



(11)

EP 2 157 221 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

24.02.2010 Bulletin 2010/08

(51) Int Cl.:

D04B 1/22 (2006.01)

D04B 7/02 (2006.01)

D04B 7/26 (2006.01)

D04B 15/00 (2006.01)

(21) Application number: **08751622.5**

(86) International application number:

PCT/JP2008/001097

(22) Date of filing: **25.04.2008**

(87) International publication number:

WO 2008/139710 (20.11.2008 Gazette 2008/47)

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**

Designated Extension States:

AL BA MK RS

(72) Inventor: **YUI, Manabu**

Wakayama-shi

Wakayama 641-8511 (JP)

(74) Representative: **Wagner, Karl H.**

Wagner & Geyer Partnerschaft

Patent- und Rechtsanwälte

Gewürzmühlstrasse 5

80538 München (DE)

(30) Priority: **02.05.2007 JP 2007121800**

(71) Applicant: **Shima Seiki Mfg., Ltd**

Wakayama-shi

Wakayama 641-8511 (JP)

(54) **PLATING-KNITTED CYLINDRICAL FABRIC, KNITTING METHOD THEREFOR, AND DESIGN DEVICE**

(57) The present invention provides a plating-knitted tubular fabric, a method for knitting the fabric, and a design apparatus which are able to solve the color blurring caused by the cross of yarns when a tubular shaped fabric is plating-knitted by a flatbed knitting machine.

As shown in Step 1, in a knitting course right before reversal of the knitting direction which knits a fabric up to the end portion of the knitting width in which cross occurs between the front yarn and the back yarn, stitches are formed except the final stitch on the knitting needle "A". As shown in Step 2, in a knitting course right after

reversing the knitting direction, a twisted loop is formed on a knitting needle "A", and stitches are formed on knitting needles "b", "d", "f", ..., "t" of a needle bed B. The cross between the front yarn and the back yarn occurs at a portion in which the knitting yarn is crossed-over from the twisted loop on the knitting needle "A" to the stitch of knitting needle "b" and no cross is formed on the stitch "b". Therefore, the phenomenon in which the back yarn comes to the surface side causing color blurs can be made less noticeable. In such event, it is desirable to carry out racking in which needle bed B is displaced to the right by 2 pitches with respect to a needle bed F.

Fig. 1



EP 2 157 221 A1

Description

Technical Field

[0001] The present invention relates to a plating-knitted tubular fabric using a front yarn and a back yarn as knitting yarns to form a tubular shaped fabric by a flatbed knitting machine, the knitting method therefore, and a design apparatus.

Background Art

[0002] Conventionally, a flatbed knitting machine having at least a pair of front and rear needle beds disposed in such a manner that head end portions are opposed each other with a needle bed gap in-between, is able to form a tubular shaped fabric by plating-knitting (for example, see Patent Citation 1). In plating-knitting, when a yarn should be caught to a hook of a knitting needle that carries out knitting motion, a front yarn and a back yarn are fed with a height difference provided. Using different colors for the front yarn and the back yarn can make the color of a fabric different between the outside and the inside to be knitted as a tubular shaped fabric. Such a fabric is able to be used as a reversible fabric that can be worn with one surface side and the other surface side turned over. In addition, in the event that a plating-knitted fabric knitted in two colors for one surface side and the other surface side is worn with the one surface side only, the color effect different from a fabric knitted by a single knitting yarn can be obtained.

[0003] In Patent Citation 1, a structure of a apparatus that feeds a front yarn and a back yarn from one yarn carrier, which having two yarn feeder ports above and below, is disclosed. The two above and below yarn feeder ports have their locations displaced so that the yarn feeder port for the front yarn leads and the yarn feeder port for the back yarn follows with respect to the yarn carrier moving direction. Since, in order to knit a fabric into a tubular shape, the yarn carrier shuttles back and forth by reversing the knitting direction in the needle bed on the other side with respect to the horizontal knitting direction in the needle bed on one side, locations of two yarn feeder ports are changed over in accordance with the knitting direction.

[0004] It is possible to knit a fabric in a tubular shape by plating-knitting, in which a front yarn and a back yarn are fed from two yarn feeders each having one yarn feeder port, respectively (for example, see Patent Citation 2). In Paragraph [0004] in the Background Art section of Patent Citation 2, the following problem is pointed out.

[0005] In case that a tubular shaped fabric is plating-knitted, a front yarn must be fed in such a manner that the front yarn constantly leads the back yarn. Since in a flatbed knitting machine, the knitting direction is reversed at the end portion of the knitting width, at the end portion of at least either one of the knitting width, locations of the yarn feeder ports of the front yarn and the back yarn are

changed over, and a crossed portion is formed between the front yarn and the back yarn. The crossed portion causes the next stitch to be formed with the positional relationship between the front yarn and the back yarn instantaneously reversed. When the positional relationship between the front yarn and the back yarn is reversed, the color which is not supposed to emerge under normal conditions emerges on the surface side, and this results in the blurring of color (color mixture) at a side end portion on the fabric and degrades the value as merchandise.

[0006] Patent Citation 2 discloses a knitting method that makes the blurring less noticeable at the knitting width end portion on the side where the yarn cross occurs in a plating-knitted wide-rib structure using a flatbed knitting machine. The wide-rib structure is one of rib structures to be formed with front stitches and back stitches, and formed by alternately repeating a section with a plurality of front stitches and a section with a plurality of back stitches. At the knitting width end portion on the side in which the cross of knitting yarns used for plating occurs, one fabric uses the front stitch of the rib structure as the edge stitch and the other fabric uses the back stitch as the edge stitch. After forming the front stitches of the rib structure in one fabric, the knitting direction is reversed and the back stitches of the rib structure of the other fabric are knitted, so that a cross of knitting yarns is formed at the loop of the wide-rib structure, and the color blurring of knitting yarns can be made less noticeable.

[0007] Incidentally, in Paragraph [0003] of Patent Citation 2, it is described that "in the present description, the tubular fabric includes a C-letter shaped fabric in which the front and the back fabrics end in mid-course of the knitting width, like a cardigan, in addition to a complete tubular shaped fabric in which the front and the back fabrics continue without break in midcourse of the knitting width." In the present description, the C-letter shaped fabric is included in the tubular shaped fabric.

Patent Citation 1: Japanese Patent No. 3899269

Patent Citation 2: Japanese Published patent application No. 2005-213706

Disclosure of the Invention

Technical Problem

[0008] As in the case of Patent Citation 2, supplying the front yarn and the back yarn from two yarn feeders allows the two yarn feeders to run back and forth in the horizontal direction at the location displaced in the front and rear direction of the needle bed, and occurrence of cross of the front yarn with the back yarn cannot be avoided. For example, in the event that the front yarn is fed from the front-side yarn feeder and the back yarn from the back-side yarn feeder, a cross occurs at the end portion on the side in which knitting on the front needle bed is shifted to knitting on the rear needle bed. That is, the cross between the front yarn and the back yarn occurs

at the end portion on the side, where the front and rear of the needle bed on the side in which a fabric is knitted coincides with the front and back of the yarn feeder which is used for feeding the front yarn. The knitting method of Patent Citation 2 is unable to be applied to cases in which the blurring at the end portion on the knit fabric is made less apparent in the event that a tubular shaped fabric other than the wide-rib structure is plating-knitted.

[0009] Even when the yarn feeder device as in the case of Patent Citation 1 is used, when the yarn-feeding direction is reversed at the end portion of the knitting width, arrangement of the two yarn feeder ports must be changed over. Changing over the yarn feeder ports is conducted by rotating a member to which two yarn feeder ports installed by 180 degrees. Rotating the member in the same direction on both ends of the knitting end causes the front yarn and the back yarn to interwind each other, and therefore the rotating direction must be reversed on both ends of the knitting width. Consequently, on one end of the knitting width, the cross occurs between the front yarn and the back yarn, and the color blurring is generated.

[0010] It is an object of the present invention to provide a plating-knitted tubular fabric, a knitting method therefore, and a design apparatus, which can solve the color blurring caused by cross of yarns when the tubular shaped fabric is plating-knitted in a flatbed knitting machine.

Technical Solution

[0011] The present invention provides a plating-knitted tubular fabric knitted in a tubular shape by shuttling a front yarn and a back yarn to feed for plating-knit, in the horizontal direction of needle beds opposed to each other in front and rear, wherein:

a fabric to be knitted at least by one of the front and rear needle beds having a twisted loop with a knitting yarn from a needle loop crossed and then connected to sinker loops on both sides on one end of each knitting course; and

the plating-knitted tubular fabric having a crossed portion of the front yarn and the back yarn between the twisted loop and a stitch, which located on the one end connected to the twisted loop on the fabric side knitted on a needle bed opposed to the one needle bed.

[0012] In addition, the plating-knitted tubular fabric according is **characterized in that**

the crossed portion of the front yarn and the back yarn is located within a range from the needle loop through the twisted loop to a sinker loop of a stitch on one end side knitted on the opposed needle bed.

