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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention is applied to a loom for an air bag, a towel, and the like, and relates to a control device for doffing-weaving in which a woven cloth is removed from a loom every predetermined weaving amount.

2. Description of the Related Art

[0002] Airbags, towels, and the like, are typically produced by so-called doffing-weaving in which a woven product of a predetermined weaving amount is removed from a loom. When weaving by a set weaving amount is completed, a predetermined operation, for example, weaving of a doffing edge for cutting is performed. When weaving of the doffing edge is completed, weaving of towel or the like for next doffing is performed. When a doffing edge reaches a doffing position in a woven-cloth path, that is, when an end portion of a woven cloth corresponding to the set weaving amount reaches the doffing position in the woven-cloth path, an operator cuts the woven cloth at a doffing-edge portion, and removes the woven cloth from the loom. Then, the operator installs a new cloth roller to the loom (see, Japanese Unexamined Patent Application Publication No. 9-3749, [0024] to [0027]).

[0003] However, in some cases, doffing is performed before the set weaving amount is achieved, due to restriction of an operation time and request of a next process. Also, depending on a production lot, the operator may decide that a winding diameter of the woven cloth still has a margin for an additional weaving amount in addition to the set weaving amount, through visual observation or measurement. In such a case, weaving is continued even after the set weaving amount is achieved, the woven cloth is produced by an amount more than the normal weaving amount, and then the doffing is performed.

[0004] When the doffing is performed by the amount other than the set weaving amount, the operator has to wait until the end portion of the woven cloth corresponding to a desired weaving amount reaches the doffing position for doffing. This may deteriorate productivity and workability.

[0005] A countermeasure to the disadvantage may be conceivable, in which, when the end portion of the woven cloth corresponding to the set weaving amount reaches the doffing position, the loom is automatically stopped, and the set weaving amount is changed to the desired weaving amount during weaving. In such a case, the set amount has to be restored to the original set amount for next doffing-weaving. The set amount may not be sometimes restored to the original set amount for a plurality of

times until an excess or a deficiency of the weaving amount is found, because of, for example, an operator's error, such as a lack of communication between operators. This may deteriorate production efficiency and cause production control to be troublesome.

SUMMARY OF THE INVENTION

[0006] In light of the above situations, an object of the present invention is, in doffing-weaving, to allow a weaving amount to be changed without deteriorating workability when the weaving amount is temporarily changed due to a certain reason during weaving, and, in next doffing-weaving or later, to reliably hold the weaving amount without an excess or a deficiency.

[0007] According to any aspect of the present invention, it is presupposed that a loom has a doffing-weaving control device which measures a weaving amount during weaving, determines whether or not the measurement value reaches a set amount, and performs a predetermined operation for doffing when the measurement value reaches the set amount.

[0008] According to a first aspect of the present invention, the loom includes a weaving amount setting unit which sets the set amount including a first set amount and a second set amount; and a manually operable command output unit which outputs a change command of changing the determination from determination based on the first set amount to determination based on the second set amount. The doffing-weaving control device performs the determination based on the first set amount after weaving is started, performs the determination based on the second set amount when the change command is input before the measurement value reaches the first set amount, and automatically changes the determination to be based on the first set amount after the measurement value reaches the second set amount.

[0009] With the first aspect, when the command output unit is operated and the determination whether or not the measurement value reaches the set amount is changed to the determination based on the second set amount, the doffing-weaving control device performs the predetermined operation for doffing when the measurement value reaches the second set amount. Accordingly, workability of doffing can be provided similarly to the case with the determination based on the first set amount. Also, the doffing-weaving control device automatically changes the determination to be based on the first set amount after the measurement value reaches the second set amount. Accordingly, an operation of restoring the determination to be based on the first set amount is not necessary in next doffing-weaving or later. An operator's error can be prevented, and the weaving amount can be provided without an excess or a deficiency.

[0010] According to a second aspect of the present invention, the doffing-weaving control device may automatically change the determination to be based on the first set amount when a weaving amount after the meas-

urement value reaches the second set amount reaches a predetermined value, or when a time clocked from a predetermined timing after the measurement value reaches the second set amount reaches a predetermined value. The weaving amount after the measurement value reaches the second set amount may be obtained by measuring a weaving length with a sensor. Alternatively, assuming that, a single rotation of a loom main shaft defines a single step, the weaving amount after the measurement value reaches the second set amount may be measured based on an integrated number of steps. When the weaving amount reaches the predetermined value, the determination is changed to be based on the first set amount. The predetermined value of the weaving amount after the measurement value reaches the second set amount may be 0. In such a case, the determination is changed to be based on the first set amount simultaneously when the measurement value reaches the second set amount. Alternatively, the determination may be changed when the time clocked from the predetermined timing after the measurement value reaches the second set amount reaches the predetermined value through measurement with a timer. The predetermined timing may be a timing at which the measurement value reaches the second set amount, a timing at which weaving is performed by a predetermined number of steps after the measurement value reaches the second set amount, or other timing.

[0011] With the second aspect, the determination is automatically changed to be based on the first set amount when the weaving amount after the measurement value reaches the second set amount reaches the predetermined value, or when the time clocked from the predetermined timing after the measurement value reaches the second set amount reaches the predetermined value. Accordingly, the determination is reliably restored to be based on the first set amount.

[0012] According to a third aspect of the present invention, the predetermined operation for doffing may include outputting a loom stop signal. The doffing-weaving control device may automatically change the determination to be based on the first set amount at a predetermined timing until when the loom is restarted through a manual operation, or at a predetermined timing after the restart.

[0013] With the third aspect, the determination is automatically changed to be based on the first set amount at the predetermined timing until when the loom is restarted, or at the predetermined timing after the restart. Accordingly, in doffing-weaving after the loom is restarted, the operator need not perform a special changing operation, thereby reliably performing the determination based on the first set amount.

[0014] According to a fourth aspect of the present invention, the predetermined operation for doffing may cause weaving to be continued even after the measurement value reaches the second set amount, and cause notification to be provided or cause the loom to be stopped when an end portion of a woven cloth corre-

sponding to weaving by the second set amount reaches a predetermined position in a woven-cloth path. Notification may include lighting-on or blinking a dedicated notification light, lighting-on or blinking a loom stop light with a pattern similar to that of normal stop, or with a pattern different from that of the normal stop.

[0015] With the fourth aspect, the notification is provided or the loom is stopped when the end portion of the woven cloth corresponding to weaving by the second set amount reaches the predetermined position in the woven-cloth path. Accordingly, the operator can be away from the loom and perform other operation after the operator operates the command output unit to change the determination to be based on the second set amount. This can increase productivity.

[0016] The second set amount may be set by inputting the value of the second set amount. Alternatively, according to a fifth aspect of the present invention, the weaving amount setting unit may store an additional weaving amount in advance, and when the change command is input, the weaving amount setting unit may set a value, in which the additional weaving amount is added to a measurement value at a timing when the change command is input, as the second set amount.

[0017] With the fifth aspect, the weaving amount setting unit stores the additional weaving amount in advance. When the change command is input, the weaving amount setting unit sets the value, in which the additional weaving amount is added to the measurement value at the timing when the change command is input, as the second set amount. Accordingly, the operator need not set the second set amount by adding the measurement value and the additional weaving amount. The productivity can be increased, and an erroneous weaving amount due to a calculation failure, an input failure of numbers, and the like, can be prevented.

[0018] According to a sixth aspect of the present invention, the loom may further include a cancel switch which cancels the change command. When the cancel switch is operated during the determination based on the second set amount, if a timing of the operation of the cancel switch is before the measurement amount reaches the first set amount and the second set amount, the doffing-weaving control device may change the determination to be based on the first set amount.

[0019] With the sixth aspect, if the determination is unexpectedly changed to be based on the second set amount, the determination can be restored to be based on the first set amount. Also, the determination can be temporarily restored to be based on the first set amount by operating the cancel switch, and then, a new second set amount can be set. Accordingly, the setting of the second set amount can be changed. Thus, it is not necessary to add a function of outputting a change command of changing the determination based on the current second set amount to that based on another second set amount, in addition to the function of outputting the change command of changing the determination based

on the first set amount to that based on the second set amount. The change of the determination to be based on a desired weaving amount can be performed. In particular, the weaving amount setting unit stores the additional weaving amount in advance, and when the change command is input, the weaving amount setting unit sets the value, in which the additional weaving amount is added to the measurement value at the timing when the change command is input, as the second set amount. Also, when the value of the second set amount is input, the determination can be temporarily restored to the first set amount by operating the cancel switch. Accordingly, the change to the desired weaving amount can be performed without a function being additionally provided in the command output unit.

[0020] According to a seventh aspect of the present invention, the loom may further include a repeat switch which repeats the determination based on the second set amount. The doffing-weaving control device may perform the determination based on the second set amount, in weaving after the measurement value reaches the second set amount, the determination is automatically changed to be based on the first set amount, and when the repeat switch is operated before the measurement value reaches the first set amount and the second set amount, the determination is changed to be based on the second set amount.

