YARN FEEDER FOR CIRCULAR KNITTING MACHINE

A yarn feeder for feeding yarn in a Jacquard circular knitting machine and a circular knitting machine provided with a yarn changer is configured so as to prevent yarn from becoming wound around the friction surface of a yarn feeding pulley or breaking due to friction against a rubber band of the yarn feeding pulley. The yarn feeder for a circular knitting machine is composed of at least one yarn feeding pulley 10, and a fixed guide 15 and movable guides 16 and 17 provided adjacent to the yarn feeding pulley 10. The fixed guide 15 has an introduction hole 15a on a yarn inlet side and an exit hole 15b on a yarn outlet side, and the at least two movable guides 16 and 17 have yarn guide holes 16a and 17a for guiding the yarn at tips thereof, and move in an arc along the surface of the yarn feeding pulley 10. The two movable guides 16 and 17 are provided with means for enabling the guides to move in tandem or separately.
Description

Technical Field

[0001] The present invention relates to a yarn feeder for a circular knitting machine, particularly a jacquard circular knitting machine and a circular knitting machine provided with a yarn changer.

Background Art

[0002] Known conventional technology literature in this field includes, for example, JP-B- 61-47777 and JP-A-10-273858. These yarn feeding devices are used to feed yarn according to the amount required by the knitting machine. They are used particularly in circular knitting machines that are provided with a yarn changer for feeding yarn to the knitting machine after switching between multiple colored yarns as necessary.

[0003] In general, the tape-driven yarn feeder used in these circular knitting machines is provided with an endless tape that runs over a plurality of drive wheels, with the tape normally being driven together with the knitting machine when the knitting machine operates. A yarn feeding pulley integrally formed coaxially with the drive wheels driven by this endless tape has a yarn guiding face around the periphery thereof that is covered with a stretchable resin band such as a rubber band having a friction surface which exerts a relatively large frictional force. A fixed guide that has an introduction hole and an exit hole on a yarn inlet side and a yarn outlet side and a movable guide that has a yarn guide hole for guiding yarn at a tip thereof and that moves in an arc along the surface of the yarn feeding pulley are provided adjacent to the yarn feeding pulley in positions relative to each other. Adjustably attached to this movable guide is an elastic device for moving the movable guide to a non-yarn feeding state by reducing the contact angle of yarn along the surface of the yarn feeding pulley, with the movable guide being moved to a yarn feeding state as the result of a greater force than the elastic force of the elastic device being generated by the tension of yarn selected by the yarn changer of the circular knitting machine. Yarn is fed to the knitting machine at substantially the same speed as the surface peripheral speed of the yarn feeding pulley, by the frictional force of the rubber band on the surface of the yarn feeding pulley.

Disclosure of the Invention

Problem to be Solved by the Invention

[0004] When stopping the yarn in the case where the yarn feeder is used in a knitting machine provided with a yarn changer, the movable guide moves so as to be in a non-yarn feeding state in which the contact angle of the yarn is reduced, although with a conventional apparatus the yarn is not completely removed from the surface of the yarn feeding pulley and remains partially in contact therewith. The contacting yarn may become wound around the friction surface of the yarn feeding pulley due to friction against the friction surface of the yarn feeding pulley or break due to friction. In the case where the yarn feeder is used in a jacquard knitting machine, the amount of yarn fed from the yarn feeder may differ from the amount required by the knitting machine depending on the pattern, causing the yarn to slacken and become wound around the friction surface of the yarn feeding pulley. This may result in a decrease in the availability of the knitting machine or a decrease in the quality of the knitted fabric.

[0005] In the embodiments of JP-B- 61-47777, to position the knitting yarn in a non-yarn feeding position in which the knitting yarn does not contact the yarn guiding face, the distance from the fulcrum of the guide means to the yarn guide hole must be increased, thus necessitating more horizontal space for installing the yarn feeder. Further, because the guide means is lengthened, its operation response time is not quick.

[0006] The present invention has been made to solve these problems with the conventional technology, and has as its object to provide a yarn feeder that is provided with yarn feeding functions compatible with both striped knitting and jacquard knitting.

Means for Solving the Problem

[0007] A yarn feeder for a circular knitting machine of the present invention includes at least one yarn feeding pulley, a fixed guide provided adjacent to the yarn feeding pulley, at least two movable guides, and a base supporting the movable guides, the fixed guide having an introduction hole on a yarn inlet side and an exit hole on a yarn outlet side, the movable guides being composed of a first movable guide and a second movable guide, and each of the movable guides having a yarn guide hole for guiding yarn at a tip thereof, and moving in an arc along a surface of the yarn feeding pulley, around a pivot shaft that is offset from a central shaft of the yarn feeder. The first movable guide has a first swing member that moves in an arc and the second movable guide has a second swing member that moves in an arc, and the first swing member has disposed thereon a first elastic member so as to generate a resistance force to a feeding
tension of yarn, and the second swing member has disposed thereon a second elastic member so as generate a resistance force to a feeding tension of yarn.

