

(19)



(11)

EP 2 468 934 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.06.2012 Bulletin 2012/26

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

(21) Application number: **11010165.6**

(22) Date of filing: **23.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **24.12.2010 JP 2010288587**

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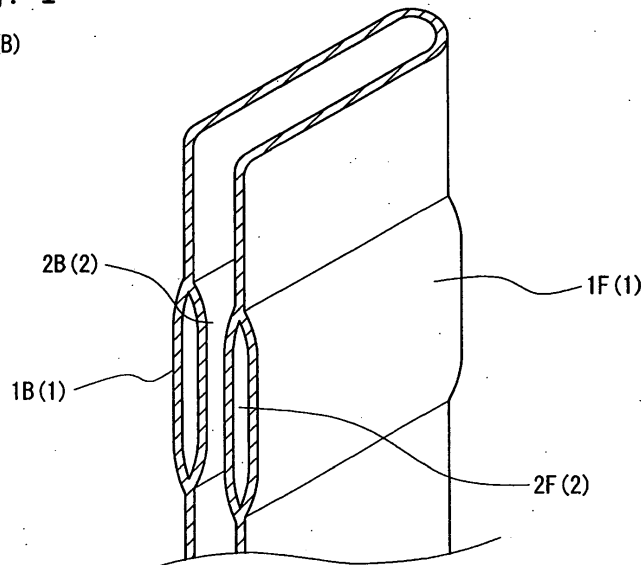
(54) Knitting method of knitted fabric having multilayered structure

(57) Provided is a knitting method of a knitted fabric having a multilayered structure capable of knitting an outer knitted fabric portion in a full gauge state when knitting a knitted fabric having a multilayered structure including an outer knitted fabric portion and an inner knitted fabric portion. The number of knitting courses of an outer front portion 1F is increased from a standard arrangement in which the outer knitted fabric portion (outer front portion 1F, outer back portion 1B) is held in a full gauge state on a lower front needle bed (FD) and a lower back needle bed (BD), and the inner knitted fabric portion (inner front portion 2F) is held in a half gauge state on an upper front

needle bed (FU) using a four-bed flat knitting machine including two pairs of front and back needle beds arranged one above the other. In this case, some stitches of the outer back portion 1B held on the BU on an opposing side 9, which faces a side (reference side 8) on which the inner front portion 2F is held, are transferred to the FU (S2, S3). The stitches of the inner front portion 2F are transferred from the reference side 8 to the knitting needles, which became empty needles due to the transfer, (S4), and the number of knitting courses of the outer front portion 1F is increased (S5). The arrangement state of each portion 1F, 1B, 2F is then returned to the standard arrangement (S6 to S8).

Fig. 1

(B)



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Description

[Patent Document 1] Japanese Patent No. 2514489

BACKGROUND OF THE INVENTION**Field of the Invention**

[0001] The present invention relates to a knitting method of a knitted fabric having a multilayered structure for knitting a knitted fabric having a multilayered structure including a tubular outer knitted fabric portion and an inner knitted fabric portion joined to the inner side of the outer knitted fabric portion in a seamless manner.

Description of the Related Art

[0002] Conventionally, there is known a knitwear (knitted fabric) having a multilayered structure including a tubular outer knitted fabric portion and an inner knitted fabric portion joined to the inner side of the outer knitted fabric portion in a seamless manner. For example, a sweater with a pocket is a representative example of knitwear having a three layered structure in a thickness direction at the position of the pocket. A knitted dress having a belt loop at a portion corresponding to the waist of the wearer is knitwear having a four layered structure in the thickness direction at the position of the belt loop. In addition, knitwear knitted with a ladder backing jacquard is also a representative example of a knitwear having a multilayered structure.

[0003] A four-bed flat knitting machine having two pairs of front and back needle beds arranged one above the other is used to knit the knitted fabric having a multilayered structure as described above. For example, Patent Document 1 discloses a knitting method of a sweater with a rib formed in two-fold, that is, a sweater having a four layered structure in a thickness direction at the position of the rib. In the technique of Patent Document 1, a set up portion of a front body rib portion and a set up portion of a back body rib portion are first knitted with the front and back needle beds on the lower stage. Then, every other stitches of each set up portion are assumed as stitches of a knitted fabric portion arranged on an outer side of the sweater, and the remaining stitches of the set up portions are assumed as stitches of a knitted fabric portion arranged on an inner side of the sweater. The number of knitting courses of a total of four knitted fabric portions, that is, two knitted fabric portions of the front body rib portion and two knitted fabric portions of the back body rib portion, is increased by also using the needle beds on the upper stage in addition to the needle beds on the lower stage.

PRIOR ART DOCUMENT**PATENT DOCUMENT**

[0004]

[0005] In the knitting method of Patent Document 1, a stitch of an appropriate size corresponding to the size of the knitting needle cannot be formed. The knitted fabric portion is to be knitted in a full gauge state (state in which there is no empty needle between the adjacent stitches of the knitted fabric portion) in order to form the stitch of an appropriate size, but all knitted fabric portions of the portion of the multilayered structure are knitted in a half gauge state (state in which there is one or more empty needles between the adjacent stitches of the knitted fabric portion) in Patent Document 1. The knitted fabric portion is knitted in the half gauge state in Patent Document 1 because if the knitted fabric portion is held in the full gauge state on the front and back needle beds of the lower stage, the knitted fabric portion held on the front and back needle beds of the upper stage becomes a hindrance and the knitted fabric portion in the full gauge state cannot be knitted, and thus an empty needle for receiving the knitted fabric portion that becomes a hindrance in knitting needs to be ensured. Therefore, a knitting method of a knitted fabric having a multilayered structure capable of knitting in the full gauge state in which the stitches of an appropriate size can be formed is desired at least for the outer knitted fabric portion that can be seen from the outside, however, such a knitting method has not been presently proposed.

SUMMARY OF THE INVENTION

[0006] The present invention has been made in view of the above circumstances, and an object of the present invention is to provide a knitting method of a knitted fabric having a multilayered structure capable of knitting an outer knitted fabric portion in a full gauge state when knitting a knitted fabric having a multilayered structure including an outer knitted fabric portion and an inner knitted fabric portion.

