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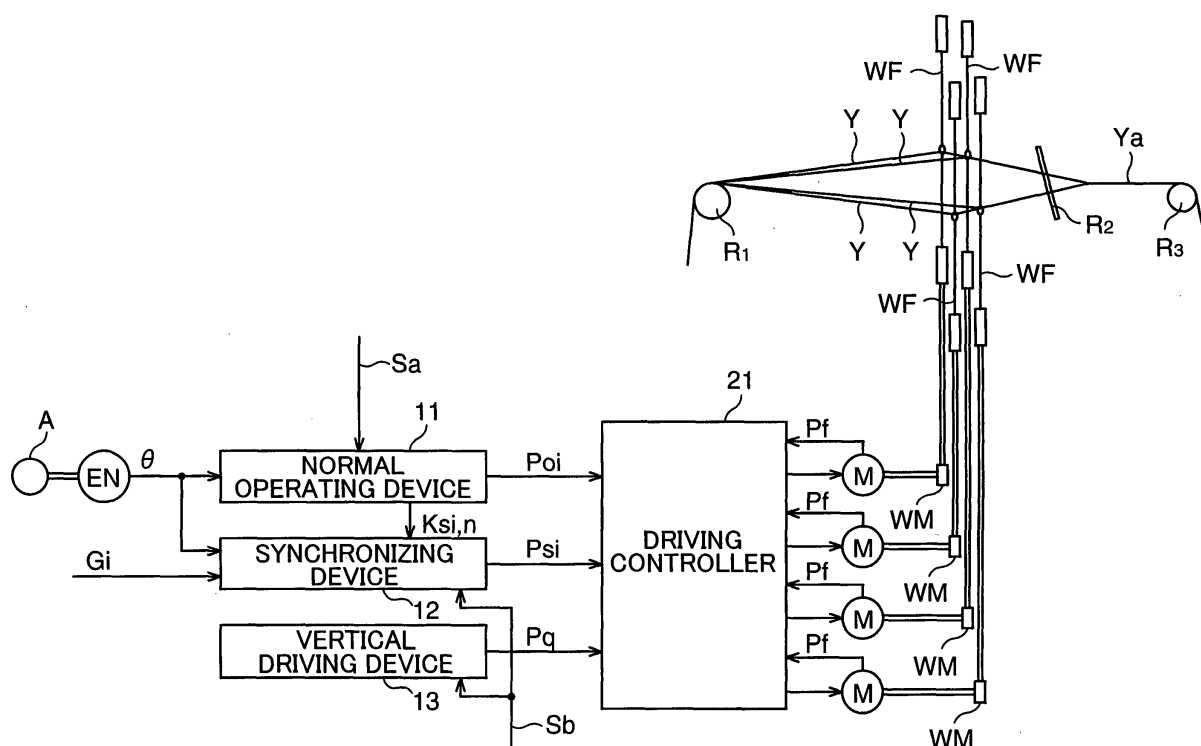
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(54) **Method for controlling restart of weaving operation of loom**

(57) Heddle frames WF are moved up and down while keeping the main shaft A non-rotated after setting the main shaft A to a restart position so as to give a sufficient strain to the warp yarn Y. Thereafter, the loom is restarted and proceeded to a normal weaving operation

after rendering the heddle frames WF to a synchronous relation to the main shaft A, thereby securing constant weft yarn density. This arrangement makes it possible to prevent formation of a filling bar in a fabric at the time of restarting the weaving operation of the loom.

FIG. 1



Description

[0001] This invention relates to a method for controlling restart of weaving operation of a loom that enables to effectively prevent formation of a filling bar in a fabric in restarting weaving operation of the loom.

[0002] When a loom such as a jet loom is brought to a suspended state due to weft insertion failure or electric power outage, for example, the loom is driven in a backward direction to conduct a pick finding, and an improperly inserted weft yarn or a weft yarn having a possibility of insertion failure is completely removed. Then, the loom is brought to a specific start state, and the weaving operation is restarted.

[0003] When the weaving operation of the loom is restarted, there is a disadvantage that the density of the weft yarn may be varied in the vicinity of the cloth fell, and a filling bar may be formed in the fabric. In order to prevent such a drawback, there is proposed an arrangement in which the loom is restarted while giving vibration to the warp yarn by way of an eccentric roller (see Japanese Unexamined Patent Publication No. 8-246296).

[0004] In the above conventional art, since vibration given to the warp yarn by way of an eccentric roller is not sufficiently large, the effect of preventing formation of a filling bar is insufficient. Specifically, a fabric cannot have a desired specific weft yarn density by beating only once, but several times of beating are required to obtain a desired proper weft yarn density. Therefore, the weft yarn density varies from rough to tight in the vicinity of the cloth fell as distanced from the cloth fell. When the loom is restarted after a temporary stop, and weft yarn insertion is resumed while giving vibration to the warp yarn, movement of the weft yarn by beating in the fabric is not the same as in the normal weaving operation before the temporary stop because a strain of the warp yarn in the weaving operation after the temporary stop is not the same as that in the normal weaving operation before the temporary stop. As a result, the warp yarn density is not kept constant.

[0005] It is an object of this invention to provide a method for controlling restart of weaving operation of a loom which has overcome the problems residing in the prior art.

[0006] It is another object of this invention to provide a method for controlling restart of weaving operation of a loom that enables to effectively prevent formation of a cloth fell resulting from varied weft yarn density without rotating a main shaft, namely by restarting weaving operation of the loom by moving a heddle frame or frames up and down in a state that all the devices other than the heddle frames are kept in an inoperative state.

[0007] According to an aspect of this invention, a loom is restarted by moving at least one heddle frame up and down without a pause while keeping a main shaft non-rotated after confirming that the main shaft is set to a restart position, and by rendering all the heddle frames to a synchronous relation to the main shaft. The "syn-

chronous relation" in this specification means that each heddle frame is brought to a certain phase relative to the main shaft so that each heddle frame is operated in accordance with a shedding pattern in a normal weaving operation.

[0008] According to another aspect of this invention, the heddle frame is selectively moved up and down in accordance with a heddle frame moving pattern dedicatedly used for the heddle frame or with a shedding pattern in the normal weaving operation.

[0009] According to yet another aspect of this invention, after the heddle frame is moved up and down, the heddle frame is rendered to a synchronous relation to the main shaft.

[0010] According to still another aspect of this invention, the heddle frame is moved up and down by a certain number of times, wherein the number is an integer.

