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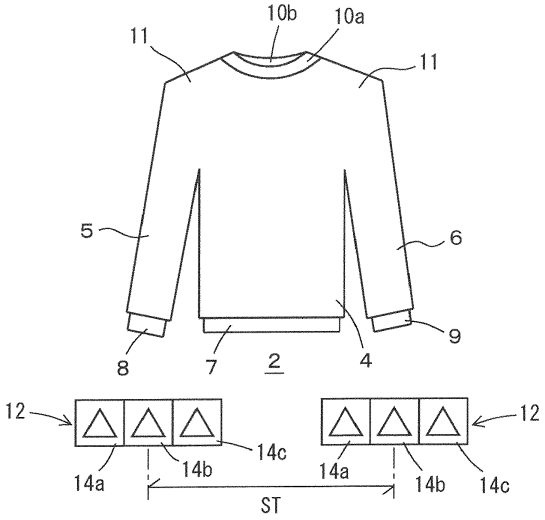
(54) A METHOD FOR KNITTING KNITWEAR AND AN ALLOCATION DEVICE FOR ALLOCATING KNITTING DATA TO CAM SYSTEMS OF A FLAT KNITTING MACHINE

(57) Parts of knitwear (2) comprising plural tubular parts (4, 5, 6) are knitted in parallel on needle beds of a flat knitting machine (20). For courses of the carriage (12, 16, 22) without stitch transfer between the needle beds (21), the knitting of a forward part in the travel direction of the carriage (12, 16, 22) in the course is allocated to a cam system (14a, 14b, 14c) of the carriage (12, 16, 22) at a forward position in the travel direction of the carriage (12, 16, 22) in the course. For courses of the carriage (12, 16, 22) with stitch transfer between the needle beds (21), the knitting of all of the parts to be knitted in the course is allocated to one or plural cam systems (14a, 14b, 14c) of the carriage (12, 16, 22). The carriage strokes are shortened and thereby, the knitting time for knitwear (2) is shortened.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a method for knitting knitwear on a flat knitting machine and an allocation device for allocating knitting data.

Background Art

[0002] Knitwear, such as pullovers and trousers, has been knitted tubularly. For example, Patent Document 1 (Japanese Patent 4233409) discloses a knitting method of a pullover comprising left and right sleeves and a central body, knitting the three tubes from the hem parts to the collar parts and then joining the sleeves to the body.

[0003] Flat knitting machines usable for knitting such knitwear have at least a pair of front and back needle beds and a carriage running over the needle beds. The carriage operates the needles in the needle beds by means of cam systems. The carriage is provided with plural cam systems, those dedicated to knitting and those dedicated to stitch transfer, or plural cam systems for both knitting and stitch transfer. Further, yarn feeders running on rails over the carriage feed knitting yarns to the needles.

[0004] According to Patent Document 1, one cam system is allocated to the right sleeve, the body, and the left sleeve, but separate yarn feeders are allocated to them. The left and right sleeves are increased in knitting width during knitting and then joined to the body. Therefore, they require stitch transfer, and other cam systems than those for knitting are used for stitch transfer.

[0005] The stroke ST of carriage in the above case is shown in Fig. 7. Indicated by 2 is a pullover, 5 the right sleeve, 6 the left sleeve, 7, 8, 9 the ribbed hem parts, 10a the front collar, and 10b the back collar. The sleeves 5 and 6 are joined to the body 4 at the armpits. The carriage 12 has three cam systems 14a, b and c capable of knitting and transferring, for example. In conventional knitting, the central cam system 14b is allocated to the body 4 and both the left and right sleeves 5, 6, for example, and the stroke ST becomes therefore longer.

Prior Art Document.

Patent Document

[0006] Patent Document 1: Japanese Patent 4233409

Summary of the Invention

Problems to be Solved by the Invention

[0007] The object of the present invention is to shorten the carriage stroke and to shorten thereby the knitting time for knitwear such as pullovers.

Means for Solving the Problem

[0008] A method for knitting knitwear according to the invention uses a flat knitting machine having at least a pair of needle beds, comprising a front needle bed and a back needle bed, and a carriage. The carriage is provided with plural cam systems, along the longitudinal direction of the needle beds, operating needles in the needle beds and forming knitted stitches.

[0009] The knitwear to be knitted comprises plural tubular parts, and the plural tubular parts are knitted in parallel on the needle beds.

[0010] For courses of the carriage without stitch transfer between the needle beds, the knitting of a forward part in the travel direction of the carriage in the course is allocated to a cam system of the carriage at a forward position in the travel direction of the carriage in the course, and the knitting of a backward part in the travel direction of the carriage in the course is allocated to a cam system of the carriage at a backward position in the travel direction of the carriage in the course.

[0011] For courses of the carriage with stitch transfer between the needle beds, the knitting of all of the parts to be knitted in the course is allocated to one or plural cam systems of the carriage.

[0012] An allocation device according to the invention allocates knitting data to the cam systems of a flat knitting machine having at least a pair of needle beds, comprising a front needle bed and a back needle bed, and a carriage provided with plural cam systems, along the longitudinal direction of the needle beds, and operating needles in the needle beds and forming knitted stitches, for knitting knitwear comprising plural tubular parts in parallel on the needle beds.

[0013] For courses of the carriage without stitch transfer between the needle beds, the knitting of a forward part in the travel direction of the carriage in the course is allocated to a cam system of the carriage at a forward position in the travel direction of the carriage in the course, and the knitting of a backward part in the travel direction of the carriage in the course is allocated to a cam system of the carriage at a backward position in the travel direction of the carriage in the course.

[0014] For courses of the carriage with stitch transfer between the needle beds, the knitting of all of the parts to be knitted in the course is allocated to one or plural cam systems of the carriage.

[0015] According to the present invention, the knitting time required for knitting the knitwear is shortened, since the strokes of the carriage are shortened. In this specification, the allocation of knitting to the cam systems for courses without stitch transfer or stitch transfers means to allocate the knitting of relevant part or parts to a cam system or cam systems that operate needles in the needle bed and form stitches.

[0016] Preferably, the carriage is provided with two cam systems along the longitudinal direction of the needle beds and the knitwear comprises both sleeves and

the body. For courses of the carriage without stitch transfer between the needle beds, the forward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a forward position in the travel direction of the carriage in the course. The body is allocated to and knitted by one of said two cam systems, and the backward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a backward position in the travel direction of the carriage in the course. In this case, knitwear comprising both sleeves and body can be efficiently knitted on a flat knitting machine having two cam systems along the longitudinal direction of the needle beds.

[0017] Preferably, the carriage is provided with at least three cam systems along the longitudinal direction of the needle beds, and the knitwear comprises both sleeves and the body. For courses of the carriage without stitch transfer between the needle beds, the forward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a forward position in the travel direction of the carriage in the course, the body is allocated to and knitted by the central cam system of the at least three cam systems, and the backward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a backward position in the travel direction of the carriage in the course. In this case, knitwear comprising both sleeves and body can be efficiently knitted on a flat knitting machine having three cam systems along the longitudinal direction of the needle beds.

