2. Here, for the convenience of the description below, the length Y and the width t2 are also measured along the direction in which the first annular bands 21 extend.

[0029] On the other hand, the angle to the axis, the intervals at which the annular bands are arranged along the axis (spacing between the adjacent annular bands), and the width are not necessarily the same between the different groups of annular bands, that is, between the group of the first annular bands 21 and the group of the second annular bands 22. Since the network area is formed of these two groups, at least the angle to the axis differs between the group of the first annular bands 21 and the group of the second annular bands 22.

[0030] As shown in Figure 4, the lengths X, Y correspond to two different sides of the parallelogrammic convex portion 1a. The width t1 corresponds to the spacing between the convex portions 1a, 1a in the direction of the length X (direction of the angle θ1 to the axis). The width t2 corresponds to the spacing between the convex portions 1a, 1a in the direction of the length Y (direction of the angle θ2 to the axis).

[0031] The occurrence of the first problem is prevented as described below.

[0032] The first problem results from the arrangement of the vertices S1, S2, S3, S4 of each parallelogrammic convex portion 1a on the same circumference. Thus, the angles θ1, θ2, the lengths X, Y, and the widths t1, t2 are set so as to avoid simultaneously establishing the relationship expressed by the following equations:

$$Y \cdot \sin\theta 1 = X \cdot \sin\theta 2 \;\ldots\ldots (1),$$ and $$t1 \cdot \sin\theta 1 = t2 \cdot \sin\theta 2 \;\ldots\ldots (2).$$

[0033] Equation (1) expresses a condition under which circumferentially opposite vertices S1, S3 of the same convex portion 1a are arranged on the same line (same circumference) in the circumferential direction. Equation (2) expresses a condition under which the vertex S3 of one of the circumferentially adjacent convex portions 1a, 1a ... and the vertex S1 of the other convex portion 1a are arranged on the same line (same circumference) in the circumferential direction; the vertice S3 and the vertice S1 are located opposite each other in the circumferential direction.

[0034] Unless the relationships expressed by Equation (1) and Equation (2) are simultaneously established, the vertices of the convex portions 1a on the roller 1 are not lined up in the circumferential direction. That is, by setting the angles θ1. θ2, the lengths X, Y, and the widths t1, t2 so as to avoid simultaneously satisfying Equation (1) and Equation (2), it is possible to prevent the concave and convex pattern on the outer peripheral surface of the front bottom roller 1 from imposing a load on a particular area of the front top roller 2 to hollow out this area. That is, the network area including the parallelograms (la, la, ...) enclosed by virtual lines (in the embodiment shown in Figure 3, the annular bands 21, 22) crossing the axis of the roller 1 at different angles (θ1, θ2) is formed on the outer peripheral surface of the roller as the concave and convex portions, and the vertices (S1, S2, S3, S4) of the same parallelogram or adjacent parallelograms are misaligned from one another in the axial direction so that the vertices of the parallelograms are not lined up in the circumferential direction. Consequently, no load is imposed on any particular area of the front roller 2. This suppresses the formation of vertical stripes on the circumference of the rubber top roller 2.

[0035] The occurrence of the second problem is prevented as described below.

[0036] The second problem occurs when the force exerted on the front top roller 2 by the convex portions la, la, ... of the front bottom roller 1 is unbalanced in the axial direction of the front top roller 2. This corresponds to unbalance in the force in the axial direction of the roller 1 exerted on the two axially arranged sides (the side with the length X and the side with the length Y) at each convex portion 1a. Thus, the relationship among the angles θ_1, θ_2 and lengths X, Y is set as follows.

[0037] As shown in Figure 5, when the pressure (force per unit area) exerted by rotatively driving the front bottom roller 1 is defined as T, the relationship indicated by Equation (3), shown below, is established between the pressure T and pressure T1 acting on the side with the length X. Further, the relationship indicated by Equation (4), shown below, is established between the pressure T and pressure T2 acting on the side with the length Y.

$$T1 = T \cdot \tan\theta 1 \;\ldots\ldots (3)$$

$$T2 = T \cdot \tan\theta 2 \;\ldots\ldots (4)$$

[0038] To offset forces generated on the right and left of the concave portion 1a in the axial direction, the relationship expressed by the following equation must be established: $Y \cdot T1 = X \cdot T2$ ...... (5). Here, $Y \cdot T1$ on the left side of Equation (5) corresponds to the force acting on the side with the length Y. $X \cdot T2$ on the right side of Equation (5) corresponds to the force acting on the side with the length X.

