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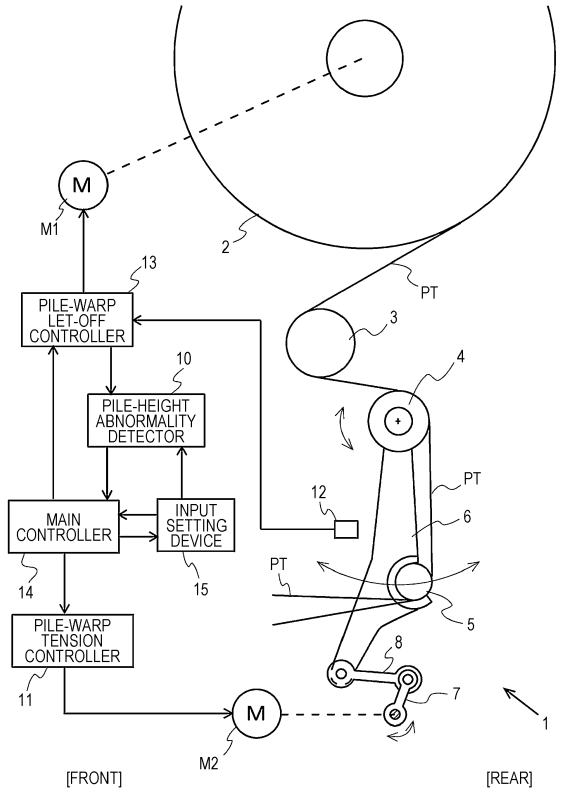
(54) METHOD OF DETECTING PILE-HEIGHT ABNORMALITY IN PILE LOOM AND PILE LOOM INCLUDING DEVICE FOR DETECTING PILE-HEIGHT ABNORMALITY

(57) A pile loom including a pile tension roller (5) supported displaceably with respect to a loom frame and a position detecting device that detects the front-rear-direction position of the pile tension roller performs tension control of a pile warp to adjust a let-off speed of a pile warp beam (2) based on a detection result of the position detecting device to cause the position of the pile tension roller to be within an allowable range to thereby cause the tension of the pile warp to be within a desired range. An abnormality determination position for determining an occurrence of a pile-height abnormality, in which pile slip-off successively occurs in pile fabrics during weaving, is previously determined. When the pile-height abnormality is detected based on the pile tension roller arriving at the abnormality determination position during operation of the loom, an abnormality signal is generated.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a pile loom including a pile tension roller on which a pile warp that is let off from a pile warp beam is wound, the pile tension roller being supported so as to be swingable and displaceable with respect to a loom frame; and a position detecting device that detects, in a front-rear direction of the loom, a position of the pile tension roller or a position of a swing member that is swung and displaced together with the pile tension roller, the pile tension roller being displaced according to tension of the pile warp to cause the tension of the pile warp to be within a desired range, the pile loom performing tension control relating to the pile warp during operation of the loom to adjust, on the basis of a result of detection performed by the position detecting device, a let-off speed of the pile warp beam so as to cause the position of the pile tension roller to be within an allowable range that is preset and that is defined by a rear limit position on a rear side of a reference position of the pile tension roller and a front limit position on a front side thereof.

2. Description of the Related Art

[0002] A pile loom similar to the aforementioned pile loom is disclosed in, for example, Japanese Unexamined Patent Application Publication No. 57-005945 (hereinafter referred to as Patent Document 1). Specifically, the pile loom disclosed in Patent Document 1 includes a pile tension roller on which a pile warp that is let off from a pile warp beam is wound. The pile tension roller is supported by an arm that is pivotably supported at a fixed fulcrum on the loom so as to be swingable and displaceable in the front-rear direction of the loom. In the pile loom, when the tension of the pile warp has a preset desired magnitude, the pile warp is positioned at a predetermined position (reference position) on the loom. Thus, when the tension of the pile warp changes during weaving in the pile loom, the pile tension roller is swung and displaced to a position in the front-rear direction in accordance with the magnitude of the tension.

[0003] In addition, the pile loom in Patent Document 1 performs, when the aforementioned position of the pile tension roller changes to fall outside a preset allowable range by being displaced as a result of the aforementioned change of the tension of the pile warp, let-off control (tension control of the pile warp) to correct a let-off amount (let-off speed) of the pile warp. In other words, since the tension of the pile warp affects the pile height of a pile fabric to be woven (for example, an increase of the tension of the pile warp causes pile slip-off to occur during weaving, which causes the pile height to decrease), such tension control of the pile warp is performed in the pile loom in consideration of the quality of pile fabrics. Incidentally, the tension of the pile warp unavoidably changes during weaving as a result of, for example, a change (decrease) of the winding diameter of the pile warp beam. Thus, the aforementioned tension control of the pile warp is performed for such an unavoidable change of the tension of the pile warp.

[0004] The allowable range is defined by positions (limit positions) that are set on the front side and the rear side of the reference position. Incidentally, in the pile loom of Patent Document 1, the aforementioned displacement of the pile tension roller is detected by proximity switches, and the front limit position and the rear limit position are determined by the positions of the proximity switches disposed respectively on the front side and the rear side of the reference position.

[0005] In addition, a pile loom that performs similar tension control is disclosed in Japanese Unexamined Patent Application Publication No. 63-275751 (hereinafter referred to as Patent Document 2). The pile loom in Patent Document 2 includes a position detector as a position detecting device for detecting the aforementioned position of the pile tension roller. According to Patent Document 2, however, the pile tension roller is supported by a tension lever so as to be swingable and displaceable, and the position detector is disposed so as to detect a position of the tension lever that is swung and displaced together with the pile tension roller. In addition, in the pile loom of Patent Document 2, each of the front limit position and the rear limit position is set as a setting value that is to be compared with a detection value obtained by the position detector.

[0006] Incidentally, in actual weaving in a pile loom, even when tension control is performed as described above, pile slip-off that causes the height of piles to be lower than a target height may successively occur in a pile immediately after the pile is formed. Such a successive occurrence of the pile slip-off during weaving results in a woven pile fabric having considerably degraded quality.

[0007] Causes of such a successive occurrence of the pile slip-off are currently unclear. However, the successive occurrence of the pile slip-off is considered to be caused due to effects of various factors. For example, factors in the loom itself include an abnormal vibration of the loom as a result of a failure occurring in a component. Specifically, when an abnormal vibration is generated in the loom as described above, pile slip-off may occur in a pile fabric during weaving. In addition, it is considered that, when the abnormal vibration continues, the pile slip-off successively occurs as described above, as a result. Meanwhile, when vibrations during operation of two looms that are installed in an identical factory have substantially identical specific frequencies and resonate with each other, abnormal vibrations may occur in these looms, even when the looms themselves have no abnormality (failure).

[0008] In addition, the aforementioned factors also in-

clude the abnormal tension of the pile warp itself. Specifically, when warp preparing process of the pile warp beam is not properly performed, variation in the winding tightness of the pile warp in the beam may be generated as a result. Moreover, the variation in the winding tightness may cause the tension of the pile warp during weaving to change differently from the aforementioned unavoidable change of the tension, which may be the aforementioned causes of the successive occurrence of the pile slip-off.

SUMMARY OF THE INVENTION

[0009] Accordingly, the present invention provides a method of detecting the aforementioned pile-height abnormality, which is a state in which pile slip-off successively occurs and which relates to the quality of pile fabrics to be woven; and a pile loom including a device for detecting the pile-height abnormality.

[0010] The present invention is applied to a pile loom including a pile tension roller on which a pile warp that is let off from a pile warp beam is wound, the pile tension roller being supported so as to be swingable and displaceable with respect to a loom frame; and a position detecting device that detects, in a front-rear direction of the loom, a position of the pile tension roller or a position of a swing member that is swung and displaced together with the pile tension roller, the pile tension roller being displaced according to tension of the pile warp to cause the tension of the pile warp to be within a desired range, the pile loom performing tension control relating to the pile warp during operation of the loom to adjust, on the basis of a result of detection performed by the position detecting device, a let-off speed of the pile warp beam so as to cause the position of the pile tension roller to be within an allowable range that is preset and that is defined by a rear limit position on a rear side of a reference position of the pile tension roller and a front limit position on a front side thereof.

