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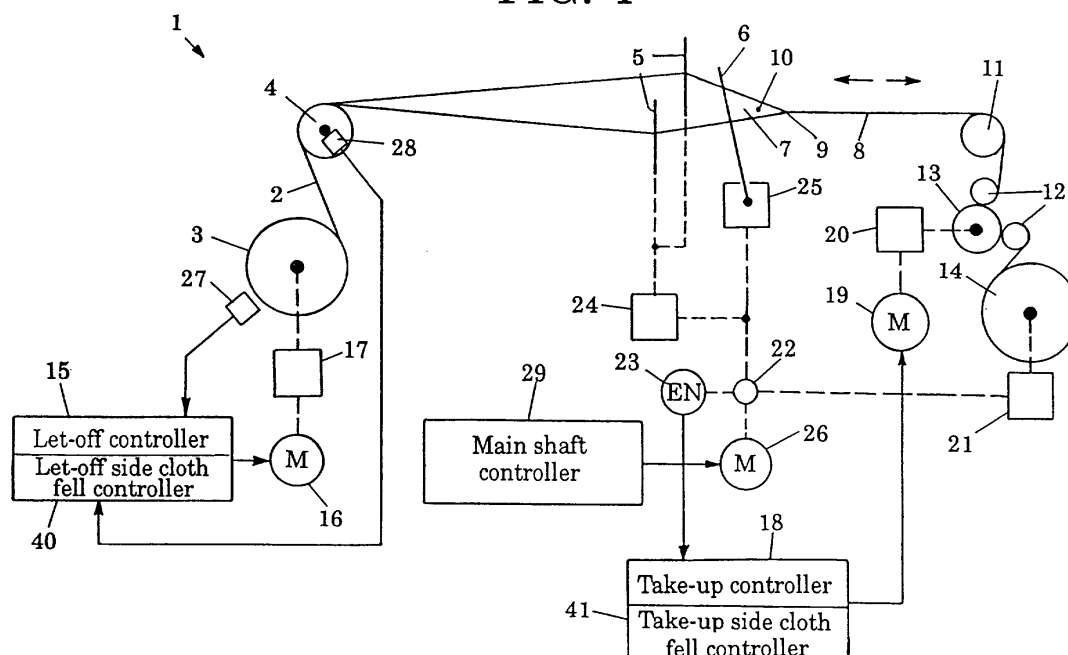
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(54) Loom-operating method and loom-operating system

(57) Aloom (1) is started for a normal weaving operation after shifting the cloth fell (9) of a fabric (8) on the loom (1) to a desired position by driving cloth fell shifting members (16, 19). A plurality of starting methods to be used selectively are set for the loom (1). The plurality of starting methods include a starting method that starts the loom (1) for a normal weaving operation after turning the main shaft (22) of the loom (1) in a normal or a re-

verse direction to a predetermined angular position different from an angular position where the main shaft (22) is stopped at the present. One of the plurality of starting methods is selected and is carried out to start the loom (1), and the position of the cloth fell (9) is adjusted according to a displacement, by which the cloth fell (9) is to be shifted, assigned to the selected starting method.

FIG. 4



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a loom-operating method that adjusts the cloth fell of a fabric on a loom at a desired position before starting the loom for a normal weaving operation, and a loom-operating system for carrying out the loom-operating method.

Description of the Related Art

[0002] Upon the occurrence of a trouble, for example, faulty picking, threads breakage of fillings or warps, etc. that stops a loom, the main shaft of the loom is braked in a weaving cycle, then the main shaft or the loom in a weaving cycle subsequent to a weaving cycle in which the trouble occurred as shown in Figs. 1 to 3. Then, the main shaft is reversed to a predetermined angular position to set the loom in a waiting state where the shed of the warp is closed and warp threads of the warp are relaxed to prevent the formation of a filling bar due to the elongation of the warp threads. After the completion of repairing work for removing the cause of the trouble, the weaving operation of the loom is restarted by operators. Such an operating method of restarting the loom is known, for example, (1) an ordinary starting method, (2) a starting method that reverses the loom (JP-A No. 124651/1986) or (3) a sixty-degree starting method, which will be described hereunder.

(1) Ordinary starting method

[0003] The ordinary starting method is a quite common starting method of starting general looms. As shown in Fig. 1, a loom is in a waiting state in a weaving cycle in which a trouble that stopped the loom occurred with the main shaft of the loom set at an angular position of 300° and the shed closed. The loom is started by a starting method A11 if the trouble is other than that caused by faulty picking, such as the breakage of a warp thread, or by a starting method A12 if the trouble is caused by faulty picking.

[0004] In case of the starting method A11, the trouble is other than that caused by faulty picking. Since the trouble is not due to faulty picking, a filling thread picked just before the occurrence of the trouble is inserted normally in the shed, and the normally picked filling thread does not need to be removed. Then, the operator performs repairing work to remove the cause of the trouble, such as repairing work for piecing together ends of a broken warp thread, and then operates a starting button. Then, the loom restarts the normal weaving operation and picks a filling thread when the main shaft is at a picking angular position. The main shaft is started from the angular position of 300°.

[0005] In case of the starting method A12, the trouble is due to faulty picking. Since the trouble is due to faulty

picking, a filling thread picked just before the stoppage of the loom must be removed. The operator operates a reversing button to reverse the loom such that the main shaft is set at an angular position of 180°, where the warp is divided in a substantially full shed, in a weaving cycle in which the trouble occurred, removes the faultily picked filling thread that caused the trouble, operates the reversing button again to set the main shaft at an angular position of 300° in a weaving cycle preceding the weaving cycle in which the trouble occurred, and then operates the starting button. Then, the loom restarts the normal weaving operation and resumes picking a filling thread when the main shaft is at a picking angular position.

(2) Starting method that reverses the loom (JP-A No. 124651/1986)

[0006] This starting method is called a reverse starting method or a blank beating starting method. This starting method is intended to prevent the formation of a filling bar that may result from insufficient beating force at the start of the loom. As shown in Fig. 2, the loom is stopped with the main shaft set at an angular position of 300° and the shed closed in a weaving cycle in which the trouble occurred. The loom is restarted by a starting method A21 if the trouble is other than that caused by faulty picking, or by a starting method A22 if the trouble is caused by faulty picking.

[0007] In case of the starting method A21, the trouble is not caused by faulty picking, so the starting method A21 does not need to remove a filling thread normally picked just before the stoppage of the loom. The operator removes the cause of the trouble, such as the breakage of a warp thread, and operates a starting button. Then, the main shaft of the loom is reversed to a first angular position, such as 120°, in the weaving cycle in which the trouble occurred or to the first angular position in a weaving cycle preceding the weaving cycle in which the trouble occurred, (the normal weaving operation of) the loom is resumed without actually picking any filling thread, and then, the loom restarts a picking operation after the main shaft has reached a picking angular position for the first time. The starting angle where the loom resumes its normal weaving operation is set at an optional angle other than 120°.

[0008] When the trouble is due to faulty picking, the starting method A22 needs to remove a filling thread picked just before the stoppage of the loom. The operator operates the reversing button to reverse the loom such that the main shaft is set at an angular position of 180°, where the warp is divided in a substantially full shed, in a weaving cycle in which the trouble occurred, removes the faultily picked filling thread that caused the trouble, operates the reversing button again to set the main shaft at an angular position of 300° in a weaving cycle preceding the weaving cycle in which the trouble occurred, and then operates the starting button. Then,

the main shaft of the loom is reversed to a first angular position, such as 120°, in the weaving cycle in which the trouble occurred or to the first angular position in a weaving cycle preceding the weaving cycle in which the trouble occurred, (the normal weaving operation of) the loom is restarted without actually picking any filling thread, and then, the loom resumes a picking operation after the main shaft has reached a picking angular position for the first time. The first angular position is set not limited to 120° and may be an optional angular position.

(3) Sixty-degree starting method

[0009] This method is used to prevent the formation of a wavy set mark, i.e., a filling bar formed in a fabric when the warp is kept divided in a shed for a long time, in a fabric of 2/1 twill design or the like. The sixty-degree starting method makes the loom perform the least necessary number of beating cycles so that a filling bar may be comparatively inconspicuous. As shown in Fig. 3, the loom is stopped with the main shaft set at an angular position of 60° in a weaving cycle subsequent to a weaving cycle in which the trouble occurred. The loom is restarted by a starting method A31 if the trouble is other than that caused by faulty picking or by a starting method A41 or A42 if the trouble is caused by faulty picking.

[0010] When the trouble is not caused by faulty picking, a filling thread picked just before the occurrence of the trouble is picked normally and hence the starting method A31 does not need to remove the picked filling thread. The operator removes the cause of the trouble, such as the breakage of a warp thread, and operates a starting button. Then, the loom starts the normal weaving operation from the waiting state and starts a picking operation normally.

