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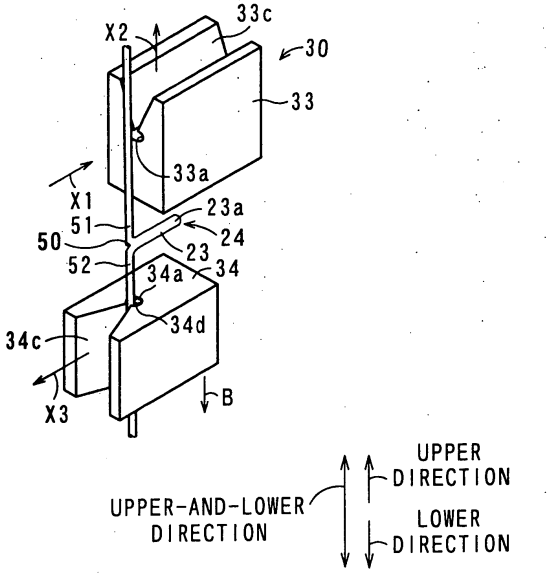
(54) YARN SPLICING METHOD AND YARN SPLICING DEVICE

(57) The invention relates to a piecing method capable of securing the strength of a spun yarn obtained by the piecing, and omitting a protrusion treatment step for a fabric knitted by the spun yarn obtained by the piecing. Tip end portions (21a, 22a) of knitting yarns (21, 22) are overlaid in the same direction, and the knitting yarn (21, 22) are intertwined into each other to form a protruding portion (23) and a plurality of branched portions (51, 52) that are branched from the protruding portion (23). Then, the protruding portion (23) is overlaid on one branched portion (51) and the protruding portion (23) is fixed to the one branched portion (51).

FIG. 6B



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Description

Technical Field

[0001] The present invention relates to a piecing method and a piecing apparatus for piecing a plurality of spun yarns into each other.

Background Art

[0002] A spun yarn used for knitting a fabric may be broken during knitting with application of excessive tension. In this case, the broken spun yarn is pieced into a new spun yarn, and the knitting is started again. Piercing is performed not only for repairing the broken spun yarn but also for knitting, for example, a fabric having an intarsia pattern using a knitting yarn, which is a type of spun yarn (see Japanese Unexamined Patent Publication JP-A 6-2250 (1994), for example).

[0003] In a piecing method according to a first conventional technique, a knotter apparatus knots end portions of two spun yarns to form a knot, thereby piecing the two spun yarns into each other. In this case, the tip end portions of the spun yarns protrude from the knot.
The tip end portions of the spun yarns can be shortened by being cut after formation of the knot, but cannot be completely removed.

[0004] In a piecing method according to a second conventional technique, a splicer apparatus pieces spun yarns into each other without forming a knot. With this piecing method, in a state where end portions of two spun yarns are overlaid in the mutually opposite directions, piecing is performed by intertwining the end portions of the two spun yarns into each other with blowing of compressed air. With this piecing method, a piecing region of the spun yarns is formed in an I-shape (see Japanese Examined Patent Publication JP-B2 60-39767 (1985), for example).

[0005] Fig. 13 is a view showing a spun yarn obtained in a piecing method according to a third conventional technique. In the piecing method according to the third conventional technique, in a state where end portions 1a and 2a of spun yarns 1 and 2 are overlaid in the same direction, with blowing of compressed air, piecing is performed by forming an intertwined portion 4 in witch the end portions 1a and 2a of the spun yarns 1 and 2 are intertwined into each other. With this piecing method, a piecing region 3 of the spun yarns 1 and 2 is formed in a T-shape (see Japanese Unexamined Patent Publication JP-A 2004-27463, for example).

[0006] In the piecing method according to the first conventional technique, the outer diameter of the knot formed in the spun yarn obtained by piecing is several times as large as that of the spun yarn. Accordingly, when this knot appears on the face stitch side of the knitted fabric, the appearance of the knitted fabric is impaired. In order to not impair the appearance, it is necessary to perform a protrusion treatment step of tucking the knot into the inner side of the knitted fabric.

[0007] In the piecing method according to the second conventional technique, the two spun yarns are overlaid in the mutually opposite directions and intertwined. Thus, a portion in which the two spun yarns are not overlaid is further twisted, and the outer diameter becomes small. Accordingly, the strength of the obtained spun yarn may become insufficient. Thus, there is limitation on spun yarns that can be pieced into each other. For example, in a case where two ply yarns, spun yarns made of chemical fibers, and the like are used as yarns that are to be pieced into each other, a piecing region of the spun yarns may be broken during knitting.

[0008] In the piecing method according to the third conventional technique, the piecing region 3 of the spun yarns is formed in the T-shape, and thus the intertwined portion 4 in witch the end portions 1a and 1b of the yarns 1 and 2 are intertwined into each other protrudes outward from the remaining portion of the piecing region 3. When the intertwined portion 4 appears on the face stitch side of the knitted fabric, the appearance of the knitted fabric is impaired. In order to not impair the appearance, it is necessary to perform a protrusion treatment step of tucking the intertwined portion 4 into the inner side of the knitted fabric so that the intertwined portion 4 is placed on the back stitch side of the knitted fabric. This sort of problem occurs also in a case where spun yarns obtained by piecing are used for weaving of a woven fabric as well as knitting of a fabric.

Disclosure of Invention

[0009] It is an object of the invention to provide a piecing method and a piecing apparatus capable of securing the strength of a spun yarn obtained by the piecing, and omitting a protrusion treatment step after piecing.

[0010] The invention is directed to a piecing method for piecing end portions of a plurality of spun yarns, comprising:

> a spun yarn joining step of forming, in the spun yarns, a joined portion at which separate portions that are separate from tip end portions of the plurality of spun yarns in directions toward base end portions are joined to each other, a protruding portion that extends from the joined portion to the tip end portions of the spun yarns, and a plurality of branched portions that extend from the joined portion respectively to the base end portions of the plurality of spun yarns, by joining the plurality of spun yarns to each other; and
>
> a protruding portion fixing step of overlaying the protruding portion on at least one of the plurality of branched portions and fixing the protruding portion and the branched portion that is overlaid on the protruding portion.

[0011] In the invention, it is preferable that, in the pro-

truding portion fixing step, the branched portion to which the protruding portion is fixed is a branched portion positioned on an upstream side in a yarn feeding direction in which each spun yarn is fed and sent, relative to the joined portion.

[0012] In the invention, it is preferable that, in the protruding portion fixing step, after both of the protruding portion and the branched portion are partially untwisted, untwisted portions are intertwined into each other, and thus the protruding portion is fixed to the branched portion.

[0013] In the invention, it is preferable that, in the protruding portion fixing step, the protruding portion is rotated about an axis of the branched portion so that the protruding portion is wound around the branched portion, and thus the protruding portion is fixed to the branched portion.

[0014] In the invention, it is preferable that, in the protruding portion fixing step, the protruding portion is wound around the branched portion in a state where the branched portions are prevented from rotating together with the protruding portion.

[0015] In the invention, it is preferable that, in he protruding portion fixing step, the protruding portion and the branched portion are fixed by blowing compressed fluid in a direction in which the protruding portion is oriented toward the branched portion for fixing.

[0016] In the invention, it is preferable that, in the spun yarn joining step, the separate portions of the plurality of spun yarns are joined to each other using one of a method in which the plurality of spun yarns are intertwined to be joined and a method in which the plurality of spun yarns are knotted to be joined.

[0017] Moreover, the invention is directed to a spun yarn obtained by piecing using the piecing method mentioned above.

[0018] Moreover, the invention is directed to a fabric knitted with a knitting yarn obtained by piecing using the piecing method mentioned above.

[0019] Moreover, the invention is directed to a piecing apparatus for piecing end portions of a plurality of spun yarns, comprising:

spun yarn joining means for forming, in the spun yarns, a joined portion at which separate portions that are separate from tip end portions of the plurality of spun yarns in directions toward base end portions are joined to each other, a protruding portion that extends from the joined portion to the tip end portions of the spun yarns, and a plurality of branched portions that extend from the joined portion respectively to the base end portions of the plurality of spun yarns, by joining the plurality of spun yarns to each other thereby; and

protruding portion fixing means for overlaying the protruding portion on at least one branched portion of the plurality of branched portions and fixing the protruding portion and the branched portion that is overlaid on the protruding portion.

[0020] In the invention, it is preferable that the protruding portion fixing means fixes the protruding portion to a branched portion positioned on an upstream side in a yarn feeding direction in which each spun yarn is fed and sent, relative to the joined portion.

[0021] In the invention, it is preferable that the protruding portion fixing means fixes the protruding portion and the branched portion using one of an intertwining method in which the protruding portion and the branched portion are partially untwisted and then untwisted portions are intertwined into each other, and a winding method in which the protruding portion is rotated about an axis of the branched portion and thus the protruding portion is wound around the branched portion.

[0022] In the invention, it is preferable that the spun yarn joining means joins the separate portions of the plurality of spun yarns to each other using one of a method in which the plurality of spun yarns are intertwined, and a method in which the plurality of spun yarns are knotted.

[0023] In the invention, it is preferable that the spun yarn joining means includes a first splicing head that joins the plurality of spun yarns by blowing compressed fluid to a portion in which the plurality of spun yarns are overlaid, and

the protruding portion fixing means includes a second splicing head that fixes the protruding portion and the branched portion by blowing compressed fluid to the protruding portion.

Brief description of Drawings

[0024] Objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawing, wherein:

Figs. 1A to 1D are front views of knitting yarns for illustrating a procedure of a piecing method according to a first embodiment of the invention;

Fig. 2 is a diagram showing a weft knitting machine 31 including a piecing apparatus 30;

Fig. 3 is an enlarged perspective view showing splicing heads' 33 and 34 included in the piecing apparatus 30;

Fig. 4 is a flowchart showing the procedure of a protruding portion fixing step in the piecing apparatus 30;

Fig. 5 is a flowchart showing the procedure of the protruding portion fixing step;

Figs. 6A to 6D are views showing operations of the piecing apparatus 30 in each step of the protruding portion fixing step;

Figs. 7A and 7B are perspective views showing the second splicing head 34 for illustrating a piecing method according to a second embodiment of the invention;

Fig. 8 is a cross-sectional view taken along a section

line S8-S8 in Fig. 7A;

Fig. 9 is a cross-sectional view taken along a section line S9-S9 in Fig. 8;

Figs. 10A and 10B are schematic views showing a piecing apparatus 30A that realizes the piecing method according to the second embodiment;

Fig. 11 is a front view showing a knitting yarn 24B obtained by joining performed in a spun yarn joining step of a piecing method according to a third embodiment of the invention;

Figs. 12A to 12D are front views respectively showing states in which protruding portions 23a and 23b are fixed; and

Fig. 13 is a view showing a spun yarn obtained in a piecing method according to a third conventional technique.

Best Mode for Carrying out the Invention

[0025] Now referring to the drawing, preferred embodiments of the invention are described below.

[0026] Figs. 1A to 1D are front views of knitting yarns for illustrating the procedure of a piecing method according to a first embodiment of the invention. The piecing procedure proceeds in the order from Fig. 1A to Fig. 1D. The piecing method is a method for piecing two knitting yarns 21 and 22 into each other. The piecing method is used, for example, in a case where a knitting yarn whose color is different from that of a currently used knitting yarn is pieced into the currently used knitting yarn. The piecing method is used also in a case where a new knitting yarn is pieced into a broken knitting yarn. In this embodiment, a method for piecing the two knitting yarns 21 and 22 into each other will be described.