[0021] With the seventh aspect, the weaving amount of the second set amount of the previous doffing-weaving can be easily obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is an explanatory illustration, in time series, showing change of determination based on a set amount during doffing-weaving, and operations for doffing, in correspondence with a weaving amount; Fig. 2 is an explanatory illustration, in time series, showing the change of the determination based on the set amount during doffing-weaving, and the operations for doffing, in correspondence with the weaving amount;

Fig. 3 is an explanatory illustration showing healds, a reed, a part of a woven-cloth-moving type terry motion device, and a take-up device, of a towel loom to which the present invention is applied;

Fig. 4 is a block diagram showing control of the towel loom;

Fig. 5 is a flowchart showing a determination procedure of a doffing-weaving control device based on a weaving amount, and an operation procedure for doffing, Fig. 5 illustrating a first part of the procedures;

Fig. 6 is a flowchart showing the determination procedure of the doffing-weaving control device based on the weaving amount, and the operation procedure

for doffing, Fig. 6 illustrating a middle part of the procedures; and

Fig. 7 is a flowchart showing the determination procedure of the doffing-weaving control device based on the weaving amount, and the operation procedure for doffing, Fig. 7 illustrating a last part of the procedures.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] Figs. 1 and 2 illustrate, in time series, change of determination whether or not a measurement value reaches a set amount, and predetermined operations for doffing, in correspondence with a weaving amount according to an embodiment of doffing-weaving to which the present invention is applied. In Figs. 1 and 2, time advances from the right side to the left side of each drawing. Fig. 1 shows a state from when previous doffing-weaving is completed, then doffing-weaving is restarted, the determination is changed to determination based on a second set amount during weaving, and a loom is automatically stopped, until when next doffing-weaving is restarted. Fig. 2 shows doffing-weaving from when the determination is changed to be based on the second set amount during weaving until when the determination is restored to be based on a first set amount. Fig. 3 illustrates healds 2, a reed 3, a part of a woven-cloth-moving type terry motion device 5, and a take-up device, of a towel loom having the woven-cloth-moving type terry motion device 5 as an embodiment of the present invention. Fig. 4 is a block diagram showing control of the towel loom. Fig. 4 illustrates operations performed by a doffing-weaving control device 19 for doffing. Figs. 5 to 7 are flowcharts showing a determination procedure of the doffing-weaving control device 19 based on a weaving amount and a predetermined operation procedure for doffing. Figs. 5 to 7 partly show a start operation of the loom and a doffing operation by an operator.

[0024] Referring to Fig. 3, the towel loom lets warps 1 off from a warp beam of pile warps and from a warp beam of ground warps (both warp beams not shown) arranged at an upstream side of a warp path. The warps 1 are guided to a cloth fell of a woven cloth 4 via the healds 2 and the reed 3. When wefts (not shown) are beaten, the warps 1 and the wefts become the woven cloth 4. The woven cloth 4 is taken up by a cloth roller 8 via the terry motion device 5, a take-up roller 6, and a plurality of pressed rollers 7, which are arranged downstream of the cloth fell along a woven-cloth path in that order.

[0025] The woven-cloth-moving type terry motion device 5 shifts the position of the cloth fell by moving the woven cloth 4 in a warp direction during weaving of a pile construction. At a first pick in which the position of the cloth fell is advanced toward the reed 3, beating causes the pile warps to be loosened in a loop manner, and hence, pile is formed. A single towel 9, that is, a towel 9 with a unit design pattern, in particular, a towel 9 which is formed by weaving with a unit design pattern generally

includes a pile construction which is woven while the terry motion device 5 is operated, and a border construction which is woven while the terry motion device 5 is not operated. Border constructions are typically arranged at both ends of a pile construction. In some cases, a border construction may be arranged between pile constructions in addition to the border constructions at both ends. Depending on a unit design pattern, a single towel 9 may be formed of only a pile construction without a border construction. A towel 9 obtained by weaving with a unit design pattern defines a unit weaving amount, or a single towel. Towels 9 are produced by a predetermined weaving amount (a number of weaving pieces) by repeating weaving with the unit design pattern. The towel 9 is generally woven by so-called doffing-weaving in which the woven cloth 4 is cut every predetermined weaving amount, or every predetermined number of pieces, and is removed from the loom. In the doffing-weaving of the embodiment, a doffing edge 11 is woven so as to continuously extend from an end portion 41 of the woven cloth 4 corresponding to weaving for a predetermined weaving amount, thereby facilitating a doffing operation. The doffing edge 11 is woven based on a doffing-edge pattern. The doffing edge 11 is formed of the border construction, or a construction serving as a doffing edge which is different from the border construction. The doffing edge 11 is woven while the terry motion device 5 is not operated, and does not include the pile construction. In the doffing-weaving in the embodiment, when the predetermined weaving amount is achieved, the end portion 41 of the woven cloth 4 is woven. Subsequently, doffing-edge weaving with the doffing-edge pattern is started. Assuming that a single rotation of a loom main shaft 17 defines a single step, the doffing edge 11 is woven in a step in which a doffing-edge pattern is formed, in particular, in a step in which a doffing-edge pattern is formed. Referring to Figs. 1 and 3, the doffing edge 11 is woven by a length B at a position adjacent to the end portion 41. Subsequently to weaving of the doffing edge 11, weaving with the unit design pattern, that is, weaving of the woven cloth 4 for next doffing is performed. Referring to Figs. 1 and 3, weaving is performed up to a number of steps S after weaving with the unit design pattern is started, and then, the loom is automatically stopped in this embodiment. Accordingly, the woven cloth 4 based on the unit design pattern is woven by a length C. Then, the loom is automatically stopped in the middle of weaving in which a first towel 9, or an N-th (N is a certain number) towel 9 is woven. Fig. 3 illustrates a state in which the weaving amount reaches the set amount, the doffing edge 11 is woven, the woven cloth 4 with the unit design pattern, for next doffing, is woven by the predetermined number of steps S so as to continuously extend from the doffing edge 11, and then the loom is automatically stopped. Since the woven cloth 4 with the unit design pattern is woven by the predetermined number of steps S, the doffing edge 11 is located downstream of the take-up roller 6. A portion of the woven cloth 4 ar-

ranged upstream of the doffing edge 11 is held by the take-up roller 6 and the pressed rollers 7. Hence, the woven cloth 4 can be cut at the doffing edge 11, and the woven cloth 4 is prevented from being loosened as a result of cutting. In this embodiment, the number of steps S is set such that the loom is automatically stopped after the doffing edge 11 reaches a position between the downstream-side pressed roller 7 and the cloth roller 8. Accordingly, the doffing operation becomes efficient.

[0026] The woven-cloth-moving type terry motion device 5 shown in Fig. 3 includes a drive device (not shown), a pair of left and right rocking levers 12, engaged levers 13, and a terry roller 14. Lower end portions of the rocking levers 12 serve as supporting points for rocking motion. Intermediate portions of the engaged levers 13 are coupled to the drive device, and first ends of the engaged levers 13 are coupled to intermediate portions of the rocking levers 12. Both ends of the terry roller 14 are fixed to upper end portions of the pair of left and right rocking levers 12 such that the terry roller 14 bridges over the rocking levers 12 in a weaving-width direction. Second ends of the engaged levers 13 are coupled to rocking levers (not shown) which supports a tension roller (not shown) of the ground warps. The terry roller 14 and the tension roller are synchronously driven in a front-rear direction, that is, in the warp direction via the engaged levers 13. Hence, the woven cloth 4 wound around the terry roller 14 is moved in the warp direction with the terry roller 14. At this time, since the tension roller is moved in the same direction as that of the terry roller 14 synchronously with the terry roller 14, change in length of the warp path as a result of movement of the woven cloth 4 is absorbed. Hence, the woven cloth 4 is not loosened as a result of decrease in tensile force of the ground warps even when the woven cloth 4 is moved to the rear side (let-off side), and an excessive tensile force as a result of increase in tensile force of the ground warps is not added to the woven cloth 4 even when the woven cloth 4 is moved to the front side (take-up side). The cloth fell of the woven cloth 4 is reliably shifted in the warp direction.

[0027] Next, control for performing a weaving amount monitoring operation by the doffing-weaving control device 19 is described with reference to the block diagram in Fig. 4 showing the control of the towel loom. The loom drives a motor 16 in response to a command from a loom control device 15. The motor 16 rotates the loom main shaft 17. The loom main shaft 17 is connected to an encoder 18. The encoder 18 detects a main shaft rotation angle, and outputs main shaft rotation angle information to the loom control device 15 and the doffing-weaving control device 19.

[0028] The loom control device 15 receives input signals from, for example, the encoder 18, a design pattern setting unit 21, the doffing-weaving control device 19, a shed pattern setting unit (not shown), a weft-insertion pattern setting unit (not shown), and a terry motion pattern setting unit (not shown). The loom control device 15

uses the input signals to drive the respective devices such as the terry motion device 5.

[0029] The design pattern setting unit 21 sets the unit design pattern and the doffing-edge pattern in the loom control device 15. The loom control device 15 recognizes a current step as a last step of a pattern set by the design pattern setting unit 21, with reference to current step advancement information based on the main shaft rotation angle information, and with reference to information on the number of steps defining the pattern. The loom control device 15 outputs an end signal to the doffing-weaving control device 19 every last step of the single design pattern, and every last step of the doffing-edge pattern.

[0030] The doffing-weaving control device 19 measures a weaving amount, and determines whether or not the measurement value reaches a set amount. The doffing-weaving control device 19 performs a predetermined operation for doffing when the measurement value reaches the set amount. In this embodiment, the predetermined operation for doffing includes a series of operations, in which the doffing-weaving control device 19 outputs a doffing-edge weaving start command to the loom control device 15, and outputs a loom stop command to the loom control device 15 when the doffing edge 11 reaches a doffing position in the woven-cloth path based on the weaving amount since the start of the doffing-edge weaving.