[0013] Further more, the present invention provides a method for knitting a plating-knitted tubular fabric, using a flatbed knitting machine equipped with at least a pair

of front and rear needle beds placed opposite to each other with a needle bed gap in-between, and feeding a front yarn and a back yarn as knitting yarns from different yarn feeder ports respectively, in such a manner that the front yarn leads and the back yarn follows to carry out plating-knitting, wherein:

forming stitches except for final stitch in a knitting course on one knitting direction side for knitting up to an end portion of the knitting width where a crossed portion is formed between the front yarn and the back yarn, without allowing a knitting yarn to be caught on a knitting needle on which the final stitch is to be formed, while moving the yarn feeder ports in such a manner that the knitting yarns passes the location of the relevant knitting needle fore the final stitch and comes out to the outside of the knitting width; and

in other knitting course in which a knitting direction is reversed, right after reversal, driving the relevant knitting needle together with knitting needles for knitting stitches on the needle bed opposed to the needle bed on which the relevant knitting needle forms the final stitch, to form a stitch on each knitting needle.

[0014] In addition, the method for knitting the plating-knitted tubular fabric is **characterized in that:**

as said flatbed knitting machine, one that enables racking to displace at least one of the front and rear needle beds horizontally with respect to the other needle bed is used; and

in a knitting course of said other direction side, the needle bed to which a knitting needle that forms the final stitch of the knitting course on said one side belongs is horizontally displaced by racking with respect to the needle bed opposite to the relevant needle bed, whereby a space between the relevant knitting needle and the knitting needles that form stitches on the opposed needle bed is expanded.

[0015] Further more, the present invention provides a design apparatus for generating knitting control data for knitting a fabric in tubular shape while feeding a front yarn and a back yarn as knitting yarns from different yarn feeder ports respectively, to a flatbed knitting machine equipped with at least a pair of needle beds opposite to each other with a needle bed gap in-between so that the front yarn leads and the back yarn follows to carry out plating-knitting, wherein:

forming stitches except for final stitch in a knitting course on one knitting direction side for knitting up to an end portion of the knitting width where a crossed portion is formed between the front yarn and the back yarn, without allowing a knitting yarn to be caught on a knitting needle on which the final stitch is to be formed, while moving the yarn feeder ports

in such a manner that the knitting yarns passes the location of the relevant knitting needle fore the final stitch and comes out to the outside of the knitting width; and

in other knitting course in which a knitting direction is reversed, right after reversal, driving the relevant knitting needle together with knitting needles for knitting stitches on the needle bed opposed to the needle bed on which the relevant knitting needle forms the final stitch, to form a stitch on each knitting needle.

Advantageous Effects

[0016] According to the present invention, in a plating-knitted tubular fabric, the fabric knitted by at least one of the front and rear needle beds has a twisted loop with a knitting yarn from a needle loop crossed and then connected to sinker loops on both sides on one end of each knitting course. Between the twisted loop and stitches connected to the twisted loop on a needle bed opposite to the needle bed on which the twisted loop is knitted, a crossed portion between a front yarn and a back yarn is located, and therefore, even when the back yarn comes out to the surface side at the crossed portion and color blurring may occur, the color blurring is able to be made less apparent, and the color blurring caused by crossing of knitting yarns can be solved, whereby commodity value of the fabric can be increased.

[0017] According to the present invention, the crossed portion between the front yarn and the back yarn is located within a range from the needle loop through the twisted loop to a sinker loop of a stitch on one end side knitted on the opposite needle bed, and therefore, the color blurring can be made less apparent from both of the front side and the back side of the fabric.

[0018] Furthermore, according to the present invention, in order to plating-knit a tubular shaped fabric on front and rear needle beds of a flatbed knitting machine, shuttle knitting is done by reversing knitting direction at knitting ends. In the event of reversing the knitting direction, occurrence of crossing between a front yarn and a back under yarn at one end of the knitting width cannot be avoided because of the reversal of the positional relation between the front yarn and the back yarn which are fed by shifting the position. In the knitting course on one side of the knitting direction for knitting a fabric up to the end of the knitting width in which crossing occurs between the front yarn and the back yarn, stitches are formed except the final stitch, and no knitting yarn is allowed to be caught on the knitting needle which should form the final stitch and the yarn feeder port is moved in such a manner that the knitting yarn passes the location of the relevant knitting needle and comes out to the outside of the knitting width. In the knitting course on the other side in which the knitting direction is reversed, the knitting needle that should form the final stitch in the knitting course on one side of the knitting direction is knit-driven together with knitting needles to knit stitches on

the needle bed opposite to the needle bed to which the knitting needle belongs, and a stitch is formed on each knitting needle. The final stitch in the knitting course on one side of the knitting direction becomes a twisted loop.

The cross of the front yarn with the back yarn is generated in a section between the twisted loop and the stitches knitted on the opposite needle bed. Since the knitting yarn in this section is less likely to appear to the fabric surface, even if the cross of the front yarn and the back yarn occurs when a tubular shaped fabric is plating-knitted on the front and rear needle bed of a flatbed knitting machine, it is possible to make a phenomenon less likely to occur, that the back yarn comes out to the surface side resulting in color blurring. Since the color blurring caused by the cross between knitting yarns can be solved, the commodity value of the tubular shaped fabric to be knitted can be increased.

[0019] According to the present invention, in the knitting course on the other side in which the knitting direction is reversed, the needle bed to which the knitting needle which should form the final stitch in the knitting course on one side is horizontally displaced by racking with respect to the needle bed opposite to the needle bed, whereby the space between the twisted loop and the stitches linked to the twisted loop on the opposite needle bed is expanded. The cross of the front yarn with the back yarn might occur in a relatively short section, or might occur under an unstable state in parallel over a relatively long section. By expanding the space, even the cross of an unstable state in which the front yarn and the back yarn go side by side can be allowed to be generated in a section between the twisted loop and the next stitch.

[0020] Furthermore, according to the present invention, the knitting control data for plating-knitting a tubular shaped fabric by a flatbed knitting machine is generated in such a manner that the final stitch in the knitting course on one side of the knitting direction becomes a twisted loop and a cross of a front yarn with a back yarn is allowed to occur within a range between the twisted loop and stitches knitted by the opposite needle bed. Since the knitting yarn of this range is less likely to come out to the surface side of the fabric, even if the cross of the front yarn with the back yarn occurs when the tubular shaped fabric is plating-knitted on the front and the rear needle beds of a flatbed knitting machine, it is possible to make the phenomenon of color blurring in which the back yarn comes out to the surface side is less likely to occur. Since the color blurring caused by the cross between knitting yarns is solved, the commodity value of the tubular shaped fabric to be knitted can be increased.

Brief Description of Drawings

[0021]

[Fig. 1] Fig. 1 is a diagram schematically showing a knitting procedure for plating-knitting a tubular shaped fabric by a flatbed knitting machine having

front and rear needle beds as one embodiment of the present invention.

[Fig. 2] Fig. 2 is a diagram showing a range in which the cross of the front yarn with the back yarn is generated by knitting in Step 2 of Fig. 1.

[Fig. 3] Fig. 3 is a simplified plan view of a needle bed 10, showing a state right after a left-traverse knitting is completed in Step 1 of Fig. 1, that is, a state right before a right-traverse knitting begins in Step 2 of Fig. 1.

[Fig. 4] Fig. 4 is a simplified plan view of the needle bed 10, showing a state right after a carriage traverses to the right to begin knitting in Step 2 of Fig. 1.

[Fig. 5] Fig. 5 is a simplified plan view of the needle bed 10, showing a state in which yarn feeders 11 and 12 move rightward from the position in Fig. 4 and a knitting needle "A" on the F side retracts a front yarn 1 and a back yarn 2 to a certain extent, and a knitting needle "b" on the needle bed B side begins retracting, too.

[Fig. 6] Fig. 6 is a simplified plan view of the needle bed 10, showing a state in which the right-traverse knitting shown in Step 2 of Fig. 1 is completed.

[Fig. 7] Fig. 7 is a diagram showing the stitch structure of a tubular shaped fabric formed by knitting, which includes those of Fig. 3 through Fig. 6.

[Fig. 8] Fig. 8 is a diagram showing a knitting procedure when a tubular shaped fabric is knitted in a C-letter shape as another embodiment of the present invention.

[Fig. 9] Fig. 9 is a diagram showing an example of a tubular shaped fabric 20 formed by both C-letter shape knitting shown in Fig. 8 and round-knitting as shown in Fig. 1.

[Fig. 10] Fig. 10 is a diagram showing an example of a tubular shaped fabric 30 knitted to compare with that formed in Fig. 9.

[Fig. 11] Fig. 11 is a block diagram schematically showing a structure of a design apparatus 40 which generates knitting control data to make color blurring less apparent, which is caused by cross between a front yarn and a back yarn in a plating-knitted tubular fabric.