[0027] In the piecing method according to the first embodiment of the invention,' first, the two knitting yarns 21 and 22 that are spun yarns are provided (Fig. 1A). Next, tip end portions 21a and 22a of the knitting yarns 21 and 22 are overlaid in the same direction. In this embodiment, 'in the same direction' refers to a state in which 'end faces of the tip end portions 21a and 22a of the knitting yarns 21 and 22 are oriented in the same direction'. In the knitting yarns 21 and 22, separate portions 21c and 22c are set at positions separate from the tip end portions 21a and 22a in the directions toward base end portions 21d and 22d by a predetermined protrusion amount H1. In a state where the knitting yarns 21 and 22 are overlaid, the knitting yarns 21 and 22 are overlaid extending in the same direction at least at tip end overlaid portions 21e and 22e from the tip end portions 21a and 22a to the separate portions 21c and 22c (Fig. 1B).

[0028] After the two knitting yarns 21 and 22 are overlaid, the tip end overlaid portions 21e and 22e of the knitting yarns 21 and 22 are untwisted. Next, the untwisted tip end overlaid portions 21e and 22e are intertwined into each other, and thus the tip end overlaid portions 21e and 22e of the knitting yarns 21 and 22 are integrally joined (Fig. 1C). Accordingly, a knitting yarn 24 after the joining in which the two knitting yarns 21 and 22 are joined to each other is formed. In the knitting yarn 24 after the joining, a joined portion 50 at which the knitting yarns 21 and 22 before joining are joined at the separate portions 21c and 22c, a protruding portion 23 that extends from the joined portion 50 to the tip end portions 21a and 22a of the knitting yarns 21 and 22 before the joining, and two branched portions 51 and 52 that extend from the joined portion 50 respectively toward the base end portions 21d and 22d of the knitting yarns 21 and 22 before the joining are formed. The branched portions 51 and 52 respectively correspond to the remaining portions obtained by excluding the tip end overlaid portions 21e and 21b from the knitting yarns 21 and 22 before the joining. The branched portions 51 and 52 are branched into two at the joined portion 50. The step of joining the two knitting yarns 21 and 22 at the tip end overlaid portions 21e and 22e thereby forming the knitting yarn 24 after the joining in this manner corresponds to a spun yarn joining step.

[0029] Next, the protruding portion 23 is folded so that the protruding portion 23 is overlaid on the branched portion 51 (hereinafter, referred to as a 'first branched portion'), which is one of the two branched portions 51 and 52 In this state, overlaid portions of the protruding portion 23 and the first branched portion 51 are partially untwisted. Next, the untwisted portions are intertwined into each other, and thus the protruding portion 23 is fixed so as to be overlaid on the first branched portion 51 (Fig. 1D). The step of fixing the protruding portion 23 to be disposed along at least one branched portion 51 corresponds to a protruding portion fixing step. In a pieced knitting yarn 25 after the piecing, a tip end portion 23a of the protruding portion 23 is fixed to the branched portion 51, and thus a protrusion amount H2 by which the protruding portion 23 protrudes from the branched portion 51 can be made smaller than the protrusion amount H1 before the protruding portion is fixed (H2 < H1). For example, the protrusion amount H1 before the protruding portion is fixed is 15 mm, while the protrusion amount H2 after the protruding portion is fixed is 1 mm. It should be noted that the protrusion amounts H1 and H2 are one example, and significantly change depending on piecing conditions such as the type of spun yarns, the number of yarns that are pieced into each other, the amount of compressed air blown, and the like.

[0030] Fig. 2 is a diagram showing a weft knitting machine 31 including a piecing apparatus 30 according to an embodiment of the invention. Fig. 3 is an enlarged perspective view showing splicing heads 33 and 34 included in the piecing apparatus 30. In Fig. 3, the upper-and-lower direction refers to the upper-and-lower direction with respect to the section of the diagram. The lower direction refers to a direction from the upstream side in the yarn feeding direction to the downstream side in the yarn feeding direction. The above-described piecing method is realized in the piecing apparatus 30, which is this embodiment. The piecing apparatus 30 is an air splicing apparatus, and included in the weft knitting machine

31 that knits a fabric. In this embodiment, two knitting yarns refer to a currently used knitting yarn that is being used for knitting, and another knitting yarn that is to be pieced into the currently used knitting yarn. The other knitting yarn is selected from among a plurality of knitting yarns as appropriate.

[0031] The piecing apparatus 30 includes the first splicing head 33 and the second splicing head 34. The splicing heads 33 and 34 blow compressed fluid to overlaid portions of two spun yarns so that both of the overlaid portions are untwisted and then intertwined into each other, and thus the overlaid portions of the two spun yarns are integrally joined.

[0032] The first splicing head 33 functions as spun yarn joining means for joining the two knitting yarns 21 and 22 to each other by performing the above-described spun yarn joining step. The first splicing head 33 has a first groove portion 33a that defines a first splicing space 60 in the shape of a tube whose axis L1 is in one horizontal direction X1 (hereinafter, referred to as an 'X1 direction'). The first groove portion 33a has a first nozzle opening 33b for supplying compressed air to the first splicing space 60. Furthermore, the first groove portion 33a is open in an upper direction X2 (hereinafter, referred to as an 'X2 direction') from one end to the other end in the X1 direction. This opening portion 33c defines a first entrance space 61 in the shape of a triangular prism that becomes wider from the first groove portion 33a in the X2 direction.

[0033] The second splicing head 34 functions as protruding portion fixing means for fixing the protruding portion 23 and the branched portion 51 by performing the above-described protruding portion fixing step. The second groove portion 34a has a second groove portion 34a that defines a second splicing space 62 in the shape of a tube extending in the upper-and-lower direction. The second splicing head 34 has a second nozzle opening 34b for supplying compressed air to the second splicing space 62. Furthermore, the second groove portion 34a is open in the other horizontal direction X3 (hereinafter, referred to as an 'X3 direction') from one end to the other end in the upper-and-lower direction. This opening portion 34c defines a second entrance space 63 in the shape of a triangular prism that becomes wider from the second groove portion 34a in the X3 direction. The second nozzle opening 34b extends downward as being away from the second splicing space 62 in the horizontal direction. In this embodiment, an axis L2 of the second splicing space 62 and an axis L3 of the second nozzle opening 34b are formed so that a relative angle θ therebetween is 30 degrees. The second nozzle opening 34b blows compressed air in an inclined direction A that proceeds to the opposite direction of a yarn feeding direction B, that is, proceeds upward as proceeding from the nozzle opening to the center of the second splicing space 62 in the direction perpendicular to the yarn feeding direction B. The inclined direction A and the axis L2 of the second splicing space 62 are arranged on the same plane.

[0034] The weft knitting machine 31 including the piecing apparatus 30 is disclosed, for example, in Japanese Unexamined Patent Publication JP-A 2006-118059. As shown in Fig. 2, the piecing apparatus 30 includes a plurality of yarn feeders 37 with which knitting yarns 41 obtained by piecing using the piecing apparatus 30 are fed to knitting needles. In the weft knitting machine 31, the knitting yarns 41 that are fed to the knitting needles can be selectively switched by switching the yarn feeders 37 that are brought by a carriage 36. Since the number of the yarn feeders 37 that can be used is limited, the types of the knitting yarns 41 that can be used is limited. The types of the knitting yarns 41 that can be fed by the yarn feeders 37 can be increased by switching the types of the knitting yarns 41 using the piecing apparatus 30.

[0035] On a yarn feed path of the knitting yarn 41, a fixed amount sending apparatus 38 of the knitting yarn 41 is disposed between the piecing apparatus 30 and the yarn feeder 37 in order to suppress a sudden change in a tensile force acting on the knitting yarn 41.
Furthermore, the weft knitting machine 31 has a control portion 39 and a counter portion 40. The control portion 39 calculates in advance the length of a knitting yarn necessary for knitting a fabric, for example, the length of a knitting yarn necessary for knitting one line in the course direction, under the condition that a change in a tensile force acting on the knitting yarns is small. Furthermore, the control portion 39 detects the position of the carriage 36 using a positional sensor that is disposed on the carriage 36. The control portion 39 calculates the timing of piecing the knitting yarns 41 based on the position of the carriage 36 and the calculate length of the knitting yarn. Based on the calculation result, the control portion 39 causes the piecing apparatus 30 to perform piecing. The control portion 39 performs control so that, in a case where piecing is performed, the speed of the fixed amount sending apparatus 38 of a knitting yarn is lowered compared with a case in which piecing is not performed. The counter portion 40 counts the time and gives the counted time to the control portion 39.

[0036] Fig. 4 is a flowchart showing the procedure of a piecing process in the piecing apparatus 30. Fig. 5 is a flowchart showing the procedure of the protruding portion fixing step. Figs. 6A to 6D are views showing operations of the piecing apparatus 30 in each step of the protruding portion fixing step. In Figs. 6A to 6D, the yarn feeding direction B of a knitting yarn is set to the lower direction. In this embodiment, piecing is performed when feeding knitting yarns with different qualities from one yarn feeder 37, for example, in intarsia knitting or the like.

[0037] In a case where it is judged that the length of a knitting yarn necessary for knitting from a currently knitted stitch to a color pattern change position matches that of a path of a knitting yarn from the first splicing head 33 to a knitting needle knitting the color pattern change position, the procedure proceeds to step s1 where the control portion 39 causes the piecing apparatus 30 to start piecing.

[0038] In step s1, which is the spun yarn joining step, the two knitting yarns 21 and 22 are joined using a method similar to the piecing method performed by the piecing apparatus disclosed, for example, in Japanese Unexamined Patent Publication JP-A 2005-314104. More specifically, a guide member guides the tip end overlaid portions 21e and 22e of the two knitting yarns 21 and 22 before the joining, from the first entrance space 61 to the first splicing space 60. At that time, in one knitting yarn 21, a remaining portion 21f obtained by excluding the tip end overlaid portion 21e extends upward from the first splicing space 60. Furthermore, in the other knitting yarn 22, a remaining portion 22f obtained by excluding the tip end overlaid portion 22e extends downward from the first splicing space 60 and passes through the second splicing space 62. In this state, portions near the separate portions 21c and 22c of the knitting yarns 21 and 22 are clamped by a clamp mechanism, and portions near the tip end portions 21a and 22a of the knitting yarns 21 and 22 are cut by a cutter. The tip end overlaid portions 22e and 22e of the two knitting yarns 21 and 22 are fitted in the first groove portion 33a so as to be overlaid in the X1 direction (Fig. 6A)..

[0039] Next, the piecing apparatus 30 blows compressed air from the first nozzle opening 33b to the first splicing space 60 thereby starting to intertwine the tip end overlaid portions 21e and 22e of the knitting yarns 21 and 22. When a first set time t1 has elapsed from the start of blowing of the compressed air, the blowing of the compressed air is ended. The first set time t1 is, for example, 100 msec, and is set to a time in which the external shape of the tip end overlaid portions 21e and 22e does not become excessively small. When the tip end overlaid portions 21e and 22e of the two knitting yarns 21 and 22 are integrally intertwined in this manner, the knitting yarn 24 having the protruding portion 23 is formed. When the blowing of the compressed air is stopped, clamping is canceled to release the knitting yarn 24 after the joining, and sending of the knitting yarn 24 is started again. Accordingly, the spun yarn joining step ends, and the procedure proceeds to step s2.

[0040] In step s2, which is the protruding portion fixing step, the procedure proceeds in the order from s21 to s25 in Fig. 5. First, after it is judged that the spun yarn joining step ends, in step s21, the counter portion 40 starts counting, and the procedure proceeds to step s22. In step s22, the fixed amount sending apparatus 38 sends the knitting yarn 24 after the joining in the yarn feeding direction B, and the control portions 39 judges whether or not the elapsed time counted by the counter portion 40 reaches a second set time t2.

[0041] When the knitting yarn 24 after the joining is sent in the yarn feeding direction B, the protruding portion 23 is removed from the first splicing space 60. Accordingly, in the knitting yarn 24, the two branched portions 51 and 52 protrude in the upper-and-lower direction, and the protruding portion 23 protrudes in the X1 direction (Fig. 6B). At that time, the first branched portion 51 extends upward and the other branched portion 52 (hereinafter, referred to as a 'second branched portion') extends downward from the joined portion 50. Furthermore, the second branched portion 52 is fitted in the second groove portion 34a.