[0039] Equation (3) and Equation (4) are substituted into Equation (5) to derive Equation (6).

$$Y = (\tan\theta 2 / \tan\theta 1) \cdot X \ldots\ldots (6)$$

[0040] If the relationship satisfying Equation (6) is established between the angles θ1, θ2 and the lengths X, Y, then the force exerted by the convex portions 1a, la, ... of the front bottom roller 1 to push the front top roller 2 is balanced in the axial direction of the front top roller 2 while the front bottom roller 1 is rotating. This prevents a disadvantageous situation where the front bottom roller 1 pushes out the front top roller 2 in the axial direction.

[0041] Further, as shown in Figure 5, of the apical angles of the parallelogrammic convex portion la, those having the vertices S1, S3 are set to be obtuse. This apical angle is defined as α. The relationship expressed by the following equation is established between the angle α and the angles θ1. θ2: $\alpha = 180° - (\theta 1 + \theta 2)$ ...... (7). That is, the combination of the angles θ1. *0* 2 is set to at most 90° .

[0042] In this case, of the apical angles of the parallelogram constituting the same convex portion 1a, those having the vertices S1, S3 are located at circumferential ends of the parallelogram. This arrangement prevents the front top roller 2 from being easily hollowed out even if the convex portions 1a come into contact with the front top roller 2 during the rotation of the front bottom roller 1. This is because the contact areas of the convex portions 1a have the obtuse angle.

[0043] The concave and convex shape of the front bottom roller 1 is determined by setting the six elements, the angles θ1, θ2, the lengths X, Y, and the widths t1, t2. The condition between the angles θ1, θ2 and the lengths X, Y is that they satisfy the relationship expressed by Equation (6). Thus, by providing input values for three of the four elements, it is possible to determine a value for the remaining one element. Further, setting the widths t1, t2 determines the rate at which the entire outer peripheral surface of the front bottom roller 1 is dented (the percentage of the entire outer peripheral surface taken up by the concave portion 1b). Appropriately setting these six elements (to be precise, five elements) makes it possible to set the concave and convex shape of the front bottom roller 1. For the six elements, it is of course essential to meet the condition that the relationships expressed by Equation (1) and Equation (2) are not simultaneously satisfied.

[0044] A general description will be given of the draft roller in the spinning machine in accordance with the present invention.

[0045] In a draft roller in a spinning machine which is a first present invention, a network area having twill lines forming parallelograms is formed into portions that are concave or convex with respect to an outer peripheral surface of a cylinder, the network area having a general shape in which a group of first annular bands cross a group of second annular bands, the first annular bands having the same width on the outer peripheral surface of the cylinder and arranged parallel to one another at the same angle to an axis of the cylinder at the same intervals along the axis, the second annular bands having the same width and arranged parallel to one another at the same angle to the axis at the same intervals along the axis. Further, relationships expressed by Equation (1) and Equation (2), shown below; are not simultaneously satisfied for the angle θ1 of the first annular bands to the axis of the cylinder, the angle θ2 of the second annular bands to the axis of the cylinder, the width t1 of each of the first annular bands in a direction along the second annular bands, the width t2 of each of the second annular bands in a direction along the first annular bands, a length X between the adjacent first annular bands in the direction along the second annular bands, and a length Y between the adjacent second annular bands in the direction along the first annular bands,

$$Y \cdot \sin\theta 1 = X \cdot \sin\theta 2 \ldots\ldots (1)$$

$$t1 \cdot \sin\theta 1 = t2 \cdot \sin\theta 2 \ldots\ldots (2)$$

[0046] In the front bottom roller 1 in accordance with the present embodiment, the network area is formed into the concave portion 1b. However, the network area may be formed into a convex portion. Further, regardless of whether the network area is formed into a concave or convex portion, it is only necessary that the outer surface of the convex portion be formed in a part of the outer peripheral surface (part of the roller having the maximum diameter) of the cylinder. The surface shape of the concave portion is not particularly limited and need not necessarily be part of outer peripheral surface of the cylinder.

