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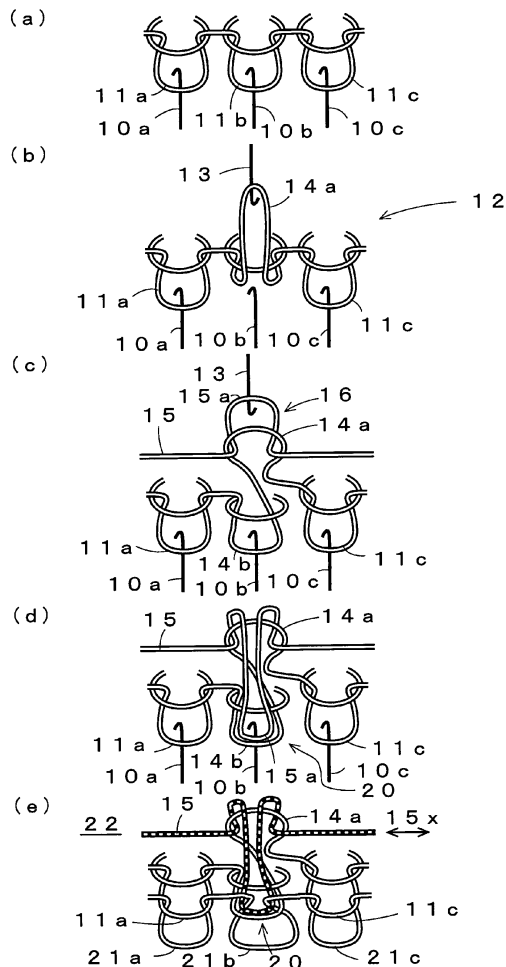
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(54) **Knitted fabric, knitting method thereof and designing apparatus**

(57) [Problem to be solved] The present invention provides a knitted fabric, a knitting method thereof and a designing apparatus, wherein the knitted fabric is knitted in such a manner that even when the cross-over yarn is reliably captured through the use of the split knit, the knitting yarn, after captured, can be prevented from being slackened to provide problem in knitting.

[Solution] A stitch 11b held by a latch needle 10b as a holding needle is transferred to an opposite latch needle 13, as shown in (b), from a state that one course of stitches 11a, 11b, 11c are formed with latch needles 10a, 10b, 10c, as shown in (a). When a cross-over yarn is yarned in, a split knit 16 is carried out to facilitate a capture of the cross-over yarn, as shown in (c). A stitch 15a formed by a latch needle 13 is transferred to the latch needle 10b to form double stitches 20, as shown in (d). After knitting of a knitted fabric 22 is ended, the cross-over yarn 15 shown in dashed line can be drawn out to a lateral direction 15x of the drawing and can be removed from the knitted fabric, as shown in (e).

Fig. 1 (a)



Description

[Technical Field]

[0001] The present invention relates to a knitted fabric, being knitted by a flatbed knitting machine and having areas knitted with different knitting yarns which are treated as cross-over yarns when used in other areas, to a knitting method thereof, and to a designing apparatus.

[Background Art]

[0002] In general, the flatbed knitting machine is provided with at least a pair of needle beds, arranged opposite to each other to define a needle bed gap between them, and a cam system, mounted on a carriage movable in reciprocation along the needle beds, for driving knitting needles arranged in parallel over the needle beds. A yarn feeder rail is built over the needle bed gap, and yarn carriers movable along the yarn feeder rail are taken by the carriage to feed the knitting yarns to the knitting needles driven by the cam system, thereby the knitted fabric is knitted. A yarn feeder port, to which the knitting yarn is fed from the yarn carrier, is positioned at a higher level with respect to an overhead direction of the needle bed gap, in order to avoid interference with the knitting needles, than a moving range within which the hooks at the front ends of the knitting needles driven to form the stitches are moved. Even when the knitting yarn is fed from such a higher level, since an edge portion of the knitting yarn fed is already held by the knitting needle or joined in the already knitted stitches of the knitted fabric or gripped by an edge yarn gripping device disposed at a lateral side of the needle bed, the knitting yarn is at a low level. With decreasing interval that allows the knitting yarn to be in the form of the cross-over yarn floating from the needle bed gap, the knitting yarn is lowered in height so that when the stitches are formed, the knitting yarn can be easily captured by a hook of a knitting needle.

[0003] With increasing distance that allows the knitting yarn to be in the form of the cross-over yarn which is not knitted in the knitted fabric as a stitch, the knitting yarn floats in height so that when a stitch is to be formed, the knitting yarn cannot be captured by a hook of a knitting needle. In a stitch transfer process, a knitting needle on the stitch passing side is advanced farther to the needle bed gap than in a stitch forming process. A latch needle used as a knitting needle can produce a result that when the latch is closed, a knitting yarn is drawn into a hook, so that, using a split knit technique, in which a stitch transfer is applied to form a stitch, provides an advantage that the cross-over yarn at the higher level can also be captured in a form of a new loop (See Patent Literature 1, for example).

[0004] Fig. 5 shows as an example applied with a knitting technique disclosed in the Patent Literature 1, that when a knitting yarn 1d is yarned in for an intarsia knitting, the knitting yarn 1d serving as the cross-over yarn which is positioned at a higher level from the needle bed gap is captured through the use of the split knit and thereafter the stitch is cast off by the captured knitting yarn 1d. It is to be noted that the knitted fabric is knitted on the front needle bed. Fig. 5(a) shows the knitted fabric 2 to be knitted. The knitted fabric 2 is formed by combination of A area 2a, B area 2b, C area 2c, and D area 2d. The D area 2d is knitted before and after the C area 2c of small in number of courses. After the knitting of the first half of the D area 2d is ended, the yarn carrier 3d for feeding the knitting yarn 1d used for the knitting is moved outside of the knitting width.

[0005] Fig. 5(b) shows the state in which the A areas 2a and B area 2b are respectively knitted with the knitting yarns 1a, 1b fed from the yarn carriers 3a, 3b. The stitches 4a, 4b are formed with the knitting needles of the front needle bed, and the stitch 4c is formed in the C area 2c. Following the stitch 4b at the right side of the B area 2c, a tuck 5 is hooked on the stitch 4c at the left side of the C area 2c, through which the B area 2b and the C area 2c are joined. The A area 2a and the B area 2b are also joined in the same manner. Fig. 5(c) shows the state in which the knitting of the C area 2c is ended and the second half of the D area 2d starts knitting with the knitting yarn 1d fed from the yarn carrier 3d. As shown in Fig. 5(d), in the process of the yarn-in of the knitting yarn 1d, for example one of the stitches 4a in the A area 2a is transferred to the back needle bed before the split knit 6. In the split knit 6, the stitch 6a transferred to the knitting needle of the back needle bed turns the old loop and a new loop of the stitch 6b is newly formed with the knitting yarn 1d, in order to prevent the floating of the cross-over yarn. By the relay of the split knit 6, the knitting yarn 1d can be reliably captured by the knitting needle at the left side of the D area 2d to form the stitch 4d. It is to be noted that when the split knit 6 is carried out, the stitch 6c is transferred to the knitting needle of the front needle bed. The stitch 6b formed with the knitting needle of the back needle bed is cast off from it, for convenience of later processes. The stitch 6b thus cast off turns a cross-over yarn, so that the relation with the knitted fabric is cut.

