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

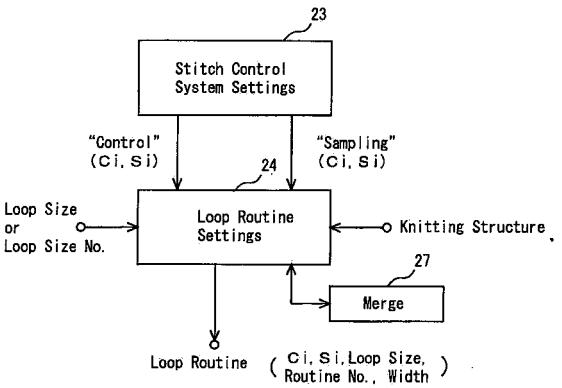
(72) Inventor: **KOMURA, Yoshiyuki**
Wakayama-shi
Wakayama 641-0003 (JP)

(74) Representative: **Wagner, Karl H.**
Wagner & Geyer
Gewürzmühlstrasse 5
80538 Munich (DE)

(54) DEVICE AND PROGRAM FOR LOOP LENGTH ROUTINE SETTING IN A FLATBED KNITTING MACHINE

(57) A device for loop routine setting (2) has a stitch control system setting (23) for analyzing knitting data for knitting a knitted fabric in a flatbed knitting machine (4), and for setting a control scheme for a carriage (42) stitch cam for each area, on the basis of the knitting width and the knitting structure in each area of the knitted fabric. The setting device further has a loop routine settings (24) for setting a loop length routine scheme on the basis of the control scheme for each area, and on the basis of the target size of stitches and the knitting structure in the area. Whereby loop routine setting can be automated.

FIG. 4



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Description

[0001] The present invention relates to setting of a loop length routine that is executed before knitting of a knitted fabric in a flatbed knitting machine.

[0002] A knitting cam system (hereafter, simply system) in a flatbed knitting machine is provided with stitch cams that can be adjusted by way of a motor or the like. The cams control the pull-down extent by which needles, having yam hooked thereon, are pulled down. The cams are used for adjusting stitch size, since the latter is determined by the pull-down extent. Stitch size can be expressed by the length of yam per pitch (hereafter, loop length). The loop length is designated by, for instance, knitting data. Knitting thus a knitted fabric according to a designated loop length allows improving the quality of the knitted fabric, in particular the texture of the knitted fabric, and allows preventing fluctuation in the size of the knitted fabric and fluctuation in the amount of yam that is required.

[0003] The applicant has disclosed technologies wherein knitting is carried out at a designated loop length, through monitoring of the yam consumption amount, using a rotary encoder or the like, and through feedback, to the stitch cams, of deviations with respect to a target value (Patent Document 1: Japanese Patent No. 2952391, Patent Document 2: Japanese Patent No. 3554088, Patent Document 3: Japanese Patent No. 3603031). These technologies are referred to as digital stitch control, herein stitch control. To implement digital stitch control, stitch cams must be adjusted, prior to the actual knitting of the knitted fabric, so that the knitted fabric may be knitted at the designated loop length. This adjustment is called a loop length routine, the execution whereof requires cumbersome setting. The inventors arrived at the present invention as a result of studies on automation of loop routine setting.

[0004]

Patent Document 1: Japanese Patent No. 2952391
Patent Document 2: Japanese Patent No. 3554088
Patent Document 3: Japanese Patent No. 3603031

[0005] An object of the present invention is to facilitate loop routine setting, in order to execute stitch control.

[0006] The present invention is a device for loop routine setting for carrying out setting relating to a loop length routine for a flatbed knitting machine in which yam is supplied from a plurality of carriers, a knitted fabric is knitted through operation of needles of needle beds by a cam system in a carriage that moves back and forth over at least a pair of front and rear needle beds, yam is supplied to the carriers via a yam length measurement device,
a stitch size is adjusted in the cam system through stitch cam control, and
a loop length routine is executed for acquiring stitch cam adjustment data, before knitting of a knitted fabric,
the device for loop routine setting being characterized in comprising:

a stitch control system settings that analyzes knitting data for knitting a knitted fabric formed of a plurality of areas, in the flatbed knitting machine, and that sets a stitch cam control scheme for each area, on the basis of a knitting structure and a knitting width of each area; and
a loop routine setting that sets a loop length routine scheme and a stitch target size in a loop length routine, on the basis of a control scheme of each area and on the basis of the knitting structure and a stitch target size of each area.

[0007] Also, the present invention is a program for loop routine setting for a device that carries out setting relating to a loop length routine for a flatbed knitting machine in which
yam is supplied from a plurality of carriers, a knitted fabric is knitted through operation of needles of needle beds by a cam system in a carriage that moves back and forth over at least a pair of front and rear needle beds, yam is supplied to the carriers via a yam length measurement device,
stitch size is adjusted in the cam system through stitch cam control, and
a loop length routine is executed for acquiring stitch cam adjustment data, before knitting the knitted fabric, the program for loop routine setting characterized in comprising:
a stitch control system setting instruction for analyzing knitting data for knitting a knitted fabric comprising a plurality of areas, in the flatbed knitting machine, and setting a stitch cam control scheme for each area, on the basis of a knitting structure and a knitting width of each area; and
a loop routine setting instruction for setting a loop length routine scheme and a stitch target size in a loop length routine, on the basis of a control scheme of each area and on the basis of the knitting structure and a stitch target size of each area.
In the present description, the features relating to the device for loop routine setting apply also to the setting program. Conversely, the features relating to the setting program apply also to the setting device.

[0008] Preferably, the carriage comprises a plurality of cam systems.
In loop routine setting, there is set a loop length routine scheme and a stitch target size in a loop length routine, in combination units of carriers and cam systems.
More preferably, upon detection of the presence of a first area of knitting in use of a first carrier, a first cam system, a first stitch target size and a first knitting structure, and a second area of knitting in use of the first carrier, a second cam system, the first stitch target size and the first knitting structure, a single loop length routine is executed for both the first area and the second area, with the first carrier, the first stitch target size and the first knitting

structure, and also in use of only one from among the first and the second cam systems; and the adjustment data, acquired in the loop length routine, is utilized for both the first cam system in the first area and the second cam system in the second area.

[0009] In stitch control scheme setting, in particular, there are preferably set, as control schemes, at least a first scheme in which a yam consumption amount is compared with a yam amount calculated on the basis of a stitch size in the knitting data, and a result thereof is fed back to a stitch cam, and a second scheme in which the yam consumption amount is compared with a yam consumption amount in a sample knitted fabric, and a result thereof is fed back to the stitch cam;
the first scheme is preferentially allocated to an area of large knitting width and of plain or ribbed knitting structure, and the second scheme is preferentially allocated to an area of narrow knitting width and of jacquard knitting structure.

