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

(11) EP 2 492 382 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.08.2012 Bulletin 2012/35

(51) Int Cl.:
D04B 7/26 *(2006.01)* ***D04B 37/02*** *(2006.01)*
D04B 1/12 *(2006.01)*

(21) Application number: **12001290.1**

(22) Date of filing: **27.02.2012**

(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

(30) Priority: **28.02.2011 JP 2011042034**

(71) Applicant: **Shima Seiki Manufacturing., Ltd.**
Wakayama-shi
Wakayama 641-0003 (JP)

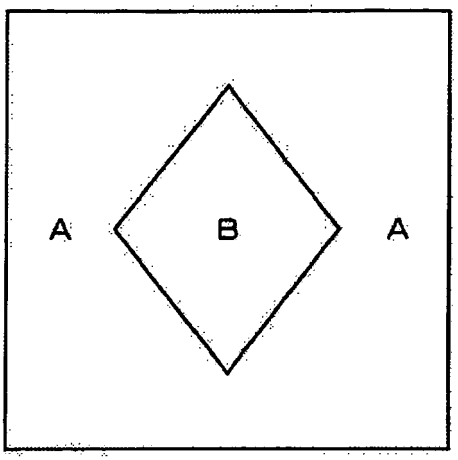
(72) Inventors:
- **Manabu, Yui**
  Wakayama-shi
  Wakayama, 641-0003 (JP)
- **Naka, Hideki**
  Wakayama-shi
  Wakayama, 641-0003 (JP)
- **Shimasaki, Yoshinori**
  Wakayama-shi
  Wakayama, 641-0003 (JP)

(74) Representative: **Schmidbauer, Andreas Konrad**
Wagner & Geyer
Patent- und Rechtsanwälte
Gewürzmühlstrasse 5
80538 München (DE)

(54) Knit design apparatus

(57) In a course in which a cam system (C1) on the front side in the travelling direction of a carriage (34) of a flat knitting machine (32) knits a first knitted fabric (A) on the rear side in the travelling direction with respect to the boundary between intarsia pattern portions and a cam system (C2) on the rear side in the travelling direction knits a second knitted fabric (B) on the front side in the travelling direction with respect to the boundary, a knit design apparatus (2) detects from knitting data a stitch that is at an end of the first knitted fabric (A) and that projects further to the front side in the travelling direction than a course knitted immediately before, as a first stitch (K3-2, 45). In a case where the first stitch (K3-2, 45) is detected, a second stitch (46) in the second knitted fabric (B) positioned one course below the first stitch (K3-2, 45) is replaced by a miss stitch.

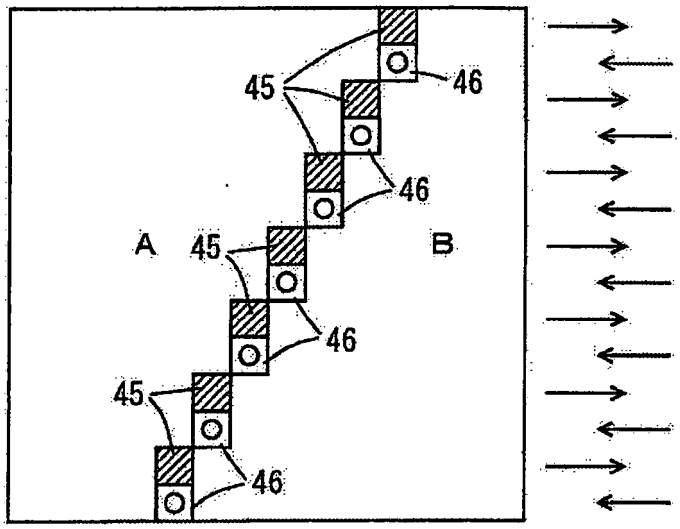
FIG. 2



EP 2 492 382 A2

(Cont. next page)

FIG. 8



Description

Technical Field

[0001] The present invention relates to knit design apparatuses for designing intarsia patterns.

Background Art

[0002] Knitted fabrics with an intarsia pattern are knitted by flat knitting machines such that different knitting yarns, typically, knitting yarns with different colors are used for respective pattern portions. Intarsia patterns and knitting thereof are well known. Here, the inventors have focused attention on the fact that, at the boundary between intarsia pattern portions, knitting may be performed while allowing a needle to catch and use a knitting yarn in an adjacent pattern portion. If a knitting yarn extending from a non-operating yarn feeder for an adjacent pattern portion to a knitted fabric is used in knitting of a pattern portion other than that adjacent pattern portion, both of a knitting yarn that should be used and the caught knitting yarn are used for knitting, and the pattern becomes unclear.

[0003] FIG. 11 illustrates this sort of problem. It is assumed that a carriage (not shown) in a flat knitting machine is travelling from the left to the right in the drawing, and is provided with a pair of cam systems arranged on the front and rear sides in the travelling direction of the carriage. Here, it is assumed that a cam system on the front side in the travelling direction of the carriage uses a knitting yarn 41 to knit a left pattern portion in FIG. 11, and a cam system on the rear side in the travelling direction uses a knitting yarn 42 to knit a right pattern portion in FIG. 11. A needle 40 at the boundary between the pattern portions was allocated to the right pattern portion in the previous course, and is allocated to the left pattern portion in the current course. Since the needle 40 formed the last stitch of the right pattern portion in the previous course, the knitting yarn 42 from a yarn feeder B extends from the needle 40 to the right pattern portion. If the needle 40 uses the yarn 41 from a yarn feeder A to form a stitch in this state, the knitting yarn 42 may be caught by the needle 40 and pulled into the stitch.

