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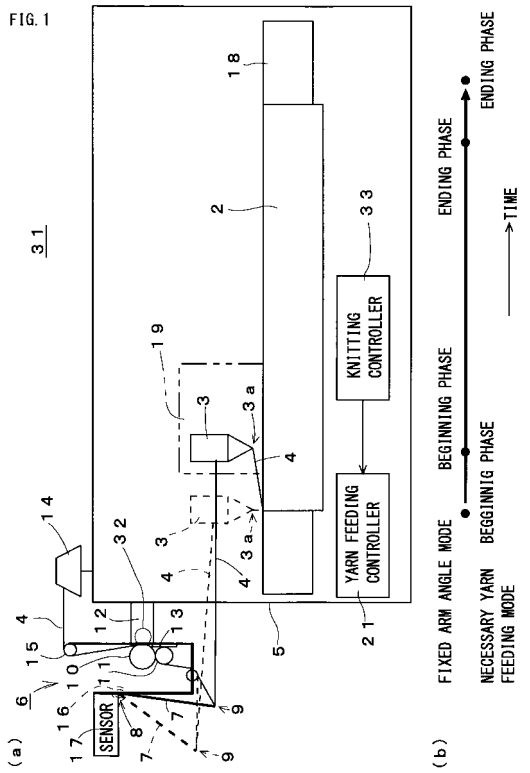
(54) FLAT KNITTING MACHINE

(57) To provide a flatbed knitting machine that can maintain the accuracy for the feed lengths of knitting yarn even when remedial process is performed while the yarn is being fed in a necessary yarn feeding mode.

In a flatbed knitting machine 31, the rotational angle of a master roller 10 of a yarn feeding device 6 is detected by an encoder 32. As the tilt angle of a buffer arm 7 approaches the lower limit or the upper limit in the midst of the necessary yarn feeding mode, the mode is switched to a fixed arm angle mode as remedial process. A knitting controller 33 performs stitch adjustment even during remedial process. The length of knitting yarn 4 fed from between the master roller 10 and a slave roller 11 to the buffer arm 7 is calculated on the basis of the difference in the rotational angles detected by the encoder 32. As shown in (b), the timing of measurement by the encoder 32 at which the knitting controller 33 performs stitch adjustment in the fixed arm angle mode corresponds to the inside of the knitting width.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a flatbed knitting machine that can compute and feed the length of knitting yarn necessary for knitting fabric in accordance with a knitting data.

Background Art

[0002] The flatbed knitting machine has been required to achieve uniform products by stabilizing a stitch loop length of a fabric to be knitted. This kind of request is achieved by having stitch adjustment in such a manner that a fabric is able to be knitted with knitting yarn of computed length in just proportion while computing and feeding the length of the knitting yarn necessary for knitting (for example, see Patent Citation 1).

[0003] Fig. 5 shows a structure of a flatbed knitting machine 1 disclosed as Fig. 1 in the Patent Citation 1. However references are changed for convenience of explanation. The flatbed knitting machine 1 feeds knitting yarn 4 to knitting needles, whose illustration is omitted, from a yarn feeder port 3a of a yarn feeding member 3, such as yarn feeder, in order to knit fabric 2. To a side cover 5 of the flatbed knitting machine 1, a yarn feeding device 6 is installed for feeding the knitting yarn 4 to the yarn feeding member 3. In the route in which the knitting yarn 4 is supplied from the yarn feeding device 6, a buffer arm 7 is equipped. A rod-form portion of the buffer arm 7 from a base end side 8, which acts as a fulcrum, to a head end side 9 is capable of oscillating displacement.

[0004] The yarn feeding device 6 is able to send out the knitting yarn 4 to the buffer arm 7 side or pull back the knitting yarn 4 from the buffer arm 7 side, with the knitting yarn 4 clipped between a master roller 10 and a slave roller 11. The master roller 10 is mounted to a rotary shaft of a servo motor 12. The slave roller 11 is driven by the servo motor 12 via a driving mechanism 13 formed by combining a plurality of gears or the like. A cone 14 that feeds the knitting yarn 4 is installed above the frame of the flatbed knitting machine 1. The knitting yarn 4 taken out from the cone 14 is guided between the master roller 10 and the slave roller 11 of the yarn feeding device 6 via a relay roller 15.

[0005] The buffer arm 7 is energized in the direction where the head end side 9 rolls away from the side cover 5 by a torque spring 16 equipped to the base end side 8. When the knitting yarn 4 is threaded to the head end side 9 of the buffer arm 7, the buffer arm 7 tilts at an angle in which the energizing force and the tension of the knitting yarn 4 equilibrate. The buffer arm 7 has a buffer function to pull in and store the knitting yarn 4 and send out the knitting yarn 4 by increasing and decreasing the tilt angle. In this way, the tilt angle of the buffer arm 7 relates to the length of the knitting yarn 4 to be stored, and therefore, a tilt angle sensor 17 to detect this tilt angle is installed.

[0006] In the flatbed knitting machine 1, a needle bed 18 for knitting the fabric 2 is installed linearly. To the needle bed 18, a large number of knitting needles, which are capable of sliding displacement vertical to this linear direction, are arranged in parallel. The knitting needle is selectively driven by a knitting cam mounted to a carriage 19 reciprocating along the needle bed 18. The knitting needles are selectively driven by knitting cams mounted on a carriage 19 which makes a reciprocating run along the needle bed 18. The knitting needle is driven in such a manner that a hook at the head end advances to or retreats from a needle bed gap formed on one side of the needle bed 18. The hook, when advances into the needle bed gap and receives the knitting yarn 4 fed from the feeder port 3a of the yarn feeding member 3 which is brought by the carriage 19, is pulled into the needle bed 18 to form a knitted loop. The knitting operation of the flatbed knitting machine 1 is controlled by a knitting controller 20. The knitting controller 20 controls the carriage 19 and knitting cams in accordance with the knitting data created in advance and knits the fabric. A yarn feeding controller 21 computes the length of the knitting yarn 4 fed from the yarn feeding device 6 in accordance with the knitting data for the fabric to be knitted. The total value of the loop length of stitches that compose one course becomes the theoretical knitting yarn length. The knitting controller 20 carries out stitch adjustment so that the knitting yarn is knitted into the fabric in proper quantities while the yarn having the theoretical length is supplied. In the stitch adjustment, the pull-in rate is corrected when the knitting cam pulls in the knitting needle into the needle bed 18. By combining the supply of the knitting yarn 4 and stitch adjustment in this kind of necessary yarn feeding mode, high-quality fabric with the stitch loop length made uniform can be obtained.

[0007] Fig. 6 shows a partial structure including the yarn feeding device 6 and the buffer arm 7 of Fig. 5. The buffer function by the buffer arm 7 is brought out when the tilt angle falls into a certain range. For example, when the tension of the knitting yarn 4 becomes too large, the tilt angle of the buffer arm 7 remains in the vicinity of the lower limit. Further the tension becomes too small, the tilt angle of the buffer arm 7 remains in the vicinity of the upper limit. On the size of the stitch loop formed by pull-in of the knitting yarn 4 by the knitting needle, tension of the knitting yarn 4 exerts big effect, too. Consequently, even in the fixed arm angle mode that controls the supply state of the knitting yarn 4 so that the tilt angle of the buffer arm 7 as the buffer condition is kept constant, the stitch loop length is expected to be made uniform by a combined use of stitch adjustment (for example, see Patent Citation 2).