[0011] When the trouble is caused by faulty picking, a filling thread picked just before the occurrence of the trouble is picked faultily and hence the starting method A41 needs to remove the picked filling thread. The operator operates the reversing button to reverse the loom such that the main shaft is set at an angular position of 180°, where the warp is divided in a substantially full shed, in a weaving cycle in which the trouble occurred, removes the faultily picked filling thread that caused the trouble, operates the reversing button again to reverse the main shaft further to an angular position of 60° in the weaving cycle in which the trouble occurred, and then operates the starting button. Then, the loom resumes the normal weaving operation from the angular position of 60° and picks a filling thread when the main shaft is at a picking angular position.

[0012] The starting method A42 may be used instead of the starting method A41. The loom is restarted by the starting method A42 when the trouble is caused by faulty picking. Therefore, the starting method A42, similarly to the starting method A41, needs to remove a faultily picked filling thread. The operator operates the revers-

ing button to reverse the loom such that the main shaft is set at an angular position of 180°, where the warp is divided in a substantially full shed, in a weaving cycle in which the trouble occurred, removes the faultily picked filling thread that caused the trouble, operates a single-picking button to pick one filling thread, and then operates the starting button. Then, the main shaft of the loom turns in the normal direction to an angular position of 300° in the weaving cycle in which the trouble occurred, and then the loom resumes the normal weaving operation from the angular position of 300° and picks a filling thread when the main shaft is at a picking angular position.

[0013] When the main shaft is at the angular position of 60°, where the starting methods A41 and A42 restarts the loom, the warp is substantially stably divided in a shed and permits picking. The angular position of the main shaft at the start of the loom is not limited to 60°, provided that a stable shed is formed and picking is possible.

[0014] In Figs. 1 to 3, numbers A11, A12, A21, A22, A31, A41 and A42 specify the specific starting methods. These numbers will be used for specifying starting methods (starting programs) in the description of the present invention. Starting methods (starting programs) other than the starting methods A11, A12, A21, A22, A31, A41 and A42 shown in Figs. 1 to 3 will be denoted by Ann.

[0015] Those known starting methods capable of starting a loom so that filling bars that may be formed when the loom is stopped accidentally may be inconspicuous, but those starting methods also have advantages and disadvantages, and the starting methods must be selectively used according to the design of the fabric, the cause of stoppage of the loom and the like. It is difficult to prevent the formation of a filling bar completely only by the starting method. Therefore, an appropriate starting method of starting a loom is used in combination with a known cloth fell shifting (adjusting) technique.

[0016] A cloth fell adjusting technique for adjusting the position of the cloth fell of a fabric on a loom at the start of the loom disclosed in JP-A No. 63749/1986 turns a warp beam in the reverse direction and in the normal direction to adjust the position of the cloth fell to a desired position before starting the loom for a normal weaving operation. Since the position of the cloth fell at the occurrence of faulty picking and that of the cloth fell at the occurrence of a trouble other than faulty picking are different from each other, this cloth fell adjusting technique determines a cloth fell displacement according to the cause of stoppage of the loom.

[0017] A filling bar preventing technique disclosed in JP-A No. 227430/1991 is based on a fact that the beating force of the reed for the first beating after the restart of a loom is dependent on the angular position of the main shaft of the loom at the restart of the loom. This filling bar preventing technique reverses at least either a take-up motor of a let-off motor according to a desired

kick-back displacement which is determined for a starting angular position of the main shaft of the loom before starting the loom.

[0018] There has not been proposed any loom capable of carrying out a proper one of a plurality of starting methods involving a reverse inching operation or a picking operation before the loom starts the normal weaving operation, and there has not been proposed any technique for setting a cloth fell displacement for a starting method selected by the loom. The inventors of the present invention found through studies that there is a proper displacement by which a cloth fell is to be shifted for each of a plurality of starting methods according to the cause of stoppage of the loom.

SUMMARY OF THE INVENTION

[0019] Accordingly, it is an object of the present invention to provide a loom-operating method that sets a plurality of different starting methods, selects one of the plurality of starting methods to start a loom, adjusts the cloth fell of a fabric on the loom to a proper position according to the selected starting method before starting the loom to prevent the formation of a filling bar effectively.

[0020] The loom-operating method of the present invention sets displacements by which the cloth fell is to be shifted respectively for the plurality of starting methods, and adjusts the position of the cloth fell according to the displacement for the selected starting method so that a conspicuous filling bar may not be formed when the loom is started.

[0021] According to the present invention, a loom drives cloth fell shifting members to shift a cloth fell of a fabric to a desired position before starting a normal weaving operation, a plurality of starting methods are determined for the loom, at least one of the plurality of starting methods includes a step of turning a main shaft included in the loom in a normal or a reverse direction from an angular position for removing a cause of stoppage to a predetermined angular position prior to the start of the normal weaving operation, displacements by which the cloth fell is to be shifted are determined respectively for the starting methods, a loom-operating method selects one of the plurality of starting methods and carries out the selected starting method to start the loom, and shifts the cloth fell by the displacement for the selected starting method.

[0022] The plurality of starting methods includes at least two of the following starting methods (1), (2) and (3):

- (1) Starting method that starts the loom for a normal weaving operation with the main shaft at an angular position for removing the cause of stoppage;
- (2) Starting method that starts a loom for a normal weaving operation after turning the main shaft in a reverse direction to a first angular position different

from an angular position for removing the cause of stoppage;

- (3) Starting method that starts a loom for a normal weaving operation after turning the main shaft in a normal direction to a second angular position different from an angular position for removing the cause of stoppage.

[0023] These starting methods (1), (2) and (3) and the foregoing starting methods A11 to A42 correspond to the following:

- (1) Starting methods that start a loom for a normal weaving operation with the main shaft of the loom at an angular position for removing the cause of stoppage ... Starting methods A11 and A31;
- (2) Starting methods that start a loom for a normal weaving operation after turning the main shaft of the loom in a reverse direction from an angular position for removing the cause of stoppage to a different first angular position ... Starting methods A12, A21, A22 and A41;
- (3) Starting methods that start a loom for a normal weaving operation after turning the main shaft of the loom in a normal direction from an angular position for removing the cause of stoppage to a different second angular position ... Starting method A42.

[0024] The plurality of starting methods are used selectively according to causes of stoppage, the displacements by which the cloth fell is to be shifted are set for the starting methods, respectively, and the displacements by which the cloth fell is to be shifted specify parameters including a stopping time. The cloth fell shifting members include at least either a take-up motor or a let-off motor.

[0025] A loom-operating system according to the present invention includes: a storage device storing a plurality of starting programs relating to driving a main shaft included in a loom when starting the loom; a program-selecting device that provides a starting program selection signal; a main shaft driving means for driving a main motor for driving the main shaft according to one starting program, specified by a program selection signal, of the plurality of starting programs; a displacement setting device for setting a displacement by which a cloth fell is to be shifted according to a program selection signal; and cloth fell control device for driving cloth fell shifting members according to a selected displacement; wherein the storage device stores a plurality of starting programs respectively corresponding to program selection signals, at least one of the starting programs includes a step of turning the main shaft in a normal or a reverse direction to a predetermined angular position prior to starting the loom for a normal weaving operation, the displacement setting device is set for displacements, by which the cloth fell is to be shifted, assigned to the starting programs for the program selection sig-

nals, the main shaft driving means execute a starting program corresponding to a program selection signal upon the application of an operating signal for driving the main motor to start the loom for a normal weaving operation, and give a preparation signal requiring preparation for operation to the cloth fell control devices prior to the start of the loom for the normal weaving operation, and the cloth fell control devices drive the cloth fell shifting members according to a displacement corresponding to the program selection signal upon the reception of the preparation signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a diagram of assistance in explaining a loom-starting method;
 Fig. 2 is a diagram of assistance in explaining a loom-starting method;
 Fig. 3 is a diagram of assistance in explaining a loom-starting method;
 Fig. 4 is a schematic side elevation of a loom;
 Fig. 5 is a block diagram of a loom-operating system;
 Fig. 6 is a table tabulating displacements by which a cloth fell is to be shifted assigned to loom-starting methods;
 Fig. 7 is a block diagram of a let-off controller and a let-off side cloth fell controller;
 Fig. 8 is a block diagram of a take-up controller and a take-up side cloth fell controller;
 Fig. 9 is a block diagram of a displacement signal generator; and
 Fig. 10 is a block diagram of a displacement signal generator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Fig. 4 shows an essential part of a loom 1 to be controlled, and a control system. In the loom 1 shown in Fig. 4, warp threads 2 like a sheet wound in a warp beam 3 are let off in a warp, are extended via a back roller 4, and are passed through heddles 5 and a reed 6. The warp is divided to form a shed 7. The warp threads 2 terminate at the cloth fell 9 of a fabric 8. A filling thread 10 picked into the shed 7 by the warp threads 2 is beaten up into the cloth fell 9 by the reed 6 to form the fabric 8. The fabric 8 is guided by a guide roller 11, a first pressure roller 12, a take-up roller 13 and a second pressure roller 12, and is taken up on a cloth roller 14.

[0028] The warp beam 3 is driven for rotation in a feed direction by a let-off controller 15, a let-off motor 16 and a let-off reduction gear 17. The let-off controller 15 includes a diameter measuring device 27 and a tension-measuring device 28. The diameter-measuring device

27 measures (or detects) the diameter of the warp beam 3. The tension-measuring device 28 determines the tension of the warp threads 2 through the measurement of load exerted on the back roller 4 by the warp threads 2.