[0047] It is undesirable that the relationships expressed by Equation (1) and Equation (2) be simultaneously satisfied.

It is thus allowable to satisfy only one of the relationships. Of course, most desirably, neither of the relationships expressed by Equation (1) and Equation (2) is satisfied.

[0048] Further, the draft roller is not limited to the front bottom roller in the four-line (system comprising four roller pairs) draft device. The present invention is applicable to any other draft rollers. Furthermore, the draft device in which the draft roller is provided is not limited to the four line type. The draft roller is applicable to any other draft devices including a five line type.

[0049] The above configuration precludes the vertices of the parallelograms formed of the twill lines from being lined up in the circumferential direction, and this prevents a large number of vertices from traveling simultaneously on the same circumference. This in turn prevents the durability of the rubber draft roller from being impaired, the rubber draft roller being used in a pair with a metal draft roller to nip the sliver between them.

[0050] A draft roller in a spinning machine which is a second invention is the first invention configured as described below. A relationship expressed by Equation (6), shown below, is satisfied for the angles θ1. θ2 and the lengths X, Y.

$$Y = (\tan\ \theta 2\ /\ \tan\theta 1) \cdot X \ldots\ldots (6)$$

[0051] With the above configuration, when the first draft roller is rotatively driven, the axial force exerted on a rubber draft roller by the first draft roller to push the rubber draft roller is balanced on the opposite sides in the axial direction and thus offset; the rubber draft roller is used in a pair with the first draft roller to nip the sliver between them. This avoids problems such as the situation where the sliver nipped between the first draft roller and the rubber draft roller is pushed out toward one side in the axial direction; the rubber draft roller is used in a pair with the first draft roller.

[0052] A draft roller in a spinning machine which is a third invention is the first or second invention configured as described below. Those of apical angles of each of the parallelograms formed of the twill lines which are located at ends of the parallelogram in a circumferential direction are obtuse.

[0053] With this configuration, when the first draft roller is rotated, even if the vertices of the parallelograms, each formed of the twill lines, come into contact with the rubber draft roller, used in a pair with the first draft roller to nip the sliver between them, the rubber draft roller is prevented from being easily hollowed out. This improves the durability of the rubber draft roller, used in a pair with the first draft roller to nip the sliver between them.

Claims

1. A draft roller in a spinning machine **characterized in that** a network area including parallelograms enclosed by virtual lines crossing an axis of a roller at different angles is formed on an outer peripheral surface of the roller as concave and convex portions, and vertices of the same parallelogram or adjacent parallelograms are misaligned from one another in an axial direction so that the vertices of the parallelograms are not lined up in a circumferential direction.

2. A draft roller in a spinning machine **characterized in that** a network area having twill lines forming parallelograms is formed into portions that are concave or convex with respect to an outer peripheral surface of a cylinder, the network area having a general shape in which a group of first annular bands is allowed to cross a group of second annular bands on the outer peripheral surface of the cylinder, the first annular bands having the same width on the outer peripheral surface of the cylinder and arranged parallel to one another at the same angle to an axis of the cylinder at the same intervals along the axis, the second annular bands having the same width and arranged parallel to one another at the same angle to the axis at the same intervals along the axis, and **in that** relationships expressed by Equation (1) and Equation (2), shown below, are not simultaneously satisfied for the angle θ1 of the first annular bands to the axis of the cylinder, the angle θ2 of the second annular bands to the axis of the cylinder, the width t1 of each of the first annular bands in a direction along the second annular bands, the width t2 of each of the second annular bands in a direction along the first annular bands, a length X between the adjacent first annular bands in the direction along the second annular bands, and a length Y between the adjacent second annular bands in the direction along the first annular bands.

$$Y \cdot \sin\theta 1 = X \cdot \sin\theta 2 \ldots\ldots (1)$$

$$t1 \cdot \sin\theta 1 = t2 \cdot \sin\theta 2 \;...... (2)$$

3. A draft roller in a spinning machine according to Claim 2, **characterized in that** a relationship expressed by Equation (6), shown below, is satisfied for the angles θ1, θ2 and the lengths X, Y.

$$Y = (\tan\theta 2 \,/\, \tan\theta 1) \cdot X \;...... (6)$$

4. A draft roller in a spinning machine according to Claim 2 or Claim 3, **characterized in that** those of apical angles of each of the parallelograms formed of the twill lines which are located at ends of the parallelogram in a circumferential direction of the roller are obtuse.

