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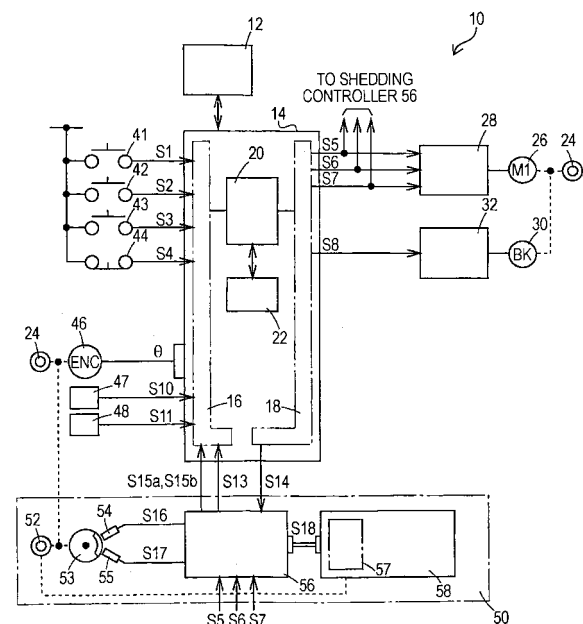
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(54) **Operational-error preventing device for loom**

(57) In an operational-error preventing device for a loom (1), a reverse-rotation prohibition angle is preliminarily set within a main-shaft-angle range in which a shedding device (50) is driven on the basis of an inverted shedding pattern. When a main-shaft angle reaches the reverse-rotation prohibition angle due to an automatic reverse rotation of a loom main shaft (24) to a set angle executed after the loom main shaft (24) has been stopped in response to an occurrence of a cause of stoppage or due to a reverse rotation executed in response to input of a reverse-rotation button signal (S3), the reverse rotation of the loom main shaft (24) is prohibited even if the reverse-rotation button signal (S3) is received.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a technique for preventing weft bars from being formed upon stoppage of a loom by setting the loom on standby with the warp shed in a closed state (leveling state). In particular, the present invention relates to a technique for preventing disadvantages caused by an operational error made when the loom is in such a standby state.

2. Description of the Related Art

[0002] In order to satisfy an increasing demand for high-value-added weaving products, an increasing number of weaving mills use looms that have shedding devices capable of easily editing weave structures (for example, a dobby device, a jacquard device, an electric shedding device that drives heald frames in a shedding motion using designated motors, etc.) so that various weave structures can be attained. With these shedding devices, complex weaves, such as twill weaves, satin weaves, and dobby weaves, can be readily attained using shedding patterns of the corresponding weaving specifications. In these shedding devices, however, the heald frames are driven in a shedding motion in which some of the heald frames are maintained at the same shedding position for one or more picks. For this reason, even when the loom main shaft is rotated in the reverse direction to the cross timing of the shedding device to set the loom on standby, it is not possible to set all of the warp threads in a closed-shed state. Consequently, if the operator arrives late to the loom such that the loom is kept stopped for a long period of time, a tension difference (stretching of the warp threads) may occur between the upper and lower warp threads, leading to formation of weft bars.

[0003] As a device for solving this problem, Japanese Unexamined Patent Application Publication No. 6-116841 (Figs. 1 to 14) (hereinafter referred to as Document 1), for example, discloses a loom equipped with an electronic dobby device having a leveling function. To briefly describe this loom, when a cause of stoppage occurs, the loom is temporarily stopped, and an inverted shedding pattern to be used in the next step is subsequently output, the inverted shedding pattern being obtained by inverting upper and lower heald positions in the shedding pattern used in the current step. While the inverted shedding pattern is being output, the loom main shaft is rotated in the reverse direction to an angle corresponding to the cross timing of the shedding device so that the warp shed is set to a central closed-shed state. Before the reactivation of the loom, there is a case where, if the cause of stoppage is, for example, weft stopping, it is necessary to remove the defective weft thread after

the leveling state has been cancelled by rotating the loom main shaft forward at low speed to a predetermined angle (in other words, in a case where the operator commands the loom for activation after commanding the loom for a reverse rotation). There is also a case where such a weft removal process is not necessary, such as when the stoppage is caused by other factors (such as warp stopping). In that case, the loom is directly activated after the broken thread, such as broken warp, has been repaired. In other words, the procedure to be implemented before the reactivation of the loom varies depending on the cause of stoppage. Therefore, if the operator erroneously operates the loom without realizing the cause of stoppage, the operational error will inevitably lead to defects in the woven cloth. In contrast, in the technique disclosed in Document 1, the operation to be performed by the operator after the loom has been set on standby in the leveling state is integrally performed by means of a recovery button or an activation button, and when one of these buttons is operated, a control device selects an activation sequence that corresponds to the cause of stoppage. Accordingly, the loom main shaft is rotated to a predetermined angle, and the loom is activated.

[0004] However, in weaving mills, there are many looms equipped with shedding devices that do not have a leveling function, or even if the looms do have a leveling function, the leveling function may be set in an inoperative mode depending on the weaving specifications. For example, if weft stopping occurs in a loom not having a leveling function, the operator commands the loom in the standby state for a reverse rotation so that a defectively inserted weft thread can be removed. Subsequently, the loom undergoes a reverse rotation to a predetermined activation position and is then reactivated.

[0005] In contrast, for an operator in charge of a mixture of looms with the leveling function set in an operative mode and looms with the leveling function set in an inoperative mode, there are cases where the operator intuitively operates operation buttons of the looms without being aware of these set conditions, which can lead to serious defects in the quality of the woven cloths. More specifically, when the loom in Document 1 is in a standby state with the leveling function set in an operative mode, the operator should normally operate a recovery button or an activation button. However, there are cases where the operator mistakenly believes that the loom does not have a leveling function set therein and thus erroneously operates a reverse-rotation button. When the loom undergoes further reverse rotation from the leveling state attained on the basis of the inverted shedding pattern, the tensile relationships among the warp threads in the open-shed state become vertically inverted, causing the cloth-fell position to become displaced by a large amount. This can cause formation of a new weft bar upon activation of the loom. In addition, as the loom undergoes further reverse rotation without the operator realizing that he/she has made the operational error, the cloth fell displaced in the upper or forward direction and the reed

moved forward interfere with each other, resulting in a cloth breakage. In either case, the quality of the woven cloth becomes seriously impaired.

[0006] These problems are not limited to a type of loom in which the operation to be performed by the operator after the loom has been set on standby in the leveling state is integrally performed by means of a designated button. Such problems can occur in looms in which the central closed-shed state is attained by rotating the loom main shaft in the reverse direction while outputting an inverted shedding pattern to be used in the subsequent step, which is obtained by inverting the current shedding pattern. However, there are no known techniques for restricting the operation by the operator with respect to looms that have the possibility of quality impairment of woven cloth caused by such an operational error.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide a technique for preventing quality impairment of woven cloth in a loom equipped with a shedding device having a leveling function by prohibiting a reverse rotation even if the operator erroneously commands the loom to perform a reverse rotation. Specifically, such a loom is a type in which a central closed-shed state is attained by rotating a loom main shaft in the reverse direction while outputting an inverted shedding pattern to be used in the subsequent step, which is obtained by inverting the current shedding pattern.

[0008] According to an aspect of the present invention, an operational-error preventing device for a loom includes a main controller that receives a loom-main-shaft-angle signal and also controls the driving of a loom main shaft in response to input of an operation-button signal including a reverse-rotation button signal, and a shedding device having a plurality of shedding patterns preliminarily set therein in correspondence to a plurality of steps and driving a plurality of healds in response to a rotation of the loom main shaft on the basis of a selected one of the shedding patterns. When the shedding device receives a leveling command output from the main controller, the shedding device changes a shedding pattern to be used for driving the healds in the subsequent step to an inverted shedding pattern obtained by inverting upper and lower positions of the healds in the current shedding pattern. When a cause of stoppage occurs in the course of a weaving operation, the main controller stops the loom main shaft, the main controller then outputting the leveling command and allowing the loom main shaft to rotate automatically in the reverse direction to a set angle so that a warp shed of the loom is set to a central closed-shed state. The main controller has a reverse-rotation prohibition angle preliminarily set therein, the reverse-rotation prohibition angle being set within a main-shaft-angle range in which the shedding device is driven on the basis of the inverted shedding pattern. When a main-shaft angle reaches the reverse-rotation prohibition an-

gle due to the automatic reverse rotation executed after the loom main shaft has been stopped or a reverse rotation executed in response to the input of the reverse-rotation button signal, the main controller prohibits the reverse rotation of the loom main shaft even if the main controller receives the reverse-rotation button signal.

[0009] The "set angle" used for stopping the automatic reverse rotation of the loom main shaft is set to a cross timing (i.e. an angle at which the healds being driven become closed) of the warp shedding device or near the cross timing. The cross timing of the shedding device is a set parameter related to a connection phase between the loom main shaft and a drive shaft and indicates a loom-main-shaft angle at which the shed amount of the vertically driven healds is zero. However, in the present invention, the central closed-shed state is not specifically limited to a state where the shed amount of warp threads is zero, and may include a state where the shed amount of warp threads is several centimeters or less (more specifically, 2 cm or less). With this shed amount, weft bars are substantially prevented or are relatively unnoticeable. The range of the aforementioned cross timing serving as a set range for the aforementioned "set angle" includes a main-shaft angle at which the shed amount of warp threads due to the driven healds is several centimeters or less.

[0010] The expression "a main-shaft-angle range in which the shedding device is driven on the basis of the inverted shedding pattern" will be described in more detail. This range indicates a range in which information corresponding to the inverted shedding pattern to be used in the subsequent step is output and then the heald frames are actually driven on the basis of that information. Specifically, in terms of the main-shaft angle, this range can be set above and below the cross timing of the shedding device, at which the warp shed becomes in a central closed-shed state in response to a reverse rotation, by 180° (total: 360°). Accordingly, the main-shaft angle which is the start point and end point of the range within which the heald frames are driven, namely, the main-shaft angle at which the shed amount of warp threads is at the maximum, is excluded from the reverse-rotation prohibition angle set within the aforementioned range.