[0029] The take-up roller 13 is driven for rotation in a take-up direction by a take-up controller 18, a take-up motor 19 and a take-up reduction gear 20. The cloth roller 14 is driven for rotation in a winding direction by a take-up driving device 21. The take-up controller 18 operates in synchronism with the rotation of a main shaft 22 included in the loom 1. Therefore, a rotation detector 23, such as an encoder, for measuring the rotation of the main shaft 22 is combined with the main shaft 22, and a rotation signal or angular position signal provided by the rotation detector 23 is given to the take-up controller 18. The take-up driving device 21 is connected to the main shaft 22 of the loom 1 and is driven for a take-up operation in synchronism with the main shaft 22.

[0030] The heddles 5 are driven by a heddle-driving device 24. The reed 6 is driven by a reed-driving device 25. The heddle-driving device 24 and the reed-driving device 25 are interlocked with the main shaft 21 for operation in synchronism with the rotation of the main shaft 21. The main shaft 22 is driven by a main motor 26 and is controlled by a main shaft controller 29.

[0031] At least either the let-off motor 16 or the take-up motor 19 serves also as a cloth fell shifting member. The cloth fell shifting member may comprise a means that directly controls the position of the cloth fell 9 through the displacement of the back roller 4 and the guide roller 11.

[0032] Referring to Fig. 5 showing an essential part of a loom-operating system 30 according to the present invention, the loom-operating system 30 includes, in addition to the let-off controller 15, the take-up controller 18 and the main shaft controller 29, a main controller 31, such as a CPU, a starting method (starting program) selector 32, a storage device 33, a setting device 34, a displacement-setting device 35, operating buttons including a starting button 36, an inching button 37, a reversing button 38 and a stopping button 39, a let-off side cloth fell controller 40 and a take-up side cloth fell controller 41.

[0033] The main controller 31 controls the operation of the main shaft 22 including starting, forward inching, reversing and stopping, a picking mechanism, and the functional components of the loom 1, and executes control operations specified by a loom-operating method of the present invention. The main controller 31 has an input side connected to the starting method (starting program) selector 32, the operating buttons including the starting button 36, the inching button 37, the reversing button 38 and the stopping button 39, and the rotation detector 23, such as an encoder, combined with the main shaft 22.

[0034] The main controller 31 has an output side connected to the main shaft controller 29, the let-off controller 15, the take-up controller 18, the let-off side cloth fell

controller 40 and the take-up side cloth fell controller 41. The main controller 31 is connected to the storage device 33 and the setting device 34 for the bi-directional transmission of signals and data.

[0035] The starting method (starting program) selector 32 may be provided with a plurality of manually operated selector switches or may be a signal generator that generates a selection signal automatically according to combined data including a cause of stoppage and weaving conditions including filling thread densities. The starting method (starting program) selector 32 sends a starting method (starting program) selection signal to the main controller 31 and the displacement-setting device 35. The main controller 31 and the main shaft controller 29 constitute a main shaft driver. The main shaft driver makes the main motor 26 drive the main shaft 22 according to a starting program specified by the starting program selection signal.

[0036] The displacement-setting device 35 sets a displacement by which the cloth fell is to be shifted according to a starting method (starting program) selection signal, stores the same, and sends the a displacement signal representing the displacement to the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 during a preparatory period.

[0037] Fig. 6 shows a mode of storage of displacements, for the let-off side and the take-up side, assigned to starting methods (starting programs) in the displacement setting device 35. In Fig. 6, F11, F12, F21, F22, F31, F41, F42, ... and Fnn are displacements for the let-off side, and R11, R12, R21, R22, R31, R41, R42, ... and Rnn are displacements for the take-up side for starting methods (starting programs) A11, A12, A21, A22, A31, A41, A42, ... and Ann. The values of the let-off side displacements F11, F12, F21, F22, F31, F41, F42, ... and Fnn, and the take-up side displacements R11, R12, R21, R22, R31, R41, R42, ... and Rnn are positive when the cloth fell is shifted in the let-off direction or the take-up direction and are negative when the cloth fell is shifted in a direction opposite to the let-off direction or the take-up direction. The signs of the let-off side displacements F11, F12, F21, F22, F31, F41, F42, ... and Fnn, and the take-up side displacements R11, R12, R21, R22, R31, R41, R42, ... and Rnn are determined according to the starting method (starting program).

[0038] The let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 drive the let-off motor 16 and the take-up motor 19 according to a cloth fell displacement signal corresponding to the selected starting method (starting program) to shift the cloth fell 9 by the specified displacement by rotating the warp beam 3 and the take-up roller 13 respectively, during the preparatory period before the loom 1 is started for the normal weaving operation.

[0039] The let-off controller 15, the take-up controller 18, the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 will be specifically described later with reference to Figs. 7 and 8.

[0040] The storage device 33 stores programs describing the starting methods based on the loom-operating method of the present invention and data necessary for controlling the starting operation of the loom 1, and gives the programs and the data to the main controller 31 as the occasion demands. The setting device 34 is set starting control data including a control starting angle, a reversing stopping angle, a picking control data, a normal weaving operation starting angle, and other necessary data and gives the same to the main controller 31.

[0041] Referring to Fig. 5, a starting method of controlling the starting operation of the loom 1 is selected by the operator's selecting operation of the starting method selector 32 or by the automatic selecting operation of the loom 1 according to the cause of stoppage. The starting method selector 32 sends a starting program selection signal requesting the selection of a starting program corresponding to the specified starting method to both the main controller 31 and the displacement-setting device 35. The main controller 31 reads the starting program corresponding to the specified starting method from the storage device 33 and prepares for the execution of the read starting program.

[0042] The displacement-setting device 35 finds a displacement, by which the cloth fell is to be shifted, assigned to the starting program of the specified starting method in the stored table shown in Fig. 6 and gives a displacement signal representing the selected displacement to both the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41. Then, the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 prepares for the start of the loom 1 on the basis of the displacement signal.

[0043] Suppose, for example, that the aforesaid sixty-degree starting method is a starting method capable of preventing the formation of a wavy set mark, and a starting method corresponding to the cause of stoppage is selected. The starting method A31 corresponding to a cause of stoppage other than faulty picking, and the starting method A41 corresponding to faulty picking are stored in the storage device 33. Displacements F31 and R31, and displacements F41 and R41 are set for the starting methods A31 and A41, respectively, by the displacement-setting device 35.

[0044] When a cause of stoppage other than faulty picking, such as the breakage of the warp thread, occurs while the loom 1 is in weaving operation, the main controller 31 executes a previously stored waiting method to stop the loom 1. The main controller 31 starts a braking operation immediately after the occurrence of the cause of stoppage, brings the loom 1 to a stop in a weaving cycle subsequent to a weaving cycle in which the cause of stoppage occurred, and sets the loom 1 in a waiting state after reversing the main shaft 22 to an angular position of 60° to avoid unnecessary beating-up. Meanwhile, a stopping cause signal is given to the starting method selector 32. Then, the starting method se-

lector 32 gives a starting method selection signal indicating the selection of the starting method A31 to the main controller 31 and the cloth fell controllers 40 and 41.

[0045] The operator comes to the loom 1, repairs the broken warp thread, and operates the starting button 36 to send a starting signal to the main controller 31. Then, the main controller 31 gives an operation preparation signal to the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 in a preparatory period before making the main shaft controller 29 start the main motor 26. During the preparatory period, the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 drive the let-off motor 16 and the take-up motor 19, i.e., cloth fell shifting means, respectively, according to the displacement signal to turn the warp beam 3 and the take-up roller 13 in predetermined directions to shift the cloth fell 9 by the displacements F31 and R31 for the selected starting method A31.

[0046] In the preparatory period, the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 stop the let-off motor 16 and the take-up motor 19, respectively, after the cloth fell 9 has been shifted by the specified displacement.

[0047] After the passage of the preparatory period, the main controller 31 gives an operation signal to the main shaft controller 29. Then, the main shaft controller 29 starts the main motor 26 according to the starting program of the specified starting method to start the loom 1 for a normal weaving operation. After the loom 1 has started the normal weaving operation, the let-off controller 15 controls the operation of the let-off motor 16 to regulate the tension of the warp, and the take-up controller 18 controls the take-up motor 19 according to a rotation signal given thereto by the rotation detector 23.

[0048] When faulty picking occurs while the loom 1 is in weaving operation, the main controller 31 executes a previously stored waiting method to stop the loom 1. The main controller 31 makes the loom 1 to stop in a weaving cycle subsequent to a weaving cycle in which faulty picking occurred, and sets the loom 1 in a waiting state after reversing the main shaft 22 to an angular position of 60°. Meanwhile, the starting method selector 32 gives a starting method selection signal indicating the selection of the starting method A41 to the main controller 31 and the cloth fell controllers 40 and 41.

