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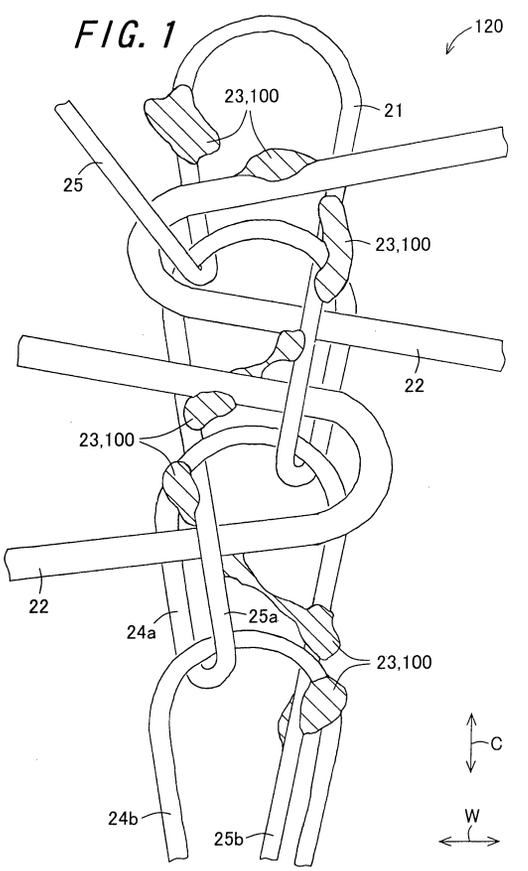
(54) PROCESS FOR PRODUCING KNITTED LACE AND KNITTED LACE

(57) The invention relates to a knitted lace fabric capable of suppressing deterioration in a sense of beauty and preventing fray of a yarn, and a method of manufacturing the same. A knitted lace fabric 120 obtained after a knitting operation is heated to a temperature which is lower than a melting temperature of a chain stitch yarn 21 and is equal to or higher than a melting temperature of a thermal bonding yarn 23 so that a part of the thermal bonding yarn 23 is partially dissolved. A part of the dissolved portion sticks to the chain stitch yarn 21 and an inserting yarn 22. Consequently, a coupling state of the yarns 21 to 23 is maintained so that the fray of the yarn can be prevented. By breaking the thermal bonding yarn 23, furthermore, it is possible to form a fused portion 100. Also in the case in which a part of the chain stitch yarn 21 constituting a chain stitch structure is divided, accordingly, fray of the chain stitch structure can be inhibited in a bonding portion of the thermal bonding yarn 23 and the fray of the chain stitch structure can be suppressed beyond the bonding portion.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a knitted lace manufacturing method and a knitted lace manufactured by the manufacturing method.

Background Art

[0002] In a knitted lace fabric disclosed in Japanese Examined Patent Publication JP-A 63-52142 (1988), a thermal bonding yarn which is thermally soluble is knitted into a scallop portion. By heating the knitted lace fabric after knitting, the thermal bonding yarn is molten. The thermal bonding yarn bonds an overlapping portion between a base portion of a picot yarn and another yarn and a portion in which the thermal bonding yarn is exposed other than the overlapping portion is dissolved and removed. Thereby fray can be prevented from being generated in the scallop portion of the knitted lace.

[0003] In a knitted lace fabric disclosed in Japanese Unexamined Patent Publication JP-A 11-81073 (1999), a covering yarn is knitted into a scallop portion. The covering yarn is constituted by a core yarn having a heat solubility and a covering yarn to be a thermoplastic synthetic fiber yarn. By heating the knitted lace fabric after knitting, a part of the core yarn in the covering yarn is molten so that a molten substance spreads from the covering yarn. Then, the molten substance is caked to bond other adjacent yarns to each other. Consequently, fray can be prevented from being generated in the scallop portion of the knitted lace.

[0004] In the knitted lace fabrics described above, a thermal bonding yarn is knitted into only the scallop portion. In this case, as to a knitted lace formed by heating a knitted lace fabric, the fray is still generated easily in portions other than the scallop portion. Further, after manufacturing the knitted lace, the thermal bonding yarn may get dissociated from residual yarns. In this case, a bond of a plurality of yarns by the thermal bonding yarn is broken, and fray may be generated from a dissociated portion.

Disclosure of Invention

[0005] Accordingly, an object of the invention is to provide a knitted lace in which a yarn is prevented from fraying, and a manufacturing method thereof.

[0006] The invention provides a method of manufacturing a knitted lace comprising:

a knitted fabric knitting step of knitting an elastic knitted fabric in such a manner that while a chain stitch structure in which a plurality of loop-shaped portions are formed is formed with a chain stitch yarn, a thermal bonding yarn having a lower melting temperature than that of the chain stitch yarn is knitted into the chain stitch structure;
a heating step of heating the knitted fabric containing the thermal bonding yarn to a temperature equal to or lower than the melting temperature of the chain stitch and equal to or higher than the melting temperature of the thermal bonding yarn; and
a breaking step of applying a tension to the knitted fabric containing the thermal bonding yarn, thereby breaking the molten thermal bonding yarn into a plurality of portions.

[0007] According to the invention, a knitted lace fabric is heated to a temperature which is lower than a melting temperature of a chain stitch yarn and is equal to or higher than a melting temperature of a thermal bonding yarn so that a part of the thermal bonding yarn is partially dissolved. A part of the dissolved portion sticks to the chain stitch yarn. By carrying out caking in this state, the chain stitch yarn coming in contact with the thermal bonding yarn can be prevented from being isolated from the thermal bonding yarn in a knitted lace manufactured by using the knitted lace fabric. Furthermore, the respective yarns coming in contact with the thermal bonding yarn can be bonded to each other through the thermal bonding yarn. Consequently, a coupling state of the respective yarns can be maintained so that fray of the yarns can be prevented.

[0008] At a breaking step, furthermore, a tension is applied to a knitted fabric containing a thermal bonding yarn. At this time, an amount of extension of the knitted fabric exceeds an extension limit of the thermal bonding yarn so that the thermal bonding yarn is divided into a plurality of portions. The thermal bonding yarn subjected to melting which sticks to a chain stitch yarn is divided into a plurality of portions so that a fused portion in which the thermal bonding yarn is disposed at an interval is formed on the chain stitch yarn. The fused portion sticking to the chain stitch yarn acts as a resisting member against the fray of the chain stitch yarn. For example, the fused portion penetrates through the loop-shaped portion of the chain stitch yarn so that a further fray of the chain stitch yarn can be prevented.

[0009] According to the invention, it is possible to prevent fray of respective yarns in a knitted lace manufactured by

heating a knitted lace fabric. For example, it is possible to prevent fray of yarns caused by a manufacturing process such as sewing or cutting of the knitted lace and the fray of the yarn caused by a using state such as wearing or washing. Thus, it is possible to enhance quality of the knitted lace fabric. Furthermore, the chain stitch structure is achieved with yarns other than the thermal bonding yarn, so that by using a yarn having a heat resistance as a chain stitch yarn, it is possible to stabilize a configuration of the whole knitted lace.

[0010] Furthermore, in this invention, it is preferable that a knitting condition at the knitted fabric knitting step and a heating condition at the heating step are set so that an extension limiting amount ε1 of the whole knitted fabric excluding the thermal bonding yarn subjected to the heating step is larger than an extension limiting amount ε2 of the thermal bonding yarn subjected to the heating step.

[0011] According to the invention, a knitting condition at a knitted fabric knitting step and a heating condition at a heating step are set so that an amount of extending and contracting limit of the whole knitted fabric subjected to the heating step is larger than an amount of extending limit of the thermal bonding yarn subjected to the heating step. For example, a stretch yarn is knitted or a chain stitch yarn itself is caused to be elastic so that an elastic knitted fabric is manufactured. By extending the elastic knitted fabric more greatly than the amount of extending limit of the thermal bonding yarn subjected to the heating step, it is possible to generate the breakage of the thermal bonding yarn without breaking yarns other than the thermal bonding yarn, for example, the chain stitch yarn. Thus, it is possible to hinder a strength of the knitted lace fabric frombeing reduced, thereby preventing fray of the knitted fabric.

[0012] Furthermore, in this invention, it is preferable that the heating step and the breaking step are carried out at the same time.

[0013] According to the invention, the heating step and the breaking step are carried out at the same time. Consequently, the heating step and the breaking step can be carried out at one time so that a manufacturing period can be shortened. For example, at a thermal setting step of arranging the knitted fabric into a predetermined shape, the heating step and the breaking step can be carried out at the same time. In this case, by simply carrying out the thermal setting step, it is possible to implement the melting of the thermal bonding yarn and the breakage of the bonding yarn into a plurality of portions in one step.

[0014] Furthermore, in this invention, it is preferable that the heating condition at the heating step is set to melt the thermal bonding yarn and to prevent yarns other than the thermal bonding yarn which are contained in the knitted fabric, from being fragile.

[0015] According to the invention, the thermal bonding yarn is molten on a heating condition that the yarns other than the thermal bonding yarn are prevented from being fragile. Consequently, it is possible to prevent fray and to suppress reduction in strength of the knitted fabric.

[0016] Furthermore, in this invention, it is preferable that the heating condition at the heating step is set to divide the thermal bonding yarn through melting.

[0017] According to the invention, the thermal bonding yarn is divided at the breaking step and the heating condition is properly set so that the thermal bonding yarn is divided also at the heating step. Consequently, it is possible to increase an amount of division of the thermal bonding yarn and to form the fused portion serving as a resisting member against the fray of the chain stitch yarn more reliably, and to prevent the fray of the chain stitch yarn further reliably.

[0018] Furthermore, in this invention, it is preferable that a polyester-based thermoplastic polyurethane elastic yarn of 10 deniers to 300 deniers is used as the thermal bonding yarn and is heated at a heating temperature of 170˚C to 195˚C for 30 sec to 90 sec at the knitted fabric knitting step.

[0019] According to the invention, a polyester based thermoplastic polyurethane elastic yarn of 10 deniers to 300 deniers is used as the thermal bonding yarn and is heated at 170˚C to 195˚C for 30 sec to 90 sec so that yarns other than the thermal bonding yarn which are contained in the knitted fabric can be prevented from being fragile and it is possible to divide the thermal bonding yarn by sufficiently melting the thermal bonding yarn.

[0020] Furthermore, in this invention, it is preferable that an inserting yarn other than the thermal bonding yarn is knitted at the knitted fabric knitting step, and

in the chain stitch portion, a first loop-shaped portion and a second loop-shaped portion are alternately connected and arranged in a plurality of stages in a course direction; the second loop-shaped portion is inserted through the first loop-shaped portion in an earlier stage in the course direction of the second loop-shaped portion and is extended toward a later stage in the course direction, and the second loop-shaped port ion is inserted through the first loop-shaped portion in the same stage in the course direction of the second loop-shaped portion and is connected to the first loop-shaped portion in the later stage in the course direction, whereby the second loop-shaped portion is formed like a chain and is extended in the course direction in the chain stitch portion; and directions of insertion of the thermal bonding yarn and the other inserting yarn between the first loop-shaped portion and the second loop-shaped portion are set to be different from each other in a portion in which both the thermal bonding yarn and the other inserting yarn are knitted.

[0021] According to the invention, directions in which the thermal bonding yarn and another inserting yarn are inserted between the first loop-shaped portion and the second loop-shaped portion are different from each other in the portion in which both the thermal bonding yarn and the another inserting yarn are knitted. Consequently, it is possible to lessen

the amount of contact of the another inserting yarn and the thermal bonding yarn, to easily cause the molten thermal bonding yarn to stick to the chain stitch yarn and to readily form a fused portion in the chain stitch yarn. For example, the inserting yarns other than the thermal bonding yarn may be a pattern yarn or a jacquard yarn for forming a pattern on a knitted lace and a stretch yarn for causing the knitted lace to be elastic.

[0022] Furthermore, in this invention, it is preferable that, at the knitted fabric knitting step, an elastic stretch yarn is knitted in addition to the thermal bonding yarn in an extending state; a first loop-shaped portion and a second loop-shaped portion are alternately connected and arranged in a plurality of stages in a course direction; the second loop-shaped portion of interest is inserted through the first loop-shaped portion in an earlier stage in the course direction of the second loop-shaped portion and is extended toward a later stage in the course direction, and is inserted through the first loop-shaped portion in the same stage in the course direction of the second loop-shaped portion and is connected to the first loop-shaped portion in the later stage in the course direction, whereby the second loop-shaped portion is formed like a chain and is extended in the course direction in the chain stitch portion; and directions of insertion of the thermal bonding yarn and the stretch yarn between the first loop-shaped portion and the second loop-shaped portion are set to be different from each other in a portion in which both the thermal bonding yarn and the stretch yarn are knitted.

[0023] According to the invention, directions in which the thermal bonding yarn and the stretch yarn are inserted between the first loop-shaped portion and the second loop-shaped portion are different from each other in the portion in which both the thermal bonding yarn and the stretch yarn are knitted. Consequently, it is possible to lessen the amount of contact of the stretch yarn and the thermal bonding yarn, to easily cause the molten thermal bonding yarn to stick to the chain stitch yarn and to readily form a fused portion in the chain stitch yarn.

[0024] In addition, in the case in which the thermal bonding yarn has a higher dissociation to the chain stitch yarn than the stretch yarn, the thermal bonding yarn is dissociated from the chain stitch yarn more easily when the thermal bonding yarn sticks to both the stretch yarn and the chain stitch yarn. In the invention, it is possible to prevent the thermal bonding yarn from sticking to both the stretch yarn and the chain stitch yarn. Therefore, it is possible to reduce a possibility that the thermal bonding yarn might be dissociated from the chain stitch yarn and to cause the fused portion acting as a resisting member against fray to easily remain in the chain stitch yarn.

[0025] Furthermore, the invention provides a knitted lace manufactured by the method mentioned above.

[0026] According to the invention, the knitted lace fabric is heated so that a part of the thermal bonding yarn contained in the knitted lace fabric is molten and binding of each yarn can be strengthened. Accordingly, it is possible to prevent the fray of the knitted lace formed by using the knitted lace fabric. By breaking the thermal bonding yarn to form the fused portion, furthermore, it is possible to further prevent the fray.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Other and further objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawings wherein:

Fig. 1 is a view showing a knitting structure, schematically illustrating a part of a knitted lace fabric according to a first embodiment of the invention;
Fig. 2 is a view showing a knitting structure, schematically illustrating a part of a first precursor knitted fabric to be a precursor of the knitted lace fabric;
Fig. 3 is a view showing a knitting structure, schematically illustrating a first precursor knitted fabric 20, in which yarns other than a chain stitch yarn and a thermal bonding yarn are omitted;
Fig. 4 is a flowchart showing a manufacturing process of the knitted lace fabric according to the embodiment;
Figs. 5A and 5B are views for explaining that a fused portion becomes a resistor against fray;
Figs. 6A and 6B are views for explaining that the fused portion becomes the resistor against the fray;
Fig. 7 is a flowchart showing other manufacturing process of the knitted lace fabric;
Fig. 8 is a knitting view for explaining a prevention of the fray of a second precursor knitted fabric according to the embodiment;
Fig. 9 is a knitting view showing the knitted lace fabric according to a comparative example;
Fig. 10 is a knitting view for explaining fray of the second precursor knitted fabric according to the embodiment;
Fig. 11 is a knitting view showing the knitted lace fabric according to the comparative example;
Fig. 12 is a side view showing a knitting portion of a raschel knitting machine for knitting the first precursor knitted fabric according to the first embodiment;
Figs. 13A to 13E are cross sectional views schematically illustrated for explaining movements of a kitting needle and a base guide bar in a chain stitch portion;
Figs. 14A to 14C are cross sectional views schematically illustrated for explaining movements of a jacquard bar and a guide bar for thermal bonding yarn;
Figs. 15A and 15B are structural views schematically illustrating an S region in Fig. 3;

Fig. 16 is a flowchart showing a manufacturing procedure of a knitted lace product;
Fig. 17 is a view showing a knitting structure, schematically illustrating a part of the first precursor knitted fabric according to a second embodiment of the invention;
Fig. 18 is a view showing a knitting structure, schematically illustrating a part of the first precursor knitted fabric according to a third embodiment of the invention;
Fig. 19 is a view showing a knitting structure, schematically illustrating the first precursor knitted fabric in which yarns other than a chain stitch yarn, a thermal bonding yarn and a stretch yarn are omitted;
Fig. 20 is a view showing a knitting structure, schematically illustrating apart of the first precursor knitted fabric according to a fourth embodiment of the invention;
Fig. 21 is a side view showing a knitting portion of a back jacquard raschel knitting machine for knitting the first precursor knitted fabric according to the third and the fourth embodiments;
Fig. 22 is a view showing a knitting structure, schematically illustrating a part of the first precursor knitted fabric according to a fifth embodiment of the invention; and
Fig. 23 is a side view showing the knitting portion of the back jacquard raschel knitting machine for knitting the first precursor knitted fabric according to the fifth embodiment.

DETAILED DESCRIPTION

[0028] Now referring to the drawings, preferred embodiments of the invention are described below.

[0029] Fig. 1 is a view showing a knitting structure, illustrating a part of a knitted lace fabric 120 according to a first embodiment of the invention. Fig. 2 is a view showing a knitting structure, illustrating a part of a first precursor knitted fabric 20 to be a precursor of the knitted lace fabric 120. Fig. 3 is a view showing a knitting structure, illustrating the first precursor knitted fabric 20 in which yarns other than a chain stitch yarn 21 and a thermal bonding yarn 23 are omitted. These Figs. 1 to 3 are views showing a knitting structure, schematically illustrated for easy understanding. In actual knitting structures of the knitted lace fabric 120 and the first precursor knitted fabric 20,radii of curvature of a first loop-shaped portion 24 and a second loop-shaped portion 25 are small and yarns 21, 22 and 23 are very close to each other or in contact with each other. In the invention, furthermore, a knitted fabric formed with each of the yarns 21, 22, and 23 is referred to as the first precursor knitted fabric 20. And what is formed by heating the first precursor knitted fabric 20 is referred to as a second precursor knitted fabric. Furthermore, a knitted fabric formed by breaking the thermal bonding yarn 23 included in the second precursor knitted fabric into a plurality thereof is referred to as a knitted lace fabric 120, and a product manufactured by use of the knitted lace fabric 120 is referred to as a knitted lace. In this embodiment, the first precursor knitted fabric 20 becomes a warp knitted fabric knitted with knitting yarns.

[0030] In the knitted lace fabric 120 and the first precursor knitted fabric 20, a plurality of through holes are formed, and a lace pattern is formed by a shape and arrangement of the through holes. In the knitted lace fabric 120 and the first precursor knitted fabric 20, furthermore, there are pattern portions in which an amount of yarns disposed on per unit area is small and ground portions in which the amount of yarns disposed on per unit area is large and patterns are formed depending on shapes and arrangements of the pattern portions and the ground portions. A knitted lace fabric having such a pattern is used for underwear for women, for example.

[0031] As shown in Fig. 2, the first precursor knitted fabric 20 is constituted by including the chain stitch yarn 21, the thermal bonding yarn 23 and the inserting yarn 22. The chain stitch yarn 21 is referred to as a warp or a ground knitting yarn in some cases. Furthermore, the inserting yarn 22 is referred to as a weft in some cases. The thermal bonding yarn 23 has a lower melting temperature than the other yarn to be used as the first precursor knitted fabric 20 and has a thermoplasticity.

[0032] Fig. 4 is a flowchart showing a process for manufacturing the knitted lace fabric 120 according to the embodiment. First of all, when a preparation for a knitted fabric formation is completed, that is, a selection of each knitting yarn to be used for a knitted lace, a determination of a pattern to be formed on the knitted lace and a design of a knitted fabric for forming a desirable knitting structure are completed at Step a0, the processing proceeds to Step a1 in which the knitted lace fabric 120 is started to be manufactured.

[0033] At the Step a1, there is carried out a knitted fabric knitting step of forming the first precursor knitted fabric 20 to be a precursor of the knitted lace fabric 120 by using a knitting machine. The knitting machine knits the respective yarns 21 and 22 such as the thermal bonding yarn 23 into the chain stitch yarn 21, thereby knitting the first precursor knitted fabric 20 shown in Fig. 2 in accordance with a knitting order designed at the Step a0. Accordingly, the first precursor knitted fabric 20 forms a chain stitch structure in which a plurality of loop-shaped portions are formed by the chain stitch yarn 21, and furthermore, the thermal bonding yarn 23 is knitted into the chain stitch structure.

[0034] At least one of the yarns provided in the first precursor knitted fabric 20 is elastic. More specifically, at least one of the chain stitch yarn 21, the thermal bonding yarn 23 and the other yarns is elastic. The knitting machine executes a knitting operation in a state in which the elastic yarn is extended. The first precursor knitted fabric 20 shrinks after knitting by a restoring force of the yarn knitted in the extending state and becomes elastic. When the knitting operation

for the first precursor knitted fabric 20 is completed, thus, the processing proceeds to Step a2.

[0035] At the Step a2, there is carried out a heating step of heating the first precursor knitted fabric 20 formed at the Step a1 to a temperature which is equal to or lower than a melting temperature of the chain stitch yarn 21 and is equal or higher than that of the thermal bonding yarn 23. Consequently, there is formed a second precursor knitted fabric in which a part of the thermal bonding yarn 23 is partially dissolved. A part of the dissolved portion of the second precursor knitted fabric sticks to the chain stitch yarn 21 and the inserting yarn 22. In this state, the thermal bonding yarn 23 is caked. Consequently, the chain stitch yarn 21 and the inserting yarn 22 which are provided in contact with the thermal bonding yarn 23 can be prevented from being released from the thermal bonding yarn 23. Furthermore, the respective yarns 21 and 22 to come in contact with the thermal bonding yarn 23 are bonded to each other through the thermal bonding yarn 23. When the thermal bonding yarn 23 thus molten is caused to stick to the other yarns 21 and 22, the processing proceeds to Step a3.

[0036] At the Step a3, there is carried out a breaking step of applying a tension to extend the second precursor knitted fabric formed at the Step a2 and breaking the thermal bonding yarn 23 subjected to the melting into a plurality of portions. In order to apply the tension to the second precursor knitted fabric, an amount of extension $\varepsilon 3$ of the second precursor knitted fabric exceeds an amount of extension $\varepsilon 1$ of the thermal bonding yarn 23 so that the thermal bonding yarn 23 is divided into a plurality of portions. When the thermal bonding yarn 23 subjected to the melting is thus broken, the knitted lace fabric 120 shown in Fig. 1 can be formed and the processing proceeds to Step a4.

[0037] At the Step a4, the knitted lace fabric 120 thus formed is refined and a heat treatment which is also referred to as a final heat set is then carried out to fix a configuration, and the knitted lace fabric is used to manufacture a lace product after the Step a3. Thus, the manufacture of the knitted lace fabric 120 is ended.

[0038] As shown in Figs. 1 and 2, the knitted lace fabric 120 according to the embodiment is formed by dividing the thermal bonding yarn 23 molten and bonded to the respective yarns as compared with the first precursor knitted fabric 20 obtained immediately after the knitted fabric is completely formed. In other words, the thermal bonding yarn 23 of the knitted lace fabric 120 is intermittently positioned in a course direction C.

[0039] The thermal bonding yarn 23 which is divided constitutes a plurality of fused portions 100 disposed at an interval in the course direction C, respectively. Each of the fused portions 100 sticks to the yarns 21 and 22 other than the thermal bonding yarn 23 at an interval, respectively. Each of the fused portions 100 is displaced with the sticking yarn irrespective of the other fused portions 100.

[0040] As shown in Fig. 1, furthermore, the fused portion 100 sticks to a yarn other than the thermal bonding yarn 23 in some cases and sticks to a plurality of yarns other than the thermal bonding yarn 23 in the other cases. For example, one of the fused portions 100 sticks to couple the chain stitch yarn 21 and the inserting yarn 22 in some cases. Furthermore, one of the fused portions 100 sticks to couple two of the chain stitch yarns 21 in some cases.

[0041] Portions of the yarns 21 and 22 other than the thermal bonding yarn 23 to which the fused portion 100 sticks form a portion which is protruded from a surface of an exposed portion in which the fused portion 100 is not present. In other words, the yarns 21 and 22 to which the thermal bonding yarn 23 sticks are provided with convex portions which are caused by the sticking of the fused portion 100. Consequently, the fused portion 100 sticking to the respective yarns 21 and 22 acts as a resisting member against fray of the respective yarns 21 and 22.

[0042] Figs. 5A and 5B are views for explaining that the fused portion 100 acts as the resisting member against the fray. Fig. 5A shows a state in which a breakage is generated in a broken portion 21A of the chain stitch yarn 21. Fig. 5B shows a state in which the chain stitch yarn 21 is pulled from the broken portion 21A.