[0011] In the inventive method, the loom is so designed that the heddle frames are moved up and down without a pause while keeping the main shaft non-rotated after confirming that the main shaft is set to the restart position to generate a sufficient strain in the warp yarn. Subsequently, the weaving operation of the loom is restarted after all the heddle frames are rendered to a synchronous relation to the main shaft. Specifically, in this arrangement, constant weft yarn density can be secured by properly moving the weft yarn in the fabric by beating operation after the loom is restarted. Thereby, a filling bar in the fabric is prevented. Since the heddle frames are moved up and down without rotating the main shaft, the heddle frames are driven by a dedicated driving motor other than a main motor for driving the main shaft, and the number of times and the speed of moving the heddle frames up and down are properly set depending on, for example, the kind of warp yarn and weft yarn.

[0012] The number of times of moving the heddle frame up and down may range from several to several tens of times in terms of a reciprocating motion, and the speed of moving the heddle frame up and down may be the same as the speed in a normal weaving operation, or may be slower or faster than the speed in the normal weaving operation. Specifically, the speed of moving the heddle frame up and down is preferably set in the range from about 50 to 200 % relative to that in the normal weaving operation for the following reasons. If the speed of the heddle frame is less than 50%, separation of the warp yarn is deteriorated with the result that a desired warp yarn strain is not provided. On the other hand, if the speed of the heddle frame is above 200%, an excessive stress is likely to be exerted to a driving system for driving the heddle frames.

[0013] Moving the heddle frames up and down in accordance with the dedicated vertical movement pattern makes it possible to move the heddle frames up and down without a pause irrespective of a required weaving pattern. Thus, the time required for vertical movement of the heddle frames can be minimized.

[0014] By moving the heddle frames up and down in

accordance with the shedding pattern in the normal weaving operation, a warp yarn strain given by the vertical movement can be made closer to the warp yarn strain given by the normal weaving operation.

[0015] Rendering the heddle frames to a synchronous relation to the main shaft after moving the heddle frames up and down is advantageous as follows. The shedding pattern after restart of the loom can be securely shifted to the shedding pattern before stop of the loom even in such a condition that the weaving operation of the loom is suspended by electric power outage with the result that a synchronous relation of the heddle frames to the main shaft is collapsed, or that the heddle frames are independently and arbitrarily moved up and down without considering a synchronous relation to the main shaft. It should be appreciated that the heddle frames are rendered to a synchronous relation to the main shaft based on the cycle number corresponding to the restart position and the crank angle of the main shaft so as to attain a desired shedding pattern in the normal weaving operation.

[0016] In the above arrangement, moving the heddle frames up and down by a certain number of times (the number is an integer) makes it possible to securely return the heddle frames to the initial position before start of the vertical movement where the heddle frames have been set to a synchronous relation to the main shaft upon termination of the vertical movement. This arrangement can dispense with a synchronizing operation after the vertical movement. Note that the loom is so designed that the heddle frames are stopped in a synchronous relation to the main shaft.

[0017] These and other objects, features and advantages of the present invention will become clear upon a reading of the following description of the preferred embodiments thereof, taken in connection with the accompanying drawings, in which:

FIG. 1 is a block diagram schematically showing an entire system of a loom embodying the invention;
 FIG. 2 is a block diagram showing essential elements of a control system of the loom;
 FIGS. 3A and 3B are diagrams showing a weaving pattern and a shedding pattern, respectively;
 FIG. 4 is a timing chart of controlling operation of the loom;
 FIG. 5 is a chart showing a relationship between time and operation of a heddle frame;
 FIG. 6 is a block diagram schematically showing essential elements of a modified control system;
 FIG. 7 is a block diagram schematically showing another modified control system; and
 FIGS. 8A and 8B are timing charts showing altered operations of the control system.

[0018] Referring to FIG. 1, a loom includes a shedding motion section provided with a normal operating device 11, a synchronizing device 12, a vertical driving device

13, and a driving controller 21. In FIG. 1, a tension roller R1 disposed at a feeding side of warp yarn Y, a reed R2, and a guide roller R3 disposed at a winding side of fabric Ya are exemplified as primary elements of the loom. The warp yarns Y form a shed by four heddle frames WF. Each of the heddle frames WF is driven by a driving mechanism WM including a dedicated driving motor M and a crank mechanism.

[0019] A crank angle θ provided from an encoder EN coupled to a main shaft A of the loom is inputted to the normal operating device 11 as a pulse train signal. The main shaft A is coupled to an unillustrated main motor. A stop signal Sa is inputted from an unillustrated loom control circuit to the normal operating device 11. The normal operating device 11 outputs to the driving controller 21 a target rotating amount Poi ($i=1, 2, 3, 4$) for driving the corresponding driving motor M as a pulse train signal. Outputs from the driving controller 21 are individually sent to the respective driving motors M. The actual rotating amount Pf of the corresponding driving motor M is fed back to the driving controller 21.

[0020] The synchronizing device 12 receives a restart signal Sb from the loom control circuit (not shown) and a current position Gi ($i=1, 2, 3, 4$) of the corresponding heddle frame WF, as well as the crank angle θ provided from the encoder EN. The current position Gi represents a current height of the relevant heddle frame WF which is detected based on the rotated position of the corresponding driving motor M. The synchronizing device 12 outputs to the driving controller 21 an adjusted rotating amount Psi ($i=1, 2, 3, 4$) for correctively driving the corresponding driving motor M as a pulse train signal. The synchronizing device 12 receives an output such as Ksi from the normal operating device 11, which will be described in a later section.

[0021] As shown in FIG. 2, the vertical driving device 13 includes a vertical movement command section 13a, a first setting section 13b, and a second setting section 13c. The vertical movement command section 13a receives the restart signal Sb from the loom control circuit (not shown), and outputs to the driving controller 21 a rotating amount Pq for moving the corresponding heddle frame WF up and down as a pulse train signal. When the integrated pulse number corresponding to the rotating amount Pq reaches a predetermined target rotating amount Pqm outputted from the first setting section 13b, the vertical movement command section 13a stops outputting the rotating amount Pq to the driving controller 21. The vertical movement command section 13a determines the pulse frequency of the rotating amount Pq based on a velocity vq of moving the heddle frame WF up and down. The velocity vq is outputted from the second setting section 13c.

[0022] The normal operating device 11 has a memory storing, for example, a weaving pattern (see FIG. 3A) of fabric Ya which is formed in terms of one repeat consisting of a certain number of cycles (cycle number $n=1, 2, \dots, 6$) with use of four heddle frames WF (frame

number $m=1, 2, 3, 4$), and a predetermined shedding pattern K_{si} ($i=1, 2, 3, 4$) (see FIG. 3B) of each heddle frame WF which is defined based on the weaving pattern. The heddle frames WF are numbered in the order of $m=1, 2, 3, 4$ from the reed R2 toward downstream with respect to the warp yarn feeding side. Referring to FIG. 3A, it should be appreciated that the heddle frame of the number m and at the cycle number n indicated by a square with a cross is shifted to an uppermost position, whereas the heddle frame indicated by a blank square is shifted to a lowermost position for forming and closing a shed.