[0004] FIG. 12 shows the relationship between the needle 40 and the knitting yarns 41 and 42 at that time. A stitch 44 formed in the previous course is positioned at the tip of the knitting yarn 42, and retained on the needle 40. The knitting yarn 42 is pressed by the knitting yarn 41 toward the needle 40, and thus is easily caught. FIG. 13 shows the stitch arrangement of the knitting yarns 41 and 42 when the knitting yarn 42 has been caught by the needle 40. A stitch denoted by a symbol K3-2 is a stitch formed by the needle 40, and is a double stitch formed with the knitting yarns 41 and 42, which makes the color of the stitch unclear. Here, the boxes on the left in FIG. 13 show needle operations each with indication of knit K or tuck T, and the horizontal lines of the boxes show courses of a carriage. Furthermore, the arrows attached outside the boxes indicate travelling directions of a carriage.

[0005] Even in the above-described state, knitting may be performed in a proper manner without catching the knitting yarn 42, and FIG. 14 shows the stitch arrangement when knitting has been performed in a proper manner. According to inventors' experience, a knitting yarn is more likely to be caught as the gauge of the knitting machine is smaller and the knitting speed is higher, and as the precision in the yarn feeder stop position is lower. As a related art document, Japanese Patent No. 4163130 has disclosed a technique in which one course of a stitch row is knitted as two separate courses of a carriage in intarsia knitting. If this technique is used to knit the right stitches in FIG 11 in two separate courses, so that the needle 40 does not retain the knitting yarn 42 in the state of FIG. 11, the problem of yarn catching does not occur. However, this processing lowers the knitting efficiency.

[0006] Related Art: Japanese Patent No. 4163130

Summary of the Invention

Problem to be Solved by the Invention

[0007] It is an object of the present invention to prevent a knitting yarn from being caught at the boundary between intarsia pattern portions, without lowering the knitting efficiency.

Means for Solving Problem

[0008] The present invention is directed to a knit design apparatus for creating knitting data of an intarsia pattern that is to be knitted by a flat knitting machine, characterized by: detection means for, in a course in which a cam system on a front side in a travelling direction of a carriage of the flat knitting machine knits a first knitted fabric on a rear side in the travelling direction of the carriage with respect to a boundary between intarsia pattern portions and a cam system on the rear side in the travelling direction of the carriage knits a second knitted fabric on the front side in the travelling direction of the carriage with respect to the boundary, detecting from knitting data a stitch that is at an end of the first knitted fabric and that projects further to the front side in the travelling direction of the carriage than a course knitted immediately before, as a first stitch; and knitting data processing means for, in a case where the first stitch is detected, modifying the knitting data such that a second stitch in the second knitted fabric positioned one course below the first stitch is replaced by a miss stitch, the first stitch is replaced by a miss stitch, or the first stitch is replaced by a stitch in the second knitted fabric.

[0009] It is a knitting yarn extending from a yarn feeder to the second stitch that is caught when forming the first stitch. If the second stitch is changed to a miss stitch, there is no knitting yarn that is to be caught, and no knit-

ting yarn is caught when forming the first stitch. If the first stitch is changed to a miss stitch, the travelling direction of the carriage is opposite the direction of the first stitch at a stitch one course above the first stitch, and, thus, the problem of yarn catching does not occur. The reason for this is that one of conditions for causing yarn catching is that a cam system on the front side in the travelling direction of the carriage knits a first knitted fabric on the rear side in the travelling direction and a cam system on the rear side in the travelling direction knits a second knitted fabric on the front side in the travelling direction, and this condition is not met. As in the case where the first stitch is replaced by a miss stitch, it is possible to prevent a knitting yarn from being caught also in a case where the first stitch is replaced by a stitch in the second knitted fabric. Also in this case, the condition for causing yarn catching is not met in which a cam system on the front side in the travelling direction of the carriage knits a first knitted fabric on the rear side in the travelling direction and a cam system on the rear side in the travelling direction knits a second knitted fabric on the front side in the travelling direction. As described above, according to the present invention, no knitting yarn is caught when forming the first stitch, and the knitting speed does not have to be lowered.

[0010] It is preferable that, in a case where the first stitch is detected, the second stitch is replaced by a miss stitch. Accordingly, the effect can be achieved that, even if a plurality of first stitches are continuously arranged in the course direction, so that a plurality of second stitches are also continuously arranged in the course direction, the length of tuck connecting intarsia pattern portions does not increase. Furthermore, it is preferable that, in a case where the detection means detects from the knitting data that a yarn feeder of the flat knitting machine for feeding a knitting yarn of the second knitted fabric is at a position for feeding a knitting yarn to a next stitch in the travelling direction of the carriage with respect to the first stitch, the knitting data processing means modifies the knitting data. Accordingly, whether or not a yarn may be caught can be more reliably judged. In this specification, regarding stitches, the course refers to a row of stitches in the knitted fabric width direction (carriage travelling direction). Furthermore, regarding a carriage, the course refers to travel of the carriage in the knitting width direction. The wale refers to a stitch direction perpendicular to the course, and a direction in the knitting height.