[0007] A knitting method of a knitted fabric having a multilayered structure of the present invention is a knitting method of a knitted fabric having a multilayered structure including an outer knitted fabric portion knitted to a tubular shape, and an inner knitted fabric portion knitted inside the tubular outer knitted fabric portion and joined to the outer knitted fabric portion in a seamless manner using a four-bed flat knitting machine including two pairs of front and back needle beds arranged one above the other. The knitting method of the knitted fabric having the multilayered structure of the present invention has characteristics in repeating the following steps when increasing the number of knitting courses of the outer knitted fabric portion from a standard arrangement in which the outer knitted fabric portion is held in a full gauge state on a lower front needle bed and a lower back needle bed, and the inner knitted fabric portion is held in a half gauge state on at least one of an upper front needle bed and an upper back needle bed, and assuming a side on which the outer

knitted fabric portion to increase the number of knitting courses is held is a reference side, and a side facing the reference side is an opposing side.

[0008]

(Step α) A step of transferring some stitches of the outer knitted fabric portion held on the lower needle bed on the reference side to the upper needle bed on the opposing side.

(Step β) A step of transferring some stitches of the outer knitted fabric portion held on the lower needle bed on the opposing side to the upper needle bed on the opposing side using knitting needles of the lower needle bed on the reference side, which became empty needles in the step α .

(Step γ) A step of returning the stitches transferred in the step α to the knitting needles of the lower needle bed on the reference side, on which the stitches were originally held before the transfer.

(Step δ) A step of transferring all stitches of the inner knitted fabric portion from the reference side to the knitting needles of the lower needle bed on the opposing side, which became empty needles in the step β . The transfer of the stitches of the inner knitted fabric portion may be carried out all at once or may be carried out over a plurality of times.

(Step ϵ) A step of increasing the number of knitting courses of the outer knitted fabric portion in a state of being held on the lower needle bed on the reference side through the step δ when plain knitting the outer knitted fabric portion. When rib knitting the outer knitted fabric portion, the stitches of the outer knitted fabric portion are allocated to the lower needle bed on the reference side and the upper needle bed on the opposing side after the step δ and the number of knitting courses of the outer knitted fabric portion is increased to transfer the stitches knitted with the upper needle bed on the opposing side to the lower needle bed on the reference side.

(Step ξ) A step of transferring the stitches of the inner knitted fabric portion on the lower needle bed on the opposing side to the upper needle bed on the reference side.

(Step η) A step of transferring some stitches of the outer knitted fabric portion knitted in the step ϵ to the upper needle bed on the opposing side.

(Step θ) A step of returning the stitches transferred in the step β to the knitting needles of the lower needle bed on the opposing side, on which the stitches were originally held before the transfer, using the knitting needles of the lower needle bed on the reference side, which became empty needles in the step η .

(Step ι) A step of returning the stitches transferred in the step η to the knitting needles of the lower needle bed on the reference side, on which the stitches were originally held before the transfer.

[0009] The timing of increasing the number of knitting courses of the inner knitted fabric portion may be appropriately selected. The inner knitted fabric portion held on the upper needle bed may become a hindrance when knitting the outer knitted fabric portion held on the lower needle bed in the full gage state, but the outer knitted fabric portion does not become a hindrance when knitting the inner knitted fabric portion. Thus, the number of knitting courses of the inner knitted fabric portion can be increased at an arbitrary timing before completing the knitted fabric. According to such a viewpoint, the number of knitting courses of the outer knitted fabric portion and the inner knitted fabric portion may be the same, or may be differed. If the number of knitting courses of the outer knitted fabric portion and the inner knitted fabric portion is the same, for example, knitting efficiency is satisfactory if the inner knitted fabric portion is knitted with the knitting of the outer knitted fabric portion in the step ϵ (S5), as shown in a first embodiment to be described later.

[0010] In accordance with one aspect of the knitting method of the knitted fabric having the multilayered structure of the present invention, the following steps are preferably repeated to newly create an inner knitted fabric portion from a state in which the outer knitted fabric portions are held in the full gauge state to form a standard arrangement. A side of creating the inner knitted fabric portion is assumed as the reference side and a side opposing the reference side is assumed as the opposing side. For example, when forming the standard arrangement in which the inner knitted fabric portion is held on the front needle bed, the front needle bed is the reference side and the back needle bed is the opposing side.

[0011]

(Step κ) A step of transferring a stitch of the outer knitted fabric portion held on the lower needle bed on the opposing side to the upper needle bed on the reference side.

(Step λ) A step of carrying out split knitting on a target stitch held on the lower needle bed on the reference side at a position facing the knitting needle, on which the stitch transferred in the step κ is originally held. In this case, the target stitch is transferred to the knitting needle, which became an empty needle in the step κ , while a split stitch pulled out from the target stitch is formed on the knitting needle, on which the target stitch was held, as a stitch of the outer knitted fabric portion.

(Step μ) A step of transferring the target stitch transferred to the lower needle bed on the opposing side with the split knitting in the step λ to the upper needle bed on the reference side as the stitch of the inner knitted fabric portion.

(Step ν) A step of returning the stitch transferred in the step κ to the lower needle bed on the opposing side, on which the stitch was originally held before the transfer.

[0012] In accordance with one aspect of the knitting method of the knitted fabric having the multilayered structure of the present invention, when forming the inner knitted fabric portion on any one of the front and back upper needle beds, that is, when knitting the knitted fabric having a three layered structure, the inner knitted fabric portion is preferably knitted with one or more empty needles provided between the adjacent stitches.

[0013] In accordance with one aspect of the knitting method of the knitted fabric having the multilayered structure of the present invention, when forming the inner knitted fabric portion on both the front and back upper needle beds, that is, when knitting the knitted fabric having a four layered structure, the inner knitted fabric portion is preferably knitted with three or more empty needles provided between the adjacent stitches.