[0023] While the loom is in a normal weaving operation, the crank angle θ is outputted from the encoder EN to the normal operating device 11 in response to rotation of the main shaft A. Upon receiving the crank angle θ , the normal operating device 11 specifies the cycle number n ($n=1, 2, \dots, 6$) in one repeat of a designated weaving pattern based on the crank angle θ , and updates (increments) the cycle number n . Further, the normal operating device 11 is allowed to output the target rotating amount P_{oi} of each driving motor M to the driving controller 21 in conformity to the crank angle θ . Upon receiving the target rotating amount P_{oi} , the driving controller 21 controls the relevant driving motor M in such a manner that the actual rotating amount P_f of the relevant driving motor M attain the target rotating amount P_{oi} . Under the control of the driving controller 21, each driving motor M moves the corresponding heddle frame WF upward or downward based on the shedding pattern K_{si} so that the heddle frames WF are moved up and down in synchronism with rotation of the main shaft A for forming and closing a shed.

[0024] If a weft yarn insertion failure occurs at the cycle number $n=n_1$ during a normal weaving operation of the loom, the stop signal S_a is generated from the loom control circuit to suspend driving of the main motor so as to suspend the weaving operation of the loom. Upon receiving the stop signal S_a , the normal operating device 11 is allowed to store the incremented cycle number $n=n_1+1$ at the time when the weaving operation of the loom is suspended. This is for the reason that if a weft yarn insertion failure occurs, a loom is generally controlled to suspend a next weft yarn insertion and to stop the weaving operation when the loom is brought to a next cycle. In suspending weaving operation of the loom, driving of each driving motor M is suspended together with driving of the main shaft A while keeping a synchronous relation to the main shaft A.

[0025] In restarting the loom for normal weaving operation, the main shaft A is rotated in a backward direction for pick finding to the position where the weft yarn insertion failure occurred at the cycle number $n=n_1$, while keeping the functions of the normal operating device 11 and the driving controller 21. After the pick finding and removal of the defective weft yarn, the main shaft A is rotated further in the backward direction to the restart position corresponding to the cycle number $n=n_1$

- 1. At this time, the normal operating device 11 decrements the cycle number n based on the crank angle θ in conformity to the backward rotation of the main shaft A from the stop position to the restart position. As shown in FIG. 4, in response to generation of the restart signal S_b in the loom control circuit, the loom is controlled to proceed to a normal weaving operation by the normal operating device 11 after vertical movement of the heddle frames WF by the vertical driving device 13 and synchronizing operation by the synchronizing device 12 are implemented in this order.

[0026] Specifically, referring to FIG. 4, upon receiving the restart signal S_b , the vertical movement command section 13a of the vertical driving device 13 outputs, to the driving controller 21, the rotating amount P_q for moving the relevant heddle frame WF up and down at the pulse frequency which is defined based on the velocity v_q outputted from the second setting section 13c. This operation is performed in the condition: $t \geq t_1$. Upon receiving the rotating amount P_q , the driving controller 21 drives the relevant driving motor M based on a constant rotating speed corresponding to the velocity v_q of the relevant heddle frame WF in such a manner that the heddle frames WF are moved up and down altogether without a pause in accordance with a specific vertical movement pattern dedicatedly used for the heddle frames WF. This operation is implemented under the condition: $t_1 \leq t < t_2$. During this operation, a sufficient strain is given to the warp yarns Y. It should be appreciated that each velocity v_q is so regulated that the rotating speed of the corresponding driving motor M during the vertical movement falls in the range from 50 to 200% relative to the rotating speed of the motor M during a normal weaving operation.

[0027] When the integrated pulse number of the rotating amount P_q reaches the predetermined target rotating amount P_{qm} , the vertical movement command section 13a suspends the output of the rotating amount P_q to stop driving the relevant motor M so as to terminate the vertical movement of the corresponding heddle frame WF at the time $t=t_2$. It should be appreciated that merely the operation of a single heddle frame WF is illustrated in FIG. 4.

[0028] Subsequently, the synchronizing device 12 reads the current cycle number n , namely, the cycle number $n=n_1 - 1$ corresponding to the restart position, as well as the shedding pattern K_{si} from the normal operating device 11, and finds the shedding pattern $K_{si}=f(n, \theta)$ based on the crank angle θ corresponding to the restart position. Then, the synchronizing device 12 calculates the adjusted rotating amount P_{si} of the relevant driving motor M that enables the corresponding heddle frame WF at the current position G_i to attain the required shedding pattern K_{si} , and outputs the calculated rotating amount P_{si} to the driving controller 21. This operation is implemented under the condition: $t \geq t_{2a}$, wherein $t_{2a} - t_2 \approx 0$. Upon receiving the adjusted rotating amount P_{si} , the driving controller 21 drives the relevant driving

motor M by the adjusted rotating amount Ψ to bring the corresponding heddle frame WF to a synchronous relation to the main shaft A during the time $t_{2a} \leq t < t_3$. Thus, the required shedding pattern Ksi is realized. It should be noted that the heddle frame WF is shifted to a lowermost position to be rendered to a synchronous relation to the main shaft A in FIG. 4.

[0029] In FIG. 4, the velocity of the heddle frame WF during a synchronizing operation may be the same as the velocity v_q of the heddle frame WF during a vertical movement or may be faster or slower than the velocity v_q , as far as the heddle frame WF is securely rendered to a synchronous relation to the main shaft A. Alternatively, the time $(t_3 - t_{2a})$ required for a synchronizing operation may be minimized by automatically selecting the driving direction of the heddle frame WF for the synchronizing operation that secures a less adjusted rotating amount Ψ for attaining the required shedding pattern Ksi, in place of making the driving direction of the heddle frame WF for the synchronizing operation identical to the driving direction during the vertical movement, as shown in FIG. 4.

[0030] After restart of the loom, the loom is proceeded to a normal weaving operation in which each heddle frame WF is set to such a position as to continue the shedding pattern Ksi before the loom is suspended by rotating the relevant driving motor M in conformity to the rotation of the main shaft A by way of the normal operating device 11 during the time $t \geq t_3$.

[0031] Alternatively, after the vertical driving device 13 moves the heddle frames WF up and down, the synchronizing device 12 may bring the heddle frames WF to a synchronous relation to the main shaft A without suspending the heddle frames WF during the time $t_2 \leq t < t_3$ in FIG. 5. In FIG. 5, merely the operation of a single heddle frame WF is illustrated, and the heddle frame WF is shifted to an uppermost position during a synchronizing operation to be rendered to a synchronous relation to the main shaft A by driving the heddle frame WF in the same direction as in the vertical movement at a speed slower than the velocity v_q . The synchronizing device 12 outputs the adjusted rotating amount Ψ of the relevant driving motor M required for attaining the shedding pattern Ksi based on the current position G_i of the corresponding heddle frame WF at the time when the vertical movement of the heddle frame WF is terminated.