Explanation of Reference

[0022]

1	Front yarn
2	Back yarn
5	Twisted loop
5a	Needle loop
5b	Sinker loop
6	Crossed portion
10	Needle bed gap
11, 12	Yarn feeder
20	Tubular shaped fabric
21	C-knitted portion

22 Round-knitted portion

Best Mode for Carrying Out the Invention

5 [0023] Fig. 1 schematically shows a knitting procedure for plating-knitting a tubular shaped fabric by a flatbed knitting machine equipped with needle beds in front and rear as one embodiment of the present invention. The front and rear needle beds of the flatbed knitting machine have the front needle bed designated as F and the rear needle bed designated as B. On each needle bed, a large number of knitting needles are disposed at constant pitches. Both needle beds are disposed opposite to each other with the needle bed gap in-between. The knitting needles of each needle bed have hooks at the head end advanced and retreated to and from the needle bed gap. Above the needle bed gap, there are disposed a plurality of yarn feeders. Above the needle bed gap, there are disposed a plurality of yarn feeder rails, too. Yarn feeders are supported by any of the yarn feeder rails to be able to move rightward and leftward.

[0024] For the convenience of description, for the front and rear needle beds F and B, uppercase characters "A" through "T" denote the knitting needles including the range used for knitting in the front needle bed F, and lowercase characters "a" through "t" denote the knitting needles including the range used for knitting in the rear needle bed B, respectively. In each knitting needle, an open circle indicates that the stitch is retained. A solid circle indicates that a new stitch is formed. S-letter on the left side indicates the standard condition. Arrow marks on the right side indicate knitting direction.

[0025] Under the standard condition shown by S-letter in Fig. 1, every other knitting needles on the F side, "A", "C", "E", ..., "S" are basically allotted to the front-side fabric. Every other knitting needles on the B side, "b", "d", "f", ..., "t" are used to carry out half gauge knitting basically allotted to the back-side fabric. Idle needles "B", "D", "F", ..., "T" on the F side are located opposite to knitting needles "b", "d", "f", ..., "t" on the B side, and are used for transferring stitches from the B side or for knitting back stitches, or the like. The same applies to idle needles "a", "c", "e", ..., "s" on the B side. Incidentally, the number of knitting needles used for knitting is stipulated only for descriptive purposes, and in actual fabrics still more needles are used in general. In addition, when a four-needle-bed knitting machine, which has two-tiered needle beds in both front and rear is used, on the front and rear needle beds on each lower-tier side which are primarily used for knitting, the all needle arrangement in which no idle needle is provided between knitting needles can be carried out.

[0026] Reference numerals 1 and 2 shown on the left side of Fig. 1 denote steps of the knitting procedure which carries out treatment to reduce effect of color blurring caused by the cross of the front yarn with the back yarn at the knitting end on the left side of the needle bed. A case is assumed in which yarn feeders used for feeding

front yarns are supported by the yarn feeder rails, respectively, in such a manner that the yarn feeders horizontally advance and retire in front of the yarn feeders used for feeding back yarns. When the knitting direction is reversed from the knitting on the front needle bed to the knitting on the rear needle bed, the cross of the front yarn with the back yarn occurs. When a tubular shaped fabric is plating-knitted by round-knitting in the left direction on the F side and in the right direction on the B side, respectively, repeating Step 1 and Step 2 can make less apparent the color blurring caused by the cross of the front yarn and the back yarn.

[0027] As shown in Step 1, on one side of the knitting direction for knitting the portion up to the end portion of the knitting width in which the cross occurs between the front yarn and the back yarn, for example, in the leftward knitting course, stitches are formed on knitting needles "S", "Q", "O", ..., "C" of the F side except for the final stitch at the knitting needle "A", and no knitting needle is allowed to be caught on a knitting needle "A" which should form the final stitch. Yarn feeders that feed the front yarn and the back yarn are moved in such a manner that the knitting yarns pass the position of the knitting needle "A" and come out to the outside of the knitting width.

[0028] As shown in Step 2, in the knitting course on the other side in which the knitting direction is reversed rightward, the knitting needle "A" is driven to knit together with knitting needles "b", "d", "f", ..., "t" which should knit stitches on the B side opposite to the F side in which the knitting needle "A" forms the final stitch to form stitches on each of the knitting needles "A", "b", "d", "f", ..., "t". The stitch formed on the knitting needle "A" on the F side becomes a twisted loop which is different from stitches formed on other knitting needles "S", "Q", "O", ..., "C" on the F side. The cross of the front yarn with the back yarn occurs at the portion in which knitting yarns are crossed-over continuously from the twisted loop of the knitting needle "A" on the F side to stitches of the knitting needle "b" on one end side on the B side, and does not occur at the stitch "b". Therefore, a phenomenon in which the back yarn emerges to the surface side and causes the color blurring can be made less noticeable.

[0029] In such event, it is desirable to carry out racking to shift the B side rightward by 2 pitches with respect to the F side. By racking, the range between the knitting needle "A" on the F side and the knitting needle "b" on the B side increases. The cross of the front yarn with the back yarn might occur in a relatively short section, or might occur in an unstable state in parallel over a relatively long section. By expanding the range by racking, in the knitting course in the rightward direction, the cross occurs before knitting needles are retracted in order of knitting needle "A" to knitting needle "b", and on the knitting needle "b", the front-back condition is normal in retraction.

[0030] Fig. 2 shows a range in which the cross occurs between the front yarn and the back yarn by knitting of Step 2 in Fig. 1. In the event that the front yarn 1 and the

back yarn 2 are fed to knit a tubular shaped fabric by plating-knitting, on the knitting needles "E" and "C" on the F side, front-side stitches 3 are formed, and on the knitting needles "b" and "d" on the B side, back-side stitches 4 are formed, respectively, and at the same time, on the final knitting needle "A" on the F side, a twisted loop 5 is formed. Accordingly, the crossed portion 6 between the front yarn 1 and the back yarn 2 is able to be generated in the range shown in black color as a portion which is transferred from the twisted loop 5 to the back-side stitch 4 of the knitting needle "b" on the B side.

[0031] Figs. 3, 4, 5, and 6 schematically show a process in which the cross of the front yarn 1 with the back yarn 2 occurs at the crossed portion 6 of Fig. 2. Advance or retreat of the knitting needle 13 to and from the needle bed gap 10 is driven by, for example, a cam carried on a carriage which advances and retires horizontally along the needle bed, but the illustration of the carriage is omitted. In addition, movement of the yarn feeders 11 and 12 is carried out in conjunction with the carriage, too.

[0032] Fig. 3 shows a condition right after leftward knitting in Step 1 of Fig. 1 is completed, that is, the condition right before rightward knitting in Step 2 of Fig. 1 begins. The front and rear needle beds F and B are opposed to each other with the needle bed gap 10 in-between. The front yarn 1 and the back yarn 2 are fed from yarn feeders 11 and 12, respectively, which move in the needle bed gap 10 horizontally. The yarn feeder 11 that feeds the front yarn 1 is located on the front side than the yarn feeder 12 that feeds the back yarn 2. The knitting needles "C" and "E" on the F side advances to the needle bed gap 10, retracts the front yarn 1 and the back yarn 2 by a hook, and forms a stitch loop by a needle loop formed by a knitting needle 13 and a sinker loop formed by a sinker 14. Since the knitting needle "A" on the F side does not advance to the needle bed gap and the front yarn 1 and the back yarn 2 pass the location of the knitting needle "A" from the hook of the knitting needle "C" that forms the final stitch, passes through the outside of the leftward knitting width, and extends to the yarn feeders 11 and 12 in standby.

[0033] Fig. 4 shows a condition right after the rightward knitting is started in Step 2 of Fig. 1. Since the yarn feeder 11 feeding the front yarn 1 precedes the yarn feeder 12 feeding the back yarn 2, even if the yarn feeder 11 is located on the left side than the yarn feeder 12 in Fig. 3, it precedes to the right side in Fig. 4. The last knitting needle "A" on the F side advanced to the needle bed gap 10 before yarn feeders 11 and 12 traverse rightward, and pass above the front yarn 1 and the back yarn 2 extending leftward shown in Fig. 3. Since the yarn feeder 11 and 12 run rightward passing above the knitting needle "A" advanced to the needle bed gap 10, the front yarn 1 and the back yarn 2 go round the left side of a needle shank of the knitting needle "A" and are turned back from the bottom side to the top side.

[0034] Fig. 5 shows a condition in which the yarn feeders 11 and 12 move rightward from the position in Fig.

4, the knitting needle "A" on the F side retracts the front yarn 1 and the back yarn 2 to a certain extent, and the knitting needle "b" on the B side begins retracting, too. Because in this way, the front yarn 1 and the back yarn 2 are retracted in order of the knitting needle "A" on the F side and the knitting needle "b" on the B side, the crossed portion 6 is formed between the front yarn 1 and the back yarn 2, and when the knitting yarn is retracted at the knitting needle "b" on the B side, the front yarn 1 and the back yarn 2 can be retracted with the front side and the back side of the front yarn 1 and the back yarn 2 brought to be normal. The crossed portion 6 of the front yarn 1 with the back yarn 2 might occur in a relatively short section or in an unstable state in which the front yarn 1 and the back yarn 2 go side by side over a relatively long section in accordance with the positional relationship between yarn feeders 11 and 12. Expanding the range between the knitting needle "A" on the F side and the knitting needle "b" on the B side by racking can form the crossed portion 6 definitely between the knitting needle "A" and the knitting needle "b".

