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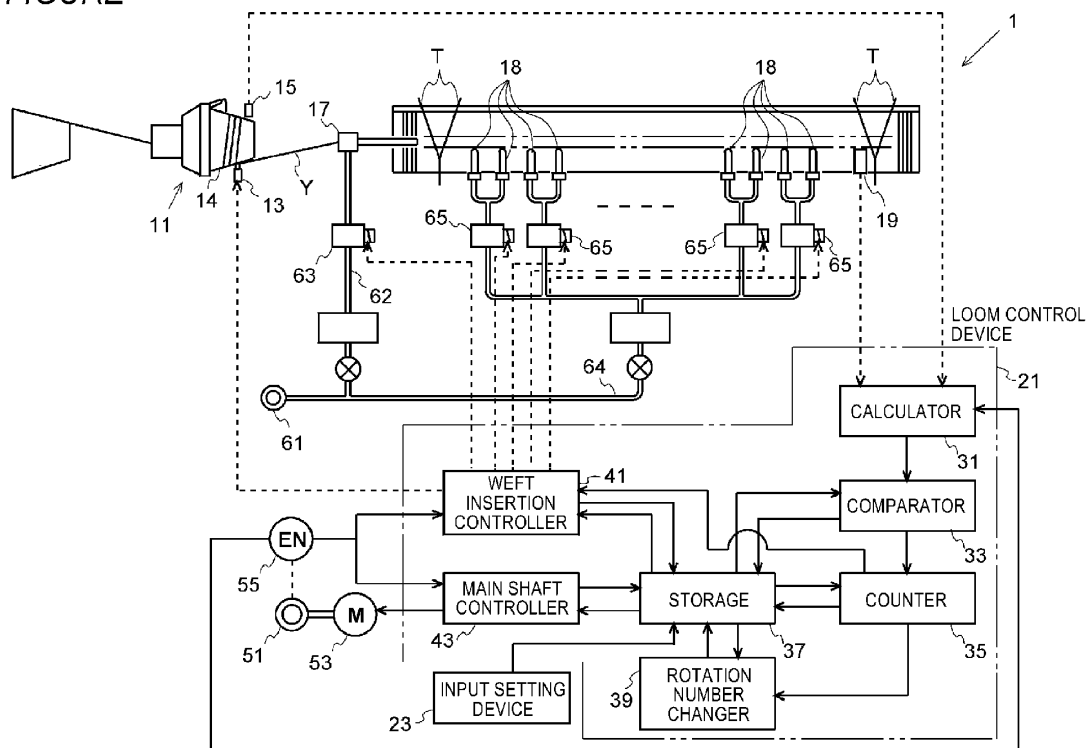
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(54) **CONTROL METHOD FOR LOOM**

(57) A control method for a loom (1) includes setting a number of picks of arrival data when an arrival timing of a weft (Y) is on a lower limit side to a smaller number than a number of picks of the arrival data when the arrival timing is on an upper limit side, and/or setting an upper limit

value and an lower limit value so that an absolute value of a difference between a target value and the lower limit value is smaller than an absolute value of a difference between the target value and the upper limit value.

FIGURE



Description

TECHNICAL FIELD

[0001] The present invention relates to a loom that obtains actual values of an arrival timing of a weft based on a detection signal of a weft sensor, uses a target arrival angle range and arrival data, the target arrival angle range being determined by an upper limit value on an upper limit side larger than a target value of the arrival timing and a lower limit value on a lower limit side smaller than the target value, the arrival data being based on the actual values as many as a plural number of picks, and performs control of a main shaft control device and/or a weft insertion control device in order to return the arrival timing to be within the target arrival angle range when the arrival data deviates from the target arrival angle range.

BACKGROUND ART

[0002] In the related art of looms, it has been known to control weft insertion and to control the number of rotations of a loom during weaving so that an arrival timing of an inserted weft (timing at which a leading edge reaches a preset position) becomes a desired timing. In addition, it is also known that even when weft insertion is performed under the same conditions, the arrival timing of the weft varies to some extent. Therefore, in the control of the related art, with respect to a target weft arrival timing (target value), an upper limit value that is an allowable value on an upper limit side larger than the target value and a lower limit value that is an allowable value on a lower limit side smaller than the target value are first determined, a target arrival angle range consisting of the upper limit value and the lower limit value is then set, and the above control is performed when an actual weft arrival timing (actual value) deviates from the target arrival angle range.

[0003] In addition, when inserting a weft during weaving, the weft arrival timing may temporarily change significantly due to various causes. However, if the control is performed when the actual value deviates from the target arrival angle range due to such a temporary change, there is a concern that a weaving operation of the loom may become unstable. Therefore, in the related art, it is also practiced that the control is executed using arrival data based on the actual values as many as a plurality of picks. Specifically, the control is performed based on comparison between an average value of the actual values as many as a plurality of picks and a target arrival angle range, or, as disclosed in Patent Literature 1, when the actual values consecutively deviate from the target arrival angle range over a plurality of picks set in advance.

