(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 154 280 A1**

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

(43) Date of publication:
17.02.2010 Bulletin 2010/07

(21) Application number: **08751621.7**

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

(51) Int Cl.:
D04B 1/22 *(2006.01)* ***D04B 7/26*** *(2006.01)*

(86) International application number:
PCT/JP2008/001096

(87) International publication number:
WO 2008/139709 (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

(30) Priority: **26.04.2007 JP 2007117469**

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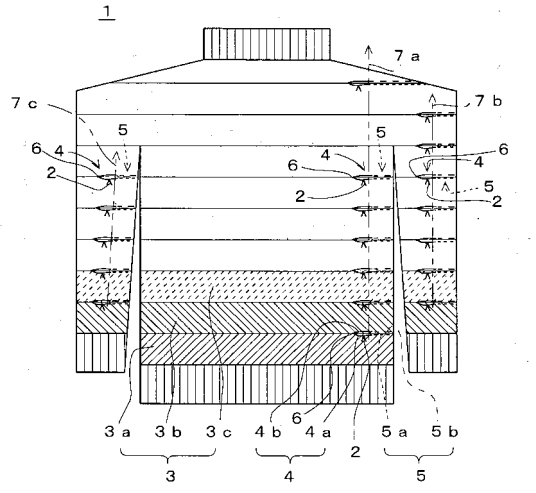
(54) FABRIC HAVING YARN-FINISHED PORTION, TREATING METHOD THEREFOR, AND DESIGN DEVICE

(57) To provide a fabric having a yarn-worked portion from which the yarn-worked portion can be easily removed for improving the knit quality, and a treating method therefor and a design apparatus.

A knit fabric 1 having a yarn-worked portion has a yarn-worked portion 2 which is processed for switching knitting yarns of various colors by a piecing device in advance, or the like. The yarn-worked portion 2 is disposed near the position where a striped border pattern 3 is switched over between a color-A region 3a and a color-B region 3b. A knitting yarn is pulled out from the fabric surface as a floating yarn 4, and the yarn-worked portion 2 shall be included in the range of the floating yarn 4 pulled out. The floating yarn 4 is folded back at the leading end and is tucked and retained in the fabric by a retaining portion 6. The floating yarn 4 is cut on the side closer to a tucking section 5 beyond the yarn-worked portion 2. The cut portion is formed along the surface of a tubular shaped fabric and therefore the cutting operation can be easily performed. The portion including the cut yarn-worked portion 2 is pulled out from the retaining portion 6 and removed.

Fig. 1



EP 2 154 280 A1

Description

Technical Field

[0001] The present invention relates to a fabric having a yarn-worked portion which is provided in a knitting yarn used for knitting a fabric by a flatbed knitting machine so that colors and other properties can be switched with yarns of different colors knitted in the knit fabric, its treating method, and a design apparatus.

Background Art

[0002] Conventionally, in a flatbed knitting machine, a plurality of yarn feeders have been used properly to switch multiple kind of knitting yarns with various colors to knit a fabric. However, the kind of knitting yarn that can be used is subject to restrictions by the number of yarn feeders. By providing a yarn-worked portion on a part along knitting yarns fed from a same yarn feeder and switching yarns by means of treatment such as connecting different knitting yarns, or the like, one yarn feeder can feed multiple kind of knitting yarns successively. That is, the number of knitting yarns that can be used is not subject to restrictions by the number of yarn feeders, and it becomes possible to knit a fabric with a large number of colors used. In the event that knitting yarns are switched by providing a yarn-worked portion on a part along a the knitting yarn, consumed amount of the knitting yarn by knitting is computed and timing when to be conducted yarn finishing is adjusted in advance so that the yarn-worked portion reaches a position where the knitting yarn can be switched in a fabric (for example, see Patent Citation 1). The yarn-worked portion remains knitted into the fabric. Processing to set the position of the yarn-worked portion and others are described to be conducted in a control device of a flatbed knitting machine. It is also known that it is possible to provide such processing functions provided for a flatbed knitting machine on a design apparatus side which prepares knitting data to knit a fabric.

[0003] Meanwhile, in the event that a plurality of yarn feeders are properly used and multiple kinds of knitting yarns are switched every predetermined number of courses, to knit a multicolor striped pattern fabric, a floating yarn is generated between the switching point of each knitting yarn and the point where the knitting yarn is next used. This floating yarn is generated outside the knitting width and therefore is to be cut. A treating method of pulling a surplus portion of the knitting yarn, generated by cutting, into a fabric by stretching the fabric is disclosed, too (for example, see Patent Citation 2).

Patent Citation 1: Japanese Patent No. 2816784
Patent Citation 2 :Japanese Patent No. 3839496

Disclosure of the Invention

Technical Problem

[0004] The yarn-worked portion as described in Patent Citation1 is mechanically formed by an yarn-piecing device such as a knotter which connects knitting yarns by knotting yarns together or a splicer which connects knitting yarns by entwining after temporarily raveling knitting yarns out, and others. The position where the yarn-worked portion is provided in the knitting yarn can be theoretically found by calculating back the consumed amount of knitting yarn by knitting from the position where the knitting yarn is switched on a fabric, making the best of the data for knitting the fabric. In the event that the position of the yarn-worked portion coincides with the position where the knitting yarn is switched, it should be able to switch the knitting yarn by knitting only. However, even if the yarn-worked portion is knitted into the knitting yarn switching position on a fabric, the yarn-connecting portion mechanically formed by a yarn-piecing device has the thickness increased as the knitting yarn and a surplus end portion is generated by knots and splices. The fabric including this kind of knitting yarn connecting portion may have a possibility of causing disfigurement of the fabric if such connecting portion is exposed to a surface when the fabric is put into practical use. Even if the connecting portion is not exposed to the surface of the fabric but to the rear surface, a wearer may comes in contact with the portion and may feel discomfort, and therefore, the quality may be degraded.

[0005] In addition, for yarn-working, it is possible to switch colors by dyeing the same knitting yarn. However, by dyeing, color blurring is apt to occur at the position where the color is switched, and even when the yarn-worked portion is precisely knitted into the color switching position of the fabric, the color blurring may spoil external appearance.

[0006] Furthermore, in actuality, occurrence of errors cannot be avoided between the position of the yarn-worked portion on the knitting yarn and the position of switching the knitting yarn on the fabric. Consequently, with the error range taken into account, in the vicinity of the yarn-worked portion of the knitting yarn, it is necessary to treat the surplus portion of the knitting yarn to knit into a fabric by knitting treatment that is not visible from the knit fabric surface. However, the yarn-worked portion mechanically formed by yarn piecing, or the like frequently has the increased thickness or a surplus portion; these could cause large resistance when the yarn is knitted by knitting needles, resulting in hitching and broken yarn.

[0007] In the event that the yarn-worked portion is included in a portion which is cut and removed as a floating yarn outside the knitting width as is the case of Patent Citation 2, the yarn-worked portion is able to be removed from the fabric. However, in the event that a yarn-worked portion is provided to switch knitting yarn colors of a striped pattern fabric, the knitting yarn fed from the same

yarn feeder is switched and the adjoining next border pattern section is knitted, too. Consequently, in the event that the knitting yarn is switched at the yarn-worked portion, there generated is no floating section, in which the knitting yarn becomes a floating yarn outside the knitting width.

[0008] It is an object of the present invention to provide a fabric having a yarn-worked portion in which the yarn-worked portion can be easily removed for knit quality improvement, a treating method therefore, and a design apparatus.

Technical Solution

[0009] The present invention provides a fabric having a yarn-worked portion, the fabric being knitted with knitting yarns to be fed from a same a yarn feeder, the yarn-worked portion being set to switch properties as a knitting yarn in advance before fed from the yarn feeder so that the properties as the knitting yarn can be switched at a position corresponding to a data, on the basis of the data how the fabric being knitted, comprising;

a floating section formed with knitting yarns used in sections before and after the yarn-worked portion, in such a manner that the knitting yarns shuttle under a condition not to be knitted into the fabric; and
at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the floating section and providing raveling-stop treatment the moving knitting yarn.

[0010] In addition, the fabric of the present invention is characterized that
said raveling-stop treatment at the raveling-stop portion is conducted by tucking said knitting yarn to said fabric at a plurality of positions.

[0011] In addition, the fabric of the present invention is characterized that
said fabric is knitted in a tubular form by a flatbed knitting machine provided with a front needle bed and a rear needle bed, the fabric being made by connecting fabrics knitted by the front and rear needle beds respectively, on both sides of knitting width, and
said floating section is formed outside of the fabric in the tubular form.

[0012] In addition, the fabric of the present invention is characterized that
a plurality of yarn-worked portions are arranged with spacing in said knitting yarn, and floating sections formed in different knitting courses with each yarn-worked portion included, respectively, are arranged along a virtual straight line.

[0013] Furthermore, the present invention provides a method for treating a yarn-worked portion on knitting yarns fed from a same a yarn feeder to knit a fabric, the yarn-worked portion being set to switch properties as a knitting yarn at a position corresponding to a data, on the basis of the data how the fabric being knitted, which comprises;
forming a floating section by allowing knitting yarns before and after the yarn-worked portion to shuttle without being knitted into the fabric before the properties as the knitting yarn are switched at the yarn-worked portion;
forming at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the connecting section and providing raveling-stop treatment the moving knitting yarn;
continuing to knit the fabric; and
after the fabric knitted, cutting the knitting yarns of the connecting section including the yarn-worked portion and removing them from the fabric.

[0014] In addition, the method of the present invention is characterized that
said raveling-stop treatment is conducted by tucking knitting yarns to the fabric at a plurality of places.

[0015] In addition, the method of the present invention is characterized that
knitting said fabric in a tubular form by a flatbed knitting machine, the fabric being made by connecting fabrics knitted by a front needle bed and a rear needle bed of the flatbed knitting machine respectively, on both sides of knitting width;
said floating section is formed outside of the fabric in the tubular form; and
pulling and absorbing knitting yarns into the fabric in the tubular form, the knitting yarns remain in the floating section after said cutting into the cylindrical knit fabric.

[0016] In addition, the method of the present invention is characterized that
said retaining at the retaining portion is conducted by tucking the knitting yarn into knitted loops which form said fabric.

[0017] In addition, the method of the present invention is characterized that
said retaining at the retaining portion is conducted by winding the knitting yarn over knitted loops which form said fabric.

[0018] In addition, the method of the present invention is characterized that
said retaining at the retaining portion is conducted by taking one stitch on edge by a knitting yarn near a folding-back position, where the knitting yarn in said floating section shuttles, to a knitting needle for which a knitted loop is not retained; and at the same time; allowing the knitting yarn of the floating section to pass between one surface side of the fabric and the other surface side; and removing the stitch from the knitting needle.

[0019] In addition, the method of the present invention is characterized that
a plurality of yarn-worked portions being arranged with spacing in said knitting yarn, and

arranging the floating sections along a virtual straight line, the floating sections formed in different knitting courses with each yarn-worked portion included, respectively.

[0020] Furthermore, the present invention provides a design apparatus for generating knitting data to knit a fabric by a flatbed knitting machine, wherein
the knitting data being generated to be implemented in the flatbed knitting machine so that
in order to treat a yarn-worked portion on knitting yarns fed from a same a yarn feeder to knit a fabric, the yarn-worked portion being set to switch properties as a knitting yarn at a position corresponding to a data, on the basis of the data how the fabric being knitted, while continuing to knit fabric;
forming a floating section by allowing knitting yarns before and after the yarn-worked portion to shuttle without being knitted into the fabric before the properties as the knitting yarn are switched at the yarn-worked portion; and
forming at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the connecting section and providing raveling-stop treatment the moving knitting yarn.

Advantageous Effects

[0021] According to the present invention, a floating section, and at least one of retaining portion or raveling-stop portion are included in a fabric, which having a yarn-worked portion for switching a knitting yarn fed from a same yarn feeder in order to knit the fabric to a knitting yarn of different properties in the midst of knitting. The floating section is formed by knitting yarns of the sections before and after the yarn-worked portion in such a manner that the knitting yarn is not knitted into the fabric. By cutting the knitting yarn containing the yarn-worked portion, the yarn-worked portion can be easily removed from the fabric. Once the yarn-worked portion is removed from the fabric, there is no chance for the yarn-worked portion to spoil the appearance or to give discomfort when the fabric is worn, and the quality of the fabric is able to be improved. Retaining a part of the knitting yarn, which shuttles in the floating section, can prevent the knitting yarn of the floating section from separating and hanging down from the fabric. Providing a raveling-stop portion on the fabric side of the portion where the knitting yarn moves to the floating section can prevent the knit fabric from raveling even if the knitting yarn of the floating section containing the yarn-worked portion is cut and removed.

[0022] In addiction, according to the present invention, raveling-stop treatment of the raveling-stop portion is conducted by tucking the knitting yarn to the fabric at a plurality of places, and therefore, effect of the treatment on the appearance, elongation, or the like of the fabric can be minimized.

[0023] In addiction, according to the present invention, after knitting a tubular fabric, the floating section is exposed to the outside and can be easily cut.

[0024] In addiction, according to the present invention, because the floating sections formed in different knitting courses are arranged along a virtual straight lines, the floating sections can be efficiently cut by moving a cutter along the straight line when the floating sections are cut after the fabric is knitted.