Brief Description of the Drawings

[0011]

FIG. 1 is a block diagram of a knit design apparatus according to an embodiment.
FIG. 2 is a diagram showing an example of an intarsia knitted fabric to be designed.
FIG. 3 is a block diagram showing a main portion of a flat knitting machine used for knitting.
FIG. 4 is a view schematically showing needles and yarns when knitting the boundary between pattern portions according to the embodiment.
FIG. 5 is a view schematically showing a state in which a yarn has been retained on a needle at the boundary between pattern portions according to the embodiment.
FIG. 6 is a diagram showing the stitch arrangement near the boundary between pattern portions according to the embodiment.
FIG. 7 is a diagram showing an example of design data for intarsia knitted fabric according to the embodiment.
FIG. 8 is a diagram showing data according to an example in which the design data in FIG. 7 is modified so as not to mistakenly use a yarn in knitting.
FIG. 9 is a diagram showing data according to a modified example of the design data in FIG. 7.
FIG. 10 is a diagram showing data according to a second modified example of the design data in FIG. 7.
FIG. 11 is a view schematically showing needles and yarns when knitting the boundary between pattern portions according to a conventional example.
FIG. 12 is a view schematically showing a state in which a yarn has been retained on a needle at the boundary between pattern portions according to the conventional example.
FIG. 13 is a diagram showing the stitch arrangement when a yarn has been mistakenly used in knitting according to the conventional example.
FIG. 14 is a diagram showing a good stitch arrangement according to the conventional example.

Mode for Carrying out the Invention

[0012] Hereinafter, an optimal embodiment for carrying out the present invention will be described. The scope of the invention should be construed in view of the description of the claims together with the possibility of change according to well known techniques.

Embodiment

[0013] FIGS. 1 to 10 show an embodiment and its modified examples. FIG. 1 shows the structure of a knit design apparatus 2, wherein 4 denotes a bus, 6 denotes a color monitor, 8 denotes a printer, and 10 denotes a pen that is used for inputting a position, a range, and the like on an image. Instead of the pen 10, a joystick, a track ball, a mouse or the like may be used. Also, 12 denotes a keyboard, 14 denotes a network interface, and 16 denotes an external memory drive.

[0014] The knit design apparatus 2 is configured with a computer that is provided with a CPU 20 and a memory 24. An input processor 22, a knitting data processor 26, a detector 28 are realized by the CPU 20, the memory 24, programs (not shown), and the like. The input proc-

essor 22 processes the design of a knitted fabric with an intarsia pattern input with the pen 10, the keyboard 12, or the like, converts the obtained design into color codes or the like, and stores the converted data in the memory 24. The knitting data processor 26 converts the design data in the memory 24 into knitting data that can be used for knitting by a flat knitting machine. Here, the knitting data is configured with data including stitch arrangement, stitch type, stitch connection, carriage control data, yarn feeder control data, and the like. The yarn feeder control data is, for example, data indicating which yarn feeder is to be conveyed by a carriage from which position and to be released at which position. The detector 28 detects a location in a knitted fabric with an intarsia pattern where a knitting yarn may be caught, and, if such a location is detected, the knitting data processor 26 modifies the knitting data so as not to catch a knitting yarn.

[0015] FIG. 2 schematically shows a knitted fabric 30 with an intarsia pattern. The knitted fabric 30 is configured with two types of pattern portions, namely A and B. If the knitted fabric 30 is knitted by a flat knitting machine 32 shown in FIG. 3, for example, when performing knitting from the left to the right in FIG. 2, a cam system C 1 on the front side in the travelling direction of a carriage 34 is allocated to the pattern portion A from among a plurality of cam systems 35 arranged on the carriage 34, and a cam system C2 on the rear side is allocated to the pattern portion B. Furthermore, when performing knitting from the right to the left in FIG. 2, the cam system C2 on the front side in the travelling direction of the carriage 34 is allocated to the pattern portion A, and the cam system C1 on the rear side is allocated to the pattern portion B. Here, 36 in FIG. 3 denotes a pair of front and back needle beds, and 38 denotes a carrier rail that guides a plurality of yarn feeders (not shown). The yarn feeders are, for example, conveyed by the carriage 34 via a convey pin (not shown).

[0016] When travelling from the left to the right in FIG. 2, the carriage 34 may pass through a location where the pattern portion A projects toward the pattern portion B. At that time, the cam system C1 on the front side in the travelling direction of the carriage 34 knits the pattern portion A on the rear side in the travelling direction prior to the pattern portion B. When forming a stitch at the location where the pattern portion A projects toward the pattern portion B in this state, a knitting yarn is likely to be caught. Furthermore, also when the carriage is travelling from the right to the left in FIG 2, a knitting yarn is likely to be caught at a location where the pattern portion A projects toward the pattern portion B.

[0017] FIGS. 4 and 5 show processing for preventing a knitting yarn from being caught according to an embodiment. Hereinafter, the same reference numerals as those in the conventional example in FIGS. 11 to 13 refer to the same constituent elements. When the needle 40 forms a stitch using the knitting yarn 41, there is the problem that the knitting yarn 42 may be caught. In the embodiment, the needle 40 of interest performs a miss at a position one course before, and forms no stitch. Thus, the position of the yarn feeder B is shifted to the right from the needle 40 by the distance for one needle as shown in FIG. 4, and, as a result, the knitting yarn 42 is not caught when the needle 40 performs knitting using the knitting yarn 41. FIG. 5 shows the state of the needle 40 at that time. The knitting yarn 42 is away from the needle 40 and pressed by the knitting yarn 41 toward the needle 40, and, thus, it is hardly pulled into the needle 40.

[0018] FIG. 6 shows a location having the problem that a knitting yarn may be caught, and the arrangement of knitting yarns in the vicinity thereof. The symbol K3-2 in FIG. 6 refers to a stitch in the third course from the bottom and the second wale from the left, and corresponds to a first stitch in the claims. A position one course below the stitch K3-2 is a miss stitch where no stitch is formed. The position of the miss stitch one course below corresponds to a position of a second stitch in the claims. Furthermore, in the claims, a knitted fabric knitted with the knitting yarn 41 corresponds to a first knitted fabric, and a knitted fabric knitted with the knitting yarn 42 corresponds to a second knitted fabric. Moreover, a travelling direction of a carriage is indicated by the arrows in the left half in FIG. 6, K refers to knit, and T refers to tuck. Furthermore, in the boxes on the left in FIG. 6, stitches on the left side of vertical double lines are formed by the cam system C1, and stitches on the right side are formed by the cam system C2.