CITATION LIST

PATENT LITERATURE

5 **[0004]** Patent Literature 1: JP2002-069800A

[0005] However, in the loom of the related art, when the control is performed using the arrival data, the control is performed using the arrival data based on the same number of picks on the upper limit side and the lower limit side. For this reason, in such a loom of the related art, in a travel state of the weft in which the actual value deviates toward the lower limit value side, weft insertion becomes unstable, and weaving malfunctions such as weft stopping may occur. The details are as follows.

10 **[0006]** First, when the loom is an air jet loom, a jetting period of each sub-nozzle is set in such a form that a timing determined on the basis of a setting weft travel curve, the setting weft travel curve being obtained from a set weft insertion start timing and the above-described target value, and a position where the sub-nozzle is provided is used as a standard and a period on a preceding side (preceding period) and a period on a succeeding side (succeeding period) are determined with respect to the timing as the standard. However, in the jetting period, the preceding period is a period of preceding jetting before the weft reaches the position of the sub-nozzle and, therefore, is generally set to be a shorter period compared to the succeeding period.

20 **[0007]** In the related art where during the weft insertion in such an air jet loom, when it becomes a travel state of the weft in which the actual value deviates from the lower limit value (the arrival timing becomes faster), the control is performed using the arrival data, the control is executed, for example, when the state in which the actual value deviates from the lower limit value occurs consecutively as many as a set number of picks. In other words, the determination as to whether to execute the control is not made until the weft insertions as many as the set number of picks are completed, and therefore, the weft insertion is continuously performed during that time even in a state in which the actual value deviates from the lower limit value.

30 **[0008]** Note that even when the travel state of the weft changes and therefore it becomes the state in which the actual value deviates from the lower limit value, if it is not caused due to an abnormality (failure) of the apparatus, and the like, a timing at which the leading edge of the weft passes the position of each sub-nozzle is close to a jetting start timing of the sub-nozzle but is usually within the preceding period. However, during the weft insertion in a loom, as described above, the arrival timing (travel state) of the weft may temporarily change significantly. For this reason, when such a significant change occurs in the travel state in which the leading edge of the weft passes at the timing close to the jetting start timing as described above, the passing timing may become earlier than the jetting start timing of the sub-nozzle, that is, the weft may reach the position of the sub-nozzle before the sub-

nozzle starts jetting. When the weft reaches the position of the sub-nozzle before the sub-nozzle starts jetting, the travel state of the weft becomes unstable, and as a result, weaving malfunctions such as weft stopping occur.

SUMMARY

[0009] Therefore, the present invention is to provide a control method for a loom on which the control is performed using the arrival data, capable of preventing occurrence of weaving malfunctions such as weft stopping as much as possible when the actual value deviates from the lower limit value.

[0010] The present invention is applied to a loom that is configured to: obtain actual values of an arrival timing of a weft based on a detection signal of a weft sensor; use a target arrival angle range and arrival data, the target arrival angle range being determined by an upper limit value on an upper limit side larger than a target value of the arrival timing and a lower limit value on a lower limit side smaller than the target value, the arrival data being based on the actual values as many as a plural number of picks; and perform control of a main shaft control device and/or a weft insertion control device in order to return the arrival timing to be within the target arrival angle range when the arrival data deviates from the target arrival angle range. A control method for a loom according to the present invention includes setting a number of picks of the arrival data when the arrival timing is on the lower limit side to a smaller number than a number of picks of the arrival data when the arrival timing is on the upper limit side, and/or setting the upper limit value and the lower limit value so that an absolute value of a difference between the target value and the lower limit value is smaller than an absolute value of a difference between the target value and the upper limit value.

[0011] According to the present invention, when the actual value deviates from the lower limit value, the control is executed at an earlier time point (time point when weft insertions corresponding to a small number of picks are completed) compared with when the actual value deviates from the upper limit value. For this reason, compared with the related art in which the control on the lower limit side is performed using the arrival data based on the same number of picks as that on the upper limit side, the number of picks that weft insertion continues in the state in which the actual value deviates from the lower limit value is reduced, so the possibility that a temporary significant change in the arrival timing will occur during that time is reduced. Thereby, the occurrence of weaving malfunctions such as weft stopping can be prevented as much as possible.

BRIEF DESCRIPTION OF DRAWING(S)

[0012] FIGURE illustrates an example of an air jet loom to which the present invention is applied.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinafter, an embodiment of a control method for a loom of the present invention will be described with reference to FIGURE. Note that the embodiment described below is an example where the present invention is applied to an air jet loom.

[0014] As shown in FIGURE, an air jet loom (hereinafter, simply referred to as "loom") 1 includes a measuring and storing device 11 including a storage drum 14 on which a weft Y is stored and a locking pin 13 that controls storage and release of the weft Y with respect to the storage drum 14, and, as a weft insertion nozzle that jets compressed air, a main nozzle 17 provided on a yarn supply side and a plurality of sub-nozzles 18 arranged in parallel along a weft insertion direction (weaving width direction).