[0025] Furthermore, according to the present invention, before the knitting yarn is switched at the yarn-worked portion, the yarn-worked portion can be included in a floating section formed to allow the knitting yarn to shuttle being not knitted in the fabric. Since the knitting yarn of the floating section containing the yarn-worked portion is cut and removed from the fabric after knitting the fabric, problems of appearance and wear discomfort when the yarn-worked portion remains in the fabric are solved and the quality of the t fabric can be improved. The yarn-worked portion is no longer required to be knitted into the fabric by knitting needles, and errors near the yarn-worked portion are absorbed, and on the fabric, the properties of the knitting yarn can be switched at the position conforming to the knitting data. Forming the retaining portion can stabilize the knitting yarn of the floating section containing the yarn-worked portion and enables easy cutting of the knitting yarn. Forming the raveling-stop portion can prevent the fabric from raveling even when the knitting yarn of the floating section containing the yarn-worked portion is cut and removed.

[0026] In addition, according to the present invention, since the raveling-stop treatment is conducted by tucking into a fabric at a plurality of places, easy treatment is achieved and effect on the fabric appearance, elongation, or the like can be minimized.

[0027] In addition, according to the present invention, since the floating section in which the knitting yarn is allowed to shuttle without knitting the knitting yarn into the fabric is formed outside a tubular fabric, the knitting yarn can be easily cut after the fabric is knitted. Since the knitting yarn after cutting is pulled into the inside of the tubular fabric and absorbed, the yarn end can be kept invisible from the outside of the tubular fabric.

[0028] In addition, according to the present invention, since the knitting yarn of the floating section is retained by tucking into knitted loops forming the fabric, the knitting yarn need not be pulled in as in the case of knitting, and can be kept to a minimum length to be knitted into the fabric. Even when the yarn-fworked portion comes to the portion where the yarn-worked portion tucks, a load to pull in the knitting yarn can be reduced.

[0029] In addition, according to the present invention, since the knitting yarn of the floating section is retained to a fabric by passing the knitting yarn over the knitted loop that forms a fabric, the knitting yarn of the floating section can be retained without being knitted into the fabric.

[0030] In addition, according to the present invention, retention of the knitting yarn of the floating section is con-

ducted by passing the knitting yarn of the floating section alternately between on surface side and the other surface side after the knitting yarn near the folding-back position is wound. Since the wound yarn is cleared away after the knitting yarn is allowed to pass the fabric, the portion allowed to pass through the fabric can be easily removed after the floating yarn is cut.

[0031] In addition, according to the present invention, the floating sections formed by a different knitting courses are disposed along a virtual straight line, and when the floating section containing the yarn-worked portion is cut after a fabric is knitted, the cutting operation can be efficiently conducted along the straight line.

[0032] Furthermore, according to the present invention, a yarn-worked portion is provided on a knitting yarn in accordance with the data for knitting a fabric, knitting yarns before and after the yarn-worked portion is kept not knitted into the fabric, and the knitting data that enables easy cutting by post-processing can be generated to allow a flatbed knitting machine to execute the process.

Brief Description of the Drawings

[0033]

[Fig. 1] Fig. 1 is a simplified front view showing a fabric 1 having a yarn-worked portion of one embodiment according to the present invention.

[Fig. 2] Fig. 2 is a schematic diagram showing a general procedure of a yarn worked portion 2 by knitting the fabric 1 as shown in Fig. 1.

[Fig. 3] Fig. 3 is a schematic diagram showing the first half of the general procedures which knit the fabric 1 having the yarn-worked portion as shown in Fig. 1 by a four-needle-bed knitting machine, which has two-tiered needle beds front and rear.

[Fig. 4] Fig. 4 is a schematic diagram showing the second half of the general procedures which knit the fabric 1 having the yarn-worked portion as shown in Fig. 1 by a four needle-bed knitting machine, which has two-tiered needle beds front and rear.

[Fig. 5] Fig. 5 is a schematic diagram showing a major part of the procedure for knitting a fabric in which the yarn-worked portion 2 can be removed in a post-process in the same manner as in the case of the fabric 1 having the yarn-worked portion of Fig. 1.

[Fig. 6] Fig. 6 is a schematic diagram showing a procedure for pulling out a floating yarn 4 without carrying out a stitch transferring in Step 3 of Fig. 3. [Fig. 7] Fig. 7 is a schematic diagram showing an example of forming a floating yarn 4 inside a tubular knit fabric without carrying out a stitch transferring in Step 3 of Fig. 3 same as Fig. 6, and at the same time, forming a tucking section in the same fabric same as in Fig. 5.

[Fig. 8] Fig. 8 is a schematic diagram showing a procedure of another method for knitting a fabric 1 having a yarn-worked portion of Fig. 1.

[Fig. 9] Fig. 9 is a schematic diagram showing a procedure of another method for knitting the fabric 1 having the yarn-worked portion of Fig. 1.

[Fig. 10] Fig. 10 is a schematic diagram partially showing a general structure of fabrics 11, 21, and 31 having a yarn-worked portion according to another embodiment of the present invention, with respect to the vicinity of the yarn-worked portion 2.

[Fig. 11] Fig. 11 is a schematic diagram showing a first half of a general procedure for knitting the fabric 11 having the yarn-worked portion as shown in Fig. 10A by a four-needle-bed knitting machine, which has two-tiered needle beds front and rear.

[Fig. 12] Fig. 12 is a schematic diagram showing a second half of the general procedure for knitting the fabric 11 having the yarn-worked portion as shown in Fig. 10A by a four-needle-bed knitting machine, which has two-tiered needle beds in front and rear.

[Fig. 13] Fig. 13 is a schematic diagram showing a first half of a general procedure for knitting the fabric 21 having the yarn-worked portion as shown in Fig. 10B by a four-needle-bed knitting machine, which has two-tiered needle beds in front and rear.

[Fig. 14] Fig. 14 is a schematic diagram showing a second half of the general procedure for knitting the fabric 21 having the yarn-worked portion as shown in Fig. 10B by a four-needle-bed knitting machine, which has two-tiered needle beds in front and rear.

[Fig. 15] Fig. 15 is a block diagram showing a general structure of a design apparatus for generating knitting data including procedures to knit fabrics 1, 11, 21, and 31 having a yarn-worked portion.

Explanation of Reference

[0034]

1, 11, 21, 31.	Knit fabric having a yarn-worked portion
2.	Yarn-worked portion
3.	Border pattern
4.	Floating yarn
4a	Outward floating section
4b	Homeward floating section
5, 5a, 5b	Tucking section
6, 16, 26	Retaining portion
40	Design apparatus

Best Mode for Carrying Out the Invention

[0035] Fig. 1 shows a schematic structure of a fabric 1 having a yarn-worked portion as one embodiment according to the present invention. The fabric 1 having a yarn-worked portion is, for example, a tubular shaped fabric knitted by a flatbed knitting machine having needle beds opposite to each other in front and rear to produce sweaters, or the like with no-sewing construction, and has a yarn-worked portion 2 at which a different knitting yarn is joined in advance by an piecing device and switched. The fabric 1 having the yarn-worked portions

2 has a multi-striped border pattern 3, and a color-A region 3a, color-B region 3b, color-C region 3c, or the like are provided thereto. The yarn-worked portion 2 is disposed near the position where, for example, the color-A region 3a of the border pattern 3 is switched to the color-B region 3b. In the fabric 1 having the yarn-worked portion 2 of the present embodiment, a knitting yarn is pulled out from the fabric surface to the outside thereof as a floating yarn 4 and the yarn-worked portion 2 is contained in the range of the pulled-out floating yarn 4. To achieve this, a knitting yarn of a length enough to absorb errors of the position of the yarn-worked portion 2 should be pulled out as the floating yarn 4 which is not knitted into the fabric.

[0036] The floating yarn 4 is folded back at the leading end in such a manner that the floating yarn makes a round trip between the outward floating section 4a and the homeward floating section 4b. To the portion pulled out to prevent the floating yarn 4 of the outward floating section 4a from being knitted into a fabric and the portion to return the floating yarn 4 of the homeward transfer section 4b, tucking sections 5a and 5b are provided, respectively, in the fabric. As discussed later, in order to remove the yarn-worked portion 2, the floating yarn 4 is cut and removed in the subsequent process after knitting the fabric 1 having the yarn-worked portion. At the tucking sections 5a and 5b, the knitting yarn is tucked into a knitted loop at a plurality of places, and therefore, even if the floating yarn 4 is cut, raveling is difficult to take place. The similar raveling-stop is also able to be performed not by tucks at a plurality of places but by knotting, or the like. The details on knotting are disclosed in, for example, Japanese Published Patent Application No. H08-188942. However, the effect exerted on the fabric appearance and properties is smaller by providing tucking sections 5a and 5b rather than knotting, and it is therefore preferable to provide tucking sections. Incidentally, when both tucking sections 5a and 5b are discussed, the tucking section 5 is stated. As is the case of the fabric 1 having a yarn-worked portion, when fabrics are knitted, respectively, by the front and rear needle beds, for example, disposing the tucking section 5a that pulls out the outward floating section 4a in a fabric to be knitted by the front needle bed, and disposing the tucking section 5b in which the homeward floating section 4b returns in a fabric to be knitted by the rear needle bed can disperse effect of the tucking section 5, which is still more preferable. In the tucking section 5, the knitting yarn is tucked not to continuous knitting needles but to a plurality of knitting needles at regular intervals.

[0037] The outward floating section 4a and homeward floating section 4b are formed by folding back the leading end of the floating yarn 4. The vicinity of the leading end of the floating yarn 4 is retained to the fabric as the retaining portion 6. For the knitting operation to carry out retention by the retaining portion 6, for example, tucking can be used. Since the yarn-worked portion 2 exists between the outward floating section 4a and the homeward floating section 4b, the yarn-worked portion 2 may be caught by the retaining portion 6. In the event that the color is switched by dyeing, or the like at the yarn-worked portion 2, even if the yarn-worked portion 2 is caught by the retaining portion 6, it can be knitted in the same manner as in the case of a knitting yarn of other portions. Even when yarns are joined at the yarn-worked portion 2, since less amount of the knitting yarn is pulled in by tucking compared to knitting, even at the yarn-worked portion 2, the floating yarn 4 can be retained in the fabric while being knitted therein. However, in the case of the yarn-worked portion 2 with thickness increased as a knitting yarn due to yarn piecing, or the like knitting could be more securely conducted if the yarn-worked portion 2 is not caught by the retaining portion 6.

[0038] In the fabric having the yarn-worked portion of Fig. 1, the color is switched at the knitting end on the right side of the figure. The length of the floating yarn 4 is set by folding back the knitting yarn from the knitting end to the inside of the knitting width so that the yarn-worked portion 2 exists in the outward floating section 4a. The length of the floating yarn 4 may be set in such a manner that the yarn-worked portion 2 exists in the homeward floating section 4b. In addition, when a plurality of yarn-worked portions 2 are disposed, the positions to pull out the floating yarn 4 are arranged along virtual straight lines 7a, 7b, and 7c in different knitting courses to treat each yarn-worked portion 2. In this case, a plurality of floating yarns 4 are disposed in a direction on which cutting tools, such as scissors, are allowed to work when the floating yarn 4 is cut. By moving the cutting tools along the straight lines 7a, 7b, and 7c, a plurality of places can be cut efficiently.

[0039] The fabric 1 of a border pattern 3 as shown in Fig. 1 can be knitted by assigning each color of knitting yarn to each yarn feeder respectively, when the number of colors used is not large. In such event, if regions of the same color exist in distant locations, a floating yarn is generated in the longitudinal direction of the figure along the surface of the intermediate region in the knitting ends of the fabric 1. In an example disclosed in Patent Citation 2, this kind of floating yarn is generated in a plurality of places in the vertical direction of the figure. For cutting the floating yarn, scissors and other tools must be allowed to work on the direction perpendicular to the paper. Since the direction on which the tool is allowed to work is perpendicular to the direction in which the floating yarn to be treated is disposed, the floating yarn must be cut individually in multiple times. Furthermore, in the event that a long floating yarn is pulled out to the side end of the fabric in short section, the floating yarn must be cut under a condition in which the floating yarn hangs down from the side end, which still more decreased the cutting efficiency.

[0040] Fig. 2 schematically shows procedures for treating the yarn-worked portion 2 by knitting the fabric 1 having the yarn-worked portion as shown in Fig. 1. On the left side, the step of the procedure sequence is ex-

pressed numerically.

[0041] In Step 1, a color-A region 3a of a border pattern is knitted in tubular shape while revolving the knitting yarn around the front and rear needle beds, which face each other with a centerline 8 of the needle bed gap in between. In Step 2, the floating yarn 4 of the outward floating section 4a with a tucking section 5a formed in a fabric knitted by the front needle bed is pulled out to the outside of the tubular shaped fabric along the fabric surface without being knitted into the fabric. The leading end pulled out in such a manner as to contain the yarn-worked portion 2 is retained to the fabric by the retaining portion 6 and the floating yarn 4 is folded back, so that the knitting yarn is returned from the homeward floating section 4b to the inside of the tubular shaped fabric. The knitting yarn of the homeward floating section 4b to be returned to the fabric is switched to a color-B knitting yarn at the yarn-worked portion 2, and a tucking section 5b is formed in a fabric knitted by the rear needle bed; then, the color-B region 3b of Step 3 continues to be knitted. By this kind of switching of the knitting yarn, on the right-side end of the tubular shaped fabric, a color switching portion 3x is generated.