Patent Citation 1: Japanese Patent No. 4016030
Patent Citation 2: Japanese Patent No. 3603031

Disclosure of Invention

Technical Problem

[0008] Feeding of the knitting yarn 4 in the fixed arm angle mode is unable to be done in such a manner as to hold the tilt angle of the buffer arm 7 completely constant. The length of the knitting yarn 4 to be knitted into the fabric 2 rapidly increases when the knitting needle is pulled in by the action of the stitch cam in the knitting cam. It is difficult to instantaneously feed this rapid increment portion from the yarn feeding device 6 so that the knitting yarn 4 stored in the buffer arm 7 is fed. By feeding the stored knitting yarn 4, the tilt angle of the buffer arm 7 is reduced, and before the next knitting needle is pulled in, the knitting yarn 4 is fed from the yarn feeding device 6 to the buffer arm 7 and the tilt angle returns. Consequently, even when the knitting yarn 4 is fed in the fixed arm angle mode, the change of the tilt angle of the buffer arm 7 must be permitted.

[0009] In the flatbed knitting machine 1 as shown in Fig. 5, the yarn feeding device 6 is installed on one side of the needle bed 18 so that the tension of the knitting yarn 4 relates to the running direction of the carriage 19. In addition, the tension of the knitting yarn 4 varies depending on whether the range of the carriage 19 bringing the yarn feeding member 3 is within the knitting width of the fabric 2. Consequently, in the fixed arm angle mode, feeding of the knitting yarn 4 takes place only in the range where the knitting yarn 4 is fed into the inside of the knitting width except the portion of the length several tens mm to 100 mm at the edge.

[0010] In the necessary yarn feeding mode, the length of the knitting yarn 4 required over the whole knitting width of the fabric 2 is computed and the stitch adjustment can be done. Consequently, as compared to the fixed arm angle mode, the necessary yarn feeding mode is expected to achieve smaller errors in the feed length of the knitting yarn 4.

[0011] In order to control the knitting yarn feeding condition, one course or a plurality of courses must be set in advance as a knitting cycle. When the feed length of the knitting yarn 4 increases in one knitting cycle, even a small error is accumulated and the change range of the tilt angle of the buffer arm 7 may approach an upper or lower limit. The buffer arm 7 is used, for example, in a range between not less than 10 degrees and not more than 90 degrees, with the lower limit set to 0 degree and the upper limit to 100 degrees. In the range less than 10 degrees, the buffer arm is close to the lower limit and in the range exceeding 90 degrees, the buffer arm is close to the upper limit, and it may easily reach the lower limit or the upper limit by mechanical inertia. When the buffer arm 7 reaches the lower limit or the upper limit, tension of the knitting yarn 4 rapidly increases or decreases, and the stitch loop length is varied, too. Consequently, high-accuracy stitch adjustment by the necessary yarn feeding mode is disabled and performing stitch adjustment may increase disturbance of the stitch loop length.

[0012] Consequently, when the tilt angle of the buffer arm 7 deviates from the use range while the knitting yarn 4 is being fed in the necessary yarn feeding mode in a certain knitting course, a remedial process is performed. For the remedial process, the necessary yarn feeding mode is changed to the fixed arm angle mode and the remaining knitting of the knitting course is performed. In this remedial process in which mode is changed over, the feed length of the knitting yarn for the fixed arm angle mode is not measured, and stitch adjustment is not done so that the accuracy of the feed length of the knitting yarn 4 is unable to be maintained.

[0013] It is an object of the present invention to provide a flatbed knitting machine capable of maintaining precise feed lengths of yarn, even when remedial process is performed while the yarn is being fed in a necessary yarn feeding mode.

Technical Solution

[0014] The present invention provides a A flatbed knitting machine provided with:

a yarn feeding means for feeding a knitting yarn to knitting needles that operate for knitting a fabric whose feeding condition is controllable;

a control means for calculating the knitting yarn length necessary for knitting the fabric every predetermined knitting cycle in accordance with the knitting data of the fabric and at the same time for controlling the supply condition of the yarn feeding means;

a measuring means for measuring the length of the knitting yarn fed from the yarn feeding means to the knitting needles;

an adjusting means for comparing the length of the knitting yarn fed to the knitting needles with a calculated result of the control means every knitting cycle measured by the measuring means and performing the stitch adjustment in accordance with the comparison results; and

a buffer means, installed to a feeding route of knitting yarn from the yarn feeding means to the knitting needles, for temporarily storing the knitting yarn in a predetermined length range while being accompanied with the state change that corresponds to the tension,

characterized in that:

the control means controls to start the yarn feeding condition of the yarn feeding means set to a necessary yarn feeding mode that feeds the knitting yarn of the length that corresponds to the calculated result every knitting cycle, and at the same time, monitors the buffer means, and when the state change exceeds a predetermined range in the midst of the knitting cycle started in the necessary yarn feeding mode, as remedial process, changes over a knitting

yarn feed condition from the yarn feeding means during the remaining period of the knitting cycle to a buffer condition mode that controls the state change of the buffer means to satisfy a predetermined conditions,

the measuring means measures lengths of the knitting yarn between the beginning phase and the ending phase, in conformity to the control in both timing of the necessary yarn feeding mode and the buffer condition mode every knitting cycle, and

when the control means changes over the yarn feeding condition of the yarn feeding means from the necessary yarn feeding mode to the buffer condition mode in the midst of the knitting cycle, the adjusting means compares the length of the knitting yarn measured between the beginning phase and the ending phase for the buffer condition mode in the relevant knitting cycle to the length of the knitting yarn that corresponds to the calculated result of the control means and performs stitch adjustment

[0015] In the present invention, the measuring means performs measurements of said beginning phase and said ending phase in said necessary yarn feeding mode, so as to include both of the beginning portion and the ending portion of said knitting cycle, and

performs measurements of said beginning phase and said ending phase in said buffer condition mode, respectively, so as to exclude the beginning portion and the ending portion of the knitting cycle.

[0016] In addition, in the present invention, the knitting cycles of said necessary yarn feeding mode and said buffer condition mode correspond to the same course to knit the fabric.

[0017] Furthermore, in the present invention, the knitting cycle of said necessary yarn feeding mode corresponds to the course to knit the fabric, and

the knitting cycle of said buffer condition mode includes the knitting cycle of the continuous necessary yarn feeding mode.