FIG.1

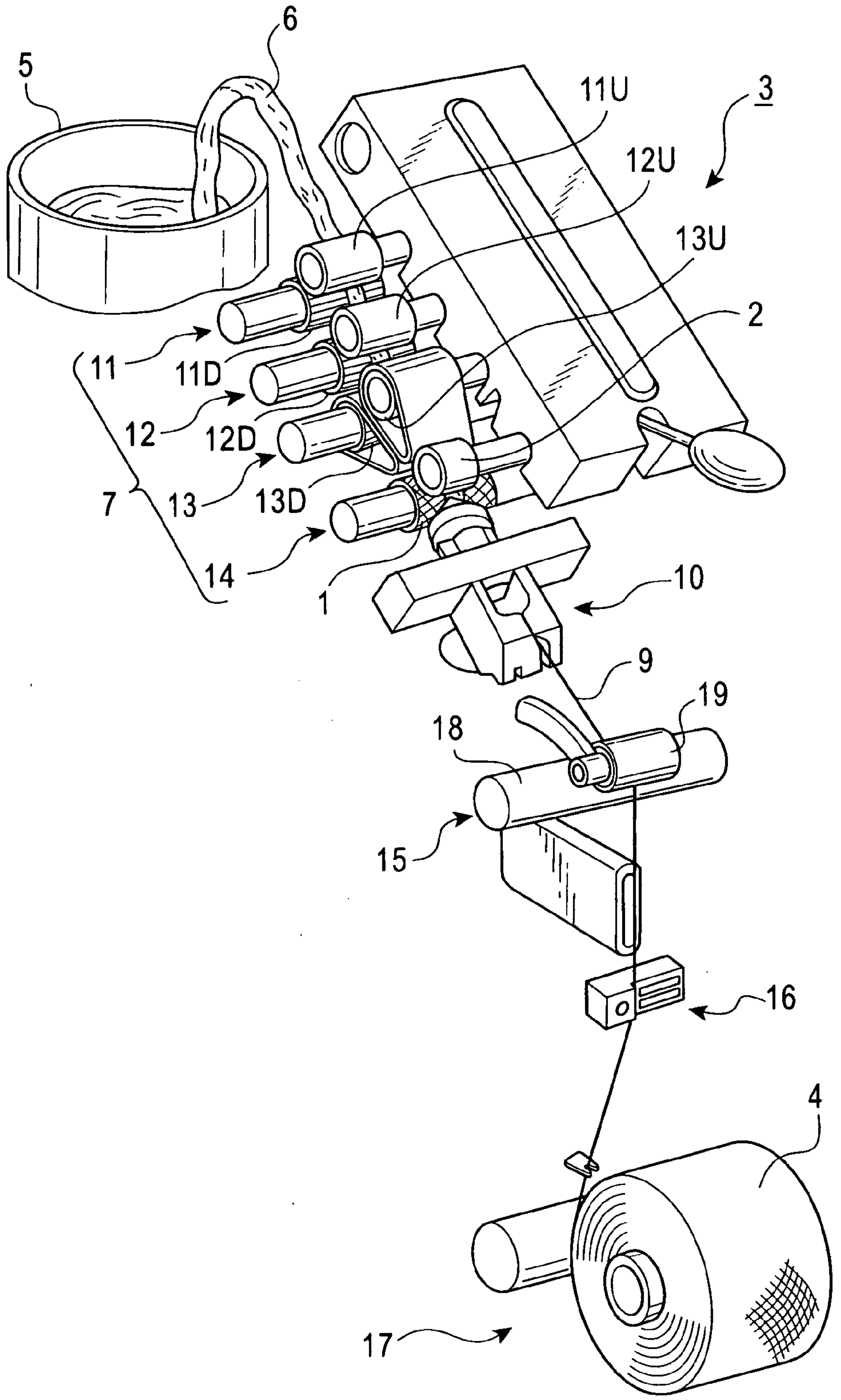


FIG. 2

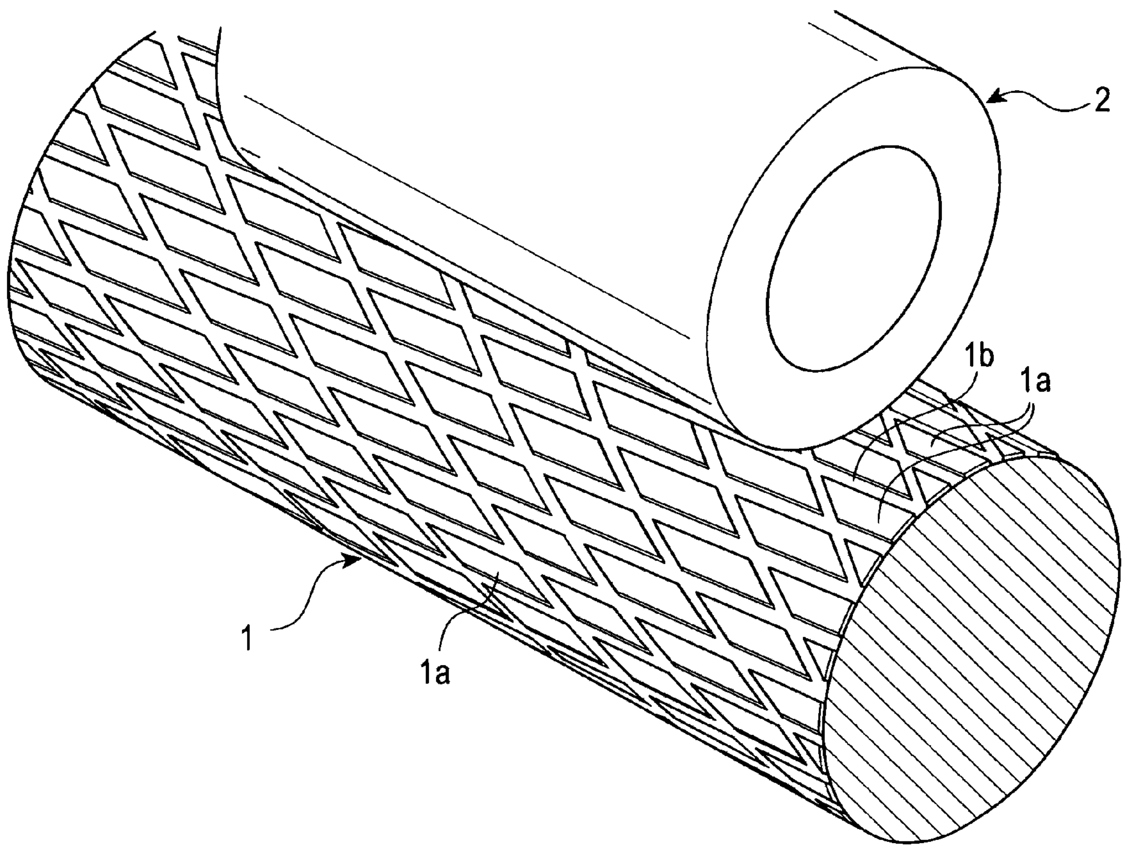