[0011] A method of detecting a pile-height abnormality according to the present invention includes previously determining an abnormality determination position that is used to determine an occurrence of a pile-height abnormality, which is a state in which pile slip-off successively occurs in a pile fabric during weaving, the abnormality determination position being set at the rear limit position or at a position on a rear side of the rear limit position; and generating an abnormality signal during the operation of the loom when an occurrence of the pile-height abnormality is detected on the basis of the pile tension roller or the swing member arriving at the abnormality determination position.

[0012] In the method of detecting the pile-height abnormality according to the present invention, the position detecting device may be a distance detecting device that outputs, as a detection value, a distance from the position detecting device to the pile tension roller or to the swing member; a distance from the position detecting device to the abnormality determination position may be preset as an abnormality determination value; and the detection value that is output by the position detecting device during the operation of the loom may be compared with the abnormality determination value, and when the detection value is more than or equal to the abnormality determination value, an arrival of the pile tension roller or the swing member at the abnormality determination position may be determined. In addition, in the method of detecting the pile-height abnormality according to the present invention, a monitor period for determining an occurrence of the pile-height abnormality may be preset, and, when a period in which the detection value is more than or equal to the abnormality determination value reaches the monitor period, an occurrence of the pile-height abnormality may be detected. Moreover, the loom may be stopped when the abnormality signal is generated.

[0013] In addition, a pile loom including a device for detecting the pile-height abnormality according to the present invention includes, in the pile loom, an abnormality detecting device that generates the abnormality signal on the basis of the pile tension roller or the swing member arriving at the abnormality determination position.

[0014] In the pile loom including the device for detecting the pile-height abnormality according to the present invention, the position detecting device may be a distance detecting device that outputs, as a detection value, a distance from the position detecting device to the pile tension roller or to the swing member; and the abnormality detecting device may store the abnormality determination value and may include a comparator that compares the detection value output by the position detecting device with the abnormality determination value and an abnormality determination unit that generates the abnormality signal when the detection value is more than or equal to the abnormality determination value as a result of comparison performed by the comparator. In addition, the abnormality detecting device may store the monitor period, the abnormality determination unit may have a function of determining an abnormal period, the abnormal period being a period in which the detection value is more than or equal to the abnormality determination value, and the abnormality determination unit may generate the abnormality signal when the abnormal period reaches the monitor period. Moreover, the abnormality signal may be a signal for stopping the loom.

[0015] According to the present invention, the abnormality determination position for determining an occurrence of the pile-height abnormality, which is a state in which pile slip-off successively occurs, is previously determined. The abnormality determination position is set in relation to the position of the pile tension roller or the position of the swing member. During the operation of the loom (during weaving), the pile-height abnormality is detected when the position of the pile tension roller or the swing member detected in the front-rear direction by the position detecting device is at the abnormality deter-

mination position. In other words, the inventors of the present invention considered that the aforementioned successive pile slip-off has an influence that causes the pile tension roller to be displaced even under the aforementioned tension control, and on the basis of the consideration, the inventors conceived of detecting the pile-height abnormality on the basis of a detected position of the pile tension roller or the swing member.

[0016] Specifically, when pile slip-off occurs, a pile warp of an amount corresponding to the pile slip-off returns to the side of the pile warp beam from the loom front side, and the pile warp is thus loosened (the tension thereof decreases) by an amount corresponding thereto. Moreover, as a result of the pile slip-off successively occurring as described above, the tension of the pile warp decreases by an amount corresponding thereto. Consequently, the decrease of the tension of the pile warp causes, as described above, the pile tension roller to be swung and displaced (specifically, displaced toward the rear side) together with the swing member.

[0017] Under the tension control, when the pile tension roller is displaced to a position outside the allowable range, the tension of the pile warp is controlled by the let-off control, as described above, to cause the pile tension roller to return within the allowable range. However, the tension control is expected to be performed for a tension change that unavoidably occurs in the pile warp in a normal state, for example, the aforementioned tension change of the pile warp due to the change of the winding diameter of the pile warp beam. In other words, the tension control is not expected to be performed for an abnormal tension change of the pile warp due to the pile-height abnormality, which is a state in which the pile slip-off successively occurs. Therefore, the tension control is insufficient for a decrease of the pile warp tension due to such an unexpected pile-height abnormality, which causes the pile tension roller not to return within the allowable range (to be further displaced toward the rear side), even when the tension control of the pile warp is performed by the let-off control.

[0018] Accordingly, in the present invention, the abnormality determination position for determining an occurrence of the pile-height abnormality is determined at the rear limit position or at a position on the rear side of the rear limit position in the allowable range. In addition, it becomes possible to detect the pile-height abnormality, which is not detected by existing pile looms, by detecting an arrival of the pile tension roller or the swing member at the abnormality determination position during the operation of the loom. In other words, when an arrival of the pile tension roller or the swing member at the abnormality determination position is detected, it is determined that the pile tension roller is displaced to a position that should not be arrived at, and on the basis of the determination, an occurrence of the pile-height abnormality is detected.

[0019] Incidentally, existing pile looms do not even expect such a pile-height abnormality, and therefore, not even an idea for detecting, in some form or another, the pile-height abnormality has been put forward in existing pile looms. Thus, even when such pile slip-off successively occurs as described above in an existing pile loom, weaving is continued as is unless the successive occurrence of the pile slip-off is noticed by an operator. Moreover, it is necessary to directly observe and check pile fabrics during weaving to notice the successive occurrence of the pile slip-off, and it is thus not possible to perform checking at a position away from the loom, which may result in delay in noticing the successive occurrence of the pile slip-off. As a result, the quality of woven pile fabrics is considerably degraded.

[0020] In contrast, according to the present invention, when the pile-height abnormality is detected as described above, the abnormality signal is generated. In this case, for example, by causing, when the abnormality signal is generated, an alarm lamp of the loom to flash and a display of the loom to display a message indicating an occurrence of a pile-height abnormality (successive pile slip-off), it is possible to notice the occurrence of the pile-height abnormality during weaving in the loom due to the alarm lamp and the like. Consequently, it is possible to notice the occurrence of the pile-height abnormality in an early stage, which avoids weaving from being continued with pile slip-off successively occurring. Moreover, by causing the loom to stop when the abnormality signal is generated, it is possible to avoid weaving from being continued with pile slip-off successively occurring, even when, for example, no operator is stationed in a weaving factory and it is thus not possible to immediately notice an occurrence of a pile-height abnormality.

[0021] According to the present invention, the pile-height abnormality is thus detected, and consequently, it is possible to avoid, as much as possible, weaving from being continued with pile slip-off successively occurring; as a result, it is possible to avoid such considerable quality degradation in pile fabrics.

[0022] When the position detecting device provided for the tension control of the pile warp is the distance detecting device, the present invention can be realized with a simplified configuration by configuring such that determination of an arrival of the pile tension roller or the swing member at the abnormality determination position is performed by comparing the detection value output by the distance detecting device with the abnormality determination value corresponding to the abnormality determination position. In other words, a detector is needed because of the necessity of determining the position of the pile tension roller or the swing member for the aforementioned determination; however, when the position detecting device originally provided for the tension control of the pile warp in the pile loom on which the present invention is based is also used as the detector, it becomes possible to realize the present invention without providing the loom with a detector dedicated to the present invention.