[0031] The set amount, which serves as a criterion of the measurement value, is set by the weaving amount setting unit 22 connected to the doffing-weaving control device 19. The weaving amount setting unit 22 sets a weaving amount of a unit design pattern (the number of weaving pieces, namely, the number of towels) as a set amount of the doffing-weaving. The weaving amount setting unit 22 includes a first weaving amount setting portion 23 and a second weaving amount setting portion 24.

[0032] The first weaving amount setting portion 23 sets a normal set amount for the weaving amount of the doffing-weaving, that is, it sets a first set amount.

[0033] The second weaving amount setting portion 24 sets a set amount when the first set amount is changed based on decision of the operator or the like, that is, it sets a second setting amount. In this embodiment, the second weaving amount setting portion 24 includes an input unit 25, a storage unit 26, and a calculation unit 27. When the operator inputs a number of pieces (at least 1) to the input unit 25 and performs a registration operation, the input number of pieces is saved, or registered, in the storage unit 26 as an additional weaving amount. When the calculation unit 27 receives a command of changing the first set amount to the second set amount from a command output unit 32 through the operation by the operator, the calculation unit 27 reads out the additional weaving amount registered in the storage unit 26, calculates the second set amount, and outputs the second set amount to the doffing-weaving control device 19. That is, the calculation unit 27 adds the read additional weaving amount to the current measurement value input from a

piece-number counter 28 via the doffing-weaving control device 19, that is, to the measurement value (the number of weaving pieces) at the timing when the command is input from the command output unit 32. The calculation unit 27 outputs the calculated value as the second set amount to the doffing-weaving control device 19.

[0034] The piece-number counter 28 adds 1 to an integrated value which is held in the piece-number counter 28 every input of the last step of the unit design pattern from the loom control device 15 via the doffing-weaving control device 19. Also, the piece-number counter 28 outputs the integrated value, that is, a count, as a measurement value, to the doffing-weaving control device 19. The doffing-weaving control device 19 determines whether or not the measurement value reaches the set amount. When the measurement value reaches the first set amount or the second set amount, the doffing-weaving control device 19 outputs a weaving start command of the doffing edge 11 so as to continuously extend from the end portion 41 of the woven cloth 4, to the loom control device 15. Also, when weaving of the doffing edge 11 is completed, the doffing-weaving control device 19 inputs a reset signal to the piece-number counter 28. Then, the piece-number counter 28 resets the integrated value, that is, the measurement value to 0.

[0035] Also, the doffing-weaving control device 19 is connected to a stop-step-number setting unit 29 and a step counter 31. The stop-step-number setting unit 29 sets a number of steps S, which is the number of steps of weaving with the unit design pattern to be performed after weaving of the doffing edge 11 is completed. The number of steps S is determined in such a way that a single rotation of the loom main shaft 17 defines a single step.

[0036] At the completion of weaving of the doffing edge 11, i.e., at the last step of the doffing-edge pattern, the loom control device 15 outputs a doffing-edge end signal to the doffing-weaving control device 19. When the doffing-edge end signal is input, the doffing-weaving control device 19 outputs a reset signal to the step counter 31, so as to reset an integrated value, that is, a measurement value of the step counter 31. The doffing-weaving control device 19 recognizes a single rotation of the loom main shaft 17 based on the main shaft rotation angle information from the encoder 18, that is, recognizes a single step of weaving. The doffing-weaving control device 19 outputs a pulse signal, as a count-up signal, to the step counter 31 every step. The step counter 31 integrates the number of steps of weaving based on the count-up signal, and outputs the integrated value to the doffing-weaving control device 19, as a measurement number of steps. When the measurement number of steps input from the step counter 31 reaches the number of steps S set by the stop-step-number setting unit 29, the doffing-weaving control device 19 outputs a loom stop signal to the loom control device 15. Accordingly, the loom is stopped such that the doffing edge 11 is at the doffing position in the woven-cloth path.

[0037] The doffing-weaving control device 19 is also connected to a repeat switch 33, a cancel switch 34, a display unit 35, and a notification light 36.

[0038] The repeat switch 33 outputs a command for performing again the determination based on the second set amount of the previous doffing-weaving, to the doffing-weaving control device 19, through a manual operation. In this embodiment, the doffing-weaving control device 19 stores, or saves the weaving amount of the previous doffing-weaving until the doffing-edge weaving is completed, regardless of the criterion of the determination (the first set amount or the second set amount) of the previous doffing-weaving. The doffing-weaving control device 19 reads out the stored weaving amount in response to the command from the repeat switch 33, so as to perform again the determination based on the second set amount of the previous doffing-weaving. Alternatively, the previous weaving amount may be saved only when the determination in the previous doffing-weaving is based on the second set amount.

[0039] The cancel switch 34 outputs a command of canceling the determination based on the second set amount, that is, a command of changing the determination to be based on the first set amount, to the doffing-weaving control device 19 through a manual operation. In response to the command from the cancel switch 34, the doffing-weaving control device 19 changes the determination to be based on the first set amount.

[0040] The display unit 35 displays the measurement value (the number of weaving pieces up to the current time), the first set amount, the second set amount, the additional weaving amount (the registered number of pieces) input by the second weaving amount setting portion 24, and the previous weaving amount or the weaving amount of the current doffing-weaving stored in the doffing-weaving control device 19.

[0041] When doffing-weaving is completed, or when the doffing edge 11 is woven, and the doffing edge 11 reaches the doffing position in the woven-cloth path, the loom is automatically stopped, and the doffing-weaving control device 19 outputs a light-on signal, resulting in the notification light 36 being lit, or blinked. Also, the notification light 36 is automatically turned OFF in this embodiment. When the operation of the loom is started for the next doffing-weaving, the doffing-weaving control device 19 outputs a light-off signal or stops the output of the light-on signal.

[0042] A determination procedure of the doffing-weaving control device 19 based on the weaving amount, and a predetermined operation procedure for doffing are described with reference to flowcharts in Figs. 5 to 7, the procedures partly including operations by the operator.

[0043] First, a case is described, in which only the determination based on the first set amount is performed, or a case without the change command or the repeat command.

[0044] In STEP 1 in Fig. 5, the doffing-weaving control device 19 automatically performs the determination of

the measurement value based on the first set amount. When the operator turns ON an operation start switch, the loom control device 15 drives the motor 16 to rotate the loom main shaft 17, and outputs a doffing-weaving start signal to the doffing-weaving control device 19. In response to the doffing-weaving start signal, the doffing-weaving control device 19 turns OFF the notification light 36.

[0045] Then, the procedure goes to STEP 2, in which the doffing-weaving control device 19 determines whether or not an end signal of the unit design pattern is input. The determination is NO immediately after the operation is started. If NO, the determination process is continued until the end signal of the unit design pattern is input. The loom control device 15 recognizes that the current step is the last step of the unit design pattern with reference to the current step advancement information of the unit design pattern based on the main shaft rotation angle information from the encoder 18 and with reference to the information on the number of steps defining the unit design pattern set by the design pattern setting unit 21. The loom control device 15 outputs the end signal of the unit design pattern to the doffing-weaving control device 19. Hence, the determination becomes YES when weaving with the unit design pattern is completed. If YES, the procedure goes to STEP 3, in which the doffing-weaving control device 19 outputs the pulse signal to the piece-number counter 28 as the count-up signal. The piece-number counter 28 adds 1 to the integrated value up to the current time, that is, adds 1 to the count.

[0046] Then, the procedure goes to STEP 4, in which the doffing-weaving control device 19 determines whether or not the repeat command is input. In this case, there is no repeat command, and hence, the determination is NO. If NO, the procedure goes to STEP 5, in which the doffing-weaving control device 19 determines whether or not the change command is input from the command output unit 32. In this case, there is no change command, and hence, the determination is NO. If NO, the procedure goes to STEP 11, in which the doffing-weaving control device 19 determines whether or not the count of the piece-number counter 28, more specifically, the measurement value of the piece-number counter 28, reaches the first set amount (a first number of weaving pieces set for doffing-weaving). In this case, since the first set amount is set as a number larger than 1, the determination is NO. If NO, the procedure returns to STEP 2. When weaving is continued, and the processes of STEPS 1 to 5, and 11 are repeated, the measurement value of the piece-number counter 28 reaches the first set amount in STEP 11, and the determination becomes YES.

[0047] If YES, the procedure goes to STEP 31 in Fig. 7, in which the doffing-weaving control device 19 outputs the weaving start command of the doffing edge 11 to the loom control device 15. Then, the procedure goes to STEP 32, in which the doffing-weaving control device 19 determines whether or not the doffing-edge end signal is input. The determination is NO immediately after weav-

ing of the doffing edge 11 is started, and the determination process is continued. The loom control device 15 recognizes that the current step is the last step of the doffing-edge pattern with reference to the current step advancement information of the doffing-edge pattern based on the main shaft rotation angle information from the encoder 18, and with reference to the information on the number of steps defining the doffing-edge pattern set by the design pattern setting unit 21. The loom control device 15 outputs the end signal of the doffing-edge pattern to the doffing-weaving control device 19. In response to the input of the end signal, the determination becomes YES. If YES, the procedure goes to STEP 33, in which the doffing-weaving control device 19 outputs the reset signal to the step counter 31. The doffing-weaving control device 19 also deletes the storage of the previous doffing-weaving amount (the number of weaving pieces), stores the measurement value of the piece-number counter 28, that is, the current doffing-weaving amount (the number of weaving pieces), and then, outputs the reset signal to the piece-number counter 28. Also, the loom control device 15 continues weaving even after the doffing-weaving is completed, and restarts weaving with the unit design pattern.