[0032] In this embodiment, the loom is so designed that the heddle frames WF are suspended in a synchronous relation to the main shaft A even if the loom is suspended due to a reason other than weft yarn insertion failure such as shortage of warp yarn and forcible manual stop operation. In restarting the loom in such a condition, the loom is returned to a normal weaving operation by setting the main shaft A to the restart position after eliminating the cause of suspending operation of the loom, and by moving the heddle frames WF up and down so as to render all the heddle frames WF to a syn-

chronous relation to the main shaft A.

[0033] If the loom is suspended owing to electric power outage, there is a likelihood that the loom is suspended in an asynchronous state to the main shaft A because the rotating amount of the main shaft A resulting from inertia force is not identical to that of the respective driving motors M resulting from inertia force. Further, it is highly likely that the weft yarn inserted immediately before the power outage has insertion failure. Even in such a case, the heddle frames WF are rendered to a synchronous relation to the main shaft A with use of the synchronizing device 12, and pick finding is conducted to remove the defective weft yarn. After setting the main shaft A to the restart position, and moving each heddle frame WF up and down by the vertical driving device 13 to render all the heddle frame WF to a synchronous relation to the main shaft A again, the loom is proceeded to a normal weaving operation.

[0034] In the above embodiment, it is possible to move at least one heddle frame WF up and down by the vertical driving device 13, in place of moving all the heddle frames WF. In such an altered arrangement, the synchronizing device 12 performs synchronizing operation merely with respect to the relevant heddle frame WF. Further, it is possible to move the heddle frames WF up and down individually in accordance with a vertical movement pattern individually set for each of the heddle frames WF by providing a vertical driving device 13 for each of the driving motors M. In such an altered arrangement, a smoother separating operation of the warp yarns Y can be effectuated by, for example, moving the heddle frames WF up and down in such a manner that the adjoining heddle frames WF are set in opposite phase to each other, or by simply moving the adjoining heddle frames WF up and down alternately.

[0035] The normal operating device 11 has a function of storing a unit shedding pattern K_{sj} ($j=1, 2, \dots$) which is defined per cycle, and a shedding pattern Ksi in one repeat, which is a combination of a plurality of unit shedding patterns K_{sj} , in place of storing a shedding pattern Ksi which is defined with respect to each of the heddle frames WF, and a function of creating a shedding pattern Ksi of each of the heddle frames WF based on the combination of the unit shedding patterns K_{sj} . Since the unit shedding pattern $K_{sj}=f(\theta)$ is usable in common among the heddle frames WF at the cycle number n , there is no need of providing a memory having an exceedingly large capacity capable of storing an increased number of the heddle frames WF and an increased number of the cycles constituting one repeat.

[0036] Alternatively, the vertical driving device 13 may allow each heddle frame WF to automatically return to its initial position where the heddle frame WF is in a synchronous relation to the main shaft A by moving the relevant heddle frame WF up and down by a certain number i of times (i is an integer). This arrangement makes it possible to omit synchronizing operation by the synchronizing device 12 which is implemented after the

vertical movement. Each heddle frame WF is controlled to be moved up and down exactly by the number i of times by setting in the first setting section 13b the predetermined target rotating amount P_{qm} which is equal to an integral multiple of the actual rotating amount P_f of the corresponding driving motor M required for reciprocating the heddle frame WF once.

[0037] In the following, described are modifications of the embodiment with reference to FIGS. 6 through 8. It should be appreciated that elements in the modifications identical to those in the embodiment are denoted at the same reference numerals.

[0038] Referring to FIG. 6, a pseudo crank angle θ_a is outputted from a vertical movement command section 13a to a normal operating device 11, in place of the arrangement that the vertical driving device 13 outputs the rotating amount P_q for moving the relevant heddle frame WF up and down to the driving controller 21. The pseudo crank angle θ_a is a pulse train signal having the same waveform as a crank angle θ provided from an encoder EN (not shown). In the altered arrangement, the vertical movement command section 13a in a vertical driving device 13 activates driving motors M by way of the normal operating device 11 and a driving controller 21 by outputting to the normal operating device 11 the pseudo

[0039] As shown in FIG. 6, a time t_q during which a relevant heddle frame WF is moved up and down is set in a first setting section 13b of the vertical driving device 13, in place of setting the predetermined target rotating amount P_{qm} for moving the relevant heddle frame WF up and down. In such an altered arrangement, the vertical movement command section 13a outputs the pseudo crank angle θ_a or the rotating amount P_q during the time t_q so as to move the relevant heddle frame WF up and down.

[0040] Further, as shown in FIG. 6, a synchronizing device 12 inputs an original point signal Sci ($i=1, 2, 3, 4$) indicating the initial position of each heddle frame WF in place of inputting the current position Gi of each heddle frame WF. In such an altered arrangement, the synchronizing device 12 outputs a signal corresponding to a moved amount of each heddle frame WF from its initial position to such a position as to attain a required shedding pattern $K_{si}=f(n, \theta)$ in terms of an adjusted rotating amount P_{si} of each driving motor M. Specifically, after activating each driving motor M and receiving the original point signal Sci , the synchronizing device 12 rotates each driving motor M by the adjusted rotating amount P_{si} to render each heddle frame WF to a synchronous relation to a main shaft A. Thus, a required shedding pattern K_{si} is provided.

[0041] Referring to FIG. 7 showing another modification, the heddle frames WF are moved up and down by

a common driving motor M by way of a common driving mechanism WM such as a cam mechanism. The driving mechanism WM is coupled to the driving motor M by way of a clutch CL1, and is coupled to a main shaft A by way of a clutch CL2. The driving mechanism WM has a function of controlling shedding operation during a normal weaving operation. In such an altered arrangement, the normal operating device 11 is omitted. Further, the clutch CL2 is a so-called one-point clutch which is selectively coupled to the main shaft A at a specific crank angle θ .

[0042] In the above modification, in response to suspending operation of the loom, the driving motor M is coupled to the driving mechanism WM by way of the clutch CL1, and at the same time, linkage of the driving mechanism WM to the main shaft A is released by way of the clutch CL2. Then, a vertical driving device 13 outputs to a driving controller 21 a rotating amount P_q for moving the relevant heddle frame WF up and down to move the heddle frames WF up and down altogether in accordance with a shedding pattern K_{si} during a normal weaving operation by way of the driving motor M and the driving mechanism WM. Further, the driving controller 21 sets the driving mechanism WM to such a position as to be engageable with the clutch CL2 by way of the driving motor M in response to receiving the adjusted rotating amount P_{si} from the synchronizing device 12 so as to render the heddle frames WF to a synchronous relation to the main shaft A. The loom is brought to a restart state after engaging the clutch CL2 with the driving mechanism WM to couple the driving mechanism WM to the main shaft A while disengaging the clutch CL1 from the driving motor M.