Advantageous Effects

[0018] According to the present invention, a control means calculates the knitting yarn length necessary for knitting the fabric every predetermined knitting cycle in accordance with the knitting data of the fabric and at the same time controls the yarn feeding means so that the supply condition of the yarn feeding means falls in a necessary yarn feeding mode for feeding the knitting yarn of the length corresponding to the calculated result and starts each knitting cycle. A measuring means measures lengths of the knitting yarn between the beginning phase and the ending phase, in conformity to the control in both timing of the necessary yarn feeding mode and a buffer condition mode every knitting cycle. The control means monitors a buffer means, and when the state change exceeds a predetermined range in the midst of the knitting cycle, changes over a knitting yarn feed condition of the yarn feeding means during the remaining period of the knitting cycle to the buffer condition mode that controls the state change of the buffer means to satisfy a predetermined conditions, and therefore, remedial process is performed. When the control means changes over the feed condition of the yarn feeding means from the necessary yarn feeding mode to the buffer condition mode in the midst of the knitting cycle, an adjusting means compares the length of the knitting yarn measured between the beginning phase and the ending phase for the buffer condition mode in the relevant knitting cycle to the length of the knitting yarn that corresponds to the calculated result of the control means and performs stitch adjustment. Consequently, even when remedial process is performed while the knitting yarn is being fed in the necessary yarn feeding mode, the flatbed knitting machine is able to maintain precise feed length of the knitting yarn by stitch adjustment.

[0019] According to the present invention, even if remedial process is performed in the midst of the necessary yarn feeding mode and the mode is changed over to the buffer condition mode, measurement of the knitting yarn length is able to be performed in appropriate timing.

[0020] In addition, according to the present invention, for each same course of knitting a fabric, remedial process is able to be performed to change over the mode from the necessary arn feeding mode to the buffer condition mode.

[0021] Furthermore, according to the present invention, the knitting cycle of the buffer condition mode includes the knitting cycle of the continuous necessary yarn feeding mode, so that, even when the knitting width of the fabric is comparatively reduced, the flatbed knitting machine can maintain the accuracy of the stitch adjustment in the buffer condition mode.

Brief Description of Drawings

[0022]

[Fig. 1] Fig. 1 is a block diagram showing a general structure of a flatbed knitting machine 31 as one embodiment of the present invention and a timing chart showing a timing of measurement to feed knitting yarn 4.

[Fig. 2] Fig. 2 is a timing chart showing an outline of operation to supply the knitting yarn 4 in a necessary yarn feeding mode for each course in the flatbed knitting machine 31 of Fig. 1.

[Fig. 3] Fig. 3 is a flow chart showing a yarn feeding procedure in which the flatbed knitting machine 31 of Fig. 1 is accompanied by the mode change-over as shown in Fig. 2.

[Fig. 4] Fig. 4 is a time chart, as another embodiment of the present invention, showing an operation that makes the range of the fixed arm angle mode different from that in the necessary yarn feeding mode,

which is changed over when remedial process is performed.

[Fig. 5] Fig. 5 is a block diagram showing a general structure of a flatbed knitting machine 1 according to the conventional technology.

[Fig. 6] Fig. 6 is a front view showing a partial structure including a yarn feeding device 6 and a buffer arm 7 of Fig. 5.

Explanation of Reference

[0023]

2. Fabric
3. Yarn feeding member
4. Knitting yarn
6. Yarn feeding device
7. Buffer arm
17. Tilt angle sensor
21. Yarn feeding controller
31. Flatbed knitting machine
32. Encoder
33. Knitting controller

Best Mode for Carrying Out the Invention

[0024] Fig. 1 shows a general structure of a flatbed knitting machine 31 as one embodiment of the present invention in (a), and shows a length measurement timing for feeding knitting yarn 4 in (b), respectively. To the flatbed knitting machine 31, for portions correspond to those of the flatbed knitting machine 1 shown in Fig. 5, the same reference characters are assigned and redundant explanations may be omitted.

[0025] As shown in Fig. 1(a), in the flatbed knitting machine 31, a rotating angle of a master roller 10 of, for example, a yarn feeding device 6 as a yarn feeding means is detected by an encoder 32 as a measuring means. The flatbed knitting machine 31, same as the flatbed knitting machine 1 of Fig. 5, changes over a necessary yarn feeding mode to a buffer condition mode, for example, a fixed arm angle mode, as remedial process when the tilt angle of the buffer arm 7, which is a condition as a buffer means, approaches a lower limit or an upper limit in the midst of the knitting cycle. However, a knitting controller 33 as an adjusting means performs stitch adjustment even in remedial process.

[0026] The length of the knitting yarn 4 sent out from between the master roller 10 and a slave roller 11 to the buffer arm 7 side is able to be calculated in accordance with the difference of rotating angles which the encoder 32 detects. As described above, the buffer arm 7 has buffer functions that temporarily store the knitting yarn 4 or send out the stored knitting yarn 4 to the yarn feeding member 3 by varying the tilt angle. In the vicinity of the edge of the knitting width of the fabric 2, the feed rate and tension of the knitting yarn 4 are varied greatly, and therefore, the tilt angle of the buffer arm 7 is varied greatly, too. Consequently, as shown in Fig. 1(b), the measurement timing by the encoder 32 for the knitting controller to perform stitch adjustment in the fixed buffer arm mode is allowed to correspond to the inside of the knitting width. This is because as described above, in the fixed arm angle mode, feeding of the knitting yarn 4 takes place only in a range where the knitting yarn 4 is fed to the inside of the knitting width except the portion of the length several tens mm to 100 mm at the edge.

[0027] In the flatbed knitting machine 31, the knitting yarn 4 is temporarily stored or sent out by the use of the buffer functions of the buffer arm 7, but the buffer functions are achieved by other structure. For example, if the knitting yarn 4 is allowed to hang under its own weight between two rollers or might be pulled down by other rollers, the hanging rate or pull-down rate is increased or decreased so as to achieve the buffer functions. In addition, the buffer functions are able to be achieved by the active system in which the yarn is taken up around a roller, etc. or rewound. However, all buffer functions have restriction to the length of the knitting yarn 4 which can be temporarily stored. The length of the knitting yarn 4 to be fed is limited to the length of the knitting yarn 4 to be stored. Consequently, even in other structure, the buffer functions must be activated under the buffer condition mode that enables the buffer functions to be thoroughly brought out in response to the fixed arm angle mode of the buffer arm 7.

[0028] In a similar way, structure of the yarn feeding device 6, encoder 32, knitting controller 33 or the like are able to be achieved by other structures having the equivalent functions. In addition, the encoder 32 and other measuring means may be arranged in any of the knitting yarn 4 feeding routes from the yarn feeding device 6 to the yarn feeding member 3.

[0029] Fig. 2 briefly shows operation for feeding the knitting yarn 4 in the necessary yarn feeding mode for each course in the flatbed knitting machine 31 of Fig. 1. Fig. 2(a) briefly shows the operation for performing stitch adjustment while supplying the knitting yarn 4 in either the necessary yarn feeding mode or fixed arm angle mode. Fig. 2(b) briefly shows the operation for changing over the mode to the fixed arm angle mode as remedial process in the midst of the necessary yarn feeding mode by the flatbed knitting machine 1 of Fig. 5 for comparison. Fig. 2(c) briefly shows the operation for changing over the mode to the fixed arm angle mode as remedial process in the midst of the necessary yarn feeding mode by the flatbed knitting machine 31.