[0048] Then, the procedure goes to STEP 34, in which the doffing-weaving control device 19 determines whether or not the count of the step counter 31, or the measurement number of steps input from the step counter 31 reaches the predetermined number of steps S set by the stop-step-number setting unit 29. At the timing when weaving with the unit design pattern is restarted, the determination is NO, and the determination process is continued. When the measurement number of steps reaches the number of steps S, and the determination is YES, the procedure goes to STEP 35, in which the weaving stop signal is output to the loom control device 15, and the light-on signal is output to the notification light 36. Hence, the loom is stopped such that the doffing edge 11 is at the doffing position in the woven-cloth path, and the notification light 36 is lit or blinked, thereby reminding the operator of the doffing operation. Also, the set amount of the doffing-weaving amount, which serves as the criterion of the measurement value, is set to the first set amount. Since the doffing-weaving amount is already set to the first set amount, the doffing-weaving control device 19 holds the first set amount as the doffing-weaving amount. Then, the procedure goes to STEP 36, in which the loom control device 15 automatically stops the loom. The operator performs the doffing operation. In particular, the operator cuts the woven cloth 4, the weaving amount of which is the first set amount, at a substantially center position of the doffing edge 11 continuously extending from the end portion 41 of the woven cloth 4. The operator removes the woven cloth 4 from the loom, and installs a cloth roller 8 to the loom for next doffing-weaving. Then, the procedure goes to STEP 37, in which the doffing-weaving control device 19 determines whether or not the repeat command is input. In this case, there is no repeat

command, and hence, the determination is NO. If NO, the procedure goes to STEP 38, in which it is determined whether or not the operation of the loom is started. If NO in STEP 38, the procedure returns to STEP 37, in which the determination process whether or not the repeat command is input is continuously performed. When the next doffing-weaving is started, and the operation of the loom is started, the determination becomes YES in STEP 38, and the procedure is ended.

[0049] Next, referring back to STEP 5 in Fig. 5, a case is described, in which the operator operates the command output unit 32 to perform the determination based on the second set amount while the determination of the measurement value is performed based on the first set amount.

[0050] In this case, in STEP 5, the determination whether or not the change command is input from the command output unit 32 is YES. If YES, the procedure goes to STEP 6, in which the doffing-weaving control device 19 changes the criterion of the measurement value from the first set amount to the second set amount (a second number of weaving pieces for doffing-weaving), and deletes the change command.

[0051] Then, the procedure goes to STEP 7, in which the doffing-weaving control device 19 determines whether or not the cancel command is input from the cancel switch 34. Assuming that the cancel switch 34 is not operated, the determination is NO.

[0052] If NO, the procedure goes to STEP 8, in which the doffing-weaving control device 19 determines whether or not the measurement value of the piece-number counter 28 reaches the second set amount. The determination is NO immediately after the command output unit 32 is operated. The procedure returns to the process of STEP 2. When weaving is continued, and the processes of STEPS 2 to 8 are repeated, the measurement value of the piece-number counter 28 reaches the second set amount. Then, the determination of the doffing-weaving control device 19 in STEP 8 becomes YES. If YES, the procedure goes to STEP 31, which is described above, and the subsequent processes of STEPS 32 to 38 are performed. In STEP 35, the doffing-weaving control device 19 sets the set amount, which serves as the criterion of the measurement value, to the first set amount, that is, the doffing-weaving control device 19 changes the determination based on the second set amount to that based on the first set amount. Then, the procedure goes to STEP 36, in which the loom is automatically stopped, and the operator performs the doffing operation.

[0053] Incidentally, in the process of STEP 7, the determination may be YES. For example, when the command output unit 32 is incorrectly operated, the operator may operate the cancel switch 34, so that the determination is restored to be based on the first set amount. Also, the operator may operate the cancel switch 34 when the second set amount is required to be changed after the command output unit 32 is operated to change the

determination to be based on the second set amount. That is, the operator operates the cancel switch 34 to temporarily restore the determination to be based on the first set amount, and then, the operator operates the command output unit 32 to change the determination to be based on a new second set amount.

[0054] As described above, when the cancel switch 34 is operated, the determination in STEP 7 becomes YES, and the procedure goes to STEP 9, in which the doffing-weaving control device 19 determines whether or not the measurement value based on the count of the piece-number counter 28 reaches the first set amount. When the measurement value reaches the first set amount, the determination becomes YES, and the procedure goes to STEP 31, in which the determination is changed to be based on the first set amount. For example, assuming that the first set amount is 100 pieces, the additional weaving amount is 15 pieces, and the command output unit 32 is operated when the measurement value is 95 pieces, the second set amount is expressed as 95 pieces + 15 pieces = 110 pieces. The determination is thus changed to be based on the second set amount. If weaving is continued and the cancel switch 34 is operated when the measurement value is 105 pieces, the measurement value reaches the first set amount. Hence, the doffing-weaving control device 19 invalidates the cancel command of changing the determination to be based on the first set amount, and the procedure goes to the next step. As the next step, the procedure may go to STEP 8 for performing the determination based on the second set amount. However, in this embodiment, it is assumed that weaving has achieved the predetermined weaving amount. Thus, the procedure goes to STEP 31, in which the weaving start command of the doffing edge 11 is output. When the measurement value does not reach the first set amount, and hence, if NO in STEP 9, the procedure goes to STEP 10, in which the doffing-weaving control device 19 changes the determination to be based on the first set amount, and deletes the cancel command. Then, the procedure goes to STEP 11, and the above-described processes are performed.

[0055] Next, referring back to STEP 4, a case is described, in which the operator operates the repeat switch 33 while the doffing-weaving control device 19 performs the determination based on the first set amount.

[0056] While the determination based on the first set amount is performed, the processes of STEPS 2 to 5, and 11 are repeated. During the repeating, when the repeat switch 33 is operated before the measurement value reaches the first set amount, a signal of changing the determination to be based on the second set amount of the previous doffing-weaving is output. In STEP 4, the determination whether or not the repeat command is input from the repeat switch 33 becomes YES.

[0057] If YES, the procedure goes to STEP 21 in Fig. 6, in which the doffing-weaving control device 19 determines whether or not the current measurement value reaches the previous doffing-weaving amount saved as

the second set amount of the previous doffing-weaving. If the current measurement value reaches the previous doffing-weaving amount, or YES, the repeat command is invalidated, and the procedure goes to STEP 5. If NO, the procedure goes to STEP 22, in which the doffing-weaving control device 19 changes the determination to be based on the previous doffing-weaving amount (the number of weaving pieces) of the previous doffing-weaving saved in STEP 33, so as to change the determination to be based on the previous second set amount, and to delete the repeat command.

[0058] After STEP 22, the procedure successively goes to STEP 23, in which the doffing-weaving control device 19 determines whether or not the cancel command is input. If YES, the procedure returns to STEP 10 in Fig. 5, in which the doffing-weaving control device 19 changes the determination to be based on the first set amount, and then, the procedure is shifted to the process in STEP 11. If NO in STEP 23, the procedure goes to STEP 24, in which the doffing-weaving control device 19 determines whether or not the measurement value input from the piece-number counter 28 reaches the saved previous doffing-weaving amount. If NO, the procedure goes to STEP 25, in which the doffing-weaving control device 19 determines whether or not the end signal of the unit design pattern is input. If NO, the determination process is continued. If YES because weaving with the unit design pattern is completed and the end signal of the unit design pattern is input, the procedure goes to STEP 26, in which the pulse signal as the count-up signal is output to the piece-number counter 28, and the procedure returns to the process in STEP 23.

[0059] As weaving is continued, and the processes in STEPS 23 to 26 are repeated, the measurement value input from the piece-number counter 28 reaches the saved previous doffing-weaving amount, or the previous second set amount, and the determination becomes YES in STEP 24. Hence, the procedure is shifted to STEP 31 in Fig. 7, in which the doffing-edge weaving is started.

[0060] Finally, referring to Fig. 7, a case is described, in which the doffing-weaving control device 19 performs the determination based on the second set amount, and the operator operates the repeat switch 33, in a time from the completion of doffing-weaving to the start of the next doffing-weaving, more specifically, from when the determination is automatically changed to be based on the first set amount in response to the output of the loom stop signal until when the next doffing-weaving is started. In STEP 8 in Fig. 5, when the measurement value reaches the second set amount and the determination becomes YES, the procedure goes to STEP 31 in Fig. 7, in which doffing-edge weaving is started. Then, the record of the previous doffing-weaving amount is deleted in STEP 33, and the current doffing-weaving amount is stored. Hence, the second set amount is stored as the current doffing-weaving amount. Then, the determination is changed to be based on the first set amount in STEP 35. The loom is automatically stopped in STEP 36, and then, the pro-

cedure goes to STEP 37. When the repeat switch 33 is operated after doffing-weaving is completed, more particularly, after the determination is automatically changed to be based on the first set amount in response to the output of the loom stop signal, the determination becomes YES, and the procedure goes to STEP 39. In STEP 39, the determination is changed to be based on the saved current doffing-weaving amount. Hence, the determination is changed to be based on the current second set amount, and the procedure is ended. The next doffing-weaving is started with the determination based on the current second set amount. If NO in STEP 37, the procedure goes to STEP 38, in which it is determined whether or not the operation of the loom is started. If NO in STEP 38, the procedure returns to STEP 37, in which the determination process whether or not the repeat command is input is continuously performed. When the next doffing-weaving is started and the operation of the loom is started, the determination becomes YES in STEP 38, and the procedure is ended. The next doffing-weaving is started with the determination based on the first set amount.