[0015] The main nozzle 17 is connected to a supply source 61 that supplies compressed air, via a piping 62. In addition, an electromagnetic opening/closing valve 63 for controlling supply (jetting timing) of compressed air to the main nozzle 17 is installed in a pipe conduit of the piping 62 connected to the main nozzle 17. Additionally, each sub-nozzle 18 is connected to the supply source 61 via a piping 64. Note that in the shown example, the sub-nozzles 18 are divided into groups of multiple (two) sub-nozzles. As an electromagnetic opening/closing valve 65 corresponding to each group, an electromagnetic opening/closing valve 65 for controlling supply (jetting timing) of compressed air to the sub-nozzles 18 of the corresponding group is installed in a pipe conduit of the piping 64 corresponding to each group.

[0016] In addition, the loom 1 includes, as a weft sensor for detecting the weft Y, a release sensor 15 that detects the weft Y that has been released from the storage drum 14, and a feeler 19 that detects the weft Y that has reached a side opposite to the yarn supply side. In addition, the loom 1 includes an encoder 55 that is an angle sensor for detecting a rotation angle (crank angle) of a main shaft 51.

[0017] In addition, the loom 1 includes an input setting device 23 for performing an input setting of each setting value related to control of each device on the loom 1. Note that each setting value includes a setting value for controlling drive of the locking pin 13, setting values for controlling drives of the electromagnetic opening/closing valve 63 and each electromagnetic opening/closing valve 65, such as a jetting start timing and a jetting end timing of the main nozzle 17 and each sub-nozzle 18, and a setting value for controlling drive of a shaft motor 53, which rotationally drives the main shaft 51, such as a number of rotations of the main shaft 51.

[0018] Additionally, in addition to a target value of an arrival timing of the weft Y, each setting value includes, as a setting value for defining a target arrival angle range, an upper limit value that is an allowable value on an upper limit side larger than the target value and a lower limit value that is an allowable value on a lower limit side

smaller than the target value. For reference, the upper limit value and the lower limit value are obtained in advance based on weaving conditions such as the number of rotations of the loom 1 and a type of the weft Y to be inserted. Additionally, in the present embodiment, it is assumed that the upper limit value is a value obtained by adding a predetermined crank angle to the target value and the lower limit value is a value obtained by subtracting a crank angle equal to the predetermined crank angle from the target value. Each of the setting values input from the input setting device 23 is stored in a storage 37 included in a loom control device 21.

[0019] In addition, the loom control device 21 includes, in addition to the storage 37, a main shaft controller 43 that controls drive of the main shaft 51 and a weft insertion controller 41 that controls weft insertion. The main shaft controller 43 is connected to the storage 37 and the encoder 55 at an input end thereof, and is connected to the main shaft motor 53 at an output end thereof. In addition, the main shaft controller 43 is configured to control drive of the main shaft 51, based on a setting number of rotations set (stored) in the storage 37.

[0020] In addition, the weft insertion controller 41 is connected to the encoder 55 at an input end thereof, and is connected to the locking pin 13, the electromagnetic opening/closing valve 63, and each electromagnetic opening/closing valve 65 at an output end thereof. Additionally, the weft insertion controller 41 is configured to control drive of the locking pin 13, the electromagnetic opening/closing valve 63, and each electromagnetic opening/closing valve 65, based on a release timing, a jetting start timing of the main nozzle 17, and a jetting start timing of each sub-nozzle 18 set (stored) in the storage 37.

[0021] In addition, the loom control device 21 includes, as a configuration for enabling the arrival timing of the weft Y to be within the target arrival angle range, a calculator 31 that obtains an actual value of the arrival timing, a comparator 33 that compares the actual value with the target arrival angle range, a counter 35 that counts consecutive deviations of the actual value from the target arrival angle range based on a result of the comparison by the comparator 33, and a rotation number changer 39 that changes the setting number of rotations based on a result of the count by the counter 35. The above configuration is described in detail, as follows.

[0022] The calculator 31 is connected to the encoder 55 and the feeler 19 at an input end thereof, and is connected to the comparator 33 at an output end thereof. The calculator 31 is configured to, when a detection signal from the feeler 19 is input, obtain a crank angle at that time point based on a signal from the encoder 55. Note that the obtained crank angle is the actual value. The calculator 31 is configured to output a signal (angle signal) indicating the obtained actual value to the comparator 33.

[0023] The comparator 33 is connected to the storage 37, and is connected to the counter 35 at an output end

thereof. The comparator 33 is configured to, each time the angle signal from the calculator 31 is input, compare the actual value indicated by the angle signal with the target arrival angle range (specifically, the upper limit value and the lower limit value) stored in the storage 37.