[0042] When the fixed amount sending apparatus 38 is driven to send the knitting yarn 24 in the yarn feeding direction B, the protruding portion 23 is fitted in the second groove portion 34a. At an upper opening portion 34d of the second groove portion 34a, the protruding portion 23 is folded from a lower opening portion 34e of the second groove portion 34a toward the upper opening portion 34d. Accordingly, a portion from the base to the tip end portion 23a of the protruding portion 23 is overlaid on the first branched portion 51 on the upstream side of the yarn feeding direction (Fig. 6C). The time from the protruding portion 23 and the first branched portion 51 are removed from the first groove portion 33a until the protruding portion 23 and the first branched portion 51 are fitted in the second groove portion 34a in this manner is the second set time t2. The second set time t2 is, for example, 100 msec. In a case where the control portion 39 judges that the second set time t2 has not elapsed, the procedure returns to step s22 where the judgment is repeated. In a case where the control portion 39 judges that the second set time t2 has elapsed, the procedure proceeds to step s23.

[0043] In step s23, blowing of compressed air from the second nozzle opening 32b to the second splicing space 62 is started. Accordingly, the protruding portion 23 and the first branched portion 51 that are fitted in the second groove portion 34a start to be partially intertwined. More specifically, the compressed air blown from the second nozzle opening 32b proceeds in the inclined direction A. When the compressed air is blown in the inclined direction A in this manner, the protruding portion 23 is folded down toward the first branched portion 51, and thus the protruding portion 23 and the first branched portion 51 are easily intertwined. When the blowing of the compressed air is started, the procedure proceeds to step s24.

[0044] In step s24, it is judged whether or not the elapsed time counted by the counter portion 40 after starting the blowing of the compressed air to the second splicing space 62 reaches a third set time t3. The third set time t3 refers to the time from the blowing is started until the joint strength of the two branched portions 51 and 52 is secured while securing the strength of the knitting yarn 25 after the piecing obtained by intertwining the protruding portion 23 and the first branched portion 51. In a case where the knitting yarn 24 after the joining is exposed to an air flow for a longer period of time, the joint strength is increased, but the outer diameter of a portion near the joint of the knitting yarn 24 after the joining becomes small, and thus the strength of the knitting yarn itself becomes poor. Conversely, in a case where the knitting yarn 24 after the joining is exposed to an air flow for a shorter period of time, the joint strength becomes poor.

In consideration of these circumstances, the third set time t3 is set. The third set time t3 is, for example, 100 msec. In a case where it is judged that the third set time t3 has not elapsed, the procedure returns to step s24 where the judgment is repeated. In a case where it is judged that the third set time t3 has elapsed, the procedure proceeds to step s25.

[0045] In step s25, the supply' of the compressed air to the second splicing space 62 is stopped, and the protruding portion fixing step ends. In this manner, the second splicing head 34 can form the knitting yarn 25 in which the portion from the base to the tip end portion 22a of the protruding portion 23 is overlaid and integrated with the first branched portion 51. After the protruding portion fixing step ends, the guide member causes the knitting yarn 25 in which the protruding portion 23 and the branched portion 51 are integrated to pass through the second entrance space 63 in the X3 direction to be removed from the second groove portion 34a so that the knitting yarn 25 passes through the opening portion 34c.

[0046] The knitting yarn 25 (41) obtained by piecing in this manner is fed by the yarn feeder 37 to a knitting needle, and thus a fabric is knitted. Accordingly, a fabric with various color patterns can be knitted with the knitting yarns 25 (41) fed from one yarn feeder 37. Furthermore, the types of the knitting yarns 41 that can be fed by the yarn feeders 37 can be increased by switching the types of the knitting yarns that are guided by the yarn feeders 37 using the piecing apparatus 30.

[0047] According to the piecing method of this embodiment as described above, in the spun yarn joining step, the kitting yarns 21 and 22 are joined at the separate portions 21c and 22c. Thus, the outer diameter of the branched portions 51 and 52 can be prevented from being small in the joining, and the strength of the knitting yarn obtained by piecing can be secured. Furthermore, in the protruding portion fixing step, the protruding portion 23 is fixed so as to be disposed along the first branched portion 51. Thus, the protrusion amount H2 of the protruding portion 23 from the branched portions 51 and 52 can be educed. In this manner, the knitting yarn 25 after the piecing in which the appearance is not impaired while the strength is secured can be produced.

[0048] In a case where a fabric is knitted using the knitting yarn 25 after the piecing, the protruding portion 23 can be prevented from protruding outward from the face stitches of the knitted fabric. Thus, an operation to confirm the protruding portion 23 protruding outward from the face stitches of the knitted fabric and an operation to tuck the protruded protruding portion 23 into the inner side of the knitted fabric can be omitted. Accordingly, the protrusion treatment step after the piecing can be omitted, and thus a knitted fabric in which the appearance is not impaired while the number of steps is reduced can be provided. Furthermore, since the protruding portion 23 is prevented from protruding, a feel of the knitted fabric can be made uniform. According to the piecing apparatus 30 of this embodiment, a piecing method that can achieve the above-described operation and effect can be realized.

[0049] Furthermore, in this embodiment, the branched portion 51 to which the protruding portion 23 is fixed is a branched portion positioned on the upstream side in the yarn feeding direction relative to the joined portion 50. Thus, compared with a case in which the tip end portion 23a of the protruding portion 23 is positioned on the downstream side in the yarn feeding direction B elative to the joined portion 50, a yarn sending resistance in feeding the knitting yarn 25 after the piecing can be reduced, and thus the yarn can be smoothly sent to the yarn feeder 37.

[0050] Furthermore, in the protruding portion fixing step, compressed air is blown in the direction A inclined relative to the direction in which the knitting yarn 24 after the joining extends. After both of the protruding portion 23 and the branched portion 51 are partially untwisted, the untwisted portions are intertwined into each other, and the protruding portion 23 is fixed to the branched portion 51. Accordingly, the protruding portion 23 and the first branched portion 51 are prevented from being excessively intertwined, part of the outer diameter of the knitting yarn 25 after the piecing is prevented from being excessively small, and thus the strength can be prevented from being poor. The compressed air is blown in a direction in which the protruding portion 23 is oriented toward the branched portion 51 for fixing. Thus, the protruding portion 23 is folded down toward the branched portion 51 for fixing, and the protruding portion 23 can be more reliably intertwined and fixed to the first branched portion 51.

[0051] Figs. 7A and 7B are perspective views showing the second splicing head 34 for illustrating a piecing method according to a second embodiment of the invention. Fig. 8 is a cross-sectional view taken along a section line S8-S8 in Fig. 7A. Fig. 9 is a cross-sectional view taken along a section line S9-S9 in Fig. 8. Figs. 10A and 10B are schematic views showing a piecing apparatus 30A that realizes the piecing method of the second embodiment. The second embodiment has the same configuration as the first embodiment, except that the direction in which compressed air is blown is different from that of the first embodiment in the protruding portion fixing step, and a description of the same configuration has been omitted.

[0052] In a state where the protruding portion 23 is fitted in the second groove portion 34a, the second splicing head 34 blows compressed air from the second nozzle opening 34b so as to flow in a rotational direction 70 in which the compressed air proceeds to one side in the axial direction of the branched portion 51 while rotating about the axis L2 of the second splicing space 62 (Fig. 7A). Accordingly, in step s23, the protruding portion 23 fitted in the second groove portion 34a is rotated about the axis of the first branched portion 51 a plurality of times to be wound around the first branched portion 51 (Fig. 7B). The protruding portion 23 and the first branched por-

tion 51 may be fixed by winding in this manner.

[0053] In this embodiment, with the second nozzle'opening 34b, the compressed air flows so as to rotate about the axis L2 while proceeding in the inclined direction A. Accordingly, the protruding portion 23 is folded down toward the first branched portion 51 and easily wound around the first branched portion 51 (Fig. 8). In a cross-section that is perpendicular to the axis L2, the inclined direction A is diverted from the axis L2 and oriented to the inner circumferential face of the second groove portion 34a. Thus, the compressed air can rotate about the axis L2 along the inner circumferential face of the second groove portion 34a (Fig. 9). Also in the second embodiment, with the procedure shown in the first embodiment, piecing can be performed in a similar manner and a similar effect to that of the first embodiment can be obtained.

[0054] Furthermore, since the protruding portion 23 is rotated, the twisted branched portion 51 can be prevented from being untwisted regardless of the period of time to blow compressed fluid, the diameter of the first branched portion 51 that is overlaid on the protruding portion 23 and the region near the overlaid portion can be prevented from being small, and thus the strength of the spun yarn obtained by piecing can be prevented from being poor. Furthermore, acceptable timings of blowing the compressed fluid can be increased, and thus the piecing control can be easily realized. The rotational direction 70 is preferably a direction in which the first branched portion 51 is twisted.

[0055] Furthermore, the piecing apparatus 30A of the second embodiment includes rotation resisting members 71 and 72 functioning as resisting members that prevent the branched portion 51 from rotating about the axis. In this embodiment, the rotation resisting members 71 and 72 are realized as tension applying devices that apply tension to the knitting yarn 41 and are arranged respectively on the upstream side and the downstream side in the yarn feeding direction of the second splicing head 34. Thus, even when a rotational flow is formed by compressed air in the protruding portion fixing step, the branched portions 51 and 52 can be prevented from rotating together with the protruding portion 23. Accordingly, the protruding portion 23 can be reliably rotated about the branched portion 51, and thus the time that is necessary to wind the protruding portion 23 around the branched portion 51 can be shortened.

[0056] In this manner, in the protruding portion fixing step, it is sufficient that the protruding portion 23 is fixed so as to be overlaid on the first branched portion 51, and either the intertwining method shown in the first embodiment or the winding method shown in the second embodiment can be used. Other methods also can be used, for example, in which the protruding portion 23 and the branched portion 51 are mechanically kneaded or twisted to be integrated.

[0057] Furthermore, in the foregoing embodiments, the methods for piecing knitting yarns were described, but the methods can be applied to all methods for piecing spun yarns obtained by spinning fibers. Accordingly, the methods also can be applied to piecing of weaving yarns made of spun yarns. Furthermore, in the foregoing embodiments, the protruding portion 23 is integrally fixed to the branched portion 51 on the upstream side in the yarn feeding direction B relative to the joined portion 50, but the protruding portion 23 may be integrally fixed to the branched portion 52 on the downstream side in the yarn feeding direction B relative to the joined portion' 50. In this case, the knitting yarn 24 after the joining can be inserted to the second groove portion 34a of the second splicing head 34 in the opposite direction of the yarn feeding direction B.

[0058] In the foregoing embodiments, the first splicing head 33 is disposed on the upper side, and the second splicing head 34 is disposed on the lower side. However, the first splicing head 33 may be disposed on the lower side, and the'second splicing head 34 may be disposed on the upper side. In this case, the yarn feeding direction B is a direction from below to above. In this manner, the arrangement of the splicing heads 33 and 34 is not limited, and the X1 to X3 directions also can be freely set. Moreover, the spun yarn joining step and the protruding portion fixing step can be performed with one splicing head.

[0059] Furthermore, in the foregoing embodiments, the splicing heads 33 and 34 blow compressed air to spun yarns, but other compressed fluid such as liquid may be blown to spun yarns. In a case where compressed air is blown to spun yarns, the spun yarns can be joined and the protruding portion can be fixed with a simple configuration. Furthermore, the piecing apparatus 30 can be used for knitting other than intarsia knitting. For example, in a case where the weft knitting machine 31 includes the piecing apparatus 30, the types of the knitting yarns 41 that can be fed by the yarn feeders 37 can be increased.