[0023] In addition, by providing the aforementioned

monitor period in the present invention, it becomes possible to accurately detect the pile-height abnormality in an earlier stage. Specifically, in the pile loom, the aforementioned unavoidable tension change also causes the pile tension roller to be displaced to a position in the vicinity of the rear limit position, and weaving may be continued in the state. In this state, when the pile tension roller is further displaced due to pile formation, inertia generated due to the displacement may cause the pile tension roller to be temporarily displaced to a position beyond the rear limit position. Therefore, when such a circumstance is expected, the abnormality determination position needs to be set at a position sufficiently separated from the rear limit position to avoid the temporary displacement from being erroneously detected as an occurrence of the pile-height abnormality. Even in this case, differently from existing pile looms, the pile-height abnormality is detected, however, the pile-height abnormality is detected when the pile tension roller or the swing member is swung and displaced to the separated position.

[0024] In contrast, by providing the aforementioned monitor period, it is possible, even when the aforementioned temporary displacement is expected, to set the abnormality determination position at a position as close as possible to (or at the position of) the rear limit position, and it is also possible to avoid the aforementioned temporary displacement from being erroneously detected as an occurrence of the pile-height abnormality. Moreover, by setting the abnormality determination position at such a position, it becomes possible to detect the pile-height abnormality at an earlier stage.

[0025] In addition, by configuring the loom, as described above, to stop when the abnormality signal is generated, it becomes possible to minimize a portion (range) that is woven with the pile-height abnormality existing, because the successive occurrence of the pile-height abnormality is stopped. Consequently, even when, for example, pile slip-off is caused to occur due to the pile-height abnormality, it is possible for an operator to complete the restoration thereof in a short time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is an illustration showing an example of a let-off device of a pile loom to which the present invention is applied; and

Fig. 2 is a block diagram showing an example of a configuration of an abnormality detecting device according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Hereinafter, an embodiment of a pile loom including an abnormality detecting device for detecting a pile-height abnormality according to the present invention will be described on the basis of the drawings.

[0028] Fig. 1 shows an example of a let-off device for a pile warp PT in the pile loom including the abnormality detecting device according to the present invention. In a let-off device 1, the pile warp PT that is let off from a pile warp beam 2 is sequentially wound on a guide roller 3, which is disposed below the pile warp beam 2, a tension shaft 4, and a pile tension roller 5, and is guided to the loom front side.

[0029] In the let-off device 1, the pile tension roller 5 is supported by a pair of left and right tension levers 6 (Fig. 1 shows only one of the levers) that are disposed away from each other in the width direction of the loom. The tension levers 6 are supported by the tension shaft 4, which extends in the width direction, so as to be swingable with respect to a loom frame (not shown). Consequently, the pile tension roller 5 is supported via the tension levers 6 so as to be swingable and displaceable with respect to the loom frame with the tension shaft 4 serving as the center of swing.

[0030] The tension levers 6 are linked to a torque motor M2 via a link mechanism constituted by a drive lever 7 and a link rod 8. The drive lever 7 is attached to an output shaft of the torque motor M2, and the link rod 8 links the drive lever 7 and the tension levers 6 to each other. Consequently, the pile tension roller 5 is linked to the output shaft of the torque motor M2 via the tension levers 6 and the link mechanism.

[0031] The torque motor M2 is connected to a pile-warp tension controller 11 for controlling the drive of the torque motor M2. The pile-warp tension controller 11 is connected to a main controller 14 of the pile loom. The main controller 14 stores a set tension value of the pile warp PT. The pile-warp tension controller 11 controls the drive of the torque motor M2 so as to generate output torque in accordance with the set tension value. Controlling, as described above, the drive of the torque motor M2 causes the pile tension roller 5 to apply an urging force in accordance with the output torque of the torque motor M2 to the pile warp PT. Consequently, the pile tension roller 5 is disposed on the loom so as to be at a position at which the urging force and the tension of the pile warp PT balance each other in the front-rear direction of the loom.

[0032] In the initial setting of the pile loom, the pile tension roller 5 is disposed at a predetermined position (reference position) in the front-rear direction of the loom. The urging force has a certain magnitude in accordance with the predetermined set tension value, and the aforementioned arrangement of the pile tension roller 5 is determined according to the balance between the urging force and the tension of the pile warp PT. Therefore, when the tension of the pile warp PT coincides with the set tension value, the pile tension roller 5 is disposed at the reference position.

[0033] As described above, however, an unavoidable tension change of the pile warp PT occurs in the pile loom during weaving. As a result, the pile tension roller 5 is swung and displaced according to the tension change of

the pile warp PT and disposed at a position in accordance with the tension of the pile warp PT.

[0034] Specifically, when the tension of the pile warp PT decreases from the balanced state, the urging force becomes larger than the tension of the pile warp PT, which causes the pile tension roller 5 to be displaced toward the rear side, which is the direction of the driving by the torque motor M2. However, as a result of the displacement of the pile tension roller 5, the path length of the pile warp PT from the pile warp beam 2 to the loom front (not shown) increases, and consequently, the tension of the pile warp PT increases. The swing and displacement of the pile tension roller 5 stops at a time point when the tension of the pile warp PT increases to a magnitude that balances with the urging force.

[0035] Similarly, when the tension of the pile warp PT increases from the balanced state, the tension of the pile warp PT becomes larger than the urging force, and the tension causes the pile tension roller 5 to be displaced toward the front side against the driving force of the torque motor M2. As a result, the path length of the pile warp PT decreases and, consequently, the tension of the pile warp PT decreases. The swing and displacement of the pile tension roller 5 stops at a time point when the tension of the pile warp PT decreases to a magnitude that balances with the urging force.

[0036] In the let-off device 1, the tension of the pile warp PT is maintained to be in accordance with the set tension value because, even when the tension of the pile warp PT changes, the change of the tension is offset by the aforementioned change of the path length as a result of the displacement of the pile tension roller 5, and the urging force and the tension of the pile warp PT constantly balance each other.

[0037] In the let-off device 1, the pile warp beam 2 is driven to rotate by a let-off motor M1. The drive of the let-off motor M1 is controlled by a pile-warp let-off controller 13. In the pile loom, the pile-warp let-off controller 13 is connected to the main controller 14. The let-off device 1 includes a winding-diameter sensor (not shown) disposed in the vicinity of the pile warp beam 2. The winding-diameter sensor is connected to the main controller 14 and outputs a detection value thereof to the main controller 14.

[0038] The main controller 14 periodically obtains the winding diameter of the pile warp PT on the pile warp beam 2 during weaving on the basis of the detection value output by the winding-diameter sensor. During weaving, a basic driving speed of the let-off motor M1 is calculated on the basis of setting values of loom RPM and weft density and the winding diameter of the pile warp PT obtained as described above. The setting values are previously stored in the main controller 14. The pile-warp let-off controller 13 controls the drive of the let-off motor M1 according to the calculated basic driving speed. Consequently, the pile warp beam 2 is driven to rotate so as to let off the pile warp PT with a let-off amount (let-off speed) in accordance with the basic driving speed of the let-off motor M1.

[0039] To cause the position in the front-rear direction (hereinafter referred to as the "front-rear position") of the pile tension roller 5, in which the front-rear position changes as described above according to the tension of the pile warp PT during weaving, to be within a preset allowable range, the pile-warp let-off controller 13 controls the drive of the let-off motor M1 (adjusts the let-off speed of the pile warp PT) on the basis of the front-rear position. The allowable range is a range defined by a limit position (rear limit position) set on the rear side of the reference position and a limit position (front limit position) set on the front side thereof. The rear and front limit positions are set such that when the pile tension roller 5 is positioned beyond one of the limit positions due to pile weaving, the weaving may be adversely affected.

[0040] The aforementioned adjustment of the let-off speed of the pile warp PT by the pile-warp let-off controller 13 will be specifically described below. As described above, the adjustment is performed on the basis of the front-rear position of the pile tension roller 5; in the present embodiment, the adjustment is performed on the basis of the front-rear position of the tension levers 6, which are swing members that are swung and displaced together with the pile tension roller 5. Regarding the allowable range, setting values respectively corresponding to the rear limit position and the front limit position, which define the range, are previously stored as a rear threshold and a front threshold in the pile-warp let-off controller 13.