[0019] In the first course in FIG. 6, for example, three stitches of the second knitted fabric are formed. In the next course, the cam system C1 performs a miss at the position for the second stitch, and the cam system C2 forms a tuck stitch T1 using the knitting yarn 41. Then, the carriage is reversed to travel from the left to the right in the drawing, the cam system C1 forms the stitch K3-2 and the like, and the following cam system C2 overlays a tuck stitch T2 on this stitch. In the last course, four stitches and a tuck stitch T3 are formed. The tuck stitches T1 to T3 link the first knitted fabric and the second knitted fabric. A location where a knitting yarn may be caught is at the stitch K3-2, but a miss is performed at the position directly therebelow. Accordingly, when forming the stitch K3-2, the yarn feeder B is at a position in the right side of a needle for forming the stitch K3-2, and, thus, no knitting yarn is caught.

[0020] FIG. 7 shows an example of the design of an intarsia pattern. Stitches 45 (belonging to the pattern portion A) at the boundary between the pattern portions A and B are stitches where a knitting yarn may be caught. Here, the travelling direction of the carriage is indicated by arrows, the stitches 45 belong to the pattern portion A, the pattern portion A projects toward the pattern portion B at the stitches 45, and, at that time, the carriage is travelling from the pattern portion A to the pattern portion B and causes a cam system on the front side in the travelling direction of the carriage to knit the pattern portion A and a cam system on the rear side in the travelling direction to knit the pattern portion B. If these conditions

are met, a knitting yarn is caught as in FIG. 11.

[0021] FIG. 8 shows modification of knitting data according to an example. The arrows indicate travelling directions of the carriage, and this applies to the following as well. Stitches (stitches belonging to the pattern portion B) directly below the stitches 45 are changed to miss stitches 46. Accordingly, no knitting yarn is caught.

[0022] FIG. 9 shows a modified example in which the stitches having the problem that a knitting yarn may be caught are changed to miss stitches 46. At a stitch one course above the stitch that has been changed to a miss stitch, the travelling direction of the carriage is opposite the stitch direction, and, thus, no knitting yarn is caught.

[0023] FIG. 10 shows a second modified example in which the stitches 45 having the problem that a knitting yarn may be caught are changed to stitches in the pattern portion B. Then, although the pattern portion A projects toward the pattern portion B at stitches directly above the stitches 45, when forming these stitches, the travelling direction of the carriage is opposite the stitch direction as in FIG. 9, and, thus, no knitting yarn is caught.

[0024] The example in FIG 8 and the modified example in FIG 9 are different from each other in the easiness in performing a tuck to connect pattern portions of an intarsia pattern if a plurality of miss stitches 46 are continuously arranged in the course direction. According to the example in FIG. 8, it is sufficient to perform a tuck from a stitch in the pattern portion A on the lower left of the miss stitch 46 to a stitch in the pattern portion B below the miss stitch 46, and the length of tuck does not increase even if miss stitches 46 are continuously arranged in the course direction. According to the modified example in FIG. 9, a tuck is performed from a stitch in the pattern portion A on the left of the miss stitch 46 to a stitch in the pattern portion B on the upper right of the miss stitch 46. Thus, the length of tuck increases if miss stitches 46 are continuously arranged in the course direction. According to the second modified example in FIG. 10, a tuck is performed from a stitch on the left of the stitch 45, whose belonging has been changed to the pattern portion B because a yarn is easily caught, to a stitch in the pattern portion B on the upper right of the stitch 45. Thus, the length of tuck increases if a plurality of stitches 45 are continuously arranged in the course direction.

[0025] As described above, according to the embodiment, a knitting yarn in an adjacent pattern portion can be prevented from being caught and used in knitting at the boundary between intarsia pattern portions, without lowering the knitting speed and without having to precisely control a yarn feeder stop position. In particular, if the gauge of the knitting machine is small, a knitting yarn in an adjacent pattern portion is easily caught at the boundary between intarsia pattern portions, and, thus, the effect is significant. Furthermore, the knit design apparatus can automatically modify knitting data as appropriate.

Claims

1. A knit design apparatus (2) for creating knitting data of an intarsia pattern that is to be knitted by a flat knitting machine (32), **characterized by**:

   detection means (28) for,
   in a course in which a cam system (C1) on a front side in a travelling direction of a carriage (34) of the flat knitting machine (32) knits a first knitted fabric (A) on a rear side in the travelling direction of the carriage (34) with respect to a boundary between intarsia pattern portions and a cam system (C2) on the rear side in the travelling direction of the carriage (34) knits a second knitted fabric (B) on the front side in the travelling direction of the carriage (34) with respect to the boundary,
   detecting from knitting data a stitch that is at an end of the first knitted fabric (A) and that projects further to the front side in the travelling direction of the carriage (34) than a course knitted immediately before, as a first stitch (K3-2, 45); and
   knitting data processing means (26) for, in a case where the first stitch (K3-2, 45) is detected, modifying the knitting data such that
   a second stitch (46) in the second knitted fabric (B) positioned one course below the first stitch (K3-2, 45) is replaced by a miss stitch,
   the first stitch (K3-2, 45) is replaced by a miss stitch, or
   the first stitch (K3-2, 45) is replaced by a stitch in the second knitted fabric (B).

2. The knit design apparatus (2) according to claim 1, **characterized in that**: in a case where the first stitch (K3-2, 45) is detected, the second stitch (46) is replaced by a miss stitch.

