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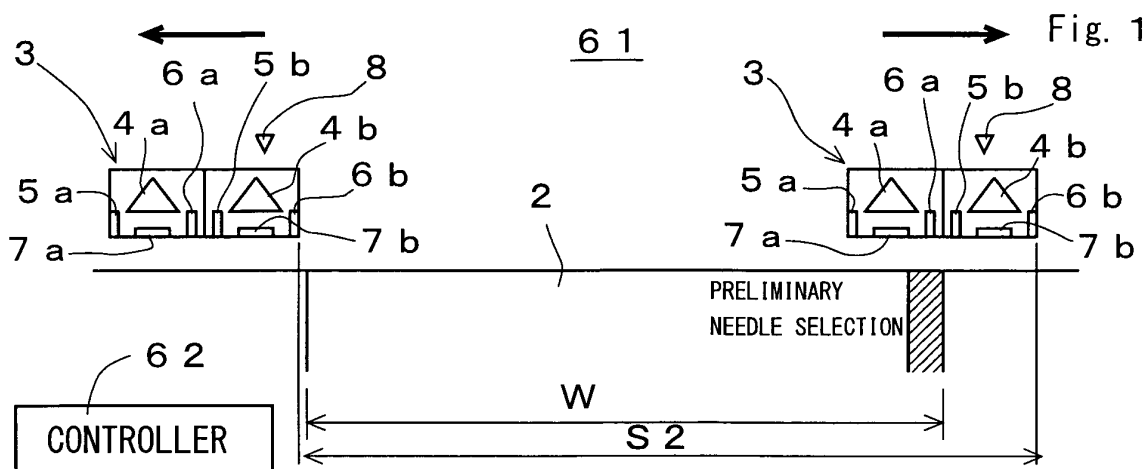
(54) **METHOD FOR SELECTING NEEDLE AND WEFT KNITTING MACHINE**

(57) A method for selecting needles and a flatbed knitting machine that can shorten the carriage running stroke and enhance the knitting efficiency are provided.

In the event that a cam system 4b on the right side only is used and a cam system 4a on the left side is not used, a preliminary needle selection section shown as shaded is provided on the right side end of the knitting width.

Setting of the preliminary needle selection section

and control related to the preliminary needle selection section are implemented by a controller 62. In the preliminary needle selection section, the first-step needle selection is conducted by a needle selecting mechanism 5b which trails the cam system 4b when the carriage 3 traverses the running direction to the right. When a trailing needle selecting mechanism 6a enters the preliminary needle selection section, the needle selecting mechanism 6a is controlled by the controller 62 so as not to disarray the preliminary needle selection state.



Description

Technical Field

[0001] The present invention relates to a method for selecting needles in two steps by the use of needle selecting mechanisms disposed on both sides of each cam system in a flatbed knitting machine provided with a carriage in which plural sets of cam systems are mounted, and to a flatbed knitting machine that executes such method of selecting needles.

Background Art

[0002] Conventionally, in a flatbed knitting machine, to a large number of knitting needles disposed on a needle bed, needle selection and knitting drive are conducted by a needle selecting mechanism and a cam system mounted to a carriage that runs along the needle bed in order to knit the fabric. The knitting operation of knitting needles basically consists of three types, knit, tuck, and miss. In knit, a hook at a front end of a knitting needle is advanced to a needle bed gap, receives a knitting yarn fed in the gap and forms a new knitted loop, while a knitted loop held till then is cleared from the hook. In tuck, the hook is advanced to the needle bed gap to an extent that the knitted loop held till then is not cleared, while a new knitted loop is formed. In miss, the hook is not advanced to the needle bed gap and no new knitted loop is formed. In order to select each knitting needle to carry out at least three types of knitting operations, two needle selecting mechanisms, each of which divides the knitting needle condition into two, are used to select needles in two steps (for example, see Patent Citation 1).

[0003] Fig. 6 shows basic structure of a flatbed knitting machine 1 that knits the fabric. The flatbed knitting machine 1 is equipped with needle beds 2 extending in the horizontal direction. The needle bed 2 has a large number of needle grooves that oriented in the direction perpendicular to the extended longitudinal direction, though the illustration is omitted. A knitting needle is housed in each needle groove, and the knitting needles are driven by cam systems 4a and 4b mounted to a carriage 3 running back and forth along the needle bed 2 and carry out knitting operations. In each of cam systems 4a and 4b, needle selecting mechanisms 5a and 6a; 5b and 6b are disposed on both sides in the running direction, respectively. Each needle selecting mechanism 5a and 6a; 5b and 6b can divide knitting needles into two groups with different states. The needle selecting states by the needle selecting mechanisms 5a and 6a; 5b and 6b can be reset to a reference state by resetting mechanisms 7a and 7b provided to each cam system 4a and 4b.

[0004] For example, in the case of a course knitting in which the carriage 3 runs to the right side of the drawing, needles for knitting the fabric by the cam system 4a on the trailing side in the running direction are selected in two steps, in which the needle selecting mechanism 5b behind the cam system 4b and the needle selecting mechanism 6a in front of the cam system 4a are used. However, in the event that the cam system 4b on the leading side in the running direction carries out the knitting operations taking along a yarn feeder 8, needles are selected only in one step by the use of the front needle selecting mechanism 6b. Patent Citation 1 discloses a method for selecting needles in which needle selection of the first step is conducted as preliminary needle selection by the needle selecting mechanism 6b which follows the cam system 4b on the trailing side when the carriage 3 reverses the running direction to the left. By conducting preliminary needle selection, when the carriage 3 reverses the running direction to carry out the next course knitting, needle selection of the second step is carried out by the needle selecting mechanism 6b used for preliminary needle selection and knitting needles are able to be selectively driven for knitting by the cam system 4b.

[0005] Fig. 7 shows one example of the structure of knitting needles 20 installed in a row in the needle bed 2 of the flatbed knitting machine 1 of Fig. 6. The knitting needle 20 is housed in a needle groove provided in a row in a direction perpendicular to the running direction of the carriage 3 on the needle bed 2 of the flatbed knitting machine 1 and is housed in the state to enable sliding displacement in which the knitting needle advances and retreats with respect to the needle bed gap in which knitting yarn is fed from the yarn feeder 8 of Fig. 6. In the knitting needle 20, a needle body 21 is engaged with a needle jack 22 at a rear part. The needle jack 22 has a knitting operation butt 22a and a transfer operation butt 22b, which are subject to the action of cam systems 4a and 4b of the carriage 3, respectively. At the back part of the knitting operation butt 22a, a select jack 23 works. The select jack 23 has a pressing butt 23a. A selector 24 that works on the select jack 23 has a needle selection butt 24c at, for example, one of the eight positions shown by a virtual line, between upper and lower butts 24a and 24b, for positioning which are subject to needle selection action by the needle selecting mechanisms 5a and 6a; 5b and 6b of Fig. 6. Whether or not the actuator of the needle selecting mechanisms 5a and 6a; 5b and 6b is in the state of pressing the needle selection butt 24c decides whether or not the selector 24 is brought into the selection state. The selector 24 in the selection state floats in the needle groove and is in the state that a cam for needle selection is able to work on the lower butt 24b. The needle selection butt 24c is pressed to sink the selector 24 in the needle groove, which is a non-selection state. The selector 24 in the non-needle selection state pushes up a resetting part 24d at the rear end by reset mechanisms 7a and 7b of Fig. 6 to allow the selector 24 to reset to the state in which it floats in the needle groove.

[0006] In the front end portion of the needle body 21, a hook 21a is provided and advances to the needle bed gap to

receive the knitting yarn fed in the gap. The hook 21a is opened and closed by a latch 21b. At a position slightly retreated from the hook 21a of the needle body 21, a clip fin 21c that holds a knitted loop on the loop sending side when knitted loop is transferred is installed. As a knitting needle 20, not only this latch needle but also a composite needle which have a hook opened and closed by a slider might be used, the structure for needle selection is same.

[0007] Fig. 8 shows an example of mechanism structure on a cam plate 3a for selectively knit-driving the knitting needle 20 of Fig. 7 in the carriage 3 of Fig. 6. In one unit of carriage 3, for example, two sets of cam systems 4a and 4b are mounted. Each of the cam systems 4a and 4b which are divided by the centerline 3b include a transfer cam for both sending and receiving 31, a fixed needle raising cam 32, a movable needle raising cam 33, stitch cams 34 and 35, and needle guide cams 36 and 37. The transfer cam for both sending and receiving 31 works on the transfer operation butt 22b of Fig. 7. On the knitting operation butt 22a, the fixed needle raising cam 32, the movable needle raising cam 33, and stitch cams 34 and 35 work.

