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(54) METHOD OF DETECTING WEFT YARN IN AIR JET LOOM

VERFAHREN ZUM ERKENNEN EINES SCHUSSFADENS IN EINER LUFTDÜSENWEBMASCHINE

PROCÉDÉ DE DÉTECTION DE FIL DE TRAME DANS UN MÉTIER À TISSER À JET D’AIR

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Description

BACKGROUND ART

[0001] The present disclosure relates to a method of detecting a weft yarn in an air jet loom.

[0002] In an air jet loom, there may occur a phenomenon in which, an inserted weft yarn, which has once reached an end of a woven fabric on one side of the air jet loom opposite to the weft insertion side of the loom from which the weft yarn was inserted, turns back and stops at a position in the woven fabric for some reason. Such phenomenon is called "a turning back" of a weft yarn. There has been known a method of detecting a weft yarn with which a turning back of a weft yarn can be detected.

[0003] Japanese Patent Application Publication No. H11-189953 discloses a method of detecting a weft yarn in an air jet loom. According to the method, the air jet loom includes an integrator that integrates detection signals that are output from a weft yarn detection device, and an electric discharge time constant of the integrator is determined and set in accordance with the elasticity of the weft yarn. By thus setting an electric discharge time constant, when detection signal of the integrator has disappeared, the level of the integral signal drops quickly, which then causes the control signal to drop accordingly, defining a detection of a turning back of a weft yarn.

[0004] According to Japanese Patent Application Publication No. S59-187647 that discloses another method of detecting a weft yarn, three weft yarn detection devices are arranged along a weft yarn insertion passage. A state of weft insertion is determined based on a resultant combination of detection signals output from each weft yarn detection device to detect a turning back of a weft yarn.

[0005] In the method of detecting a weft yarn disclosed in Japanese Patent Application Publication No. H11-189953, the electric discharge time constant of the integrator needs to be set appropriately in accordance with the elasticity of the weft yarn. There is a problem, however, that the setting of the specific constant requires fine adjustment that should be performed taking the properties of a weft yarn used, such as the elasticity, into consideration, and such adjustment is difficult.

[0006] Furthermore, the method of detecting a weft yarn disclosed in Japanese Patent Application Publication No. S59-187647 requires a plurality of weft yarn detection devices and therefore has a problem that the cost for the components of the air jet loom and hence the manhour for manufacturing the air jet loom are increased.

[0007] The present disclosure, which has been made in view of the above circumstances, is directed to providing a method of detecting a weft yarn with which a turning back of an inserted weft yarn can be detected with ease.

SUMMARY

[0008] In accordance with an aspect of the present disclosure, there is provided a method of detecting a weft yarn in an air jet loom. The air jet loom includes an optical type weft yarn detection device that is disposed adjacent to an end of a woven fabric that is opposite to a weft insertion side of the air jet loom from which a weft yarn is inserted. The optical type weft yarn detection device is configured to detect the inserted weft yarn and output a detection signal. The method includes: setting a first weft yarn detection period between a point in time after a start of a weft insertion at which a weft yarn is inserted and a point in time before the weft insertion is completed; setting a second weft yarn detection period within the first weft yarn detection period so that the second weft yarn detection period starts after the inserted weft yarn is held by warp yarns; setting a first threshold for the detection signal detected during the first weft yarn detection period; and setting a second threshold for the detection signal detected during the second weft yarn detection period. The method further includes determining that a turning back of the weft yarn has occurred when the detection signal detected during the first weft yarn detection period is equal to or greater than the first threshold and the detection signal detected during the second weft yarn detection period is smaller than the second threshold. In the turning back of the inserted weft yarn, the inserted weft yarn once reached the end of the woven fabric but turned back toward the woven fabric.

[0009] Other aspects and advantages of the disclosure will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The disclosure, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 is a view schematically illustrating an end of a woven fabric and the vicinity thereof according to a first embodiment of the present disclosure;

FIG. 2A is a schematic view illustrating a state of weft insertion of a weft yarn Y shown in FIG. 1;

FIG. 2B is a schematic view illustrating a state of weft insertion of the weft yarn Y of FIG. 1;

FIG. 2C is a schematic view illustrating a state of weft insertion of the weft yarn Y of FIG. 1;

FIG. 3 is a timing diagram illustrating detecting operation of the weft yarn Y illustrated in FIGS. 2A to 2C;

FIG. 4A is a graph for explaining a method of detecting a level of a detection signal at an RH feeler 93 illustrated in FIG. 1;

FIG. 4B is a graph for explaining a method of detecting a level of a detection signal at the RH feeler 93 illustrated in FIG. 1; and

FIG. 4C is a graph for explaining a method of detecting a level of detection signal at the RH feeler 93 illustrated in FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

First Embodiment

[0011] The following will describe a method of detecting a weft yarn in an air jet loom according to a first embodiment of the present disclosure, with reference to the accompanying drawings.

[0012] FIG. 1 illustrates an end of a woven fabric on one side of the air jet loom that is opposite to the weft insertion side of the air jet loom from which weft yarns are inserted. The air jet loom includes a slay 10 that is fixed to a rocking shaft (not illustrated) via a slay sword (not illustrated). The slay 10 is turned about an axis extending in a width direction of the air jet loom (or in a weaving direction). The slay 10 includes a reed 20 which has a weft yarn guide passage 40 that is opened on a cloth fell 30 side. A temple 60 is disposed so as to extend over an end 51 of a woven fabric 50 and a waste selvedge 52 in the width direction of the air jet loom.

[0013] A weft yarn Y, which has passed by the temple 60, is cut with a cutter 70 disposed between the woven fabric 50 and the waste selvedge 52. The weft yarn Y is transferred by air jets from a main nozzle (not illustrated) and a tandem nozzle (not illustrated). A plurality of auxiliary nozzles 80 is disposed at intervals on the slay 10 so as to transfer the inserted weft yarn Y with air jets from the auxiliary nozzles 80.

[0014] As illustrated in FIG. 1, warp yarns 53 form the woven fabric 50 and waste selvedge yarns 54 form the waste selvedge 52. An RH feeler 91 is mounted on the slay 10 at a position in the width direction of the air jet loom between one of the warp yarns 53 located at the end 51 of the woven fabric 50 and the waste selvedge yarns 54. AW feeler 92 is disposed such that the waste selvedge yarns 54 are located between the RH feeler 91 and the W feeler 92 in the width direction of the air jet loom. The warp yarns 53 and the waste selvedge yarns 54 correspond to the warp yarns of the present disclosure.

[0015] The RH feeler 91 and the W feeler 92 each include a light-emitting portion having a light-emitting element and the like (not shown) and a light-receiving portion having a light-receiving element and the like (not shown). The RH feeler 91 and the W feeler 92 are disposed such that the light-emitting portions and the light-receiving portions face the weft yarn guide passage 40 of the reed 20. The RH feeler 91 and the W feeler 92 are reflection type optical sensors. In each of the RH feeler 91 and the W feeler 92, light emitted from the light-emitting portion is reflected by the weft yarn Y, and the reflected light is received by the light-receiving portion, which constitutes a detection of the weft yarn Y, and in response to the detection of the weft yarn Y, a detection signal is output as a pulse signal. The RH feeler 91 forms the optical type weft yarn detection device of the present disclosure.

[0016] The RH feeler 91 and the W feeler 92 are electrically connected to a main controller 100 of the air jet loom. The RH feeler 91 is configured to detect that the weft yarn Y is transferred to the position of the waste selvedge 52. The W feeler 92 is configured to detect an arrival of the weft yarn Y at an abnormal position beyond the position of the waste selvedge 52 that has resulted from a breakage of the weft yarn Y or a weft yarn Y of an excess length.

[0017] The following will describe operations performed during a weft insertion by the air jet loom according to the first embodiment.

[0018] As illustrated in FIG. 1, the RH feeler 91 detects the weft yarn Y during a weft insertion and outputs a pulse signal to the main controller 100 as a detection signal. The main controller 100 counts the number of pulses in the detection signal received.