3. The knit design apparatus (2) according to claim 1 or 2, **characterized in that**: in a case where the detection means (28) detects from the knitting data that a yarn feeder of the flat knitting machine (32) for feeding a knitting yarn (42) of the second knitted fabric (B) is at a position for feeding a knitting yarn to a next stitch in the travelling direction of the carriage (34) with respect to the first stitch (K3-2, 45), the knitting data processing means (26) modifies the knitting data.

FIG. 1

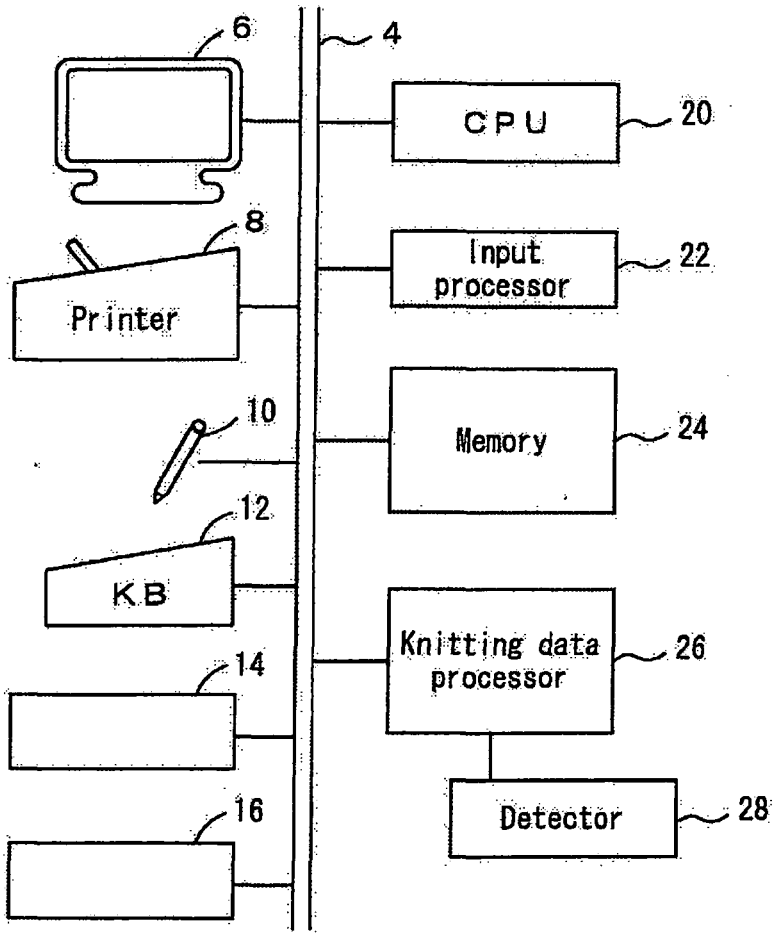
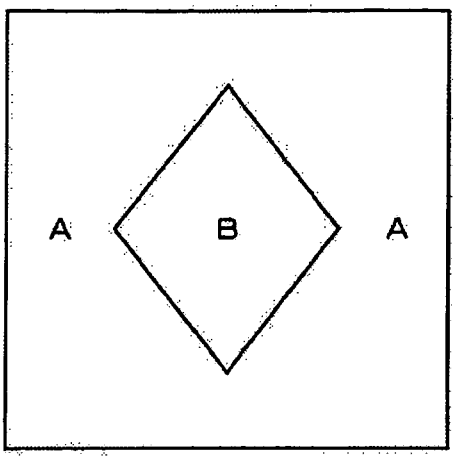
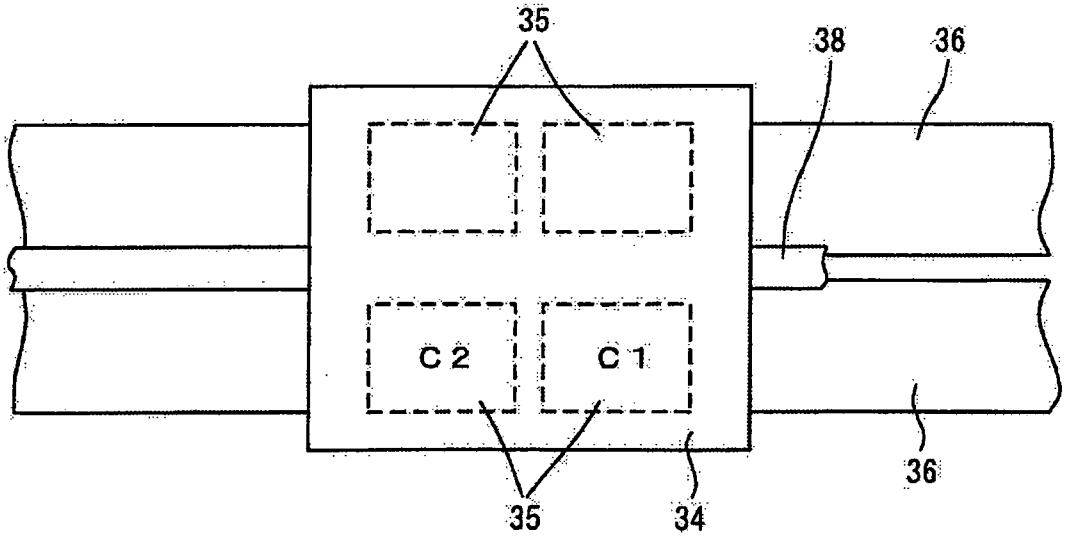

6
4
CPU
20
8
Printer
Input processor
22
10
Memory
24
12
KB
Knitting data processor
26
14
Detector
28
16
2