[0014] According to the knitting method of the knitted fabric of the present invention, a knitted fabric including a tubular outer knitted fabric portion knitted in a full gauge state, and an inner knitted fabric portion, knitted in a half gauge state, arranged on an inner side of the outer knitted fabric portion and joined to the outer knitted fabric portion in a seamless manner can be knitted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1(A) is a schematic view of a sweater knitted in a first embodiment and Fig. 1(B) is a cross-sectional view taken along line B-B of Fig. 1(A);

Fig. 2 is a knitting step diagram showing a first half of the knitting steps related to a knitting method of a knitted fabric having a multilayered structure shown in the first embodiment;

Fig. 3 is a knitting step diagram showing a second half of the knitting steps related to the knitting method of the knitted fabric having the multilayered structure shown in the first embodiment; and

Fig. 4 is a knitting step diagram related to a knitting method of a knitted fabric having a multilayered structure shown in a third embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Embodiments of the present invention will be hereinafter described based on the drawings. The knitting described in the embodiments describes a knitting example using a four-bed flat knitting machine having a lower front needle bed (hereinafter referred to as FD) and a lower back needle bed (hereinafter referred to as BD) extending in a transverse direction and disposed opposite to each other in a cross direction, as well as an upper front needle bed (hereinafter referred to as FU) and an upper back needle bed (hereinafter referred to as BU) being arranged on the upper side of the FD and the BD and having a large number of knitting needles arranged

in a row at the same pitch as the lower needle beds. In such a flat knitting machine, stitches can be transferred between the front and back needle beds, and the BD, BU arranged in the flat knitting machine can be racked in the transverse direction. In the existing commercially available flat knitting machine, stitches can be transferred between the FD and the BD, between the FD and the BU, and between the BD and the FU, but cannot be transferred between the FU and the BU.

<First embodiment>

[0017] In the first embodiment, a sweater 10 in which a tubular inner knitted fabric portion 2 is arranged on an inner side of a tubular body (outer knitted fabric portion 1) is knitted, as shown in Fig. 1. The outer knitted fabric portion 1 is divided into a front knitted fabric portion (hereinafter referred to as outer front portion 1F) knitted with the front needle bed, and a back knitted fabric portion (hereinafter referred to as outer back portion 1B) knitted with the back needle bed. The inner knitted fabric portion 2 is also divided into a front knitted fabric portion (hereinafter referred to as inner front portion 2F) knitted with the front needle bed, and a back knitted fabric portion (hereinafter referred to as inner back portion 2B) knitted with the back needle bed. The knitting of the portion having such four layers will be described below based on the knitting step diagrams of Figs. 2 and 3.

[0018] In the knitting step diagrams of Figs. 2 and 3, only part of the needle beds is shown for the sake of convenience of explanation, and furthermore, the number of stitches of the knitted fabric is smaller than the number used in the actual knitting and the racking operation of the BD and the BU is omitted. In the figures, "alphabet + number" indicates the number of the knitting step, and the capital letter alphabet indicates the position in a knitting width direction of the knitting needle. The circle in the figure indicates the stitch held on the knitting needle, the black circle indicates the stitch newly formed in the relevant knitting step, the arrow indicates the direction of transfer, and the thick line indicates the operation carried out in each knitting step. Moreover, in the figures, a V mark is denoted on the stitch of the outer front portion 1F, a reverse V mark is denoted on the stitch of the outer back portion 1B, an x mark is denoted on the stitch of the inner front portion 2F, and a + mark is denoted on the stitch of the inner back portion 2B.

[0019] In S1, there is shown a state (standard arrangement) in which the outer front portion 1F is held on the knitting needles B to Q of the FD, the outer back portion 1B is held on the knitting needles B to Q of the BD, the inner front portion 2F is held on the knitting needles D, H, L, P of the FU, and the inner back portion 2B is held on the knitting needles C, G, K, O of the BU. Such a held state of the stitches corresponds to the portion where the two-layer knitted fabric portion starts to be divided into the four-layer knitted fabric portion in Fig. 1(B), where the outer front portion 1F and the inner front portion 2F

are connected through the knitting yarn, and the outer back portion 1B and the inner back portion 2B are connected through a knitting yarn. The adjacent stitches in the inner front portion 2F (inner back portion 2B) are spaced apart by four needles from each other to ensure a space for transferring the stitches of the other portions 2B (2F), 1F, 1B.

[0020] From the state of S1, the number of knitting courses of the outer front portion 1F and the inner front portion 2F is increased by the knitting of S2 to S8, and the number of knitting courses of the outer back portion 1B and the inner back portion 2B is increased by the knitting of S9 to S15. The side on which the outer knitted fabric portion to increase the number of knitting courses is held is the reference side and the side opposite thereto is the opposing side, where enclosed reference numerals 8, 9 are respectively denoted thereon and shown in the figures. In Fig. 2, FD, FU are needle beds on the reference side 8, and BD, BU are needle beds on the opposing side 9.

[0021] In S2, some stitches of the outer front portion 1F held on the knitting needles E, I, M, Q of the FD are transferred to the knitting needles F, J, N, R on the opposing BU so that the knitting needles E, I, M, Q of the FD become empty needles (step α).

[0022] In S3, the stitches configuring part of the outer back portion 1B held on the knitting needles C, G, K, O of the BD are respectively transferred to the knitting needles A, E, I, M of the FD, and further transferred to the knitting needles A, E, I, M of the BU (step β). The stitches held on the BD are once transferred to the FD and then transferred to the BU because the stitches cannot be directly transferred from the BD to the BU.

[0023] In S4, the stitches of the inner front portion 2F held on the knitting needles D, H, L, P of the FU are transferred to the knitting needles C, G, K, O of the BD, which became empty needles due to the transfer of S3 (step δ), and the stitches of the outer front portion 1F transferred in S2 are transferred from the knitting needles F, J, N, R of the BU to the empty needles of the FD (knitting needles E, I, M, Q of FD) (step γ). At the time point S4 is finished, the stitches of the outer front portion 1F transferred from the FD to the BU in S2 are again returned to the same knitting needles of the FD, so that the stitches of the outer front portion 1F are held on the FD in the same state as in S1.

[0024] In S5, the inner front portion 2F held on the knitting needles C, G, K, O of the BD is knitted for one course while moving a yarn feeder to one side in the knitting width direction of the knitted fabric, and then the outer front portion 1F held on the knitting needles Q to B of the FD is knitted for one course while moving the yarn feeder to the other side (step ϵ).

[0025] The timing to knit the inner front portion 2F is not limited to the step ϵ , and may be arbitrarily selected. For example, the timing may be between S1 and S2, or may be between S8 of Fig. 2 and S9 of Fig. 3, to be described later. Furthermore, the number of knitting

courses of the inner front portion 2F may not be increased. In such a case, the inner front portion 2F is knitted by one course every time the outer front portion 1F is knitted for a plurality of courses, so that the number of knitting courses of the outer front portion 1F becomes greater than the number of knitting courses of the inner front portion 2F and irregularities can be formed on the knitted fabric.