[0019] The following will describe states or results of weft insertions of the weft yarn Y with reference to FIGS. 2A to 2C. It is to be noted that, in FIGS. 2A to 2C, the RH feeler 91 and the W feeler 92 illustrated in FIG. 1 are located above the weft yarn guide passage 40, and some of the components illustrated in FIG. 1 are not illustrated for ease of understanding.

[0020] As illustrated in FIG. 2A, the inserted weft yarn Y is transferred in a direction indicated by an arrow A within the weft yarn guide passage 40. The weft yarn Y is thus transferred to the position of the waste selvedge yarns 54. Then, the weft yarn Y travels through and interlaces with the waste selvedge yarns 54, and the waste selvedge yarns 54 hold the weft yarn Y between them. In this case, the weft insertion is completed successfully. When a weft insertion is completed successfully, the weft yarn Y is detected by the RH feeler 91 both before and after the weft yarn Y is held by the waste selvedge yarns 54, and the weft yarn Y is not transferred to the position of the W feeler 92 and stops at a position where the W feeler 92 cannot detect the weft yarn Y That is, the weft yarn Y is out of the detection range of the W feeler 92.

[0021] Meanwhile, as is the case of a weft yarn Y1 illustrated in FIG. 2B, there may occur a phenomenon called turning back of the weft yarn in which a weft yarn Y, which has once been transferred to the position of the waste selvedge yarns 54, fails to be held by the waste selvedge yarns 54, for example, due to the elasticity of the weft yarn Y In the case of the turning back illustrated in FIG. 2B, after a timing at which the weft yarn Y is supposed to be held by the waste selvedge yarns 54, the weft yarn Y is at a position where the weft yarn Y is detected by the RH feeler 91 but not detected by the W feeler 92. This type of turning back does not constitute a defect because the weft yarn Y does not go back to the woven fabric 50. The above-described turning back of the weft yarn Y illustrated in FIG. 2B corresponds to the turning back of the weft yarn of the present disclosure in which an inserted weft yarn once reaches an end of a woven fabric but turns back toward the woven fabric.

[0022] As illustrated in FIG. 2C, another type of the turning back which constitutes a defect of the fabric may occur. In the case of the turning back of a weft yarn Y2 illustrated in FIG. 2C, the weft yarn Y has once reached the position of the waste selvedge yarns 54, but the weft yarn Y fails to be held by the waste selvedge yarns 54 and turns back to the woven fabric 50, constituting a defect of the fabric. In the turning back illustrated in FIG. 2C, the weft yarn Y stops at a position where the weft yarn Y is not detected by the RH feeler 91 and the W feeler 92 after a timing at which the weft yarn Y is supposed to be held by the waste selvedge yarns 54. That is, the weft yarn Y is out of the detection ranges of the RH feeler 91 and the W feeler 92. The above-described turning back of the weft yarn Y illustrated in FIG. 2C also corresponds to the turning back of the weft yarn of the present disclosure.

[0023] The following will describe a method of determining a weft insertion detection result of the weft yarn Y with the RH feeler 91.

[0024] As described earlier, when a weft insertion has been completed successfully, as illustrated in FIG. 2A, the inserted weft yarn Y is detected by the RH feeler 91 before and after the waste selvedge yarns 54 hold the weft yarn Y. Thus, it can be determined that the weft insertion has been completed successfully by determining the detection signal sent from the RH feeler 91 both during a time frame before the inserted weft yarn Y is held by the waste selvedge yarns 54, which is measured from the weft insertion start timing, and during a time frame after the inserted weft yarn Y is held by the waste selvedge yarns 54.

[0025] Specifically, the main controller 100 counts the number of pulses in the detection signal output from the RH feeler 91 (see FIG. 1) during a time frame between a first detection start timing T1 and a second detection start timing T2, and during a time frame between the second detection start timing T2 and a detection end timing T3, as illustrated in FIG. 3. The first detection start timing T1, the second detection start timing T2, and the detection end timing T3 herein are each determined beforehand based on a rotational angle of a crank of the air jet loom. The first detection start timing T1 is a timing specified after a timing at which a weft insertion starts. The second detection start timing T2 is a timing at which the waste selvedge yarns 54 hold the weft yarn Y, which happens when the weft insertion is successful. The detection end timing T3 is a timing specified before a timing at which the weft insertion ends. It is to be noted that in the second detection start timing T2, "the waste selvedge yarns 54 hold the weft yarn Y" refers not only to a complete contact between the waste selvedge yarns 54 and the weft yarn Y but also to application of any braking force between the waste selvedge yarns 54 and the weft yarn Y caused, for example, by a fluff of the waste selvedge yarns 54 or the weft yarn Y.

[0026] Determination of a successful weft insertion, which is illustrated as Example 1 in FIG. 3, will now be described. Here, a time frame between the first detection start timing T1 and the detection end timing T3 is set as a first weft yarn detection period P1, and a time frame between the second detection start timing T2 and the detection end timing T3 is set as a second weft yarn detection period P2. The second weft yarn detection period P2 is a time frame set within the first weft yarn detection period P1. In the first weft yarn detection period P1, when the number of pulses in the detection signal reaches a specified threshold, it is determined that the weft yarn Y is at the position of the RH feeler 91. The threshold is herein referred to as a first pulse threshold S1. In the first embodiment, the first pulse threshold S1 is a count of 13. In the second weft yarn detection period P2, when the number of pulses in the detection signal reaches another threshold, it is determined that the weft yarn Y is at the position of the RH feeler 91. The threshold is herein referred to as a second pulse threshold S2. In the first embodiment, the second pulse threshold S2 is a count of 5. The first pulse threshold S1 and the second pulse threshold S2 correspond to the first threshold and the second threshold, respectively, of the present disclosure.

[0027] When the weft insertion is successfully completed, the weft yarn Y is transferred to the position of the waste selvedge yarns 54 before the second detection start timing T2 is reached. The weft yarn Y is detected by the RH feeler 91 during the first weft yarn detection period P1. Therefore, 13, which is the predetermined first pulse threshold S1, or more pulses are counted and detected in the detection signal during the whole first weft yarn detection period P1. In Example 1, 15 pulses are detected.

[0028] Since the weft insertion is successfully completed, the weft yarn Y is kept held after the second detection start timing T2 and does not return to the woven fabric 50. Therefore, in the second weft yarn detection period P2, the duration in which the weft yarn Y is detected by the RH feeler 91 is sufficiently long, so that five pulses, which corresponds to the predetermined second pulse threshold S2, or more pulses are counted and detected in the detection signal. In Example 1, five pulses are detected.

[0029] In other words, when a condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1 and a condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is equal to or greater than the second pulse threshold S2 are satisfied, then the main controller 100 determines that the weft insertion has been successfully completed. It is to be noted that the first pulse threshold S1 and the second pulse threshold S2 may appropriately be modified in accordance with the weft yarn Y to be detected or specifications of the air jet loom.

[0030] Determination of a weft insertion failure, which is illustrated as Example 2 in FIG. 3, will now be described. In Example 2, a weft insertion failure occurs and the weft yarn Y does not reach the position of the waste selvedge yarns 54. Therefore, the weft yarn Y is not detected by the RH feeler 91 both in the first and second weft yarn detection periods P1 and P2. Thus, the number of pulses counted in the detection signal during the first weft yarn detection period P1 is smaller than 13 or the first pulse threshold S1; and the number of pulses counted in the detection signal during the second weft yarn detection period P2 is smaller than 5 or the second pulse threshold S2.

[0031] In other words, when a condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is smaller than the first pulse threshold S1 and a condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 are satisfied, then the main controller 100 determines that a weft insertion failure has occurred.

[0032] Determination of a turning back of a weft yarn, which is illustrated as Example 3 in FIG. 3, will now be described. In Example 3, the weft yarn Y is inserted at an earlier timing, so that the weft yarn Y reaches the position of the waste selvedge yarns 54 before the second detection start timing T2 is reached. Therefore, the weft yarn Y is detected by the RH feeler 91. In the weft insertion of Example 3, 13 pulses, which corresponds to the first pulse threshold S1, or more pulses are counted and detected in the detection signal between the first detection start timing T1 and the second detection start timing T2. In Example 3, 15 pulses are detected.