[0008] On the pressing butt 23a of the select jack 23 of Fig. 7, needle guide cams 36 and 37 work, and at the same time, in accordance with the needle selecting condition, a tack presser 41 and a half presser 42, or a fixed presser 43 work. In two-step needle selection by the use of needle selecting mechanisms 5a and 6a; 5b and 6b, the position of the pressing butt 23a is decided to be either of three positions of A, H, or B. No presser is disposed at position A and the pressing butt 23a is not subject to pressure. At position H, the pressing butt 23a is subject to pressure by the tuck presser 41 and the half presser 42. However, the tuck presser 41 and the half presser 42 are able to be changed over between action and no-action, and when it is set to the no-action, the pressing butt 23a is not pressurized. The fixed presser 43 constantly pressurizes the pressing butt 23a at position B.

[0009] Needle selecting mechanisms 5a and 6a; 5b and 6b on both sides of each of cam systems 4a and 4b include needle selecting actuators 50a and 51a; 50b and 51b, selector raising cams 52a and 53a; 52b and 53b, and selector guide cams for raising 54 and 55, respectively. The needle selecting mechanisms 6a and 5b include raising protrusions 54a and 54b of the selector guide cam for raising 54, respectively, too. The needle selecting mechanisms 5a and 6b include raising protrusions 55a and 55b of the selector guide cam for raising 55, respectively, too. The needle selecting mechanisms 6a and 5b include clearing protrusions 56a and 56b of the selector guide cam for clearing 56, respectively, too. The needle selecting mechanisms 5a and 6b include clearing protrusions 57a and 57b of the selector guide cam for clearing 57, respectively, too.

[0010] Clearing protrusions 56a, 56b, 57a, and 57b work on the upper butt 24a of the selector 24 shown in Fig. 7, and selector raising cams 52a, 52b, 53a, and 53b as well as raising protrusions 54a, 54b, 55a, and 55b work on the lower butt 24b of the selector 24. To the resetting part 24d of the selector 24, selector floating cams 59a and 59b work, which are included in the reset mechanisms 7a and 7b, while the upper butt 24a lowered to the reference state corresponding to position B by the guide cam for clearing 58. On the needle selection butt 24c of the selector 24, pressing claws 60 of needle selecting actuators 50a, 50b, 51a, and 51b work. In each of needle selecting actuators 50a, 50b, 51a, and 51b, a plurality of pressing claws 60 are disposed in accordance with the type of the position of the needle selection butt 24c. The pressing claw 60 is electromagnetically controlled by a solenoid, etc., displaces in such a manner not to press the needle selection butt 24c in the selection state and presses the needle selection butt 24c to sink the selector 24 in the needle groove in the non-selection state. Since the width of the pressing claw 60 shown in the lateral direction in the drawing is larger than the arrangement interval of knitting needles, the selector 24 is disposed in such a manner that the position of the needle selection butt 24c is deviated between adjacent knitting needles 20, and each of pressing claws 60 works on the individual needle selection butt 24c. The selector raising cam 52a and the selector raising cam 53a as well as the selector raising cam 52b and the selector raising cam 53b are able to be changed over in such a manner that the leading side protrudes and the trailing side is immersed (for example, see Patent Citation 2).

[0011] In the event that the carriage 3 runs to the right side in the drawing and knitting needles are knit-driven by the cam system 4a, the needle is selected in two steps by the use of the needle selecting mechanisms 5b and 6a. In the first-step needle selection by the needle selecting actuator 50b, the lower butt 24b of the selector 24 in the needle selection state is pushed up by the raising protrusion 54a of the selector guide cam for raising 54. Next, the upper butt 24a is pushed down by the clearing protrusion 56c of the selector guide cam for clearing 56; then, the selector 24 is pushed up by the push-up force received from the selector guide cam 54. By this push-up of the selector 24, the select jack 23 is pushed up to the position H. In the event that the second-step needle selection is conducted in the needle selecting actuator 51a, the selector raising cam 53a in the protrusion state works on the lower butt 24b below the selector 24, and pushes up the select jack 23 to position A via the selector 24. In the event that the knitting operation is carried out by the cam system 4b, needles are selected in two steps only by the needle selecting mechanism 6b by using preliminary needle selection. Patent Citation 1: Japanese Examined patent Application publication No.S61(1986)-20670 Patent Citation 2: Japanese Published patent application No.H05(1993)-156553

Disclosure of the Invention

Technical Problem

5 **[0012]** Even when plural cam systems 4a and 4b as shown in Fig. 6 are mounted to the carriage 3, all the cam systems 4a and 4b are not always used for every course knitting. It is possible to knit two courses of fabric by one travel of the carriage 3 if knitting yarn is supplied taking the yarn feeder 8 to each cam system 4a and 4b, respectively, to knit the fabric, but different knitting yarns are used alternately for each course. In the event that the fabric is knitted continuously by the same knitting yarn, one cam system only is used. In addition, cam systems 4a and 4b may be sometimes used by sorting them into cam system for knitted loop formation and that for loop transferring.

10 **[0013]** Concerning the two cam systems 4a and 4b mounted to the carriage 3 in Fig. 6, it is assumed that the cam system 4a on the left side is not used. In this way, when the cam system 4a is included but is not used for knitting, it is no longer necessary for the cam system 4a not in use to run out from the right side of the knitting width W when the carriage 3 runs rightward relative to the needle bed 2. As illustrated, two needle selecting mechanisms 6a and 5b, which carry out two-step needle selection for the cam system 4b at the time of next leftward run, only need to run out from the right side of the knitting width W to stop the carriage 3 at the position in which the knitting needle is reset into the reference state to the knitting end by the reset mechanism. When the carriage 3 runs to the left, preliminary needle selection is conducted by the needle selecting mechanism 6b following the cam system 4b used and then, the carriage 3 is stopped at the position where the second-step needle selection by the needle selecting mechanism 6b is enabled. The distance S1 between positions where the carriage 3 stops on both sides of the needle bed 3 is the running stroke of the carriage 3.

20 **[0014]** The running stroke of the carriage 3 is desirably as small as possible with respect to the knitting width W. This is because the increased running stroke relative to the knitting width W increases the ratio of time in which no knitting operation takes place and deteriorates the knitting efficiency.

25 **[0015]** It is an object of the present invention to provide a method for selecting needles and a flatbed knitting machine, in which the knitting efficiency is enhanced by reducing the carriage running stroke.

Technical Solution

30 **[0016]** The present invention is a method for selecting needles, in a flatbed knitting machine to knit a fabric by a carriage, on which plural sets of cam systems for knit-driving are mounted and which runs back and forth along a needle bed, by providing a needle selecting mechanism to divide knitting needles into two groups on both sides in the running direction of each cam system, and by selecting needles in two steps between cam systems when adjacent cam systems are used together, wherein;

35 in the event, while the carriage runs to one side and then reverses running direction to the other side, all the cam systems being disposed on the other side of the cam systems used for knitting the fabric are not used;

in such manner that, when the carriage runs out from one side of a knitting width of the fabric, the carriage is able to stop at a position where a needle selecting mechanism on the other side of the cam systems in use runs out at least the knitting width; and

40 at the end portion on the one side of the knitting width in which a needle selecting mechanism which leads to the needle selecting mechanism on the other side cannot select needles even when the carriage reverses the running direction to the other side, one-step needle selection is conducted as a preliminary needle selection in the needle selecting mechanism on the other side when the carriage runs to the one side before reversing the running direction, and in a needle selecting mechanism on the other side of the needle selecting mechanism which conducted the preliminary needle selection, keeping the preliminary needle selection state so as not to be disarrayed.

45 **[0017]** In addition, in the present invention, wherein:

three or more sets of cam systems are mounted to said carriage; and

in the event that said cam systems not in use are located on both sides of the cam systems in use, said preliminary needle selection is conducted at the end portions on both sides of the knitting width.

50 **[0018]** In addition, in the present invention, wherein:

in each of said cam systems, a reset mechanism for resetting all the knitting needle selection states to the reference state is installed on the inner side of said needle selecting mechanisms on both sides; and

55 said preliminary needle selection starts in a section, from a termination end of a range in which the reset mechanism resets the knitting needle to the reference state before the carriage stops, to an initiation end of a range in which a needle selecting mechanism remaining in the knitting width adjacent to the needle selecting mechanism carrying out the preliminary needle selection is able to select needles when the carriage reverses the running direction, and

ends at the end portion of the knitting width.