[0041] In the vicinity of the tension levers 6, a position detector 12 that detects the front-rear position of the tension levers 6 is disposed. In the present embodiment, the position detector 12 is a distance sensor that detects a distance from the position detector 12 to the tension levers 6. The position detector 12 is connected to the pile-warp let-off controller 13 and outputs a detection signal (signal corresponding to the detected distance) thereof to the pile-warp let-off controller 13. The pile-warp let-off controller 13 detects the front-rear position (distance from the position detector 12) of the tension levers 6 on the basis of the detection signal. Thus, in the present embodiment, a distance detecting device as a position detecting device is constituted by the position detector 12 and the pile-warp let-off controller 13.

[0042] As described above, the front-rear position of the tension levers 6 is detected as a distance from the position detector 12, and thus, each of the setting values of the rear threshold and the front threshold is also set as a distance from the position detector 12.

[0043] The pile-warp let-off controller 13 calculates, for each cycle (period from 0° to 360° (0°) rotation angles of a loom main shaft) of the loom, an average value of the front-rear position of the tension levers 6 detected by the position detector 12 and compares each average value (detection value) with each of the rear threshold and the front threshold. When it is determined, as a result of the comparison, that the detection value is larger than the rear threshold, that is, when it is determined that the ten-

sion levers 6 are displaced toward the rear side beyond the rear limit position, the pile-warp let-off controller 13 adjusts and decreases the let-off speed of the pile warp PT. Consequently, the tension of the pile warp PT balancing with the urging force increases and, as described above, the pile tension roller 5 (the tension levers 6) is displaced toward the front side.

[0044] When it is determined that the detection value of the tension levers 6 is smaller than the front threshold, that is, when it is determined that the tension levers 6 are displaced toward the front side beyond the front limit position, the pile-warp let-off controller 13 adjusts and increases the let-off speed of the pile warp PT. Consequently, the tension of the pile warp PT decreases and, as described above, the pile tension roller 5 (tension levers 6) is displaced toward the rear side. When the front-rear position of the tension levers 6 returns within the allowable range, the pile-warp let-off controller 13 controls the drive of the let-off motor M1 to maintain the adjusted let-off speed. As a result, the front-rear position of the tension levers 6 is positioned on the front side of the rear limit position and on the rear side of the front limit position, that is, within the allowable range.

[0045] Thus, in the let-off device 1, the pile tension roller 5 applies the urging force in accordance with the set tension value to the pile warp PT and, when the urging force applied by the pile tension roller 5 and the tension of the pile warp PT balance each other, the tension of the pile warp PT coincides with the set tension value, and the pile tension roller 5 is positioned in accordance with the balance. In this state, tension control of the pile warp PT to adjust the let-off speed of the pile warp PT so that the position of the pile tension roller 5 (tension levers 6) is within the preset allowable range is performed in the let-off device 1.

[0046] In the present invention, the pile loom including the let-off device 1 described above includes the abnormality detecting device for detecting the pile-height abnormality, which is a state in which pile slip-off successively occurs. The abnormality detecting device generates an abnormality signal on the basis of the pile tension roller 5 or the tension levers 6, which are the swing members, arriving at an abnormality determination position that is used to determine (hereinafter also referred to as the "abnormality determination") an occurrence of the pile-height abnormality and that is set at the rear limit position or at a position on the rear side of the rear limit position. A specific example of the abnormality detecting device according to the present invention will be described below as a pile-height abnormality detector 10 of the present embodiment.

[0047] The abnormality determination needs determination of an arrival of the pile tension roller 5 or the tension levers 6 at the abnormality determination position. The determination of the arrival needs a detector for determining the front-rear position of the pile tension roller 5 or the tension levers 6. Meanwhile, as described above, in the present embodiment, the let-off device 1 uses the distance detecting device to detect the front-rear position of the tension levers 6 for the tension control of the pile warp PT. In the present embodiment, the distance detecting device is also used as the detector, and the determination of the arrival is performed by using the detection value of the distance detecting device. In other words, in the present embodiment, the distance detecting device, which is a part of the let-off device 1 and used to detect the front-rear position of the tension levers 6, is also a part, as the detector, of the pile-height abnormality detector 10.

[0048] In addition, in the present embodiment, the determination of the arrival is performed by comparing the detection value detected by the distance detecting device with the abnormality determination value that is preset as the distance from the position detector 12 to the abnormality determination position. The abnormality determination is performed on the basis of the detection value being more than or equal to the abnormality determination value; in the present embodiment, a monitor period for the abnormality determination is preset, and the abnormality determination is performed on the basis of an abnormal period, which is a period in which the detection value is more than or equal to the abnormality determination value, reaching the monitor period. In the present embodiment, the monitor period is set in units of the number of the cycles of the loom. Thus, the abnormal period to be compared with the monitor period is also obtained in units of the number of the cycles of the loom.

[0049] As a result of the abnormality determination, the pile-height abnormality detector 10 outputs the abnormality signal. In the present embodiment, the abnormality signal is a signal (loom stop signal) for stopping the loom. In other words, the pile loom in the present embodiment is configured to stop when the abnormality signal is generated.

[0050] As shown in Fig. 2, the pile-height abnormality detector 10 includes a storage 21 that stores the abnormality determination value and the monitor period, a comparator 22 that compares the abnormality determination value with the front-rear position (detection value) of the tension levers 6 during weaving, and an abnormality determination unit 23 that generates the abnormality signal on the basis of a result of the comparison and the abnormal period.

[0051] The input side of the storage 21 is connected to an input setting device 15 of the pile loom and the output side thereof is connected to the comparator 22 and the abnormality determination unit 23. The input setting device 15 has, for example, a touch panel display screen, and the display screen displays a setting screen and the like that enable various setting values to be input and set. The abnormality determination value and the monitor period are input and set in the input setting device 15. When being input and set, the abnormality determination value and the monitor period are sent to and stored in the storage 21.

[0052] Regarding the abnormality determination value

stored in the storage 21, in the present embodiment, the abnormality determination position to which the abnormality determination value corresponds is determined as a position on the rear side of the aforementioned rear limit position and in the vicinity of the rear limit position. Accordingly, the abnormality determination value is set, as described above, as a distance from the position detector 12 to the abnormality determination position.

[0053] The monitor period stored in the storage 21 is set to avoid the temporary displacement of the pile tension roller 5 toward the rear side from being detected as an occurrence of a pile-height abnormality.

[0054] Specifically, the aforementioned tension control of the pile warp PT is performed in the let-off device 1, and when the front-rear position of the pile tension roller 5 (tension levers 6) changes to fall outside the allowable range (limit positions), the let-off speed is adjusted to return the front-rear position of the tension levers 6 within a range between the limit positions. Thus, in the let-off device 1, the tension levers 6 may be positioned in the vicinity of one of the limit positions in the range within the limit positions. In the pile loom, the pile tension roller 5 operates during pile formation such that the pile tension roller 5 is temporarily displaced toward the front side and returned to an original position. When the pile tension roller 5 operates as described above in a state in which the tension levers 6 are positioned, as described above, in the vicinity of one of the limit positions, the inertia thereof may cause the front-rear position of the tension levers 6 to be temporarily displaced beyond the one of the limit positions. In the present embodiment, as described above, the abnormality determination position is set as a position in the vicinity of the rear limit position, and therefore, the detection value may become more than or equal to the abnormality determination value due to the displacement.

[0055] The temporary displacement is, however, not the displacement of the pile tension roller 5 as a result of an occurrence of pile slip-off and thus needs to be avoided from being detected as the displacement of the pile tension roller 5 due to a successive occurrence of pile slip-off.

[0056] Moreover, as described above, the displacement of the pile tension roller 5 with the front-rear position of the tension levers 6 being beyond the rear limit position is caused as a result of pile slip-off occurring in piles formed by the pile loom and successive occurrence of the pile slip-off. Causes of the occurrence of the pile slip-off are not generated in proportion to the progress of weaving and may be temporary (short period), such as an abnormal vibration of the loom as a result of, for example, the resonance of two looms. When a cause of the occurrence is temporary as described above, no pile slip-off occurs (successive occurrence of pile slip-off stops) after the cause of the occurrence stops, which stops the displacement of the pile tension roller 5 due to pile slip-off. In the let-off device 1, the aforementioned tension control of the pile warp PT is performed, and the front-rear position of the tension levers 6 thus returns within the range between the limit positions due to the tension control.

