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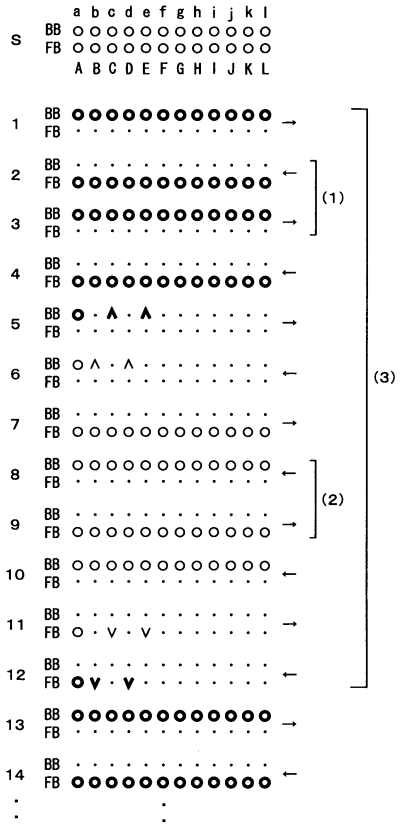
(54) METHOD FOR KNITTING TUBULAR FABRIC HAVING BORDER PATTERN

(57) The present invention aims to provide a knitting method that can prevent a stitch level difference that occurs at a yarn switching position when a tubular knitted fabric having a border pattern using a flat knitting machine. The first color part of the border pattern is knitted circularly in a unidirectional direction and the second color part of the border pattern is knitted circularly in the opposite direction. Between the knitting of the first color part and the knitting of the second color part, the step is inserted that the knitting yarn of the first color part is fed to a needle positioned across a boundary of the circular knitting and holding an adjacent loop, to form a knitted loop thereat, first, and then the knitting yarn is fed to a needle subsequent to said needle, to form a tuck loop thereat, and thereafter, the knitting yarn of the second color part is fed to the needle holding the knitted loop formed by the knitted yarn of the first color part, to form a new knitted loop subsequent to said knitted loop thereat.

【Fig. 3】



EP 1 964 953 A1

Description

Technical Field

[0001] The present invention relates to a knitting method for knitting a tubular knitted fabric having a border pattern by using a flat knitting machine so that a stitch level difference that occurs at a knitting yarn switching position can be prevented.

Background Art

[0002] When a tubular knitted fabric is knitted to have a border pattern (a horizontal-striped pattern) knitted therein, a stitch level difference occurs at a knitting yarn switching position. This spoils an appearance of the knitted fabric, leading to reduction of the commercial value of the knit products. FIG. 4 shows a general diagram for knitting a two-color border pattern of an A-color part 7 and a B-color part 9 by using two yarn feeders (hereinafter they are simply abbreviated to YF). In FIGS. 4 and 5, an A-color YF is indicated by a black triangle and a B-color YF is indicated by a white triangle. X-X indicates a left boundary between a front knitted fabric 3 and a back knitted fabric 5. In FIG. 4, the two YF are set on the left side of the knitted fabric and are fed circularly in the clockwise direction for the knitting, during which every time four courses are knitted, the YF used are switched to knit the border pattern. In this knitting, the stitch level difference occurs at the boundary at which the knitting yarns are switched, as illustrated. FIG. 5 shows an example of the knitting adopted for preventing the occurrence of the stitch level difference at the knitting yarn switching position. In this knitting, the YF are set on the right and left sides of the knitted fabric, respectively, and are controlled so that the B-color knitting yarn cannot be switched at the left boundary X-X to prevent continuous occurrence of the stitch level difference at the boundary of the border pattern.

[0003] The applicant of this application previously proposed a knitting technique as disclosed by Patent Document 1, in order to cope with the occurrence of the stitch level difference. The Patent Document 1 discloses that a stitch of at least one knitted fabric is intentionally missed at the knitting yarn switching position to prevent the occurrence of the stitch level difference thereat and also relieve the after-treatment of edge yarns including cross-over yarns caused by the switching of the knitting yarns.