[0011] According to the above-described aspect of the present invention, even when the operator erroneously operates the reverse-rotation button, the main controller prohibits the reverse rotation of the loom main shaft if the main-shaft angle exceeds the reverse-rotation prohibition angle within the range in which the shedding device is driven on the basis of the inverted shedding pattern. Accordingly, this prevents quality impairment of woven cloth, such as formation of weft bars caused by a displaced cloth fell or a cloth breakage caused by a beating motion resulting from driving of the loom main shaft, namely, the warp shedding device, in response to an erroneous reverse-rotation command.

[0012] The reverse-rotation prohibition angle is set to an angle at which the quality impairment of woven cloth

actually does not occur. The reverse-rotation prohibition angle may be set to an angle preliminarily determined by the manufacturer in view of the above or may be adjustable by the user.

[0013] Like the aforementioned "set angle", the reverse-rotation prohibition angle is preferably set to or near the cross timing (closed-shed timing) of the shedding device. This range for the reverse-rotation prohibition angle includes a main-shaft-angle range in which the shed amount of warp threads shed by the driven healds is several centimeters or less (for example, a range above and below the cross timing of the shedding device by 50°). Accordingly, a reverse rotation that causes the cloth-fell position to become displaced by a large amount can be prohibited. More preferably, the reverse-rotation prohibition angle is set equal to the set angle at which the aforementioned automatic reverse rotation is stopped. Accordingly, when the loom is set on standby with the warp shed in a central closed-shed state due to an occurrence of a cause of stoppage, a manual reverse-rotating operation cannot be performed, whereby the aforementioned quality impairment of woven cloth can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a block diagram showing the inside of a control device for a loom and a shedding device, which function as an operational-error preventing device;

Fig. 2 illustrates the operation of the shedding device from a point at which the loom is set on standby with a warp shed in a central closed-shed state due to an occurrence of a weft breakage, which is a kind of a weft-insertion error, to a point at which the loom is reactivated, Fig. 2 showing two set ranges for a reverse-rotation prohibition angle respectively indicated by circled letters "a" and "b" below the horizontal axis (main-shaft angle);

Figs. 3A and 3B illustrate two kinds of shedding patterns, respectively, Fig. 3A showing normal shedding patterns and Fig. 3B showing inverted patterns obtained by inverting the normal shedding patterns; Fig. 4 is a flowchart of a process executed by a main controller serving as the operational-error preventing device according to the present invention, the process being performed after the loom is stopped with the warp shed in the central closed-shed state;

Fig. 5 illustrates the warp shed and the cloth-fell position when the main shaft is at an angle indicated by a circled letter "A" in Fig. 2;

Fig. 6 illustrates the warp shed and the cloth-fell position when the main shaft is at an angle indicated by a circled letter "B" in Fig. 2;

Fig. 7 illustrates the warp shed and the cloth-fell position when the main shaft is at an angle indicated

by a circled letter "C" in Fig. 2; and

Fig. 8 illustrates the warp shed and the cloth-fell position when the main shaft is at an angle indicated by a circled letter "D" in Fig. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] An exemplary embodiment of the present invention will now be described with reference to the drawings.

[0016] Fig. 1 is a block diagram showing the inside of a control device 10 for a loom and a warp shedding device 50 for generating a warp shedding motion. The control device 10 functioning as a control system for the loom mainly includes a setting unit 12 for setting various weaving parameters and a main controller 14 for controlling the loom on the basis of the set parameters input to the setting unit 12 and other input data.

[0017] The main controller 14 includes an input port 16 that receives input signals, an output port 18 that outputs output signals, a central processing unit (CPU) 20 that outputs control signals to various circuits, and a storage unit 22 that stores various kinds of information. In the storage unit 22, a plurality of control programs (control routines) written by the machinery manufacturer is preliminarily stored. The storage unit 22 also temporarily stores control data, such as a current control value.

[0018] The main controller 14 is connected to a drive circuit 28 for driving a main-shaft motor 26, and to a drive circuit 32 for driving an electromagnetic brake 30. Furthermore, although not shown, the main controller 14 is also connected to a take-up control circuit for driving a take-up motor, a let-off control circuit for driving a let-off motor, and a weft-insertion controller for controlling weft insertion. These circuits are controlled on the basis of signals output from the main controller 14 via the output port 18.

[0019] The main controller 14 is also connected to an activation button 41 operated for activating the loom, an inching button 42 that functions as a low-speed forward-rotation button operated when forward inching rotation is to be performed, a reverse rotation button 43 that functions as a low-speed reverse rotation button operated when reverse rotation is to be performed, and a stop button 44 operated when the loom in continuous operation is to be stopped. Thus, the main controller 14 receives operation signals from these operation buttons through the input port 16, the operation signals including an activation operation signal S1, an inching operation signal S2, a reverse operation signal S3, and a stop operation signal S4. In addition to these operation signals, the main controller 14 also receives, through the input port 16, a weft-insertion error signal S10 from a weft detection circuit 47, a warp breakage signal S11 from a warp breakage sensor 48, and a main-shaft-angle signal θ from an angle-signal generator 46 connected to a loom main shaft 24. The CPU 20 executes the control programs (control routines) stored in the storage unit 22 and controls the

drive circuit 28, the drive circuit 32, other circuits that are not shown, and a shedding controller 56 by outputting one or more control signals thereto through the output port 18.

[0020] The main shaft 24 functioning as a crankshaft of the loom is connected to the angle-signal generator (ENC) 46, such as a known absolute encoder, which detects the angle θ as a rotational phase. The angle-signal generator 46 is capable of outputting the main-shaft-angle signal θ of which the beating timing is set at 0° . The main-shaft-angle signal θ is used by the main controller 14 for controlling the overall operation of the loom, such as activating and stopping the loom. In addition, as described below, the main-shaft-angle signal θ is also used for stopping the loom to set the loom in a central closed-shed state upon occurrence of a cause of stoppage. This involves rotating the loom main shaft 24 in the reverse direction and stopping the loom main shaft 24 at a set angle.

[0021] Depending on the type of signal output from the main controller 14 (namely, an activation signal S5, a forward rotation signal S6, or a reverse rotation signal S7), the drive circuit 28 supplies power to the main-shaft motor 26 in correspondence to a drive mode (high-speed forward rotation, low-speed forward rotation, low-speed reverse rotation, etc.). If the main-shaft motor 26 is, for example, an induction motor, the drive circuit 28 may include a known inverter that generates an alternating-current power having a frequency that corresponds to the drive mode of the main-shaft motor 26. Alternatively, the drive circuit 28 may also be a known drive circuit including a low-frequency-output inverter device that functions as a low-speed drive source, a commercial power source that functions as a high-speed drive source, and an electromagnetic switch that selectively supplies the power output from the inverter device or the commercial power source to the primary winding of the main-shaft motor 26.

[0022] When the loom is in operation, the drive circuit 28 receives an ON output of the activation signal S5 (activation ON signal S5) from the main controller 14 and rotates the main-shaft motor 26 forward at high speed, thus maintaining the normal operational state of the loom. When the loom is to be driven forward at low speed, the drive circuit 28 receives an ON output of the forward rotation signal S6 (forward rotation ON signal S6) and rotates the main-shaft motor 26 forward at low speed. When the loom is to be driven in the reverse direction at low speed, the drive circuit 28 receives an ON output of the reverse rotation signal S7 (reverse rotation ON signal S7) and rotates the main-shaft motor 26 in the reverse direction at low speed.

[0023] When the forward rotation, the reverse rotation, or the operation of the loom is to be terminated, the drive circuit 32 receives an ON output of a brake signal S8 (brake ON signal S8) from the main controller 14 and sends power to the electromagnetic brake 30 necessary for braking the main shaft 24. The electromagnetic brake

30 may be of any type as long as it can generate a braking force in response to a brake command, and is not limited to a type that generates a braking force by applying an attractive force to a disc by excitation.

[0024] The weft detection circuit 47 is a known circuit that determines whether or not a weft thread is properly inserted during the normal operation of the loom on the basis of a thread signal sent from a feeler head (not shown), such as an H1 feeler and an H2 feeler. Such a feeler head is disposed on a weft traveling path and located near the cloth edge that is distant from the thread feeding side. In the case of a weft insertion error or weft breakage, the weft detection circuit 47 generates a weft-insertion error signal S10 that indicates such a condition. The warp breakage sensor 48 is a known sensor that has, for example, a plurality of pins through which the warp threads individually extend. When a pin drops in response to a warp breakage, the warp breakage sensor 48 electrically detects the pin and generates a warp breakage signal S11.

[0025] The setting unit 12 includes a touch panel having both a function for displaying the conditions of the set parameters and control information of the loom in the form of characters, numbers, or graphics and a function as a setting unit for inputting information. The setting unit 12 exchanges information with the circuits in the main controller 14 and the shedding controller 56. The parameters set in the setting unit 12 include parameters for starting and stopping the loom (the detailed operations will be described below with reference to Fig. 2) and weaving parameters. The weaving parameters include, for example, a weft density, a warp tension, information regarding the types of weft and warp threads, set values for the weft-insertion controller, the weft detection circuit 47, and the warp breakage sensor 48, a warp shedding pattern for the warp shedding device 50, and a weft selection mode. The operator can input set values into the setting unit 12 by touching a display section for setting values, and then touching a selection menu and a keypad for inputting numerical values, etc. displayed on a screen (not shown). In addition, selection information representing whether or not to use a control function, such as a leveling function, for the above-described electronic dobby device can be set in the setting unit 12 by operating the screen (not shown).

[0026] On the other hand, the loom 1 includes the warp shedding device 50. In this embodiment, an electronic dobby device is described as an example of a warp shedding device. Specifically, such an electronic dobby device outputs an electric selection signal in accordance with an electrically stored shedding pattern preliminarily set for each shedding step number. Using the electronic dobby device, a shedding motion of each heald frame can be arbitrarily selected.

[0027] The shedding device 50 basically includes a shedding-device drive shaft 52 connected to the loom main shaft 24, the shedding controller 56, and a shedding-motion driving mechanism 58. A plurality of healds

63 arranged in the cloth width direction and in the warp traveling direction is held by a plurality of heald frames (not shown) extending in the width direction. The shedding-motion driving mechanism 58 is a known mechanism that can drive these heald frames individually. Moreover, the shedding-motion driving mechanism 58 contains selection solenoids 57 having a plurality of solenoids that correspond to the respective heald frames. Consequently, the shedding device 50 is a known electronic dobby shedding device that drives the heald frames in accordance with the driving modes of the plurality of solenoids. The drive shaft 52 is mechanically connected to the shedding-motion driving mechanism 58 and serves as a power source for moving each heald frame by transmitting the rotational force of the main shaft 24. In addition, the drive shaft 52 has a dog 53 attached thereto for generating two step signals S16 and S17, and moreover, sensors 54 and 55 are arranged so as to detect a detection piece of the dog 53 with an angular delay. The step signals S16 and S17 are obtained by the respective sensors 54 and 55 and are sent to the shedding controller 56.