[0060] Fig. 11 is a front view showing a knitting yarn 24B obtained by joining performed in a spun yarn joining step of a piecing method according to a third embodiment of the invention. Figs. 12A to 12D are front views respectively showing states in which protruding portions 23a and 23b are fixed. The third embodiment has the same configuration as the first or second embodiment, except that the joining method is different from that of the first or second embodiment in the spun yarn joining step, and a description of the same configuration has been omitted.

[0061] In the third embodiment, the plurality of knitting yarns 21 and 22 are joined by being knotted using a knotter apparatus, which is a yarn knotting apparatus. In a state where the two knitting yarns 21 and 22 are joined, a knot is formed at the separate portions 21c and 22c. Accordingly, the joined portion 50, the protruding portions 23a and 23b that extend from the joined portion 50 to the tip end portions 21a and 21b of the knitting yarns 21 and 22, and the plurality of branched portions 51 and 52 that extend from the joined portion 50 respectively toward the

base end portions 21d and 22f of the plurality of knitting yarns 21 and 22 are formed. In the third embodiment, the number of the protruding portions 23a and 23b formed is the number of the knitting yarns 21 and 22 that are'joined. The knotter apparatus is disclosed, for example, in JP-A 6-2250 (1994).

[0062] Also in the third embodiment, as in the first or second embodiment, the protruding portions 23a and 23b are fixed so as to be overlaid on at least one branched portion 51 or 52 in the protruding portion fixing step. In the protruding portion fixing step, the protruding portions 23a and 23b may be fixed so as to be intertwined into one branched portion 51 (Fig. 12A), or the protruding portions 23a and 23b may be fixed so as to be intertwined respectively into the different branched portions 51 and 52 (Fig. 12B). Alternatively, in the protruding portion fixing step, the protruding portions 23a and 23b may be fixed so as to be wound around one branched portion 51 (Fig. 12C), or the protruding portions 23a and 23b may be fixed so as to be wound respectively around the different branched portions 51 and 52 (Fig. 12D). Also in the third embodiment, with the protruding portion fixing step, protrusion amounts H12 to H15 by which the protruding portions 23a and 23b protrude from the branched portion 51 can be made smaller than a protrusion amount H11 before the protruding portion is fixed.

[0063] In this manner, in the spun yarn joining step, it is sufficient that the knitting yarns 21 and 22 are joined so that the plurality of branched portions 51 and 52 are branched from the protruding portion 23, and either the intertwining method shown in the first embodiment or the knotting method shown in the third embodiment can be used. Furthermore, a knotter apparatus that forms a knot other than that shown in Fig. 11 also may be used. Other methods for forming the protruding portion 23 also can be used, for example, in which the knitting yearns 21 and 22 are joined by a kneading method or a twisting method.

[0064] In the foregoing embodiments, the methods for piecing the two knitting yarns 21 and 22 were described. However, also in a case where three or more knitting yarns are pieced into each other as in a two yarn stitch or multiple yarn stitch, a similar piecing method can be applied by taking the plurality of overlaid knitting yarns as one knitting yarn. Furthermore, the machine that includes the piecing apparatus 30 of this embodiment is not limited to the weft knitting machine 31, and it is possible to use other machines such as a weaving machine or winder. Furthermore, the invention includes a spun yarn obtained by piecing using the piecing method, and a knitted fabric and a woven fabric knitted or woven with the spun yarn.

[0065] The invention may be embodied in other various forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and the range of equivalency of the claims are therefore intended to be embraced therein.

Industrial Applicability

[0066] According to the invention, in the spun yarn joining step, a joined portion, a protruding portion, and a plurality of branched portions are formed in spun yarns. In a case where the spun yarns are joined at the joined portion, the outer diameter of each branched portion can be prevented from being small when joining the spun yarns, and thus the strength of a spun yarn obtained by piecing can be secured. Furthermore, in the protruding portion fixing step, the protruding portion is overlaid on the branched portion and the protruding portion and the branched portion are fixed, and thus the protrusion amount by which the protruding portion protrudes from the branched portion can be suppressed. Moreover, in a case where a fabric is knitted using the spun yarn obtained by piecing, the protruding portion can be prevented from protruding outward from the face stitches of the knitted fabric, and thus a protrusion treatment step of tucking the protruding portion protruding outward from the face stitches of the knitted fabric into the inner side of the knitted fabric can be omitted.

[0067] According to the invention, the branched portion positioned on the upstream side in the yarn feeding direction and the protruding portion are fixed. Thus, compared with a case in which the tip end of the protruding portion is positioned on the downstream side in the yarn feeding direction, a yarn sending resistance in feeding the yarn can be reduced, and the spun yarn obtained by piecing can be smoothly sent.

[0068] According to the invention, in the protruding portion fixing step, both of the protruding portion and the branched portion are partially untwisted, and then intertwined. Accordingly, the protruding portion and the branched portion can be prevented from being excessively intertwined, the diameter of the branched portion that is overlaid on the protruding portion and a region near the overlaid portion can be prevented from being small, and thus the strength of the spun yarn obtained by piecing can be prevented from being poor.

[0069] 'According to the invention, in the protruding portion fixing step, the protruding portion is rotated about the axis of the branched portion so that the protruding portion is wound around the branched portion. Since the protruding portion is rotated, the twisted branched portion can be prevented from being untwisted, the diameter of the branched portion that is overlaid on the protruding portion and a region near the overlaid portion can be prevented from being small, and thus the strength of the spun yarn obtained by piecing can be prevented from being poor.

[0070] According to the invention, in the protruding portion fixing step, the branched portions are prevented from rotating together with the protruding portion. Accordingly, the protruding portion can be reliably rotated about the

branched portion, and thus the time that is necessary to wind the protruding portion around the branched portion can be shortened.

[0071] According to the invention, in the protruding portion fixing step, a force to cause the protruding portion to be folded down toward the branched portion for fixing can be applied with blowing of compressed fluid, and thus the protruding portion can be more reliably fixed to the branched portion.

[0072] According to the invention, in the spun yarn joining step, a plurality of spun yarns can be joined by joining the spun yarns using one of a method in which the yarns are intertwined to be joined and a method in which the yarns are knotted to be joined.

[0073] According to the invention, the strength can be prevented from being poor, and the protrusion amount by which the protruding portion protrudes from the branched portion can be suppressed so that a spun yarn that is less uneven in the radial direction can be obtained.

[0074] According to the invention, a fabric in which part of spun yarns is prevented from protruding outward in the thickness direction can be realized.

[0075] According to the invention, the spun yarn joining means joins spun yarns at the joined portion, and thus the outer diameter of each branched portion can be prevented from being small when joining the spun yarns, and thus the strength of a spun yarn obtained by piecing can be secured. Furthermore, the protruding portion fixing means fixes the protruding portion so as to be disposed along the branched portion, and thus the protrusion amount by which the protruding portion protrudes from the branched portion can be suppressed. Accordingly, the protruding portion can be prevented from protruding outward from the face stitches of the knitted fabric, and thus a protrusion treatment step of tucking the protruding portion into the inner side of the knitted fabric can be omitted.

[0076] According to the invention, the protruding portion fixing'means fixes the branched portion positioned on the upstream side in the yarn feeding direction and the protruding portion. Thus, a yarn sending resistance can be reduced, and the spun yarn obtained by piecing can be smoothly sent.

[0077] According to the invention, the protruding portion fixing means can fix the protruding portion and the branched portion, by partially intertwining the protruding portion and the branched portion or winding the protruding portion around the branched portion.

[0078] According to the invention, the spun yarn joining means can join the separate portions of the plurality of spun yarns, by intertwining or knotting the plurality of spun yarns.

[0079] According to the invention, the first splicing head joins the plurality of spun yarns by blowing compressed fluid to a portion in which the plurality of spun yarns are overlaid, and the second splicing head fixes the protruding portion formed by the first splicing head and the branched portion by blowing compressed fluid to the protruding portion. The plurality of spun yarns can be joined, and the protruding portion and the branched portion can be fixed, using the compressed fluid in this manner.

Claims

1. A piecing method for piecing end portions of a plurality of spun yarns, comprising:

   a spun yarn joining step of forming, in the spun yarns, a joined portion at which separate portions that are separate from tip end portions of the plurality of spun yarns in directions toward base end portions are joined to each other, a protruding portion that extends from the joined portion to the tip end portions of the spun yarns, and a plurality of branched portions that extend from the joined portion respectively to the base end portions of the plurality of spun yarns, by joining the plurality of spun yarns to each other; and

   a protruding portion fixing step of overlaying the protruding portion on at least one of the plurality of branched portions and fixing the protruding portion and the branched portion that is overlaid on the protruding portion.

2. The piecing method of claim 1, wherein, in the protruding portion fixing step, the branched portion to which the protruding portion is fixed is a branched portion positioned on an upstream side in a yarn feeding direction in which each spun yarn is fed and sent, relative to the joined portion.

3. The piecing method of claim 1 or 2, wherein, in the protruding portion fixing step, after both of the protruding portion and the branched portion are partially untwisted, untwisted portions are intertwined into each other, and thus the protruding portion is fixed to the branched portion.

4. The piecing method of claim 1 or 2, wherein, in the protruding portion fixing step, the protruding portion is rotated about an axis of the branched portion so that the protruding portion is wound around the branched portion, and thus the protruding portion is fixed to the branched portion.

5. The piecing method of claim 4, wherein, in the protruding portion fixing step, the protruding portion is wound around the branched portion in a state where the branched portions are prevented from rotating together with the protruding portion.

6. The piecing method of any one of claims 3 to 5, wherein, in the protruding portion fixing step, the pro-

truding portion and the branched portion are fixed by blowing compressed fluid in a direction in which the protruding portion is oriented toward the branched portion for fixing.

7. The piecing method of any one of claims 1 to 6, wherein, in the spun yarn joining step, the separate portions of the plurality of spun yarns are joined to each other by intertwining the plurality of spun yarns.

8. The piecing method of any one of claims 1 to 6, wherein, in the spun yarn joining step, the separate portions of the plurality of spun yarns are joined to each other by knotting the plurality of spun yarns.

9. A spun yarn obtained by piecing using the piecing method of any one of claims 1 to 8.

10. A fabric knitted with a knitting yarn obtained by piecing using the piecing method of any one of claims 1 to 8.

11. A piecing apparatus for piecing end portions of a plurality of spun yarns, comprising:

spun yarn joining means for forming, in the spun yarns, a joined portion at which separate portions that are separate from tip end portions of the plurality of spun yarns in directions toward base end portions are joined to each other, a protruding portion that extends from the joined portion to the tip end portions of the spun yarns, and a plurality of branched portions that extend from the joined portion respectively to the base end portions of the plurality of spun yarns, by joining the plurality of spun yarns to each other thereby; and

protruding portion fixing means for overlaying the protruding portion on at least one branched portion of the plurality of branched portions and fixing the protruding potion and the branched portion that is overlaid on the protruding portion.

12. The piecing apparatus of claim 11, wherein the protruding portion fixing means fixes the protruding portion to a branched portion positioned on an upstream side in a yarn feeding direction in which each spun yarn is fed and sent, relative to the joined portion.

13. The piecing apparatus of claim 11 or 12, wherein the protruding portion fixing means fixes the protruding portion and the branched portion by partially untwisting the protruding portion and the branched portion and then intertwining untwisted portions into each other.

14. The piecing apparatus of claim 11 or 12, wherein the protruding portion fixing means fixes the protruding portion and the branched portion by rotating the protruding portion about an axis of the branched portion and thus winding the protruding portion around the branched portion.

15. The piecing apparatus of any one of claims 11 to 14, wherein the spun yarn joining means joins the separate portions of the plurality of spun yarns to each other by intertwining the plurality of spun yarns.

16. The piecing apparatus of any one of claims 11 to 14, wherein the spun yarn joining means joins the separate portions of the plurality of spun yarns to each other by knotting the plurality of spun yarns.