[0049] The operator comes to the stopped loom 1, then operates the reversing button 38 to remove a mispicked filling thread and gives the main controller 31 a reversing signal as a reversing operating signal. Then, the main controller 31 reverses the main shaft 22 to an angular position of 180° in a weaving cycle in which faulty picking occurred by the starting method A41. Then, the operator removes the mispicked filling thread and operates the reversing button 38 again to give the main controller 31 a reversing signal again. Then, the main controller 31 turns the main shaft 22 to an angular position of 60° in the weaving cycle in which faulty pick-

ing occurred by the starting method A41. Then, the operator operates the starting button 36. Then, the main controller 31a gives preparation signal to the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 in a preparatory period before the start of a normal weaving operation. During the preparatory period, the let-off side cloth fell controller 40 and the take-up side cloth fell controller 41 drive the let-off motor 16 and the take-up motor 19 according to the displacements F41 and R41 assigned to the starting method A41, respectively, to shift the cloth fell 9.

[0050] The following modifications of the foregoing embodiment are possible. The starting method A41 includes steps of operating the push buttons to drive the main shaft 22 in a period between the removal of the cause of stoppage and the start of the normal weaving operation. Operations following the first operation of the push button may be carried out automatically. The time for shifting the cloth fell 9, i.e., the time for providing the preparatory signal, is not limited to time just before the start of the normal weaving operation and may be provided any time in the period between time when the loom 1 is set in the waiting state and time when the loom 1 is started for the normal weaving operation, which applies also to other starting methods.

[0051] Although the starting methods A31 and A41 were selected in the foregoing embodiment, any suitable starting methods may be chosen from those included in the different groups (1), (2) and (3). For example, a combination of the starting methods A11 and A31 in the different groups or a combination of the starting methods A21 and A31 in the different groups may be selected depending on weaving conditions, such as the cause of stoppage, the type of fabric and filling thread density. The starting methods of the groups (2) and (3), i.e., starting methods including turning the main shaft 22 to the first or the second angular position in the normal or the reverse direction by inching, in which the first and the second angular position are different angular positions may be selected. Cloth fell displacements may be determined for such as the selected starting methods (starting program) respectively.

[0052] With thus the starting method based on the operating method of the invention, an appropriate cloth fell displacement is set adapted for every starting method (starting program) in the preparatory period, and then starts loom for the normal weaving operation. Therefore, the formation of a filling bar can be surely prevented even if the starting method (starting program) is changed.

[0053] The preferred embodiment shown in Fig. 5 drives simultaneously the let-off motor 16 for letting off the warp threads 2, and the take-up motor 19 for taking up the fabric 8 by the loom-operating method of the present invention. However, the loom-operating method of the present invention may drive at least either the let-off motor 16 for letting off the warp threads 2, or the take-up motor 19 for taking up the fabric 8.

[0054] Fig. 7 shows the let-off controller 15 and the let-off side cloth fell controller 40. Referring to Fig. 7, the displacement-setting device 35 gives a displacement signal indicating a cloth fell displacement assigned to the starting program of the selected starting method on the basis of the stored data shown in Fig. 6 to a displacement signal generator 53 included in the let-off side cloth fell controller 40. Upon the reception of a preparatory signal and a starting method selection signal, the displacement signal generator 53 corrects the cloth fell displacement by the warp beam diameter and, when necessary, receives a stoppage duration signal from the stoppage time calculator 54, corrects the displacement according to the stoppage duration to determine an appropriate cloth fell displacement, and sends a displacement signal indicating a proper displacement to a plus terminal of an adder-subtractor 55.

[0055] A speed command signal provided by the adder-subtractor 55 is transmitted through a switch 49 kept closed during a preparatory period and an adder 51 to a driving amplifier 52. The switch 49 is kept in an on-state in the preparatory period prior to the start of the normal weaving operation. The driving amplifier 52 drives the let-off motor 16 according to the speed command signal to shift the cloth fell 9 by a proper displacement.

[0056] A rotation detector 56 measures the rotation of the let-off motor 16 and applies a rotation signal indicating a measured rotation to the minus input terminal of the adder-subtractor 55. After the let-off motor 16 has rotated by a rotation corresponding to the predetermined cloth fell displacement, the output, i.e., the speed command signal, of the adder-subtractor 55 goes zero and the driving amplifier 52 stops driving the let-off motor 16.

[0057] After the normal weaving operation has been started following the termination of the preparatory period, the tension measuring device 28 measures the tension of the warp threads 2 at a position corresponding to the back roller 4, and the let-off controller 15 controls the operation of the let-off motor 16 to regulate the tension of the warp of the warp threads 2. A negative signal representing a measured tension is added to a desired tension signal indicating a set tension set by desired tension setting device 42 at an addition point 43, and a thus calculated tension deviation is given to a tension controller 44. The tension controller 44 executes a PID control and applies a speed command signal proportional to the tension deviation to an addition point 45.

[0058] On the other hand, a basic speed generator 46 generates a basic speed command signal on the basis of weaving conditions including the rotating speed of the main shaft 22 of the loom 1 and filling thread density and applies the same to the addition point 45. A diameter corrector 47 receives an input signal produced by adding the speed command signal proportional to the tension deviation and the basic speed command signal, processes the input signal by a necessary correcting op-

eration using an expression: $\{(\text{Speed command signal proportional to the tension deviation}) + (\text{Basic speed command signal})\} / (\text{Diameter of the warp beam})$ using the diameter of the warp beam 3 measured by the diameter measuring device 27 to provide a final speed command signal. The final speed command signal is sent through a switch 48 and an addition point 51 to the driving amplifier 52. The switch 48 is closed when the operation signal is provided. The driving amplifier 52 drives the let-off motor 16 according to the final speed command signal while the loom 1 is in the normal weaving operation.

[0059] Referring to Fig. 8 showing the take-up controller 18 and the take-up side cloth fell controller 41, the displacement setting device 35 sends a displacement signal indicating a displacement assigned to the starting program of the selected starting method to a displacement signal generator 59 included in the take-up side cloth fell controller 41 in the preparatory period prior to the normal weaving operation. Upon the reception of a preparation signal and a starting method selection signal, the displacement signal generator 59 sends a displacement signal indicating a cloth fell displacement suitable for the selected starting method through an addition point 58 to the plus input terminal of an adder-subtractor 60.

[0060] The adder-subtractor 60 receives the displacement signal indicating the cloth fell displacement from the displacement signal generator 59, and gives a take-up command signal to a driving amplifier 61. Then, the driving amplifier 61 drives the take-up motor 19 for operation corresponding to the cloth fell displacement suitable for the selected starting method to shift the cloth fell 9 by the cloth fell displacement. The output basic speed signal of the basic speed signal generator 57 is interrupted during the preparatory period.

[0061] A rotation detector 62 measures the rotation of the take-up motor 19 and applies a rotation signal indicating a measured rotation to the minus input terminal of the adder-subtractor 60. After the take-up motor 19 has rotated by a rotation corresponding to the predetermined cloth fell displacement, the output, i.e., the speed command signal, of the adder-subtractor 60 goes zero and the driving amplifier 61 stops driving the take-up motor 19. Thus, the take-up side cloth fell controller 41 drives the take-up motor 19 for operation corresponding to the proper cloth fell displacement during the preparatory period to shift the cloth fell 9 to a position suitable for the selected starting method.

[0062] After the normal weaving operation has been started following the termination of the preparatory period, the basic speed generator 57 included in the take-up controller 18 generates a basic take-up speed command signal on the basis of a main shaft speed signal indicating the rotating speed of the main shaft 22 measured by the rotation detector 23 and a signal indicating a filling thread density, and applies the same through the addition point 58 to the plus input terminal of the

adder-subtractor 60. During the foregoing operation of the take-up controller 18, the displacement signal generator 59 does not provide any signal. The adder-subtractor 60 receives the basic take-up speed signal from the basic speed signal generator 57, generates a take-up signal, and gives the take-up signal to a driving amplifier 61. The driving amplifier 61 drives the take-up motor 19 to take up the fabric 8 according to the progress of the normal weaving operation.

[0063] Incidentally, cloth fell displacements are set for the starting methods (starting programs), respectively. More specifically, the cloth fell displacements are determined taking into consideration; (a) an angular position to which the main shaft is turned by inching or reversing, and an angular position for starting the normal weaving operation to reflect the condition of the shed before the normal weaving operation is started, (b) information about whether or not a filling thread picked just before the stoppage of the loom is removed in removing the cause of stoppage, and whether or not any filling thread will be picked before the start of the normal weaving operation to reflect the cause of stoppage, (c) information about whether or not beating-up is performed by inching or reversing before the normal weaving operation is started, and the number of beating-up operations if beating-up is performed to reflect the condition of beating-up, and (d) the time between the stoppage and the start of the loom to deal with the elongation of the warp threads causing the cloth fell to shift.

[0064] From the foregoing point of view, the displacement signal generators 53 and 59 uses a circuit shown in Fig. 9 or 10, or a circuit that generates an empirical displacement signal determined taking those into consideration to set a cloth fell displacement. The cloth fell displacement may be either a displacement toward the take-up side (forward displacement) or that toward the let-off side (backward displacement). The cloth fell may be shifted by a cloth fell shifting method mentioned in JP-A No. 63749/1886 that shifts the cloth fell by a timed combination of a displacement toward the take-up side (forward displacement) and a displacement toward the let-off side (backward displacement), taking frictional resistance exerted on the warp thread 2 by the reed 6 and heddles 5.