[0057] As described above, pile slip-off occurs throughout a period in which the cause of the occurrence is generated; however, when the cause of the occurrence is temporary and stops after a short period, the front-rear position of the tension levers 6 returns again to a position not beyond the abnormality determination position, even when the front-rear position of the tension levers 6 is temporarily at the abnormality determination position or beyond the abnormality determination position. In other words, even when the detection value of the tension levers 6 is temporarily more than or equal to the abnormality determination value, the detection value returns again to be less than the abnormality determination value.

[0058] Regarding pile fabrics, in pile fabrics of some types, successive occurrence of pile slip-off may be allowable from the point of view of quality depending on the size of the range of the occurrence because pile slip-off is, for example, less noticeable depending on the patterns of the pile fabrics. In other words, in pile fabrics of some types, successive occurrence of pile slip-off during weaving is not necessarily considered abnormal and may not be considered abnormal depending on the size of the range of the occurrence.

[0059] Considering above, in the present embodiment, the aforementioned monitor period is set to avoid pile slip-off allowable in the pile fabrics, in addition to the aforementioned displacement of the pile tension roller 5 with the detection value of the tension levers 6 being more than or equal to the abnormality determination value due to the inertia of the operation during pile formation, from being detected as abnormality. Moreover, in the present embodiment, even when the detection value of the tension levers 6 is more than or equal to the abnormality determination value as described above, the displacement is not detected as abnormality unless the period in which the detection value is more than or equal to the abnormality determination value reaches the monitor period. In other words, in the present embodiment, when the period in which the detection value is more than or equal to the abnormality determination value reaches the monitor period, a pile-height abnormality is detected.

[0060] Thus, in the present embodiment, the monitor period is set as a period in accordance with a degree (size of the range of the occurrence) of pile slip-off allowable from the point of view of quality in pile fabrics to be woven. As described above, in the present embodiment, the monitor period is set in units of the number of the cycles of the loom. In the pile loom, one pile is formed in a plurality of cycles of the loom, and therefore, an integral multiple of the number of the cycles required for the loom to form one pile is set as the setting value of the monitor period.

[0061] The input side of the comparator 22 is connected to the storage 21 and the pile-warp let-off controller 13 and the output side thereof is connected to the abnor-

mality determination unit 23. As described above, the pile-warp let-off controller 13 calculates, for each cycle of the loom, an average value of the front-rear position of the tension levers 6 detected by the position detector 12. The pile-warp let-off controller 13 outputs the calculated average value to the comparator 22 each time of the calculation. Thus, in the present embodiment, the thus calculated average value is used as the detection value of the front-rear position of the tension levers 6 in each cycle of the loom.

[0062] When the detection value output by the pile-warp let-off controller 13 is input into the comparator 22, the comparator 22 compares the detection value with the abnormality determination value stored in the storage 21 and obtains a deviation of the detection value with respect to the abnormality determination value. In addition, the comparator 22 outputs a deviation signal in accordance with the magnitude of the obtained deviation to the abnormality determination unit 23. In other words, the comparator 22 outputs, for each cycle of the loom, the deviation signal to the abnormality determination unit 23. In the present embodiment, the deviation includes zero. When the deviation is zero, the comparator 22 outputs the deviation signal corresponding to deviation = 0 to the abnormality determination unit 23.

[0063] The input side of the abnormality determination unit 23 is connected to the storage 21 and the comparator 22 and the output side thereof is connected to the main controller 14. In addition, the abnormality determination unit 23 includes a counter 24 as a counter that counts the abnormal period obtained, as described above, in units of the number of the cycles of the loom. On the basis of the deviation signal output by the comparator 22, the abnormality determination unit 23 determines whether the detection value is more than or equal to the abnormality determination value and increments the count value (abnormal period) of the counter 24 when determining that the detection value is more than or equal to the abnormality determination value. When determining that the detection value is less than the abnormality determination value, the abnormality determination unit 23 resets the count value.

[0064] Thus, according to the above configuration, when the detection value is first determined to be more than or equal to the abnormality determination value (when the deviation is determined to be more than or equal to zero), counting of the number of the cycles in the counter 24 of the abnormality determination unit 23 is started and incrementing of the count value in the counter 24 is continued while the detection value is more than the abnormality determination value (while the deviation is more than zero). Even after the counting of the number of the cycles in the counter 24 is started, when the detection value is determined to be less than the abnormality determination value (when the deviation is determined to be less than zero), the count value of the counter 24 is reset, and until before the detection value is first determined again to be more than or equal to the abnormality determination value, the count value is maintained at zero.

[0065] The abnormality determination unit 23 further includes a reach monitor 25 that monitors, each time when the count value is updated (incremented), whether the abnormal period reaches the monitor period by comparing the updated count value (abnormal period) with the setting value of the monitor period. When the reach monitor 25 detects, as a result of the monitoring, that the count value corresponding to the abnormal period is more than or equal to the setting value of the monitor period, (in other words, when an occurrence of a pile-height abnormality with the abnormal period reaching the monitor period is detected), the abnormality determination unit 23 outputs the loom stop signal as the abnormality signal to the main controller 14.

[0066] The pile-height abnormality detector 10 in the present embodiment described above operates as described below.

[0067] When pile slip-off occurs due to some reasons during weaving, the pile warp PT of an amount corresponding to the pile slip-off returns from the loom front side to the side of the pile warp PT, and the tension of the pile warp PT thus decreases by a degree corresponding thereto. As a result of the change of the tension of the pile warp PT, the pile tension roller 5 is displaced toward the rear side. At this time, when the pile slip-off successively occurs, the displacement of the pile tension roller 5 toward the rear side due to the pile slip-off continues.

[0068] When the front-rear position of the tension levers 6 is beyond the aforementioned rear limit position as a result of the displacement, the pile-warp let-off controller 13 adjusts the let-off speed of the pile warp PT to return the front-rear position of the tension levers 6 within the allowable range. The adjustment of the let-off speed of the pile warp PT is, however, expected to be performed for an unavoidable tension change of the pile warp PT due to the change (decrease) of the winding diameter of the pile warp beam 2 and is not expected to be performed for an abnormal tension change of the pile warp PT due to pile slip-off. In other words, the adjustment of the let-off speed performed by the pile-warp let-off controller 13 is unsuitable for the aforementioned displacement of the pile tension roller 5 due to pile slip-off. Therefore, adjusting the let-off speed as described above does not cause the front-rear position of the pile tension roller 5 (tension levers 6) to return, and the displacement of the pile tension roller 5 toward the rear side thus continues in a state in which the pile slip-off continues to occur.

[0069] During weaving, the pile-warp let-off controller 13 outputs, for each cycle of the loom, the detection value to the comparator 22 of the pile-height abnormality detector 10. The comparator 22 compares the detection value with the abnormality determination value, each time when the detection value is input, to obtain the deviation and outputs the deviation signal that indicates the magnitude of the deviation to the abnormality determi-

nation unit 23.

[0070] When the front-rear position of the tension levers 6 is at or beyond a front-rear position corresponding to the abnormality determination value, as described above, as a result of the displacement of the pile tension roller 5 continuing, the detection value is more than or equal to the abnormality determination value. Thus, the deviation signal output by the comparator 22 is a signal indicating that deviation ≥ 0.

[0071] When the deviation signal indicating that deviation ≥ 0 is input into the abnormality determination unit 23, the abnormality determination unit 23 increments (+1) the count value of the counter 24 (initial value zero of the count value is incremented by 1). In other words, while the deviation signal indicating that deviation ≥ 0 is successively input, the abnormality determination unit 23 counts the number of the input in the counter 24. The deviation signal is output for each cycle of the loom, and therefore, the count value (total value) thereof is the abnormal period obtained in units of the number of the cycles of the loom.