FIG. 3

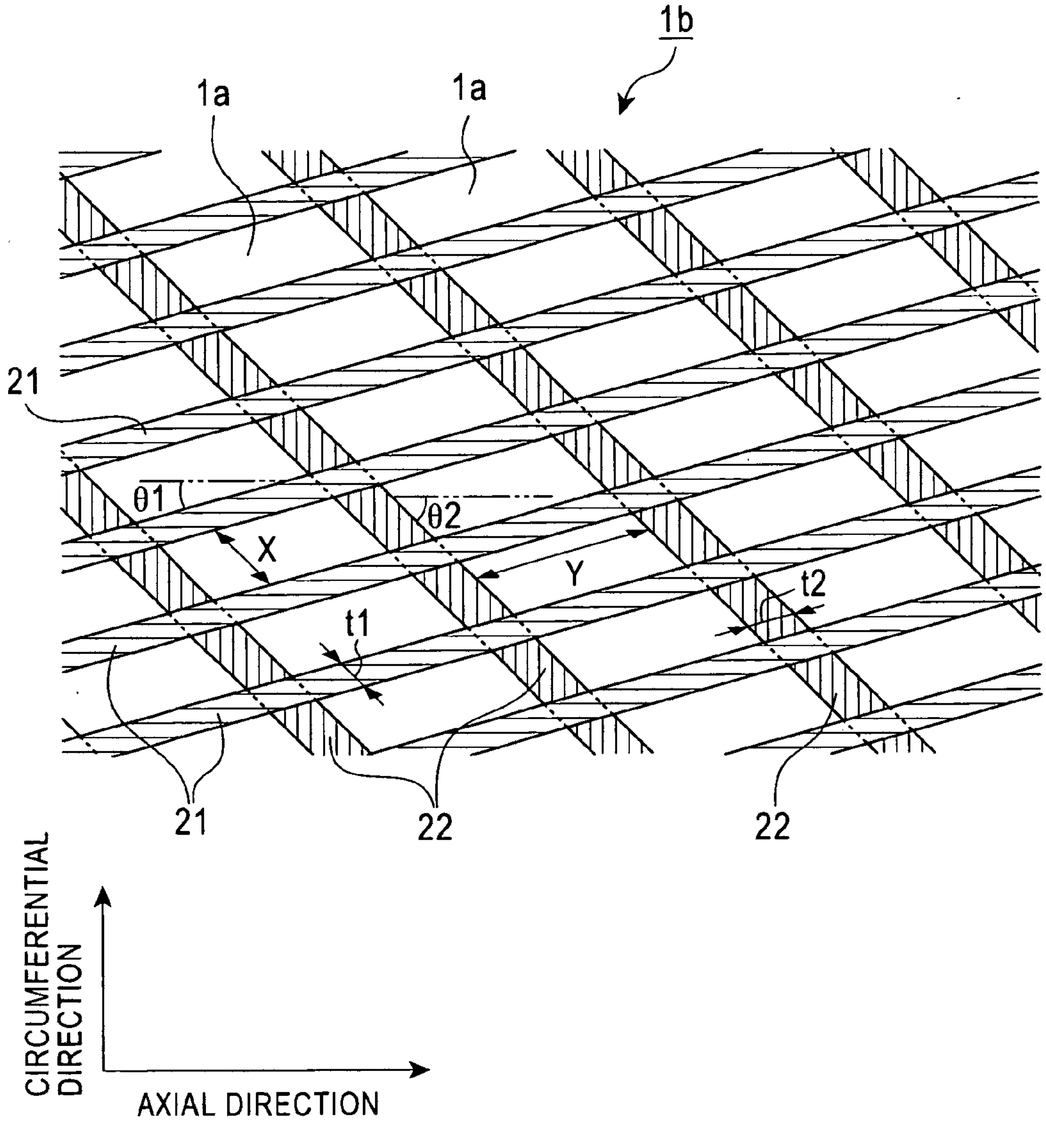

1b
1a
1a
21
θ1
θ2
X
Y
t1
t2
21
22