[0006] In this regard, however, it has been proved that depending on the characteristic features, such as stretch properties or frictional properties, of the knitting yarn 1d, there is a possibility that the knitting yarn 1d which takes the form of the stitch 6b may not be drawn out completely from the stitch 6a to cause slackness 7 in the vicinity of the stitch 6c remaining in the knitting needle on the front needle bed, as shown in Fig. 5(e), or even when drawn out completely, the knitting yarn 1d may be slackened and stayed over the needle bed gap.

[0007] Fig. 6 shows another example of the phenomenon occurring in the process of yarn in during intarsia knitting,

that the knitting yarn 1d positioned at a higher level from the needle bed gap is captured in the form of a new loop of the stitch 6b by the knitting needle of the back needle bed through the use of the split knit 6 and thereafter the stitch 6b is cast off. Since the processes (a) to (d) of Fig. 6 are the same as the processes (a) to (d) of Fig. 5, the processes (a) to (c) are omitted. Thus a plurality of yarn carriers 3a, 3b, 3d are used, they must be moved along tracks different in position from each other with respect to the back and forth direction, in order to be moved in the lateral direction, as viewed from the drawing, without interfering with each other. Suppose that the yarn carriers are arranged in the order of 3a, 3d, 3b with respect to the back and forth direction from the front side, an intersection between the knitting yarns 11b, 11d is caused at the left side of the B area 2b. When the stitch 6b formed by the knitting needle of the back needle bed in the split knit 6 is cast off, the knitting yarn 1d is pulled downwards and in turn the intersected knitting yarn 1b is pulled downwards, as shown in Fig. 6(e), so that the knitting yarn 1b extending to the yarn carrier 3b from the stitch at the widthwise end of the B area 2b may be excessively increased in length to cause slackness 8.

[Citation Listed]

[Patent Literature]

[0008] [Patent Literature 1] WO 2007/119272 A1

[Disclosure of the Invention]

[Technical Problem]

[0009] When the knitting yarn 1d serving as the cross-over yarn is captured at a midpoint thereof by the hook of the latch needle through the use of the split knit, as is the case with the Patent Literature 1, the knitting yarn 1d can be lowered in level so that the first stitch can be reliably formed in the area 2d knitted with the knitting yarn 1d. However, when the stitch, after formed, is cast off from the hook, there is a possibility that slackness 7, 8 as shown in Figs. 5 and 6 may be produced. If the slackness 7 as is shown in Fig. 5 is produced, there is a possibility that such slackness 7 also be caught for the knitting of the A area 2a and may be knitted in the knitted fabric to produce defective knit products. Also, if the slackness 8 as is shown in Fig. 6 is caused by the back and forth relation between the yarn carriers 3b, 3d, that will lead to defective knit products. When a number of yarn carriers are used, the intersection resulting from the back and forth relation cannot be avoided.

[0010] It is an object of the present invention to provide a knitted fabric, a knitting method thereof and a designing apparatus, wherein the knitted fabric is knitted in such a manner that even when the cross-over yarn is reliably captured through the use of the split knit, the knitting yarn, after captured, can be prevented from being slackened to provide problem in knitting.

[Technical Solution]

[0011] The present invention provides a knitted fabric being knitted by a flatbed knitting machine capable of split knit using latch needles, while a knitting yarn which is not used for forming stitches but serves as a cross-over yarn in at least a specific area of the knitted fabric being remained in the area through the use of a part of stitches in the area, wherein the knitting yarn serving as the cross-over yarn is overlapped with and remained in the stitches used in the state of being captured when split knit is carried out using the stitches.

[0012] Further, the present invention provides a knitting method of a knitted fabric comprising a process that when the knitted fabric is knitted by a flatbed knitting machine provided with at least a pair of front and back needle beds arranged opposite to each other to define a needle bed gap and a number of latch needles as knitting needles arranged on the respective needle beds, while a knitting yarn, which is different from that used for forming stitches but serves as a cross-over yarn, is remained in the knitted fabric through the use of a part of stitches in the knitted fabric, wherein the knitting yarn serving as the cross-over yarn, when split knit is provided between a holding needle for holding a part of the stitches used and an opposite needle opposite to the holding needle across the needle bed gap, is captured in the form of a newly formed loop by a hook of the knitting needle on the stitch transferring side in the split knit and thereafter the stitch held by the opposite needle is transferred and overlapped with the stitch held by the holding needle so that it can be remained in the form of one of the overlapped stitches in the knitted fabric.

[0013] In the knitting method of the present invention, the stitch held by said holding needle is transferred to the opposite needle before said split knit is provided, then the split knit is carried out, with the opposite needle as the knitting needle on said stitch transferring side, so that the knitting yarn serving as the cross-over yarn is captured by the hook of the knitting needle in such a manner as to form the new loop, and then the new loop is transferred to and overlapped with the stitch held by the holding needle.

[0014] In the knitting method of the present invention, the split knit is carried out, with said holding needle as the knitting needle on said stitch transferring side, so that the knitting yarn serving as the cross-over yarn is captured in the form of a new loop by the hook of the holding needle, and then the stitch held by the opposite needle is transferred to and overlapped with the stitch held by the holding needle.

[0015] In the knitting method of the present invention, the knitting yarn serving as said cross-over yarn, when the knitting yarn is yarned in from its standby state in which the knitting yarn is drawn outside the knitting width of the already knitted fabric and is dropped downwardly in the needle bed gap, intersects with a knitting yarn used for knitting the other area.

[0016] Further, the present invention provides a designing apparatus for use in a knitting method of a knitted fabric including a process that when the knitted fabric is knitted by a flatbed knitting machine provided with at least a pair of front and back needle beds arranged opposite to each other to define a needle bed gap and a number of latch needles as knitting needles arranged on the respective needle beds, while a knitting yarn, which is different from that used for forming stitches but serves as a cross-over yarn, is remained in the knitted fabric through the use of a part of stitches in the knitted fabric, comprising

a means for generating knitting data in such a manner that the knitting yarn serving as the cross-over yarn, when split knit is provided between a holding needle for holding a part of the stitches used and an opposite needle opposite to the holding needle across the needle bed gap, is captured in the form of a new loop by a hook of the knitting needle on the stitch transferring side in the split knit and thereafter the stitch held by the opposite needle is transferred and overlapped with the stitch held by the holding needle so that it can be remained in the form of one of the overlapped stitches in the knitted fabric.