[0072] Then, the detection value continues to be more than or equal to the abnormality determination value when successive occurrence of the pile slip-off continues and when the displacement of the pile tension roller 5 due to the pile slip-off continues. Thus, the deviation signal output for each cycle of the loom by the comparator 22 is the signal indicating that deviation ≥ 0 throughout a period in which the detection value is more than or equal to the abnormality determination value. Consequently, the abnormality determination unit 23 increments the count value of the counter 24 each time when the deviation signal is input.

[0073] As described, however, pile slip-off may stop after a short period because the cause of the occurrence thereof is temporary. In this case, the displacement of the pile tension roller 5 toward the rear side due to the pile slip-off stops. At a time point when the displacement stops, the detection value is more than the rear threshold. Thus, the pile-warp let-off controller 13 adjusts the let-off speed of the pile warp PT, and the pile tension roller 5 is thereby displaced toward the front side. As a result, the detection value becomes less than the abnormality determination value. Consequently, the deviation signal output by the comparator 22 is a signal indicating that deviation < 0, and therefore, the abnormality determination unit 23 resets (the count value is returned to zero) the count value (abnormal period) of the counter 24.

[0074] Each time when the count value of the counter 24 is updated (incremented), the abnormality determination unit 23 outputs the updated count value (abnormal period) to the reach monitor 25. The reach monitor 25 compares the count value with the setting value of the monitor period. When it is determined, as a result of the comparison, that the count value is more than or equal to the setting value of the monitor period (in other words, the abnormal period reaches the monitor period), the reach monitor 25 outputs the abnormality signal to the main controller 14.

[0075] In the present embodiment, when the abnormality signal is input, the main controller 14 performs control for stopping the loom. Consequently, weaving is stopped in the pile loom, which avoids weaving from being continued with pile slip-off successively occurring as described above. Therefore, according to the pile-height abnormality detector 10 described above, it is possible to minimize, as much as possible, a portion (range) to be woven with pile slip-off existing, which avoids the quality of woven pile fabrics from being considerably degraded.

[0076] In addition, the main controller 14 lights an alarm lamp disposed on the loom when the abnormality signal is input and outputs a signal indicating a cause (successive occurrence of the pile slip-off) of stoppage of the loom to the input setting device 15 to cause the display screen thereof to display a message indicating the cause of the stoppage. Consequently, it is possible to inform an operator of the stoppage of the loom due to the successive occurrence of the pile slip-off.

[0077] Moreover, in the pile-height abnormality detector 10 according to the present embodiment, the monitor period is set to avoid the abnormality signal from being output, even when the pile slip-off successively occurs, if the range of the occurrence is within an allowable range, which avoids the loom from being unnecessarily stopped.

[0078] Specifically, as described above, the pile tension roller 5 may be temporarily displaced beyond the rear limit position, even when pile slip-off does not successively occur. Moreover, even when pile slip-off does successively occur, the occurrence of the pile slip-off may be allowed from the point of view of quality depending on the size of the range of the occurrence. Taking these circumstances into consideration, it is conceivable to set the abnormality determination position to a position away from the rear limit position and to only compare the abnormality determination value corresponding to the abnormality determination position with the detection value to determine whether to generate the abnormality signal. However, the amount of pile slip-off of each pile is not necessarily constant, and it is thus difficult to determine the range of the occurrence in a woven pile fabric in strict association with the amount of the displacement (front-rear position) of the pile tension roller 5. Thus, when only the abnormality determination position is used for the determination, it is necessary to set the abnormality determination position while considering a case in which the amount of pile slip-off of each pile is minimum. In such a case, the abnormality signal may be output, even when the range of the occurrence is within the allowable range.

[0079] In contrast, according to the pile-height abnormality detector 10 in the present embodiment, the abnormality determination position is set at a position in the vicinity of the rear limit position, and the monitor period corresponding to the allowable range of the occurrence is set. Consequently, it is possible to avoid the abnormality signal from being output due to the aforementioned temporary displacement of the pile tension roller 5 and

to avoid the abnormality signal from being output, even when the range of the occurrence is within the allowable range. As a result, it is possible to avoid the loom from being unnecessarily stopped.

[0080] Moreover, in the present embodiment, the monitor period is set in units of the number of the cycles of the loom. Meanwhile, the range of occurrence corresponds to the number of piles formed in a period of the occurrence, and the number of the cycles of the loom (pile formation cycle) required for forming one pile is previously known. Accordingly, when the monitor period is set, as described above, in units of the number of the cycles of the loom, it is easy to set the monitor period.

[0081] Note that the present invention is not limited to the embodiment (the aforementioned embodiment) described above and can be carried out in a modified embodiment described below.

(1) In the aforementioned embodiment, the abnormality detection is performed on the basis of the front-rear position of the tension levers 6 (swing members) that are swung and displaced together with the pile tension roller 5. However, in the present invention, it is possible to perform the abnormality detection on the basis of the front-rear position of the pile tension roller 5. In this case, the abnormality determination position is set as a position corresponding to the front-rear position of the pile tension roller 5.

(2) In the aforementioned embodiment, detection of the pile-height abnormality (hereinafter, also referred to as the "abnormality detection") is performed on the basis of the period in which the front-rear position of the tension levers 6 (swing members) is beyond the abnormality determination position reaching the preset monitor period. However, in the present invention, the monitor period may not be set and the abnormality detection may be performed when the front-rear position of the swing members or the pile tension roller (hereinafter collectively referred to as the "detected member") is at (or determined to be beyond) the abnormality determination position. In this case, the abnormality determination position is preferably set at a position away from the rear limit position in consideration of the aforementioned temporary displacement of the pile tension roller 5.

(3) As described above, the detector for determining the front-rear position of the detected member is required to determine an arrival of the detected member at the abnormality determination position. In the aforementioned embodiment, the position detecting device (distance detecting device) originally provided for tension control of the pile warp in the let-off device of the pile loom is also used as the detector. However, the present invention is not limited to such a configuration; the detector may be a dedicated device provided separately from the position detecting device (the abnormality detecting device may include the detector dedicated thereto).

[0082] In the aforementioned embodiment, the average value of the front-rear position of the detected member (tension levers 6) calculated for each cycle of the loom is used as the detection value of the front-rear position of the detected member. However, the detection value may not be the average value; the detection value of the front-rear position of the detected member detected with a predetermined rotation angle of the loom main shaft may be used as it is. Moreover, the detection value of the front-rear position of the detected member may not be obtained for each cycle of the loom and may be obtained for a plurality of cycles of the loom.

(4) In the aforementioned embodiment, the distance detecting device described above (also used as a part of the let-off device 1) is used as the detector. In the present invention, however, in both cases in which the detector is also used as the let-off device 1 and in which the detector is provided as a device dedicated to the abnormality detecting device, the detector is not limited to such a device; the detector may have a different detection configuration. For example, the detector may be a device that detects an inclination (swing angle) of the detected member that changes as a result of the swing and displacement of the detected member. Specifically, the detector may be an angle sensor such as a potentiometer. In this case, the abnormality determination position is set as the swing angle.

[0083] In addition, the detector is not limited to a device that is capable, similarly to the distance detecting device and the angle sensor, of successively detecting the position (state) of the detected member; the detector may be a device that detects an arrival of the detected member at a specific position.

[0084] Specifically, the detector may be a proximity switch, and a proximity body that serves as a detection target of the proximity switch may be attached to the detected member. In addition, in the abnormality detecting device, the proximity switch may be disposed at a position corresponding to a predetermined abnormality detection position. According to such a configuration, when the detected member is displaced and the proximity body arrives at the position of the proximity switch present at the abnormality determination position, the proximity switch detects the proximity body (detected member) and outputs a detection signal. The detection signal may be used as the abnormality signal or, similarly to the aforementioned embodiment, the abnormality signal may be generated after a lapse of a preset monitor period after the detected member arrives at the abnormality detection position.