22
CIRCUMFERENTIAL DIRECTION
AXIAL DIRECTION

FIG. 4

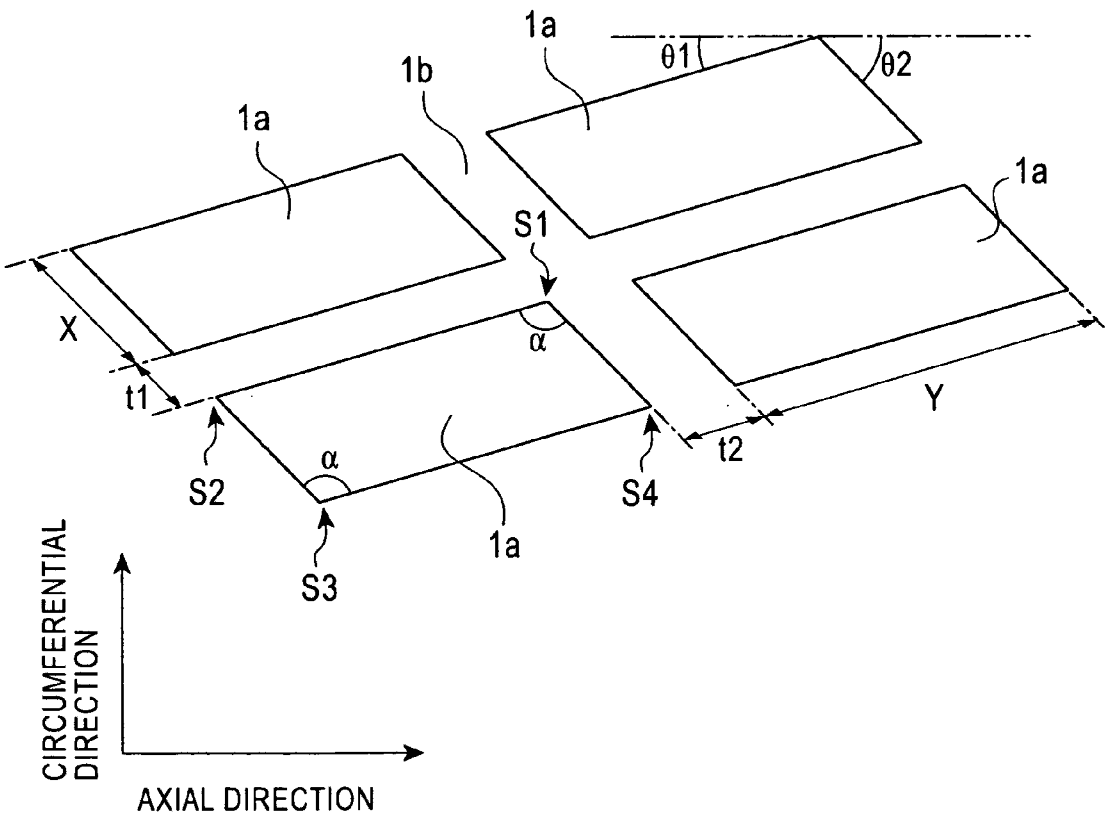

1a
1b
1a
θ1
θ2
1a
S1
X
α
t1
α
Y
t2
S2
S4
1a
S3
CIRCUMFERENTIAL DIRECTION
AXIAL DIRECTION