Patent Document 1: Pamphlet of International Publication No. WO01/61092

Disclosure of the Invention

Problem to be solved by the invention

[0004] The method of FIG. 5 can provide improvement in occurrence of the stitch level difference, as compared with the method of FIG. 4, but the improvement is less effective and also requires that the two YF be set on the right and left sides of the knitted fabric, respectively. The Patent Document 1 discloses an effective coping way to prevent the stitch level differences which occur at the knitting yarn switching positions in the knitting diagram of FIG. 4 when the tubular knitted fabric is knitted circularly to a unidirectional direction. It is an object of the present invention to provide a knitting method that can provide the same effective coping way as that of the Patent Document 1 on the prevention of the occurrence of the stitch level differences by taking a different approach from that of the Patent Document 1.

Means for solving the problem

[0005] The present invention provides a knitting method for knitting a tubular knitted fabric having an at least two-color border pattern of a first color part and a second color part, each comprising a proper number of courses, whose front knitted fabric and back knitted fabric are joined together at lateral ends of a knitting width thereof, using a flat knitting machine having at least a pair of first and second needle beds disposed opposite to each other,

the knitting method comprising the first step of knitting the first color part of the border pattern circularly from the front knitted fabric to the back knitted fabric or from the back knitted fabric to the front knitted fabric, and the second step of knitting the second color part of the border pattern circularly to a direction opposite to the knitting direction of the first color part,

wherein the following knitting step is inserted in between the first step and the second step,

a) that the knitting yarn of the first color part is fed to at least one needle positioned across a boundary of the circular knitting and holding an adjacent loop, to form a knitted loop thereat and then is fed to a needle subsequent to said needle, to form at least one tuck loop thereat, and thereafter, the knitting yarn of the second color part is fed to the needle holding the knitted loop formed by the knitted yarn of the first color part, to form a new knitted loop subsequent to said knitted loop thereat.

[0006] The first color part and the second color part are knitted by using the same YF, the knitting yarn of the first color part and the knitting yarn of the second color part being switched by a yarn switching device, such as a splicer, and a connection of the knitting yarns is knitted behind in the tubular knitted fabric by the step a).

[0007] The first color part and the second color part are knitted by using the different YF to be switched and the knitted loop and the tuck loop are formed by the respective YF.

[0008] The boundary of the circular knitting is formed at a boundary of the front and back needle beds.

Effect of the invention

[0009] The present invention is based on the knitting diagram as shown in FIG. 2. In detail, the knitting yarn switching position is set at one end of the knitted fabric and also the direction of the circular knitting of the A-color part and that of the B-color part are reversed on each switching of the knitting yarns. This can prevent the color-switching parts of the respective color parts from being aligned on the same course at the boundary, as shown in FIG. 4. Further, since the directions of the circular knitting are reversed, the final course of the A-color part 7 on the left side of FIG. 2 and the first course of the B-color part 9 form a course where they are continuous to each other with respect to a vertical direction. Due to this, the final course of the A-color part 7 and the first course of the B-color part 9 are pulled away from each other. In other words, the knitting course of the A-color part on the left side of the boundary is pulled upwards, while at the same time the knitting course of the B-color part is pulled downwards. As a result of this action, the final course of the A-color parts 7 of the front knitted fabric 3 and that of the back knitted fabric 5 come to be on a level with each other, while also the first course of the B-color parts of the front knitted fabric and that of the back knitted fabric come to be on a level with each other. This contributes to the prevention of the occurrence of the stitch level difference. Further, during the knitting of the courses of the A-color part and the B-color part, a knitted loop is formed at the boundary therebetween by the knitting yarn of the A-color part 7 being fed across the boundary of the circular knitting to at least one needle holding an adjacent loop and then a tuck loop is formed at the position where the directions of the circular knitting are switched and, thereafter, another knitted loop subsequent to said knitted loop is formed by the knitting yarn of the second color part, so that local deformation at the boundary can be absorbed and also a hole-forming at the position where the directions of the circular knitting are switched can be prevented by the tuck. This can prevent the stitch level difference and can produce a tubular knitted fabric having a good-looking border pattern.