[0043] In the embodiment, when the chain stitch yarn 21 is pulled toward a later stage side in the course direction C by setting the broken portion 21A to be a starting point as shown in Fig. 5A, an adjacent portion to the broken portion 21A of the chain stitch yarn 21 is sequentially drawn to pass through a first loop-shaped portion 24 on an earlier stage side in the course direction C in some cases. When a portion of the chain stitch yarn 21 to which the fused portion 100 sticks reaches the first loop-shaped portion 24 as shown in Fig. 5B, however, the fused portion 100 is caught on the first loop-shaped portion 24. Thus, the fused portion 100 is caught on the first loop-shaped portion 24 so that a resistance to the drawing operation for the chain stitch yarn 21 is generated and the chain stitch yarn 21 can be prevented from being further drawn. Consequently, it is possible to hinder the progress of the fray of the chain stitch yarn 21, thereby preventing the fray of the chain stitch yarn 21.

[0044] Furthermore, Fig. 5B shows a space 102 of the first loop-shaped portion 24 having such a shape that the fused portion 100 can pass for easy understanding. However, the actual space 102 of the first loop-shaped portion 24 is formed to be sufficiently smaller than the fused portion 100. Accordingly, it is possible to achieve an advantage that it is possible to prevent the fray from being caused by the catch-on of the fused portion 100.

[0045] Figs. 6A and 6B are views for explaining that the fused portion 100 to be a protruded molten sticking substance acts as the resisting member against the fray. Fig. 6A shows a state in which the breakage is generated in another broken portion 21B of the chain stitch yarn 21. Fig. 6B shows a state in which the chain stitch yarn 21 is pulled from the other broken portion 21B.

[0046] In the embodiment, when the chain stitch yarn 21 is pulled toward the later stage side in the course direction

C by setting the other broken portion 21B to be a starting point as shown in Fig. 6A, an adjacent portion to the other broken portion 21B in the chain stitch yarn 21 is sequentially drawn from the loop-shaped portion to pass through the first loop-shaped portion 24 on the earlier stage side in the course direction C in some cases. When a portion of the chain stitch yarn 21 which sticks to the inserting yarn 22 through the fused portion 100 reaches the first loop-shaped portion 24 as shown in Fig. 6B, however, the inserting yarn 22 bonded to the chain stitch yarn 21 is caught on the first loop-shaped portion 24. Thus, the inserting yarn 22 is caught on the first loop-shaped portion 24 so that a resistance to the drawing operation for the chain stitch yarn 21 is generated and the chain stitch yarn 21 can be prevented from being further drawn. Consequently, it is possible to hinder the progress of the fray of the chain stitch yarn 21, thereby preventing the fray of the chain stitch yarn 21.

[0047] Furthermore, Fig. 6B shows a state in which a part of the inserting yarn 22 passes through the space 102 of the first loop-shaped portion 24. In some cases, a part of a short fiber (a monofilament) constituting the inserting yarn 22 is drawn and a residual short fiber is not drawn but the inserting yarn 22 is caught thereon. Also in this case, it is possible to sufficiently achieve an advantage that the fray can be prevented from being caused by the catch-on of the inserting yarn 22.

[0048] Also in the case in which the fused portion 100 and the inserting yarn 22 are released from each other, furthermore, the fused portion 100 acts as a resisting member against the fray in the same manner as in the cases shown in Figs. 5A and 5B when the fused portion 100 sticks to the chain stitch yarn 21. Thus, it is possible to prevent the fray of the chain stitch yarn 21.

[0049] According to the embodiment, thus, the thermal bonding yarn 23 sticking to the chain stitch yarn 21 is positively divided to break an original shape of the thermal bonding yarn 23 at the breaking step. Consequently, the fused portion 100 having the thermal bonding yarn 23 disposed at an interval sticks to the chain stitch yarn 21. Thus, the shape of the bonding yarn 23 is changed to form a concavo-convex portion on the chain stitch yarn 21. In other words, a denier nonuniformity (a thickness nonuniformity) is generated on the chain stitch yarn 21. The fused portion 100 acts as the resisting member against the fray of the chain stitch yarn 21 so that the progress of the fray of the chain stitch yarn 21 can be prevented. Furthermore, the thread-shaped thermal bonding yarn 23 does not remain in the knitted lace fabric 120. Therefore, a pattern is less influenced by the thermal bonding yarn 23 so that a sense of beauty can be enhanced.

[0050] In the embodiment, furthermore, the knitting condition in the knitted fabric knitting step and the heating condition at the heating step are set in such a manner that the extension limiting amount $\varepsilon 1$ of the whole second precursor knitted fabric excluding the thermal bonding yarn 23 is larger than the extension limiting amount $\varepsilon 2$ of the thermal bonding yarn 23 obtained after the heating step ($\varepsilon 1 > \varepsilon 2$). For example, by knitting a stretch yarn into the chain stitch yarn 21 in the extending state, causing the chain stitch yarn itself to be elastic or forming a knitted structure which can easily be stretched, the extension limiting amount $\varepsilon 1$ of the whole second precursor knitted fabric excluding the thermal bonding yarn 23 is increased.

[0051] On the other hand, by using the thermal bonding yarn 23 having a small fineness, using the thermal bonding yarn 23 having a small extension limiting amount obtained after the melting or implementing the thermal boning yarn 23 by a material to generate a fragility after a dissolution, the extension limiting amount $\varepsilon 2$ of the thermal bonding yarn 23 obtained after the heating step is reduced.

[0052] By carrying out the setting, thus, an extension amount $\varepsilon 3$ of the second precursor knitted fabric to be extended at the breaking step is set to be larger than the extension limiting amount $\varepsilon 2$ of the thermal bonding yarn 23 and to be smaller than the extension limiting amount $\varepsilon 1$ of the whole second precursor knitted fabric excluding the thermal bonding yarn 23 ($\varepsilon 2 < \varepsilon 3 < \varepsilon 1$). Consequently, it is possible to break the thermal bonding yarn 23 without breaking the yarns 21 and 22 other than the thermal bonding yarn 23, for example, the chain stitch yarn 21. Thus, it is possible to hinder a strength of the knitted lace fabric 120 from being reduced, thereby preventing the fray of the knitted lace fabric 120.

[0053] Furthermore, the heating condition at the heating step is set in such a manner that the thermal bonding yarn 23 is molten and the yarns other than the thermal bonding yarn 23 which are contained in the knitted fabric are prevented from being fragile. Furthermore, it is preferable that the heating condition at the heating step should be set to divide the thermal bonding yarn 23 through melting. Also before the breaking step, consequently, the thermal bonding yarn 23 divided into a plurality of portions can be caused to stick to the respective yarns after the heating step. More specifically, the thermal bonding yarn 23 may be molten partially or wholly. By melting the whole thermal bonding yarn 23 to prevent a thread-like original shape from being maintained, furthermore, it is possible to form a large fused portion 100, thereby preventing the fray more reliably.

[0054] For the heating condition, a heating temperature and a heating time are set, for example. The lowest melting temperature for melting the thermal bonding yarn 23 is represented by B1 and a time required for softening when heating is carried out at the lowest melting temperature is represented by D1. Furthermore, the lowest melting temperature at which the yarns other than the thermal bonding yarn 23 are made fragile is represented by B2 and a time required for softening when the heating is carried out at the lowest melting temperature is represented by D2. In this case, in the embodiment, $B1 < B3 < B2$ and $D1 < D3 < D2$ are set, wherein a heating temperature and a heating time at the heating step are represented by B3 and D3 respectively.

[0055] In the embodiment, a polyester based thermoplastic polyurethane elastic yarn of 10 deniers to 300 deniers, and preferably 10 deniers to 50 deniers is used as the thermal bonding yarn 23. Furthermore, a heat treatment is carried out at a heating temperature which is equal to or higher than 170˚C and is equal to or lower than 195˚C for a heating time which is equal to or longer than 30 sec and is equal to or shorter than 90 sec. Consequently, the thermal bonding yarn 23 is molten and the residual yarns can be prevented from being fragile. In addition, the thermal bonding yarn 23 can be divided by the melting. Furthermore, it is preferable that the thermal boning yarn 23 should be constituted by a material which is caked after the melting, thereby increasing a fragility, that is, reducing a strength than before the melting.

[0056] For example, in the case in which the heating time is constant, a bonding force of the molten thermal bonding yarn 23 and the residual yarns is reduced when the heating temperature is set to be lower than 170˚C. Furthermore, the yarn is not divided as the bonding yarn but the bonding yarn itself remains so that the second precursor knitted fabric is hardened. When the heating temperature exceeds 195˚C, furthermore, a residual material such as nylon causes a hot shortness. On the other hand, in the embodiment, it is possible to eliminate the problems by setting the heating temperature to be equal to or higher than 170˚C and to be equal to or lower than 195˚C as described above.

[0057] When the fineness is excessively increased, furthermore, the thermal bonding yarn 23 is hard to break. When the fineness is excessively reduced, furthermore, the bonding force is reduced and the fused portion 100 cannot be enlarged. On the other hand, by setting the fineness of the thermal bonding yarn 23 to be equal to or higher than 10 deniers and to be equal to or lower than 300 deniers, it is possible to easily carry out the breakage, and furthermore, tomaintain the bonding force and to enlarge the fused portion 100. By further setting the fineness of the thermal bonding yarn 23 to be equal to or higher than 10 deniers and to be equal to or lower than 50 deniers, it is possible to prevent the thermal bonding yarn 23 from being more conspicuous than the pattern, thereby increasing the bonding force of the chain stitch yarn 21 and the thermal bonding yarn 23.

[0058] Table 1 shows a result of fray test for the knitted lace according to the embodiment in which the thermal bonding yarn 23 is broken and a knitted lace according to a comparative example in which the thermal bonding yarn 23 is not broken.

[Table 1]

			Knitted lace according to embodiment	Knitted lace according to comparative example
Breaking state of yarn			Broken	Not broken
Washing resistance test	Number of washing times: 30	Fray of scallop portion	⊙ (No abnormality)	○ (Slight fray)
		Fray of lace cut surface	○ (Slight fray)	△ (Fray)
	Number of washing times: 50	Fray of scallop portion	⊙ (No abnormality)	○ (Slight fray)
		Fray of lace cut surface	○ (Slight fray)	△ (Fray)

[0059] For the fray test, the washing operation was repetitively carried out by a washing method defined in the JIS-L-0217 103 Laws and a test for checking whether fray is generated on a lace was performed.

[0060] As shown in the Table 2, in the embodiment in which the thermal bonding yarn 23 is broken, the degree of the fray is lower than that in the comparative example in which the thermal bonding yarn 23 is not broken. For this reason, the knitted lace according to the embodiment can be prevented from being frayed more greatly than in the comparative example.

[0061] Furthermore, it is preferable that the thermal bonding yarn 23 should be formed by polyurethane elastic yarns manufactured by a melting spinning technique excluding a polyether based polyurethane elastic yarn. Consequently, it is possible to prevent the thermal bonding yarn 23 from being dissociated from the chain stitch yarn 21, thereby breaking the thermal bonding yarn 23 suitably.

[0062] Fig. 7 is a flowchart showing another manufacturing process for the knitted lace fabric 120. First of all, when a preparation for a knitted fabric formation is completed at Step b0 in the same manner as in the Step a1, the processing proceeds to Step b1 in which the manufacture of the knitted lace fabric 120 is started.

[0063] At the Step b1, a knitted fabric knitting step of forming the first precursor knitted fabric 20 to be a precursor of the knitted lace fabric 120 is carried out in the same manner as in the Step b1. When the knitted fabric formation is

completed, the processing proceeds to Step b2.

[0064] At the Step b2, a thermal setting step of arranging the knitted fabric into a predetermined shape is carried out. At the thermal setting step, the knitted fabric is maintained to have the predetermined shape. For example, the predetermined shape is flat or is provided with pleats. At the thermal setting step, the first precursor knitted fabric is heated to a melting temperature of the thermal bonding yarn 23 or more in a state in which the first precursor knitted fabric is extended and is held to have a shape to be maintained. Consequently, the thermal bonding yarn 23 is molten to stick to another yarn. When the thermal bonding yarn 23 is caked, the knitted fabric can be held to have a shape maintained in the thermal setting and can be prevented from being deformed from the maintained shape. At the thermal setting step, thus, the heating step of melting the thermal bonding yarn 23 and the breaking step of extending the knitted fabric are carried out at the same time. When the thermal setting step is completed, it is possible to form the knitted lace fabric 120 shown in Fig. 1 and the processing proceeds to Step b3.

[0065] At the Step b3, a lace product including the knitted lace fabric 120 is manufactured by using the knitted lace fabric 120 which is formed after the Step b3, and the manufacture of the knitted lace fabric 120 is ended.

[0066] As described above, the heating step and the breaking step are carried out in parallel at the thermal setting step of arranging the knitted fabric into a predetermined shape. By simply carrying out the thermal setting step, consequently, it is possible to melt the thermal bonding yarn 23 and to break the bonding yarn 23 into a plurality of portions. By carrying out the heating step and the breaking step at the same time, thus, it is possible to shorten a manufacturing period. While the heating step and the breaking step are carried out at the same time in the thermal setting step of arranging the knitted fabric into a predetermined shape in the embodiment, it is also possible to carry out the heating step and the breaking step at the same time without intending the thermal setting. Furthermore, the heating step and the breaking step may be carried out in another step such as a dyeing step.

[0067] As shown in Fig. 3, in the first precursor knitted fabric 20, the chain stitch yarn 21 is subjected to chain stitching so that the first loop-shaped portion 24 and the second loop-shaped portion 25 are formed. The first loop-shaped portion 24 and the second loop-shaped portion 25 are alternately connected and arranged in a plurality of stages in a course direction C. In some cases, the first loop-shaped portion 24 is referred to as a needle loop and the second loop-shaped portion 25 is referred to as a sinker loop.

[0068] The first loop-shaped portion 24 and the second loop-shaped portion 25 are linked alternately and extended in the course direction C so that a wale 26 is formed. A plurality of wales 26 are arranged and formed in the course direction C and are linked to each other so that a chain stitch structure, that is, a chain stitch configuration is formed. Furthermore, the chain stitch yarn 21 is properly swung transversely to couple the adjacent wale 26 in a wale direction W so that a chain stitch structure having a fray preventing function is formed. A portion in which the chain stitch yarn 21 is swung transversely is referred to as a run stopping portion 42.

[0069] The first loop-shaped portions 24 are formed in a substantially U shape respectively and are arranged and disposed almost in the predetermined course direction C and the wale direction W which is orthogonal to the course direction C. Furthermore, each of the first loop-shaped portions 24 is opened in an earlier stage in the course direction C. The first loop-shaped portions 24 are arranged in a line in the wale direction W to form a course and are arranged in a line in the course direction C to form the wale 26.

[0070] The second loop-shaped portion 25 couples the first loop-shaped portions 24 arranged in the course direction C. For example, attention is paid to one second loop-shaped portion 25a. The second loop-shaped portion 25a of interest has one end coupled to an end of a first loop-shaped portion 24a in the same stage as the second loop-shaped portion 25a of interest. The second loop-shaped portion 25a of interest extends from one end thereof to the other end thereof such that the second loop-shaped portion 25a of interest is inserted through a first loop-shaped portion 24b in the earlier stage in the course direction C of the second loop-shaped portion 25a of interest from one side to the other side and is thus extended toward a later stage in the course direction C, and is inserted through the first loop-shaped portion 24a in the same stage as the second loop-shaped portion 25a of interest from the other side to the one side and is thus extended toward the later stage in the course direction C and is connected to an end of a first loop-shaped portion 24c in the later stage in the course direction C of the second loop-shaped portion 25a of interest. Consequently, the loop-shaped portions 24 and 25 are coupled to each other like a chain so that the wale 26 extended in the course direction C is formed. The respective yarns 22 and 23, for example, the inserting yarn 22 and the thermal bonding yarn 23 are interposed between the first loop-shaped portion 24 and the second loop-shaped portion 25 and are thus knitted into the wale 26.

[0071] In a front face of the first precursor knitted fabric 20, the first loop-shaped portion 24 is hidden by the inserting yarn 22 and the thermal bonding yarn 23. In the front face of the first precursor knitted fabric 20, accordingly, a pattern and a lace pattern which are formed on the first precursor knitted fabric 20 appear more clearly as compared with a back face.

[0072] For example, the second loop-shaped portion 25a of interest is inserted, toward the front face side, through the first loop-shaped portion 24b in the earlier stage in the course direction C of the second loop-shapedportion 25a and is inserted, toward the back face side, through the first loop-shaped portion 24a in the same stage in the course direction

C of the second loop-shaped portion 25a, and is thus connected to the first loop-shaped portion 24c in the later stage in the course direction C.

[0073] The inserting yarn 22 serves to form a lace pattern in a chain stitch structure. The inserting yarn 22 is knitted into the wales 26 which are adjacent to each other in the wale direction W respectively, thereby coupling two wales 26 which are adjacent to each other in the wale direction W. As shown in Figs. 1 and 2, the inserting yarn 22 has a transverse swing portion extended from one of the wales 26 to the other wale 26 which are adjacent to each other in the wale direction W and an inserting yarn knitting portion knitted into the wale 26.

[0074] A space surrounded by two transverse swing portions arranged in the course direction C and the wale coupled by the transverse swing portions is provided with a through hole inserted in a vertical direction of the knitted fabric. The transverse swing portion of the inserting yarn 22 is selectively disposed so that the shape and arrangement of the through hole is regulated. Consequently, a lace pattern represented by the arrangement and shape of the through hole can be formed on the first precursor knitted fabric 20. The through hole surrounded by the transverse swing portion and the wale 26 is filled with a pattern yarn which will be described below and a pattern is thus formed in some cases.

[0075] The inserting yarn 22 is extended to the front face side with respect to the first loop-shaped portion 24. The inserting yarn 22 is inserted between the first loop-shaped portion 24 and the second loop-shaped portion 25 which are preset, and is extended in the wale direction W. In the embodiment, furthermore, a plurality of inserting yarns 22 are knitted into the chain stitch structure and are arranged and knitted in the wale direction W. A position in which each of the inserting yarns 22 is to be knitted is properly selected by the lace pattern formed on the first precursor knitted fabric 20.

[0076] The thermal bonding yarn 23 is implemented by a yarn having a lower melting point temperature than the chain stitch yarn 21 and the inserting yarn 22. In the embodiment, a yarn to be partially molten is used in a heating state at a heating step to be carried out after the formation of the first precursor knitted fabric 20. The thermal bonding yarn 23 is used for preventing fray of the chain stitch yarn 21 and the inserting yarn 22 which constitute the first precursor knitted fabric 20. In the embodiment, the thermal bonding yarn 23 is implemented by a non-covering yarn, that is, a so-called bare yarn which is not covered with a covering yarn and is implemented by a polyurethane elastic yarn having a melting temperature which is equal to or higher than approximately 140˚C and is equal to or lower than 195˚C. The thermal bonding yarn 23 is knitted into the chain stitch structure in an extending state to a natural condition.

[0077] In the embodiment, furthermore, a yarn having a low heat resistance in the polyurethane elastic yarns is used as the thermal bonding yarn 23. More specifically; any thermal bonding yarn 23 in the following Table 2 is used.

[Table 2]

Type name	Fineness (dtex)	Breaking extension percentage (%)	Breaking strength (cN/dtex)	100% extension stress (cN)	300% extension stress (cN)
Elastic yarn	20	370	1.5	2.6	16.2
	44	470	1.1	3.1	13.5

[0078] In the thermal bonding yarn 23 according to the embodiment, furthermore, when a treating time is set to be 60 minutes, an extension ratio is maintained to be 100% and a heat and humidity treating temperature is set to be 105˚C, a set ratio of approximately 85% is obtained. When the heat and humidity treating temperature is set to be 120˚C, furthermore, a set ratio of approximately 93% is obtained. When the heat and humidity treating temperature is set to be 130˚C, furthermore, a set ratio of approximately 93% is obtained.

[0079] When the extension ratio is maintained to be 100% with a treating time set to be one minute and the heat and humidity treating temperature is set to be 120˚C, furthermore, a set ratio of approximately 78% is obtained. When the heat and humidity treating temperature is set to be 140˚C, furthermore, a set ratio of approximately 85% is obtained.

[0080] The thermal bonding yarn 23 is extended along the wale and is knitted into all of the loop-shaped portions constituting the wale. Accordingly, the thermal bonding yarn 23 is knitted into both a ground portion in which an amount of the yarn per unit area is small and a pattern portion in which the amount of the yarn per unit area is larger than that in the ground portion in the chain stitch structure. In the embodiment, furthermore, the first precursor knitted fabric 20 has a plurality of thermal bonding yarns 23 and each of the thermal bonding yarns 23 is knitted per wale. Thus, the thermal bonding yarn 23 is knitted over a whole region of the chain stitch structure.

[0081] The thermal bonding yarn 23 is disposed on the front face side (this side in a perpendicular direction to the paper in Figs. 1 to 3) with respect to the first loop-shaped portion 24 and is disposed on the back face side with respect to the second loop-shaped portion 25. The thermal bonding yarn 23 advances zigzag in the course direction C along the corresponding wale. For example, when the thermal bonding yarn 23 passes from one of the wales to the other wale in the course direction C between the first loop-shaped portion 24a and the second loop-shaped portion 25a which are of interest, it passes from one of the wales to the other wale between the first loop-shaped portion 24c and the second

loop-shaped portion 25c in a course of the later stage in the course direction C of the first loop-shaped portion 24a of interest (an upper part in Figs. 1 to 3).

[0082] Immediately after the knitting operation, the thermal bonding yarn 23 passes through the front face side with respect to the first loop-shaped portion 24 and is extended over the region at the back face side of the first precursor knitted fabric 20 with respect to the inserting yarn 22. Accordingly, the thermal bonding yarn 23 is inserted between the first loop-shaped portion 24 and the inserting yarn 22 in a region in which the thermal bonding yarn 23 and the inserting yarn 22 are inserted between the first loop-shaped portion 24 and the second loop-shaped portion 25. Furthermore, the inserting yarn 22 is inserted between the thermal bonding yarn 23 and the second loop-shaped portion 25. In this case, the chain stitch yarn 21 is stretched in the course direction C so that radii of curvature of the first loop-shaped portion 24 and the second loop-shaped portion 25 are decreased so that the thermal bonding yarn 23 is disposed between the inserting yarn 22 and the first loop-shaped portion 24 to come in contact with the inserting yarn 22 and the first loop-shaped portion 24.

[0083] In the embodiment, the thermal bonding yarn 23 and the inserting yarn 22 cross each other and pass through the first loop-shaped portion 24 and the second loop-shaped portion 25 in the region in which the thermal bonding yarn 23 and the inserting yarn 22 are inserted between the first loop-shaped portion 24 and the second loop-shaped portion 25. More specifically, the thermal bonding yarn 23 passes through the first loop-shaped portion 24a of interest and the second loop-shaped portion 25a in the course in the same stage in the course direction C from the side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C (a lower part in Figs. 1 to 3).

[0084] On the other hand, the inserting yarn 22 passes through the first loop-shaped portion 24a of interest and the second loop-shaped portion 25a in the course in the same stage in the course direction C from the opposite side to the side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C. In this case, the first precursor knitted fabric 20 is stretched in the course direction C so that the thermal bonding yarn 23 and the inserting yarn 22 are close to each other in a portion 31 in which both of them pass through the second loop-shaped portion 25.

[0085] In the embodiment, thus, the directions in which the thermal bonding yarn 23 and the inserting yarn 22 are inserted between the first loop-shaped portion and the second loop-shaped portion are different from each other in a portion of the first precursor knitted fabric 20 in which both the thermal bonding yarn 23 and the inserting yarn 22 are knitted into the chain stitch yarn 21.

[0086] Consequently, it is possible to reduce a contact amount in which the inserting yarn 22 and the thermal bonding yarn 23 come in contact with each other, to cause the thermal boding yarn 23 molten at the heating step to easily stick to the chain stitch yarn 21, and to easily form the fused portion 100 on the chain stitch yarn 21 in the knitted lace fabric 120. While the inserting yarn is set in addition to the thermal bonding yarn 23 in the embodiment, furthermore, other yarns may be set. For example, a pattern yarn or a jacquard yarn for forming a pattern on a knitted lace and a stretch yarn for causing the knitted lace to be elastic may be used for the yarns to cross each other without running along the thermal bonding yarn 23.

[0087] Immediately after the knitting operation, furthermore, the inserting yarn 22 and the thermal bonding yarn 23 which are to be knitted into the chain stitch structure are not completely confined to the chain stitch structure. In some cases, therefore, some of a plurality of portions in which the inserting yarn 22 and the thermal bonding yarn 23 come in contact with each other have a portion in which the thermal bonding yarn 23 is disposed on the front face side with respect to the inserting yarn 22. Also in these cases, in most of the portions in which the inserting yarn 22 and the thermal bonding yarn 23 come in contact with each other, the thermal bonding yarn 23 is disposed on the back face side with respect to the inserting yarn 22.