[0042] When the fabric 1 having the yarn-worked portion as in the case of Fig. 1 is knitted, in Step 4, the subsequent process to cut the floating yarn 4 takes place. The transfer yarn 4 is cut at a position 7 closer to the tucking section 5 side than the yarn-worked portion 2. Since the section to be cut is exposed to the outside of the fabric along the surface of the tubular shaped fabric, cutting operation can be performed easily. Furthermore, if a plurality of cut positions 7 are disposed along the straight lines 7a, 7b, and 7c as shown in Fig. 1, the plurality of positions can be cut efficiently. After cutting, as shown as Step 5, the leading end side of the floating yarn 4 containing the yarn-worked portion 2 is removed from the fabric. Since at the retaining portion 6, the floating yarn 4 is retained to the fabric by tucking only, in either outward floating section 4a or homeward floating section, pulling the floating yarn 4 from the side containing the yarn-worked portion 2 can easily pull out the floating yarn 4 which is not knitted in the fabric. The yarn end remaining on the tucking section 5 after cutting is pulled into the inside of the tubular shaped fabric by stretching the fabric in Step 6 so that the yarn end can be invisible from the outside. Since raveling-stop treatment is provided by both tucking sections 5a and 5b respectively, the fabric is prevented from being raveled from the yarn end.

[0043] Fig. 3 to Fig. 8 schematically show procedures to knit the fabric 1 having the yarn-worked portion as shown in Fig. 1 by a four-needle-bed knitting machine, which has two-tiered needle beds in front and rear. Incidentally, conducting half-gauge knitting can knit the fabric having the yarn-worked portion in the same procedure even on a two-needle-bed knitting machine having one-tiered needle beds in front and rear.

[0044] In each figure, intermediate lattice cells show status of knitting needles of each needle bed. The downward tier and the upward tier of the front needle bed are expressed by FD and FU respectively, and the downward tier and the upward tier of the rear needle bed are expressed by BD and BU. The locations of knitting needles of the front needle bed are expressed by A through O, while the locations of knitting needles of the rear needle bed are expressed by a through o. The locations of the cell correspond to the location of A through O and a through o of knitting needles. However, the number of knitting needles is merely for the convenience of explanation, and when actually a fabric is knitted, in general, much larger number of knitting needles are used. A circle in the cell shows a knitted loop. A V mark indicates a tuck. When knitted loops are newly formed by knitting or when tucking is conducted newly, thick line is used. A color-A knitting yarn is expressed by diagonally left down shade and a color-B knitting yarn is expressed by diagonally right down shade, respectively. An arrow mark in a cell shows a status in which a knitted loop is transferred to the opposite needle bed.

[0045] The left side of the lattice cells shows a numerical value of the step that corresponds to the procedure. However, the numerical value of the step does not always correspond to, for example, the stroke of a carriage, or the like. There are cases in which a plurality of carriage strokes correspond to one step. In addition, when a plurality of cam systems that drive knitting needles are mounted to a carriage, there are cases in which one stroke of a carriage may correspond to a plurality of steps. The right side of the lattice cells shows the moving direction of a yarn feeder which feeds a knitting yarn and carries out knitting or forming of a floating yarn.

[0046] Fig. 3 and Fig. 4 show basic knitting procedures. In Step 1 of Fig. 3, with a color-A knitting yarn, a course on the front needle bed side of a tubular shaped fabric is knitted in the left direction. Then, in Step 2, with the color-A knitting yarn, a course on the rear needle-bed side is knitted in the right direction. This kind of tubular knitting is repeated, and no knitting is conducted on the final knitting needle "o" on the final course. In this way, the color-A region 3a of Fig. 1 is knitted except the final knitted loop. In Step 3, knitted loops to be retained to knitting needles "E" through "H" of FD corresponding to the section in which the floating yarn 4 of Fig. 1 is pulled out are transferred to knitting needles "e" through "h" of BU by transferring. In next Step 4, the color-A knitting yarn is tucked to knitting needles "N","L", and "J" of FD and the tuck section 5a of Fig. 1 is formed. From the location of knitting needle "H" to the location of knitting needle "D", the knitting yarn is not knitted into the fabric but pulled out to form the outward floating section 4a of Fig. 1. By tucking the leading end of the floating yarn 4 to the knitting needle "D" that retains a knitting loop, the retaining portion 6 of Fig. 1 is formed. In next Step 5, the knitting yarn tucked to the knitting needle "D" is folded back, the knitting yarn is not knitted into the fabric to the knitting needle "j" of BD to form the homeward floating section 4b of Fig. 1, and is tucked to knitting needles "j",

"I", and "n" of BD to form the tuck section 5b of Fig. 1. The knitting yarn that forms the homeward floating section 4b and the tuck section 5b is switched to the color-B knitting yarn at the yarn-worked portion of Fig. 1.

[0047] Next, in Step 6 of Fig. 4, knitted loops retained at knitting needles "e" through "h" of BU are returned to knitting needles "E" through "H" of FD. The floating yarn 4 of this section is pushed out and goes outside of the tubular shaped fabric. In Step 7, on the final knitting needle "o" of BD, a knitted loop is formed by the color-B knitting yarn. However, the yarn feeding direction is the left direction, reversal to the right direction in which the color-A knitting yarn is fed to knitting needles "a" through "n" in Step 2. In Step 8, the yarn feeder is kicked back to form a twisted loop to the knitting needle "o", and the yarn feeder is brought outside of the knitting width so that the yarn feeder is located on the right side of the knitting needle "o". Instead of forming this kind of twisted loop, it is possible to perform round-knitting by knitting the front-side fabric in the left direction on FD and the back-side fabric in the right direction on BD, respectively. However, the knitted loop formed on the final knitting needle "o" of BD is deviated by one course from the knitted loop formed on the initial knitting needle "O" of FD. In order to make the stepped difference less visible upon changing the knitting yarn from color-A to color-B between knitting needles "O" and "o", it is preferable to carry out the treatment shown in Step 7 to Step 8.

[0048] In Step 9, with the knitting yarn which is switched to color B, the course on the front needle bed side of the tubular shaped fabric is knitted in the left direction. In Step 10, a rear needle-bed side course is knitted in the right direction. Thereafter, when the knitting yarn is switched from color B to color A or to any other colors, the same procedure can be repeated to knit a tubular shaped fabric having border pattern 3 regions as shown in Fig. 1 in multi-colors can be knitted.

[0049] Fig. 5 shows the major part of a procedure for knitting a fabric, from which the yarn-worked portion 2 can be removed in the subsequent process as in the case of the fabric 1 having the yarn-worked portion 2 of Fig. 1. Step 1 through Step 4 are same as those described in Fig. 3 so that the description is omitted. In Step 5, the homeward tacking section 5b is formed on the front needle bed side, too. However, in the event that the knitting yarn has been tucked to knitting needles "J", "L", and "N" of FD in the outward tucking section 5a, the knitting yarn is tacked to different knitting needles "I", "K", and "M" in the homeward tucking section 5b. It is preferable to avoid duplication of knitting needles to be tucked. This is because duplication of the knitting needles to be tucked could deteriorate the flexibility of the fabric. Stitch transferring in Step 6 is conducted in the same manner as in Step 6 of Fig. 4. Thereafter from Step 7 to Step 10, operations same as those of Fig. 4 shall be conducted.

[0050] As shown in Fig. 5, the outward tucking section 5a and the homeward tucking section 5b may be formed on the same fabric. Even to a single knit fabric which is not a tubular shaped fabric and is directed by Patent Citation 1, the present invention may be applied and the yarn-worked portion 2 can be removed. Switching of knitting yarns by forming the yarn-worked portion 2 can be conducted not only for the border pattern 3 in which knitting yarns are switched every course as in the case of Fig. 1 but also diamond-patterns of the intarsia-pattern knit fabric as shown in Fig. 9 of Patent Citation 1, in which knitting yarns are switched in the midst of the course.

[0051] Fig. 6 shows a procedure for pulling out the floating yarn 4 without transferring stitch in Step 3 of Fig. 3. That is, Step 3 is not conducted after Step 1 and Step 2 of Fig. 3. As Step 4, the knitting yarn is formed as the floating yarn 4 after being tucked to knitting needles "N", "L", and "J" of FD, and the leading end is retained to the knitting needle "D" of FD by tucking. In Step 5, the floating yarn 4 is folded back and the knitting yarn that returns from the homeward floating section 4b is tucked to knitting needles "j", "I", and "n" of BD. No knitted loop is returned to knitting needles as in the case of Step 6 of Fig. 4 but the procedures same as those in Step 7 to Step 10 are practiced. Since knitted loops "E" through "H" are not transferred, the floating yarn 4 stays at the needle bed gap between the needle beds, and stays inside the fabric to be knitted on the front and rear needle beds. After completion of knitting, turning back the tubular shaped fabric allows the floating yarn 4 to be easily cut and removed in the same manner as is the case of the examples of Fig. 3 to Fig. 5.

[0052] Fig. 7 shows an example of forming the floating yarn 4 on the inside of the tubular shaped fabric without conducting the stitch transferring in Step 3 of Fig. 3 as in the case of Fig. 6 and forming the tucking section, too, in the same knit fabric as is the case of Fig. 5. Step 1 and Step 2 are conducted in the same manner as in Fig. 3 so as to be omitted. In Step 4, the floating yarn 4 is formed in the same manner as in the case of Step 4 of Fig. 6. However, the tucking section 5b formed by the knitting yarn returning from the homeward floating section 4b in Step 5 is formed by the use of knitting needles "I", "K", and "M" of FD.

[0053] Fig. 8 shows a procedure of another method for knitting the fabric 1 having the yarn-worked portion of Fig. 1. In Fig. 8, the leading end of the floating yarn 4 is retained not by tucking to a knitted loop but by winding the knitting yarn over the knitted loop. That is, after performing Step 1 and Step 2 in the same manner as in the case of Fig. 3, in Step 3, the knitted loop to be tucked in Fig. 3 is transferred from the knitting needle "D" of FD to the knitting needle d of BU. The point of transferring knitted loops on knitting needles "E" through "H" of FD to knitting needles "e" through "h" of BU is the same as that in Fig. 3. In Step 4-1, the knitting yarn is tucked to knitting needles "N", "L", and "J" of FD, and then, the knitting yarn is pulled out on the left beyond the knitting needle "D". In next Step 4-2, knitted loops are transferred from knitting needle "d" of BU to knitting needle "D" of FD and are put back in place. In Step 5, the knitting yarn is fed to the

right direction and tucked to knitting needles "j", "l", and "n" of BD. The knitting yarn pulled out to the left in Step 4-1 forms the outward floating section 4a of the floating yarn 4. By putting the knitted loop retained to the knitting needle "D" of FD back in place from the knitting needle "d" of BD, the portion in the vicinity of the leading end of the floating yarn 4 of the outward floating section 4a is pushed out from the needle bed gap to the outside at the position of the knitted loop retained to the knitting needle "D". The floating yarn 4 turns over inside the needle bed gap of the knitted loop retained to the knitting needle "D" of FD by the yarn fed to the right direction in Step 5, and therefore, the knitting yarn is winded over the knitted loop retained to the knitting needle "D" and is folded back. The folded-back portion of the floating yarn 4 is retained by winding over to the knitting loop and the floating yarn 4 to be folded back forms the homeward floating section 4b.

[0054] By transferring knitted loops from knitting needles "e" through "h" of BU to knitting needles "E" through "H" of FD in Step 6 and putting them back in place, in the section of knitting needles "E" through "H", the floating yarn 4 is pushed out to the outside of the needle bed gap on the front needle bed side, and can be exposed to the outside of the tubular shaped fabric. The retention of the folded-back portion at the leading end of the floating yarn 4 is formed by winding the knitting yarn over a knitted loop only, and therefore, even when the knitting yarn is folded back at the yarn-worked portion 2, the knitting yarn is able to be retained without being tucked into the fabric.

[0055] Fig. 9 shows an example in which the treatment of the floating yarn 4 to be winded over a knitted loop retained at the knitting needle "D" of FD is conducted by transferring stitch later as in the case of Fig. 8. In Step 3, transferring of a knitted loop to be retained on the knitting needle "D" of FD is not conducted but knitted loops to be retained to knitting needles "E" through "H" are transferred to knitting needles "e" through "h" of BU, respectively. After pulling the knitting yarn to the left beyond the knitting needle "D" in Step 4-1, the knitted loop to be retained to the knitting needle "D" is transferred to the knitting needle "d" of BU in Step 4-2. The knitting yarn is pushed out to the needle bed gap on the rear needle bed side by the knitted loop transferred to the knitting needle "d" of BU. By feeding the yarn in the right direction in Step 5, the floating yarn 4 enters the inside of the needle bed gap of the knitted loop to be retained to the knitting needle "d" of BU and is retained by winding over the knitted loop at the folded back portion. When the knitted loops retained to knitting needles "d" through "h" of BU are retuned to knitting needles "D" through "H" of FD, the floating yarn 4 is pushed out to the outside of the tubular shaped fabric by the knitted loop retained to the knitting needles "E" through "H". For the knitting loop to be retained to the knitting needle "D" of FD, the portion inside the needle bed gap when it is retained to the knitting needle "d" of BU before stitch transferring becomes the outside of the tubular shaped fabric and the portion pushed out to the outside the needle bed gap on the rear needle bed side becomes the inside of the tubular shaped fabric on the inside of the needle bed gap.

[0056] Fig. 10 partially shows schematic structure of fabrics 11, 21, and 31 having a yarn-work portion of another embodiment of the present invention with respect to the vicinity of the yarn-worked portion 2. The same reference numbers are assigned to the elements which have the corresponding portions in Fig. 1 and Fig. 2 and redundant description will be omitted.