[0024] Additionally, the comparator 33 is configured to, when the actual value is larger than the upper limit value as a result of the comparison, output an upper limit deviation signal, which indicates that the actual value deviates from the target arrival angle range on the upper limit side, to the counter 35, and when the actual value is smaller than the lower limit, output a lower limit deviation signal, which indicates that the actual value deviates from the target arrival angle range on the lower limit side, to the counter 35. Additionally, the comparator 33 is configured to output a non-deviation signal to the counter 35 when the actual value is equal to or larger than the lower limit value and equal to or smaller than the upper limit value, that is, when the actual value is within the target arrival angle range.

[0025] The counter 35 is connected to the storage 37, and is connected to the rotation number changer 39 at an output end thereof. Additionally, the counter 35 includes two counters into which the upper limit deviation signal, the lower limit deviation signal, and the non-deviation signal from the comparator 33 are input. One of the two counters is an upper limit-side counter that counts the number of inputs of the upper limit deviation signal, and the other is a lower limit-side counter that counts the number of inputs of the lower limit deviation signal. Additionally, the upper limit-side counter is configured to reset its count value when the non-deviation signal or the lower limit deviation signal is input, and the lower limit-side counter is configured to reset its count value when non-deviation signal or the upper limit deviation signal is input.

[0026] According to the upper limit-side counter and the lower limit-side counter, the number of consecutive inputs of the upper limit deviation signal or the lower limit deviation signal is counted, respectively. The count value corresponds to the number of picks that the actual values consecutively deviate from the target arrival angle range on the upper limit side or the lower limit side.

[0027] Note that the number of picks (setting number of picks), which is a standard for executing correction control that is control for returning the actual values to be within the target arrival angle range when the actual values consecutively deviate from the target arrival angle range on the upper limit side or the lower limit, is set in the storage 37. The counter 35 is configured to output a decrease command signal regarding the number of rotations to the rotation number changer 39 when the count value of the upper limit-side counter reaches the setting number of picks. Additionally, the counter 35 is configured to output an increase command signal to the rotation number changer 39 when the count value of the lower limit-side counter reaches the setting number of picks. Additionally, the counter 35 is configured to reset the

count value of the upper limit-side counter along with the output of the lowering command signal and to reset the counter value of the lower limit-side counter along with the output of the increase command signal.

[0028] In addition to being connected to the counter 35 as described above, the rotation number changer 39 is also connected to the storage 37. In addition, in the present embodiment, the correction control described above is control that increases or decreases the number of rotations of the loom 1 by adding or subtracting the set number of rotations (correction number of rotations) with respect to the current setting number of rotations of the loom 1. Therefore, the correction number of rotations is set in the storage 37. Note that the correction number of rotations is obtained in advance based on weaving conditions such as an initial setting number of rotations and a type of weft Y

[0029] The rotation number changer 39 is configured to read the current setting number of rotations and the correction number of rotations from the storage 37 when the increase command signal or the decrease command signal from the counter 35 is input. In addition, the rotation number changer 39 is configured to add the correction number of rotations to the current setting number of rotations when the input signal is the increase command signal, and to subtract the correction number of rotations from the current setting number of rotations when the input signal is the decrease command signal. The rotation number changer 39 is configured to set a setting number of rotations obtained by the addition or subtraction, in the storage 37 as a new setting number of rotations.

[0030] In the loom 1 including the loom control device 21 having the above configuration, when the weft-inserted weft Y is detected by the feeler 19 and a detection signal thereof is input to the calculator 31, the actual value regarding the arrival timing is obtained in the calculator 31 and is output to the comparator 33. Then, in the comparator 33, the actual value is compared with the upper limit value and the lower limit value, and as a result of the comparison, any one of an upper limit deviation signal, a lower limit deviation signal, or a non-deviation signal is output to the counter 35.

[0031] In the counter 35, when the upper limit deviation signal is consecutively input to the upper limit-side counter or the lower limit deviation signal is consecutively input to the lower limit-side counter, the number of input times is counted in each counter. However, when the non-deviation signal is input to the upper limit-side counter or lower limit-side counter during counting, the count value is reset. Additionally, when the lower limit deviation signal is input to the upper limit-side counter or the upper limit deviation signal is input to the lower limit-side counter during counting, the count value is reset. Then, when the count value of the upper limit-side counter reaches the setting number of picks, a decrease command signal is output to the rotation number changer 39. Additionally, when the count value of the lower limit-side counter

reaches the setting number of picks, an increase command signal is output to the rotation number changer 39.

[0032] Then, along with the output of the decrease command signal or the increase command signal from the counter 35, the setting number of rotations is changed by the rotation number changer 39 to a number of rotations added or subtracted by the correction number of rotations, and the loom 1 is put into a state in which it is operated according to the setting number of rotations. The number of rotations of the loom 1 is changed and the operating speed of the loom 1 relative to the travel of the weft Y by weft insertion changes in this way, so that the actual value is returned to be within the target arrival angle range and the state in which the actual values consecutively deviate from the target arrival angle range is eliminated.