[0008] Preferably the base and the second swing member are coupled by the second elastic member, and the second swing member and the first swing member are coupled by a second shaft and the first elastic member.

[0009] Preferably the second movable guide is set so as to move in a travel direction of yarn with a weaker force than the first movable guide. In other words, the resistance force generated by the second elastic member corresponding to the second movable guide that moves the second movable guide in a counter-travel direction of yarn is set to be weaker than the resistance force generated by the first elastic member corresponding to the first movable guide that moves the first movable guide in the counter-travel direction of yarn.

[0010] More preferably the second elastic member and the first elastic member are set to cause at least one of the following (a) to (e), that is: (a) yarn passing through the first movable guide, the second movable guide and the exit hole from the introduction hole to be held without contacting a yarn guiding face with the yarn feeder in a non-yarn feeding state; (b) the second movable guide to move from the non-yarn feeding state to a movement start state together with the first movable guide while maintaining the interval therebetween, in a case where a force generated by the feeding tension of yarn passing through the yarn guide hole that moves the first movable guide in the travel direction of yarn is stronger than the resistance force generated by the second elastic member corresponding to the second movable guide that moves the second movable guide in the counter-travel direction of yarn becomes stronger than the resistance force generated by the first elastic member corresponding to the first movable guide that moves the first movable guide in the counter-travel direction of yarn after the second movable guide has reached a position of the yarn feeding state; (d) only the first movable guide to move from the yarn feeding state to the movement start state, in a case where the force generated by the feeding tension of yarn passing through the yarn guide hole that moves the first movable guide in the travel direction of yarn becomes weaker than the resistance force generated by the first elastic member corresponding to the first movable guide that moves the first movable guide in the counter-travel direction of yarn; and (e) the second movable guide to move to the non-yarn feeding state together with the first movable guide while maintaining the interval therebetween, in a case where the force generated by the feeding tension of yarn passing through the yarn guide hole that moves the second movable guide in the travel direction of yarn becomes weaker than the resistance force generated by the second elastic member corresponding to the second movable guide that moves the second movable guide in the counter-travel direction of yarn.

[0011] Preferably an elastic force adjustment device is provided such that an elastic force of the second elastic member or the first elastic member is adjustable.

[0012] As for the elastic force adjustment device, a plurality of selectable pins provided on the base can be used, which are capable of changing a terminal setting position of the second elastic member, or a combination of a plurality of selectable holes provided in the base and a swingable lever having at one end a protrusion that is engageable with the holes can be used. Preferably the lever is a leaf spring, and the protrusion is pushed into the holes by the spring force thereof. The elastic force adjustment device is not limited to the above, and may be a mechanism that allows the lever to stop freely within the range of movement of the lever.

[0013] Preferably means for regulating an angle of the arc movement of both the second swing member and the first swing member is provided.

[0014] As for the means for regulating the angle of the arc movement of both swing members, a combination of a third pin of one swing member and a link groove of the other swing member, or a positioning member provided on one of the second swing member and the first swing member can be used, for example.

[0015] Preferably a stopper for restricting the revolution of the movable guides is provided to restrict the range of movement of the first movable guide and the second movable guide.

[0016] The stopper is, for example, composed of a vertical portion that abuts against the second movable guide 17 and an arc-shaped holding portion provided above the vertical portion, with an arc-shaped groove corresponding to the holding portion being provided in a housing of the yarn feeder, and the vertical portion being held so as to be moveable in an arc circumferentially around the yarn feeding pulley.

[0017] Further, preferably the stopper can be provided with an adjustment mechanism for adjusting a contact area between the yarn and the yarn feeding pulley depending on the type of yarn.

[0018] The adjustment mechanism is, for example, a plurality of notches provided in the holding portion, a ball disposed on the housing so as to correspond to the notches, and a hole provided in an upper portion of the ball and in which a spring and a screw are disposed.

[0019] In other configurations, the first swing member can be omitted from the first movable guide, and the first movable guide can itself be replaced by a single leaf spring.
Effects of the Invention

[0020] According to the present invention, the first movable guide and the second movable guide are movable in tandem between the introduction hole and the exit hole, around the yarn guiding face. Further, the first movable guide and the second movable guide move to the yarn feeding position as a result of the contact angle of the yarn with the yarn guiding face increasing and to the non-yarn feeding position as a result of the contact angle of the yarn with the yarn guiding face decreasing, with the feeding tension of yarn increasing or decreasing according to the desired knitting pattern.

[0021] In the non-yarn feeding position, knitting yarn passing through the first movable guide, the second movable guide and the exit hole from the introduction hole is held without contacting the yarn guiding face. Thus, the problem of yarn becoming wound around the friction surface of the yarn feeding pulley or breaking due to friction is eliminated.