[0057] The fabric 11 having the yarn-worked portion shown in Fig. 10(a) is formed by passing the vicinity of the leading end at which the floating yarn 4 is folded back through the inside of the tubular shaped fabric at positions of a plurality of knitted loops 12, 13, and 14. The floating yarn 4 is allowed to pass to the outside of the tubular shaped fabric between knitted loops 12, 13, and 14 or at positions of adjacent knitted loops. In the fabric 11, the floating yarn 4 is passed alternately inside and outside the knit fabric in this way to form the retaining portion 16. The point in which the outward floating section 4a and the homeward floating section 4b, both containing the yarn-worked portion 2, are brought outside the tubular shaped fabric is the same as that of the fabric 1 having the yarn-worked portion of Fig. 1. However, the retaining portion 16 by the section containing a plurality of knitted loops 12, 13, and 14 is not retained to the fabric at the leading end of the folded-back floating yarn 4. The floating yarn 4 in a fabric 11 has the vicinity of the leading end merely allowed to alternately pass inside and outside the fabric at the section containing knitted loops 12, 13, and 14, and thus the floating yarn 4 can be easily removed after cutting. Since the floating yarn 4 is retained by a plurality of knitted loops 12, 13, and 14, the transfer yarn 4 is able to be securely retained until the transfer yarn 4 is cut.

[0058] In a knit fabric 21 having a yarn-worked portion shown in Fig. 10(b), the majority of the floating yarn 4 is fixed to the inside of the tubular shaped fabric, and only the vicinity of the leading end to be folded back is allowed to pass a knitted loop 22 to the outside of the tubular shaped fabric to form the retaining portion 26. The floating yarn 4 at the retaining portion 26 is retained by allowing the floating yarn 4 to pass alternately inside the tubular shaped fabric in the knitted loop 22, and outside the tubular shaped fabric in a knitted loop adjacent to the left of the knitted loop 22.

[0059] In a fabric 31 having a yarn-worked portion shown in Fig. 10(c), the floating yarn 4 is only pulled out to the outside of the tubular shaped fabric with raveling-stop provided in the tucking section 5, and retention to the vicinity of the leading end is omitted. Even if the floating yarn 4 is not retained, manual cutting is possible.

[0060] Fig. 11 through Fig. 14 schematically show a procedure for knitting the fabrics 11 and 21 having the yarn-worked portion as shown in Fig. 10(a) and Fig. 10 (b) by a four-needle-bed knitting machine having two-tiered needle beds in front and rear. Description on knit-

ting in Fig. 11 through Fig. 14 is made under the conditions same as those for the description in Fig. 3 through Fig. 9. Though the number of knitting needles are described to be different, respectively, this is merely for the convenience for explanation, and in actual knitting of a fabric, a necessary quantity of knitting needles should be used.

[0061] In Fig. 11 and Fig. 12, the fabric 11 having the yarn-worked portion shown in Fig. 10(a) is knitted. In Step 1, a course on the front needle bed side of a tubular shaped fabric is knitted by a color-A knitting yarn in the left direction. Next, a course on the rear needle bed side is knitted by a color-A knitting yarn in the right direction. Tubular knitting by this kind of round-knitting is repeated and in the final course shown as Step 2, no knitting is conducted in the final knitting needle "w" of BD. In this way, the color-A region 3a of Fig. 10(a) is knitted except the final knitted loop.

In Step 3, knitted loops retained on knitting needles "K" through "P" of FD corresponding to the section from which the floating yarn 4 of Fig. 10(a) is pulled out are moved to knitting needles "k" through "p" of BU by transferring. In addition, knitted loops retained on knitting needles "E", "G", and "I" adjacent to knitting needles "F", "H", and "J" of FD corresponding to knitted loops 12, 13, and 14 are moved to knitting needles "e", "g", and "i" of BU by stitch transferring. Furthermore, a knitted loop retained on the knitting needle "D" of FD to which the leading end of the floating yarn 4 is to be hanged over is moved to the knitting needle "d" of BU by stitch transferring, and the knitting needle "D" is kept vacated.

[0062] In next Step 4, the color-A knitting yarn is tucked to knitting needles "V" and "S" of FD and is pulled out from the vicinity of he position of the knitting needle "R" to the position of the knitting needle "D". Furthermore, the knitting yarn is hanged over the knitting needle "D" which is kept vacant and the outward floating section 4a of Fig. 10(a) is formed. In next Step 5-1, the knitting yarn hanged over the knitting needle "D" is folded back and tucked to knitting needles "s" and "v" of BD. The knitting yarn which forms the tacking section 5 of Fig. 10(a) by knitting needles "V" and "S" of FD and knitting needles "s" and "v" of BD is switched to the color-B on the homeward side from the color-A on the outward side by switching at the yarn-worked portion 2 of Fig. 10(a). Then, in Step 5-2, knitted loops retained on knitting needles "e", "g", "i", and "k" through "p" of BU are returned to knitting needles "E", "G", "I", and "K" through "P" of FD. The floating yarn 4 at the position of knitting needles "E", "G", and "I" and in the section of knitting needles "K" through "P" goes out to the outside of the needle bed gap on the front needle bed side with respect to the knitted loops retained on each of the knitting needles "E", "G", "I", and "K" through "P".

[0063] In Step 6 of Fig. 12, a knitted loop is formed on the final knitting needle "w" of BD by the color-B knitting yarn. However, the yarn feeding direction is the left direction, reversal to the right direction in which the color-A knitting yarn is fed to knitting needles "a" through "v" in Step 2, and in Step 7-1, the yarn feeder is kicked back to form a twisted loop to the knitting needle "w", and the yarn feeder is brought on the right side of the knitted width. In order to make the stepped difference less visible upon changing the knitting yarn from color-A to color-B between knitting needles "W" and "w", it is preferable to carry out this kind of treatment, which is same as in Step 7 to Step 8 of Fig. 4.

[0064] In Step 7-2, the loop of the floating yarn 4 hanged over the knitting needle "D" of FD is removed. The leading end of the floating yarn 4 is disengaged from a hook of the knitting needle "D" but it passes inside and outside the tubular shaped fabric alternately in the section of knitting needles "E" through "J", and this enables the floating yarn 4 to keep the retention condition. In Step 7-3, the knitted loop is returned from the knitting needle "d" of BU to the knitting needle "D" of FD. In such event, the folded-back portion of the leading end of the floating yarn 4 is pushed out to the outside of the needle bed gap by the knitted loop retained to the knitting needle "D" on the front needle bed side. Thereafter, in Step 8, with the knitting yarn switched to color-B, the course on the front needle bed side of the tubular shaped fabric is knitted in the left direction. Thereafter, repeating the same procedures when the knitting yarn is switched from color-B to color-A or any other colors can knit the tubular shaped fabric having the regions of the border pattern 3 as shown in Fig. 1 in multicolors.

[0065] In Fig. 13 and Fig. 14, the knit fabric 21 having the yarn-worked portion shown in Fig. 10(b) is knitted. From Step 1 to Step 2 of Fig. 13, the fabric is knitted in the basically same manner as in the case of Step 1 to Step 2 of Fig. 11. In Step 3 of Fig. 13, knitted loops retained are moved from the knitting needle "E" adjacent to the knitting needle "F" of FD for retaining the knitted loop 22 of Fig. 10(b) and the knitting needle "D" which the floating yarn 4 is to be passed over, to knitting needles "e" and "d" by stitch transferring.

[0066] In next Step 4, the color-A knitting yarn is pulled out from the knitting needle "q"of BD which formed the final knitted loop in Step 2 to the position of the knitting needle "D" of FD, the yarn is hanged over the knitting needle "D" which is vacant, and the outward floating section 4a of Fig. 10(a) is formed. Then, in Step 5-1, the knitting yarn with which a hanged-over loop was made on the knitting needle "D" is folded back and the homeward floating section 4b is formed. The knitting yarn is switched from the color-A on the outward side to the color-B on the homeward side by the switching at the yarn-worked portion 2 of Fig. 10(b). Then, in Step 5-2, the knitted loop retained to the knitting needle "e" of BU is returned to the knitting needle "E" of FD. The floating yarn 4 at the position of the knitting needle "E" is pushed out to the outside of the needle bed gap by the knitted loop retained to the knitting needle "E" on the front needle bed side.

[0067] In Step 6 of Fig. 14, a knitted loop is formed by

the color-B knitting yarn on the final knitting needle "r" of BD. However, the yarn-feeding direction is the left direction, which is reversal to the right direction in which the color-A knitting yarn is fed to knitting needles "a" through "q" in Step 2. In Step 7-1, the yarn feeder is kicked back to form a twisted loop to the knitting needle "r", and is brought on the right side of the knitted width. This kind of the twisted loop is formed in the same manner as is the case of Step 6 to Step 7-1 of Fig. 12.

[0068] In Step 7-2 to Step 7-3, same as Step 7-2 to Step 7-3 of Fig. 12, a knitted loop of the floating yarn 4 hanged over the knitting needle "D" of FD is cleared away; the knitted loop is returned to the knitting needle "D" of FD from the knitting needle "d" of BU; and folded-back portion of the leading end of the floating yarn 4 is pushed out to the outside of the needle bed gap by the knitted loop on the front needle bed side. Thereafter, in Step 8, with the knitting yarn switched to color-B, the course on the front needle bed side of the tubular shaped fabric is knitted in the left direction. Thereafter, repeating the same procedures when the knitting yarn is switched from color-B to color-A or any other colors can knit the tubular shaped fabric having the regions of the border pattern 3 as shown in Fig. 1 in multicolors.

[0069] Knitting of the fabric 31 having the yarn-worked portion as shown in Fig. 10(c) is conducted, for example, by carrying out the treatment, like as carried out at the knitting needle "D", at the knitting needle "J" instead of carrying out processing in knitting needles "E" through "J" of FD from Step 3 of Fig. 11 through Step 7-3 of Fig. 12. The folded-back portion at the leading end of the floating yarn 4 is temporarily hanged over the knitting needle "J" of FD but is cleared away from a hook of the knitting needle "J" and is pushed out to the outside of the needle bed gap on the front needle bed side. Since the floating yarn 4 pushed out to the outside of the needle bed gap is located on the outside of the tubular shaped fabric after completion of knitting, the directions can be aligned by manual operation and the portion containing the yarn-worked portion 2 can be easily cut.

[0070] Incidentally, the yarn-worded portion 2 may be formed not only by disposing an piecing device, or the like in the knitting yarn feeding route and working the knitting yarn in real time but also may be formed in advance by working the knitting yarn by prior batch treatment. In the prior batch treatment, time restriction is alleviated. Thus even if time is required for drying or the like, in switching colors by dyeing, or the like, the treatment can be satisfactorily carried out.

[0071] Fig. 15 schematically shows a structure of a design apparatus 40 that generates knitting data for the knitting fabrics 1, 11, 21, and 31 having the yarn-worked portion as shown in Fig. 1 and Fig. 10 by a flatbed knitting machine. The design apparatus 40 is achieved by installing software for conducting fabric design to a general-purpose computer 41. To the computer 41, an input unit 42 such as a keyboard, a digitizer, or a mouse, display unit 43 such as graphic display, communication device 44 that can communicate with the external via LAN, or the like, external recording device 45 to which various recording media are able to be mounted and removed, and others are connected.

[0072] Installation of software to the computer 41 is conducted by downloading via the communication device 44, or mounting a recording medium to the external recording device 45. An operator enters design data in the input unit 42 to design fabrics 1, 11, 21, and 31 having the yarn-worked portion and while watching the design results displayed on the display unit 43. The operator sets whether the yarn-worked portion 2 is disposed in the outward floating section 4a or the homeward floating section 4b. In addition, when a plurality of yarn-worked portions 2 must be treated, the operator sets the layout. Furthermore, the operator sets whether or not the tucking section 5 and retaining portions 6, 16, and 26 are provided, and how they should be arranged if they should be provided. In accordance with this setting, the computer 41 generates knitting data that deals with the floating yarn 4, tucking section 5, retaining portions 6, 16, and 26, or the like. The generated knitting data is transmitted to a flatbed knitting machine via communications device 44 or recorded by the external recording device 45 to recording media such as disks, USB memory, etc., and then entered in a flatbed knitting machine, and knitting offabrics 1, 11, 21, and 31 having the yarn-worked portion are conducted.

Claims

1. A fabric having a yarn-worked portion, the fabric being knitted with knitting yarns to be fed from a same a yarn feeder, the yarn-worked portion being set to switch properties as a knitting yarn in advance before fed from the yarn feeder so that the properties as the knitting yarn can be switched at a position corresponding to a data, on the basis of the data how the fabric being knitted, comprising;

   a floating section formed with knitting yarns used in sections before and after the yarn-worked portion, in such a manner that the knitting yarns shuttle under a condition not to be knitted into the fabric; and
   at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the floating section and providing raveling-stop treatment the moving knitting yarn.

2. The fabric having the yarn-worked portion according to claim 1, wherein
   said raveling-stop treatment at the raveling-stop portion is conducted by tucking said knitting yarn to said fabric at a plurality of positions.

3. The fabric having the yarn-worked portion according to claim 1 or 2, wherein
said fabric is knitted in a tubular form by a flatbed knitting machine provided with a front needle bed and a rear needle bed, the fabric being made by connecting fabrics knitted by the front and rear needle beds respectively, on both sides of knitting width, and said floating section is formed outside of the fabric in the tubular form.

4. The fabric having the yarn-worked portion according to any one of claims 1 to 3, wherein
a plurality of yarn-worked portions are arranged with spacing in said knitting yarn, and floating sections formed in different knitting courses with each yarn-worked portion included, respectively, are arranged along a virtual straight line.