17. The piecing apparatus of any one of claims 13 to 15, wherein the spun yarn joining means includes a first splicing head that joins the plurality of spun yarns by blowing compressed fluid to a portion in which the plurality of spun yarns are overlaid, and
the protruding portion fixing means includes a second splicing head that fixes the protruding portion and the branched portion by blowing compressed fluid to the protruding portion.

FIG. 1A

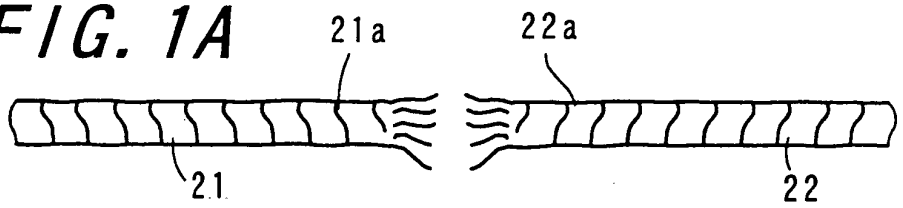


FIG. 1B

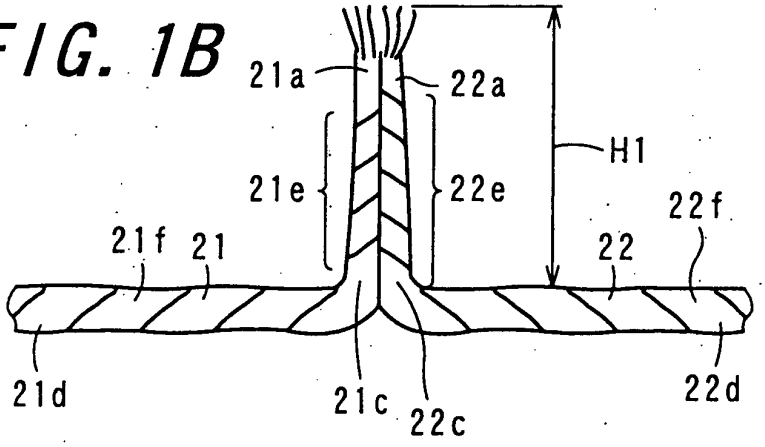


FIG. 1C

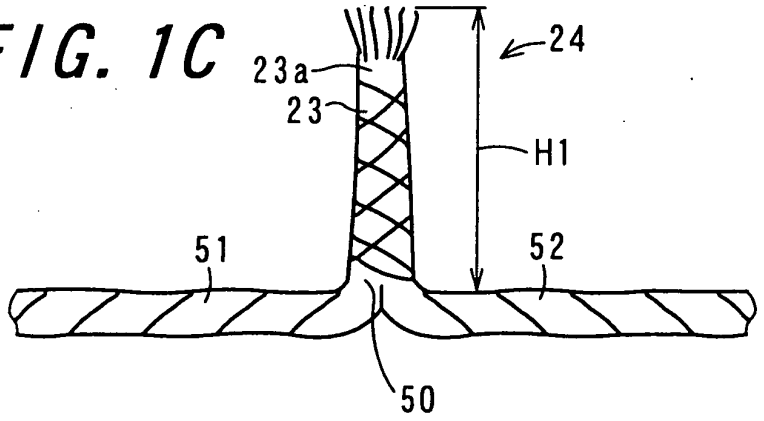


FIG. 1D

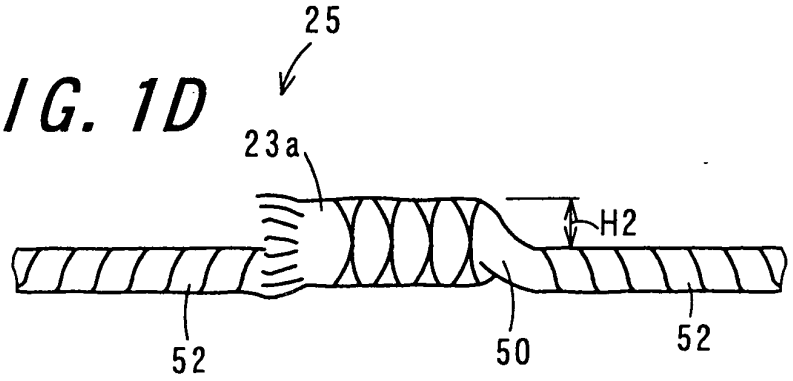


FIG. 2

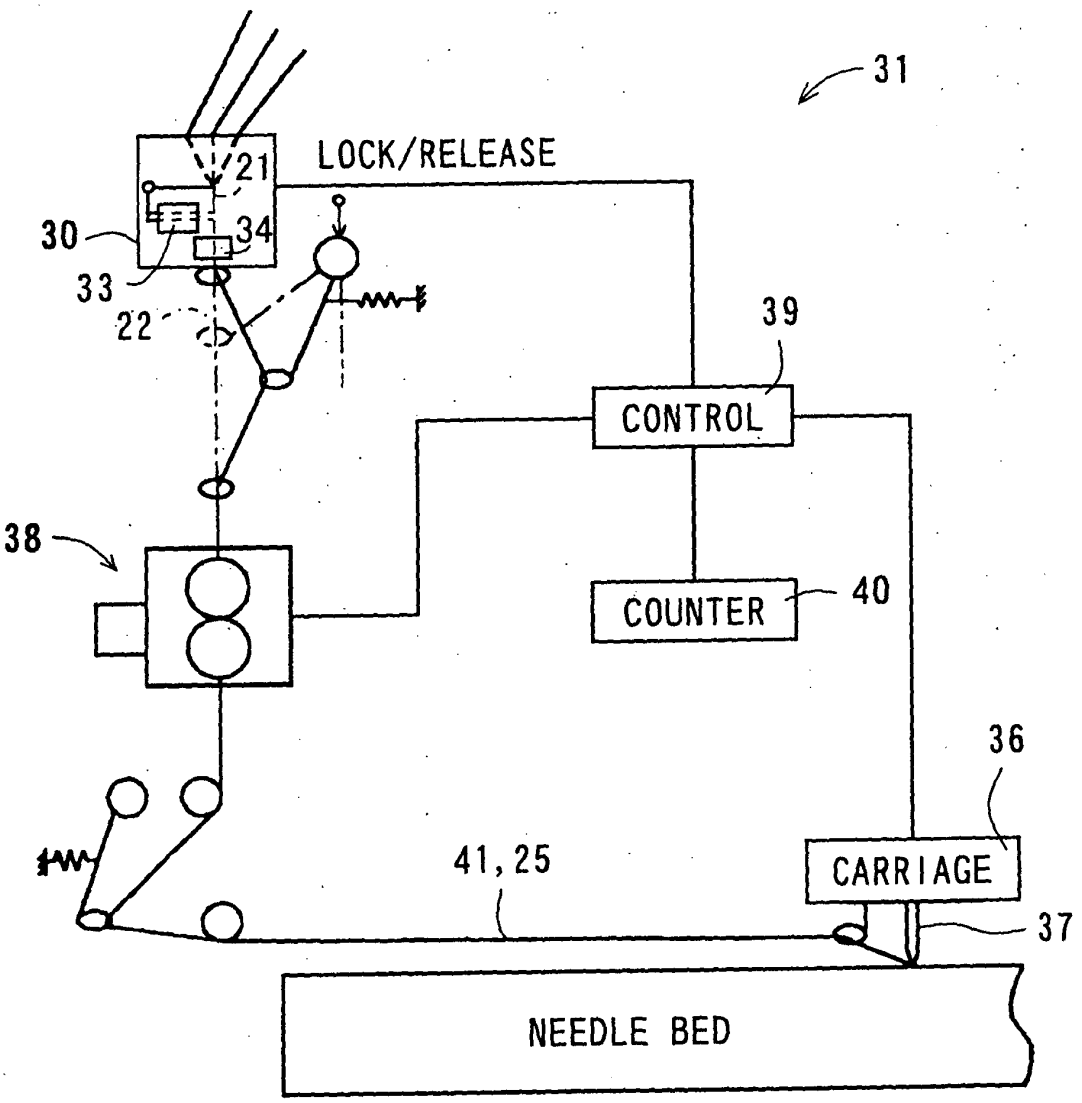

31
LOCK/RELEASE
21
30
34
33
22
39
CONTROL
38
COUNTER
40
36
41, 25
CARRIAGE
37
NEEDLE BED

FIG. 3

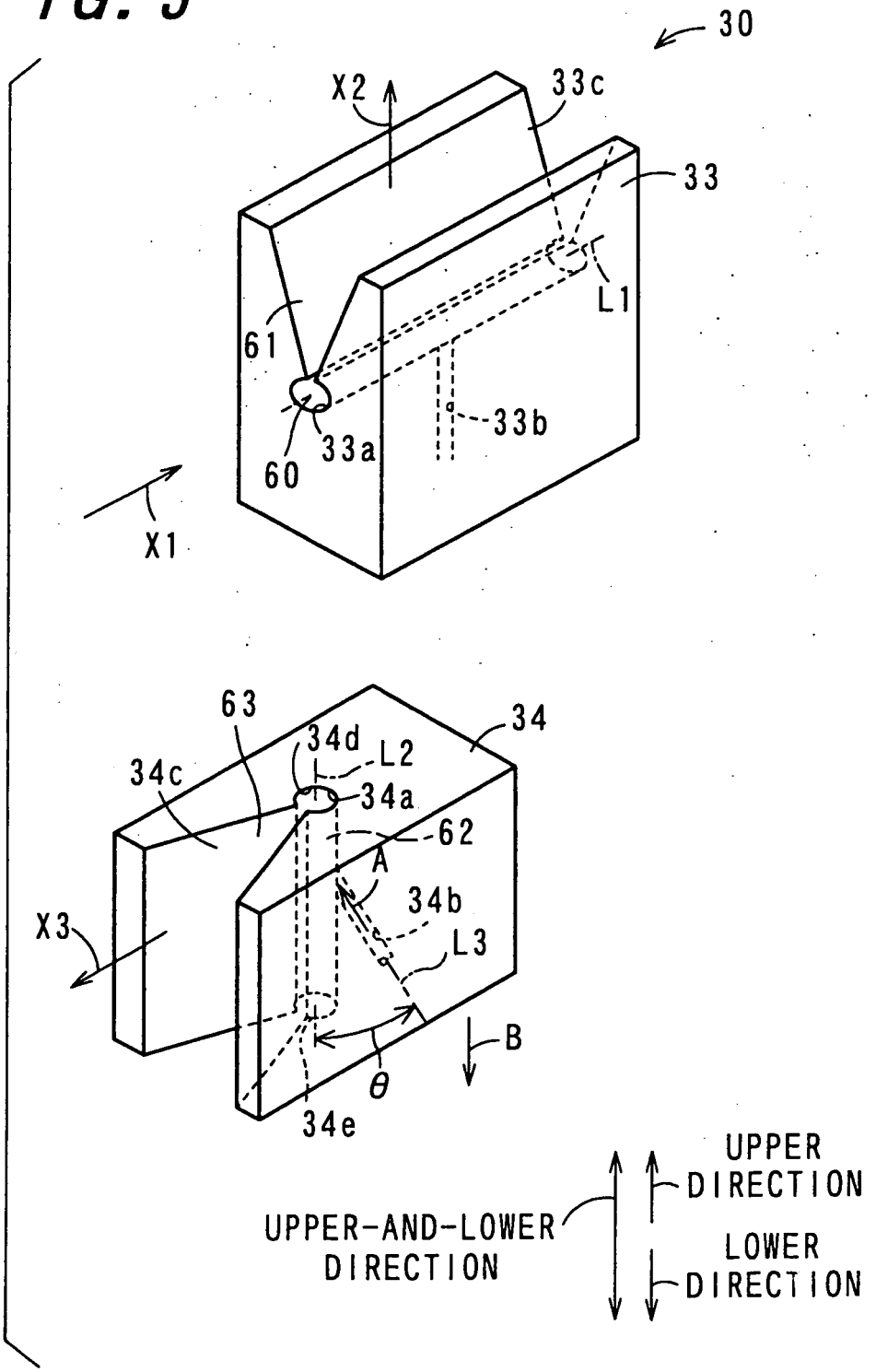

30
X2
33c
33
L1
61
33b
33a
60
X1
63
34
34d
L2
34c
34a
62
A
34b
X3
L3
B
θ
34e
UPPER DIRECTION
UPPER-AND-LOWER DIRECTION
LOWER DIRECTION