[Advantageous Effects]

[0017] According to the present invention, the knitted fabric is knitted by the flatbed knitting machine capable of split knit using latch needles. When the split knit is carried out, the knitting yarn serving as the cross-over yarn is captured and is remained in the state of the stitches being overlapped with each other in the area where the knitting yarn turns the cross-over yarn floating from the knitted fabric. In a post-process after completion of the knitting, the knitting yarn corresponding to the cross-over yarn can be drawn out from the knitted fabric. This can bring the split stitch back to substantially the same state as the former state before the split knit. In the course of the knitting of the knitted fabric, the cross-over yarn is remained in the knitted fabric. This can provide the result that the cross-over yarn can be prevented from being slackened to provide problem that may be caused by the slackness.

[0018] Further, according to the present invention, when the knitted fabric is knitted by the flatbed knitting machine, the knitting yarn serving the cross-over yarn can be reliably captured when the split knit is carried out for the stitch held by the holding needle. The cross-over yarn is transferred in such a manner that the stitch held by the opposite needle is overlapped with the stitch held by the holding needle so that it can be remained in the form of one of the overlapped stitches in the knitted fabric. This can prevent from occurrence of the problem that the knitting yarn may be slackened in the course of the knitting. After the end of the knitting, the cross-over yarn can be drawn out and removed from the knitted fabric. Hence, the influence of the split knit can also be removed from the knitted fabric.

[0019] Also, according to the present invention, since a large proportion of the cross-over yarn is remained in one side of the knitted fabric, the removal work after the end of the knitting can be facilitated.

[0020] Also, according to the present invention, since the split knit required for the capture of the cross-over yarn is carried out via the stitch transfer from the holding needle to the opposite needle, the knitting process can be shortened

[0021] Also, according to the present invention, even when the cross-over yarn is fed in from below within the knitting width of the knitted fabric to intersect with the other knitting yarn, since the cross-over yarn after captured is remained in the knitted fabric, the other intersecting knitting yarn can be prevented from being drawn downwardly.

[0022] Further, according to the present invention, in the case where the knitting yarn which is difficult to be hooked by the knitting needle floats from the needle bed gap and turns the cross-over yarn, the knitting data can be generated that can allow the reliable capture via the split knit and prevent from occurrence of the problem resulting from the slackness after the capture

[Brief Description of Drawings]

[0023]

[Fig.1] Fig. 1 is a view showing schematically a stitch structure of a principal part of a knitting method of a certain embodiment of the present invention.

[Fig.2] Fig. 2 is a knitting diagram showing an example of a process for knitting a knitted fabric by use of the knitting method shown in Fig. 1.

[Fig.3] Fig. 3 is a view showing typically a stitch structure of a principal part of a knitting method of another embodiment of the present invention.

[Fig.4] Fig. 4 is a block diagram showing a schematic structure of a designing apparatus 30 which is still another embodiment of the present invention.

[Fig.5] Fig. 5 is a knitting diagram simplistically showing an example of a slackening state of a cross-over yarn after captured.

[Fig.6] Fig. 6 is a knitting diagram simplistically showing another example of a slackening state of a cross-over yarn after captured.

[Description of Embodiments]

[0024] Hereinafter, with reference to Figs. 1 and 2, a knitting method of a certain embodiment of the present invention is explained. With reference to Fig. 3, another knitting method of another embodiment of the present invention is explained. In these knitting methods, latch needles are provided as knitting needles on a front needle bed and a back needle bed which are arranged opposite to each other to define a needle bed gap between them, explanation however is given on the case that a knitted fabric is knitted using the latch needles on the front needle bed. For simplification of explanation, only three latch needles are shown, though a number of latch needles are used in practice for the knitting. Likewise, only a single latch needle on the back needle bed is shown which is a counterpart for stitch transfer or split knit. With reference to Fig. 4, a designing apparatus 30 which is still another embodiment of the present invention is explained. For avoidance of redundancy of explanation, corresponding parts, when presented in the preceding explanation, are sometimes labeled the same reference characters used in the preceding explanation throughout the drawings.

[Example 1]

[0025] Fig. 1 is a view showing schematically a stitch structure of a principal part of a knitting method of a certain embodiment of the present invention. Fig. 1(a) shows a state in which for example one course of stitches 11a, 11b, 11c are formed with latch needles 10a, 10b, 10c on the front needle bed of Fig. 5. Fig. 1(b) shows a state in which the stitch 11b held by the latch needle 10b, which serves as a holding needle out of the latch needles 10a, 10b, 10c of Fig. 1(a), is transferred to and held by a latch needle 13 on the back needle bed which corresponds in position to the latch needle 10b across a needle bed gap 12. Fig. 1(c) shows a state in which when a knitting yarn serving as a cross-over yarn 15 is yarned in, a split knit 16 is provided between the latch needle 10b on the front needle bed and the latch needle 13 on the back needle bed. The split knit 16 is provided for the transferred stitch 14a in Fig. 1(b), the cross-over yarn 15 is captured by the hook of the latch needle 13 which is the opposite needle, on the back needle bed, and a stitch 15a is formed as a new loop, while also the transferred stitch 14a is knocked over as an old loop. By the stitch transfer for the split knit 16, a stitch 14b is formed with the latch needle 10b, which is the holding needle, on the front needle bed. As described in the Patent Literature 1, the use of the split knit 16 can facilitate the capture of the cross-over yarn 15.

[0026] Fig. 1(d) shows a state in which the stitch 15a formed with the latch needle 13 on the back needle bed in Fig. 1(c) is transferred to the latch needle 10b on the front needle bed and is overlapped with the stitch 14b held by the latch needle 10b to form double stitches 20. Fig. 1(e) shows a state in which stitches 21a, 21b, 21c in the course next to the course including the double stitches 20 are formed. In the following courses as well, stitches are formed by their respective latch needles 10a, 10b, 10c on the front needle bed in the same manner, to thereby produce a knitted fabric 22, and the knitted fabric 22 thus knitted can allow the cross-over yarn 15, shown in dashed line, to be removed by drawing out in the lateral direction 15x as viewed in the drawing. After the cross-over yarn 15 is drawn out, the stitch 14a, which becomes an old loop in Fig. (c), is absorbed in the surrounding stitches and is returned to the former sinker loop between the stitches 11b, 11c. In case the knitted fabric 22 is knitted on the front needle bed, since the cross-over yarn 15 remains in the back side of the knitted fabric 22 on the back needle bed side, the drawing of the cross-over yarn can be facilitated.