[0010] In the present invention, there is analyzed knitting data for knitting a knitted fabric comprising a plurality of areas, in the flatbed knitting machine, and a stitch cam control scheme is set for each area, on the basis of a knitting structure and a knitting width of each area. As a result, stitch cam control schemes can be set substantially automatically.
In the present invention, also, there is set a loop length routine scheme and a stitch target size in a loop length routine, on the basis of a control scheme of each area and on the basis of the knitting structure and a stitch target size of each area. As a result, setting relating to loop length routines can also be carried out substantially automatically.
The user is freed thereby from stitch control scheme setting and loop routine setting. Accordingly, it becomes easier for the user to knit a stable, uniform knitted fabric through feedback of the yam consumption amount to the stitch cams.

[0011] The loop length routine scheme and the stitch target size in a loop length routine are set in combination units of carriers and cam systems, whereupon the loop length routine is executed for each combination of yam and cam system. As a result, stitch cams can be adjusted accurately before knitting of the actual knitted fabric.
Herein it is detected whether or not there is a first area of knitting with a first carrier, a first cam system, a first stitch target size and a first knitting structure, and a second area of knitting with the first carrier, a second cam system, the first stitch target size and the first knitting structure. Upon detection, there is executed a single loop length routine, for both the first area and the second area, with the first carrier, the first stitch target size and the first knitting structure, and only one from among the first and the second cam systems; and the adjustment data, acquired in the loop length routine, is used for both the first cam system in the first area and the second cam system in the second area. The number of loop length routines can be reduced that way. In this case, moreover, the carriers and stitch target sizes are the same, and the stitch cams can be adjusted accurately even with fewer loop length routines.

[0012] In stitch control scheme setting there are set, as control schemes, at least a first scheme in which a yam consumption amount is compared with a yam amount calculated on the basis of stitch size in the knitting data, and is fed back to a stitch cam, and a second scheme in which the yam consumption amount is compared with a yam consumption amount in a sample knitted fabric, and is fed back to the stitch cam. The first scheme is preferentially allocated to an area of large knitting width and of plain or ribbed knitting structure. The second scheme is preferentially allocated to an area of narrow knitting width and of jacquard knitting structure. Thus, there can be used the first scheme that involves knitting at a designated stitch size in areas where stitches can be knitted easily according to the target stitch size, and there can be used the second scheme that involves knitting with the same yam consumption amount as that of a sample, in areas where knitting according to the target size is difficult, so that stitch cams can be controlled according to schemes correspond to the areas.

[0013]

Fig. 1 is a block diagram illustrating a design system in an example, and illustrating a flatbed knitting machine;
Fig. 2 is a diagram illustrating stitch control data setting in an example;
Fig. 3 is a diagram illustrating a stitch control data setting program in an example;
Fig. 4 is a diagram illustrating loop routine setting in an example;
Fig. 5 is a diagram illustrating a loop routine setting program in an example;
Fig. 6 is a diagram illustrating an example of stitch control and loop routine setting;
and
Fig. 7 is a diagram illustrating an example of stitch control and loop routine setting, in particular, merging of loop length routines in multiple-cam knitting.

[0014] Optimal embodiments for carrying out the invention are explained below.

Examples

[0015] Examples are explained in Fig. 1 to Fig. 7. In the figures, the reference numeral 2 denotes a design system and 4 a flatbed knitting machine. The design system 2 and the flatbed knitting machine 4 are connected by way of an LAN 6. A storage medium such as a CD-ROM or the like may also be used to connect the design system 2 and the flatbed knitting machine 4. The design system 2 comprises a bus 8, and input/output units such as a color monitor 9, a keyboard 10, a color printer 11, a mouse 12 or the like. Other than the mouse 12 there may

also be provided a manual input unit such as a trackball, a joystick or a stylus.

[0016] The reference numeral 15 denotes a 3D graphic system that simulates three-dimensionally the state of knitted fabric that is knitted in accordance with knitting data. For instance, yam layout is simulated in three dimensions on the basis of the knitting data. The reference numeral 16 denotes a file memory in which there are stored various files and knitting data, as well as setting programs of, for instance, a loop length routine. In the explanation below, the design system 2 operates in accordance with a program stored in the file memory 16, but the design system 2 is not limited thereto. The reference numeral 17 denotes an image memory in which there are stored, for instance, images that correspond to simulation data and knitting data.

[0017] The reference numeral 20 denotes a knit design unit that designs a knitted fabric and/or a garment in accordance with inputs from the keyboard 10, the mouse 12 or the like. In the present description, the knitted fabric includes also a garment. The reference numeral 21 denotes a data conversion that converts design data obtained from the knit design unit 20 to knitting data that can be executed in the flatbed knitting machine 4. The knitting data includes data on what operation is to be performed by the needles of a needle bed, and from what carrier yam is to be supplied, during the travel of a carriage over needle beds 41 of the flatbed knitting machine 4. In the knitting data there is designated, for each area, a target loop length for the stitches or a loop number corresponding to a target loop length. The type of each stitch is also learned from the knitting data.

[0018] A knitting data analyzer 22 analyzes the knitting data according to a knitting data analysis instruction 51, and acquires, for instance, the knitting width stitch target size, the number of the cam system that is used, and the stitch type, for each area. A stitch control system settings 23 decides which feedback control scheme to use for the carriage stitch cam, on the basis of the results of the analysis of knitting data. This scheme is carried out for area units, specifically for combinations units of cam systems and carriers in the area.

[0019] A loop routine setting 24 performs setting relating to loop length routine, and decides which loop length routine scheme to perform, to what stitch target size and what knitting width, using a combination of which cam system and which carrier . There are three loop length routine schemes, depending on the knitting structure, for instance a scheme for plain knitting (loop length routine 1), a scheme for rib kitting or the like (loop length routine 2), and a scheme for jacquard or the like (loop length routine 3).

[0020] An LAN interface 30 sends knitting data, together with, for instance, control data and setting data for a loop length routine, to a controller 46 of the flatbed knitting machine 4. A disc drive 31 outputs these data to a disc, thereby allowing the data to be read by a disc drive, not shown, of the controller 46.