[0061] A case is described, in which the determination of doffing-weaving is changed from the first set amount to the second set amount, with reference to Fig. 1 in time series. Fig. 1 illustrates time series from the right side to the left side. The loom has the first set amount of N pieces, while a woven cloth obtained by weaving with a unit design pattern defines a single piece having a length A. The count of the piece-number counter 28, that is, the measurement value of the piece-number counter 28 is N. When weaving of the woven cloth for N pieces is completed, weaving of the doffing edge 11 is started such that the doffing edge 11 continuously extends from the end portion 41 of the woven cloth. Weaving is performed with a doffing-edge pattern by a length B, and then, the piece-number counter 28 and the step counter 31 are reset, so as to continuously perform weaving with the unit design pattern for next doffing. When weaving is completed by a predetermined number of steps S which is set by the stop-step-number setting unit 29, the loom is automatically stopped, and the notification light 36 is lit or blinked. The operator performs so-called doffing operation, in which the woven cloth is cut at the doffing-edge portion, and the woven cloth is removed from the loom. Then, the operator installs a new cloth roller 8 to the loom. Then, when the operator operates the operation start switch, the determination based on the first set amount is automatically performed. Weaving with the unit design pattern is repeated to continuously produce a woven cloth having the length A. The count is incremented every weaving with the unit design pattern. When the operator inputs 2 as an additional weaving amount, to the input unit 25 and operates the command output unit 32 during weaving of a (M+1)-th piece, since the measurement value of the piece-number counter 28 is M at the operation, the determination is changed to be based on the second set amount, which is M+2. When weaving is performed by

M+2, and when the measurement value of the piece-number counter 28 reaches M+2, weaving of the doffing edge 11 is started.

[0062] Next, with reference to Fig. 2, a case is described, in which the determination in doffing-weaving is changed from the determination based on the first set amount to that based on the second set amount. The same procedure is held until the determination is changed to be based on the second set amount (M+2). When the cancel switch 34 is operated during weaving of a (M+2)-th piece, the determination is changed to be based on the first set amount. Thereafter, the count of the piece-number counter 28 is incremented every weaving with the unit design pattern.

[0063] In this embodiment, since the doffing edge 11 is woven so as to continuously extend from the end portion 41 of the woven cloth 4 corresponding to weaving of the first set amount and the second set amount, the cutting operation in the doffing operation is easily performed. However, the doffing edge 11 does not have to be woven. In this case, the cutting operation is performed at a border between the woven clothes 4 produced by two cycles of doffing-weaving, that is, at the end portion 41 of the woven cloth 4, or at a position near the end portion 41.

[0064] In this embodiment, the loom is automatically stopped when the doffing edge 11 reaches the doffing position in the woven-cloth path, that is, when the end portion 41 of the woven cloth 4 reaches the predetermined position in the woven-cloth path. However, the loom does not have to be automatically stopped. In particular, as long as the end portion 41 is at a predetermined position located downstream of a winding position of the take-up roller 6, the woven cloth 4 is not loosened at the upstream side even when the woven cloth 4 is cut at the end portion 41 of the woven cloth 4. The doffing operation can be performed while the operation of the loom is continued. Since the notification light 36 is lit or blinked when the end portion 41 reaches the predetermined position in the woven-cloth path, the notification light 36 visually notifies the operator of the doffing timing. The operator performs the doffing operation including a light-off operation of the notification light 36.

[0065] In this embodiment, the set amount uses the number of pieces, a piece corresponding to a unit design pattern. However, the unit of length, such as yard, meter, or the like, may be used. The stop-step-number setting unit 29 does not have to set the number of steps S, and may set an actual weaving length. In this case, preferably, the input weaving length may be converted into the number of steps S in accordance with a weft density or the like.

[0066] In this embodiment, the determination is changed to be based on the first set amount when it is detected that the count of the step counter 31 reaches the set number of steps S, and the change of the determination is performed in response to the output of the loom stop signal and the light-on signal of the notification light 36. Accordingly, the change of the determination is

performed at a predetermined timing until the restart of the loom, or at a predetermined timing after the restart. The predetermined timing corresponds to output of the loom stop signal. However, the change of the determination may be performed when a timer is operated in response to the output of the loom stop signal and a predetermined time elapses from the output of the loom stop signal. Alternatively, the change of the determination may be automatically performed in association with a manual operation of restart. Still alternatively, the determination may be automatically changed to be based on the first set amount when measurement with a counter or a timer is automatically started in association with the manual operation of restart and when weaving by a predetermined number of steps as a weaving amount after the restart is completed, or when a predetermined time elapses. In this embodiment, the determination is automatically changed to be based on the first set amount when a weaving amount or a time after the weaving amount reaches the second set amount reaches a predetermined value. Hence, the predetermined timing for changing corresponds to the output of the loom stop signal and the light-on signal. However, the changing may be performed before the output of the loom stop signal and the light-on signal. For example, the determination may be changed to be based on the first set amount when it is detected that the measurement value of the piece-number counter 28 reaches the second set amount. Yet alternatively, for example, the change of the determination may be performed in response to the end signal in a last weft-insertion step in doffing-weaving. Still alternatively, for example, measurement with a timer may be started at the detection of that the measurement value of the piece-number counter 28 reaches the second set amount, or at the detection of the end signal in the last weft-insertion step in doffing-weaving, and the changing may be performed after a predetermined time elapses. Still further alternatively, a sensor or a limit switch may be provided, and the doffing operation may be detected by detecting attachment or detachment of the cloth roller 8, so that the changing is automatically performed. In any case, the operator need not perform a special operation merely for changing the determination to be based on the first set amount.

[0067] In this embodiment, the display unit 35, the input unit 25 of the second weaving amount setting portion 24, an input unit (not shown) of the first weaving amount setting portion 23, the repeat switch 33, the cancel switch 34, an input unit (not shown) of the stop-step-number setting unit 29, and the command output unit 32 are provided in a common liquid crystal display screen of an operation panel. However, some of these elements may be provided on different liquid crystal display screens of the operation panel. Alternatively, when commercially available devices are used, these elements do not have to be provided on a liquid crystal display screen.

[0068] In this embodiment, the second weaving amount setting portion 24 can change the number of pieces

to be input to the input unit 25, as the additional weaving amount, during the determination being performed based on the second set amount until the measurement value reaches the second set amount. However, an invariable predetermined number of pieces may be registered in the storage unit 26. In this case, the input unit 25 may be omitted. Alternatively, the number of pieces input to the input unit 25 does not have to be set as the additional weaving amount, but may be set as the second set amount. In this case, the calculation unit 27 may be omitted.

[0069] Further, in the second weaving amount setting portion 24, the operation signal for registering the input number of pieces input to the input unit 25 may be also used as a change command for changing the determination to be based on the second set amount. In this case, the command output unit 32 may be omitted.

[0070] In this embodiment, the command output unit 32 only has a function of outputting the change command for changing the determination based on the first set amount to that based on the second set amount. However, the command output unit 32 may additionally have a new function of outputting a change command for changing the determination from the determination based on the current second set amount to that based on another second set amount. To change the determination from the determination based on the current second set amount to that based on another desired second set amount, the cancel switch 34 may be operated so as to restore the determination to be based on the first set amount. Alternatively, the command output unit 32 may be operated so as to change the determination to be based on the another desired second set amount without the determination being restored to be based the first set amount.

[0071] The piece-number counter 28 and the step counter 31 are provided separately from the doffing-weaving control device 19. However, the piece-number counter 28 and the step counter 31 may be installed into the doffing-weaving control device 19. That is, by performing an operation program for determination of the measurement value and a doffing operation regarding the determination, a portion of the doffing-weaving control device 19 may serve as counters, so that the operations of the counters are cooperatively performed.