[0065] Since the displacement signal generators 53 and 59 are identical with each other, only the displacement signal generator 53 will be described by way of example. Referring to Fig. 9 showing a circuit of the displacement signal generator 53, a starting method selector 63 receives a starting method selection signal, selects one of a plurality of signal generators 64 respectively for a plurality of starting methods, and gives an output signal to a multiplier 65. Upon the reception of a preparation signal, the multiplier 65 generates a displacement signal generated by multiplying a desired cloth fell displacement set by the displacement setting device 35 and a signal provided by the selected signal generator 64 together. Thus, a setting operation for set-

ting cloth fell displacements respectively for the plurality of starting methods is not necessary and hence setting work is simplified.

[0066] Fig. 10 shows another circuit of the displacement signal generator 53. Referring to Fig. 10, a parameter generator 66 gives, from the aforesaid point of view, (a) data on an angular position to which the main shaft is turned by inching or reversing, and an angular position for starting the normal weaving operation, (b) data on whether or not a filling thread picked just before the stoppage of the loom is removed in removing the cause of stoppage, and data on whether or not any filling thread will be picked before the start of the normal weaving operation, (c) data on whether or not beating-up is performed by inching or reversing before the normal weaving operation is started and the number of beating-up operations if beating-up is performed to a function generator 67. The function generator 67 receives (d) data on the time between the stoppage and the start of the loom from a time generator 68 in addition to (a), (b) and (c). The function generator 67 generates, on the basis of those input data, a function signal that varies proportionally, inversely proportionally, exponentially, in a quadratic function or in an Nth degree function (N is the positive integer number), and gives the function signal to a multiplier 69. Upon the reception of a preparation signal, the multiplier 69 multiplies a desired displacement set by the displacement setting device 35 and the signal generated by the function generator 67 together to provide a displacement signal. Thus, a setting operation for setting cloth fell displacements respectively for the plurality of starting methods is not necessary and hence setting work using complicated data is simplified.

[0067] As mentioned previously, the cloth fell shifting means does not need to include both the let-off motion for letting off the warp threads 2 and the take-up motion for taking up the fabric 8, but may be either the let-off motion or the take-up motion. The cloth fell shifting means may be a means capable of directly changing the position of the cloth fell, such as a mechanism capable of moving the back roller 4 forward and backward or a cloth moving mechanism of a pile loom, other than means relating with the let-off motion for letting off the warp threads 2 and the take-up motion for taking up the fabric 8.

[0068] As apparent from the foregoing description, according to the present invention, the plurality of different starting methods are set beforehand, one of the plurality of starting methods is selected for starting the loom, and the position of the cloth fell is adjusted by a displacement assigned to the selected starting method. Consequently, a filling mark formed at the start of the loom is faint and inconspicuous.

[0069] Although the invention has been described in its preferred embodiments with a certain degree of particularity, many changes and variations are possible therein. It is therefore to be understood that the present invention may be practiced otherwise than as specifical-

ly described herein without departing from the scope and spirit thereof.

Claims

1. A loom (1) that drives cloth fell shifting members (16, 19) to shift a cloth fell (9) of a fabric (8) to a desired position before starting a normal weaving operation;

a plurality of starting methods are determined for the loom (1), at least one of the plurality of starting methods includes a step of turning a main shaft (22) included in the loom (1) in a normal or a reverse direction from an angular position for removing a cause of stoppage to a predetermined angular position prior to the start of the normal weaving operation, displacements by which the cloth fell (9) is to be shifted are determined respectively for the starting methods;

a loom-operating method selects one of the plurality of starting methods and carries out the selected starting method to start the loom (1), and shifts the cloth fell (9) by the displacement for the selected starting method.

2. The loom-operating method according to claim 1, wherein the plurality of starting methods includes at least two of the following starting methods:

(1) Starting method that starts the loom (1) for a normal weaving operation with the main shaft (22) at an angular position for removing the cause of stoppage;

(2) Starting method that starts a loom (1) for a normal weaving operation after turning the main shaft (22) in a reverse direction to a first angular position different from an angular position for removing the cause of stoppage;

(3) Starting method that starts a loom (1) for a normal weaving operation after turning the main shaft (22) in a normal direction to a second angular position different from an angular position for removing the cause of stoppage.

3. The loom-operating method according to claim 1, wherein the plurality of starting methods include starting methods differing from each other in at least either the first or the second angular position.

4. The loom-operating method according to any one of claims 1 to 3, wherein the plurality of starting methods are used selectively according to causes of stoppage, respectively, and the displacements by which the cloth fell (9) is to be shifted are set for the starting methods, respectively.

5. The loom-operating method according to any one of claims 1 to 4, wherein the displacements by which the cloth fell (9) is to be shifted specify parameters including a stopping time for which the loom(1) is stopped.

6. The loom-operating method according to any one of claims 1, to 5, wherein the cloth fell shifting members (16, 19) include at least either a take-up motor (16) or a let-off motor (19).

7. A loom-operating system comprising:

a storage device (33) storing a plurality of starting programs relating to driving a main shaft (22) included in a loom (1) when starting the loom (1);

a program-selecting device (32) that provides a starting program selection signal;

a main shaft driving means (29, 31) for driving a main motor (26) for driving the main shaft (22) according to one starting program, specified by a program selection signal, of the plurality of starting programs;

a displacement setting device (35) for setting a displacement by which a cloth fell (9) is to be shifted according to a program selection signal; and

cloth fell control device (40, 41) for driving cloth fell shifting members (16, 19) according to a selected displacement;

wherein the storage device (33) stores a plurality of starting programs respectively corresponding to program selection signals, at least one of the starting programs includes a step of turning the main shaft (22) in a normal or a reverse direction to a predetermined angular position prior to starting the loom (1) for a normal weaving operation, the displacement setting device(35) is set for displacements, by which the cloth fell (9) is to be shifted, assigned to the starting programs for the program selection signals, the main shaft driving means (29, 31) execute a starting program corresponding to a program selection signal upon the application of an operating signal to the main motor (26) to start the loom (1) for a normal weaving operation, and give a preparation signal requiring preparation for operation to the cloth fell control devices (40, 41) prior to the start of the loom for the normal weaving operation, and the cloth fell control devices (40, 41) drive the cloth fell shifting members (16, 19) according to a displacement corresponding to the program selection signal upon the reception of the preparation signal.