[0010] When a connection of the knitting yarns is knitted behind in the knitted fabric while the border pattern is formed by using the yarn switching device such as a splicer, not only the occurrence of the stitch level difference can be prevented but also the hand treatment of a cross-over yarn extending between the border patterns after completion of the knitting can be relieved.

[0011] When the boundary of the circular knitting is set at the boundary of the front and back needle beds, simplification of the knitting can be yielded.

Brief Description of the Drawings

[0012]

FIG. 1 shows a tubular knitted fabric having a border pattern according to an embodiment of the present invention.

FIG. 2 shows a diagram of the embodiment of the present invention corresponding to FIGS. 4 and 5.

FIG. 3 shows a diagram showing the knitting steps of the tubular knitted fabric of the embodiment of the present invention.

FIG. 4 shows a general diagram for knitting a two-color border pattern. and

FIG. 5 shows an example of the way of knitting the border pattern to prevent occurrences of stitch level differences.

Explanation of letters or numerals

[0013]

1: Tubular knitted fabric	3: Front knitted fabric
5: Back knitted fabric	7: A-color part
9: B-color part	

Best Mode for Carrying out the Invention

[0014] In the following, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0015] FIG. 1 shows a tubular knitted fabric 1 having a two-color border pattern of an A-color and a B-color. A flat knitting machine used includes yarn switching devices such as splicers and knotters provided between yarn packages for A-color yarn and B-color yarn, not shown, and YF movable reciprocally on the needle beds. It also includes a controller for controlling operation timing of the yarn switching devices properly under the controls of the knitting data to switch the knitting yarns. The flat knitting machines that can be used include the flat knitting machine cited in JP Patent No. 2816784 (which corresponds to US Patent No. 536966 and European Patent No. 0574881), for example.

[0016] FIG. 2 shows a diagram for the knitting of the embodiment of the present invention which corresponds to FIGS. 5 and 6 cited above. The knitting step additionally inserted at the yarn switching positions are omitted from FIG. 2. An A-color YF is indicated by a black triangle and a B-color YF is indicated by a white triangle. X-X shows a left boundary between a front knitted fabric 3 and a back knitted fabric 5. The YE are set on the left side of the knitted fabric. The two YF are illustrated in FIG. 2, but actually, it is only one YF that is used for the knitting yarns to be switched by the yarn switching devices. The tubular knitted fabric 1 is knitted circularly, with the A-color part 7 and the B-color part 9 knitted in the directions opposite to each other.

[0017] FIG. 3 shows in detail the knitting steps of the tubular knitted fabric 1. The arrows on the right side of the drawing indicate the knitting directions. FB designates a front needle bed and BB designates a back nee-

dle bed, A-L designate needles of the front needle bed, and a-1 designate needles of the back needle bed. The front knitted fabric 3 and the back knitted fabric 5 of the tubular knitted fabric 1 are knitted in plain knitting with the needles of the front needle bed FB and the needles of the back needle bed BB, respectively. For explanatory convenience, a fewer number of needles than the actual number of needles used for the knitting is shown.

[0018] The A-color part 7 of the tubular knitted fabric 1 is knitted circularly in the clockwise direction, with its back knitted fabric 5 knitted rightwards and its front knitted fabric 3 knitted leftwards. On the other hand, the B-color part 9 is knitted circularly in the counterclockwise direction opposite to the direction to which the A-color part 7 is knitted, with its front knitted fabric 3 knitted rightwards and its back knitted fabric 5 knitted leftwards. The steps 1-4 indicate the steps for knitting the A-color part 7 and the steps 7-10 indicate the steps for knitting the B-color part 9. The steps 5, 6 and the steps 11, 12 both indicate the knitting steps at the knitting yarn switching positions, at which the knitting step of drawing out the knitting yarns and knitting them behind in the back knitted fabric 5 to prevent a connection of the A-color/B-color knitting yarns (a color change) from appearing on the front side of the knitted fabric and the knitting step of making the stitch level difference occurring at the color change positions less noticeable are simultaneously performed. Shown in the step 13 and subsequent steps are the knitting steps of the A-color part 7 subsequent to the B-color part 9. In this embodiment, a cycle (3) is set to jump the knitting to the step 1 from the step 12 so that the border pattern consisting of the A-color and the B-color can be knitted repeatedly. A cycle (1) is for adjusting the number of courses of the A-color part 7, and a cycle (2) is for adjusting the number of courses of the B-color part 9.