[0018] In a modification of the invention, for courses of the carriage with stitch transfer between the needle beds, a course of the carriage re-transferring back at least a stitch of the back knitted fabric of the plural tubular parts and transferring at least a stitch of the front knitted fabric of the plural tubular parts simultaneously by one single cam system capable of transfer from the front needle bed to the back needle bed, and knitting at least a stitch on the at least a stitch of the front knitted fabric transferred to the back needle bed, by a cam system capable of knitting is performed. And a further course of the carriage re-transferring back at least a stitch of the front knitted fabric of the plural tubular parts and transferring at least a stitch of the back knitted fabric of the plural tubular parts simultaneously by one single cam system capable of transfer from the back needle bed to the front needle bed, and knitting at least a stitch on the at least a stitch of the back knitted fabric transferred to the front needle bed, by a cam system capable of knitting is performed.

[0019] According to the modification, the re-transfer of stitch and initial stitch transfer are carried out by the same cam system, and therefore, the knitting efficiency is improved. The modification is particularly suitable for rib knitting

[0020] Preferably in the modification, four cam systems capable of transferring and knitting are used.

[0021] For courses of the carriage with stitch transfer between the needle beds, the top cam system in the travel direction of the carriage is allocated to stitch transfer, the second cam system is allocated to knitting of at least a forward part of the plural tubular parts in the travel direction of the carriage, the third cam system is allocated to stitch transfer, and the fourth cam system is allocated to knitting of at least a backward part of the plural tubular parts in the travel direction of the carriage.

[0022] Or alternatively, for courses of the carriage with stitch transfer between the needle beds, the top cam system in the travel direction of the carriage is allocated to knitting of at least a forward part of the plural tubular parts in the travel direction of the carriage, the second cam system is allocated to stitch transfer, and the third cam system is allocated to knitting of at least a backward part of the plural tubular parts in the travel direction of the carriage, and the fourth cam system is allocated to stitch transfer.

[0023] In this case, the allocation of cam systems between stitch transfer and the knitting is reversed between the knitting of the front knitted fabric and the back knitted fabric. Then, the cam system can carry out the re-transfer of stitch and the initial stitch transfer of stitch, and the strokes of the carriage are shortened.

[0024] Preferably in the modification, three cam systems capable of transferring and knitting are used. For courses of the carriage with stitch transfer between the needle beds, when the carriage travels in a first direction, the top cam system in the first direction is allocated to knitting of at least a forward part of the plural tubular parts in the first direction, the second cam system is allocated to stitch transfer, and the third cam system is allocated to knitting of at least a backward part of the plural tubular parts in the first direction.

[0025] And when the carriage travels in a second direction, the top cam system in the second direction is allocated to stitch transfer, the second cam system is allocated to knitting of the plural tubular parts, and the third cam system is allocated to stitch transfer.

[0026] Also in this case, the allocation of cam systems between stitch transfer and the knitting is reversed between the knitting of the front knitted fabric and the back knitted fabric. The first direction and the second direction are reversed, one of them is for knitting the front knitted fabric, and the other is for knitting the back knitted fabric. Also in this case, the cam system can carry out the re-transfer of stitch and the initial stitch transfer of stitch, and the strokes of the carriage are shortened.

[0027] The knitwear to be knitted includes pullovers, trousers, and cardigans which are knitted by knitting plural tubular fabrics in parallel.

Brief Description of the Drawings

[0028]

Fig. 1: A schematic diagram indicating the allocation of cam systems and the carriage stroke when knitting

knitwear according to a first embodiment.

Fig. 2: A schematic diagram indicating the allocation of cam systems and the carriage stroke when knitting the knitwear according to a second embodiment.

Fig. 3: A flowchart indicating the algorithm for the allocation of cam systems according to the first and second embodiments.

Fig. 4: A front view of the flat knitting machine used in the second embodiment.

Fig. 5: A schematic diagram indicating another carriage equivalent to the carriage in Fig. 4.

Fig. 6: A schematic diagram of the carriage suitable for the first embodiment.

Fig. 7: A schematic diagram of the allocation of cam systems and the carriage stroke when knitting the knitwear according to a conventional method.

Fig. 8: A diagram indicating a modification of the knitting method in which the same cam systems are used to perform both the re-transfer of transferred stitches and the transfer of other stitches.

Fig. 9: A schematic diagram of the modification in which four cam systems for both knitting and transfer are used and thereby, the knitting method of Fig. 8 is applied to the embodiment.

Fig. 10: A schematic diagram of the modification in which three cam systems for both knitting and transfer are used and thereby, the knitting method of Fig. 8 is applied to the embodiment.

Features for Carrying out the Invention

[0029] The best and other embodiments for carrying out the invention will be described. Embodiment

[0030] Fig. 1 shows a knitting method according to a first embodiment. In Fig. 1, indicated by 2 is knitwear, here a pullover, but may be trousers comprising a pair of left and right tubular knitted fabrics, and so on. The knitwear 2 comprises plural tubular parts. Indicated by 4 is the body, 5 the right sleeve, and 6 the left sleeve, all of which are tubular. They are knitted from the ribbed hem parts 7, 8, 9, and the sleeves 5, 6 are joined to the body 4 at the armpits. Indicated by 10a is the front collar, 10b the back collar, and 11 the shoulder.

[0031] The knitwear 2 is knitted on a flat knitting machine having a carriage 12 with three cam systems 14a, b, c. In the knitting, the body 4 and the sleeves 5, 6 are knitted in parallel. The cam systems 14a, b, c are capable of both knitting and stitch transfer. For knitting courses without stitch transfer, the cam system 14a is allocated to the right sleeve 5, the cam system 14b to the body 4, and the cam system 14c to the left sleeve 6. In this way, a forward cam system in the travel direction of the carriage 12 is allocated to the forward part in the same direction of travel. The central cam system is also allocated to the central part, and the backward cam system is allocated to the backward part in the travel direction.

[0032] Here, one knitting course means one stroke of the carriage 12. Further, the sleeves 5, 6 and the body 4 are fed with knitting yarns from separate yarn feeders. The carriage 12 is provided with the three cam systems 14a, b, c over both the front and back needle beds. The cam systems over the front needle bed operate the needles in the front needle bed to knit the front knitted fabrics of tubular knitted fabrics. The cam systems over the back needle bed knit the back knitted fabrics of tubular knitted fabrics by operating the needles in the back needle bed. The cam systems over the front needle bed and the cam systems over the back needle bed are symmetrically arranged with respect to the central longitudinal direction between the needle beds. In the following, the allocations of the cam systems over the front needle bed will be described, and the cam systems over the back needle bed will be samely allocated to the parts of the knitwear.