[0027] Fig. 2 shows an example of processes for knitting the knitted fabric. A carriage is equipped with three cam systems S1, S2, S3. Explanation is provided to a case in which the knitting operations of the knit, the tuck and the miss and the stitch transfer are able to be done by each cam system S1, S2, S3 similarly, and the split knit is able to be done by at least the intermediate cam system S2. As for the three cam systems, the cam system on the leading side is referred to S1 and the cam system on the trailing side is referred to S3, according to the running direction of the carriage. The knitted fabric 2 shown in Fig. 5 is supposed as a fabric knitted, and each area corresponding to A area 2a, B area 2b, C area 2c and D area 2d is indicated by A, B, C, and D, respectively. Yarn carriers used in the respective areas are also indicated by A, B, C, and D. Numerical numbers 1-12 on the left side of the drawing designate strokes of the carriage. S1, S2, S3 on the right side of the drawing designate the cam system to be used.

[0028] In the stroke 1, the carriage moves rightwards, and the areas A, C are knitted by the cam system S1 and the area B is knitted by the cam system S2, respectively. In the stroke 2, the carriage moves leftwards, and the areas C, A are knitted by the cam system S1 and the area B is knitted by the cam system S2, respectively. The related areas are

interconnected by the tuck. The stroke 1 and the stroke 2 are repeated to knit the areas A, B, C. In the stroke 3, since the knitting yarn used in the knitting of the area C is yarned out to the right, while the carriage moves rightwards and the yarn carrier C is moved rightwards, the stitches are transferred from the front needle bed to the back needle bed by the cam system S1, then, the split knit is provided from the back needle bed to the front needle bed by the cam system S2, and the double stitches are formed by the stitch transfer from the back needle bed to the front needle bed by using the cam system S3. When the split knit is provided by the cam system S2, the knitting yarn in the area C as was yarned out to the right is captured as a new loop on the back needle bed and then transferred to the front needle bed when the double stitches are formed by the cam system S3.

[0029] In the stroke 4, only the carriage moves leftwards. In the stroke 5, the yarn carrier D moves leftwards, so that the knitting yarn used for the knitting of the area D is yarned in from the left side. The stitches are transferred from the front needle bed to the back needle bed by the cam system S1 first, then, while the split knit is provided by the cam system S2, the cross-over yarn is captured by the knitting needle on the back needle bed and is formed as a new loop and the loop is transferred to the front needle bed. By the cam system S3, the new loop is transferred from the back needle bed to the front needle bed to form double stitches with the knitting needle on the front needle bed. This process involving the split knit should preferably be taken at several points according to a required distance for the yarn in, in order to ensure the capture of the cross-over yarn.

[0030] In the stroke 6, the carriage moves from the area D to the area B and the yarn carrier D as moved to the area D in the stroke 5 is kicked back to the area B. In the following, the stroke 7 and the stroke 8 are repeated to knit the areas A, B, D. In this regard, however, in the first stage of the process 7, the left end of the area D shown in dashed line is formed by the miss, because it has already been knitted in the stroke 5. In the second or later stage of the stroke 7 repeated, the stitches of the area D are formed including the left end shown in the dashed line. In the stroke 9, the carriage moves from the area B to the area D and the yarn carrier D as moved to the area B in the stroke 8 is kicked back to the area D. In the stroke 10, the yarn carrier D moves leftwards and the knitting yarn used for the knitting of the area D is yarned out to the left side. In order to ensure the capture of the cross-over yarn, the split knit may also be taken at several points according to a required distance for the yarn out. In the stroke 11, only the carriage moves rightwards, and in the stroke 12, the yarn carrier C moves from the right side so that the knitting yarn used for the knitting of the area C is yarned in from the right.

[0031] As seen from the foregoing, since the cross-over yarn involved in the yarn in or the yarn out is captured and held in the form of an overlapped loop through the split stitch, a possible yarn catch problem that may be caused by slackness 7 in the knitting yarn as shown in Fig. 5(e) can be avoided. Also, even if intersection is caused by the back and forth relationship between the tracks along which the yarn carriers used moves so that the knitting yarn yarned in may be put in the condition of being pulled downwards, as shown in Fig. 6, since the split stitch 15a is not cast off, possible problem to provide slackness 8 in the knitting yarn as shown in Fig. 6(e) can be prevented.

[Example 2]

[0032] Fig. 3 shows typically a stitch structure of a principal part of a knitting method of another embodiment of the present invention. Fig. 3(a) shows a state in which one course of stitches 11a, 11b, 11c are formed with the latch needles 10a, 10b, 10c on the front needle bed, as is the case with Fig. 1(a). Fig. 3(b) shows a state in which when the knitting yarn serving as the cross-over yarn 15 is yarned in, the split knit 23 is provided to capture the cross-over yarn 15 by the hook of the latch needle 10b serving as the holding needle and form the stitch 15a as a new loop, while also part of the held stitch is knocked over as the old loop 14a so that the stitch 14b is formed with the latch needle 13, which is the opposite, by the stitch transfer. Fig. 3(c) shows a state in which the stitch 14b transferred to the latch needle 13 via the split knit 23 in Fig. 3(b) is transferred back to the former latch needle 10b and is overlapped with the stitch 15a held by the latch needle 10b, to form double stitches 24. Fig. 3(d) shows a state in which stitches 21a, 21b, 21c in the course next to the course including the double stitches 24 are knitted. In the following courses as well, stitches following the stitches 21a, 21b, 21c are formed in the same manner. After knitting of a knitted fabric 25, the cross-over yarn 15 shown in dashed line can be drawn out in the lateral direction 15x as viewed from the drawing and removed. When the cross-over yarn 15 is drawn out, the stitch 14a formed in Fig. 3(b) is absorbed in the surrounding stitches and is returned to the sinker loop between the former stitches 10b, 10c. According to this embodiment, since the stitch transfer is not provided before the split knit 23, the processes for capturing the cross-over yarn 15 can be cut to that extent, as compared with the embodiment of Fig. 1.

[Example 3]

[0033] Fig. 4 shows a schematic structure of a designing apparatus 30 which is still another embodiment of the present invention. The designing apparatus 30 generates knitting data required for knitting a knitted fabric by using a flatbed knitting machine provided with at least a pair of needle beds, such as a front needle bed and a back needle bed, which

are arranged opposite to each other to define a needle bed gap between them, and a number of latch needles 10a, 10b, 10c, 13 used as knitting needles which are arranged on the respective needle beds. The designing apparatus 30 is worked out by installing knitted fabric designing software in a general-purpose computer 31. Various operations can be input in the computer 31 via an input device 32, and operation results and processing results can be displayed via a display device 33. A communication device 34 can be used for software download and data communication. A recording equipment 35 can be used for recording the software and data. The knitting data generated by the designing apparatus 30 can be fed to the flatbed knitting machine via recording media in which the data can be recorded by the communication device 34 and the recording equipment 35.