FIG. 2



30

FIG. 3



32

FIG. 4

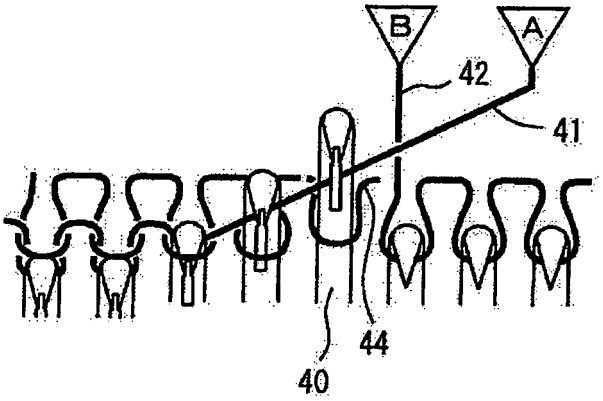


FIG. 5

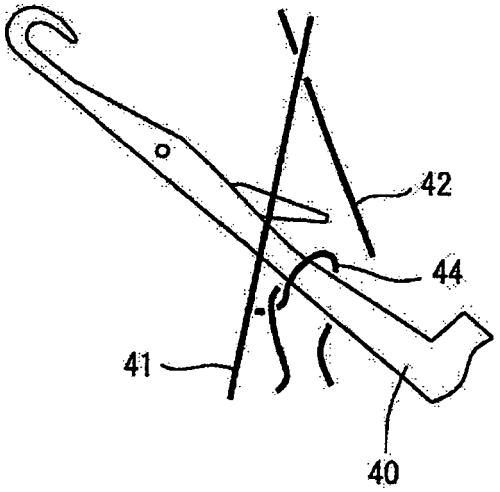


FIG. 6

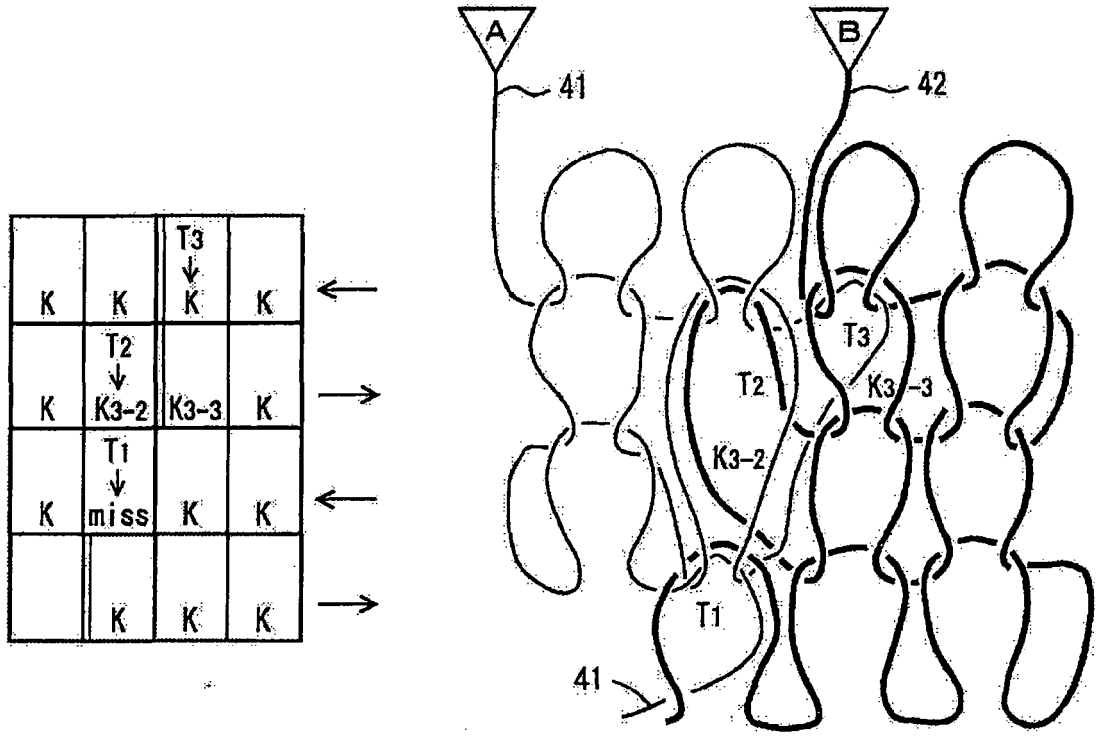
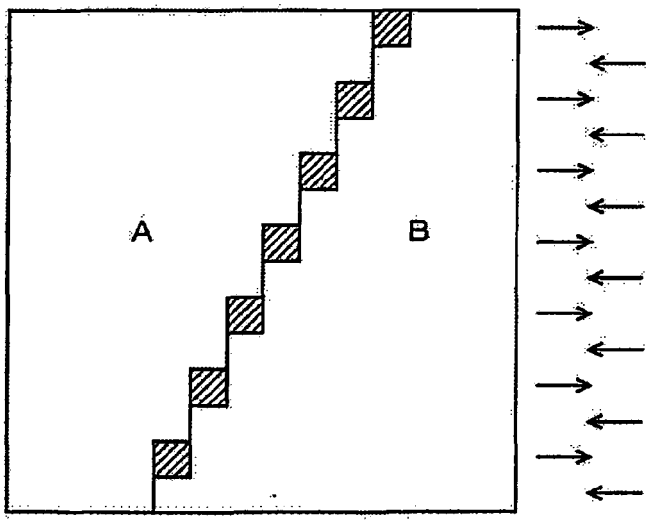