[0022] With the move from the non-yarn feeding position to the yarn feeding position, firstly the second movable guide moves so as to approach the exit hole, following an increase in the feeding tension. Following this move, the first movable guide moves in tandem with the second movable guide so as to approach the exit hole while maintaining the interval between the first movable guide and the second movable guide at the non-yarn feeding position. Thus, there is no excess slack in the yarn, and the problem of yarn becoming wound around the friction surface of the yarn feeding pulley is eliminated.

[0023] After the second movable guide has moved to the maximum position allowed, the first movable guide moves to the maximum position allowed. At this time, the contact angle of the yarn with the yarn guiding face is maximized.

[0024] Further, even in the case where pattern knitting requiring different amounts of yarn is used, there is no slackening of the yarn since the yarn is tensioned by a plurality of guide means, thus preventing the yarn from becoming wound around the friction surface of the yarn feeding pulley.

[0025] Hereinafter, embodiments of the present invention will described with reference to the accompanying drawings.

Brief Description of Drawings

[0026] FIG. 1 is a top view of a conventional yarn feeder, with (a) showing the non-yarn feeding state, and (b) showing the yarn feeding state.

FIG. 2 is a top view of a yarn feeder of a first embodiment of the present invention, with (a) showing the non-yarn feeding state, (b) showing the movement start state, and (c) showing the yarn feeding state.

FIG. 3 is a top view of a yarn feeder of a second embodiment of the present invention, with (a) showing the non-yarn feeding state, (b) showing the movement start state, and (c) showing the yarn feeding state.

FIG. 4 is a side view of a yarn feeder of the present invention installed in a circular knitting machine.

FIG. 5 is a partial enlarged view of the yarn feeder of the first embodiment of the present invention.

FIG. 6 is a partial enlarged view of the yarn feeder of the second embodiment of the present invention.

FIG. 7 is a cross-sectional view of a portion around a drive pulley.

FIG. 8 is a partial enlarged view showing an elastic force adjustment mechanism for a second elastic member.

FIG. 9 is a diagram showing a stopper for restricting the range of arc movement of the second movable guide.

FIG. 10 is a partial enlarged view of a yarn feeder of a third embodiment of the present invention.

FIG. 11 is a top view of the yarn feeder of the third embodiment of the present invention, with (a) showing the non-yarn feeding state, (b) showing the movement start state, and (c) showing the yarn feeding state.

Best Mode for Carrying Out the Invention

Embodiment 1

[0027] FIG. 4 is a side view showing a device 1 for feeding yarn to a circular knitting machine. This yarn feeder 1 has a housing 2, and this housing 2 is attached by a screw 3 to a circular support ring 4. A front portion of the housing 2 is, as shown in FIG. 7, provided with a shaft 6 that is supported by ball bearings 5. At an upper portion of the shaft 6 is provided a drive means 7. The drive means 7 is composed of two drive wheels 7a and 7b, and these wheels are fixed to the shaft 6 by a screw 8.

[0028] A large number of yarn feeders 1 are provided on the circular support ring 4, and endless tapes 9 extend circumscribedly around all of the drive wheels 7a and 7b thereof. These endless tapes 9 are the same as known endless tape, and are driven in synchronization with operation of the circular knitting machine.

[0029] Between the first drive wheel 7a and the second drive wheel 7b is provided a clutch 12 that is movable in a vertical direction and can be set to three positions. The rotation of the first drive wheel 7a on the upper side is transmitted.
to a yarn feeding pulley 10 when this clutch 12 is moved to the upper position, and the rotation of the second drive wheel 7b on the lower side is transmitted to the yarn feeding pulley 10 when the clutch 12 is moved to the lower position. A neutral position in which the rotation of the drive wheels 7a and 7b is not transmitted to the yarn feeding pulley 10 is achieved when the clutch 12 is moved to the intermediate position.

[0030] At a lower portion of the shaft 6 is provided a plurality of yarn feeding pulleys 10, which are yarn feeding means that are rotatable at the same speed as the drive means 7 and each have at least one yarn guiding face. These yarn pulleys 10 are fixed to the shaft 6 by a screw 11.

[0031] As shown in FIG. 2, a fixed guide 15 and at least two movable guides, namely, a first movable guide 16 and a second movable guide 17, are provided adjacent to the yarn feeding pulley 10.

[0032] The fixed guide 15 has an introduction hole 15a and an exit hole 15b on a yarn inlet side and a yarn outlet side.

[0033] The first movable guide 16 and the second movable guide 17 are movable in tandem between the introduction hole 15a and the exit hole 15b, around a yarn guiding face 10a. The tips of the first movable guide 16 and the second movable guide 17 are respectively provided with a first yarn guide hole 16a and a second yarn guide hole 17a for guiding yarn. A wear-resistant material such as a porcelain or a ceramic that is not readily worn by friction against yarn is preferably used for the first yarn guide hole 16a and the second yarn guide hole 17a.