[0028] The shedding controller 56 preliminarily receives information related to each shedding step number set in the setting unit 12, the information including a drive mode of each heald frame (selection of up-and-down motion of the heald frame) and an output mode of selection signals used for switching weft threads in multicolor weft insertion or for changing the weft insertion density. The received information is stored in a storage unit (not shown) included in the shedding controller 56. The shedding controller 56 determines the rotating direction of the drive shaft 52, or in other words, the rotating direction of the loom main shaft 24, on the basis of the step signals S16 and S17 from the respective sensors 54 and 55. The shedding controller 56 increments or decrements the shedding step number by one in accordance with the number of turns of the drive shaft 52, and updates the shedding pattern and the selection pattern in a one-by-one fashion. Based on the updated shedding pattern and selection pattern, the shedding controller 56 outputs a selection signal S18, which represents the drive mode of each of the heald frames to be driven in the subsequent shedding step, to the selection solenoids 57 provided as actuators for the respective heald frames through an electronic circuit (not shown). In addition, the shedding controller 56 outputs various selection signals S13, such as a weft selection signal, to the circuits included in the loom and also outputs reversal-prohibiting signals S15a and S15b to the main controller 14 to prohibit the reversal of the rotating direction when the loom is in a reversal-prohibiting period that inevitably exists due to the structure of the electronic dobby device. When the shedding controller 56 receives a leveling command S14 from the main controller 14, the shedding controller 56 outputs the signal S18 on the basis of an inverted shedding pattern obtained by inverting a reverse-rotation shedding pattern to be used in the subsequent shedding step for reverse

rotation with respect to a current shedding step number, thereby performing a leveling function for setting the warp shed in a central closed-shed state.

[0029] Fig. 2 is a chart that shows transitions in the operational state of the loom. In Fig. 2, the horizontal axis represents the loom-main-shaft angle θ , and the vertical axis represents the output mode of each signal and the actual shedding pattern of the warp threads. More specifically, Fig. 2 shows, from the top to the bottom of the page, the actual warp shedding pattern, pattern numbers of the heald-frame patterns output by the shedding controller 56 for forward and reverse rotations, and the logical output states of the step signals S16 and S17 from the sensors 54 and 55, respectively. In addition, the angular transition in the operational state that occurs in accordance with the rotation of the loom main shaft is shown in a time-series fashion towards the bottom of the page with the angle (timing) at which the weft-insertion error signal S10 is generated being located at the center. Moreover, the actual warp shedding pattern obtained when the leveling command S14 is input to the shedding controller 56 and the logical output state of the heald-frame pattern output by the shedding controller 56 for reverse rotation are shown at the bottom.

[0030] A process for restarting the loom after an occurrence of a weft breakage, which is one of the causes of stoppage in a continuous operation of the loom performing weft insertion, will be described below as an example. This example is based on the assumption that when a weft breakage occurs, the operator manually performs the recovery process instead of using an automatic recovery device. This implies that the loom holds the warp shed in a central closed-shed state while waiting for the operator to arrive. In addition, the central closed-shed state is set using the leveling function of the electronic dobby device, as described in detail below. These operations, including the leveling function, are performed mainly in response to various commands output from the main controller 14 and are implemented by executing the control programs (control routines) stored in the main controller 14 or the shedding controller 56. The process will be described in detail below with reference to Fig. 2.

[0031] Referring to Fig. 2, when a stoppage occurs during a continuous operation of the loom, the main controller 14 determines the cause of stoppage on the basis of signals output from the various sensors. Then, a process that corresponds to the determined cause of stoppage is implemented. In this example, it is assumed that the cause of stoppage is weft breakage. First, the weft detection circuit 47 detects a weft breakage and outputs the weft-insertion error signal S10 at a main-shaft angle of 310° . The main controller 14 then immediately turns off the activation signal S5 and outputs the brake signal S8 for a predetermined period. Thus, the drive circuit 28 stops supplying electricity to the main-shaft motor 26, and the drive circuit 32 activates the electromagnetic brake 30 by supplying electricity thereto, thereby stopping the loom main shaft 24. As a result, as shown in Fig.

2, the main shaft 24 rotates about one turn after the detection of the weft insertion error and stops at 320°. It is needless to say that, for causes of stoppage other than a weft insertion error, such as a warp breakage, the processes corresponding to such causes are implemented.

[0032] Next, in order to set the loom 1 in a standby state in which the loom 1 waits for the operator, the main controller 14 turns off the brake signal S8 and turns on the reverse rotation signal S7 so that the main shaft 24 automatically rotates about one turn in the reverse direction to 300° at which the warp shed is set to a central closed-shed state. The main-shaft angle that corresponds to the standby state is an angle at which the heald frames are set at the central closed-shed position, that is, a set cross timing 300° of the shedding device 50. The reverse rotation is performed by executing a control routine for rotating the main shaft 24 in the reverse direction until the main shaft 24 reaches the angle 300° which is preliminarily set in the setting unit 12. The cross timing for the shedding device is appropriately set by adjusting the connection phase between the main shaft 24 and the drive shaft 52, and is adequately adjusted within the range of \pm several tens of degrees in terms of the main-shaft angle depending on the weaving specification. In Fig. 2, the cross timing for the shedding device is set at 300°.

[0033] The operation of the electronic dobby device (shedding controller 56) will be briefly described below. In the example shown in Fig. 2, the actual shedding pattern is set such that a single repeat includes five cycles, i.e. 2 → 3 → 4 → 5 → 1..., which correspond to five turns of the loom main shaft 24. A forward-rotation frame pattern that contributes to the shedding pattern for forward rotation is generated in response to the step signals S16 and S17 received from the respective sensors 54 and 55 such as to precede the actual shedding pattern by one cycle as 3 → 4 → 5 → 1 → 2 ..., whereby a predetermined shedding motion can be achieved. When the loom main shaft is rotated in the reverse direction, that is, when the actual shedding pattern changes in the direction from the right to the left of the figure as 5 → 4 → 3 → 2 ..., a reverse-rotation frame pattern that contributes to the shedding pattern for reverse rotation is generated in response to the step signals S16 and S17 such as to precede the actual shedding pattern by one cycle as 4 → 3 → 2 → 1 ... in the direction from the right to the left of the figure, whereby a predetermined shedding motion can be achieved. A period in which the signal of the solenoid-selection shedding pattern is output corresponds to a predetermined period in which a shedding motion in a certain cycle is changed to a shedding motion in the subsequent cycle, that is, a range of a main-shaft angle that corresponds to the maximum shed amount by the shedding device.

[0034] The reversal-prohibiting signals S15a and S15b are output from the shedding controller 56 on the basis of the step signals S16 and S17 from the sensors 54 and 55, respectively. This is because the electronic dobby

device has a period that prohibits a reversal of rotating direction of the drive shaft 52, that is, a reversal of rotating direction of the main shaft 24, due to the mechanism for selecting the heald-frame motion. If the rotation of the drive shaft 52 is reversed within this prohibition period, a heald-frame selection failure (so-called harness-skip) will occur. Accordingly, the shedding controller 56 determines a rotating direction of the drive shaft 52 when the activation signal S5, the forward rotation signal S6, or the reverse rotation signal S7 from the main controller 14 is turned on, and selectively outputs the reversal-prohibiting signal S15a or S15b in synchronization with the step signal S16 or S17 depending on the determined rotating direction. More specifically, when the rotating direction is forward, only the reversal-prohibiting signal S15b that prohibits reversal from forward rotation to reverse rotation is output in synchronization with the step signal S17. On the other hand, when the rotating direction is reverse, only the reversal-prohibiting signal S15a that prohibits reversal from reverse rotation to forward rotation is output in synchronization with the step signal S16. The reversal-prohibiting signals S15a and S15b are input to the main controller 14, and the main controller 14 prevents a reversal of rotating direction of the loom main shaft, which is prohibited in accordance with the state of signal input, from being executed when a manual operation button is operated or automatic rotation is started.

[0035] Fig. 3A shows an example of the setting state of a normal shedding pattern for weaving using five heald frames H1, H2, ..., H5. In Fig. 3A, the spaces with "x" show that the heald frames are at the upper position, whereas the blank spaces show that the heald frames are at the lower position. As the shedding step number changes from "1" to "5" in the vertical direction, or in other words, as the shedding pattern changes from "1" to "5", one heald frame is at the upper position whereas the remaining heald frames are at the lower position.

[0036] When the shedding controller 56 performs the leveling operation, the loom main shaft is rotated one turn in the reverse direction to establish the leveling state. At this time, prior to the reverse rotation, the current solenoid selection pattern is changed to a pattern obtained by inverting the actual current shedding pattern, whereby a reverse-rotation frame pattern is output. In the figures, the inverted patterns are denoted by numbers having bars over them. Fig. 3B shows inverted patterns that are obtained by inverting the normal shedding patterns. In this case, the inverted patterns are patterns that are obtained by reversing the upper and lower positions of the heald frames in the corresponding normal shedding patterns.

[0037] Consequently, the main controller 14 outputs the leveling command S14 to the shedding controller 56, and the shedding controller 56 inverts the signal to be output to the selection solenoids 57, namely, the solenoid-selection shedding pattern. In addition, the main controller 14 turns off the brake signal S8 and turns on the reverse rotation signal S7 so that the loom main shaft

rotates about one turn in the reverse direction. While the loom main shaft rotates about one turn in the reverse direction, the actual shedding pattern changes in accordance with the inverted pattern. Accordingly, all of the heald frames H1, H2, ..., H5 move upward or downward. More specifically, when the normal actual shedding pattern is pattern "4", the four heald frames H1, H2, H4, and H5 are set to the lower position and the remaining one heald frame H3 is set to the upper position. Therefore, while the loom main shaft rotates about one turn in the reverse direction, the heald frames H1, H2, H4, and H5 at the lower position are moved upward and the heald frame H3 at the upper position is moved downward in accordance with the inverted pattern 4. As a result, all of the heald frames H1, H2, ..., H5 are moved to the leveling position, that is, to the vertical center, as the loom main shaft approaches an angle (300°) where the upper and lower heald frames cross each other. Such a function is not limited to the normal shedding pattern in which a single repeat includes five cycles, and may also be obtained in a plain-weave shedding pattern or shedding patterns for other weave structures.