[0033] Note that in the present embodiment, the correction control is performed based on the consecutive deviation of the actual values from the target arrival angle range as described above. Accordingly, in the present embodiment, a set of the consecutive actual values corresponds to arrival data (based on the actual values as many as a plural number of picks) referred to in the present invention. In addition, the correction control (control for returning the actual values to be within the target angle range) is control that changes the setting number of rotations to change the number of rotations (operating speed) during an operation of the loom 1. The operation of the loom 1 (the drive of the main shaft 51) is controlled by the main shaft controller 43. Therefore, in the present embodiment, the main shaft controller 43 corresponds to a main shaft control device that performs control of returning the arrival timing to be within the target arrival angle range.

[0034] In the loom 1 described above, in the present embodiment based on the present invention, the number of picks of the arrival data when the arrival timing is on the lower limit side is set to a smaller number than the number of picks of the arrival data when the arrival timing is on the upper limit side.

[0035] Specifically, as described above, the setting number of picks that serves as a standard for executing the correction control is input and set by the input setting device 23, and is set (stored) in the storage 37 of the loom control device 21. In addition, the loom 1 is configured such that the input setting device 23 and the loom control device 21 (storage 37) can separate and set the setting number of picks into a number of upper limit-side picks regarding the upper limit side and a number of lower limit-side picks regarding the lower limit side.

[0036] The counter 35 is configured to compare the count value by the upper limit-side counter with the number of upper limit-side picks when the actual values consecutively deviate from the target arrival angle range on the upper limit side. Additionally, the counter 35 is configured to compare the count value by the lower limit-side counter with the number of lower limit-side picks when the actual values consecutively deviate from the

target arrival angle range on the lower limit side.

[0037] Note that the number of upper limit-side picks and the number of lower limit-side picks are determined based on weaving conditions such as a type of weft Y. In the present invention, the number of lower limit-side picks is set to a smaller value than the number of upper limit-side picks. Additionally, in the present embodiment, the number of upper limit-side picks is set to "8" and the number of lower limit-side picks is set to "6".

[0038] Therefore, according to such a loom 1, when it becomes a state in which the actual values consecutively deviate from the target arrival angle range, the correction control described above (in the present embodiment, the change in the number of rotations of the loom 1) is executed at a time point when the deviating number of picks reaches the setting number of picks, and the actual values are returned to be within the target arrival angle range. Additionally, when the deviation is on the upper limit side, because the number of upper limit-side picks, which is the setting number of picks, is set to 8 picks, the correction control is executed at a time point when the deviating number of picks reaches 8 picks.

[0039] On the other hand, when the deviation is on the lower limit side, because the number of lower limit-side picks, which is the setting number of picks, is set to 6 picks, which is a smaller value than the number of upper limit-side picks, the correction control is executed at a time point when the deviating number of picks reaches 6 picks, that is, at a time point that is two picks earlier than the upper limit side with respect to the time point when the consecutive deviations start. Accordingly, when the deviation is on the lower limit side, the actual values are returned to be within the target arrival angle range at an earlier time point compared with when the deviation is on the upper limit side.

[0040] According to such a control method for the loom 1, when the deviation occurs on the lower limit side, it is possible to suppress as much as possible the occurrence of weaving malfunctions such as weft stopping accompanying the consecutive deviations.

[0041] More specifically, determining whether to execute the correction control using the arrival data is because the arrival timing (the actual value) of the weft Y varies and temporarily changes significantly, as described above, and the setting number of picks that is a basis of the arrival data is set for that purpose. Regarding the setting number of picks, it is considered desirable to set the setting number of picks to the larger number of picks, taking into account the influence of temporary significant change (temporary change) in the arrival timing described above. Note that the idea about the change in the arrival timing is common to both the upper limit side and the lower limit side, and there is no particular change in the tendency of the change. Therefore, in the related art, there was no idea of making the setting number of picks different on the upper limit side and the lower limit side, and generally, a common (same) number of picks was set on the upper limit side and the lower limit side as

the setting number of picks.

[0042] On the other hand, in the case where the deviation is on the lower limit side, in the setting of the jetting period of the general sub-nozzle, a period in the setting travel state of the weft Y from the jetting start timing of each sub-nozzle to the passing timing of the leading edge of the weft at the position of the sub-nozzle is short and a timing margin between the jetting start timing and the lower limit value is small. Therefore, when the temporary change occurs, the leading edge of the weft Y reaches the position of the sub-nozzle before the jetting start timing, resulting in weaving malfunctions such as stopping. The larger the setting number of picks, the higher the possibility that the temporary change will occur during the consecutive deviations.