[0088] Furthermore, a fineness of each of the chain stitch yarn 21 and the inserting yarn 22 is equal to or smaller than 50 deniers, and particularly, a multifilament having a fineness of 40 deniers or less is used. The chain stitch yarn 21 has such a thickness as not to be cut when it is used as a knitted lace product and the chain stitch yarn 21 which is as thin as possible is used. For example, the chain stitch yarn 21 can be implemented by various fibers such as nylon (a polyamide type synthetic fiber), rayon, polyester, acryl, wool, cotton, hemp, rayon and polypropylene. Furthermore, the various yarns used in the embodiment are only illustrative and other types of yarns may be used. In the embodiment, the chain stitch yarn 21 is formed by a nylon fiber and a yarn having a fineness of 30 deniers is selected. In addition, the inserting yarn 22 is formed by a multifilament fiber and a yarn having a fineness of 30 deniers is selected.

[0089] For the thermal bonding yarn 23, furthermore, there is used a polyurethane elastic yarn having a fineness which is equal to or higher than 10 deniers and is equal to or lower than300deniers. In addition, it is preferable to use a material which has a comparatively low melting temperature and a thermoplasticity in addition to the polyurethane elastic yarn. The thermal bonding yarn 23 may be implemented by a polyamide type synthetic fiber. Furthermore, the thermal bonding yarn 23 may be formed by using a non-extensible yarn.

[0090] The first precursor knitted fabric 20 according to the embodiment has a melting temperature which is equal to or higher than the melting temperature of the thermal bonding yarn 23 after the knitting operation and is heated at a

temperature which is lower than the melting point temperatures of the residual yarns 21 and 22. Consequently, a part of the thermal bonding yarn 23 is partially dissolved. Apart of the dissolved portions stick to the chain stitch yarn 21 and the inserting yarn 22 which are adjacent to each other. By carrying out caking in this state, the chain stitch yarn 21 and the inserting yarn 22 which come in contact with the thermal bonding yarn 23 can be prevented from being isolated from the thermal bonding yarn 23. Furthermore, the yarns 21 and 22 coming in contact with the thermal bonding yarn 23 can be bonded to each other through the thermal bonding yarn 23. Consequently, a coupling state of the respective yarns can be maintained so that the fray of the yarn can be prevented.

[0091] Thus, the binding of the chain stitch structure is strengthened in a sticking portion in which the thermal bonding yarn 23 sticks to another yarn. More specifically, the first loop-shaped portion 24 and the second loop-shaped portion 25 are bonded to each other through the thermal bonding yarn 23. Also in the case in which a part of the chain stitch yarn 21 is divided, consequently, it is possible to prevent the second loop-shaped portion 25 from being isolated from the first loop-shaped portion 24. Thus, the fray of the chain stitch yarn 21 is prevented in the bonding portion of the first loop-shaped portion 24 and the second loop-shaped portion 25 so that the chain stitch yarn 21 can be prevented from being frayed beyond the bonding portion. Also in the second precursor knitted fabric 20A obtained before the thermal bonding yarn 23 is broken, accordingly, there is an advantage that the fray can be prevented. Description will be given to the fray preventing effect of the second precursor knitted fabric 20A.

[0092] Fig. 8 is a knitting view for explaining a prevention of the fray of the second precursor knitted fabric 20A according to the embodiment and Fig. 9 is a knitting view showing the knitted lace fabric 10A according to a comparative example. In Fig. 8, the second precursor knitted fabric 20A, which is obtained by heating the first precursor knitted fabric 20 in which thermal bonding yarn 23 is knitted, is shown. Furthermore, in Fig. 9, the knitted lace fabric in which the thermal bonding yarn 23 is not knitted, is shown.

[0093] As shown in Fig. 9, in the knitted lace fabric 10A according to the comparative example, in the case in which two second loop-shaped portions 25 arranged in the course direction C are cut off in dividing portions 40 and 41, the dividing portion 40 in the later stage C in the course direction is pulled in a direction of the front face side, so that a portion with which the chain stitch yarn 21 is to be engaged is broken and the chain stitch structure gets loose along an earlier stage in the course direction C from the dividing portion 40. In the knitted lace fabric 10A according to the comparative example, the loosening of the chain stitch structure progresses along the earlier stage in the course direction C to reach the run stopping portion 42, and the loosening is suppressed in the run stopping portion 42. In order to shorten the progress of the loosening, accordingly, it is necessary to increase the number of the run stopping portions 42. When the number of the run stopping portions 42 is increased, the number of yarns extended in the wale direction W is increased, so that a sense of transparency of the knitted lace fabric 10A is damaged.

[0094] On the other hand, as shown in Fig. 8, the thermal bonding yarn 23 is extended in the course direction C in the second precursor knitted fabric 20A according to the embodiment. Therefore, the first loop-shaped portion 24 and the second loop-shaped portion 25 in a same stage in every course are bonded to each other.

[0095] In the second precursor knitted fabric 20A according to the embodiment, in the case in which two second loop-shaped portions 25 arranged in the course direction C are cut off in the dividing portions 40 and 41, even if the dividing portion 40 in the later stage in the course direction C is pulled in the direction of the front face side, the loosening of the chain stitch structure can be hindered in a bonding portion 44 in which the first loop-shaped port ion 24 and the second loop-shaped portion 25 are bonded to each other in the further later stage than the dividing portion 40 in the course direction C because of the presence of the bonding portion 44 and a further progress of the loosening can be prevented. As compared with the knitted lace fabric 10A according to the comparative example, accordingly, it is possible to prevent the chain stitch structure from being loosened. Furthermore, the loosening is suppressed in the bonding portions 43 and 44. Therefore, it is possible to decrease or eliminate the run stopping portions 42. As compared with the comparative example, thus, the sense of transparency of the knitted lace can be enhanced more greatly. In the embodiment, furthermore, the first loop-shaped portion 24 and the second loop-shaped portion 25 in the same stage in the course direction C are bonded to each other in every course direction C, so that it is possible to prevent the wale from being divided in the course direction C, even if a part of the second loop-shaped portion 25 is divided. As described above, in the embodiment, the thermal bonding yarn 23 is extended along the wale and is formed. As to the chain stitch structure, therefore, it is possible to increase the binding in the course direction C and enhancing a durability thereby.

[0096] Fig. 10 is a knitting view for explaining fray of the second precursor knitted fabric 20A according to the embodiment and Fig. 11 is a knitting view showing the knitted lace fabric 10A according to the comparative example. In Fig. 10, the second precursor knitted fabric 20A, which is obtained by heating the first precursor knitted fabric 20 in which thermal bonding yarn 23 is knitted, is shown. Furthermore, a knitted lace fabric 10A according to the comparative example shown in Fig. 11 is a knitted lace fabric 10A in which the thermal bonding yarn 23 is not knitted. In Figs. 10 and 11, the inserting yarn 22 is knitted over a plurality of wales.

[0097] As shown in Fig. 11, in the knitted lace fabric 10A according to the comparative example, in the case in which the inserting yarn 22 is cut off in the dividing portion 45, even if the portion 46 in one of the wale directions W which is beyond at least one wale from the dividing portion 45 is pulled in the wale direction W in inserting yarn 22, so that the

dividing portion 45 slips from the wale and the inserting yarn 22 slips from the knitted lace fabric 10A. For example, the inserting yarn 22 is only prevented from moving by frictional force with the chain stitch yarn 21. By great force, therefore, the inserting yarn 22 is shifted from a knitted portion or slips in some cases.

[0098] On the other hand, as shown in Fig. 10, the thermal bonding yarn 23 is knitted into each wale 26 in the second precursor knitted fabric 20A according to the embodiment. Therefore, the inserting yarn 22 is bonded to the first loop-shaped portion 24 and the second loop-shaped portion 25 for each wale.

[0099] In the second precursor knitted fabric 20A according to the embodiment, in the case in which the inserting yarn 22 is cut off in the dividing portion 45, even if the portion 46 in one of the wale directions W which is beyond at least one wale from the dividing portion 45 is pulled in the wale direction W in the inserting yarn 22, bonding portions 47 and 48, in which the inserting yarn 22 and the wale 26 are bonded, are bonded to each other, so that the dividing portion 45 can be prevented from slipping from the wale 26 and a progression of the shift of the inserting yarn 22 can be prevented. In the embodiment, thus, the inserting yarn 22 is fixed to the chain stitch structure by the bonding force of the thermal bonding yarn 23, with the result that it is possible to prevent the inserting yarn 22 from being shifted and slipping.

[0100] Furthermore, the wales 26 which are adjacent to each other in the wale direction W are bonded to each other through the inserting yarn 22, so that an interval between the adjacent wales can be prevented from being expanded or narrowed. Thus, it is possible to prevent a lace pattern of the knitted lace fabric 120 from being disarranged.

[0101] As described above, according to the embodiment, it is possible to prevent the fray of each of yarns constituting the second precursor knitted fabric 20A. Furthermore, even if the knitted lace fabric 120 is formed by breaking the thermal bonding yarn 23 in the second precursor knitted fabric 20A into a plurality thereof, a fray-prevention effect in the knitted lace fabric 120 achieved in the second precursor knitted fabric 20A can be further enhanced. Consequently, it is possible to prevent the fray of the yarn caused by a manufacturing state such as sewing or cutting operation and using state such as wearing or washing in the knitted lace fabric 120. Thus, it is possible to enhance quality.

[0102] According to the embodiment, furthermore, the thermal bonding yarn 23 is a bare yarn in which a surface portion has a heat solubility. When the first precursor knitted fabric 20 is heated, accordingly, a portion of the thermal bonding yarn 23 which comes in contact with the chain stitch yarn 21 is molten and sticks to the chain stitch yarn 21. Furthermore, a portion of the thermal bonding yarn 23 which comes in contact with the inserting yarn 22 is molten and sticks to the inserting yarn 22. According to the embodiment, thus, an exposed portion of the thermal bonding yarn 23 which directly comes in contact with other yarns becomes a portion to stick to the other yarns. Therefore, an amount of the thermal bonding yarn 23 to stick to the other yarns can be increased, so that a bonding force can be enhanced. Therefore, the fray of each yarn can be prevented further reliably.

[0103] Furthermore, by implementing the thermal bonding yarn 23 with the non-covering yarn, that is, the bare yarn which is not covered with the covering yarn, furthermore, it becomes possible to further decrease the amount of the yarns in the ground portion and to increase the difference in the density of the yarns between the ground portion and the pattern portion. Thus, the sense of transparency of the knitted lace fabric 120 can be enhanced and the pattern can be clear.

[0104] According to the embodiment, furthermore, the thermal bonding yarn 23 is knitted over the whole region of the chain stitch structure. Therefore, it is possible to prevent the fray of the yarns in the whole knitted 1 knitted lace fabric 120. For example, even if the knitted lace fabric 120 is sewn or cut in an arbitrary position, it is possible to prevent the yarns from being frayed in a sewn portion and a cut portion.

[0105] Furthermore, it is possible to prevent the fray of the yarns over the whole knitted lace fabric 120. For example, in the case in which the knitted lace fabric 120 according to the embodiment is used as the knitted lace fabric for forming the eyelash lace, it is possible to prevent the fray of the eyelash-shaped portion. Referring to a motif cut in which the knitted lace fabric 120 is cut in an arbitrary position, furthermore, it is possible to prevent the fray of the cut portion. Thus, an application to a wide lace can also be carried out. Furthermore, it is possible to prevent the fray over the whole knitted lace fabric 120. Therefore, it is possible to use the knitted lace fabric 120 also in a part of a coat requiring durability. As described above, according to the embodiment, it is possible to prevent the fray of the yarn over the whole knitted lace fabric 120. Consequently, use application can be expanded.

[0106] According to the embodiment, furthermore, the thermal bonding yarn 23 and the inserting yarn 22 are inserted between the first loop-shaped portion 24 and the second loop-shaped portion 25 and are thus knitted into the chain stitch structure. In the knitted lace fabric 120, a face on the side where the first loop-shaped portion 24 is disposed with respect to the inserting yarn 22 knitted into the chain stitch structure is a rear face, and a face on an opposite side thereof is a front face. In the embodiment, the inserting yarn 22 is disposed in the front face direction Z1 rather than thermal bonding yarn 23 in a portion in which the thermal bonding yarn 23 and the inserting yarn 22 are knitted in common. As seen from the front face of the knitted lace fabric 120, accordingly, the thermal bonding yarn 23 and the first loop-shaped portion 24 are hidden by the inserting yarn 22.

[0107] As described above, the thermal bonding yarn 23 can be hidden by the inserting yarn 22 and can be difficult to be seen from the front face. Consequently, a pattern to be formed on the knitted lace fabric 120 can be clear. Further, even if the thermal bonding yarn 23 is molten, it is possible to lessen an influence on the pattern seen from the front

face. Furthermore, the thermal bonding yarn 23 passes through a portion between the first loop-shaped portion 24 and the inserting yarn 22, so that the first loop-shaped portion 24 and the inserting yarn 22 can be bonded to each other and the inserting yarn 22 can be prevented from being removed from the chain stitch structure.

[0108] In the embodiment, furthermore, the thermal bonding yarn 23 and the inserting yarn 22 pass through the loop-shaped portion 25 in different directions from each other in a region in which the thermal bonding yarn 23 and the inserting yarn 22 are inserted between the first loop-shaped portion 24 and the second loop-shaped portion 25. In this case, the knitted lace fabric 120 is pulled in the wale direction W, so that the regions surrounded by the thermal bonding yarn 23 and the inserting yarn 22 are close to each other in the wale direction W, and then an approaching portion 34, in which the thermal bonding yarn 23, the inserting yarn 22, the first loop-shaped portion 24 and the second loop-shaped portion 25 approach each other, is generated. When the first precursor knitted fabric 20 is heated in a pulling state in the wale direction W, thus, a part of the thermal bonding yarn 23 can be molten in the approaching portion 34, so that a bonding force for bonding the thermal bonding yarn 23, the inserting yarn 22, the first loop-shaped portion 24 and the second loop-shaped portion 25 can be increased.

[0109] In the embodiment, furthermore, the fineness of the thermal bonding yarn 23 is set to 10 deniers to 300 deniers and the fineness of the chain stitch yarn is set to 20 deniers to 70 deniers. When the thermal bonding yarn 23 has fineness which is smaller than 10 deniers, there is a possibility that all of the thermal bonding yarns in the knitted lace might be molten. Also in the case in which a part of the thermal bonding yarn 23 is set to be molten, furthermore, there is a possibility that the amount of bonding of the thermal bonding yarn 23 to the other yarns might be insufficient. In this case, the fray of the yarn might be caused. When the thermal bonding yarn 23 has a fineness which is greater than 300 deniers, furthermore, the sense of transparency of the knitted lace is deteriorated, and a sense of beauty is decreased due to decrease of the difference in the density of the yarns between the groundportion and the pattern portion through the thermal bonding yarn 23. Furthermore, the knitted lace is hardened. On the other hand, in the invention, it is possible to eliminate the fray of the yarns and to suppress reduction in the sense of beauty by setting the thermal bonding yarn 23 to have a fineness which is 10 deniers to 300 deniers. By setting the thermal bonding yarn 23 to have a fineness of equal to or smaller than 70 deniers, furthermore, it is possible to further suppress the reduction in the sense of beauty.

[0110] Fig. 12 is a side view showing a knitting portion of a raschel knitting machine 60 for knitting the first precursor knitted fabric 20 according to the first embodiment. The first precursor knitted fabric 20 can be knitted by the back jacquard raschel knitting machine, for example. The back jacquard raschel knitting machine 60 (hereinafter referred to as a knitting machine 60) has yarn guiding means for guiding the chain stitch yarn 21, the inserting yarn 22 and the thermal bonding yarn 23 toward a knitting position 73 in the vicinity of a knitting needle 72. In the embodiment, the yarn guiding means for guiding the thermal bonding yarn 23 toward the knitting position 73 is disposed behind the yarn guiding means for guiding the inserting yarn 22 toward the knitting position 73 in a rear part of the knitting machine. The rear part of the knitting machine is set in a direction from a back face of the knitting needle 72 toward a hook portion.

[0111] More specifically, the yarn guiding means provided in the knitting machine is implemented by a guide bar for thermal bonding yarn 61, jacquard bars 62 and 63, a plurality of pattern guide bars 64 and a base guide bar 65. The chain stitch yarn 21 is inserted through the base guide bar 65, the inserting yarn 22 is inserted through the jacquard bars 62 and 63, and the thermal bonding yarn 23 is inserted through the guide bar for thermal bonding yarn 61. In the case in which a pattern yarn to be a yarn for forming a pattern is knitted into the wale 26, furthermore, the pattern yarns are inserted through the pattern guide bars 64. Description will be given to the case in which the pattern yarn is knitted in addition to the thermal bonding yarn 23 and the inserting yarn 22.

[0112] Such yarn guiding means 61 to 65 are arranged radially toward the knitting position 73 in which the knitting needle 72 catches the chain stitch yarn 21 and are disposed in order of the base guide bar 65, the pattern guide bars 64, the jacquard bars 62 and 63, and the guide bar for thermal bonding yarn 61 toward the rear part of the knitting machine to be the direction

in which the knitting needle 72 catches the chain stitch yarn 21. Accordingly, the yarns are arranged in the rear part of the knitting machine from a predetermined knitting position in order of the chain stitch yarn 21, the pattern yarns, the inserting yarn 22 and the thermal bonding yarn 23.

[0113] The knitting needles 72 are arranged and formed in a direction perpendicular to an anteroposterior direction of the knitting machine and are fixed to a needle bar 69 to be holding means for holding each of the knitting needles 72. The needle bar 69 causes each knitting needle 72 to carry out an up-down motion. Furthermore, the needle bar 69 is operated, so that the yarns guided to the yarn guiding means 61 to 65 are guided to predetermined knitting positions.

[0114] The respective yarn guiding means 61 to 65 carry out an overlapping (a stitch knitting motion) for moving each yarn corresponding in a space formed in the rear part of the knitting machine to the knitting needle 72 in a direction in which the needles 72 are arranged synchronously with the up-down motion of the knitting needle 72 and an underlapping (inserting motion) for moving each yarn corresponding in a space formed in the front part of the knitting machine to the knitting needle 72 in the direction in which the knitting needles 72 are arranged. Furthermore, a so-called swing (a swing motion) for a movement in a direction in an orthogonal direction to the direction in which the knitting needles 72 are arranged is carried out in addition to these lap motions. More specifically, there are two swing operations.

[0115] In a swing-in (back swing) operation to be a first swing operation, each corresponding yarn is moved from the space formed in the front part of the knitting machine to the space formed in the rear part of the knitting machine with respect to the knitting needle 72 through a side of the knitting needle 72. In a swing-out (front swing) operation to be a second swing operation, furthermore, each corresponding yarn is moved from the space formed in the front part of the knitting machine to the space formed in the rear part of the knitting machine with respect to the knitting needle 72 through the side of the knitting needle 72. Guides attached to the yarn guiding means 61 to 65 are operated, so that each corresponding yarn passes in accordance with a predetermined path around the knitting needle 72 and a knitted fabric including each corresponding yarn is thus formed.

[0116] Furthermore, the knitting portion includes a stitch comb bar 71, a trick plate bar 68 and a tongue bar 70. In the tongue bar 70, a plurality of tongues are formed in a tip portion corresponding to the knitting needles. The knitting machine 60 knits the first precursor fabric 20 by the operations of the yarn guiding means 61 to 65 and the needle bar 69. The knitted lace fabric 20 formed by a knitting subsidiary function of the stitch comb bar 71 is subsidiarily knitted and the trick plate bar 68 is caused to pass therethrough, thereby winding the first precursor knitted fabric 20 by means of a winding portion provided in the vicinity of the knitting portion.

[0117] Figs. 13A to 13E are cross sectional views schematically illustrated for explaining movements of the knitting needle 72 and the base guide bar 65 in the chain stitch portion, and a knitting work of the chain stitch portion of the chain stitch yarn 21 progresses in order of Figs. 13A to 13E. In the knitting needle 72, a hook portion 50 for engaging the chain stitch yarn 21 is formed in a tip portion and a knitting needle stem 51 formed on a base end. Furthermore, in a tip portion of the tongue bar 70, a tongue 52 for opening/closing an opening formed by the hook portion 50 is formed. The knitting needle 72 and the tongue 52 are formed to be individually ascendable/descendable with respect to the base guide bar 65. Referring to Figs. 13A to 13E, only the knitting operation for the wale 26 will be first described and the inserting yarn 22 and the thermal bonding yarn 23 which are to be knitted into the wale 26 will be described later.

[0118] As shown in Fig. 13A, the hook portion 50 catches a new first loop-shaped portion 24j formed by the chain stitch 21 in a state in which the base guide bar 65 is disposed before the knitting needle 72 and the tongue 52 closes the opening of the hook portion 50. As shown in Fig. 13B, next, the knitting needle 72 is moved upward toward the base guide bar 65 with respect to the tongue 52. Consequently, the opening of the hook portion 50 is opened, so that the first loop-shaped portion 24j of the chain stitch 21 caught by the hook portion 50 slips out of the hook portion 50 and is moved to the knitting needle stem 51.

[0119] Next, the base guide bar 65 carries out the back swing with respect to the knitting needle 72 as shown in Fig. 13C. Then, the base guide bar 65 carries out the overlapping, and furthermore, carries out the front swing. Consequently, the chain stitch yarn 21 guided to the base guide bar 65 is moved so as to wind the knitting needle 72, thereby forming a new first loop-shaped portion 24k. The new first loop-shaped portion 24k is caught by the hook portion 50. As shown in Fig. 13D, thereafter, the tongue 52 is moved upward toward the hook portion 50 to close the opening of the hook portion 50. At this time, the old first loop-shaped portion 24j formed on the knitting needle stem 51 and the new first loop-shaped portion 24k with which the hook portion 50 is engaged are formed on the knitting needle 72.

[0120] As shown in Fig. 13E, subsequently, the knitting needle 72 and the tongue 52 are moved downward together so that the old first loop-shaped portion 24j is removed from the knitting needle 72 and is moved to the trip plate 53 side. Then, the hook portion 50 catches the new first loop-shaped portion 24k formed by the chain stitch 21 in a state in which the base guide bar 65 is disposed before the knitting needle 72, so that almost the same state as that in Fig. 13A is brought. By repeating the operation cycle shown in Figs. 13A to 13E, the first loop-shaped portion 24 is sequentially formed, and furthermore, there is formed the wale 26 in which a second loop-shaped portion 25j coupling the first loop-shaped portions 24j and 24k is sequentially formed. In the example, the base guide bar 65 properly carries out the underlapping, so that the wales 26 are coupled in the wale direction C. The inserting yarns such as the inserting yarn 22 and the thermal bonding yarn 23 are knitted into the wale 26 while the knitting work for the wale 26 is carried out. Consequently, it is possible to form the first precursor knitted fabric 20 according to the embodiment.

[0121] Figs. 14A to 14C are cross sectional views schematically illustrating for explaining movements of the jacquard bar 62 and the guide bar for thermal bonding yarn 61, and the operation progresses in order of Figs. 14A to 14C. Figs. 14A, 14B and 14C correspond to Figs. 13C, 13D and 13E respectively, and additionally show the jacquard bar 62 and the guide bar for thermal bonding yarn 61 respectively. As described above, in the knitting machine 60, the jacquard bars 62 and 63 are disposed behind the base guide bar 65 for guiding the chain stitch yarn in the rear part of the knitting machine. Furthermore, the guide bar for thermal bonding yarn 61 to be a guide bar for thermal bonding yarn is disposed behind the jacquard bars 62 and 63 in the rear part of the knitting machine.

[0122] As shown in Figs. 14A and 14C, in a state in which the base guide bar 65 is disposed in the rear part of the knitting machine with respect to the knitting needle 72, the jacquard bar 62 and the guide bar for thermal bonding yarn 61 are also disposed in the rear part of the knitting machine with respect to the knitting needle 72. As shown in Fig. 14B, furthermore, the jacquard bar 62 and the guide bar for thermal bonding yarn 61 are also disposed before the knitting needle 72 in a state in which the base guide bar 65 is disposed in the front part of the knitting machine with respect to the knitting needle 72.

[0123] Furthermore, the jacquard bar 62 and the guide bar for thermal bonding yarn 61 carry out the underlapping in a state in which the base guide bar 65 performs a back swing so that the thermal bonding yarn 23 and the inserting yarn 22 which are guided cross the chain stitch yarn 21 as shown in Fig. 14B. When a loop is newly formed with the chain stitch yarn 21 in this state, the thermal bonding yarn 23 and the inserting yarn 22 are knitted into the loop. Thus, the guide bar for thermal bonding yarn 61 and the jacquard bar 62 are operated synchronously with the swing operation of the base guide bar 65.

[0124] The jacquard bar 62 is disposed ahead of the guide bar for thermal bonding yarn 61 in the front part of the knitting machine. In the case in which the thermal bonding yarn 23 and the inserting yarn 22 are knitted into the chain stitch portion formed by the base guide bar 65, consequently, the thermal bonding yarn 23 guided to the knitting position is disposed behind the inserting yarn 22 guided to the knitting position in the rear part of the knitting machine and the inserting yarn 22 is positioned on the front face side of the first precursor knitted fabric 20 from the thermal bonding yarn 23.