[0043] In the above modifications, the velocity v_q of moving each heddle frame WF up and down which is set in the second setting section 13c is properly determined depending on the kind of warp yarn Y and weft yarn. Further, as shown in FIGS. 8A and 8B, a vertical driving device 13 may drive a driving motor M at a varied speed in place of driving the driving motor M at a constant speed. Specifically, the vertical driving device 13 may stepwise (see FIG. 8A) or continuously (see FIG. 8B) change the rotating speed v of each driving motor M during a vertical movement of the heddle frames WF by altering the rotating amount P_q for moving the relevant heddle frame WF up and down or the pulse frequency of the pseudo crank angle θ_a in time-series.

[0044] As described above, a sufficient strain is given to warp yarns by moving the heddle frames up and down while keeping the main shaft non-rotated in restarting weaving operation of the loom. This arrangement is advantageous in eliminating a drawback that constant weft yarn density is not secured in the vicinity of a cloth fell immediately after restart of the loom and in effectively suppressing formation of a filling bar in the fabric resulting from a varied weft yarn density at the restart of the loom.

[0045] As this invention may be embodied in several

forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the claims.

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Claims

1. A method for controlling restart of a weaving operation of a loom comprising the steps of:

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moving at least one heddle frame up and down without a pause while keeping a main shaft non-rotated after setting the main shaft to a restart position; and

restarting the weaving operation of the loom after rendering all the heddle frames to a synchronous relation to the main shaft.

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2. The method according to Claim 1, wherein the heddle frame is moved up and down in accordance with a dedicated vertical movement pattern.

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3. The method according to Claim 1, wherein the heddle frame is moved up and down in accordance with a shedding pattern in a normal weaving operation.

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4. The method according to any one of Claims 1 through 3, wherein the heddle frame is rendered to a synchronous relation to the main shaft after moving the heddle frame up and down for a certain number of times.

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5. The method according to any one of Claims 1 through 3, wherein the heddle frame is moved up and down for a certain number of times, the number being an integer.

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FIG. 1

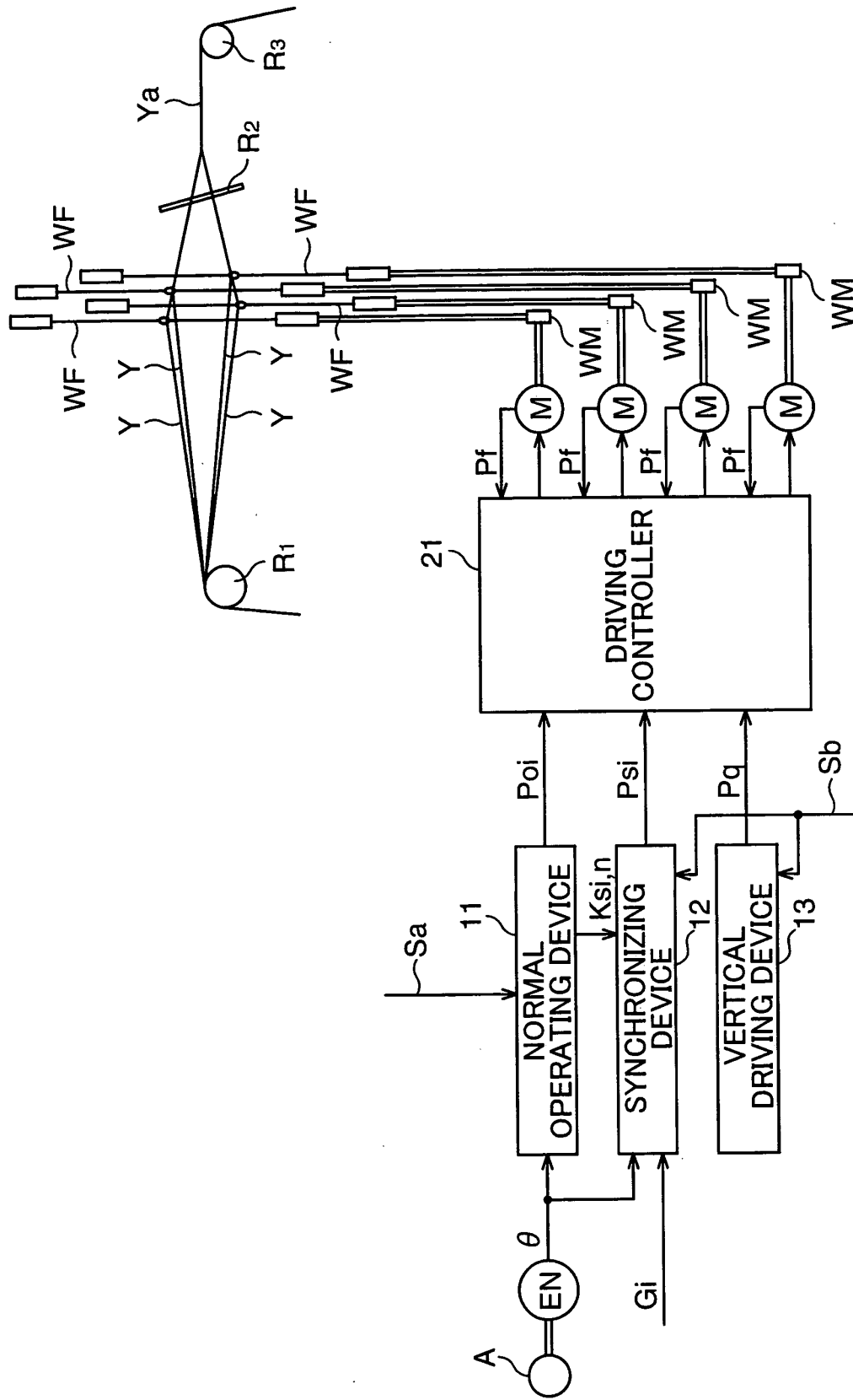
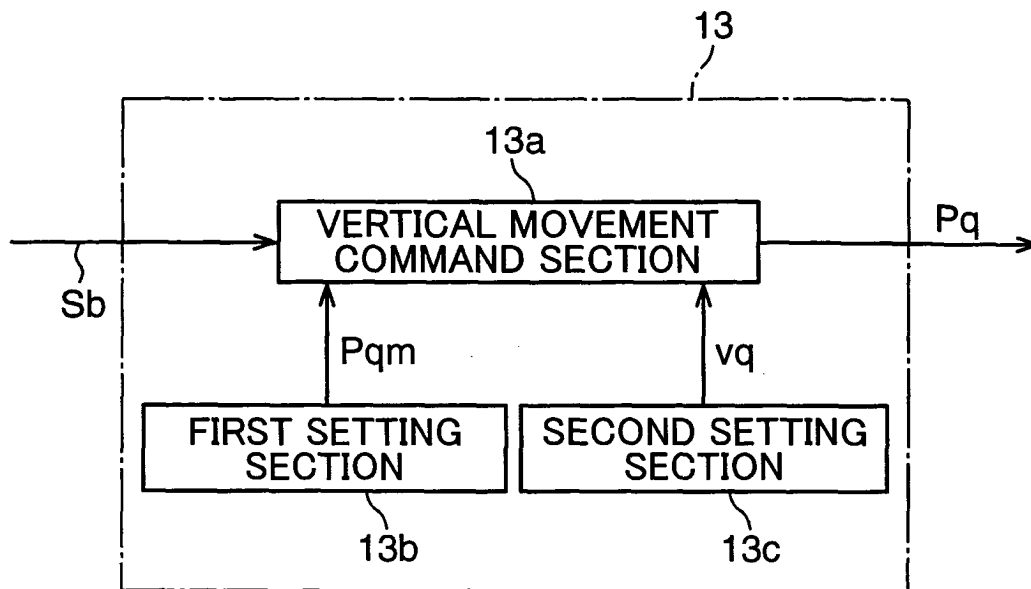