5. A method for treating a yarn-worked portion on knitting yarns fed from a same a yarn feeder to knit a fabric, the yarn-worked portion being set to switch properties as a knitting yarn at a position corresponding to a data, on the basis of the data how the fabric being knitted, which comprises;

forming a floating section by allowing knitting yarns before and after the yarn-worked portion to shuttle without being knitted into the fabric before the properties as the knitting yarn are switched at the yarn-worked portion;
forming at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the connecting section and providing raveling-stop treatment the moving knitting yarn;
continuing to knit the fabric; and
after the fabric knitted, cutting the knitting yarns of the connecting section including the yarn-worked portion and removing them from the fabric.

6. The method for treating the yarn-worked portion according to claim 5, wherein
said raveling-stop treatment is conducted by tucking knitting yarns to the fabric at a plurality of places.

7. The method for treating the yarn-worded portion according to claim 5 or 6, wherein
knitting said fabric in a tubular form by a flatbed knitting machine, the fabric being made by connecting fabrics knitted by a front needle bed and a rear needle bed of the flatbed knitting machine respectively, on both sides of knitting width;
said floating section is formed outside of the fabric in the tubular form; and
pulling and absorbing knitting yarns into the fabric in the tubular form, the knitting yarns remain in the floating section after said cutting into the cylindrical knit fabric.

8. The method for treating the yarn-worked portion according to any one of claims 5 to 7, wherein
said retaining at the retaining portion is conducted by tucking the knitting yarn into knitted loops which form said fabric.

9. The method for treating the yarn-worked portion according to any one of claims 5 to 7, wherein
said retaining at the retaining portion is conducted by winding the knitting yarn over knitted loops which form said fabric.

10. The method for treating the yarn-worked portion according to any one of claims 5 to 7, wherein
said retaining at the retaining portion is conducted by taking one stitch on edge by a knitting yarn near a folding-back position, where the knitting yarn in said floating section shuttles, to a knitting needle for which a knitted loop is not retained; and at the same time; allowing the knitting yarn of the floating section to pass between one surface side of the fabric and the other surface side; and removing the stitch from the knitting needle.

11. The method for treating the yarn-worked portion according to any one of claims 5 to 10, wherein
a plurality of yarn-worked portions being arranged with spacing in said knitting yarn, and
arranging the floating sections along a virtual straight line, the floating sections formed in different knitting courses with each yarn-worked portion included, respectively.

12. A design apparatus for generating knitting data to knit a fabric by a flatbed knitting machine, wherein
the knitting data being generated to be implemented in the flatbed knitting machine so that
in order to treat a yarn-worked portion on knitting yarns fed from a same a yarn feeder to knit a fabric, the yarn-worked portion being set to switch properties as a knitting yarn at a position corresponding to a data, on the basis of the data how the fabric being knitted, while continuing to knit fabric;
forming a floating section by allowing knitting yarns before and after the yarn-worked portion to shuttle without being knitted into the fabric before the properties as the knitting yarn are switched at the yarn-worked portion; and
forming at least one or the other of a retaining portion to retain a part of the knitting yarns shuttling in the floating section, or of a raveling-stop portion provided on the fabric side where the knitting yarn moves to the connecting section and providing raveling-stop treatment the moving knitting yarn.

Fig. 1

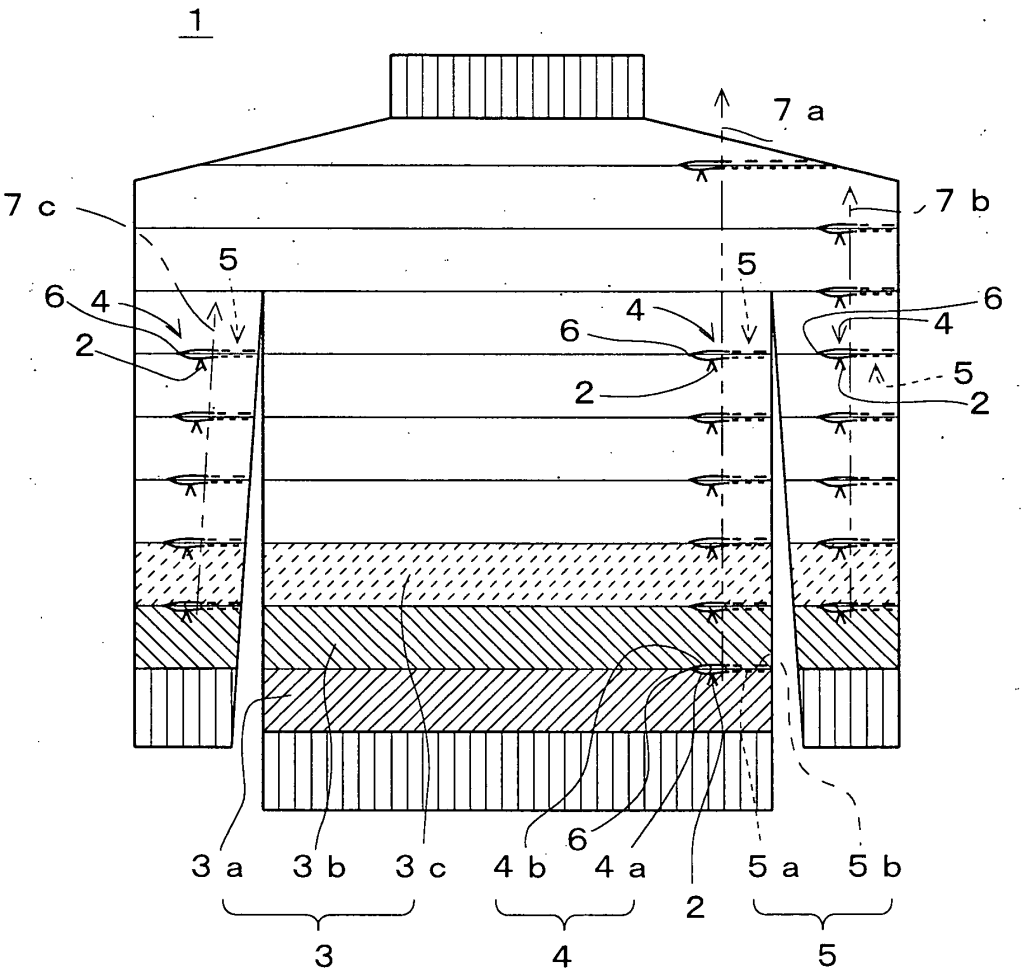
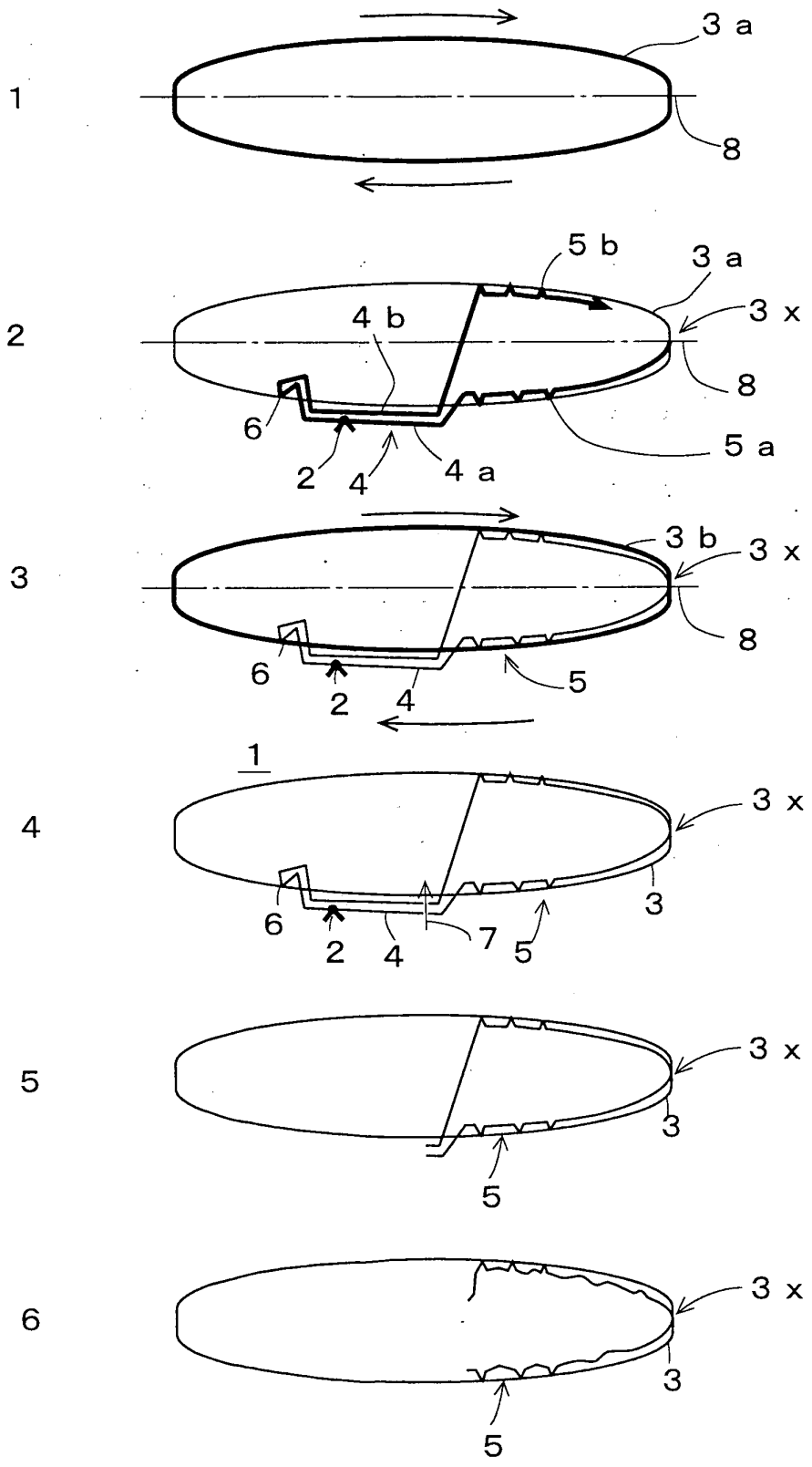


Fig. 2


1
3 a
8
2
5 b
3 a
3 x
4 b
8
6
5 a
2
4
4 a
3
3 b
3 x
8
6
5
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1
3 x
6
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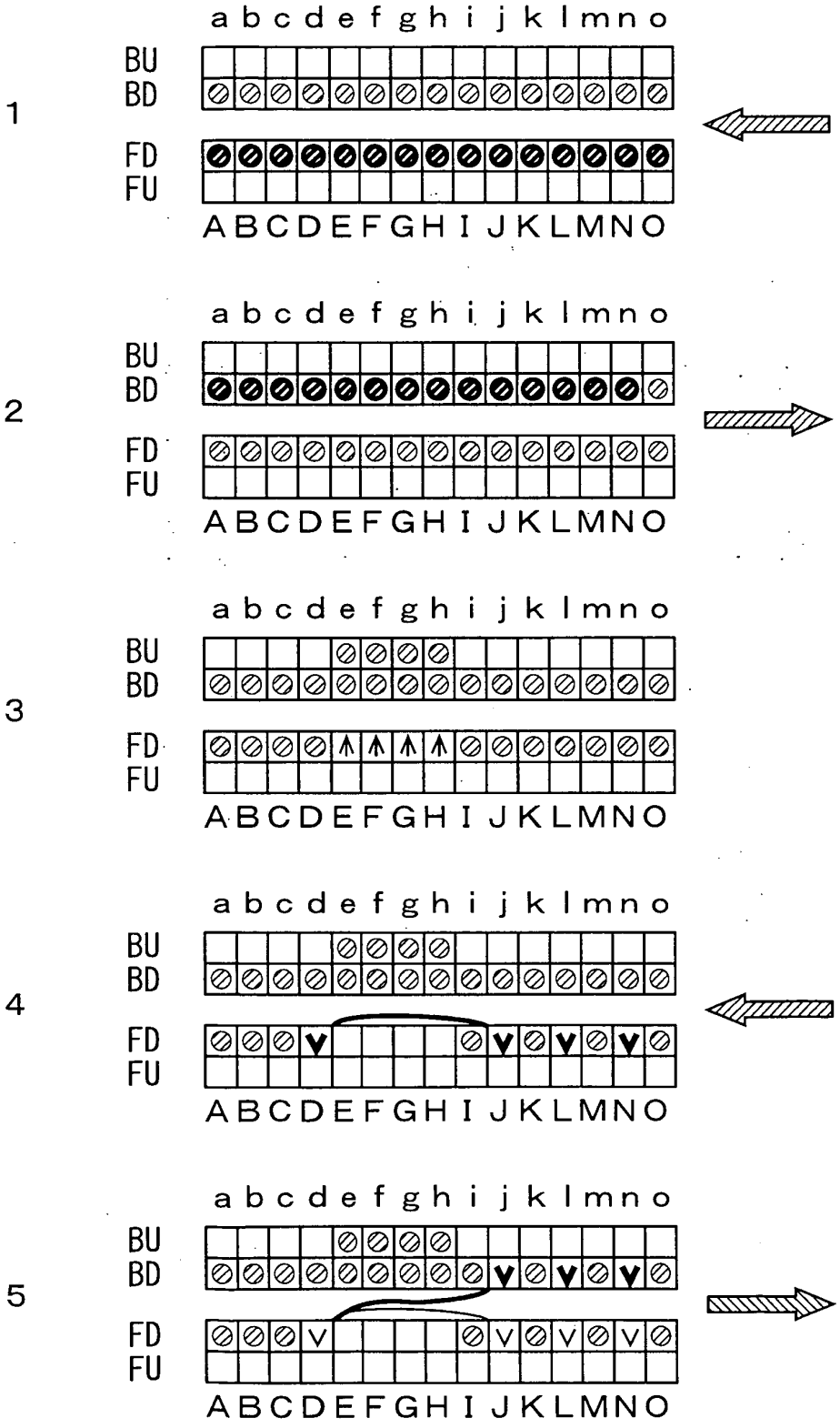
7
5
5
3 x
3
5
6
3 x
3
5