[0034] The knitting data includes the data on the process of making the cross-over yarn 15 remaining in the knitted fabric 22, 25 by using the latch needle 10b holding the stitch 11b as the holding needle. The knitting yarn serving as the cross-over yarn 15 is captured and formed as a new loop 15a by the hook of the latch needle, which serves as stitch transfer side when the split knit 16, 23 is provided between the latch needle 10b serving as the holding needle and the latch needle 13 arranged opposite to the latch needle 10b across the needle bed gap 12. The knitting data is generated to allow the stitch hooked by the opposite needle to be transferred to and overlapped with the stitch hooked by the holding needle so that it can be remained in the knitted fabric in the form of one of the double stitches.

[Reference Signs List]

[0035]

10a, 10b, 10c, 13	Latch needle
11a, 11b, 11c, 14a, 14b, 15a, 21a, 21b, 21c	Stitch
15	Cross-over yarn
16, 23	Split knit
22, 25	Knitted fabric
30	Designing apparatus

Claims

1. A knitted fabric (22, 25) being knitted by a flatbed knitting machine capable of split knit using latch needles (10a, 10b, 10c, 13), while a knitting yarn which is not used for forming stitches (11a, 11b, 11c, 21a, 21b, 21c) but serves as a cross-over yarn (15) in at least a specific area of the knitted fabric (22, 25) being remained in the area through the use of a part of stitches (11b) in the area,
characterized in that the knitting yarn serving as the cross-over yarn (15) is overlapped with and remained in the stitches (14a, 14b) used in the state of being captured when split knit (16, 23) is carried out using the stitches (11b).
2. A knitting method of a knitted fabric (22, 25) comprising a process that when the knitted fabric (22, 25) is knitted by a flatbed knitting machine provided with at least a pair of front and back needle beds arranged opposite to each other to define a needle bed gap (12) and a number of latch needles (10a, 10b, 10c, 13) as knitting needles arranged on the respective needle beds, while a knitting yarn, which is different from that used for forming stitches (11a, 11b, 11c, 21a, 21b, 21c) but serves as a cross-over yarn (15), is remained in the knitted fabric (22, 25) through the use of a part of stitches (11b) in the knitted fabric (22, 25),
characterized in that the knitting yarn serving as the cross-over yarn (15), when split knit (16, 23) is provided between a holding needle (10b) for holding a part of the stitches (11b) used and an opposite needle (13) opposite to the holding needle (10b) across the needle bed gap (12), is captured in the form of a newly formed loop (15a) by a hook of the knitting needle (13, 10b) on the stitch transferring side in the split knit (16, 23) and thereafter the stitch (15a, 14b) held by the opposite needle (13) is transferred and overlapped with the stitch (14b, 15a) held by the holding needle (10b) so that it can be remained in the form of one of the overlapped stitches (20, 24) in the knitted fabric (22, 25).
3. The knitting method according to claim 2,
characterized in that the stitch (11b) held by said holding needle (10b) is transferred to the opposite needle (13)

before said split knit (16) is provided, then the split knit (16) is carried out, with the opposite needle (13) as the knitting needle on said stitch transferring side, so that the knitting yarn serving as the cross-over yarn (15) is captured by the hook of the knitting needle (13) in such a manner as to form the new loop (15a), and then the new loop (15a) is transferred to and overlapped with the stitch (14b) held by the holding needle (10b).

4. The knitting method according to claim 2,
characterized in that the split knit (23) is carried out, with said holding needle (10b) as the knitting needle on said stitch transferring side, so that the knitting yarn serving as the cross-over yarn (15) is captured in the form of a new loop (15a) by the hook of the holding needle (10b), and then the stitch (14b) held by the opposite needle (13) is transferred to and overlapped with the stitch (15a) held by the holding needle (10b).
5. The knitting method according to any one of claims 2 to 4,
characterized in that the knitting yarn serving as said cross-over yarn (15), when the knitting yarn is yarned in from its standby state in which the knitting yarn is drawn outside the knitting width of the already knitted fabric and is dropped downwardly in the needle bed gap (12), intersects with a knitting yarn used for knitting the other area.
6. A designing apparatus (30) for use in a knitting method of a knitted fabric (22, 25) including a process that when the knitted fabric (22, 25) is knitted by a flatbed knitting machine provided with at least a pair of front and back needle beds arranged opposite to each other to define a needle bed gap (12) and a number of latch needles (10a, 10b, 10c, 13) as knitting needles arranged on the respective needle beds, while a knitting yarn, which is different from that used for forming stitches (11a, 11b, 11c, 21a, 21b, 21c) but serves as a cross-over yarn (15), is remained in the knitted fabric (22, 25) through the use of a part of stitches (11b) in the knitted fabric (22, 25),
characterized in that the designing apparatus being provided with a means for generating knitting data in such a manner that the knitting yarn serving as the cross-over yarn (15), when split knit (16, 23) is provided between a holding needle (10b) for holding a part of the stitches (11b) used and an opposite needle (13) opposite to the holding needle (10b) across the needle bed gap (12), is captured in the form of a new loop (15a) by a hook of the knitting needle (13, 10b) on the stitch transferring side in the split knit (16, 23) and thereafter the stitch (15a, 14b) held by the opposite needle (13) is transferred and overlapped with the stitch (14b, 15a) held by the holding needle (10b) so that it can be remained in the form of one of the overlapped stitches (20, 24) in the knitted fabric (22, 25).