[0038] Referring back to Fig. 2, when the loom main shaft is to be rotated in the reverse direction from the current angle of 320° , the main controller 14 executes the leveling function by outputting the leveling command S14 to the shedding controller 56 at an angle prior to the cross timing by one-half turn (180°) in terms of the main-shaft angle. Consequently, the shedding pattern obtained by inverting the current shedding pattern is input to the selection solenoids 57. In addition, the main controller 14 turns off the brake signal S8 and turns on the reverse rotation signal S7 so that the loom main shaft is rotated in the reverse direction at low speed. When the main-shaft angle θ reaches 300° in response to the reverse rotation, the main controller 14 turns off the leveling command S14 and stops the main shaft 24. Then, the main controller 14 informs the operator that the loom is in a standby state by turning on a tower lamp (not shown) or presenting a display that indicates the current situation on the display screen of the setting unit 12. As a result, all of the heald frames are moved to the central position, whereby the warp shed is set to the central closed-shed state (central leveling), as shown in Fig. 6.

[0039] Fig. 5 shows the state of the warp shed when the leveling function is inoperative and the main shaft is stopped at 300° . When the loom is on standby with the warp shed in the state shown in Fig. 5, the warp threads in the open-shed state become stretched as time progresses, leading to weft bars (so-called filling bars). However, by setting all of the heald frames in the central closed-shed state as shown in Fig. 6, all the warp threads can extend through the healds with uniform tension, whereby such weft bars can be prevented.

[0040] Figs. 5 and 6 schematically illustrate a reed 64 of the loom 1 as viewed from the right side thereof. A plurality of warp threads 61 is let off from a warp beam (not shown) and extends to a cloth fell 62 by passing

through a back roller (not shown), a warp breakage sensor (not shown), healds 63, and the reed 64. A woven cloth 60 extending from the cloth fell 62 is guided forward by a temple 65 and is taken up by a cloth roller (not shown) after passing through a guide roller (not shown) and a take-up roller (not shown). A motion converting mechanism (not shown) connected to the main shaft 24 converts the rotation of the main shaft 24 into a rocking motion for the reed 64 so that the reed 64 is driven in a beating motion. The warp threads 61 are transferred from the left to the right of the figure.

[0041] When the loom is on standby with the warp shed in a central closed-shed state, the operator manually repairs the broken weft thread or manually rotates the main shaft in the reverse direction to an activation position. However, if the operator makes an error in this manual operation, the error can lead to defects in the quality of the woven cloth, such as weft bars and cloth breakages, caused by shifting of the cloth fell, which is one of the problems to be solved by the invention. Therefore, for descriptive purposes, the proper operation that should be performed by the operator will be described first before proceeding to the detailed description of the device according to the invention.

[0042] In order to activate the loom on standby with the warp shed in a central closed-shed state, the operator operates the inching button 42 to rotate the main shaft 24 forward at low speed so that the warp shed is changed back to an open-shed state, based on the normal shedding pattern, from the central closed-shed state, based on the aforementioned inverted pattern. In this case, the angle at which the manual forward rotation is stopped may be a timing at which the driving of the heald frames is to be started on the basis of the normal shedding pattern. The main controller 14 may continuously output the forward rotation signal S6 to rotate the main shaft 24 forward at low speed until the main shaft 24 leaves the reversal prohibition period of the electronic dobby device (specifically, until the main-shaft angle exceeds 210° at which the step signal S15 output in synchronization with the step signal S16 is turned off).

[0043] When the leveling state is canceled in this manner, the operator operates the reverse rotation button 43. The main controller 14 has already turned off the leveling command S14 while continuously outputting the reverse rotation signal S7 in response to the reverse operation signal S3 until the main shaft reaches an angle at which the broken weft thread appears at the cloth fell (specifically, until the main shaft reaches 180°). On the other hand, in accordance with the leveling command S14 in the off state, the shedding controller 56 outputs the pattern "3" as the shedding pattern, which is the normal shedding drive mode, so as to drive the heald frames. Consequently, the defectively inserted weft thread appears at the cloth fell and thus becomes removable. The operator then removes the broken weft thread from the cloth fell and operates the reverse rotation button 43 again so that the main shaft 24 is rotated in the reverse

direction at low speed to 300° , which corresponds to the predetermined activation start position. Subsequently, when the operator presses the activation button 41, the main controller 14 turns off the brake signal S8 and turns on the activation signal S5, whereby the main shaft 24 is activated. Thus, the main shaft 24 is rotated forward at high speed, and the loom enters a continuous operational mode and starts the weft insertion process. In the above-described manner, a series of steps from a point at which the weft-insertion error signal S10 as a stop signal is generated to a point at which the loom is reactivated is implemented.

[0044] As described above, the loom in a standby state is reactivated after several operations have been performed by the operator, such as thread repairing and manual operation. However, this does not necessarily mean that the operator always performs the same operations. For example, if the loom is set on standby with the warp shed in the central closed-shed state due to weft stopping, it is necessary to operate the loom in a forward inching rotation, cancel the leveling state, and then operate the loom in a reverse rotation. However, if the operator is focused on removing a weft thread, there are often cases where the operator intuitively operates the loom in a reverse rotation without the forward inching rotation. Therefore, as shown with a dotted arrow in Fig. 2, it is assumed that the heald frames are rotated further in the reverse direction from the position corresponding to the cross timing 300° , which is within a range in which the driving is implemented on the basis of an inverted shedding pattern. Based on this assumption, Fig. 7 illustrates the state of the warp shed when the main shaft is rotated about one-half turn further in the reverse direction from the cross timing 300° (angle of 180° ; indicated by a circled letter "C" in Fig. 2). Once the cloth fell 62 is shifted by a large amount in this manner, even if a shedding motion is subsequently implemented on the basis of the normal shedding pattern, the cloth fell 62 cannot be shifted back to its normal position, thus leading to weft bars. Furthermore, since the heald frames are driven on the basis of an inverted pattern instead of the normal shedding pattern, the defectively inserted weft thread cannot be removed from the warp threads even if the angle is the same as that at the time of occurrence of the weft insertion error. In other words, the operator cannot remove the defectively inserted weft thread interwoven with the warp threads. There are also cases where the operator operates the loom to further rotate the main shaft about one-half turn in the reverse direction without realizing that the cause of inability to remove the defective weft thread is in the previous operational error by the operator. Fig. 8 illustrates the state of the warp shed based on the assumption that the main shaft is rotated in the reverse direction (angle of 300° ; and indicated by a circled letter "D" in Fig. 2). While reaching such a state, the cloth fell 62 is shifted upstream even further, and the reed 64 shifted forward in response to the reverse rotation of the main shaft 24 interferes with the cloth fell 62, re-

sulting in a cloth breakage. In Figs. 5, 7 and 8, the woven cloth and the traveling path of the warp threads in the central closed-shed state shown in Fig. 6 are indicated by dotted lines as a reference.

[0045] In contrast, according to the operational-error preventing device of the present embodiment, even when the operator operates the reverse rotation button of the loom in which the warp heald frames are driven on the basis of an inverted pattern, the device executes a control routine that prevents the angle of the main shaft rotated in the reverse direction from exceeding a predetermined reverse-rotation prohibition angle, thereby providing an operational-error preventing function in the loom. In this embodiment, the main controller 14 that receives a loom activation operation signal and controls the entire operation of the loom functions as the operational-error preventing device.

[0046] Fig. 4 is a flowchart of the process executed by the main controller 14 in response to input of an operation-button signal when the loom is in a stopped state. When the operator operates one of the plurality of manual operation buttons 41 to 44 (step ST001), the process proceeds to step ST002. In step ST002, the main controller 14 determines the input conditions of the plurality of operation-button signals, and the process proceeds from the current step to a subsequent step that corresponds to the determined result of the operation signals. In this case, the main controller 14 receives the reverse operation signal S3 in an ON state, whereby the process proceeds to step ST003.

[0047] In step ST003, the main controller 14 determines whether the leveling function is set in an operative or inoperative mode. The process then proceeds from step ST003 to a subsequent step that corresponds to the determined result. The operative/inoperative information of the leveling function is set in the setting unit 12 prior to the continuous operation of the loom, such as during a looming operation. For example, when the leveling function is set in the operative mode, if the loom is to be set on standby after an occurrence of a cause of stoppage, the main controller 14 will output the leveling command S14 so that the driving is implemented on the basis of an inverted shedding pattern as shown in Figs. 2 and 5, thereby setting the warp shed to the central closed-shed state. On the other hand, if the leveling function is set in the inoperative mode, the main controller 14 will not output the leveling command S14, which means that the driving is implemented on the basis of the normal shedding pattern.

[0048] The process related to reversal prohibition in the course of driving based on an inverted pattern, which is a characteristic of the present invention, may be implemented only when the leveling function is operative. If the leveling function is determined to be inoperative in step ST003 (that is, if the determination result is "NO"), the determination steps to be described below will be skipped so that the process proceeds directly to step ST006 where the loom is controlled on the basis of a

manual reverse rotation mode as a control mode of the loom. On the other hand, if the leveling function is determined to be operative in step ST003 (that is, if the determination result is "YES"), the process proceeds to step ST004.