[0021] The flatbed knitting machine 4 comprises at least a pair of front and rear needle beds 41. A carriage 42 moves back and forth along the top of the needle beds 41. The carriage 42 comprises, for instance, two cam systems S1, S2. The cam systems S1, S2 knit a knitted fabric by operating the needles of the needle beds 41. The number of cam systems ranges from one to, for instance, four. The cam systems S1, S2 comprise respective stitch cams that can be adjusted by way of a motor. The stitch cams pull the needles down towards the needle bed, after the yam is hooked by the needles. Stitch size, i.e. the yam length per stitch, can be controlled by adjusting the extent of needle pull-down by the stitch cams.

[0022] The carriage 42 carries the plurality of carriers 43 along, and supplies yam from the carriers 43 to the needles. The yam is supplied from cones 45 by way of an encoder 44. The length of yam paid out is measured by the encoder 44. The type of the encoder 44 is arbitrary. Also, there may be added a device for pulling back the yam paid out from the encoder 44. The reference numeral 46 denotes the above controller that works out the yam consumption amount on the basis of signals from the encoder 44, and that controls the carriage 42 to cause thereby the needle beds 41 to move back and forth and to carry the designated carriers 43 along. The stitch cams of the cam systems S1, S2 are adjusted, to bring the stitch size closer to a target value, on the basis of the yam consumption amount from the encoder 44.

[0023] Fig. 2 and Fig. 3 illustrate stitch cam setting and a stitch control data setting program 50. Knitting data is analyzed by the knitting data analyzer 22, according to a knitting data analysis instruction 51, to elucidate as a result the knitting structure and the knitting width of each area. Next, a stitch control scheme is allocated according to a stitch control scheme allocation instruction 52. A "control" scheme is used in knitting areas of large knitting width, for rib structures and plain structures. In this scheme there is compared a yam consumption amount and a target loop size in the knitting data, for one to a plurality of course units. To avoid confusion with other control schemes, this scheme is also referred to hereafter as "course unit control" scheme.

[0024] A "sampling/comparison" scheme is used when the knitting width is medium. No feedback control of the stitch cams is carried out when the knitting width is small. In jacquard structures, stitch cams are not controlled when the knitting width is small, but are controlled in accordance with a "sampling/comparison" scheme when the knitting width is medium to large. The above rules are stored in a rule table 26, but may be stored in a database or the like, instead of a table. Herein, a large knitting width denotes, for instance, 25 cm or more, a medium knitting width denotes 12.5 to 25 cm, and a small knitting width denotes a width smaller than 12.5 cm.

[0025] In the "course unit control" scheme, the yam consumption amount calculated on the basis of the stitch size designated by the knitting data, i.e. the loop length per stitch, is compared with the actual yam consumption

amount, and is fed back to the stitch cams. The yam consumption amount calculated on the basis of the loop length per stitch is a kind of theoretical value relating to the yam consumption amount. Examples of feedback units include, for instance, three kinds of units, namely feedback for each course, feedback for each back-and-forth travel of the carriage, i.e. for every two courses, or feedback in which the yam consumption amount is integrated over three or more courses. The above types are selected depending on the size of the knitting width.

[0026] In the "sampling/comparison" scheme, feedback control is performed on the stitch cams in such a manner so as to achieve a yam consumption amount identical to that of a knitted fabric sample. The frequency of feedback control, for instance it terms of yam consumption amount, ranges for instance from 1 to 30 m. If there is knitted at least a sample of an area that utilizes a sampling/comparison scheme in a sample that has a satisfactory texture, then the shape of the sample may be different from that of the knitted fabric that is actually knitted. The above applies also to the case of a control scheme in course units. In case of complex structures such as jacquard or the like, it is difficult to accurately specify the yam consumption amount on the basis of knitting data. Also, carriers are frequently switched during the knitting process, and hence it is likewise difficult to control accurately the yam consumption amount. Accordingly, stitch cams are controlled in such a way so as achieve a yam consumption amount identical to that of a sample that is taken as a reference. As the "course unit control" scheme and the "sampling/comparison" scheme become more difficult to utilize, feedback control of the stitch cams is no longer carried out in case of narrow knitting width or in cases were multiple-color jacquard is used. The initial adjustment of the stitch cams is performed in the loop length routine, even if no feedback control is carried out.

[0027] In the merge instruction 53 of Fig. 3, a narrow area is merged into a large area. For instance, the "course unit control" scheme and the "sampling/comparison" scheme are used for a combination of a carrier C1 and a cam system S1. In case that the area of the "sampling/comparison" scheme is narrower than the area of the "course unit control" scheme, the entire area of the combination of the carrier C1 and the cam system S1 is processed in accordance with the "course unit control" scheme. In a standard process in the merge instruction 53, for instance, a narrow-area control scheme is matched with a large-area control scheme.

[0028] In the user edit instruction 54, the user can edit stitch control setting data, via the keyboard 10, the mouse 12 or the like. For instance, a small area merged according to the merge instruction 53 may be more important to the user than a large area nearby. In this case, the user can unify the control scheme to, for instance, the "sampling/comparison" scheme, which is appropriate for small areas.

[0029] Fig. 4 illustrates loop routine setting and Fig. 5 illustrates a loop routine setting program 60. In the loop length routine, a loop target size is designated for each combination of carrier and cam system, and there is decided which loop length routine is executed. There is also decided the knitting width of the knitted fabric that is knitted in accordance with the loop length routine. In the acquisition instruction 61 of the stitch control scheme, the loop routine settings 24 acquires a stitch control scheme from the stitch control system settings 23. The stitch control scheme designates the scheme according to which the stitches are controlled in each combination of carrier and cam system.

[0030] Next, there is acquired, from the knitting data, the type of knitting structure for each area, for instance plain, rib, jacquard or the like, as well as the loop length for each area. This instruction is a knitting structure/loop length acquisition instruction 62. Next, the conditions of the loop length routine for each area are temporarily set in a loop length routine temporary setting instruction 63. Specifically, a loop length routine scheme is decided for each area. A loop length routine 1 (scheme 1) is used for plain knitting. The length resulting from adding the loop length for each stitch is taken as the target consumed yam length in the loop length routine. A loop length routine 2 (scheme 2) is used as the loop length routine scheme for rib structures. The result of adding the prolongation length to the loop length of each stitch is taken as the target value of consumed yam length in the loop length routine. The result of adding loop target sizes is used also in a scheme 3 suitable for jacquard and the like. Herein, the loop target size includes prolongation portions. When in loop length routines 1, 2 the target loop lengths are dissimilar, the adjustment values of the stitch cams are not shared, even if the cam system and the carrier are the same, but are further adjusted in accordance with the difference between target loop lengths. By contrast, when the cam system and the carrier are the same in the loop length routine 3 (scheme 3), for instance the adjustment values of the stitch cams are shared, even if the target loop lengths are dissimilar. As described above, a loop target size (consumed yam length) is designated for each area in a loop length routine. The knitting width of the area is set as the knitting width in the loop length routine.