[0034] As shown in FIG. 4, a plurality of fixed guides 15, first movable guides 16 and second movable guides 17 are provided in correspondence to the positions of the plurality of yarn feeding pulleys 10.

[0035] Next, a more detailed description of each guide will be given with reference to FIG. 5, which is a partial enlarged view of FIG. 2.

[0036] Near the introduction hole 15a of the fixed guide 15 is fixed one end of a base 18 (see FIGS. 2 and 4). At the other end of the base 18, a first swing member 21 and a second swing member 19 are axially supported rotatably around a second shaft 22. The shaft portions of the first swing member 21 and the second swing member 19 are preferably provided with bearings.

[0037] The first swing member 21 has secured thereto the first movable guide 16, and the second swing member 19 has secured thereto the second movable guide 17. These swing members and movable guides may be integrated by resin molding. Also, the second swing member 19 has an extension, and at the end of this extension is provided a first pin 20 for fastening an elastic member (see FIG. 5).

[0038] Further, the first swing member 21 is provided with a link groove 21a in order to regulate the angle of arc movement. A third pin 23 that is secured to the second swing member 19 is fitted into this link groove 21.

[0039] The second movable guide 17 has attached thereto in an elastic force adjustable manner a second elastic member 24, in order to move the second movable guide 17 to the non-yarn feeding state by reducing the contact angle of yarn along the surface of the yarn feeding pulley 10. The second elastic member 24 preferably is a tension spring, and one end thereof is supported by the base 18 while the other end is supported by the second swing member 19. As shown in FIG. 2, on the base 18 is provided a plurality of pins 26, and the elastic force of the second elastic member 24 is adjustable by selectively moving the end of the second elastic member 24 on the base side to any of these pins 26.

[0040] The first movable guide 16 has attached thereto a first elastic member 25, in order to move the first movable guide 16 to the non-yarn feeding state by reducing the contact angle of yarn along the surface of the yarn feeding pulley 10. The first elastic member 25 preferably is a tension spring, and one end thereof is fastened by the first pin 20 of the second swing member 19 while the other end is fastened by the first swing member 21. Although not shown, the elastic force of the first elastic member 25 can also be configured to be adjustable similarly to the second elastic member. For example, the elastic force of the spring can be adjusted by replacing the spring with springs of different elastic forces.

[0041] The second elastic member 24 and the first elastic member 25 are set to satisfy the following relationship. That is, the total force calculated by multiplying the distance from the point of force to the point of application by the elastic force of the elastic member is set to be weaker for the second elastic member 24 than the first elastic member 25.

[0042] FIG. 2 illustrates (a) the non-yarn feeding state, (b) the movement start state, and (c) the yarn feeding state of the yarn feeder 1.

[0043] As shown in FIG. 2(a), with the yarn feeder 1 in the non-yarn feeding state, the knitting yarn passing through the first movable guide 16, the second movable guide 17 and the exit hole 15b from the introduction hole 15a is held without contacting with the yarn guiding face.

[0044] In the case where the force generated by the feeding tension of yarn selected by the yarn changer of a circular knitting machine or the feeding tension of yarn that changes depending on the amount of yarn required for a pattern using different amounts of yarn that moves the second movable guide 17, 117 in the travel direction of yarn is stronger than a resistance force generated by the second elastic member 24, 124 corresponding to the second movable guide 17, 117 that moves the second movable guide 17, 117 in the counter-travel direction of yarn, the second movable guide 17 moves from the non-yarn feeding state to the movement start state together with the first movable guide 16 while maintaining the interval therebetween (Movement A).

[0045] In the case where the force generated by the feeding tension of yarn passing through the yarn guide hole 16a, 116a that moves the first movable guide 16, 116 in the travel direction of yarn becomes stronger than the resistance
force generated by the first elastic member 25, 125 corresponding to the first movable guide is 16, 116 that moves the first movable guide 16, 116 in the counter-travel direction of yarn after the second movable guide 17 has reached the yarn feeding state position, only the first movable guide 16 moves from the movement start state to the yarn feeding state (Movement B).

On the other hand, in the case where the force generated by the feeding tension of yarn passing through the yarn guide hole 16a, 116a that moves the first movable guide 16, 116 in the travel direction of yarn becomes weaker than the resistance force generated by the first elastic member 25, 125 corresponding to the first movable guide 16, 116 that moves the first movable guide 16, 116 in the counter-travel direction of yarn, only the first movable guide 16 moves from the yarn feeding state to the movement start state (Movement C).