[0019] In the following, the knitting steps of FIG. 3 are described. The step S shows the state of the tubular knitted fabric 1 being held on the needle beds, in which the front knitted fabric 3 is held by the needles A-L of the front needle bed FB and the back knitted fabric 5 is held by the needles a-1 of the back needle bed BB. In the step 1, the YF is moved rightwards to knit the courses of the back knitted fabric 5 of the A-color part 7 of the tubular knitted fabric 1. In the subsequent step 2, the YF is moved leftwards to knit the courses of the front knitted fabric 3 of the same part. The steps 3 and 4 show the steps corresponding to the steps 1 and 2. The cycle (1) is repeated twice to form four courses of circular courses in the A-color part 7.

[0020] In the next step 5, in order to switch from the A-color to the B-color, the YF is moved rightwards and a loop is knitted with the needle a of the back needle bed BB and loops are tucked with the subsequent needles c and e. In the step 6, the YF is moved leftwards and loops are tucked with the needles d, b and a loop is knitted with the needle a. The steps 5 and 6 are taken for the purpose of enabling the switching of the yarns that can provide an exact color discrimination and prevention of the stitch level difference of the border pattern at the boundary. During these steps, the connection of the knitting yarns is drawn out from the YF and is knitted behind in the tubular knitted fabric 1. This means that the connection of the knitting yarns is placed within the tuck zones of the steps 5 and 6. When the splicers are used as the yarn switching devices, the need for the yarn treatment after completion of the knitting of the knitted fabric can be eliminated. In this embodiment, four needles are used for the tuck. In the case where the position of the connection of the knitting yarns can be controlled more accurately, the number of needles used for the tuck can be reduced further. On the other hand, in the case where the position of the connection of the knitting yarns can only be roughly controlled, the number of needles used for the tuck may be increased to expand the range of absorbing the error. Other ways than the tuck may alternatively be adopted to absorb the error.

[0021] In the subsequent step 7, courses of the front knitted fabric 3 of the B-color part 9 are knitted. In the subsequent step 8, courses of the back knitted fabric 5 of the same are knitted. The steps 9 and 10 indicate the steps corresponding to the steps 7 and 8. Then, in the step 11, in order to switch the colors of the border pattern again, the YF is moved rightwards and a loop is knitted with the needle A of the front needle bed FB and loops are tucked to the needles C and E. In the step 12, loops are tucked with the needles D and B and a loop is knitted with the needle A. These steps are taken with the same concepts of the previous steps 5 and 6. The cycle (2) is repeated twice to form four courses of circular courses in the B-color part 9 in the same manner.

[0022] In the embodiment mentioned above, the result that more knitted loops are formed by the needle a of the back needle bed BB and by the needle A of the front needle bed FB than those formed by other needles is provided by the knitting steps 5, 6 and the knitting steps 11, 12. This can provide the result of absorbing deformation at the boundary and preventing the stitch level difference occurring thereat to thereby produce a nearly-level border pattern. Although it is possible to form knitted loops with two or more needles, not exclusively limited to the above, it is preferable to form a knitted loop with the single needle, in order to prevent the stitch level difference at the boundary and produce a good-looking appearance.

[0023] Although the example using the yarn switching devices, such as the splicers, has been taken in the embodiment described above, it is, of courses, possible to use two YF of the A-color YF and the B-color YF, in place of the yarn switching devices, to knit while switching them to each other, as usual.