[0031] In the merge instruction 64 there are merged routines for which the same carrier and cam system are used and for which the routine scheme is the same. For instance, a loop size is designated for a main area, and a loop length routine is executed, in a case where the loop length target sizes are dissimilar from among routines for which the combination of carrier and cam system is the same but the loop length routine schemes are different. Alternatively, the loop length routine is set by designating a loop length for an area that is knitted initially. For other areas, the stitch cams are adjusted in such a manner so as to add an adjustment value according to a difference in loop length. In the merge instruction 65 there are merged next routines for which the same carrier

but a different system is used, and for which the routine scheme is the same and the loop target size is the same, to reduce the number of loop length routines. User editing is performed in the user edit instruction 66. This concludes the setting of the loop length routine. If the knitting width is different in the merge instructions 64, 65 depending on the area, there is used, for instance, the larger knitting width, or alternatively, the knitting width corresponding to the area that is knitted first.

[0032] Fig. 6 and Fig. 7 illustrate examples of stitch control scheme setting and of loop routine setting. In a garment 70 of Fig. 6, the reference numeral 71 denotes a hem knit portion comprising a rib structure, 72 denotes a main body, and 73, 74 denote two shoulder portions, left and right. The knitting width of the hem knit portion 71 is large enough, and hence the stitch control scheme is a "course unit control" scheme. The structure is ribbed, and hence the loop length routine scheme is 2. In the main body 72, the knitting width is large and the structure is plain. Hence, the stitch control scheme is a "course unit control" scheme, and the loop length routine scheme is 1.

[0033] At the shoulder portions 73, 74, the structure is plain and the knitting width is small. Hence, the stitch control scheme is a "sampling/comparison" scheme or, alternatively, the stitch control is turned off. In case that stitch control is turned off, the loop length routine may be omitted even if, for instance, the loop length routine 3 is executed. In a case of the "sampling/comparison" scheme, there is executed the loop length routine 3. The stitch control scheme, the loop length routine scheme and so forth can be automatically set on the basis of knitting data, as described above.

[0034] In a garment 80 of Fig. 7, the reference numeral 81 denotes a hem knit portion. Areas 82 to 85, which make up a main body, use two types of yam. Therefore, the carriers C1, C2 and cam systems S1, S2 are selectively assigned to the areas. Area 82 and area 85 have the same carrier but a different cam system. The knitting structure is plain in both cases, and the corresponding loop length routine is scheme 1. The target loop size is the same. Area 83 and area 84 have the same carrier but a different cam system. The knitting structure is plain in both cases, and the corresponding loop length routine is scheme 1. The target loop size is the same.

[0035] The loop length routines can be merged provided that, for instance, the knitting structure is the same (same type of loop length routine) and the target loop size is shared, for areas having the same carrier but a different cam system. Herein, there are executed the loop length routine for area 82 and the loop length routine for area 83, while the loop length routines for areas 84, 85 are omitted. The result of the loop length routine for area 82 is copied to the cam system S2 upon start of knitting in area 85. The execution result of the loop length routine for area 83 is copied to the cam system S1 upon start of knitting in area 84. Also, correction values of stitch cams at a time halfway during knitting of the actual knitted fabric may be copied for the areas in which loop length routines are merged. The reference numerals 86, 87 denote the area of both shoulders. The process for the area is the same as that of the two shoulder portions 73, 74 in Fig. 6.

[0036] The loop length routine result can be copied to another stitch cam, and the number of loop length routines can be reduced also in case that stitch target sizes are different or the knitting structures are different. When, for instance, the stitch target sizes are different, the adjustment value of the stitch cam may be corrected in proportion and then copied. When the knitting structures are different, the adjustment value of the stitch cam may be corrected in proportion and then copied.

[0037] The present embodiment elicits the following effects.

1) Setting of the control scheme of the stitch cams and setting of the loop length routine can be performed substantially automatically.
2) Loop length routines can be merged for areas having the same carrier but different cam systems.
3) An optimal stitch cam control scheme can be set automatically in accordance with the knitting width and the type of knitting structure.

[0038]

2	design system
4	flatbed knitting machine
6	LAN
8	bus
9	color monitor
10	keyboard
11	color printer
12	mouse
15	3D graphic system
16	file memory
17	image memory
20	knit design unit
21	data conversion
22	knitting data analyzer
23	stitch control system settings
24	loop routine settings
26	rule table
27	merge
30	LAN interface
31	disc drive
41	needle bed
42	carriage
43	carrier
44	encoder
45	cone
46	controller
50	stitch control data setting program
51	knitting data analysis instruction
52	stitch control scheme allocation instruction
53	merge instruction
54	user edit instruction

60	loop routine setting program
61	stitch control scheme acquisition instruction
62	knitting structure / loop length acquisition instruction
63	loop length routine temporary setting instruction
64, 65	merge instruction
66	user edit instruction
70,	80 garment
71, 81	hem knit portion
72	main body
73,	74 shoulder portions
82 to 87	area

Claims

1. A device for loop routine setting (2) for carrying out setting relating to a loop length routine for a flatbed knitting machine (4) in which
yam is supplied from a plurality of carriers (43), a knitted fabric is knitted through operation of needles of needle beds (41) by a cam system in a carriage (42) that moves back and forth over at least a pair of front and rear needle beds (41), yam is supplied to the carriers (43) via a yam length measurement device (44),
a stitch size is adjusted in the cam system through stitch cam control, and
a loop length routine is executed for acquiring stitch cam adjustment data, before knitting the knitted fabric,
the device for loop routine setting (2) being **characterized in** comprising:

a stitch control system setting (23) that analyzes knitting data for knitting a knitted fabric formed of a plurality of areas, in the flatbed knitting machine (4), and that sets a stitch cam control scheme for each area, on the basis of a knitting structure and a knitting width of each area; and
a loop routine settings (24) that sets a loop length routine scheme and a stitch target size in a loop length routine, on the basis of a control scheme of each area and on the basis of the knitting structure and a stitch target size of each area.

2. The device for loop routine setting (2) according to claim 1, **characterized in that** the carriage (42) comprises a plurality of cam systems, and
the loop routine settings (24) sets a loop length routine scheme and a stitch target size in a loop length routine, in combination units of carriers (43) and cam systems.