Further, in the case where the force generated by the feeding tension of yarn passing through the yarn guide hole 17a, 117a that moves the second movable guide 17, 117 in the travel direction of yarn becomes weaker than the resistance force generated by the second elastic member 24, 124 corresponding to the second movable guide 17, 117 that moves the second movable guide 17, 117 in the counter-travel direction of yarn, the second movable guide 17 moves to the non-yarn feeding position together with the first movable guide 16 while maintaining the interval therebetween (Movement D).

In the case where the tension of yarn changes depending on the amount of yarn required for a pattern using different amounts of yarn, yarn can be fed to the knitting machine while maintaining the feeding tension of yarn by repeating the operations of movements B and C and feeding the amount of yarn required by the knitting machine. Thus, the problem of yarn slackening and becoming wound around the friction surface of the yarn feeding pulley is resolved.

A stopper 27 abuttable against the second movable guide 17 is provided, in order to restrict the range of the arc movement of the second movable guide 17 when transitioning from the non-yarn feeding state to the yarn feeding state, according to the frictional resistance between the yarn guiding face and the yarn (see FIG. 9). The stopper 27 is composed of a vertical portion 27a that abuts against the second movable guide 17 and an arc-shaped holding portion 27b provided above the vertical portion 27a. The housing 2 of the yarn feeder 1 is provided with an arc-shaped groove corresponding to the holding portion 27b, and the vertical portion 27a is held so as to be movable in an arc around the yarn feeding pulleys 10.

The stopper 27 is provided with an adjustment mechanism 2a, 27d for adjusting the contact area between the yarn and the yarn feeding pulleys depending on the type of yarn. This adjustment mechanism is composed of a plurality of notches 27d provided in the holding portion 27b and a ball disposed on the housing 2 so as to correspond to these notches 27d. An upper portion of the ball is provided with a hole 2a in which a spring and a screw are disposed, enabling the ball to be held by the plurality of notches 27d.

When the first and second movable guides 16 and 17 are not in use, shaft portions 16b and 17b of the first and second movable guides 16 and 17 can be fixed in place by being hooked into L-shaped grooves 27c provided in the vertical portion 27a of the stopper. While L-shaped grooves are provided in order to fix the movable guides in place, the fixing means are not limited to L-shaped grooves.

Although not illustrated for the sake of simplicity, the top of the base 18 in FIGS. 2 and 5 is covered with a cover so as to prevent lint or the like produced from the knitting yarn from sticking to the swing members and elastic members.

Embodiment 2

In the second embodiment, the schematic of the yarn feeder is similar to the first embodiment (see [0027] to [0034]), and thus a description of this portion is omitted.

Next, a detailed description of each guide will be given with reference to FIG. 3 and FIG. 6, which is a partial enlarged view of FIG. 3.

Near the introduction hole 15a of the fixed guide 15 (see FIGS. 2 and 4) is provided one end of a base 118. At the other end of this base 118, a second swing member 119 is pivotally supported so as to be movable in an arc around a fourth pin 100. The second movable guide 117 is secured to this second swing member 119.

At one end of the second swing member 119, a first swing member 121 is pivotally supported so as to be movable in an arc around a second shaft 122. The first movable guide 16 is secured to this first swing member 121. The base 18 and the first swing member 121 are not directly connected.

The second swing member 119 is provided with a first positioning member 119a and a second positioning member 119b in order to regulate the angle of the arc movement of the first movable guide 116.

The second movable guide 117 has attached thereto a second elastic member 124, in order to move the second movable guide 117 to the non-yarn feeding state by reducing the contact angle of yarn along the surface of the yarn feeding pulley 10. The second elastic member 124 is preferably a tension spring, and one end thereof is fastened by the base 118 while the other end is fastened by a first pin 120 that is attached to a central portion of the second swing member 119.
The second elastic member 124 is attached in a manner that enables the elastic force thereof to be adjusted. As shown in FIG. 8, a lever 126 is swingably supported on the base 118 by a fulcrum 126a provided at a central portion thereof, and a protrusion 127 is provided at one end of the lever 126. The protrusion 127 moves in an arc as a result of swinging the other end of the lever 126. A plurality of holes 118a engageable with the protrusion 127 are provided on the arc. The end of the second elastic member 124 on the base side is supported between the fulcrum of the lever and the protrusion 127. The elastic force of the second elastic member 124 is adjustable by selectively moving the protrusion 127 among the plurality of holes 118a. Preferably the lever 126 is a leaf spring and the protrusion 127 is pushed into the holes 118a by the spring force thereof. Also, the elastic force adjustment device is not limited to the above, and may be a mechanism that allows the lever to stop freely within the range of movement of the lever.

Referring back to FIG. 6, the first movable guide 116 has attached thereto a first elastic member 125, in order to move the first movable guide 116 to the non-yarn feeding state by reducing the contact angle of yarn along the surface of the yarn feeding pulley 10. The first elastic member 125 preferably is a torsion spring, and one end thereof is supported by the first pin 120 attached to a central portion of the second swing member 119 while the other end is wrapped around the center of the first swing member 121.