Claims

1. A loom having a doffing-weaving control device (19) which measures a weaving amount during weaving, determines whether or not the measurement value reaches a set amount, and performs a predetermined operation for doffing when the measurement value reaches the set amount, the loom comprising:

a weaving amount setting unit (22) which sets the set amount including a first set amount and

- a second set amount; and
 a manually operable command output unit (32)
 which outputs a change command of changing
 the determination from determination based on
 the first set amount to determination based on
 the second set amount,
 wherein the doffing-weaving control device (19)
 performs the determination based on the first
 set amount after weaving is started, performs
 the determination based on the second set
 amount when the change command is input be-
 fore the measurement value reaches the first set
 amount, and automatically changes the deter-
 mination to be based on the first set amount after
 the measurement value reaches the second set
 amount.
2. The loom having the doffing-weaving control device
 (19) according to claim 1, wherein the doffing-weav-
 ing control device (19) automatically changes the de-
 termination to be based on the first set amount when
 a weaving amount after the measurement value
 reaches the second set amount reaches a predeter-
 mined value, or when a time clocked from a prede-
 termined timing after the measurement value reach-
 es the second set amount reaches a predetermined
 value.
3. The loom having the doffing-weaving control device
 (19) according to claim 2, wherein the predetermined
 operation for doffing includes outputting a loom stop
 signal, and the doffing-weaving control device (19)
 automatically changes the determination to be
 based on the first set amount at a predetermined
 timing until when the loom is restarted through a
 manual operation, or at a predetermined timing after
 the restart.
4. The loom having the doffing-weaving control device
 (19) according to any of claims 1 to 3, wherein the
 predetermined operation for doffing causes weaving
 to be continued even after the measurement value
 reaches the second set amount, and causes notifi-
 cation to be provided or causes the loom to be
 stopped when an end portion (41) of a woven cloth
 (4) corresponding to weaving by the second set
 amount reaches a predetermined position in a wov-
 en-cloth path.
5. The loom having the doffing-weaving control device
 (19) according to any of claims 1 to 4, wherein the
 weaving amount setting unit (22) stores an additional
 weaving amount in advance, and when the change
 command is input, the weaving amount setting unit
 (22) sets a value, in which the additional weaving
 amount is added to a measurement value at a timing
 when the change command is input, as the second
 set amount.
6. The loom having the doffing-weaving control device
 (19) according to any of claims 1 to 5, further com-
 prising:
 a cancel switch (34) which cancels the change
 command,
 wherein when the cancel switch (34) is operated
 during the determination based on the second
 set amount, if a timing of the operation of the
 cancel switch (34) is before the measurement
 amount reaches the first set amount and the sec-
 ond set amount, the doffing-weaving control de-
 vice (19) changes the determination to be based
 on the first set amount.
7. The loom having the doffing-weaving control device
 (19) according to any of claims 1 to 6, further com-
 prising:
 a repeat switch (33) which repeats the determi-
 nation based on the second set amount,
 wherein the doffing-weaving control device (19) per-
 forms the determination based on the second set
 amount, in weaving after the measurement value
 reaches the second set amount, the determination
 is automatically changed to be based on the first set
 amount, and when the repeat switch (33) is operated
 before the measurement value reaches the first set
 amount and the second set amount, the determina-
 tion is changed to be based on the second set
 amount.

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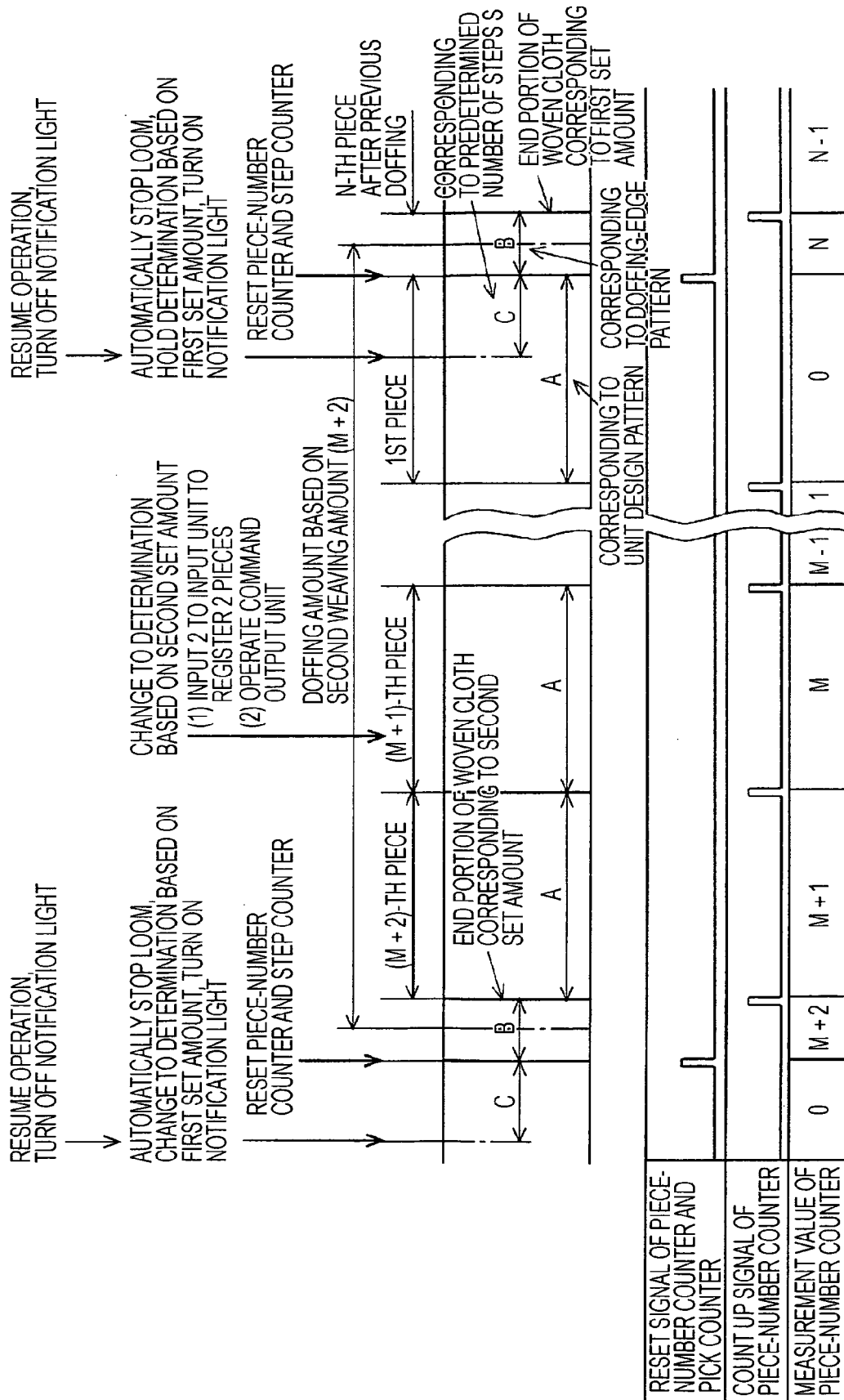


FIG. 2

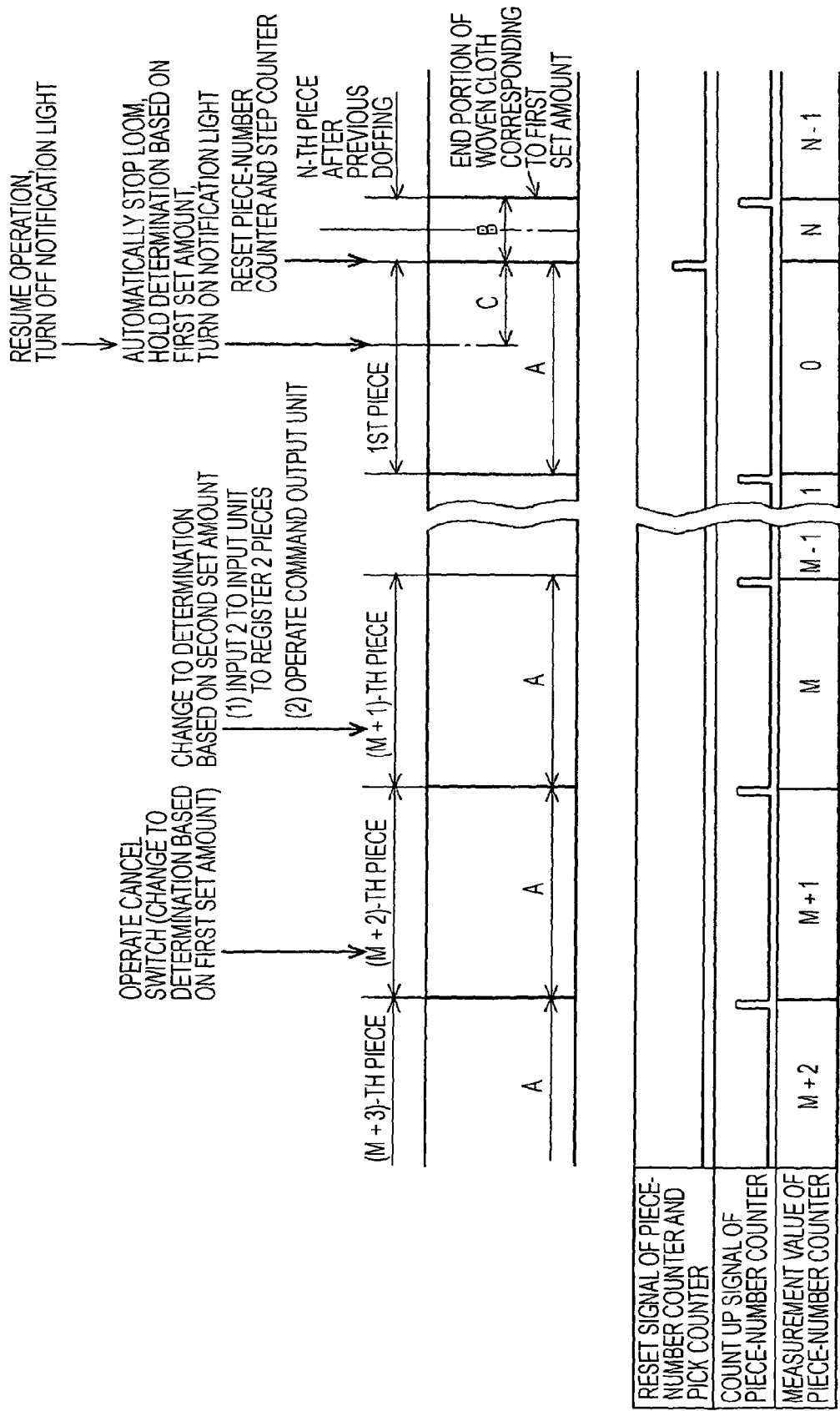
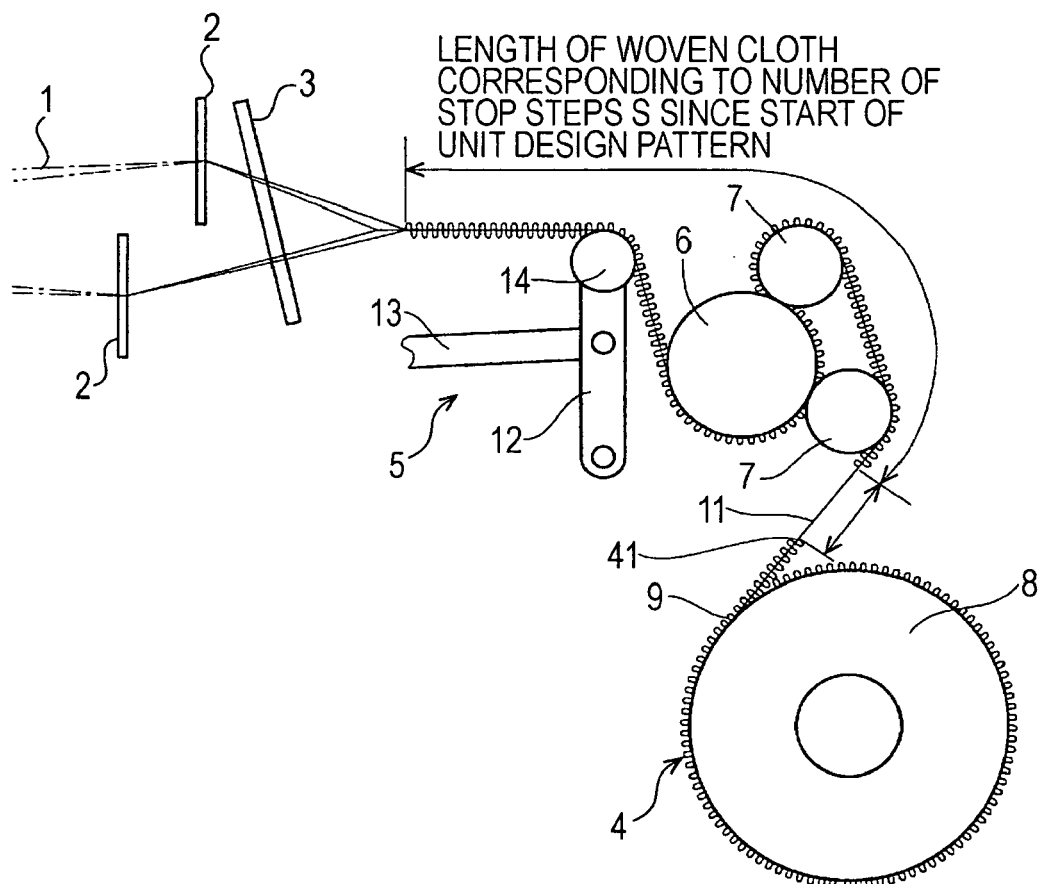