FIG. 4

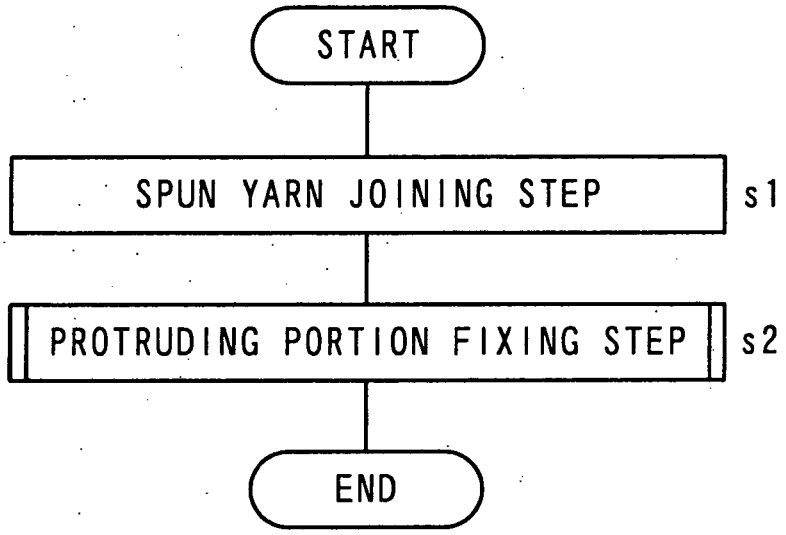

START
SPUN YARN JOINING STEP
s1
PROTRUDING PORTION FIXING STEP
s2
END

FIG. 5

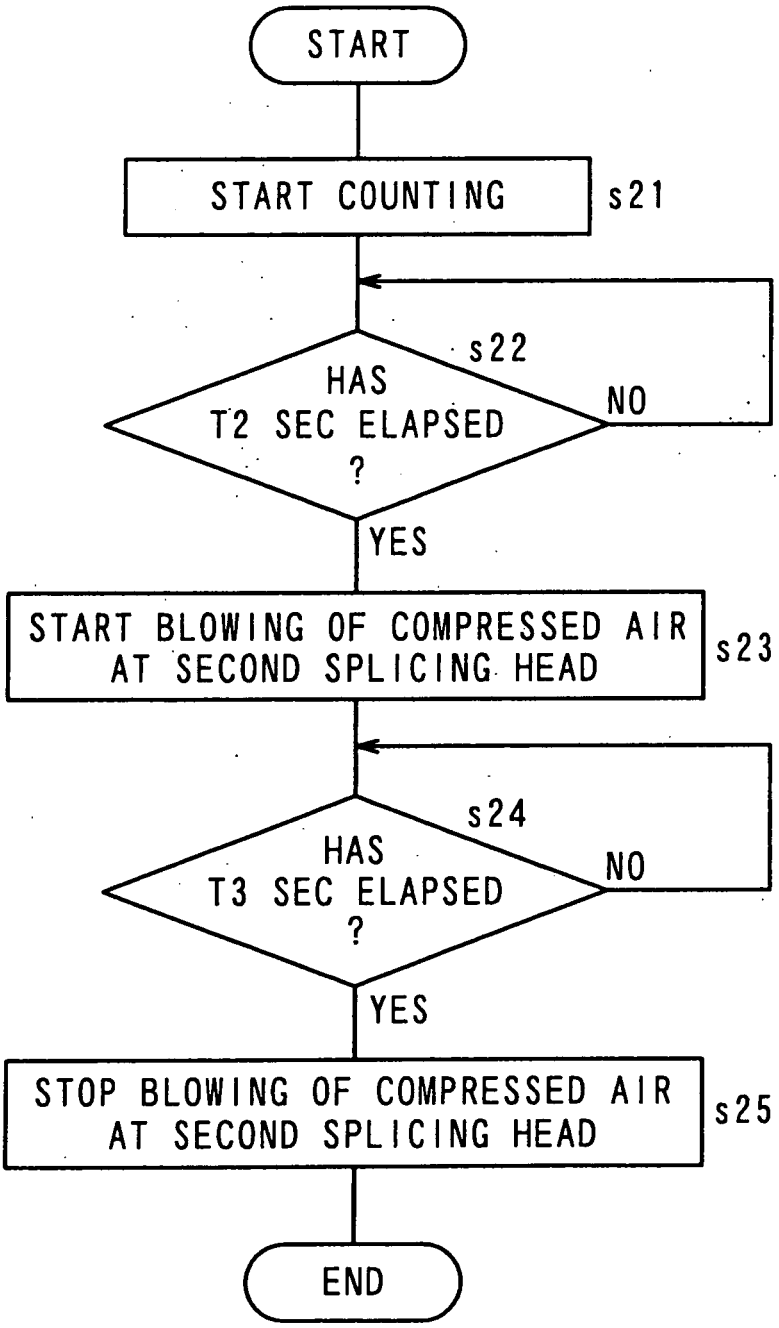

START
START COUNTING
s21
s22
HAS T2 SEC ELAPSED ?
NO
YES
START BLOWING OF COMPRESSED AIR AT SECOND SPLICING HEAD
s23
s24
HAS T3 SEC ELAPSED ?
NO
YES
STOP BLOWING OF COMPRESSED AIR AT SECOND SPLICING HEAD
s25
END

FIG. 6A

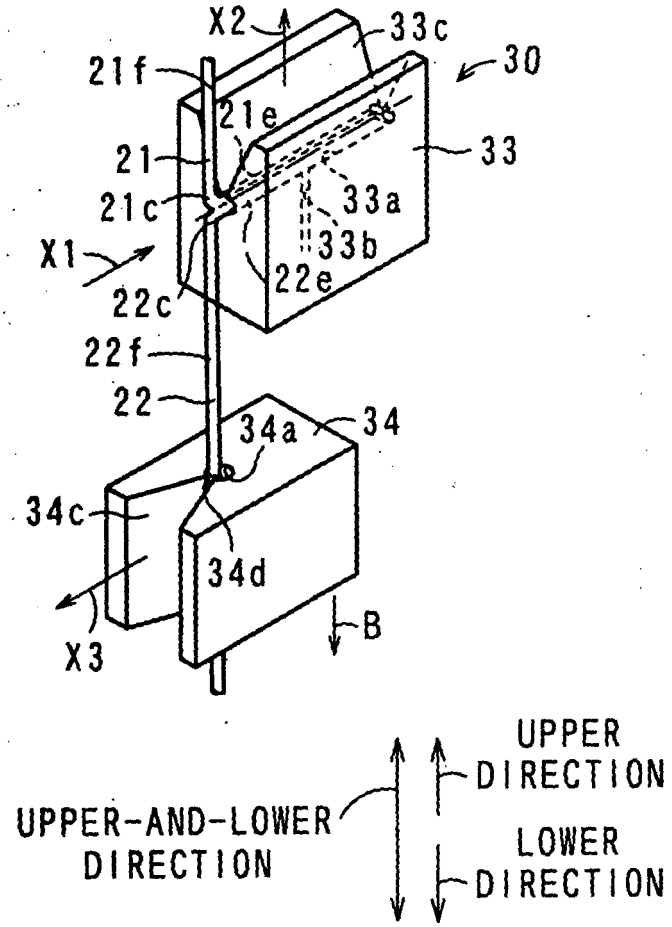

X2
33c
30
21f
21e
21
33
21c
33a
33b
X1
22e
22c
22f
22
34a
34
34c
34d
B
X3
UPPER DIRECTION
UPPER-AND-LOWER DIRECTION
LOWER DIRECTION

FIG. 6B

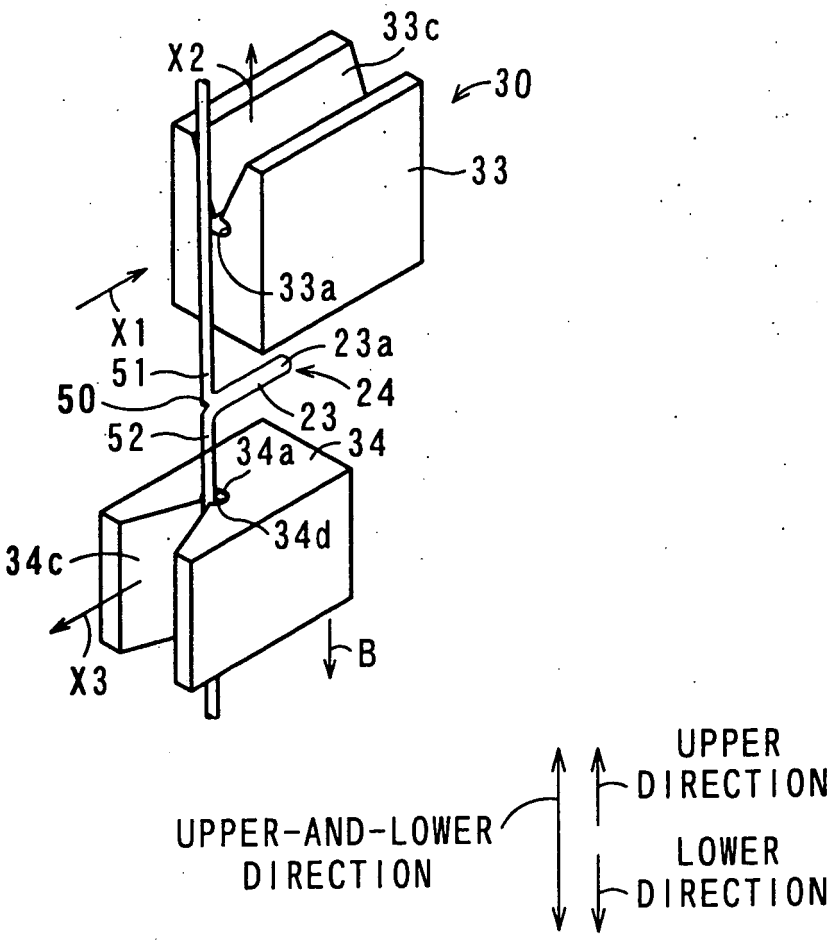

33c
X2
30
33
33a
X1
23a
51
24
50
23
52
34a
34
34d
34c
X3
B
UPPER
DIRECTION
UPPER-AND-LOWER
DIRECTION
LOWER
DIRECTION

FIG. 6C

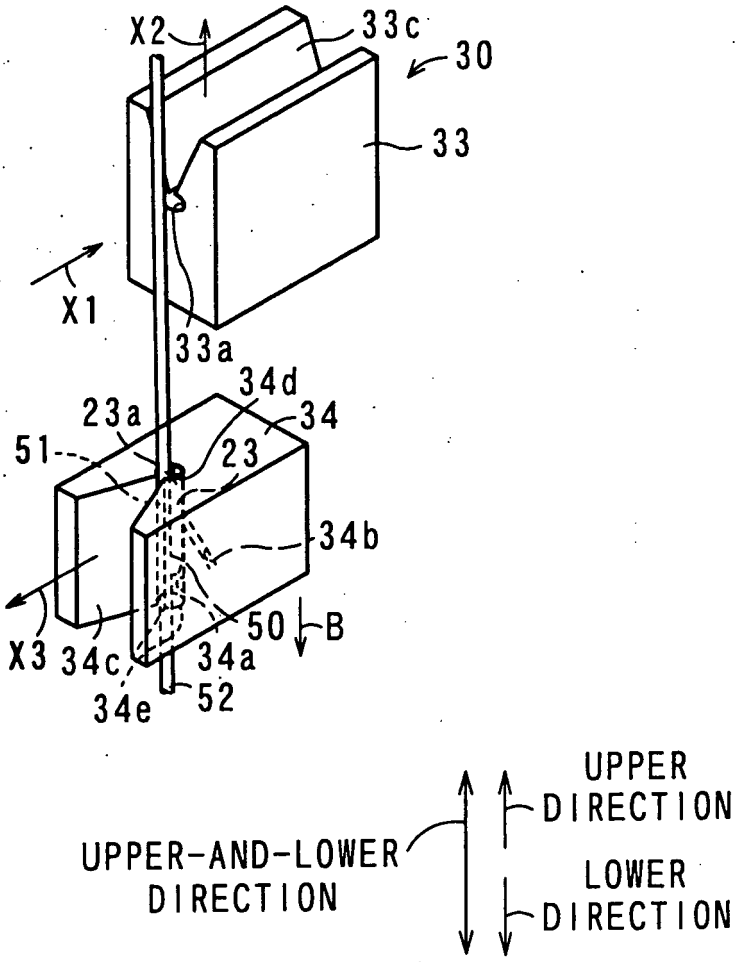

X2
33c
30
33
X1
33a
34d
23a
34
51
23
34b
50
B
X3
34c
34a
34e
52
UPPER-AND-LOWER DIRECTION
UPPER DIRECTION
LOWER DIRECTION