[0125] Figs. 15A and 15B are structural views schematically illustrating an S region in Fig. 3, and Fig. 15A is a structural view of the chain stitch yarn 21 and Fig. 15B is a structural view of the thermal bonding yarn 23.

[0126] For example, a knitting needle 72 placed in an arbitrary position is set to be a first knitting needle 72a, an adjacent knitting needle 72 to the first knitting needle 72a in one wale direction W is set to be a second knitting needle 72b, and an adjacent knitting needle 72 to the second knitting needle 72b in another wale direction W is set to be a third knitting needle 72c. An interval between the first knitting needle 72a and the knitting needle 72 disposed in another wale direction W with respect to the first knitting needle 72a is set to be a first knitting needle interval L1, an interval between the first knitting needle 72a and the second knitting needle 72b is set to be a second knitting needle interval L2, an interval between the second knitting needle 72b and the third knitting needle 72c is set to be a third knitting needle interval L3, and an interval between the third knitting needle 72c and the knitting needle 72 disposed in one wale direction W with respect to the third knitting needle 72c is set to be a fourth knitting needle internal L4.

[0127] The base guide bar 65 for guiding each chain stitch yarn 21 carries out the same knitting operation as that of the chain stitch yarn 21. In a first course C1, description will be given by paying attention to a chain stitch yarn guide for catching the chain stitch yarn 21 on the second knitting needle 72b and description for the residual chain stitch yarn guides will be omitted.

[0128] As shown in Fig. 15A, in the first course C1, a chain stitch yarn guide of interest carries out a back swing in the third knitting needle interval L3, and then carries out the overlapping to pass through the second knitting needle interval L2 and performs a front swing. In a second course C2, the chain stitch yarn guide of interest carries out the back swing in the second knitting needle interval L2, and then carries out the overlapping to pass through the second knitting needle interval L2 and performs the front swing.

[0129] In a third course C3, the chain stitch yarn guide of interest carries out the underlapping in the fourth knitting needle interval L4, carries out the back swing in the fourth knitting needle interval L4, and then carries out the overlapping to pass through the third knitting needle interval L3 and performs the front swing. In a fourth course C4, the chain stitch yarn guide of interest carries out the back swing in the third knitting needle interval L3, and then carries out the overlapping to pass through the fourth knitting needle interval L4 and performs the front swing. In a fifth course C5, the chain stitch yarn guide of interest carries out the back swing in the fourth knitting needle interval L4, and then carries out the overlapping to pass through the third knitting needle interval L3 and performs the front swing.

[0130] The same operation as that in the fourth course C4 is carried out in a sixth course C6 and the same operation as that in the fifth course C5 is carried out in a seventh course C7. In an eighth course C8, the chain stitch yarn guide of interest carries out the underlapping in the fourth knitting needle interval L4, carries out the back swing in the fourth knitting needle interval L4, and then carries out the overlapping to pass through the third knitting needle interval L3 and performs the front swing. In a ninth course C9, the chain stitch yarn guide of interest carries out the underlapping in the second knitting needle interval L2, carries out the back swing in the second knitting needle interval L2, and then carries out the overlapping to pass through the third knitting needle interval L3 and performs the front swing.

[0131] Thus, the base guide bar 65 repetitively carries out an operation for catching the predetermined chain stitch yarn 21 on each knitting needle 72 in each course by using a guide provided for each chain stitch yarn 21. Consequently, it is possible to form the chain stitch portion extended like a chain. In the embodiment, furthermore, the knitting machine 60 properly carries out the underlapping in a process for catching the chain stitch yarn 21 on the knitting needle 72 in each source. Consequently, the second loop-shaped portion 25 can be caused to swing transversely in the wale direction Wand another wale direction W so that the adjacent wales 26 in the wale direction W can be coupled to form a chain stitch structure having a fray preventing function.

[0132] The thermal bonding yarn 23 carries out a swing operation synchronously with the base guide bar 65 by the guide bar for thermal bonding yarn 61. The guide bar for thermal bonding yarn 61 which serves to guide each of the thermal bonding yarns 23 carries out the same knitting operation for the each of the thermal bonding yarns 23. In the first course C1, description will be given by paying attention to the thermal bonding yarn guide for positioning the thermal bonding yarn 23 in the second knitting needle interval L3, and the description for the residual thermal bonding yarn guides will be omitted.

[0133] As shown in Fig. 15B, in the first course C1, the thermal bonding yarn guide of interest carries out the underlapping in the second knitting needle interval L2 to reach the third knitting needle interval L3. In the second course C2, furthermore, the thermal bonding yarn guide carries out the underlapping in the third knitting needle interval L3 to reach the second knitting needle interval L2. The thermal bonding yarn guide of interest sequentially repeats the operations of the first course C1 and the second course after the second course C2. Thus, the thermal bonding yarn 23 is reciprocated with the underlapping between the two adjacent knitting needle intervals synchronously with the swing operation of the base guide bar 65 by the guide bar for thermal bonding yarn 61.

[0134] Referring to the inserting yarn other than the thermal bonding yarn, for example, the inserting yarn 22, similarly, the jacquard bar 62 repeats the underlapping for a predetermined distance and direction in a predetermined position synchronously with the swing operation of the base guide bar 65. For a pattern yarn, similarly, the base guide bar 64 repeats the underlapping for a predetermined distance and direction in a predetermined position synchronously with the swing operation of the base guide bar 65.

[0135] Thus, the guide bar for thermal bonding yarn 61, the jacquard bars 62 and 63, a plurality of pattern guide bars 64, the base guide bar 65 and the knitting needle 72 carry out the knitting operation so that a knitted lace fabric portion can be formed in the S region. In the knitting machine 60, the base guide bar 65, the jacquard bars 62 and 63 and the guide bar for thermal bonding yarn 61 are disposed in order toward the rear part of the knitting machine so that the inserting yarn 22 can be disposed on the front face side of the first precursor knitted fabric 20 with respect to the thermal bonding yarn 23. Thus, it is possible to form the first precursor knitted fabric 20 according to the embodiment shown in Fig. 2.

[0136] Fig. 16 is a flowchart showing a procedure for manufacturing a knitted lace product. First of all, when a pattern of a knitted lace to be formed is determined at Step s0, the processing proceeds to Step s1. At the Step s1, the chain stitch yarn 21, the inserting yarn 22, the thermal bonding yarn 23 and the pattern yarn are prepared and an operation program for each yarn guiding means of the knitting machine 60 is input in order to obtain the pattern determined at the Step s0. Next, the knitting machine 60 is operated. Consequently, the first precursor knitted fabric 20 having a desirable pattern can be formed. When the work for forming the first precursor knitted fabric 20 is completed, the processing proceeds to Step s2.

[0137] At the Step s2, the first precursor knitted fabric 20 formed at the Step s1 is dyed. When the dyeing operation is completed, the processing proceeds to Step s3. At Step s3, the first precursor knitted fabric 20 is heated to a predetermined temperature so as to be arranged. At this time, the first precursor knitted fabric 20 is heated in a pulling state in the wale direction W. Consequently, the knitted fabric is arranged, and furthermore, a part of the thermal bonding yarn 23 is molten and sticks to another adjacent yarn. The first precursor knitted fabric 20 is heated for a predetermined duration at a predetermined temperature, and the processing proceeds to Step s4. In the embodiment, a state at 180 to 195˚C is maintained for 60 seconds to manufacture the knitted lace fabric 120. Since the knitted lace fabric 120 is obtained by heating the first precursor knitted fabric 20, a part of the thermal bonding yarn 23 is fixed to another yarn. Furthermore, the knitted lace fabric 120 is extended compared to after Step s2, so that the thermal bonding yarn 23 is broken into a plurality thereof.

[0138] At Step s4, the knitted lace fabric 120 is cut and the cut knitted lace fabric 120 is sewn, thereby manufacturing a knitted lace product. When the knitted lace product is manufactured, the processing proceeds to Step s5 in which the work is ended.

[0139] At the cutting and sewing step in the Step s5, a part of the thermal bonding yarn 23 is fixed to another yarn. Therefore, the binding of the chain stitch structure is strengthened. In the cutting or sewing operation, accordingly, each yarn can be prevented from being frayed so that the yield of the knitted lace product which is manufactured can be enhanced, and quality can be improved. Referring to the knitted lace product which is manufactured, similarly, the binding of the chain stitch structure is strengthened. Therefore, it is possible to prevent the fray from being caused by use for wearing or washing, thereby enhancing a durability of the knitted lace product.

[0140] At the heating step shown in the Step s3, furthermore, the first precursor knitted fabric 20 is heated in the pulling state in the wale direction W so that the inserting yarn 22 and the thermal bonding yarn 23 approach the loop-shaped portions 24 and 25. Consequently, the loop-shaped portions 24 and 25 and the inserting yarn 22 can be bonded strongly by the thermal bonding yarn 23.

[0141] Fig. 17 is a view showing a knitting structure, typically illustrating a part of a first precursor knitted fabric 20B according to a second embodiment of the invention. In the first precursor knitted fabric 20B according to the second embodiment, a direction in which a thermal bonding yarn 23 passes through a second loop-shaped portion 25 is different from that in the first precursor knitted fabric 20 according to the first embodiment, and the other structures are the same. Accordingly, the same structures as those in the first precursor knitted fabric 20 according to the first embodiment have the same reference numerals and description will be omitted.

[0142] In the embodiment, the thermal bonding yarn 23 passes through the second loop-shaped portion 25 in the same direction as a inserting yarn 22 and is inserted between a first loop-shaped portion 24 and the inserting yarn 22. More specifically, the thermal bonding yarn 23 and the inserting yarn 22 pass through a first loop-shaped portion 24a

of interest and a second loop-shaped portion 25a in the same stage in a course direction from an opposite side to a side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in an earlier stage C1 in the course direction.

[0143] Thus, the thermal bonding yarn 23 is inserted through the second loop-shaped portion 25 in the same direction as the inserting yarn 22 so that the number of contact portions of the inserting yarn 22, and the thermal bonding yarn 23 can be increased and a bonding force for the thermal bonding yarn 23 to bond the inserting yarn 22 can be enhanced. Consequently, it is possible to prevent the fray of the inserting yarn 22 more reliably.

[0144] As another embodiment, furthermore, the invention also includes the case in which the thermal bonding yarn 23 and the inserting yarn 22 pass through the first loop-shaped portion 24a of interest and the second loop-shaped portion 25a in the same stage in the course direction C from the side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C.

[0145] Furthermore, the invention also includes the case in which the thermal bonding yarn 23 passes through the second loop-shaped portion 25a in the same stage in the course direction C as the first loop-shaped portion 24a of interest from the side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C, and the inserting yarn 22 passes through the second loop-shaped portion 25a in the same stage in the course direction C as the first loop-shaped portion 24a of interest from the opposite side to the side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C.

[0146] Fig. 18 is a view showing a knitting structure, schematically illustrating a part of a first precursor knitted fabric 20D according to a third embodiment of the invention. Fig. 19 is a view showing a knitting structure, schematically illustrating the first precursor knitted fabric 20D in which yarns other than a chain stitch yarn 21, a thermal bonding yarn 23 and a stretch yarn 27 are omitted. In the first precursor knitted fabric 20D according to the third embodiment, the elastic stretch yarn 27 is further knitted separately from the thermal bonding yarn 23 as compared with the first precursor knitted fabric 20B according to the second embodiment and the other structures are the same. Accordingly, the same structures as those in the first precursor knitted fabric 20 according to the first embodiment have the same reference numerals and description will be omitted.

[0147] The first precursor knitted fabric 20D according to the third embodiment is knitted in a state in which the stretch yarn 27 is extended separately from the thermal bonding yarn 23 so that the first precursor knitted fabric 20D obtained after the knitting contracts. Consequently, it is possible to give an elasticity to the first precursor knitted fabric 20D. For example, a polyurethane elastic yarn, a so-called spandex is used for the stretch yarn.

[0148] The stretch yarn 27 is extended to the first loop-shaped portion 24 side with respect to the inserting yarn 22. Furthermore, the stretch yarn 27 and the thermal bonding yarn 23 cross each other and pass through the second loop-shaped portion 25 and are knitted into the chain stitch structure. In other words, the thermal bonding yarn 23 is knitted while extending in a different direction from a direction in which the stretch yarn 27 extends. The stretch yarn 27 is knitted into each of wales and thus passes zigzag in the course direction C along the wales respectively.

[0149] In the embodiment, the stretch yarn 27 passes through a first loop-shaped portion 24a of interest and a second loop-shaped portion 25a in the same stage in a course direction from a side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in an earlier stage C1 in the course direction. Furthermore, the inserting yarn 22 and the thermal bonding yarn 23 pass through the first loop-shaped portion 24a of interest and the second loop-shaped portion 25a in the same stage in the course direction from an opposite side to a side on which the first loop-shaped portion 24a of interest is connected to the second loop-shaped portion 25b in the earlier stage in the course direction C. In a portion in which the stretch yarn 27, the thermal bonding yarn 23 and the inserting yarn 22 pass through the same loop together, accordingly, the stretch yarn 27 crosses the thermal bonding yarn 23 and the inserting yarn 22.

[0150] Referring to the case in which the stretch yarn 27 is knitted into the first precursor knitted fabric 20D as in the third embodiment, it is possible to obtain the same advantages as those in the first embodiment. More specifically, the thermal bonding yarn 23 bonds another yarn so that the fray of each yarn can be prevented. Furthermore, the thermal bonding yarn 23 bonds the stretch yarn 27 and the chain stitch yarn 21 so that it is possible to prevent a so-called span slip in which the stretch yarn 27 slips from the chain stitch structure.

[0151] In the third embodiment, furthermore, the first precursor fabric 20D is pulled in the wale direction W so that regions surrounded by the stretch yarn 27 and the inserting yarn 22 approach each other in the wale direction W to generate an approaching portion 34 in which the thermal bonding yarn 23, the inserting yarn 22, the stretch yarn 27, the first loop-shaped portion 24 and the second loop-shaped portion 25 approach each other. By heating the first precursor knitted fabric 20D in the pulling state in the wale direction W, thus, it is possible to melt a part of the thermal bonding yarn 23 in the approaching portion 34. Thus, it is possible to increase a bonding force for bonding the thermal bonding yarn 23, the stretch yarn 27, the inserting yarn 22, the first loop-shaped portion 24 and the second loop-shaped portion 25.

[0152] In the embodiment, the inserting yarn 22 and the thermal bonding yarn 23 are extended in the same direction. Consequently, the number of the contact portions in which the thermal bonding yarn 23 comes in contact with the

inserting yarn 22 can be increased and the inserting yarn 22 can be prevented from slipping off more reliably. Furthermore, the thermal bonding yarn 23 and the stretch yarn 27 cross each other so that the thermal bonding yarn 23 is bonded to the stretch yarn 27. Thus, it is possible to lessen restraining portions for restraining the stretch yarn 27. Consequently, it is possible to prevent a span slip while suppressing a reduction in elasticity of the knitted lace fabric.

[0153] In the embodiment, furthermore, the directions in which the thermal bonding yarn 23 and the stretch yarn 27 are inserted between the first loop-shaped portion and the second loop-shaped portion are different from each other in a portion of the first precursor knitted fabric 20 in which both the thermal bonding yarn 23 and the stretch yarn 27 are knitted into the chain stitch yarn 21.

[0154] Consequently, it is possible to reduce a contact amount in which the stretch yarn 27 and the thermal bonding yarn 23 come in contact with each other, to cause the thermal boding yarn 23 molten at the heating step to easily stick to the chain stitch yarn 21, and to easily form the fused portion 100 on the chain stitch yarn 21 in the knitted lace fabric 120.

[0155] The thermal bonding yarn 23 and the stretch yarn 27 are formed by the same kind of polyurethane based materials, and the chain stitch yarn 21 is formed of a different material from the thermal bonding yarn 23 such as nylon (a polyamide type synthetic fiber) in some cases. In these cases, when the thermal bonding yarn 23 sticks to the stretch yarn 27 formed of the same kind of material, it is hard to dissociate. On the other hand, when the thermal bonding yarn 23 sticks to the chain stitch yarn 21 formed of a different material, it can easily be dissociated.

[0156] In the case in which the thermal bonding yarn 23 sticks to both the stretch yarn 27 and the chain stitch yarn 21, it is easily dissociated from the chain stitch yarn 21. In the embodiment, it is possible to prevent the thermal bonding yarn 23 from sticking to both the stretch yarn 27 and the chain stitch yarn 21. Therefore, it is possible to reduce a possibility that the thermal bonding yarn 23 might be dissociated from the chain stitch yarn 21. Thus, the fused portion 100 can be caused to remain in the chain stitch yarn 21.

[0157] Fig. 20 is a view showing a knitting structure, schematically illustrating a part of a first precursor knitted fabric 20E according to a fourth embodiment of the invention. In the first precursor knitted fabric 20E according to the fourth embodiment, a direction in which a stretch yarn 27 is extended is different from that in the first precursor knitted fabric 20D according to the third embodiment and the other structures are the same. In the embodiment, the stretch yarn 27 passes through a first loop-shaped portion 24a of interest and a second loop-shaped portion 25a in the same stage in a course direction C from an opposite side to a side on which the first loop-shaped portion 24a of interest is connected to a second loop-shaped portion 25b in an earlier stage C in the course direction. In the case in which the stretch yarn 27, a inserting yarn 22 and a thermal bonding yarn 23 pass through the same second loop-shaped portion 25 together, accordingly, they pass in the same direction. In a portion in which the stretch yarn 27, the inserting yarn 22 and the thermal bonding yarn 23 pass through the same second loop-shaped portion together, the yarns 22, 23 and 27 are placed in close positions to each other. In the case in which the thermal bonding yarn 23 is molten, therefore, it is possible to increase a force for bonding the inserting yarn 22 to the stretch yarn 27.

[0158] Fig. 21 is a side view showing a knitting portion of a back jacquard raschel knitting machine 60C for knitting the first precursor knitted fabrics 20D and 20E according to the third and fourth embodiments. In the knitting machine 60, a guide bar for stretch yarn 66 to be yarn guiding means for guiding the stretch yarn 27 toward the knitting position 73 is disposed between the jacquard bar 62 and the guide bar for thermal bonding yarn 61. Since the other structures are the same as those in the knitting machine shown in Fig. 12, description will be omitted.

[0159] Thus, the guide bar for stretch yarn 66 and the guide bar for thermal bonding yarn 61 are disposed so that the guide bar for stretch yarn 66 and the guide bar for thermal bonding yarn 61 are provided on a back face side with respect to the inserting yarn 22. In the case in which the knitted lace fabric 120 is seen from a front face side, consequently, the stretch yarn 27 and the thermal bonding yarn 23 are hidden by the inserting yarn 22. Thus, the pattern of the knitted lace fabric can be clear. By causing the operations of the jacquard bars 62 and 63, the guide bar for stretch yarn 66 and the guide bar for thermal bonding yarn 61 to be different from each other, furthermore, it is possible to knit the first precursor knitted fabric 20D and 20E described in the third and fourth embodiments. Furthermore, the guide bar for stretch yarn and the guide bar for thermal bonding yarn may be disposed to be longitudinally reverse. In this case, a longitudinal relationship between the stretch yarn and the thermal bonding yarn is reverse in the knitted lace fabrics according to the third and fourth embodiments. The case in which the stretch yarn and the thermal bonding yarn are inverted longitudinally is also included in the invention. In addition to the back jacquard knitting machine, the knitted lace fabric formed by a front jacquard knittingmachine in which the jacquard bars 62 and 63 are disposed before the knitting machine from the pattern yarn is also included in the invention in the case in which the thermal bonding yarn 23 is knitted.

[0160] Fig. 22 is a view showing a knitting structure, schematically illustrating a part of a first precursor knitted fabric 20F according to a fifth embodiment of the invention. Although it is preferable that a thermal bonding yarn 23 should be disposed on a back face side with respect to the inserting yarn 22, the case in which the thermal bonding yarn 23 is knitted into a front face side with respect to the inserting yarn 22 is also included in the invention as shown in Fig. 22. Fig. 23 is a side view showing a knitting portion of a back jacquard raschel knitting machine 60F for knitting the first precursor knitted fabric 20F according to the fifth embodiment. In the knitting machine 60, the guide bar for thermal bonding yarn 61 is disposed in a front part of the knitting machine from the jacquard bar 62. Since the other structures

are the same as those in the knitting machine shown in Fig. 20, description will be omitted.

[0161] Also in the first precursor knitted fabrics 20B, and 20D to 20F according to the second to fifth embodiments as described above, it is possible to obtain the same advantages as those in the first embodiment. Further more, the embodiment according to the invention is a simple example of the invention and the structures can be changed within the range of the invention. For example, although the thermal bonding yarn 23 and the inserting yarn 22 are knitted into the chain stitch structure having a fray preventing function in the embodiment, it is sufficient that the knitted fabric to be a base is formed by a chain stitch and the chain stitch structure is not restricted. For example, the same advantages can be obtained also in a chain stitch structure in which the second loop-shaped portion of the chain stitch yarn 21 does not swing transversely, that is, a chain stitch structure having no fray stopping effect. Furthermore, the knitted fabric to be the base may be a tulle knitted fabric in addition to a basic chain stitch structure and may be formed to have a power net structure. By the formation into the power net structure, it is possible to form an elastic clear pattern in multiple directions. Furthermore, the knitted fabric to be the base may be a wide lace (allover lace) and a narrow lace.

[0162] Furthermore, the knitted lace fabric formed by the knitting machine according to the embodiment becomes elastic by knitting a spandex into the chain stitch structure. The invention is not restricted thereto. More specifically, a knitted lace fabric formed by a knitting machine which does not knit the spandex is also included as the knitting machine according to another embodiment of the invention. In this case, the knitted lace fabric is hardly elastic but is a so-called rigid knitted lace fabric. Furthermore, the thermal bonding yarn 23 may be a yarn whose elasticity is low or a yarn which is not elastic. The thermal bonding yarn 23 may consist of a material other than the aforementioned material, if the yarn can be broken after a weld.

[0163] In the embodiment, furthermore, the inserting yarn may be a pattern yarn or a floating yarn. Furthermore, the thermal bonding yarn 23 does not need to be knitted into all of the chain stitch portions but may be knitted into the chain stitch portion at an interval in the wale direction W and the course direction C. Thus, the knitted lace fabric structures according to the embodiments are only illustrative and it is possible to properly change a structure of a knitted fabric to be a base, a way of knitting each inserting yarn and types of the chain stitch yarn and each of the inserting yarns. Although the thermal bonding yarn 23 is set to be a non-covering yarn, furthermore, it may be implemented by a covering yarn constituted by a core yarn and a covering yarn.

[0164] In each of the embodiments, the following correspondences (1) to (7) can be applied.

(1) A knitted lace fabric having a chain stitch structure in which a plurality of loop-shaped portions are formed with a chain stitch yarn, comprising a ground portion including a portion in which a thermal bonding yarn having a lower melting temperature than the chain stitch yarn is knitted in the chain stitch structure and having a nondense yarn, and a pattern portion including a portion in which the thermal bonding yarn and an inserting yarn for forming a pattern are knitted in the chain stitch structure and having a dense yarn.

There are provided a pattern portion in which an amount of a yarn per unit area is large and a ground portion in which the amount of the yarn per unit area is small. By combining the pattern portion and the ground portion, it is possible to make a contrast on a knitted fabric depending on a difference in a density between the yarns and to form a knitted lace fabric having a pattern. The knitted lace fabric is heated to a temperature which is lower than a melting temperature of a chain stitch yarn and is equal to or higher than a melting temperature of a thermal bonding yarn so that a part of the thermal bonding yarn is partially dissolved. A part of the dissolved portion sticks to a chain stitch yarn and an inserting yarn. By carrying out caking in this state, the chain stitch yarn and the inserting yarn which come in contact with the thermal bonding yarn can be prevented from being isolated from the thermal bonding yarn in a knitted lace manufactured by using the knitted lace fabric. Furthermore, the yarns coming in contact with the thermal bonding yarn can be bonded to each other through the thermal bonding yarn. Consequently, a coupling state of the respective yarns can be maintained so that fray of the yarns can be prevented.

The binding of a chain stitch structure is strengthened in a sticking portion in which the thermal bonding yarn sticks to another yarn. Also in the case in which a part of the chain stitch yarn constituting the chain stitch structure is divided, consequently, the chain stitch structure can be hindered from being frayed in the sticking portion and the chain stitch structure can be prevented from being frayed beyond the sticking portion. Furthermore, a part of the thermal bonding yarn sticks to a portion in which the inserting yarn and the chain stitch yarn cross each other. Consequently, it is possible to prevent the inserting yarn from being shifted or separated from the chain stitch structure. In the case in which the thermal bonding yarn is extended over two adjacent chain stitch yarns, furthermore, it is possible to prevent the two adjacent chain stitch yarns from being separated from each other by bonding the inserting yarns to the respective chain stitch yarns through the thermal bonding yarn.