Fig. 3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FU
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BU
BD
2
FD
FU
A B C D E F G H I J K L M N O
a b c d e f g h i j k l m n o
BU
BD
3
FD
FU
A B C D E F G H I J K L M N O
a b c d e f g h i j k l m n o
BU
BD
4
FD
FU
A B C D E F G H I J K L M N O
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BU
BD
5
FD
FU
A B C D E F G H I J K L M N O

Fig. 4

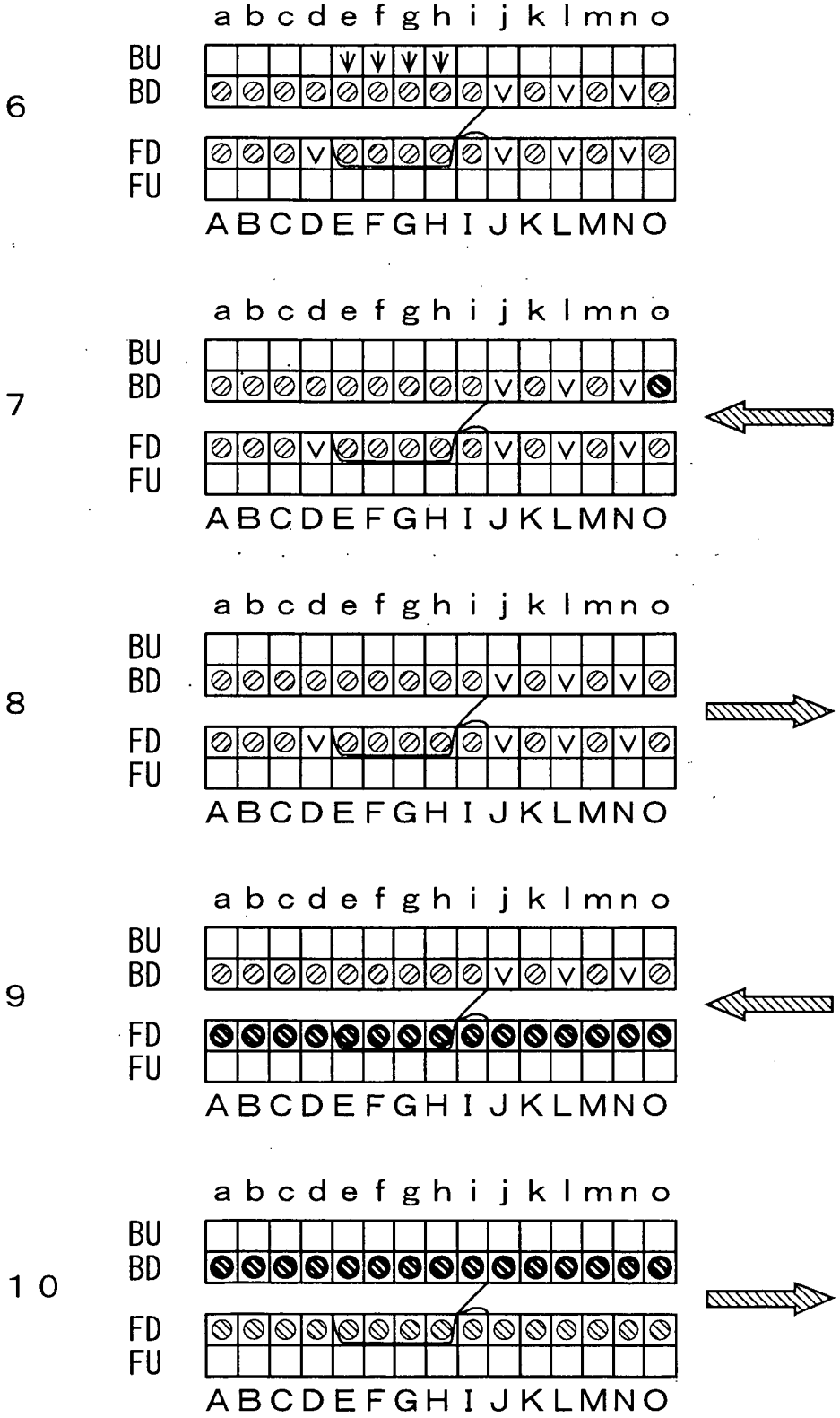
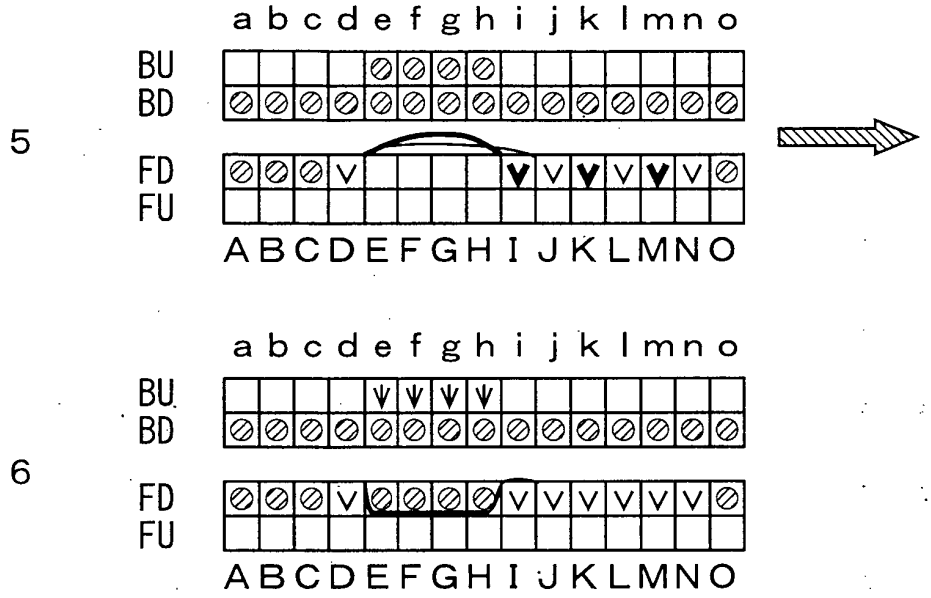


Fig. 5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BU
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Fig. 6

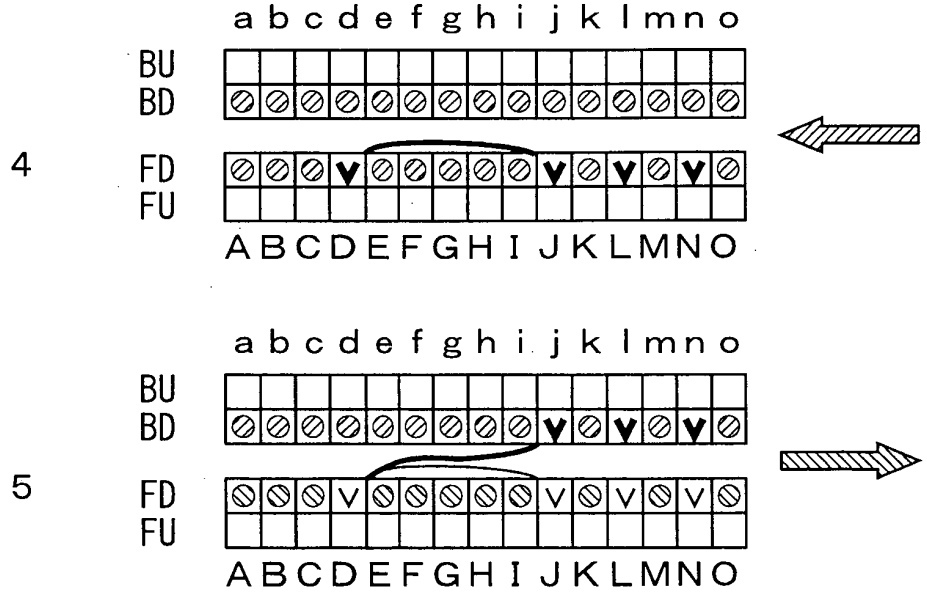
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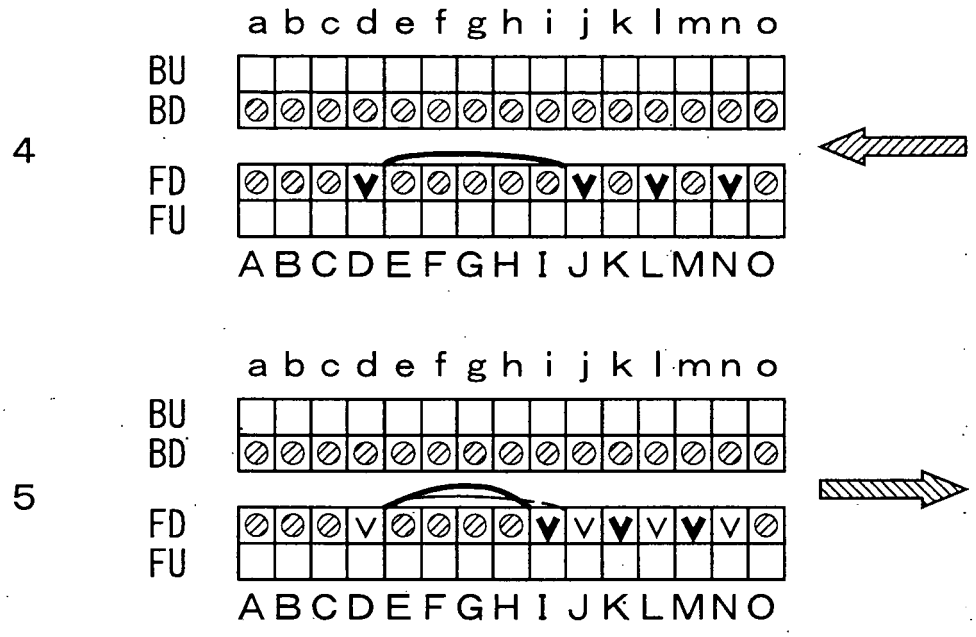
Fig. 7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FU
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Fig. 8