[0026] In S6, the stitches of the outer front portion 1F held on the knitting needles C, G, K, O of the FD of the stitches of the outer front portion 1F knitted in S5 are transferred to the knitting needles B, F, J, N of the BU (step η) and the stitches of the inner front portion 2F knitted with the knitting needles C, G, K, O of the BD in S5 are returned to the knitting needles D, H, L, P of the FU (step ξ).

[0027] In S7, the stitches of the outer back portion 1B transferred to the knitting needles A, E, I, M of the BU in S3 are returned to the knitting needles C, G, K, O of the BD through the knitting needles C, G, K, O of the FD, which became empty needles due to the transfer of S6 (step θ). At the time point S7 is finished, a state in which only the stitches of the outer back portion 1B are held on the BD (state same as S1) is obtained.

[0028] In S8, the stitches of the outer front portion 1F transferred to the knitting needles B, F, J, N of the BU in S6 are returned to the knitting needles C, G, K, O of the

FD (step ι). Looking at the held state of each portion 1F, 1B, 2F, 2B at the time point S8 is finished, the standard arrangement exactly the same as S1 is obtained.

[0029] According to S2 to S8, the outer front portion 1F and the inner front portion 2F are knitted by one course each. Thereafter, the outer back portion 1B and the inner back portion 2B are knitted by one course each according to the knitting steps shown in and after 59 of Fig. 3. The basic idea of the knitting steps is similar to S2 to S8, and hence will be briefly described. However, BD, BU are the needle beds on the reference side 8 and FD, FU are the needle beds on the opposing side 9 in Fig. 3 since the needle bed on which the outer knitted fabric portion (outer back portion 1B) to increase the number of knitting courses is held is the back needle bed.

[0030] As shown in S9 of Fig. 3, the stitches of the outer back portion 1B held on the knitting needles B, F, J, N of the BD are first transferred to the knitting needles A, E, I, M of the FU (step α). Then, the stitches of the outer front portion 1F held on the knitting needles C, G, K, O of the FD are transferred to the knitting needles B, F, J, N of the FU through the BD (S10: step β). The stitches of the outer back portion 1B transferred to the knitting needles A, E, I, M of the FU in S9 are returned to the knitting needles B, F, J, N of the BD, on which the stitches were originally held (step γ), and the stitches of the inner back portion 2B held on the knitting needles C, G, K, O of the BU are transferred to the knitting needles C, G, K, O of the FD (S11: step δ).

[0031] When S11 is finished, the arrangement of the

outer back portion 1B and the inner back portion 2B for increasing the knitting courses of the outer back portion 1B and the inner back portion 2B is put in place, so that the number of knitting courses of the outer back portion 1B and the inner back portion 2B is increased in S12. Specifically, the inner back portion 2B transferred to the knitting needles C, G, K, O of the FD is knitted for one course, and the outer back portion 1B held on the knitting needles Q to B of the BD is knitted for one course (step ε).

[0032] Thereafter, the stitches of the inner back portion 2B knitted on the knitting needles C, G, K, O of the FD in S12 are transferred to the knitting needles C, G, K, O of the BU (step ζ), and the stitches of the outer back portion 1B held on the knitting needles B, F, J, N of the BD are transferred to the knitting needles A, E, I, M of the FU (S13: step η). The stitches of the outer front portion 1F temporarily placed on the knitting needles B, F, J, N of the FU in S10 are then returned to the knitting needles C, G, K, O of the FD, on which the stitches were originally held, through the BD (S14: step θ). Lastly, the stitches of the outer back portion 1B temporarily placed on the knitting needles A, E, I, M of the FU in S13 are returned to the knitting needles B, F, J, N of the BD, on which the stitches were originally held (S15: step t).

[0033] The outer back portion 1B and the inner back portion 2B are knitted by one course each according to S9 to S15. That is, the outer knitted fabric portion 1 and the inner knitted fabric portion 2 of Fig. 1 are knitted by one course through S2 to S15. Looking at the held state of each portion 1F, 1B, 2F, 2B in S15 of Fig. 3, the standard arrangement same as S1 of Fig. 2 is obtained. Therefore, the knitting similar to S2 to S15 is to be repeated in the case of further increasing the number of knitting courses of the outer knitted fabric portion 1 and the inner knitted fabric portion 2. After knitting the inner knitted fabric portion 2 up to the upper end in the wale direction as shown in Fig. 1, the stitches of the inner knitted fabric portion 2 may be overlapped on the stitches of the outer knitted fabric portion 1 and the knitted fabric portions 1, 2 may be joined.

[0034] According to the knitting method of the first embodiment described above, since the outer knitted fabric portion 1 of the sweater 10 of Fig. 1 is knitted in the full gauge state, the stitches of the outer knitted fabric portion 1 may become the size corresponding to the size of the knitting needles arranged in the flat knitting machine to use. On the other hand, the stitches of the inner knitted fabric portion 2 become large as compared to the outer knitted fabric portion 1 since it is knitted in the half gauge state, but cannot be seen from the outer side of the sweater 10.

<Second embodiment>

[0035] The outer knitted fabric portion 1 is knitted with plain stitches in the first embodiment, but it may be rib knitted. In this case, the stitches of the outer front portion 1F (outer back portion 1B) are allocated to the FD and

the BU, and then the number of knitting courses of the outer front portion 1F (outer back portion 1B) may be increased in S5 of Fig. 2 (S12 of Fig. 3).

5 <Third embodiment>

[0036] In a third embodiment, a knitting method of having the held state of the stitches shown in S1 of Fig. 1 is explained referring to Fig. 4 on the basis of the technical concept similar to the first embodiment. Fig. 4 is seen in a similar manner to that of Figs. 2 and 3.

[0037] T1 shows a state in which the outer front portion 1F and the outer back portion 1B knitted in the full gauge state are held on the FD and the BD. In the subsequent knitting, the stitches of the inner front portion 2F are formed from the state of T1. The side of the front needle bed where the FU scheduled to form the inner front portion 2F is present is the reference side 8, and the side of the back needle bed is the opposing side 9.

[0038] First, in T2, the stitch of the outer back portion 1B held on the knitting needle D of the BD is transferred to the knitting needle E of the FU (step κ). Then, in T3, a new stitch is formed following the stitches held on the knitting needles B, D of the FD in T2, and split knitting is carried out on the stitch (target stitch) held on the knitting needle D of the FD in T2 to set up the inner front portion 2F (step λ).