3. The device for loop routine setting (2) according to claim 2, **characterized in that** the loop routine settings (24) is provided with a merge (27) that detects the presence of a first area of knitting in use of a first carrier, a first cam system, a first stitch target size and a first knitting structure, and a second area of knitting in use of the first carrier, a second cam system, the first stitch target size and the first knitting structure, and that executes a single loop length routine, for both the first area and the second area, in use of the first carrier, the first stitch target size and the first knitting structure, and also in use of only one from among the first and the second cam systems, and further that utilizes adjustment data, acquired in the loop length routine, for both the first cam system in the first area and the second cam system in the second area.

4. The device for loop routine setting (2) according to claim 1, **characterized in that** the stitch control system setting (23) sets, as control schemes, at least a first scheme in which a yam consumption amount is compared with a yam amount calculated on the basis of a stitch size in the knitting data, and a result thereof is fed back to a stitch cam, and a second scheme in which the yam consumption amount is compared with a yam consumption amount in a sample knitted fabric, and a result thereof is fed back to the stitch cam; and
the stitch control system setting (23) comprises a rule storage that preferentially allocates the first scheme to an area of large knitting width and of plain or ribbed knitting structure, and preferentially allocates the second scheme to an area of narrow knitting width and of jacquard knitting structure.

5. A program for loop routine setting (60) for a device that carries out setting relating to a loop length routine for a flatbed knitting machine (4) in which
yam is supplied from a plurality of carriers (43), a knitted fabric is knitted through operation of needles of needle beds (41) by a cam system in a carriage (42) that moves back and forth over at least a pair of front and rear needle beds (41), yam is supplied to the carriers (43) via a yam length measurement device (44),
a stitch size is adjusted in the cam system through stitch cam control, and
a loop length routine is executed for acquiring stitch cam adjustment data, before knitting of the knitted fabric,
the program for loop routine setting (60) being **characterized in** comprising:

a stitch control system setting instruction for analyzing knitting data for knitting a knitted fabric comprising a plurality of areas, in the flatbed knitting machine (4), and setting a stitch cam control scheme for each area, on the basis of a knitting structure and a knitting width of each area; and
a loop routine setting instruction for setting a

loop length routine scheme and a stitch target size in a loop length routine, on the basis of a control scheme of each area and on the basis of the knitting structure and a stitch target size of each area.

6. The loop routine setting program (60) according to claim 5, **characterized in that** the carriage (42) comprises a plurality of cam systems,
the loop routine setting instruction sets a loop length routine scheme and a stitch target size in a loop length routine, in combination units of carriers (43) and cam systems; and
the loop routine setting instruction is provided with a merging instruction (64, 65) for detecting the presence of a first area of knitting in use of a first carrier, a first cam system, a first stitch target size and a first knitting structure, and a second area of knitting in use of the first carrier, a second cam system, the first stitch target size and the first knitting structure; and for executing a single loop length routine, for both the first area and the second area, in use of the first carrier, the first stitch target size and the first knitting structure, and also in use of only one from among the first and the second cam systems; and for utilizing adjustment data, acquired in the loop length routine, for both the first cam system in the first area and the second cam system in the second area.

FIG. 1

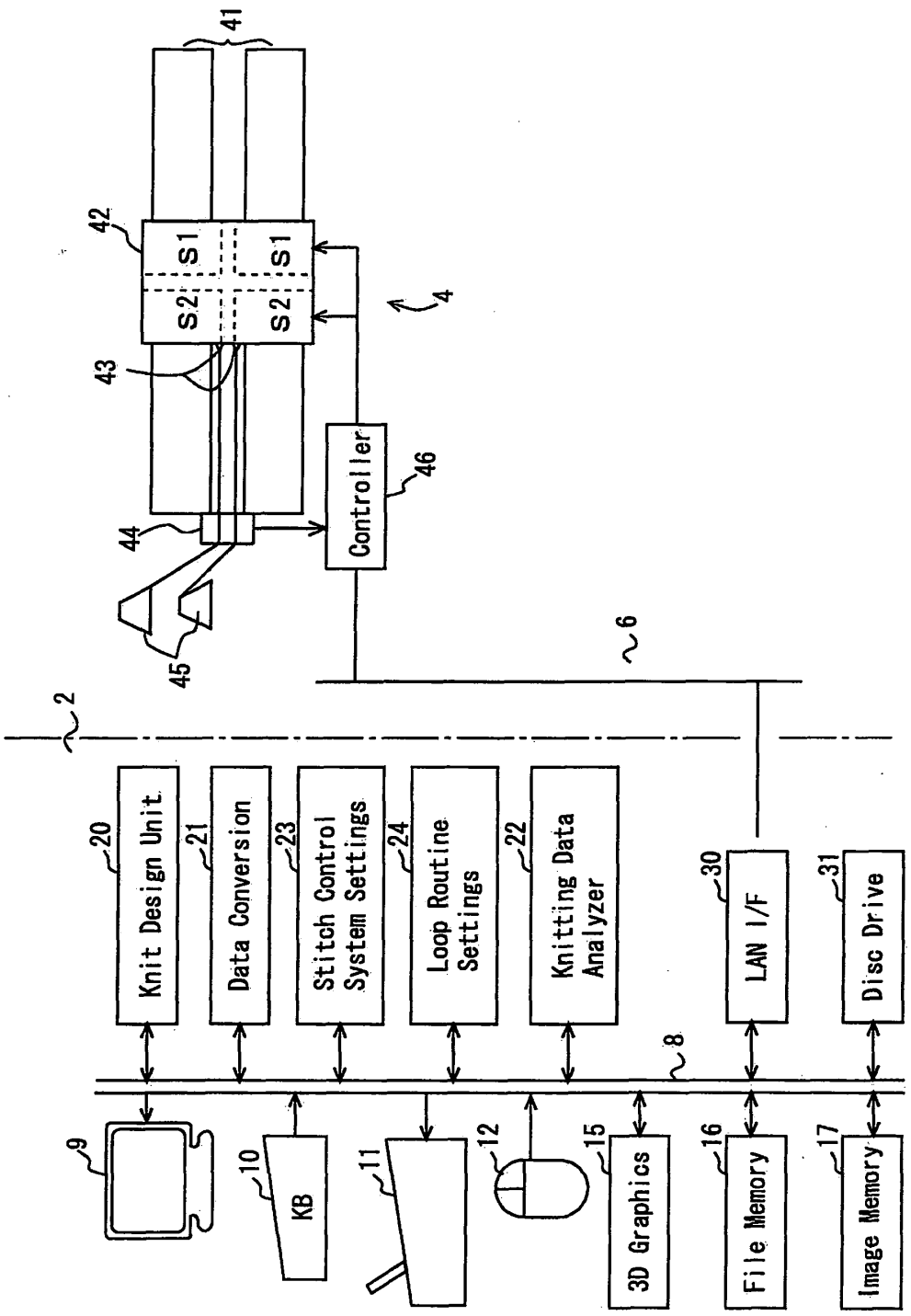

41
42
S1
S1
S2
S2
4
43
Controller
46
44
45
6
2
20
Knit Design Unit
21
Data Conversion
23
Stitch Control System Settings
24
Loop Routine Settings
22
Knitting Data Analyzer
30
LAN I/F
31
Disc Drive
8
9
10
KB
11
12
15
3D Graphics
16
File Memory
17
Image Memory