FIG. 1

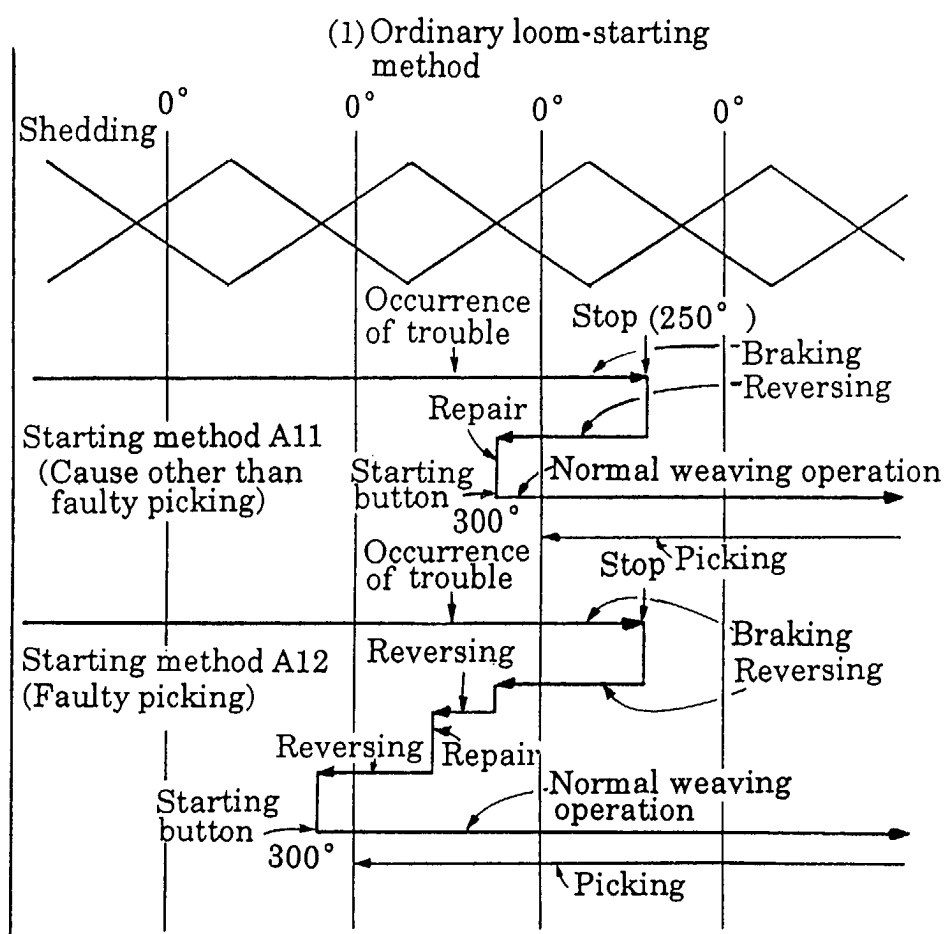


FIG. 2

(2) Loom-starting method
including a reversing step

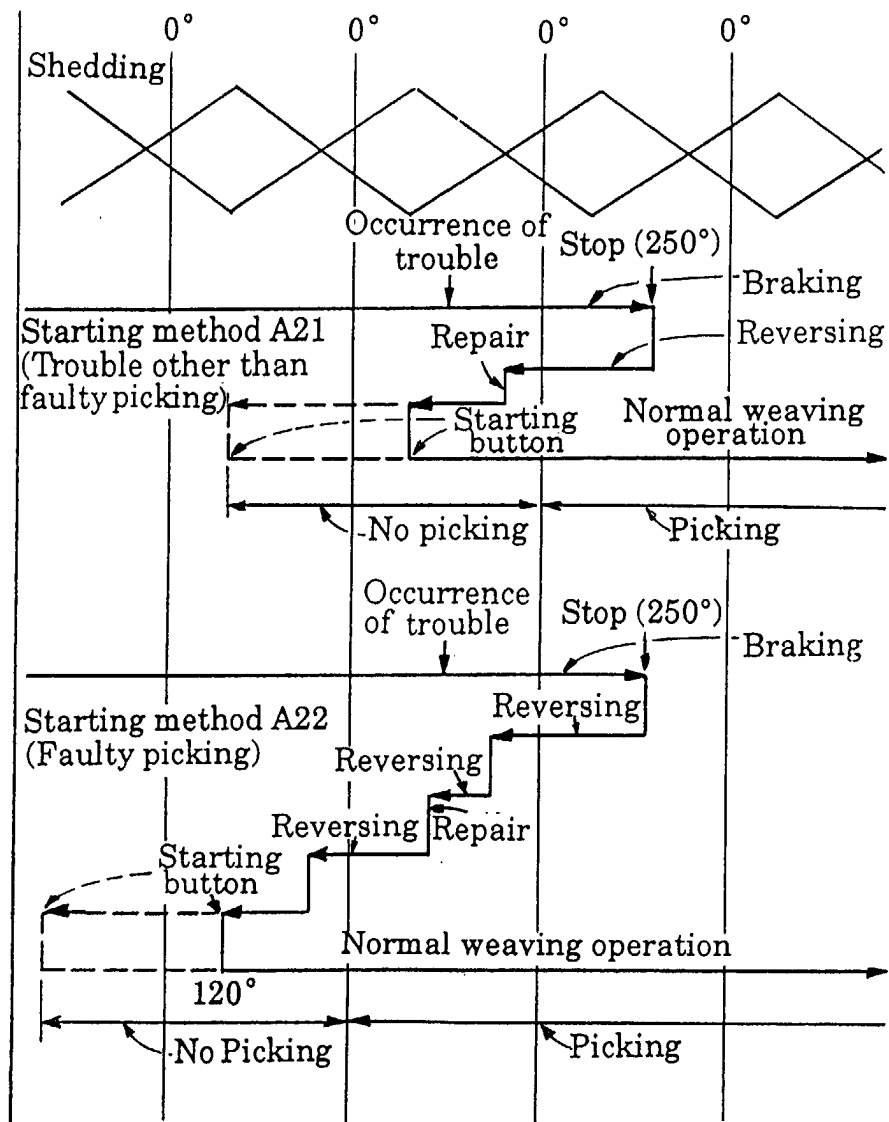


FIG. 3

(3) Sixty-degree starting method

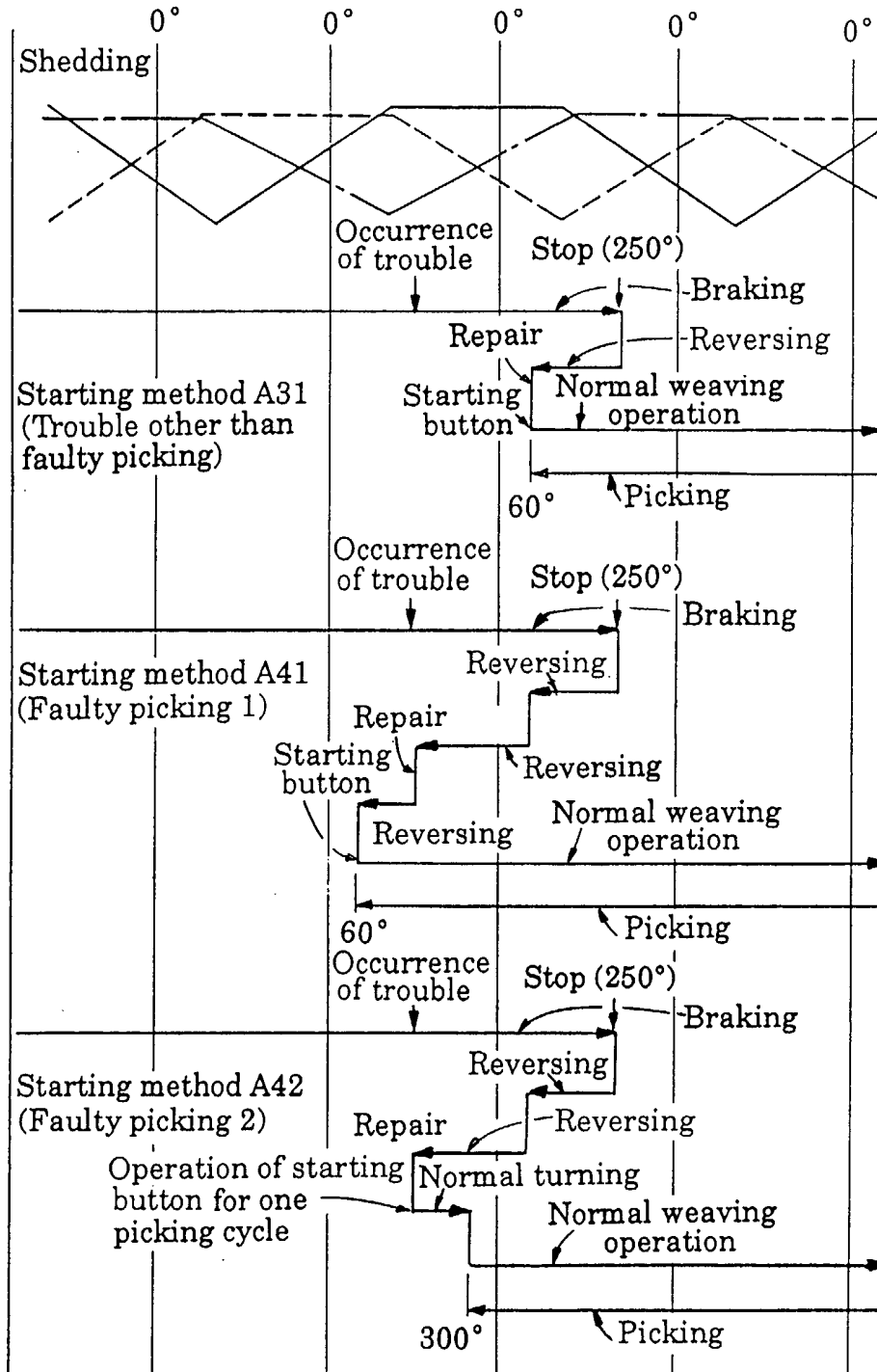
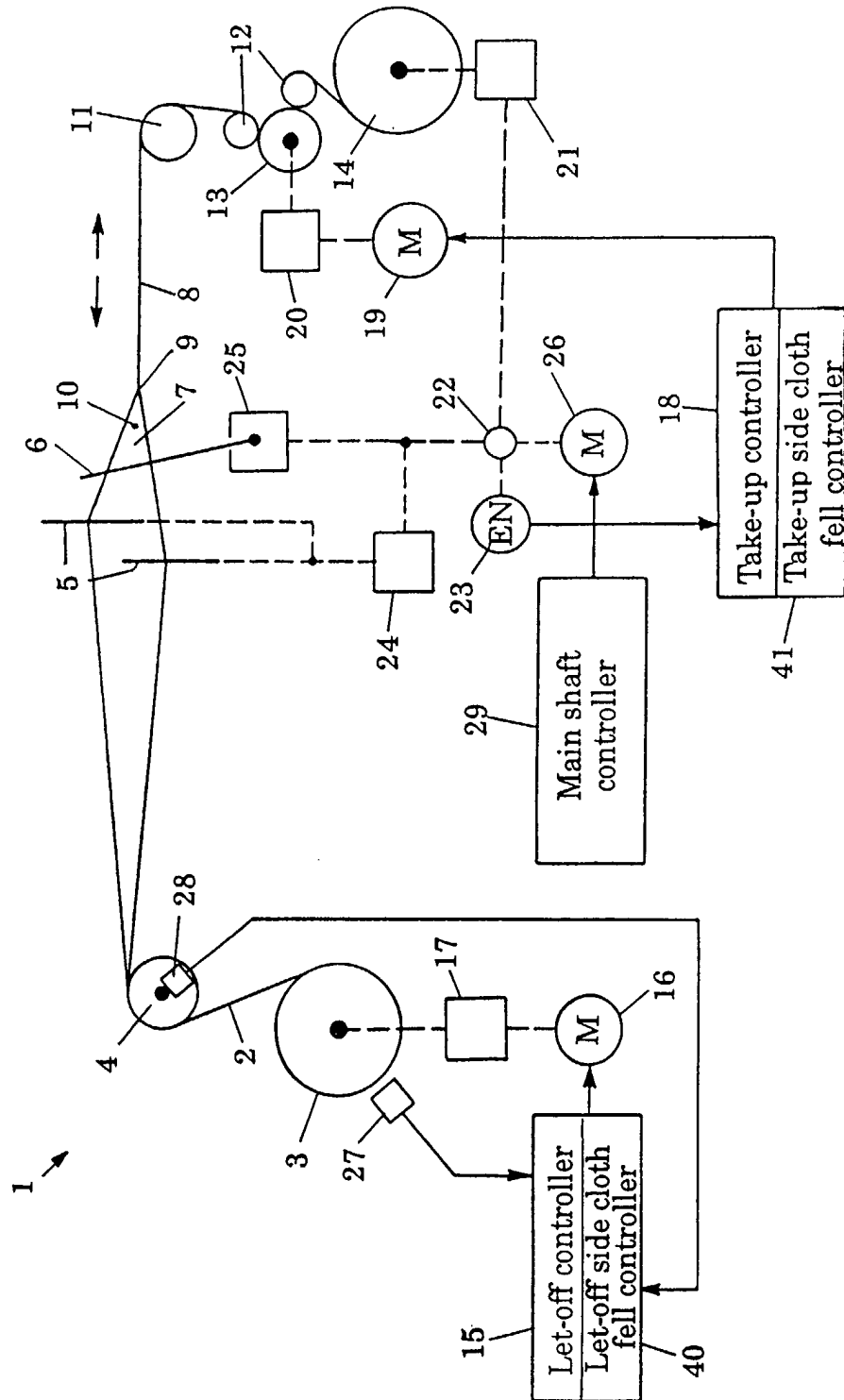