Thus, it is possible to prevent the fray of each yarn for a knitted lace manufactured by heating a knitted lace fabric. For example, it is possible to prevent the fray of the yarn caused by a manufacturing state such as sewing or cutting of the knitted lace and the fray of the yarn caused by a using state such as wearing or washing. Thus, it is possible to enhance quality. Furthermore, the chain stitch structure is achieved by yarns other than the thermal bonding yarn. By using a yarn having a heat resistance as a chain stitch yarn, therefore, it is possible to stabilize a configuration

of the whole knitted lace.

In the case in which the chain stitch structure is formed by using the thermal bonding yarn, for example, the thermal bonding yarn is to be thickened in order to leave the chain stitch structure also after heating. Consequently, the number of the yarns to constitute the ground portion is increased so that a difference in a density of the yarn between the ground portion and the pattern portion is reduced.

On the other hand, the chain stitch structure is formed by using different chain stitch yarns from the thermal bonding yarn so that the thermal bonding yarn does not need to be thickened in order to leave the chain stitch structure and it is possible to thin the chain stitch yarn and the thermal bonding yarn. By decreasing an amount per unit volume of the yarn constituting the ground portion, consequently, it is possible to increase the difference in the density of the yarn between the ground portion and the pattern portion. As a result, a sense of transparency of a knitted lace can be enhanced and a pattern can be clear. Furthermore, it is possible to reduce an amount of melting of the thermal bonding yarn. By reducing the influence of a molten portion on the whole knitted lace, it is possible to prevent the pattern from being damaged. Furthermore, the chain stitch yarn can be thinned. Therefore, it is possible to cause the knitted lace to be soft, in other words, to be easily deformable. Consequently, the knittedlace can be suitably used for a cloth such as underwear.

(2) The knitted lace fabric wherein the thermal bonding yarn is extended in a course direction in which a plurality of loop-shaped portions are formed in series and is knitted in a chain stitch structure.

The thermal bonding yarn is extended along the course and is thus knitted in the chain stitch structure. Therefore, it is possible to increase binding in a knitting direction for the chain stitch structure. Consequently, it is possible to decrease a transverse swing portion of the chain stitch yarn to be formed for preventing the fray of the chain stitch structure, that is, a run stopping portion. Thus, it is possible to decrease the run stopping portion to be formed on the knitted lace obtained by heating the knitted lace fabric. Therefore, it is possible to prevent the yarn from being undesirably extended between adj acent wales, thereby enhancing a sense of beauty more greatly.

(3) The knitted lace fabric wherein the thermal bonding yarn is a bare yarn having a thermal solubility in a surface portion.

The thermal bonding yarn is a bare yarn in which a surface portion has a heat solubility. When the knitted lace fabric is heated, accordingly, a portion of the thermal bonding yarn which comes in contact with the chain stitch yarn is molten and sticks to the chain stitch yarn. Furthermore, the portion of the thermal bonding yarn which comes in contact with the inserting yarn is molten and sticks to the inserting yarn.

Thus, an exposed portion of the thermal bonding yarn which comes in contact with the other yarn sticks to the other yarn. Consequently, it is possible to increase the amount of sticking of the thermal bonding yarn to the other yarn, thereby enhancing a bonding force. Accordingly, it is possible to prevent the fray of each yarn more reliably. By implementing the thermal bonding yarn with a non-covering yarn, that is, a bare yarn which is not covered with a covering yarn, furthermore, it is possible to decrease the amount of the yarn in the ground portion more greatly. Thus, it is possible to increase a difference in a density of the yarn between the ground portion and the pattern portion, thereby enhancing a sense of transparency of the knitted lace and causing a pattern to be clear.

(4) The knitted lace fabric wherein the thermal bonding yarn is knitted over a whole region of the chain stitch structure.

The thermal bonding yarn is knitted over the whole region of the chain stitch structure. Consequently, it is possible to prevent the fray of the yarn over the whole knitted lace. For example, also in the case in which the knitted lace is sewn or cut in an optional position, it is possible to prevent the yarn from being frayed in a sewing portion and a cutting portion. Thus, it is possible to prevent the fray of the yarn over the whole knitted lace. Consequently, it is possible to increase the uses. For example, it is possible to prevent the fray over the whole knitted lace. Thus, the knitted lace can also be used for a part of a coat requiring a durability.

(5) The knitted lace fabric wherein the chain stitch portion has a first loop-shaped portion and a second loop-shaped portion linked alternately and arranged in a plurality of stages in a course direction, the second loop-shaped portion of interest is inserted through the first loop-shaped portion in an earlier stage in a direction of the second loop-shaped portion and is extended toward a later stage in the course direction, and is inserted through the first loop-shaped portion in the same stage in the course direction of the second loop-shaped portion and is linked to the first loop-shaped portion in the later stage in the course direction, and is thus formed like a chain and is extended in the course direction, and an inserting yarn is inserted between the first loop-shaped portion and the second loop-shaped portion and a thermal bonding yarn is inserted between the inserting yarn and the first loop portion in a potion in which both the thermal bonding yarn and the inserting yarn are knitted.

The thermal bonding yarn and the inserting yarn are inserted between the first loop-shaped portion and the second loop-shaped portion and are thus knitted into the chain stitch structure. In the knitted lace fabric, a plane on a side where the first loop-shaped portion is disposed is a rear face and a plane on an opposite side is a front face with respect to the inserting yarn to be knitted into the chain stitch structure. The inserting yarn is disposed on the front face side with respect to the thermal bonding yarn in a portion in which the thermal bonding yarn and the inserting yarn are knitted in common. As seen from the front face of the knitted lace fabric, accordingly, the thermal bonding

yarn and the first loop-shaped portion are hidden by the inserting yarn.

The thermal bonding yarn can be hidden by the inserting yarn and can be seen from the front face with difficulty. Referring to the knitted lace formed by heating the knitted lace fabric, consequently, it is possible to cause the formed pattern to be clear. Also in the case in which the thermal bonding yarn is molten, furthermore, it is possible to lessen the influence on the pattern seen from the front face. Furthermore, the thermal bonding yarn passes through a portion between the first loop-shaped portion and the inserting yarn so that the first loop-shaped portion and the inserting yarn can be bonded to each other and the inserting yarn can be prevented from being removed from the chain stitch structure.

(6) The knitted lace fabric wherein the chain stitch structure has portions in which a thermal bonding yarn and an elastic stretch yarn are knitted therein, respectively.

The stretch yarn having an elasticity is knitted into the chain stitch structure in a stretch state. Consequently, it is possible to give the elasticity to the knitted lace. Furthermore, the knitted lace is heated after the knitting operation so that a part of the thermal bonding yarn sticks to the stretch yarn in a portion in which the thermal bonding yarn and the stretch yarn come in contact with each other. Consequently, it is possible to prevent the stretch yarn from slippingout of the chain stitch structure. Thus, it is possible to prevent the stretch yarn from slipping out of the sewing portion, for example.

Thus, the thermal bonding yarn is knitted into the chain stitch structure. For the elastic knitted lace, consequently, it is possible to prevent the fray of the yarn. Also in the case in which the knitted lace repeats an expansion and contraction after the knitting operation, furthermore, it is possible to prevent each yarn from being shifted by the thermal bonding yarn. Consequently, the pattern of the knitted lace in an expansion and contraction can be prevented from being greatly different from the pattern of the knitted lace before the expansion and contraction. Thus, it is possible to maintain the sense of beauty of the knitted lace for a long period of time.

(7) A knitted lace manufactured by the knitted lace fabric.

[0165] The knitted lace fabric is heated so that a part of the thermal bonding yarn contained in the knitted lace fabric is molten and the binding of the respective yarns is strengthened. Accordingly, it is possible to prevent the fray of the knitted lace formed by using the knitted lace fabric. Furthermore, the chain stitch structure is formed by using the chain stitch yarn which is different from the thermal bonding yarn. Consequently, it is not necessary to thicken the thermal bonding yarn in order to leave the chain stitch structure. Thus, it is possible to thin the thermal bonding yarn and the chain stitch yarn. As a result, it is possible to decrease an amount per unit area of the yarn constituting the ground portion, thereby increasing the difference in the density of the yarn between the ground portion and the pattern portion.

[0166] Thus, the knitted lace is manufactured by using the knitted lace fabric. Consequently, it is possible to prevent the fray of the yarn and to increase the difference in the density of the yarn between the ground portion and the pattern portion, to enhance a sense of transparency of the knitted lace and to cause the pattern to be clear, thereby suppressing deterioration in a sense of beauty.

[0167] The invention may be embodied in other specific 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.

Claims

1. A method of manufacturing a knitted lace comprising:

a knitted fabric knitting step of knitting an elastic knitted fabricy in such a manner that while a chain stitch structure in which a plurality of loop-shapedportions are formed is formed with a chain stitch yarn, a thermal bonding yarn having a lower melting temperature than that of the chain stitch yarn is knitted into the chain stitch structure;

a heating step of heating the knitted fabric containing the thermal bonding yarn to a temperature equal to or lower than the melting temperature of the chain stitch and equal to or higher than the melting temperature of the thermal bonding yarn; and

a breaking step of applying a tension to the knitted fabric containing the thermal bonding yarn, thereby breaking the molten thermal bonding yarn into a plurality of portions.

2. The method of claim 1, wherein a knitting condition at the knitted fabric knitting step and a heating condition at the heating step are set so that an extension limiting amount $\varepsilon 1$ of the whole knitted fabric excluding the thermal bonding

yarn subjected to the heating step is larger than an extension limiting amount ε2 of the thermal bonding yarn subjected to the heating step.

3. The method of claim 1 or 2, wherein the heating step and the breaking step are carried out at the same time.

4. The method of any one of claims 1 to 3, wherein the heating condition at the heating step is set to melt the thermal bonding yarn and to prevent yarns other than the thermal bonding yarn which are contained in the knitted fabric, from being fragile.

5. The method of any one of claims 1 to 4, wherein the heating condition at the heating step is set to divide the thermal bonding yarn through melting.

6. The method of any one of claims 1 to 5, wherein a polyester-based thermoplastic polyurethane elastic yarn of 10 deniers to 300 deniers is used as the thermal bonding yarn and is heated at a heating temperature of 170˚C to 195˚C for 30 sec to 90 sec at the knitted fabric knitting step.

7. The method of any one of claims 1 to 6, wherein an inserting yarn other than the thermal bonding yarn is knitted at the knitted fabric knitting step, and
in the chain stitch portion, a first loop-shaped portion and a second loop-shaped portion are alternately connected and arranged in a plurality of stages in a course direction; the second loop-shaped portion is inserted through the first loop-shaped portion in an earlier stage in the course direction of the second loop-shaped portion and is extended toward a later stage in the course direction, and the second loop-shapedportion is inserted through the first loop-shaped portion in the same stage in the course direction of the second loop-shaped portion and is connected to the first loop-shaped portion in the later stage in the course direction, whereby the second loop-shaped portion is formed like a chain and is extended in the course direction in the chain stitch portion; and directions of an insertion of the thermal bonding yarn and the other inserting yarn between the first loop-shaped portion and the second loop-shaped portion are set to be different from each other in a portion in which both the thermal bonding yarn and the other inserting yarn are knitted.

8. The method of any one of claims 1 to 7, wherein, at the knitted fabric knitting step, an elastic stretch yarn is knitted in addition to the thermal bonding yarn in an extending state; a first loop-shaped portion and a second loop-shaped portion are alternately connected and arranged in a plurality of stages in a course direction; the second loop-shaped portion of interest is inserted through the first loop-shaped portion in an earlier stage in the course direction of the second loop-shaped portion and is extended toward a later stage in the course direction, and is inserted through the first loop-shaped portion in the same stage in the course direction of the second loop-shaped portion and is connected to the first loop-shaped portion in the later stage in the course direction, whereby the second loop-shaped portion is formed like a chain and is extended in the course direction in the chain stitch portion; and directions of an insertion of the thermal bonding yarn and the stretch yarn between the first loop-shaped portion and the second loop-shaped portion are set to be different from each other in a portion in which both the thermal bonding yarn and the stretch yarn are knitted.

9. A knitted lace manufactured by the method of any one of claims 1 to 8.

FIG. 1

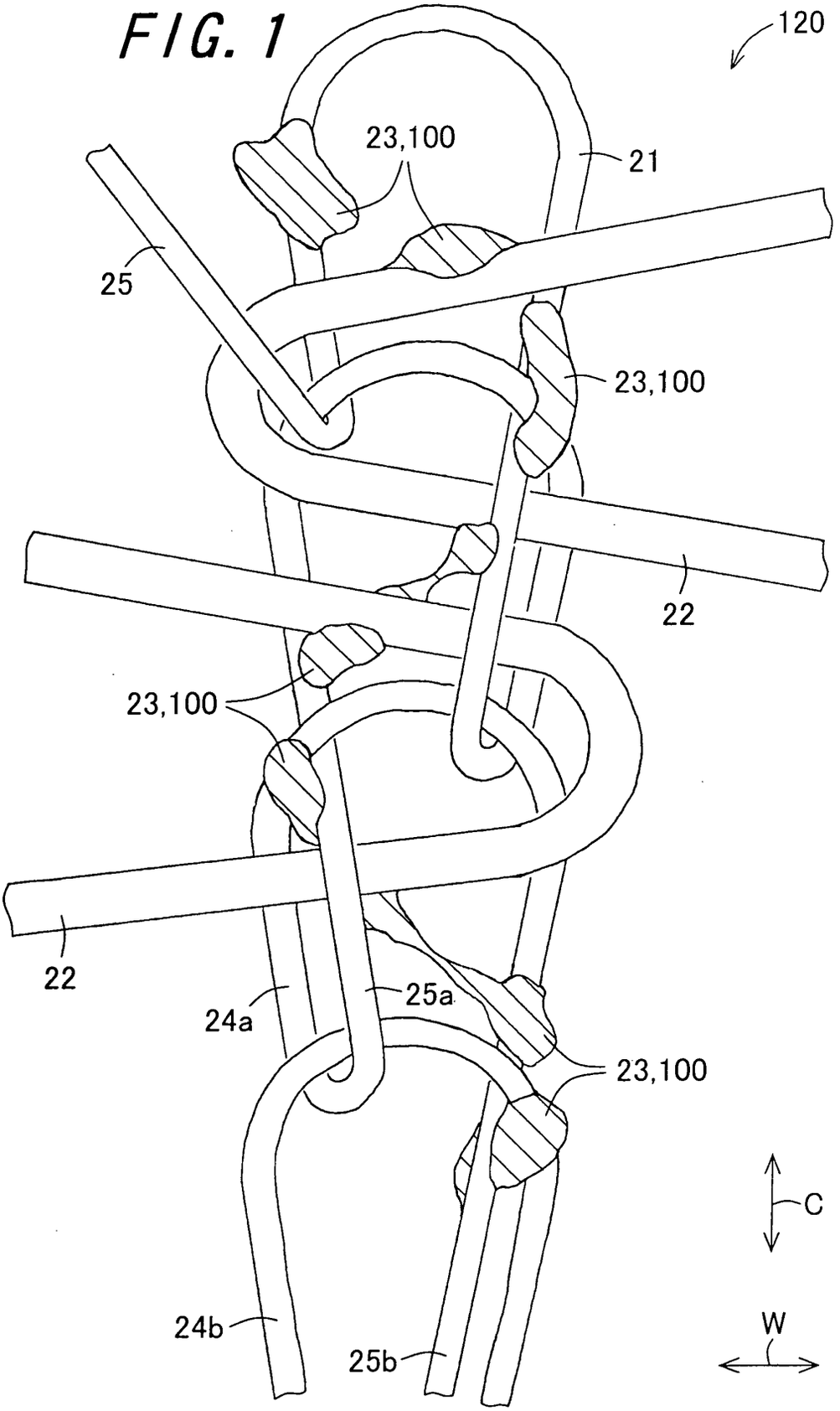


FIG. 2

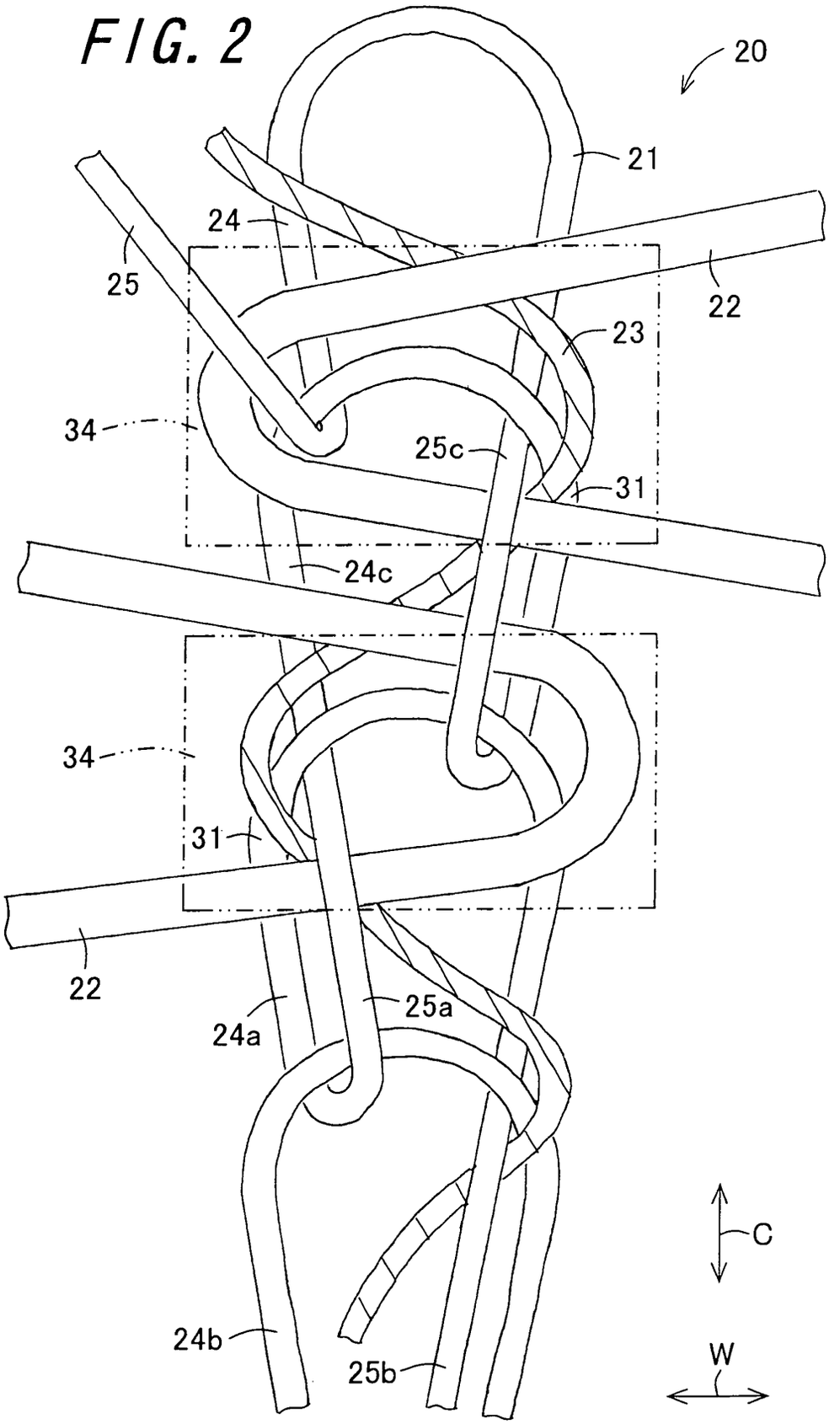


FIG. 3

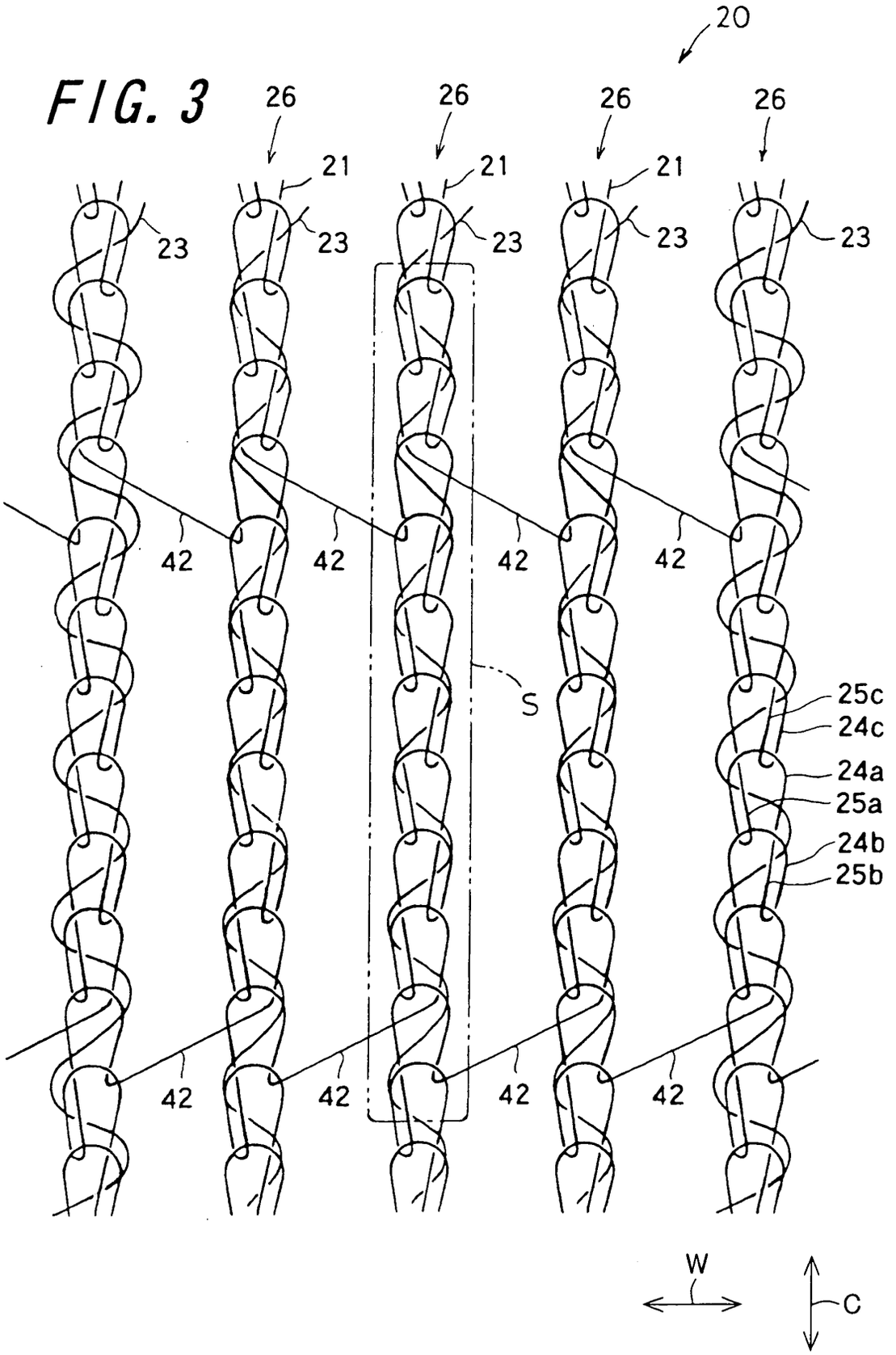

20
26
26
26
26
21
21
21
23
23
23
23
23
42
42
42
42
S
25c
24c
24a
25a
24b
25b
42
42
42
42
W
C