[0024] Although the case where the knitting yarn switching position is set at the boundary between the front knitted fabric and the back knitted fabric of the tubular knitted fabric or at the lateral end of the knitting width of the knitted fabric put on the needle bed has been

illustrated in the embodiment described above, the knitting yarn switching position is not exclusively limited to the lateral end of the knitting width. The knitting method of the present invention may of courses be used even when the knitting yarn switching position is set at a center portion of the front knitted fabric, for example. In this case, the knitting in the steps may be shifted in the horizontal direction according to the position of the boundary.

[0025] In the case where the border pattern in the tubular knitted fabric is formed by frequently repeated stripes, it is preferable that the knitting yarn switching positions are shifted accordingly to prevent the knitting for the miss and tuck for making the stitch level difference unnoticeable from being repeatedly performed by use of the same needles so that the number of courses of the knitting yarn switching positions can be prevented from being reduced extremely more than those of the other wale.

Claims

1. A knitting method for knitting a tubular knitted fabric having an at least two-color border pattern of a first color part and a second color part, each comprising a proper number of courses, whose front knitted fabric and back knitted fabric are joined together at lateral ends of a knitting width thereof, using a flat knitting machine having at least a pair of first and second needle beds disposed opposite to each other,
the knitting method comprising the first step of knitting the first color part of the border pattern circularly from the front knitted fabric to the back knitted fabric or from the back knitted fabric to the front knitted fabric, and the second step of knitting the second color part of the border pattern circularly to a direction opposite to the knitting direction of the first color part, wherein the following knitting step is inserted in between the first step and the second step,

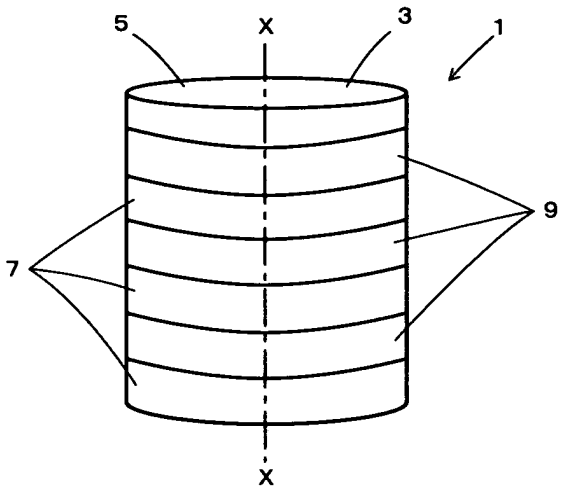
    a) that the knitting yarn of the first color part is fed to at least one needle positioned across a boundary of the circular knitting and holding an adjacent loop, to form a knitted loop thereat and then is fed to a needle subsequent to said needle, to form at least one tuck loop thereat, and thereafter, the knitting yarn of the second color part is fed to the needle holding the knitted loop formed by the knitted yarn of the first color part, to form a new knitted loop subsequent to said knitted loop thereat.

2. The knitting method for knitting the tubular knitted fabric having the border pattern according to Claim 1, wherein the first color part and the second color part are knitted by using the same YF, the knitting yarn of the first color part and the knitting yarn of the second color part being switched by a yarn switching device, such as a splicer, and a connection of the knitting yarns is knitted behind in the tubular knitted fabric by the step a).

