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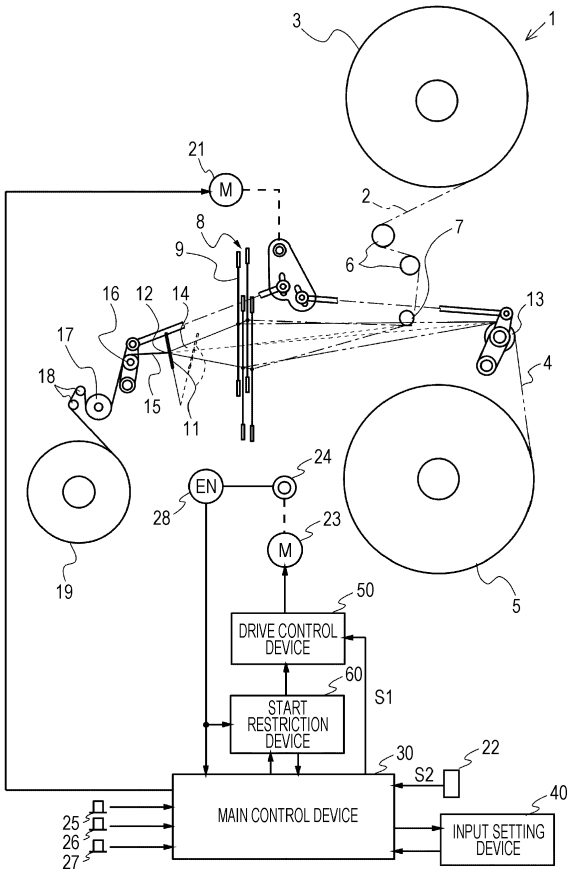
(54) START RESTRICTION METHOD AND DEVICE OF PILE LOOM

(57) A start restriction method of a pile loom (1) from which an operator removes a defective yarn when a weft-insertion failure occurs includes previously storing a start reverse-rotation number set so that a same numerical value as a pile step is assigned to a loose pick and a first fast pick included in pile picks, and 1 is assigned to second and later fast picks; when a weft-insertion failure occurs, reading from the start reverse-rotation number and storing as a current value, a numerical value corresponding to the pile pick with the failure; updating the current value by adding 1 (subtracting 1) every time when a rotational angle of a main shaft (24) passes 0° by forward (reverse) rotation of the main shaft through a subsequent motion of the loom; and inhibiting start of the loom by an operation on an operation button (26) until the current value becomes 0.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a start restriction method and a start restriction device of a pile loom in which a one-pile formation cycle consisting of a plurality of loom cycles is constituted of a pile pattern consisting of pile picks including a loose pick and a fast pick, the loom being configured to form a pile by changing relative positions of a beating position and a cloth-fell position in accordance with the pile pattern in each pile step included in the one-pile formation cycle, an operator removing a defective yarn from the loom when a weft-insertion failure occurs.

[0002] The term "pile pick" is a general term of so-called loose pick and fast pick that are performed for forming a pile by a pile loom.

[0003] Moreover, regarding the term "pile pattern", one pile is formed through at least two loose picks and at least one fast pick to be performed after the loose picks. Based on this, the term "pile pattern" is a combination of the number of loose picks and the number of fast picks. For example, when one pile is formed through two-time loose picks (L) and one-time fast pick (F), the pile pattern is a combination of 2L and 1F and is expressed as "2L-1F".

[0004] Furthermore, the term "one-pile formation cycle" is a loom cycle in which one repetition of a pile pattern consisting of a plurality of pile picks as described above is executed (completed). Each pile pick is performed in one loom cycle, and hence the number of one-pile formation cycle (the number of cycle) corresponds to the number of loom cycles for the total number of pile picks in a pile pattern. Thus, for example, when the pile pattern is the 2L-1F, the one-pile formation cycle corresponds to three loom cycles.

[0005] Furthermore, the term "pile step" is a phase on a loom cycle basis in the one-pile formation cycle, and the phase (ordinal number) is expressed by a step number.

2. Description of the Related Art

[0006] When a weft-insertion failure occurs during weaving in a loom, the loom stops. Then, a recovery work including removal of a weft causing the weft-insertion failure (hereinafter, referred to as "defective weft") is performed. In the recovery work, for example, the defective weft woven into a woven cloth is removed from the cloth fell and the loom is restarted. The recovery work is similarly applied to a pile loom. In the case of the pile loom, when only the defective weft is removed and the loom is restarted, a defect (hereinafter, referred to as "missing of pile") may occur in a woven pile fabric. Specifically, in a case where a weft-insertion failure occurs during weft insertion in one of loom cycles of second and later loose picks and a first fast pick, if only the defective weft is removed and the loom is restarted, the holding force of the weft for the formed pile or the pile to be formed next decreases. A pile warp is pulled to a let-off side by subsequent weaving, and missing of a pile occurs. Thus, in the above-described case, it is necessary to remove the defective weft and in addition all wefts inserted in loom cycles of previous loose picks of the one-pile formation cycle in the recovery work.

[0007] In a case of a loom configured to automatically remove such a weft, no trouble arises. In contrast, in a case of a loom in which an operator performs the recovery work such as removal of a defective weft, the operator may forget removal of other wefts to be removed, may remove only the defective weft, and may restart the loom. In such a case, the woven fabric may involve missing of a pile as described above. Owing to this, as a technology that prevents restart of a loom while such wefts to be removed remain, there is a technology disclosed in Japanese Unexamined Patent Application Publication No. 7-126961 (hereinafter, referred to as "related art").

[0008] The related art inhibits start of a loom from a loom cycle of a second loose pick or a loom cycle of a first fast pick following the loose pick when the loom is to be restarted after the loom is stopped due to a weft-insertion failure, to prevent missing of a pile as described above.

[0009] The related art can handle only a case of pile pattern of "2L-1F" or "2L-2F" like a case disclosed in the related art, that is, a case of two loom cycles of loose picks; however, cannot handle the other pile patterns.

[0010] Specifically, regarding the types of pile fabrics expected to be woven by a certain pile loom are typically three or more types rather than the above-described two types. Three or more types of pile fabrics likely include fabrics woven with a pile pattern set to include loose picks of three or more loom cycles. Regarding this, for example, there is expected a case where a pile pattern includes loose picks of three loom cycles and a weft-insertion failure occurs during weft insertion of a first fast pick. In this case, if an operator removes only a defective weft and intends to restart the loom, the state of the loom at the time point of restart is a loom cycle of a third loose pick.

[0011] With the related art, only a situation is expected in which restart is inhibited in the loom cycle of the second loose pick among loose picks. In the above-described case, the loom may be restarted. In this case, missing of a pile as described above may occur.

[0012] Moreover, in the pile loom expected to weave pile fabrics of three or more types as described above, the number of pile patterns set in the pile loom is the number corresponding to expected pile weaving. In this case, when restart is intended to be inhibited as described above based on the related art, the preparation for the inhibition of restart requires great efforts and time.

[0013] Specifically, in the related art, pile steps (loose pick of step number 2 and fast pick of step number 3) that are included in the pile pattern and in which restart

of the loom is inhibited are set in advance in a program of a loom control computer, thereby inhibiting restart in the loom cycles of the pile steps. That is, the related art requires setting of all pile steps in which restart is inhibited for each pile pattern. Thus, when weaving of three or more types of pile fabrics is expected as described above, the number of pile patterns corresponding to the types of pile fabrics expected to be woven is set in the pile loom as a matter of course. The pile steps in which restart is inhibited have to be set in advance for all pile patterns to be set. In addition, in the related art, the setting is performed on the program of the loom control computer, that is, the setting requires modification of the program. Thus, in this case, when restart of the pile loom is intended to be inhibited based on the related art, the setting (preparation) for the inhibition of restart of the pile loom requires great efforts and time.

SUMMARY OF THE INVENTION

[0014] The present invention is made in light of the above-described situations, and an object of the present invention is to provide a start restriction method and a start restriction device each of which prevents occurrence of missing of a pile caused by an operational error of an operator and that facilitate setting for inhibiting restart in a loom cycle of a specific pile pick even when weaving for a pile fabric is performed by using a pile pattern including loose picks of three or more loom cycles in the pile loom described in the Field of the Invention.

[0015] The present invention presupposes a pile loom from which an operator removes a defective yarn when a weft-insertion failure occurs. In the pile loom, a one-pile formation cycle consisting of a plurality of loom cycles is constituted of a pile pattern consisting of pile picks including a loose pick and a fast pick. The pile loom forms a pile by changing relative positions of a beating position and a cloth-fell position in accordance with the pile pattern in each pile step included in the one-pile formation cycle.

[0016] Based on the presupposition, a start restriction method of the pile loom according to the present invention includes previously storing a start reverse-rotation number being set so that a same numerical value as the pile step is assigned to the loose pick and a first fast pick, which is a first one of the fast pick, included in the pile picks, the start reverse-rotation number being set so that, when the pile pattern includes a plurality of the fast picks, 1 is assigned to second and later ones of the fast picks; when a weft-insertion failure occurs during weaving, reading, from the start reverse-rotation number, a numerical value corresponding to the pile pick of a loom cycle in which the weft-insertion failure occurs, and storing the read numerical value as a current value; updating the stored current value by adding 1 thereto every time when a rotational angle of a main shaft of the loom passes 0° by forward rotation of the main shaft through a subsequent motion of the loom, and updating the stored current value by subtracting 1 therefrom every time when the rotational angle of the main shaft passes 0° by reverse rotation of the main shaft through the subsequent motion of the loom; and inhibiting start of the loom by an operation on an operation button until the updated current value becomes 0.

[0017] Moreover, in the start restriction method of the pile loom according to the present invention, a start allowable section that is determined as a range of rotational angles of the main shaft in a loom cycle of the fast pick may be previously set, and the start of the loom by the operation on the operation button at a rotational angle of the main shaft outside the start allowable section may be inhibited.