[0085] In such a device, only while the proximity switch detects the proximity body, the detection signal is output

by the proximity switch. To cause the abnormality signal to be generated, as described above, after a lapse of the monitor period in the device, the proximity body may have a shape extending toward the front side so that the proximity switch continues detection of the proximity body even in a state in which the detected member is further displaced toward the rear side beyond the abnormality determination position. In addition, similarly to the aforementioned embodiment, counting of the abnormal period may be started when the proximity body is detected by the proximity switch (when output of the detection signal is started), and the abnormality signal may be output when a state in which the detection signal is output continues throughout the monitor period.

(5) In the aforementioned embodiment, the abnormality determination position is set at a position on the rear side of the rear limit position. In the present invention, however, the abnormality determination position is not limited to such a position and may be set at a position identical to the rear limit position. In other words, the rear threshold in the aforementioned embodiment may be also used as the abnormality determination value. However, as described above, the rear limit position is set such that the tension control is performed when the detected member is positioned beyond the rear limit position; thus, the rear limit position may be arrived at by the detected member even in a normal weaving state in which no pile slip-off occurs. Accordingly, when the rear limit position is used as the abnormality determination position, it is necessary to set the monitor period similarly to the aforementioned embodiment and to configure the abnormality signal to be generated after a lapse of the monitor period after the detected member arrives at the abnormality determination position, to avoid the abnormality detection from being performed even when no pile slip-off occurs.
(6) The aforementioned embodiment is an example in which the abnormality signal is used as the loom stop signal, and the pile loom performs stop operation to stop when the abnormality signal is generated and performs alarm operation to light the alarm lamp and display operation to cause the display screen of the input setting device to display a message. However, operations to be performed in the pile loom on which the present invention is based when the abnormality signal is generated are not limited to these three operations; one or two of the operations may be performed. In other words, when the abnormality signal of the present invention is generated, the pile loom may perform at least one of the stop operation, the alarm operation, and the display operation.

[0086] Note that the present invention is not limited to the examples described above and can be modified, as appropriate, within the range not deviating from the concept of the invention.

Claims

1. A method of detecting a pile-height abnormality in a pile loom, the pile loom including a pile tension roller (5) on which a pile warp (PT) that is let off from a pile warp beam (2) is wound, the pile tension roller (5) being supported so as to be swingable and displaceable with respect to a loom frame, and a position detecting device that detects, in a front-rear direction of the loom, a position of the pile tension roller (5) or a position of a swing member that is swung and displaced together with the pile tension roller (5), the pile tension roller (5) being displaced according to tension of the pile warp (PT) to cause the tension of the pile warp (PT) to be within a desired range, the pile loom performing tension control relating to the pile warp (PT) during operation of the loom to adjust, on the basis of a result of detection performed by the position detecting device, a let-off speed of the pile warp beam (2) so as to cause the position of the pile tension roller (5) to be within an allowable range that is preset and that is defined by a rear limit position on a rear side of a reference position of the pile tension roller (5) and a front limit position on a front side thereof, the method comprising:

   previously determining an abnormality determination position that is used to determine an occurrence of a pile-height abnormality, which is a state in which pile slip-off successively occurs in a pile fabric during weaving, the abnormality determination position being set at the rear limit position or at a position on a rear side of the rear limit position; and
   generating an abnormality signal during the operation of the loom when an occurrence of the pile-height abnormality is detected on the basis of the pile tension roller (5) or the swing member arriving at the abnormality determination position.

2. The method of detecting the pile-height abnormality in the pile loom according to Claim 1,
wherein the position detecting device is a distance detecting device that outputs, as a detection value, a distance from the position detecting device to the pile tension roller (5) or to the swing member,
wherein a distance from the position detecting device to the abnormality determination position is preset as an abnormality determination value, and
wherein the detection value that is output by the position detecting device during the operation of the loom is compared with the abnormality determination value, and when the detection value is more than or equal to the abnormality determination value, an arrival of the pile tension roller (5) or the swing member at the abnormality determination position is determined.

3. The method of detecting the pile-height abnormality according to Claim 2,
wherein a monitor period for determining an occurrence of the pile-height abnormality is preset, and
wherein, when a period in which the detection value is more than or equal to the abnormality determination value reaches the monitor period, an occurrence of the pile-height abnormality is detected.

4. The method of detecting the pile-height abnormality according to any one of Claims 1 to 3, wherein the loom is stopped when the abnormality signal is generated.

5. A pile loom including a pile tension roller (5) on which a pile warp (PT) that is let off from a pile warp beam (2) is wound, the pile tension roller (5) being supported so as to be swingable and displaceable with respect to a loom frame, and a position detecting device that detects, in a front-rear direction of the loom, a position of the pile tension roller (5) or a position of a swing member that is swung and displaced together with the pile tension roller (5), the pile tension roller (5) being displaced according to tension of the pile warp (PT) to cause the tension of the pile warp (PT) to be within a desired range, the pile loom performing tension control relating to the pile warp (PT) during operation of the loom to adjust, on the basis of a result of detection performed by the position detecting device, a let-off speed of the pile warp beam (2) so as to cause the position of the pile tension roller (5) to be within an allowable range that is preset and that is defined by a rear limit position on a rear side of a reference position of the pile tension roller (5) and a front limit position on a front side thereof, the pile loom comprising:

an abnormality detecting device that generates an abnormality signal on the basis of the pile tension roller (5) or the swing member arriving at an abnormality determination position that is used to determine an occurrence of a pile-height abnormality, which is a state in which pile slip-off successively occurs in a pile fabric during weaving, the abnormality determination position being set at the rear limit position or at a position on a rear side of the rear limit position.

6. The pile loom according to Claim 5,
wherein the position detecting device is a distance detecting device that outputs, as a detection value, a distance from the position detecting device to the pile tension roller (5) or to the swing member, and
wherein the abnormality detecting device stores an abnormality determination value preset as a distance from the position detecting device to the abnormality determination position, the abnormality detecting device including
a comparator (22) that compares the detection value output by the position detecting device with the abnormality determination value, and
an abnormality determination unit (23) that generates the abnormality signal when the detection value is more than or equal to the abnormality determination value as a result of comparison performed by the comparator (22).

7. The pile loom according to Claim 6,
wherein the abnormality detecting device stores a monitor period for determining an occurrence of the pile-height abnormality, and
wherein the abnormality determination unit (23) has a function of determining an abnormal period, the abnormal period being a period in which the detection value is more than or equal to the abnormality determination value, the abnormality determination unit (23) generating the abnormality signal when the abnormal period reaches the monitor period.

8. The pile loom according to any one of Claims 5 to 7, wherein the abnormality signal is a signal for stopping the loom.