FIG. 2

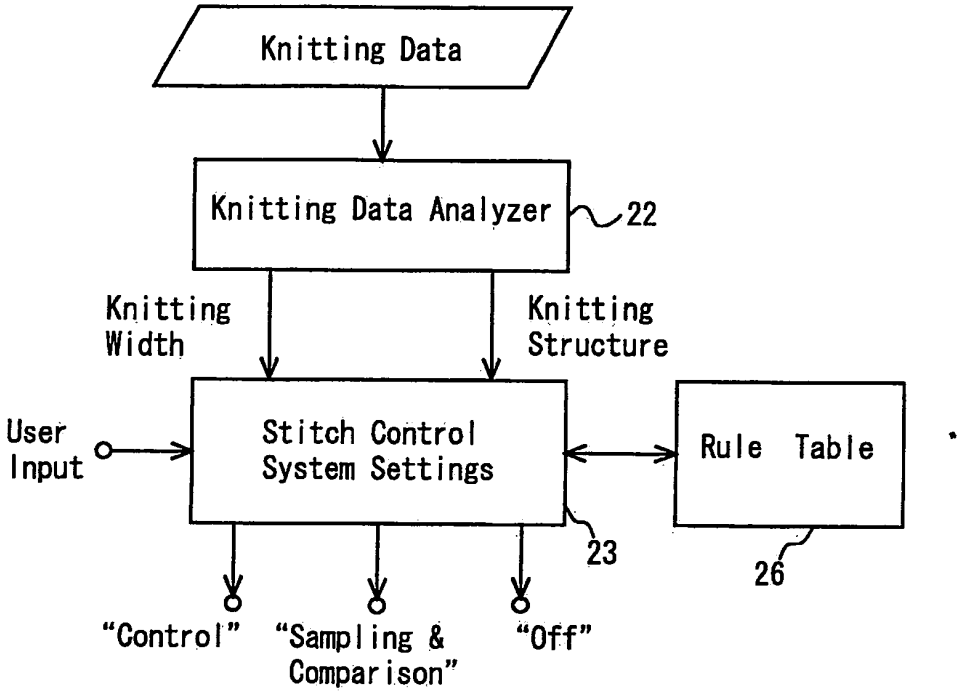

Knitting Data
Knitting Data Analyzer
22
Knitting Width
Knitting Structure
User Input
Stitch Control System Settings
Rule Table
23
26
"Control"
"Sampling & Comparison"
"Off"

FIG. 3

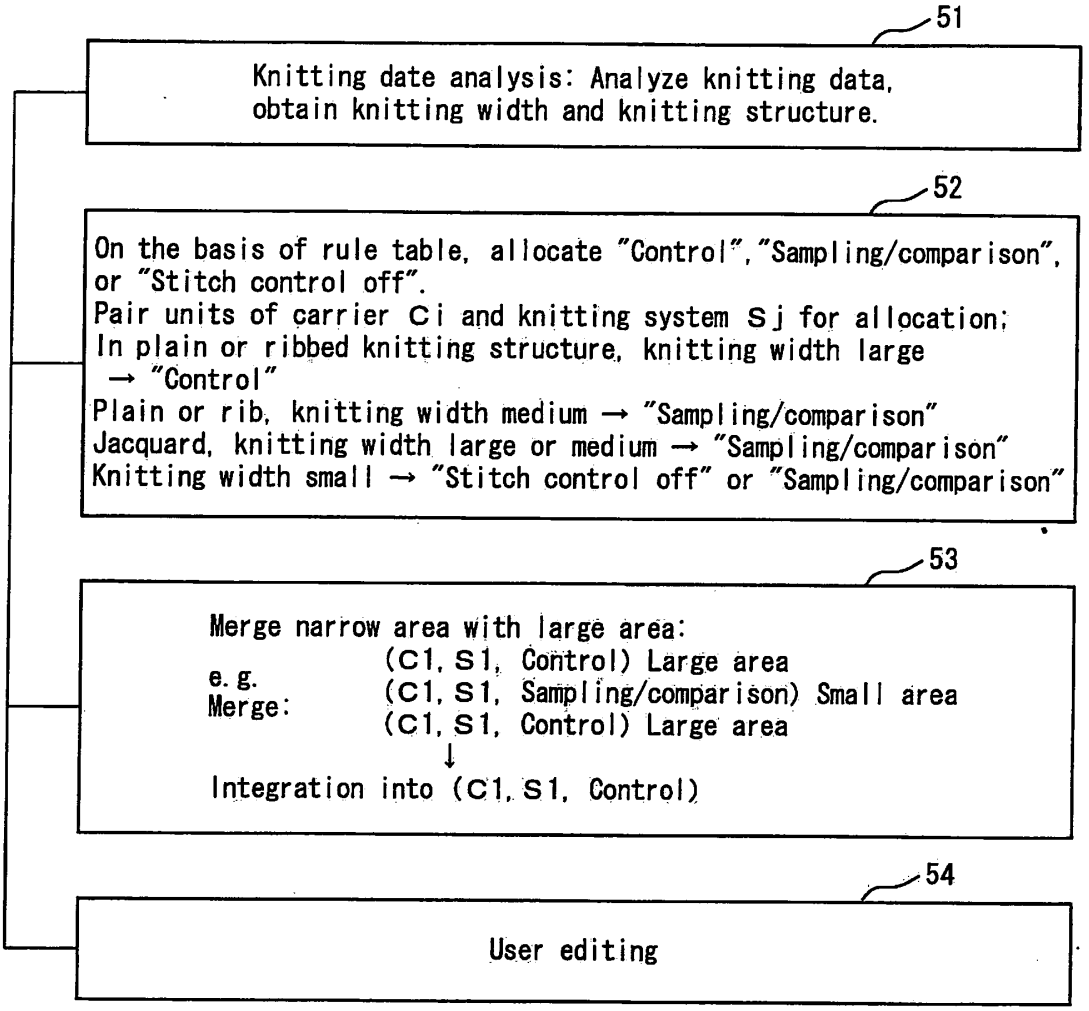

51
Knitting date analysis: Analyze knitting data, obtain knitting width and knitting structure.
52
On the basis of rule table, allocate "Control","Sampling/comparison", or "Stitch control off".
Pair units of carrier Ci and knitting system Sj for allocation;
In plain or ribbed knitting structure, knitting width large → "Control"
Plain or rib, knitting width medium → "Sampling/comparison"
Jacquard, knitting width large or medium → "Sampling/comparison"
Knitting width small → "Stitch control off" or "Sampling/comparison"
53
Merge narrow area with large area:
e.g.
Merge:
(C1, S1, Control) Large area
(C1, S1, Sampling/comparison) Small area
(C1, S1, Control) Large area
↓
Integration into (C1, S1, Control)
54
User editing
50