[0018] A start restriction device of a pile loom according to the present invention includes a first memory unit, a second memory unit, an arithmetic unit, and a start control unit as described below. The first memory unit previously stores a start reverse-rotation number being set so that a same numerical value as the pile step is assigned to the loose pick and a first fast pick, which is a first one of the fast pick, included in the pile picks, the start reverse-rotation number being set so that, when the pile pattern includes a plurality of the fast picks, 1 is assigned to second and later ones of the fast picks. The second memory unit stores a numerical value as a current value, the numerical value being read from the start reverse-rotation number stored in the first memory unit upon generation of a detection signal of a weft-insertion failure, the numerical value corresponding to the pile pick of a loom cycle in which the weft-insertion failure occurs. The arithmetic unit updates the current value stored in the second memory unit by adding 1 thereto every time when a rotational angle of a main shaft of the loom passes 0° by forward rotation of the main shaft through a motion of the loom, and updates the current value by subtracting 1 therefrom every time when the rotational angle of the main shaft passes 0° by reverse rotation of the main shaft through the motion of the loom. The start control unit monitors the updated current value and inhibits start of the loom by an operation on an operation button until the current value becomes 0.

[0019] Moreover, in the start restriction device of the pile loom according to the present invention, the first memory unit may store a start allowable section that is determined as a range of rotational angles of the main shaft in a loom cycle of the fast pick, and the start control unit may inhibit the start of the loom by the operation on the operation button at a rotational angle of the main shaft outside the start allowable section.

[0020] Even for a pile loom that performs pile weaving by using a pile pattern including loose picks of three or more loom cycles, the present invention realizes inhibition of start of the loom in the loom cycles of all loose picks when the pile loom is restarted after the loom stops due to occurrence of a weft-insertion failure. Specifically, for a pile pattern in which the numbers of loose picks and fast picks are not limited, setting of assigning a numerical value (start reverse-rotation number) to each pile step is

performed, and start of the loom is inhibited in relation with the start reverse-rotation number and a forward/reverse rotational operation number of a main shaft in a predetermined period (more specifically, the forward/reverse rotational operation number of the main shaft in a period from a time point at which a weft-insertion failure is detected to a time point at which the loom is rotated reversely in a loom cycle in which a defective weft is removed and the loom can be started).

[0021] Based on this, the setting for the inhibition of start of the loom (the setting of the start reverse-rotation number) according to the present invention is performed such that the same numerical value as the pile step is assigned to the loose pick and the first fast pick, and also when the pile pattern includes a plurality of the fast picks, 1 is assigned to second and later ones of the fast picks. Accordingly, with the present invention, individual setting on pile steps for inhibiting restart of each pile pattern is not required unlike the related art, and hence the efforts and time for the setting (preparation) work can be reduced. Thus, with the present invention, even for a pile loom that performs pile weaving by using a pile pattern including loose picks of three or more loom cycles, the present invention can realize the inhibition of start of the loom without great efforts and the like on the setting (preparation).

[0022] Moreover, in the present invention, the start allowable section is previously determined as the range of the rotation angles of the main shaft (hereinafter, referred to as "crank angle"), and restart is inhibited at a crank angle outside the start allowable section. This prevents occurrence of a situation in which weft insertion is not performed normally immediately after restart.

[0023] Specifically, in a normal loom, weft insertion immediately after start may not be performed normally depending on the crank angle at which the loom is started. In other words, the loom is required to be started in a state in which the crank angle is a rotational angle (hereinafter, referred to as "weft-insertion allowable angle") within an angular range in which weft insertion is normally performed. Thus, according to the present invention, the loom is brought into a state of a loom cycle in which restart is allowable (a loom cycle in which the current value becomes 0) by a forward/reverse rotation operation (hereinafter, referred to as "restart preparation operation") of the loom (main shaft) directed to restart after a defective weft is detected. In the loom, the crank angle at the time point of restart is required to be the weft-insertion allowable angle in the loom cycle in which the restart is allowable.

[0024] However, in the reverse-rotation operation of the main shaft toward the crank angle at which restart is finally performed in the restart preparation operation, an operational error of an operator may stop the reverse-rotation operation in a state in which the crank angle is other than the weft-insertion allowable angle although being in the loom cycle in which the current value is 0. If the loom is restarted in this state, the above-described situation in which weft insertion is not normally performed may occur.

[0025] In contrast, the first memory unit previously stores, as the start allowable section, the rotational range in which weft insertion is normally performed, and the start control unit inhibits start from the rotational angle of the main shaft outside the start allowable section. Accordingly, the situation in which weft insertion is not normally performed immediately after restart due to an operational error such as one described above can be prevented from occurring.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is an explanatory diagram illustrating an example of a pile loom to which the present invention is applied;

Fig. 2 is an explanatory diagram illustrating an example of a pattern setting screen for inputting and setting weaving patterns set according to the present invention;

Fig. 3 is a block diagram illustrating an example of a start restriction device of the pile loom of the present invention;

Fig. 4 is a table describing an example of setting of start reverse-rotation numbers corresponding to a plurality of pile patterns;

Fig. 5 is an explanatory diagram illustrating workings of the pile loom when removal of a weft and an operation of the loom are performed by a correct procedure;

Fig. 6 is an explanatory diagram illustrating workings of the pile loom when an operation button is operated by a wrong procedure; and

Fig. 7 is a block diagram illustrating an embodiment obtained by modifying the start restriction device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Fig. 1 illustrates an example of a pile loom to which the present invention is applied. The pile loom of this embodiment is a cloth-shifting pile loom that forms piles by moving a cloth-fell position in a front-rear direction by a terry motion mechanism in accordance with a pile pattern and hence changing relative positions of the cloth-fell position and a beating position.

[0028] As illustrated in Fig. 1, a pile loom 1 includes two warp beams 3 and 5. The warp beam (pile warp beam) 3 is for supplying pile warps. Multiple pile warps 2 in a sheet shape are wound around the pile warp beam 3. The warp beam (chain warp beam) 5 is for supplying chain warps. Multiple chain warps 4 in a sheet shape are wound around the chain warp beam 5.

[0029] The pile warps 2 are let off from the pile warp beam 3, and guided to a cloth fell 12 via a guide roller 6, a pile tension roller 7, a heald frame 8 (heald 9), and a

reed 11. The chain warps 4 are let off from the chain warp beam 5, wound around a tension roller 13 for chain warps, and then guided to the cloth fell 12 via the heald 9 and the reed 11.

[0030] The warps 2 and 4 let off from the warp beams 3 and 5 form a shed 14 by an up-down motion of the heald frame 8, and a weft (not illustrated) inserted into the shed 14 is beaten by the reed 11 to the cloth fell 12, thereby forming a woven cloth 15. The woven cloth 15 is wound around and guided by a cross guide 16, and then is taken up by a take-up beam 19 via a take-up roller (surface roller) 17 and a guide roller 18.

[0031] Such a pile loom repetitively performs pile weaving of forming piles and chain weaving of forming, for example, borders. The pile loom 1 of this embodiment is a so-called cloth-shifting pile loom that performs pile weaving by moving the cloth-fell position relative to the front-most position of the reed 11 as described above.

[0032] In such a pile loom, the motion of moving the cloth fell as described above is also called terry motion. The terry motion is performed by displacing the chain-warp tension roller 13 around which the chain warps 4 are wound and the cross guide 16 around which the woven cloth 15 is wound, in the front-rear direction. The configuration of displacing the tension roller 13 and the cross guide 16 is known and the description thereof is omitted. In the illustrated example, a drive motor 21 is used as a drive source of the motion. The drive motor 21 is driven in accordance with a pile pattern previously stored in a main control device 30 of the pile loom 1.

[0033] The pile pattern is set in an input setting device 40 and is stored in the main control device 30. Fig. 2 illustrates a pattern setting screen 41 with which a weaving pattern including a pile pattern is set in the input setting device 40. A right column 42 of the pattern setting screen 41 is a pile-pattern setting display column 42. The weaving pattern includes tensions of pile warps and chain warps, loom RPM, weft type (color), weft density, shed pattern, and pile pattern. In the pattern setting screen 41, shed pattern, color, weft density, and pile pattern among the above-listed elements are set per one loom cycle in the pattern setting screen 41.

[0034] In the pattern setting screen 41, numbers 43a in a left end column 43 indicate step numbers of weaving patterns (one step = one loom cycle). A column 44, in which cells C are arranged in a grid shape, on the right side of the left end column 43 is a shed-pattern setting display column 44. Moreover, numerical values indicating numbers of heald frames are displayed in a portion 44a on the upper side of the shed-pattern setting display column 44. Furthermore, a center column 45 of the pattern setting screen 41 is a color and weft-density setting display column 45.

[0035] In the illustrated pattern setting screen 41, a pile pattern is set, in a form of "5 3L-2F" or "4 3L-1F" in a column "P" of the pile-pattern setting display column 42. In this display (for example, "5 3L-2F"), "L" indicates a loose pick and "F" indicates a fast pick as described above. Hence, "3L-2F" represents a pile pattern including three-time loose picks and two-time fast picks. The numerical value on the left side ("5" of "5 3L-2F") represents the total number of pile picks constituting the pile pattern, that is, the number of loom cycles for a one-pile formation cycle.

[0036] To complete the pile pattern during weaving, the loom cycles for the one-pile formation cycle are required. In the column "P" in the pile-pattern setting display column 42, the same pile pattern is set in cells for the number of the loom cycles. Specifically, since five loom cycles are required to complete the pile pattern of 3L-2F, "5 3L-2F" is set in cells for the five loom cycles.

[0037] In addition, the number in a column "S" on the right side of the column "P" in the pile-pattern setting display column 42 indicates a step number of a pile step in the pile pattern set in the column "P". In the pile pattern of 3L-2F, pile steps of step numbers 1 to 3 correspond to loose picks, and pile steps of step numbers 4 and 5 correspond to fast picks.

[0038] Then, the terry motion is performed in accordance with the pile pattern set in the pattern setting screen 41 as described above. Specifically, with the pile pattern of 3L-2F, the cloth-fell position moves in a direction (forward) away from the front-most position of the reed in a first loose pick in the pile pattern (the pile step of the step number "1"). Also, the cloth-fell position moves (returns) to the front-most position of the reed in a first fast pick in the pile pattern (the pile step of the step number "4").