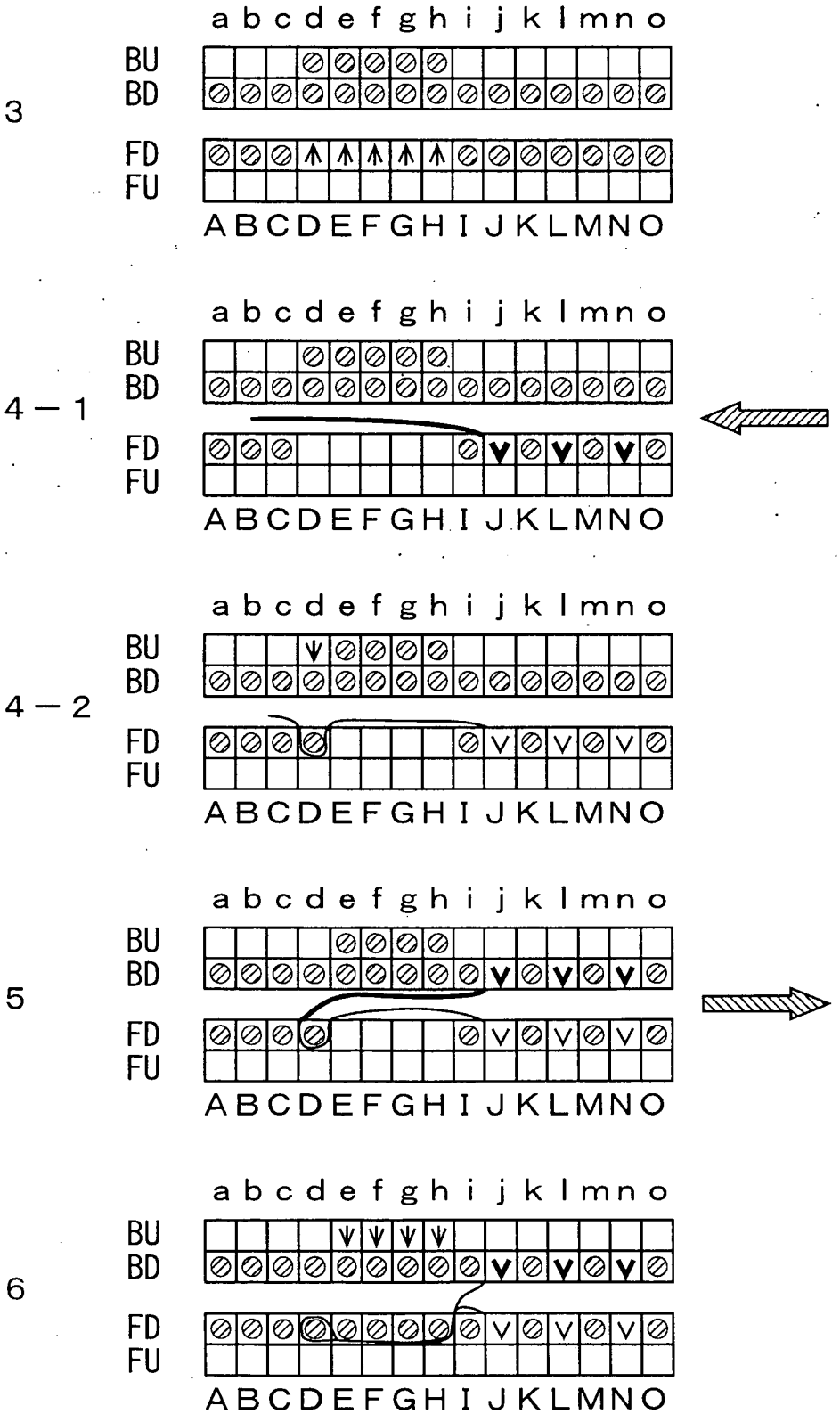


Fig. 9

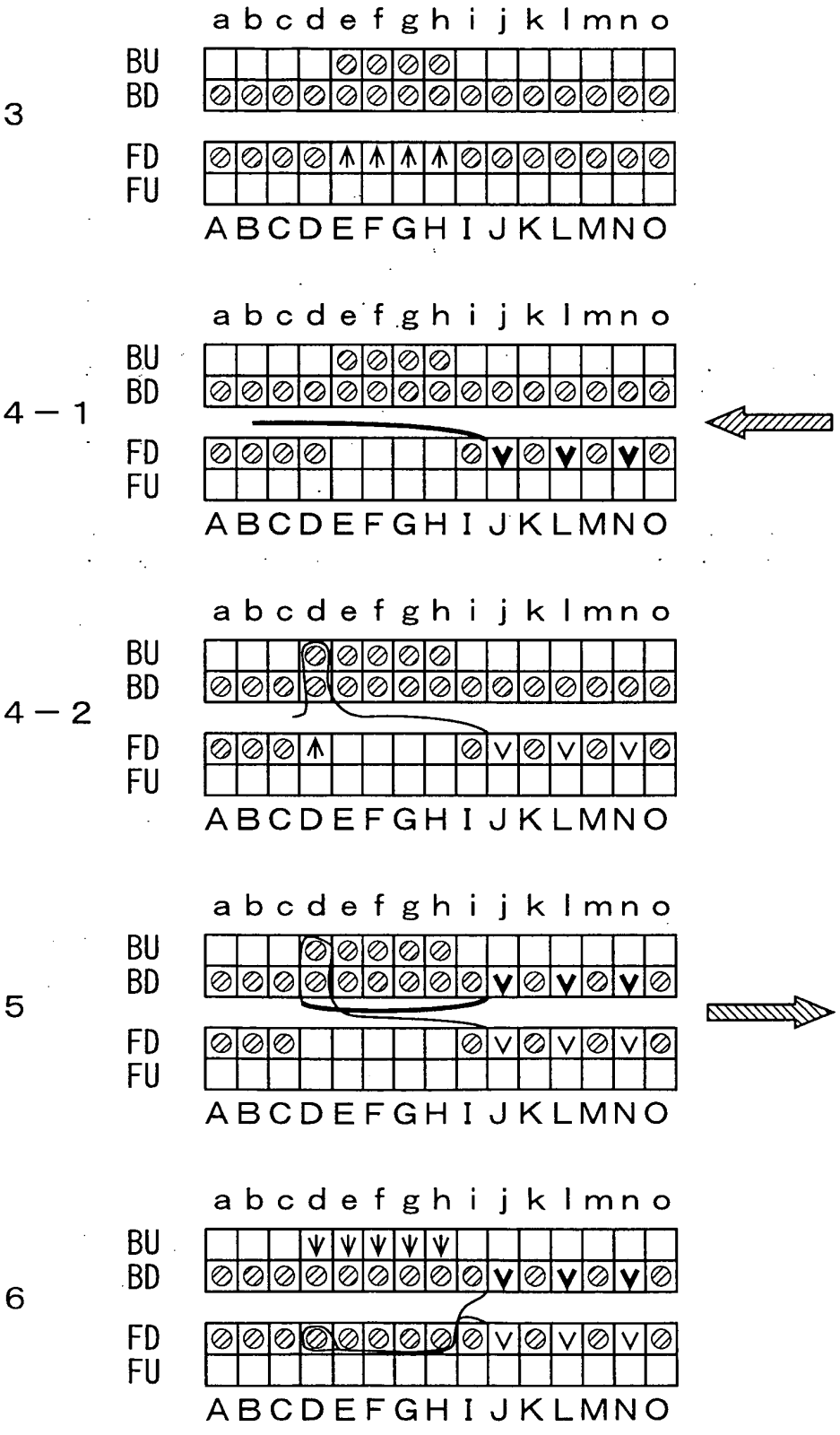
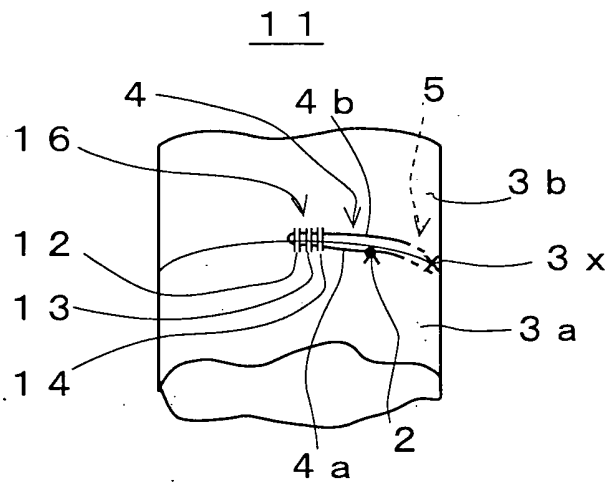


Fig. 10

(a)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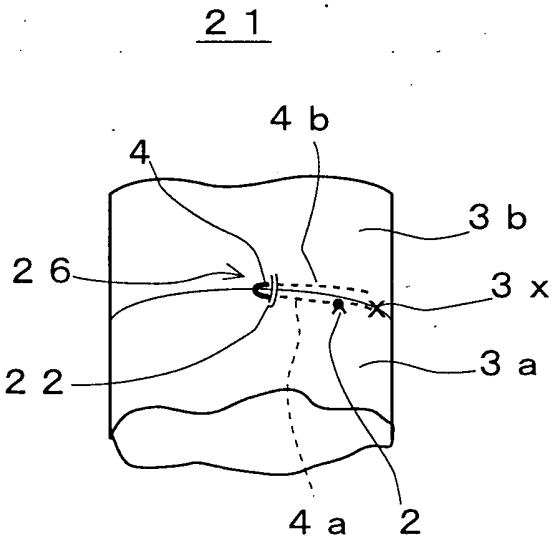
4b
5
16
3b
12
3x
13
3a
14
2
4a

(b)


21
4b
4
3b
26
3x
22
3a
4a
2

(c)

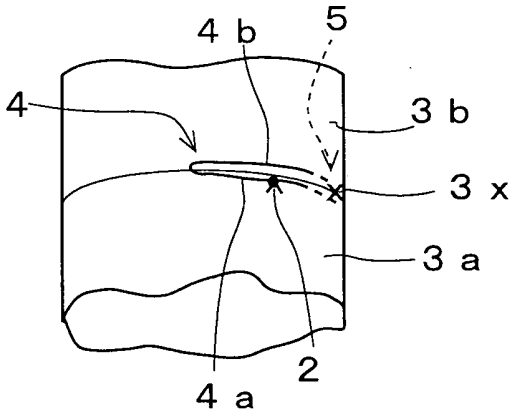
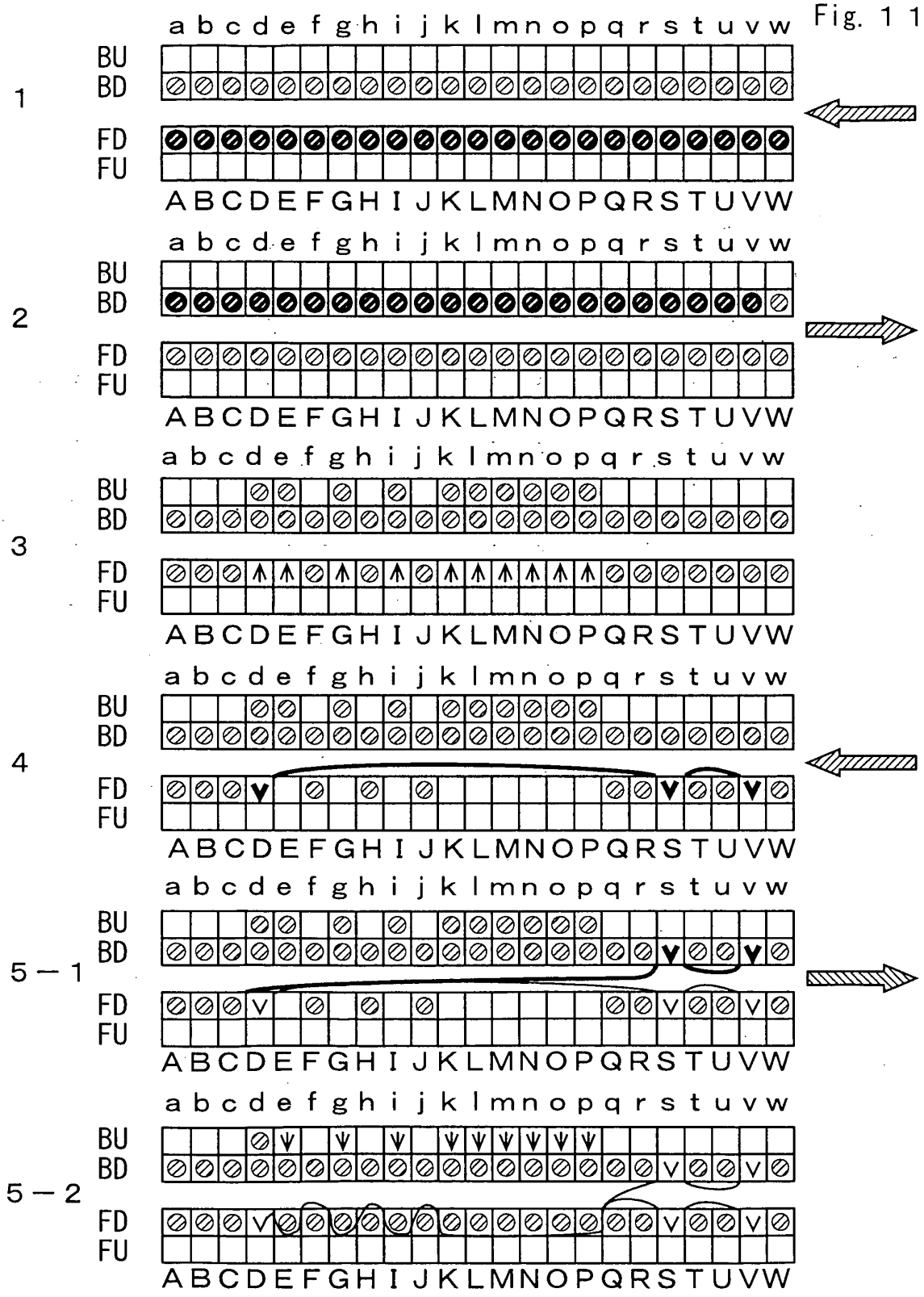

31
4b
5
4
3b
3x
3a
2
4a

Fig. 11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BD
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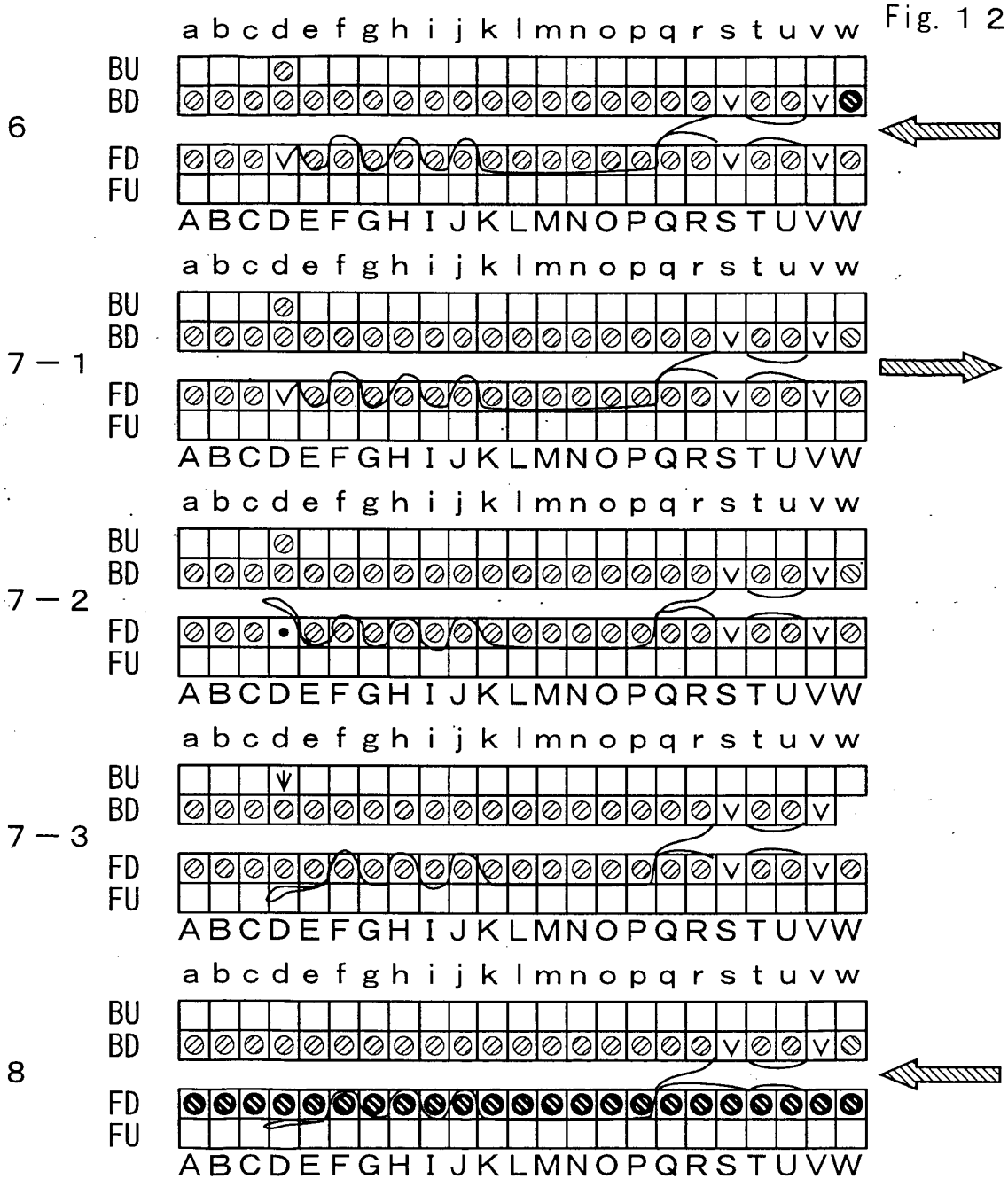
FD
FU
A B C D E F G H I J K L M N O P Q R S T U V W
2
3
4
5 — 1
5 — 2