[0033] When knitting a fabric tubularly, the knitting of ribbed hem parts 7, 8, and 9 require stitch transfer. Further stitch transfer is necessary for increasing the knitting width of sleeves 5, 6 during knitting and for joining the sleeves 5, 6 to the body 4. Knitting courses with stitch transfer require separate cam systems for knitting and for stitch transfer. For this reason, the central cam system 14b is allocated to knitting, and the cam systems 14a, c on both sides are allocated to stitch transfer, for example.

[0034] According to the embodiment of Fig. 1, the stroke ST of carriage 12 is shortened for knitting courses without stitch transfer. A knitting course without a stitch transfer is one comprising forming of front knit stitches and front tuck stitches and missing only. One end of the stroke ST is determined to satisfy the condition that a needle selection device, not shown, present between the cam systems 14a and 14b, can select needles for knitting the right sleeve 5. The other end of the stroke is determined to satisfy the condition that a needle selection device, not shown, between the cam systems 14b and 14c can select needles for knitting the left sleeve 6. As a result, the stroke ST of carriage 12 is shortened than that in Fig. 7, and the needed knitting time is reduced, for example, by several percent.

[0035] Fig. 2 shows a second embodiment which uses two cam systems 14a, 14b for both knitting and stitch transfer. As a remark, another carriage provided with two cam systems dedicated to knitting and other two cam systems dedicated to stitch transfer may be used. According to the second embodiment, the cam system 14a is allocated to right sleeve 5 and body 4, and the cam system 1 4b is allocated to the left sleeve 6, for example. The stroke ST of carriage 16 is shown in Fig. 2 and is shortened than that in Fig. 7. Of course, the cam system 14a can be allocated to the right sleeve 5, and the cam system 14b can be allocated to the body 4 and left sleeve 6.

[0036] Fig. 3 shows the allocation algorithm of cam systems according to the first and second embodiments. The process in Fig. 3 can be carried out by a design system that converts the design data of knitwear 2 into knitting data, or by a controller in a flat knitting machine. Further, the process in Fig. 3 can be carried out by a

computer system independent of both the design system and the flat knitting machine.

[0037] Assuming that the knitting data for knitting the knitwear 2 is given in advance, in step S1, the knitting data is retrieved from an appropriate memory. The knitting data specifies, for each knitting course, which yarn feeders are to be moved and with what stroke, and which needles of needle beds 21 are how operated by the carriage 12, 16. However, the allocation of which cam systems 14a, b, c are used for knitting can be changed.

[0038] When a knitting course includes stitch transfer, the knitting (forming stitches) of all parts of the right sleeve 5, the body 4, and the left sleeve 6 is allocated to one cam system, for example (steps S2, S3). However, the knitting may be allocated to plural cam systems. Further, stitch transfer and knitting are carried out by separate cam systems.

[0039] When a knitting course does not include stitch transfer, a forward part in the direction of carriage travel is allocated to the forward cam system in the same direction. The backward part in the direction of carriage travel is allocated to the backward cam system in the same direction (step S4).

[0040] For example, in Fig. 1, assuming that the direction of travel of carriage 12 is from left to right in the diagram, it is most efficient that the left sleeve 6 is allocated to the forward cam system 14c, the body 4 is to the central cam system 14 b, and the right sleeve 5 is to the backward cam system 14a, and, when the travel direction of carriage 12 is reversed, the same allocation is maintained. Namely, it is most efficient that, when allocating the three cam systems 14a, b, c to the three parts 4, 5, 6, the left cam system 14a over the needle beds is allocated to the left part 5, that the central cam system 14b is to the central part 4, and that the right cam system 14c is to the right part 6.

[0041] While less efficient, it is possible that the cam system 14c is allocated to the left sleeve 6 and that the cam system 14a is allocated to the body 4 and the right sleeve 5. Similarly and less efficiently, it is possible that the cam system 14c is allocated to the left sleeve 6 and the body 4 and that the cam system 14a is allocated to the right sleeve 5.

[0042] In Fig. 2, assuming that the direction of travel of carriage 12 is from left to right in the diagram, the left sleeve 6 is allocated to the cam system 14b, and the body 4 and the right sleeve 5 are allocated to the backward cam system 14a, and, when the travel direction of carriage 12 is reversed, the same allocation is maintained. When the cam system 14b is allocated to the left sleeve 6 and the body 4 and when the cam system 14a is allocated to the right sleeve 5, the same knitting efficiency is achieved, and the same allocation concept regarding the cam systems 14a, b is maintained. In summary, the left cam system 14a over the needle beds is allocated to the left part 5, the right cam system 14b is allocated to the right part 6, and either of the left and right cam systems is allocated to the central part 4.

[0043] When knitting knitwear comprises a pair of left and right tubular fabrics, in both cases of Figs. 1 and 2, the forward cam system in the travel direction of carriage 12 is allocated to the forward tubular fabric in the same direction, and the backward cam system is allocated to the backward tubular fabric in the same direction.

[0044] When the processes of steps S2 to S4 are carried out for all knitting courses, and when the allocation of the cam systems is completed for all the courses, the results of allocation for each knitting course are outputted (steps S5, S6) .

[0045] Fig. 4 shows a flat knitting machine 20, provided with an allocation device 32 for allocating the cam systems to the parts of knitwear. The allocation device 32 may be provided in a knitwear design system or may be an independent device.

[0046] The flat knitting machine 20 has, for example, a front needle bed 21 and a back needle bed not shown, and may have further needle beds. Carriage 22 travels back and forth over the needle beds 21 by means of a driver 23. The carriage 22 has, for example, two cam systems 24 dedicated to knitting and other two cam systems 25 dedicated to stitch transfer.

[0047] The carriage 22 is provided with the cam systems symmetrically over the front needle bed 21 and those over the back needle bed, not shown. The cam systems 24 and 25 over the front needle bed knit the front knitted fabric and the cam systems over the back needle bed, not shown, knit the back knitted fabric. The cam systems, over the front and back needle beds, at the same position along the longitudinal direction of needle beds are allocated to the same parts.

[0048] Plural rails 26 are arranged parallel over the needle beds 21, and yarn feeders, not shown, run on the rails and feed knitting yarns to needles in the needle beds 21. Further, the knitting yarns are fed to the yarn feeders from yarn packages, not shown, on a top plate 27, via top tension devices or the like, not shown.

[0049] The allocation device 32 has a CPU 34 and memories 35, 36 and stores the knitting data before the allocation of cam systems 24, 24 in the memory 35. The allocation device allocates either left or right of the cam systems 24, 24 to knitting courses without stitch transfer according to the algorithm in Fig. 3 and stores the resulted allocation in the memory 36. In the case of Fig. 4, the data in the memory 36 is outputted to the controller, not shown, in the flat knitting machine 20. When the allocation device 32 is provided in a design system, the data in the memory 36 is used within the design system, and the knitting data specifying the cam system allocation is outputted.

[0050] The carriage 22 in Fig. 4 is equivalent to the carriages 16 in Figs. 2 and 5. The carriage 16 has dual-use cam systems 14a, b for both stitch transfer and knitting. This is equivalent to having two cam systems 24 dedicated to knitting and two cam systems 25 dedicated to stitch transfer in turn.