[0039] The present invention presupposes a pile loom (hereinafter, also merely referred to as "loom") from which an operator removes a defective weft when a weft-insertion failure occurs. When a weft-insertion failure occurs in such a loom, an operation such as the following operation is performed in the loom.

[0040] First, it is presupposed that a weft feeler 22 that is a sensor that detects arrival of a weft is connected to the main control device 30. The main control device 30 has a function of determining whether weft insertion is normally performed (whether a weft-insertion failure occurs) based on a weft arrival signal S2 input from the weft feeler 22. When the main control device 30 determines that a weft-insertion failure occurs, the main control device 30 outputs a stop signal S1 to a drive control device 50. The drive control device 50 performs stop control of the loom by stopping rotation of a main-shaft motor 23 and activating a brake (not illustrated) in response to an input of the stop signal S1.

[0041] Hence, the loom has inertial rotation by about one rotation of the main shaft 24 from a time point at which the stop control is started, and then temporarily stops at a crank angle of about 280° in a loom cycle next to the loom cycle in which a weft-insertion failure occurs. The crank angle at which the loom temporarily stops is referred to as "first stop-position crank angle". Then, a reverse-rotation motion is automatically started. The loom stops after the reverse-rotation motion is completed, and is brought into a standby state in which the loom

waits for an operator. The crank angle at which the loom is in the standby state is referred to as "second stop-position crank angle". The reverse-rotation motion of the loom is performed such that the main shaft 24 is rotated reversely by about one rotation. Hence, the loom is brought into the standby state at a crank angle of about 300° in the loom cycle in which a weft-insertion failure occurs, and the crank angle passes 0° in the process of reverse rotation.

[0042] When an operator arrives at the loom, the operator operates a reverse-rotation button 25, and rotates the loom reversely to a crank angle of about 180°. Thus, the warps are shedded and a defective weft becomes accessible. The operator performs the removal work of removing the defective weft from the shed 14 of the warps in this state.

[0043] After the removal work, when the weft located closest to the cloth-fell side is the weft inserted in a loom cycle of a loose pick (hereinafter, referred to as "loose-pick cycle"), the weft is also required to be removed before the loom is restarted. In this case, the operator rotates the loom reversely in the manner similar to the above to cause the weft to be accessible, and the operator performs the removal work of the weft.

[0044] The removal work is performed on all wefts to be removed including the defective weft. Then, the operator operates the reverse-rotation button 25, and rotates the loom reversely to a crank angle (start angle) for restarting the loom. The start angle is set to, for example, a crank angle of about 300° in a loom cycle that is one cycle before the loom cycle in which the last weft to be removed is removed. Hence, even in the process of reverse rotation directed to restart of the loom, the loom passes the crank angle of 0°.

[0045] When the loom is rotated reversely to the start angle, the operator ends the operation on the reverse-rotation button 25 to stop the loom, and operates an operation button 26 (hereinafter, referred to as "operation on operation button"). Accordingly, the loom is restarted. The loom is also provided with a forward-rotation button 27. The operator operates the forward-rotation button 27 to rotate the loom forward if required in the weft removal work and the work of aligning the crank angle of the loom with the start angle.

[0046] In the pile loom described above, according to the present invention, the loom includes a start restriction device that restricts restart by an operation on the operation button after the removal work of a defective weft. The start restriction device is described below in detail.

[0047] As illustrated in Fig. 3, a start restriction device 60 is connected at its input terminal to the main control device 30, and is connected at its output terminal to the drive control device 50 that controls driving of the main-shaft motor 23 of the loom. The start restriction device 60 includes, as components, a first memory unit 61 that stores a start reverse-rotation number (described later) and the like, a current-value arithmetic unit 62 connected at its input terminal to the first memory unit 61 and the main control device 30, and a start control unit 63 connected at its input terminal to the first memory unit 61, the current-value arithmetic unit 62, and the main control device 30.

[0048] The loom includes an encoder 28 as a device for detecting the crank angle. The start control unit 63 of the start restriction device 60 is also connected at its input terminal to the encoder 28. The start control unit 63 receives a signal indicating the crank angle (angular signal θ) detected by the encoder 28. Furthermore, the start control unit 63 is connected at its output terminal to the drive control device 50. The start control unit 63 outputs an operation command signal S4, which is a signal for restarting the loom, to the drive control device 50.

[0049] The first memory unit 61 previously stores set values relating to inhibition of restart of the loom, such as a start reverse-rotation number and a start allowable section. The start reverse-rotation number among the set values is a set value to be used for determining whether restart of the loom is inhibited. The start reverse-rotation number is set for each of all pile patterns stored in the main control device 30.

[0050] Specifically, when the pile picks in the pile steps are a loose pick and a first fast pick, the start reverse-rotation number is set so that the same numerical value as the step number of the pile step is assigned. Moreover, for the pile pattern set to include a plurality of fast picks, the start reverse-rotation number is set as described above, and in addition, is set so that 1 is assigned to second and later fast picks. The numerical value (hereinafter, referred to as "assigned value") that is assigned to the start reverse-rotation number for each pile pick of a pile pattern corresponds to the number of loom cycles in a period from a loom cycle in which a weft-insertion failure is detected (hereinafter, abbreviated as "detected cycle") to a loom cycle in which restart is allowable.

[0051] More specifically, after the removal work of a weft as described above, when the weft located closest to the cloth-fell side is the weft inserted in a loose-pick cycle, the weft is also required to be removed before the loom is restarted. When the weft located closest to the cloth-fell side is determined as the weft inserted in a loom cycle of a fast pick (hereinafter, referred to as "fast-pick cycle"), a problem can be prevented from occurring in weaving after the loom is restarted. In normal circumstances, the loom (the main shaft 24) is rotated reversely to the start angle of the fast-pick cycle closest to the detected cycle in the reverse-rotation direction, and the loom is restarted in this state. When the detected cycle is a loose-pick cycle or a first fast-pick cycle, the last fast-pick cycle in the pile formation cycle, which is one pile formation cycle previous to the pile formation cycle including the detected cycle, is the fast-pick cycle closest to the detected cycle.

[0052] As described above, in the method of restart in normal circumstances, the loom is restarted in the fast-pick cycle closest to the detected cycle. The loom cycle in which restart is performed is the loom cycle, which is

the number of pile steps of the detected cycle previous to the detected cycle. In other words, by rotating the main shaft 24 reversely on a one rotation basis by the number of pile steps of the detected cycle from the detected cycle, the loom is brought into the loom cycle in which restart is performed.

[0053] The start reverse-rotation number is used for determination whether restart of the loom is inhibited as described above. The determination is made according to whether reverse rotation corresponding to the assigned value has been performed from the detected cycle. When the detected cycle is a loose-pick cycle or a first fast-pick cycle, the assigned value of the start reverse-rotation number is the same numerical value as the step number of the pile step of the detected cycle. When the detected cycle is a second or later fast-pick cycle, the loom cycle, which is one loom cycle previous to the detected cycle, is also a fast-pick cycle. The fast-pick cycle closest to the detected cycle is the loom cycle, which is one cycle previous to the detected cycle. In this case, the assigned value of the start reverse-rotation number is 1. The start reverse-rotation number is set every pile pattern in a manner that the assigned value is assigned to each pile step in the pile pattern.

[0054] Fig. 4 illustrates an example of the above-described start reverse-rotation number. Fig. 4 is a table describing how start reverse-rotation numbers are set for a plurality of types of pile patterns. In the table in Fig. 4, pile patterns are indicated in a left-most end column of the table, and for each of the pile patterns, a pile pick in each pile step and the assigned value of the start reverse-rotation number corresponding to the pile step are indicated in columns arranged on the right side of the pile pattern. Specifically, "F/4" in the column in which the step number of the pile pattern of 3L-2F is 4 (4th) represents that the pile pick in the loom cycle is a fast pick and the assigned value of the start reverse-rotation number is 4.

[0055] A typical pile loom can handle weaving with plural types of pile patterns. Also in this embodiment, the start reverse-rotation number to be stored in the first memory unit is stored as system data in the first memory unit in a manner that start reverse-rotation numbers (for example, all values described in Fig. 4) respectively corresponding to the plurality of types of pile patterns are respectively associated with pile patterns.

[0056] Moreover, the start allowable section among the set values is a section in which restart is allowable in a loom cycle (during one rotation of the main shaft) and is a section set using an angular range of crank angles. In other words, the start allowable section is a section determined for inhibiting restart at a crank angle outside the set angular range. More specifically, an angular range of crank angles at which weft insertion is normally performed immediately after restart is set as the start allowable section. The angular range is determined based on weaving conditions (for example, the loom RPM, jetting start timing and jetting pressure of a weft-insertion nozzle, and width of a pile fabric to be woven). Based on this, it is assumed that an angular range from 241° to 340° is set as the start allowable section in this embodiment.

[0057] The current-value arithmetic unit 62 includes a memory section 64 and an arithmetic section 65 as illustrated in Fig. 3. The memory section 64 corresponds to a second memory unit according to the present invention. When a detection signal S6 of a weft-insertion failure (hereinafter, merely referred to as "detection signal") is generated, the memory section 64 stores, as a current value P, an assigned value N that is a numerical value (assigned value) corresponding to the pile pick of the loom cycle in which the weft-insertion failure occurs and that is an assigned value N read from the start reverse-rotation number stored in the first memory unit 61. Moreover, the arithmetic section 65 corresponds to an arithmetic unit according to the present invention, and updates the current value P stored in the memory section 64 every time when the crank angle passes 0° by a forward/reverse rotation of the main shaft 24 through the motion of the loom. The current-value arithmetic unit 62 thus configured is described below in further detail.

[0058] It is presupposed that the main control device 30 is connected to the arithmetic section 65 of the current-value arithmetic unit 62 as illustrated in Fig. 3. When determining that a weft-insertion failure occurs based on the weft arrival signal S2 input from the weft feeler 22, the main control device 30 performs the above-described loom stop control and outputs the detection signal S6 to the arithmetic section 65.