FIG. 6D

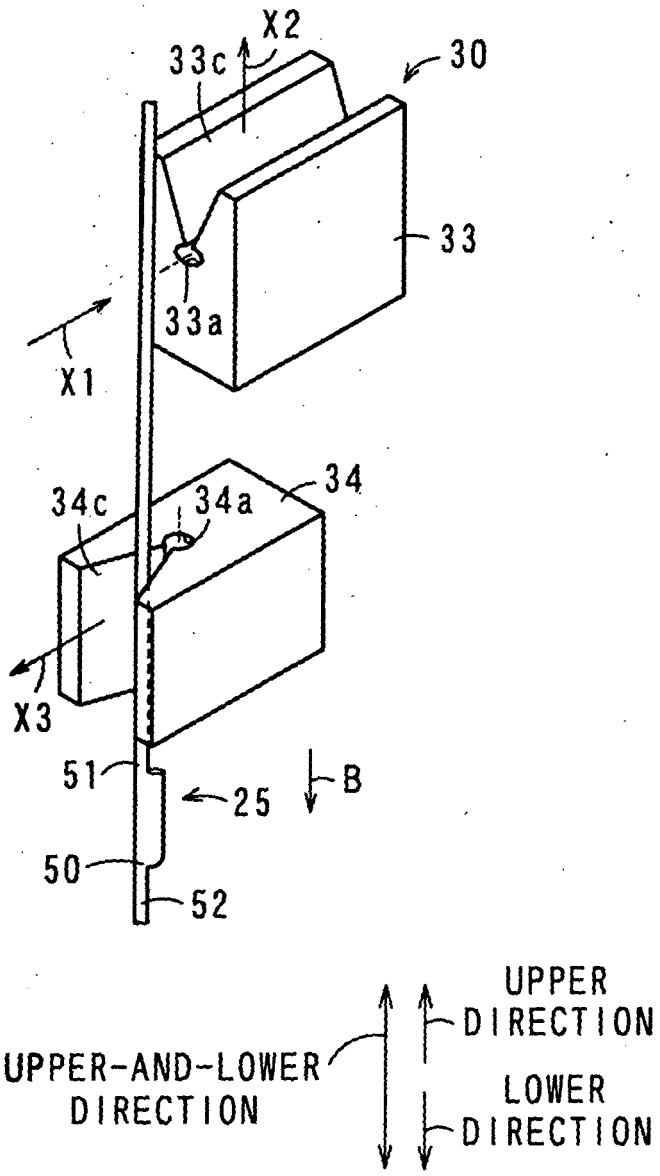

X2
33c
30
33
33a
X1
34c
34a
34
X3
51
25
B
50
52
UPPER-AND-LOWER DIRECTION
UPPER DIRECTION
LOWER DIRECTION

FIG. 7A

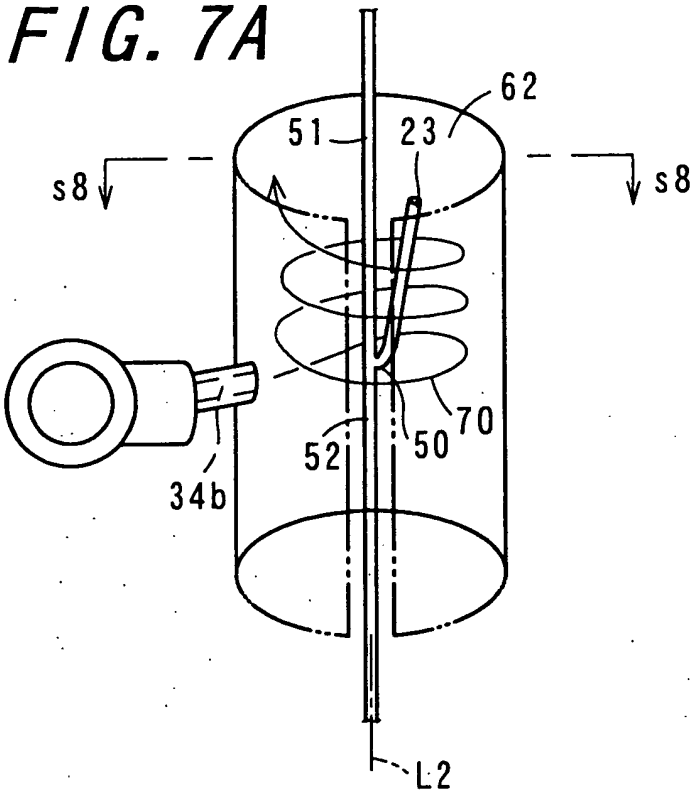


FIG. 7B

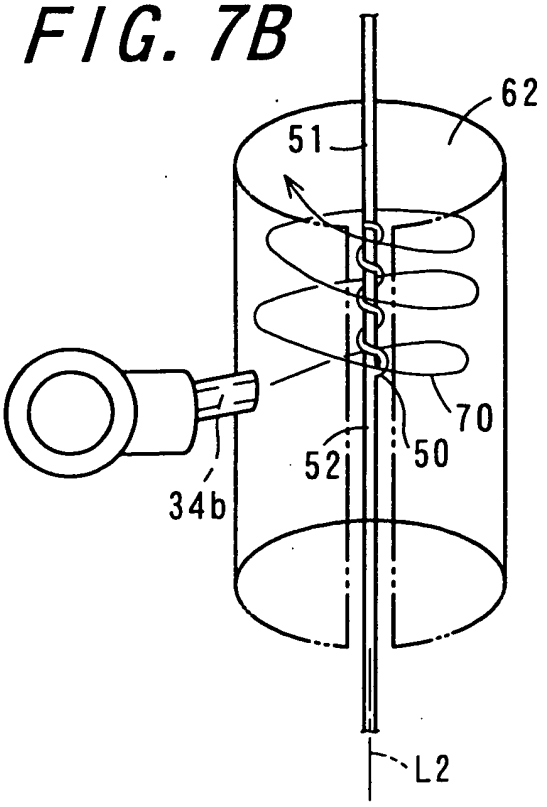


FIG. 8

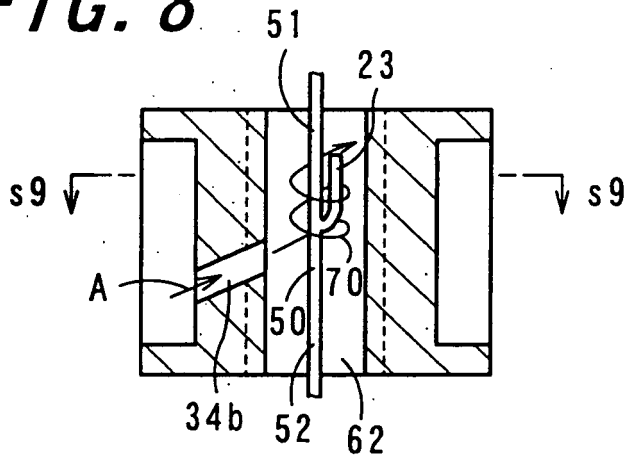


FIG. 9

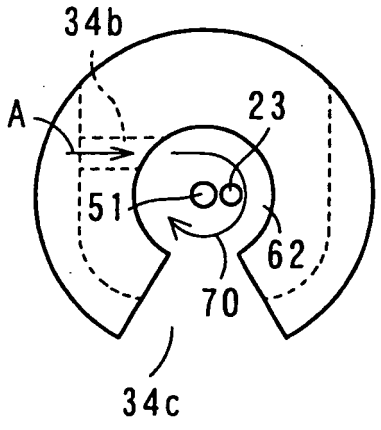


FIG. 10A

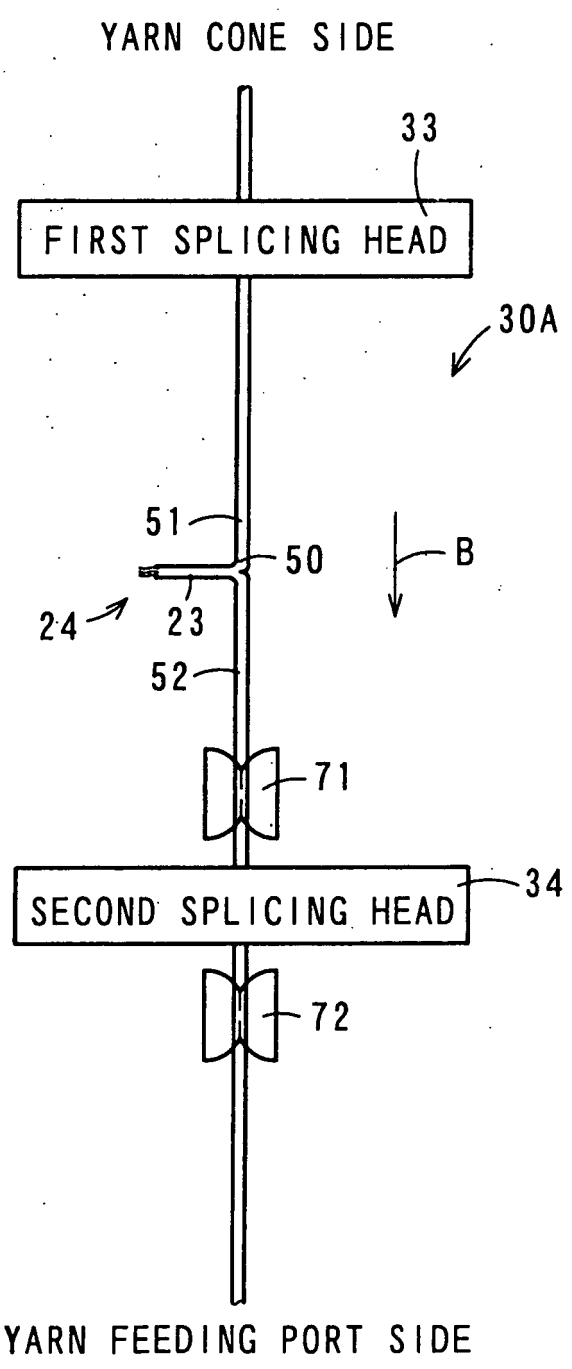

YARN CONE SIDE
33
FIRST SPLICING HEAD
30A
51
50
B
24
23
52
71
SECOND SPLICING HEAD
34
72
YARN FEEDING PORT SIDE

FIG. 10B

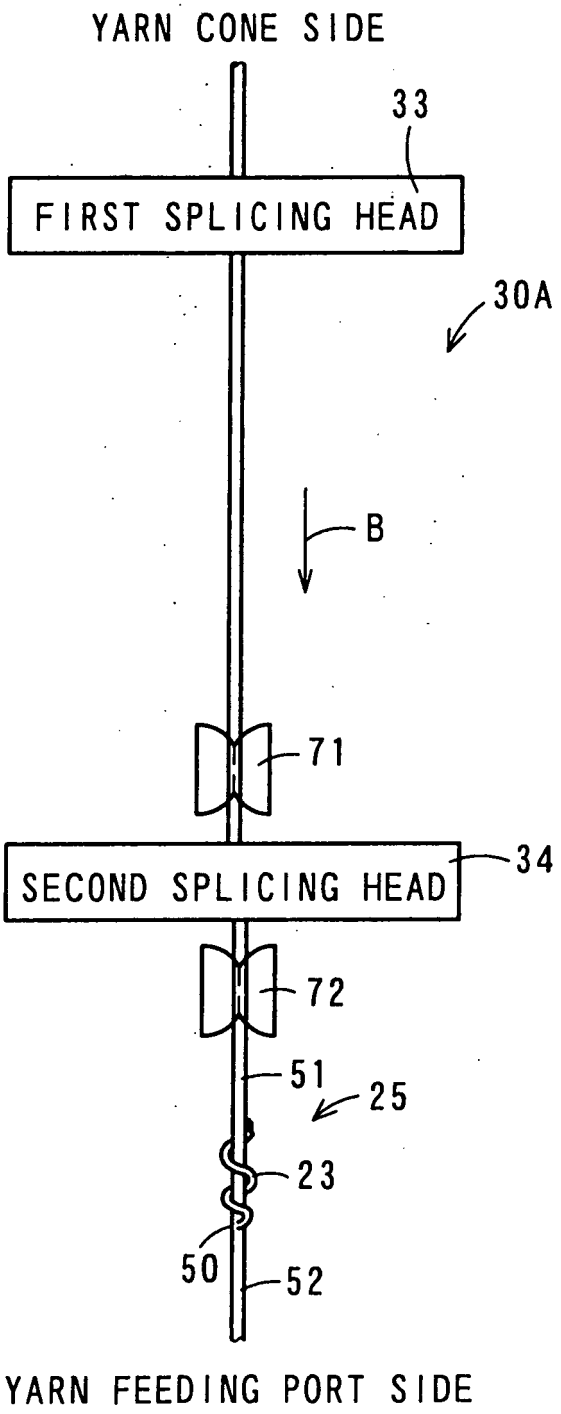

YARN CONE SIDE
33
FIRST SPLICING HEAD
30A
B
71
SECOND SPLICING HEAD
34
72
51
25
23
50
52
YARN FEEDING PORT SIDE

FIG. 11

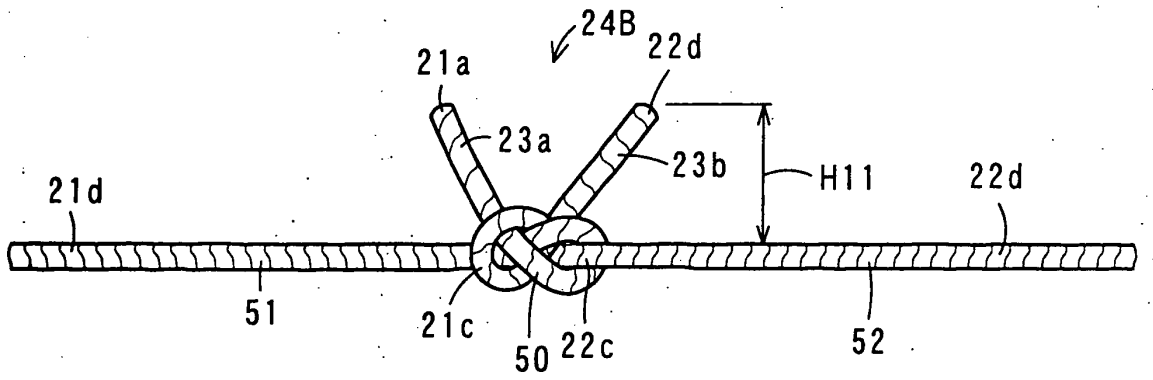


FIG. 12A

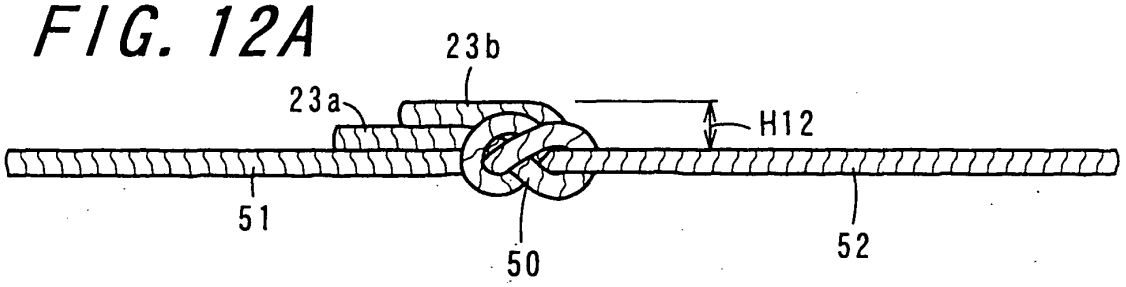


FIG. 12B

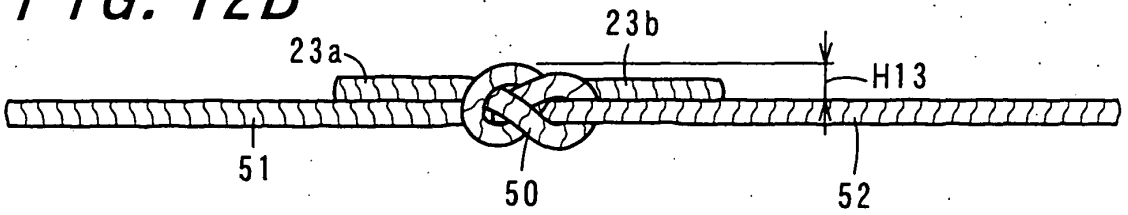


FIG. 12C

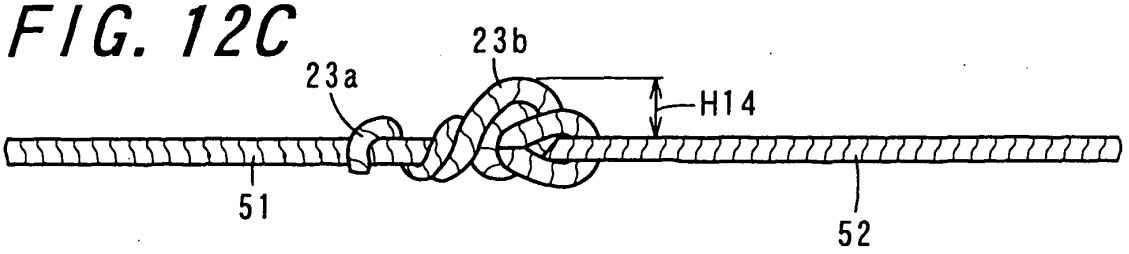


FIG. 12D

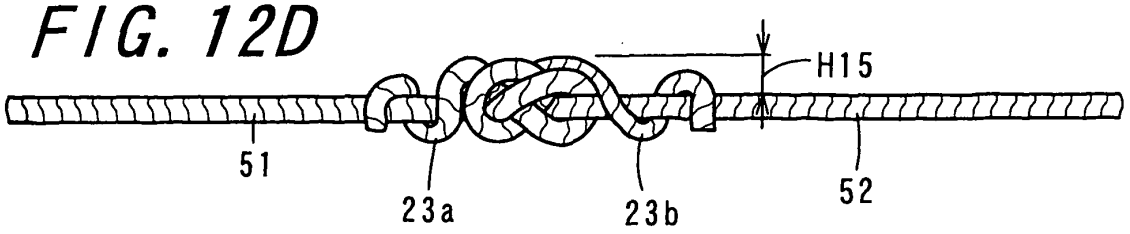
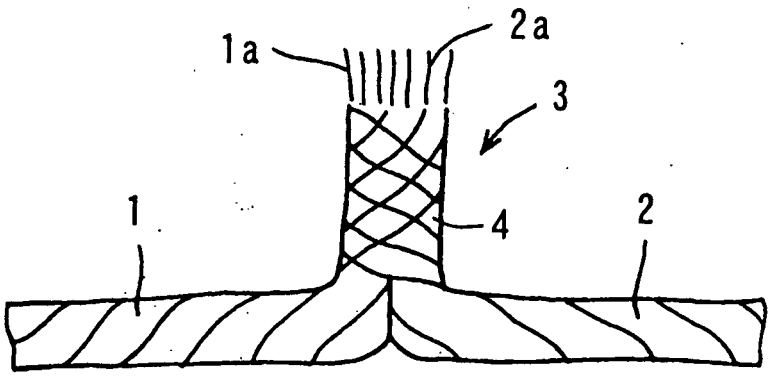


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/063047

A. CLASSIFICATION OF SUBJECT MATTER
D01H15/00(2006.01)i, *B65H69/04*(2006.01)i, *B65H69/06*(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)
D01H1/00-17/02, B65H69/04, B65H69/06

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 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 2740185 A (Sperry Rand Corp.), 03 April, 1956 (03.04.56), Column 1, line 64 to column 2, line 41; Figs. 1, 2 (Family: none)	1,8 3-6,9-11,13, 14,16 2,7,12,15,17
Y A	JP 2006-52043 A (Murata Machinery Ltd.), 23 February, 2006 (23.02.06), Par. Nos. [0016] to [0043]; all drawings (Family: none)	3,5,6,9,10, 13 1,2,4,7,8, 11,12,14-17
Y A	JP 5-66310 B2 (Murata Machinery Ltd.), 21 September, 1993 (21.09.93), Column 3, line 14 to column 6, line 3; Fig. 7 (Family: none)	4-6,9,10,14 1-3,7,8, 11-13,15-17