Fig. 1 (a)

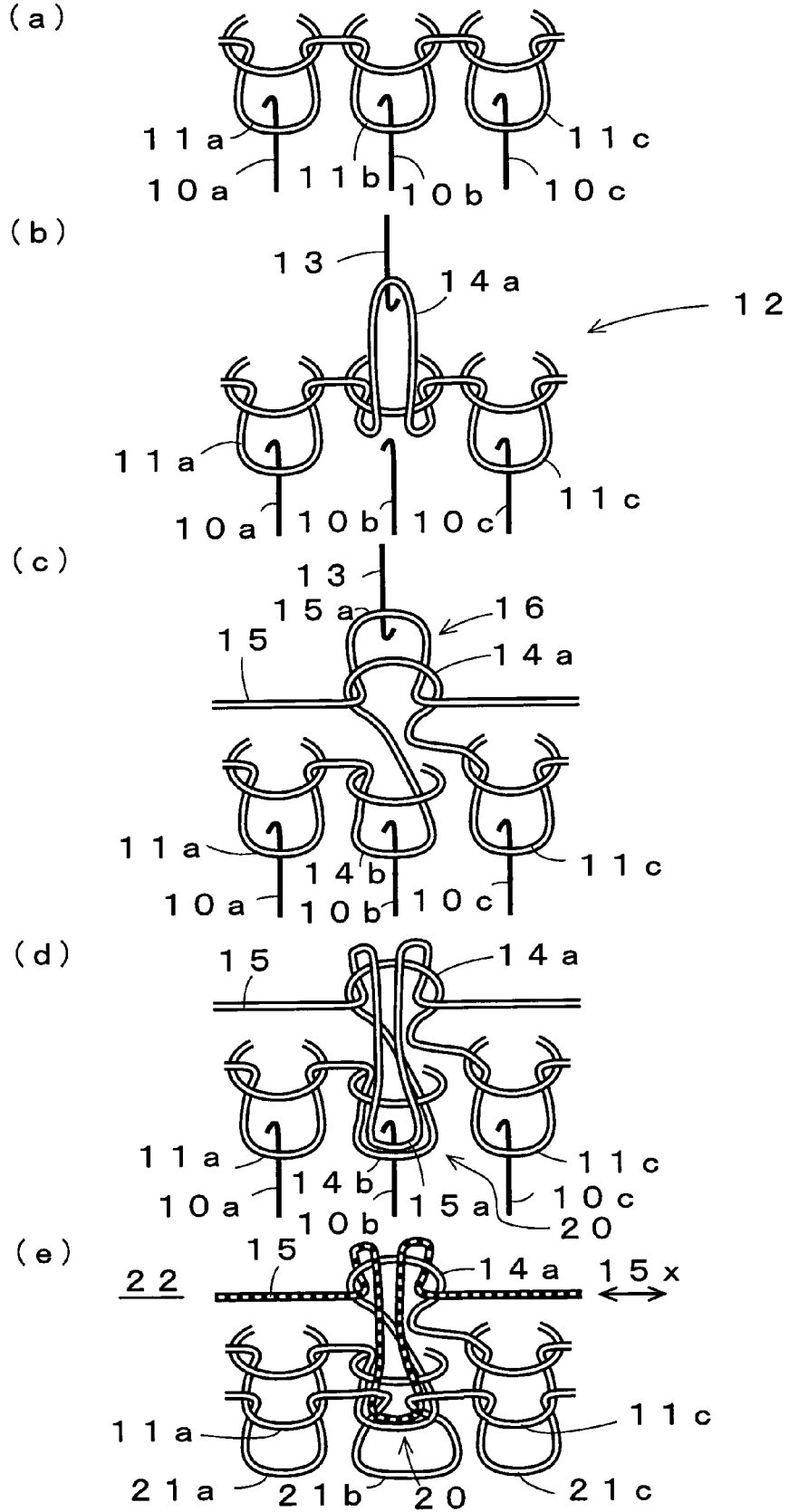


Fig. 2

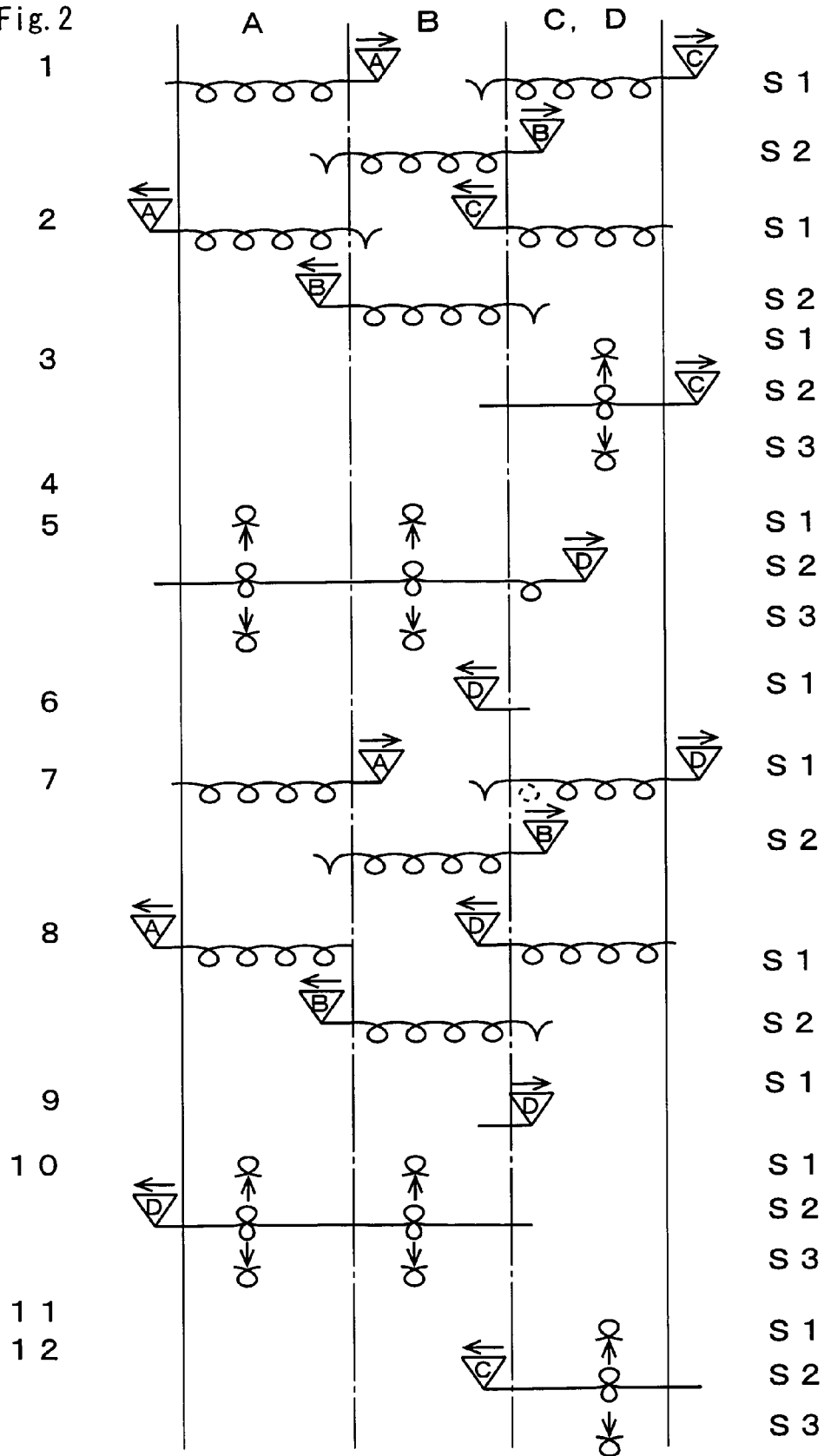
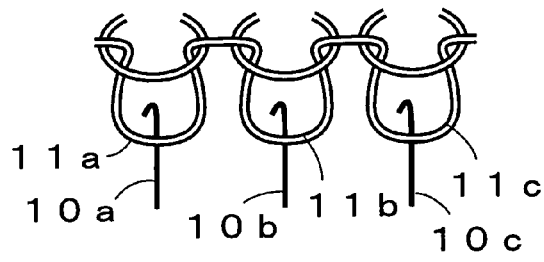
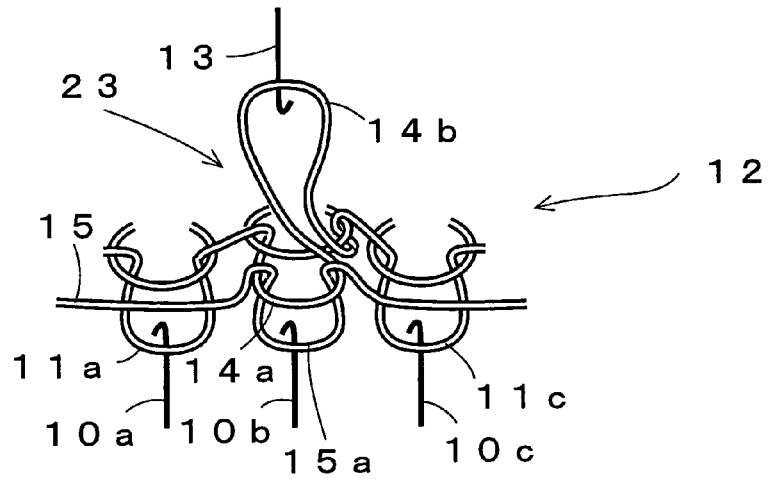