FIG. 4

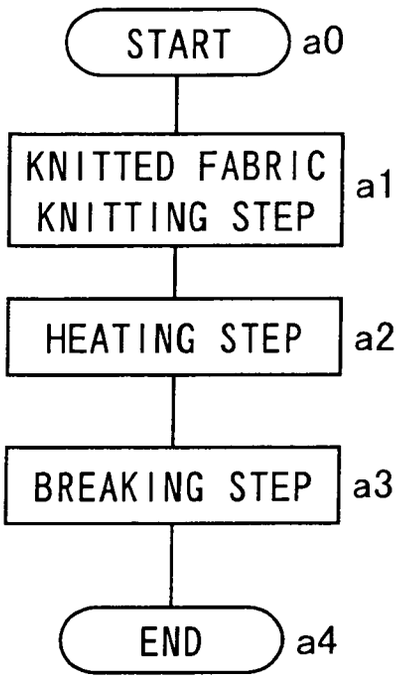

START
a0
KNITTED FABRIC KNITTING STEP
a1
HEATING STEP
a2
BREAKING STEP
a3
END
a4

FIG. 5A

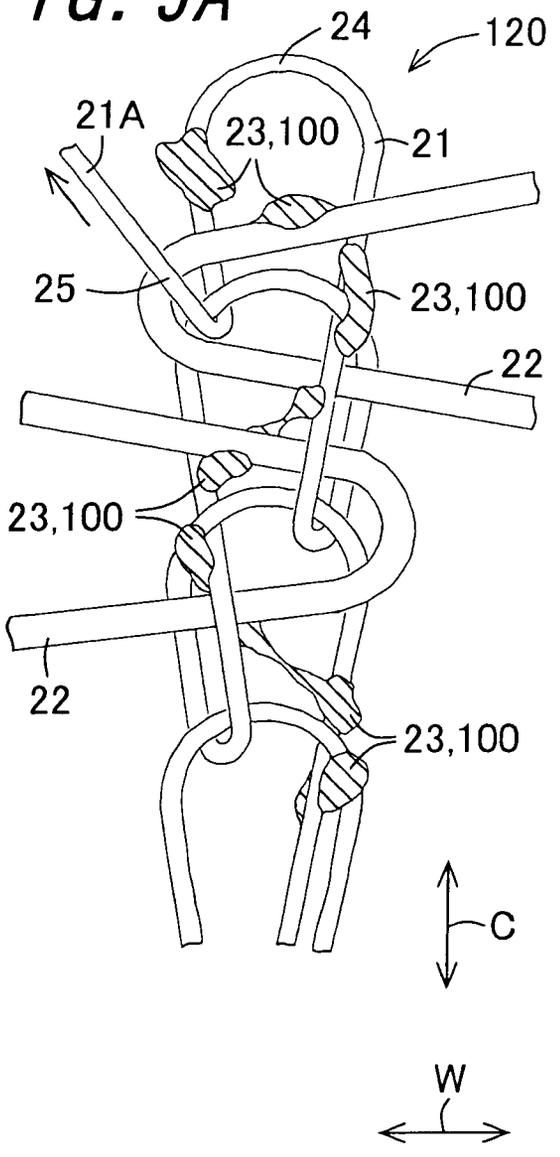


FIG. 5B

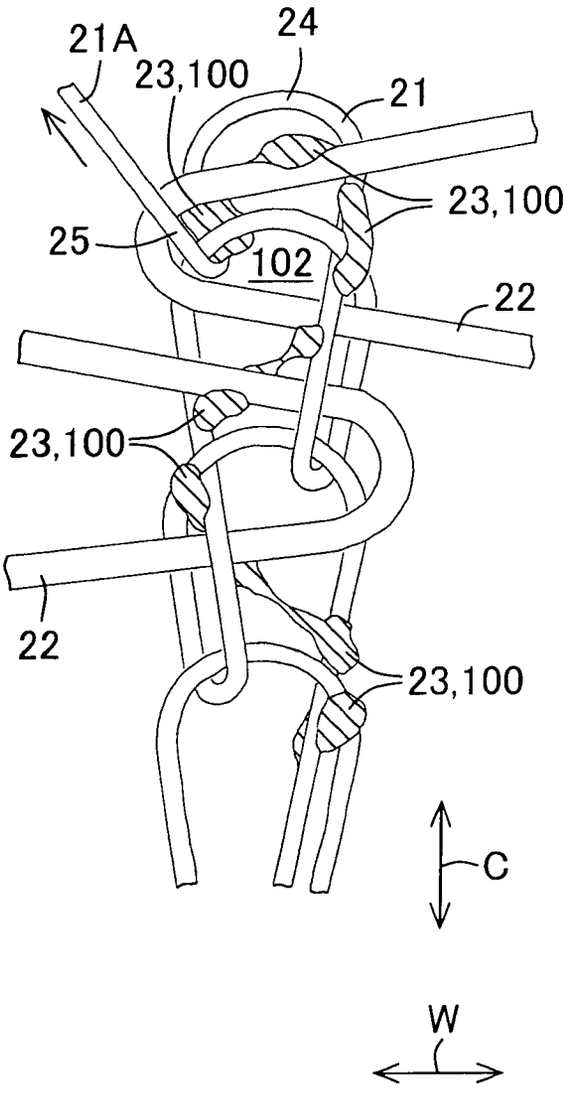


FIG. 6A

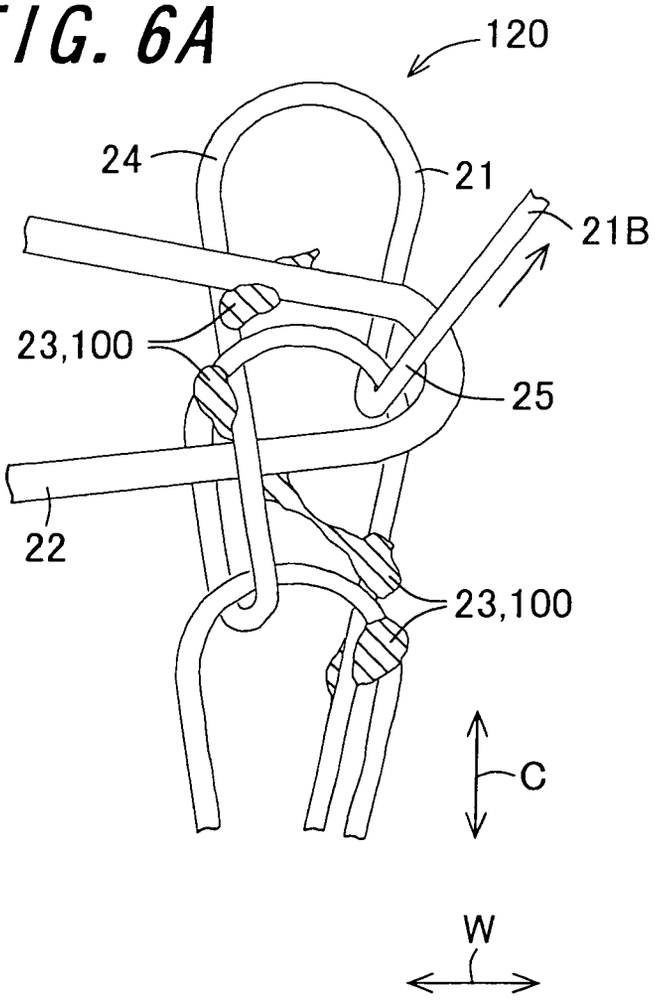


FIG. 6B

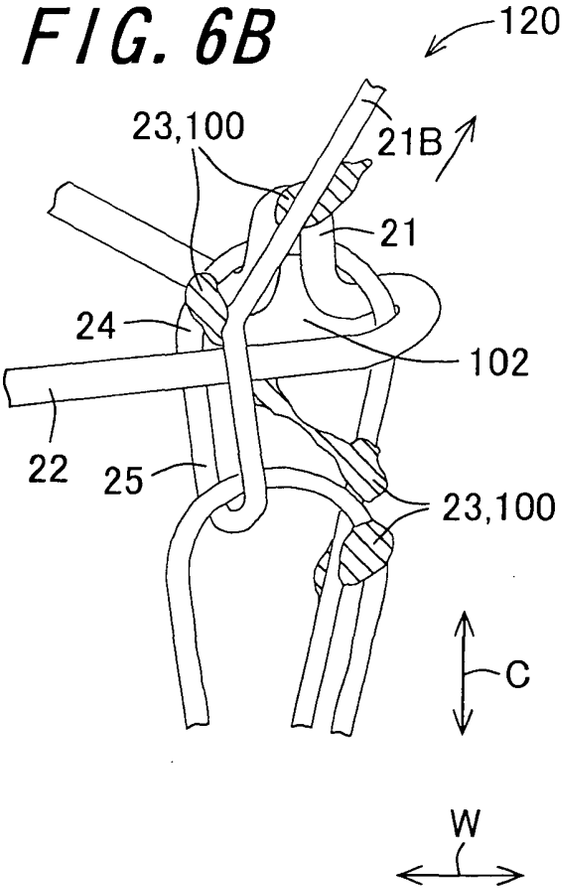

120
23,100
21B
21
24
102
22
25
23,100
C
W

FIG. 7

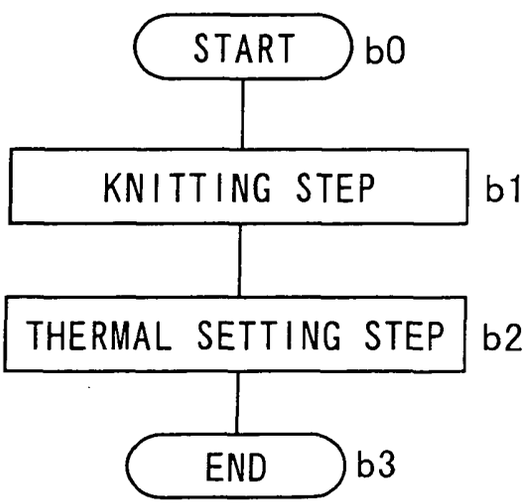

START
b0
KNITTING STEP
b1
THERMAL SETTING STEP
b2
END
b3

FIG. 8

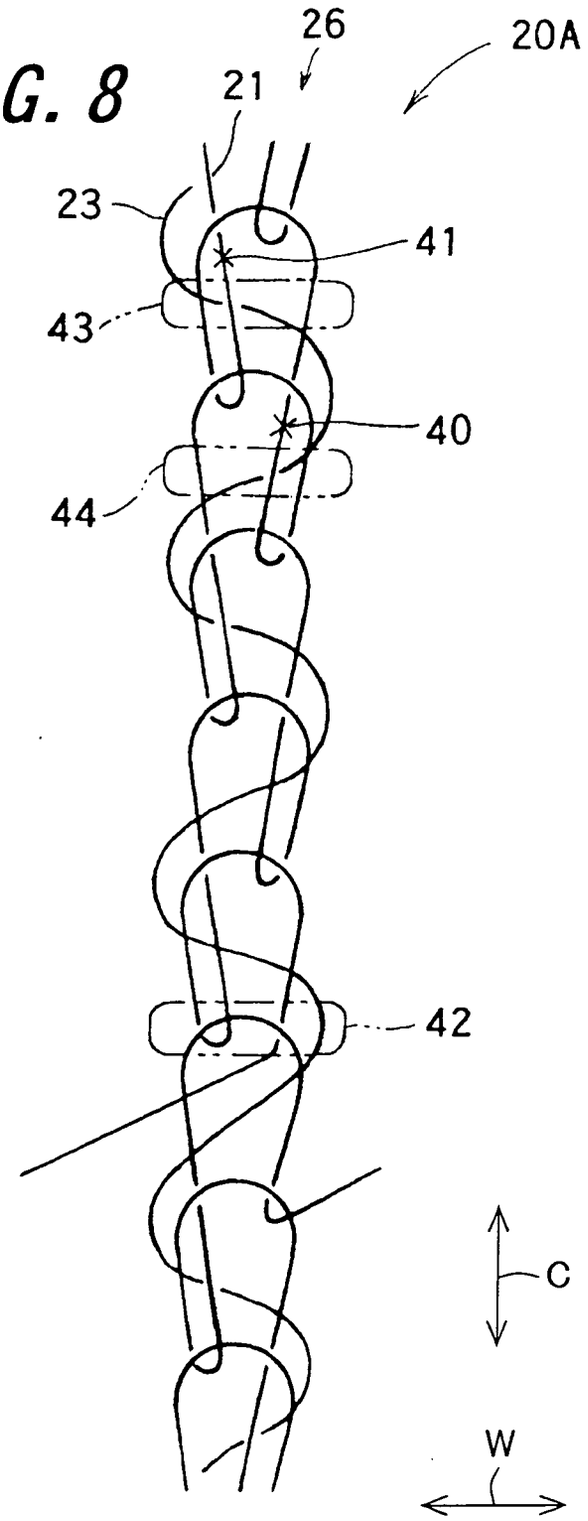


FIG. 9

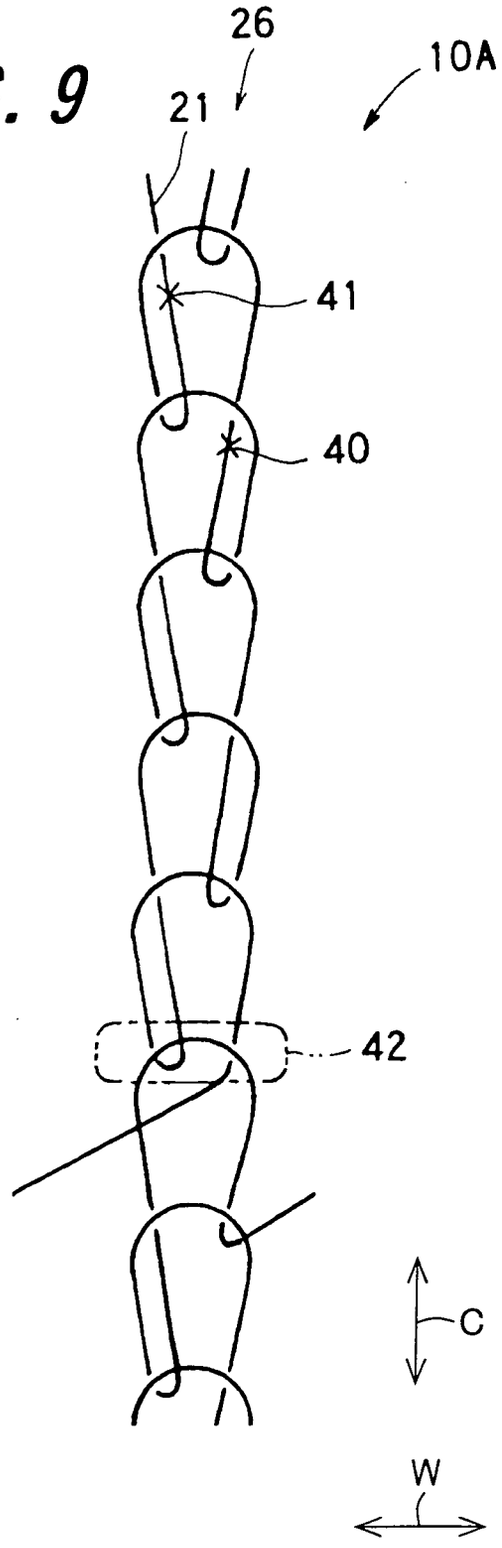


FIG. 10

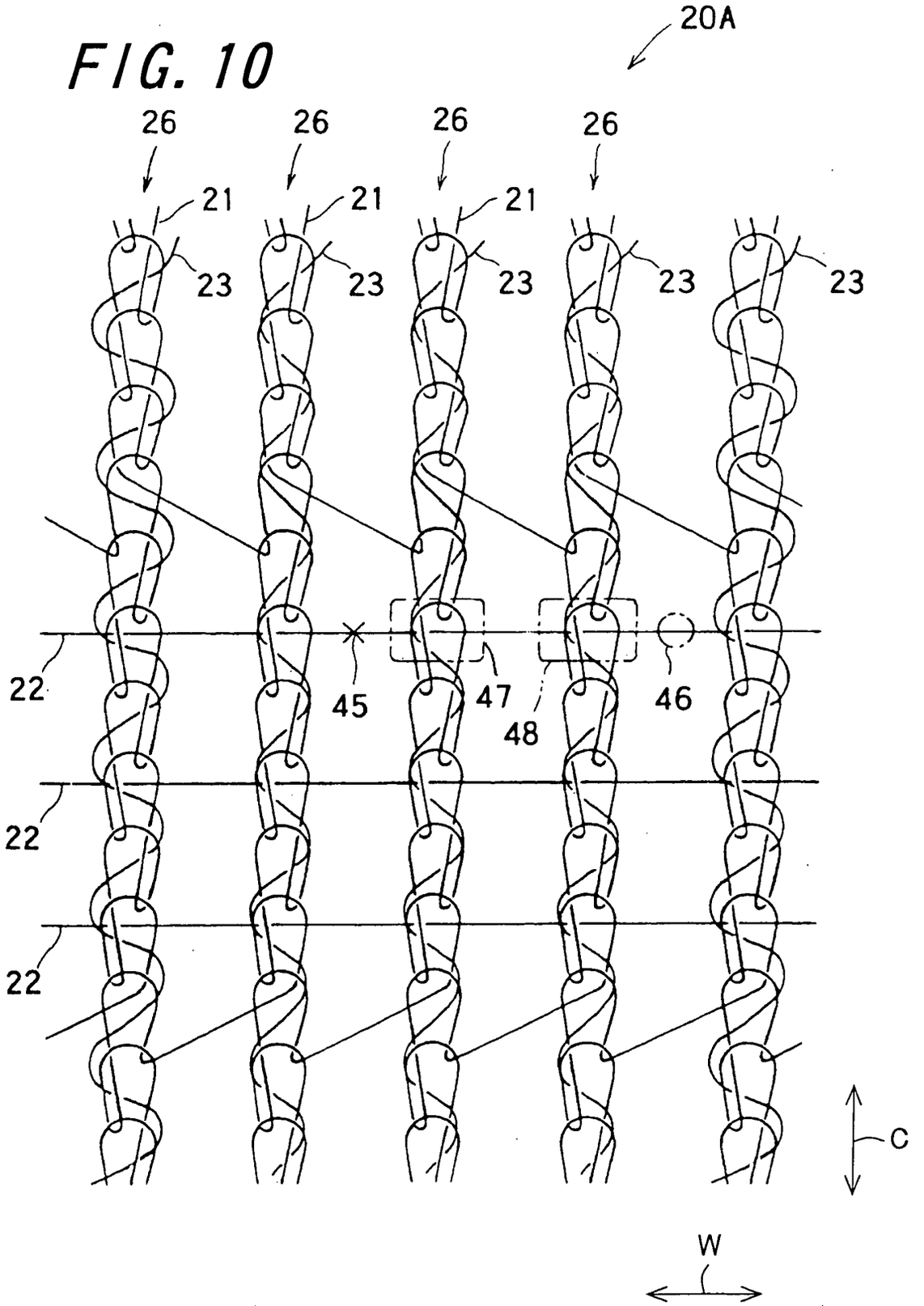
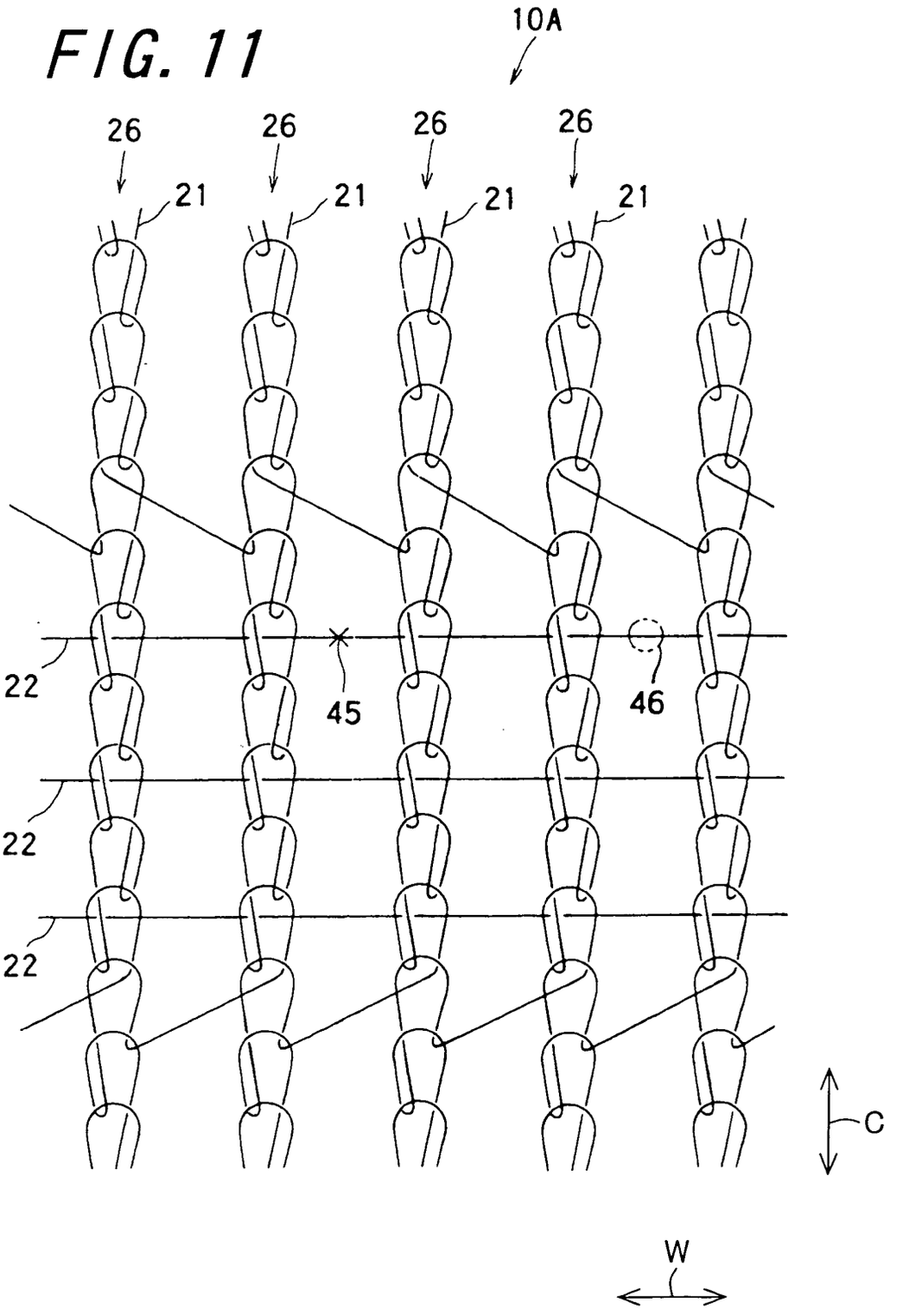


FIG. 11



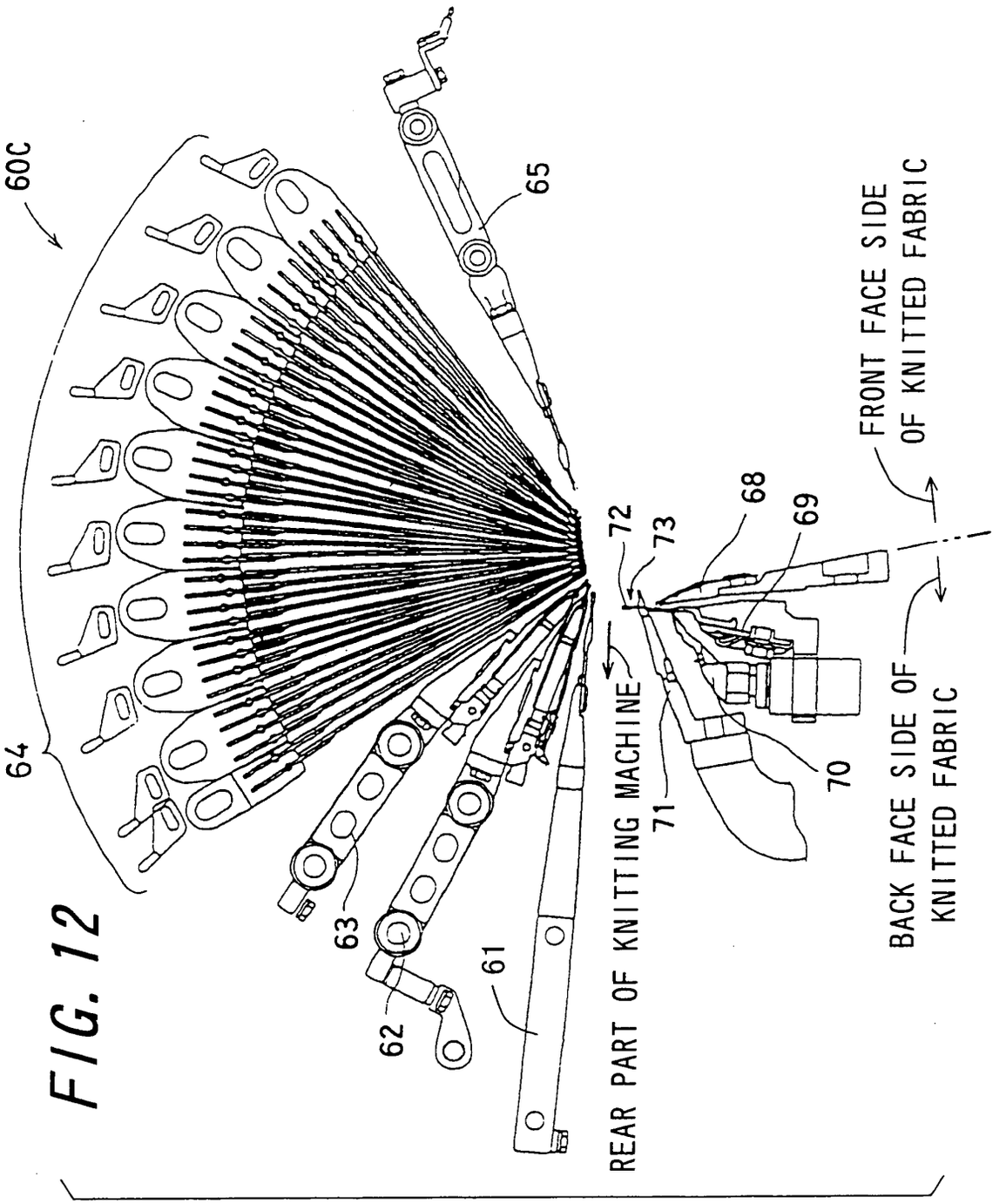

60C
64
65
63
62
61
72
73
68
69
71
70
REAR PART OF KNITTING MACHINE
FRONT FACE SIDE OF KNITTED FABRIC
BACK FACE SIDE OF KNITTED FABRIC