[0035] Fig. 6 shows a condition when rightward knitting shown in Step 2 of Fig. 1 is finished. Each knitting needle 13 is retracted into each needle bed so as that the head end of knitting needle 13 gets further away from the needle bed gap 10 than the sinker 14. It is preferable to retract the knitting needle "A" on the F side under the conditions in which the crossed portion 6 of the front yarn 1 with the back yarn 2 is formed on the hook side of the knitting needle "A" than the sinker 14 adjacent to the knitting needle "A".

[0036] Fig. 7 shows the stitch structure of a tubular shaped fabric formed with the knitting of Fig. 3 through Fig. 6 included. The twisted loop 5 formed by the knitting needle "A" on the F side is twisted so as that the portion linked from a needle loop 5a to a sinker loop 5b between adjacent front-side stitch 3 and the back-side stitch 4 crosses. As shown in Fig. 6, if the crossed portion 6 of the front yarn 1 and the back yarn 2 is able to be generated on the hook side of the knitting needle 13 from the sinker 14, in the knitting structure, the crossed portion 6 is able to be generated at the twisted loop 5 and at the location between the sinker loop 5b and the needle loop 5a on the front and rear boundary 10c side. If the cross is able to be generated at above location, even if the back yarn 2 emerges to the surface side due to the cross, it is possible to make it less apparent.

[0037] Fig. 8 shows a knitting procedure when a tubular shaped fabric is knitted in a C-letter shape as the other embodiment according to the present invention. That is, the tubular shaped fabric is knitted by one of the front and rear needle beds using, for example, whole knitting needles "b", "d", "f", ..., "t" of the knitting width in the case of the rear needle bed B, and knitting needles "A", "C", "E", "G", and "I"; "K", "M", "O", "Q", and "S" on both end portions excluding the intermediate portion of the knitting width in the case of the front needle bed F, which is the other one of the front and rear needle beds. As shown in

Step 1, on one end side of the front needle bed, for example, in the case of knitting needles "K", "M", "O", "Q", and "S" on the right end side, the knitting yarn is fed leftward, i.e., the inward of the knitting width, and then, as shown in Step 2, the feeding direction is reversed and the knitting yarn is fed rightward, i.e., outward of the knitting width. As shown in Step 3, after the feeding direction is reversed, on the B side, the knitting yarn is fed leftward in order of knitting needles "t", "r", "p", ..., "d" from the right end side of the knitting width to the left-end side, excluding the final knitting needle "b". As shown in Step 4, after the feeding direction is reversed, the knitting yarn is fed rightward, i.e., inward of the knitting width to the knitting needle "b" of the B side and knitting needles "A", "C", "E", "G", and "I" on the left end side of the F side from the left end side. As shown in Step 5, the feeding direction is reversed and the knitting yarn is fed leftward, i.e., outward of the knitting width to knitting needles "I", "G", "E", and "C" on the left end side on the F side excluding the final knitting needle "A". As shown in Step 6, the knitting yarn is fed rightward to the knitting needle "A" on the F side and knitting needles "b", "c", "f", ..., "t" from the left end side to the right end side on the B side. In this way, the present embodiment forms a tubular shaped fabric by repeating feeding the knitting yarn back and forth in the C-letter shape as a whole.

[0038] Feeding yarn by the use of a yarn carrier which is equipped with two yarn feeder ports as disclosed in Patent Citation 1 and is able to change over the yarn feeding position of the two yarn feeder ports can carry out the treatment of forming a twisted loop and preventing the color blurring collectively on the left side. As in the case of Fig. 3 through Fig. 6, in the event that the front yarn 1 and the back yarn 2 are fed from two yarn feeders 11 and 12 and the yarn feeder 11 feeding the front yarn 1 is located on the front side of the yarn feeder 12 feeding the back yarn 2, knitting is carried out to form a twisted loop also on the knitting needle "S", on the right end on the F side, not in Step 3 and Step 4 of Fig. 8 but in Step 2 and Step 3 of Fig. 8. In such event, in Step 4 of Fig. 8, no racking is performed and instead, in Step 3, racking is carried out to shift the needle bed B by four pitches with respect to the needle bed F.

[0039] As described above, the C-letter shaped tubular fabric shown in Fig. 8 is formed by connecting, on both side ends of the knitting width, a fabric which is continuous on one needle bed to a fabric which is not continuous at the intermediate on the other needle bed. The C-letter shaped tubular fabric is able to be knitted by connecting the continuous fabrics on both needle beds at one end only of the knitting width and not connecting on the other end of the knitting width. Even in this kind of tubular shaped fabric, the color blurring problem is same as Fig. 8, and the preventive treatment can be conducted in the same manner.

[0040] Fig. 9 and Fig. 10 show examples of plating-knitted tubular fabric knitted by the use of SWG-FIRST (product name), no-sewing computerized flatbed knitting

machine commercially available from Shima Seiki Mfg., Ltd. having a knitting needle arrangement pitch of 12G.

[0041] Fig. 9 shows an example of a tubular shaped fabric 20 formed by both C-letter shape knitting as shown in Fig. 8 and round knitting as shown in Fig. 1. In a C-knitted portion 21 in which C-letter shape knitting is performed, a front-side fabric 21a is knitted on the front needle bed and a back-side fabric 21b is knitted on the rear needle bed. The front-side fabric 21a and the back-side fabric 21b are connected at the boundary portion 21c which corresponds to the needle bed gap. The front-side fabric 21a lacking the intermediate portion is knitted so as to be folded back at an end portion 21d. In the round-knitted portion 22 in which round knitting is conducted, the front-side fabric 22a and the back-side fabric 22b are connected at the boundary portion 22c, which corresponds to the needle bed gap. In the boundary portions 21c and 22c, the color blurring due to the cross of the front yarn with the back yarn scarcely occurs. In the tubular shaped fabric 20, both C-knitted portion 21 and the round-knitted portion 22 are included, but even in the case of including one portion only, the color blurring becomes less apparent, thereby increasing the commodity value.

[0042] Fig. 10 shows an example of a tubular shaped fabric 30 knitted for comparison with Fig. 9. The tubular shaped fabric 30 is knitted without carrying out color blurring preventive treatment by forming a twisted loop and racking. In a C-knitted portion 31 of the tubular shaped fabric 30 in which C-letter shape knitting is conducted, a front-side fabric 31a is knitted on the front needle bed and a back-side fabric 31b is knitted on the rear needle bed. The front-side fabric 31a and the back-side fabric 31b are connected at a boundary portion 31c that corresponds to the needle bed gap. The front-side fabric 31c lacking the intermediate portion is knitted so as to be folded back at an end portion 31d. In a round-knitted portion 32 in which round-knitting is conducted, the front-side fabric 32a and the back-side fabric 32b are connected at the boundary portion 32c which corresponds to the needle bed gap. At the boundary portions 31c and 32c, the color blurring due to the cross of the front yarn with the back yarn occurs. In the C-knitted portion 31, feeding front and back yarns by the use of a yarn carrier which has two yarn feeder ports and is able to change over the yarn feeding position of two yarn feeder ports as in the case of the C-knitted portion 21 of Fig. 9 enables the color blurring to occur in stitches on both ends which sandwich the one boundary portion 31c of the knitting width and not to occur on the other boundary portion of the knitting width. However, in the tubular shaped fabric 30, the color blurring occurs on one side of the knitting width and it is impossible to make the color blurring less apparent as in the case of the boundary portion 21c shown in Fig. 9.

[0043] Fig. 11 schematically shows a structure of a design apparatus 20 which generates the knitting control data to make the color blurring due to the cross of the

front yarn with the back yarn less apparent in the plating-knitting of the tubular shaped fabric as shown in Fig. 1 and Fig. 8 by a flatbed knitting machine. The design apparatus 40 is achieved by installing software that executes knit-fabric design to a general-purpose computer 41. To the computer 41, an input unit 42 such as a keyboard, digitizer, mouse, or the like, a display unit 43 such as graphic display, or the like, a communication device 44 capable of communications with the outside via LAN, or the like, and an external recorder 45 to which various detachable recording media are mounted, and other units are connected.

[0044] Software can be installed to the computer 41 by downloading via the communication device 44 or by mounting recording media to the external recorder 45. An operator enters design data to the input unit 42, and designs the tubular shaped fabric 20 shown in Fig. 9, or the like while monitoring the design results displayed on the display unit 43. The operator designates the C-knitted portion 21, round-knitted portion 22, or the like. In addition, the operator designates a yarn feeder or yarn carrier that feeds the front yarn and the back yarn. Based on the arrangement of the yarn feeder port decided pursuant to this designation, the computer 41 can decide the knitting needle which forms a twisted loop and can generate the knitting control data including the procedure to make the color blurring less apparent. In addition, the knitting control data containing above mentioned procedures is prepared as a standard and is able to be inserted into the computer in accordance with the selection of the operator. The knitting control data generated is transmitted to a flatbed knitting machine via the communication device 44 or recorded in recording media such as disks and USB memory, and entered into the flatbed knitting machine to knit the tubular shaped fabric 20 or the like.