FIG. 2



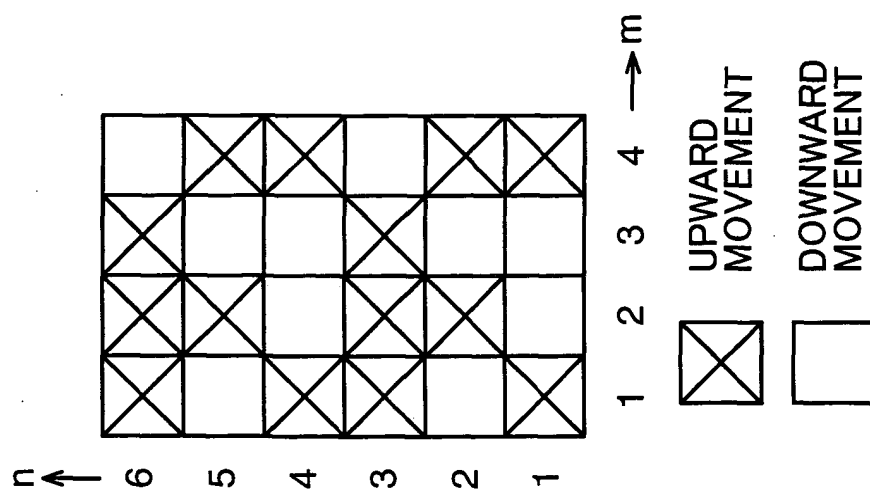


FIG. 3A

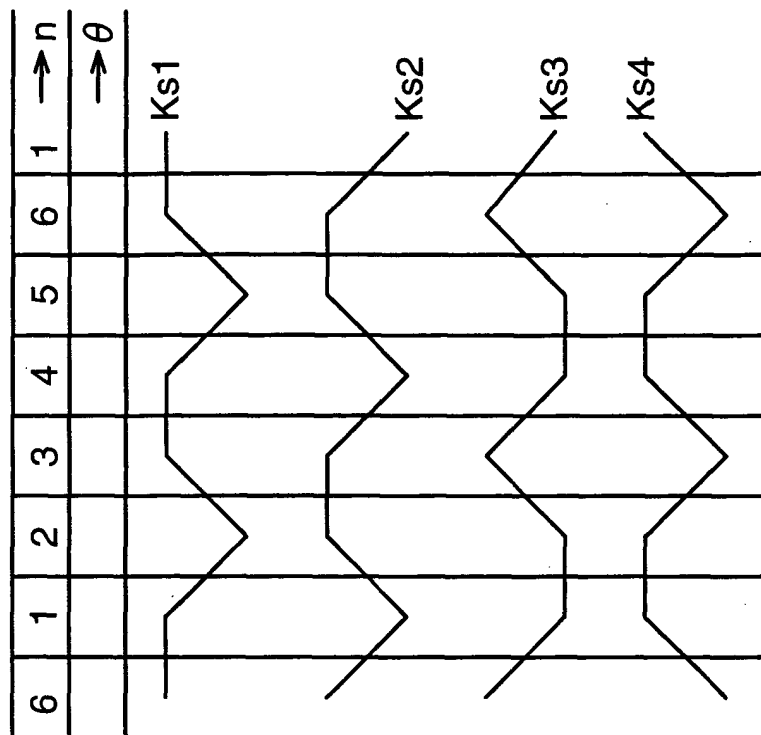


FIG. 3B

FIG. 4

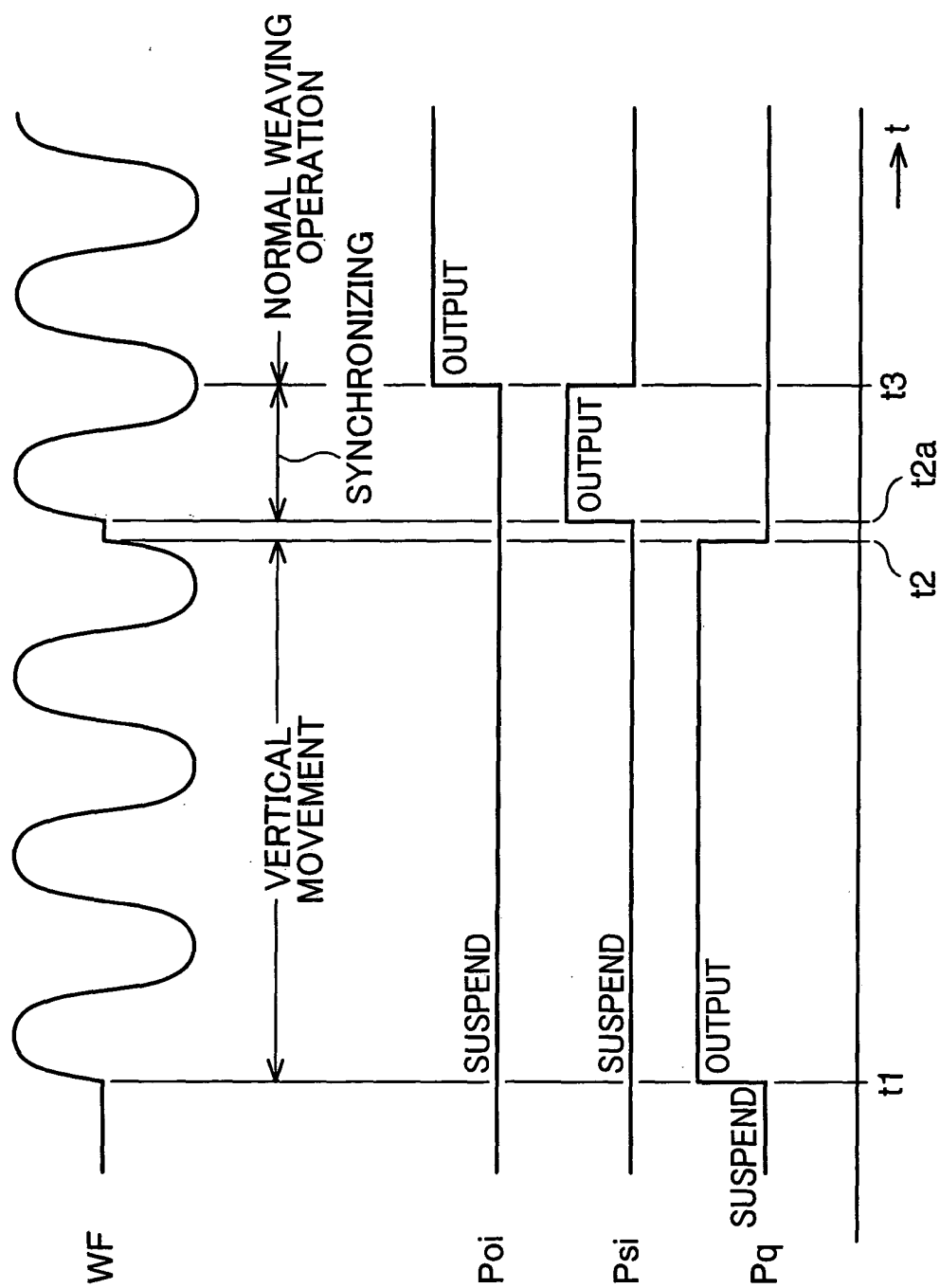


FIG. 5