FIG. 12

FIG. 13A

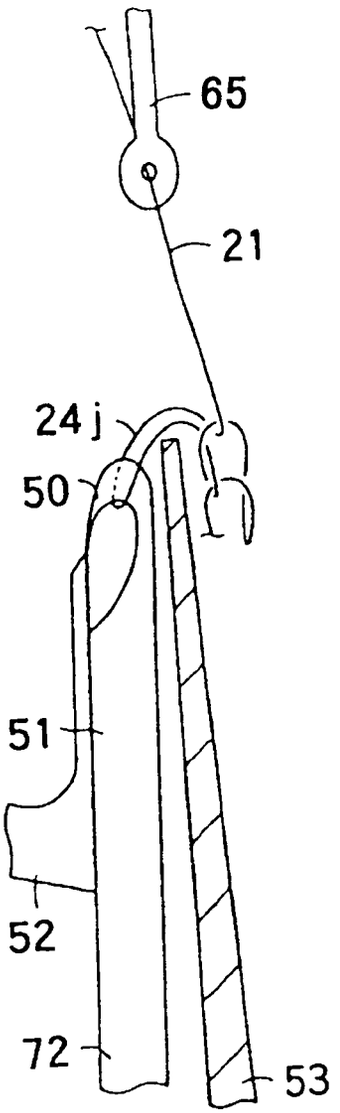


FIG. 13B

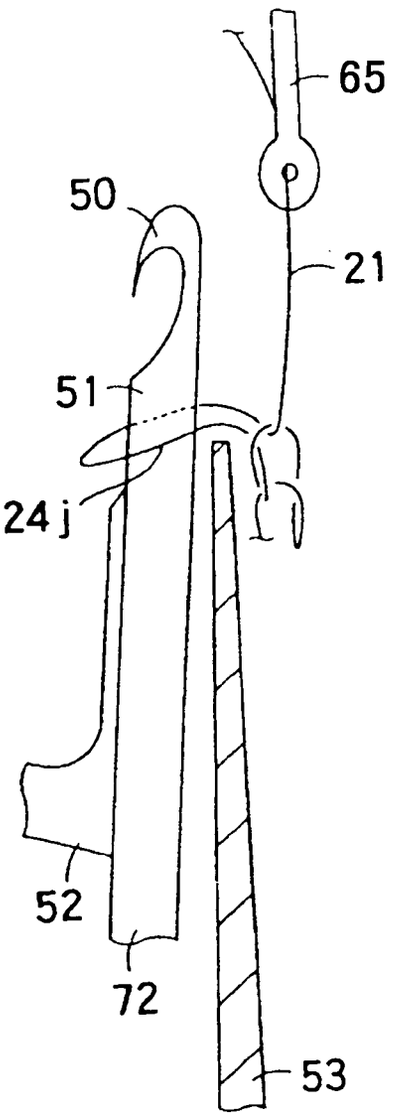


FIG. 13C

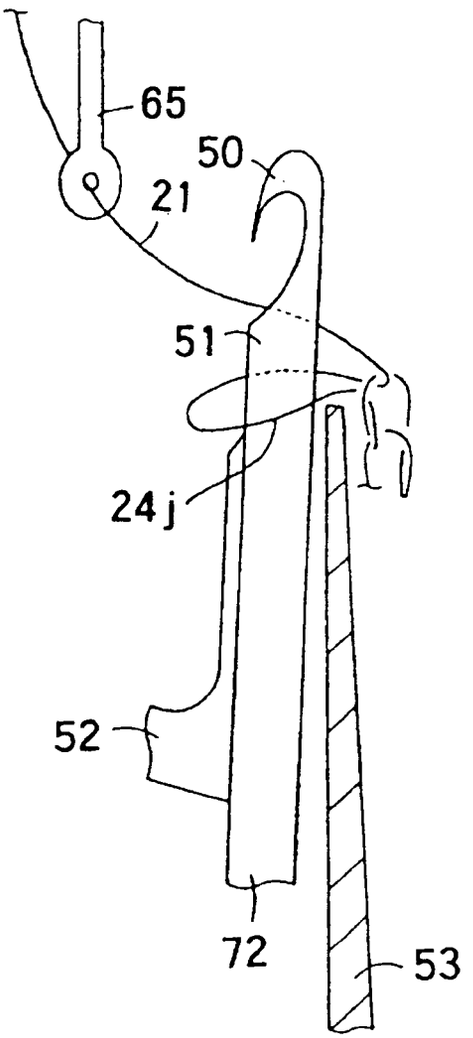


FIG. 13D

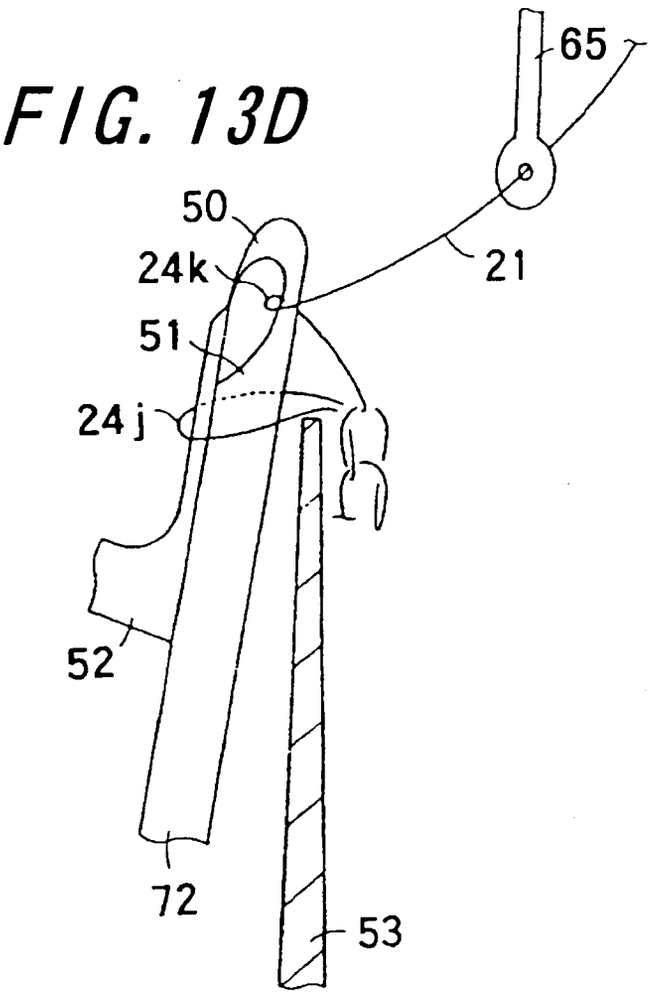


FIG. 13E

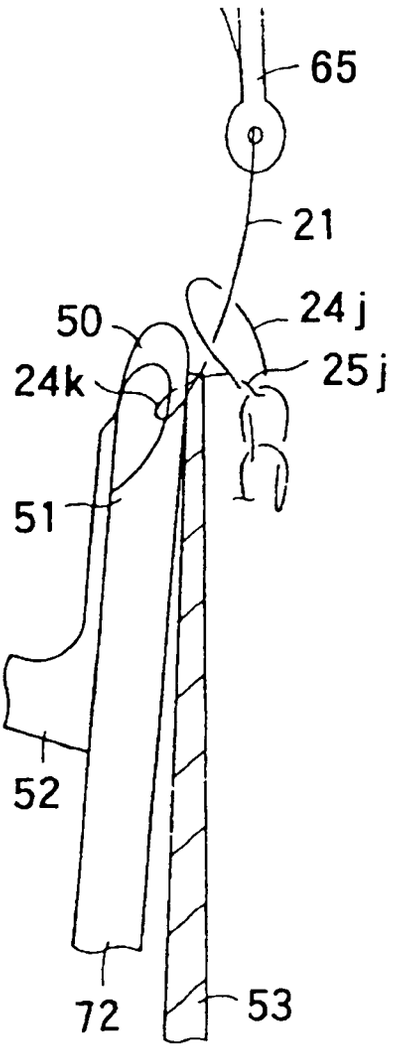


FIG. 14A

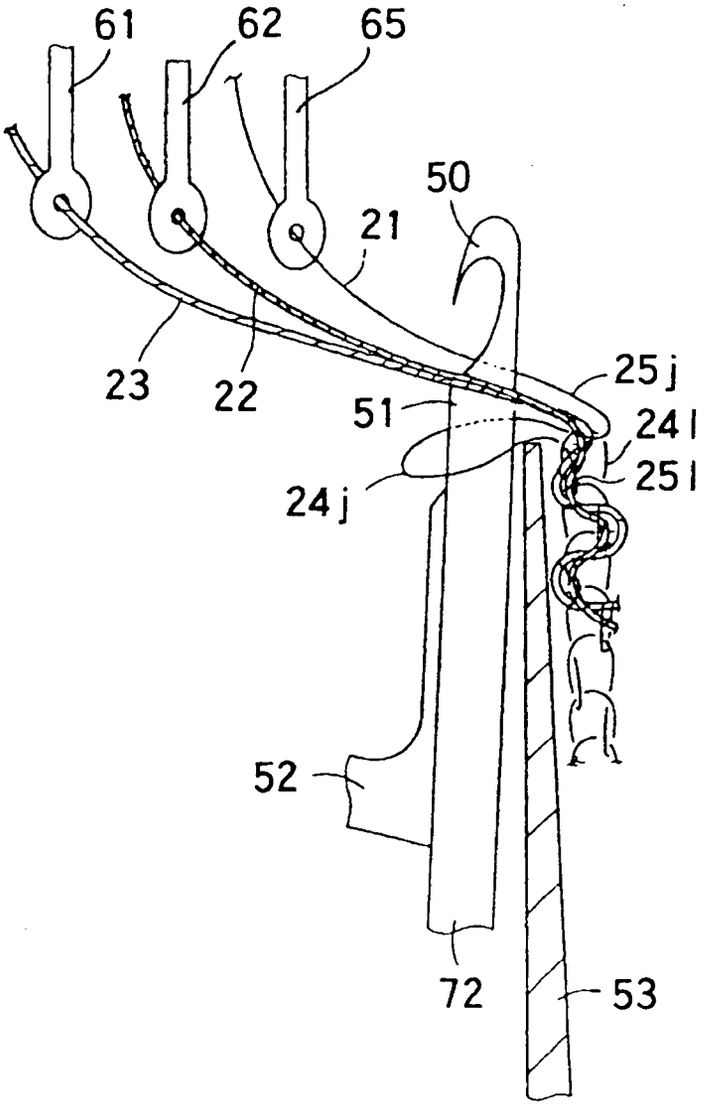


FIG. 14B

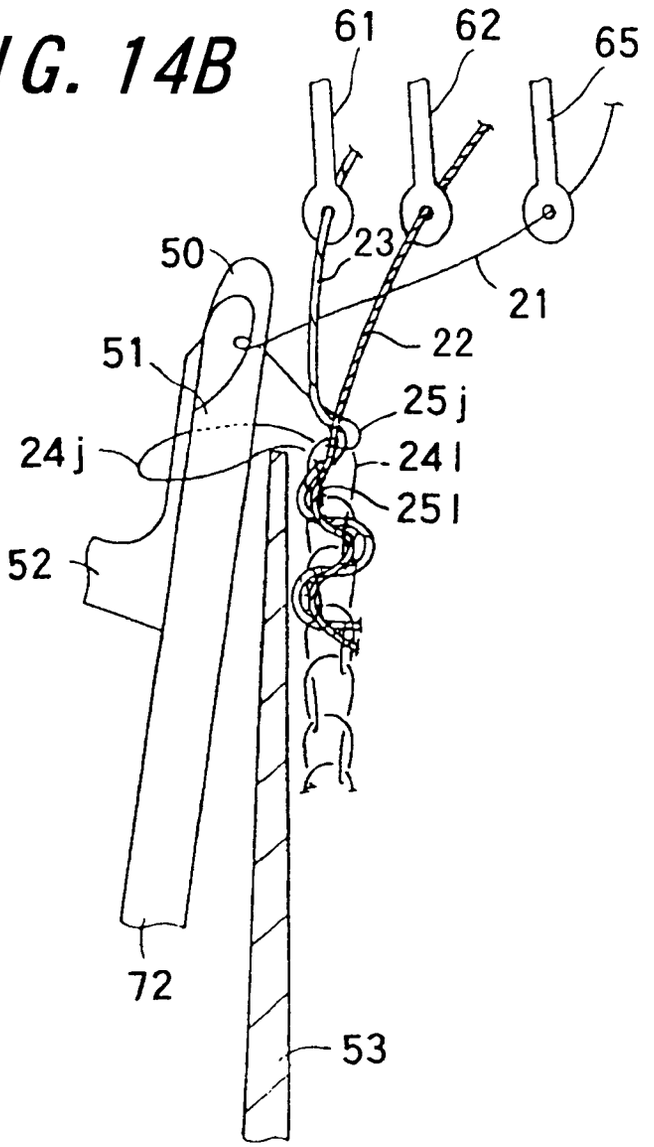


FIG. 14C

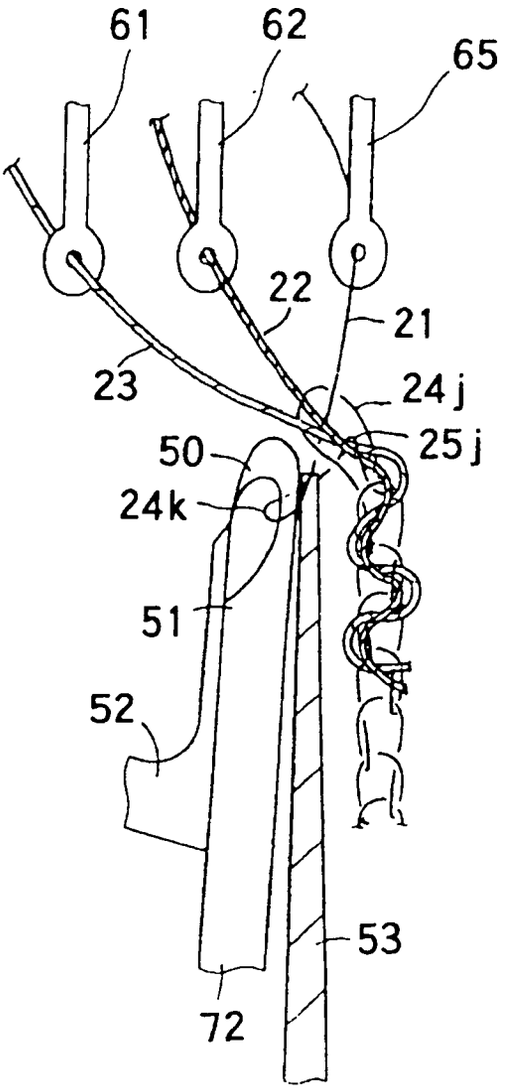


FIG. 15A

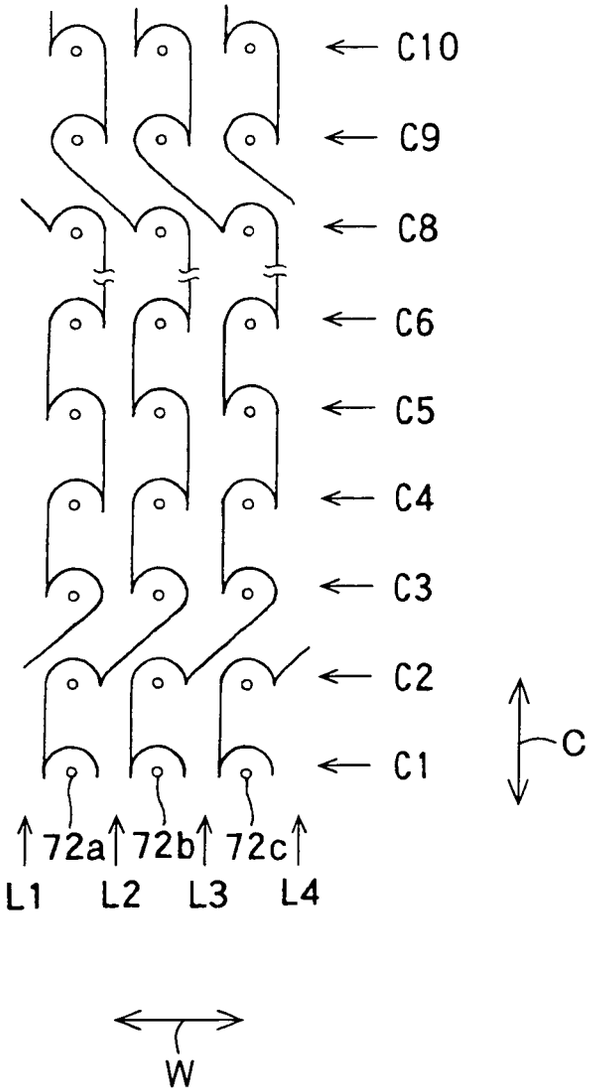


FIG. 15B

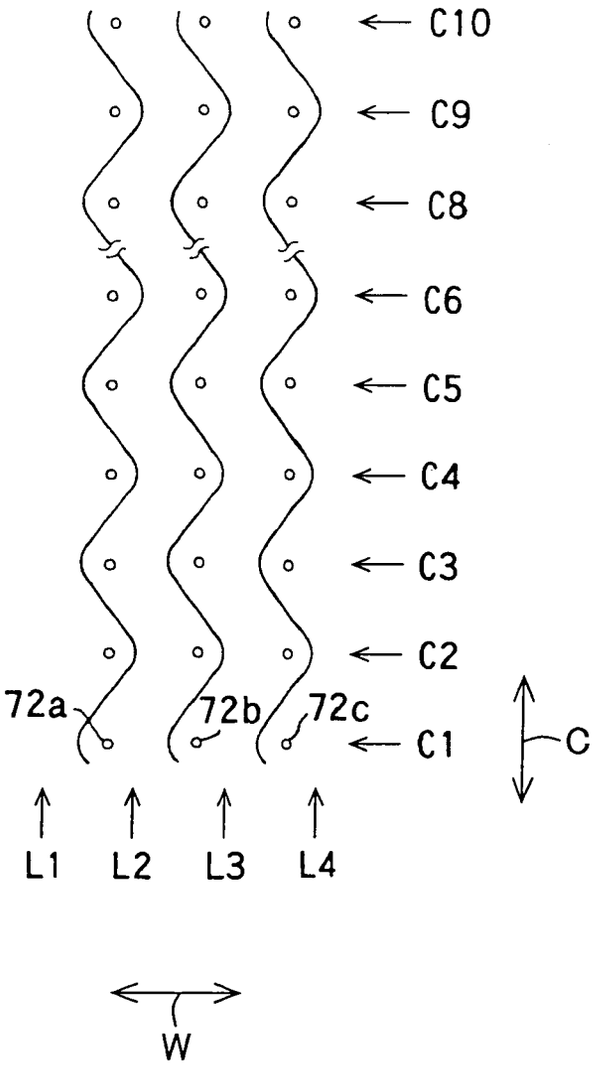


FIG. 16

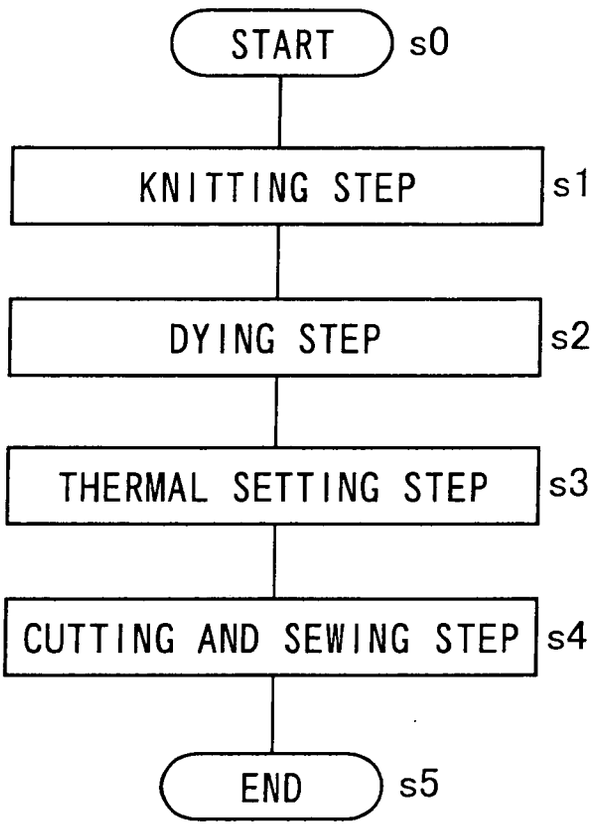

START
s0
KNITTING STEP
s1
DYING STEP
s2
THERMAL SETTING STEP
s3
CUTTING AND SEWING STEP
s4
END
s5

FIG. 17

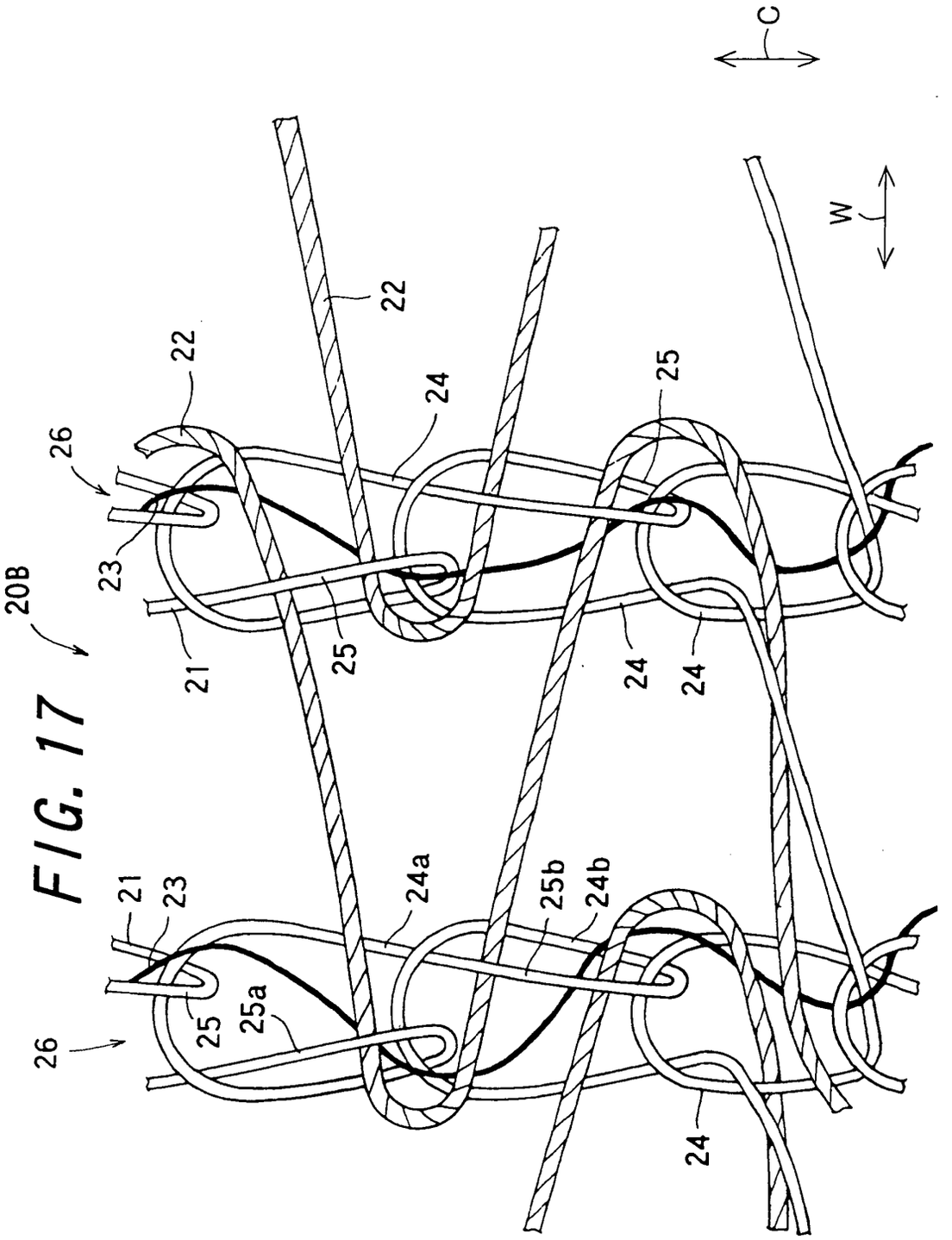


FIG. 18

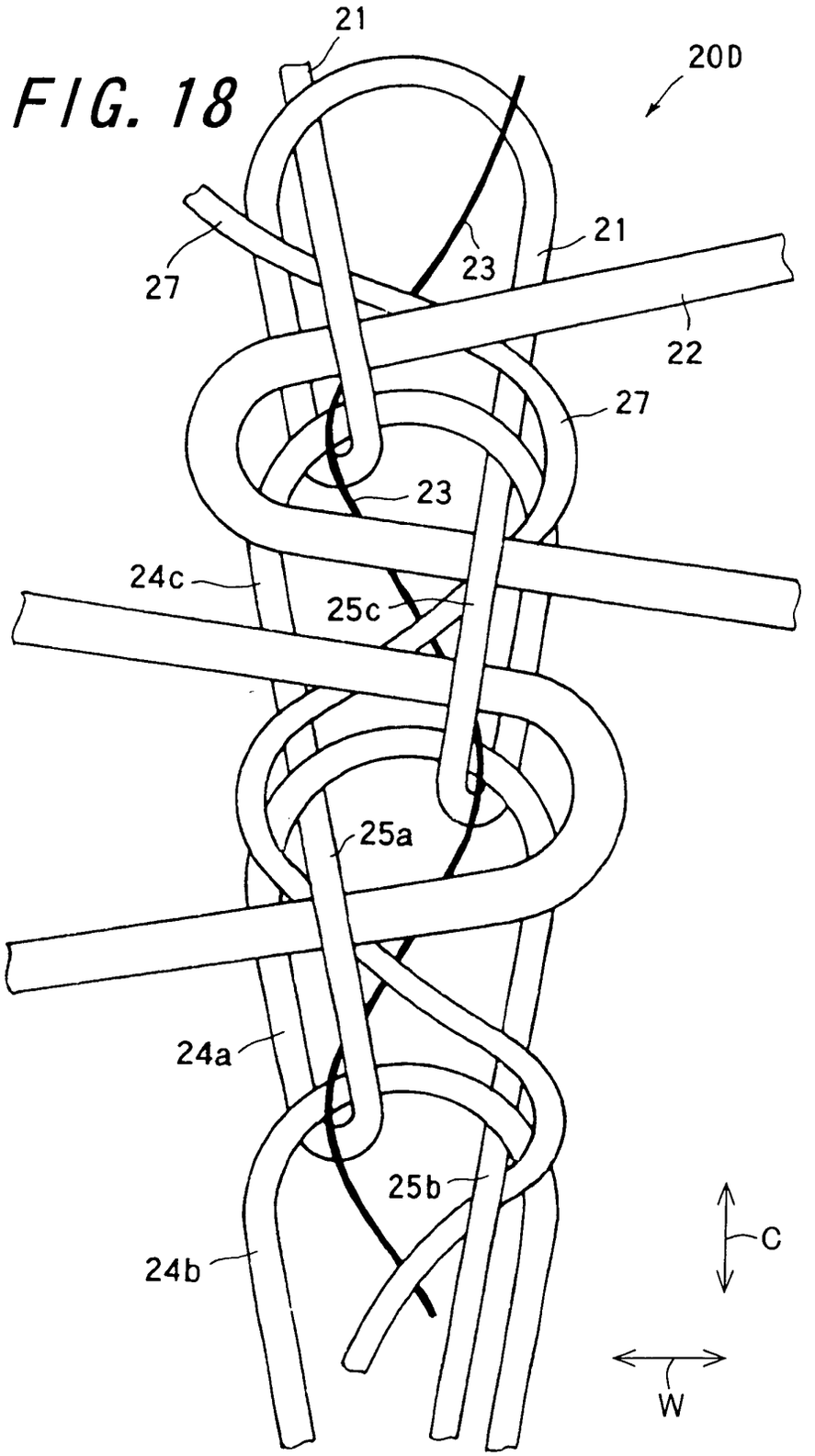


FIG. 19

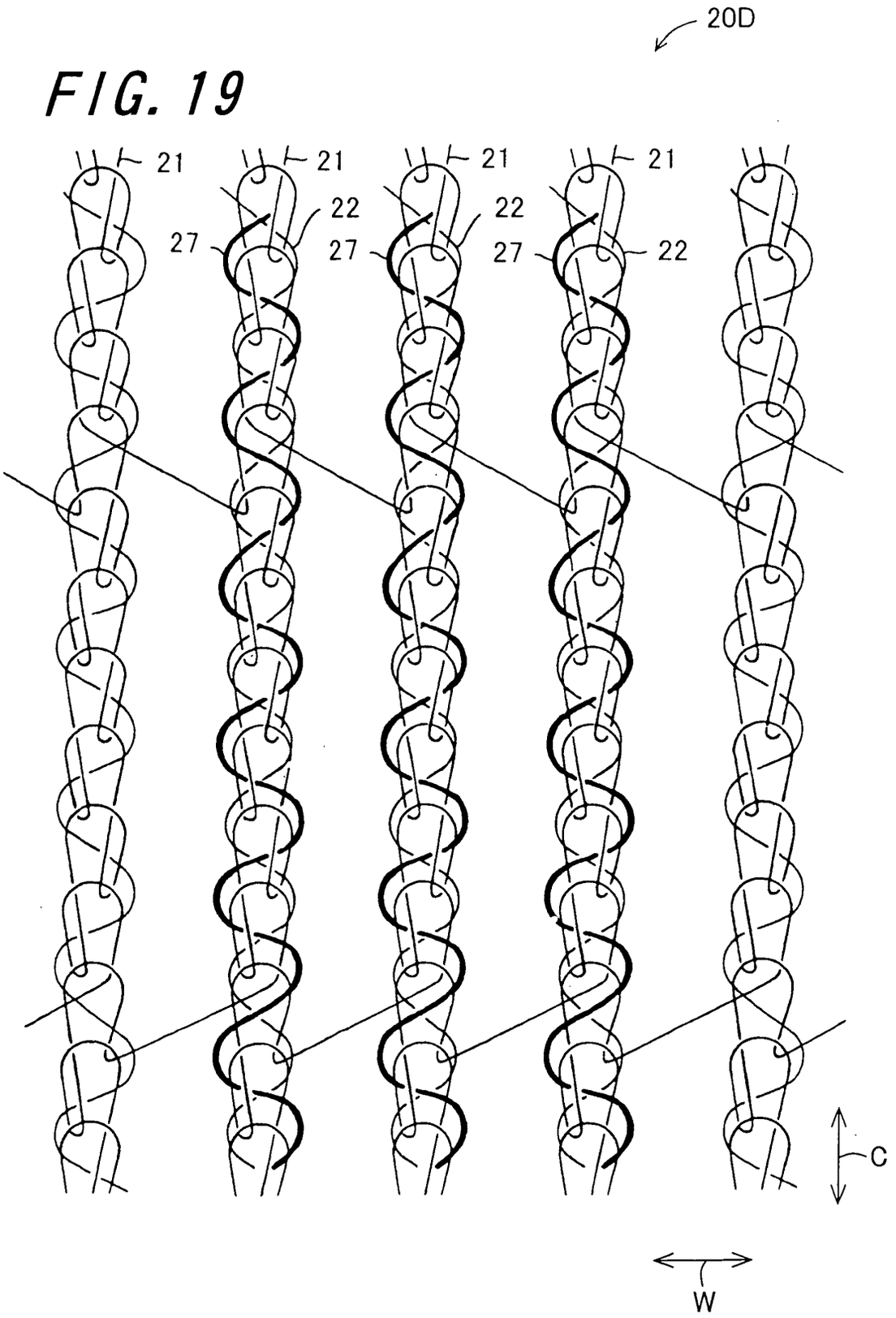


FIG. 20

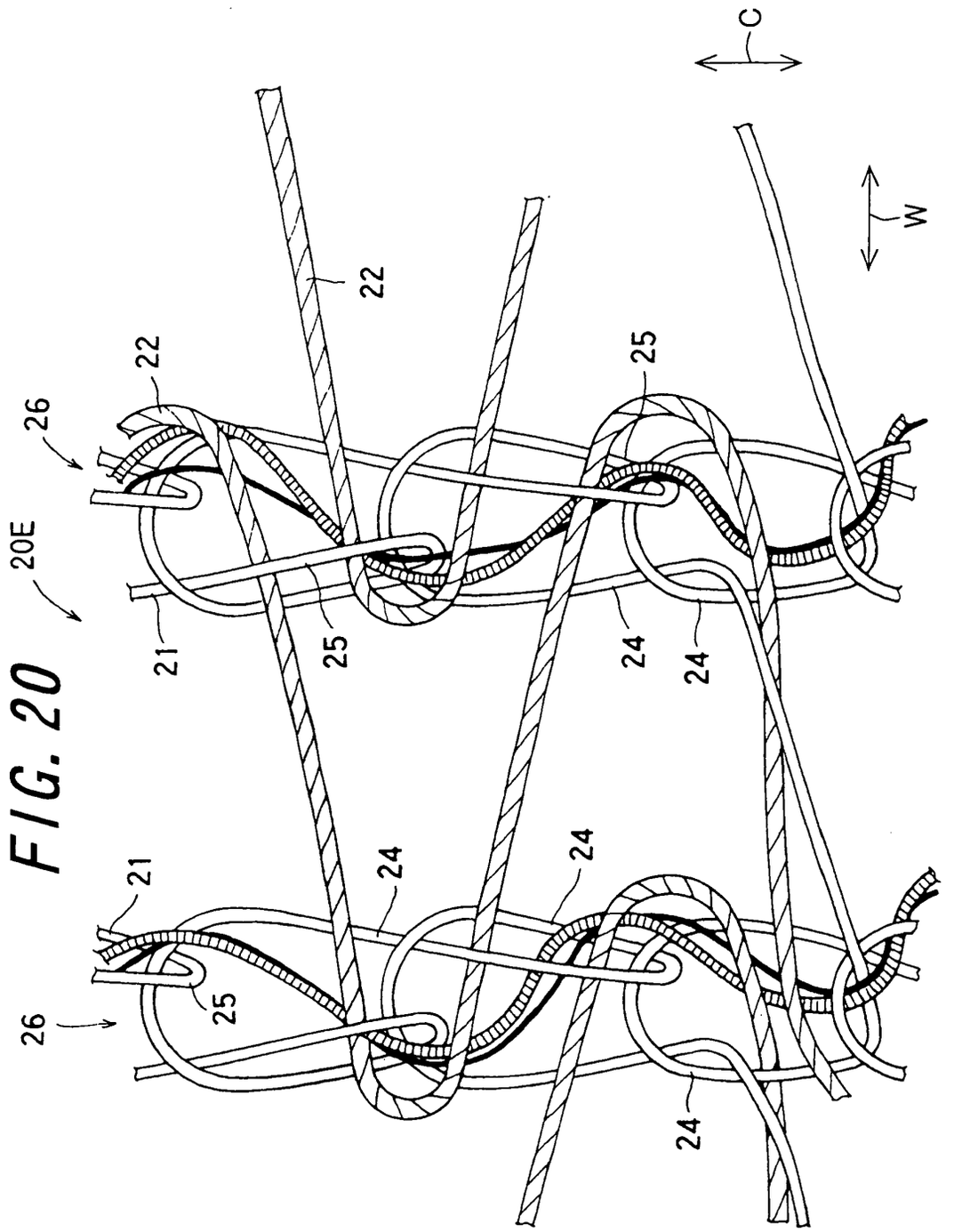


FIG. 21

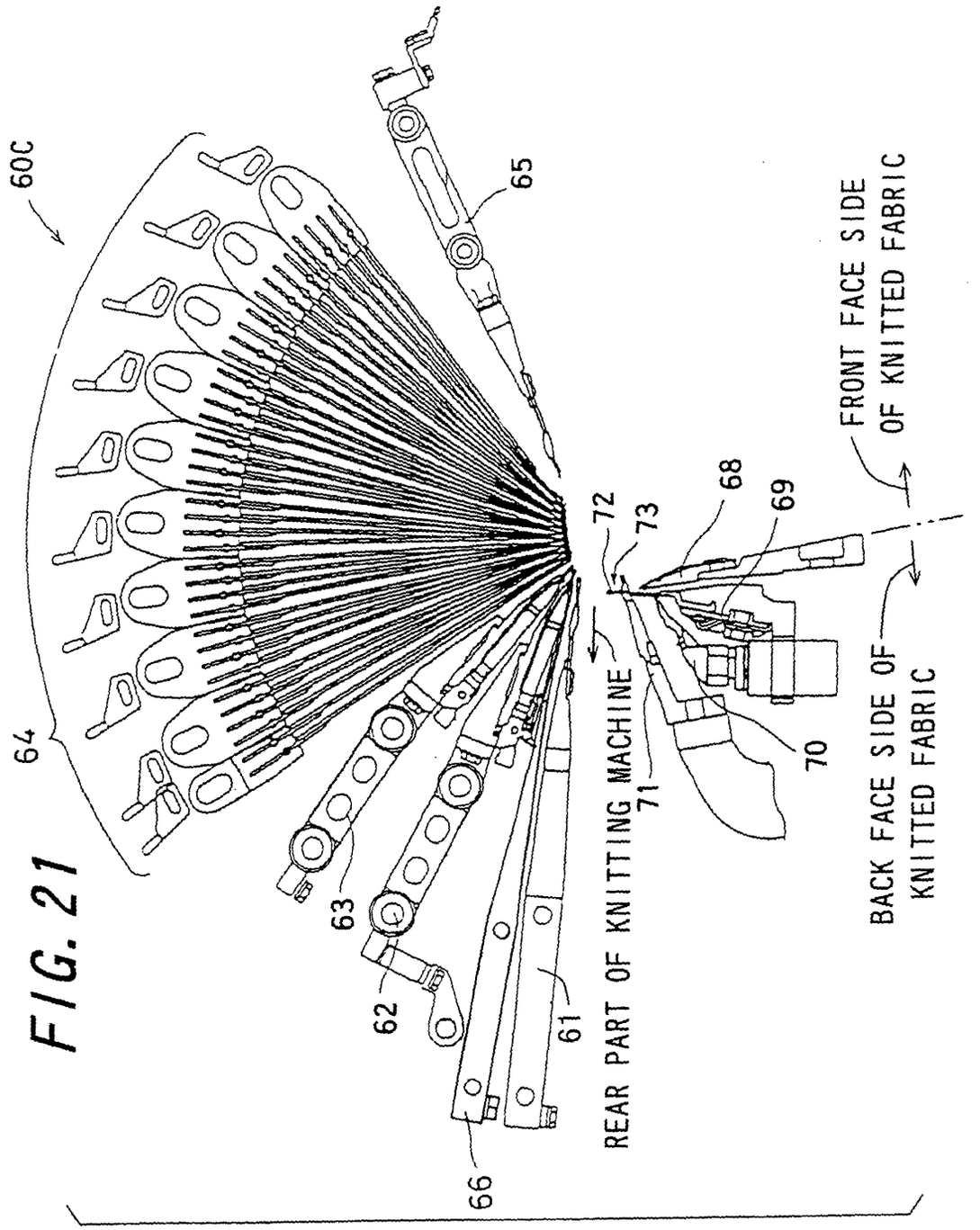
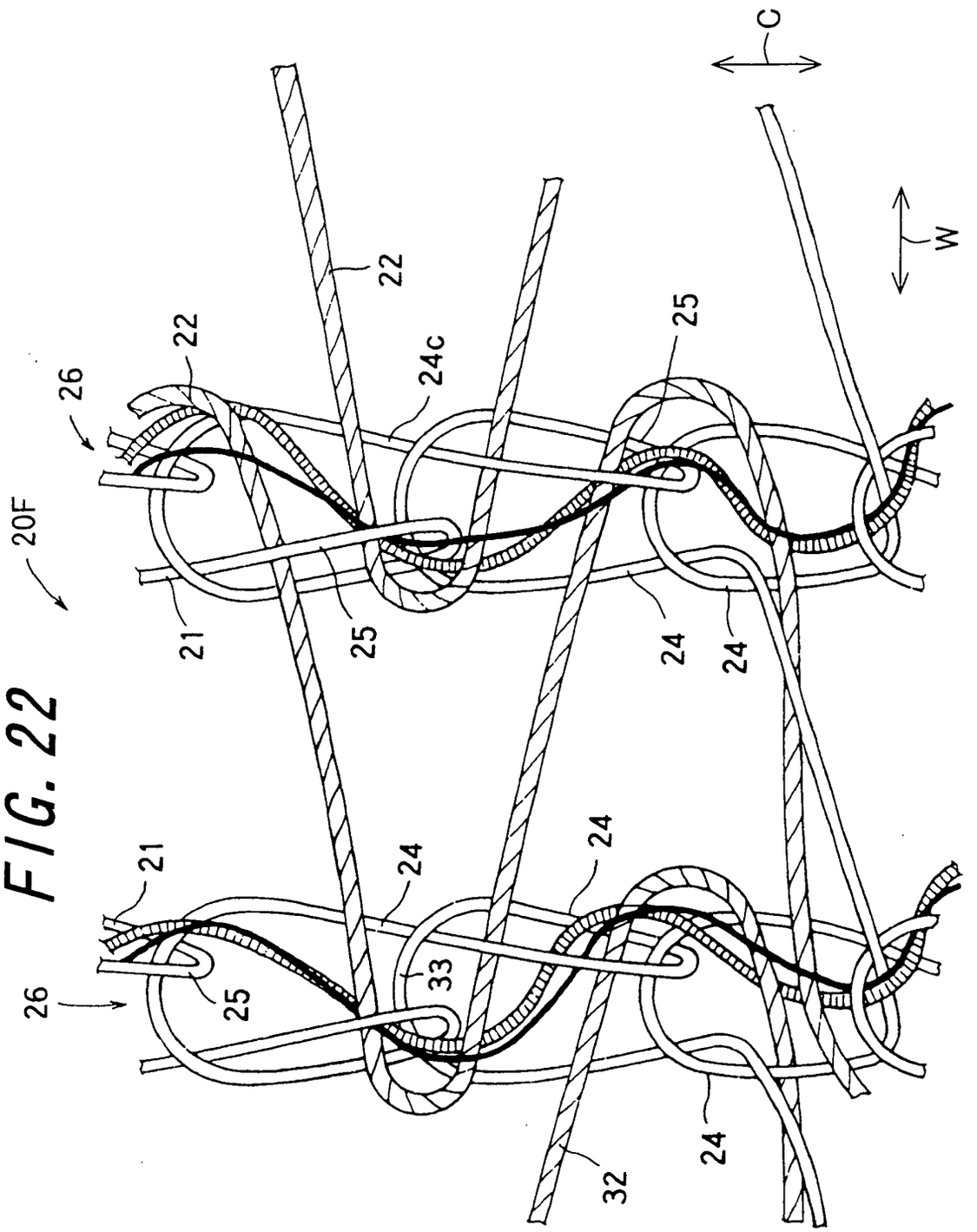
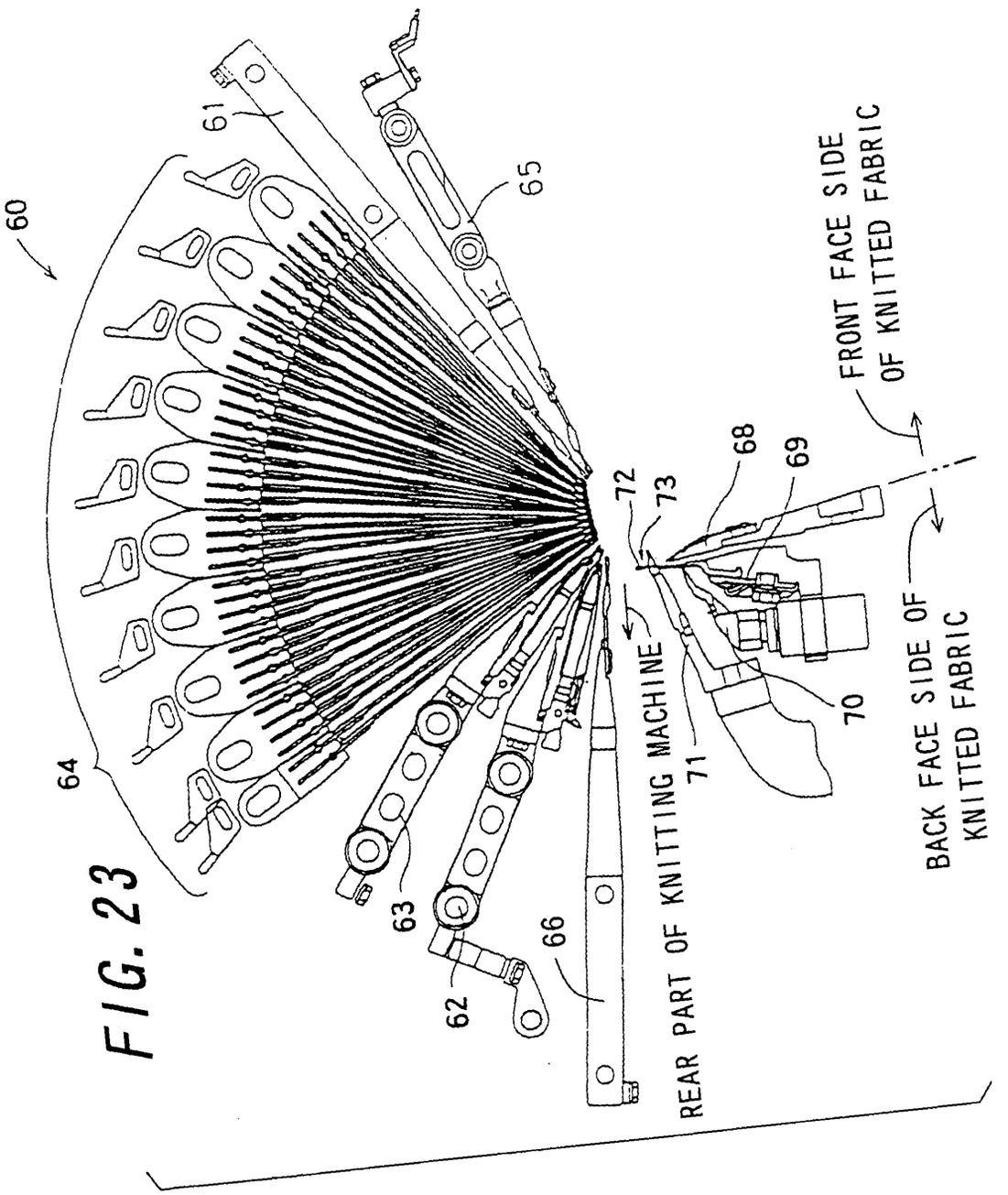

60C
64
65
63
62
61
66
72
73
68
69
70
71
REAR PART OF KNITTING MACHINE
FRONT FACE SIDE OF KNITTED FABRIC
BACK FACE SIDE OF KNITTED FABRIC

FIG. 22

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FRONT FACE SIDE OF KNITTED FABRIC
BACK FACE SIDE OF KNITTED FABRIC
REAR PART OF KNITTING MACHINE

FIG. 23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/067060

A. CLASSIFICATION OF SUBJECT MATTER