[0039] The split knitting is a knitting operation of transferring a stitch (target stitch) held on one of the front and back needle beds to the knitting needle of the other opposing needle bed, and meanwhile, forming a new stitch (split stitch) on the knitting needle of the one needle bed so as to be pulled out from the target stitch, for example, as described in Japanese Unexamined Patent Publication No. 4-73245. The split stitch is held on the knitting needle, on which the target stitch was originally held. That is, the stitch of the inner front portion 2F held on the knitting needle D of the BD in T3 is the stitch of the outer front portion 1F held on the knitting needle D of the FD in T1, T2. Furthermore, the stitch of the outer front portion 1F held on the knitting needle D of the FD in T3 is the split stitch pulled out from the stitch formed on the knitting needle D of the BD. Through such split knitting, the inner front portion 2F can be set up with the outer front portion 1F and the inner front portion 2F in a connected state.

[0040] In T4, the stitch held on the knitting needle D of the BD, which became the stitch of the inner front portion 2F through T3, is transferred to the knitting needle D of the FU (step μ), and in the following T5, the stitch of the outer back portion 1B transferred to the knitting needle E of the FU in T2 is returned to the knitting needle D of the BD, on which it was originally held before the transfer (step ν).

[0041] Thereafter, as illustrated in T6, the knitting similar to T2 to T5 is carried out at the position four needles from the inner front portion 2F formed in T4 to complete the inner front portion 2B (see T7). Although not shown, the inner back portion can also be formed based on the

technical concept similar to T2 to T5.

[0042] According to the knitting steps of the third embodiment described above, the tubular inner knitted fabric portion can be set up while being joined in a seamless manner to the outer knitted fabric portion knitted in the full gauge state.

<Fourth embodiment>

[0043] According to the knitting method of the knitted fabric having a multilayered structure of the present invention, the knitted fabric having a three layered structure can be knitted, differing from the first to third embodiments. For example, the knitting similar to S2 to S8 of Fig. 2 may be carried out when knitting a knitted fabric having a three layered structure including only the inner front portion with respect to the outer knitted fabric portion, and the knitting similar to S9 to S15 of Fig. 3 may be carried out when knitting a knitted fabric having a three layered structure including only the inner back portion with respect to the outer knitted fabric portion. However, in the case of the knitted fabric having a three layered structure, the adjacent stitches in the inner knitted fabric portion merely need to be spaced apart from each other by two or more needles. This is because the space for transfer worth one needle is sufficient between the stitches in the inner knitted fabric portion.

<Fifth embodiment>

[0044] In the third embodiment, the knitting method of the knitted fabric having a multilayered structure of the present invention is used to achieve the standard arrangement. However, the standard arrangement can be achieved without using the knitting method of the knitted fabric having the multilayered structure of the present invention. For example, while moving the yarn feeder in the right direction in the plane of drawing from the state of T1 of Fig. 4, the stitches of the outer front portion 1F are formed on the knitting needles B, C, E to G, I to K, M to O, Q of the FD, and the stitches of the inner front portion 2F including pickup stitches are formed on the knitting needles D, H, L, P of the FU. However, it is necessary to use the knitting method of the present invention as shown in the first embodiment after setting up the inner knitted fabric portion.

[0045] The embodiments of the present invention are not limited to the embodiments described above, and may be appropriately changed within a scope not deviating from the gist of the present invention. For example, the inner knitted fabric portion is joined to one part of the outer knitted fabric portion in the embodiment, but the inner knitted fabric portion may be formed over the entire outer knitted fabric portion. Furthermore, the knitted fabric including a pattern such as a rib jacquard and a tubular jacquard, or a ladder backing jacquard knitted using the front and back knitting needles so that the front and back stitches are integrated without separating so as to appear

as a single layer are also encompassed in the knitted fabric having a multilayered structure of the present invention.

Claims

1. A knitting method of a knitted fabric having a multilayered structure for knitting a knitted fabric having a multilayered structure including an outer knitted fabric portion (1F, 1B) knitted to a tubular shape, and an inner knitted fabric portion (2F, 2B) knitted inside the tubular outer knitted fabric portion (1F, 1B) and joined to the outer knitted fabric portion (1F, 1B) in a seamless manner using a four-bed flat knitting machine including two pairs of front and back needle beds arranged one above the other; the method **characterized by** comprising:

when increasing the number of knitting courses of the outer knitted fabric portion (1F (1B)) from a standard arrangement in which the outer knitted fabric portion (1F, 1B) is held in a full gauge state on a lower front needle bed (FD) and a lower back needle bed (BD), and the inner knitted fabric portion (2F, 2B) is held in a half gauge state on at least one of an upper front needle bed (FU) and an upper back needle bed (BU), and

assuming a side on which the outer knitted fabric portion (1F (1B)) to increase the number of knitting courses is held is a reference side (8), and a side facing the reference side (8) is an opposing side (9),

a step α of transferring some stitches of the outer knitted fabric portion (1F (1B)) held on the lower needle bed (FD (BD)) on the reference side (8) to the upper needle bed (BU (FU)) on the opposing side (9);

a step β of transferring some stitches of the outer knitted fabric portion (1B (1F)) held on the lower needle bed (BD (FD)) on the opposing side (9) to the upper needle bed (BU (FU)) on the opposing side (9) using knitting needles of the lower needle bed (FD (BD)) on the reference side (8), which became empty needles in the step α ; a step γ of returning the stitches transferred in the step α to the knitting needles of the lower needle bed (BD (FD)) on the reference side (8), on which the stitches were originally held before the transfer;

a step δ of transferring stitches of the inner knitted fabric portion (2F (2B)) from the reference side (8) to the knitting needles of the lower needle bed (BD (FD)) on the opposing side (9), which became empty needles in the step β ;

a step ϵ of increasing the number of knitting courses of the outer knitted fabric portion (1F