[0049] In step ST004, the main controller 14 determines whether or not the warp heald frames are currently driven on the basis of an inverted shedding pattern (reverse-rotation frame pattern) generated for central leveling. The main controller 14 is capable of controlling the overall operation of the loom from the point of occurrence of the cause of stoppage to the point of reactivation of the loom. In addition to controlling the output of the leveling command S14, the main controller 14 also receives the main-shaft angle signal θ and the signals S15a and S15b from the shedding device. More specifically, the signals S15a and S15b are called a forward-rotation prohibition signal and a reverse-rotation prohibition signal, respectively, and are output regardless of whether or not a leveling function is provided as in the present invention. The signals S15a and S15b are output in accordance with the rotating direction of the drive shaft 52. More specifically, when the shedding controller 56 receives the activation signal S5 or the forward rotation signal S6, the shedding controller 56 turns off the signal S15a serving as the forward-rotation prohibition signal and outputs the signal S15b serving as the reverse-rotation prohibition signal in synchronization with input of the step signal S17. On the other hand, when the shedding controller 56 receives the reverse rotation signal S7, the shedding controller 56 turns off the signal S15b serving as the reverse-rotation prohibition signal and outputs the signal S15a serving as the forward-rotation prohibition signal in synchronization with input of the step signal S16.

[0050] Accordingly, in a state where the leveling command S14 is output from the main controller 14, the logical input state of the signal S15b is switched from off to on, whereby the drive mode is determined to be based on the inverted pattern for leveling and an internal process flag A is thus set to an ON state. In addition, the number of times the signals are input (i.e. the number of times the main shaft passes this angle) is subsequently counted so as to correspond to multiple reverse rotations. Supposedly, after such a state where the drive shaft of the shedding device is rotated in the reverse direction by multiple turns on the basis of the inverted pattern for leveling, the drive shaft can be rotated forward to switch the signal S15a from on to off, so that the count value for the number of outputs can be decremented by one. Eventually, when the count value reaches zero, the internal process flag A is set to an OFF state. This process can be implemented by the main controller 14 as a control routine.

[0051] In other words, if the logical state of the internal process flag A is on, it can be determined that the drive mode is based on the inverted shedding pattern for leveling, whereas if the logical state is off, it can be determined that the drive mode is based on the normal shed-

ding pattern. Thus, in step ST004, the main controller 14 determines whether or not the drive mode is based on the inverted shedding pattern in accordance with the set state of the internal process flag A. If the internal process flag A is on, it is determined that the drive mode is based on the inverted pattern, and the process proceeds to the next step (step ST005).

[0052] In step ST005, the main controller 14 determines whether or not the current main-shaft angle θ has reached the reverse-rotation prohibition angle preliminarily set in the setting unit 12. If the current main-shaft angle θ has not reached the reverse-rotation prohibition angle, the process proceeds to step ST006 where the loom is driven on the basis of a manual reverse-rotation mode as the control mode of the loom. On the other hand, if the current main-shaft angle θ has reached the reverse-rotation prohibition angle, the process proceeds to step ST007 where the control mode of the loom is set to a stop mode.

[0053] In step ST006, the control mode of the loom is set to the manual reverse-rotation mode, and the brake signal S8 is turned off so that the electromagnetic brake 30 is released. In addition, the reverse rotation signal S7 is turned on so that the main shaft 24 is rotated in the reverse direction at low speed. In contrast, in step ST007, the brake signal S8 is turned on and the signals S5, S6, and S7 are turned off so that the control mode of the loom is set to the stop mode.

[0054] Furthermore, in step ST002 described above, if signals excluding the reverse operation signal S3, namely, the activation operation signal S1, the inching operation signal S2, and the stop operation signal S4, are received by the main controller 14, the process proceeds to step ST00X, which is not described in detail. In step ST00X, a necessary determination process and switching process of the control mode are performed, and the corresponding signal is output so that the loom is driven in accordance with the corresponding operation button. On the other hand, when the inching operation signal S2 and the reverse operation signal S3 are turned off, the process proceeds to step ST007 along a flow indicated by a circled letter "A". In step ST007, the control mode of the loom is set to the stop mode. Thus, the previously output forward rotation signal S6 and reverse rotation signal S7 are turned off, and the brake signal S8 is turned on so that the loom is stopped.

[0055] Furthermore, if the determination result regarding the leveling function in step ST003 is NO, or if the determination result in step ST004 regarding whether or not the drive mode is based on the inverted pattern is NO, the process proceeds directly to step ST006 where the mode is switched to the manual reverse-rotation mode so that the low-speed reverse rotation of the loom is immediately executed.

[0056] The series of steps shown in Fig. 4 is performed repetitively while the loom is in the stopped state. While the reverse rotation button 43 is pressed, the process proceeds through steps ST004 and ST005 so that the

low-speed reverse rotation is continuously executed. When the reverse rotation button 43 is continuously pressed and the main-shaft angle reaches the manual reverse-rotation prohibition angle preliminarily set in the setting unit 12 in step ST005 (i.e. the determination result is YES), the process proceeds to step ST007 where the loom is automatically stopped at the reverse-rotation prohibition angle. The preliminarily set reverse-rotation prohibition angle may be set by means of the setting unit 12, or may be determined automatically when, for example, the cross timing of the shedding device is set, or may be set to a value preliminarily determined by the manufacturer. The present embodiment is based on the assumption that the reverse-rotation prohibition angle is set by means of the setting unit 12 and is preliminarily set to 280° included within the range of several tens of degrees with respect to 300° which is the angle that corresponds to the cross timing of the shedding device.

[0057] Referring to Fig. 2, when the loom is on standby with the warp shed in the central closed-shed state and the main shaft stopped at 300°, the operator should cancel the central closed-shed state by a forward inching operation. However, supposing that the operator erroneously performs a manual reverse-rotating operation instead of the forward inching operation for releasing the central closed-shed state, the determination results for steps ST003 and ST004 will both be "YES" in the process shown in Fig. 4. For this reason, the process will proceed to step ST005. In this case, since the main-shaft angle θ has not reached the reverse-rotation prohibition angle 280°, the determination result will be "NO". Thus, the process proceeds to step ST006 where the loom starts to rotate further in the reverse direction at low speed. On the other hand, the process shown in Fig. 4 is repeated at short time cycles, and the determination result in step ST005 becomes "YES" at the point when the main-shaft angle reaches the preliminarily set reverse-rotation prohibition angle 280° as a result of the low-speed reverse rotation. The process thus proceeds to step ST007 where the control mode of the loom is switched to the stop mode, whereby the low-speed reverse rotation is immediately terminated so that the loom is stopped. Consequently, even if the operator operates the reverse rotation button 43 again, the reverse rotation is prohibited as long as the leveling state is not canceled (in other words, until the internal process flag A is turned off by rotating the main shaft forward to the main-shaft angle corresponding to the shed position based on the normal shedding pattern). Accordingly, the operator can realize that he/she had erroneously performed the reverse-rotating operation. Thus, the operator can perform the forward inching operation, which is the proper operation that should have been performed by the operator, so as to cancel the leveling state and set the drive mode that is based on the normal shedding pattern. Subsequently, the operator can implement the reverse-rotating operation so as to repair a defectively inserted weft thread or a broken thread, and can then reactivate the loom. Accordingly, preventing

these operational errors can properly solve serious problems that can affect the quality of the woven cloth, such as weft bars and cloth breakages.

[0058] The reverse-rotation prohibition angle used in the above-described manner may be arbitrarily determined within a range in which the angle does not cause serious defects in the woven cloth. For example, two set ranges for the reverse-rotation prohibition angle are indicated by circled letters "a" and "b" below the horizontal axis (the main-shaft angle) in Fig. 2. The set range indicated by "a" specifically shows a range in which the shedding device is driven on the basis of an inverted shedding pattern. The blank circles indicate that the main-shaft angle at which the shed amount of warp threads is at the maximum is not included within the set range "a". More specifically, the set range "a" is above and below 300° by 180° (that is, between 120° of the current pick and 120° of the next pick but not including 120° at both ends). The set range indicated by "b" is a preferred range that is above and below the cross timing of the shedding device by several tens of degrees. More specifically, the preferred set range is above and below 300° by 50° (that is, between 250° and 350°). Accordingly, these set ranges at least prevent the occurrence of weft bars that are caused by large displacement of the cloth-fell position.

[0059] More preferably, the reverse-rotation prohibition angle may be set to 300°, which is the set angle for the cross timing. For example, the reverse-rotation prohibition angle may be set to an angle, such as 320°, which is subsequent to the aforementioned cross timing. Thus, when the loom is temporarily stopped due to an occurrence of a cause of stoppage, the loom is set to the central closed-shed state by having the main shaft rotated automatically in the reverse direction to the set angle of 300°. In this case, with either of the abovementioned set angles, the main-shaft angle will have already exceeded the reverse-rotation prohibition angle at the point when this automatic reverse rotation is finished. Therefore, even if the reverse rotation button is operated in this standby state, the determination result in step ST005 of the process shown in Fig. 4 will always be "YES". Thus, the process proceeds to step ST007 where the control mode of the loom is set to the stop mode, thereby prohibiting the reverse rotation.

[0060] Although the above embodiment is directed to a case where the loom is stopped in response to an occurrence of a cause of stoppage, the condition for setting the loom on standby with the warp shed in the central closed-shed state is not limited to the above. For example, the present invention is similarly applicable to a case where an additional manual leveling button is provided, such that when the manual leveling button is operated, the loom main shaft is automatically rotated in the reverse direction and an inverted shedding pattern is output from the shedding controller, thereby achieving the central closed-shed state.

[0061] The following modification of the above embodiment is permissible. Although the process for determin-

ing whether or not the warp heald frames are driven on the basis of an inverted pattern for leveling is implemented in the main controller 14 in the above embodiment, the load of such a determination process may alternatively be shared between the main controller 14 and the shedding controller 56, or between the main controller 14 and a separately provided determination circuit. In detail, the shedding controller 56 may generate a manual reverse-rotation prohibition signal in a period in which the warp healds are driven on the basis of the inverted pattern for leveling. Thus, while the manual reverse-rotation prohibition signal is being output, the main controller 14 does not output the reverse rotation signal S7 even if the main controller 14 receives the reverse operation signal S3.

[0062] The above embodiment has been described with reference to a loom equipped with a so-called electronic dobby shedding device as a shedding device. However, the shedding device is not limited to such an electronic dobby shedding device and may include other devices that drive the warp healds on the basis of a preliminarily set shedding pattern in response to an electric selection signal. Specific examples of the shedding device are an electronic jacquard device that drives the healds in a shedding motion by means of an electromagnetic actuator provided in correspondence to the warp threads and an electric shedding device that drives the heald frames by means of electric motors provided for the respective heald frames. Furthermore, the present invention is applicable to looms that are equipped with such devices. Moreover, examples of looms to which the present invention can be applied are fluid jet looms, such as air jet looms, and shuttleless looms, such as rapier looms.