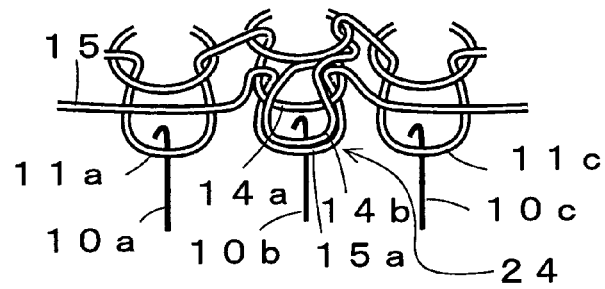
Fig. 3(a)



(b)



(c)



(d) 25

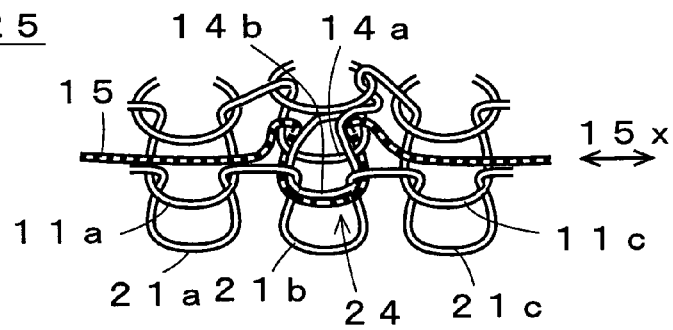


Fig. 4

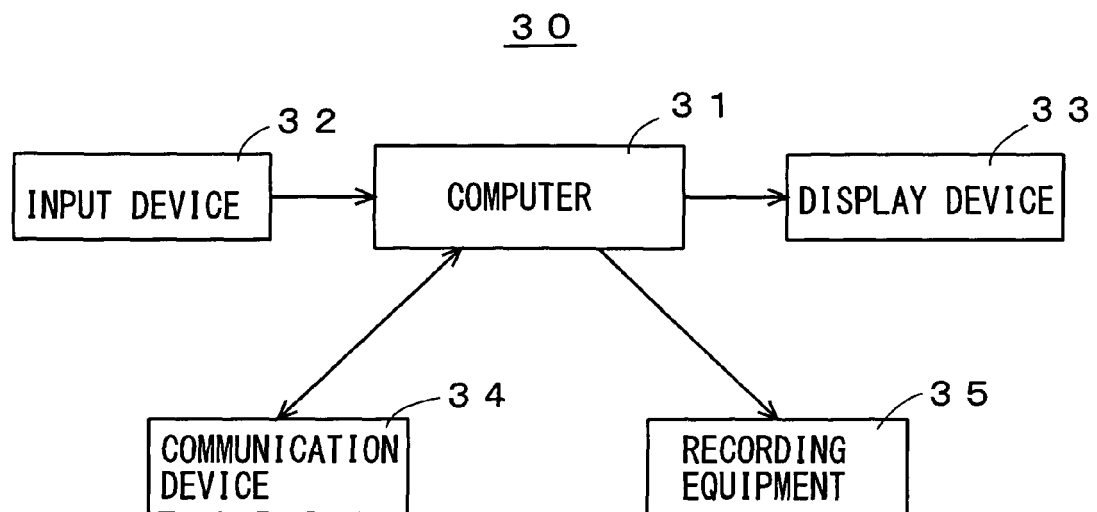


Fig. 5

(e)