The second movable guide 17, 117 is set so as to move in the travel direction of yarn with a weaker force than the first movable guide 16, 116. In other words, the resistance force generated by the second elastic member 24, 124 corresponding to the second movable guide 17, 117 that acts to move the second movable guide 17, 117 in the counter-travel direction of yarn is set to be weaker than the resistance force generated by the first elastic member 25, 125 corresponding to the first movable guide 16, 116 that acts to move the first movable guide 16, 116 in the counter-travel direction of yarn.

The operation and effect of the guides in the second embodiment are substantially the same as those in the first embodiment (see [0042] to [0052]), and thus a description thereof is omitted.

Experimental Verification of Effects

The following knitting tests were carried out using a polyester yarn of 84 dtex/36 filaments with a 34-inch diameter, 18-gauge Fukuhara V-LEC3DGTY6 electronic jacquard striper knitting machine.

a) When yarn changed from stopped state to yarn feeding state in the case of striped knitting:

As shown in Table 1, the problem of yarn becoming wound around the friction surface of the yarn feeding pulley is eliminated since the movable guides tension the yarn as they move, thus removing any excess slack in the yarn.

<table>
<thead>
<tr>
<th>Winding</th>
<th>Breaking-1</th>
<th>Breaking-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Technology</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td>Embodiment 1</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Embodiment 2</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

○ : 0 times △ : Less than 10 times × : 10 times or more

b) When yarn stopped in the case of striped knitting

As shown in Table 2, the problem of yarn becoming wound around the friction surface of the yarn feeding pulley or breaking due to friction is eliminated since the yarn is completely removed from and does not come into contact with the surface of the yarn feeding pulley.

<table>
<thead>
<tr>
<th>Winding</th>
<th>Breaking-1</th>
<th>Breaking-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Technology</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td>Embodiment 1</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

7
c) In the case of jacquard knitting:

[0066] As shown in Table 3, yarn does not become wound around the friction surface of the yarn feeding pulley since the yarn is tensioned by the plurality of guide means, thus removing any slack in the yarn.

<table>
<thead>
<tr>
<th>Embodiment</th>
<th>Winding</th>
<th>Breaking-1</th>
<th>Breaking-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embodiment 2</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

○: 0 times  △: Less than 10 times  ×: 10 times or more

Note: 40-count single cotton yarn was used in the Breaking-2 test

[0067] As the results of these experiments show, the present invention enables the availability and knitted fabric quality of a knitting machine to be improved. Moreover, the horizontal space required to install the yarn feeder in a circular knitting machine is similar to the past.

Embodiment 3

[0068] FIGS. 10 and 11 show a third embodiment of the present invention.

[0069] The third embodiment differs from the second embodiment in that the first swing member is omitted, and the first movable guide 216 is itself replaced by a single leaf spring. The hundreds digit in the second embodiment is changed from "1" to "2" for components in the third embodiment that correspond to the second embodiment, and a detailed description thereof is omitted. The operation and effect of the third embodiment are substantially the same as the first and second embodiments.

Industrial Applicability

[0070] The present invention is a yarn feeder for feeding yarn in a circular knitting machine, particularly a jacquard circular knitting machine and a circular knitting machine provided with a yarn changer, and is suitable for ameliorating the problem of yarn becoming wound around the friction surface of the yarn feeding pulley or breaking due to friction against the rubber band of the yarn feeding pulley depending on the type of yarn.

List of Reference Numerals

[0071]

1  Yarn feeder
10 Yarn feeding pulley
11 Rubber band
15 Fixed guide
15a Introduction hole
15b Exit hole

16, 116, 216 First movable guide
16a, 116a First yarn guide hole
17, 117, 217 Second movable guide
17a, 117a Second yarn guide hole
18, 118 Base
19, 119 Second swing member
21, 121, 219 First swing member
24, 124, 224 Second elastic member
25, 125 First elastic member

Citation List

[0072]


Claims

1. A yarn feeder for a circular knitting machine, comprising at least one yarn feeding pulley (10), a fixed guide (15) provided adjacent to the yarn feeding pulley (10), at least two movable guides (16, 17, 116, 117), and a base (18) supporting the movable guides (16, 17, 116, 117), the fixed guide (15) having an introduction hole (15a) on a yarn inlet side and an exit hole (15b) on a yarn outlet side, the movable guides being composed of a first movable guide (16, 116) and a second movable guide (17, 117), and each of the movable guides (16, 17, 116, 117) having a yarn guide hole (16a, 17a, 116a, 117a) for guiding yarn at a tip thereof, and moving in an arc along a surface of the yarn feeding pulley (10), around a pivot shaft that is offset from a central shaft (6) of the yarn feeder, wherein the first movable guide (16, 116) has a first swing member (21, 121) that moves in an arc, and the second movable guide (17, 117) has a second swing member (19, 119) that moves in an arc, and the first swing member (21, 121) has disposed thereon a first elastic member (25, 125) so as to generate a resistance force to a feeding tension of yarn, and the second swing member (19, 119) has disposed thereon a second elastic member (24, 124) so as generate a resistance force to a feeding tension of yarn.