[0043] Therefore, in the present invention, instead of using a common setting number of picks on the upper limit side and the lower limit side as in the prior art, the setting number of picks can be differently set on the upper limit side and the lower limit side, and the setting number of picks set for each is used. In addition, regarding the upper limit side, a larger number of picks is set as the number of upper limit-side picks, which is the setting number of picks, taking into account the change in the arrival timing described above, whereas regarding the lower limit side, the number of lower limit-side picks as the setting number of picks is set to the smaller number of picks than the number of upper limit-side picks, taking into account the change in the arrival timing and the possibility of the occurrence of the weaving malfunctions in that case. In the present embodiment, considering weaving conditions such as a type of the weft Y, the number of upper limit-side picks is set to 8 and the number of lower limit-side picks is set to 6.

[0044] According to such a control method for the loom 1 of the present embodiment (the present invention), in the case where the correction control is executed based on the arrival data, the correction control is executed on the lower limit side and the actual value is returned to be within the target arrival angle range at an earlier time point, compared with a case where a common setting number of picks is used on the upper limit side and the lower limit side. This suppresses as much as possible the occurrence of the temporary change and the occurrence of the weaving malfunctions during a state in which the continuous deviations occur on the lower limit side.

[0045] Note that the present invention is not limited to the embodiment described above (the above embodiment), and can also be implemented in the following modified embodiments (1) to (4).

(1) As for the arrival data based on the actual values of the arrival timing as many as a plural number of picks, in the above embodiment, the set of the consecutive actual values as described above is assumed to correspond to the arrival data. However, in the present invention, the arrival data is not limited to such a set of consecutive actual values, and may

be an average value of the actual values.

[0046] Specifically, the loom control device is configured to, for example, for each number of picks set in advance, calculate an average value of the actual values and compare the average value with the target arrival angle range, that is, compare the average value with the upper limit value and the lower limit value. In addition, the loom control device is configured to obtain two types of average values so that the average value to be compared with the upper limit value and the lower limit value is an average value obtained from different numbers of picks, and to compare each average value with the corresponding upper limit value or the lower limit value. In this case, it is assumed that the number of picks (the number of lower limit-side calculation picks) for obtaining the average value to be compared with the lower limit value is set to a smaller number than the number of picks (the number of upper limit-side calculation picks) for obtaining the average value to be compared with the upper limit value.

[0047] According to such a configuration, since the number of lower limit-side calculation picks is set to a smaller number than the number of upper limit-side calculation picks, the comparison between the lower limit value and the average value is performed at a shorter cycle than the comparison between the upper limit value and the average value. Accordingly, in a case where the arrival timing (the actual value) has changed so that the average value deviates on the lower limit side, the correction control is executed at an earlier time point than a case where the actual value has changed so that the average value deviates on the upper limit side. Therefore, also in this case, the occurrence of weaving malfunctions accompanying the temporary significant changes in the arrival timing is suppressed as much as possible.

[0048] (2) In the example described above, as for the control method according to the present invention (the present control method) for the purpose of ensuring that the correction control is executed at an earlier time point when the arrival timing (the actual value) is on the lower limit side than when the arrival timing (the actual value) is on the upper limit side, the purpose is achieved by setting the number of picks of the arrival data to a smaller number on the lower limit side than on the upper limit side. However, the present control method is not limited to being executed by making the number of picks of the arrival data different, and may be executed by, regarding the target arrival angle range, setting an allowable range on the lower limit side for the target value of the arrival timing to be smaller than an allowable range on the upper limit side.

[0049] More specifically, regarding the target arrival angle range, the upper limit value is set similarly to the related art for the difference (absolute value) between the target value, which is the allowable range on the upper limit side, and the upper limit value, and then, the lower limit value is set to be smaller than the difference on the

upper limit side for the difference (absolute value) between the target value, which is the allowable range on the lower limit side, and the lower limit value. Accordingly, also in the case where the arrival timing deviates toward the upper limit side or the lower limit side in a similar tendency, the occurrence of weaving malfunctions accompanying the temporary significant change in the arrival timing is suppressed as much as possible because the arrival data deviates from the lower limit side even when the amount of deviation is smaller on the lower limit side than on the upper limit side.

[0050] Note that, in the case of this example, the number of picks of the arrival data may be the same on the upper limit side and the lower limit side, or as in the above embodiment or the example of the above (1), the number of picks of the arrival data may be set to be smaller on the lower limit side than the upper limit side. That is, a combination of this example and the above-described example may also be implemented.

[0051] (3) As for the control (the correction control) that is performed in order to return the arrival timing to be within the target arrival angle range when the arrival data deviates from the target arrival angle range, in the above embodiment, the number of rotations of the loom is set as the control target of the correction control, and then, the correction control is performed by the main shaft control device in the form of adding or subtracting the correction number of rotations (fixed value) set in advance with respect to the current setting number of rotations.

[0052] However, even in the case where the number of rotations is set as the control target, the correction control is not limited to being performed using such a correction number of rotations set in advance. For example, as in the example of the above (1), when the average value of the actual values is set as the arrival data, a deviation between the average value and the target value may be obtained, and the correction control may be executed at a correction number of rotations corresponding to the deviation.