(1B)) in a state of being held on the lower needle bed (FD (BD)) on the reference side (8) through the step δ when plain knitting the outer knitted fabric portion (1F (1B)), or of allocating the stitches of the outer knitted fabric portion (1F (1B)) to the lower needle bed (FD (BD)) on the reference side (8) and the upper needle bed (BU (FU)) on the opposing side (9) after the step δ and increasing the number of knitting courses of the outer knitted fabric portion (1F (1B)) to transfer the stitches knitted with the upper needle bed (BU (FU)) on the opposing side (9) to the lower needle bed (FD (BD)) on the reference side (8) when rib knitting the outer knitted fabric portion (1F (1B));

a step ξ of transferring the stitches of the inner knitted fabric portion (2F (2B)) on the lower needle bed (BD (FD)) on the opposing side (9) to the upper needle bed (FU (BU)) on the reference side (8);

a step η of transferring some stitches of the outer knitted fabric portion (1F (1B)) knitted in the step ϵ to the upper needle bed (BU (FU)) on the opposing side (9);

a step θ of returning the stitches transferred in the step β to the knitting needles of the lower needle bed (BD (FD)) on the opposing side (9), on which the stitches were originally held before the transfer, using the knitting needles of the lower needle bed (FD (BD)) on the reference side (8), which became empty needles in the step η ; and

a step ι of returning the stitches transferred in the step η to the knitting needles of the lower needle bed (FD (BD)) on the reference side (8), on which the stitches were originally held before the transfer.

2. The knitting method of the knitted fabric having the multilayered structure according to claim 1, **characterized in that**

when newly creating an inner knitted fabric portion (2F) from a state in which the outer knitted fabric portion (1F, 1B) is held in the full gauge state to form the standard arrangement, and

assuming a side of creating the inner knitted fabric portion (2F) is the reference side (8) and a side opposing the reference side (8) is the opposing side (9), a step κ of transferring a stitch of the outer knitted fabric portion (1B) held on the lower needle bed (BD) on the opposing side (9) to the upper needle bed (FU) on the reference side (8),

a step λ of carrying out split knitting on a target stitch held on the lower needle bed (FD) on the reference side (8) at a position facing the knitting needle, on which the stitch transferred in the step κ is originally held, to transfer the target stitch to the knitting needle,

which became an empty needle in the step κ , and form a split stitch pulled out from the target stitch on the knitting needle, on which the target stitch was held, as a stitch of the outer knitted fabric portion (1F);

a step μ of transferring the target stitch transferred to the lower needle bed BD on the opposing side (9) with the split knitting in the step λ to the upper needle bed (FU) on the reference side (8) as the stitch of the inner knitted fabric portion (2F); and

a step ν of returning the stitch transferred in the step κ to the lower needle bed BD on the opposing side (9), on which the stitch has been originally held before the transfer, are repeated.

3. The knitting method of the knitted fabric having the multilayered structure according to claim 1 or 2, **characterized in that** when forming the inner knitted fabric portion (2F (2B)) on any one of the front and back upper needle beds (FU (BU)), the inner knitted fabric portion (2F (2B)) is knitted with one or more empty needles provided between the adjacent stitches.
4. The knitting method of the knitted fabric having the multilayered structure according to claim 1 or 2, **characterized in that** when forming the inner knitted fabric portion (2F, 2B) on both the front and back upper needle beds (FU, BU), the inner knitted fabric portion (2F, 2B) is knitted with three or more empty needles provided between the adjacent stitches.

Fig. 1

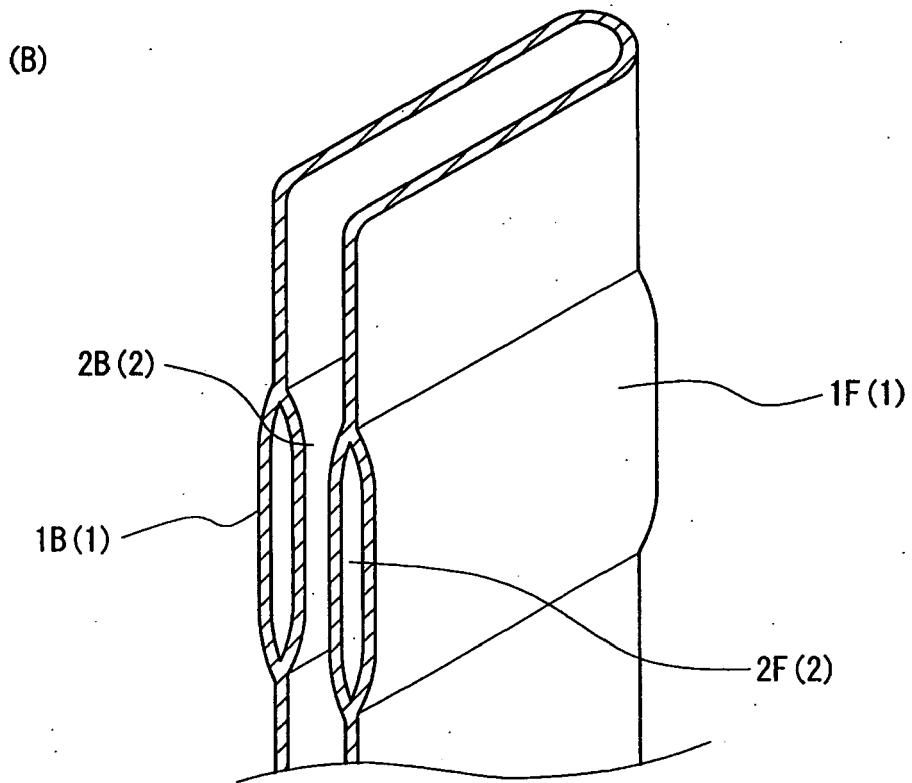
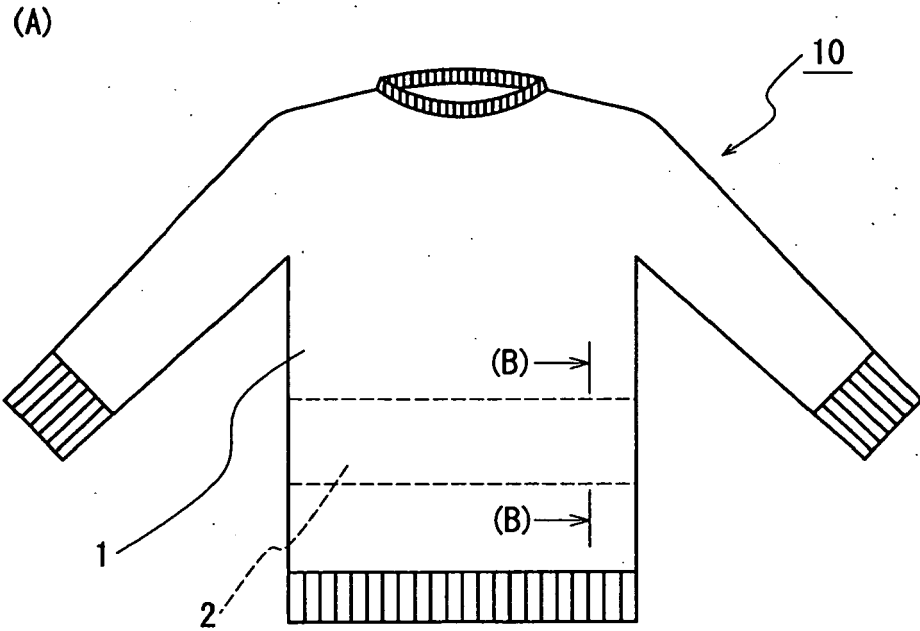