[0051] Instead of the carriage 22, the carriage 12 of

Figs. 1 and 6 may be used. The carriage 12 has three cam systems 14a, b, c for both stitch transfer and knitting in total.

[0052] According to the embodiments, the strokes ST of the carriages 12, 16, 22 moving back and force are shortened, and the knitting efficiency of knitwear is improved.

Modification

[0053] Fig. 8 shows a modification concerning the stitch transfer. When knitting knitted fabric that requires stitch transfer, such as tubular rib knitted fabrics, a part of the stitches in the front knitted fabric is transferred to the back needle bed, then the front knitted fabric is further knitted, and the transferred stitches of the front knitted fabric are re-transferred back to the front needle bed. Further, a part of the stitches in the back knitted fabric is transferred to the front needle bed, then the back knitted fabric is further knitted, and the transferred stitches of the back knitted fabric are re-transferred back to the back needle bed. Conventionally, the stitch transfer and the knitting have been performed separately. Therefore, for the above knitting, four cam systems in total are operated for the stitch transfer, and two cam systems are operated for the knitting. When the same cam systems perform the stitch transfer and the knitting simultaneously, the knitting efficiency is improved.

[0054] The course 1) in Fig. 8 shows a state before rib knitting is started where alternate needles in the needle beds are used for stitch formation. In Fig. 8, the white circles indicate the front stitches of the front knitted fabric, the black circles indicate the back stitches of the front knitted fabric, the white triangles indicate the front stitches of the back knitted fabric, and the black triangles indicate the back stitches of the back knitted fabric. The upper needle bed is the back needle bed, and the lower needle bed is the front needle bed. The solid lines between the stitches indicate the knitting yarn. The knitting can be carried out on a flat knitting machine with two needle beds at the front and back, or on a flat knitting machine with a total of four needle beds at the front and back, respectively at the upper and lower.

[0055] In the course 2), the stitches are transferred for the preparation of the rib knitting, and in the course 3), the front knitted fabric is rib knitted in one course. The courses 1) to 3) are the preparation of the modification and can be changed as required.

[0056] In the course 4), the back stitches of the front knitted fabric and the back stitches of the back knitted fabric are transferred to the front needle bed by one single cam system. In other words, the re-transfer back of the back stitches of the front knitted fabric after the rib knitting and the transfer of the back stitches of the back knitted fabric are performed simultaneously by the same cam system. Then, in the course 5), the back knitted fabric is rib knitted in one course.

[0057] In the course 6), the back stitches of the back knitted fabric and the back stitches of the front knitted fabric are transferred to the back needle bed by one cam system. In other words, the back stitches of the back knitted fabric after the rib knitting and the back stitches of the front knitted fabric are transferred by the same cam system. Next, in the course 7), the front knitted fabric is rib knitted in one course. The course 7) is the same to the course 3). Then, the courses 3) to 6) are repeated. Since, in the courses 4) and 6), the re-transfer of stitches after rib knitting and transfer of stitches before rib knitting are performed by the same cam system, and therefore, the knitting efficiency is improved.

[0058] Fig. 9 shows an example of applying the knitting method in Fig. 8 to the embodiments. The ribbed hem parts 7, 8, 9 in the body 4, the right and left sleeves 5 and 6 are knitted by a carriage having four cam systems 144a-d capable of both knitting and transfer. The "front" above the central arrow indicates a rib knitting course for the front knitted fabric, and the "back" indicates a rib knitting course for the back knitted fabric.

[0059] For knitting the front knitted fabric, the top cam system 144a and the third cam system 144c are allocated to stitch transfer, and the transfer here comprises the re-transfer of stitches of the back knitted fabric and the transfer of stitches of the front knitted fabric. The second cam system 144b and the fourth cam Allocating system 144d are allocated to knitting. The second cam system 144b is allocated to the right sleeve 5 and the body 4, and the fourth cam system 144d is allocated to the left sleeve 6.

[0060] For knitting the back knitted fabric, the top (the most forward) cam system 144d and the third cam system 144b are allocated to the re-transfer of the stitches of the front knitted fabric and also the transfer of the stitches of the back knitted fabric. The second cam system 144c and the fourth (the last from the top) cam system 144a are allocated to knitting. The second cam system 144c is allocated to knitting the left sleeve 6, and the fourth cam system 144a is allocated to knitting the right sleeve 5 and the body 4.

[0061] In Fig. 9, the stroke required for the cam system 144b is the stroke ST1, and the stroke required for the cam system 144d is stroke ST2. In total, the stroke of the carriage is reduced. In addition, since one cam system is used for both transfer and re-transfer of stitches, the cam system needed for stitch transfer between cam systems for knitting is one. Therefore, two of the four cam systems can be used for knitting.

[0062] As a remark, the knitting of the body 4 may be allocated to the cam systems 144d, 144c. Further, the top and third cam systems in the direction of travel may be allocated to knitting, and the second and last cam systems may be allocated to stitch transfer. Specifically, the top and second cam systems at the forward in the direction of travel may be allocated to the knitting and transfer of stitches of the parts at the forward position of travel, and the third and fourth cam systems at the back in the direction of travel may be allocated to knitting and transfer of stitches of the parts at the backward position

of travel. In both cases, the allocation of cam systems is reversed between knitting and transfer between the knitting of the front knitted fabric and the knitting of the back knitted fabric.

[0063] In Fig. 10, three cam systems capable of both knitting and transfer are used, and the ribbed hem parts 7, 8, 9 of the body 4, the left and right sleeves 5, 6 are knitted. The symbols in Fig. 10 are the same as those in Fig. 9. For knitting the front fabric, the top cam system 144a is allocated to knitting the right sleeve 5 and the body 4. The second cam system 144b is allocated to the transfer (re-transfer of stitches of the front fabrics and also transfer of stitches of the back fabrics in the right sleeve and the body, and transfer of stitches of the front fabric and also re-transfer of stitches of the back fabric in the left sleeve). The third cam system 144c is allocated to the knitting of the left sleeve 6.

[0064] In the knitting of the back knitted fabric, the top cam system 144c is allocated to the re-transfer of stitches of the front knitted fabric and the transfer of stitches of the back knitted fabric. The second cam system 144b is allocated to the knitting of the left and right sleeves 5, 6 and body 4. The third cam system 144a is allocated for the re-transfer of stitches of the back knitted fabric and the transfer of the stitches of the front knitted fabric.

[0065] In the knitting of the front knitted fabric, the stroke required for the cam system 144a is stroke ST1, and the stroke required for the cam system 144c is stroke ST2. They are substantially the same as strokes ST1 and ST2 in Fig. 9. The stroke required for the cam system 144b for knitting both the front and back knitted fabrics is stroke ST3. Regarding the entire carriage with the cam systems 144a-c, the strokes are reduced for knitting both the front and back fabrics. In addition, the same cam system is used for the re-transfer and the transfer of stitches, and therefore, knitting can be done efficiently.