FIG. 4



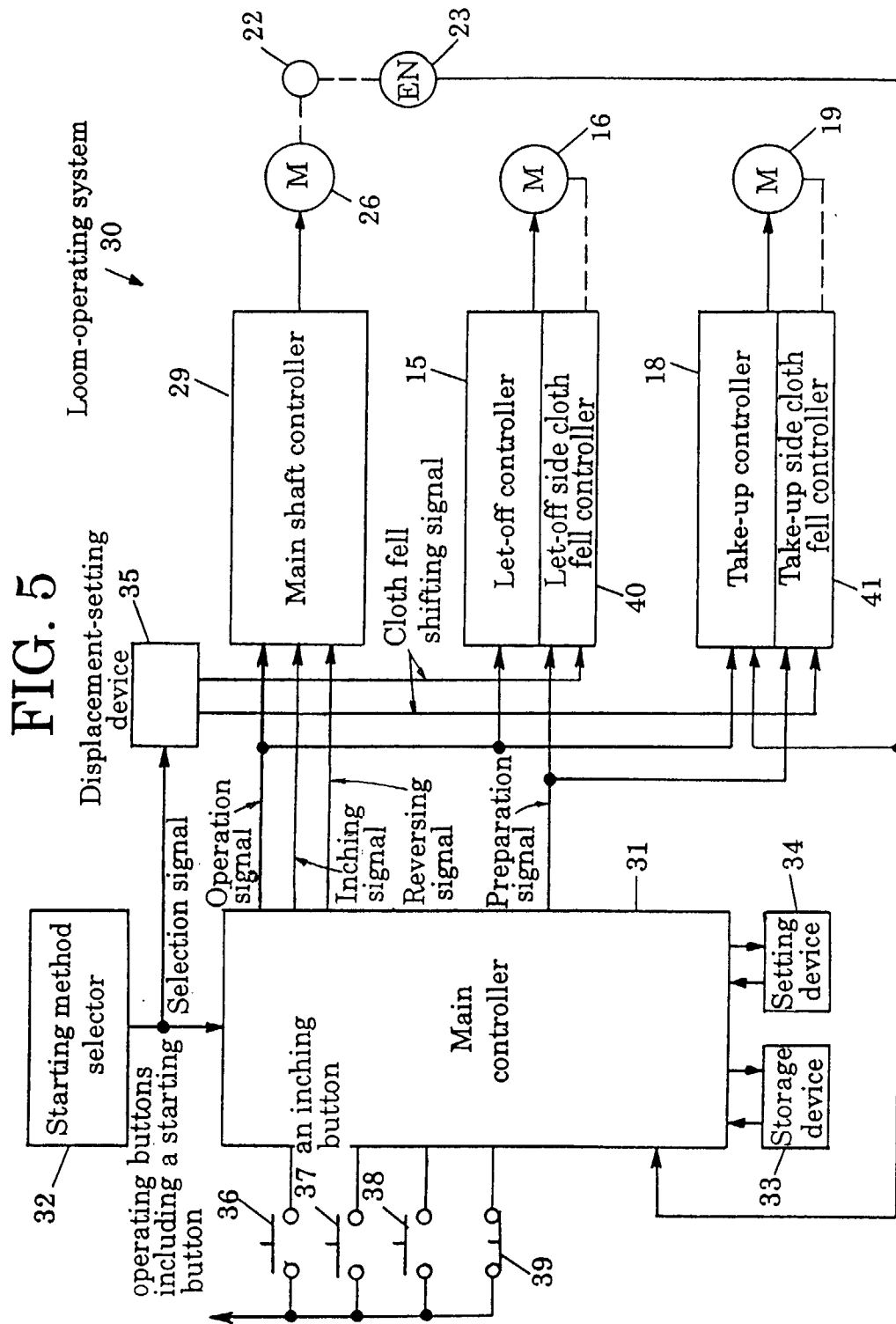


FIG. 6

Loom-starting method	Cloth fell displacement	Cloth fell displacement
A11	F11	R11
A12	F12	R12
A21	F21	R21
A22	F22	R22
A31	F31	R31
A41	F41	R41
A42	F42	R42
⋮	⋮	⋮
Ann	Fnn	Rnn