[0030] As shown in Fig. 2(a), rotating angles by the encoder 32 necessary for operations in the necessary yarn feeding mode and the fixed arm angle mode are detected in parallel. The necessary yarn feeding mode and the fixed arm angle mode are switchable at the time of starting the course, but in general, the necessary yarn feeding mode in which stitch adjustment is done at high accuracy is selected. When the tilt angle of the buffer arm 7 becomes outside a predetermined range, either

less than 10 degrees or over 90 degrees in the midst of the yarn feeding in the necessary yarn feeding mode, an error occurs and remedial process takes place. As shown in Fig. 2(b), in the conventional flatbed knitting machine 1, for remedial process, feed of the knitting yarn 4 is changed over to the fixed arm angle mode only and no stitch adjustment is done. As shown in Fig. 2(c), in the flatbed knitting machine 31, even if the mode is changed over to the fixed arm angle mode by remedial process, the encoder 32 detects the rotating angle in the beginning of the course and performs initial measurement, so that performing the measurement in the ending phase at the end of the course can do stitch adjustment on the basis of differences between measured values in the ending phase and the beginning phase.

[0031] Fig. 3 shows a yarn feeding procedure in which the flatbed knitting machine 31 is accompanied by the mode change-over as in the case of Fig. 2. In this embodiment, the knitting cycle for controlling the knitting yarn feeding condition is designated as one course, and the length of the knitting yarn 4 required for the course is calculated by the yarn feeding controller 21 as a control means for every course to knit the fabric 2. In step s1, the knitting controller 33 stores in memory the initial value of the tilt angle of the buffer arm 7 indicated by the tilt angle sensor 17. In addition, in step s2, the knitting controller 33 detects the rotating angle by the encoder 32, and stores in memory the detected angle as the initial value in the necessary yarn feeding mode. From step s3, the yarn feeding controller 21 controls the yearn feeding device 6 and feeding of the knitting yarn 4 in the necessary yarn feeding mode begins.

[0032] When in step s4, the timing for measuring the initial value in the fixed arm angle mode is reached in the midst of the necessary yarn feeding mode, the rotating angle of the encoder 32 is stored in memory. In step s5, the tilt angle of the buffer arm which the tilt angle sensor 17 indicates becomes outside a predetermined range and the knitting controller 33 determines whether remedial process is required. If remedial process is not required, step s5 and step s6 are repeated until the course is determined to be finished in step s6. When the course is determined to be finished in step s6, the knitting controller 33 stores the rotating angle of the encoder 32 in memory as the final value in the necessary yarn feeding mode in step s7. The knitting controller 33 stores in memory the tilt angle of the buffer arm 7 indicated by the tilt angle sensor 17 in step s8, too.

[0033] When in step s5, remedial process is determined to be needed, from s9, the mode is changed over to the fixed arm angle mode. The yarn feeding controller 21 controls the yarn feeding device 6 so that the tilt angle of the buffer arm 7 is within the angle range in the fixed arm angle mode. The knitting controller 33 stores in memory the rotating angle of the encoder 32 as the final value in the ending phase of the fixed arm angle mode. When step s8 or step s9 are finished, stitch adjustment is controlled by the knitting controller 33 in step s10, and the procedure of one course is finished.

[0034] Corresponding stitch adjustment is done in response to the necessary yarn feeding mode or the fixed arm angle mode, in accordance with the judgment concerning remedial process in step s5. For the necessary yarn feeding mode, the length of the knitting yarn 4 fed is calculated on the basis of the difference between the tilt angle of the buffer arm 7 detected by the tilt angle sensor 17 in step s1 and that in step s8 and the difference between initial and final rotating angles detected by the encoder 32 in step s2 and step s7. For the fixed arm angle mode, the length of the knitting yarn 4 fed is calculated on the basis of the difference between the initial rotating angle detected by the encoder 32 in step s4 and the final rotating angle detected by the encoder 32 in step s9. Stitch adjustment is done in such a manner as to decrease the difference of the supply lengths of the knitting yarn 4 and the theoretical value of the stitch loop length that is calculated. The theoretical value of the stitch loop length is that of the whole course for the necessary yarn feeding mode and that in the middle of the knitting width for the fixed arm angle mode.

[0035] Fig. 4 shows, as another embodiment of the present invention, the operation that makes the range of the fixed arm angle mode different from that in the necessary yarn feeding mode, which is changed over when the buffer arm tilt angle falls outside a predetermined range in the necessary yarn feeding mode and remedial process is performed. This kind of operation becomes effective when the knitting width of the fabric 2 is comparatively reduced and performing stitch adjustment at the middle only with the vicinity of edges of knitting width excluded increases errors. For example, the necessary yarn feeding mode performs stitch adjustment with two courses corresponding to the round trip of the carriage 19 designated as one round for the knitting cycle for controlling the knitting yarn feeding condition, whereas the fixed arm angle mode performs stitch adjustment with three courses designated as one round. In stitch adjustment, using the initial value and the final value of each mode, the feed length of the knitting yarn 4 is calculated. Consequently, the initial value and the final value are detected every 2 courses for the necessary yarn feeding mode, and at the same time, the initial value and the final value are detected every 3 courses for the fixed arm angle mode.

[0036] In the event that any error occurs in course b, which makes one round with course a in the necessary yarn feeding mode, the remainder section of course b moves to the fixed arm angle mode by remedial process. The feed of the knitting yarn 4 returns to the necessary yarn feeding mode in course c. Consequently, only from the middle of course b, the knitting yarn 4 is fed in the fixed arm angle mode, but stitch adjustment takes place in response to the fixed arm angle mode throughout courses a, b, and c.

Claims

1. A flatbed knitting machine provided with:

a yarn feeding means for feeding a knitting yarn to knitting needles that operate for knitting a fabric whose feeding condition is controllable;
a control means for calculating the knitting yarn length necessary for knitting the fabric every predetermined knitting cycle in accordance with the knitting data of the fabric and at the same time for controlling the supply condition of the yarn feeding means;
a measuring means for measuring the length of the knitting yarn fed from the yarn feeding means to the knitting needles;
an adjusting means for comparing the length of the knitting yarn fed to the knitting needles with a calculated result of the control means every knitting cycle measured by the measuring means and performing the stitch adjustment in accordance with the comparison results; and
a buffer means. installed to a feeding route of knitting yarn from the yarn feeding means to the knitting needles, for temporarily storing the knitting yarn in a predetermined length range while being accompanied with the state change that corresponds to the tension,
characterized in that:
the control means controls to start the yarn feeding condition of the yarn feeding means set to a necessary yarn feeding mode that feeds the knitting yarn of the length that corresponds to the calculated result every knitting cycle, and at the same time, monitors the buffer means, and when the state change exceeds a predetermined range in the midst of the knitting cycle started in the necessary yarn feeding mode, as remedial process, changes over a knitting yarn feed condition from the yarn feeding means during the remaining period of the knitting cycle to a buffer condition mode that controls the state change of the buffer means to satisfy a predetermined conditions,
the measuring means measures lengths of the knitting yarn between the beginning phase and the ending phase, in conformity to the control in both timing of the necessary yarn feeding mode and the buffer condition mode every knitting cycle, and
when the control means changes over the yarn feeding condition of the yarn feeding means from the necessary yarn feeding mode to the buffer condition mode in the midst of the knitting cycle, the adjusting means compares the length of the knitting yarn measured between the beginning phase and the ending phase for the buffer condition mode in the relevant knitting cycle to the length of the knitting yarn that corresponds to the calculated result of the control means and performs stitch adjustment.