[0019] Furthermore, the present invention is a flatbed knitting machine to knit a fabric by a carriage, on which plural sets of cam systems for knit-driving are mounted and which runs back and forth along a needle bed, by providing a needle selecting mechanism to divide knitting needles into two groups on both sides in the running direction of each cam system, and by selecting needles in two steps between cam systems when adjacent cam systems are used together, comprising:

a setting means for setting a preliminary needle selection section at the end portion on one side of the knitting width, when all the cam systems disposed on the other side of the cam systems used for knitting while the carriage runs to the one side are not used, and all the cam systems on the other side are not used either while the carriage reverses the running direction to the other side; and

a control means for controlling each needle selecting mechanism, in the preliminary needle selection section, so as to select needles in one step as a preliminary selection by the needle selecting mechanisms on the other side of the cam systems in use while the carriage runs to the one side before reverses the running direction to the other side, and so as not to disarray a preliminary needle selection state by the needle selecting mechanisms on the other side of the needle selecting mechanisms which conducted the preliminary needle selection, as well as for controlling the carriage so as to stop at the position in which the needle selecting mechanism on the other side of the cam systems in use runs out at least the knitting width when the carriage runs out one side of the knitting width of the fabric.

Advantageous Effects

[0020] According to the present invention, plural sets of cam systems for knit-driving are mounted to a carriage of a flatbed knitting machine, and needle selecting mechanisms that divide knitting needles into two groups are installed to each of the cam systems on both sides of the running direction. In the event that the cam systems on the other side are not used and the cam systems on the one side are used when the carriage runs out from the one side of the knitting width of the fabric, the carriage is able to be stopped at the position in which the needle selecting mechanism on the other side of the cam systems in use at least runs out the knitting width. It is possible to bring the carriage stop position closer to the end portion of the knitting width and to shorten the carriage running stroke in order to enhance the knitting efficiency. In the needle selecting mechanism on the other side of the cam system used when the carriage runs to the one side before reversing the running direction, one-step needle selection is carried out as a preliminary needle selection, and in the needle selecting mechanisms on the other side of the needle selecting mechanism which conducted the preliminary needle selection, the preliminary selection state is not disarrayed. In the carriage that carries out the two-step needle selection, a reset mechanism is installed to reset all the knitting needles to the reference state after providing a space so that knitting needles are guided to different routes in accordance with the needle selection results after the needles are selected. Since knitting needles at the end portion of the knitting width, after bringing the carriage stop position is close to the end portion of the knitting width, are less likely to reach the reset mechanism even if they pass the needle selecting mechanism on the other side of the needle selecting mechanism which conducted the preliminary needle selection, if the preliminary needle selection state is kept disarrayed, it is possible for the second-step needle selection to be conducted by the needle selecting mechanism which conducted the preliminary needle selection after the carriage reverses the running direction. In addition, in the event that the knitting needle, for which the preliminary needle selection was conducted before the carriage reverses the running direction, reaches the reset mechanism, the first-step needle selection is conducted in the needle selecting mechanism on the other side after the carriage reverses the running direction, the knitting needles are selected as is the case of the preliminary needle selection, and the preliminary needle selection state is eventually able to be kept disarrayed.

[0021] In addition, according to the present invention, three or more sets of cam systems are mounted to the carriage and in the event that cam systems not in use are located on both sides of the cam systems in use, the preliminary needle selection is conducted at the end portions on both sides of the knitting width. Thus, the running stroke can be shortened on both sides of the carriage running.

[0022] In addition, according to the present invention, even if a reset mechanism that resets the knitting needle selection states of all the knitting needles to the reference state is installed on the inner side of the needle selecting mechanisms on both sides, shortening of the carriage running stroke can be achieved with the section in which preliminary needle selection is carried out designated as a range not subject to the reset mechanism.

[0023] Furthermore, according to the present invention, a flatbed knitting machine includes a setting means and a control means. The setting means sets a preliminary needle selection section, when all the cam systems disposed on the other side of the cam systems used for knitting while the carriage runs toward the one side are not used, and all the cam systems on the other side are not used when the carriage reverses running direction to the other side. This kind of setting is able to be implemented on the basis of the results designated throughout continuous plurality of courses or

on the basis of the results judged in accordance with the knitting data that controls the flatbed knitting machine. The control means controls each needle selecting mechanism so as to select needles in one step as the preliminary needle selection by the needle selecting mechanisms on the other side of the cam systems in use while the carriage runs to the one side before reversing the running direction, and so as not to disarray the preliminary needle selection state by needle selecting mechanisms on the side other than the needle selecting mechanisms which conducted the preliminary needle selection. Thus, the carriage is stopped at the position in which the needle selecting mechanism on the other side of the cam systems in use runs out at least the knitting width when the carriage runs out the one side of the knitting width of the fabric, and the running stroke is shortened and the knitting efficiency can be enhanced.

Brief Description of the Drawings

[0024]

[Fig. 1] Fig. 1 shows basic structure of a flatbed knitting machine 61 as one embodiment of the present invention.
 [Fig. 2] Fig. 2 shows a relation between the layout of a mechanism on a cam plate 3a of a carriage 3 of Fig. 1 and a preliminary needle selection section.
 [Fig. 3] Fig. 3 is a block diagram that schematically shows system structure of a controller 62 that enables operation of preliminary needle section as described above in the flatbed knitting machine 61 of Fig. 1.
 [Fig. 4] Fig. 4 is a flow chart that schematically shows a control procedure by CPU100 of the controller 62 of Fig. 3.
 [Fig. 5] Fig. 5 schematically shows a method for selecting needles accompanied by setting a preliminary needle selection section in a flatbed knitting machine 111 as the other embodiment of the present invention.
 [Fig. 6] Fig. 6 is a diagram showing basic structure of a conventional flatbed knitting machine 1.
 [Fig. 7] Fig. 7 is a side view showing the structure of knitting needles 20.
 [Fig. 8] Fig. 8 is a diagram that shows the relationship between the layout of a mechanism on the cam plate 3a and a knitting width on the carriage 3 of the flatbed knitting machine 1 of Fig. 6.

Explanation of Reference

[0025]

61, 111	Flatbed knitting machine
2.	Needle bed
3, 113	Carriage
4a, 4b, 4c	Cam system
5a, 5b, 5c, 6a, 6b, 6c	Needle selecting mechanism
7a, 7b, 7c	Reset mechanism
8	Yarn feeder
20	Knitting needle
50a, 50b, 51a, 51b	Needle selecting actuator
54, 55	Raising selector guide cam
59a, 59b	Selector lifting cam
62, 112	Controller

Best Mode for Carrying Out the Invention

[0026] Fig. 1 shows basic structure of a flatbed knitting machine 61 as one embodiment of the present invention. Hereinafter, like reference characters are designated to portions corresponding to the structure shown in Fig. 6 through Fig. 8, and redundant explanation is omitted. In the event that in the flatbed knitting machine 61, same as the flatbed knitting machine 1 of Fig. 6, concerning the two cam systems 4a and 4b, the cam system 4b on the right side only is used and the cam system on the left side is not used, a preliminary needle selection section is provided as shown shaded at the end portion on the right side of the knitting width. Incidentally, the cam systems 4a and 4b are judged as being in use when they are used for knit loop forming operation such as knit, tuck, and miss with a yarn feeder 8 taken along, loop transferring operation, or the like. Setting of the preliminary needle selection section and control relating to the preliminary needle selection section are conducted by a controller 62. In the flatbed knitting machine 1 of Fig. 6, another controller that controls a carriage 3, cam systems 4a and 4b, and needle selecting mechanisms 5a and 6a; 5b and 6b, is provided but illustration is omitted. The controller 62 of Fig. 1 has functions similar to those of a controller of a conventional flatbed knitting machine 1 as well as functions relating to section setting of preliminary needle selection at the end portion of knitting width.

[0027] In the preliminary needle selection section, the first-step needle selection similar to the preliminary needle selection of Patent Citation 1 is conducted in the needle selecting mechanism which follows the cam system 4b when the carriage 3 runs to the right side. However, in the preliminary needle selection section, the needle selecting mechanism 6a can enter, too. The needle selecting mechanism 6a is controlled by the controller 62 so as not to disarray the preliminary needle selection state when it enters the preliminary needle selection section. In order not to disarray the preliminary needle selection state, for example all the knitting needles should be selected. The knitting needle 20, which is once set to the non-needle selection state as shown in Fig. 7, is held in the needle groove and is unable to float until selector floating cams 59a and 59b of the reset mechanisms 7a and 7b are activated. By providing a section for preliminary needle selection, the stop position of the carriage 3 when running to the right can be designated at, for example, a position from which the needle selecting mechanism 5b runs out the end portion of the knitting width. Even if the stop position of the carriage 3 when running to the left is the same as in the flatbed knitting machine 1 of Fig. 6, it is possible to reduce the necessary space of the carriage 3 at the time of right running and the stop position can be brought close to the end of the knitting width. A running stroke S2 of Fig. 1 is able to be reduced, for example, several tens of mm, compared to the running stroke S 1 of Fig. 6, and by accumulation of shortening, the knitting efficiency can be improved by about several percent.