[0033] In the case of a turning back of a weft yarn of Example 3, the weft yarn Y has returned to the woven fabric 50 side after the second detection start timing T2, so that the weft yarn Y is out of the detection range of the RH feeler 91. Thus, the weft yarn Y is not detected by the RH feeler 91 during the second weft yarn detection period P2, so that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than 5, which is the second pulse threshold S2.

[0034] In other words, when a condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1 and a condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 are satisfied, then the main controller 100 determines that a turning back of the weft yarn Y has occurred.

[0035] As described above, in the method of detecting a weft yarn in an air jet loom according to the first embodiment, the air jet loom includes an optical type weft yarn detection device that is disposed adjacent to the end 51 of the woven fabric that is opposite to the weft insertion side of the air jet loom. The optical type weft yarn detection device is configured to detect the inserted weft yarn Y and output a detection signal. The detection method includes the following: the first weft yarn detection period P1, which is a time frame set between a point in time after a start of weft insertion and a point in time before the weft insertion is completed; the second weft yarn detection period P2, which is a time frame set within the first weft yarn detection period P1 and starts after the weft yarn Y is held by the waste selvedge yarns 54; the first pulse threshold S1 that is set for the detection signal detected during the first weft yarn detection period P1; and the second pulse threshold S2 that is set for the detection signal detected during the second weft yarn detection period P2. According to the detection method, when the condition that the number of pulses in the detection signal that are detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1 and the condition that the number of pulses in the detection signal that are detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 are satisfied, an occurrence of a turning back of the weft yarn Y is determined. Thus, a turning back of a weft yarn can be detected easily.

[0036] The detection signal is a pulse signal, and a specified number of pulses in the pulse signal is set for each of the first and second pulse thresholds S1 and S2. Therefore, the detection of the weft yarn Y may be performed accurately.

[0037] When the condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is smaller than the first pulse threshold S1 and the condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 are satisfied, then it is determined that a weft insertion failure of the weft yarn Y has occurred. Thus, a weft insertion failure as well as a turning back of the weft yarn Y may be detected.

Second Embodiment

[0038] The following will describe a method of detecting a weft yarn in an air jet loom according to a second embodiment of the present disclosure. It is to be noted that in the description of the second embodiment, components that are the same as or similar to the components of the first embodiment are described using the same reference numerals that are in FIGS. 1 to 3, so that description of such components are simplified or omitted.

[0039] The method of detecting a weft yarn in an air jet loom of the second embodiment is different from the detection method of the first embodiment in that, as the detection signal that indicates detection of the weft yarn Y, a pulse signal and a level signal are used in combination, and a number of pulses in the pulse signal and a value of the level signal are specified as the thresholds for determining the weft insertion detection result of the weft yarn Y.

[0040] As illustrated in FIG. 1, instead of the RH feeler 91 of the first embodiment, the air jet loom includes an RH feeler 93 that is disposed at the same position as the RH feeler 91. The numeral 93 denoting the RH feeler 93 of the second embodiment is shown in parentheses in FIG. 1. The RH feeler 93 is also a reflection type optical sensor that includes a light-emitting portion and a light-receiving portion, and is disposed at the same position and in the same manner as the RH feeler 91. The RH feeler 93 outputs a detection signal as a level signal. The RH feeler 93 is electrically connected to a main controller 200 of the air jet loom. The numeral 200 denoting the main controller 200 is shown in parentheses in FIG. 1. The RH feeler 93 forms the optical weft yarn detection device of the present disclosure. In other respects and the configuration, the second embodiment is the same as the first embodiment.

[0041] The following will describe a method of determining a weft insertion result of the weft yarn Y according the second embodiment with reference to FIGS. 2A to 2C.

[0042] As is the case of the first embodiment, the weft yarn Y is inserted and transferred in the direction indicated by the arrow A, as illustrated in FIGS. 2A to 2C. FIG. 2A illustrates a weft insertion in which the weft yarn Y is transferred successfully in the arrow A direction. In this case, the weft yarn Y has been transferred to a position in the detection range of the RH feeler 93. It is to be noted that in FIGS. 2A to 2C, the reference numerals 93 and 200 denoting the RH feeler 93 and the main controller 200, respectively, are shown in parentheses.

[0043] FIG. 2B illustrates a weft insertion in which the weft yarn Y, which has once been transferred in the direction of the arrow A, is caused to turn back, like the weft yarn Y1 of the first embodiment, but does not return to the woven fabric 50. In this case, the weft yarn Y stops at a position in the detection range of the RH feeler 93.

[0044] FIG. 2C illustrates a weft insertion in which a weft yarn Y, which has once been transferred in the direction of the arrow A, is caused to turn back to the woven fabric 50, like the weft yarn Y2 of the first embodiment, constituting a defect of the fabric. In this case, the weft yarn Y stops at a position that is out of the detection range of the RH feeler 93.

[0045] The following will describe a method of determining a weft insertion detection result of the weft yarn Y with the RH feeler 93.

[0046] In the case of an air jet loom employing an extendable nozzle, the air jet loom may not be able to detect pulses in the detection signal properly and therefore reliable detection may not be performed by the general detection method that uses a pulse signal. In such a case, the presence or absence of a weft yarn Y may be determined by detecting a level of a signal. Meanwhile, when the weft yarn Y is black colored or thin, detection using a pulse signal is more suitable than the detection using a level signal. Therefore, in the method of detecting a weft yarn Y with the RH feeler 93, a level signal and a pulse signal are used in combination, as described below.

[0047] As illustrated in FIG. 4A, the RH feeler 93 outputs a detection signal indicative of a detection of the weft yarn Y in a form of a level signal. In each of FIGS. 4A to 4C, the vertical axis represents the strength of the level signal, and the horizontal axis represents time, and the predetermined detection start timings (see FIG. 3) that are determined beforehand based on the rotational angle of the crank of the air jet loom are depicted. As generally depicted in FIGS. 4A to 4C, when the RH feeler 93 detects the weft yarn Y, the strength of the level signal is high, while when the RH feeler 93 does not detect the weft yarn Y, the strength of the level signal is low.

[0048] As also depicted in FIG. 4B, the main controller 200 rectifies the full wave of the level signal that is output by the RH feeler 93 to thereby obtain a pulse signal as the detection signal.

[0049] In the first weft yarn detection period P1 (see FIG. 3), when the level of the detection signal reaches a specified threshold, it is determined that the weft yarn Y is at the position of the RH feeler 93. The threshold is herein referred to as a first level threshold S3. In the second weft yarn detection period P2, when the level of the detection signal reaches another specified threshold, it is determined that the weft yarn Y is at the position of the RH feeler 93. The threshold is herein referred to as a second level threshold S4. The first pulse threshold S1 and the first level threshold S3 correspond to the first threshold of the present disclosure, and the second pulse threshold S2 and the second level threshold S4 correspond to the second threshold of the present disclosure.

[0050] In the second embodiment, the main controller 200 determines whether the number of pulses in the pulse signal detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1, and at the same time determines whether the level of the level signal detected during the first weft yarn detection period P1 is equal to or greater than the first level threshold S3. When either a condition that the number of pulses in the pulse signal is equal to or greater than the first pulse threshold S1 or a condition that the level of the level signal is equal to or greater than the first level threshold S3 is satisfied, then the main controller 200 determines that the weft yarn Y is at the position of the RH feeler 93 in the first weft yarn detection period P1.

[0051] The main controller 200 also determines whether the number of pulses in the pulse signal detected during the second weft yarn detection period P2 is equal to or greater than the second pulse threshold S2, and at the same time determines whether the level of the level signal detected during the second weft yarn detection period P2 is equal to or greater than the second level threshold S4. When either a condition that the number of pulses in the pulse signal is equal to or greater than the second pulse threshold S2 or a condition that the level of the level signal is equal to or greater than the second level threshold S4 is satisfied, then the main controller 200 determines that the weft yarn Y is at the position of the RH feeler 93 in the second weft yarn detection period P2.