FIG. 1

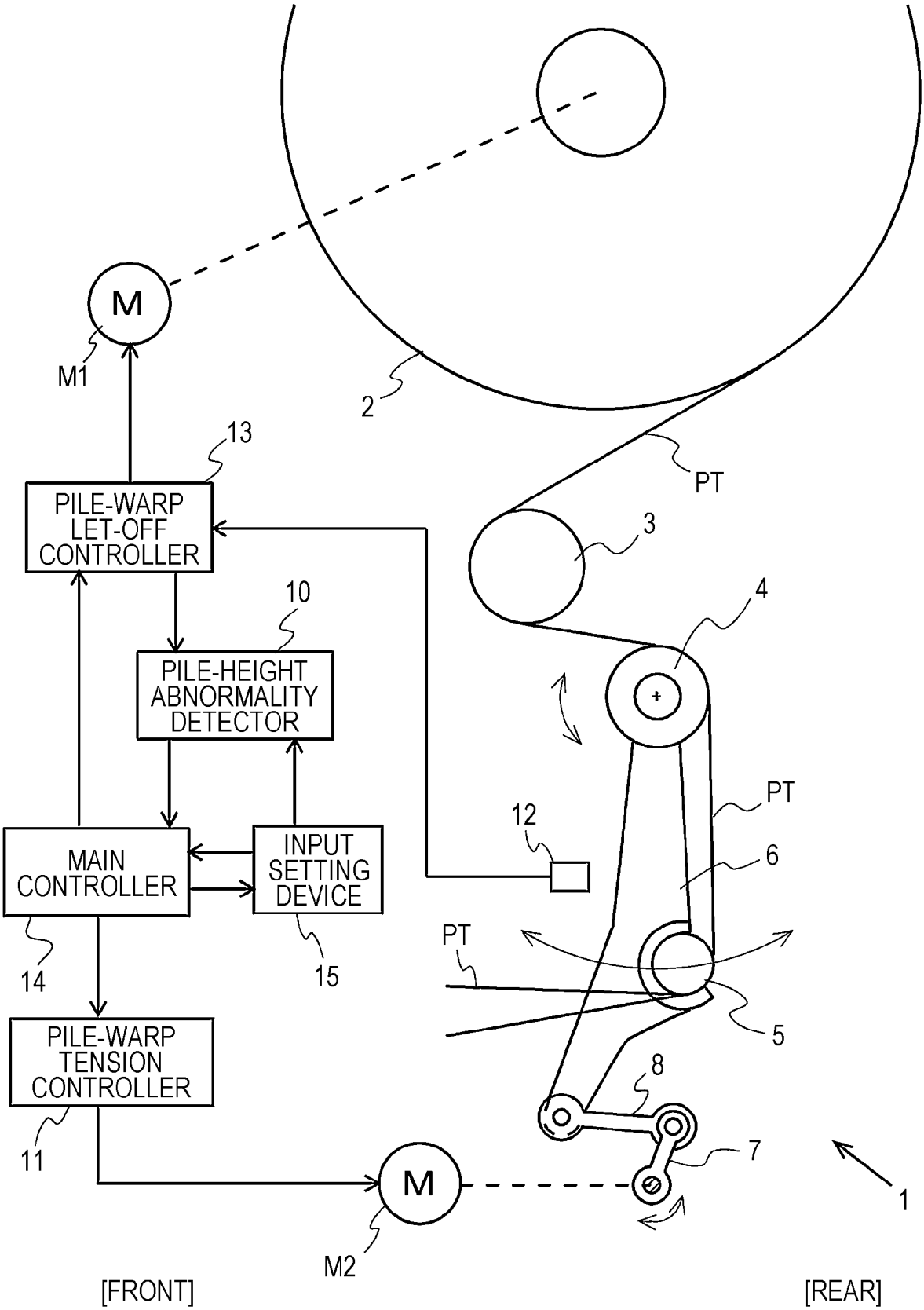
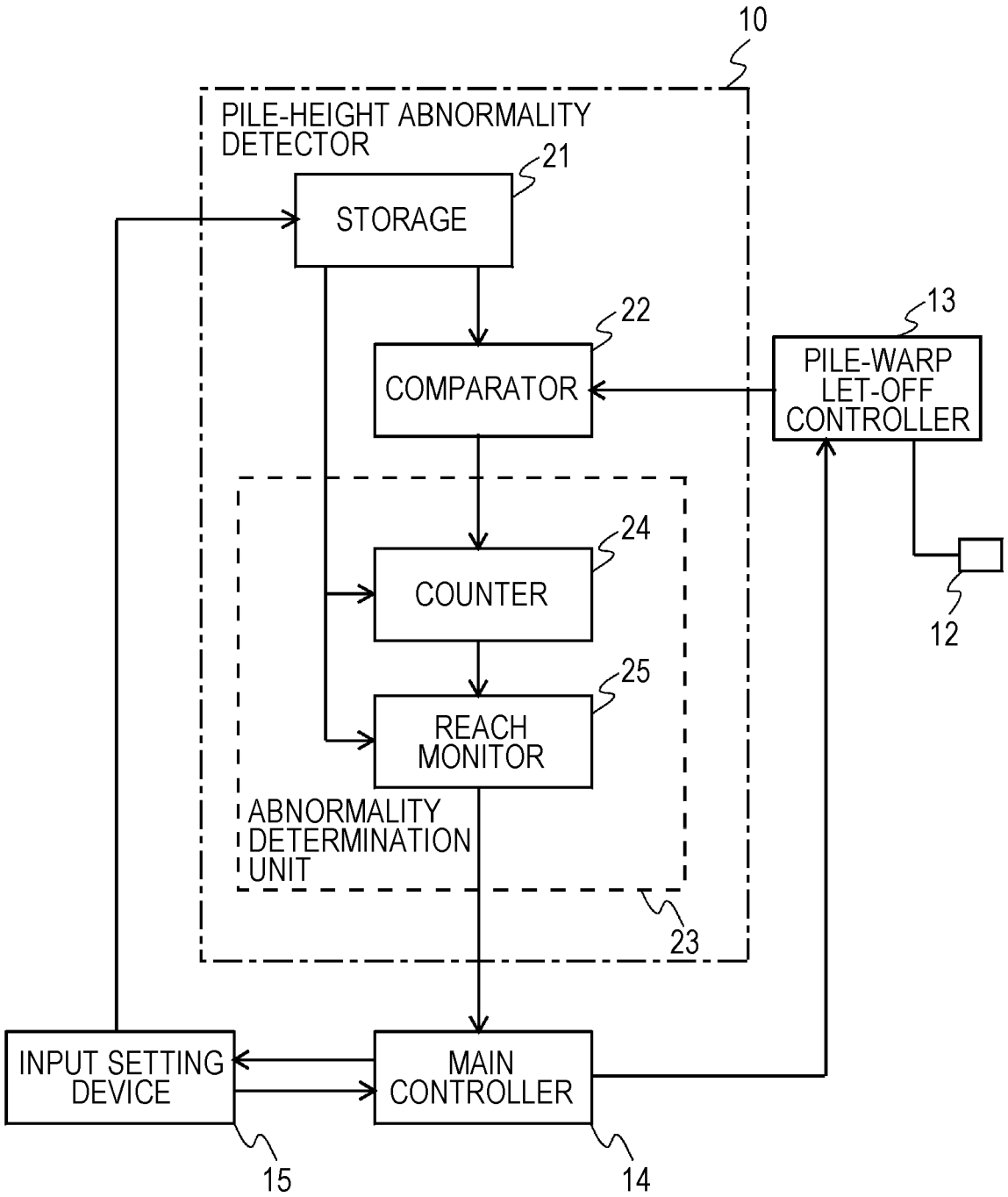

M
M1
2
13
PT
PILE-WARP LET-OFF CONTROLLER
3
10
4
PILE-HEIGHT ABNORMALITY DETECTOR
PT
12
MAIN CONTROLLER
INPUT SETTING DEVICE
6
PT
14
15
5
PILE-WARP TENSION CONTROLLER
8
7
11
M
1
M2
[FRONT]
[REAR]

FIG. 2


10
PILE-HEIGHT ABNORMALITY DETECTOR
21
STORAGE
22
COMPARATOR
13
PILE-WARP LET-OFF CONTROLLER
24
COUNTER
25
REACH MONITOR
ABNORMALITY DETERMINATION UNIT
23
12
INPUT SETTING DEVICE
MAIN CONTROLLER
15
14

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 0260

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S63 145450 A (YOSHIKAWA MASAYASU) 17 June 1988 (1988-06-17) * the whole document *	1,2,4-6, 8	INV. D03D39/22 D03D49/10
X	DE 43 25 038 A1 (REGATRON AG STEINACH [CH]; WILLI GROB AG ESCHENBACH [CH]) 24 February 1994 (1994-02-24) * column 3, lines 14-21 * * column 4, lines 28-64 * * column 6, lines 21-30 * * column 7, line 66 - column 8, line 11 * * column 9, lines 26-52 * * column 13, lines 62-67; figures 1-12 *	1-8	

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	2 April 2019	Louter, Petrus

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 21 0260

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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02-04-2019

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