Claims

1. An operational-error preventing device for a loom (1), comprising:
 - a main controller (14) that receives a loom-main-shaft-angle signal (θ) and also controls the driving of a loom main shaft (24) in response to input of an operation-button signal including a reverse-rotation button signal (S3); and
 - a shedding device (50) having a plurality of shedding patterns preliminarily set therein in correspondence to a plurality of steps and driving a plurality of healds (63) in response to a rotation of the loom main shaft (24) on the basis of a selected one of the shedding patterns, wherein when the shedding device (50) receives a leveling command (S14) output from the main controller (14), the shedding device (50) changes a shedding pattern to be used for driving the healds (63) in the subsequent step to an inverted shedding pattern obtained by inverting upper

and lower positions of the healds (63) in the current shedding pattern, wherein when a cause of stoppage occurs in the course of a weaving operation, the main controller (14) stops the loom main shaft (24), the main controller (14) then outputting the leveling command (S14) and allowing the loom main shaft (24) to rotate automatically in the reverse direction to a set angle so that a warp shed of the loom (1) is set to a central closed-shed state, wherein the main controller (14) has a reverse-rotation prohibition angle preliminarily set therein, the reverse-rotation prohibition angle being set within a main-shaft-angle range in which the shedding device (50) is driven on the basis of the inverted shedding pattern, and wherein when a main-shaft angle reaches the reverse-rotation prohibition angle due to the automatic reverse rotation executed after the loom main shaft (24) has been stopped or a reverse rotation executed in response to the input of the reverse-rotation button signal (S3), the main controller (14) prohibits the reverse rotation of the loom main shaft (24) even if the main controller (14) receives the reverse-rotation button signal (S3).

2. The operational-error preventing device according to Claim 1, wherein the reverse-rotation prohibition angle is set to or near a cross timing of the shedding device (50).
3. The operational-error preventing device according to one of Claims 1 and 2, wherein the reverse-rotation prohibition angle is set equal to the set angle.