[0059] Furthermore, the main control device 30 stores the pile pattern input and set in the input setting device 40 as described above. The main control device 30 updates the current step number in the weaving pattern every one rotation of the main shaft 24 during weaving, and to control the drive motor, updates the pile pattern and the pile step to values corresponding to the updated step number. Thus, the main control device 30 recognizes the pile pattern and the pile step at the current time point in each loom cycle. When outputting the detection signal S6 to the arithmetic section 65 as described above, the main control device 30 also outputs a pile information signal S8 indicating the current pile pattern and the current pile step to the arithmetic section 65.

[0060] Based on such a presupposition, the arithmetic section 65 reads the assigned value N of the start reverse-rotation number from the first memory unit 61 based on the pile pattern and the pile step indicated by the pile information signal S8 in response to inputs of the detection signal S6 and the pile information signal S8 from the main control device 30. Specifically, when the pile pattern is 3L-2F and the pile step (step number) is 4 in the pile information signal S8 input from the main control device 30, the arithmetic section 65 reads 4 as the assigned number N of the start reverse-rotation number from the first memory unit 61. Furthermore, the arithmetic section 65 causes the memory section 64 of the current-value arithmetic unit 62 to store the read assigned value

N as the current value P.

[0061] Moreover, the arithmetic section 65 updates the current value P stored in the memory section 64 as described above every time when the crank angle passes 0° by a forward/reverse rotation of the main shaft 24 through the motion of the loom. More specifically, the main control device 30 outputs a rotation signal S10 (forward-rotation signal/reverse-rotation signal) indicating the rotation direction of the main shaft 24 when the main shaft 24 is driven, to the arithmetic section 65. The rotation signal S10 is a signal that is output in a period except during weaving. Thus, even during inertial rotation by the above-described stop control, the forward-rotation signal is output to the arithmetic section 65. It is noted that "during weaving" indicates a period from an operation start time point of the loom to an occurrence time point of the factor of stop such as a weft-insertion failure in this embodiment. The rotation signal S10 is also output to the drive control device 50. The drive control device 50 performs drive control on the main-shaft motor 23 based on the rotation direction indicated by the rotation signal S10.

[0062] The main control device 30 also detects the crank angle based on the angular signal θ input from the encoder 28. Furthermore, the main control device 30 outputs a signal (0° signal) θa indicating the crank angle of 0° to the arithmetic section 65 every time when the crank angle of 0° is detected.

[0063] When receiving, as an input, the 0° signal θa in the state in which the forward-rotation signal is input from the main control device 30, the arithmetic section 65 reads the current value P from the memory section 64 and adds 1 to the current value P, and causes the memory section 64 to store the added numerical value as a new current value P (the current value P stored in the memory section 64 is overwritten). Moreover, when receiving the 0° signal θa in a state in which a reverse-rotation signal is input from the main control device 30, the arithmetic section 65 reads the current value P from the memory section 64 and subtracts 1 from the current value P, and causes the memory section 64 to store the subtracted numerical value as a new current value P.

[0064] Since the arithmetic section 65 is configured as described above, the current value P stored in the memory section 64 is updated to the numerical value obtained by adding 1 (+1) to the numerical value before passage of 0° every time when the crank angle passes 0° by the forward rotation of the loom. Moreover, the current value P stored in the memory section 64 is updated to the numerical value obtained by subtracting 1 (-1) from the numerical value before passage of 0° every time when the crank angle passes 0° by the reverse rotation of the loom.

[0065] When the current value P is other than 0 and when the crank angle is outside the angular range (241° to 340°) set as the start allowable section although the current value P is 0, the start control unit 63 inhibits start of the loom by an operation on the operation button. The start control unit 63 is described below in further detail.

[0066] As a presupposition, the operation button 26 is connected to the main control device 30 connected to the start control unit 63 as illustrated in Fig. 3. When the operation button 26 is operated, the main control device 30 outputs an operation signal S12 to the start control unit 63. The start control unit 63 is also connected to the current-value arithmetic unit 62 as described above. The arithmetic section 65 of the current-value arithmetic unit 62 transmits the current value P stored in the memory section 64 to the start control unit 63 in response to a request from the start control unit 63.

[0067] When receiving, as an input, the operation signal S12 from the main control device 30, the start control unit 63 outputs a request signal S14 for the above-described request to the current-value arithmetic unit 62 (the arithmetic section 65). Furthermore, when the current value P is 0, the start control unit 63 reads the set value of the start allowable section from the first memory unit 61 and compares the set value with the current crank angle detected based on the angular signal θ input from the encoder 28. Then, as the result of the comparison, when the crank angle falls within the angular range (241° to 340°) of the start allowable section, the start control unit 63 outputs the operation command signal S4 to the drive control device 50. In other words, the start control unit 63 does not perform the comparison when the current value P is not 0. As the result that the comparison is not performed, the start control unit 63 does not output the operation command signal S4 to the drive control device 50.

[0068] With this configuration, when the current value P stored in the current-value arithmetic unit 62 (the memory section 64) is 0, the operation command signal S4 is output to the drive control device 50 from the start control unit 63 by the operation on the operation button 26 and the loom is restarted normally. In contrast, when the current value P is not 0, the operation command signal S4 is not output from the start control unit 63 although the operation button 26 is operated. The loom is not restarted. That is, in the latter case, the operation signal S12 is output from the main control device 30 by the operation on the operation button 26. However, the start restriction device 60 restricts restart of the loom in response to the output of the operation signal S12 (by the drive control device 50).

[0069] In the latter case, the start control unit 63 also outputs an inhibition signal S16 indicating inhibition of restart, to the main control device 30. In contrast, the main control device 30 causes the input setting device 40 to display a message of such as invalidation of an operation on the operation button in response to the input of the inhibition signal S16.

[0070] The workings of the pile loom including the start restriction device 60 according to this embodiment are described below with reference to Figs. 5 and 6. Figs. 5 and 6 illustrate an example when the pile pattern is 3L-2F and when a weft-insertion failure occurs in a first fast-pick cycle that is a pile step of a step number 4. It is to be noted that "1st (Loose)" and "4th (Fast)" in an upper

section of the drawing indicate pile steps and pile picks of a pile pattern in the loom cycles. For example, "4th (Fast)" indicates a fast-pick cycle whose step number of the pile step is 4. Fig. 5 is an explanatory diagram illustrating workings of the pile loom when the weft removal work in the period from stop to restart of the loom and the operations on the reverse-rotation button 25 and the operation button 26 are performed by a correct procedure. In contrast, Fig. 6 is an explanatory diagram illustrating workings of the pile loom when an operation on the operation button 26 is performed by a wrong procedure. Described first are the workings of the pile loom when the weft removal work and the operations on the reverse-rotation button 25 and the operation button 26 are performed by the correct procedure with reference to Fig. 5 in the order from (1) to (7).

(1) When a weft-insertion failure occurs, the main control device 30 performs the stop control of the loom, and the start restriction device 60 outputs the detection signal S6 and the pile information signal S8 to the current-value arithmetic unit 62 (the arithmetic section 65). Along with this, the arithmetic section 65 reads "4" as the assigned number N of the start reverse-rotation number from the first memory unit 61 based on the pile pattern (3L-2F) and the pile step (step number 4) indicated in the pile information signal S8, and causes the memory section 64 to store "4" as the current value P. Fig. 5 illustrates the current value P at a position near the crank angle at the time point of occurrence of a weft-insertion failure (circled number 4).

(2) The main shaft 24 inertially rotates to the crank angle of the first stop position by the stop control and then is stopped. The rotation is in the forward-rotation direction, and hence the main control device 30 outputs the forward-rotation signal to the current-value arithmetic unit 62 (the arithmetic section 65) during the inertial rotation. The inertial rotation is about one rotation as described above. The crank angle passes 0° during the inertial rotation. Hence, the 0° signal is output from the main control device 30 to the arithmetic section 65 only once during the inertial rotation. Accordingly, the arithmetic section 65 reads the current value P of "4" stored in the memory section 64 and adds 1 to the current value P, and causes the memory section 64 to store the added numerical value "5" as a new current value P.

(3) Then, the loom temporarily stops at the crank angle of the first stop position, and then is automatically rotated reversely to the crank angle of the second stop position at which the loom is brought into the standby state as described above. Since the crank angle passes 0° during the reverse-rotation motion as described above, the main control device 30 outputs the reverse-rotation signal and the one-time 0° signal to the current-value arithmetic unit 62 (the arithmetic section 65) during the reverse rotation to the second stop position. Accordingly, the arithmetic section 65 reads the current value P of "5" stored in the memory section 64 and subtracts 1 from the current value P, and causes the memory section 64 to store the subtracted numerical value "4" as a new current value P. After the automatic reverse rotation, the loom is brought into the standby state at the crank angle of the second stop position (the crank angle of about 300°).

(4) When the operator arrives at the loom in the standby state, the operator operates the reverse-rotation button 25 to rotate the loom reversely to a crank angle of about 180° in the loom cycle, and performs the removal work of a defective weft.

(5) In this embodiment, the case is exemplified in which a weft-insertion failure occurs in the first fast-pick cycle. Hence, a work of removing all wefts inserted in three previous loose-pick cycles is performed. Specifically, the work of rotating the loom reversely to a crank angle of about 180° in the previous loom cycle and removing the wefts is repeated as described above, and hence the state in which the wefts inserted in the three previous loom cycles are removed can be attained. In the process of removing the wefts inserted in the three loose-pick cycles, as illustrated in Fig. 5, the crank angle passes 0° three times by the reverse-rotation motion of the loom. The subtraction processing is performed every time when the crank angle passes 0° as described above. At the time point when the removal work is completed, the current value P stored in the memory section 64 of the current-value arithmetic unit 62 is "1".

(6) Then, the operator operates the reverse-rotation button 25 for restart, and hence rotates the loom reversely to the start angle (300°) in the previous loom cycle. Since the crank angle passes 0° even during the reverse-rotation motion, the subtraction processing is performed, and the current value P stored in the memory section 64 becomes "0". After the reverse rotation is completed, when the operator operates the operation button 26, the main control device 30 outputs the operation signal S12 to the start control unit 63.

(7) When receiving the operation signal S12, the start control unit 63 determines whether the current value P is 0. Since the current value P is "0" as described above, the start control unit 63 compares the angular range (in this embodiment, 241° to 340°) of the start allowable section with the current crank angle (the start angle: 300°). Then, since the current crank angle falls within the angular range of the start allowable section, the start control unit 63 outputs the operation command signal S4 to the drive control device 50, and hence the loom is restarted.