FIG. 3



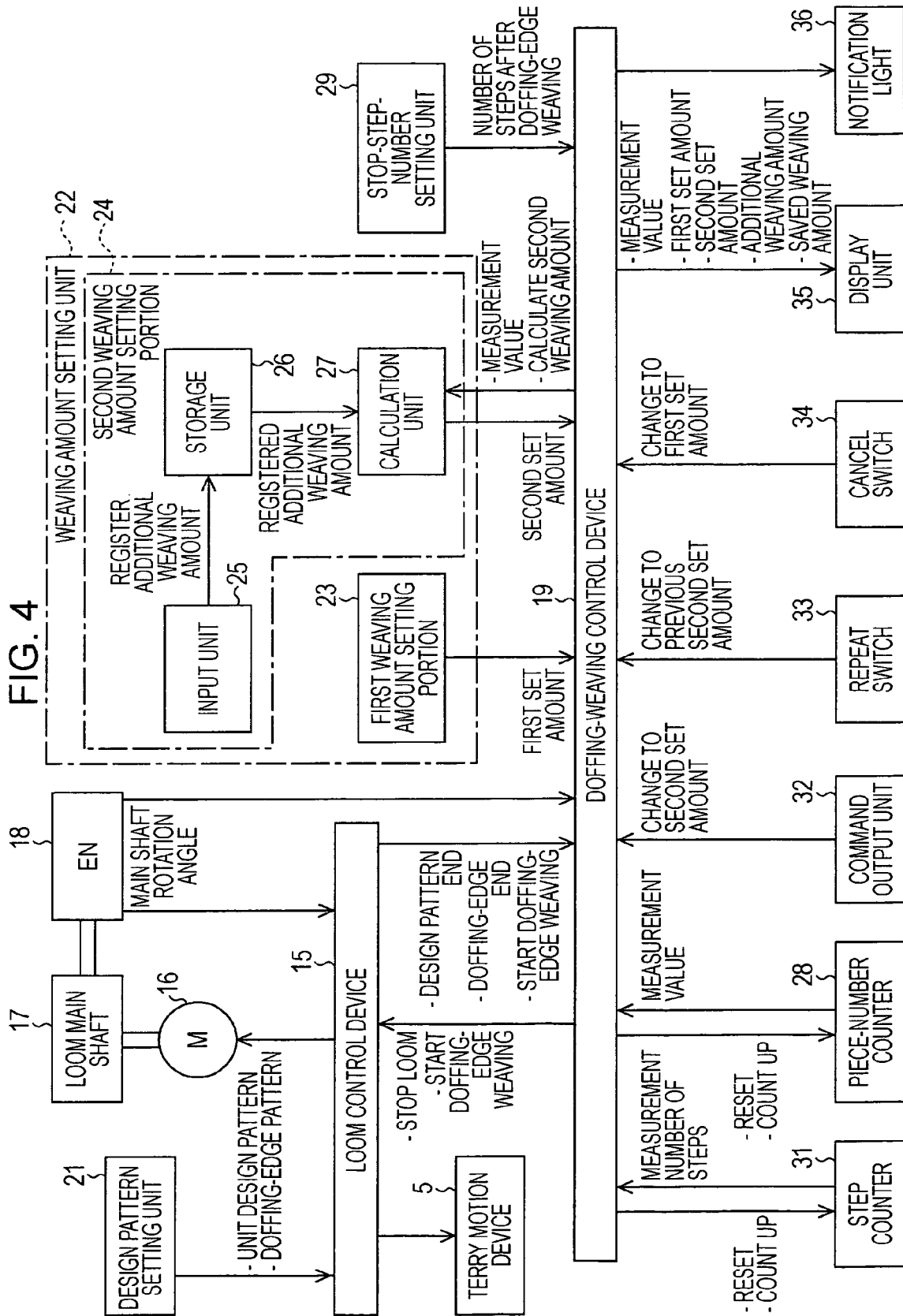


FIG. 5

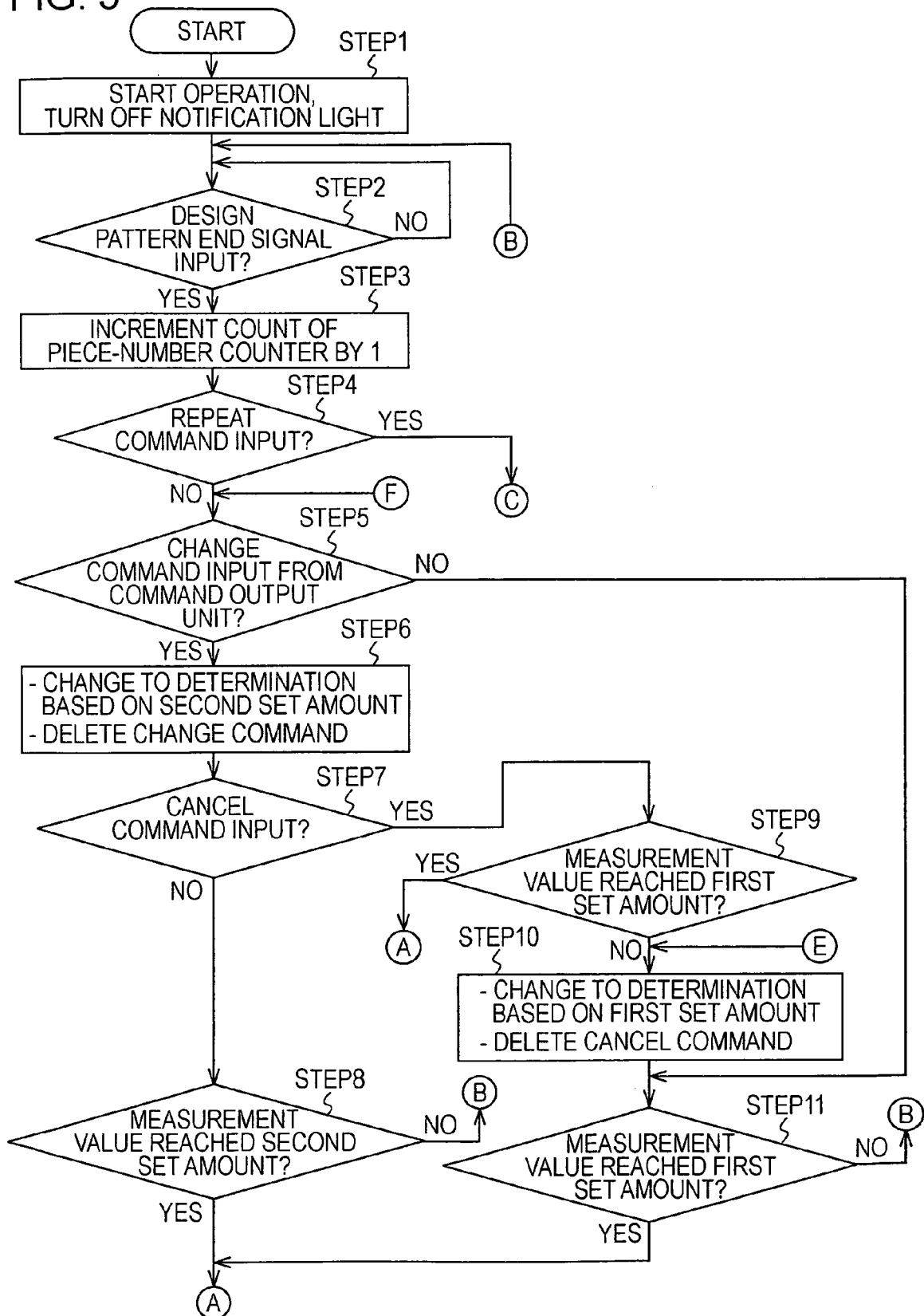


FIG. 6

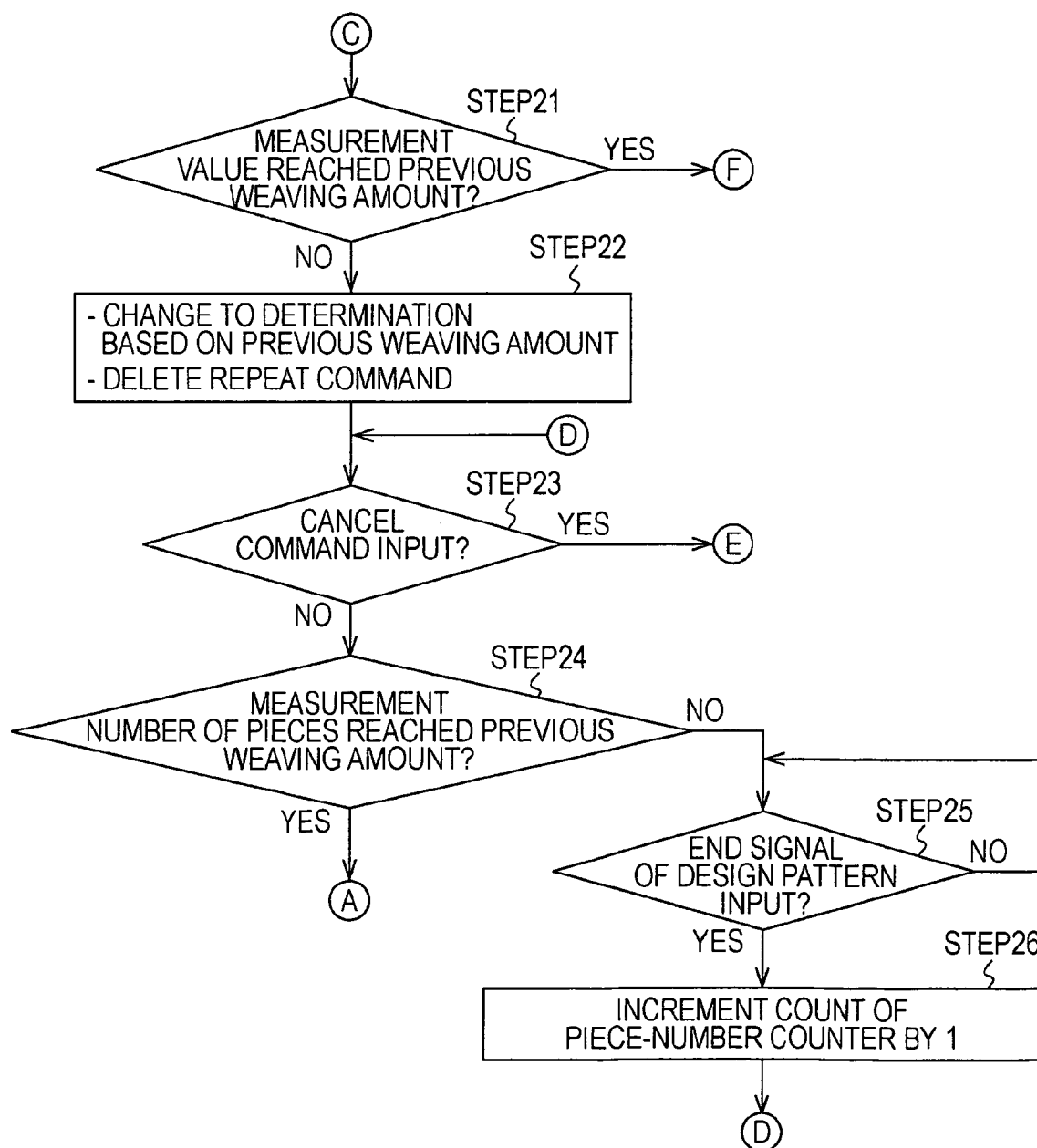