[0066] When knitting the front knitted fabric, the knitting of the body 4 can be allocated to the cam system 144c. Further, when knitting the front knitted fabric, the two cam systems 144a, 144c can be allocated to the transfer of stitches, and the cam system 144b can be allocated to knitting. And in this case, the two cam systems 144a and 144c can be allocated to knitting of the back knitted fabric, and the cam system 144b can be allocated to the transfer of stitches. In both cases, the allocation of cam systems is reversed between the knitting of the front knitted fabric and the knitting of the back knitted fabric.

[0067] Regarding the embodiments, rib knitting at the ribbed hem parts has been described as an example of knitting courses with stitch transfer; however, rib knitting other than the ribbed hem parts is samely carried out. Garter knitting, and so on, knitting front stitches and back stitches mixed in the same knitted fabric, can be knitted samely.

Description of Symbols

[0068]

2	knitwear (pullover)
4	body
5	right sleeve
6	left sleeve
7, 8, 9	ribbed hem part
10a	front collar
10b	back collar
12, 16	carriage
14a, b, c	cam system
20	flat knitting machine
21	front needle bed
22	carriage
23	driver
24	cam system dedicated to knitting
25	cam system dedicated to stitch transfer
26	rail
27	top plate
32	allocation device
34	CPU
35,36	memory
ST	stroke of carriage

Claims

1. A method for knitting knitwear, on a flat knitting machine having at least a pair of needle beds, comprising a front needle bed and a back needle bed, and a carriage, wherein said carriage is provided with plural cam systems, along the longitudinal direction of the needle beds, operating needles in the needle beds and forming knitted stitches,

   wherein said knitwear comprises plural tubular parts and the plural tubular parts are knitted in parallel on said needle beds, being **characterized by**,
   for courses of the carriage without stitch transfer between the needle beds, allocating knitting of a forward part in the travel direction of the carriage in the course to a cam system of the carriage at a forward position in the travel direction of the carriage in the course, and allocating knitting of a backward part in the travel direction of the carriage in the course to a cam system of the carriage at a backward position in the travel direction of the carriage in the course and,
   for courses of the carriage with stitch transfer between the needle beds, allocating knitting of all of the parts to be knitted in the course to one or plural cam systems of the carriage.

2. The method for knitting knitwear of claim 1, being **characterized in that** said carriage is provided with two cam systems along the longitudinal direction of the needle beds;

   that said knitwear comprises both sleeves and

the body;
for courses of the carriage without stitch transfer between the needle beds,
that the forward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a forward position in the travel direction of the carriage in the course;
that the body is allocated to and knitted by one of said two cam systems; and
that the backward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a backward position in the travel direction of the carriage in the course.

3. The method for knitting knitwear of claim 1, being **characterized in that** said carriage is provided with at least three cam systems along the longitudinal direction of the needle beds;

that said knitwear comprises both sleeves and the body;
for courses of the carriage without stitch transfer between the needle beds,
that the forward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a forward position in the travel direction of the carriage in the course;
that the body is allocated to and knitted by the central cam system of said at least three cam systems; and
that the backward sleeve in the travel direction of the carriage in the course is allocated to and knitted by a cam system of the carriage at a backward position in the travel direction of the carriage in the course.

4. The method for knitting knitwear of claim 1, being **characterized in that**

for courses of the carriage with stitch transfer between the needle beds,
a course of the carriage re-transferring back at least a stitch of the back knitted fabric of the plural tubular parts and transferring at least a stitch of the front knitted fabric of the plural tubular parts simultaneously by one single cam system capable of transfer from the front needle bed to the back needle bed, and knitting at least a stitch on said at least a stitch of the front knitted fabric transferred to the back needle bed, by a cam system capable of knitting;
and
a course of the carriage re-transferring back at least a stitch of the front knitted fabric of the plural tubular parts and transferring at least a stitch of the back knitted fabric of the plural tubular parts simultaneously by one single cam system capable of transfer from the back needle bed to the front needle bed, and knitting at least a stitch on said at least a stitch of the back knitted fabric transferred to the front needle bed, by a cam system capable of knitting
are performed.

5. The method for knitting knitwear of claim 4, being **characterized in**

that four cam systems capable of transferring and knitting are used and
that, for courses of the carriage with stitch transfer between the needle beds, the top cam system in the travel direction of the carriage is allocated to stitch transfer, the second cam system is allocated to knitting of at least a forward part of the plural tubular parts in the travel direction of the carriage, the third cam system is allocated to stitch transfer, and the fourth cam system is allocated to knitting of at least a backward part of the plural tubular parts in the travel direction of the carriage, or alternatively
that, for courses of the carriage with stitch transfer between the needle beds, the top cam system in the travel direction of the carriage is allocated to knitting of at least a forward part of the plural tubular parts in the travel direction of the carriage, the second cam system is allocated to stitch transfer, and the third cam system is allocated to knitting of at least a backward part of the plural tubular parts in the travel direction of the carriage, and the fourth cam system is allocated to stitch transfer.

6. The method for knitting knitwear of claim 4, being **characterized in**

that three cam systems capable of transferring and knitting are used,
for courses of the carriage with stitch transfer between the needle beds,
that, when the carriage travels in a first direction, the top cam system in the first direction is allocated to knitting of at least a forward part of the plural tubular parts in the first direction, that the second cam system is allocated to stitch transfer, and the third cam system is allocated to knitting of at least a backward part of the plural tubular parts in the first direction,
and
that, when the carriage travels in a second direction, the top cam system in the second direction is allocated to stitch transfer, the second cam system is allocated to knitting of the plural tubular parts, and that the third cam system is

allocated to stitch transfer.

7. An allocation device for allocating knitting data to cam systems of a flat knitting machine having at least a pair of needle beds, comprising a front needle bed and a back needle bed, and a carriage, for knitting knitwear comprising plural tubular parts in parallel on said needle beds, wherein said carriage is provided with plural cam systems, along the longitudinal direction of the needle beds, operating needles in the needle beds and forming knitted stitches,

being **characterized in that** said allocation device is configured
for courses of the carriage without stitch transfer between the needle beds, to allocate knitting of a forward part in the travel direction of the carriage in the course to a cam system of the carriage at a forward position in the travel direction of the carriage in the course, and to allocate knitting of a backward part in the travel direction of the carriage in the course to a cam system of the carriage at a backward position in the travel direction of the carriage in the course, and
for courses of the carriage with stitch transfer between the needle beds, to allocate knitting of all of the parts to be knitted in the course to one or plural cam systems of the carriage.