2. The yarn feeder according to claim 1, wherein the base (18, 118) and the second swing member (19, 119) are coupled by the second elastic member (24, 124), and the second swing member (19, 119) and the first swing member (21, 121) are coupled by a second shaft (22, 122) and the first elastic member (25, 125).

3. The yarn feeder according to claim 1 or 2, wherein the resistance force generated by the second elastic member (24, 124) corresponding to the second movable guide (17, 117) that acts to move the second movable guide (17, 117) in a counter-travel direction of yarn is weaker than the resistance force generated by the first elastic member (25, 125) corresponding to the first movable guide (16, 116) that acts to move the first movable guide (16, 116) in the counter-travel direction of yarn.
4. The yarn feeder according to any of claims 1 to 3, wherein the second elastic member (24, 124) and the first elastic member (25, 125) are set so as to cause at least one of

- (a) yarn passing through the first movable guide (16), the second movable guide (17) and the exit hole (15b) from the introduction hole (15a) to be held without contacting a yarn guiding face with the yarn feeder (1) in a non-yarn feeding state;
- (b) the second movable guide (17) to move from the non-yarn feeding state to a movement start state together with the first movable guide (16) while maintaining the interval therebetween, in a case where a force generated by the feeding tension of yarn passing through the yarn guide hole (17a, 117a) that moves the second movable guide (17, 117) in the travel direction of yarn is stronger than the resistance force generated by the second elastic member (24, 124) corresponding to the second movable guide (17, 117) that moves the second movable guide (17, 117) in the counter-travel direction of yarn;
- (c) the first movable guide (16) to move from the movement start state to a yarn feeding state, in a case where a force generated by the feeding tension of yarn passing through the yarn guide hole (16a, 116a) that moves the first movable guide (16, 116) in the travel direction of yarn becomes stronger than the resistance force generated by the first elastic member (25, 125) corresponding to the first movable guide (16, 116) that moves the first movable guide (16, 116) in the counter-travel direction of yarn after the second movable guide (17) has reached a position of the yarn feeding state;
- (d) only the first movable guide (16) to move from the yarn feeding state to the movement start state, in a case where the force generated by the feeding tension of yarn passing through the yarn guide hole (16a, 116a) that moves the first movable guide (16, 116) in the travel direction of yarn becomes weaker than the resistance force generated by the first elastic member (25, 125) corresponding to the first movable guide (16, 116) that moves the first movable guide (16, 116) in the counter-travel direction of yarn; and
- (e) the second movable guide (17) to move to the non-yarn feeding state together with the first movable guide (16) while maintaining the interval therebetween, in a case where the force generated by the feeding tension of yarn passing through the yarn guide hole (17a, 117a) that moves the second movable guide (17, 117) in the travel direction of yarn becomes weaker than the resistance force generated by the second elastic member (24, 124) corresponding to the second movable guide (17, 117) that moves the second movable guide (17, 117) in the counter-travel direction of yarn.

5. The yarn feeder according to any of claims 1 to 4, wherein an elastic force adjustment device is provided, such that an elastic force of at least one of the second elastic member (24, 124) and the first elastic member (25, 125) is adjustable.

6. The yarn feeder according to claim 5, wherein the elastic force adjustment device is a plurality of selectable pins (26) provided on the base (18), and is capable of changing a terminal setting position of the second elastic member (24, 124).

7. The yarn feeder according to claim 5, wherein the elastic force adjustment device is a combination of a plurality of selectable holes (118a) provided in the base (18) and a swingable lever (126) having at one end a protrusion (127) that is engageable with the holes (118a).

8. The yarn feeder according to any of claims 1 to 7, wherein means for regulating an angle of the arc movement of both the second swing member (19, 119) and the first swing member (21, 121) is provided.

9. The yarn feeder according to claim 8, wherein the means for regulating the angle of the arc movement of both swing members is a third pin (23) of one swing member and a link groove (21a) of the other swing member.

10. The yarn feeder according to claim 8, wherein the means for regulating the angle of the arc movement of both swing members is a positioning member (119a, 119b) provided on one of the second swing member (19, 119) and the first swing member (21, 121).