[0028] Incidentally, in Fig. 1, concerning the two cam systems 4a and 4b mounted to the carriage 3, the case using the cam system 4b on the right side only is explained. In the case in which the left-side cam system 4a only is used, the similar preliminary needle selection section should be provided on the left side of the knitting width W.

[0029] Fig. 2 shows the relationship between the layout of the mechanism on the cam plate 3a of the carriage 3 and the preliminary needle selection section. The layout of the mechanism on the cam plate 3a is same as that of Fig. 8 but the right-side end of the knitting width is able to be set on the right of the centerline 3b. If all the needle selecting actuators 51a of the needle selecting mechanism 6a are kept in the needle selection state when the carriage 3 which conducts preliminary needle selection runs to the right, a needle selection butt 24c of a selector 24 of the knitting needle 20 selected in the needle selecting actuator 50b is not pressed and the selector 24 keeps the selection state to float in the needle groove. A lower butt 24b is subject to the operation of a protruding selector raising cam 53a and ascends as shown on the leftward side of a broken arrow. As the selector 24 ascends, an upper butt 24a, too, ascends as shown on the rightward side of the broken arrow, and at the same time, a select jack 23 is pushed up, and a pressing butt 23a, too, ascends as shown on the leftward side of the broken arrow. The pressing butt 23a ascends to position A and is not subject to pressure by a half presser 42 at position H and a fixing presser 43 at position B, and therefore a knitting operation butt 22a of a needle jack 22 ascends along the gradient of the fixed needle raising cam 32 as shown by the left-pointing broken arrow, and the knitting needle 20 advances to the needle bed gap in the needle groove. Such rightward running of the carriage 3 is continued in this way, the knitting operation butt 22a of the needle jack 22 which belongs to the knitting needle 20 same as that of the selector 24, which has relatively run leftward and passed the needle selecting actuator 51a, comes close to the stitch cam 35 of the cam system 4a. However, the stitch cam 35 is on the leading side and ascends to the zero stitch value position, and therefore, there is no problem if it is the case in that the knitting operation butt 22a comes close to the stitch cam 35. This is because when the carriage 3 reverses the running direction, the selector 24 and the select jack 23 which have ascended return to the original position as shown with the rightward side of the broken arrow. The knitting operation butt 22a of the needle jack 22 does not return and holds the ascending position as shown with the broken arrow but if it is a small ascending extent that reaches the bottom of the stitch cam 35, there is no problem.

[0030] However, depending on the layout of the mechanism on the cam plate 3a, there might be cases in which the knitting operation butt 22a of the needle jack 22 is guided to a chevron type knit route formed on the fixed needle raising cam 32 and the mobile needle raising cam 33. When the knitting operation butt 22a is guided to the top of the knit route, the hook 21a or the like at the head end of the knitting needle 20 could advance to the needle bed gap. In such event, on the route where the pressing butt 23a of the needle jack 23 passes in position A, a presser that operates at the time of preliminary needle selection is installed, and the pressing butt 23a is pressed to sink the needle jack 22 in the needle groove, thereby preventing the knitting operation butt 22a from being guided to the route that passes the knit route.

[0031] The selector 24 of the knitting needle 20 which is brought to the non-needle selection state in the preliminary needle selection sinks in the needle groove because the needle selection butt 24c is pressed in the needle selecting actuator 50b, and is not subject to the operation of the needle selecting actuator 51a. The butt 24b below the selector 24 which sinks in the needle groove is not subject to pushup operation by raising protrusions 54b and 54a of selector guide cam for raising 54 or selector raising cam 53a. In this way, ascending of the knitting needle 20 after the needle selecting actuator 51a passes is carried out by push-up of the selector raising cam 53a to the lower butt 24b below the selector 24. Enabling the selector raising cam 53a to independently float and sink and allowing it to be immersed in the preliminary needle selection section can prevent the knitting needle 20 from ascending at all even if it is brought to the preliminary needle selection state. However, the knitting operation butt 22a of the knitting needle 20 preliminarily selected holds the position H route, and therefore in the case of the layout of the mechanism on the cam plate 3a as described above, the knitting motion butt 22a may enter the knit route and guided to the top. In such event, even in the position H

route, the half presser 42 is operated to prevent the knitting motion butt 22a from entering the knit route.

[0032] When the knitting needle 20 preliminarily selected enters a range on which a selector floating cam 59a works, the selector 24 sunk in the needle groove in preliminary needle selection resets to float, too. For the reset selector 24, the first-step needle selection should be conducted by the needle selecting actuator 51a when the carriage 3 traverses the running direction to the left, but preliminary needle selection need not to be conducted. Consequently, the leftward boundary of the preliminary needle selection section may be the position where operation of the selector floating cam 59a is started at the maximum. In addition, in a region where it is unable to select the needle in the first step by the needle selecting actuator 51a when the carriage runs to the left, preliminary needle selection must be conducted without fail. In the state in which the selection butt 24c of the selector 24 stops on the way of the range of a pressing claw 60 of the needle selecting actuator 51a, it is unable to change over the needle selecting actuator 51a from the totally needle-selected state to the first-step needle selection state due to mechanical interference. Since it is the region left of the left end of the pressing claw 60 that change-over of the needle selection condition by the needle selecting actuator 51a is made effective, preliminary needle selection must be conducted in the region right of the left end of the pressing claw 60. Consequently, the boundary left of the preliminary needle selection section is the position of the left end of the pressing claw 60, at minimum.

[0033] The right boundary of the preliminary needle selection section is the position where preliminary needle selection by the needle selecting mechanism 5b is finished when the carriage 3 stops at the end right of the knitting width. Preliminary needle selection is the first-step needle selection by the needle selecting actuator 50b, and the needle selection state is established when the lower butt 24b below the selector 24 is pushed up to the top of the raising protrusion 54b of the selector guide cam for raising 54. In addition, the vicinity of the position of the center line 3b of the cam plate 3a may be set as the right boundary of the knitting width, too. Consequently, the right boundary of the knitting width, that is, the right boundary of the preliminary needle selection section may be provided in the range from the center line 3b to the position of the raising protrusion 54b of the selector guide cam for raising 54. This position can shorten the running stroke of the carriage 3 by bringing it up near the right side of the figure as much as possible.

[0034] Fig. 3 schematically shows system structure of a controller 62 that enables operation of the preliminary needle selection as described above in the flatbed knitting machine 61 of Fig. 1. In the flatbed knitting machine 61, the needle beds 2 are installed in front and rear of the needle bed gap, and to the front and rear needle beds 2, carriages 3 are installed, respectively. Needle selection of the knitting needles 20 by the needle selecting actuators 50a, 50b, 51a, and 51b mounted to the carriage 3 is conducted by determining the position of each carriage 3 relative to the needle bed 2. The position of the carriage 3 can be directly detected by the position sensor 70 relative to the needle bed 2. From a needle selection gauge separately installed to the frame of the flatbed knitting machine 61 in parallel to the needle bed 2, the position of the carriage 3 can be detected by the position sensor 70, too. The needle selection gauge is disclosed in, for example, Domestic Re-publication of PCT International Publication for Patent Application No. 2003-091490, and the like.

[0035] The controller 62 controls carriages 3 installed to each front and rear needle bed 2 of the flatbed knitting machine 61 by the front carriage control unit 71 and the rear carriage control unit 72, respectively. The position of the carriage 3 of each needle bed 2 is detected by a carriage position two-phase signal detector 73 on the basis of outputs of position sensors 70 which are installed corresponding to arrangement pitch of the knitting needle 20 to the needle selection gauge and which magnetically or optically detect irregularities or bright and dark fringes, or the like. The needle selecting actuators 50a, 50b, 51a and 51b of the carriage 3 of the front and rear needle beds 2 are driven by a front actuator ON/OFF output unit 74 and a rear actuator ON/OFF output unit 75, respectively.

[0036] Since inside of the front carriage control unit 71 and inside of the rear carriage control unit 72 have basically equivalent structure, the front carriage control unit 71 only is explained and the description on the rear carriage control unit 72 is omitted. In the front carriage control unit 71, as a software processing unit 80, a carriage speed calculator 81, speed correction unit 82, and needle selection data storage unit 83 are included. As a hardware processing unit 90, a carriage position counter 91, adder 92, output position judgment device 93 and an actuator ON/OFF setter 94 are included.