FIG. 4

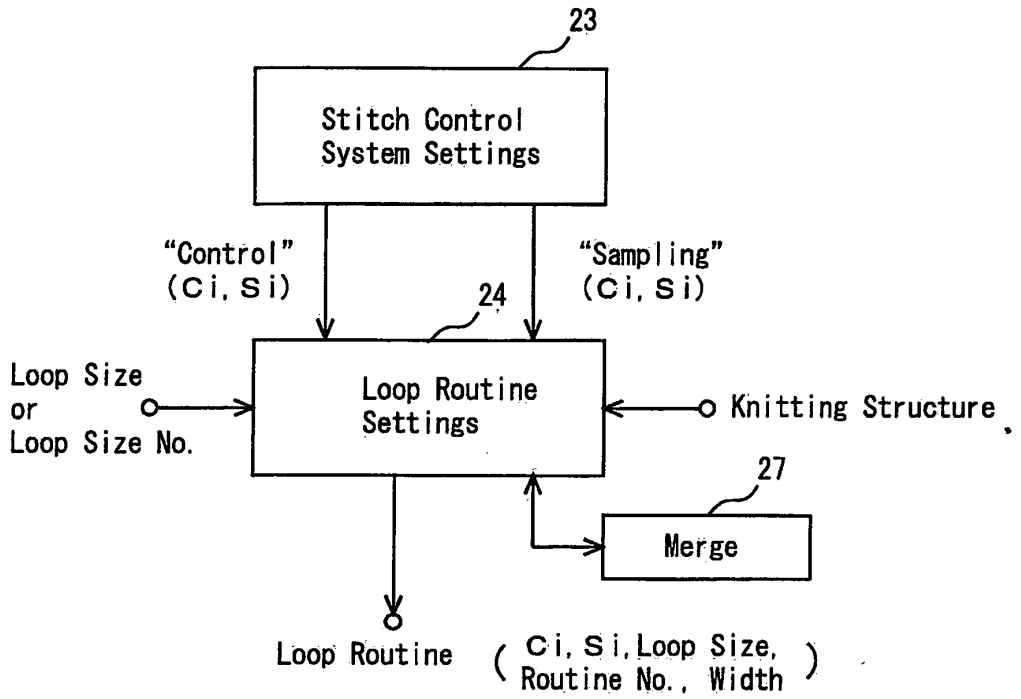

23
Stitch Control System Settings
"Control" (Ci, Si)
"Sampling" (Ci, Si)
24
Loop Size or Loop Size No.
Loop Routine Settings
Knitting Structure
27
Merge
Loop Routine
(Ci, Si, Loop Size, Routine No., Width)