FIG. 7



~45 : Stitch where knitting yarn may be caught

FIG. 8

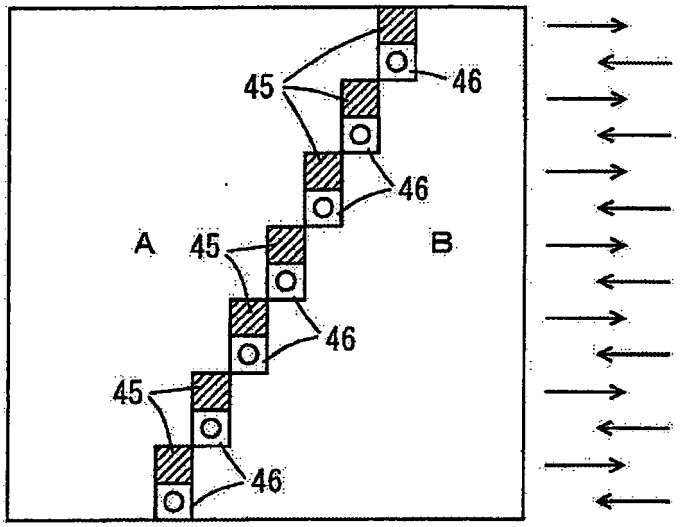


FIG. 9

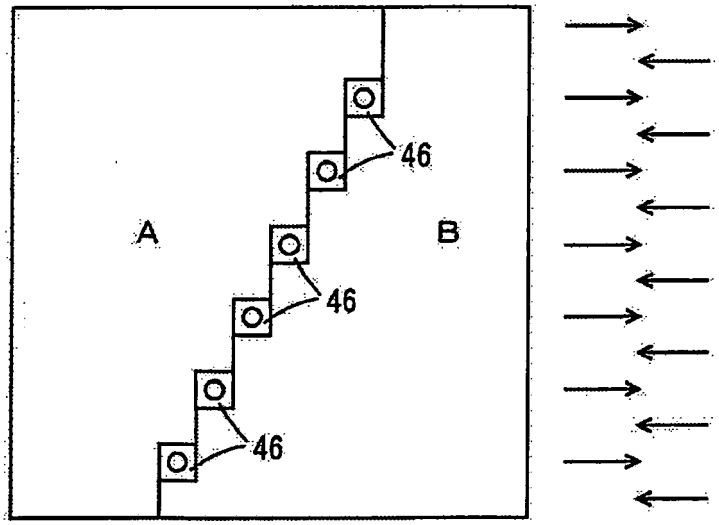


FIG. 10

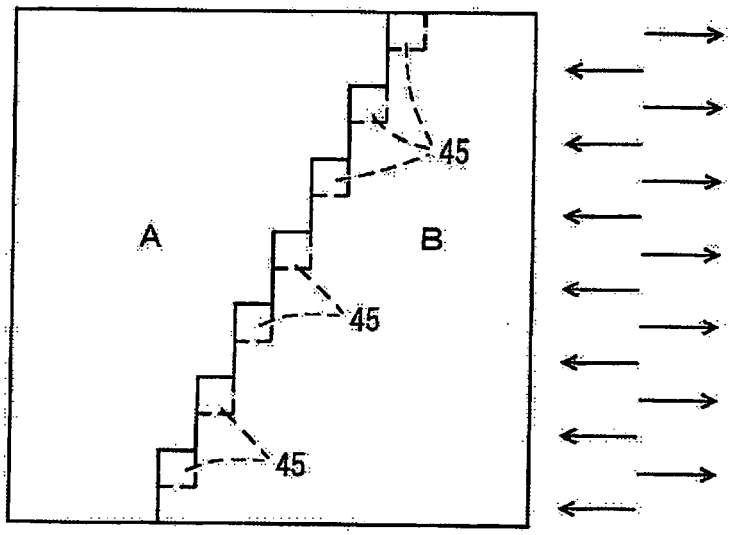
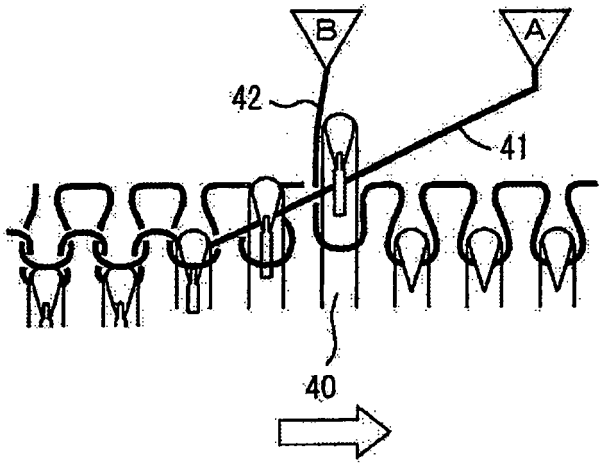
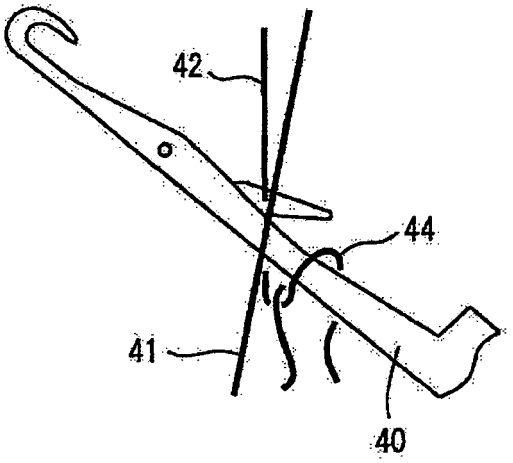