Claims

1. A plating-knitted tubular fabric knitted in a tubular shape by shuttling a front yarn and a back yarn to feed for plating-knit, in the horizontal direction of needle beds opposed to each other in front and rear, wherein:

a fabric to be knitted at least by one of the front and rear needle beds having a twisted loop with a knitting yarn from a needle loop crossed and then connected to sinker loops on both sides on one end of each knitting course; and
the plating-knitted tubular fabric having a crossed portion of the front yarn and the back yarn between the twisted loop and a stitch, which located on the one end connected to the twisted loop on the fabric side knitted on a needle bed opposed to the one needle bed.

2. The plating-knitted tubular fabric according to claim

1, wherein

the crossed portion of the front yarn and the back yarn is located within a range from the needle loop through the twisted loop to a sinker loop of a stitch on one end side knitted on the opposed needle bed.

5

3. A method for knitting a plating-knitted tubular fabric, using a flatbed knitting machine equipped with at least a pair of front and rear needle beds placed opposite to each other with a needle bed gap in-between, and feeding a front yarn and a back yarn as knitting yarns from different yarn feeder ports respectively, in such a manner that the front yarn leads and the back yarn follows to carry out plating-knitting, wherein:

10

15

forming stitches except for final stitch in a knitting course on one knitting direction side for knitting up to an end portion of the knitting width where a crossed portion is formed between the front yarn and the back yarn, without allowing a knitting yarn to be caught on a knitting needle on which the final stitch is to be formed, while moving the yarn feeder ports in such a manner that the knitting yarns passes the location of the relevant knitting needle fore the final stitch and comes out to the outside of the knitting width; and

20

25

in other knitting course in which a knitting direction is reversed, right after reversal, driving the relevant knitting needle together with knitting needles for knitting stitches on the needle bed opposed to the needle bed on which the relevant knitting needle forms the final stitch, to form a stitch on each knitting needle.

30

35

4. The method for knitting the plating-knitted tubular fabric according to claim 3, wherein:

as said flatbed knitting machine, one that enables racking to displace at least one of the front and rear needle beds horizontally with respect to the other needle bed is used; and

40

in a knitting course of said other direction side, the needle bed to which a knitting needle that forms the final stitch of the knitting course on said one side belongs is horizontally displaced by racking with respect to the needle bed opposite to the relevant needle bed, whereby a space between the relevant knitting needle and the knitting needles that form stitches on the opposed needle bed is expanded.

45

50

5. A design apparatus for generating knitting control data for knitting a fabric in tubular shape while feeding a front yarn and a back yarn as knitting yarns from different yarn feeder ports respectively, to a flatbed knitting machine equipped with at least a pair of

55

needle beds opposite to each other with a needle bed gap in-between so that the front yarn leads and the back yarn follows to carry out plating-knitting, wherein:

forming stitches except for final stitch in a knitting course on one knitting direction side for knitting up to an end portion of the knitting width where a crossed portion is formed between the front yarn and the back yarn, without allowing a knitting yarn to be caught on a knitting needle on which the final stitch is to be formed, while moving the yarn feeder ports in such a manner that the knitting yarns passes the location of the relevant knitting needle fore the final stitch and comes out to the outside of the knitting width; and

in other knitting course in which a knitting direction is reversed, right after reversal, driving the relevant knitting needle together with knitting needles for knitting stitches on the needle bed opposed to the needle bed on which the relevant knitting needle forms the final stitch, to form a stitch on each knitting needle.