FIG. 5

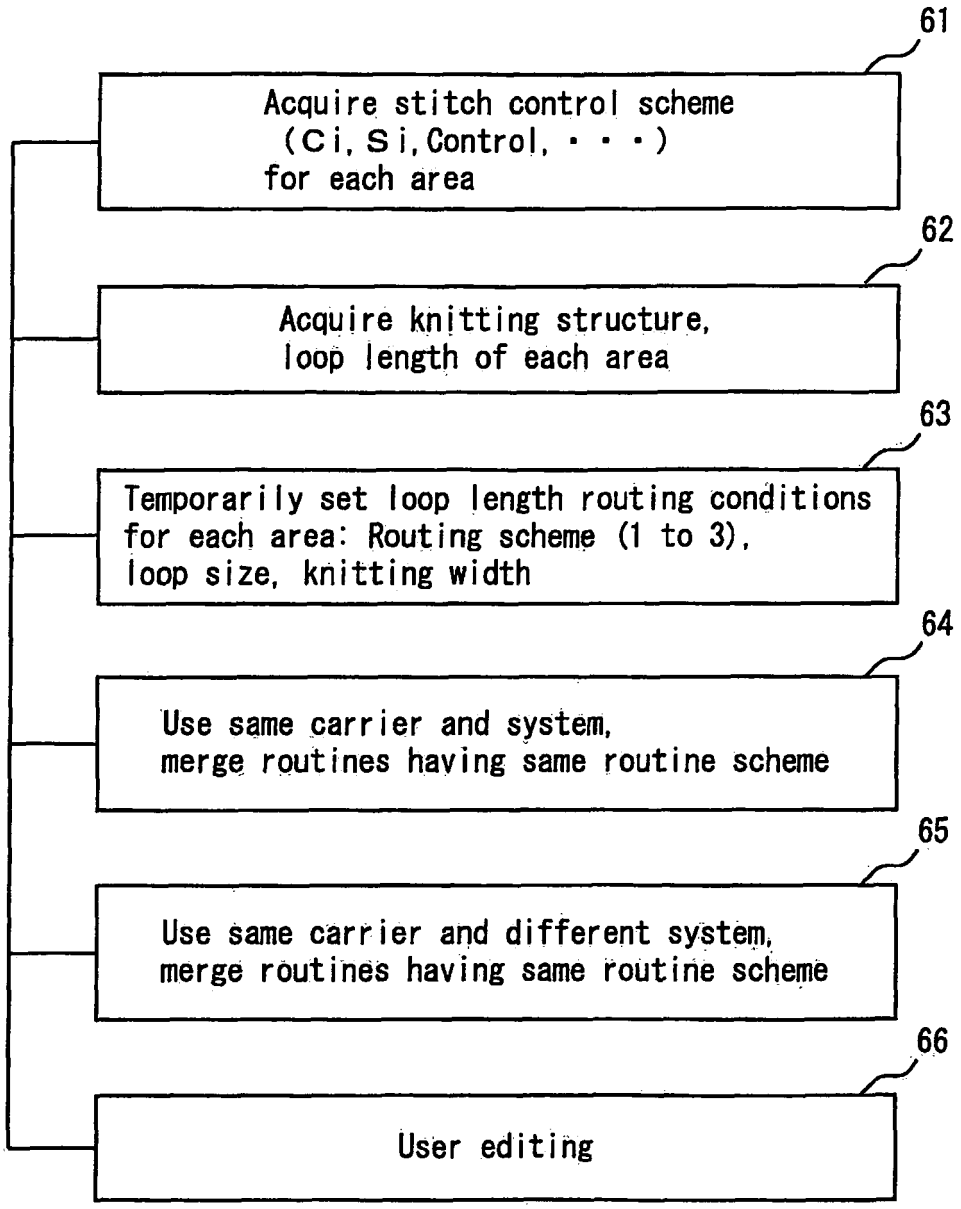

61
Acquire stitch control scheme
(Ci, Si, Control, ・・・)
for each area
62
Acquire knitting structure,
loop length of each area
63
Temporarily set loop length routing conditions
for each area: Routing scheme (1 to 3),
loop size, knitting width
64
Use same carrier and system,
merge routines having same routine scheme
65
Use same carrier and different system,
merge routines having same routine scheme
66
User editing
60

FIG. 6

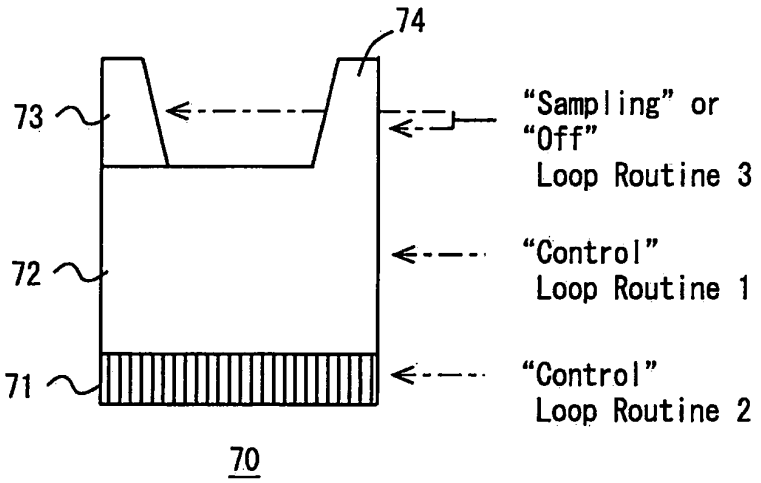
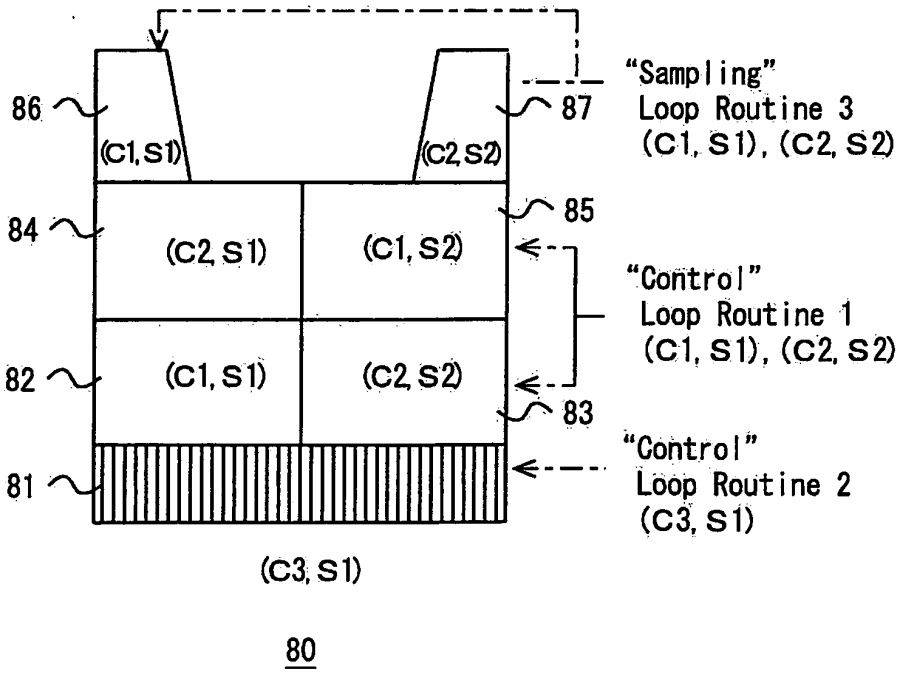

74
73
72
71
"Sampling" or "Off" Loop Routine 3
"Control" Loop Routine 1
"Control" Loop Routine 2
70

FIG. 7


86
(C1, S1)
87
(C2, S2)
"Sampling" Loop Routine 3 (C1, S1), (C2, S2)
84
(C2, S1)
(C1, S2)
85
"Control" Loop Routine 1 (C1, S1), (C2, S2)
82
(C1, S1)
(C2, S2)
83
81
"Control" Loop Routine 2 (C3, S1)
(C3, S1)
80

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/057889

A. CLASSIFICATION OF SUBJECT MATTER
D04B15/48(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, 15/48-15/52

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 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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.
X Y	WO 2008/016028 A1 (Shima Seiki Mfg., Ltd.), 07 February, 2008 (07.02.08), (Family: none)	1,2,4,5 3,6
Y	JP 11-57261 A (Brother Industries, Ltd.), 02 March, 1999 (02.03.99), & US 5954004 A	3,6
A	JP 2001-3247 A (Tsudakoma Corp.), 09 January, 2001 (09.01.01), (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 May, 2009 (14.05.09)	09 June, 2009 (09.06.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/057889

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006-183176 A (Shima Seiki Mfg., Ltd.), 13 July, 2006 (13.07.06), & US 2008/0167749 A1 & EP 1832674 A1 & WO 2006/070636 A1 & KR 10-2007-0089682 A & CN 101091012 A	1-6
A	JP 2952391 B2 (Shima Seiki Mfg., Ltd.), 27 September, 1999 (27.09.99), & IT 1259362 A	1-6
A	JP 3554088 B2 (Shima Seiki Mfg., Ltd.), 11 August, 2004 (11.08.04), & EP 699792 A1 & DE 69506341 C	1-6
A	JP 3603031 B2 (Shima Seiki Mfg., Ltd.), 15 December, 2004 (15.12.04), & US 2002/0139152 A1 & EP 1231310 A1 & KR 10-2002-0064200 A & CN 1369422 A	1-6

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Patent documents cited in the description

- JP 2952391 B **[0003] [0004]**
- JP 3554088 B **[0003] [0004]**
- JP 3603031 B **[0003] [0004]**