2. The flatbed knitting machine according to claim 1, wherein the measuring means
performs measurements of said beginning phase and said ending phase in said necessary yarn feeding mode, so as to include both of the beginning portion and the ending portion of said knitting cycle, and
performs measurements of said beginning phase and said ending phase in said buffer condition mode, respectively, so as to exclude the beginning portion and the ending portion of the knitting cycle.

3. The flatbed knitting machine according to claims 1 or 2, wherein the knitting cycles of said necessary yarn feeding mode and said buffer condition mode correspond to the same course to knit the fabric.

4. The flatbed knitting machine according to claims 1 or 2, wherein the knitting cycle of said necessary yarn feeding mode corresponds to the course to knit the fabric, and
the knitting cycle of said buffer condition mode includes the knitting cycle of the continuous necessary yarn feeding mode.

FIG. 1

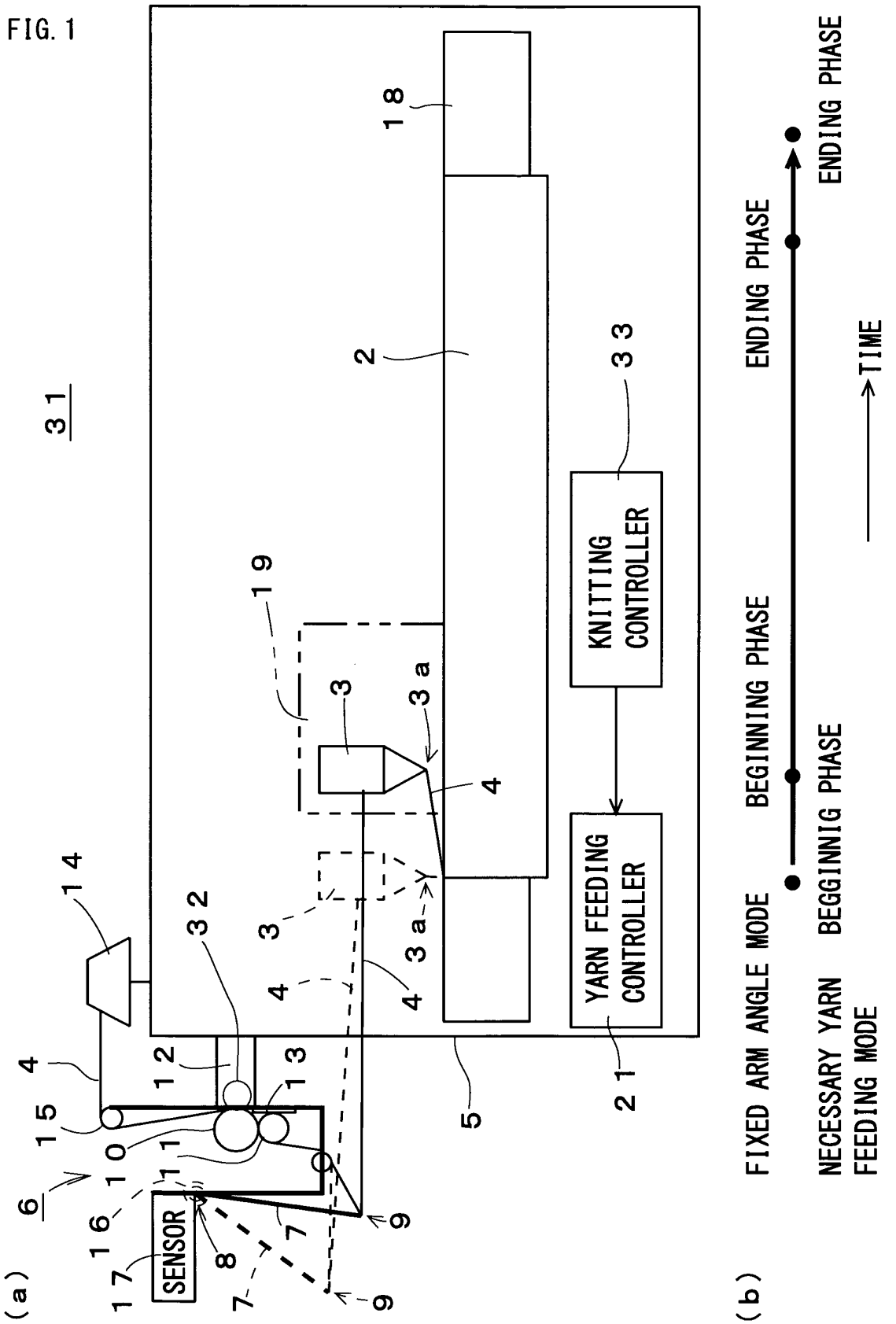

(a)
31
18
2
33
KNITTING CONTROLLER
19
3
3a
4
14
32
3
4
3a
Y
4
12
13
15
10
11
6
16
17
SENSOR
8
7
7
9
9
5
21
YARN FEEDING CONTROLLER
(b)
FIXED ARM ANGLE MODE
BEGINNING PHASE
ENDING PHASE
ENDING PHASE
TIME
NECESSARY YARN FEEDING MODE
BEGGINNIG PHASE