Described next are the workings of the pile loom when the operation on the operation button 26 is performed by a wrong procedure with reference to

Fig. 6 in the order from (8) to (11).

(8) In some cases, the operator may forget or make a mistake in the number of wefts to be removed, and may perform an operation for restart although the wefts to be removed remain. Specifically, after the operator removes the defective weft, the operator may assume that restart is allowable in the phase in which the operator removes the weft inserted in the third or second loose-pick cycle and that the reverse rotation of the loom from this phase is up to the start angle in the previous loom cycle. The operator may operate the operation button 26 in a phase in which the loom is rotated reversely to the start angle.

(9) However, as it is apparent from the above description, the current value P stored in the current-value arithmetic unit 62 (the memory section 64) in this phase is not 0. Hence, although the operator operates the operation button 26 in this phase, the start control unit 63 does not perform the comparison and does not output the operation command signal S4 to the drive control device 50.

(10) Moreover, even when the operator correctly performs the removal work, the operator may make a mistake in the reverse-rotation operation toward the crank angle at which restart of the loom is finally performed. The operator may rotate the loom reversely to a crank angle at which weft insertion is not normally performed immediately after restart, that is, a crank angle outside the angular range of the start allowable section, and may operate the operation button 26 in this state. In this case, the start control unit 63 performs the comparison; however, since the crank angle at this time point does not fall within the angular range of the start allowable section, the start control unit 63 does not output the operation command signal S4 to the drive control device 50 similarly to the above-described case as the result of the comparison.

(11) In this way, when not all the wefts to be removed are removed (when the current value P is not 0), or when all the wefts to be removed are removed (when the current value P is 0) but the loom is rotated reversely to a crank angle (a crank angle outside the angular range of the start allowable section) at which weft insertion immediately after restart is not performed normally, the start restriction device 60 does not output the operation command signal S4 to the drive control device 50 although the operation button 26 is operated. Thus, the drive control on the main-shaft motor 23 by the drive control device 50 is not restarted, and the loom is not restarted. That is, in any of these cases, the start restriction device 60 restricts restart of the loom by an operation on the operation button 26.

[0071] The present invention is not limited to the above-described embodiment (the embodiment), and may be an embodiment modified like 1) to 3) as follows.

1) According to the embodiment, regarding the start restriction device 60, the start allowable section is previously set as the angular range in the fast-pick cycle, and at a crank angle outside the start allowable section, the operation command signal S4 is not output to the drive control device 50 although the operation button 26 is operated. However, according to the present invention, the start allowable section may not be set.

For example, there may be a loom configured such that, when the reverse-rotation button 25 is operated in a stop state, the loom is rotated reversely to a previously set crank angle in the previous loom cycle and the reverse rotation is temporarily stopped at the crank angle. Thus, with the loom configured in this way, the crank angle of the temporary stop may be set within the angular range of the start allowable section. In this case, as a correct operation, when the loom is rotated reversely until the reverse rotation stops at the crank angle after the removal work of defective wefts and when wefts to be removed still remain, the reverse-rotation button 25 is operated to further remove wefts. In contrast, when all wefts to be removed have been removed, the operation button 26 is operated to restart the loom. Accordingly, at least a situation in which the operator operates the operation button 26 at the crank angle at which weft insertion is not performed normally immediately after restart does not occur. For such a loom, the start allowable section may not be set.

2) In the start restriction device 60 according to the embodiment, the arithmetic section 65 of the current-value arithmetic unit 62 corresponding to the arithmetic unit according to the present invention has a function of reading the current value P and causing the memory section 64 of the current-value arithmetic unit 62 corresponding to the second memory unit to store the read current value P, in addition to the function of updating the current value P as described above. That is, in the start restriction device 60, the arithmetic unit has the function of reading the current value from the first memory unit 61 and causes a second memory unit 67 to store the current value. However, in the start restriction device according to the present invention, the arithmetic unit does not have to have the function, and the start restriction device may include a dedicated section having the function separately from the arithmetic unit. Specifically, as illustrated in Fig. 7, a start restriction device 60A includes a current-value transmission unit 66 as the dedicated section, and the current-value transmission unit 66 is connected to the first memory unit 61, the second memory unit 67, and the main control device 30. In this case, an arithmetic unit 68 of the start restriction device 60A is not connected to the first memory unit 61. Moreover, the detection signal S6 and the pile information signal S8 from the main control device 30 are not output to the arithmetic unit

68, but are output to the current-value transmission unit 66. The current-value transmission unit 66 reads the numerical value (the assigned value N according to the embodiment) from the start reverse-rotation number stored in the first memory unit 61 based on the pile pattern and the pile step indicated by the pile information signal S8 in response to an input of the detection signal S6, and causes the second memory unit 67 to sore the numerical value as the current value P. Accordingly, similarly to the embodiment, at a time point at which a weft-insertion failure occurs, the current value P corresponding to the time point is stored in the second memory unit 67.

3) In the start restriction device 60 according to the embodiment, the start reverse-rotation number is stored as the system data in the first memory unit 61, and to handle weaving with a plurality of types of pile patterns expected in the pile loom, a plurality of start reverse-rotation numbers respectively corresponding to the plurality of types of pile patterns are stored. However, according to the present invention, the plurality of start reverse-rotation numbers corresponding to the plurality of types of expected pile patterns do not have to be stored in the first memory unit. Only start reverse-rotation numbers corresponding to pile patterns that are actually used for weaving may be stored in the first memory unit. For example, the following two aspects (first aspect, second aspect) are conceivable as an aspect in which only start reverse-rotation numbers corresponding to pile patterns that are actually used for weaving may be stored (set) in the first memory unit.

[0072] In the first aspect, the input setting device in the pile loom is configured such that the assigned value of the start reverse-rotation number can be input and set for a pile step of a pile pattern that is actually used for weaving. Specifically, in the first aspect, for example, a setting screen for setting the assigned value of the start reverse-rotation number is provided in the input setting device. In the setting screen, the assigned value of the start reverse-rotation number can be input and set for each pile step of the pile pattern. The pile pattern that is set on the pattern setting screen may be automatically displayed on the setting screen.

[0073] Then, at the time point at which the input and setting of the assigned value are completed, the input setting device may transmit the input and set assigned value (start reverse-rotation number) to the first memory unit in association with the pile pattern. In the case of the configuration, in a preparation phase before new weaving is started, along with setting of the pile pattern used for the weaving, the operator inputs and sets the start reverse-rotation number corresponding to the pile pattern. When the input and setting are completed, the start reverse-rotation number corresponding to the pile pattern that is used for weaving at this time is stored in the first memory unit. The assigned value of the start reverse-rotation number is determined based on a (simple) setting mode that determines the relationship with the pile pattern. Hence, a burden on the operator by the input and setting is small.

[0074] In the second aspect, the input setting device is configured such that, when a pile pattern is set on the pattern setting screen, a start reverse-rotation number corresponding to the pile pattern is automatically set. Specifically, in the second aspect, for example, a program for determining a start reverse-rotation number (assigned value) based on a setting aspect like one described above with reference to the input and set pile pattern is previously installed in the input setting device, and the input setting device is configured such that, when a pile pattern is input and set on the pattern setting screen, the start reverse-rotation number corresponding to the input and set pile pattern is automatically set according to the program.

[0075] Moreover, the input setting device may transmit the obtained start reverse-rotation number to the first memory unit in association with the pile pattern. In the case of this configuration, when the setting of the pile pattern used for the weaving is completed in the preparation phase, the start reverse-rotation number corresponding to the pile pattern is stored in the first memory unit.

[0076] The present invention is not limited to the above-described embodiment and the modifications, and may be properly changed within the range not departing from the scope of the invention.

Claims

1. A start restriction method of a pile loom (1) in which a one-pile formation cycle consisting of a plurality of loom cycles is constituted of a pile pattern consisting of pile picks including a loose pick and a fast pick, the loom (1) being configured to form a pile by changing relative positions of a beating position and a cloth-fell position in accordance with the pile pattern in each pile step included in the one-pile formation cycle, an operator removing a defective yarn from the loom (1) when a weft-insertion failure occurs, the method comprising:

   previously storing a start reverse-rotation number being set so that a same numerical value as the pile step is assigned to the loose pick and a first fast pick, which is a first one of the fast pick, included in the pile picks, the start reverse-rotation number being set so that, when the pile pattern includes a plurality of the fast picks, 1 is assigned to second and later ones of the fast picks;

   when a weft-insertion failure occurs during weaving, reading, from the start reverse-rotation number, a numerical value corresponding to the

pile pick of a loom cycle in which the weft-insertion failure occurs, and storing the read numerical value as a current value;
updating the stored current value by adding 1 thereto every time when a rotational angle of a main shaft (24) of the loom (1) passes 0° by forward rotation of the main shaft (24) through a subsequent motion of the loom (1), and updating the stored current value by subtracting 1 therefrom every time when the rotational angle of the main shaft (24) passes 0° by reverse rotation of the main shaft (24) through the subsequent motion of the loom (1); and
inhibiting start of the loom (1) by an operation on an operation button (26) until the updated current value becomes 0.