[0037] The needle selection data stored in the needle selection data storage unit 83 covers the overall needle bed 2. This needle selection data is outputted from a CPU100 that totally controls the knitting operation of the flatbed knitting machine 61. The CPU100 combines the data preliminarily saved in a knit fabric data storage unit 101 and a knitting machine parameters storage unit 102 and enters it as the knitting data 103 and outputs the needle selection data for each knitting course. In the knit fabric data storage unit 101, data on shapes and patterns of knit fabric to be knitted, knitting yarns to be used, and others are prepared in advance and stored. In the knitting machine parameter storage unit 102, parameters necessary for knitting by the flatbed knitting machine 61 are stored. The data concerning the section in which preliminary needle selection as shown in Fig. 1 is also stored. Based on the data for each course which CPU100 outputs, a carriage drive unit 104 controls the direction, speed, and running range in which the carriage drive unit 104 drives the carriage 3.

[0038] The position of the carriage 3 with respect to the front and rear needle beds 2 are entered to the CPU100 as outputs of the adder 92. The carriage speed calculator 81, speed correction unit 82, carriage position counter 91 and

adder 92 determine the position of the carriage 3 with respect to the needle bed 2. The CPU100 can control in such a manner as to properly select the knitting needle 20 relating to the preliminary needle selection section on the basis of the position of the carriage 3 with respect to the needle bed 2.

[0039] Fig. 4 schematically shows a control procedure by CPU100 of the controller 62 of Fig. 3. The procedure begins from Step s0, and in Step s1, the knitting data is entered for each course. In the vicinity of the end of each course, the knitting data on the vicinity of the starting end of the following course is entered. At the finishing end and starting end, a section which is possible to be set as a section of preliminary needle selection is included. In Step s2, whether or not unused cam systems are included in the cam systems mounted to the carriage 3 is determined. The presence or absence of unused cam systems may be designated and entered in advance by the operator or may be automatically determined from the knitting data of courses before and after. In addition, for example, even the case in which the cam system is used in a range which is not subject to the preliminary needle selection, such as loop transferring or partial knitting, may be judged to be unused. When it is judged that unused cam systems are included, the preliminary needle selection section is set in Step s3. In the following Step s4, the carriage 3 is controlled.

[0040] In Step s5, whether or not the trailing side of the used cam system, for example the needle selecting mechanism 5b relative to the cam system 4b at the time of a rightward running, enters in the preliminary needle selection section. If the needle selecting mechanism 5b has not entered, judgment repeats until the needle selecting mechanism 5b enters. When the needle selecting mechanism 5b enters the preliminary needle selection section, preliminary needle selection by the needle selecting mechanism 5b is conducted in Step s6. In Step s7, whether or not the unused cam system, for example the needle selecting mechanism 6a leading the cam system 4a, has entered in the preliminary needle selection section. If the needle selecting mechanism 6a has not entered in the section, judgment repeats until the needle selecting mechanism 6a enters in the section. When the needle selecting mechanism 5b enters the preliminary needle selection section, in Step s8, the needle selecting mechanism 6a is brought into the total needle selection state so as not to disarray the preliminary needle selection state.

[0041] In the following Step s9, it is judged whether or not the carriage 3 reaches the stop position. For example, as shown in Fig. 2, when the right end of the knitting width reaches the rightward boundary of the section, it is judged that the carriage 3 has reached the stop position. If the carriage 3 has not yet reached the stop position, the carriage 3 is decelerated and moved to run to the stop position. When the carriage 3 reaches the stop position, the carriage 3 is stopped in Step s10. Change over of rising and sinking of the selector raising cam 52a and selector raising cam 53a, and selector raising cam 52b and selector raising cam 53b are conducted, too. In Step s11, running direction of the carriage 3 is reversed, and for example, leftward running is started as against the above-mentioned rightward running. In Step s12, the controller controls the needle selecting mechanism 5b which leads the cam system 4b to be used to carry out the second-step needle selection to the preliminary needle selection. In Step s13, it is judged whether or not the needle selecting mechanism 6a which trails the unused cam system 4a that leads the cam system 4b runs out the preliminary needle selection section. The needle selecting mechanism 6a continues the total needle selection state set in Step s8 until the needle selecting mechanism 6a runs out the preliminary needle selection section. The needle selecting mechanism 6a carries out first-step needle selection to conduct knitting operation by the cam system 4b in Step s14 when the needle selecting mechanism 6a runs out the preliminary needle selection section. Then, the control returns to Step s1, and knitting data is entered for the remainder courses at least including the course in which the carriage 3 began running.

[0042] When it is judged that the unused cam system is not included in the cam system in Step s2, the carriage is driven in Step s15 and the needle selection control similar to conventional control takes place in Step s16. When the carriage 3 reaches the termination end of the running stroke, in Step s17, whether or not knitting is finished is judged and if it is not finished, the control returns to Step s1, and if knitting is finished, knitting is completed in Step s18. In the event that the preliminary needle selection section is set in Step s3, it is premised that the carriage 3 reverses the running direction and starts knitting the following courses, therefore, it is not judged whether or not knitting is finished.

[0043] Fig 5 schematically shows the needle selection method accompanied by the setting of the preliminary needle selection section in a flatbed knitting machine 111 as the other embodiment of the present invention. In the flatbed knitting machine 111, a controller 112 is used to control a carriage 113 with three cam systems 4a, 4b, and 4c mounted in, the procedure similar to that in Fig. 4, and preliminary needle selection sections are provided on both sides of the knitting width W. In the event that, concerning the three cam systems 4a, 4b, and 4c, the cam system 4b at the center only is used for knit loop forming operation such as knit, tuck, and miss with a yarn feeder 8 taken along, or knitting loop transferring operation, or the like. as is the case of two cams of Fig. 1, with the left-side cam system 4a retained in the knitting width W when running to the right and with the right-side cam system 4c retained in the knitting width W when running to the left, running stroke of the carriage 113 can be shortened on both sides.

[0044] Incidentally, in the event that concerning the three cam systems 4a, 4b, and 4c, the right-side cam system 4c only is used, the cam system 4c should be brought to have correspondence with the cam system 4b of Fig. 1, and the needles should be selected in the preliminary needle selection section in the needle selecting mechanism 5c. Similarly, in the event that the left-side cam system 4a only is used, the preliminary needle selection section should be provided

on the left side of the knitting width W and the needles should be selected in the preliminary needle selection section in the needle selecting mechanism 6a. For example, as is the case of not using the cam system 4b only, even if the unused cam system 4b exists among a plurality of cam systems 4a and 4b following the cam system 4c on the leading side of the rightward running carriage, the carriage 3 must run rightward until the used cam system 4a goes through the knitting end if a used cam system 4a also exists. Thus, it is unable to shorten the running stroke by providing a preliminary needle selection section. In the event that no preliminary needle selection section is provided, for example, in Step s3 of Fig. 4, the preliminary needle selection section should be set to zero. When four sets or more cam systems are mounted to a carriage and there is any unused cam system, the preliminary needle selection section may be provided in the similar manner and the carriage running stroke can be shortened.

Claims

1. A method for selecting needles, in a flatbed knitting machine to knit a fabric by a carriage, on which plural sets of cam systems for knit-driving are mounted and which runs back and forth along a needle bed, by providing a needle selecting mechanism to divide knitting needles into two groups on both sides in the running direction of each cam system, and by selecting needles in two steps between cam systems when adjacent cam systems are used together, wherein;
 in the event, while the carriage runs to one side and then reverses running direction to the other side, all the cam systems being disposed on the other side of the cam systems used for knitting the fabric are not used;
 in such manner that, when the carriage runs out from one side of a knitting width of the fabric, the carriage is able to stop at a position where a needle selecting mechanism on the other side of the cam systems in use runs out at least the knitting width; and
 at the end portion on the one side of the knitting width in which a needle selecting mechanism which leads to the needle selecting mechanism on the other side cannot select needles even when the carriage reverses the running direction to the other side, one-step needle selection is conducted as a preliminary needle selection in the needle selecting mechanism on the other side when the carriage runs to the one side before reversing the running direction, and in a needle selecting mechanism on the other side of the needle selecting mechanism which conducted the preliminary needle selection, keeping the preliminary needle selection state so as not to be disarrayed.
2. The method for selecting needles according to claim 1, wherein: three or more sets of cam systems are mounted to said carriage; and
 in the event that said cam systems not in use are located on both sides of the cam systems in use, said preliminary needle selection is conducted at the end portions on both sides of the knitting width.
3. The method for selecting a needle according to claim 1 or 2, wherein:
 in each of said cam systems, a reset mechanism for resetting all the knitting needle selection states to the reference state is installed on the inner side of said needle selecting mechanisms on both sides; and
 said preliminary needle selection starts in a section, from a termination end of a range in which the reset mechanism resets the knitting needle to the reference state before the carriage stops, to an initiation end of a range in which a needle selecting mechanism remaining in the knitting width adjacent to the needle selecting mechanism carrying out the preliminary needle selection is able to select needles when the carriage reverses the running direction, and ends at the end portion of the knitting width.
4. A flatbed knitting machine to knit a fabric by a carriage, on which plural sets of cam systems for knit-driving are mounted and which runs back and forth along a needle bed, by providing a needle selecting mechanism to divide knitting needles into two groups on both sides in the running direction of each cam system, and by selecting needles in two steps between cam systems when adjacent cam systems are used together, comprising:
 a setting means for setting a preliminary needle selection section at the end portion on one side of the knitting width, when all the cam systems disposed on the other side of the cam systems used for knitting while the carriage runs to the one side are not used, and all the cam systems on the other side are not used either while the carriage reverses the running direction to the other side; and
 a control means for controlling each needle selecting mechanism, in the preliminary needle selection section, so as to select needles in one step as a preliminary selection by the needle selecting mechanisms on the other side of the cam systems in use while the carriage runs to the one side before reversing the running direction to the other side, and so as not to disarray a preliminary needle selection state by the needle selecting mechanisms