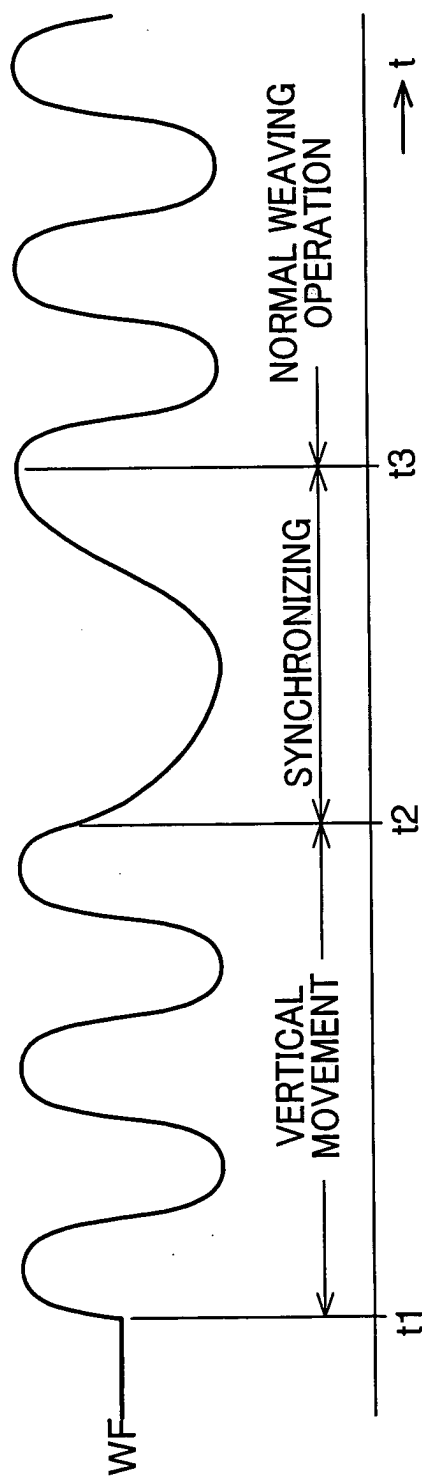


FIG. 6

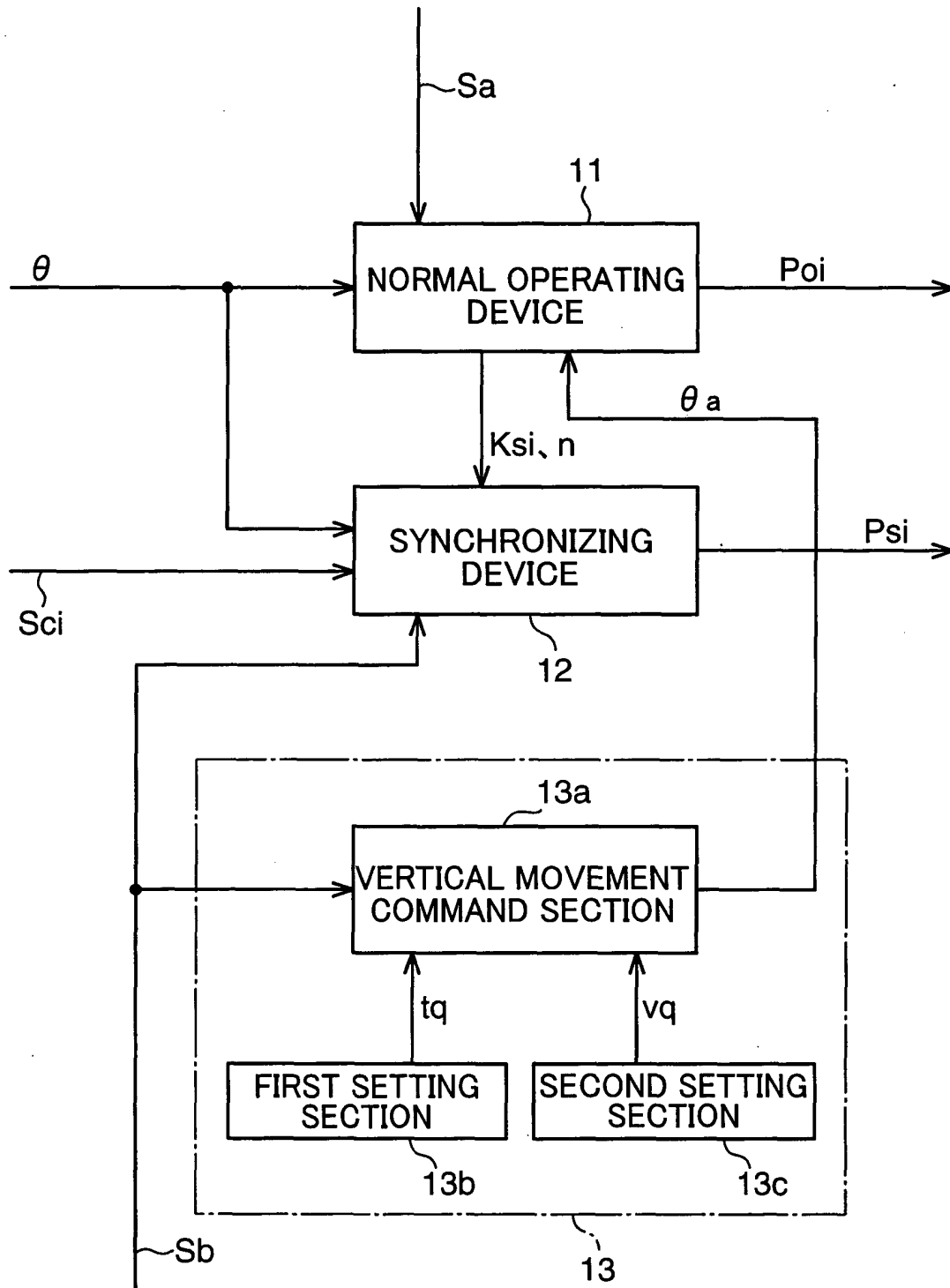
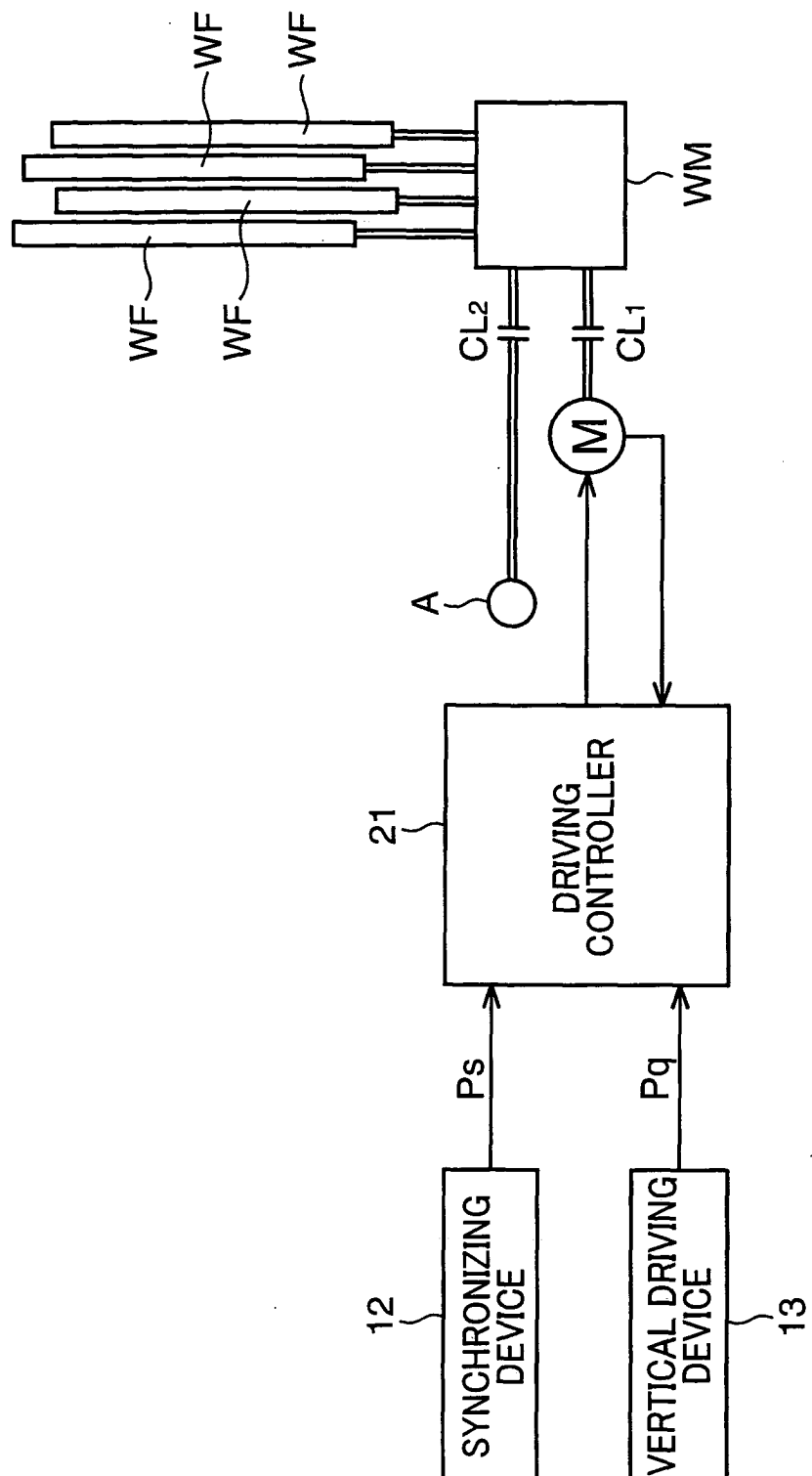


FIG. 7



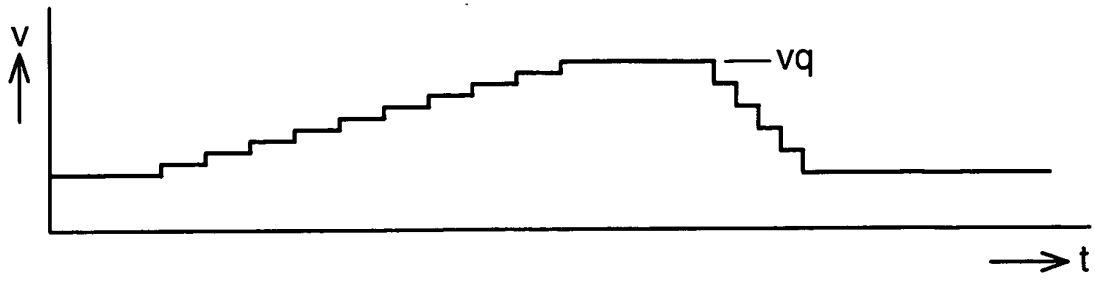


FIG. 8A

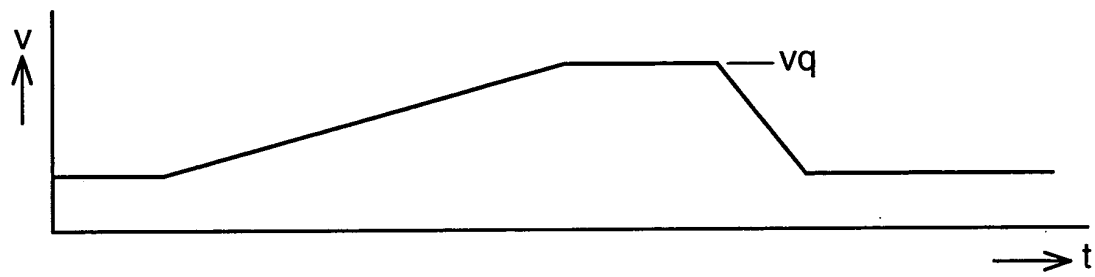


FIG. 8B



European Patent
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Application Number
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