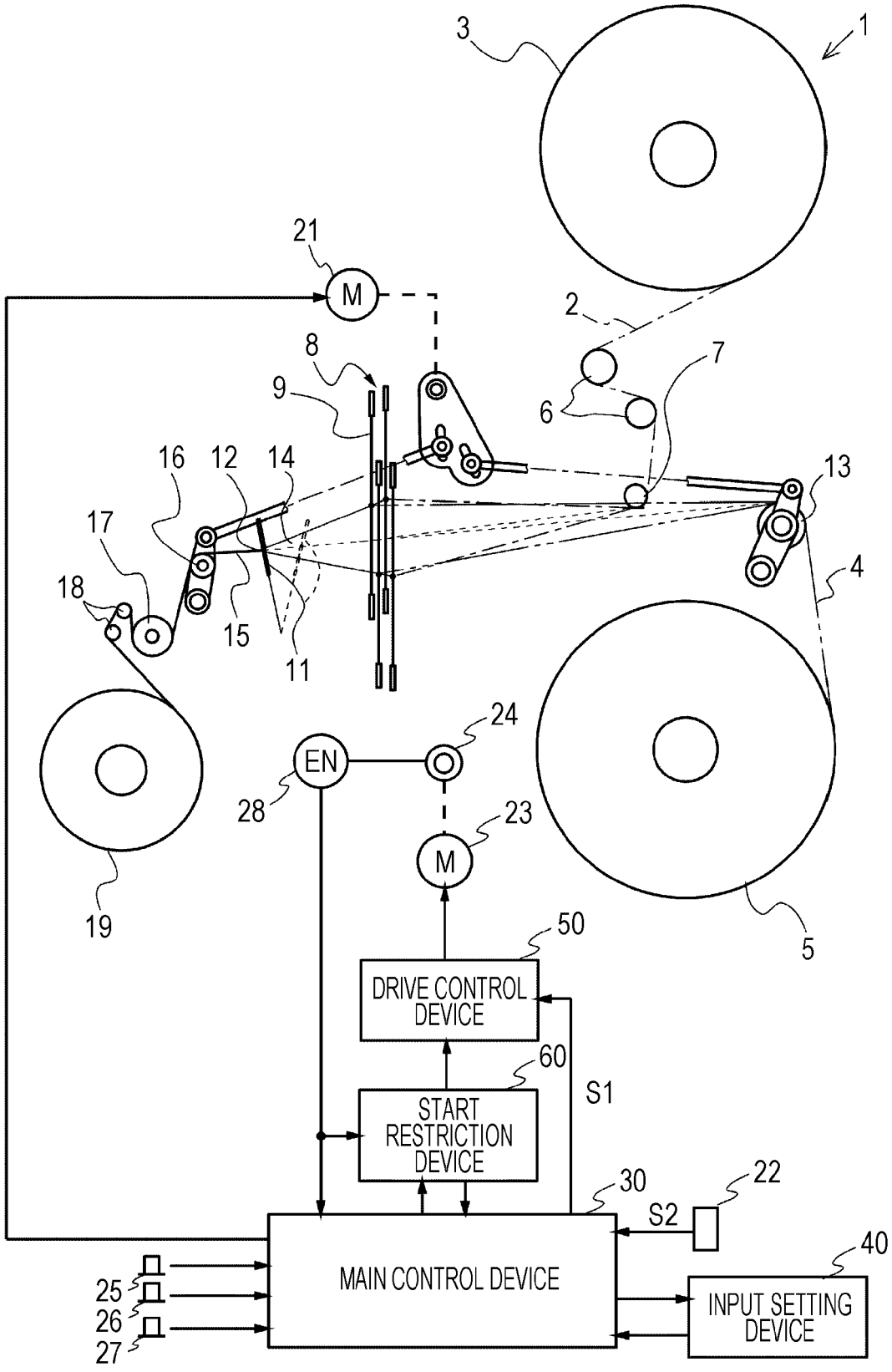
2. The start restriction method of the pile loom (1) according to Claim 1,
wherein a start allowable section that is determined as a range of rotational angles of the main shaft (24) in a loom cycle of the fast pick is previously set, and wherein the start of the loom (1) by the operation on the operation button (26) at a rotational angle of the main shaft (24) outside the start allowable section is inhibited.

3. A start restriction device (60) of a pile loom (1) in which a one-pile formation cycle consisting of a plurality of loom cycles is constituted of a pile pattern consisting of pile picks including a loose pick and a fast pick, the loom (1) being configured to form a pile by changing relative positions of a beating position and a cloth-fell position in accordance with the pile pattern in each pile step included in the one-pile formation cycle, an operator removing a defective yarn from the loom (1) when a weft-insertion failure occurs, the device (60) comprising:

a first memory unit (61) that previously stores a start reverse-rotation number being set so that a same numerical value as the pile step is assigned to the loose pick and a first fast pick, which is a first one of the fast pick, included in the pile picks, the start reverse-rotation number being set so that, when the pile pattern includes a plurality of the fast picks, 1 is assigned to second and later ones of the fast picks;
a second memory unit (67) that stores a numerical value as a current value, the numerical value being read from the start reverse-rotation number stored in the first memory unit (61) upon generation of a detection signal of a weft-insertion failure, the numerical value corresponding to the pile pick of a loom cycle in which the weft-insertion failure occurs;
an arithmetic unit (62) that updates the current value stored in the second memory unit (67) by adding 1 thereto every time when a rotational angle of a main shaft (24) of the loom (1) passes 0° by forward rotation of the main shaft (24) through a motion of the loom (1), and updates the current value by subtracting 1 therefrom every time when the rotational angle of the main shaft (24) passes 0° by reverse rotation of the main shaft (24) through the motion of the loom (1); and
a start control unit (63) that monitors the updated current value and that inhibits start of the loom (1) by an operation on an operation button (26) until the current value becomes 0.

4. The start restriction device (60) of the pile loom (1) according to Claim 3,
wherein the first memory unit (61) stores a start allowable section that is determined as a range of rotational angles of the main shaft (24) in a loom cycle of the fast pick, and
wherein the start control unit (63) inhibits the start of the loom (1) by the operation on the operation button (26) at a rotational angle of the main shaft (24) outside the start allowable section.

FIG. 1


3
1
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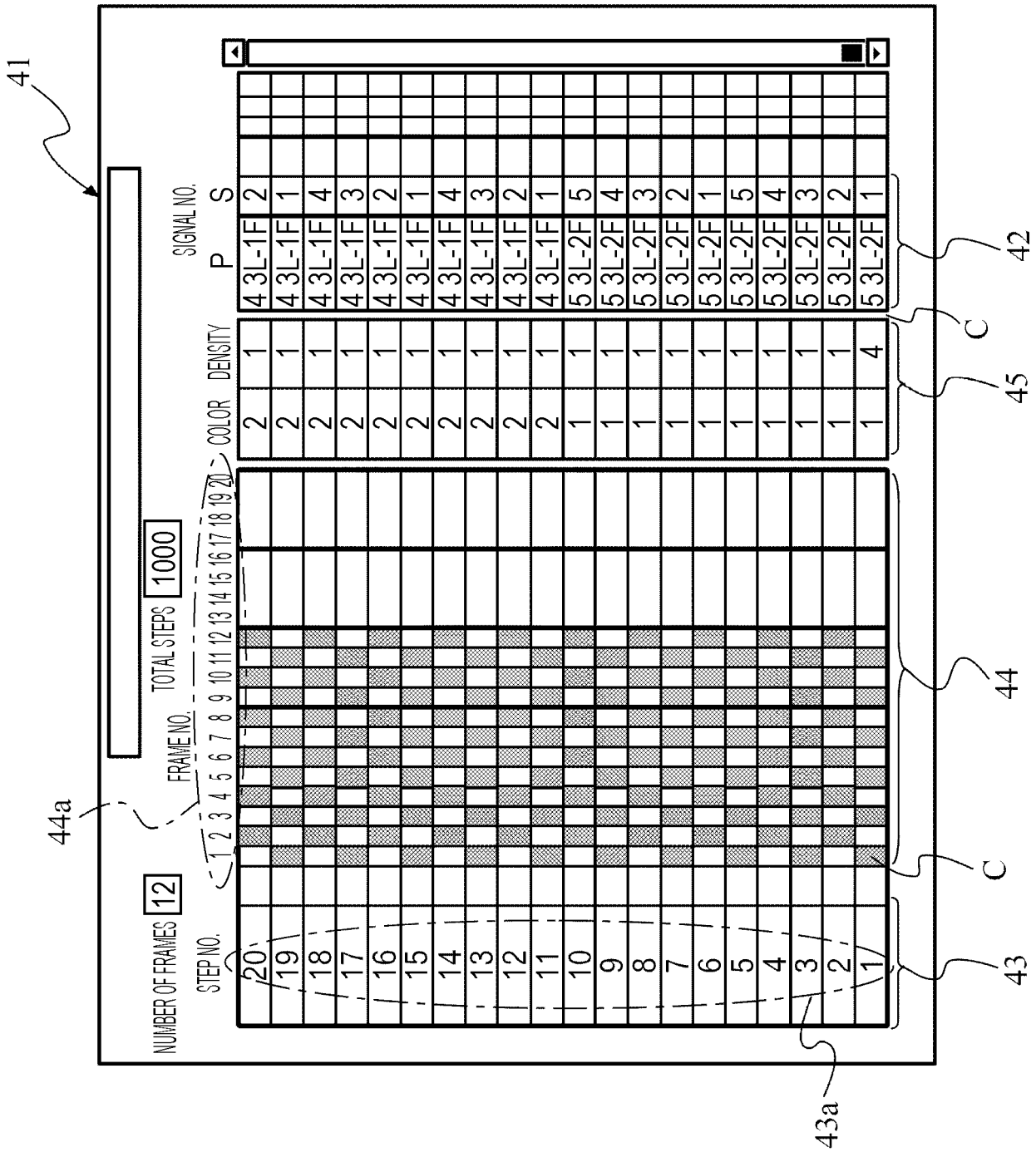
2
8
9
7
6
16
12
14
13
17
18
15
11
4
24
EN
28
23
M
19
5
50
DRIVE CONTROL DEVICE
60
START RESTRICTION DEVICE
S1
30
22
S2
40
MAIN CONTROL DEVICE
INPUT SETTING DEVICE
25
26
27