FIG. 5

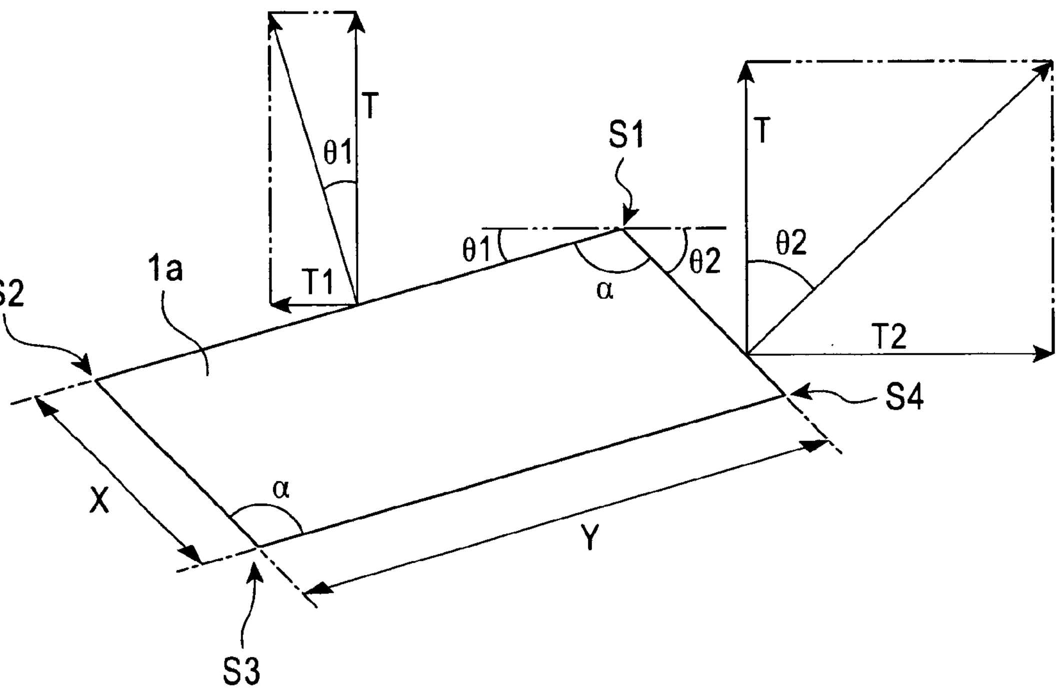
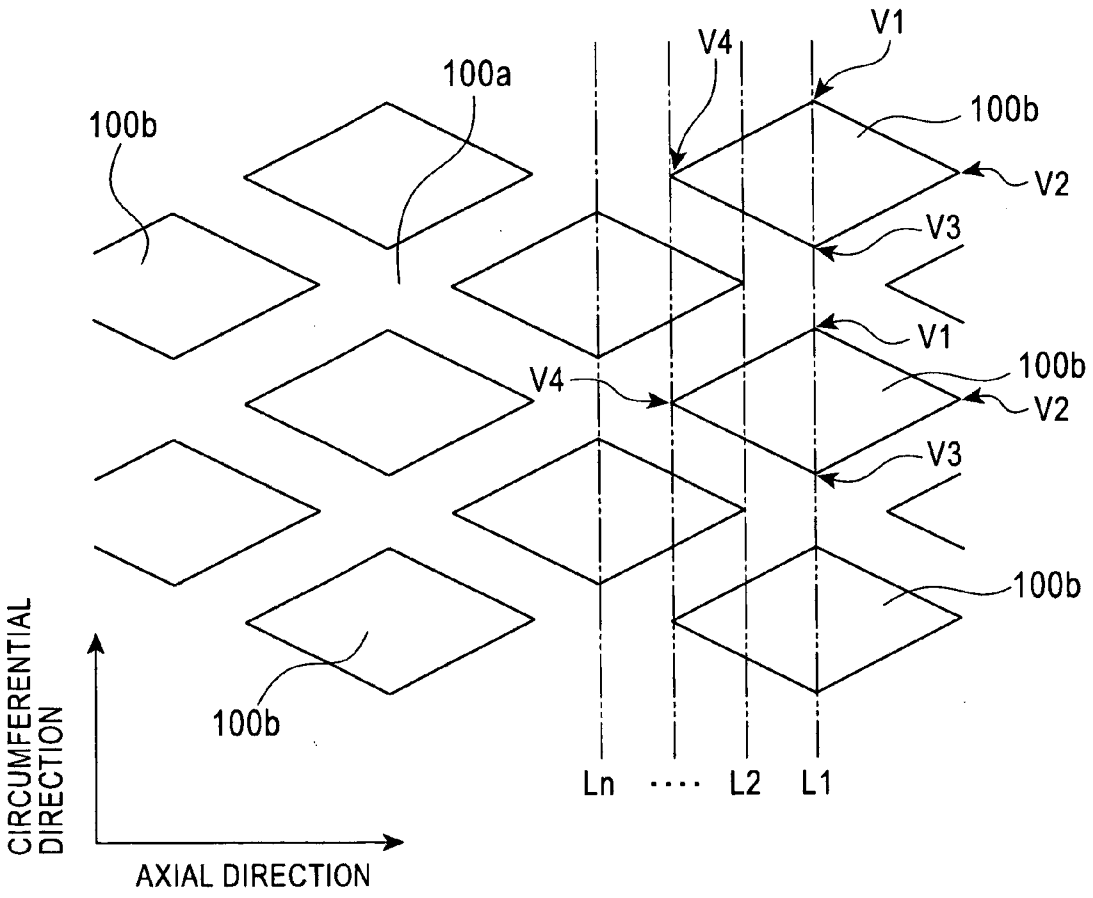


FIG. 6


100b
100a
V4
V1
100b
V2
V3
V1
100b
V4
V2
V3
100b
100b
CIRCUMFERENTIAL DIRECTION
AXIAL DIRECTION
Ln
L2
L1