Fig. 12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BU
BD
6
FD
FU
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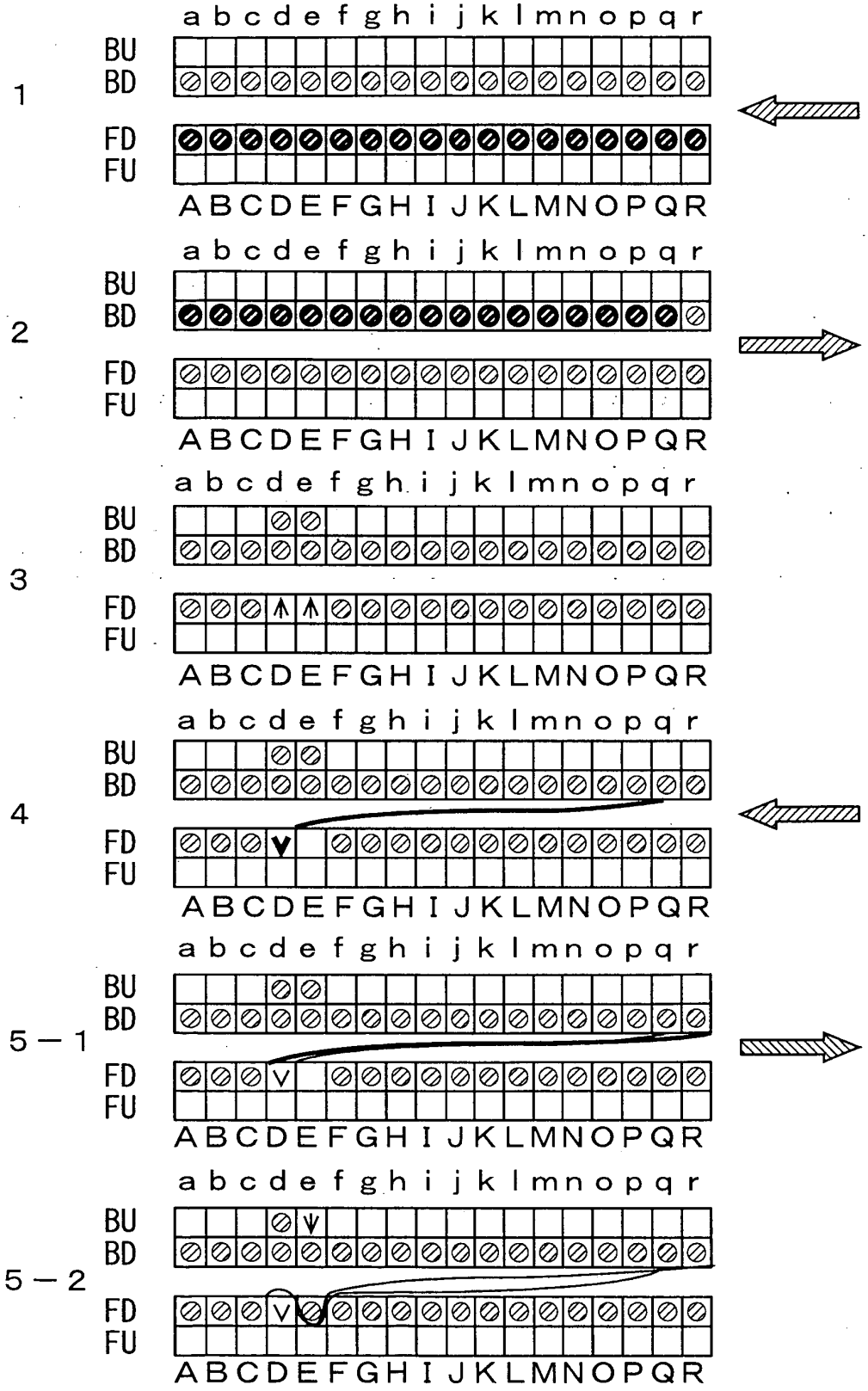
7 − 1
7 − 2
7 − 3
8

Fig. 13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FD
FU
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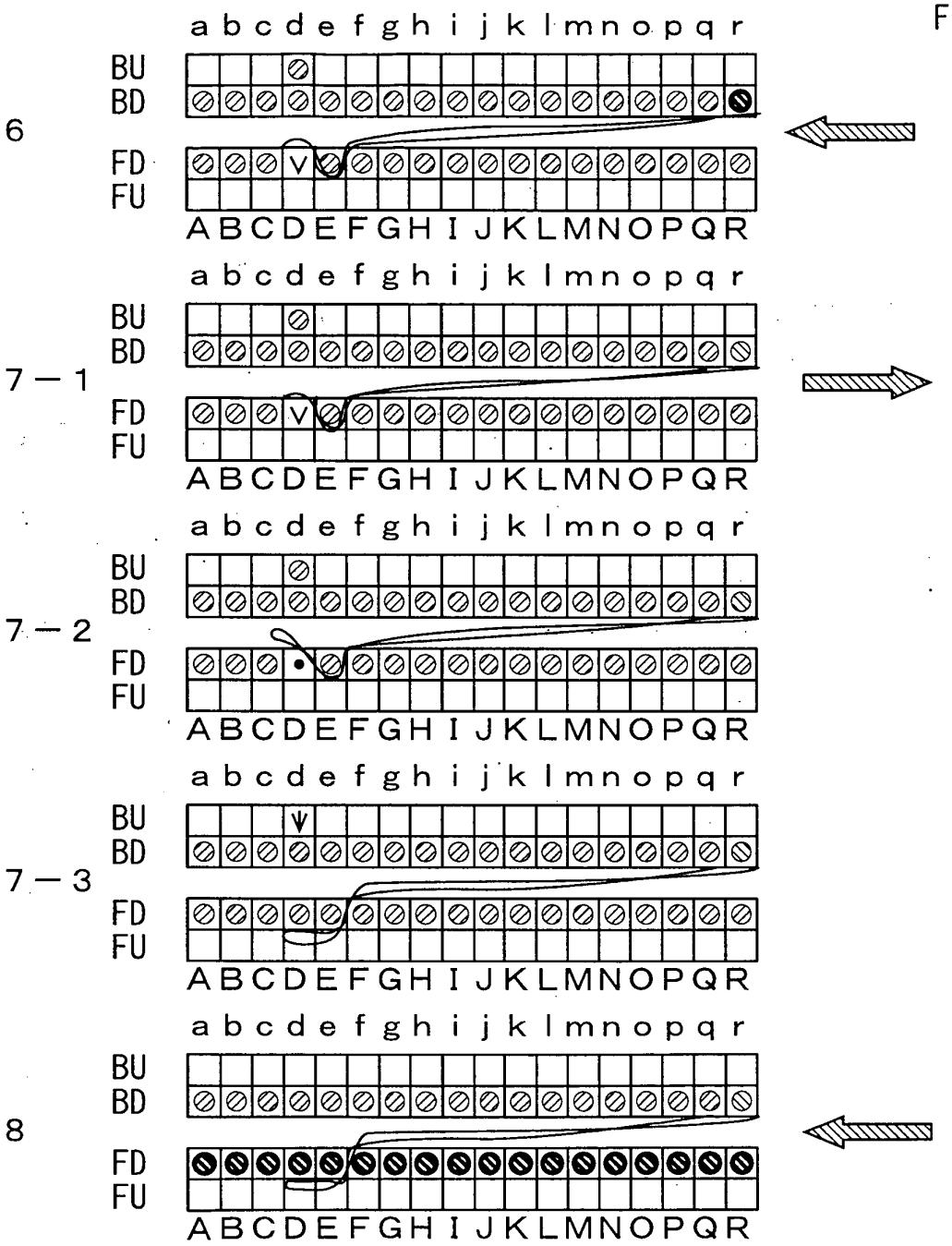
2
3
4
5 — 1
5 — 2

Fig. 14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BD
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FD
FU
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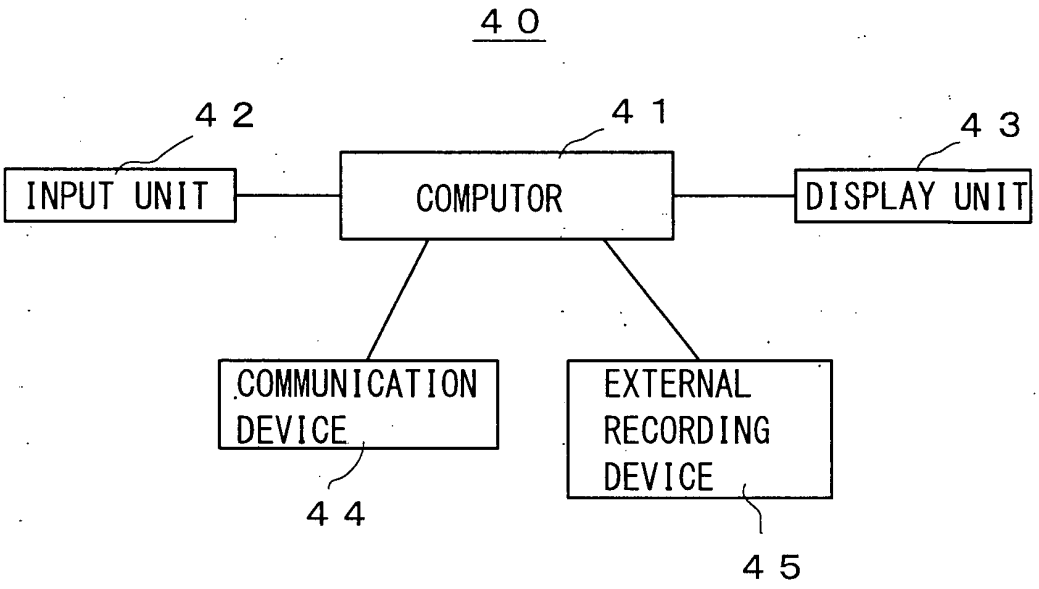
7 — 1
7 — 2
7 — 3
8

Fig. 15


40
42
41
43
INPUT UNIT
COMPUTOR
DISPLAY UNIT
COMMUNICATION DEVICE
44
EXTERNAL RECORDING DEVICE
45

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/001096

A. CLASSIFICATION OF SUBJECT MATTER
D04B1/22(2006.01)i, *D04B7/26*(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, D04B7/26

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 2816784 B2 (Shima Seiki Mfg., Ltd.), 27 October, 1998 (27.10.98), Claims; drawings & US 5369966 A & EP 574881 A1 & CN 1085970 A	1-12
A	JP 3839496 B2 (Shima Seiki Mfg., Ltd.), 01 November, 2006 (01.11.06), Claims; drawings (Family: none)	1-12
A	JP 8-188942 A (Shima Seiki Mfg., Ltd.), 23 July, 1996 (23.07.96), Claims; drawings (Family: none)	1-12

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 August, 2008 (05.08.08)	19 August, 2008 (19.08.08)
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/JP2008/001096

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 2006-118059 A (Shima Seiki Mfg., Ltd.), 11 May, 2006 (11.05.06), Claims; drawings & WO 2006/43398 A1 & EP 1803845 A1 & US 2007/0260353 A1	1-12
A	JP 3-27660 B2 (Shima Seiki Mfg., Ltd.), 16 April, 1991 (16.04.91), Claims; drawings & US 4840046 A & GB 2203173 A & DE 3712264 A & FR 2613733 A & CH 674031 A & ES 2006566 A & IT 1215940 B	1-12
P,A	WO 2007/058090 A1 (Shima Seiki Mfg., Ltd.), 24 May, 2007 (24.05.07), Claims; drawings (Family: none)	1-12

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Patent documents cited in the description

- JP 2816784 B **[0003]**
- JP 3839496 B **[0003]**
- JP H08188942 B **[0036]**