Fig. 2

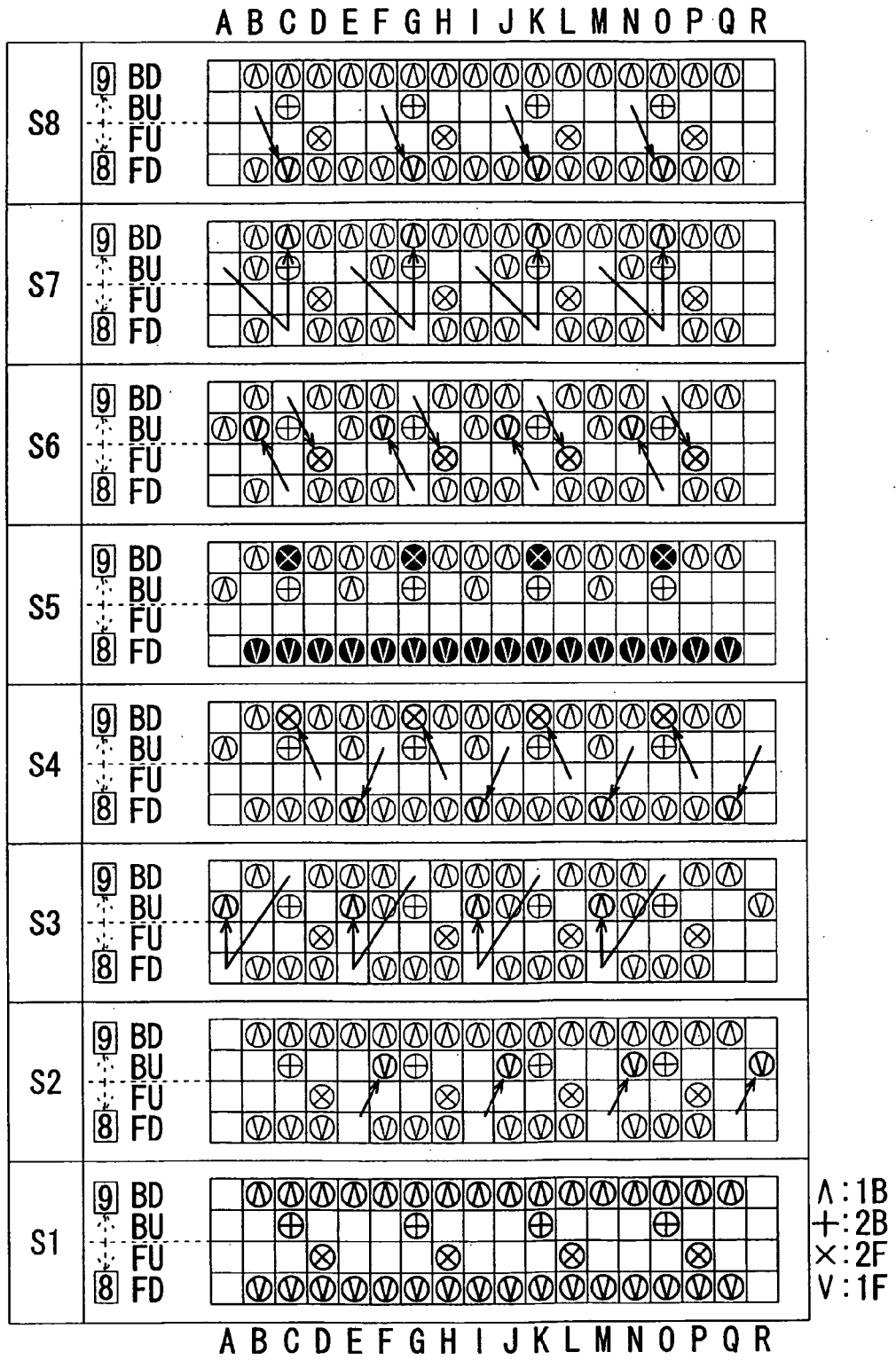


Fig. 3

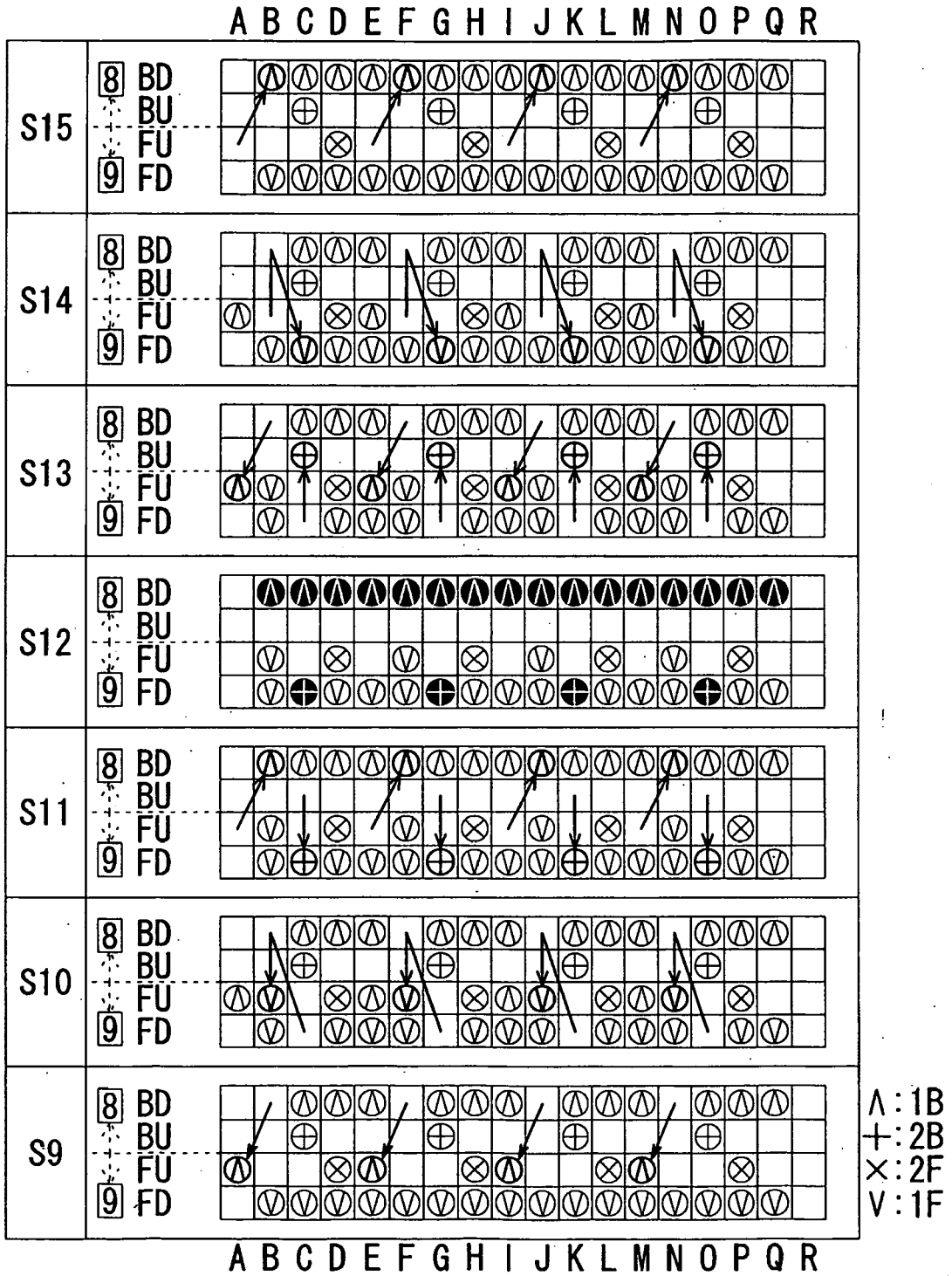
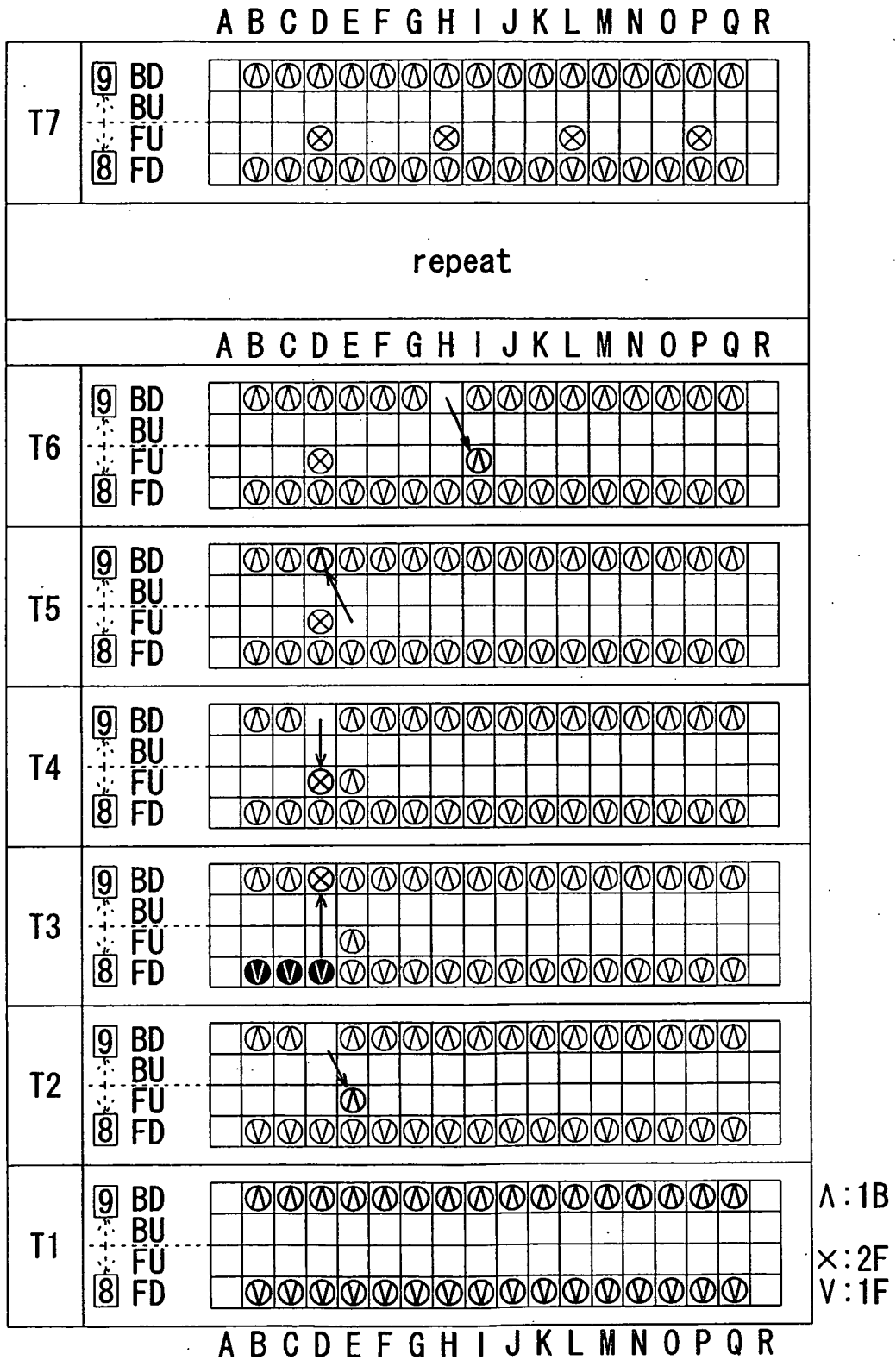


Fig. 4



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2514489 B [0004]
- JP 4073245 A [0039]