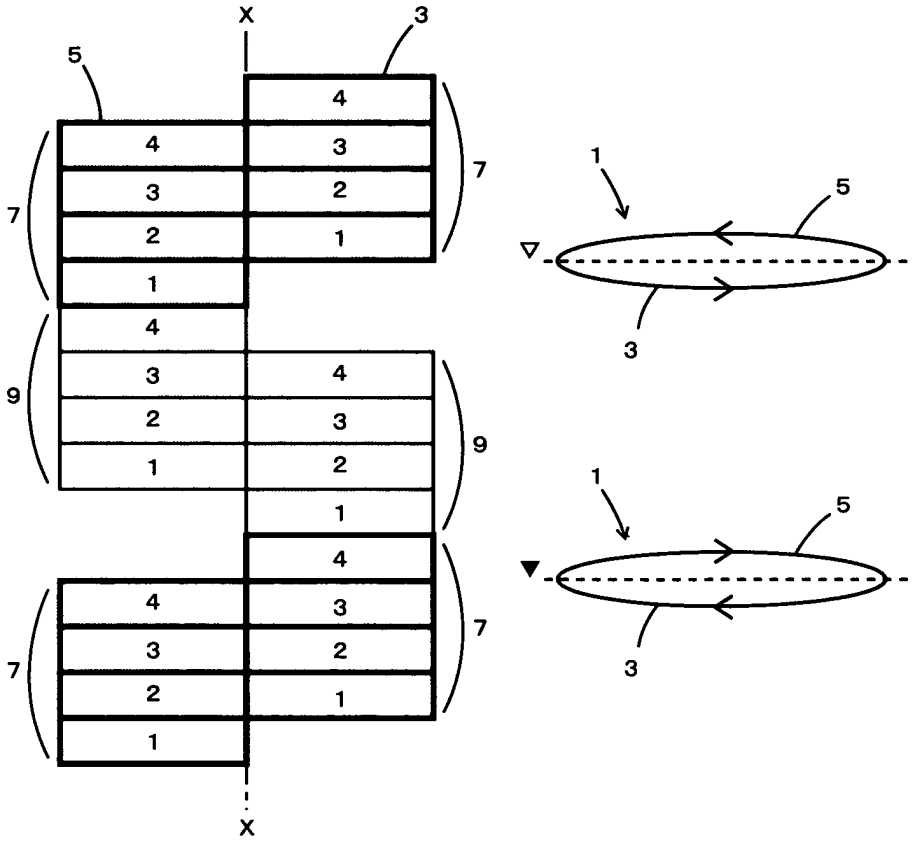
3. The knitting method of knitting the tubular knitted fabric having the border pattern according to Claim 1, wherein the first color part and the second color part are knitted by using the different YF to be switched, and the knitted loop and the tuck loop are formed by the respective YF.

4. The knitting method of knitting the tubular knitted fabric having the border pattern according to any one of Claims 1-3, wherein a boundary of the circular knitting is formed at the boundary of the front and back needle beds.