[0052] The method of determining an occurrence of a turning back of the weft yarn Y based on the presence or absence of the weft yarn Y in the first and second weft yarn detection periods P1 and P2 is the same as the method described in the first embodiment. In other words, when a weft insertion has been completed successfully, the weft yarn Y is transferred to the position of the waste selvedge yarns 54 before the second detection start timing T2 is reached. Thus, the weft yarn Y is detected by the RH feeler 93 during the first weft yarn detection period P1. Then, the main controller 200 confirms at least either the number of pulses in the detection signal that is equal to or greater than the predetermined first pulse threshold S1 or the level of the detection signal that is equal to or greater than the predetermined first level threshold S3.

[0053] Since the weft insertion is successfully completed, the weft yarn Y is kept held after the second detection start timing T2 and does not return to the woven fabric 50. Therefore, in the second weft yarn detection period P2, the duration in which the weft yarn Y is detected by the RH feeler 93 is sufficiently long, so that the main controller 200 confirms at least either the number of pulses in the detection signal that is equal to or greater than the predetermined second pulse threshold S2 or the level of the detection signal that is equal to or greater than the predetermined second level threshold S4.

[0054] In other words, when either the condition that the number of pulses in the pulse signal detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1 or the condition that the level of the level signal detected during the first weft yarn detection period P1 is equal to or greater than the first level threshold S3 is satisfied, and at the same time, when either the condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is equal to or greater than the second pulse threshold S2 or the condition that the level of the detection signal detected during the second weft yarn detection period P2 is equal to or greater than the second level threshold S4 is satisfied, then the main controller 200 determines that the weft insertion has successfully been completed.

[0055] Determination of a weft insertion failure according to the second embodiment will now be described. When a weft insertion failure has occurred and the weft yarn Y does not reach the position of the waste selvedge yarns 54, the weft yarn Y is not detected by the RH feeler 93 both in the first and second weft yarn detection periods P1 and P2. Therefore, in the first weft yarn detection period P1, the number of pulses in the detection signal detected by the main controller 200 is smaller than the first pulse threshold S1, and the level of the detection signal detected by the main controller 200 is smaller than the first level threshold S3. In the second weft yarn detection period P2, the number of pulses in the detection signal detected by the main controller 200 is smaller than the first level threshold S3, and the level of the detection signal detected by the main controller 200 is smaller than the second level threshold S4.

[0056] Thus, when the condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is smaller than the first pulse threshold S1 and the condition that the level of the detection signal detected during the first weft yarn detection period P1 is smaller than the first level threshold S3 are satisfied, and at the same time the condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 and the condition that the level of the detection signal detected during the second weft yarn detection period P2 is smaller than the second level threshold S4 are satisfied, then the main controller 200 determines that a weft insertion failure has occurred.

[0057] Determination of a turning back of a weft yarn according to the second embodiment, illustrated in FIG. 2C, will now be described. When a turning back has occurred, the weft yarn Y has been transferred to the position of the waste selvedge yarns 54 before the second detection start timing T2 is reached. Thus, since the weft yarn Y is detected by the RH feeler 93 during the first weft yarn detection period P1, the main controller 200 confirms at least either the number of pulses in the detection signal that is equal to or greater than the predetermined first pulse threshold S1 or the level of the detection signal that is equal to or greater than the predetermined first level threshold S3.

[0058] Since the weft yarn Y has returned to the woven fabric 50 side after the second detection start timing T2, the weft yarn Y is out of the detection range of the RH feeler 93. Thus, the weft yarn Y is not detected by the RH feeler 93 during the second weft yarn detection period P2, so that the main controller 200 confirms the number of pulses in the detection signal that is smaller than the predetermined first pulse threshold S1 and the level of the detection signal that is smaller than the predetermined second level threshold S4.

[0059] In other words, when either the condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is equal to or greater than the first pulse threshold S1 or the condition that the level of the detection signal detected during the first weft yarn detection period P1 is equal to or greater than the first level threshold S3 is satisfied, and at the same time, when both of the condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is smaller than the second pulse threshold S2 and the condition that the level of the detection signal detected during the second weft yarn detection period P2 is smaller than the second level threshold S4 are satisfied, then the main controller 200 determines that a turning back has occurred.

[0060] In this way, a pulse signal and a level signal are used as the detection signals, and a number of pulses and a level are specified for each of the first threshold and the second threshold. Therefore, when the weft yarn Y to be detected is black colored or thin, the weft yarn Y may be detected by using a pulse signal and a level signal in combination.

[0061] It is to be noted that, although in the above first and second embodiments of the present disclosure, the RH feelers 91 and 93, and the W feeler 92 are provided by reflection type optical sensors, the feelers may be provided by transmission type optical sensors. In this case, the light-emitting portion and the light-receiving portion of each transmission type optical sensor are disposed opposite to each other across the weft insertion passage so that the light-receiving portion receives light from the light-emitting portion when the weft yarn Y is not present between them. An interception of the light from the light-emitting portion to the light-receiving portion constitutes a detection of the weft yarn Y.

[0062] In the above first and second embodiments of the present disclosure, a weft insertion result is determined based on the detecting condition of the weft yarn Y in the first and second weft yarn detection periods P1 and P2. However, a delayed arrival of the weft yarn Y may further be determined when the condition that the number of pulses in the detection signal detected during the first weft yarn detection period P1 is smaller than the first pulse threshold S1 and the condition that the number of pulses in the detection signal detected during the second weft yarn detection period P2 is equal to or greater than the second pulse threshold S2 are satisfied.

[0063] A method of detecting a weft yarn in an air jet loom includes: setting a first weft yarn detection period (P1); setting a second weft yarn detection period (P2); setting a first threshold (S1, S3) for the detection signal detected during the first weft yarn detection period (P1); setting a second threshold (S2, S4) for the detection signal detected during the second weft yarn detection period (P2); and, when the detection signal detected during the first weft yarn detection period (P1) is equal to or greater than the first threshold (S1, S3) and the detection signal detected during the second weft yarn detection period (P2) is smaller than the second threshold (S2, S4), determining that a turning back of the inserted weft yarn (Y) has occurred in which the inserted weft yarn (Y) once reached an end (51) of a woven fabric (50) but turned back toward the woven fabric (50).

Claims

1. A method of detecting a weft yarn in an air jet loom, the air jet loom comprising an optical type weft yarn detection device (91, 93) that is disposed adjacent to an end (51) of a woven fabric (50) that is opposite to a weft insertion side of the air jet loom from which a weft yarn (Y) is inserted, the optical type weft yarn detection device (91, 93) being configured to detect the inserted weft yarn (Y) and output a detection signal, **characterized in that** the method includes:

   setting a first weft yarn detection period (P1) between a point in time (T1) after a start of a weft insertion at which a weft yarn (Y) is inserted and a point in time (T3) before the weft insertion is completed;
   setting a second weft yarn detection period (P2) within the first weft yarn detection period (P1) so that the second weft yarn detection period (P2) starts after the inserted weft yarn (Y) is held by warp yarns;
   setting a first threshold (S1, S3) for the detection signal detected during the first weft yarn detection period (P1);
   setting a second threshold (S2, S4) for the detection signal detected during the second weft yarn detection period (P2); and
   determining that a turning back of the inserted weft yarn (Y) has occurred when the detection signal detected during the first weft yarn detection period (P1) is equal to or greater than the first threshold (S1, S3) and the detection signal detected during the second weft yarn detection period (P2) is smaller than the second threshold (S2, S4), wherein the inserted weft yarn (Y) once reached the end (51) of the woven fabric (50) but turned back toward the woven fabric (50).

2. The method of detecting a weft yarn in the air jet loom according to claim 1, **characterized in that** the detection signal includes a pulse signal, and a specified number of pulses in the pulse signal is set for each of the first threshold (S1, S3) and the second threshold (S2, S4).

3. The method of detecting a weft yarn in the air jet loom according to claim 1, **characterized in that** the detection signal includes a pulse signal and a level signal, and a number of pulses in the pulse signal and a level of the level signal are set for each of the first threshold (S1, S3) and the second threshold (S2, S4).