FIG. 2

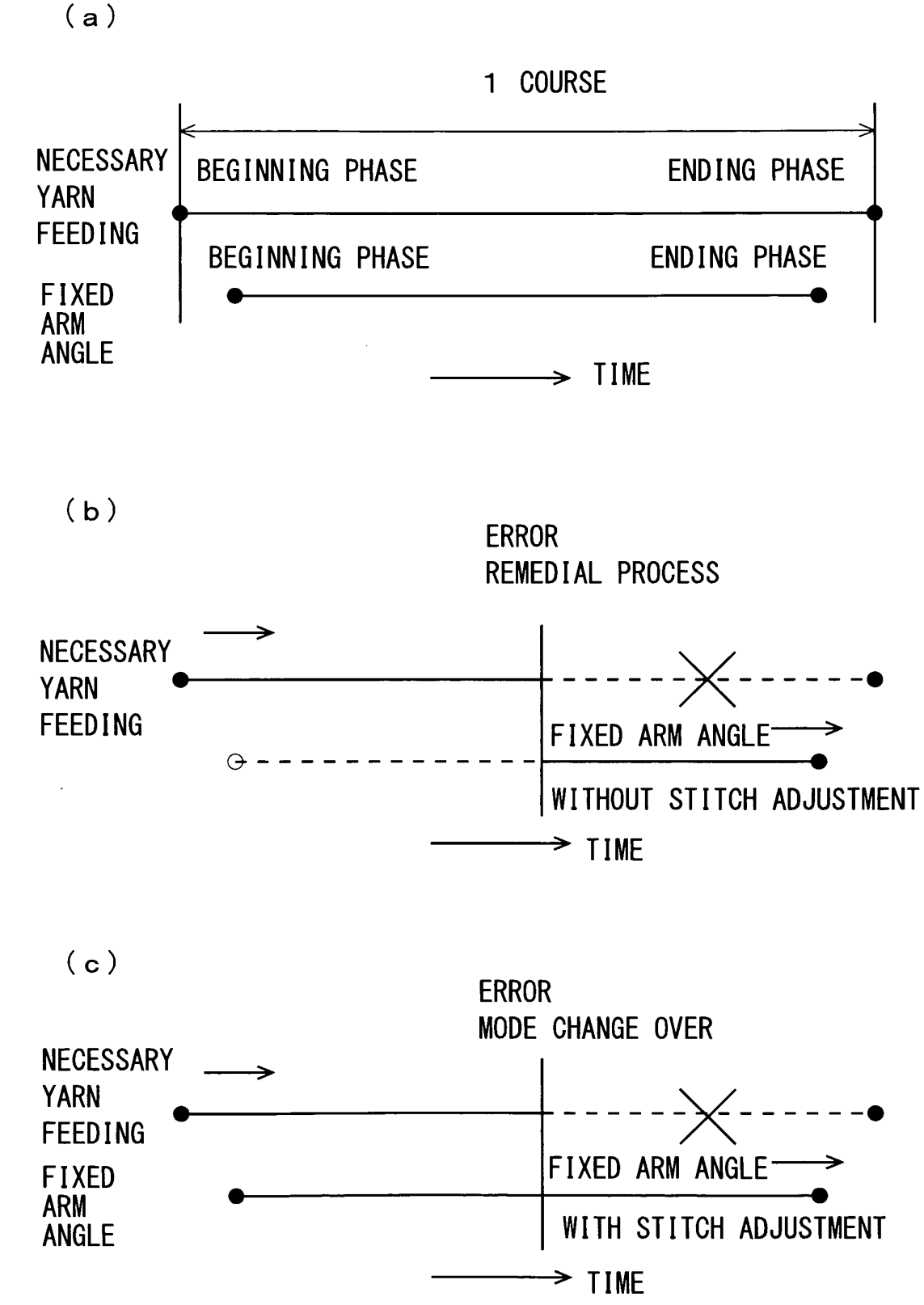

(a)
1 COURSE
NECESSARY YARN FEEDING
BEGINNING PHASE
ENDING PHASE
BEGINNING PHASE
ENDING PHASE
FIXED ARM ANGLE
TIME
(b)
ERROR REMEDIAL PROCESS
NECESSARY YARN FEEDING
FIXED ARM ANGLE
WITHOUT STITCH ADJUSTMENT
TIME
(c)
ERROR MODE CHANGE OVER
NECESSARY YARN FEEDING
FIXED ARM ANGLE
FIXED ARM ANGLE
WITH STITCH ADJUSTMENT
TIME

FIG. 3

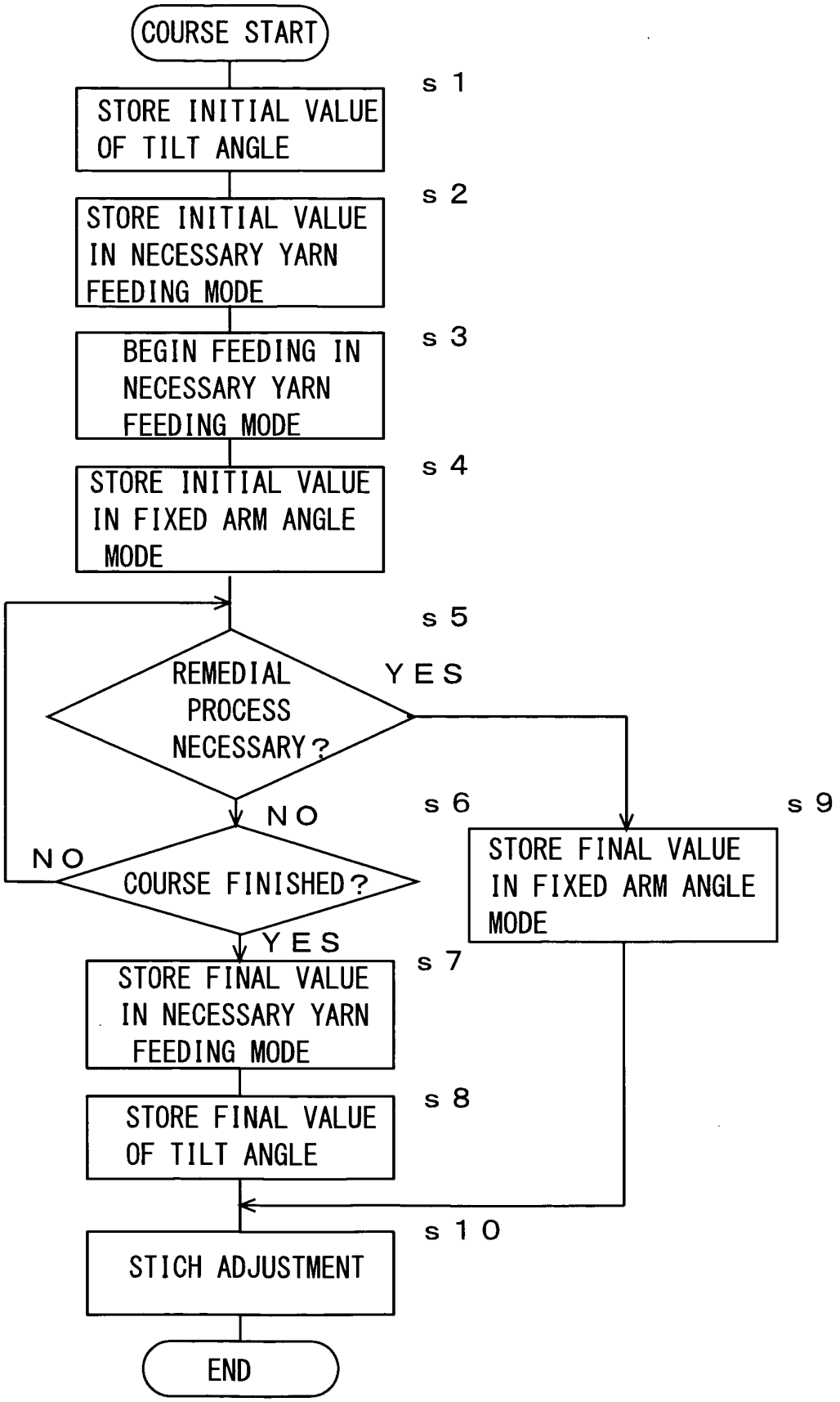

COURSE START
STORE INITIAL VALUE OF TILT ANGLE
s 1
STORE INITIAL VALUE IN NECESSARY YARN FEEDING MODE
s 2
BEGIN FEEDING IN NECESSARY YARN FEEDING MODE
s 3
STORE INITIAL VALUE IN FIXED ARM ANGLE MODE
s 4
s 5
REMEDIAL PROCESS NECESSARY?
YES
NO
s 6
s 9
NO
COURSE FINISHED?
STORE FINAL VALUE IN FIXED ARM ANGLE MODE
YES
s 7
STORE FINAL VALUE IN NECESSARY YARN FEEDING MODE
s 8
STORE FINAL VALUE OF TILT ANGLE
s 10
STICH ADJUSTMENT
END