FIG. 1

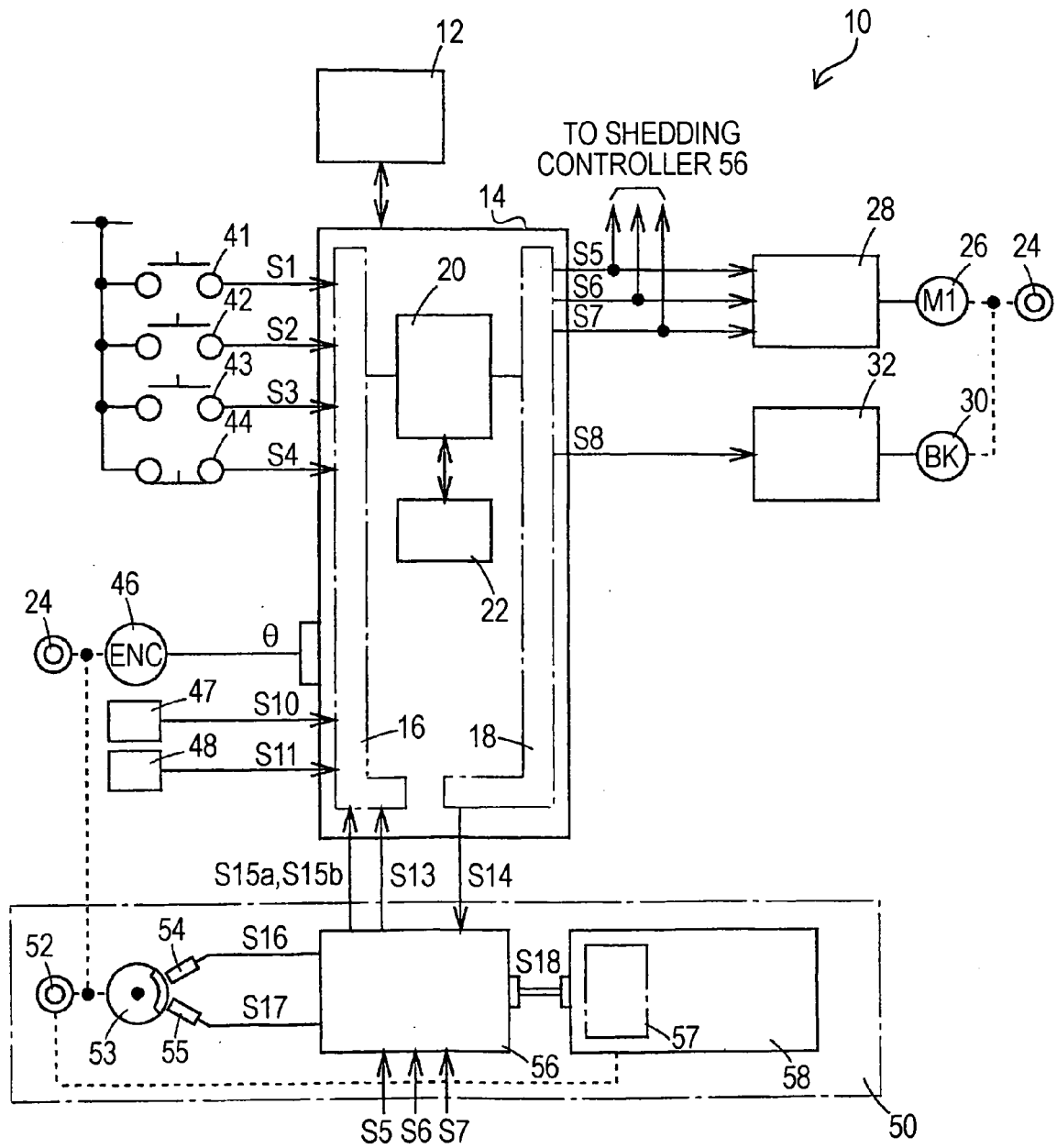


FIG. 2

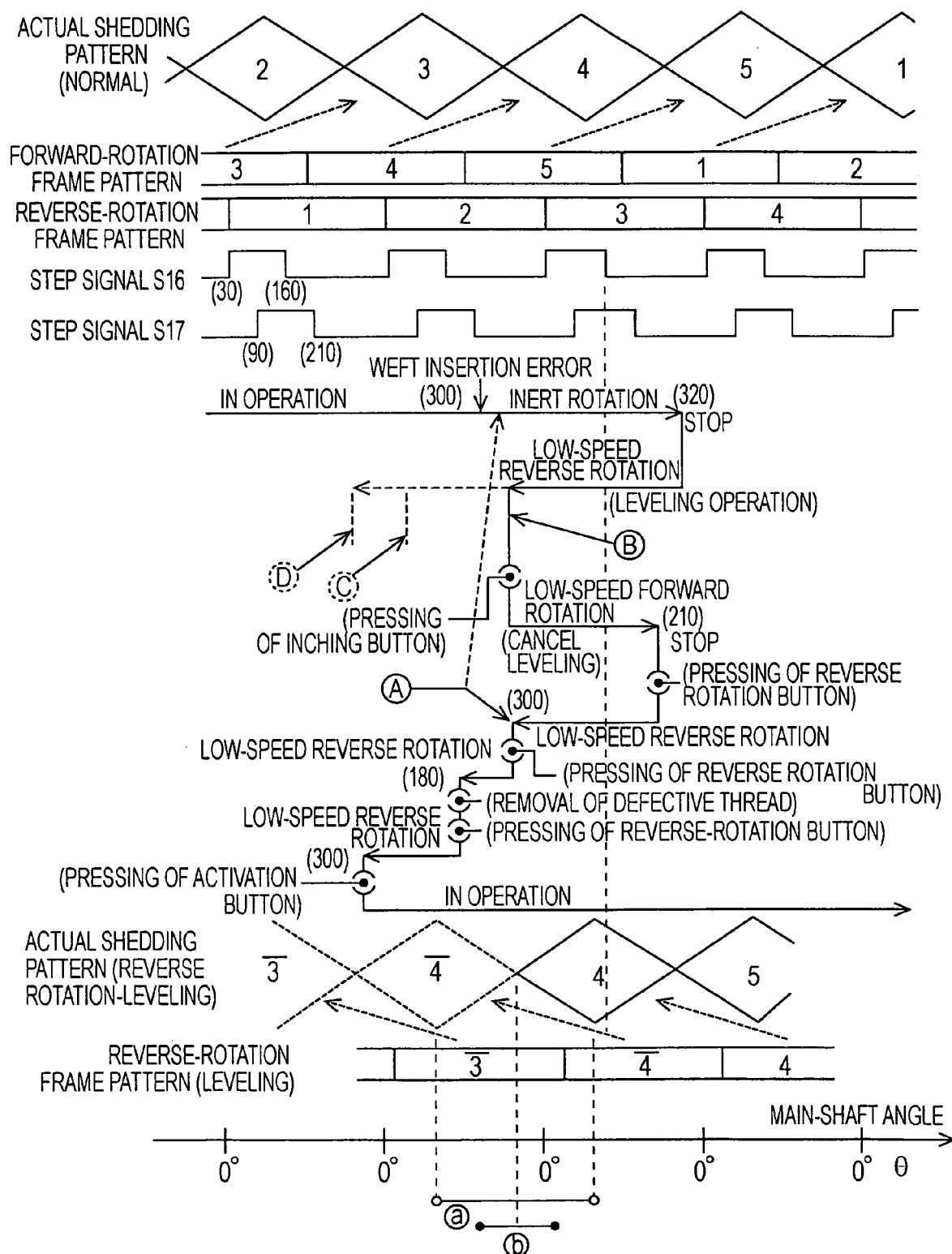


FIG. 3B

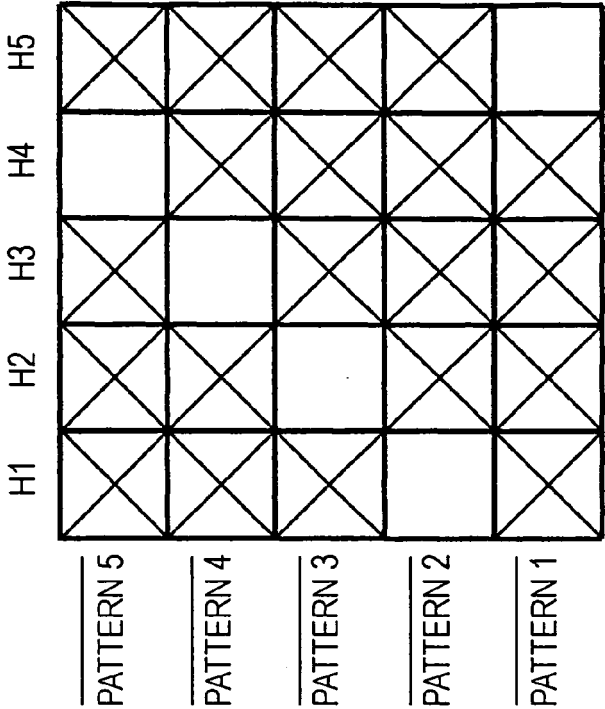


FIG. 3A

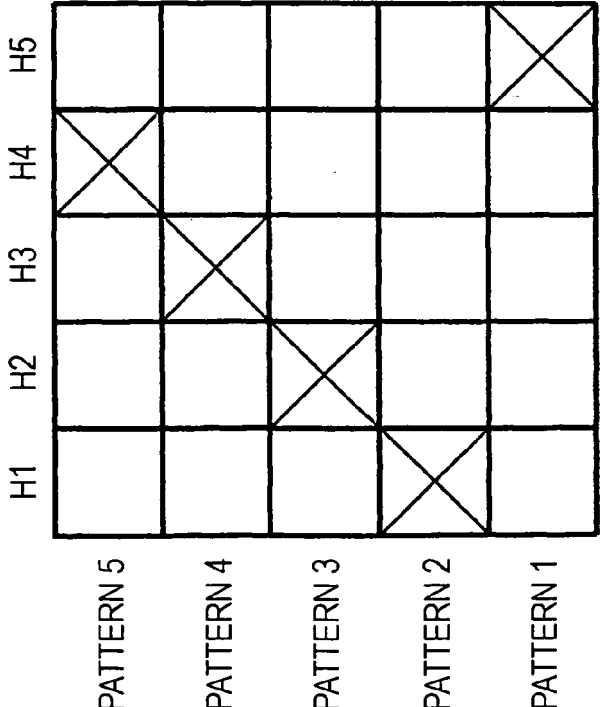


FIG. 4

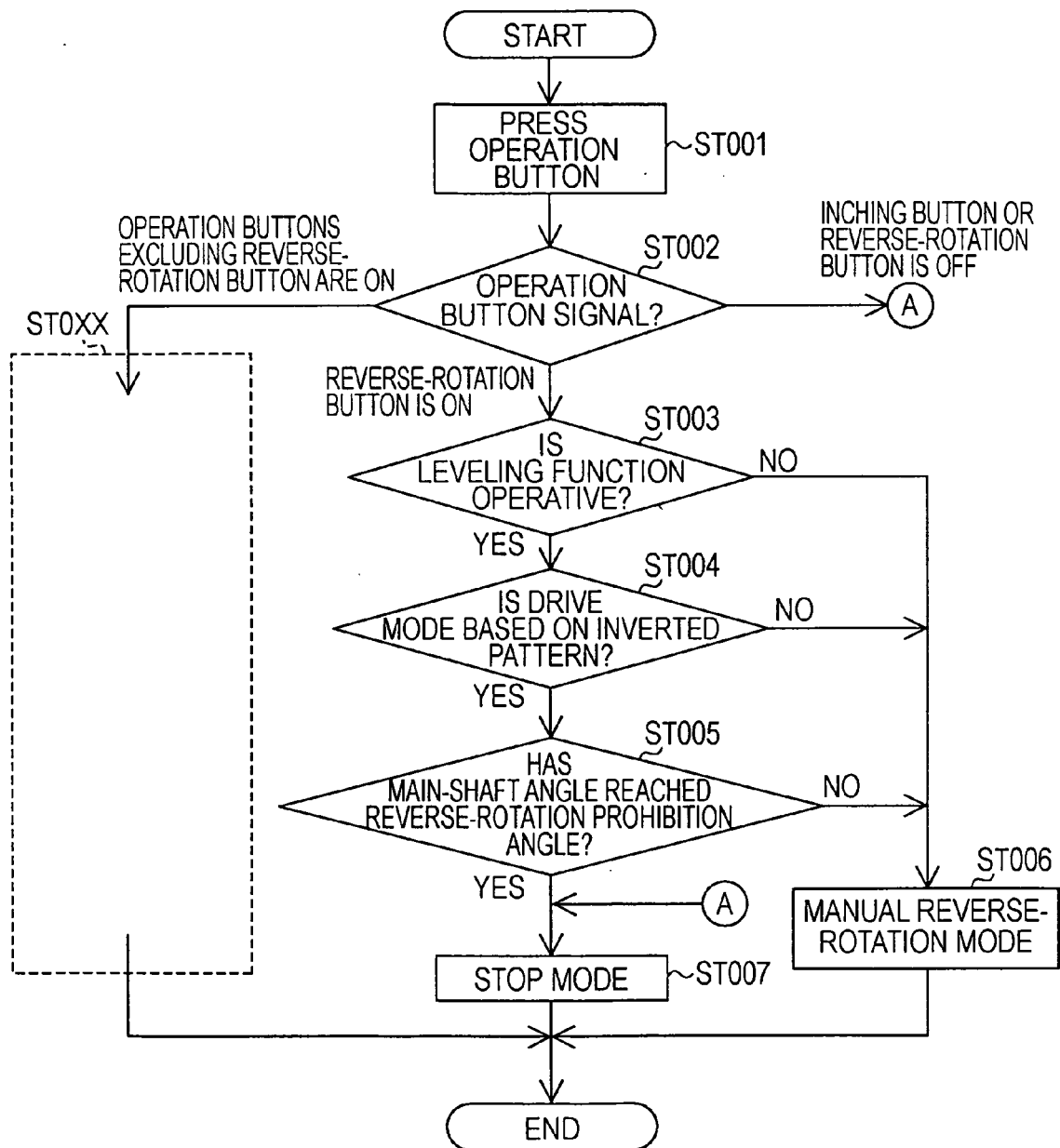


FIG. 5

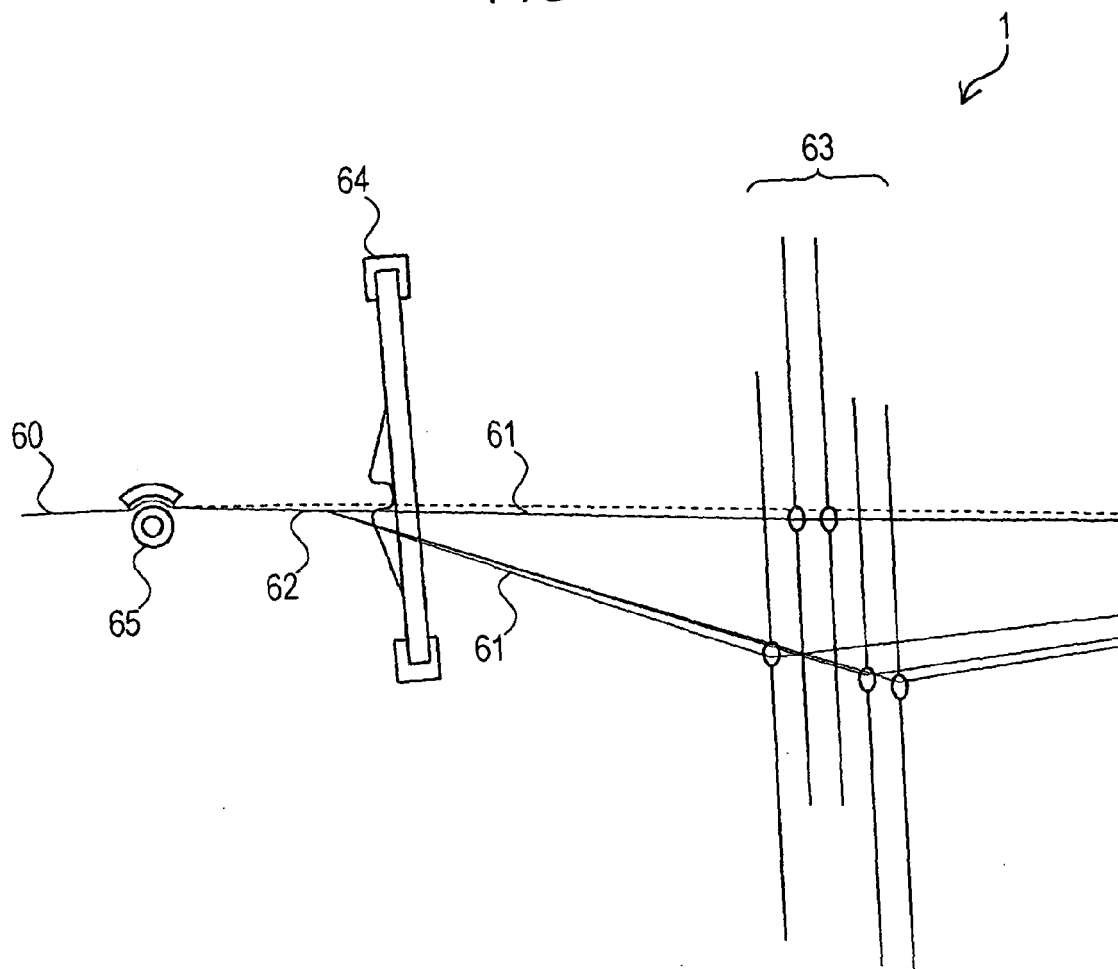


FIG. 6

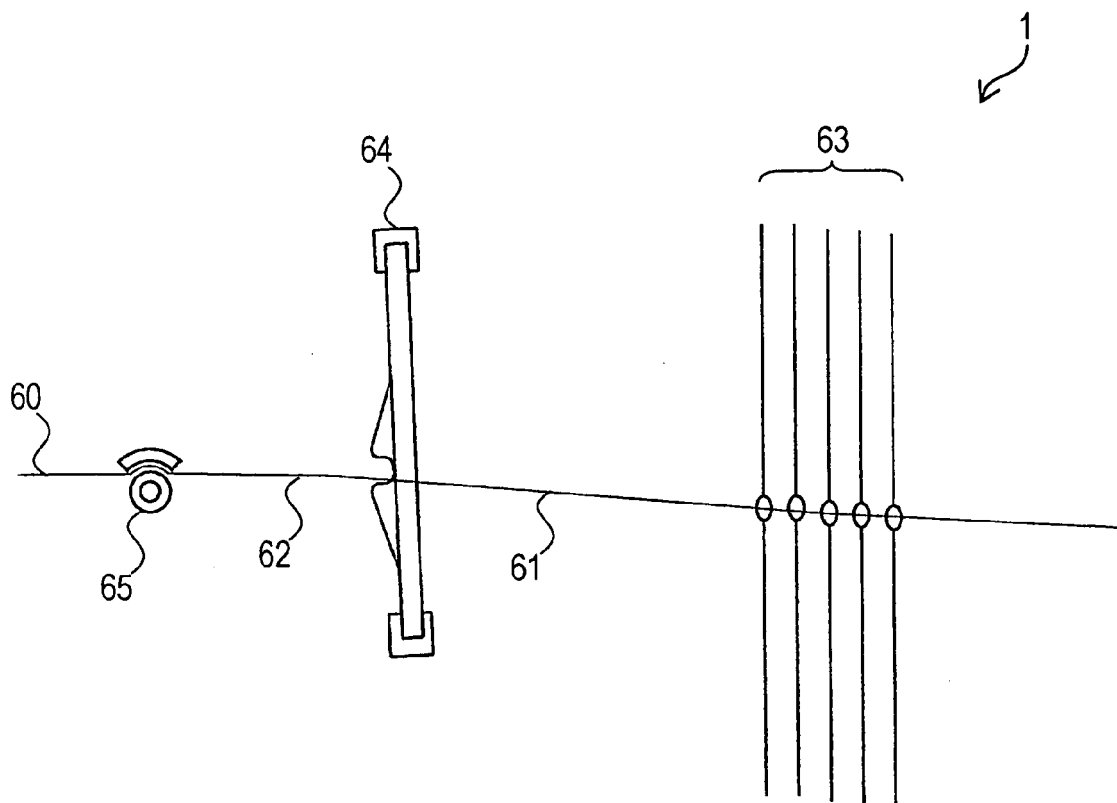


FIG. 7

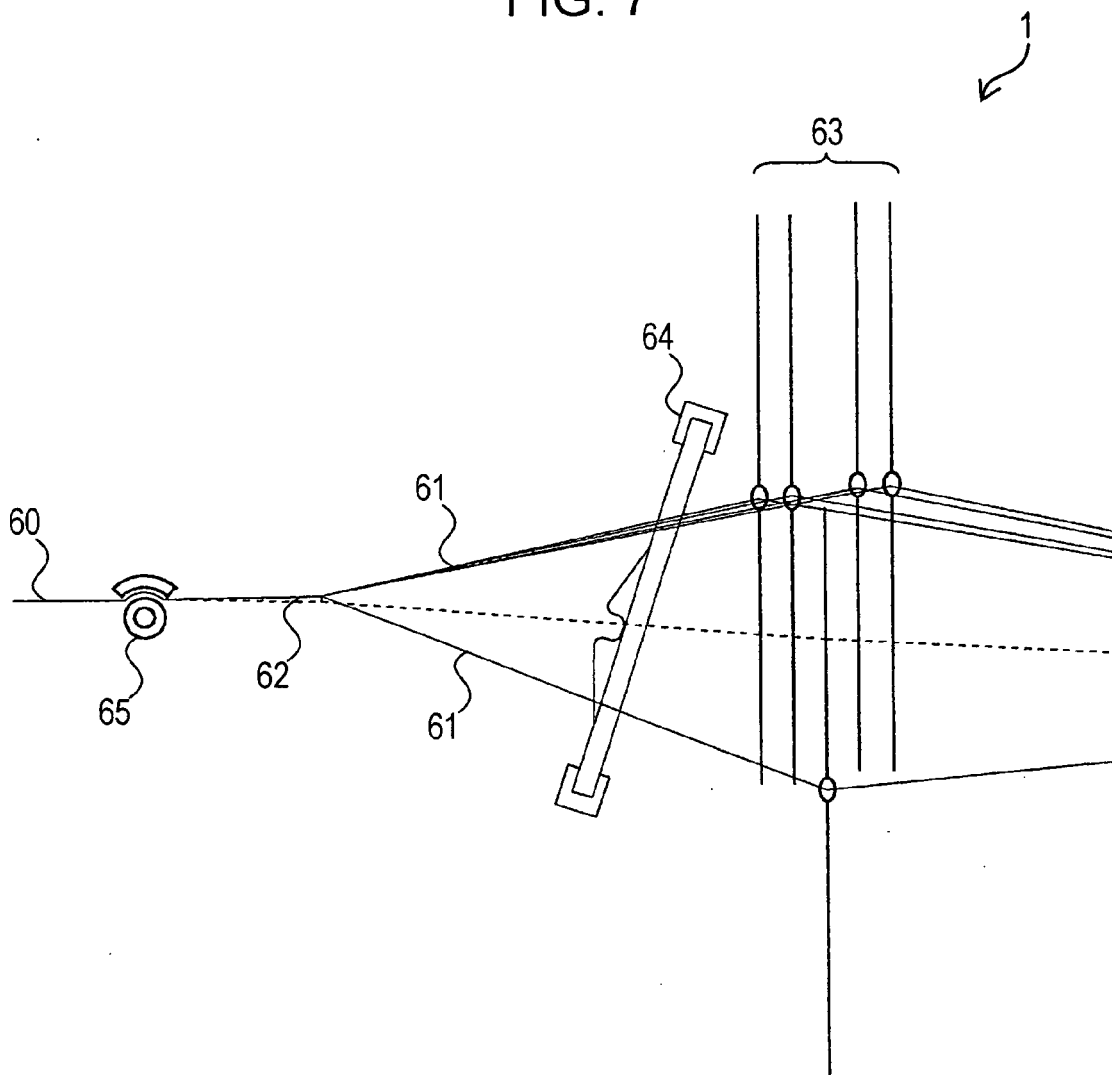
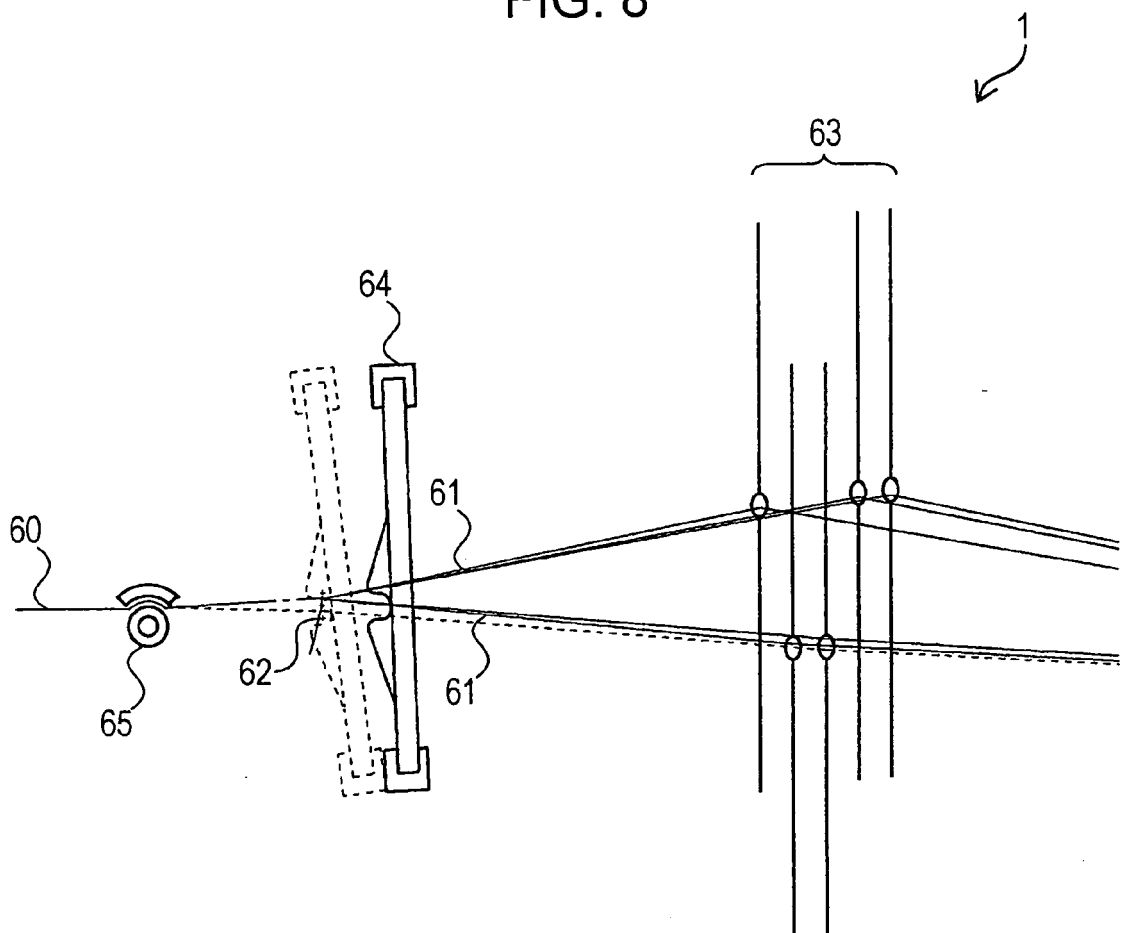


FIG. 8





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 00 8338

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 0 839 939 A1 (TSUDAKOMA IND CO LTD [JP]) 6 May 1998 (1998-05-06) * columns 1-13; figures 1-8 *	1-3	INV. D03D51/00
Y	JP 03 113052 A (TSUDAKOMA IND CO LTD) 14 May 1991 (1991-05-14) * abstract *	1-3	
D,A	JP 06 116841 A (TSUDAKOMA IND CO LTD) 26 April 1994 (1994-04-26) * abstract *	1-3	
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A	EP 1 637 636 A (TSUDAKOMA IND CO LTD [JP]) 22 March 2006 (2006-03-22) * the whole document *	1-3	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) D03D D03J
Place of search Munich		Date of completion of the search 20 June 2007	Examiner Iamandi, Daniela
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