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on the other side of the needle selecting mechanisms which conducted the preliminary needle selection, as well as for controlling the carriage so as to stop at the position in which the needle selecting mechanism on the other side of the cam systems in use runs out at least the knitting width when the carriage runs out one side of the knitting width of the fabric.

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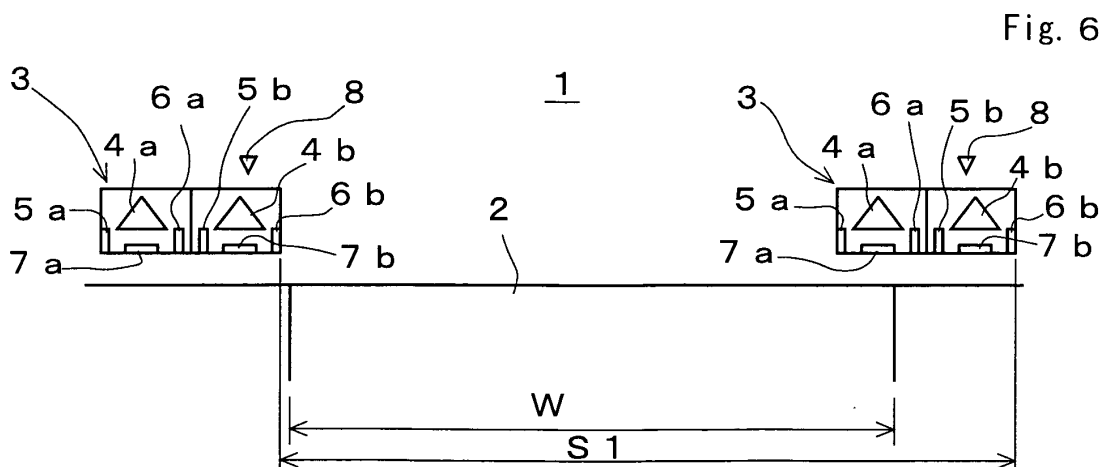
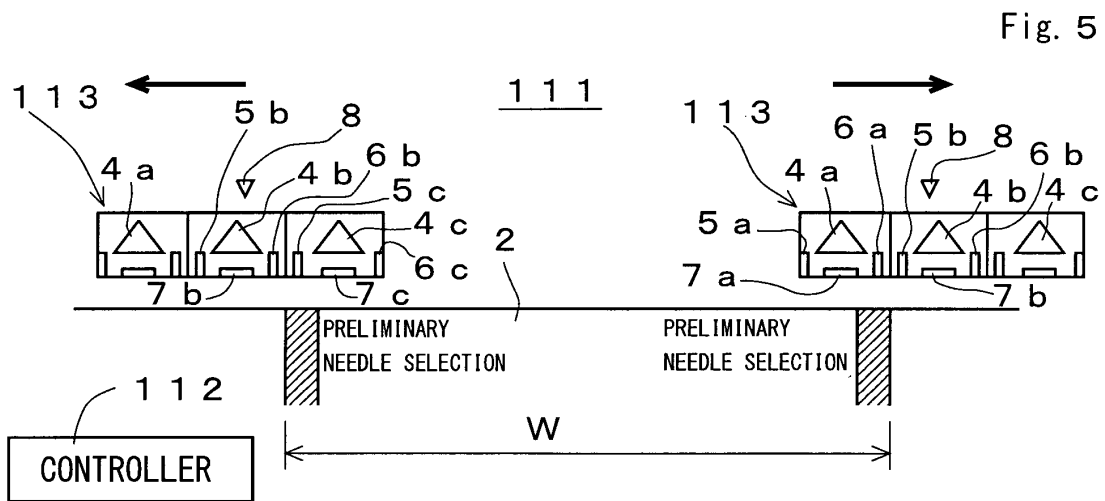
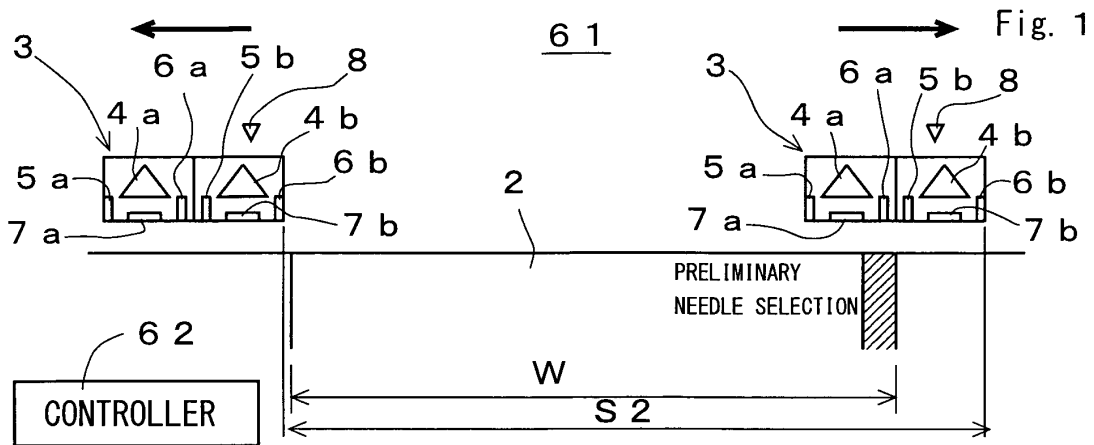
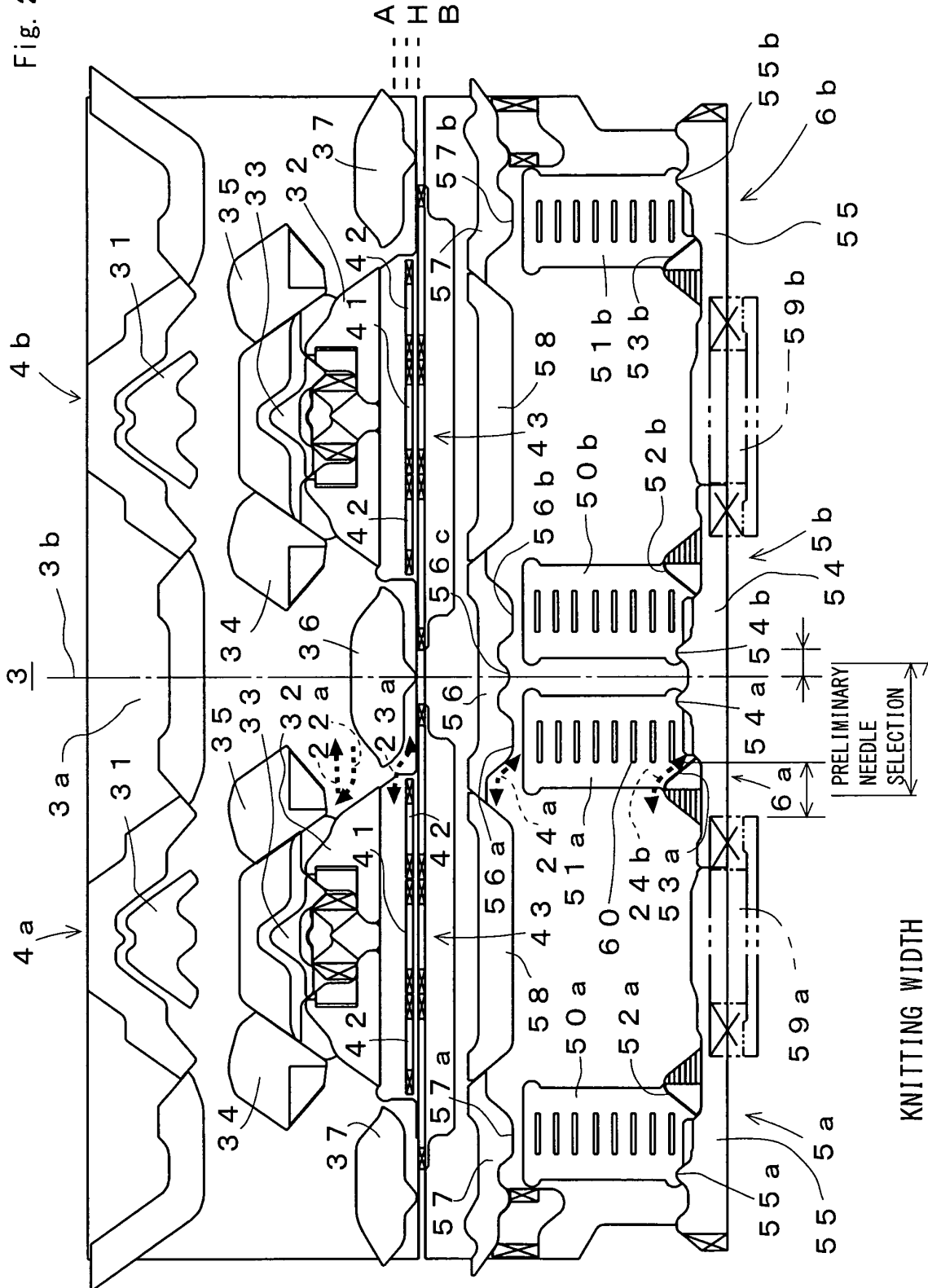