11. The yarn feeder according to any of claims 1 to 10, wherein a stopper (27) for restricting the arc movement of the movable guides is provided to restrict a range of movement of the first movable guide (16, 116) and the second movable guide (17, 117).
12. The yarn feeder according to claim 11,
wherein the stopper (27) is composed of a vertical portion (27a) that abuts against the second movable guide 17 and an arc-shaped holding portion (27b) provided above the vertical portion (27a), with an arc-shaped groove corresponding to the holding portion (27b) being provided in a housing (2) of the yarn feeder (1), and the vertical portion (27a) being held so as to be moveable in an arc circumferentially around the yarn feeding pulley (10).

13. The yarn feeder according to any of claims 11 or 12,
wherein the stopper (27) is provided with an adjustment mechanism (2a, 27d) for adjusting a contact area between the yarn and the yarn feeding pulley (10) depending on the type of yarn.

14. The yarn feeder according to claim 13,
wherein the adjustment mechanism is a plurality of notches (27d) provided in the holding portion (27b), a ball disposed on the housing (2) so as to correspond to the notches (27d), and a hole (2a) provided in an upper portion of the ball and in which a spring and a screw are disposed.

15. A yarn feeder for a circular knitting machine, comprising at least one yarn feeding pulley (10), a fixed guide (15) provided adjacent to the yarn feeding pulley (10), at least two movable guides (216, 217), and a base (218) supporting the movable guides (216, 217),
the fixed guide (15) having an introduction hole (15a) on a yarn inlet side and an exit hole (15b) on a yarn outlet side,
the movable guides being composed of a first movable guide (216) and a second movable guide (217), and each of the movable guides (216, 217) having a yarn guide hole (216a, 217a) for guiding yarn at a tip thereof, and moving in an arc along a surface of the yarn feeding pulley (10), around a pivot shaft that is offset from a central shaft (6) of the yarn feeder,
wherein the first movable guide (216) is composed of a first elastic member so as to generate a resistance force to a feeding tension of yarn, and the second movable guide (217) has a second swing member (219) that moves in an arc, the second swing member (219) having disposed thereon a second elastic member (224) so as generate a resistance force to a feeding tension of yarn.

16. The yarn feeder according to claim 15,
wherein the first movable guide (216) is composed of a leaf spring.
FIG. 1
(a) Non-yarn feeding state  (b) Yarn feeding state

FIG. 2
(a) Non-yarn feeding state  (b) Movement start state  (c) Yarn feeding state
FIG. 3

(a) Non-yarn feeding state  (b) Movement start state  (c) Yarn feeding state

FIG. 4
FIG. 5

(a) Non-yarn feeding state  (b) Movement start state  (c) Yarn feeding state

FIG. 6

(a) Non-yarn feeding state  (b) Movement start state  (c) Yarn feeding state
FIG. 11

(a) Non-yarn feeding state   (b) Movement start state   (c) Yarn feeding state
**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

**D04B15/48(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**D04B15/48**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

- Jitsuyo Shinan Koho 1922-1996
- Jitsuyo Shinan Toroku Koho 1996-2010
- Kokui Jitsuyo Shinan Koho 1971-2010
- Toroku Jitsuyo Shinan Koho 1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y A</td>
<td>US 2658367 A (Mellor Bromley &amp; Co., Ltd.), 10 November 1953 (10.11.1953), entire text; all drawings (Family: none)</td>
<td>1, 5, 6, 11, 13, 2-4, 7-10, 12, 14-16</td>
</tr>
<tr>
<td>Y A</td>
<td>JP 2001-240308 A (Memminger-IRO GmbH), 04 September 2001 (04.09.2001), paragraph [0027]; fig. 5</td>
<td>1, 5, 6, 11, 13, 2-4, 7-10, 12, 14-16</td>
</tr>
<tr>
<td></td>
<td>US 2002/0047034 A1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EP 1126063 A2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DE 10006599 A1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CZ 20010550 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA 2331910 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TW 541373 B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CN 1309201 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RU 2207974 C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SG 89372 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA 2331910 A1</td>
<td></td>
</tr>
</tbody>
</table>

* Further documents are listed in the continuation of Box C.

See patent family annex.

| * Special categories of cited documents: |
| **A**: document defining the general state of the art which is not considered to be of particular relevance |
| **E**: earlier application or patent published on or after the international filing date |
| **L**: document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) |
| **O**: document referring to an oral disclosure, use, exhibition or other means |
| **P**: document published prior to the international filing date but later than the priority date claimed |
| **T**: later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| **X**: document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| **Y**: document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| **&**: document member of the same patent family |

Date of the actual completion of the international search

**11 May, 2010 (11.05.10)**

Date of mailing of the international search report

**25 May, 2010 (25.05.10)**

Name and mailing address of the ISA/

**Japanese Patent Office**

Authorized officer

**Telephone No.**

Form PCT/ISA/210 (second sheet) (July 2009)
### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>
REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 61047777 B [0002] [0005]
- JP 10273858 A [0002] [0072]
- JP 61047777 A [0072]