4. The method of detecting a weft yarn in the air jet loom according to any one of claims 1 to 3, **characterized in that** the method includes determining that a weft insertion failure of the inserted weft yarn (Y) has occurred when the detection signal detected during the first weft yarn detection period (P1) is smaller than the first threshold (S1, S3) and the detection signal detected during the second weft yarn detection period (P2) is smaller than the second threshold (S2, S4).

Patentansprüche

1. Verfahren zur Erfassung eines Schussfadens in einer Luftdüsenwebmaschine, wobei die Luftdüsenwebmaschine eine optische Schussfaden-Erfassungsvorrichtung (91, 93) umfasst, die neben einem Ende (51) eines gewebten Stoffes (50) angeordnet ist, das einer Schusseintragsseite der Luftdüsenwebmaschine, von der ein Schussfaden (y) eingetragen wird, gegenüberliegt, wobei die optische Schussfaden-Erfassungsvorrichtung (91, 93) dazu eingerichtet ist, den eingetragenen Schussfaden (Y) zu erfassen, und ein Erfassungssignal auszugeben, **dadurch gekennzeichnet, dass** das Verfahren enthält:

   das Einstellen einer ersten Schussfaden-Erfassungszeit (P1) zwischen einem Zeitpunkt (T1) nach Beginn eines Schusseintrags, zu dem ein Schussfaden (Y) eingetragen wird, und einem Zeitpunkt (T3), bevor der Schusseintrag abgeschlossen ist;
   das Einstellen einer zweiten Schussfaden-Erfassungszeit (P2) innerhalb der ersten Schussfaden-Erfassungszeit (P1), sodass die zweite Schussfaden-Erfassungszeit (P2) beginnt, nachdem der eingetragene Schussfaden (Y) von Kettfäden gehalten wird;
   das Einstellen eines ersten Schwellenwerts (S1, S3) für das Erfassungssignal, das während der ersten Schussfaden-Erfassungszeit (P1) erfasst wird;
   das Einstellen eines zweiten Schwellenwerts (S2, S4) für das Erfassungssignal, das während der zweiten Schussfaden-Erfassungszeit (P2) erfasst wird; und
   das Bestimmen, dass eine Drehung des eingetragenen Schussfadens (Y) aufgetreten ist, wenn das Erfassungssignal, das während der ersten Schussfaden-Erfassungszeit (P1) erfasst wird, gleich oder größer als der erste Schwellenwert (S1, S3) ist, und das Erfassungssignal, das während der zweiten Schussfaden-Erfassungszeit (P2) erfasst wird, kleiner als der zweite Schwellenwert (S2, S4) ist, wobei der eingetragene Schussfaden (Y) zwar einmal das Ende (51) des gewebten Stoffes (50) erreicht hat, aber zum gewebten Stoff (50) zurückgedreht ist.

2. Verfahren zur Erfassung eines Schussfadens in der Luftdüsenwebmaschine gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das Erfassungssignal ein Impulssignal enthält, und eine bestimmte Anzahl an Impulsen in dem Impulssignal jeweils für den ersten Schwellenwert (S1, S3) und den zweiten Schwellenwert (S2, S4) eingestellt ist.

3. Verfahren zur Erfassung eines Schussfadens in der Luftdüsenwebmaschine gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das Erfassungssignal ein Impulssignal und ein Pegelsignal enthält, und eine Anzahl von Impulsen in dem Impulssignal und ein Pegel in dem Pegelsignal jeweils für den ersten Schwellenwert (S1, S3) und den zweiten Schwellenwert (S2, S4) eingestellt ist.

4. Verfahren zur Erfassung eines Schussfadens in der Luftdüsenwebmaschine gemäß einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Verfahren die Bestimmung enthält, dass ein Schusseintragsfehler des eingetragenen Schussfadens (Y) aufgetreten ist, wenn das Erfassungssignal, das während der ersten Schussfaden-Erfassungszeit (P1) erfasst wird, kleiner als der erste Schwellenwert (S1, S3) ist, und das Erfassungssignal, das während der zweiten Schussfaden-Erfassungszeit (P2) erfasst wird, kleiner als der zweite Schwellenwert (S2, S4) ist.

Revendications

1. Procédé de détection d'un fil de trame dans un métier à tisser à jet d'air, dans lequel le métier à tisser à jet d'air comprend un dispositif de détection de fil de trame de type optique (91, 93) qui est disposé adjacent à une extrémité (51) d'un tissu tissé (50) qui est opposée à un côté d'insertion de fil de trame du métier à tisser à jet d'air à partir duquel un fil de trame (Y) est inséré, dans lequel le dispositif de détection de fil de trame de type optique (91, 93) est configuré pour détecter le fil de trame (Y) inséré et pour sortir un signal de détection, **caractérisé en ce que** le procédé comprend :

   l'établissement d'une première période de détection de fil de trame (P1) entre un instant (T1) après un début d'une insertion de fil de trame auquel un fil de trame (Y) est inséré et un instant (T3) avant la fin de l'insertion de fil de trame ;
   l'établissement d'une deuxième période de détection de fil de trame (P2) dans les limites de la première période de détection de fil de trame (P1) de sorte que la deuxième période de détection de fil de trame (P2) débute après que le fil de trame (Y) inséré a été maintenu par des fils de chaîne ;
   l'établissement d'un premier seuil (S1, S3) pour le signal de détection détecté pendant la première période de détection de fil de trame (P1) ;
   l'établissement d'un deuxième seuil (S2, S4) pour le signal de détection détecté pendant la deuxième période de détection de fil de trame (P2) ; et

la détermination qu'un renvoi du fil de trame (Y) inséré a eu lieu lorsque le signal de détection détecté pendant la première période de détection de fil de trame (P1) est supérieur ou égal au premier seuil (S1, S3) et que le signal de détection détecté pendant la deuxième période de détection de fil de trame (P2) est inférieur au deuxième seuil (S2, S4), dans lequel le fil de trame (Y) inséré a atteint une fois l'extrémité (51) du tissu tissé (50) mais est retourné vers le tissu tissé (50).

2. Procédé de détection d'un fil de trame dans le métier à tisser à jet d'air selon la revendication 1, **caractérisé en ce que**
le signal de détection comprend un signal impulsionnel, et
un nombre spécifié d'impulsions dans le signal impulsionnel est établi pour chacun du premier seuil S3) et du deuxième seuil (S2, S4).

3. Procédé de détection d'un fil de trame dans le métier à tisser à jet d'air selon la revendication 1, **caractérisé en ce que**
le signal de détection comprend un signal impulsionnel et un signal de niveau, et
un nombre d'impulsions dans le signal impulsionnel et un niveau du signal de niveau sont établis pour chacun du premier seuil S3) et du deuxième seuil (S2, S4).

4. Procédé de détection d'un fil de trame dans le métier à tisser à jet d'air selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que**
le procédé comprend la détermination qu'un défaut d'insertion de fil de trame du fil de trame (Y) inséré s'est produit lorsque le signal de détection détecté pendant la première période de détection de fil de trame (P1) est inférieur au premier seuil S3) et que le signal de détection détecté pendant la deuxième période de détection de fil de trame (P2) est inférieur au deuxième seuil (S2, S4).