D06H7/16(2006.01)i, *D04B21/12*(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)
D06H1/00-7/24, D04B21/00-21/20, D03D1/00-27/18

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.
P,A	WO 2007/060786 A1 (Kabushiki Kaisha Kuroda Tex), 31 May, 2007 (31.05.07), Claims 1 to 7; Par. No. [0072] (Family: none)	1-9
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 203088/1985(Laid-open No. 110290/1987) (Toyobo Co., Ltd.), 14 July, 1987 (14.07.87), Claim 1 (Family: none)	1-9

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

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"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 30 November, 2007 (30.11.07)	Date of mailing of the international search report 11 December, 2007 (11.12.07)
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/JP2007/067060

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 4-34052 A (Toyobo Co., Ltd.), 05 February, 1992 (05.02.92), Claim 2 (Family: none)	1-9
A	JP 2003-336150 A (Kuroda Lace Co., Ltd.), 28 November, 2003 (28.11.03), Claim 1 (Family: none)	1-9
A	WO 2004/053218 A1 (Nisshinbo Industries, Inc.), 24 June, 2004 (24.06.04), Claims 1 to 5 & EP 1595987 A1 & US 2006/030229 A1	1-9
A	JP 11-81073 A (Toyobo Co., Ltd.), 26 March, 1999 (26.03.99), Claims 1 to 6 (Family: none)	1-9
A	JP 63-52142 B2 (Sakae Lace Co., Ltd.), 18 October, 1988 (18.10.88), Claim 1 (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 63052142 A **[0002]**
- JP 11081073 A **[0003]**