41
44a
NUMBER OF FRAMES 12
TOTAL STEPS 1000
FRAME NO.
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STEP NO.
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
COLOR
DENSITY
SIGNAL NO.
P
S
4 3L-1F 2
4 3L-1F 1
4 3L-1F 4
4 3L-1F 3
4 3L-1F 2
4 3L-1F 1
4 3L-1F 4
4 3L-1F 3
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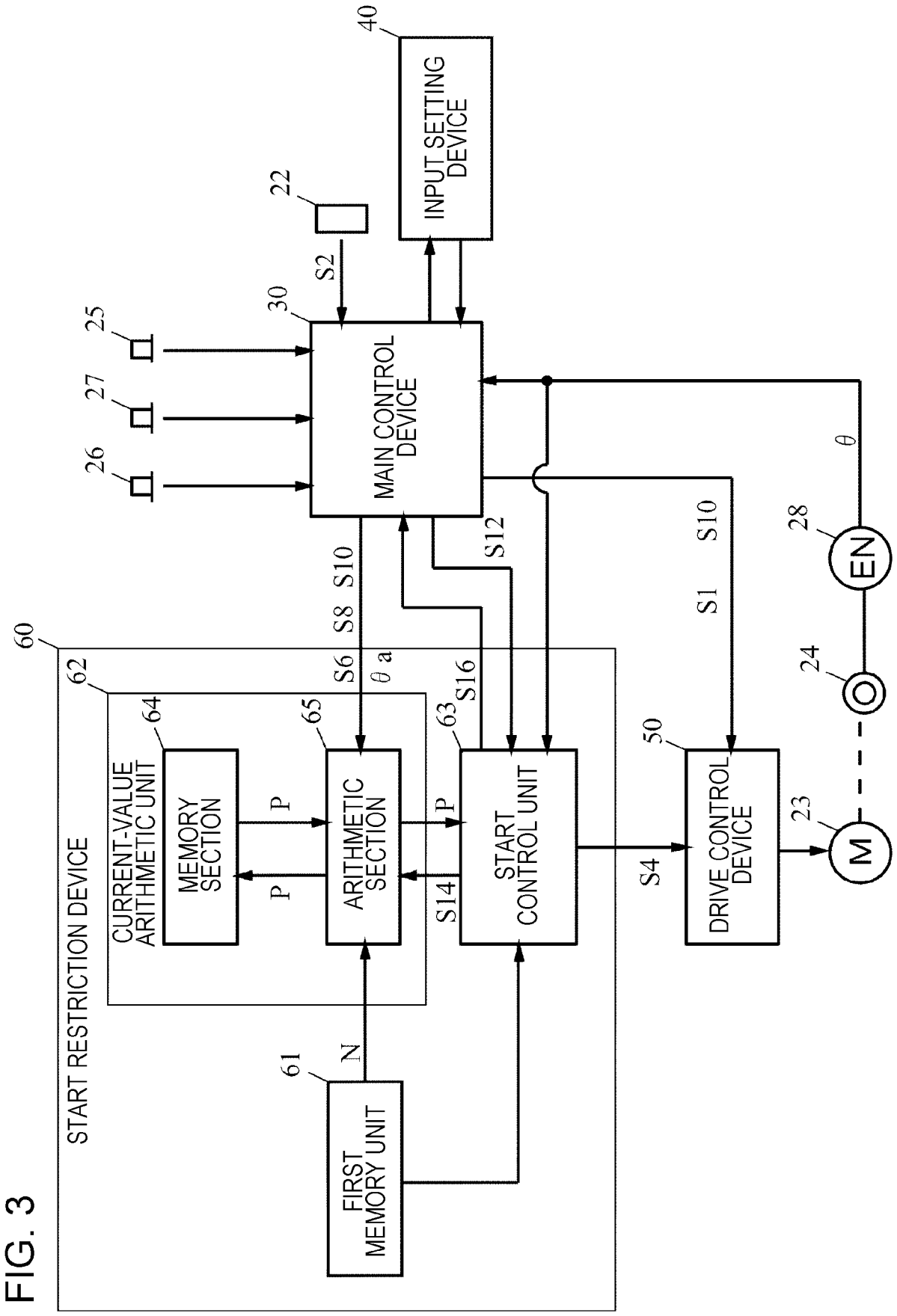
C
43
43a

FIG. 2

FIG. 3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INPUT SETTING DEVICE
22
S2
30
MAIN CONTROL DEVICE
25
27
26
θ
28
EN
S1
S10
S12
S10
S8
S6
θa
S16
60
START RESTRICTION DEVICE
62
CURRENT-VALUE ARITHMETIC UNIT
64
MEMORY SECTION
65
ARITHMETIC SECTION
63
START CONTROL UNIT
50
DRIVE CONTROL DEVICE
24
23
M
P
P
P
S14
S4
61
N
FIRST MEMORY UNIT

FIG. 4

PILE PATTERN	LOOSE OR FAST PICK/START REVERSE-ROTATION NUMBER (ASSIGNED VALUE) IN EACH PILE STEP						
	1st	2nd	3rd	4th	5th	6th	7th
2L-1F	L/1	L/2	F/3	–	–	–	–
3L-1F	L/1	L/2	L/3	F/4	–	–	–
2L-2F	L/1	L/2	F/3	F/1	–	–	–
4L-1F	L/1	L/2	L/3	L/4	F/5	–	–
3L-2F	L/1	L/2	L/3	F/4	F/1	–	–
2L-3F	L/1	L/2	F/3	F/1	F/1	–	–
5L-1F	L/1	L/2	L/3	L/4	L/5	F/6	–
4L-2F	L/1	L/2	L/3	L/4	F/5	F/1	–
3L-3F	L/1	L/2	L/3	F/4	F/1	F/1	–
6L-1F	L/1	L/2	L/3	L/4	L/5	L/6	F/7
5L-2F	L/1	L/2	L/3	L/4	L/5	F/6	F/1

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FIG. 5

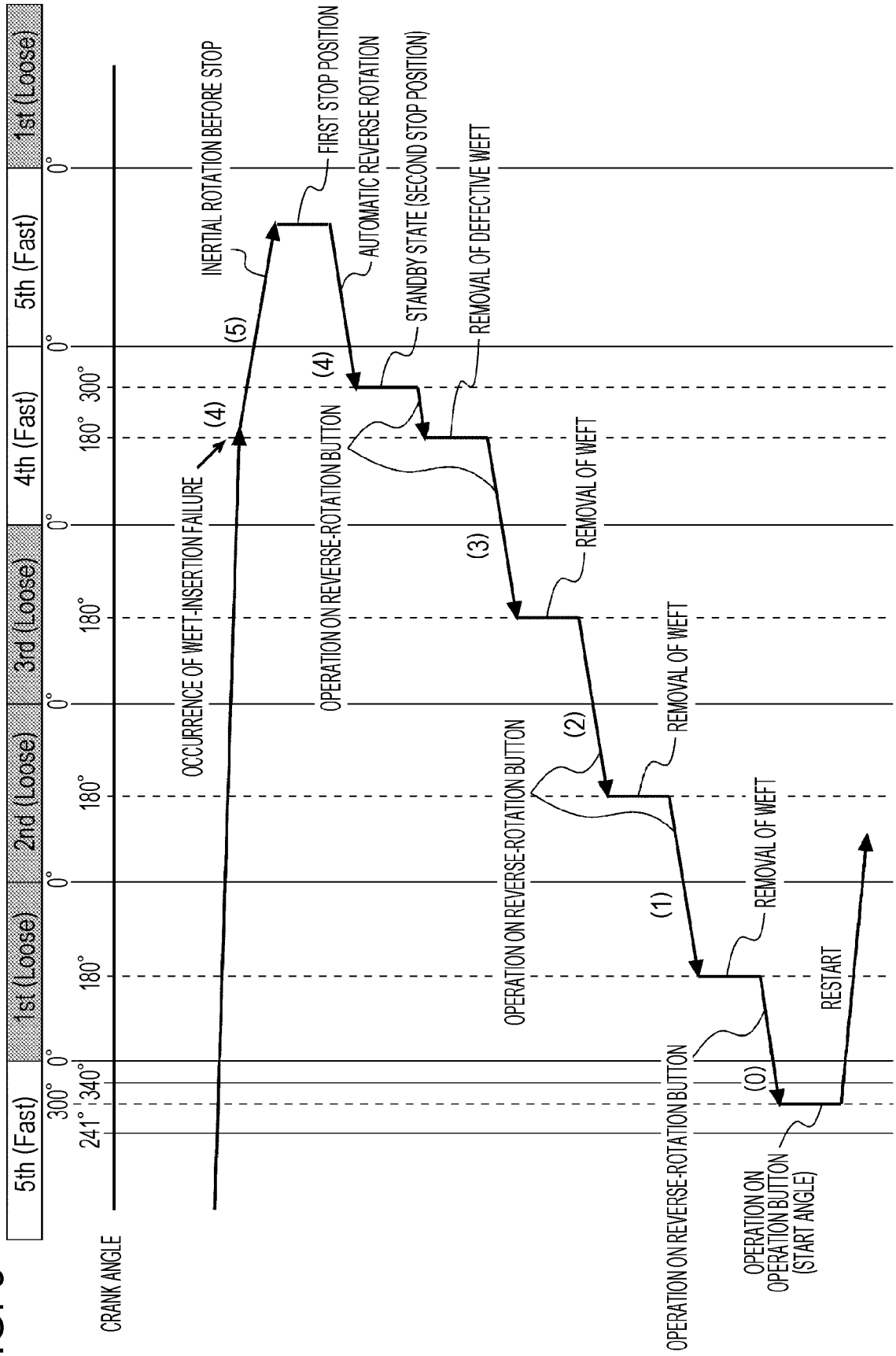

CRANK ANGLE
5th (Fast)
1st (Loose)
2nd (Loose)
3rd (Loose)
4th (Fast)
5th (Fast)
1st (Loose)
0°
180°
300°
241°
340°
OCCURRENCE OF WEFT-INSERTION FAILURE
(4)
INERTIAL ROTATION BEFORE STOP
(5)
FIRST STOP POSITION
AUTOMATIC REVERSE ROTATION
OPERATION ON REVERSE-ROTATION BUTTON
(4)
STANDBY STATE (SECOND STOP POSITION)
REMOVAL OF DEFECTIVE WEFT
(3)
REMOVAL OF WEFT
OPERATION ON REVERSE-ROTATION BUTTON
(2)
REMOVAL OF WEFT
(1)
REMOVAL OF WEFT
OPERATION ON REVERSE-ROTATION BUTTON
(0)
RESTART
OPERATION ON OPERATION BUTTON (START ANGLE)