FIG. 1

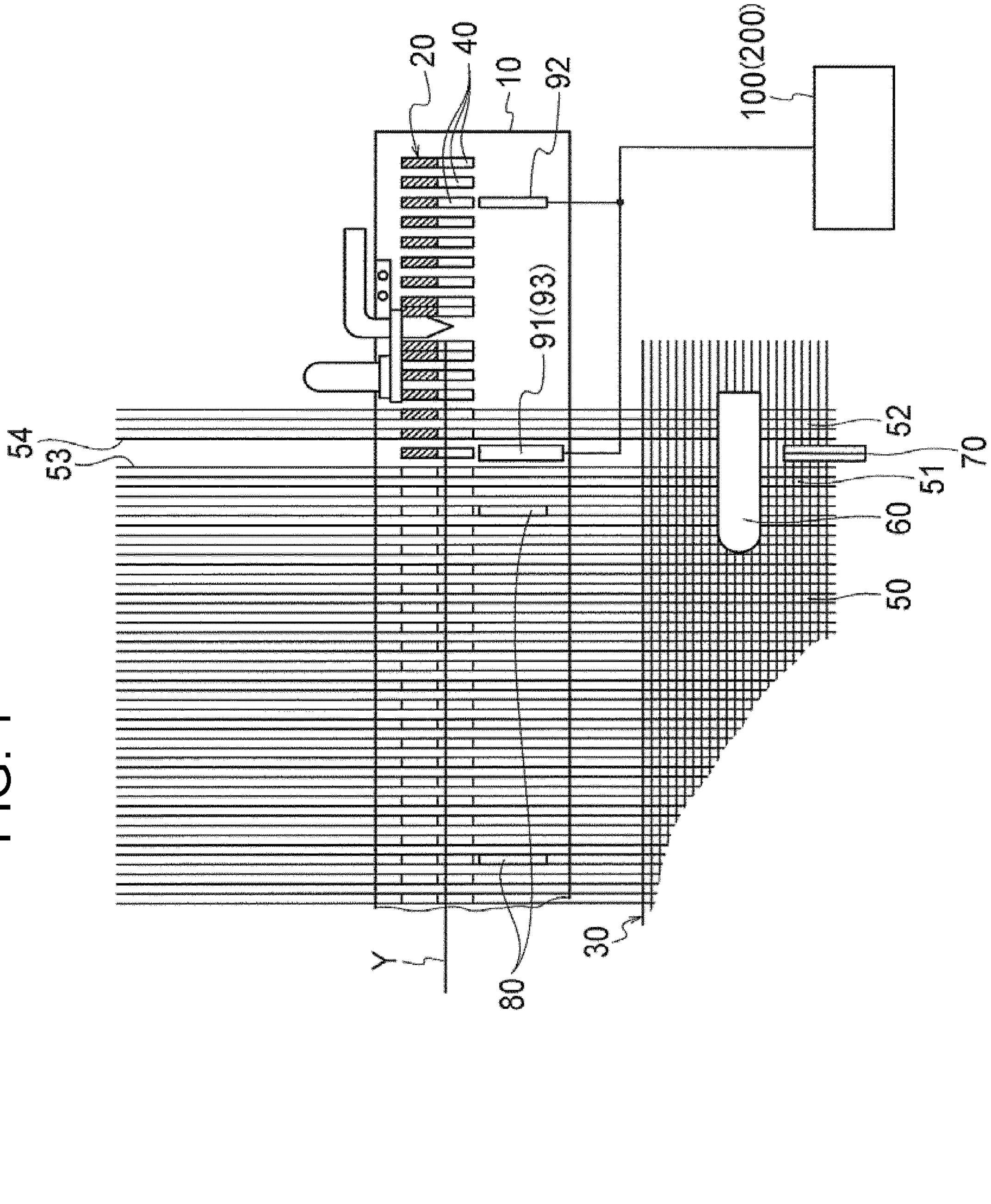


FIG. 2A

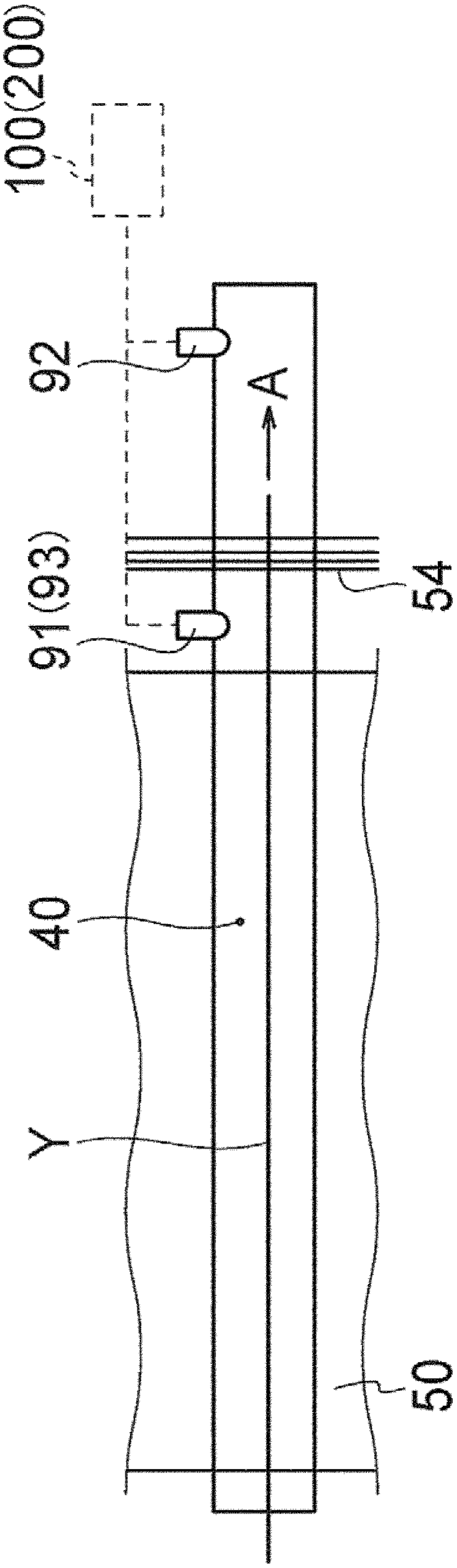


FIG. 2B

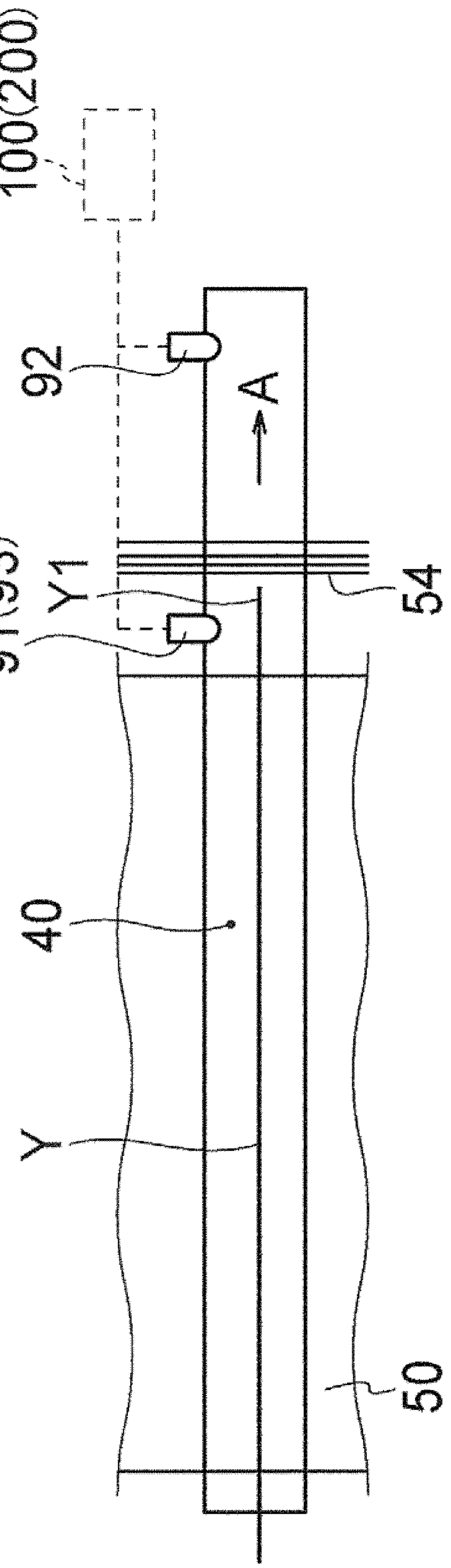


FIG. 2C