[0053] Additionally, the control target of the correction control is not limited to the number of rotations of the loom as described above, and may also be weft insertion conditions such as a timing or pressure related to weft insertion. Specifically, the operation timing of the locking pin, the jetting timing of the main nozzle or each sub-nozzle, the pressure of compressed air supplied to the main nozzle or each sub-nozzle, and the like as weft insertion conditions may be set as the control target, and when the arrival data deviates from the target arrival angle range, the correction control (control of returning the arrival timing to be within the target arrival angle range) may be executed by changing the weft insertion conditions with a weft insertion control device.

[0054] In addition, in the case where the weft insertion conditions are set as the control target, the correction control may be executed in the form of setting a correction timing and a correction pressure used to change the weft insertion conditions as fixed values set in advance, and

when the arrival data deviates from the target arrival angle range, adding or subtracting the correction timing with respect to the current jetting timing of the main nozzle or each sub-nozzle, or adding or subtracting the correction pressure with respect to the current setting pressure of compressed air. In addition, when the average value of the actual values is set as the arrival data, the correction control may be executed in the form of obtaining, from a deviation between the average value and the target value, a correction timing or correction pressure corresponding to the deviation and using the correction timing or correction pressure.

[0055] Additionally, the control target of the correction control is not limited to either the number of rotations of the loom or the weft insertion conditions, and may be both the number of rotations of the loom and the weft insertion conditions. In this case, for example, the correction control may first be executed with the weft insertion condition as the control target, and then, when a correction amount becomes large, the correction control may be switched to the correction control with the number of rotations of the loom as the control target.

[0056] (4) In the above embodiment, the arrival timing used as the actual value is determined based on the detection signal of the weft sensor (the feeler 19) that detects the arrival of the weft on side opposite to the yarn supply side. That is, in the above embodiment, the timing at which the leading edge of the weft reaches a predetermined position on the side opposite to the yarn supply side is set as the arrival timing. However, in the present invention, the arrival timing is not limited to the timing at which the leading edge of the weft reaches a predetermined position on the side opposite to the yarn supply side, and may be a timing at which the leading edge of the weft passes a predetermined position in a weft insertion direction within a warp shed. In this case, the arrival timing is obtained based on a detection signal of a weft sensor (release sensor) that detects the weft released from the storage drum of the measuring and storing device on the yarn supply side.

[0057] Note that when the arrival timing is obtained based on the detection signal of the release sensor, the present invention is not limited to the air jet loom of the above embodiment and can also be applied to a water jet loom.

[0058] Additionally, the present invention is not limited to the above embodiment, and can be appropriately changed without departing from the gist of the present invention.

REFERENCE SIGNS LIST

[0059]

1: loom
11: measuring and storing device
13: locking pin
14: storage drum

15: release sensor
17: main nozzle
18: sub-nozzle
19: feeler
21: loom control device
23: input setting device
31: calculator
33: comparator
35: counter
37: storage
39: rotation number changer
41: weft insertion controller
43: main shaft controller
51: main shaft
53: main shaft motor
55: encoder
61: supply source
62, 64: piping
63, 65: electromagnetic opening/closing valve
Y: weft
T: warp

Claims

1. A control method for a loom (1),

the loom being configured to:

obtain actual values of an arrival timing of a weft (Y) based on a detection signal of a weft sensor (15);

use a target arrival angle range and arrival data, the target arrival angle range being determined by an upper limit value on an upper limit side larger than a target value of the arrival timing and a lower limit value on a lower limit side smaller than the target value, the arrival data being based on the actual values as many as a plural number of picks; and

perform control of a main shaft control device (43) and/or a weft insertion control device (41) in order to return the arrival timing to be within the target arrival angle range when the arrival data deviates from the

target arrival angle range,

the control method comprising:

setting a number of picks of the arrival data when the arrival timing is on the lower limit side to a smaller number than a number of picks of the arrival data when the arrival timing is on the upper limit side, and/or
setting the upper limit value and the lower limit value so that an absolute value of a difference

between the target value and the lower limit value is smaller than an absolute value of a difference between the target value and the upper limit value.