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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Date of the actual completion of the international search	Date of mailing of the international search report
12 July, 2007 (12.07.07)	24 July, 2007 (24.07.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/063047

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 60-39767 B2 (Murata Machinery Ltd.), 07 September, 1985 (07.09.85), Full text; all drawings & DE 3347496 A & FR 2538798 A & CH 665619 A & IT 1171891 B	1-17
A	US 2808356 A (The Cellucord Corp.), 01 September, 1957 (01.09.57), Full text; all drawings (Family: none)	1-17
A	JP 2005-314104 A (Murata Machinery Ltd.), 10 November, 2005 (10.11.05), Full text; all drawings & EP 1584595 A1	1-17
A	JP 2004-27463 A (Murata Machinery Ltd.), 29 January, 2004 (29.01.04), Full text; all drawings & CN 1456721 A	1-17
A	JP 2006-52485 A (Murata Machinery Ltd.), 23 February, 2006 (23.02.06), Full text; all drawings (Family: none)	1-17
A	JP 2004-149941 A (Kuroiwa Knitting Machine Co., Ltd.), 27 May, 2004 (27.05.04), Full text; all drawings (Family: none)	1-17
A	US 5357740 A (Darron Moreland), 25 October, 1994 (25.10.94), Full text; all drawings (Family: none)	1-17
A	US 4788814 A (Fieldcrest Cannon Inc.), 06 December, 1988 (06.12.88), Full text; all drawings (Family: none)	1-17
P,A	WO 2007/043336 A1 (Murata Machinery Ltd.), 19 April, 2007 (19.04.07), Full text; all drawings (Family: none)	1-17
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REFERENCES CITED IN THE DESCRIPTION

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- JP 60039767 B **[0004]**
- JP 2004027463 A **[0005]**
- JP 2006118059 A **[0034]**
- JP 2005314104 A **[0038]**