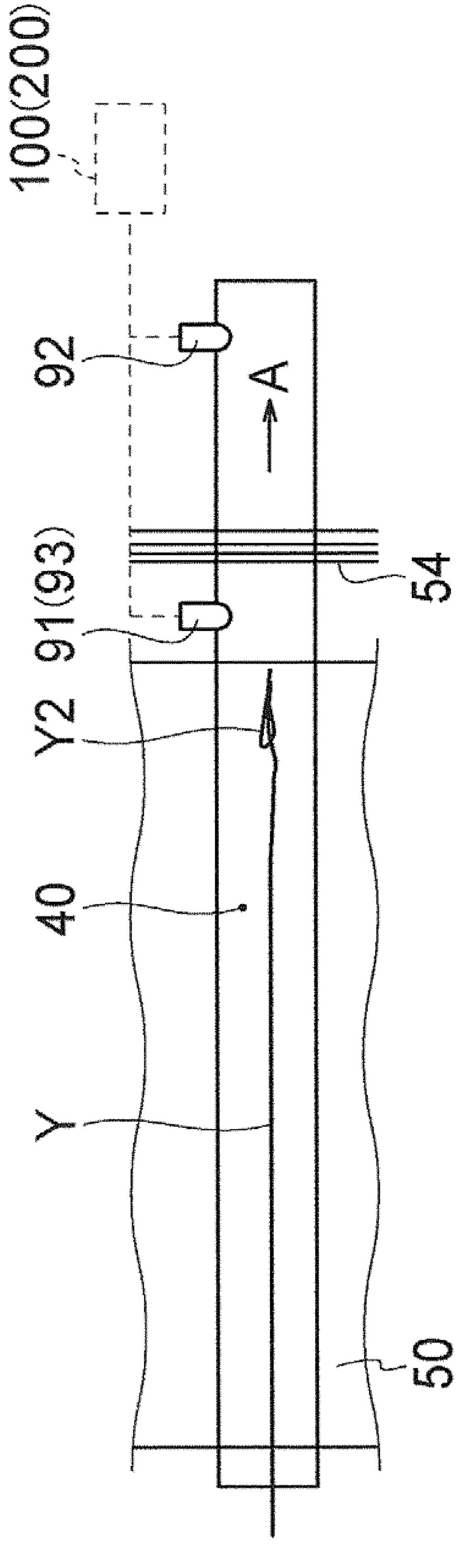


FIG. 3

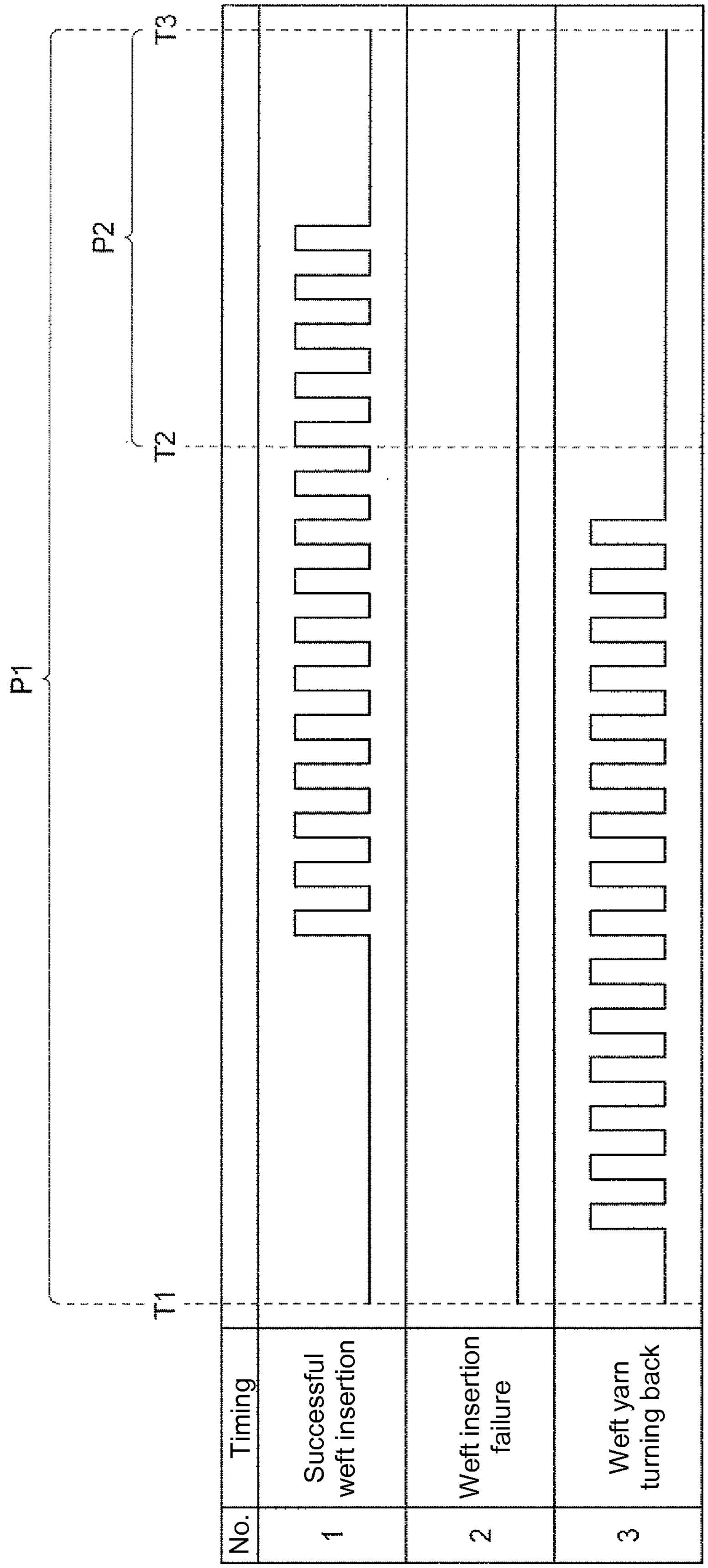

No.
Timing
1
Successful weft insertion
2
Weft insertion failure
3
Weft yarn turning back
T1
T2
T3
P1
P2