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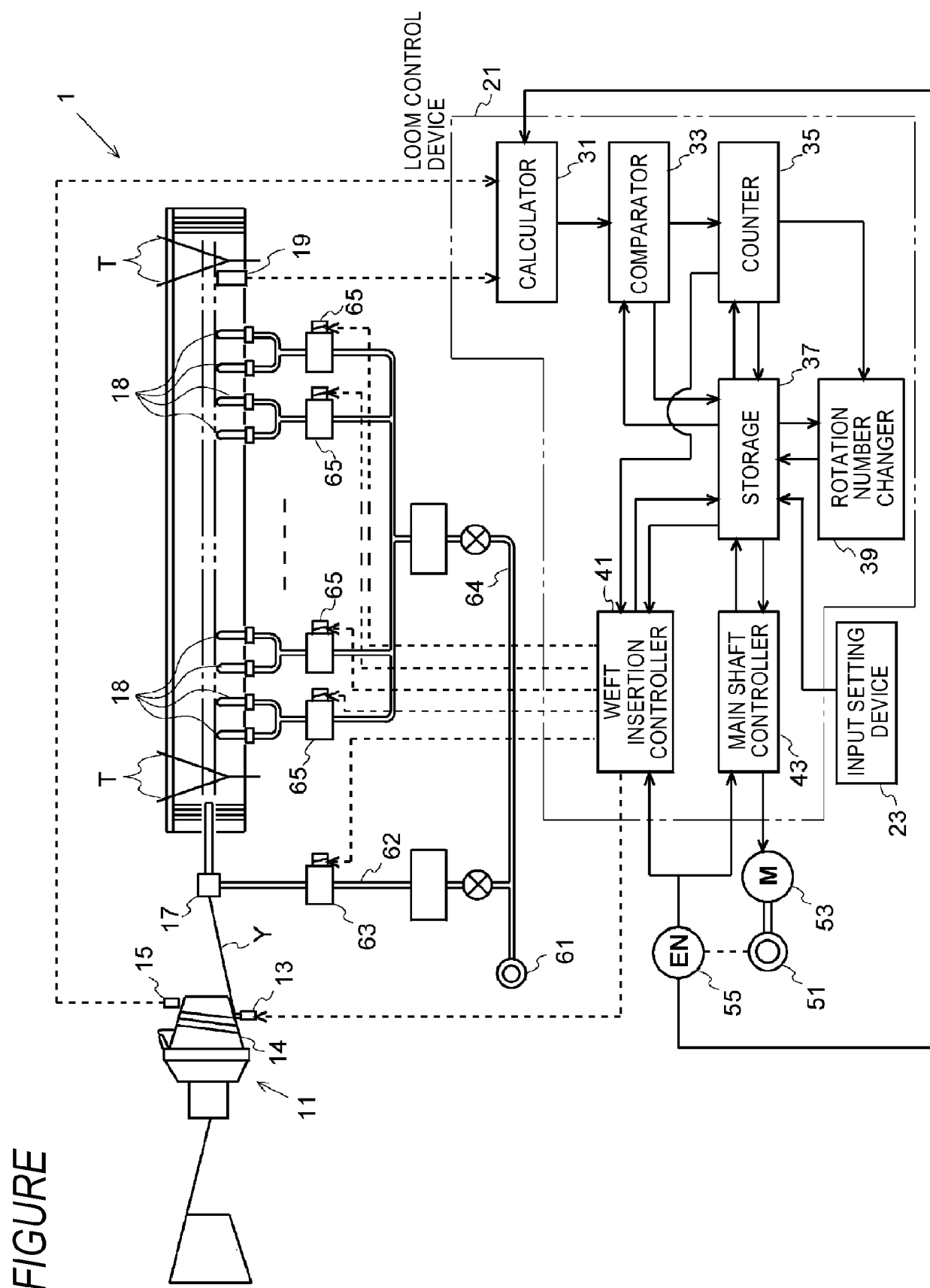
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EUROPEAN SEARCH REPORT

Application Number

EP 24 18 4685

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2002 069800 A (TSUDAKOMA IND CO LTD) 8 March 2002 (2002-03-08) * abstract *	1	INV. D03D47/30 D03D51/00
A,D	& EP 1 209 268 B1 (TSUDAKOMA IND CO LTD [JP]) 4 October 2006 (2006-10-04) * paragraph [0007] - paragraph [0009] * * paragraph [0013] - paragraph [0020] * * figures 1-3 *	1	
A	JP 2003 171853 A (TSUDAKOMA IND CO LTD) 20 June 2003 (2003-06-20) * paragraph [0004] - paragraph [0009] * * paragraph [0025] - paragraph [0028] * * figures 1-9 *	1	
A	US 7 055 554 B2 (TSUDAKOMA IND CO LTD [JP]) 6 June 2006 (2006-06-06) * column 1, line 60 - column 2, line 24 * * column 9, line 37 - column 10, line 43 * * figures 1-10 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		3 December 2024	Hausding, Jan
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 18 4685

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report		Publication date		Patent family member(s)		Publication date
JP 2002069800	A	08-03-2002	DE	60123551 T2		24-05-2007
			EP	1209268 A2		29-05-2002
			JP	2002069800 A		08-03-2002
			US	2002026962 A1		07-03-2002

JP 2003171853	A	20-06-2003	NONE			

US 7055554	B2	06-06-2006	CN	1470695 A		28-01-2004
			DE	60301597 T2		14-06-2006
			EP	1384800 A1		28-01-2004
			JP	2004052171 A		19-02-2004
			US	2004011419 A1		22-01-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002069800 A [0004]