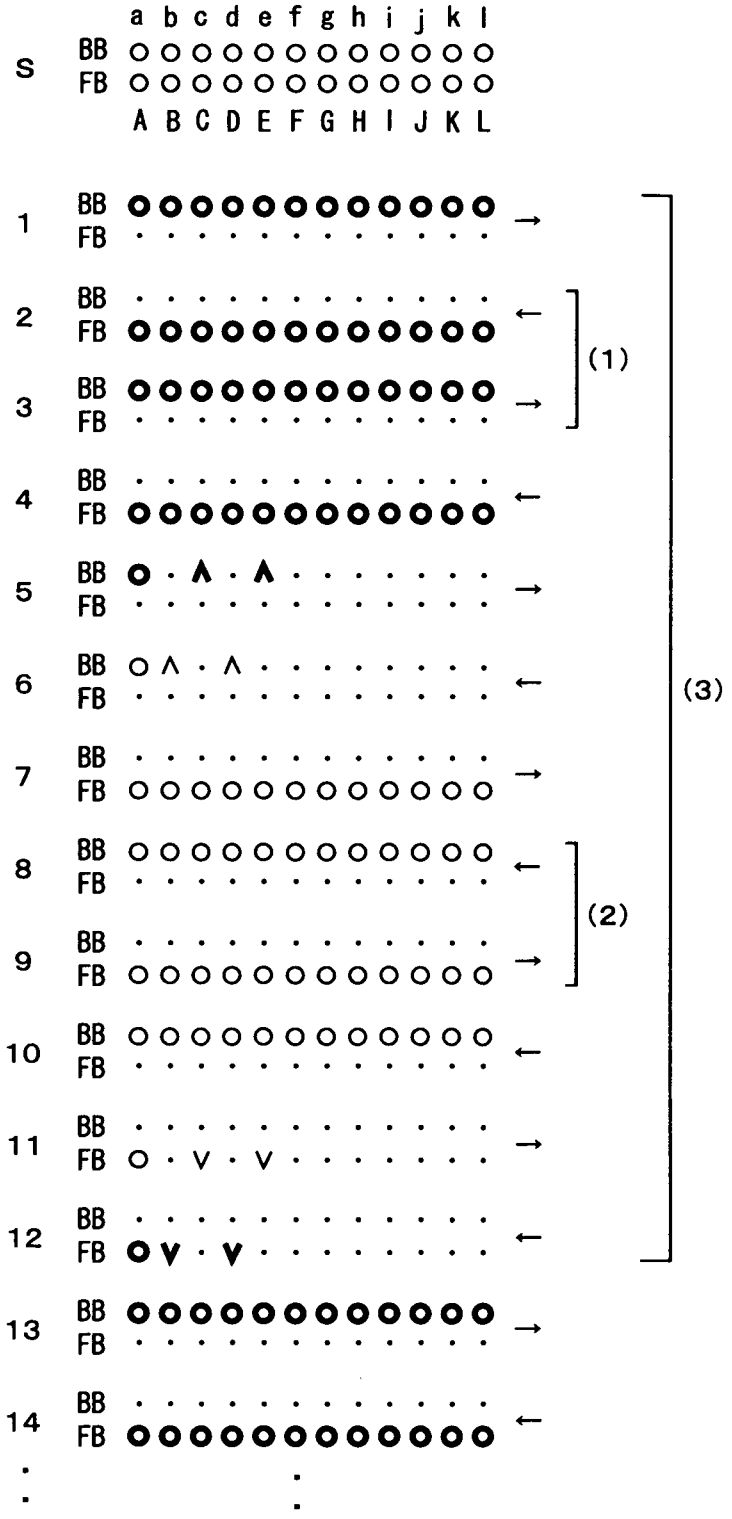
【Fig. 1】



【Fig. 2】



【Fig. 3】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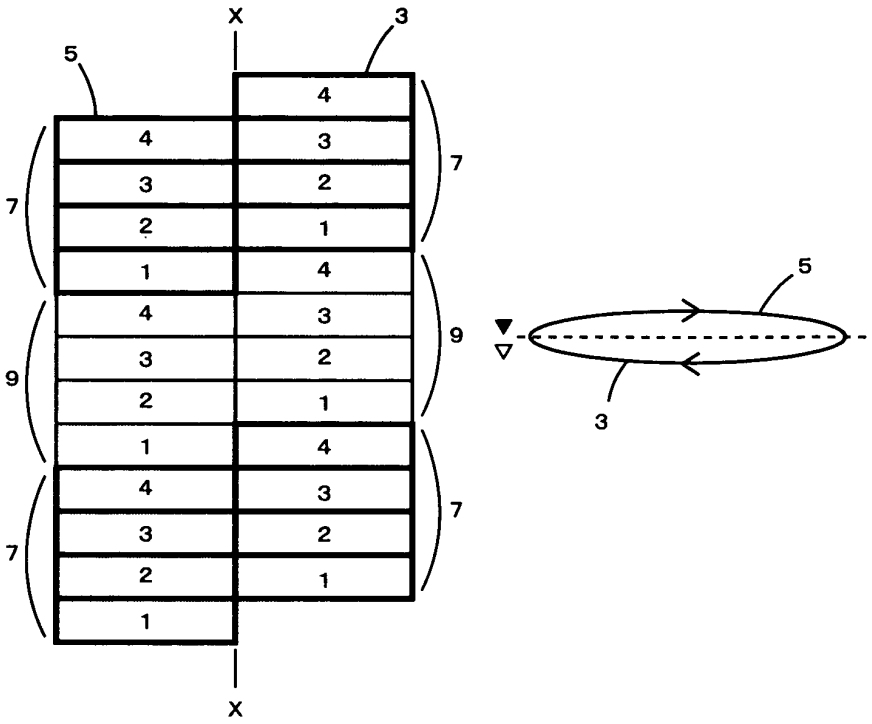
【Fig. 4】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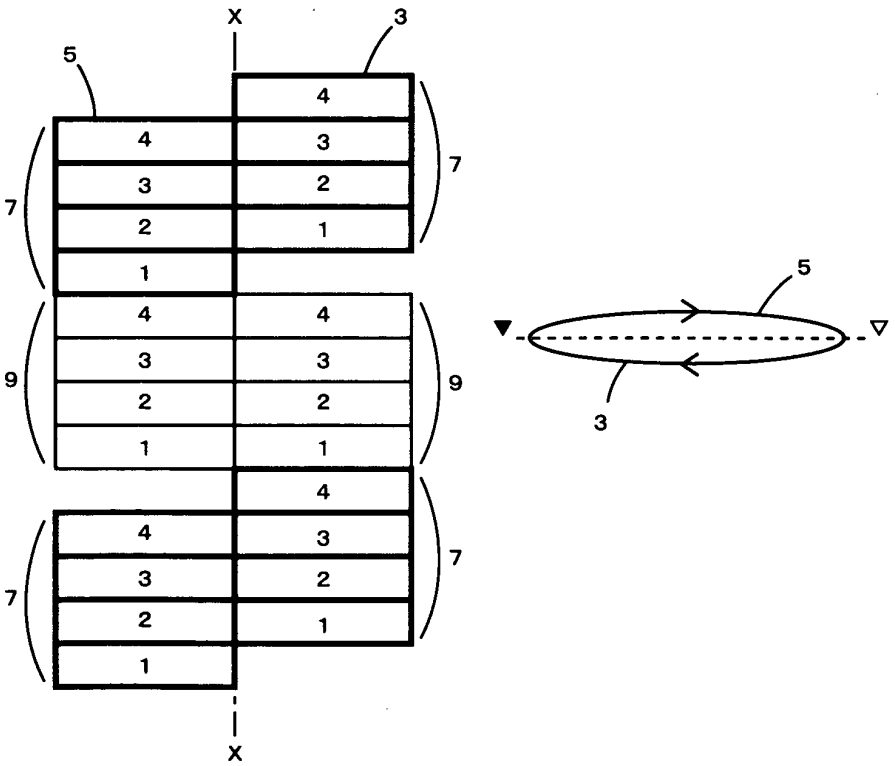
【Fig. 5】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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/322192

A. CLASSIFICATION OF SUBJECT MATTER
D04B7/26(2006.01)i, *D04B1/10*(2006.01)i, *D04B7/32*(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)
D04B1/00-1/28, 7/00-7/34

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.
A	WO 2005/014902 A1 (Shima Seiki Mfg., Ltd.), 17 February, 2005 (17.02.05), & JP 2005-060861 A & EP 1652980 A	1-4
A	WO 01/61092 A1 (Shima Seiki Mfg., Ltd.), 23 August, 2001 (23.08.01), & US 2003/0010069 A1 & EP 1266989 A1 & AU 3061601 A & TW 479084 B & CN 1404538 A	1-4
A	JP 3099304 B2 (Shima Seiki Mfg., Ltd.), 16 October, 2000 (16.10.00), & US 5628209 A1 & EP 699791 A1 & DE 69502557 C	1-4

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Date of the actual completion of the international search	Date of mailing of the international search report
16 January, 2007 (16.01.07)	30 January, 2007 (30.01.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/322192

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 2816784 B2 (Shima Seiki Mfg., Ltd.), 27 October, 1998 (27.10.98), & US 5369966 A1 & EP 574881 A1 & DE 69320871 C & CN 1085970 A	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 0161092 A **[0003]**
- JP 2816784 B **[0015]**
- US 536966 A **[0015]**
- EP 0574881 A **[0015]**