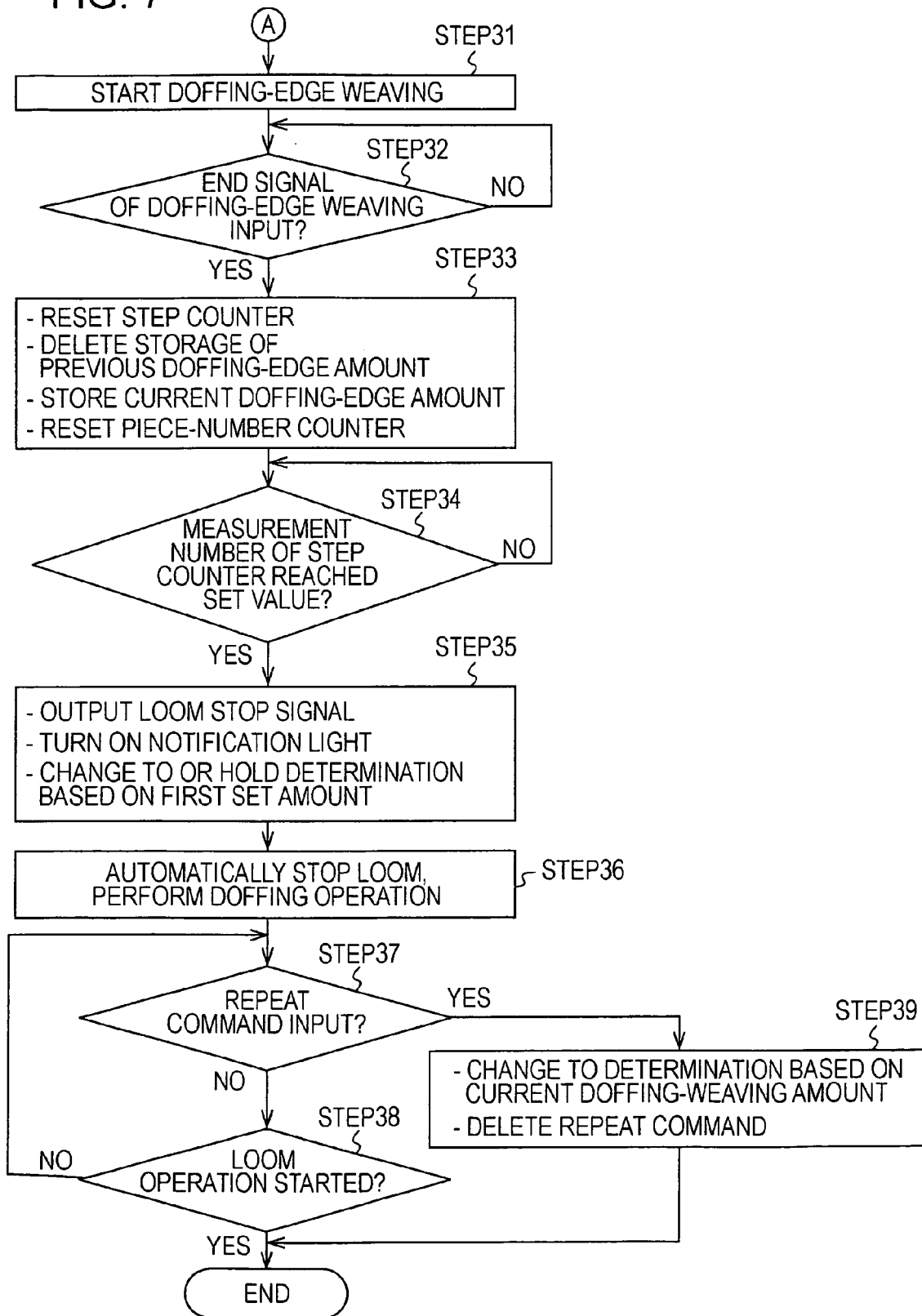


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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