FIG. 11



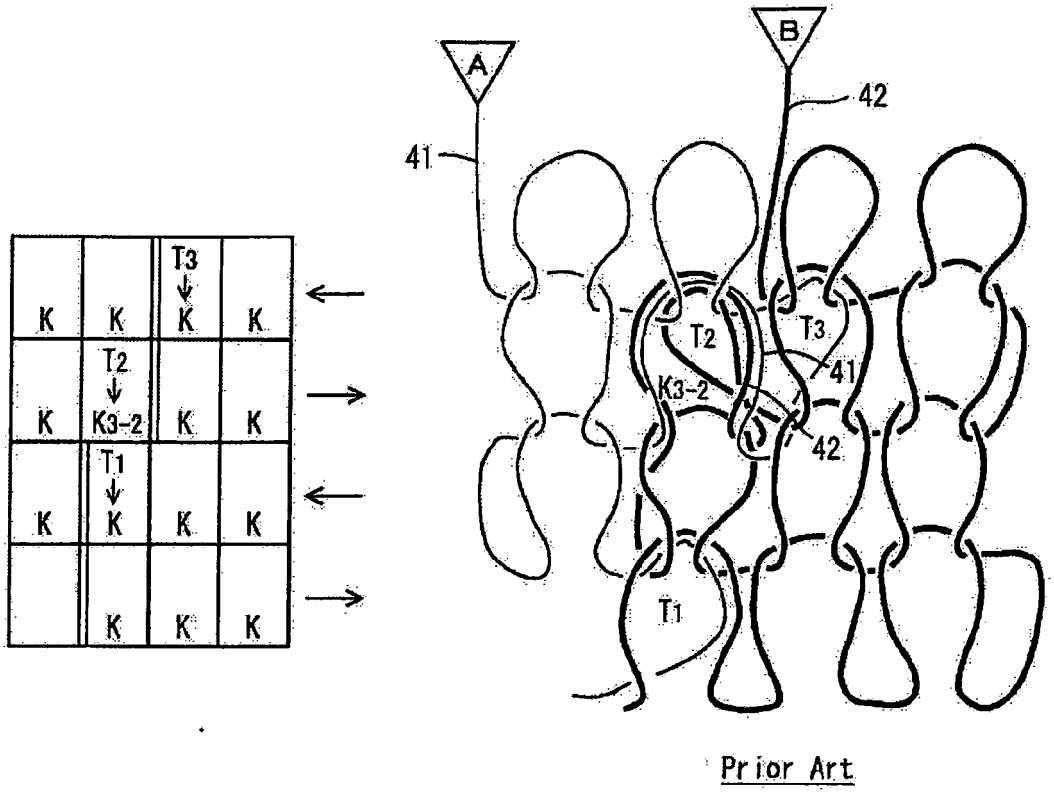
Prior Art

FIG. 12



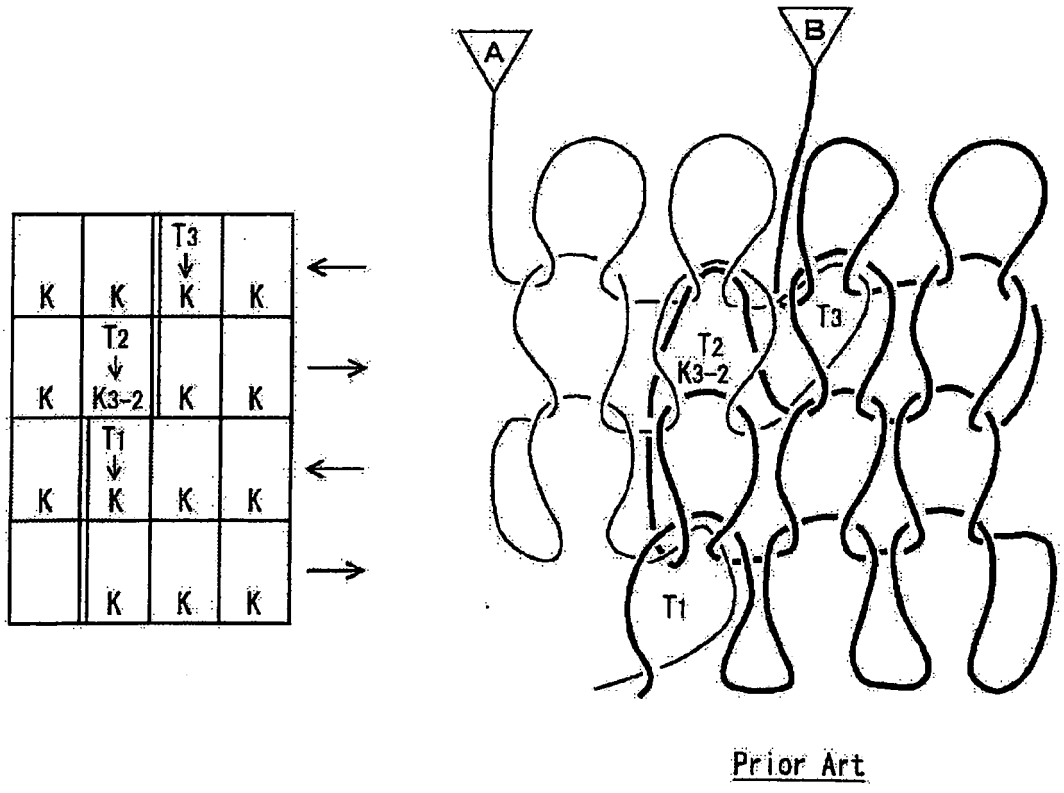
Prior Art

FIG. 13



Prior Art

FIG. 14



Prior Art

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 4163130 B **[0005] [0006]**