Fig. 1

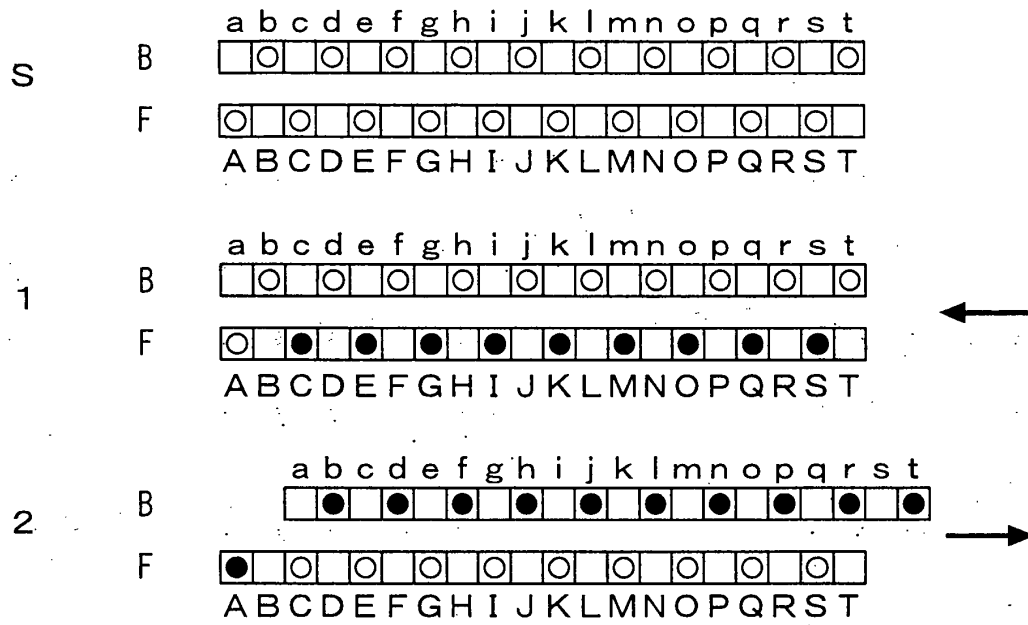


Fig. 2

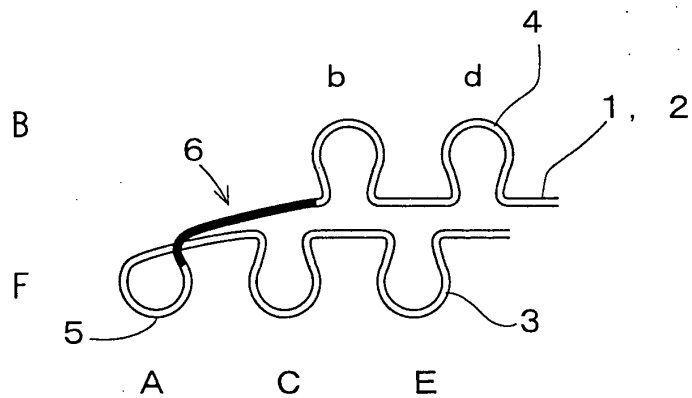


Fig. 3

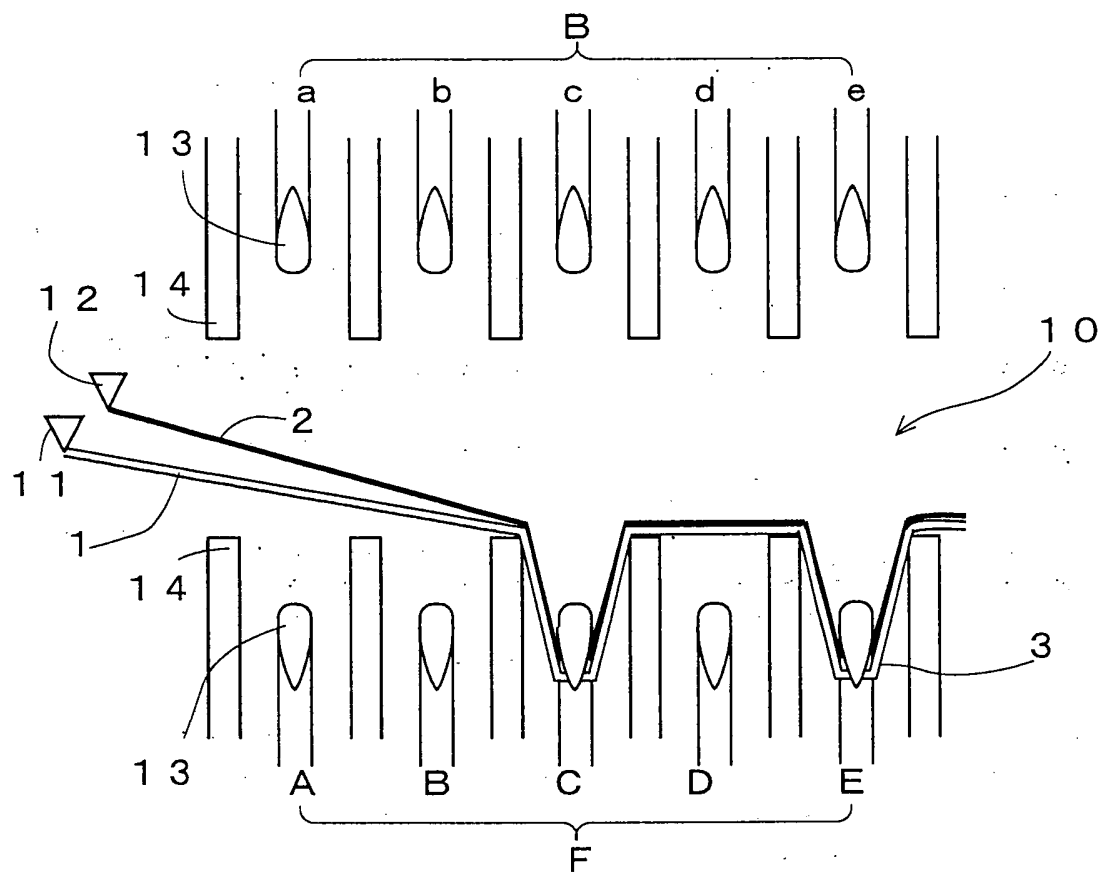


Fig. 4

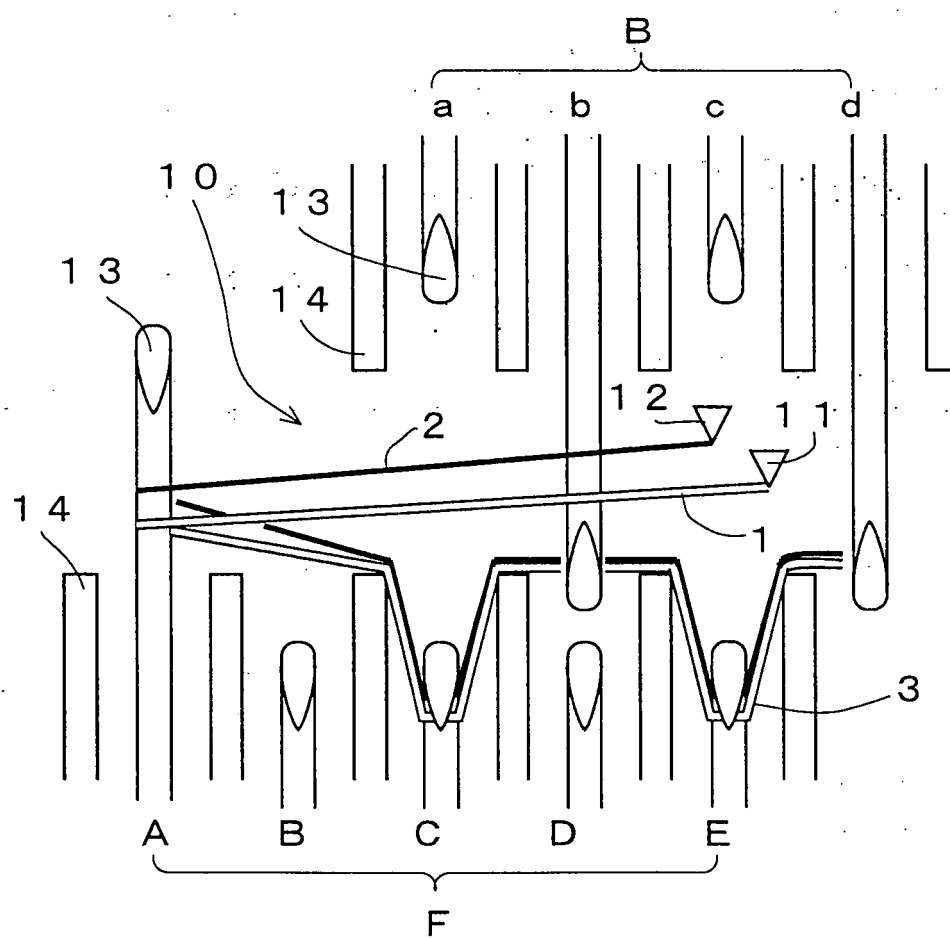


Fig. 5

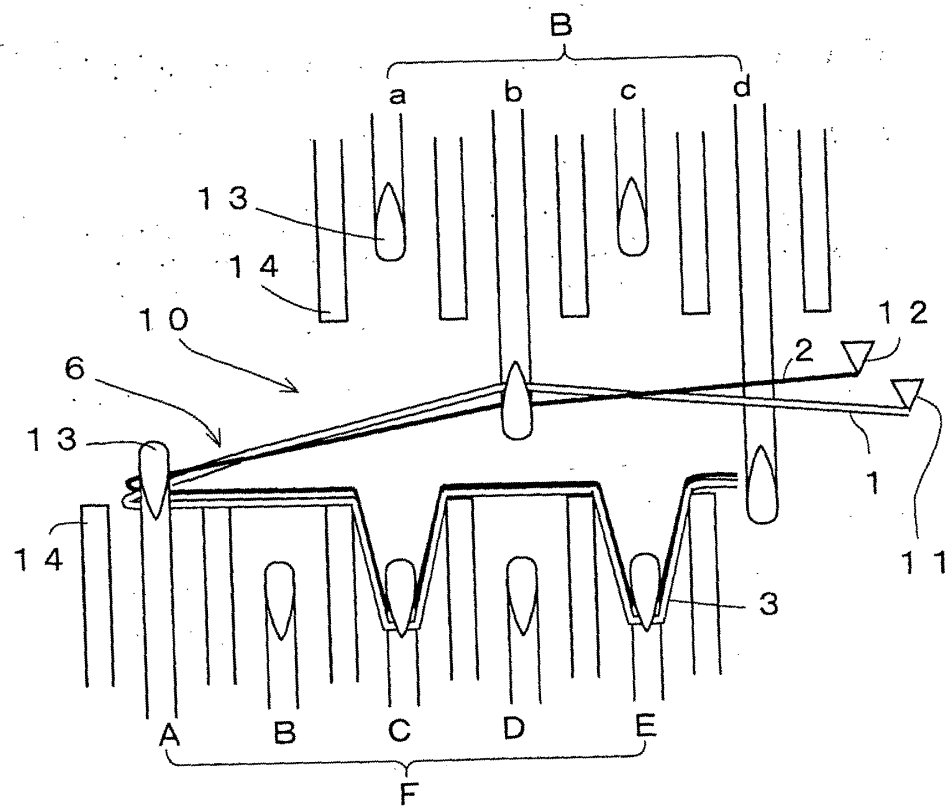


Fig. 6

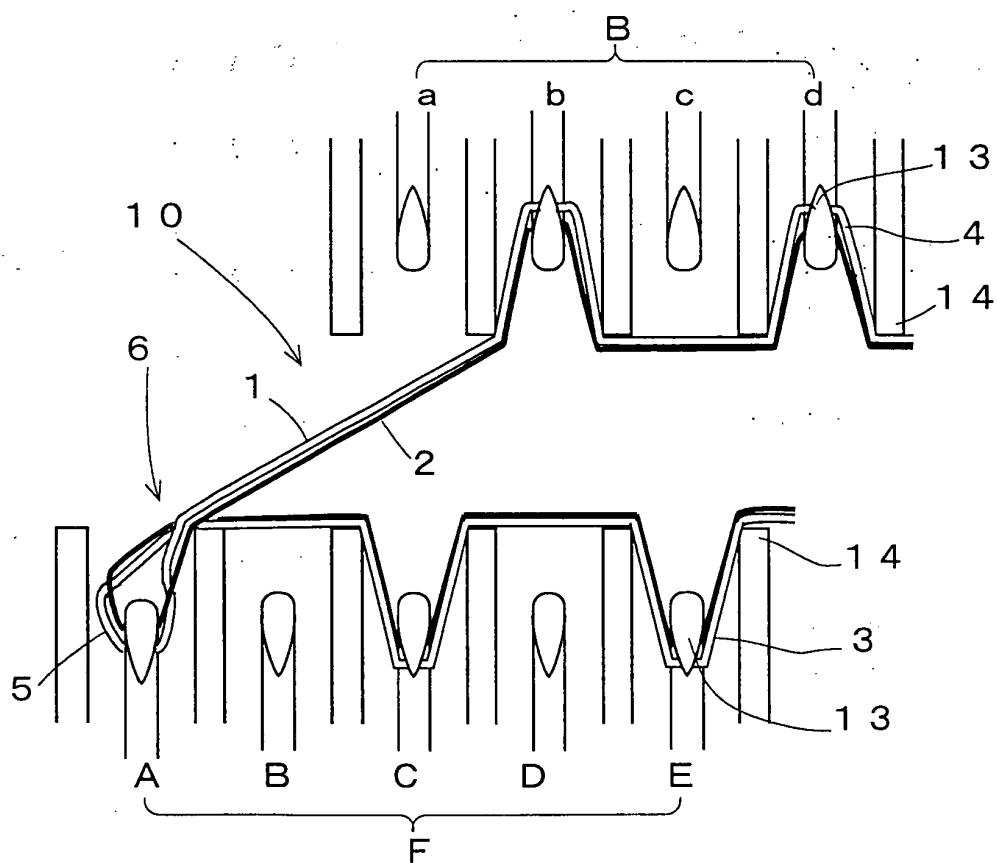


Fig. 7

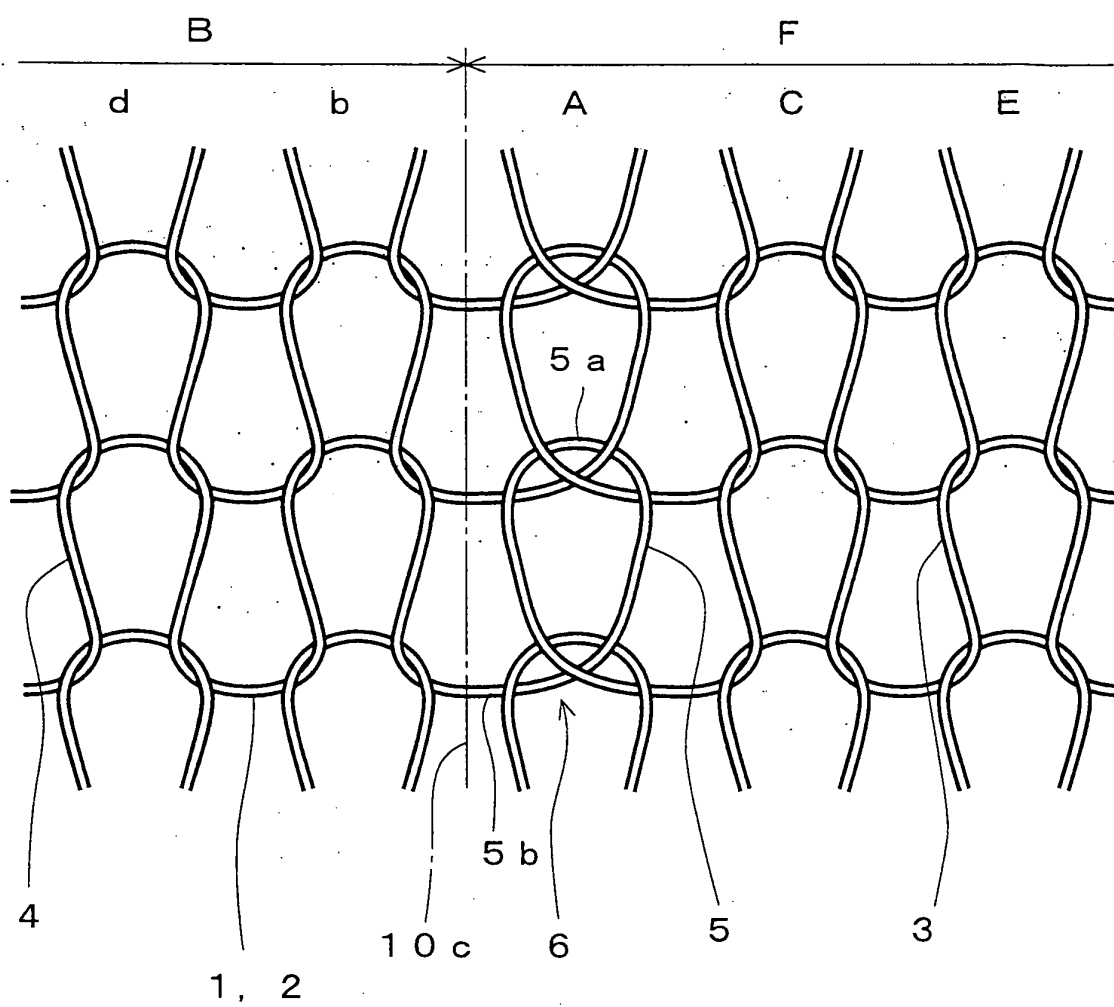


Fig. 8

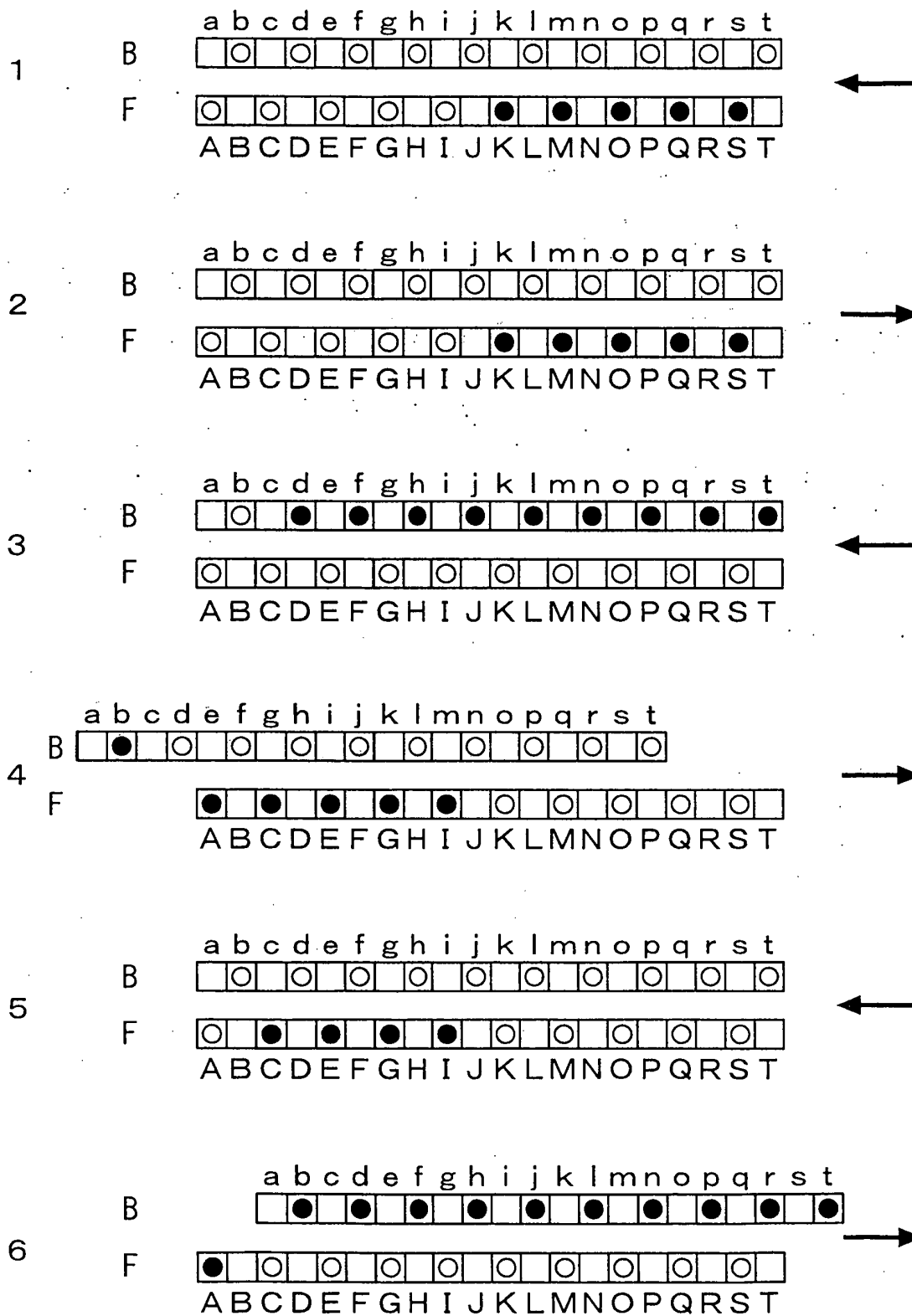


Fig. 9

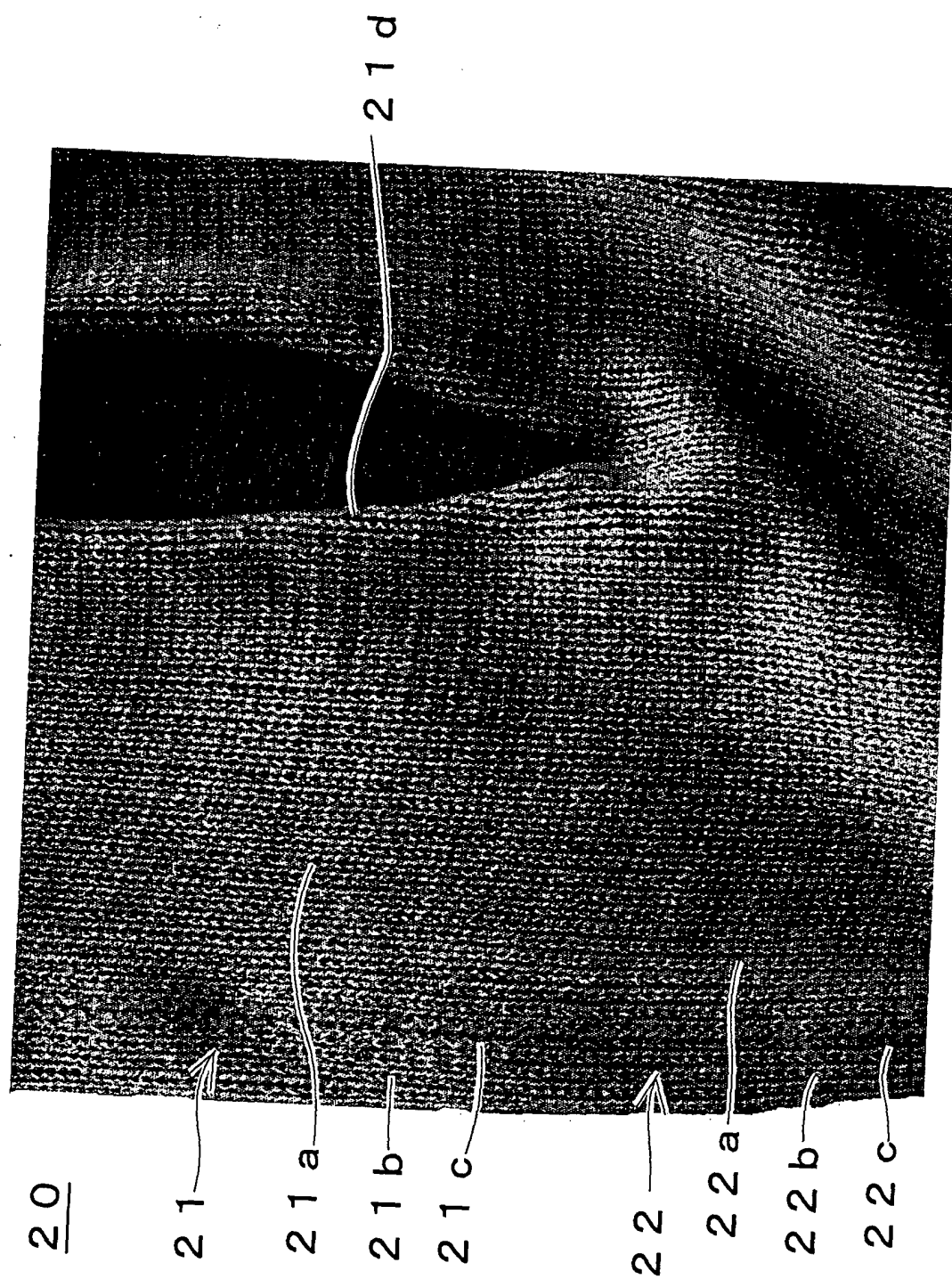


Fig. 10

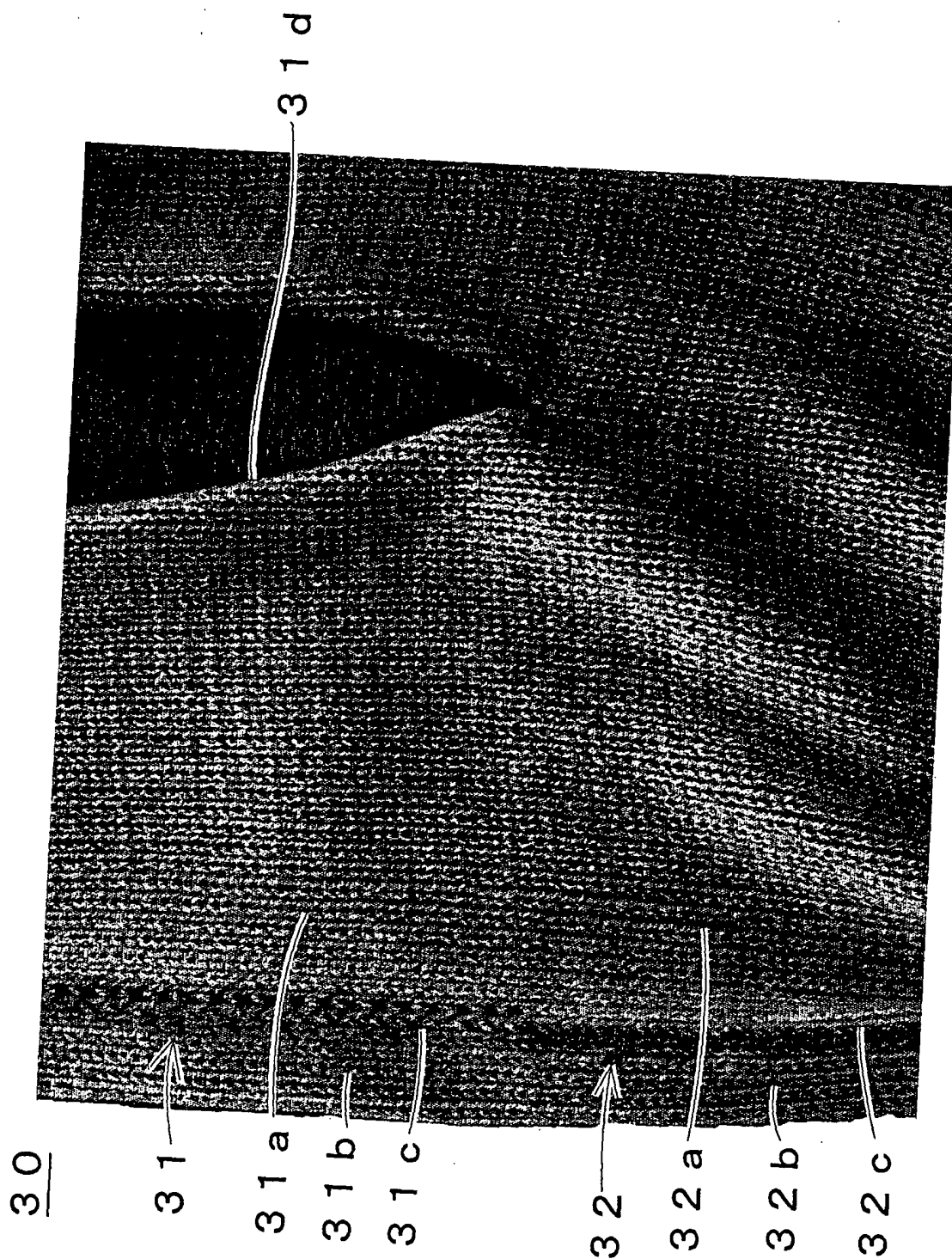
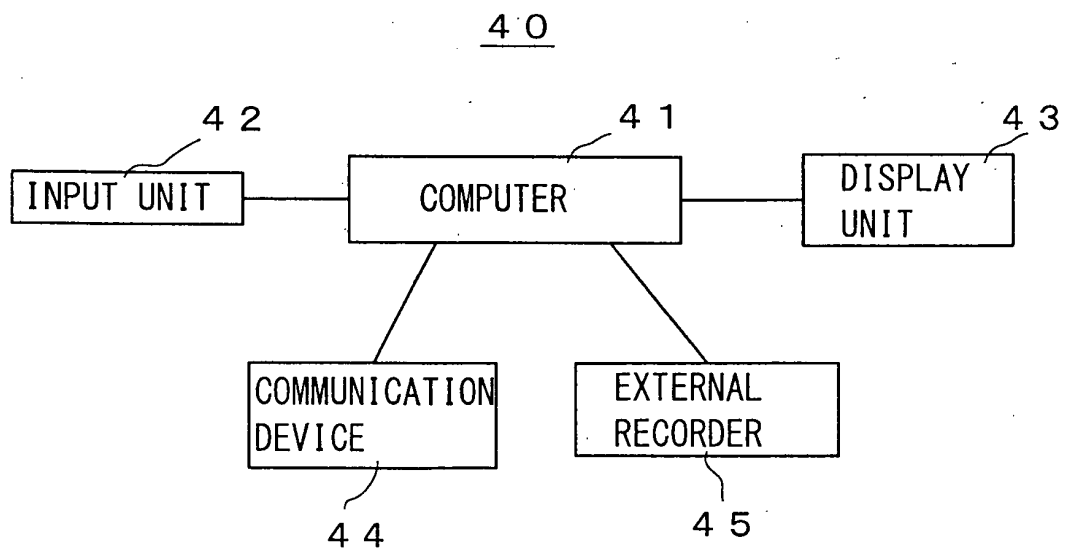


Fig. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/001097

A. CLASSIFICATION OF SUBJECT MATTER D04B1/22(2006.01)i, D04B7/02(2006.01)i, D04B7/26(2006.01)i, D04B15/00(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) D04B1/22, D04B7/02, D04B7/26, D04B15/00 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 1996-2008 Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008 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.
A	JP 3899269 B2 (Shima Seiki Mfg., Ltd.), 28 March, 2007 (28.03.07), Claims; drawings & WO 2001/064989 A1 & EP 1260625 A1 & US 2003/0037575 A1	1-5
A	JP 2005-213706 A (Shima Seiki Mfg., Ltd.), 11 August, 2005 (11.08.05), Claims; drawings & WO 2005/073445 A1 & EP 1728908 A1 & US 2007/0169517 A1	1-5
A	WO 2001/064988 A1 (Shima Seiki Mfg., Ltd.), 07 September, 2001 (07.09.01), Claims; drawings & EP 1260624 A1 & US 2003/0019247 A1	1-5
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 06 August, 2008 (06.08.08)		Date of mailing of the international search report 19 August, 2008 (19.08.08)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 3899269 B [0007]
- JP 2005213706 A [0007]