FIG. 7

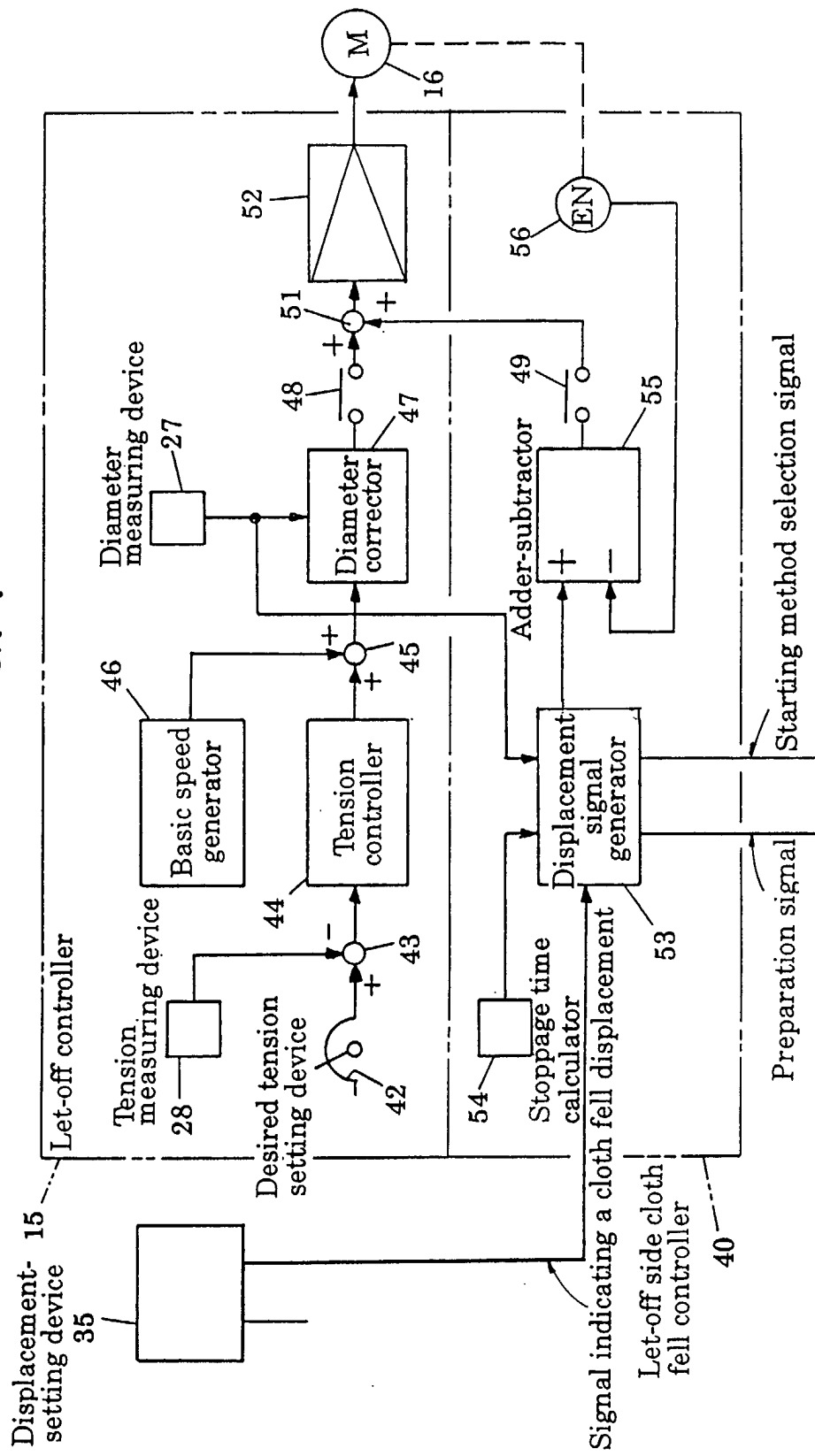


FIG. 8

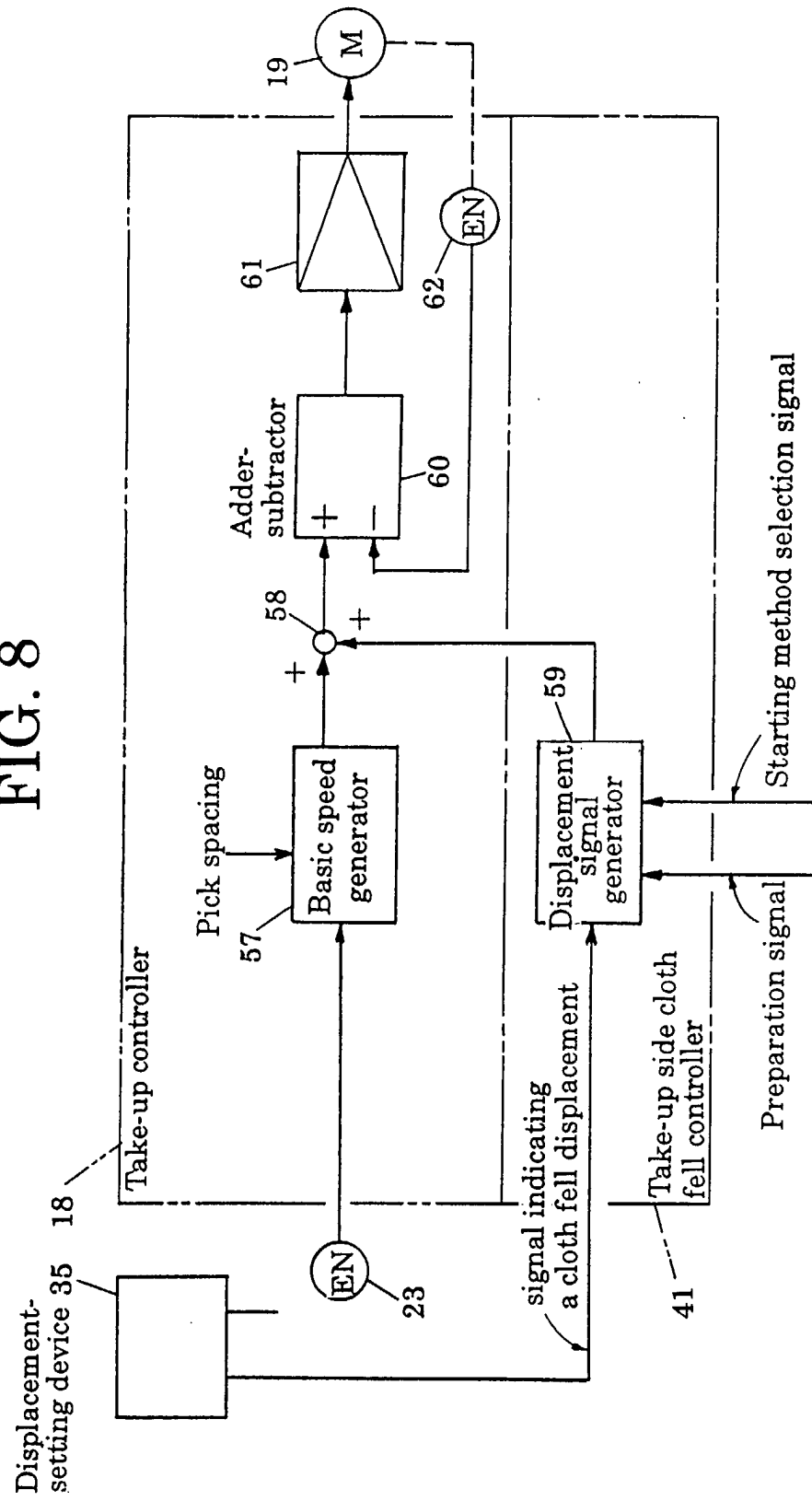


FIG. 9

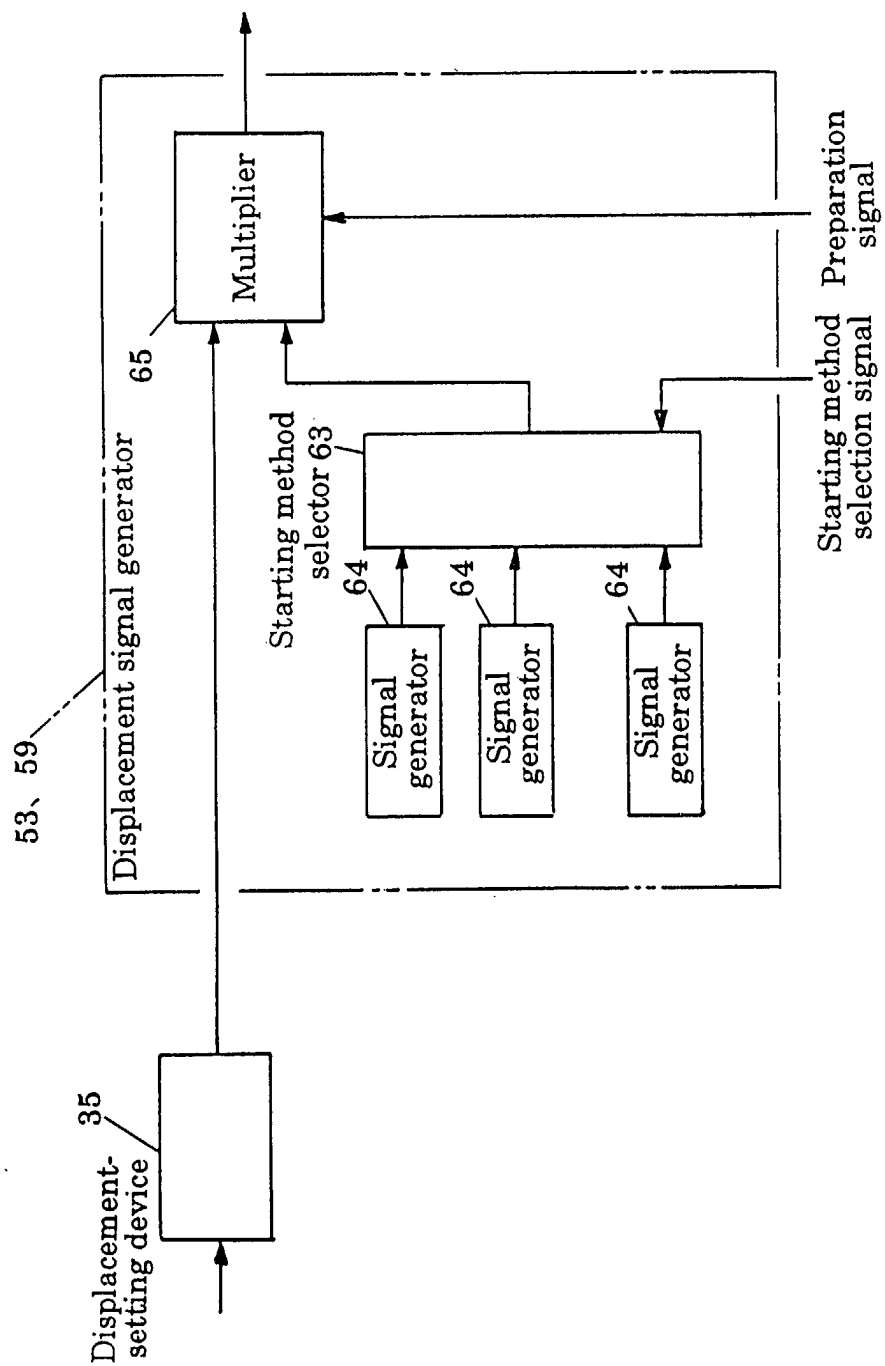


FIG.10