Fig. 2



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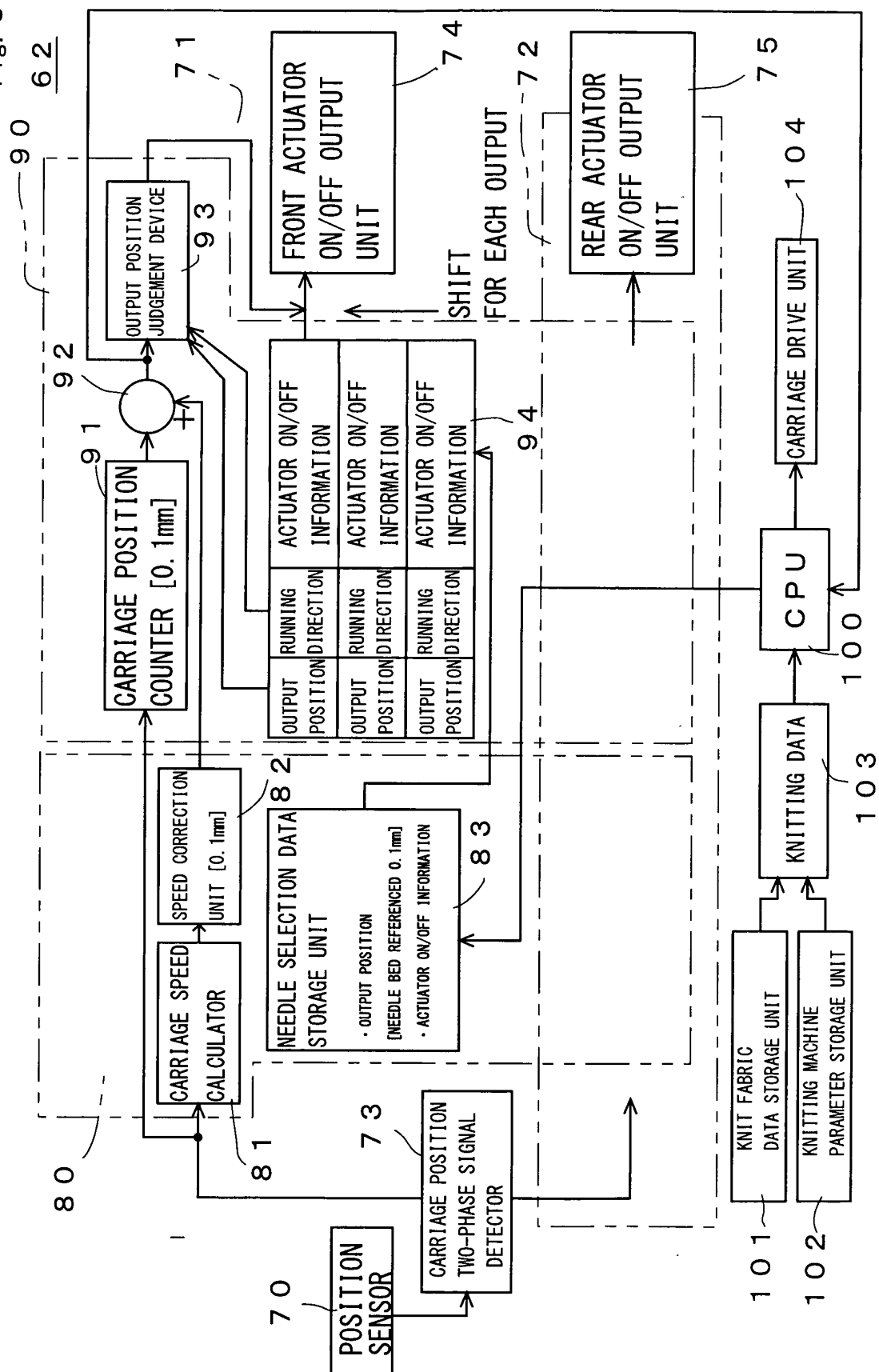