FIG. 4

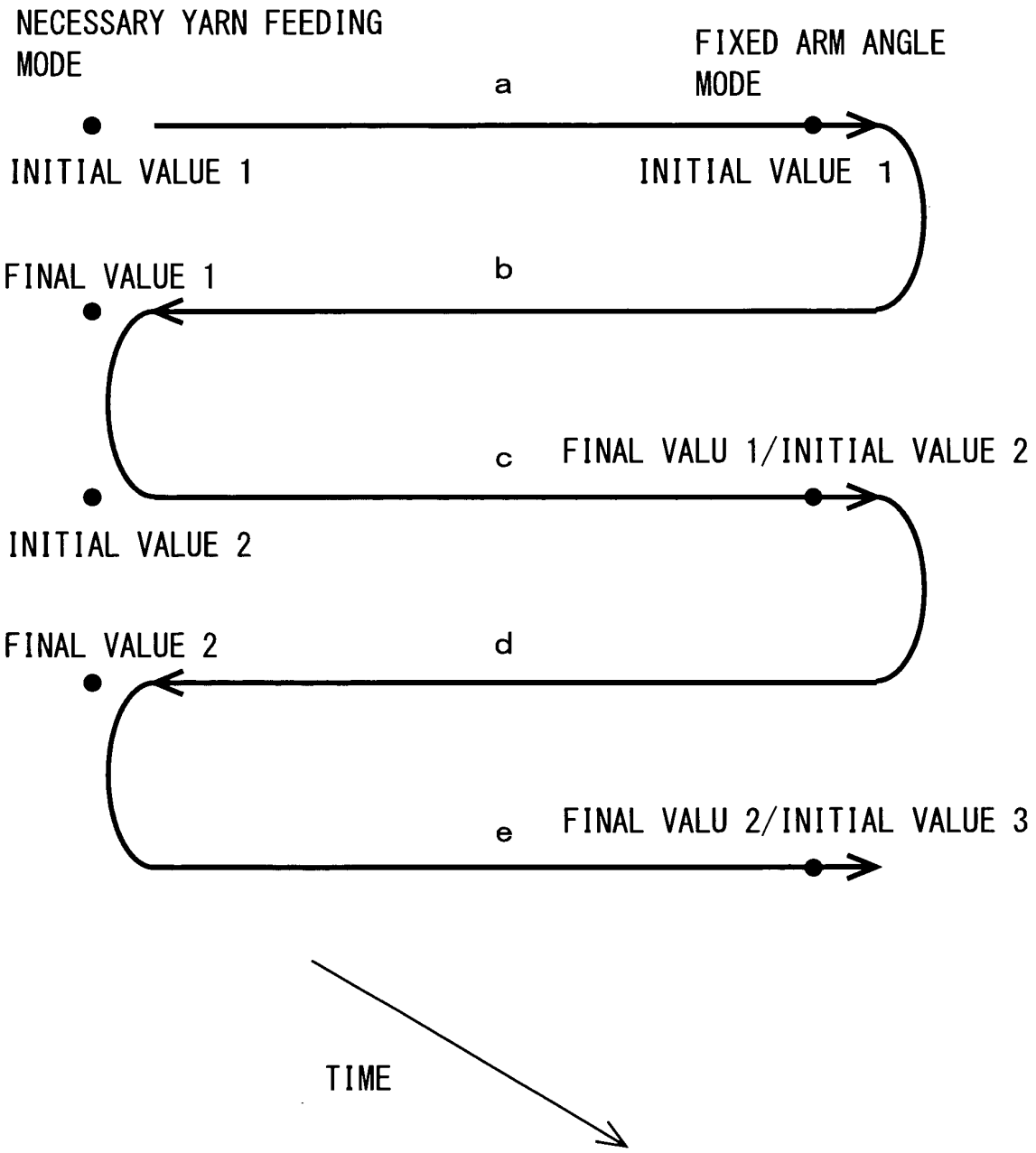

NECESSARY YARN FEEDING MODE
FIXED ARM ANGLE MODE
a
INITIAL VALUE 1
INITIAL VALUE 1
FINAL VALUE 1
b
c
FINAL VALU 1/INITIAL VALUE 2
INITIAL VALUE 2
FINAL VALUE 2
d
e
FINAL VALU 2/INITIAL VALUE 3
TIME