FIG. 4A

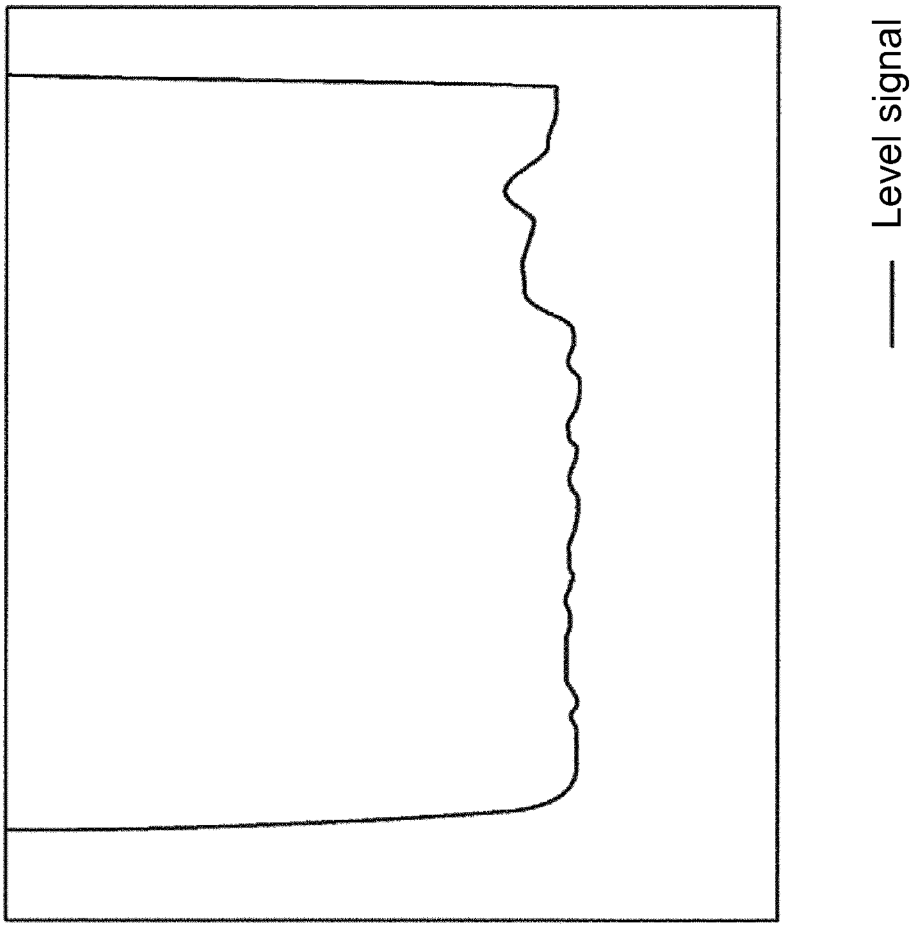


FIG. 4B

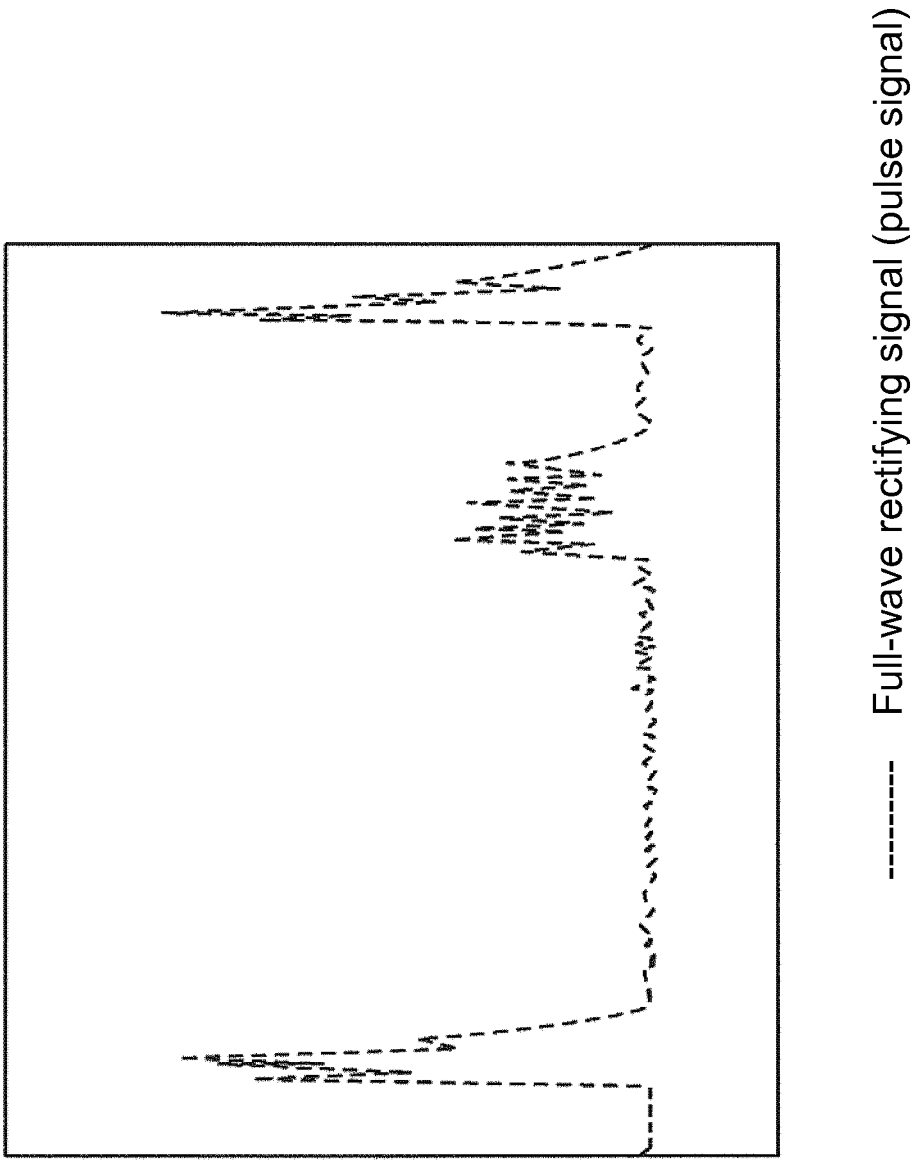
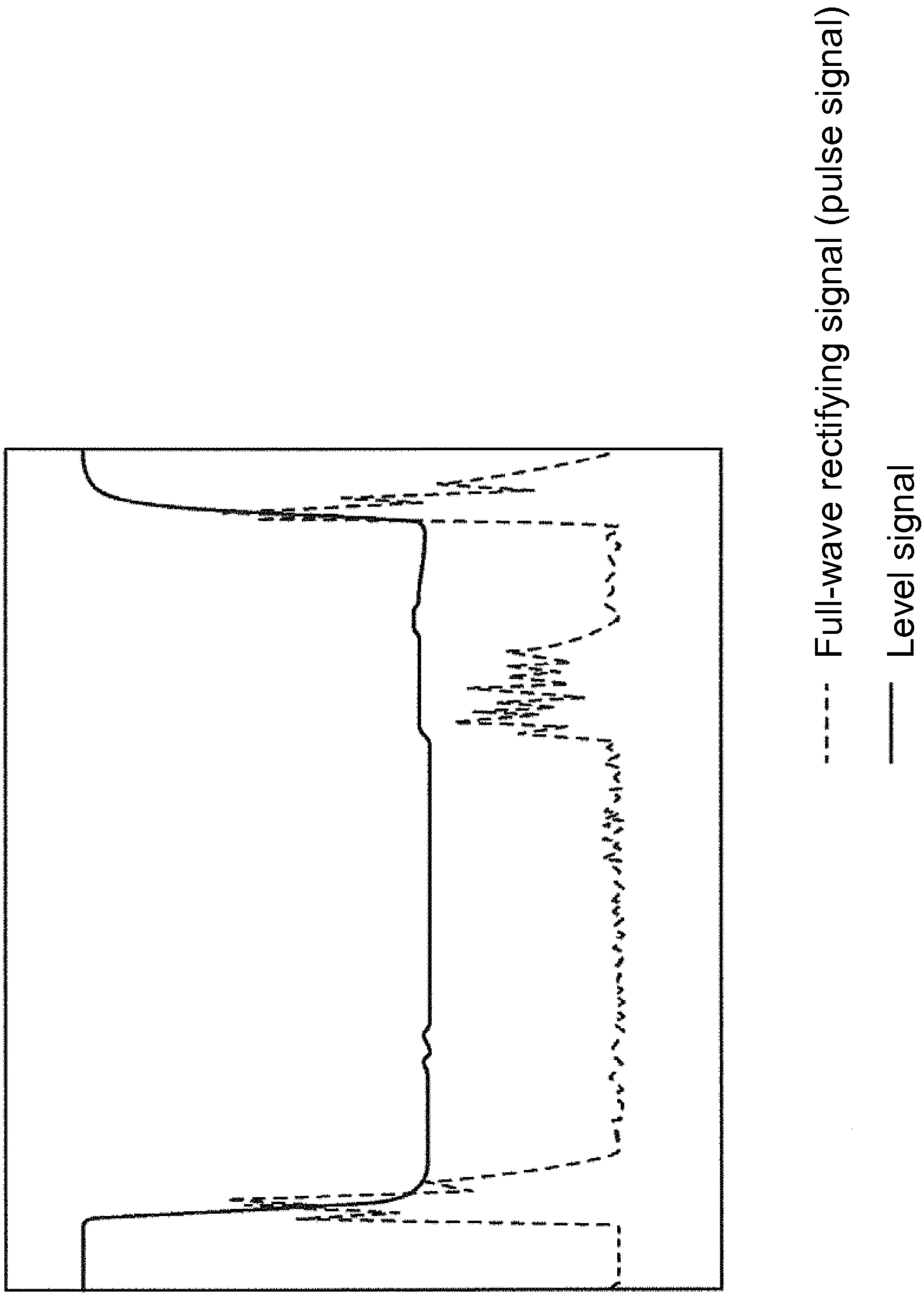


FIG. 4C



REFERENCES CITED IN THE DESCRIPTION

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- JP H11189953 B **[0003] [0005]**
- JP S59187647 B **[0004] [0006]**