FIG. 6

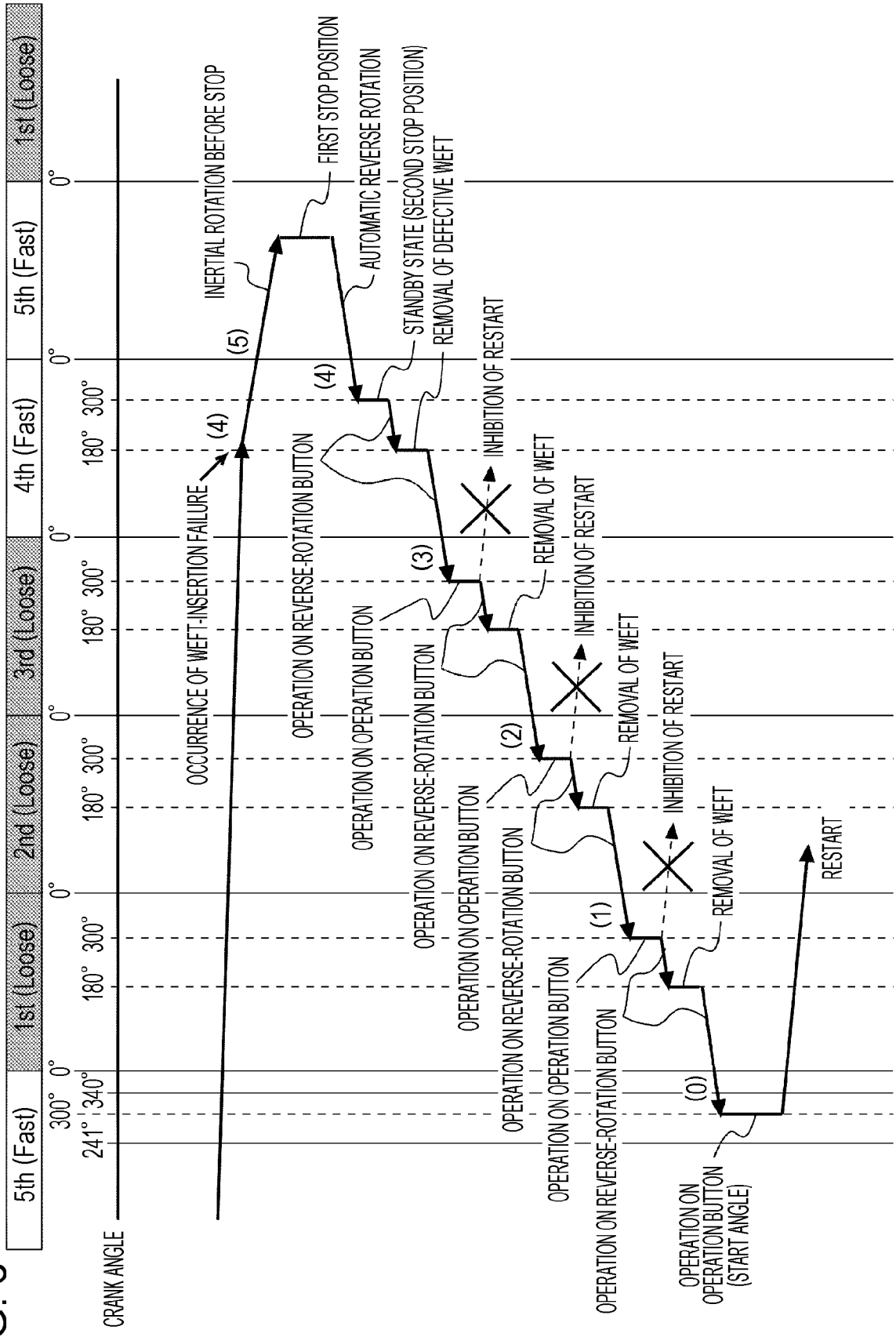
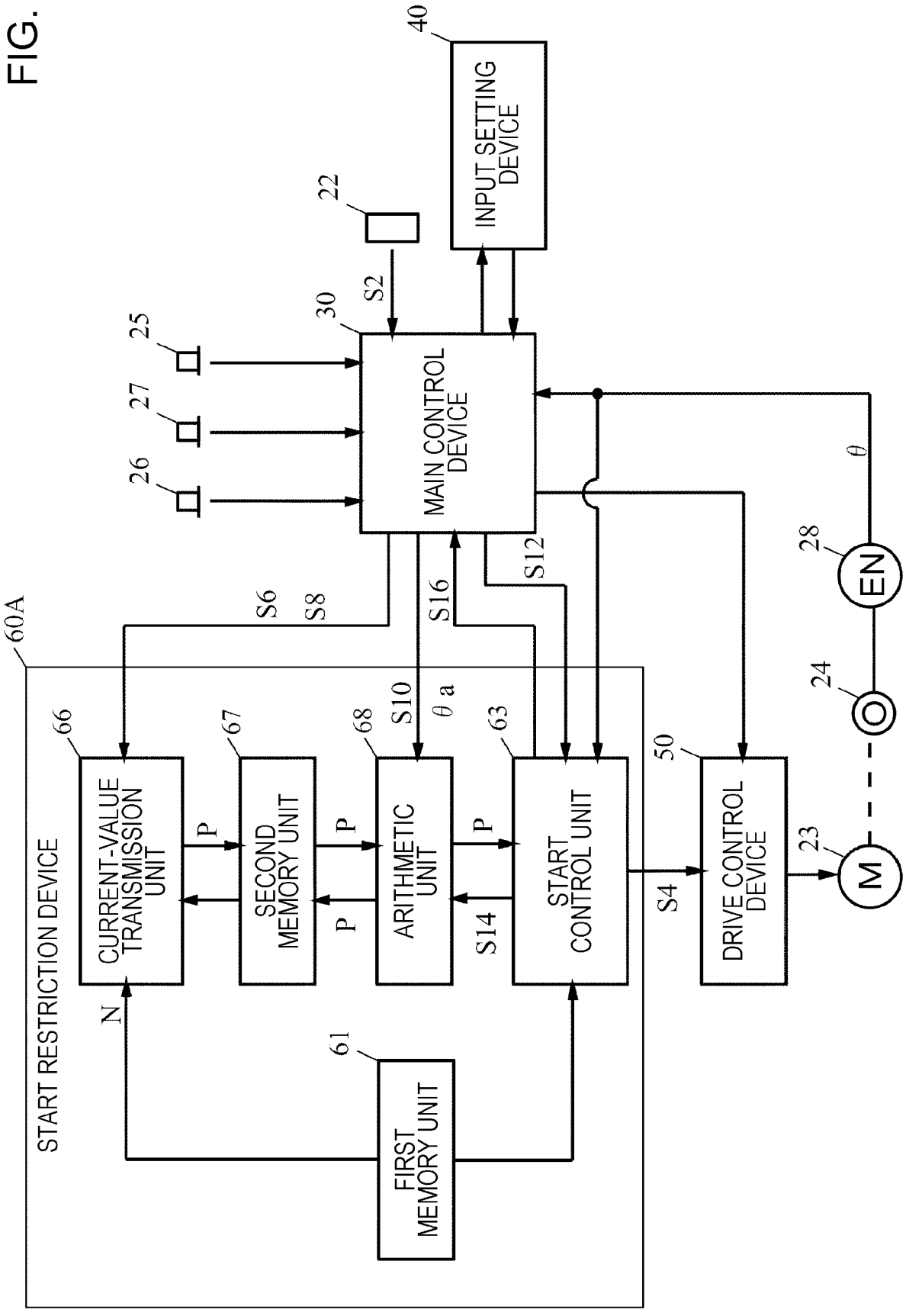

5th (Fast)
1st (Loose)
2nd (Loose)
3rd (Loose)
4th (Fast)
5th (Fast)
1st (Loose)
CRANK ANGLE
241°
340°
300°
180°
0°
OCCURRENCE OF WEFT-INSERTION FAILURE
(4)
INERTIAL ROTATION BEFORE STOP
(5)
FIRST STOP POSITION
AUTOMATIC REVERSE ROTATION
STANDBY STATE (SECOND STOP POSITION)
REMOVAL OF DEFECTIVE WEFT
OPERATION ON REVERSE-ROTATION BUTTON
(4)
INHIBITION OF RESTART
OPERATION ON OPERATION BUTTON
(3)
REMOVAL OF WEFT
OPERATION ON REVERSE-ROTATION BUTTON
INHIBITION OF RESTART
OPERATION ON OPERATION BUTTON
(2)
REMOVAL OF WEFT
OPERATION ON REVERSE-ROTATION BUTTON
INHIBITION OF RESTART
OPERATION ON OPERATION BUTTON
(1)
REMOVAL OF WEFT
OPERATION ON REVERSE-ROTATION BUTTON
RESTART
OPERATION ON OPERATION BUTTON (START ANGLE)
(0)

FIG. 7


40
INPUT SETTING DEVICE
22
S2
30
MAIN CONTROL DEVICE
25
27
26
θ
28
EN
S12
S6
S8
S16
60A
START RESTRICTION DEVICE
66
CURRENT-VALUE TRANSMISSION UNIT
67
SECOND MEMORY UNIT
68
ARITHMETIC UNIT
S10
θ a
63
START CONTROL UNIT
50
DRIVE CONTROL DEVICE
24
23
M
P
P
P
P
S14
S4
N
61
FIRST MEMORY UNIT

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 9758

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP H07 126961 A (TOYODA AUTOMATIC LOOM WORKS) 16 May 1995 (1995-05-16) * paragraph [0022] - paragraph [0039] * * figures 1-12 *	1-4	INV. D03D39/22 D03D51/08
A	JP H07 133558 A (TOYODA AUTOMATIC LOOM WORKS; IWAMA LOOM WORKS) 23 May 1995 (1995-05-23) * paragraph [0024] - paragraph [0035] * * paragraph [0038] * * figures 1-11 *	1-4	
A	JP H07 189081 A (TOYODA AUTOMATIC LOOM WORKS) 25 July 1995 (1995-07-25) * paragraph [0021] * * paragraph [0030] - paragraph [0041] * * paragraph [0048] - paragraph [0053] * * figures 1-12 *	1-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 May 2020	Hausding, Jan

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27-05-2020

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