FIG. 5

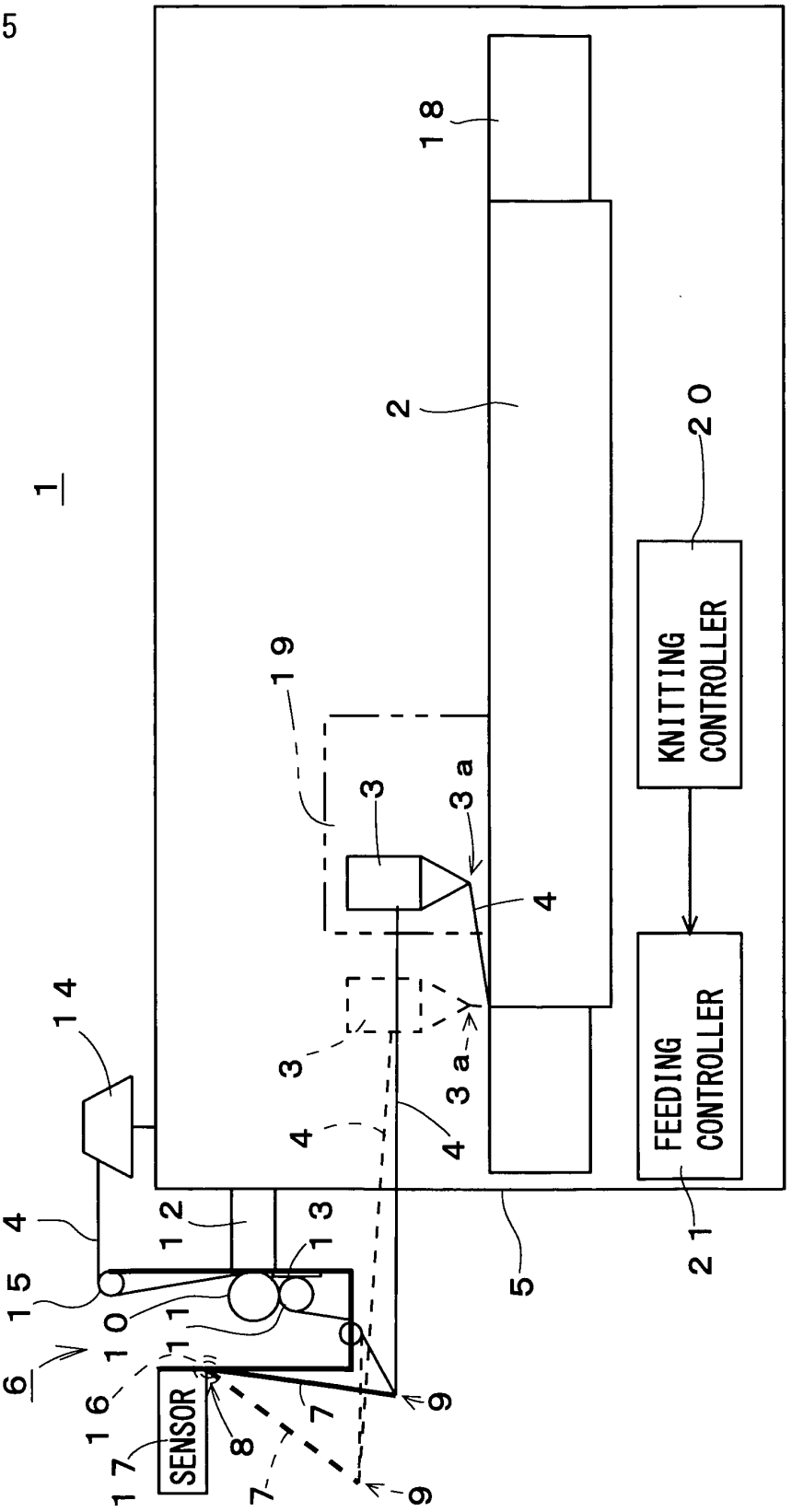
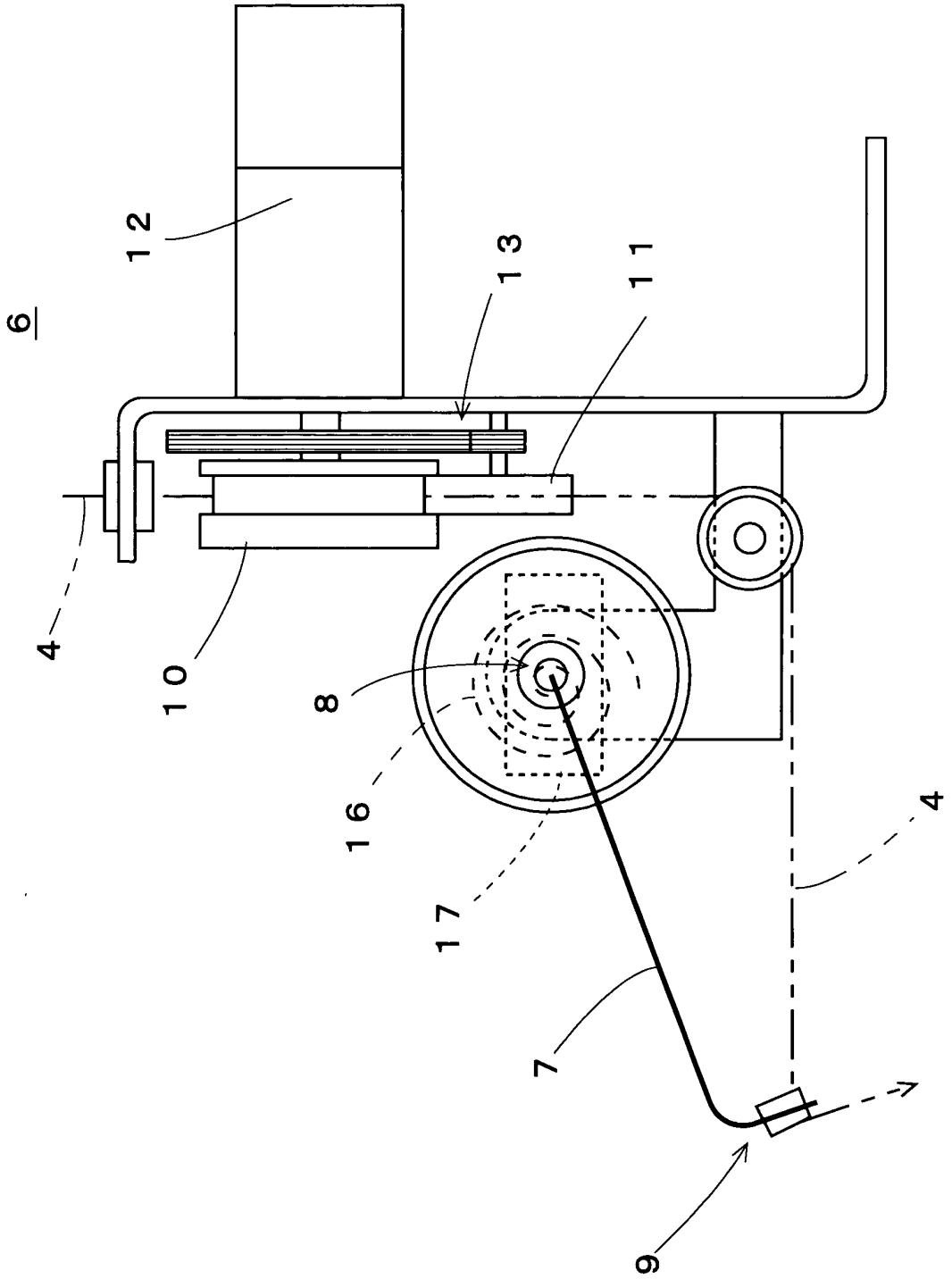

1
2
3
3a
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
KNITTING CONTROLLER
FEEDING CONTROLLER
SENSOR

FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/004012

A. CLASSIFICATION OF SUBJECT MATTER
D04B15/48(2006.01)i, *D04B15/44*(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)
D04B15/44-D04B15/52

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.
A	JP 4016030 B2 (Shima Seiki Mfg., Ltd.), 05 December 2007 (05.12.2007), (Family: none)	1-4
A	JP 3603031 B2 (Shima Seiki Mfg., Ltd.), 15 December 2004 (15.12.2004), & US 2002/0139152 A1 & EP 1231310 A1 & DE 60218917 D & KR 10-2002-0064200 A & CN 1369422 A & ES 2283471 T	1-4
A	JP 2006-169675 A (Shima Seiki Mfg., Ltd.), 29 June 2006 (29.06.2006), & US 2008/0148782 A1 & EP 1837427 A1 & WO 2006/064767 A1 & KR 10-2007-0089713 A & CN 101233270 A	1-4

☒ 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
04 November, 2009 (04.11.09)	17 November, 2009 (17.11.09)
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/JP2009/004012

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 6-264342 A (Tsudakoma Corp.), 20 September 1994 (20.09.1994), (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4016030 B **[0007]**
- JP 3603031 B **[0007]**