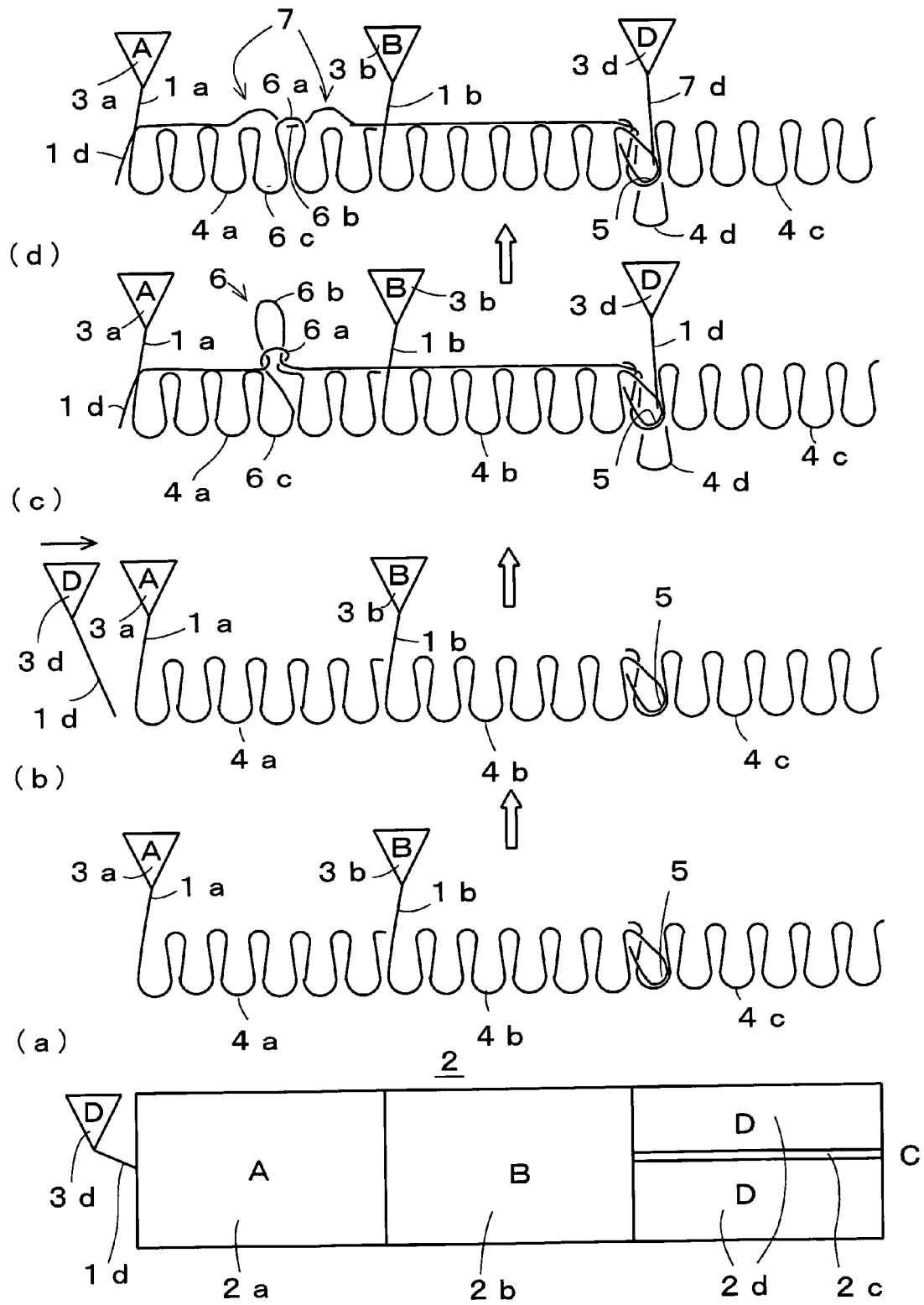
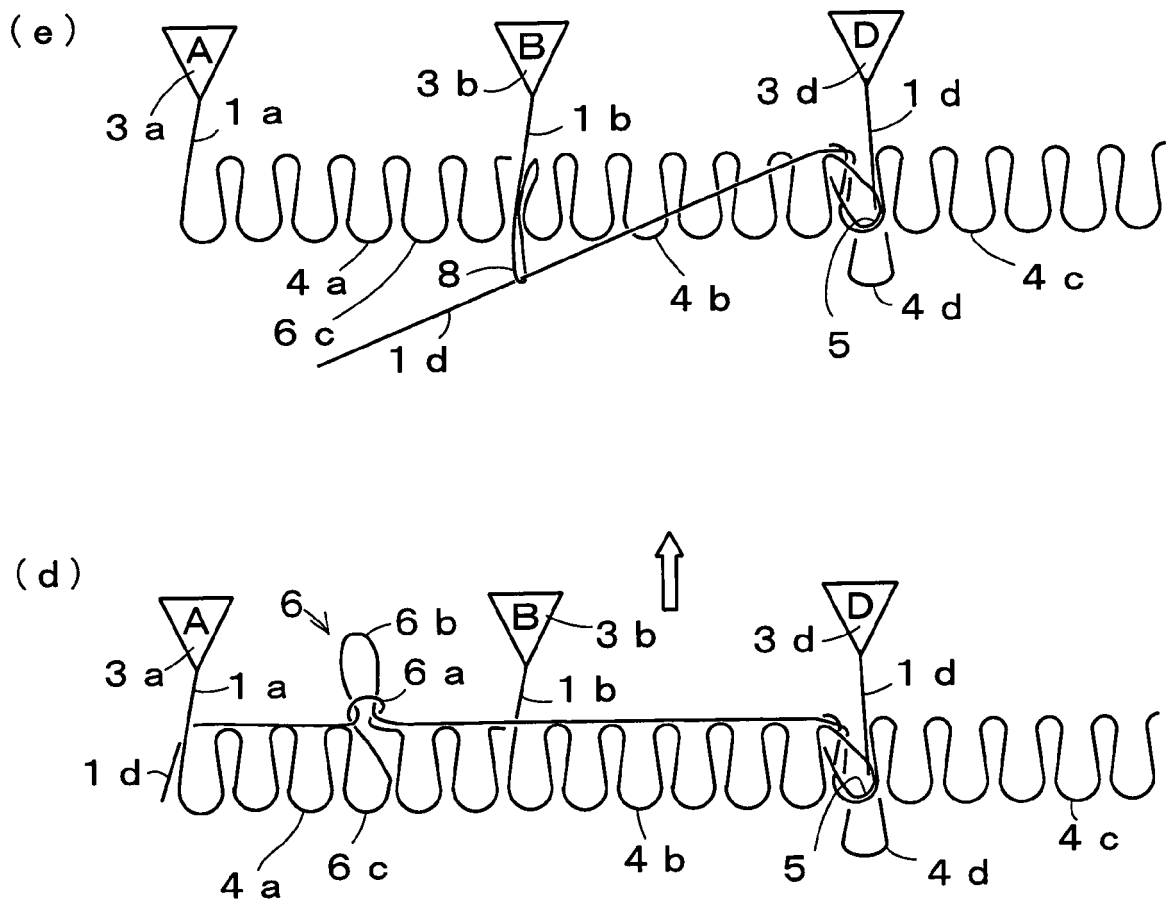


Fig. 6





EUROPEAN SEARCH REPORT

Application Number
EP 11 00 2149

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	EP 1 995 363 A1 (SHIMA SEIKI MFG [JP]) 26 November 2008 (2008-11-26)	6	INV. D04B1/12
A	* paragraphs [0053] - [0059], [0063]; claims 3, 7; figures 7, 10, 13 *	1,2	
A	EP 2 003 231 A1 (STOLL H GMBH & CO KG [DE]) 17 December 2008 (2008-12-17) * paragraphs [0027] - [0035]; claim 1; figures 2-4 *	1,2,6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D04B
Place of search		Date of completion of the search	Examiner
Munich		16 August 2011	Sterle, Dieter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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16-08-2011

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