FIG. 1

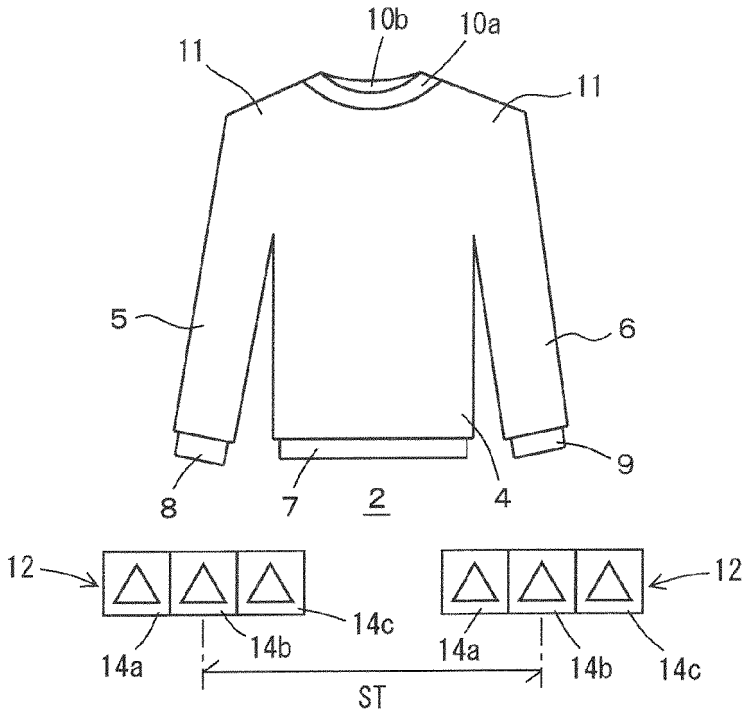

10b
10a
11
11
5
6
9
8
7
2
4
12
12
14c
14a
14b
14a
14b
14c
ST

FIG. 2

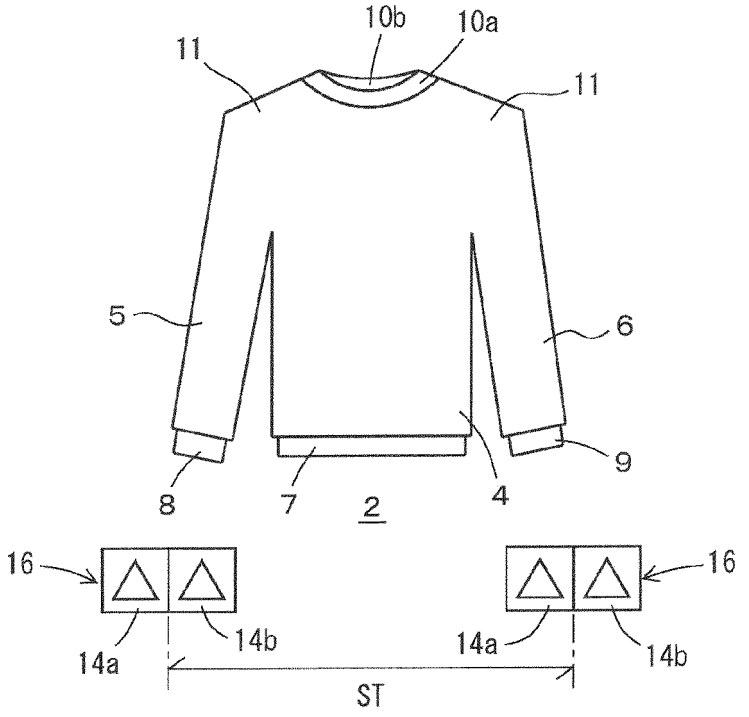

10b
10a
11
11
5
6
9
8
7
2
4
16
16
14a
14b
14a
14b
ST

FIG. 3

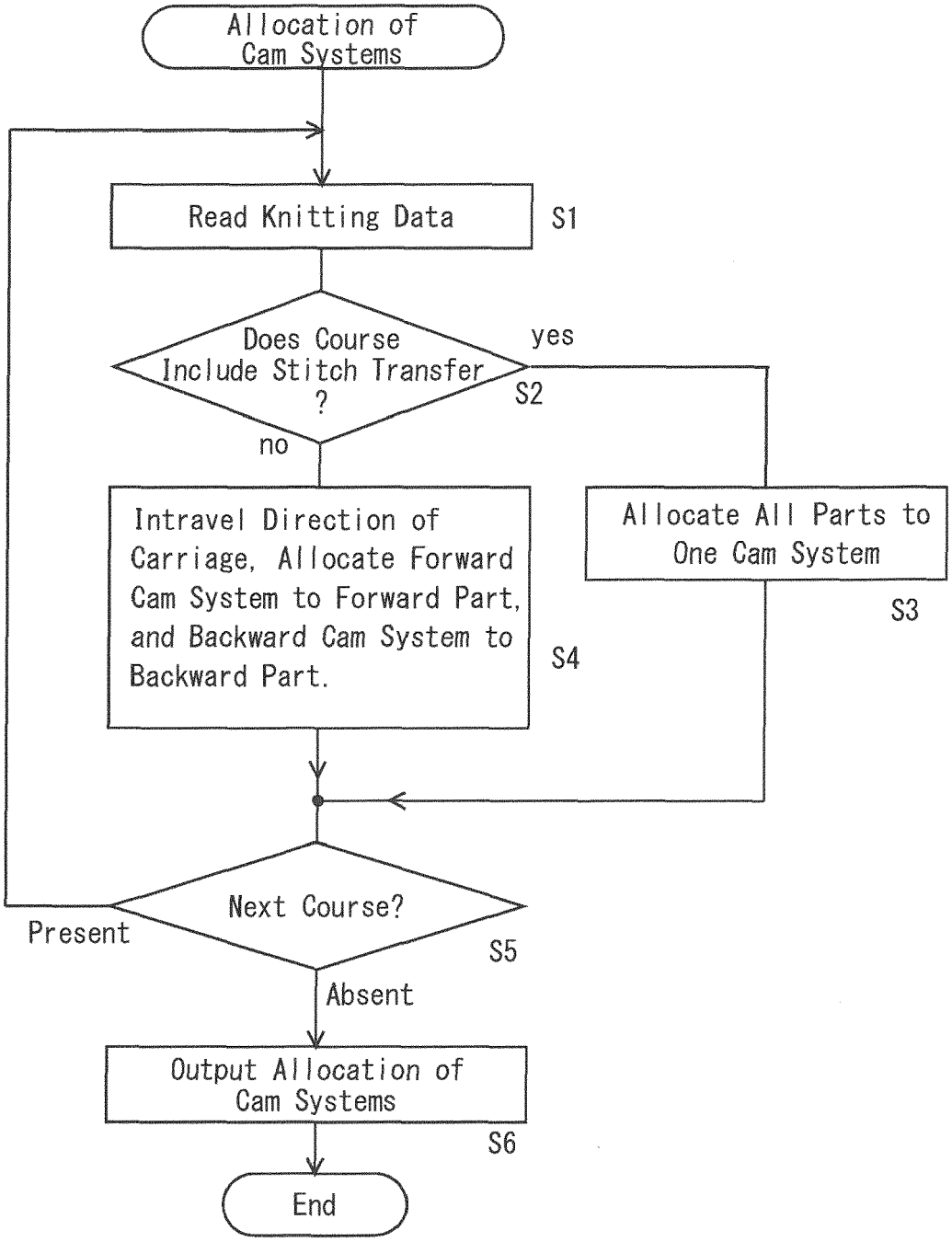

Allocation of Cam Systems
Read Knitting Data
S1
Does Course Include Stitch Transfer ?
yes
S2
no
Intravel Direction of Carriage, Allocate Forward Cam System to Forward Part, and Backward Cam System to Backward Part.
S4
Allocate All Parts to One Cam System
S3
Next Course?
Present
S5
Absent
Output Allocation of Cam Systems
S6
End