Fig. 4

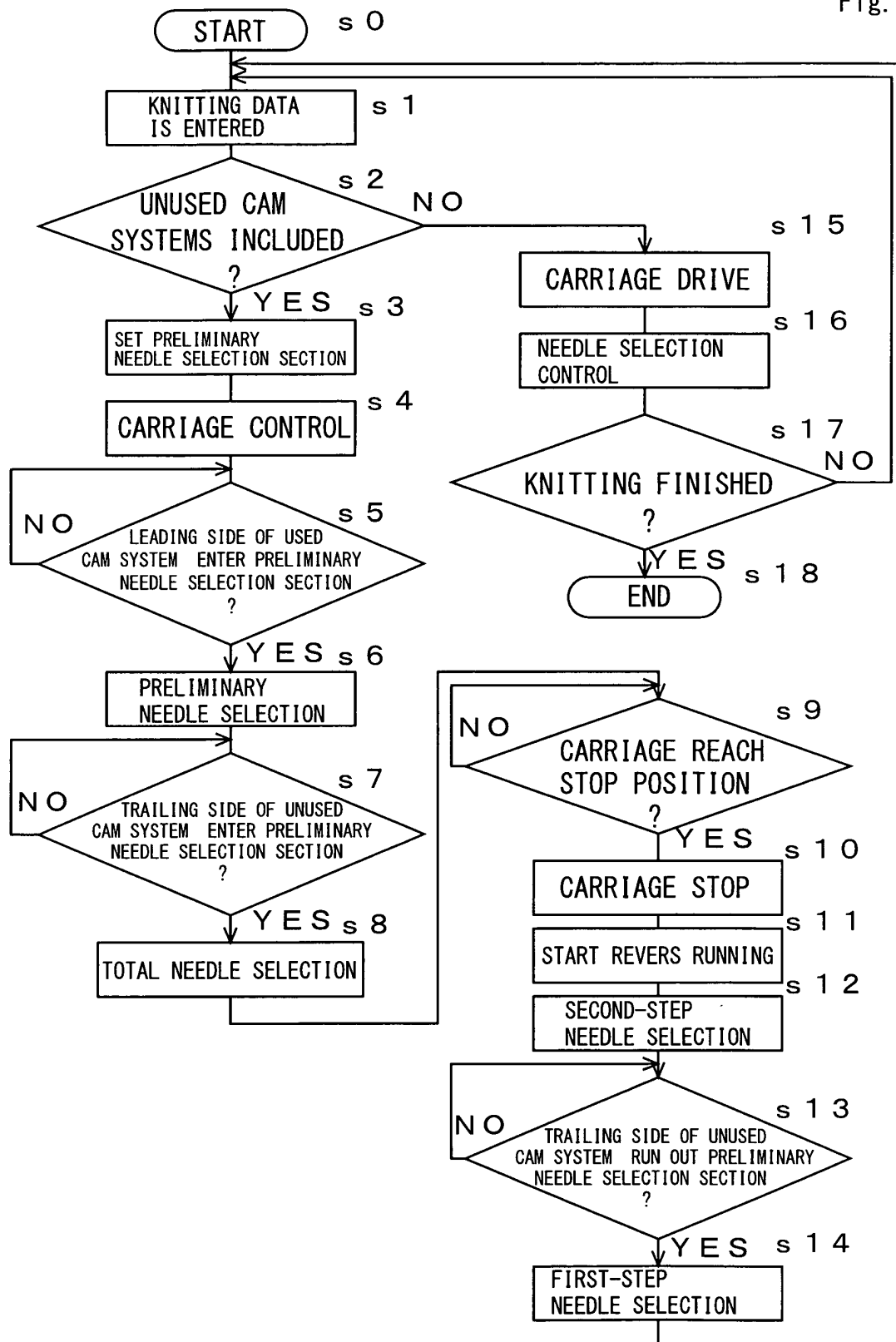


Fig. 7

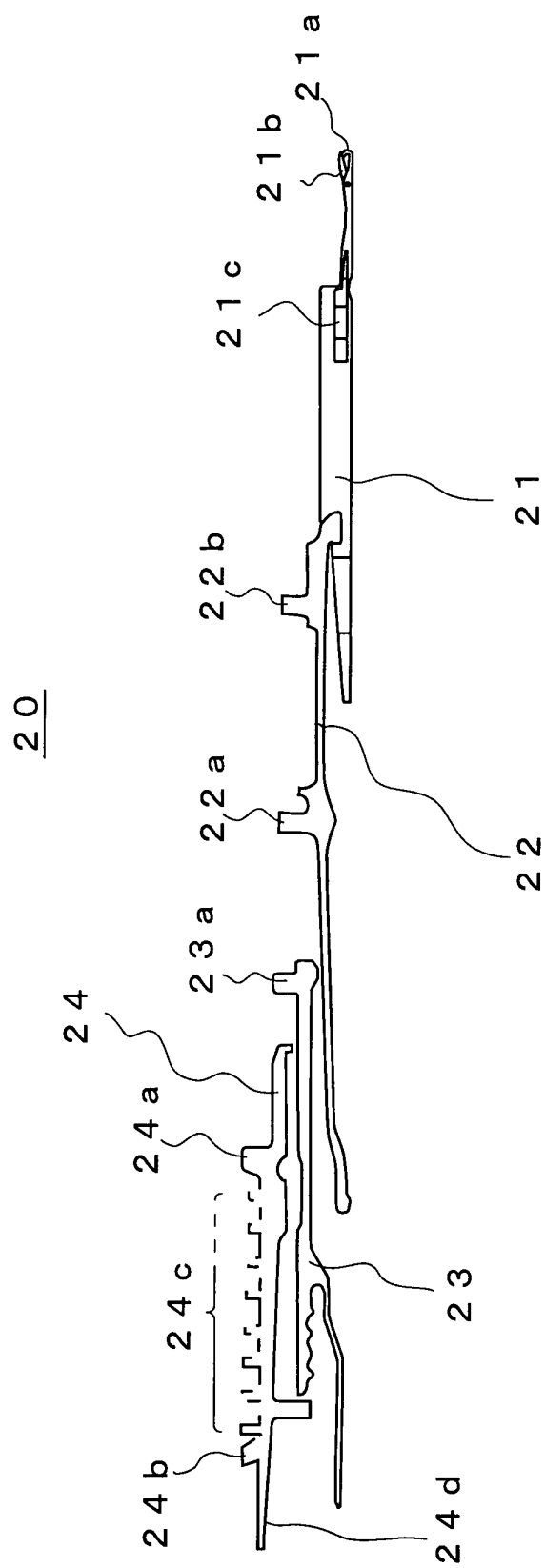
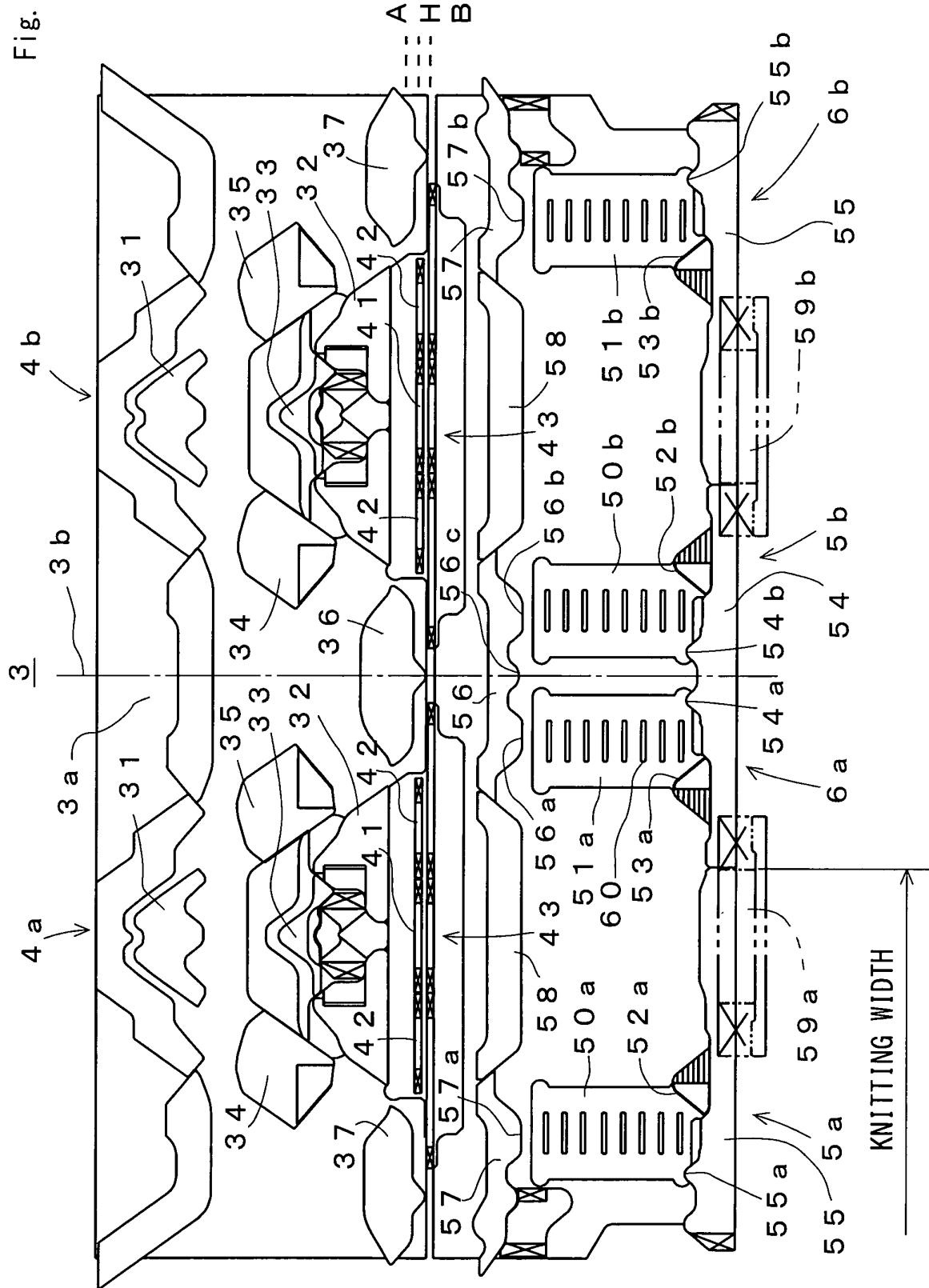


Fig. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/001460

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/96(2006.01) i, D04B15/36(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04B15/36, 15/66-15/86, 15/96-15/99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2008
Kokai Jitsuyo Shinan Koho	1971-2008	Toroku Jitsuyo Shinan Koho	1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-20670 B2 (Kabushiki Kaisha Shima Idea Center), 23 May, 1986 (23.05.86), & WO 81/000869 A & DE 2953846 A & US 4409801 A & GB 2072713 B & ES 8401539 A & SU 1168097 A & CH 654043 B & IT 1128682 B	1-4
A	JP 2794144 B2 (Shima Seiki Mfg., Ltd.), 03 September, 1998 (03.09.98), & US 5398527 A & EP 594169 B1 & KR 249119 B1 & CN 1052273 C	1-4
A	JP 05-156553 A (Shima Seiki Mfg., Ltd.), 22 June, 1993 (22.06.93), (Family: none)	1-4

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
06 February, 2008 (06.02.08)Date of mailing of the international search report
19 February, 2008 (19.02.08)Name and mailing address of the ISA/
Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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