FIG. 4

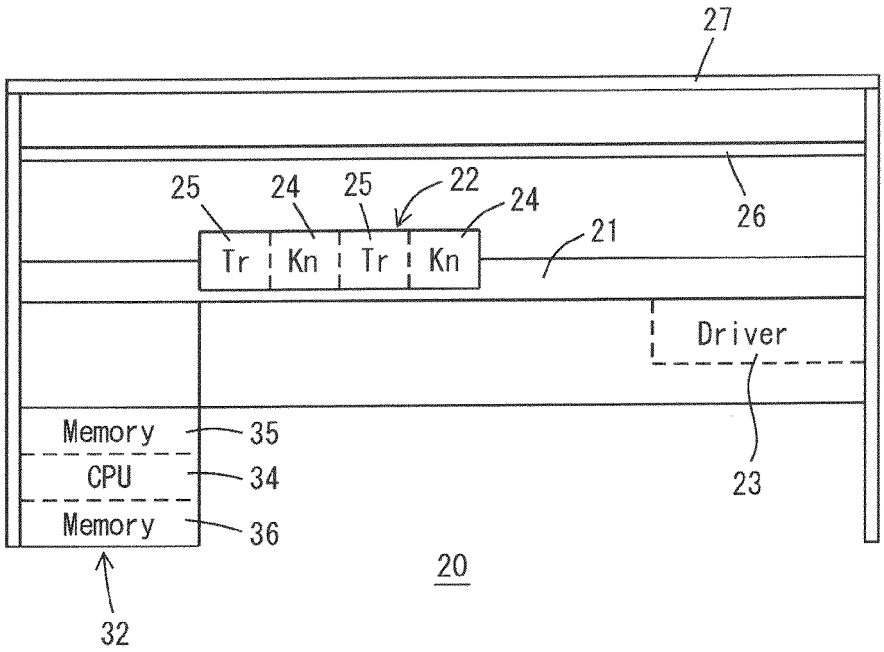


FIG. 5

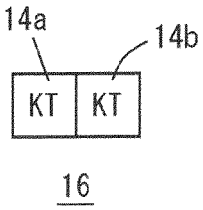


FIG. 6

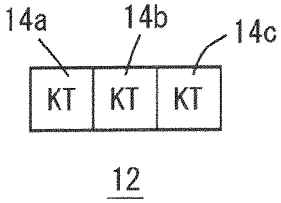


FIG. 7

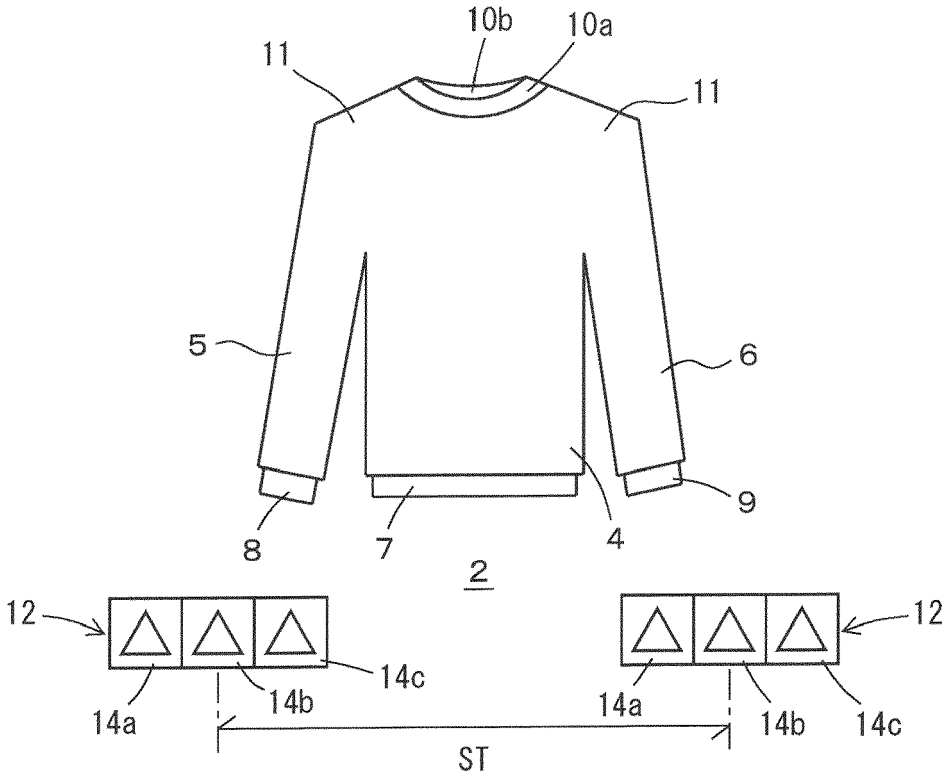


FIG. 8

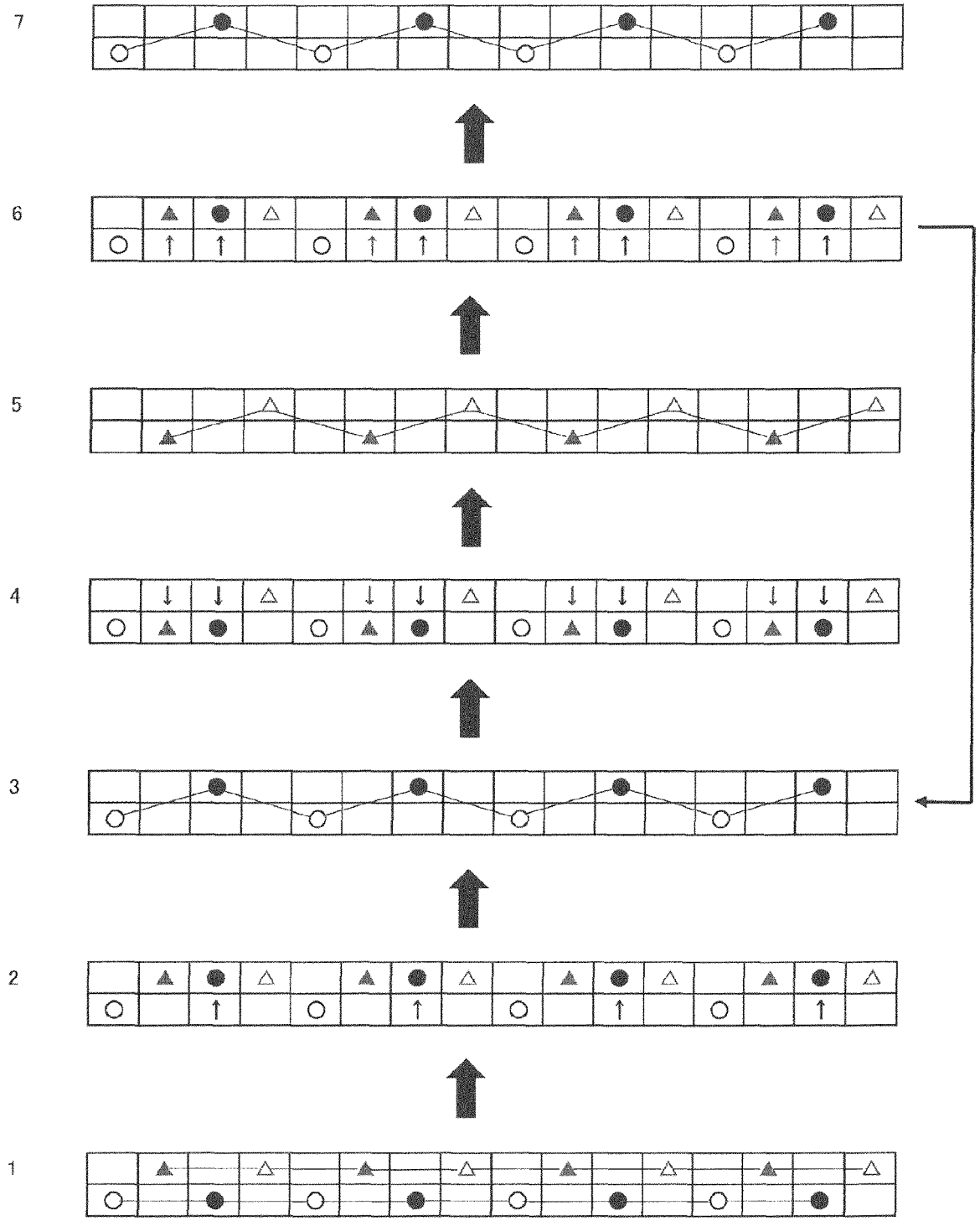

7
6
5
4
3
2
1
● Back stitches in the front fabric
▲ Back stitches in the back babric
○ Front stitches in the front fabric
△ Front stitches in the back fabric

FIG. 9

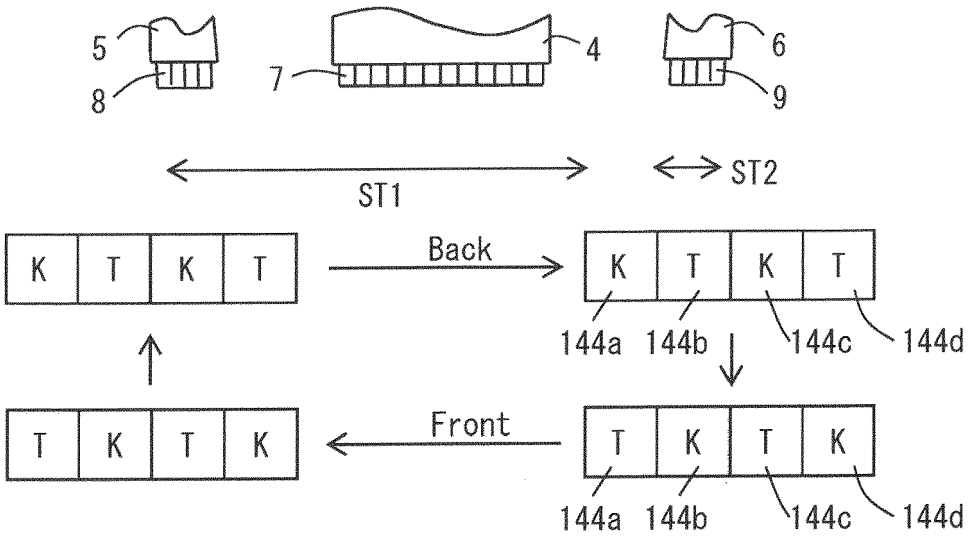
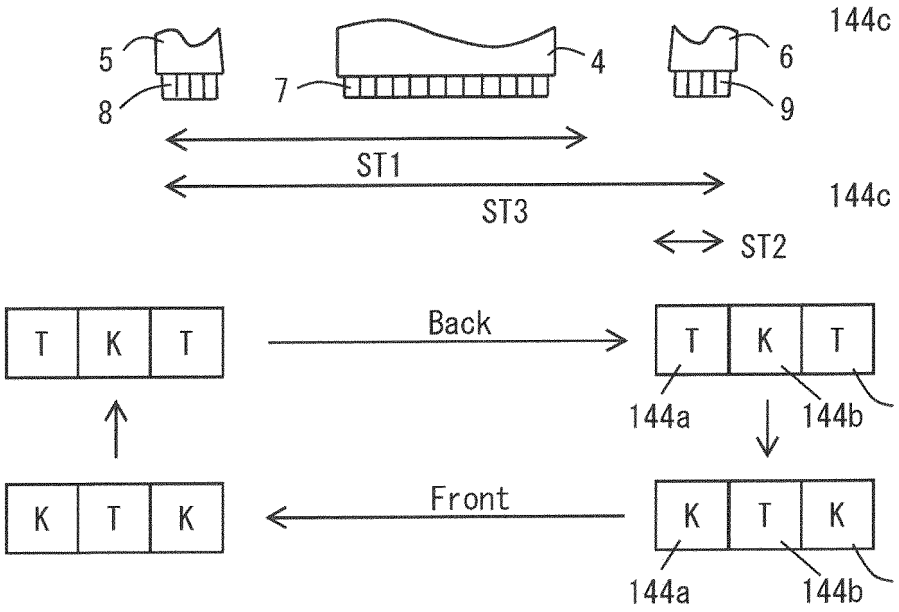

5
8
7
4
6
9
ST1
ST2
K T K T
Back
K T K T
144a 144b 144c 144d
T K T K
Front
T K T K
144a 144b 144c 144d

FIG. 10


144c
5
8
7
4
6
9
ST1
ST3
144c
ST2
T K T
Back
T K T
144a 144b
K T K
Front
K T K
144a 144b

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 7592

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 990 452 A1 (SHIMA SEIKI MFG [JP]) 12 November 2008 (2008-11-12) * paragraphs [0021] - [0029]; figures 1,5 *	1-7	INV. D04B1/10 D04B7/04 D04B7/28 D04B37/00 D04B15/36 D04B1/24
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A	EP 1 004 695 A2 (SHIMA SEIKI MFG [JP]) 31 May 2000 (2000-05-31) * paragraphs [0022] - [0026]; figures 1-9 *	1-7	

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D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 October 2022	Kirner, Katharina

CATEGORY OF CITED DOCUMENTS

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28-10-2022

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